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Opportunistic maintenance and adaptation of warranty maintenance tasks for Power Plant equipment

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Abstract: - This paper makes a link between opportunistic maintenance literature and warranty analysis of a power plant. A new plant warranty maintenance tasks are observed over a two year period. The main aim is to see how opportunistic maintenance could be incorporated when the warranty period has elapsed. The paper examine the warranty period maintenance task list and propose adequate methods for assessing opportunistic maintenance as a preventive maintenance task in order to ensure reliability and availability of the plant equipment. Statistical approach is used to give an insight to the plant equipment status and a modeling approach is proposed to also assess maintenance information defined by experts in the context of actual operating regimes. This study focuses on the power plant's critical equipment. Failure Mode and Effect Analysis (FMEA) is conducted on the power plant Booster Fans. This gives an insight about equipment failure mode patterns and maintenance requirements. A simulation example is presented based in the failure modes results obtained and a graphical display of optimum preventive maintenance schedule cost curves is also presented.

Keywords: *- opportunistic maintenance, warranty, FMEA, preventive maintenance, optimization*

I. INTRODUCTION

In this paper a power generating plant that has three generating units is considered. New plant equipment is built into an existing power plant and it is in the view of the asset owner and plant maintenance manager to consider incorporating opportunistic maintenance to the existing plant maintenance tasks when a window of opportunity arises after the warranty period has elapsed. A full assessment of the plant maintenance process would in this case require a review for best practise to 'fit in' with the plant maintenance policy. The main challenge is to focus on the maintenance tasks of both the new equipment and existing plant systems. However emphasis will be focused on critical equipments in the first instance. Relevant maintenance tasks are needed to be identified and added to the plant register and hence computerised maintenance management systems. Initial investigation show that all the new plant equipment maintenance tasks derived from the original equipment manufacturer (OEM) manual and expert opinion were elicited before listing them on the power plant register. This paper presents a new development and builds upon previous work conducted on the conversion of the warranty tasks by Alkali and McGibney [1]. The focus here is to see how opportunistic maintenance could be utilised. The main reasons for driving the use of opportunistic maintenance is that when other equipment in the plant are required to generate power and are out of service then the critical equipment in the plant can be maintained without further major loss of power, and redundancy. However, it is possible that opportunities will be left unused, for example because of the need to generate full production depending on the demand in the electricity market.

The paper links the wider academic literature on opportunistic maintenance and discusses how historic maintenance warranty models and data collected can be used in decision making process. The study of plant maintenance warranty task of complex systems has grown in importance along-side reliability analysis because of the souring cost associated with repair and replacement. The challenges and solutions of the integration of power plant information systems with a business information system in the open electricity market has been a major issue [2]. A comprehensive discussion of preventive maintenance policies within warranty contracts framework of product is discussed by Chen and Chien [3] and the aging systems losses incorporating warranty

maintenance contract is presented by We *et al*. [4]. A review of maintenance models and how the performance of a repairable system under maintenance and repair contracts can be optimised is presented in Lugtigheid, *et al*.[5]. The planning of maintenance problem consists of a sequence of decision points over time, whereby decisions are made to repair or replace a equipment based on its condition. This problem can be further complicated by prevailing failure characteristics, and downtime costs. An optimal replacement-repair policy for multi-state deteriorating products under renewing free replacement warranty [6] show how repair and replacement decisions are made for warranted product subject to deterioration. [7] Discuss the repair and replacement decisions for warranted product under Markov deterioration. Extensive information about optimizing the repair and replacement of systems under warranty contracts is also discussed [8-12].

In this study, the idea of equipment giving off signs of defects, failure is likely to occur within a short interval of time. The decision maker could envisage bringing a fixed preventive maintenance time forward. It then makes sense to use opportunistic maintenance on other equipment if there are available resources, and also if one has information on the status of the equipment through condition monitoring data. A study by Coolen *et al*.,[13] consider the opportunity-based age replacement (OAR) of a unit upon failure and upon the first opportunity after reaching a predetermined threshold age, whichever occurs first. They also showed that the method can take extra information into account appropriately, and also revealed that on some occasions counter-intuitive results may appear which is shown and explained by the optimality criterion. An integrated approach into a comprehensive maintenance strategy of a power station is also discussed in MacIntyre, *et al*., [14], they also mentioned the types of mechanical problems experienced with power plant operation. A multi-component inspection system model based upon the delay time concept that incorporates the case of opportunistic inspection at failures is discussed by Wang and Christer [15]. There are a vast majority of literature on opportunistic maintenance and warranty models on complex systems subject to age replacement, renewal process, and repair amongst others. The theory is not new, however the application to real systems seems to be scarce.

1.1 Power Plant Process Description

The power Plant considered in this investigation agreed a contract on a full service warranty period of two years from the end of the plant ‘reliability test run’. This is when the plant is operated for ninety days continuously without any problems. As part of the warranty agreement, the vendor has given over the full operation and maintenance manuals (database) to the plant maintenance department. The plant management contract must ensure they ‘carry out and record’ the required maintenance tasks, as set out by vendor in order to retain the warranty status for the plant. These maintenance tasks list make up the foundation for the future maintenance schedule for the Plant. This investigation focuses particularly on the Booster Fan. The data selected in the study are man-hours, downtime, and cost for each of the PM’s associated with each area of the plant. The area for the Booster fan is broken down into the following: 6 sub systems (the fans & fan bearings, motor and motor bearings, lubrication system, Variable Inlet Vanes coupling, brake and Control Vane Actuator). A summary of one year data for the whole Booster downtime, cost and man-hours required following a failure and schedule maintenance is displayed on the graph in Fig. 1 below.

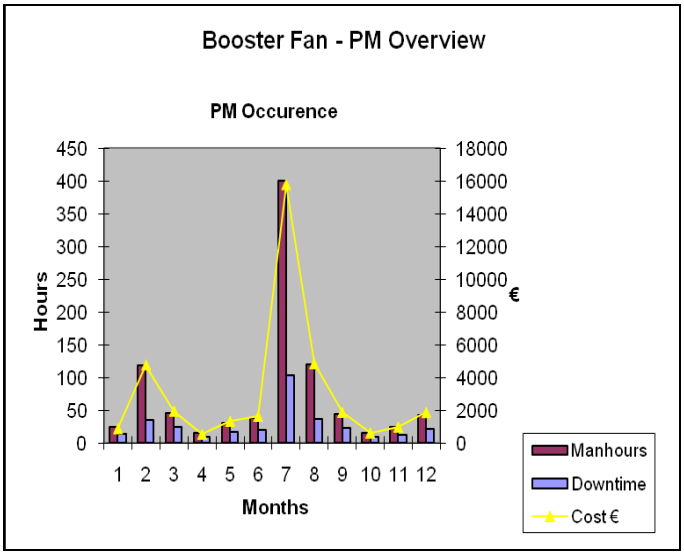

Fig. 1 Booster Fan PM downtime, man-hours and cost

The downtime following corrective maintenance (CM) and preventive maintenance (PM) activities on the booster fan is plotted on a graph in Fig. 2.

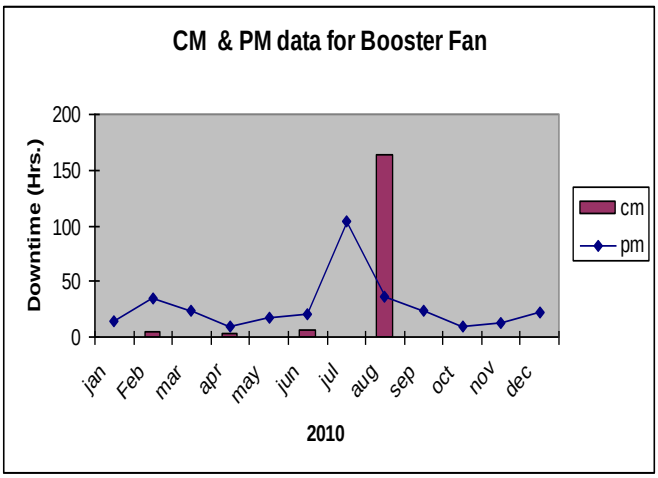

Fig. 2 Booster Fan CM and PM downtime

However, the questions here is how much man hours and resources can be made available to consider opportunistic maintenance and do preventive maintenance task and also the costing associated to all level of staff if required. Better planning and the use of resources is also possible from the graphs presented rather than looking at database formatted data. The graph highlights maintenance scheduling issues on the booster fan in the plant and shows the annual PM and CM downtime. It is clear to see that a major failure occurred almost immediately after the PM's activities carried out. This subsequently led to the following questions:

- Should the PM with strong grouping be more spread out evenly across the year?
- Should the main PM's be done opportunistically when inspections are conducted during an outage/overhaul where better time and attention can be given to the task?
- Are the competing failure modes directly linked to the group of PM carried out just prior to the failure?

The downtime labor profile following CM, PM and inspections on the booster fan are presented in Fig. 3. Note that the frequency of inspections is more compared to the PM activities. However, the large inspection times are due to the warranty tasks specified by the OEM.

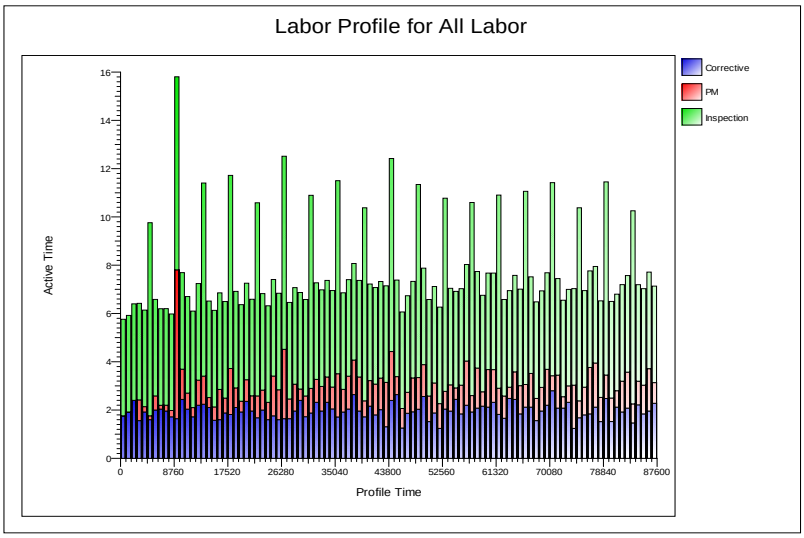

Fig. 3 Labor downtime profile following CM, PM and inspection

II. POWER PLANT MAINTENANCE POLICY

The maintenance policies considered at the power plant in this investigation are of a number of different types:

- Overhauls are carried out at fixed intervals, generally giving a system that is as good as new.
- Scheduled preventive maintenance is carried out following a fixed pattern.

- Opportunistic maintenance is not considered frequently when other parts of the plant system have gone down or are not required.

Opportunistic maintenance may be preventive or corrective, but the logistic burden involve give preference to adequate PM where possible, and hence restoring the system to as near as possible to "good as new". In this paper we attempt to model the plant process and incorporate opportunistic maintenance within the maintenance framework. The diagram in Fig. 4 present a process flow for the preventive maintenance policy review process and modeling to support decision on optimum maintenance policy. An opportunity arises if failure of some other parts of the equipment allows the component or part in question to be replaced. An example is presented regarding the loss of power supply from a generating plant which may give an opportunity to perform some preventive replacement on one or more components that are not performing reasonably well or faulty. The identification of critical equipment and relevant data information from databases are sort in the first instance. FMEA approach is considered to identify possible failure modes that could be apparent or hidden to the maintainer and a review of the warranty tasks that are obvious specified by the OEM. Elicitation from expert is vital although subjective, Mazzuchi, *et al*., [16] and O'Hagan [17] discuss the importance of elicitation and it relevance in maintenance optimization and practical applications respectively.

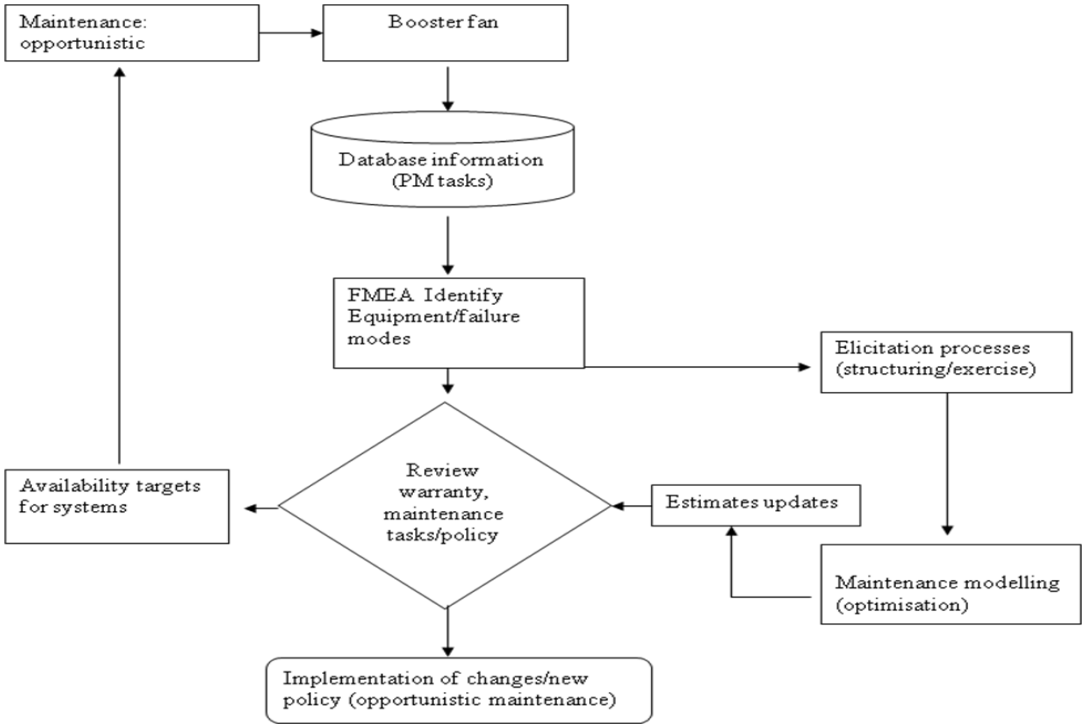

Fig. 4 Process flow for maintenance optimization

A practical review to the framework of warranty cost management and warranty cost analysis for multi-component systems is discussed by Diaz, *et al.*[18] and Park and Pham [12] respectively. Wu, *et al*., [4] demonstrate how general periodic preventive maintenance policies can be incorporated into warranty contracts for system's aging losses. The decision for implementation of new maintenance policy need to be justified from the maintenance modeling results obtained available resources (such as downtimes and man-hours), event severity and environmental targets play a significant role in supporting the decision making process on maintenance policy.

III. FMEA AND PREVENTIVE MAINTENANCE REVIEW

The preventive maintenance (PM) and corrective maintenance (CM) task lists in the plant are assessed in order to ascertain which PM tasks are worthwhile to retain. The existing PM listing are reviewed by expert's elicitation (maintenance staff, operations staff and contractors are involved). This stage is made up of two main steps:

1. Carry out a 'PM Review' through expert's elicitation with all Front Line Managers (FLM) and careful consultation with the plant maintenance engineers to preserve irrelevant tasks and document all reasons.
2. Conduct Failure Mode and Effects Analysis to identify any potential failure modes and ensuring all the valid maintenance tasks are applied to ensure safe and reliable operation of the plant in question.

The following steps are considered in our initial analysis on the selections of maintenance tasks from both database and expert's opinion:

1. Obtain and agree the database working version to use
2. Divide database activities into three sections
3. Ensure the number of tasks across the three units are equal and amend with expert's advice
4. Restore all obsolete tasks
5. Restore tasks that are no longer essential
6. Repeat steps 3-5 on a regular basis
7. Agree and confirm the database with the 'Master' listing for the maintenance tasks
8. Assign each of the tasks to required maintenance task group.

These list are non exhaustive and also form the basis for the eventual maintenance tasks uploaded onto the CMMS. The critical equipment considered in this study is the Booster fan. The Booster fan has 42 maintenance tasks and these tasks are similar in all the other fans in the other generating units. In order to have a better insight of the failure behavior and to justify the need for opportunistic maintenance we conducted failure mode and effect analysis (FMEA) on the booster fan to assess the maintenance requirements.

3.1 Failure Mode and Effect Analysis

The FMEA is to identify the relevant failure modes and propose appropriate maintenance task requirements. The results obtained from the FMEA analysis of the Booster fan is presented in Table 1. The risk priority number (RPN) values following the identified failure modes give a low value. These results are not surprising as the booster fan is fairly new. The risk priority number is the product of the severity, occurrence and detection, this gives an indication on the effect it has to the failure caused by the selected failure modes.

Table 1. Booster Fan FMEA and RPN results

Equipment	Function	Functional Failure	Failure modes	Effect of Failure	Severity	Occurrence	Detection	RPN
Booster Fan	**To blow hot air**	**Unable to blow hot air and operate to the desired performance**	Brake fails, wear and tear of bearings, low oil level, oil leakage, motor mounting moved	Possible fire, loss of production, large downtimes	5	1	1	5
		Fan stops un assisted	Brake stag closed, excessive vibration, high temperature	Possible fire, loss of production, large downtimes	9	1	1	9
			Brake pads opened, debris in bearing casing Brake pads too thin, high temperature vibration, high discharge pressure	Possible fire, loss of production, large downtimes	8	1	1	8

The graph in Fig, 5 below show the cost contribution of failure modes (causes) toward the effects it has on the booster fan. The Booster fan failure modes identified such as oil leakage, white metal debris in the bearings and high discharge pressure contribute significantly to the cost of failure of the fans.

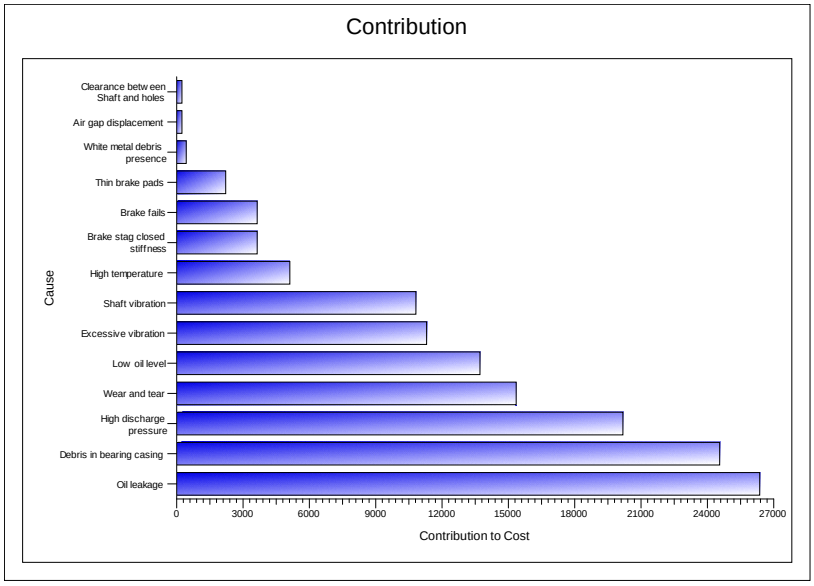

Fig. 5 Cost contributions of booster fan failure modes (causes)

The FMEA resulted in a better understanding of the Booster fan failure modes. The outcome and proposed task highlighted how good a detection system could be on site. The result is compared to the existing maintenance listing. We observed that the plant warranty on inspections, PM and CM are deemed 'excessive' to ensure reliability during the two year period. The analysis has given some insight to the equipment behavior and the following benefits of the FMEA outcomes obtained are:

- Improved 'awareness' of the Booster fan –components and operation.
- Increases chance of early problem detection and prevention.
- Reassures Maintenance that all possible failure is catered for through the existing maintenance schedule.
- Highlighted areas for further analysis
- Created better teamwork between operations and maintenance teams.

The proposed proactive maintenance tasks are;

- PM to include visual inspection of oil levels
- PM to include visual inspection of vibration noise and temperature alarm checks
- PM to include visual monitoring of white metal in bearing and ensure they remain clean from debris
- Ensure spares are in stock and develop protocols for staff to ensure that adequate maintenance task are conducted

These proposed tasks can be conducted whenever there is a window of opportunity to use opportunistic maintenance for the proposed PM task. Bedford and Alkali [19] propose models for competing risk involving censoring through opportunistic maintenance, in the paper they address competing risk statistical estimation problems which are a common concern in much of the maintenance literature, and focus attention on non-age-related information available to maintenance managers.

IV. MAINTENANCE OPTIMIZATION

We consider the situation where each time a booster fan fails, it is repaired and returned to full operational condition some components can be replaced and repaired. For a preliminary analysis, we assume that repair times are negligible for some task. Suppose T_1, T_2, T_3,…are the times to successive failures of the booster fan components, and $X_i = T_i - T_{i-1}$ is the time between failure $i-1$ and failure i where $T_0 = 0$. The T_i and X_i are random variables and t_i and x_i are defined to be their corresponding realized values. The fundamental model is then the *non-homogeneous Poisson process* (NHPP). Under the NHPP model the X_i are said to be neither independent nor identically distributed and can be defined by the intensity function of a stochastic point process.

Remark – this set of events may include observations such as vibration exceeding some given level, types of noise being generated, etc. When these events occur then their time of occurrence would be noted. The set may also include indicators that a certain time period has elapsed since some previous event (or since putting the equipment into service).

A comprehensive review of maintenance optimisation models and analysis is discussed by Dekker [20]. A subjective approach of maintenance policy based on costs and downtimes after non-renewing warranty contract is discussed by Jung, et al., [21]. Other cost based models with associated maintenance warranty contracts are demonstrated by Diaz, et al., [18] and Park and Pham [12].

In this paper the booster fan has a failure time distribution *F(t)* with finite mean μ and a density *f(t)*. Then failure rate is given as

$$r(t) = f(t) / \overline{F}(t) \tag{1}$$

and the cumulative hazard is give as;

$$R(t) = \int_0^t r(y)dy \tag{2}$$

which has a relation $\overline{F}(t) = 1 - F(t)$, where $\overline{F}(t) = \exp\{-R(t)\}$.

It is further assumed that the failure rate *r(t)* is continuous, strictly increasing, and remains undisturbed by minimal repair. If $T=\infty$, then the survival distribution of the time between successive failure is given by

$$\overline{F}_p(t) = \exp[-\int_0^t p(x)r(x)dx] \tag{3}$$

The cost of the failure process is governed in the interval (0, *t*), which corresponds to the period of observation. With the renewal reward theorem the expected cost in operating a unit over the specified interval is envisaged. The expected cost rate in this case can be obtained and the optimal *T** which would minimizes the PM cost.

4.1 Simulation example

We now present comparative simulations of the NHPP model to illustrate the characteristic of the failure modes obtained from our FMEA using RCMCost Availability Workbench Software. For the sake of comparison, 4 prominent failure modes which include; oil leakage, low level oil, excessive vibration and white metal debris respectively are considered as the cost contributions attributed by them are somewhat significant. The failure times are simulated from this model as follows; for the first case of failure caused by oil leakage, we assume that the underlying lifetime distribution is Weibull with shape parameter 1.3 and scale parameter 1. We run simulation by generating random sample from a weibull distribution. Preventive maintenance optimization plot in Fig. 6 suggest run to failure for low oil level related failures. The safety, operational and environmental criticality target are very constant over time. However the cost curve becomes almost flat from 8,990 operating hours and our simulation results suggest run to failure for low level oil related failures.

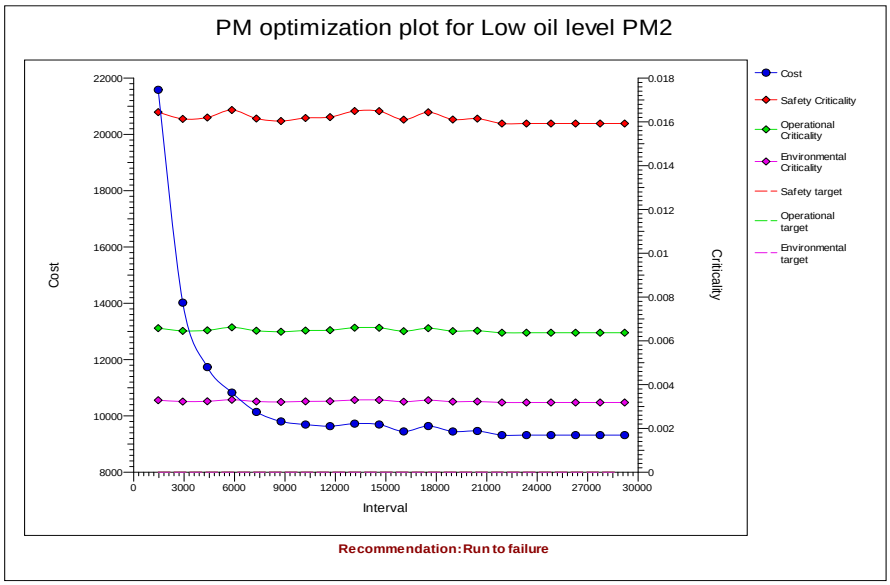

Fig. 6. PM optimization of oil level related failures

Similarly we run simulation for the most significant failure related failure mode (oil leakage) identified. The result of optimum PM is presented in Fig. 7. The simulation result in Fig. 6 gives multiple optimum points for PM schedules; the lowest optimum PM interval is at 9,000 operating hours, subsequent optimum points at higher interval vary and becomes constant at about 22,000 operating hours.

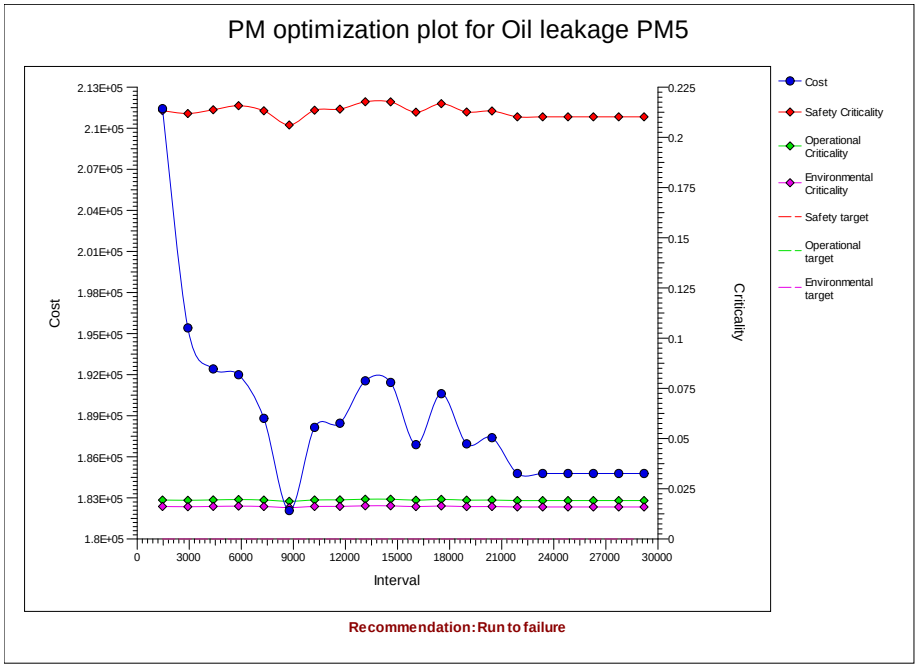

Fig. 7 Optimization plot for leakage related failures

The model fit recommend run to failure. We further explore and fitted the simulation model to failure resulting from excessive vibration related failure modes in Fig. 8, and the cost curve recommend run to failure. The safety criticality plot increases super linearly and has a bleep is observed at 13,000 operating hours interval and stabilizes at 19,000. The operational and environmental criticality patterns are very similar and increases in a predictable fashion and becomes constant from 15,000 operating hours.

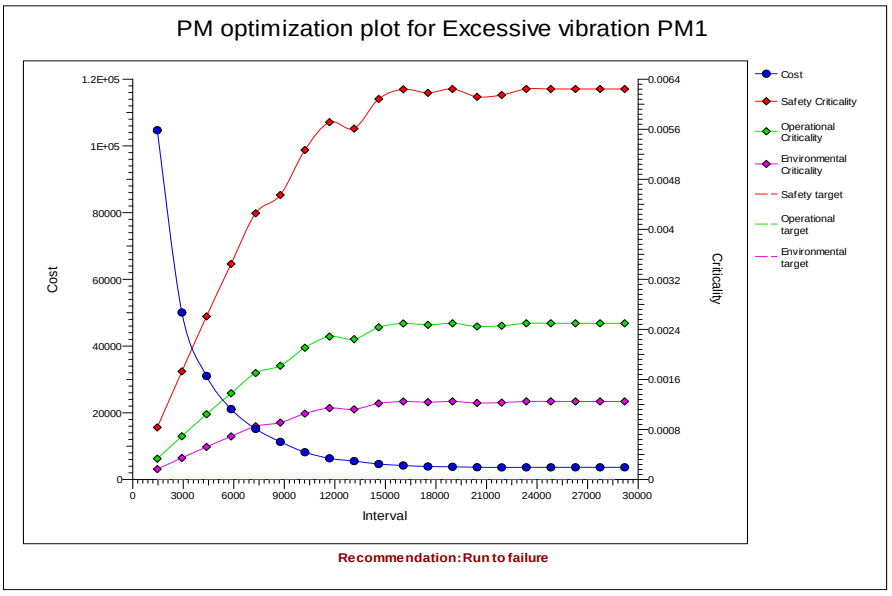

Fig. 8. PM optimization for vibration related failures

In the power plant the number of visual inspections related to the booster fan as recommended by the OEM to cover the warranty maintenance tasks is vast. One is not sure whether some of the tasks are relevant, however multiple inspections are expected under normal circumstances. An inspection is a form PM strategy, and we the fitted the Weibull distribution simulation model to the failure caused by white metal debris in the bearing casing. The optimum inspection expected cost curve presented in Fig. 9 is decreasing over the specified operating interval, but the simulation result does not recommend visual inspections for white metal debris in the bearing casing. In practice, inspection task specified by the OEM could be daunting and oil analysis in the lab would be adequate in this case.

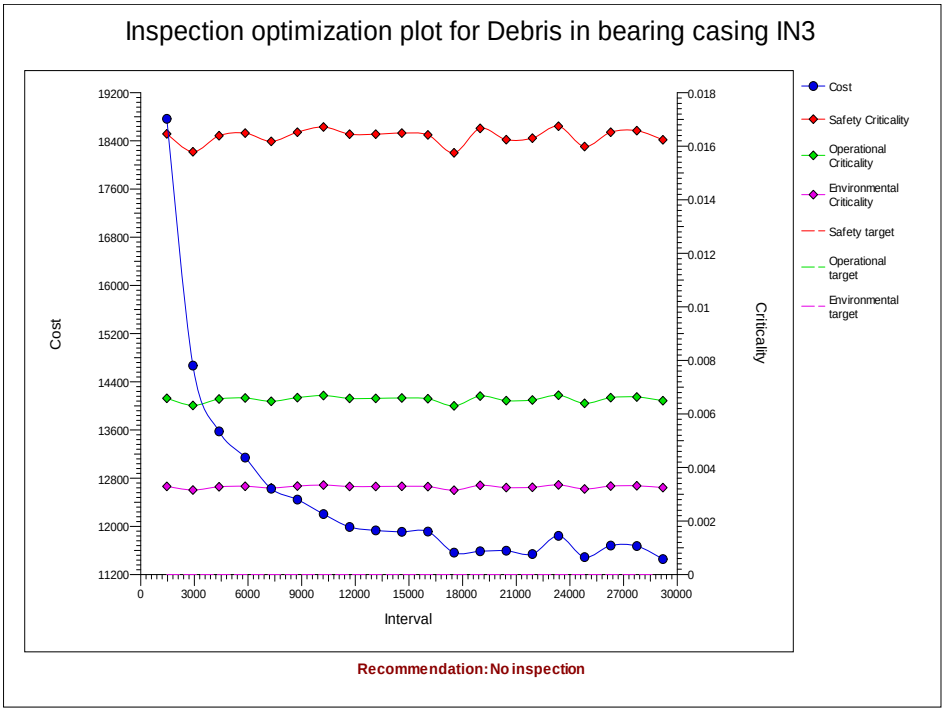

Fig. 9 Optimum inspection for white metal debris related failures

In practice, when there are multiple components in a system, the rescheduling of the inspections following preventive maintenance a defective component would not cause inspections to become unsynchronized; it would just mean some components would continue to be inspected for longer. Although, one could imagine a policy in which if one component is preventively replaced at inspection, the inspections of all components would be rescheduled. This justified adaptation of opportunistic maintenance as an option to consider by asset managers.

V. CONCLUSION

In this paper a new plant under warranty maintenance preventive maintenance task is considered. The paper focuses on Booster fan and a comprehensive FMEA is conducted on the selected critical equipment and critical failure modes are identified. Opportunistic maintenance is envisaged and critical appraisal of the literature is linked with the warranty maintenance task. A non-homogenous poison process model is considered within a simulation framework and adequate candidate distributions are selected. The Booster fan PM optimization results show the expected cost per unit time following failures caused by the critical failure modes. To place these result in the context of the power plant we have been studying, it should be acknowledged that the booster fans are complex pieces of equipment embedded in a more complex system.

The maintenance opportunities are determined largely by the upstream failures in the boiler and the turbine. However these opportunities can be shared in the same generating unit and since manpower is limited in the plant a choice has to be made about which PM task to prioritize. Hence the PM times are linked across different equipment, and not all opportunities will be taken because a "better" opportunity will be available elsewhere. The PM optimization graphical presentation gives an insight to the PM process and highlighted the safety, operational and environmental criticality. Downtimes and man-hours are also associated with the cost of PM schedules. Cost has been the main significant factor for all maintenance scheduling problem. Modeling the PM and failure process will in no doubt support decision on optimal cost effective maintenance strategy and hence allow the decision maker to adapt opportunistic maintenance where necessary. It is important to note that results from this paper led to changes in maintenance policy when the warranty period has elapsed.

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An order level EOQ model for deteriorating items in a single warehouse system with price depended demand and shortages.

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Abstract: - In this paper a deterministic inventory model is developed deterioration rate is time proportional. Demand rate is a function of selling price. Deterioration rate, inventory holding cost and ordering cost are all of function of time. The planning horizon is infinite. The optimum replacement policy and decision rule, which minimizes the total cost, is developed. In this study an order level inventory model for deteriorating items with single warehouse is developed where shortages are taken into consideration and it is completely backlogged. The results are illustrated with the help of numerical example. The sensitivity of the solution with the changes of the values of the parameters associated with the model is discussed.

Keywords: - *Deteriorating items; shortages; price dependent demand; time varying holding cost.*

I. INTRODUCTION

In recent years, mathematical ideas have been used in different areas in real life problems, particularly for controlling inventory. One of the most important concerns of the management is to decide when and how much to order or to manufacture so that the total cost associated with the inventory system should be minimum. This is somewhat more important, when the inventory undergo decay or deterioration. Deterioration is defined as change, damage, decay, spoilage obsolescence and loss of utility or loss of original value in a commodity that results in the decreasing usefulness from the original one. It is well known that certain products such as vegetable, medicine, gasoline, blood and radioactive chemicals decrease under deterioration during their normal storage period. As a result, while determining the optimal inventory policy of that type of products, the loss due to deterioration cannot be ignored.

In classical inventory models the demand rate is assumed to be a constant. In reality demand for physical goods may be time dependent, stock dependent and price dependent. Selling price plays an important role in inventory system Burwell, [1] developed economic lot size model for price-dependent demand under quantity and freight discounts. An inventory system of ameliorating items for price dependent demand rate was considered by Mondal, et. al [2]. You, [3] developed an inventory model with price and time dependent demand.

In most models, holding cost is known and constant. But holding cost may not always be constant. In generalization of EOQ models, various functions describing holding cost were considered by several researchers like Naddor, [4], Van der Veen, [5], Muhlemann and Valtis Spanopoulos, [6], Weiss, [7], and Goh, [8]. In this present paper, I have developed a generalized EOQ model for deteriorating items in a single Warehouse system and demand rate is a function of selling price. Shortages are allowed here and are completely backlogged.

The aim of the paper is to develop an EOQ (Economic Order Quantity) model for a single-item inventory having a price-varying demand. Inventory modelers have so far considered only two types of price dependent demands, linear and exponential. Linear price-dependence of demand implies a uniform change in the demand rate of the product per unit price. This is rarely seen to occur in the real market. On the other hand, an exponentially price-varying demand also seems to be unrealistic because an exponential rate of change is very high and it is doubtful whether the market demand of any product may undergo such a high rate of change as exponential**.** In the opinion of the authors, an alternative (and perhaps more realistic) approach is to consider selling price dependence of demand. A brief review of the literature dealing with price-varying demands is made in the following paragraphs.

In formulating inventory models, two factors of the problem have been of growing interest to the researchers, one being the deterioration of items and the other being the variation in the demand rate with time. Silver and Meal [9] developed an approximate solution procedure for the general case of a deterministic, time-varying demand pattern. The classical no-shortage inventory problem for a linear trend in demand over a finite time-horizon was analytically solved by Donaldson [10]. However, Donaldson's solution procedure was computationally complicated. Silver [11] derived a heuristic for the special case of a positive, linear trend in demand and applied it to the problem of Donaldson. Ritchie [12] obtained an exact solution, having the simplicity of the EOQ formula, for Donaldson's problem for a linear, increasing demand. Mitra et al [13] presented a simple procedure for adjusting the economic order quantity model for the case of increasing or decreasing linear trend in demand. The possibilities of shortage and deterioration in inventory were left out of consideration in all the models. Dave and Patel [14] developed an inventory model for deteriorating items with time- proportional demand. This model was extended by Sachan [15] to cover the backlogging option. Bahari-Kashani [16] discussed a heuristic model for obtaining order quantities when demand is time-proportional and inventory deteriorates at a constant rate over time. Deb and Chaudhuri [17] studied the inventory replenishment policy for items having a deterministic demand pattern with a linear (positive) trend and shortages; they developed a heuristic to determine the decision rule for selecting the times and sizes of replenishment over a finite time-horizon so as to keep the total costs minimum. This work was extended by Murdeshwar [18]. Subsequent contributions in this direction came from researchers like Goyal ([19],[20]), Dave [21], Hariga [22], Goswami and Chaudhuri [23], Xu and Wang [24], Chung and Ting ([25],[26]), Kim [27], Hariga ([28],[29]), Jalan, Giri and Chaudhuri [30], Jalan and Chaudhuri [31], Giri and Chaudhuri [32], Lin, Tan and Lee [33], etc. The assumption of the constant deterioration rate was relaxed by Covert and Philip [34] who used a two-parameter Weibull distribution to represent the distribution of time to deterioration. This model was further generalized by Philip [35] by taking a three-parameter Weibull distribution. Misra [36] also adopted a two-parameter Weibull distribution deterioration to develop an inventory model with a finite rate of replenishment.
These investigations were followed by several researchers like Shah and Jaiswal [37], Aggarwal [38], Roy-Chowdhury and Chaudhuri [39], etc. Recently Wee [40] and Jalan and Chaudhuri [41] and Chakrabarti and Choudhury [42] worked with an exponentially time-varying demand. In the present paper, we assume a generalized EOQ model for weibull deteriorating items in a single Warehouse system and demand rate is a function of selling price. Shortages are allowed here and are completely backlogged. An analytical solution of the model is discussed and it is illustrated with the help of a numerical example. Sensitivity of the optimal solution with respect to changes in different parameter values is also examined.

II. ASSUMPTIONS & NOTATIONS

The mathematical model in this paper was developed based on the following

Assumptions:

(i) The scheduling period was prescribed constant and no-supply lead time.
(ii) Demand rate is price depending and is of the form $D(p) = ap^{-b}$, a, b >0, p-- is the selling price.
(iii) Shortages are allowed and backlogging.
(iv) The rate of deterioration at any time t>0 follow the two-parameter Weibull distribution as $\theta=\alpha\beta t^{(\beta-1)}$, where α ($0<\alpha<1$) is the scale Parameter and β (>0) is the shape parameter.
(v) Deterioration of the units is considered only after they have been received Into the inventory.
(vi) At the beginning of every period the initial stock level is raised to order level.

Notations:

The following **notation** was used throughout the paper.

(i) T: Scheduling Period.
(ii) D(p) = Demand rate.
(iii) θ: Deteriorating rate.
(iv) Q(t): Inventory level at time t.
(v) S_1: Maximum Shortage level
(vi) S: Initial stock level at the beginning of every inventory.
(vii) Cs: Shortage cost.
(viii) C_2: Shortage cost per unit.
(ix) C_H: Holding Cost.
(x) C_1: Holding cost per unit.
(xi) D_θ : Total-deteriorating items.
(xii) C_d : Deteriorating cost per unit.
(xiii) TIC: Total Inventory Cost.

The Model Description and Analysis:

The initial stock was S at time t = 0, then inventory level decreases mainly due to meet up demands and partly from deterioration. By this process the stock reaches zero level at $t = t_1$. Now shortages occur and accumulate to the level S_1, at t = T.

The differential equations describing the state of Q(t) in the interval (0,T) are given by,

$$\frac{dQ(t)}{dt} + \alpha\beta t^{(\beta-1)}\, Q(t) = -a\, p^{-b} \qquad , 0 \le t \le t_1 \quad \text{..... (1)}$$

$$\frac{dQ(t)}{dt} = -a\, p^{-b} \qquad , t_1 \le t \le T \quad \text{..... (2)}$$

With the boundary condition Q(0)=S, $Q(t_1)=0$ and $Q(T)= -S_1$
Solving above differential equations using boundary conditions we get,

$$Q(t) = \left[S - ap^{-b} \left(t + \frac{\alpha}{\beta+1}\, t^{\beta+1} \right) \right] e^{-\alpha\, t^{\beta}} \quad \text{..... (3)}$$

And $Q(t) = a\,(t_1 - t)\, p^{-b}$ ..... (4)

At $t=t_1$,

$$S = a\, p^{-b} \left(t_1 + \frac{\alpha}{\beta+1}\, t^{\beta+1} \right) \quad \text{..... (5)}$$

At $t=T$,

$S_1 = a\,(T-t_1)\, p^{-b}$, since $Q(t)=-S_1$ ..... (6)

Total deteriorating units during the (0,T) are following,

$$D_\theta = \int_0^{t_1} \theta\, Q(t)\, dt$$

$$= S\left(\alpha t_1^{\beta} - \frac{\alpha^2}{2} t_1^{2\beta} \right) - a\, p^{-b} \left[\frac{\alpha\beta}{\beta+1} t_1^{\beta+1} - \frac{\alpha^2\beta}{(\beta+1)(2\beta+1)} t_1^{2\beta+1} - \frac{\alpha^3\beta}{(\beta+1)(3\beta+1)} t_1^{3\beta+1} \right] \text{..... (7)}$$

The deteriorating cost is given by,

$C_d = c_d\, D_\theta$

$$= c_d\, S\left(\alpha t_1^{\beta} - \frac{\alpha^2}{2} t_1^{2\beta} \right) - a\, p^{-b} \left[\frac{\alpha\beta}{\beta+1} t_1^{\beta+1} - \frac{\alpha^2\beta}{(\beta+1)(2\beta+1)} t_1^{2\beta+1} - \frac{\alpha^3\beta}{(\beta+1)(3\beta+1)} t_1^{3\beta+1} \right] \text{..... (8)}$$

Carrying cost over the period (0,T) is given by,

$$C_H = c_1 \int_0^{t_1} Q(t)\, dt$$

$$= c_1 S \left(t_1 - \frac{\alpha}{\beta+1} t_1^{\beta+1} \right) - a c_1\, p^{-b} \left[\frac{t_1}{2} - \frac{\alpha\,\beta}{(\beta+1)(\beta+2)} t_1^{\beta+2} - \frac{\alpha^2}{(\beta+1)(2\beta+2)} t_1^{2\beta+2} \right] \text{.... (9)}$$

Shortage **c**ost is given by

$$C_s = c_2 \left[-\int_{t_1}^{T} Q(t)\, dt \right]$$

$$= a c_2\, p^{-b} \left(\frac{T^2 + t_1^2}{2} - T t_1 \right) \quad \text{..... (10)}$$

Hence the Total Inventory Cost is given by,

$TIC = C_d + C_H + C_s$

$$= c_d\, S\left(\alpha t_1^{\beta} - \frac{\alpha^2}{2} t_1^{2\beta} \right) - a\, p^{-b} \left[\frac{\alpha\beta}{\beta+1} t_1^{\beta+1} - \frac{\alpha^2\beta}{(\beta+1)(2\beta+1)} t_1^{2\beta+1} - \frac{\alpha^3\beta}{(\beta+1)(3\beta+1)} t_1^{3\beta+1} \right]$$

$$+ \quad c_1 S \left(t_1 - \frac{\alpha}{\beta+1} t_1^{\beta+1} \right) - a c_1\, p^{-b} \left[\frac{t_1}{2} - \frac{\alpha\,\beta}{(\beta+1)(\beta+2)} t_1^{\beta+2} - \frac{\alpha^2}{(\beta+1)(2\beta+2)} t_1^{2\beta+2} \right]$$

$$+ a c_2\, p^{-b} \left(\frac{T^2 + t_1^2}{2} - T t_1 \right) \quad \text{..... (11)}$$

Numerical Examples:

To illustrate the order level model developed here, we consider an inventory system with the following hypothetical values.

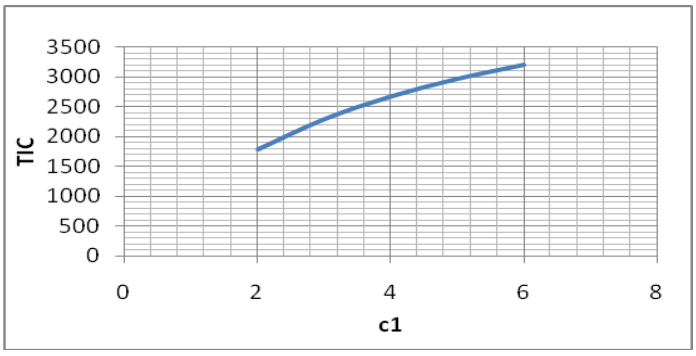
We Consider a=10, b=1, α=0.005, β=0.4, p=6.00, C_1=5.00, C_2=4.00, C_d=2.00

Then we obtained S=29.88595~30units

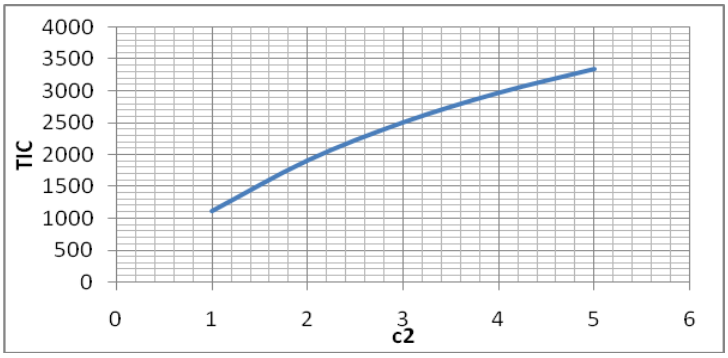
And TIC=2968.41

Sensitivity Analysis:

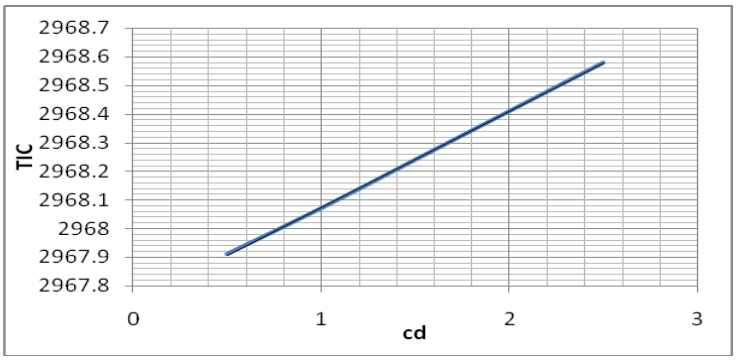
Change Value		S	t_1	TIC
C_1	2	44.95	26.62	1783.99
	3	38.48	22.81	2291.89
	4	33.64	19.95	2672.52
	5	29.89	17.73	2968.41
	6	26.88	15.96	3205.04
C_2	1	11.16	6.65	1111.74
	2	19.17	11.39	1906.79
	3	25.19	14.96	2503.71
	4	29.88	17.73	2968.41
	5	33.64	19.95	3340.45
C_d	0.5	29.88	17.73	2967.91
	1	29.88	17.73	2968.07
	1.5	29.88	17.73	2968.24
	2	29.88	17.73	2968.41
	2.5	29.88	17.73	2968.58
T	25	18.65	11.09	1159.31
	30	22.39	13.30	1669.52
	35	26.14	15.52	2272.55
	40	29.88	17.73	2968.41
	45	33.64	19.95	3757.12
p	3	59.77	17.73	5936.82
	4	44.83	17.73	4452.62
	5	35.86	17.73	3562.09
	6	29.88	17.73	2968.41
	7	25.62	17.73	2544.35



Graphically change of C_1 - TIC



Graphically change of C_2 - TIC



Graphically change of C_d - TIC

Observations:

From the above table we observe the following observations:

(1) Increase in Shortage cost (C_2) per unit, Total Inventory Cost also increases.
(2) Increase in Holding cost (C_1) per unit, Total Inventory Cost also increases
(3) Increase in Deteriorating Cost (C_d) per unit, Total Inventory Cost and decreasing rate. Here also in this case there is a minor increase in Total cost, which is negligible. From 0.91 to 1.58 there is slide change in total cost.
(4) Increase in time Period (T), Total Inventory Cost also increases.
(5) If there is a change in Price (P), Total Inventory Cost decreases.

III. CONCLUSION

In this present paper, I have developed a generalized EOQ model for deteriorating items. The principle features of the model are as follows:

The deterministic demand rate is assumed to be a function of selling price. Selling price is the main criterion of the consumer when he/she goes to the market to buy a particular item.

Shortages are allowed and are completely backlogged in the present model. In many practical situations, stock out is unavoidable due to various uncertainties. There are many situations in which the profit of the stored item is high than its backorder cost. Consideration of shortages is economically desirable in these cases.

The deterioration factor has been taken into consideration in the present model as almost all items undergo either direct spoilage (like fruits, vegetables etc.) or physical decay (in case of radioactive substances, volatile liquids etc.) in the course of time, deterioration is a natural feature in inventory system. There are many items like perfumes, photographic films etc. which incur a gradual loss of potential or quality over time.

In future, researchers can do more work about several types of demand, variable costs etc.

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An Appraisal of the Quality Control Practices in Sandcrete Blocks Production in Yewa South Area of Ogun State, Nigeria

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Abstract: **-** The paper focuses on the appraisal of quality control practices by commercial block manufacturers on the quality of blocks produced in the Yewa South Area of Ogun State, Nigeria. Both visual inspection and laboratory testing were adopted as the means of ascertaining the quality of blocks produced. Block production sites were visited for physical inspection to assess their conformity with block production processes as stipulated in relevant codes and standards. Samples of Sandcrete blocks were collected from block manufacturers and tested for dry density, water absorption, volume porosity, moisture content and compressive strength. Control experiment was set up to obtain desirable result when production is done according to laid down procedures. The study confirmed that the staff of contractors had no formal training in quality control of block production and that mix ratio, quality, and mixing of the constituent materials as well as curing method affected the quality of sandcrete blocks. It was also confirmed that the quality of blocks produced by commercial manufacturers does not conform to the required standard in BS 2028 of 1970.

Keywords: **-** *Quality control, production processes, visual inspection, laboratory testing, sandcrete blocks.*

I.INTRODUCTION

There are three basic necessities of life, food, clothing and shelter, the latter being the most lacked in the society today especially in developing countries. A visit to major towns and cities in Nigeria reveals that people live in over-populated houses and rooms. In Lagos, for example, there are reported cases of a single family of ten members living in just one rented room, while many other people sleep in garages, under kiosks and bridges. This is as a result of their inability to have a building of their own and they cannot afford the exorbitant amount of renting a place of abode. It was stated by [1] that one of the major challenges and problems identified in the developing countries in this twenty first century is provision of shelter. He further said that there is the need to make housing affordable and accessible to the people so as to overcome this challenge.

According to [2], block is defined as a masonry unit of larger size in all dimensions than that specified for bricks and not exceeding 650mm in all dimensions of height, length or thickness. There is no specified unit for voidage relative to volume but external shell wall thickness should not be less than 75mm or 1.75 of nominal maximum size of aggregates which ever is greater. Sandcrete blocks are defined as a permanent durable material which is produced from natural sandy soil or a modified sandy soil such that cohesion of the freshly moulded blocks is insufficient to allow the unsupported handling or curing. Block depth may be greater than 100mm, typically, 230mm with the use of dynamic compaction for producing more common uniform compaction resulting in insufficient strength for the block to retain its moulded shape though not enough for unsupported handling or stack curing. Sancrete blocks refer to blocks made or moulded with sand, water and cement which serve as a binder. It possesses an intrinsic low compressive strength hence its susceptibility to seismic activity. It is a major component material in the construction of buildings in Nigeria and many other countries in Africa [3]. Previous research conducted has revealed dismal production result of commercial sandcrete blocks which exhibit compressive strength far below standardized strength for construction [4]. This is due to the apparent simplicity and relatively low cost in setting up of block making factories which requires no formal qualification judging from the proportion of the population that constitutes the bulk of the operators.

It was equally said that "the quality of products and services is the major concern of every consumer and producers" [5] and [6]. According to [7] quality means compliance with specifications while [8] stated that

quality may be viewed as the totality of features required by a product or service to satisfy a given need. The affirmation of [9] was that there is conflict relative to opinions about the concept of quality while [5] postulates that for quality, the building owner has an implicit expectation of quality for his/her building; the designer has his/her own professional view of quality depending on architectural and engineering tradition and the manufacturers and constructors have to make judgements about quality as it relates to price while on the other hand, stipulated codes and regulations impacts on projects, with a view of quality, which may itself conflict with those of other participants. They further stated that the result of all this confusion is very often a frustrated client, a disillusioned designer, a commercially embarrassed contractor and distrusted manufacturers. They concluded that quality is a summation of all those characteristics which together make a product acceptable to the market.

The position of [10] was that for a long time until perhaps a few years ago, these blocks were manufactured without any reference to any specification either to suit local building requirements or for good quality work. They further observed that the situation has since changed as the standard organisation of Nigeria now has a document in place giving the specifications both for the manufacture and use of standard sandcrete blocks. However the high and increasing cost of the constituent materials especially cement has resulted in compromise on the quality of commercial block production as manufacturers resorted to sharp practices in block production processes by lowering the mix ratio of constituent materials. However, [11], confirmed that mix ratio, materials quality, and mixing of the constituent materials affect the quality of sandcrete blocks. While [12] observed that blocks which have high coefficient of variation is an indication of very poor quality control in the production process. Block production process was one of the three major influencing variables that can affect the properties and long-term performance of sandcrete blocks. The other two major variables of equally significant influence were identified as quality of constituent material as well as the action of environmental agents.

The aim of the paper is to appraise the quality control practices of block producers in Yewa South Area of Ogun State, Nigeria with a view to proffering solution to the production of poor quality blocks in the area.

II.MATERIALS AND METHODS

Constituent materials used in the production of samples of sandcrete blocks tested in the laboratory are: Ordinary Portland Cement (OPC) from West African Portland Cement Company, Ewekoro in Ogun State whose properties conform to [13], well graded sand with a continuous or dense gradation, of low plasticity index and free from clay, loam, dirt, soluble salts and organic or chemical matter which can have harmful effects on OPC both during hydration and even after hardening and fresh, colourless, odourless and tasteless portable water. The mix proportion being used by commercial block producers in all the sites visited varied from 1:10 to 1:12**.** No definite water - cement ratio was used in all the sites visited, water was being added randomly as deemed fit by the operators. Compression of the damp soil and stabiliser mix was done mechanically by the commercial block producers where block samples were collected. While curing of green blocks was done by spraying or sprinkling of water in the morning and in the evening for two days in an open place. Laboratory based experiments were planned for in the research methodology mainly to test ideas, theories and designs that had been formulated. For all laboratory tests attempts were made to ensure that the results obtained satisfied three basic conditions: accuracy, reliability and reproducibility. Only standard methods were used in the production of sandcrete blocks. Inspection of production sites was carried out with the objective of assessing the organisational set-up of the site, and to compare individual production sub-processes against a pre-prepared check-list of good practice. Departures from the norm were carefully noted. Two production sites each were visited at Idiroko and Ilaro respectively for this exercise At both locations, there was no centralised yard for mixing, proportioning, etc. The preparation of specimen for the control experiment was carried out with careful selection and proportioning of constituent materials. All necessary precautions were taken so as to obtain quality product for testing and by inference a desirable result from the test procedures. The planned experiments demanded that specimens be prepared to a high degree of accuracy, reliability and consistency. Extra care had to be taken at all stages of the block production process: soil preparation, mixing, compression, and curing of the samples. Specimen design and preparation describes the procedures adopted and the precautions taken to produce the required number of block specimens for the various tests planned. The description is based on the four main stages of sandcrete block production: soil preparation, mixing, moulding and curing.

Six separate tests and experiments, all of which have direct bearing with the investigation of the effect on the durability of blocks, were selected and conducted. The bulk properties identified as likely to influence durability of sandcrete blocks include: Block dry density (BDD), Total water absorption (TWA), Total volume porosity (TVP), Moisture Content (MC), Wet compressive strength (WCS), and Dry Compressive strength (DCS).

Each of these properties are investigated in this study.

III.RESULTS AND DISCUSSION

The results obtained from the various tests carried out are presented below. In Fig. 1 is the dry density of the blocks for both the commercial samples and the control experiment, Fig. 2 presents the result of the total water absorption for both the commercial samples and the control experiment, while Fig. 3 contains the result of the total volume porosity for both the commercial samples and the control experiment. Fig. 4 has the result of the moisture content for both the commercial samples and the control experiment while Figs. 5 and 6 contains the results of the wet compressive strength and the dry compressive strength respectively for both the commercial samples and the control experiment. From the responses to the pre-prepared check-list of good practice administered at the four block production sites visited the following were deduced:

The concept of batching is not closely followed so there is the likelihood of wastage and misuse of the stabiliser. Also batching of constituent materials is by volume and not by weight and moisture content test was not carried out on the sand used hence no compensation is made for bulking. All the commercial block producers used different mix ratio ranging from 1:8 to as lean as 1:12 (cement sand). Measuring out of the soil mix fed into the mould is not strictly done hence the high level of variation in the dry density of tested block samples. No special attention was given to the corners and edges of green blocks. Curing conditions were not categorised into wet and dry stages as curing was done under direct sunshine by spraying water on moulded blocks daily for two to four days before the blocks are stacked for sale. Blocks were apparently used earlier than the specified curing periods of 28 days required for the OPC. There was no quality checks carried out on the constituent materials used in block production in all the sites visited. The soil used for sandcrete block production was not graded. Quality of water used for mixing and curing were not determined. Laboratory tests such as dry density, water absorption, volume porosity water content and compressive strength tests which are the hall marks of good quality sandcrete blocks were not carried out. These shortcomings are likely to compromise the quality of blocks produced. Experimental results on BDD reveal that for the commercial samples, 150mm hollow blocks have the least value of 1614kg/m^3, followed by 225mm hollow blocks which has 1650kg/m^3. For the control experiment, 150mm blocks have 1806kg/m^3 while 225mm hollow block has the highest value of 1822kg/m^3. (see Fig. 1). The values obtained experimentally for the various types of blocks in this study fall within the range of recommended value for concrete blocks as stated in [2]. It is also pertinent to state that the densities of all blocks tested (both commercial samples as well as the samples for the control experiment) falls within the range of type A blocks [14]. There is not much difference in the values obtained in the control experiment whereas there is a higher level of variation in the commercial samples. This could be as a result of the fact that due process was not followed in the production of commercial samples and there was no quality control.

The results of the TWA values shown in Figure 2 compare well with current recommended maximum values for sandcrete blocks. The recommended maximum is 15% [15]. Although this value is neither absolute nor widely adopted by other researchers, it still serves as a useful purpose. The values obtained were favourable when compared with those of like materials (clay bricks 0 to 30%; concrete blocks 4 to 25%; calcium silicate bricks 6 to 16% [16] see Figure 2. According to [17], TWA values below 7% are regarded as being low, while those above 12% as high. The values for all collected samples from the commercial manufacturers are slightly higher than 12% and as such can be regarded as high while for the control experiment the values for the hollow blocks falls within the range and can be regarded as low. There are marked significant differences in the values of the collected samples and that of the control experiment (see Fig. 2). This can be attributed to lack of adherence to specified procedure by the commercial block producers as there was no specified water/ cement ratio and also the curing process was not properly carried out. The above results also confirm that sandcrete blocks have the potential to absorb appreciable amounts of water and possibly retain it too. The total volume porosity values are lower in commercial samples than that of the control experiment as shown in Fig. 3. The values for both categories of blocks however compare well with those of like materials. Materials with TVP above 30% are considered to be of high porosity [16]. All the blocks examined during this research can therefore be considered to be of low porosity which proves that the TVP for all samples are acceptable (see Fig. 3). The moisture content of the commercial samples show a considerable range of variation and the values obtained are also considerably lower than the recommended values in literature (see Fig. 4). This is perhaps due to the fact that there was no specified water cement ratio and the fact that poor curing process was followed. It can thus be adduced to be responsible for the higher value of water absorption which is an indication of poor quality block. For the control experiment, the obtained values are closer to the recommended value of 80kg/m^3 [18] (see Fig. 4). The corresponding values obtained for water absorption is considerably low, an indication of a better quality block than those obtained for the commercial samples.

The values of the mean Wet Compressive Strength (WCS) in the commercial samples ranged between 1.48N/mm^2 and 1.68N/mm^2 while the values for the control experiment were 6.61mm^2 to 7.18N/mm2(see Fig.

5). The equivalent values of their dry compressive strengths ranged between 2.37N/mm^2 and 2.61N/mm^2 for the commercial samples and 7.27N/mm^2 to 8.09N/mm^2 for the control experiment. (see Fig. 6). The results for the commercial blocks compare well with results obtained by earlier researchers and conforms with the recommendation that the ratio of the mean dry and wet compressive strength in sandcrete blocks should not be greater than 2 [19]. The ratio in the commercial samples range between 1.55N/mm^2 and 1.60N/mm^2 and is much higher than the corresponding values obtained in the control experiment which ranges between 1.10N/mm^2 and 1.13N/mm^2. The result of the compressive strength indicates higher values for the control experiment than the commercial samples (see Figs. 5 and 6). The wet compressive strength for the commercial samples is far below the recommended value for the grade of their densities.

IV.CONCLUSIONS AND RECOMMENDATIONS

From the various reports and experimental results the following conclusions can be drawn: Commercial block producers are ignorant of the existence of any relevant code or specifications relating to block production and properties, as a result, standard process of production and quality control are not ensured. The consequence of this is the production of low quality blocks. This is equally responsible for the marked significant difference in the results obtained from the collected samples and that of the control experiment. The dry densities of all samples tested whether the fall within the category of type "A" blocks according to the specification of [14]. While there is significant variation in the values obtained in the commercial samples, there is no significant difference in the values of the control experiment. The values obtained for the water absorption capacity of the commercial samples is higher than that of the control experiment, although all the samples are within the specified range and compares favourably well with recommended values for other like materials. The total volume porosity ratio is higher in commercial samples than the control experiment; however all the samples are within the specified range and compares favourably well with recommended values for other like materials. The moisture content of the commercial samples show a considerable range of variation and the values obtained are also considerably low. For the control experiment, the obtained values are closer to the recommended value of 80kg/m^3 [18]. Both the wet and dry compressive strength of the commercial samples fall below the recommended values for type "A" blocks for the equivalent value of the recommended densities [14] while the values for the Control experiments are above the recommended values in [14].

From the discussions and the conclusions drawn above, the following recommendations are presented. The Nigerian Building Code of practice should be made available to all stakeholders in the construction industry. Nigerian Building Standard Enforcement Agency (NBSEA) should be set up and empowered like the NAFDAC to ensure conformity of all stakeholders in the construction industry to specified standard of labour, materials and workmanship. Compulsory and regular organised workshop and training on quality control practices in block production processes should be arranged for all stakeholders in the construction industry.

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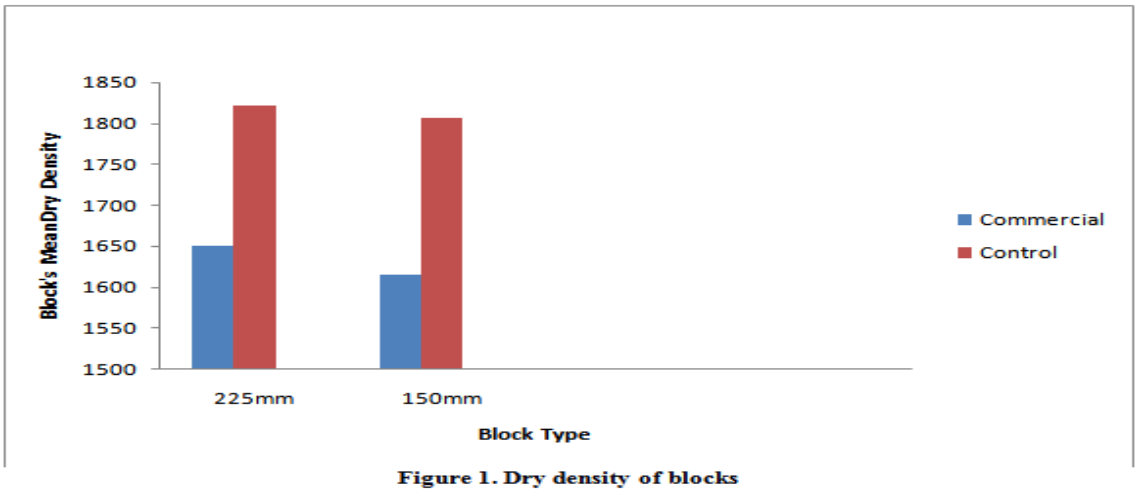

Figure 1. Dry density of blocks

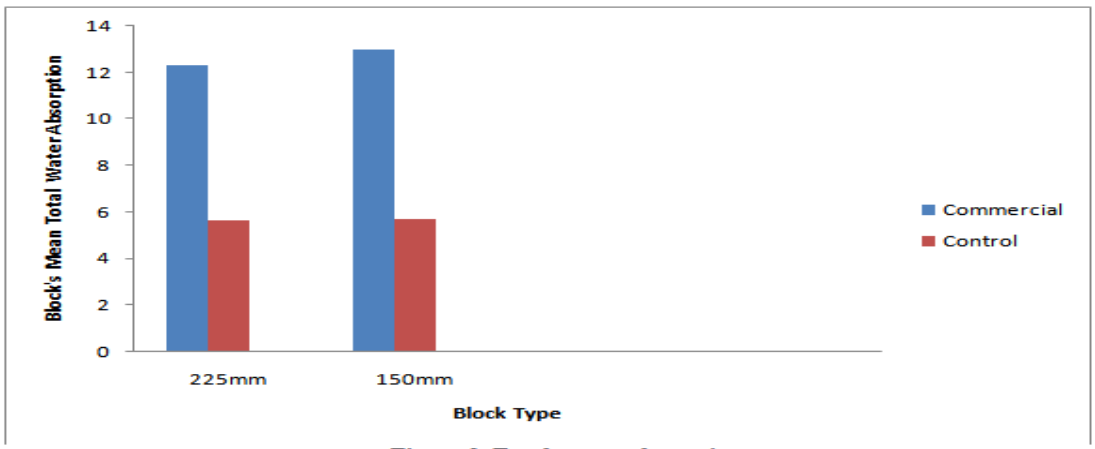

Figure 2. Total water absorption

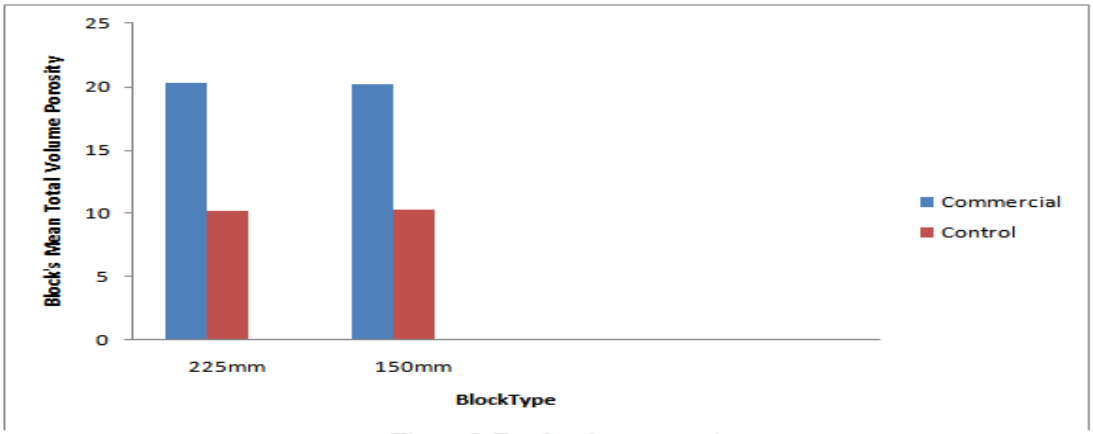

Figure 3. Total volume porosity

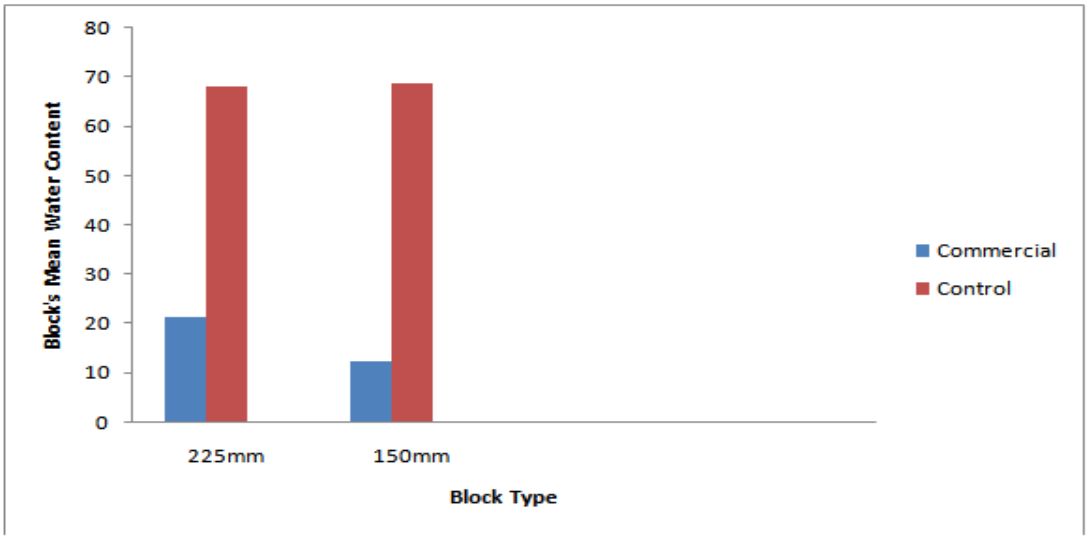

Figure 4. Moisture content

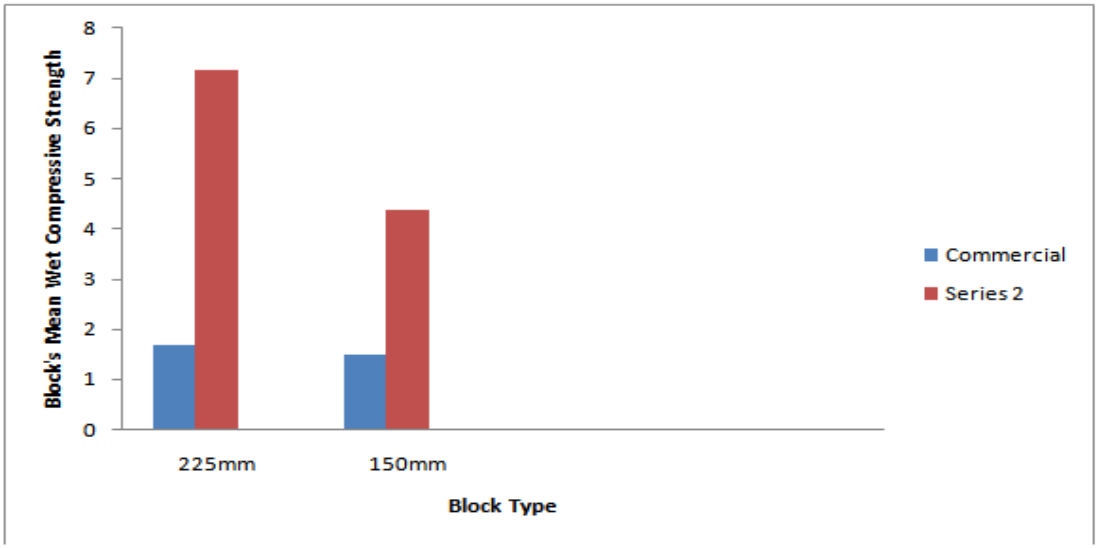

Figure 5. Wet compressive Strength

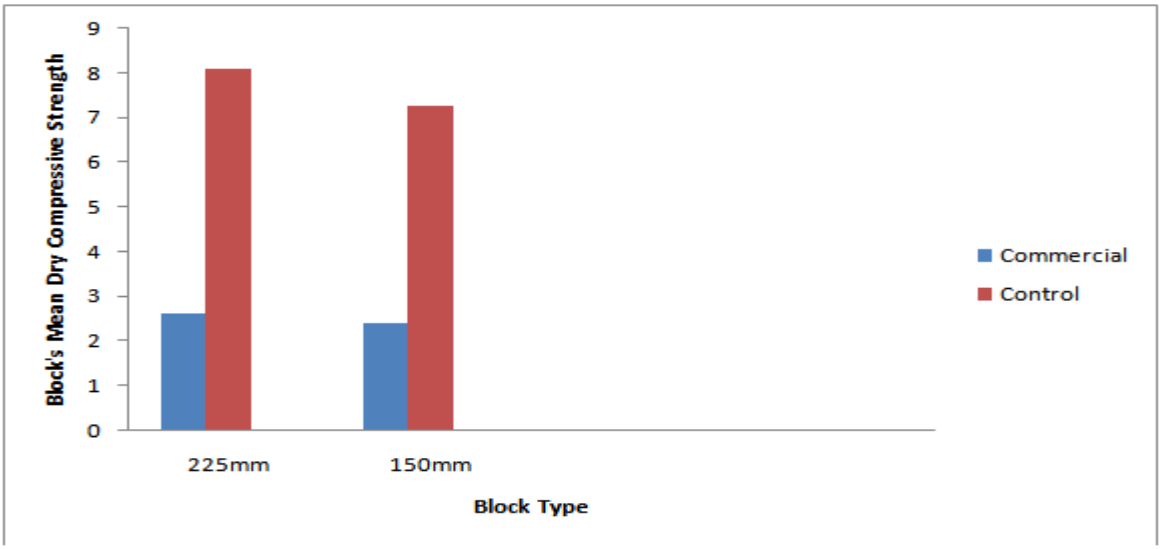

Figure 6. Dry compressive strength

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Automatic wipers with mist control

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***Abstract*: -** This paper illustrates Automatic wipers with mist control. In modern days, the accidents are most common in commercial vehicles. One of the reasons for these accidents is formation of the mist inside the vehicle due to heavy rain. In rainy seasons for commercial vehicles, the wiper on the windshield has to be controlled by the driver himself, which distracts his concentration on driving. Also when the rain lasts for more time (say for about 15 minutes) the formation of mist on the wind shield is also hinders the visibility of the driver and makes driving difficult.
The main aim of the project is to prevent the distractions to the driver of a truck or bus. The rain intensity is measured by the set of sensors placed in the beaker at the predetermined levels. The level of the water in the beaker decides the rain intensity and the same will be sensed by each set of sensors and passes the signals corresponding to the level of water in a beaker to microcontroller. Depending on the rain intensity microcontroller controls the speed of the wiper motor. The principle of conductance is used for the working of external and the internal sensors. The programmed microcontroller is used to actuate external and internal wiper motors.

***Keywords*: -** *Microcontroller, Mist Control, Sensor, Wiper motor*

I. INTRODUCTION

All the four wheeled vehicles are equipped with the wipers. These wipers are used to wipe the water on the windshield during rainy seasons. When the wipers were first implemented in the vehicles, the wipers used to oscillates at a single speed. This caused distraction to the driver's visibility. This led to the invention of different speed wiper motors. This increases the visibility of the driver. But the wiper actuation has to be controlled by the driver himself. To provide tension free driving, automatic wipers were invented. For the working of the automatic wipers, the sensing of rain intensity must be provided. There are different kinds of rain sensing methods. Some of them are as discussed below

1.1 CONDUCTIVE METHOD

This method uses a sensor, which consists of two sets of contacts separated by an insulator. When water falls on the sensor, the water conducts the signal and closes the circuit. Then it sends the signals to the next unit to operate the wiper motor. This system has some fundamental problems, the sensors used here are prone to oxidization and become unusable. Also the dirt can foul the sensors. So it is very difficult to design such sensors.

1.2 CAPACITIVE METHOD

Capacitive method utilizes capacitive proximity detection techniques. They are reasonably successful, but can be susceptible to stray electrical fields. The electronic component used in this case is highly expensive due to the incorporation of tuning components.

1.3 PIEZO ELECTRIC METHOD

This method uses a piezo crystal element. While Rain falls on the windscreen generates the sound waves at a certain frequency. These waves are transmitted through and across the windscreen. The Piezo crystal

senses the sound waves, and also compares them with the other noises caused due to wind, dust, etc. this crystal responds only to the sound waves due to rain. Again this system is susceptible to false triggering.

1.4 OPTICAL METHOD

Optical sensors utilize light and the principle of total internal refraction within the windshield. The optical sensor consists of a light source, a light detector and an optical assembly. The optical assembly consists of two lenses and a light guides. A beam of light is directed through the optical assembly to the windshields, the light is trapped within the glass due to total internal refraction. The light reflect from the outside surface of the glass back to the inside surface of the windshield glass until it is picked up by the second optical assembly. If rain falls on the windshield within the sensing area, light is directed by the water droplet in the other direction opposite to the optical assembly. This causes a corresponding reduction in the light intensity falling on the second optical assembly. The microprocessor is used to distinguish between different amounts of rain and to provide the best wiping method. So the Optical sensors are reliable and effective detectors of rain. By using the suitable rain sensing methods it is possible to develop the automatic wipers

1.5 NEED OF AUTOMATIC WIPERS

In case of trucks, the actuation of wipers during rainy season is based on the switch which is being operated by the driver. In plain roads or four lane roads, this may not be big problem. But in the congested or hilly areas during heavy rain driving is a bit difficult because of operating the wiper continuously along with the driving.

Few years ago, there were some accidents reported in north India. These accidents claimed precious lives due to hinder in the visibility of the driver during heavy rain.

There was an accident reported in the hilly regions of Himalayas. A driver was driving the truck in heavy rain in this region. Due to heavy rain, the mist formed inside the windshield, the driver was unable to see the road properly. The result was that the truck fell into a cliff of height 50mts. This accident claimed four lives.

Even though driver operates the wiper, will not clear the visibility because of formation of the mist inside the vehicle. The same mist should be removed frequently to improve the visibility of the driver in case of commercial vehicles.

From the above incident it clearly shows that one of the reason for the accidents due to unclear vision during heavy rain.

II. WORKING PRINCIPLE OF AUTOMATIC WIPERS

The working of automatic wipers and internal wiper to wipe the mist formed inside the vehicles is based on the concept, which makes use of a combination of a sensor, microcontroller and the wiper motor.

The external sensors placed inside the beaker at a prescribed position are used to detect the amount of rain falling on the vehicle. These sensors send data to the microcontroller depending on the water collected in the beaker, which measures the rain intensity. The microcontroller is programmed in such a way that to actuate the wiper motor at predetermined speeds. The principle of conductance is used for the working of external sensors. Each part of this project is described in detail in the successive sections.

The internal mist sensor is placed on the windshield inside the vehicle at prescribed position, is used to sense the mist formed during heavy rain. This sensor works on the principle of conductance and sends the signals to the microcontroller to actuate the internal wiper motor.

III. BASIC COMMPONENTS OF AUTOMATIC WIPERS

The basic components of automatic wipers are

- External sensors
- Internal sensors
- Microcontroller
- Wiper motor

The details of each component are explained below

EXTERNAL SENSORS

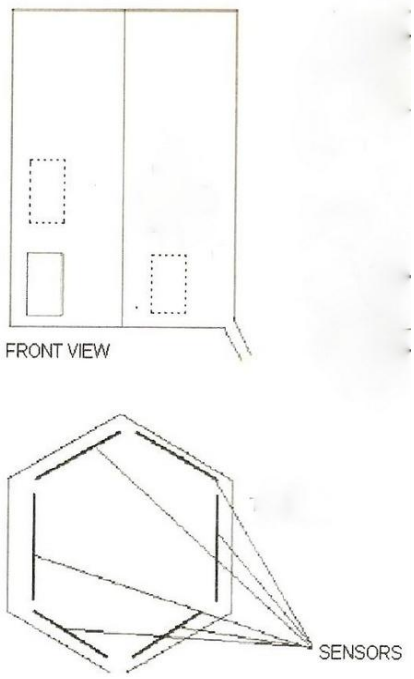


Fig 1 Position of external sensors in the beaker

INTERNAL SENSORS

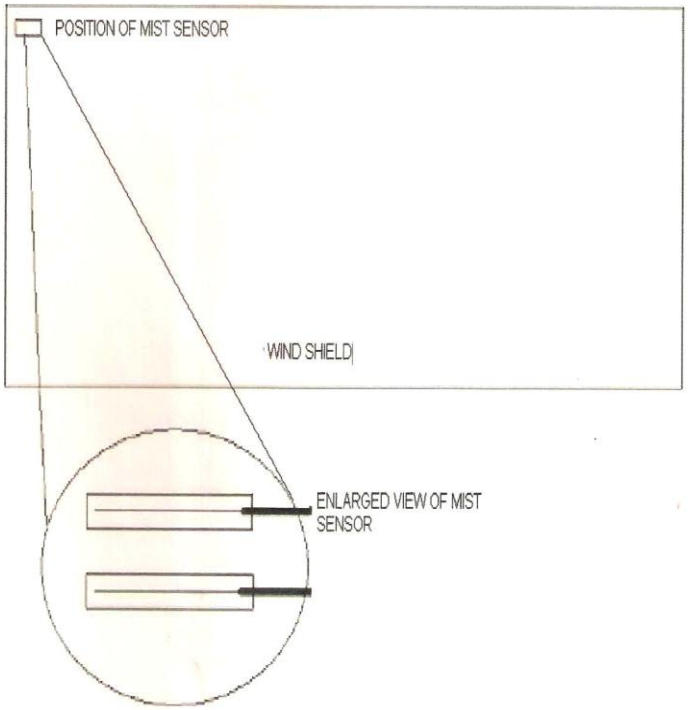


Fig 2 Internal sensor and its position on the windshield inside the commercial vehicles**.**

In the Fig1, there are three sensors which are used to sense the level of the water in the beaker. The water falling on the windshield is collected in the beaker which is placed at a prescribed position. The beaker has a constant outflow at the bottom. This provided to ensure right amount of water, which is collected in the beaker based on the amount of rain falling. If the rain drizzles, only small amount of water will be collected in the beaker. At this point sensor1 are kept in the opposite sides of the beaker at the same level. When the rain is medium, the water collected in the beaker will up to the half of the beaker. At this place another sensor2 are placed opposite to each other in the beaker. When the rain is heavy, the water collected in the beaker will be up to the maximum level of the beaker. At this level another sensor3 are placed opposite to each other in the beaker.

These sensors are supplied with a current of 5V from the micro controller. So, when the water collects to the bottom level covers the sensor1, the current pass between these sensors and hence completes the circuit of the first set of sensors. In the same way, the other two sets of sensors 2 and 3 will conduct the current when the water level reaches respective positions

The mist sensors are placed on the windshield in such a way that the wires connected to the set of sensor I are faced towards the windshield. So that the mist formed on the wind shield is being sensed by these sensors. The two set of sensors are placed very close to each other.

The internal sensor is also works on the same principle as that of the external one as explained in the previous section. Internal sensor also has a current of 5V from the same microcontroller. When the mist is formed on the windshield inside the vehicle the circuit is closed and sends the signal to the microcontroller to actuate the internal wiper motor.

WIPER MOTOR

The wiper motor is used in this project is of two speed stepper motor of 12V. The two speeds are used for the wiping actions.

MICROCONTROLLER

The microcontroller used is an 8051 microcontroller The details of microcontroller explained in the next chapters.

IV. METHODOLOGY

2.1 EXTERNAL WIPER CIRCUIT FOR DRIZZLE

For the actuation of wiper motor during drizzle, the microcontroller receives the signal from the first sensor1. As this signal is sensed by the microcontroller, it sends the signals to the wiper motor to run at slow speed. This signal is timed one. After one complete revolution of the motor it gives an interval of about four seconds. This action is continued until the water in the beaker is lowered or goes below the sensor1 position. Delay period is provided to stop the motor for four seconds by microcontroller. The program for the delay period of the microcontroller is given in the Appendix I.

2.2 EXTERNAL WIPER CIRCUIT FOR MEDIUM RAIN

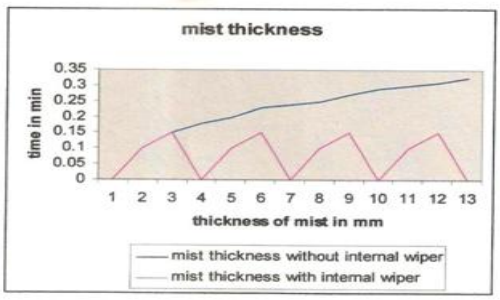
When the rain is medium, the microcontroller receives the signal from the sensor2. Then its sends a continuous signal to the wiper motor to actuate at a slow speed. At this time the microcontroller switch OFF the first output signal corresponding to the sensor1. This action is continued, till the water in the beaker is lowered or goes below the sensor2. Here the motor rotates continuously at the slow speed only

2.3 EXTERNAL WIPER CIRCUIT FOR HEAVY RAIN

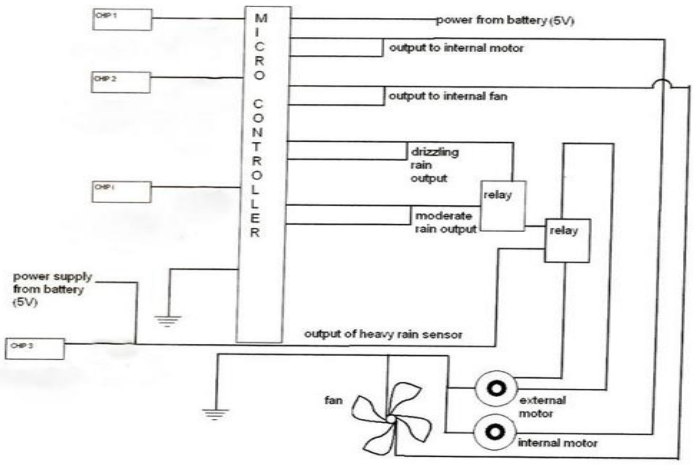
The microcontroller 8051 is limited to two interrupts only, the third cannot be provided. For heavy rain set of sensors +3 & -3, the relay is used. When the sensor3 sends the signal, the relay switch OFF the output from the microcontroller . At this time relay switch ON the direct circuit which runs the motor at high speed.

2.4 INTERNAL WIPER CIRCUIT FOR MIST CONTROL

When the mist is formed on the windshield, the set of sensorI senses the mist and sends the signals to the microcontroller. Then the microcontroller sends the signals to the internal wiper motor. The internal wiper motor rotates once and turns OFF. The blower is placed near by the sensors is switched ON as soon as the wiper motor stops. This blower blows away the mist between the sensors in 20 sec and turns OFF. This action is continued, when the mist is formed again, during heavy rain



The Fig 3 shows a schematic representation of the circuit used in the project. This circuit compromises of basic components used in automatic wiper.

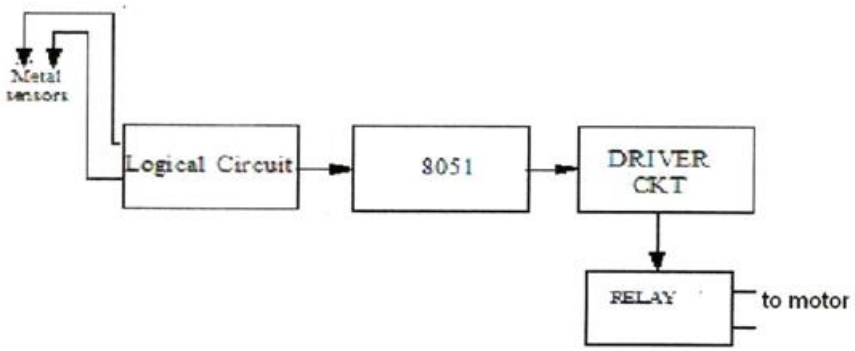


The fig 4 shows a schematic representation of the circuit used in the project . this circuit compromises of basic components used in automatic wiper .

2.5 MICROCONTROLLER

This aim of the project is to wipe the windshield automatically on both the sides of motor is controlled. This project is facilitated with an internal wiper, which removes the mist formed inside the commercial vehicles.

This project is executed with the help of digital circuits, to sense the mist. This digital circuit is connected to the microcontroller to control the wiper motors with the help of relays. The microcontroller is depicted as in the Fig 7.1



Each components of the microcontroller is explained below in detail

2.5.1 METAL SENSORS

Metal sensors are made of low resistance metal for sensing the water and also the mist. The low resistance metal sensors are preferred because of their good conductivity.

2.5.2 LOGICAL CIRCUIT

This circuit consists of logical gate which provides high output to the microcontroller when the water is sensed. When there is no sensing of water, the logical circuit gives low output to the microcontroller.

2.5.3 DRIVER CIRCUIT

The output of microcontroller circuit is 5V only. By having this 5V, it is not possible to drive the relay and DC motor. So the driver circuit is used to increase the output signal from 5V to 12V. A driver circuit comprises of signal transistor, which increases the DC level to a required value of 12V. This 12V is enough to operate the relay and DC motor.

2.5.4 RELAY

A relay is a switch, which works with the help of an electromagnet. A relay is used as an amplifier. The12V current in the circuit is used by the relay to control the motor circuit, which drives the wiper motor.

2.6 WORKING OF DUAL POWER SUPPLY

To construct the power supply circuit of different voltages, different transformers, rectifier circuits, filter circuits and regulator circuits are required. This type of construction requires many components like transformers, capacitors, regulators etc. So, the size of the power supply becomes bulky and costly. This problem can be eliminated by using a regulator, integrated chip and a transformer.

The circuit consists of following components. The function of each component of the circuit is explained below in detail.

- Transformer
- Rectifier
- Filter and
- Regulator

2.6.1 TRANSFORMER

It is an electrical device which transfers the power from one winding to the other winding with isolation. All the electronic gadgets work for less voltages. So a step down transformer is used, whose function is to step down the AC voltage from 230V to required 12 V. The output of the transformer is 12V AC which is connected to the diodes for rectification.

2.6.2 RECTIFIER CIRCUIT

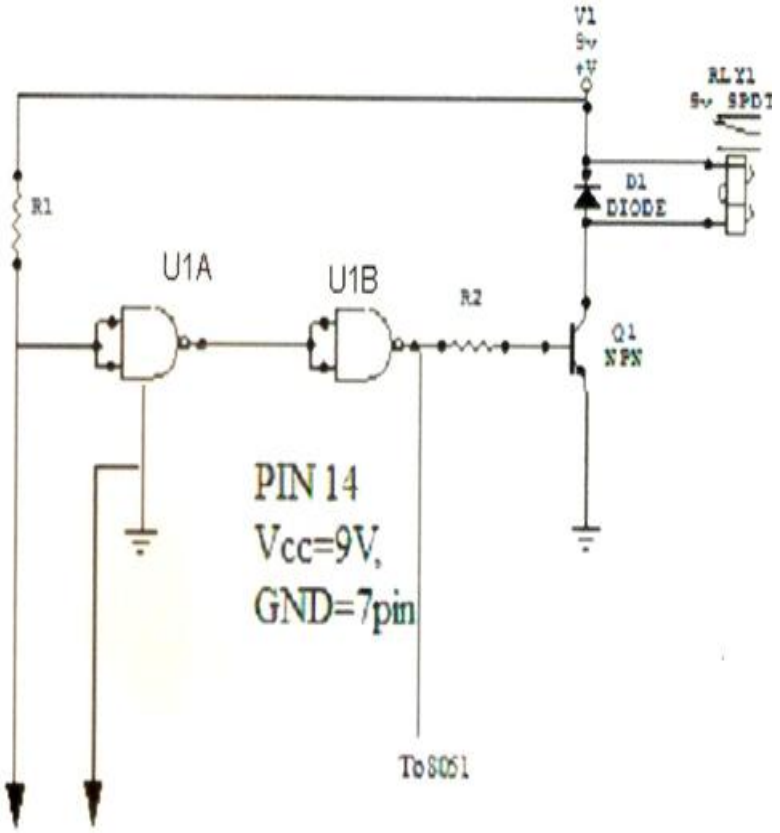
It employs diodes, which convert AC into DC. The output of the rectifier circuit is not a DC. It also consists of some AC components, which are called as ripples. In order to remove these ripples, filter circuits are employed. So the output of the rectifier circuit is input the filter circuit or capacitor.

2.6.3 FILTER CIRCUIT

Filter circuit employs electrolytic capacitors in order to remove the AC components. The capacitor does not allow AC components to pass through it, because it offers high reactance to the AC components, so all DC components will be bypass the capacitors. Hence the output from the filter circuit will be DC only.

2.6.3 REGULATOR

Regulator is an electronic circuit whose function is to keep the output always constant, though the input is varied. The three terminal Integrated Chip regulators are used for providing output DC voltages.



WORKING OF MIST SENSING CIRCUIT:

The Fig shows a circuit diagram shows a circuit of a mist sensing unit. When the rain falls on wind shield, the input to U1A (NAND gatel) becomes LOW and the output of U1A becomes HIGH. The output of U1A is input to the U1B (NAND gate2). The input and output of the U1B are HIGH and LOW respectively. The same LOW output is input to the microcontroller. Similarly, when there is no rain fall on the wind shield the, input of U1A becomes HIGH and the output of the same will be LOW. The output of Ul A is the input to the U1B, Now the input of U1B becomes LOW and the output of the U1B is HIGH. The same HIGH output of the U1B becomes input to the microcontroller. The same circuit is used for drizzle and heavy rain, but the program executes as per the signals received by the microcontroller.

DETAILS OF PIN DIAGRAM.

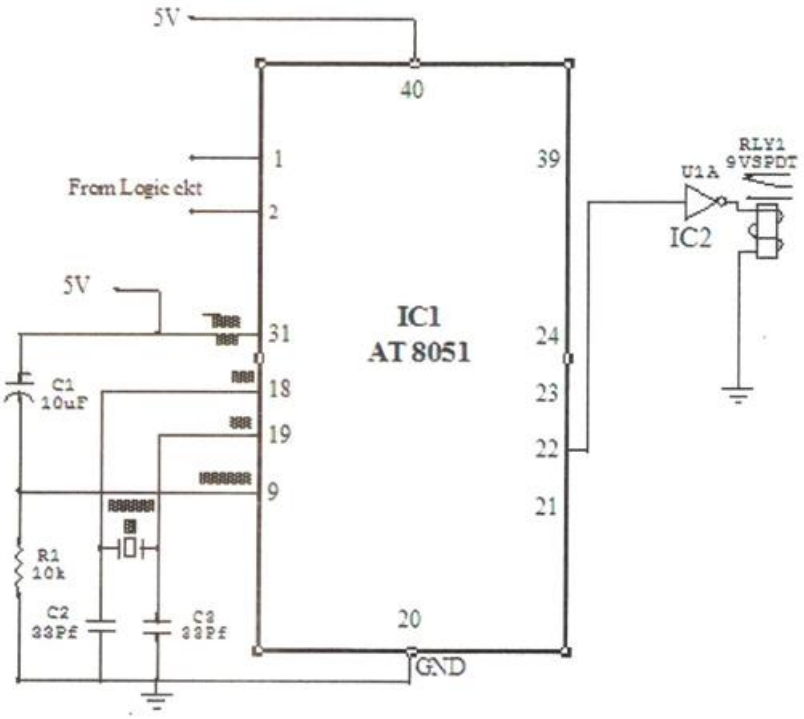


Fig 7 pin diagram of a mist sensing device

The parameters relevant to the pin diagram as shown in the Fig 7 are explained as follows

INPUT VOLTAGE (V_{CC})
Pin 40 provides supply voltage to the sensor. The voltage source is +5V.

GROUND (GND)
Pin 20 is the ground.

INPUT PINS (XTAL1 and XTAL2)
Even though the microcontroller has an on-chip oscillator to maintain the time intervals, also it requires an external clock to operate it. In most of the case a quartz crystal oscillator connected to the inputs XTAL1 (pin 19) and XTAL2 (pin 18). The quartz crystal oscillator needs two capacitors of 30 micro Fared. One side of each capacitor grounded as shown in pin diagram.

V. RESET

Pin 9 is the RESET pin. By applying a high pulse to this pin, the microcontroller will reset and terminate all the activities. This is often referred as power-ON reset. By activating the power- ON reset, the values stored in the register will be erased.

When the Microcontroller is ON, the Program stored in the ROM of Microcontroller starts execution and microcontroller functions as per the program. The microcontroller keeps on checking the signals arriving at the input port. If there is no signal, no function will be executed. Depending upon the signal received by the port, the microcontroller makes the relay to operate the motor.

3.1 WIPER MOTOR

Wiper motor used is a two speed steeper motor. It uses a current of 12 volt supplied by the microcontroller. The output of the wiper motor is connected to the linkages to actuate the wipers.

In case of two speed motor, the high speed is obtained when the current is supplied to the brush g and brush 1 as in Fig . By Fleming's right hand rule the current, force and the magnetic fields are mutually perpendicular to each other. In this motor as the current is supplied to the brush 1 and brush g, the magnetic field is generated perpendicular to the armature shaft. This induces a force in the armature which makes the armature to rotate. Since, the magnetic fields generated are opposite to each other the shaft rotates at a high speed. In the second speed the brush 2 and brush g gets magnetized. Since the magnetic fields produced by them are at perpendicular to the force generated on the copper winding, will be less than the force generated by the brush 1 and brush g. This makes the armature shaft to rotate at a lower speed.

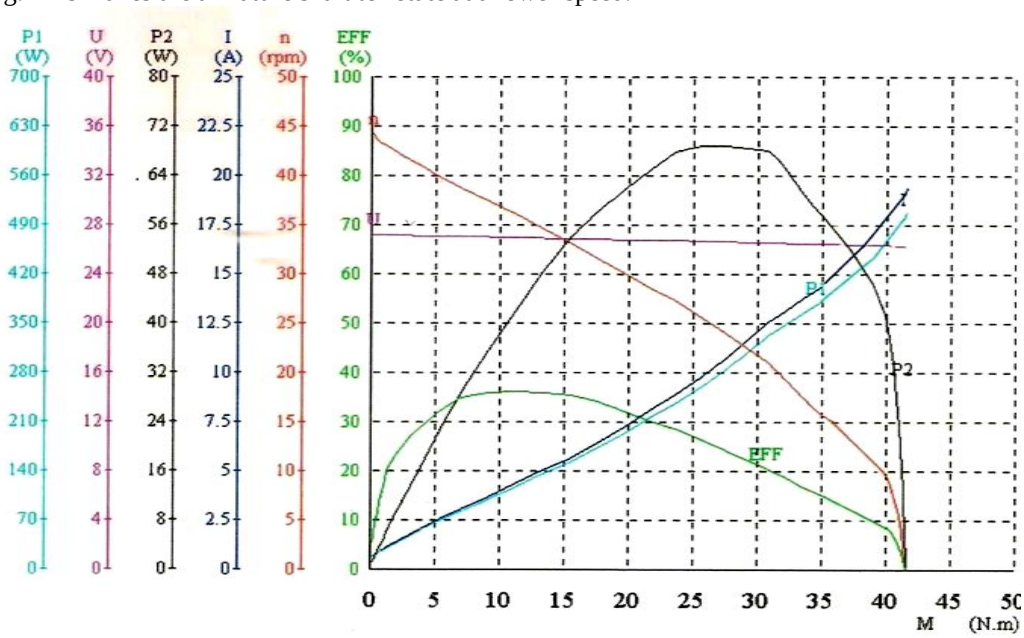


Fig 8 Performance characteristic curves of the motor

The Fig 8 shows the graph in which the variation of the force generated with respect to the power generated in the brush 1, voltage applied to the motor, power generated by the brush 2, current flowing through the motor, speed and efficiency of the motor respectively.

From the graph it is clear that the torque is generated by the brush 1 and brush g will be higher than the torque generated by the brush 2 and brush g.

The maximum efficiency of a motor is 35%. At this efficiency the torque generated by the motor is 10 to 15Nm. Further, increase in the torque, will reduces the efficiency of the motor.

The voltage applied across the brushes will be constant of 27 volts. As indicated in the graph the speed of the motor reduces as the torque increases

3.2 WIPER LINKAGE MECHANISM

The linkage mechanism is used to convert the rotary motion to linear motion. One end of the link is connected to wiper motor and other end is connected to the ankle. The wiper linkage combines two mechanisms.

A combination of electric motor and worm gear reduction provides power to the wipers.

A linkage converts the rotational output of the motor into the to and fro motion of the wipers.

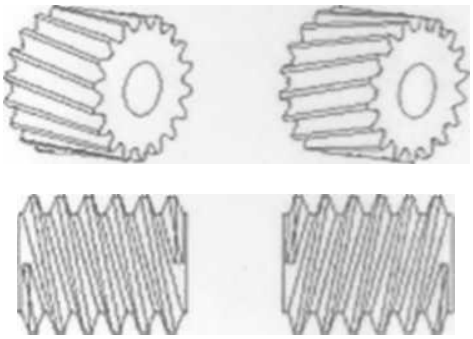


Fig 9 Worm and worm wheel arrangement used in wiper motor.

It takes a lot of torque to accelerate the wiper blades to and fro across the windshield. In order to generate this type of force, a worm gear is used on the output shaft of the electric motor.

The main function of this gear is to multiply the torque generated by the motor. This torque is used to drive the linkages which connect the external wiper sticks. The worm is connected to the armature shaft of motor. The worm wheel drives the motor wheel. This wheel is connected to the linkages which drives the wiper stick. In this project, the motor used multiplies the torque by 25 times.

3.2.1 EXTERNAL LINKAGE MECHANISM

THE LINKAGE FOR EXTERNAL WIPER

The link mechanism for the external wiper mainly has 3 parts

- Link
- Link rods
- Knobs

The link, from the motor is a simple one. The output wheel of the motor, which has a shaft with outer groves on it. The one side of the link has a hole with internal grove fixes into the wheel of the motor. This link will also fit to the wheel of the motor by screw and nut arrangement. The other side of the link has a spherical ball which connects to the linkage rods.

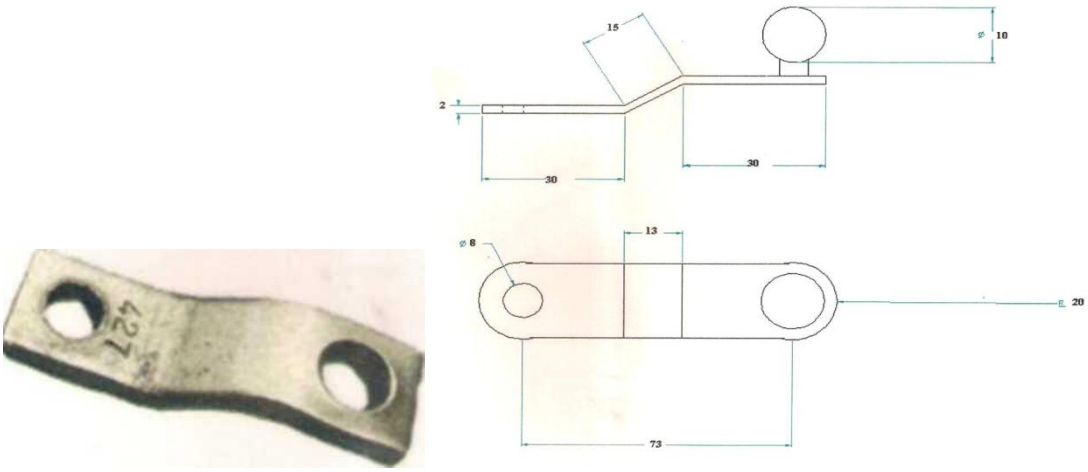


Fig 9.1 Dimensions of a link

Link rods used for the external wiper actuation has two cylindrical rods of outer diameter 12mm. In the figure shown, one end of the link 1 is connected to the motor. The other end of the link l is connected to the ankle, which converts the linear motion of the rod to the rotary motion of the wiper holder. The link 2 is connects the ankle. The other end of the link2 is connected to the wiper holder.

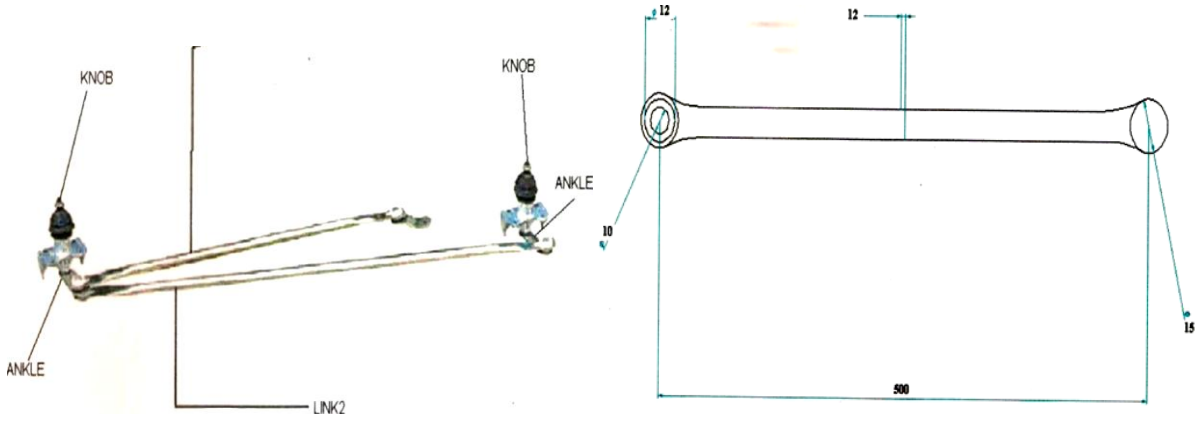


Fig 9.2 Links used for external wiper.

Knob is the one which holds the wiper stick. This gets rotary motion from the linkage, and is transferred to the wiper stick which oscillates in the same angle as that of the linkage.

3.2.2 INTERNAL LINKAGE MECHANISM

Link rods used for the internal wiper actuation has one cylindrical rods of outer diameter 12mm. In the figure shown, one end of the link is connected to the motor. The other end of the link is connected to the ankle, which converts the linear motion of the rod to the rotary motion of the wiper holder

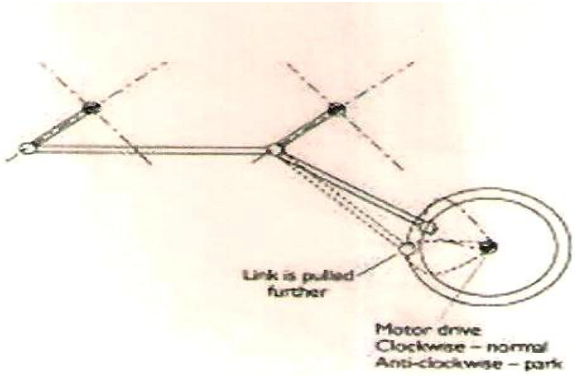


Fig 9.3 Internal wiper linkage

TECHNICAL DETAILS OF AUTOMATIC WIPERS

Torque generated in motor = 1.8Nm Radius of the motor wheel = 25mm Torque generated by the motor wheel T= (Radius of the motor wheel)* (Torque generated in motor) = 1.8*25 = 45 Nm Gear ratio between the worm and the wheel of the motor = 25: 1 Length of the link = 73 mm
The force generated at the end of the link of the motor = (length of the link) / (torque generated by the motor) = 6.5N
Length of the link 1 = 500mm
Ankle length = 45mm
Forced generated at the ankle = 6.5 N
Torque generated at the wiper knob
= (ankle length)*(force generated at the link)
= 6.5 * 45 = 30 Nm

3.2.3 WIPER BLADES

The wiper arms moves the thin rubber strip across the windshield to clear the water on it.
To obtain the key to streak-free operation of wiper, it is necessary to create even pressure over the length of the rubber blades. The position of the motor decides the pressure on the blades. The wiper blades fix on the knob of the linkage by a screw.

VI. CONCLUSION

The concept of Automatic Wipers with Mist Control has been implemented successfully. After the experimental setup the wiper motor was tested for all the following conditions drizzling, heavy rain, medium rain. The test have been conducted under mist on the wind shield. The mist has been removed successfully from the wind shield. By the uses of automatic wipers one can drive the commercial vehicles without any distractions to operate the wipe. Use of internal wipers ensures good visibility to the driver, which in turn prevents the accidents.

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Algal-based CO_2 Sequestration Technology and Global Scenario of Carbon Credit Market: A Review

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Abstract: - The objective of this paper is to provide an overview of the global and national scenario of Carbon credit. This paper will also discuss the advantages of the algae-based carbon capture technology in growing carbon credit market. Carbon Dioxide (CO_2), the most important greenhouse gas produced by combustion of fuels, has become a cause of global panic as its concentration in the Earth's atmosphere has been rising alarmingly. However, it is now turning into a product that helps people, countries, consultants, traders, corporations and even farmers earn billion of rupees. A carbon credit is a generic term for any tradable certificate or permit representing the right to emit one tone of CO_2 or CO_2 equivalent (CO_2-e). Businesses can exchange, buy or sell carbon credits in the international markets at the prevailing market price. India and China are likely to emerge as biggest seller and Europe is going to be biggest buyers of carbon credits. Using algae for reduction the CO_2 concentration in the atmosphere is known as algae-based carbon capture technology. This new technology has attracted companies that need inexpensive CO_2 sequestration solutions. Algae farming emerge as the best CO_2 sequestration technique in comparison with other methods.

Keywords: - *Carbon credits, Global warming, Algae-based CO_2 sequestration, Carbon trading.*

I. INTRODUCTION

Carbon Dioxide (CO_2), the most important greenhouse gas produced by combustion of fuels, has become a cause of global panic as its concentration in the Earth's atmosphere has been rising alarmingly, due to anthropogenic interventions. The concept of carbon credits came into existence as a result of increasing awareness of the need for controlling emissions. The mechanism was formalized in the Kyoto Protocol, an international agreement between more than 170 countries, and the market mechanisms were agreed through the subsequent Marrakesh Accords [6]. Businesses can exchange, buy or sell carbon credits in the international markets at the prevailing market price. India and China are likely to emerge as biggest seller and Europe is going to be biggest buyers of carbon credits. Algae farming emerge as beast GHGs reduction technology. Algae can consumes tons of CO_2 for growth, thus reducing harmful greenhouse gases [2] and earn carbon credit. The objective of this paper is to provide an overview of the global and national scenario of Carbon credit. Further more we will also discuss the key advantages of the algae-based carbon capture technology in growing carbon credit market.

II. CARBON CREDITS

A carbon credit is a generic term for any tradable certificate or permit representing the right to emit one tone of CO_2 or CO_2 equivalent (CO_2-e) [3]. Carbon credit is an application of an emissions trading which is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. The carbon trade to meet Kyoto Protocol targets is registered and monitored under the Clean Development Mechanism (CDM) of the United Nations Framework Convention on Climate Change [6].

How carbon credit works?

1. Company A in a developing country cuts GHGs emissions with the help of investment from developed countries. It gets an assessment done by a private consultant to establish the quantum of reduced emissions.

2. The Consultant then forwards the proposal to a national authority for validation. In India it is the environment ministry. Once attested, the project's carbon credits are then certified and are made available for international trading.
3. These credits can be traded at international carbon exchanges like the Chicago Climate Exchange. The price of accredit fluctuates like stocks. Credits can be brought at a lower price and offloaded when prices go up on demand.
4. The Company B in a developed country buys the carbon credits from the exchange to allow itself more emissions and meet its Kyoto targets. Those who have invested in green projects redeem the credits generated from these projects. Excess credits are traded.

Global and Indian Scenario of Carbon credit

Last year global carbon credit trading was estimated at $5 billion, with India's contribution at around $1 billion. India is one of the countries that have 'credits' for emitting less carbon [4]. India and China have surplus credit to offer to countries that have a deficit. India has emerged as a world leader in reduction of greenhouse gases by adopting Clean Development Mechanisms (CDMs) in the past few years. More than 200 Indian entities have applied for registering their CDM Project for availing carbon credits. India has 478 registered CDM projects, accounting for 28.3 per cent of the global credits. Each credit, equivalent to a reduction of one metric tonne of CO_2, sells from anywhere between Rs 650-1,115 [1]. This has potential to generate annual revenue worth several hundred million dollars. India has generated some 30 million carbon credits and has roughly another 140 million to push into the world market. The 800 million farming community in India has also a unique opportunity where they can sell Carbon Credits to developed nations. Government of India has a target of installing 12.34 million biogas plants by 2010. This target has a global warming mitigation potential (GMP) of 120 Mt CO_2 equiv. $year^{-1}$ and US $1,197 million as carbon credit under the clean development mechanism (CDM) [8].
Carbon credits can be created in many ways but there are two broad types CO_2 sequestration (capturing or retaining carbon dioxide from atmosphere) and CO_2 saving project (such as use of renewable energies). Recently, algae had shown a great potential to earn carbon credits with other by products benefits.

III. ALGAE-BASED CO_2 SEQUESTRATION TECHNOLOGY

Using algae for reducing the CO_2 concentration in the atmosphere is known as algae-based CO_2 sequestration Technology. The growth of algae requires carbon dioxide as one of the main nutrients needed. There is an opportunity to efficient sequester CO_2 by using flue gas emissions from industrial sources as the CO_2 feed for algae cultivation. An acre of algae farm can consumes 60 tons CO_2 per year (Table 1). It is estimated that a 3 acre algae farm will consume up to 54,000 metric ton of carbon dioxide and produce 29 metric ton of biomass per year.

Table-1 Production/Consumption of CO_2 per year

Produces/Consumes	CO_2 (in tons per year)
Average person produces	2.3
Average car produces	6
An acre of normal forest consumes	2-3
An acre of oranges consumes	1-2
An acre of typical farm consumes	2
An acre of algae consumes(approx.)	60

An additional benefit from this technology is that the oil found in algae can be processed into a biodiesel. Remaining components of the algae can be used to make ethanol and livestock feed. Algae emits no GHGs on energy production in comparison to all potential feedstocks for biofuel production [5].

Key advantages of the process of CO_2 sequestration using algae

- Owing to the fact that high purity CO_2 gas is not required for algae cultivation, flue gas containing CO_2 and water can be fed directly to the photobioreactor.
- Power plants that are powered by natural gas or syngas have virtually no SO_2 in the flue gas. The other polluting products such as NO_x can be effectively used as nutrients for micro algae.
- Algae can grow in temperatures ranging from below freezing to 158^oF.
- The entire process is a renewable cycle.

Table No.2 GHGs emission (Kg of CO_2 produced per Kilo Joule of energy produced) from biofuel feedstocks [7].

Crop	Used to produce	GHGs emission
Corn	Ethanol	81-85
Sugar cane	Ethanol	4-12
Switch grass	Ethanol	-24
Wood residue	Ethanol, Biodiesel	N/A
Soybeans	Biodiesel	49
Rapeseed, canola	Biodiesel	37
Algae	Biodiesel	-183

- Micro algae culturing yields high value commercial products that will offset the capital and the operation costs of the process.

In addition to biofuels, algae are also as the starting point for high-protein animal feeds, agricultural fertilizers, biopolymers / bioplastics, glycerin and more.

IV. CONCLUSION

Carbon credit is thus expected to redefine global trade and may bring about a drastic change in the ratings of various countries in the global market in the near future. The companies or projects that could benefit from carbon credits are: Renewable energy; biomass; Hydropower; Geothermal; Wind and solar energy; Co-generation; Fuel switch; waste processing; landfill gas extraction; biogas applications; afforestation /reforestation, etc. As algae consumes carbon dioxide, thus reducing harmful greenhouse gases and earn carbon credit. The by-product left over after extracting the oil can be used in cattle feed, vitamins, pigments, cosmetics, etc. and algae can also be used to clean up waste water. Algae-based CO_2 sequestration techniques thus provides the companies the opportunity to capture CO_2 (and possibly earn carbon credits) while at the same time other benefits also such as feedstock for biofuel, fertilizer, nutrient supplements etc.

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Design and Fabrication of an Electrically Powered Rotary Slicer for Raw Plantain Chips Production

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Abstract: - This work focused on the design and fabrication of an electrically powered rotary slicer for raw plantain chips production. The machine was designed for medium scale industries but can also be used for domestic purposes which also include the slicing of cucumbers. The machine works on shear cutting principle and has the capacity to produce raw plantain chips of uniform sizes in lesser time and can slice up to a maximum of 70mm diameter finger of raw plantain in just 2-3 seconds. Machine maintenance is simple and requires just lubrication of rotating members and proper cleaning after use.

Keywords: - *Domestic purposes, electrically powered, plantain chips, rotary slicer, uniform sizes.*

I. INTRODUCTION

Plantain is a type of banana which is common in tropical regions. It is starchier and less sweet when compared to bananas. Plantains are usually served steamed, boiled or fried, although ripe plantains can be eaten raw. They are a rich source of antioxidants, vitamin B-6 and minerals, and their soluble fiber content may help ward off intestinal problems [1]. Plantain for local consumption plays an important role in food and income security and has the potential to contribute to national food security and reduce rural poverty [2].

Plantains provide the essential minerals that help the body to function efficiently. A cup of sliced or cooked plantain has 49 milligrams of magnesium and 716 milligrams of potassium, giving the body 15 percent of the recommended daily intake for each of these minerals. The body needs magnesium for proper muscle contraction and nerve function, while potassium is a crucial component in the body fluids. A cup of plantains also contains 5 to 10 percent of the iron need of the body. Iron helps to carry oxygen through the bloodstream which serves as a benefit to the muscles of the body.

Although raw plantain is bitter and starchy, some people like them raw. They are more nutritious raw, with about 10 percent more magnesium, phosphorus and potassium. A cup of raw plantains has 27 milligrams of thiamin, a B-vitamin that helps the body's cells use carbohydrates as energy and helps ensure the proper functioning of the heart, muscles and the nervous system. A cup of cooked plantain has less than 1 milligram of thiamin [1]. Considering the enormous benefits of raw plantain, slicing it can create additional benefits in terms of post-harvest processing. Plantain processed into flour can be stored for up to a maximum of two years [2]. The purpose of the machine is to make slicing process less laborious especially for medium scale industries and for domestic purposes.

Obeng [3] developed a mechanized plantain slicer which took 5-7 seconds to slice a finger of plantain. When compared with the traditional method of cutting with a sharp knife, the traditional method took 40-80 seconds per finger of plantain. Because of the lesser time taken to slice a finger of raw plantain and uniformity of chips sizes produced, an electrically powered rotary slicer incorporating two feeding chuteshas technological edge over traditional slicing methods.

II. DESIGN ANALYSIS AND CALCULATIONS

The machine works on shear cutting principle. When the cutting blade impacts on the cylindrical surface of the raw plantain, the surface gets cut by shearing along a plane.

Determination of the Shearing Force for the Raw Plantain

Considering the shear strength of the raw plantain and the area under shear, the impact force required to shear the raw plantain may be obtained from the following equation:

$$F_P = A_P \times \tau_P \quad (1)$$

Where

F_P = Force required for shearing the raw plantain

A_P = Area under shear

τ_P = Shear stress of the raw plantain

The area under shear can be determined using the following equation:

$$A_P = \pi \frac{D_P^{\,2}}{4} \quad (2)$$

Where,

D_P = Diameter of raw plantain

The average force required to shear raw plantain of diameters ranging from 30-70mm is 33.15N [3]. This force reduces as the plantain ripens and softens. The measured diameter of the raw plantain was in the range of 30-70mm, averagely 50mm. From equation (2), we get

$$A_P = \pi \frac{(0.050)^2}{4} = 1.96 \times 10^{-3}\ m^2$$

Determination of the Power Required by the Cutter for Slicing the Raw Plantain

Cutter velocity is another important parameter in the slicing process. The optimum value of cutter velocity required for slicing is 2.65m/s [4]. The power required by the cutter to slice the raw plantain may be obtained from the following expression:

$$P_C = F_P \times V_C \quad (3)$$

Where,

P_C = Power required by the cutter

V_C = linear velocity of the cutting blade = 2.65m/s

From equation (3), we get

$$P_C = 33.15 \times 2.65 = 87.85\ W$$

Determination of the Power Required by the Electric Motor

The power required by the electric motor may be obtained from the following equation:

$$P_M = P_C \times P_F \quad (4)$$

Where,

P_M = Power of electric motor

P_F = Power factor = 1.5

From equation (4), we get

$$P_M = 87.85 \times 1.5 = 131.78W$$

Selected capacity of electric motor = 0.37kW (0.5Hp)
Speed = 1400rpm

Determination of the Driving Pulley Diameter

For a belt velocity of 4.98m/s, the driving pulley diameter is calculated using the relation below:

$$D_1 = \frac{V_1 \times 60}{\pi \times N_1} \quad (5)$$

Where,

D_1 = Driving pulley diameter

V_1 = Peripheral velocity of the belt on the driving pulley

N_1 = Speed of driving pulley = 1400rpm

From equation (5), we get

$$D_1 = \frac{4.98 \times 60}{\pi \times 1400} = 68mm$$

Determination of the Driven Pulley Diameter

The relation between the driving pulley diameter and the driven pulley diameter is given by:

$$\pi \times D_1 N_1 = \pi \times D_2 N_2 \Rightarrow \frac{D_1}{D_2} = \frac{N_2}{N_1} \quad (6)$$

Where,

N_2 = Speed of driven pulley

D_2 = Diameter of driven pulley

For N_2 = 400rpm. Substituting into equation (6) and simplifying, we get

$$D_2 = \frac{D_1 N_1}{N_2} = \frac{68 \times 1400}{400} = 238mm$$

Determination of the Belt Tension

The expression which shows the relationship between the power transmitted, belt tension and linear velocity is given as [5]:

$$P_M = (T_1 - T_2) \times V_1 \quad (7)$$

Where,

T_1 = Tension in the tight side of the belt

T_2 = Tension in the slack side of the belt

From equation (7), we get

$$T_1 - T_2 = \frac{0.37 \times 10^3}{4.98} = 74.30 \quad (8)$$

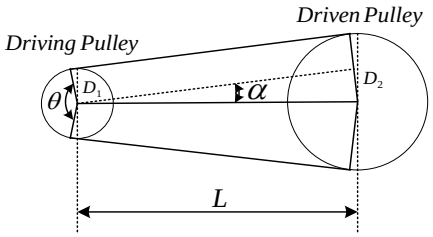

Figure 1: Belt Drive Geometry

From figure 1,

$$\sin \alpha = \frac{D_2 - D_1}{2L} \quad (9)$$

Where,

α = angle of cap on the smaller pulley

From equation (9), we get

$$\sin\alpha = \frac{238-68}{2\times 440} \Rightarrow \alpha = \sin^{-1}(0.1932) = 11.14^{o}$$

The angle of contact may be obtained from

$$\theta = (180 - 2\alpha)\frac{\pi}{180} \qquad (10)$$

Where,

θ = Angle of contact on the smaller pulley

From equation (10), we get

$$\theta = (180 - 2\times 11.14)\frac{\pi}{180} = 2.75$$

The relation between the belt tensions in the tight and slack side in terms of the coefficient of friction and the angle of contact or angle of lap is given as [5]:

$$\frac{T_1}{T_2} = e^{\mu\theta} \qquad (11)$$

Where,

μ = Coefficient of friction between belt and pulley = 0.3

$$\frac{T_1}{T_2} = e^{0.3\times 2.75} = 2.28 \Rightarrow T_1 = 2.28\times T_2 \qquad (12)$$

Substituting equation (12) into (8), we get

$$(2.28-1)T_2 = 74.30 \Rightarrow T_2 = \frac{74.30}{1.28} = 58.05N \qquad (13)$$

Substituting equation (13) into (12), we get

$$T_1 = 2.28\times 58.05 = 132.35N$$

Determination of Bending Moments acting on the Shaft

Figure 2 shows the vertical load diagram.

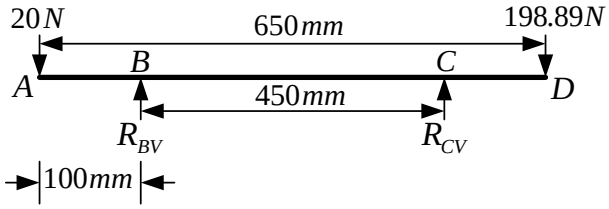

Figure 2: Vertical Load Diagram

Summing forces in the vertical direction gives;

$$R_{BV} + R_{CV} = 20 + 198.89 = 218.89N \qquad (14)$$

Taking moment about B, we get

$$R_{CV}\times 0.45 = 198.89\times 0.55 - 20\times 0.10 \Rightarrow R_{CV} = 238.64N$$

From equation (14), we get

$$R_{BV} = 218.89 - R_{CV} = -19.75N$$

From figure 2,

$$M_{AV} = 0Nm$$

$$M_{BV} = -20\times 0.10 = -2Nm$$

$$M_{CV} = -20\times 0.55 - 19.75\times 0.45 = -19.89Nm$$

$$M_{DV} = -20 \times 0.65 - 19.75 \times 0.55 + 238.64 \times 0.10 = 0 Nm$$

Figure 3 shows the horizontal load diagram.

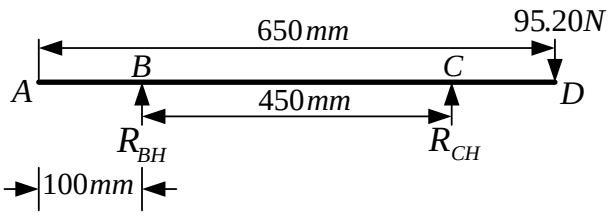

Figure 3: Horizontal Load Diagram

Summing forces in the horizontal direction gives;

$$R_{BH} + R_{CH} = 95.20N \quad (15)$$

Taking moment about B, we get

$$R_{CH} \times 0.45 = 95.20 \times 0.55 \Rightarrow R_{CH} = 116.36N$$

From equation (15),

$$R_{BH} = 95.20 - R_{CH} = -21.16N$$

From figure 3,

$$M_{AH} = 0 Nm$$

$$M_{BH} = 0 Nm$$

$$M_{CH} = -21.16 \times 0.45 = -9.52 Nm$$

$$M_{DH} = -21.16 \times 0.55 + 116.36 \times 0.10 = 0 Nm$$

Resultant bending moment at A

$$M_A = \sqrt{(M_{AV})^2 + (M_{AH})^2} = 0 Nm \quad (16)$$

Resultant bending moment at B

$$M_B = \sqrt{(M_{BV})^2 + (M_{BH})^2} = 2 Nm \quad (17)$$

Resultant bending moment at C

$$M_C = \sqrt{(M_{CV})^2 + (M_{CH})^2} = 22.05 Nm \quad (18)$$

Resultant bending moment at D

$$M_D = \sqrt{(M_{DV})^2 + (M_{DH})^2} = 0 Nm \quad (19)$$

From equation (18), the maximum moment occurs at C with a value of 22.05Nm

Determination of the Twisting Moment acting on the Shaft

Twisting moment acting on the shaft may be obtained from the following equation:

$$M_t = \frac{30 \times P_M}{\pi \times N_2} \quad (20)$$

From equation (20), we get

$$M_t = \frac{30 \times 370}{\pi \times 400} = 8.83 Nm$$

Determination of the Shaft Diameter

A shaft is a rotating cylindrical machine element which is used to transmit power from one place to another. One important approach to designing a transmission shaft is to use American Society of Mechanical Engineers

(ASME) code [6]. For a solid shaft having little or no axial loading, the shaft diameter may be determined from the following ASME code equation [6]:

$$D^3 = \frac{16}{\pi \tau_{\max}} \sqrt{(k_b M_b)^2 + (k_t M_t)^2} \qquad (21)$$

Where,

D = Shaft diameter

$\tau_{\max}$ = Permissible shear stress

M_b = Maximum value of bending moment

M_t = Maximum value of twisting moment

k_b = Combined shock and fatigue factor applied to bending moment

k_t = Combined shock and fatigue factor applied to twisting moment

The ASME code for shaft design is based on the maximum shear stress theory of failure [6]. According to the ASME code, the maximum permissible working stresses in tension or compression may be taken as [5]
(a) 112 MPa for shafts without allowance for keyways.
(b) 84 MPa for shafts with allowance for keyways.

The maximum permissible shear stress may be taken as
(a) 56 MPa for shafts without allowance for key ways.
(b) 42 MPa for shafts with allowance for keyways.

For suddenly applied load, $k_b = 2.0$ and $k_t = 1.5$. From equation (21), we get

$$D = \sqrt[3]{\frac{16}{\pi \times 42 \times 10^6} \sqrt{(2.0 \times 22.05)^2 + (1.5 \times 8.83)^2}} = 17.74mm$$

A standard size of 25mm was selected.

Determination of the Shaft Torsional Rigidity

The permissible angle of twist varies from about 0.25^o per meter length for machine tool applications to about 3^o per meter length for line shafts. The torsional rigidity may be determined from the torsion equation [6]

$$\theta = \frac{584 \times M_t \times L}{G \times D^4} \qquad (22)$$

Where,

θ = Angle of twist in degree

G = Modulus of rigidity of shaft material = 70GPa

L = Length of shaft subjected to twisting moment

From equation (22), we get

$$\theta = \frac{584 \times 8.83 \times 0.65}{70 \times 10^9 \times 0.025^4} = 0.12^o / m$$

Since the value obtained is within the range quoted for shafting, the selected diameter is safe.

III. TESTING

Before testing was carried, the machine was properly assembled and aligned. Lubrication was also done to reduced friction in the rotating members. Figure 4 shows the photograph of the fabricated electrically powered rotary slicer in its assembled form. The electric motor was then switched on and test running was done for ten minutes so as to study the behavior of the machine. It was observed during this process that blade rotated without wobbling. Testing of the machine with load was then carried out, and during this process, the raw plantain held by hand was forced into the chute and with the aid of a short wooden stick with a stopper, the raw plantain was forces into the cutter which slices it in the shortest possible time. In this case, it took 2-3 seconds, depending on the length, to slice a finger of raw plantain.

Figure 4: Electrically Powered Rotary Slicer

IV. CONCLUSION

The work centered on the design of an electrical rotary slicer for raw plantain chips. Fabrication was carried out using materials that were sourced locally. Though this machine was designed for medium scale industries for raw plantain chips production, it can also be used for domestic purposes. The machine can slice up to a maximum of 70mm diameter raw plantain and is capable of slicing a finger of raw plantain in just 2-3 seconds. Maintenance of the machine is simple requires just lubrication of rotating members and proper cleaning after use.

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Assessment and analysis of spatial patterns and tourism species in Mashhad metropolis

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Abstract: - Urban tourism is one of the most important tourism patterns will be shaped so that today one of the most important functions of urban, modern services is tourism. Mashhad is one of the metropolitan cities due to the Imam Reza's shrine every year about 20 million tourists are welcome. Influx of the volume of tourists Metropolis Mashhad different consequences for citizens and for tourists to follow. The urban tourism flow in the Metropolis requires efficient integrated management, which has the ability to organize the huge mass of tourists. Accordingly, the results indicate that the shift in Mashhad has played an important role in the typology of tourists. Due to the distance of displacement, tourists into three categories: The traditional pilgrims, Pilgrim tourism and religious tourism are classified. Each category has its own features and related information. Therefore, tourism, urban management, it should be classified and needs of each category shall consider the welfare of tourists. On the other hand, optimal performance of Mashhad tourism structure must also be considered.

Keywords: - *Spatial Patterns, Mashhad, Tourism, Urban Management*

I. INTRODACTION

Tourism in the 21st century due to the expansion of economic infrastructure, health, security and communication has become an unavoidable fact. Travel to other sites with different incentives for tourism in this century, is part of the essentials of life. The fact that the current national and international borders are hitting approach is beyond the nation-state (Papoli Yazdi, Saghaei; 2007: 7). Therefore tourism in the world, especially in the economic dimension is very important. So that tourism consumption, public and private investment in tourism and export growth in 2004 is equivalent to 5/9 of about 5/5 trillion dollars is (Chiang Lee, 2008: 180).

The many benefits of tourism as economic activity improves quality of life of residents in different areas of employment, revenues, and increase understanding of the location, the development is considered to be an important parameter. The local authorities in the areas of enhancing competitiveness, attracting investment and tourism, social welfare and development of tourism markets based on redistribution of wealth associated with the management of technological modernization act (Saghaei, 2007: 8).

Competitive power market in different regions, tourism strategies and policies for local authorities on the one hand and on the other hand, is dependent on the ability of tourism in different regions. This means that in the first place should be studied in different areas of tourism potential. And the identification of appropriate capabilities and tourism market, with regard local authorities initiatives suited to strategies is Obtaining.

Among the incentives that human life always has prompted him to travel, "Pilgrimage" is. Religious tourism is one of tourism are identified and written history dating back to as old as religion. Religious tourism has many differences from other types of tourism. In Iran, according to the holy shrine of the eighth Imam (AS) in the Shiite holy city of Mashhad, the different classes throughout the year all over the country and from neighboring countries near and far are Razavi pilgrimage to the Shrine. This type of tourism is one of the most common forms of tourism worldwide. Religious, and possibly holy shrine every year many tourists are attracted towards.

This type of tourist accommodation and entertainment facilities such as motels and Zaersra according to social context and the cultural and ideological tourists with its peculiarities is that in every country of the wide variety whole. Mashhad in the metropolis of the kingdom of the blessed shrine of Imam Reza (AS) as a gem among all the cities of Islamabad and shines beautifully. Mashhad, with a special place in the national and international tourism. Generally speaking excellence and unique metropolitan Mashhad is the most important characteristic of a great religious center of the Metropolis. Holy Shrine of Imam Reza (AS) has always been regarded as a strong religious and pilgrimage attractions to attract large numbers of Shiites that. More than 20 million passengers yearly pilgrimage to the shrine of Imam Reza (AS) and visit the great places of historical, religious, cultural and beautiful countryside in this city, this country is headed. Influx of the volume of tourists and pilgrims Metropolis of Mashhad has different consequences for citizens and tourists future. The urban tourism flow in the Metropolis and efficient integrated management, which requires the ability to organize that huge mass of tourists and pilgrims have to be(Mafi, Saghaei, 2010: 28 - 30).

Research objectives

1. Identify problems, constraints and obstacles in the process of urban tourism.
2. Appropriate for use in all cities and tourist area attracting tourists.
3. Create more consistency coefficient of tourists and pilgrims with better service and more security
4. Explores the motivations and goals of pilgrims and tourists visit the entrance to the Metropolis of Mashhad.

Research hypotheses

1. It seems that the Metropolitan Mashhad pilgrimage and tourism single-purpose trips, multiple trips tend to have.
2. It seems that tourist arrivals are divided into different groups Metropolis of Mashhad.

Theoretical Principles Research

"Tourism and the Greek origin of the word is getting around the Tour means Greek to Spanish and French and has finally found its way to England the following definitions are used in the Oxford Dictionary:

1) The place or places where the short travel a lot to see.
2) Pass a short trip somewhere.
3) Means that large amounts of money through the tourism industry, with foreign tourists who come to earn some countries are.

In general, the word tour is derived from the word tourism means a trip back to the spot and follow a specific itinerary. (Ali Asgari, 1997)« Tourism (Tourism) is the activity or activities that people can relax, work or other reasons outside of their usual travel and at least one night stay for a maximum of one year in succession where the chosen.

"Tourism is a phenomenon of the distant past, societies have been considered According to the different needs of economic, social, historical, and… The momentum has continued This phenomenon since the Industrial Revolution, particularly during the last century, has expanded dramatically, Underlying science and technology in international relations and economic development of nations "(Ali Asgari, 1997).

When "Thomas Cook" of London launched his first tour, about 150 years ago, this action over a century and a half of ups and downs and changes, the largest social movement in human history became here goes the next century, the greatest economic, social and cultural wellbeing. In total, a staggering increase in tourism due to improved communications, increased wealth and prosperity and more leisure is (Bonnie Face, 1995: 15) Tourism or tourism industry since 1950 with great changes that some have called it a revolution tourism this led to the development and maturation of "mass tourism" and in the near future "quality tourism" will become. We have a strong and professional tourism activity worldwide is great So that before the first oil, then placed in a row and then above it is growing.

"According to the World Tourism Organization, which is affiliated to the United Nations, tourism is the largest industry in the world" (Lund Berg and others, 1995: 3) The first travel in most countries and regions to exploit its economic interests" (World Tourism Organization 2001, 66) The World Tourism Organization statistics that show offers an important impact on tourism in the global economic system, the third largest industry after oil and automobile industries, dynamic and growing industry is the only industry where the introduction .. "As a force for social change, tourism has been the impact of the Industrial Revolution. In less than three decades, tourism has transformed the world's view of business "(quoted from Bonnie Facebook Svdjych 1995: 16). Today tourism has become one of the greatest levers of economic social change in human history So that the number of international tourists in 1950, which did not exceed 25 million in 1992 have been to over 594 million people . According to the World Tourism Organization predicts the number of tourists in 2010 to one billion people in 2020 to 6/1 billion people will increase. The magnitude of tourism to create jobs and income is not limited. If the thought of planning and development, direct and indirect benefits of tourism to

the economic, social, cultural and political environment and make a significant contribution to play in national development In other words, to promote social justice indicators, improved living standards, prosperity and regional balance lead. In some cases, regional economists, tourism as the only resource deployment and development of less developed regions have seen "(Masumi 2007: 10).

"Cultural environment - social media activity is tourism. Thus, culture and tourism community interact with each other. This discussion is related to two aspects:

- Impact and influence on each other's culture and society, culture and tourism community.
- The impact of tourism on culture and society.

"The benefits of tourism to the local community and cultural patterns and also bring problems. Social work - cultural tourism, including tourism development in each region are the most important considerations, however, measure the impact of the economic and environmental impact is far more difficult. In countries that are still socially and economically very traditional, very critical of these works are important. Although the incidence of social tourism - cultural, but it should be remembered that in principle lead to the development of any new changes are sought. Tourism is the only source of change in society "(World Tourism Organization 1994: 78-79). Economic consequences usually measurable and manifest contrast, only some of the social costs of tourism are obvious, but in other cases not. In the past, the Dutch capital of Amsterdam was the center of attraction hippie and drug addicts. The city's reputation was tarnished, which is a social cost (Lund Berg and others 199: 83).

"Social problems caused by drug addiction, alcoholism, crime, and prostitution, as well as the tourists are likely to intensify.

Research suggests that these problems are rarely the main reason for this is that tourism but can they provide developments"(World Tourism Organization 1994: 82).

II. INTRODUCING THE STUDIED AREA

The holy Mashhad is the name of a capital city in the vast province of Khorasan Razavi; it is located in 59 minutes, 3-60 degrees and 35 minutes of east-longitude and 42 minutes till 36 degrees and 59 minutes of north-longitude. From the north it is connected to the Kalat city, from North-Western to Dargaz, from west to Chenaran, and Naishabour and from east it is connected to Sarakhs and Torbat Jam. Based on the census which was done for populations and domiciles in the year of 2012, it was indicated that the population of this city is more than 6009941 people, and from these people about 2772287 people are the inhabitants of mashhad city.

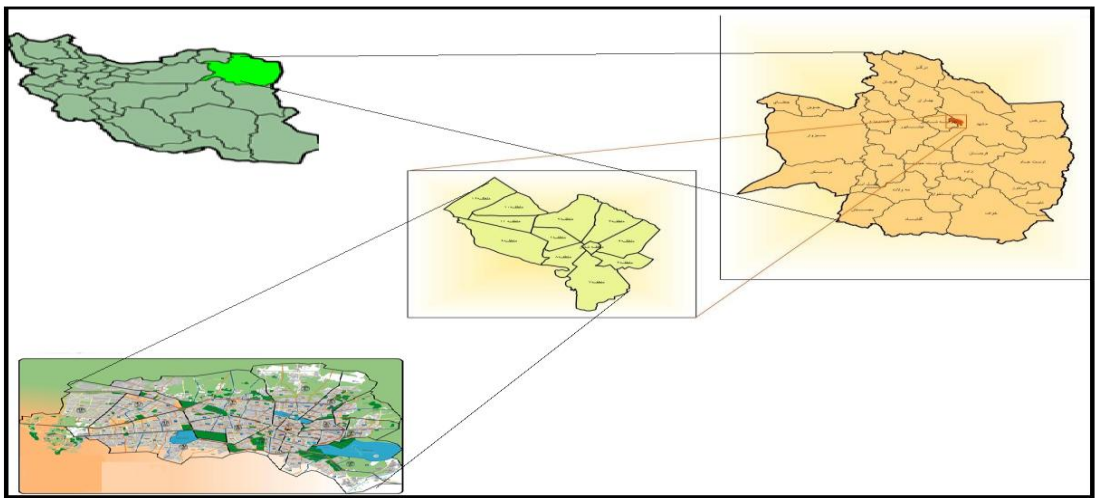

Figure (1): Geographic map of Mashhad city.

III. DISCUSSION AND CONCLUSIONS

Research findings

Question 1:

In the first part of the claim is considered "best place to stay is near the shrine" and Chart (1) as well as tourists respond to these claims is arranged.

Table (1): places to stay near the shrine

Options	x_i	f_i	$f_i x_i$	$(x_i - \bar{x})^2$	$f_i(x_i - \bar{x})^2$
Very low	1	20	20	5/13	102/6
Low	2	20	40	1/60	32
Average	3	30	90	0/07	2/1
much	4	60	240	0/538	32/28
Very much	5	20	100	3/0	60
Total	15	150	490	10/338	228/98

Source: search results

$$\frac{3.266-1.539}{\frac{0.950}{\sqrt{150}}} = 22/25$$

As a result, the value of T equal to 22/25 and 1/64 is more. As a result, the above relationship is established. Therefore, the null hypothesis is confirmed and the claim is accepted. The distance between the places of residence of the shrine is effective accommodation choices for tourists.

Question 2:

The first of these claims is discussed in this section: "except pilgrimage incentives - such as the entertainment, shopping, and others on their journey to Mashhad has played a role" and Table (2) also the answer to the claim regular tourists it is.

Table (2): Reasons travel to Mashhad

Options	x_i	f_i	$f_i x_i$	$(x_i - \bar{x})^2$	$f_i(x_i - \bar{x})^2$
Very low	1	10	10	5/13	51/3
Low	2	30	60	1/60	48
Average	3	40	120	0/07	2/8
much	4	50	200	0/537	18/5
Very much	5	20	100	3/00	30
Total	15	150	490	10/337	150/6

Source: search results

$$\frac{3.267-1.271}{\frac{0.950}{\sqrt{150}}} = 25/72$$

As a result, the value of T equal to 25/72 and 1/64 is more. Therefore, the null hypothesis is confirmed and the claim is accepted. Apart from the pilgrimage, other motives such as entertainment, shopping, and others on their journey to Mashhad has played a role.

Question 3:

The first of these is discussed in this section to claim, "the cost of providing adequate access and stay away from areas provides sanctuary" and Table (3) as well as the response to the claim has been sorted.

Table (3): places to stay away from the shrine

Options	x_i	f_i	$f_i x_i$	$(x_i - \bar{x})^2$	$f_i(x_i - \bar{x})^2$
Very low	1	9	9	6/08	54/72
Low	2	12	24	2/14	26/68
Average	3	52	156	0/217	11/28
much	4	58	232	0/285	16/53
Very much	5	19	95	2/353	44/70
Total	15	150	516	11/07	153/91

Source: search results

$$\frac{3.466-1.056}{\frac{0.950}{\sqrt{150}}}=31/05$$

As a result, the value of T equal to 31/05 and 1/64 is more. Therefore, the null hypothesis is confirmed and the claim is accepted. The cost of providing adequate access and stay away from the shrine where it provides.

Question 4:

In the first part of the claim is raised: "If being provided access to income ratio you want to visit from the promenade around the city of Mashhad," and Table (4) as well as tourists respond to these claims is arranged.

Table(4): visiting on promenade the city of Mashhad

Options	x_i	f_i	$f_i x_i$	$\left(x_i-\bar{x}\right)^2$	$f_i\left(x_i-\bar{x}\right)^2$
Very low	1	22	22	3/73	82/06
Low	2	28	56	0/87	24/36
Average	3	56	118	4/48	250/88
much	4	24	96	1/138	27/31
Very much	5	20	100	4/27	85/4
Total	15	150	392	14/48	470/01

Source: search results

$$\frac{2.933-1.405}{\frac{0.950}{\sqrt{150}}}=19/69$$

As a result, the value of T equal to 19/69 and 1/64 is more. Therefore, the null hypothesis is confirmed and the claim is accepted. Hence, in the case of providing access to income ratio you want to visit from the promenade around the city of Mashhad.

Question 5:

The first of these claims is discussed in this section: "Given the number of tourists tend to stay within the shrine and unwillingness to address other incentives as a traditional pilgrims categories." And Table (5), as well as tourists respond to these claims is arranged.

Table (5): the traditional pilgrims

Options	x_i	f_i	$f_i x_i$	$\left(x_i-\bar{x}\right)^2$	$f_i\left(x_i-\bar{x}\right)^2$
Very low	1	20	20	5/13	102/6
Low	2	20	40	1/60	32
Average	3	30	90	0/07	28/1
much	4	60	240	0/538	32/28
Very much	5	20	100	3/0	60
Total	15	150	490	10/338	228/98

Source: search results

$$\frac{3.266-1.539}{\frac{0.950}{\sqrt{150}}}=22/25$$

As a result, the value of T equal to 22/25 and 1/64 is more. Therefore, the null hypothesis is confirmed and the claim is accepted. Hence, the number of tourists due to the desire to stay within the shrine, and not wanting to deal with other incentives, as pilgrims traditionally is classified.

Question 6:

All tourists alike and are similar in Mashhad and Mashhad in no way want to visit other parts are not. Table (6) is arranged according to the response of tourists to this claim.

Table (6): did not visit other parts of the city of Mashhad

Options	x_i	f_i	$f_i x_i$	$(x_i - \bar{x})^2$	$f_i(x_i - \bar{x})^2$
Very low	1	16	16	5/11	81/76
Low	2	28	56	1/60	44/8
Average	3	44	132	0/07	3/08
much	4	32	128	0/537	17/18
Very much	5	30	150	3	90
Total	15	150	482	10/31	163/82

Source: search results

$$\frac{3.040-1.673}{\frac{0.950}{\sqrt{150}}}=1/61$$

As a result, the value of T equal to 1/61 and 1/64 is lower. Therefore, the null hypothesis cannot be verified, and the claim that all tourists alike and are similar in Mashhad and Mashhad are not in any way want to visit other parts of the city are not accepted.

Question 7:
In the first of these claims have been made that tourism needs to visit the shrine in Mashhad in addition to shopping centers and entertainment including Almase Shargh is like as a Moujhai Abi. Table (7) as well as tourists respond to these claims is arranged.

Table (7): shopping and entertainment along with pilgrimage

Options	x_i	f_i	$f_i x_i$	$(x_i - \bar{x})^2$	$f_i(x_i - \bar{x})^2$
Very low	1	10	10	12/52	152/2
Low	2	24	48	2/36	56/64
Average	3	36	108	0/290	10/44
much	4	48	192	0/212	10/17
Very much	5	32	160	2/13	68/16
Total	15	150	518	17/51	297/61

Source: search results

$$\frac{3.539-1.459}{\frac{0.950}{\sqrt{150}}}=26.80$$

As a result, the value of T equal to 26/80 and 1/64 is more. Therefore, the null hypothesis is confirmed and the claim is accepted. Hence the need for pilgrimage tourism in Mashhad addition to visiting shopping centers and entertainment including Almase Shargh is like as a Moujhai Abi.

Question 8:
The first of these claims is discussed in this section: tourists who travel to the city of Mashhad, according to income, vehicle transportation, places to visit and places to stay, things are different. And Table (8), as well as tourists respond to these claims is arranged.

Table (8): difference between the tourist city of Mashhad

Options	x_i	f_i	$f_i x_i$	$(x_i - \bar{x})^2$	$f_i(x_i - \bar{x})^2$
Very low	1	0	0	0	0
Low	2	33	66	29/87	985/71
Average	3	37	111	0/217	8/029
much	4	52	208	0/285	14/82
Very much	5	28	140	2/353	65/88
Total	15	150	525	37/275	1074/43

Source: search results

$$\frac{3.466-0.922}{\frac{0.950}{\sqrt{150}}}=33/21$$

As a result, the value of T equal to 33/21 and 1/64 is more. Therefore, the null hypothesis is confirmed and the claim is accepted. The tourists who travel to the city of Mashhad, according to income, vehicle transportation, places to visit and places to stay, things are different.

IV. TESTING HYPOTHESES

Hypothesis 1: seems to be the Metropolis of Mashhad pilgrimage and tourism single-purpose trips (motivated pilgrimage) to the multi-purpose trips (the first visit) is biased.

According to this hypothesis claimed that incentives to Mashhad for pilgrimage and tourism over recent years to address the state of pilgrimage and the lack of other incentive to address the changed. And these days, in addition to other incentives as motivational priorities pilgrimage to visit recreation centers like Moujhai Abi, Shandiz and similar phenomenon has also been considered. To investigate this claim, two questions in the questionnaire was devoted to this hypothesis, a second question or question that is dedicated to the question "except pilgrimages, other motives such as entertainment, shopping, and others on their journey to Mashhad has played a role "the result was as follows:

$$\frac{3.267-1.271}{\frac{0.950}{\sqrt{150}}}=25/72$$

As a result, the value of t is equal to 25/72 and 1/64 is more? Therefore, the null hypothesis is confirmed and the claim is accepted. Apart from the pilgrimage, other motives such as entertainment, shopping and the like is involved in journey to Mashhad.

Additionally, upside in Question 6 This question was posed to tourists, which "all tourists alike and are similar in Mashhad and Mashhad in no way want to visit other parts are not.

$$\frac{3.040-1.673}{\frac{0.950}{\sqrt{150}}}=1/61$$

As a result, the value of t is equal to 1/61 and 1/64 is lower. Therefore, the null hypothesis cannot be verified, and the claim that all tourists alike and are similar in Mashhad and Mashhad are not in any way want to visit other parts of the city are not accepted.

Due to the positive response of tourists to the second question, and prove that the tourists traveling to the shrine in Mashhad and other incentives are also considered. According to the response to question 6 as the answer, not to visit other tourist attractions in the city of Mashhad, the first hypothesis of this study is demonstrated

.

Second hypothesis: seems that tourist arrivals are divided into different groups Metropolis of Mashhad.

Questionnaire data were also used to evaluate this hypothesis. To study the typology of tourism between the three levels of the pilgrim, pilgrims, tourists and religious tourism, as well as demographic characteristics and Tourism. There is a significant relationship or not? T-test was used for the results in Table 9 are given.

Table (9): T-test the typology of tourism and tourism

features

Group Statistics

	جنس	N	Mean	Std. Deviation	Std. Error Mean
Y65	زن	60	19.3667	5.46783	.70589
	مرد	219	17.1735	4.91273	.33197

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Y65	Equal variances assumed	.000	.995	2.989	277	.003	2.1932	.73383	.74855	3.63775
	Equal variances not assumed			2.812	86.834	.006	2.1932	.78006	.64266	3.74364

Source: search results

The table shows that the output value 0/003 is because the amount of 0/05, then the least we can conclude that there is a significant relationship between demography and tourism point of view of Assumption 2 is also proved.

V. RESULTS

The results obtained from this study is based on a conceptual model represents a typology of tourism and its metropolitan area is Mashhad. Due to the large volume of tourists in Mashhad, and constraints and bottlenecks that involve the direction of the city. Typology can be a major tourist city of Mashhad, the local and regional scale and attract more tourists to overflow its surrounding area in the city of Mashhad; Mashhad has been a major pilgrimage tourism circuit. Mashhad become the country's second largest metropolitan center of pilgrimage tourism, as well as fixed and variable demand of increasing population, causing the widening sphere of influence and attract more areas of Mashhad, Mashhad, villages and towns in the metropolitan system is the Mashhad, one must consider the needs of tourism, recreation and leisure constant growing population (about 3 million) and variable (monthly average of 1 to 1/5 million) to answer visitors and pilgrims.

Mashhad Tourism is the main function and dynamic metropolis with its urban economy is dependent on tourism and tourists and pilgrims. This necessitates the metropolis Mashhad TBD or the "business tourism" should be defined. On the one hand, tourists and pilgrims to the problems associated with this area are known. On the other hand, obtaining a solution that would facilitate tourism and increasing the quality of the tourism experience in this area of practice. Based on the obtained results, the following strategies are offered in different sizes:

Suggestions

- Recommended that management is responsible for organizing and promoting tourism in the city of pilgrims and the management of local authorities can be formed.
- Stable policy of tourism development in the pilgrim town. This is necessary in order to prepare the ground for investments in tourism, pilgrim, in order to prevent false investment activity and inflationary.
- Improve the quantity and quality of tourism services in each city zone Pilgrim prioritized according to the measuring zone and tourism services in the city Pilgrim TFS
- Increase citizen awareness towards the resolution of a pilgrim town and the neighboring town and its advantages in economic, social, cultural and physical space.
- Recommended banks involved in the development of tourism in the region shared by public and private investment to develop tourism in the town of Pilgrim recommended.

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Globalization and rural economic inconstancy (Case study: Kashmar County)

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Abstract: - In recent years "globalization" has developed the geographical boundaries as process. Also, it has been positive and negative effects on economic, social, political and cultural conditions. The growth of technology has doubled its impacts. So in this paper, were analyzed threats and opportunities in Iran by emphasizing on "Kashmar city" villages. Thus, this research is applied and the research method is "descriptive – analytical". The method of data collected is field and questionnaire. Therefore were used 381 questionnaires. The finding shows the globalization has been happened in three periods. They are: 1- previous of Islamic revolution, 2- after war (between Iran & Iraq), 3- recent years. On the other hand, results show that the effects of globalization haven't been equal in three periods. Also, in recent years the globalization phenomenon has been influenced more than other periods.

Keywords: - *Globalization, economic, village, Kashmar*

I. INTRODUCTION

In recent year one of the most important concepts is "globalization". Although in its simplistic sense globalization refers to the widening, deepening and speeding up of global interconnectedness, such a definition begs further elaboration. … Globalization can be located on a continuum with the local, national and regional. At one end of the continuum lie social and economic relations and networks which are organized on a local and/or national basis; at the other end lie social and economic relations and networks which crystallize on the wider scale of regional and global interactions. Globalization can be taken to refer to those spatio-temporal processes of change which underpin a transformation in the organization of human affairs by linking together and expanding human activity across regions and continents.

Without reference to such expansive spatial connections, there can be no clear or coherent formulation of this term. … A satisfactory definition of globalization must capture each of these elements: extensity (stretching), intensity, velocity and impact (Taylor, 1997).

'Globalization' is a big problem in every sense of the term. It is, first and foremost, a problem in a material sense, insofar as its associated syndrome of processes creates highly uneven geographical and social outcomes. … It is also a problem in a rhetorical or discursive sense, in that its meaning and significance are deeply and widely contests. … 'Globalization' has evolved into a catch-all term, used by many to bundle together all the goods and buds of contemporary society.

Economies of the world are being increasingly integrated as new technology and communication has brought people together. We often hear the phrase that the 'world has become a global village' - which itself signifies how much has changed in the world in the past few decades. American businessmen are investing their time in studying the culture of the Middle East, so that they can negotiate with their counterparts in a better way (Khaje nori, 1996:85). Young graduates in India are being taught how the Americans roll their R's, so as to make a seamless conversation with their clients in many of the call-centers! The phenomenon that is globalization has brought new dimensions to this world, and people are mingling with each other like never before. The social, economic, and political changes that globalization has brought have been accompanied by some challenges. We will not approach its negative effects as a cynic, but as a student or an observer, so that we are free of any kind of prejudice and bias, and understand the topic in a better way.

1.1. The Negative Effects of Globalization

- There are various schools of thought who argue that globalization has led to an increase in activities such as child labor and slavery. In countries with little or no accountability, corporations employing children can work smoothly by bribing the officials, which may result in an increase in illegal activities. Critics opine that globalization has resulted in a fiercely-competitive global market, and an unethical practice in business is a by-product of this.
- Globalization may have inadvertently helped terrorists and criminals. At the heart of globalization is an idea that humans, materials, food etc. be allowed to travel freely across borders, but 9/11 was a ghastly reminder that people with evil intentions can use it as an opportunity and cause damage.
- It is not only the developed nations that are complaining about its negative effects, people in developing nations - where most of the industries have been set up, have their own set of reasons against globalization. They often complain that their cities have been reduced to garbage-dumps where all the industrial waste is accumulated and pollution levels are sky-high.
- Fast food chains like McDonalds and KFC are spreading fast in the developing world. People are consuming more junk food which has an adverse impact on their health. Apart from the health concerns, there is something else that globalization has been criticized for, and it is the accusation that it has opened floodgates for restaurants and eateries which are insensitive to the religious beliefs of the host nation. For example, a lawsuit had to be filed against McDonalds in India, after it was accused of serving beef in their burgers.
- While the rich are getting richer, the poor are struggling for a square meal. If the current Occupy Wall Street protests are a reminder of how angry people are with the current set-up, then those who govern us should take notice, and work towards alleviating poverty. Ideally, globalization should have resulted in creation of wealth and prosperity, but corporate greed and corrupt government has ensured that money is not distributed equally.
- When the first-known case of AIDS came up in America, only few would have traced its origin to Sub-Saharan Africa. Globalization bought people from various countries together, and this is perhaps the reason that a virus from a jungle was transported to almost every country in the world.
- Environmental degradation is an issue which has been debated ferociously in various international meetings, and it has to be accepted that globalization is one of the most important factors that has aggravated the situation. The amount of raw materials needed to run industries and factories is taking a toll on the natural reserves of planet earth, and pollution has severely impacted the quality of air that we need so very much for our survival.

As we mentioned in the beginning of the article that like everything else, globalization has its own share of kudos and brickbats. We have reached a stage since our evolution that discarding the concept of globalization may not be possible at all, therefore, the strategy should be to find solutions to the threats it poses to us so that we can work towards a better, fulfilling future (Mehregan 2002:34).

1.2. Research questions

Due to the purpose of research, the main question is:

1- Has effected process of globalization on rural economic and subsectors such as agriculture, industry or no?

1.3. Research purpose

According to negative and positive effects of globalization on Iran the main purpose is, analyzing no development rural area in Kashmar County due to this phenomenon.

1.4. The method of research

This research is applied and the research method is "descriptive – analytical". The method of data collected is field and questionnaire. In order to was used from libraries resource, organizations internet and papers (eshraqi, 2001:45). Also, the studied area is villages of Kashmar County. Therefore the sample size is 381. Totally there are 58 number villages in studied area. Also, based on census in 2012 the population of Kashmar County is 157149 people. Also, there are 61187 people in studied area. On the other hand we used from Cochran formulate. So at first step were classified villages based on their populations. Thus, are deleted six number villages due to having fewer than 100 people. Table 1 shows sample villages.

Table 1: selected villages

Classification	Numerous villages	Selected villages	Villages
fewer than 100	6	-	-
100-499	15	2	Qaracheh , Koche nama
500-999	13	2	Tunder , Nay
1000-2499	19	2	Sarhozak , Mushak
2500-4999	5	1	Rezq abad
TOTAL	58	7	7

Source: researcher studied

Therefore, has been used Cochran formulate. The results are:

$$n = \frac{NZ^2pq}{Nd^2 + Z^2pd}$$

$$n = \frac{NZ^2pq}{Nd^2 + Z^2pd} = \frac{18650 \times (1.96)^2 \times 0.5 \times 0.5}{18650 \times (0.05)^2 \times (1.96 \times 0.5 \times 0.05)} = \frac{17911}{47} = 381$$

Thus sample size is 381.

Table 2: detail of sample villages

Sort	Sample villages	Population	Numerous questionnaire
1	Koche nama	420	21
2	Qaracheh	42	23
3	Nay	715	36
4	Tunder	771	38
5	Sarhozak	1063	53
6	Mushak	1537	77
7	Rezq abad	2590	133
TOTAL	7	7558	381

Source: researcher studied

II. GLOBALIZATION AND VILLAGES

Globalization involves the movement of people, goods, ideas and information across national boundaries. It has been defined as 'the intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa'. (Dollfuss, 1990: 64). Globalization is not new. The Roman Empire, based on militarism, political refinement and technology was in its day, global in its influence. So was the Arab Empire that followed and that brought together the latest in scientific thought. The social, artistic and commercial affects that spread – originally from Italy - during the Renaissance beginning what historians call 'the early modern period' was also an example of globalization. Today it is the globalization of production that is most influential in influencing and molding relationships. This is based on the integration of economic activities – and economies - on a world scale which is being spearheaded by multinational companies (Berman, 2005: 113). The encyclopedia Britannica dictionary defines modernization as the "transformation of a society from a rural and agrarian condition to a secular, urban, and industrial one". Modernization is mostly associated to "industrialization". This is because when there is industrialization there is division of labor and specialization. In addition, when there is division of labor and specialization, it signifies presence of modernization. Modernization is a situation whereby there is a fall in the traditional values of the people. It is also a situation whereby there is an increase in similarities between different cultural groups.

One of those theorists of Marxism who tired to trace the origin of globalization is Wallerstein. According to Wallerstein, "globalization does not constitute a new phenomenon", Wallerstein (1998:32) is the process, completed in the 20th century by which the capitalist world system spread across the actual globe,

which since its development, the world system had maintained some of it features over several centuries. So according to him, globalization is the "ideological celebration of so-called globalization is in reality the swan song of our historical system". He focuses on the economic sphere. He believes the world has being going social compression since the beginning of the sixteenth century. He says the world is experiencing acceleration globalization, which is cultural and reflexive in character to an extent that it can be regarded as an accomplishment. He traces the origins of globalization starting form the human societies. He argued that the defining characteristic of all social system is the division of labor in economic of exchange. Wallerstein makes readers to understand that there are only two ways in which societies are organized. That is the mini and the world systems. The mini system he said refers where there is division of labor and economic exchange occurs only within discrete group like the traditional and isolated hunter-gathering societies. He believes those societies were rare and are now virtually in non- existence. While Giddens talks of 'time-space distanciation', Wallerstein talks of 'time-space realities'.

The origins of globalization are analyzed according to Giddens under four dimensions. That is, "capitalism, military order, surveillance, and industrialization" Giddens (1990:70-78). He believes that the liberation of time and space is an entirely modernizing development and is a prerequisite for globalization. Thus, modernization according to Giddens is a direct consequence of modernization. Giddens says, 'The concept of globalization is best understood as expressing the fundamental aspects of time-space distanciation' Giddens (1990, 1991). In addition, time- space distanciation was believed by Giddens to be the first step towards the process of globalization. For Giddens, it has come with the advent of modernization. In addition, when there is time space distanciation and disembodying (that is the lifting of social relations out of the local environment), there is the development of complex relationships between local activities and interaction across distances. He believes globalization is directly allied to the development of modern societies to the industrialization and the accumulation of material resources, and is a continuation of modernity rather than a break with it. The contemporary period Giddens terms it high modernity, by which he means modernity has now moved into a global stage. Society has become a 'world society' and social institutions that have become global confront the individual. People everywhere cannot avoid coming into contact with the global through 20th century brand marketing, imagery and fashions. He defines three factors in the 20th century that in his opinion, have resulted in contemporary globalization (Jamshidi, 2011:6).

According above writing, globalization has both positive and negative impacts. Also it has different affects in countries. On the other hand, globalization has various affects in third worlds countries or developing countries. Sometime it is led to expansion of poverty and some time is led to decreasing poverty due to using technology and etc. also , globalization effects on rural communities .

III. AFFECTS OF GLOBALIZATION ON RURAL AREAS

The relational approach to place has become prevalent in geography in recent decades, offering a way of moving beyond the flawed perspectives of essentialist accounts that presented places as fixed and bounded, structuralism accounts that denuded the significance of locality in emphasizing super-structures, and social constructivist approaches that prioritized the discursive to the neglect of the material. Relational perspectives positions space as "a product of practices, trajectories, interrelations" (Massey, 2004, p. 5), that is dynamic and contingent. Space is not segmented into territorialized places; rather relational space contains places that are brought into being as meeting points or entanglements of diverse social, economic, cultural and political relations. Massey (2005) refers to this as the "thrown togetherness of place", that places are always hybrid, always fluid, always changing, and always threaded together with other places.

In a relational perspective the rural can be understood as neither a bounded and definable territory nor as a purely imaginary space without material foundation. Rather the rural is relational, discursively constructed in relation to external referents such as the city or the nation, but also given material form through the hybridization and entwinement of different social, economic and cultural processes and relations to produce evocatively 'rural' articulations (Murdoch, 2003; Woods, 2011). Take, for example, the family farm, which sits at the heart of discourses of rurality in many Iranian nations. The family farm is a product of diverse economic relations and processes, social processes, labor relations, cultural conventions, landscape practices and family relations. It is the particular combination of these different relations that produces the distinctive model of the 'family farm' that is so iconic of the essence of rurality. Yet, it is also these relations that tie the family farm into broader networks and structures, and which make the family farm vulnerable to distant events, such as commodity price fluctuations, agricultural policy reforms, or changes in environmental regulations.

Globalization hence impacts on rural areas through the relations that constitute rural place.

Indeed, globalization can be perceived to be intrinsically relational as it is in essence about

The refashioning of relations across space. As Steger's (2003) four-fold definition encapsulates, globalization involves firstly, "the creation of new, and the multiplication of existing, social networks and activities that increasingly overcome traditional political, economic, cultural and geographical boundaries" (p.

9); secondly, “the expansion and stretching of social and economic relations, activities and interdependencies over increasing distances” (p. 12); thirdly," the intensification and acceleration of social exchanges and activities, with connections able to be made across increasing distances in increasingly less time and with increasing frequency” (ibid.); and fourthly, the development of a global consciousness that changes how people relate to each other.

A relational approach to globalization therefore rejects easy narratives about domination and homogenization and time-space compression in exchange for more demanding questions about how precisely rural places are remade under globalization, about how rural localities are enrolled into new or refashioned relations with other places, and about how extra-local relations are captured, manipulated and exploited by rural actors .

IV. INEQUALITY

One of the results of globalization is inequality. Of course inequality is different in each country. On the other hand degree of inequality in developing countries is more than developed countries ((Jamshidi, 2011: 7).

The debate on the distributional effects of globalization is often polarized between two points of view. One school of thought argues that globalization leads to a rising tide of income, which raises all boats. Hence, even low-income groups come out as winners from globalization in absolute terms. This optimistic view has parallels with the Kuznets hypothesis from the development literature, which proposed that even though inequality might rise in the initial phases of industrial development, it eventually declined as the country’s transition to industrialization was completed. The opposing school argues that although globalization may improve overall incomes, the benefits are not shared equally among the citizens of a country, with clear losers in relative and possibly even absolute terms. Moreover, widening income disparities may not only raise welfare and social concerns, but may also limit the drivers of growth because the opportunities created by the process of globalization may not be fully exploited. The sustainability of globalization will also depend on maintaining broad support across the population, which could be adversely affected by rising inequality.

Michel lepton believed that there is conflict between rural and urban classes. Totally, there are some methods of planning such as Egalitarian, democratic, traditional. Often, Developing countries are using traditional method. The approach of these planning is huge projects the due to need maximum population, having been implemented in central cities or metropolitan. So in this method is paid attention to urban civilization more than rural areas (Rahimi, 2011: 4).

One of the most common claims today is that globalization typically leads to growing income inequality within countries, so that its benefits go primarily to the rich. In fact, it is one of the big myths of the anti-globalization movement. Certainly there are important examples, notably China, where opening has gone hand-in-hand with rising inequality, but that has not been a general pattern. In many developing countries, integrating with the international market has coincided with stable inequality or declines in inequality. When trade liberalization goes hand-in-hand with stable or declining inequality, the benefits for the poor are quite powerful. Trade creates jobs which help for the poverty reduction. Here, the link from trade to poverty reduction was very clear.

Even where inequality has increased, it is still the case that globalization has led to rapid poverty reduction. China is perhaps the best example of this. But the benefits of the globalization for the poor are particularly strong in the cases where inequality is stable or declining. There is ample evidence that the gap between the richest and poorest countries, and between the richest and poorest groups of individuals in the world, has increased. But inequality may increase without an increase in poverty rates, for example if globalization increases opportunities for the wealthy more rapidly than for the poor. Since increasing wealth may be due to many causes, showing that the rich get richer because the poor get poorer is trickier than recording and lamenting the fact of inequality as such. Developing countries can take steps to make globalization as a tool for poverty eradication. The three most important ways to do this are through basic education, through social protection measures to deal with adjustments, and through ensuring that all regions of a country are connected to the global economy.

V. POVERTY

One of the globalization phenomenons is poverty. Globalization has helped raise the standard of living for many people worldwide. It has also, however, driven many deeper into poverty. Small businesses and third world countries are not capable of updating their technology as often as their larger, wealthier counterparts. Unable to compete with multinational firms and wealthy nations, small businesses and third world countries are forced to do business locally, not growing and reaching their full potential.

Chen and Ravallion have estimated between (1981-2001) years. They find a clear indication of rising poverty counts in Sub-Saharan Africa (SSA) for both lines, though with encouraging signs of a reduction in the

percentage below the line after 2000, in keeping with other regions. The rate of decline in SSA's $1 a day poverty is about one % point per year from 1999 to 2004; in absolute terms this is slightly higher than the rate of decline for the developing world as a whole, although (given Africa's higher than average poverty rate) the proportionate rate of decline over 1999-2004 is still lower than average. Using the $2 line, we still see progress in SSA since the 1990s, although the rates of decline in the incidence of poverty lag behind the developing world as a whole. (Chen and ravallion, 2004:141)

The regional composition of poverty has changed dramatically. Since the decline in poverty between 1981 and 1984 is rather special (being largely due to China), let us focus on 1984 and 2004. In 1984, the region with the highest share of the world's $1 a day poor (assuming there are none in developed countries) was East Asia, with 44% of the total; one third of the poor were in China at that time. By 2004, East Asia's share had fallen to 17% (13% for china). This was made up largely by the rise in the share of the poor in South Asia (from 35% in 184 to 46% in 2004) and (most strikingly) Sub-Saharan Africa, which saw its share of the number of people living under $1 a day rise from 16% in 1984 to 31% 20 years later. Projecting these numbers forward to 2015, SSA's share of the "$1 a day poor" will be almost 40%.

Was and Zegar believe culture and economic are according to world village. Also, they believe globalization effects on native agriculture. Globalization could be change traditional village to modern village. Their idea is that the important of villages Poland country problems is appropriate marks in Europe and world. There are some factors for proving organic productions.

– Producing farms in order to nurturing animal and plants with modern methods.
– Providing organic production (flowers, fruits, native vegetable, herbs and etc) (was and zegar, 2002:88).

Globalization creates tensions, especially within nations and companies, between those who have the skills and resources to compete in the global market and those who do not. When the Internet was first introduced to the public, the wealthier countries in the world were able to incorporate it into their economies before the poorer countries. The wealthier countries had already established a strong hold on the Internet by the time the poorer countries were able to buy computers and pay for Internet access. According to one prediction, "by 2001, two hundred sixty-eight million computers will be connected to one another". However, the great majority will be purchased and connected to the Internet by people in wealthy countries. The wealthy countries control most world-renowned businesses and services on the Internet. They also control the registration of domain names on the Internet, forcing the poor countries to pay the wealthy countries for the rights to names to create e-companies. The Internet "instantly link[ed] retailers to suppliers". Through digitization, voices, sounds, pictures, and documents can by turned into computer bits transferable on the Internet. Federal Reserve Chairman Alan Greenspan even "linked . . . upturn[s] in productivity to massive investments . . . in computers and other technology (Workers). By the time the poorer countries were able to benefit from the use of the Internet, the wealthy countries had only increased their wealth. Technological advances in the transportation industries have also benefited wealthy countries more than poor countries. As the use of automobiles and airplanes spread throughout the world, the poorer countries were forced to use standard horses and buggies and ships because the price of automobiles and airplanes were too high (Qarib, 2002:6).

This gave the wealthier countries an enormous advantage because a product that previously required months to ship by sea would take a matter of days to reach its destination by air and automobile. Businesses in the wealthier countries were also able to send their executives around the world to meet with executives from other countries and close their deals, while the executives of businesses from poorer countries were still on their boats traveling. If a country does not update its transportation industries, international companies will not want to build warehouses and distribution centers within that country.

Most of the general statements one sees in popular presentations on the impact of globalization on poverty are essentially those of correlation. Pro globalizes point to the large decline in poverty in China, India and Indonesia (countries long characterized by massive rural poverty) in the recent decades of international economic integration. Chen and Ravallion have estimated that between 1981 and 2001 the percentage of rural people living below an international poverty line of $1.08 per day (at 1993 purchasing power parity) declined from about 79 per cent2 to about 27 per cent in China, from about 63 percent to about 42 per cent in India, and 55 per cent to 11 per cent in Indonesia. But, contrary to repeated assertions in the international financial press, no one has yet convincingly demonstrated that this decline is mainly due to globalization. In China it could instead be, to a large extent, due to internal factors like expansion of infrastructure or the massive 1978 land reforms or policy changes relating to grain procurement prices or the relaxation of restrictions on rural-to-urban migration. That the spurt in agricultural growth following the 1978 de collectivization and land reform may be largely responsible for poverty reduction in China is suggested by the fact that the substantial part of the decline in poverty in the last two decades already happened by mid-1980's, before the big strides in foreign trade or investment3. Similarly, rural poverty reduction in India may be attributable to the spread of Green Revolution in agriculture, large anti-poverty programs or social movements in India, and not the trade liberalization of the

1990's (in fact as we'll discuss later, there is some evidence of trade liberalization slowing down poverty reduction in India). In Indonesia4 sensible macro-economic policies, an active rice price stabilization policy, massive investment in rural infrastructure, and the Green Revolution played a substantial role in the large reduction of rural poverty between 1981 and 2001 (note that by early 80's the oil boom was largely over and by 2001 the economy has not fully recovered from the financial crisis) (Bardhan, 2005:1393).

In many countries a majority of the small-scale producers are located in rural areas, absorbing workers when seasonal effects reduce agricultural employment (Liedholm and Mead 1987,p. 28). Underdevelopment also spawns small firms because Engel effects skew demand for manufactured products toward simple items like baked goods, apparel, footwear, metal products, and furniture.

All of these products can be efficiently produced using cottage technologies, so there is little incentive to consolidate production in several large plants and incur the extra distribution costs (Tybout, 2000:38).

Perhaps, the important of globalization effects is modern technology. This phenomenon is led to that the rural areas don't develop from other areas (Bahrami, 2003:8).

VI. UNEMPLOYMENT

Today's major question is of course massive underemployment (approximately six million people in France, if we include those, in increasing numbers, benefiting from basic social income). This massive underemployment completely distorts the distribution of incomes and considerably reduces social mobility and social advancement. It creates unacceptable insecurity, not only for those who do not have regular employment, but also for millions of others whose jobs are dangerously threatened. It gradually damages the social fabric. This situation is economically, socially and ethically unacceptable in all respects. This unemployment is the cause of the development of aggressive, violent and riotous criminality everywhere and the State no longer seems capable of guaranteeing the safety, of either material goods or of people, one of its major obligations. Extra-community immigration also undermines the very foundations of social cohesion, a major condition for the efficient and just functioning of the market economy (Tudaro, 2006:90). As a whole, this situation creates deep discontent everywhere and generates all the conditions that sometime in the future, will seriously compromise public order and even the survival of our society. The situation today is certainly more serious than in 1968 in France when unemployment, which was then less than 600,000, was practically inexistent but public order nevertheless almost collapsed.

Unemployment is a very complex phenomenon and has many different causes, which when analyzed can be classified for the most part into five fundamental factors:

1- Chronic unemployment caused on a national level, independent of external trade, by social protection procedures;

2- Unemployment caused by global free exchange and an international monetary system which generates imbalance;

3- Unemployment caused by extra-community immigration;

4- Technological unemployment;

5- Conjectural unemployment.

In fact, the major cause of unemployment today is the global liberalization of exchange in a world that is characterized by considerable disparities in real salaries. These adverse effects are aggravated by the system of floating exchange rates, the total deregulation of the movements of capital, and "monetary dumping" by many countries following undervaluation of their currencies. This unemployment of course has only been able to develop because of the existence of low salaries and insufficient flexibility in the labor market. But to neutralize the effects on unemployment of globalist free exchange and the factors that are associated with it, we would have to accept a considerable reduction of salaries for the least qualified workers. The effects of globalist free exchange are not only limited to a massive increase in unemployment. They also mean an increase in inequality, a progressive destruction of the industrial fabric and a considerable slowing-down in the increase of living standards

According to current opinion, unemployment in western economies is essentially the result of real salaries that are too high and insufficiently flexible, of the speed of technological progress in the information and transport sectors, and of a monetary policy that is judged to be unjustifiably restrictive. For all major international organizations, unemployment in developed countries is due to their inability to adapt to new conditions that are inevitably imposed on them by globalization. This adaptation demands that the cost of salaries be reduced, and particularly the salaries of the least qualified. According to all these organizations, free exchange is bound to create jobs and increase living standards. Competition from countries where salaries are low cannot be considered as a cause of growing unemployment and the future of all countries is conditioned by the international development of generalized free trade. In fact, these assertions have been constantly denied by economic analysis as well as by observation data. The reality is that globalization is the major cause of massive unemployment and inequalities that continue to develop in most countries.

Globalization of the economy is certainly very profitable for some privileged groups. But the interests of these groups cannot be identified with those of the whole of humanity. Hasty and anarchic globalization can only cause unemployment, injustice, disorder and instability everywhere, and in the end, will inevitably be a disadvantage for the whole of mankind. It is not inevitable, necessary or desirable. It would be conceivable only if it were preceded by world political unity, comparable development of different economies and the establishment of an appropriate world institutional and ethical framework, conditions that obviously are not and cannot be currently met.

For two decades, a new doctrine has gradually been imposed, the doctrine of globalist free exchanges, implying the disappearance of all obstacles to the free movement of goods, services and capital. According to this doctrine, the elimination of all obstacles to these movements was a necessary and sufficient condition for the optimal distribution of resources on a world scale.

In fact, the total liberalization of exchange and the movements of capital is only possible or desirable within the framework of regional entities which group together countries that are economically and politically associated, with comparable economic and social development, at the same time ensuring a market that is a wide enough to allow competition to develop efficiently and constructively (Behkish, 2011:98). Each regional organization must be able to set up, within an appropriate institutional, political and ethical framework, reasonable protection from the outside. This protection must have two objectives:

1- Avoid unwarranted distortion of competition and the adverse effects of external disruptions

2- make undesirable specializations impossible – specializations that unnecessarily cause imbalance and unemployment, a condition that totally opposes the establishing of a situation of maximum efficiency on a world scale and the international distribution of income that is commonly acceptable within a liberal and humanist framework.

VII. GLOBALIZATION EFFECTS IN STUDIED AREA

Totally, Kashmar villages were divided to section: mountainous and flat. After that the researcher used from questionnaire between residents. For analyzing, at first was considered descriptive information and in second step was used distribution graph. At finally by using Pierson correlation test and Spearman correlation test was calculated relation between globalization and rural Inequality. In this case study, relation between globalization and rural inequality was positive.

7.1. Correlation test

If "P" is Coefficient correlation between globalization and rural economic inequality, the hypotheses will be following:

H0: P=0

H1: $P \neq 0$

Finding shows the meaningful level is 0.05 (α =0.05) by analyzing coefficient correlation and sample size . So, in this level H0 are deleted. Therefore, there is oriented relation between globalization and economic rural inequality. Table 3 shows the results.

Table3: factors of correlation test between globalization and rural economic inequality

Test / Variable	Pierson		Spearman	
	R	P	rs	-P
Globalization score	0.834	0.000	0.632	0.000
rural economic inequality score				

Source: researcher studied

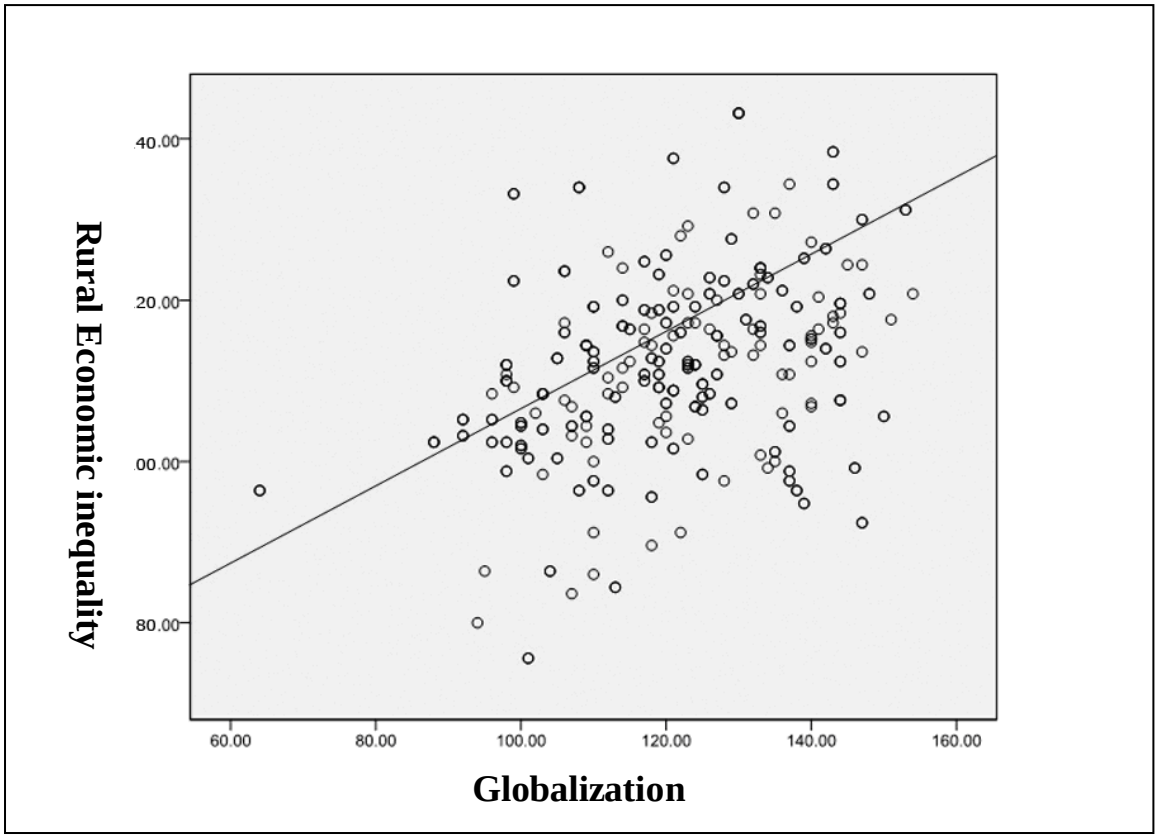

Figure 1: distribution between globalization and rural economic inequality

The graph shows sharp growth. Thus, there is positive correlation between globalization and rural economic inequality.

7.2. Correlation test between rural industry inequality & globalization

If "P" is Coefficient correlation between globalization and rural industry inequality, the hypotheses will be following:

H0: P=0

H1: P ≠ 0

Finding shows the meaningful level is 0.05 (α =0.05) by analyzing coefficient correlation and sample size . So, in this level H0 are deleted. Therefore, there is oriented relation between globalization and industry rural inequality. Table 3 shows the results.

Table4: factors of correlation test between globalization and rural industry inequality

Test / Variable	Pierson		Spearman	
	R	P	rs	-P
Globalization score / rural industry inequality score	0.617	0.000	0.587	0.000

Source: researcher studied

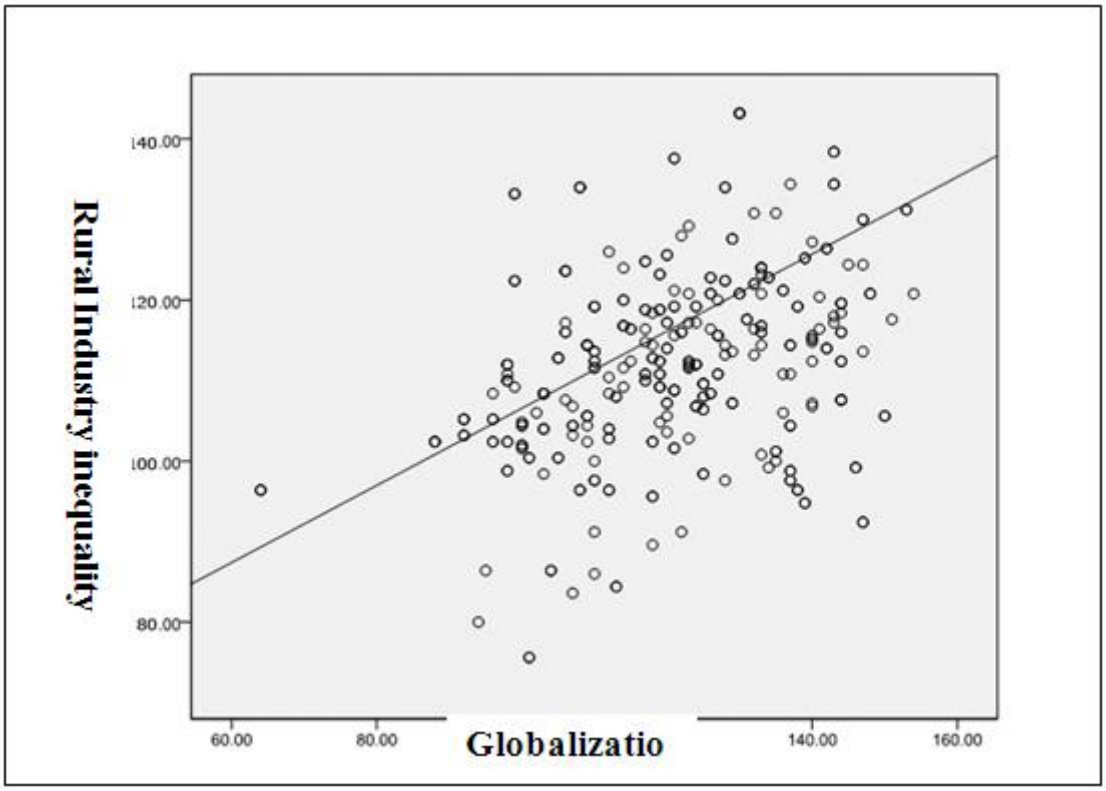

Figure 2: distribution between globalization and rural industry inequality

The graph 2 shows sharp growth. Thus, there is positive correlation between globalization and rural industry inequality.

7.3. Correlation test between rural agriculture inequality & globalization

If "P" is Coefficient correlation between globalization and rural agriculture inequality, the hypotheses will be following:

H0: P=0

H1: P ≠ 0

Finding shows the meaningful level is 0.05 (α =0.05) by analyzing coefficient correlation and sample size. So, in this level H0 are deleted. Therefore, there is oriented relation between globalization and rural agriculture inequality. Table 3 shows the results.

Table5: factors of correlation test between globalization and rural industry inequality

Test / Variable	Pierson		Spearman	
	R	**P**	**rs**	**-P**
Globalization score	0.810	0.000	0612	0.000
rural agriculture inequality score				

Source: researcher studied

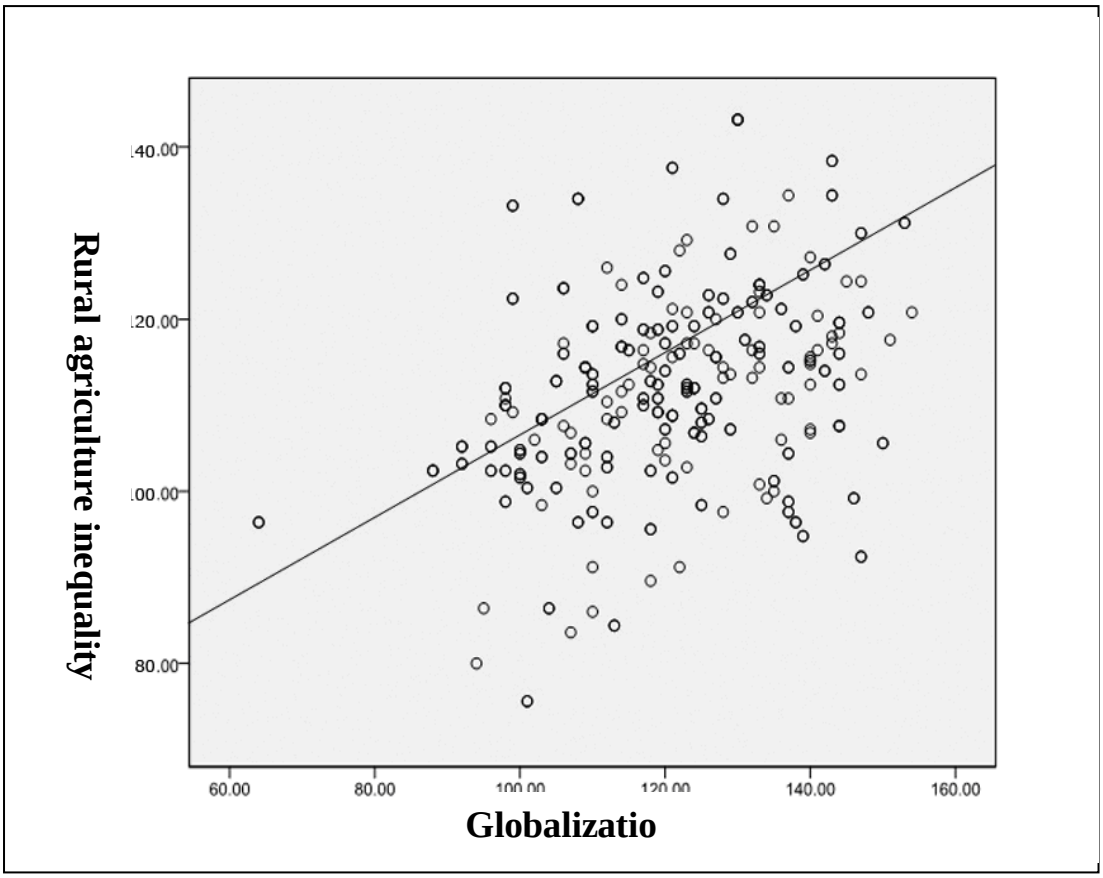

Figure 3: distribution between globalization and rural agriculture inequality

The graph 3 shows sharp growth. Thus, there is positive correlation between globalization and rural agriculture inequality.

VIII. RESULTS

According to finding, there are effects of globalizations on studied area. Also, these effects was analyzed in 3 three aspect. They are economic, industry and agriculture. After Islamic revolution, farmer use from mechanical machines more than other time. Therefore there is relation between rural agriculture and globalization due to should be purchased from foreign market. Although, these relation isn't bad, but was led to appearing unemployment in developing countries (studied area).unemployment was led to migration to cities and increasing poverty in villages.

In last decades, the rural resident produced their needs themselves. Unfortunately, with globalization effect rural industry was weak. Therefore, this phenomenon created unemployment and inequality in villages.

In general the debates on globalization often involve a clash of counterfactuals. On one side those who are against the pace of business-as-usual global trade and investment are making a plea for doing something about the jobs and entrepreneurial opportunities for the poor and for small enterprises that are being wiped out, and against the monopolistic practices of giant multinational companies and the environmental damages caused by the economic expansion. So their counterfactual is the world of more social justice and less dominant trading and investment companies, which gives some more breathing space to the poor producers and workers.

8.1 Suggestions

There are some suggestions in order to improving villages condition against globalization .they are:

- paying attention to agriculture as the most important producer in international levels.
- identifying agricultural potential in countries
- using from native agriculture productions such as dung, spawn and etc.
- creating relation between academic centers and universities with native agriculture in order to decreasing globalization effects.
- paying attention to rural industries.
- Support of government from little rural industries.

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Power Improvement of Transmission Line Using High Voltage Direct Current (Hvdc) Transmission System

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Abstract: - The use of long EHV (Extremely High Voltage) ac lines for the transmission of electrical energy increases the line reactance and susceptance which limits the thermal loadings on the line in order to keep sufficient margin against transient instability. With the scheme proposed in this paper, it is possible to load the lines very close to their limit with zero reactance and susceptance. The conductors are allowed to carry usual ac along with dc superimposed on it. The added dc power flow does not cause any transient instability.
The scheme comprises a twelve-pulse bridge rectifier, dc-links, pulse width modulated (PSW)-voltage sourced inverter (VSI) and converter transformers. The master current controller is used to implement the scheme which senses ac current and regulates the dc current orders for converters online such that conductor current never exceeds its thermal limit.
This paper gives the feasibility of converting a double circuit ac line into composite ac–dc power transmission line given the advantage of stability improvement, damping oscillations, voltage stabilization and reactive power compensation for ac weak buses.
Simulation and experimental studies using MATLAB (Matrix Laboratory) are carried out for the coordinated control as well as independent control of ac and dc power transmissions.

Keywords: - *Transmission System, Transient Stability, High Voltage Direct Current, Reactive Power, Damping Oscillation, Pulse Width Modulation, Voltage Source Inverter*

I. INTRODUCTION

Electric energy is the most popular form of energy, because it can be transported easily at high efficiency and reasonable cost (Saadat, 1999). The basic function of a transmission system is to transfer electrical power from one place to another or from one network to another network (Gupta, 2005). For transmitting power over very long distances it may be more economical to convert the EHV-ac to HVDC (High Voltage Direct Current), transmit the power over two lines, and invert it back to ac at the other end. Studies show that it is advantageous to consider dc lines when the transmission distance is 500km or more (Saadat, 1999). Dc lines have no reactance and are capable of transferring more power for the same conductor size than ac links. The dc transmission tie line acts as an asynchronous link between the two rigid system eliminating the instability problem inherent in the ac links (Saadat, 1999).

During the past two decades, utilities have been trying to compensate for the varying load conditions (Johnson et al., 1972 ; Gyugyi et al., 1976), enhance and control transmission lines power transfer capacity (Czech et al., 1980), improve power system transient and dynamic stabilities (Olgward et al., 1980; Sharaf et al., 1985; Xing et al., 1988) using voltage regulators, power factor correction capacitors and static reactive power compensators.

The limitations of a mono-polar dc transmission with ground as return path result to high amount of dc voltage which require more discs added to the insulator string to withstand the increased voltage.
In this paper, the feasibility study of conversion of double circuit ac line to composite ac –dc line without altering the original line conductors, tower structures, and insulator strings has been presented.

II. POWER IMPROVEMENT OF TRANSMISSION LINE USING HVDC TRANSMISSION

A. Configuration

The configuration shown in figure 1 consists of ac filters , transformer, converters, phase reactors, dc filters capacitor

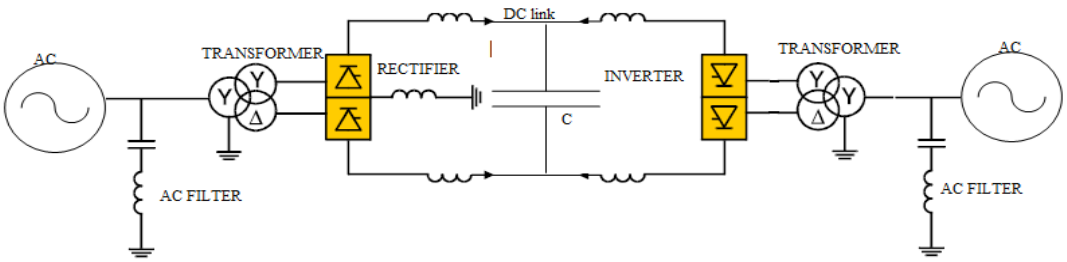

Figure 1: Configuration of the transmission using HVDC system

B. Components and its Operation

This scheme is based on the voltage source converter (VSC), where the valves are built by IGBT (Insulated Gate Bipolar Transistor) and PWM (Pulse Width Modulation) is used to create a desired waveform. The main function of the VSC-HVDC is to transmit constant dc power from the rectifier to the inverter.

i. Converters

The converter is a 12-pulse double bridge converter which consists of two 6-pulse bridge converters connected in series and employs IGBT power semiconductors, one operating as a rectifier and the other as inverter.

ii. Transformers

The converters are normally connected to the ac system via the transformers. The most important function is to transform ac voltage to a value suitable for the converter.

iii. Phase reactors

The phase reactors are used for controlling both the active and reactive power flow by regulating current through them. It can also function as ac filters to reduce harmonic contents as a result of switching.

iv. AC filters

The output of AC voltage contains harmonic components. These harmonics have to be removed to prevent them from being emitted into the ac system and causing equipment malfunctioning or radio and telecommunication interference. High –pass filters are installed to mitigate the harmonics.

v. DC capacitors

The objective of the dc capacitor is to provide a low inductive path for the turned off current and energy storage to be able to control the power flow. It also reduces the ripples on the dc side. The size of the capacitors depends on the required dc voltage.

vi. AC source

Ideally the ac source model can be developed by using the thevenin's equivalent circuit. However, for simplicity, the source was modelled using ideal symmetrical three-phase voltage. (Shri harsha et al., 2012)

III. CONTROL DESIGN OF DC TRANSMISSION

The current flowing in the dc transmission is determined by the dc voltage difference between the two converter stations.

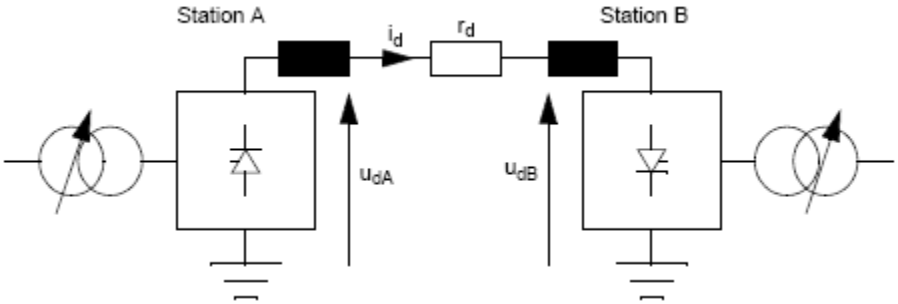

Figure 2: Control design of DC transmission

Using the notation shown in figure 2, where *rd* represents the total resistance of the line, we get for the DC current

$$i_d = \frac{u_{dA} - u_{dB}}{r_d} \qquad \text{(i)}$$

Where u_{dA} = dc voltage at station A
u_{dB} = dc voltage at station B

and the power transmitted into station B is

$$p_d = u_{dB} \cdot i_d = u_{dB} \cdot \frac{u_{dA} - u_{dB}}{r_d} \qquad \text{(ii)}$$

IV. MASTER CONTROL SYSTEM

The rectifier controls the dc voltage and the inverters controls the active power while the reactive power cannot be independently controlled. The PWM technology makes it possible to control the reactive power and the active power independently.

The master control, however, is usually designed with specification depending on the requirements of transmission. The control can be designed for constant current or constant power transmitted, or it can be designed to help stabilize the frequency in one of AC networks by varying the current of active power transmitted. The master control is only active in a station selected to act as the master station, which controls the current command. In order to synchronize the two converters and assume that they operate with the same current command, a telecommunication is required. The telecommunication system should be fault-free to avoid the current command to both converter station from been frozen. It is equipped with an IEEE type AC 4A excitation system of which block diagram is shown in Figure 3. Transmission lines are represented as the Bergeron model. It is based on a distributed LC parameter travelling wave line model, with lumped resistance. It represents the L and C elements of a PI section in a distributed manner.

A master current controller (MCC), shown in Figure 4, is used to control the current order for converters. It measures the conductor ac current, computes the permissible dc current, and produces dc current order for inverters and rectifiers.

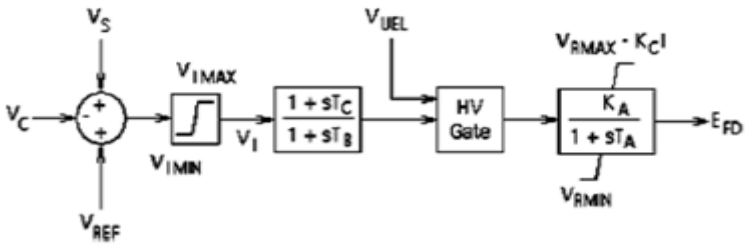

Figure 3: IEEE type AC4A excitation system

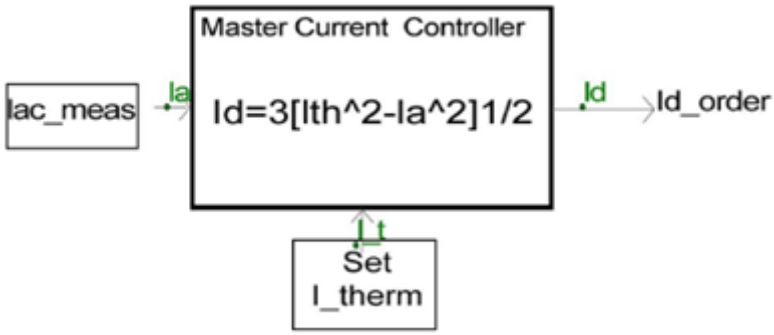

Figure 4: Master current controller

V. SIMULATION AND RESULTS

A. Simulink model

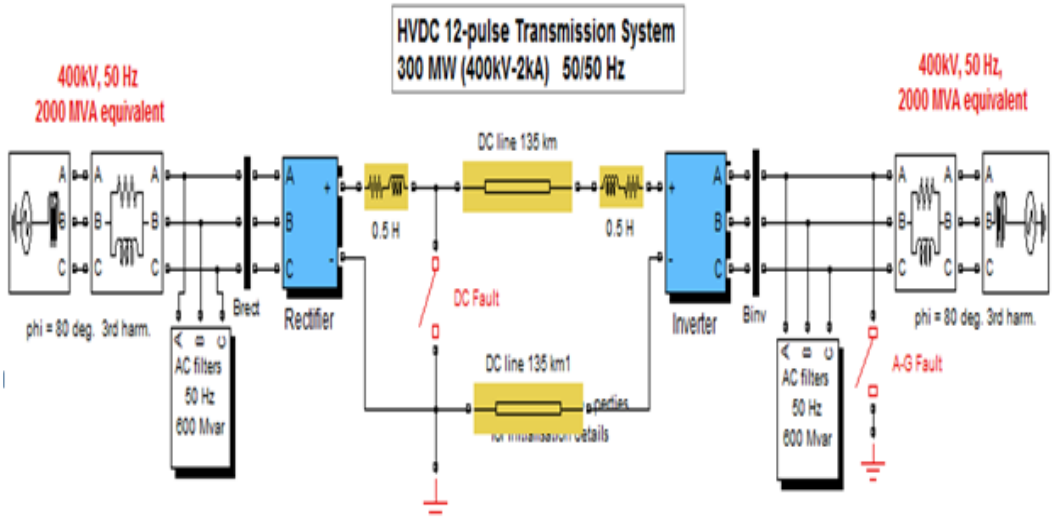

Figure 5: Simulink model of the scheme

B. System description

A 300MW (150kV) force commutated VSC is used to transmit dc power from a 400kV ,2000MVA, 50Hz system to another ac system. The rectifier and the inverter are connected through a 125km line (i.e. distributed parameter line) and two 8mH phase reactors. The sinusoidal pulse width modulation switching uses a frequency 27 times the fundamental frequency (1350Hz). A converter transformer (Y/D) is used to permit the optimal voltage transformation.

To meet ac system harmonic specifications, ac filters form an essential part of the scheme. They can either be connected on the ac system side or the converter side of the converter transformer.

C. Design procedure

The rectifier and inverter are the three level of VSC that use the IGBT/diode module available in the MATLAB/Simulink/ Simpower system. The design procedure is:

DC voltage rating: 150kV

System frequency: 50Hz

Source AC voltage: 400kV

$$\text{Rated DC current} = \frac{\text{Rated DC power}}{\text{Rated DC voltage}} = \frac{300\text{MW}}{150\text{kV}} = 2\text{kA} \qquad \text{(iii)}$$

D. AC system modelling

A simple three phase AC source is used to model the AC system with internal resistance and inductance that is calculated from short circuit level MVA calculations.

Source AC voltage: 400kV (phase to phase)

System frequency: 50Hz
Source inductance from MATLAB = 0.2546H

$$\frac{X}{R} = 10 \quad \text{(iv)}$$

$X = 2\pi fL = 2\pi \times 50 \times 0.2546 = 80\Omega$
$R = 8\Omega$

E. Transformer design

A star/ delta transformer is used to permit the optimal voltage transformation. It also functions to block triplen harmonics produced by the converter.
The following data are used for the transformer:
Nominal power:
Nominal frequency:
Winding 1: Y connected
Nominal voltage: 400kV x 0.915 = 366kV
Resistance: 0.0025pu
Leakage reactance: 0.0075pu
Winding 2: D connected
Nominal voltage: 150kV
Resistance: 0.0025pu
Leakage reactance: 0.075pu
Magnetising losses: resistive = 500pu, inductive = 500pu

F. Filter design

The Three-Phase Harmonic Filter is built of RLC elements. The resistance, inductance, and capacitance values are determined from the filter type and from the following parameters: Reactive power at nominal voltage Tuning frequencies Quality factor. The quality factor is a measure of the sharpness of the tuning frequency. It is determined by the resistance value. The filter is made up of passive R, L, C components their values can be computed using specified nominal reactive power, tuning frequency and quality factor.
Nominal voltage: 150kV
Nominal frequency: 50Hz
Nominal reactive power: 25% of real power (300MW) 78.5MVar
Tuning frequency: 27 * 50 and 54 * 50
Quality factor: 15
(Shri harsha et al., 2012)

G. Simulation results

A. System's performance under Normal starting operation

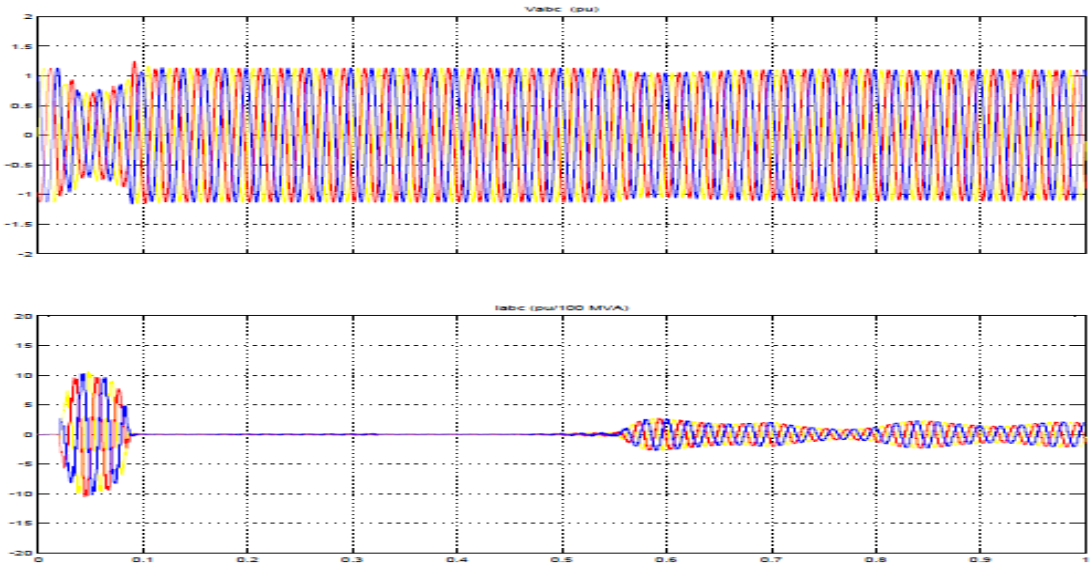

Figure 6. AC Rectifier terminal voltage and current under normal operating conditions.

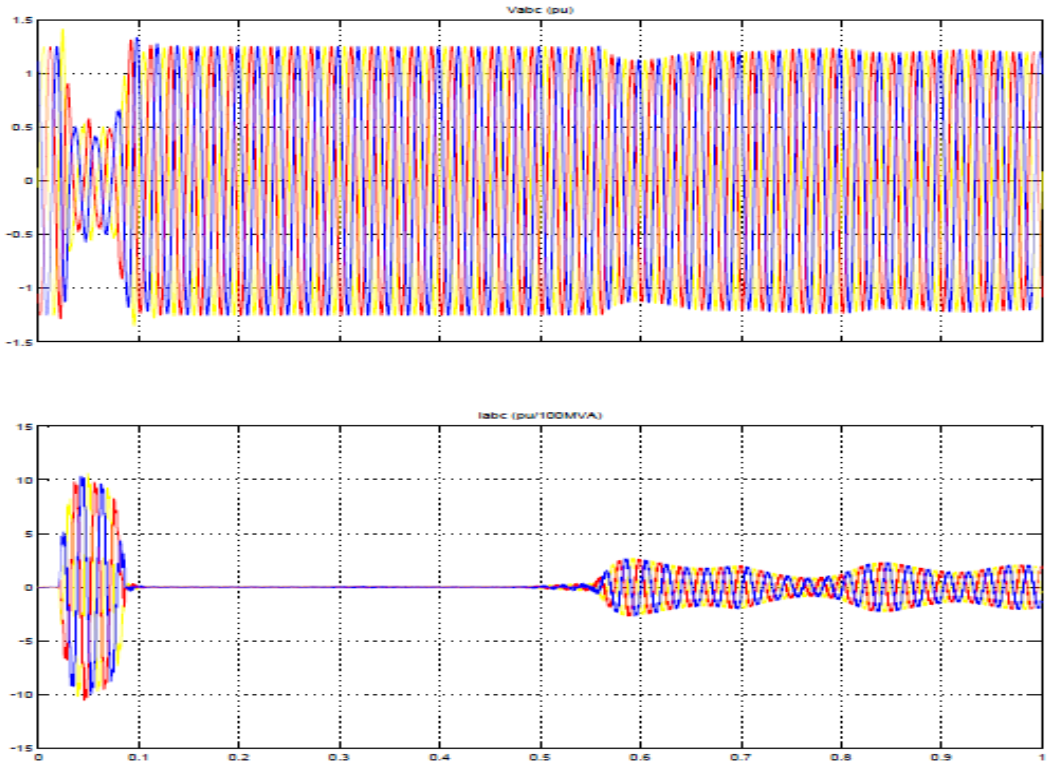

Figure 7: AC Inverter terminal voltage/current under normal operating conditions

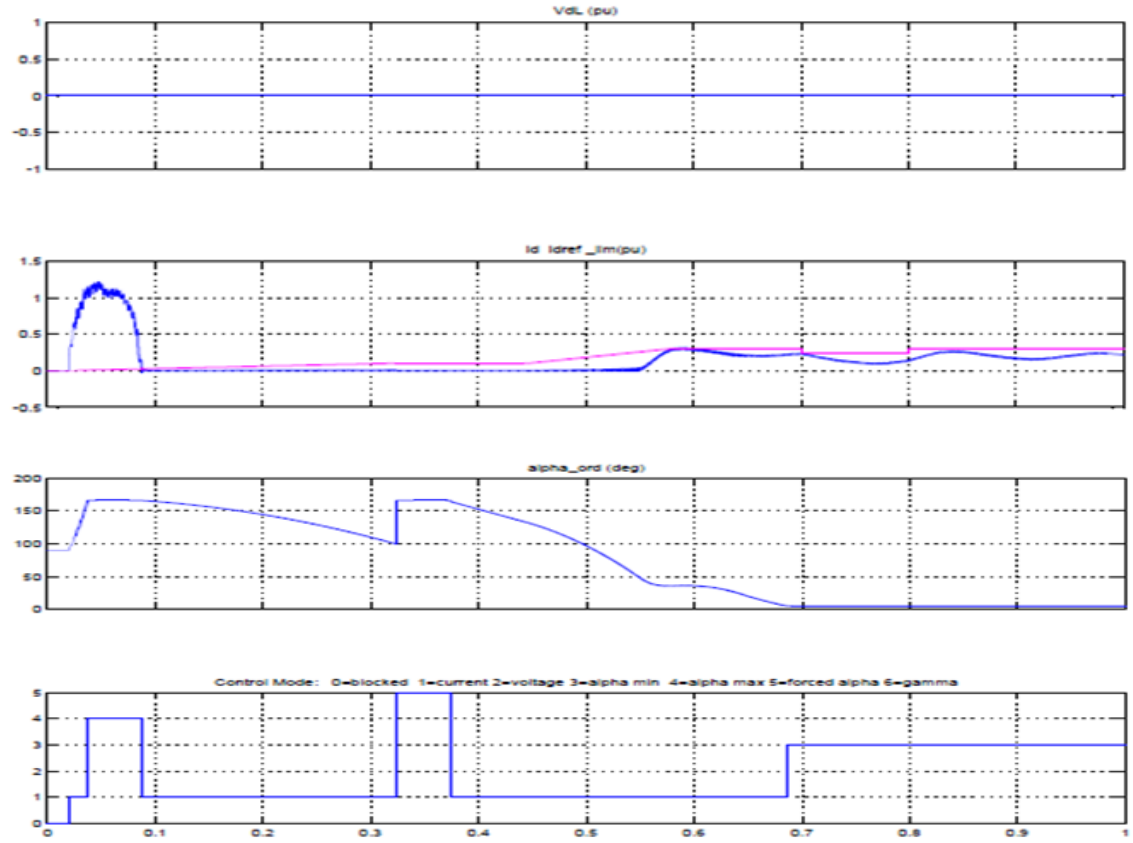

Figure 8: Rectifier current and voltage reference when steps is applied under normal operating conditions

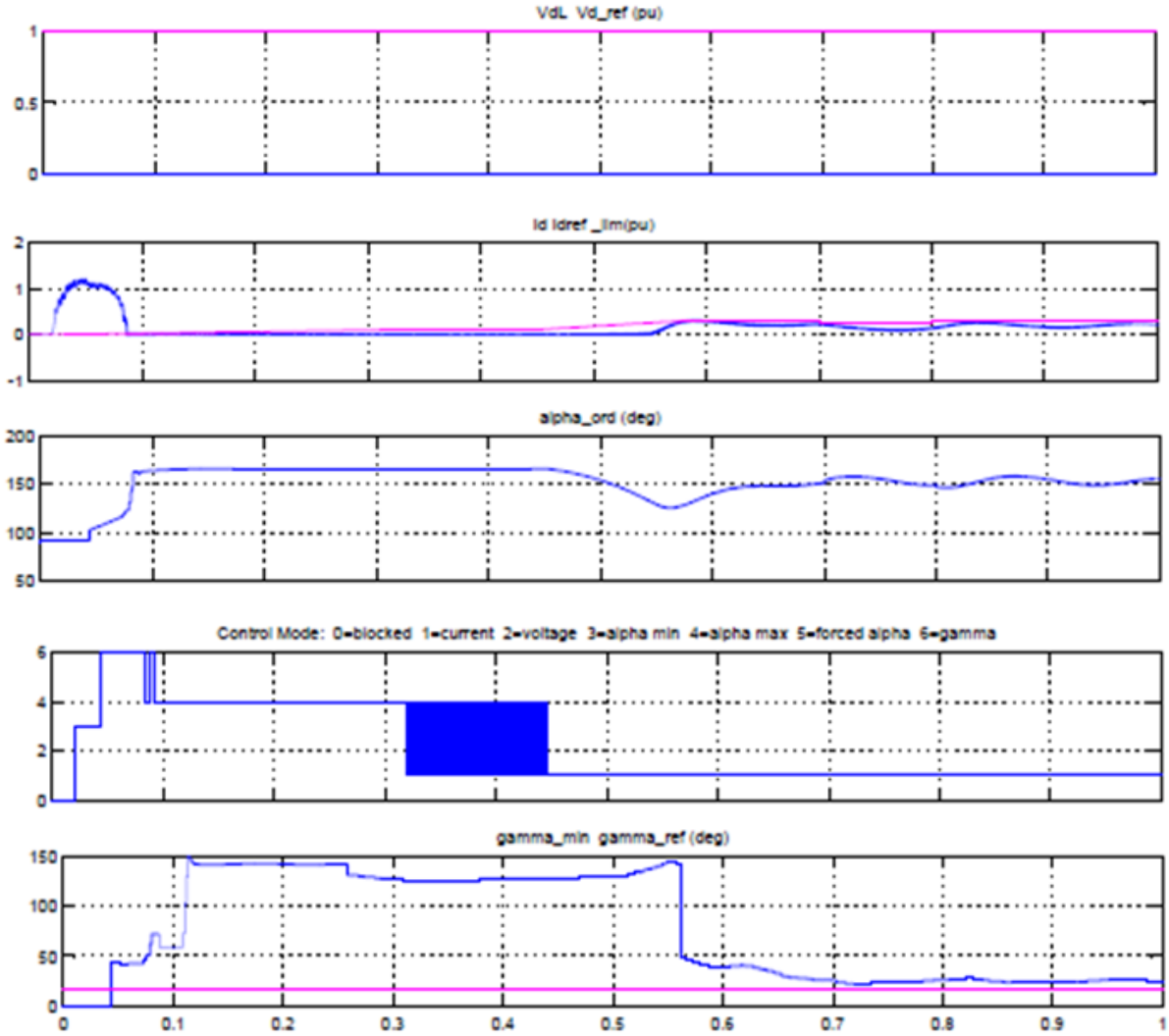

Figure 9: Inverter current and voltage reference when a step is applied under normal operating Conditions.

B. System performance under improvement

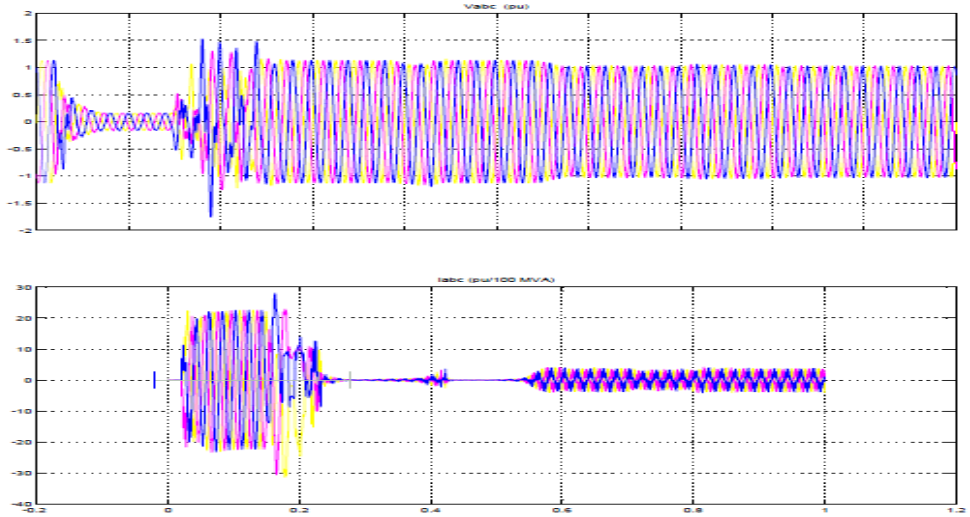

Figure 10: Rectifier voltage-current behaviour under improvement.

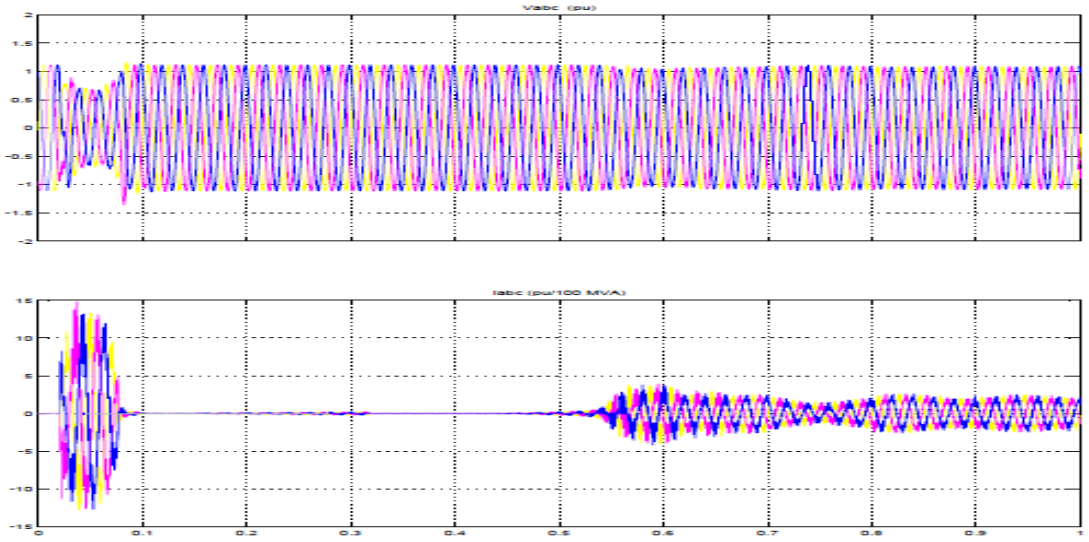

Figure 11: Inverter voltage-current behaviour under improvement

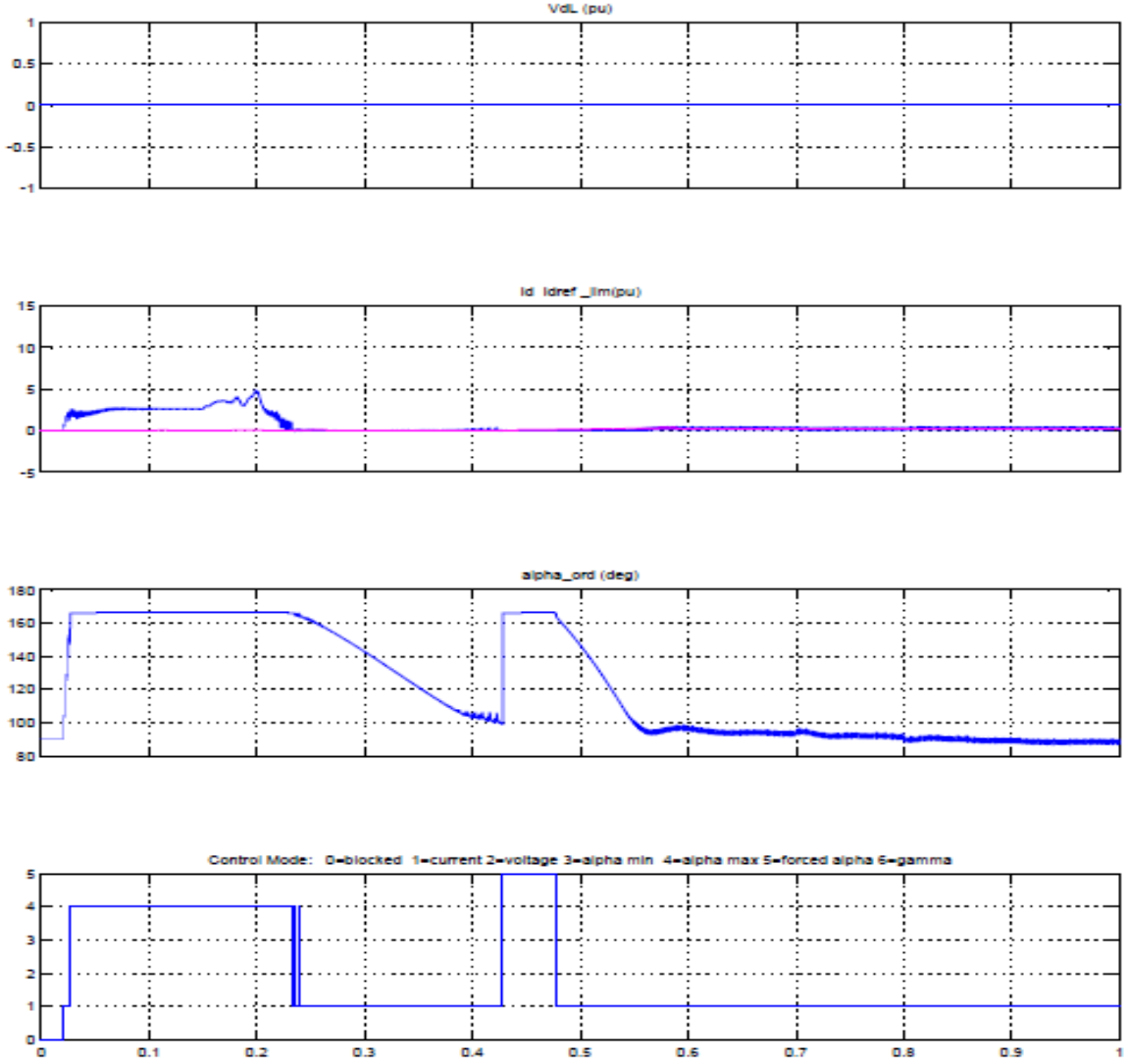

Figure 12: Rectifier current and voltage reference under improvement

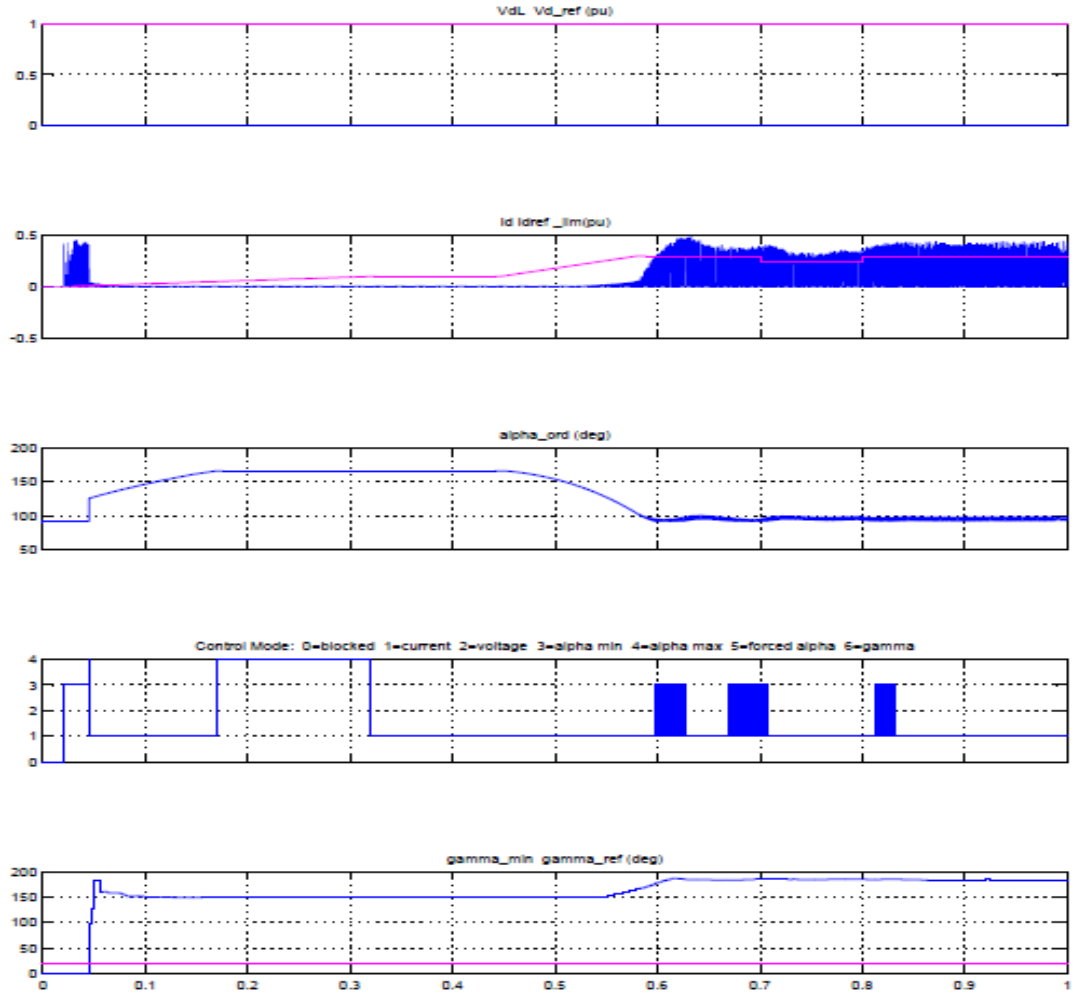

Figure 13: Inverter current and voltage reference under improvement

H. Result Discussion

A. Discussion of Result for normal operation

Under normal operating condition, figure 6 to figure 9 reveals the responses at different parts of the system. Figure 6 shows the p.u three phase voltage and current of the AC Rectifier while figure 7 indicates the three phase voltage and current of the AC inverter after completing the conversion process. The result shows a normal waveforms of a rectifier and inverter under normal operation condition without any conditioning.

When a step is applied first to the reference current and later to the voltage reference, the resulting waveform of the dynamic response of the regulators is shown in Figure 8 and figure 9. The rectifier controls the current and the inverter controls the voltage. Trace 1 of both Figure 8 and figure 9 shows the DC line voltage (1 pu = 330 kV). At the inverter, the voltage reference is also shown. Trace 2 shows the reference current and the measured Id current (1 pu = 2 kA). During the ramp, the inverter is actually controlling the current (Trace 4: Mode = 1) to the value of Id_ref_lim less the Current Margin (0.1 pu) and the rectifier tries to control the current at Id_ref_lim. At the inverter, the control mode changes from current control to gamma control (Mode = 6) before stabilizing to voltage control (Mode = 2) at t = 0.3 s. The rectifier becomes thereafter in control of the current. However, a control mode change will occur and alpha is limited to the minimum value of 5 degrees (Mode = 3) during an increase of the DC voltage initiated by a voltage reference increase at the inverter. At steady state, the α firing angles are around 16.5 degrees and 143 degrees respectively on the rectifier and inverter side. At the inverter, two Gamma Measurement blocks measure the extinction angle γ for each thyristor of the two six-pulse bridges by determining the elapsed time expressed in electrical degrees from the end of current conduction to the zero crossing of the commutating voltage. The mean value of the measured gamma for the last 12 extinctions (6 of the Delta converter and 6 of the Wye converter) is shown in traces 5 along with Gamma reference. In steady state, the mean γ is around 22.5 degrees.

B. Discussion of Result under improvement

The performance of the system is analysed under improvement when the lines are loaded beyond their thermal and the response of the system is given in figure 10 to figure 13. Figure 10 shows the voltage-current behaviour of the Rectifier under improvement and it shows the transient stability of the system has shifted from -0.2 and 0. 2 seconds under normal condition to 0.2 and 0.6 seconds when improved.

Figure 11 responses remain the same as when operating under normal operating condition but with a slight shift from 0 to 0.01 seconds indicating that when loaded beyond the thermal limit, the effect is minimal in the inverter station compared to the rectifier station.

Figure 12 and figure 13 shows the reference voltage and current when steps are applied under loading conditions. Figure 12 reveals that the rectifier at t = 0.24s, controls the current. The control mode change will occur and the alpha is limited to minimum value during the increase in DC voltage initiated by a voltage reference increased at the inverter. The control mode changes from current control to gamma control before stabilizing the voltage control at t = 0.05s. The extinction angle reaches the reference value and the gamma regulator takes control at t = 0.25s. At t = 0.55s the voltage regulator retakes control of the voltage as seen in figure 13.

It can also be observed that with the configuration used, the reactive power at the sending end was minimised while the receiving end voltage was maintained without any compensation.

VI. CONCLUSION

This paper presents a feasibility of a steady-state stability performance of dc Transmission and the system studied shows there is a substantial increase in the load ability of the line. The line is loaded to its thermal limit with the superimposed dc current. The dc power flow does not impose any stability problem. The advantage of parallel ac–dc transmission is obtained.

It can be concluded that the system response is fast; high quality ac voltages and ac currents can be obtained at the receiving station; the active and reactive power can be controlled independently. The scheme also ensures that the receiving voltage can be maintained without compensation.

This scheme can also be tailored to a multitude of applications depending on the control strategy selected. The knowledge obtained from this simulation can be used to predict the characteristic behaviour and the performance of the real system.

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Research Paper Open Access

"Simulation of Active and Reactive Power Control of DFIG"

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Abstract: - The penetration of wind energy generation units into existing electrical power system network is In creasing rapidly during recent years. The number of Doubly-Fed Induction Generator (DFIG) has grown over the last few years in several countries as a result of the tremendous increase in wind power generation. They use electronic converters in order to operate at different speeds. This converter system decouples the electrical and mechanical behavior of the generator from the grid voltage and frequency. The generator is fully decoupled from the grid by the power converter; therefore the power factor of the generator does not affect the reactive power factor at the grid connection. The behaviour of the DFIG has been modelled in the dedicated power electronics and system simulation tool PSCAD/EMTDC. This paper presents a model through which steady-state behaviours of a Doubly-Fed Induction Generator (DFIG) can be simulated for analytical studies. It presents the complete picture of the independent control of active power and reactive power using the decoupled control.

Keywords: - *DFIG, PSCAD, Vector control, FOC, back-to- back connected converters.*

I. INTRODUCTION

Advances in technology have changed the world into a place with better living standards and higher consumer expectations than ever before. For sustaining this trend, worldwide, the need is for maintaining an increased and continual supply of energy amidst the depletion of finite fossil fuel reserves at an alarming rate. Amongst the available types of wind turbine generators, Doubly-Fed Induction Generator (DFIG) is gaining more attention and application in wind energy systems due to its ability to extract maximum power. This is because of its unique ability of varying its rotor speed to match the wind velocity.

The main advantages of DFIG are as follows [1]:

1. Independent control of stator side active and reactive power is possible; hence power factor can be controlled.
2. Ability to supply power at constant voltage and frequency while the rotor speed varies.
3. Lower power rating of power electronic converters is required because the converters handle a fraction (20% to 30%) of total power i.e. the slip power.
4. Rotor speed may vary according to wind speed in order to improve wind generator efficiency.
5. Mechanical stress is reduced as well as torque oscillations are not transmitted to the grid; gusts of wind can be absorbed as energy is stored in the mechanical inertia of the turbine.

The main disadvantages of DFIG are [1]:

1. Control is more complicated.
2. Cost is more as more electronic components are used.
3. Use of slip rings induction machine may result into increase of maintenance.

II. MACHINE DESCRIPTION

The DFIG would generate the electrical energy if driven at a speed greater than its synchronous speed. But the rotor would absorb the electrical power from the system at lesser speed than its synchronous speed. The generated voltage frequency is directly proportional to the difference in two frequencies, known as slip frequency. The slip frequency is transformed to grid frequency before the generated power is taken to the grid. The stator is normally connected directly with the supply grid. The rotor is then supplied using a frequency converter. A part of the developed model in PSCAD is shown in Figure 1.

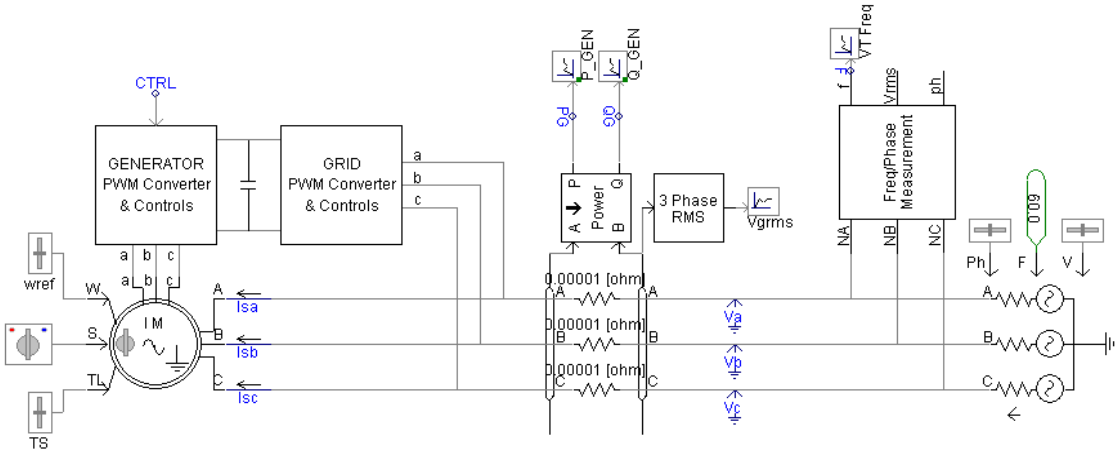

Figure 1 Model of DFIG in PSCAD

The back-to-back connected converters are able to transfer energy in both directions enabling them to work as a rectifier or as an inverter [2]. The net power output is a combination of the power of the machine's stator and the rotor through the converter. Using a proper field orientation, the stator and rotor currents can be decomposed into a flux producing component and torque producing component and these two components are then controlled independently. The rotor-side converter is used to optimize the power generation and improve the stability and stator-side converter maintains a constants voltage on the DC link with a desired power factor, regardless of the magnitude and direction of the power [2]. Generally field orientation can be classified into stator air-gap flux and rotor flux orientation. In order to achieve the independent control of the active and reactive power flowing between the grid and converter, stator flux vector is aligned with d-axis.

III. MATHEMATICAL MODEL

It is well known that a DC drive has excellent dynamic performance, as it is possible to decouple the stator magnetic flux and electromagnetic torque of the drive. The vector control, also known as Field Orientation Control (FOC), of induction machines emulates the DC drive control. In this section a dynamic model of DFIG and its control have been presented using the generator convention. The DFIG modelling and control have been carried out in the well known coordinate systems using Park's transformation for both three-phase to two-phase and two-phase to three-phase axes transformation. The stator and rotor windings of a three-phase induction machine are represented by two sets of orthogonal fictitious coils [4, 5]. The model is based on the commonly known as 'Park model'.

The equivalent circuit of a DFIG in an arbitrary reference frame rotating at synchronous speed is shown in Figure 2.

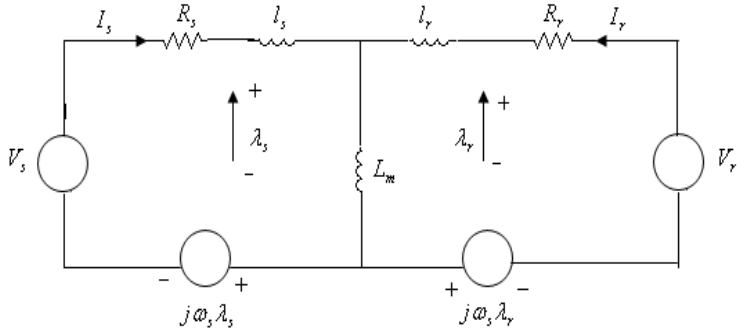

Figure 2 Equivalent circuit of DFIG in an arbitrary reference frame rotating at synchronous speed

According to the Figure 2, the stator and rotor fluxes λ_s and λ_r are represented by equation (1) [3].

$$\left.\begin{aligned}\lambda_s &= (l_s + L_m)i_s + L_m i_r = L_s i_s + L_m i_r \\ \lambda_r &= (l_r + L_m)i_r + L_m i_s = L_m i_s + L_r i_r\end{aligned}\right\} \quad (1)$$

The stator and rotor voltage in reference frame are expressed by equation (2).

$$\left.\begin{aligned}V_s &= R_s i_s + j\omega_s \lambda_s + \frac{d\lambda_s}{dt} \\ V_r &= R_r i_r + j(\omega_s - \omega_r)\lambda_r + \frac{d\lambda_r}{dt}\end{aligned}\right\} \quad (2)$$

The above set of equations for stator and rotor voltages in d-q coordinates can be written as shown in equation (3).

$$\left.\begin{aligned}V_{ds} &= R_s i_{ds} - \omega_s \lambda_{qs} + \frac{d\lambda_{ds}}{dt} \\ V_{qs} &= R_s i_{qs} + \omega_s \lambda_{ds} + \frac{d\lambda_{qs}}{dt} \\ V_{dr} &= R_r i_{dr} - s\omega_s \lambda_{qr} + \frac{d\lambda_{dr}}{dt} \\ V_{qr} &= R_r i_{qr} + s\omega_s \lambda_{dr} + \frac{d\lambda_{qr}}{dt}\end{aligned}\right\} \quad (3)$$

The subscripts d and q indicate the direct and quadrature axis components of the reference frame, where s and r represent stator and rotor quantities, respectively. The decomposition into d-q coordinate systems is required for the control.

The equations for active and reactive power in d-q axes are expressed by equation (4).

$$\left.\begin{aligned}P_s &= V_{ds} i_{ds} + V_{qs} i_{qs} \\ Q_s &= V_{qs} i_{ds} - V_{ds} i_{qs}\end{aligned}\right\} \quad (4)$$

Normally a medium to high power generator is used in wind farms; therefore the stator resistances can be neglected. The stator voltage along d-q axis from equations (3) will reduce to equation (5).

$$\left.\begin{aligned}V_{ds} &= -\omega_s \lambda_{qs} + \frac{d\lambda_{ds}}{dt} \\ V_{qs} &= \omega_s \lambda_{ds} + \frac{d\lambda_{qs}}{dt}\end{aligned}\right\} \quad (5)$$

In vector control method, which is used to achieve independent control of active and reactive power, the stator flux vector is aligned with d- axis which gives the following equation (6).

$$\left.\begin{aligned}\lambda_{ds} &= \lambda_s = L_s i_{ds} + L_m i_{dr} \\ \lambda_{qs} &= L_s i_{qs} + L_m i_{qr} = 0\end{aligned}\right\} \quad (6)$$

The stator voltage in DFIG, which is a variable-speed constant-frequency generator, remains constant. Moreover the three-phase sinusoidal voltage is transformed into d-q synchronous reference frame. This gives the relation as shown in equation (7).

$$\left.\begin{aligned} V_{ds} &= 0 \\ V_{qs} &= V_s \end{aligned}\right\} \qquad (7)$$

From equations (4), (6) & (7), the stator active and reactive power can be obtained as shown in equations (8) & (9) respectively.

$$P_s = V_s \frac{L_m}{L_s} i_{qr} \qquad (8)$$

$$Q_s = \frac{V_s \lambda_s}{L_s} - \frac{V_s L_m}{L_s} i_{dr} \qquad (9)$$

From equations (8) & (9), it can be concluded that the delivered power depends directly on the d-q components of rotor currents except that for the reactive power there is second term, which represents power needed to magnetize the machine.

Using transformed axes, the rotor currents (i_{ra}, i_{rb}, i_{rc}) of the machine are resolved into direct and quadrature components idr and i_{qr}. The component i_{dr} produces a flux in the air gap, which is aligned with the rotating flux vector linking the stator; whereas the component i_{qr} produces flux at a right angle to this vector. Once the stator flux vector is aligned with d-axis, the component i_{dr} then controls the reactive power entering the machine. In order to calculate the stator flux linkage vector in the rotor reference frame, its value in the stationary frame is estimated first. It is then transformed into the rotor α-β frame using the rotor position. In the stationary reference frame, the stator flux linkage λ_s is estimated as shown in equation (10) [2]

$$\lambda_s = \int (V_s - I_s R_s) dt \qquad (10)$$

Since the stator voltage V_s is relatively free of harmonics and its frequency is fixed, the above equation will provide an accurate estimation of the stator flux. The correct values of i_{dr} and i_{qr} in the rotor are achieved by generating the corresponding phase currents references $i_{ra\text{-}ref}$, $i_{rb\text{-}ref}$, $i_{rc\text{-}ref}$ and then using a Voltage Source Converter (VSC) based current source to force these currents into the rotor. The latter action is achieved using Current-Reference Pulse Width Modulation (CRPWM). The crucial step is to obtain the instantaneous position of the rotating flux ($Ø_s$) in space in order to obtain the rotating reference frame. This is achieved by realizing that on account of Lenz's law of electromagnetism, the stator voltage (after subtracting resistive drop) is simply the derivative of the stator flux linkage λ_s as in equation (10).

The location of the rotating flux vector ($Ø_s$) is found using the control structure in Figure 3. The three phase stator voltages (after removal of resistive voltage drop) are converted into the Clarke (α-β) components V_α and V_β which are orthogonal in the balanced steady state. This transformation is explained in the previous chapter. Integrating V_α and V_β, we obtainλ_α and λ_β, the Clarke components of stator flux. Converting to polar form gives equation (11).

$$|\lambda| = \sqrt{\lambda_\alpha^2 + \lambda_\beta^2} \qquad \text{and} \qquad \phi_s = \tan^{-1}\left(\lambda_\beta / \lambda_\alpha\right) \qquad (11)$$

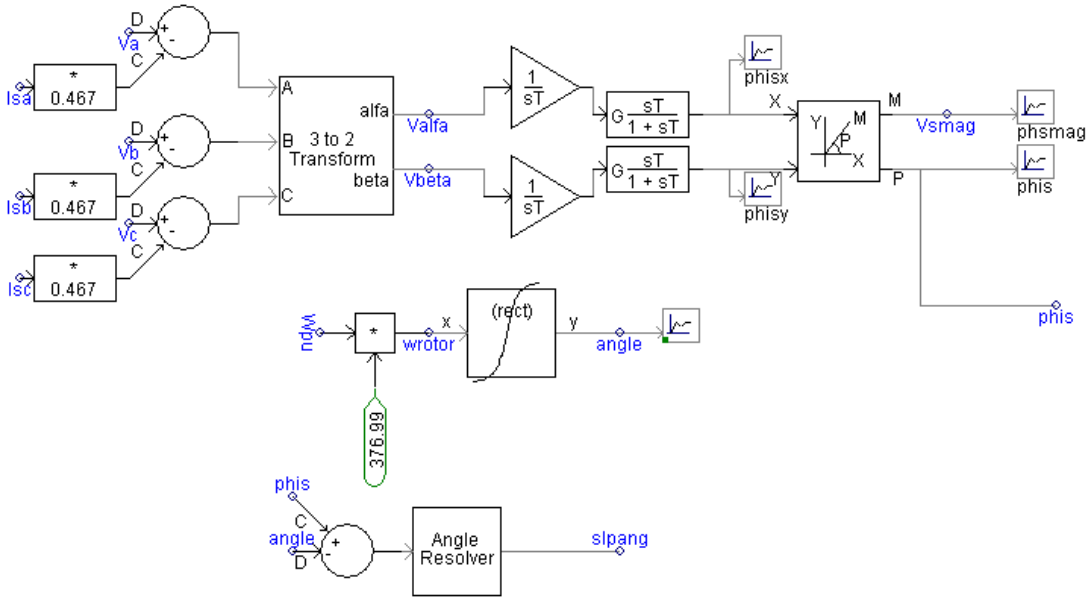

Figure 3 Determination of rotating magnetic flux vector location

The angle $Ø_s$ gives the instantaneous location of the stator's rotating magnetic field. The rotor itself rotates and is instantaneously located at angle $Ø_r$ (rotor angle). Thus, with a reference frame attached to the rotor, the stator's magnetic field vector is at location $Ø_s$- $Ø_r$ which is referred to the 'slip angle'. This slip angle is used to determine the difference between stator flux and the rotor position for resolving rotor currents. The instantaneous values for the desired rotor currents are then readily calculated using the inverse d-q transformation, with respect to slip angle, as shown in Figure 4 [6, 7].

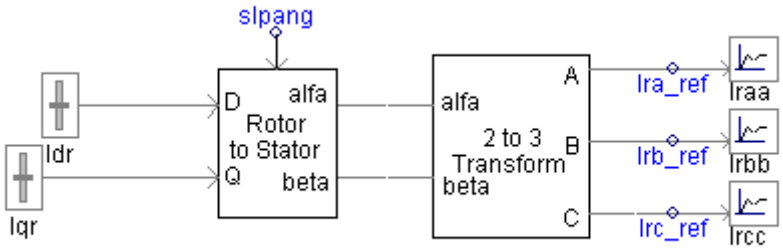

Figure 4 Generation of rotor phase reference currents

IV. SIMULATION RESULTS

The PSCAD is a powerful tool for solving and representing mathematical differential equations and therefore provides an opportunity to combine a wide range of different modelling issues. It is a highly developed graphical interface that is instrumental in PWM control [6]. Therefore, the proposed system model is developed in the dedicated power electronics and system simulation tool, PSCAD/EMTDC. The three-phase sinusoidal voltage and currents can be depicted as vectors and resolved into orthogonal components in phase and in quadrature with the stator magnetic field. Vector control method transforms rotor currents into two parallel controllers, one for the q-component and other d-component. The stator flux rotating synchronously with grid voltage is aligned with the d- axis and equations (8) and (9) indicate that q - component of the rotor current is used to control the active power, while the d component is used to control the reactive power.

To investigate the control of active power under steady-state conditions, initially the active and reactive power references are adjusted approximately to 2.2 MW and zero respectively, by adjusting the i_{qr} and i_{dr}. The machine is simulated at super-synchronous condition (1.2 pu). A step increment in i_{qr} is applied at 2 sec and is held constant for the remaining period of simulation. The simulation in Figure 5 shows that the active power (P-Gen) is increased showing that the active power can be directly controlled by i_{qr}, but there is no appreciable change in reactive power (Q- Gen).

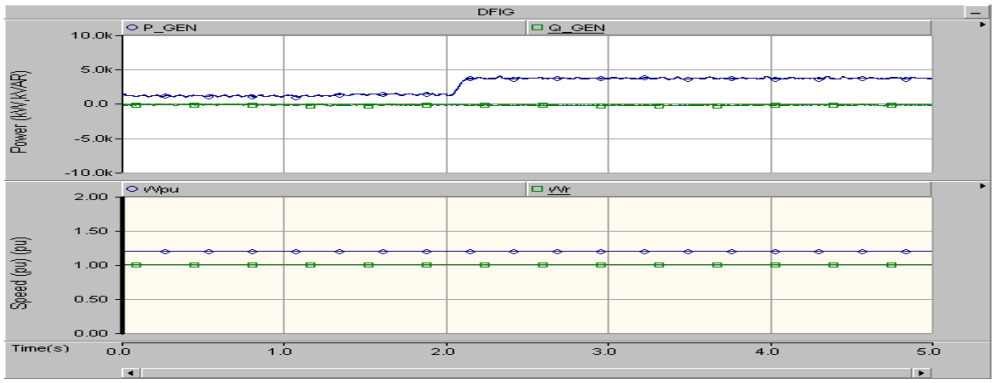

Figure 5 Effect of change in i_{qr}

The reactive power exchanged with the grid at stator terminals is dependent on the direct component of the rotor currents. It also depends on the control of the grid-side converter feeding the rotor-side. Normally the reactive power is adjusted to zero, which means that the grid-side converter operates at unity factor. The generator is fully decoupled from the grid by the power converter; therefore the power factor of the generator does not affect the reactive power factor at the grid connection. It is mentioned in equation (9) that reactive power can be controlled by decoupled component i_{dr} of the rotor currents. The model is simulated to investigate the control of reactive power by applying a step change in i_{dr} at 2 sec and is held constant for the remaining part of simulation. The simulation result confirms Figure 6 that a change in i_{dr} controls the reactive power while the active power remains unchanged.

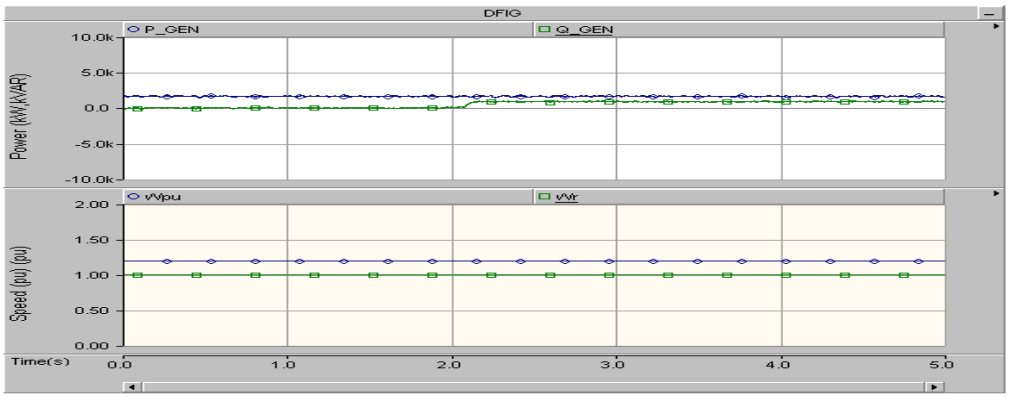

Figure 6 Effect of change in i_{dr}

The model is also simulated for sub-synchronous and super-synchronous speeds. The responses of the various parameters can be observed in Figures 7 and 8 for sub-synchronous speed. It is observed in the Figure 6 that the active power (P-Gen) is supplied from the stator to the grid. At this point the reactive power (Q-Gen) supplied by the stator is very less. However, the rotor power flow is negative at sub-synchronous speed showing that the power is drawn into the generator from the source as observed in Figure 7. It means that the converter is feeding power in to the rotor circuit.

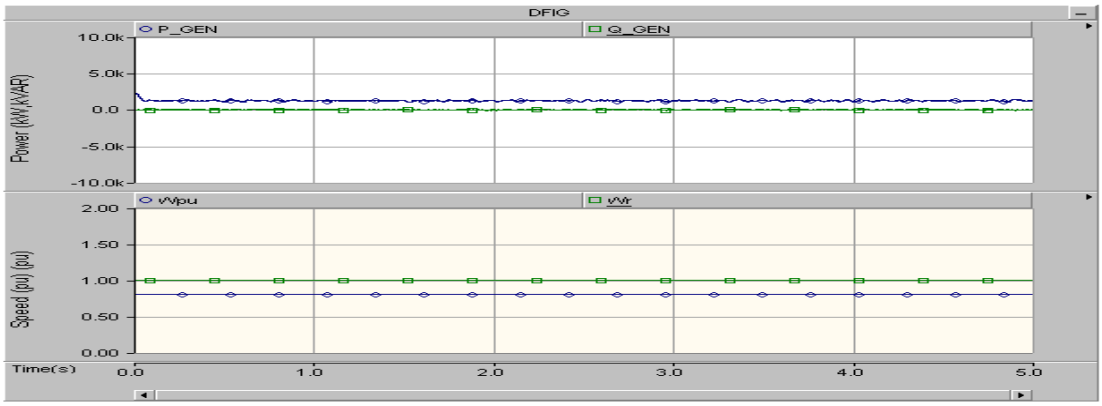

Figure 7 Stator power flow at sub-synchronous speed

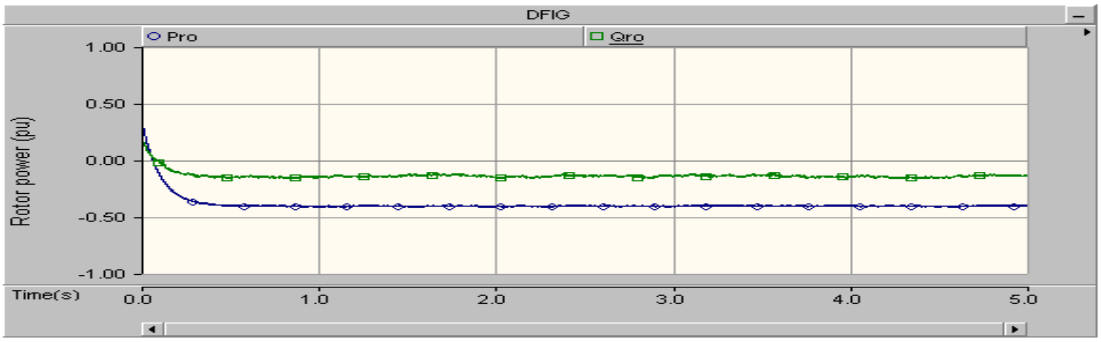

Figure 8 Rotor power flow at sub-synchronous speed

Further, the system is simulated for a change in speed from sub-synchronous speed (0.8 pu) to super-synchronous speed (1.2 pu) at 2s. (Figure 9). This causes in the phase sequence of rotor currents as shown in Figure 10 as slip is changed from sub-synchronous to super-synchronous speed,

Figure 9 Change in speed from sub-synchronous to super-synchronous speed

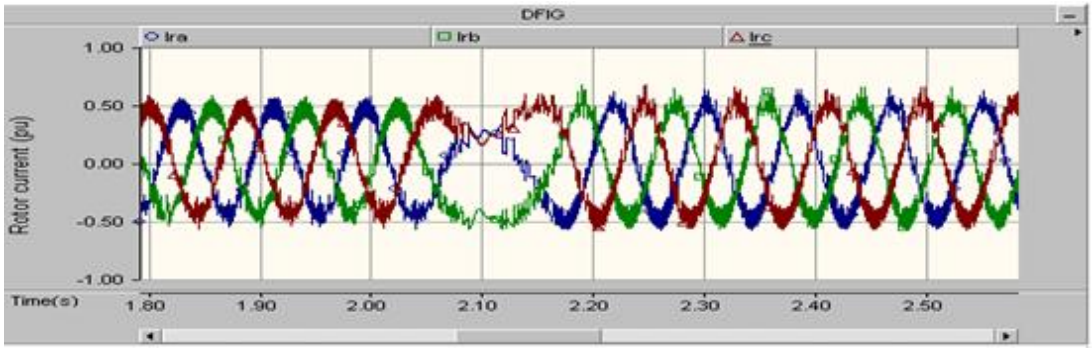

Figure 10 Rotor and stator currents for change in speed from sub-synchronous to super-synchronous

In DFIG, the electrical rotor power output P_r is positive for negative slip (super-synchronous speed) and is negative for positive slip (sub-synchronous speed). This means that, below the synchronous-speed, the rotor-side power P_r flows from the grid to the rotor of the DFIG, whereas at super-synchronous speed, it flows in the opposite direction. Therefore when the speed was changed from sub-synchronous to super-synchronous speed, it resulted in reversal of rotor output power. The change in the active power P_{ro} and reactive power Q_{ro} in rotor circuit are verified in Figure11.

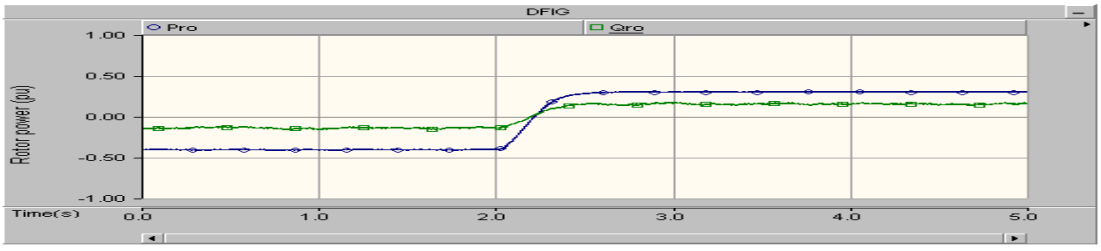

Figure 11 Rotor power flow from sub-synchronous to super-synchronous speed

V. CONCLUSION

The nature of real & reactive powers in stator and rotor circuits of doubly-fed induction generator has been investigated under decoupled control. The system was developed in PSCAD/EMTDC software. These findings suggest that vector control can optimize the output of DFIG. The real and reactive powers generated are also controlled independently to obtain proper operational stability.

Machine Data: 2.2 MW, 13.8 kV, Wound rotor Induction Machine [6].

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BIOGRAPHY

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Friction Surfacing In Steel 304

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Abstract: - Surface engineering deals with the surface of the solid matter and it is sub-discipline of The surface phase of a solid interacts with the surrounding environment. This interaction can degrade the surface phase over time, may result in loss of material from its surface. Environmental degradation of the surface phase over time can be caused by wear, corrosion, creep, fatigue loads, shear loads, tensile loads, cutting forces or when exposed to higher temperature. Wear can be minimized by modifying the surface properties of solids by surface finishing or by use of lubricants. Friction surfacing not only gives good bond on plane surfaces but also on other contours by design of special purpose machines using CNC technology. Since bond strength is very good, these deposits are expected to serve better during service. These are also used to impart a wide range of functional properties, including physical, chemical, electrical, electronic, magnetic, mechanical, wear-resistant and corrosion-resistant properties at the required substrate surfaces. Almost all types of materials, including metals, ceramics, polymers, and composites can be coated on materials, similar or dissimilar.

Keyword(s):- *bond strength, Surface engineering, bond, fatigue loads, shear loads, tensile loads.*

I. INTRODUCTION

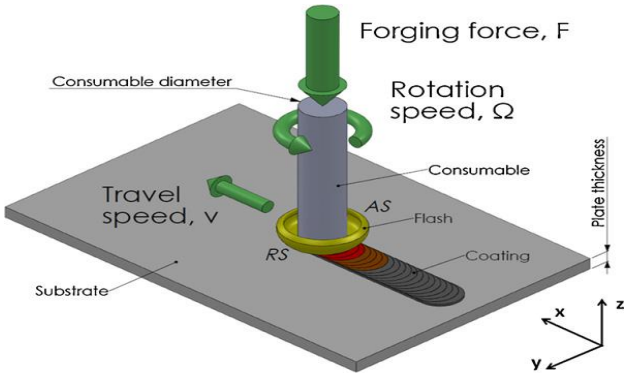


Fig 1.1 Schematic of friction surfacing

Surface engineering has become a relevant research field for manufacturing industries, as it enables advanced component design and a selective functionalization of surfaces. Solid state processing technologies are now mature and reliable alternatives to conventional processes, as stated by Mishra and Ma (2005).

Friction surfacing is a promising new technology for depositing metallurgically bonded coatings on engineering components to combat wear and corrosion. Being a solid state process, friction surfacing elimates the problems such as porosity, hot cracking, segregation, and dilution which are commonly associated with fusion-based techniques. This is attained because no melting is involved in this process.

Hard facing /coating techniques based on fusion welding and thermal spraying are generally employed to protect steel surface from corrosion. But fusion welding based coating techniques generally suffers from dilution and thermal spraying results in mechanical bonding rather than metallurgical bonding

Research so far has revealed that in friction surfacing the mechatrode force (F), mechatrode rotation speed (N) and substrate traverse speed (V_x) are of critical importance for the final quality of the coating and bond.

In the present study, three state variables that reflect coating quality were considered as a subject for optimisation and in this context a target for process parameter selection. These are coating thickness (C_t), coating width (C_w). The optimisation procedure considered in this study involved.

Development of a methodology for in-process precision measurement of axial load, traverse speed and rotational speed.

Development of an empirical model involving process parameters of coating quality state variables i.e coating thickness and coating width.

The friction surfacing machine consists of a power rotor which can move vertically with high precision Z. Under the rotor there is an XY table, which can be positioned and moved accurately. The system is controlled using a serial computer link. The input parameters to the machine being:

Spindle rotation speed

Spindle direction

Table movement

II. LITERATURE REVIEW

H.Khalid Rafi, G.D.Janaki Ram, G.Phanikumar and K.Prasad Rao [1] studied the effects of traverse speed on the geometry, interfacial bond characteristics and mechanical properties of coatings .

M.Chandrasekaran, A.W.Batchelor and S.Jana [2] studied that mild steel bonded well with the substrate and there was evidence of interfacial compound formation whereas in case of stainless steel there was no evidence of mixing and coating.

G.Madhusudhan Reddy and T. Mohandas [3] studied that stainless steel coating of mild steel leads to the formation of carbides in the stainless steel adjacent to the interface as a result of carbon migration from mild steel towards stainless steel.

J.John Samuel Dilip and G.D.Janaki Ram [4] studied the individual layers upto the thickness of 1mm to 2mm can be added up successively by friction deposition. A solid cylinder of 20mm diameter and 50mm height was successfully produced with austenitic stainless steel AISI 304.

H. Khalid rafi, N.Kishore babu, G.Phanikumar and K.Prasad Rao [5] studied the microstructural evolution of stainless steel AISI 304 on low carbon steel using optical microscopy,electron back scattered diffraction and transmission electron microscopy.

Ramesh Puli, E. Nandha Kumar and G.D. Janaki Ram [6] showed that the microstructure tests showed good hardness results when stainless steel is coated over mild steel. Bend and shear tests indicated excellent coating/substrate bonding.

J.Gandra, R.M.Miranda and P.Vilac [7] studied the influence of axial force, rotation and traverse speed on interfacial bond properties were investigated.

G.M. Bedford, V.I. Vitanov and I.I. Voutchkov [8] studied the mechanism of auto hardening of the mechatrode coating on substrate is studied.

B.Jaworski, G.M.Bedford, I.Voutchkov and V.I.Vitanov [9] studied the procedures for data collection, management and optimization of friction surfacing process and found that the thickness of the coated layer is typically between 0.5-3mm depending on the mechatrode material and diameter.

V.I.Vitanov, I.I.Voutchkov and G.M.Bedford [10] studied the three state variables, that reflect coating quality were considered as a subject for optimization and in this context a target for process parameter selection which are coating thickness, coating width, coating bond strength.

M.Chandrasekaran, A.W.Batchelor and S.Jana [11] studied that a nominal contact pressure as high as 21.9Mpa was required to obtain an adherent coating of uniform quality for mild steel with tool steel and inconel.

D.Govardhan, A.C.S.Kumar, K.G.K.Murti and G.Madhusudhan Reddy [12] studied the effect of process parameters such as frictional pressure, rotational speed of the mechatrode and welding speed .Their interaction effects on the deposit for the consumable rod are identified.

III.EXPERIMENTAL WORK AND GEOMETRY MEASUREMENT

Fig 4.1 Substrate before grinding **Fig 4.2 Substrate after grinding**

4.1 Specimen Preparation (Substrate)

Step 1: Making to a proper dimension
Initially the ductile iron plate was of 1500*1000*8 mm dimension. After cutting the raw material with gas arc cutter, it became 100*150*8 mm which is perfect for our friction surfacing process.

Step 2: Rough finishing by emery paper
Initially the ductile iron material got from shop is fully corroded. But with corroded surface friction surfacing will not be good, and thus must be removed. Emery is a type of paper that can be used for sanding down hard and rough surfaces. Even after hard rubbing with emery paper the ductile iron plate is still corroded. Hence fine finishing with surface grinding machine is a must after rough finishing.

Step 3: Fine finishing with surface grinding
This is used to get a fine finish over the roughly finished surface obtained by emery paper. Surface grinding machine is being used.

Step 4: Applying acetone solution over the surface.
The surface of the SG iron is cleaned with acetone. Acetone removes all impurities like oil, grease, dust etc.

Step 5: Corrosion free surface
Finally we get a ductile iron plate without any corrosive layer. After the fine finis0hing process followed by acetone cleaning, our material is completely ready to use for friction surfacing.

IV .Specimen Preparation (Mechatrode)
22mm diameter 304 stainless steel rod is cut into 105 mm length pieces.
These rods are turned by holding between the centers of lathe to get uniform 20mm in diameter with a 100 mm length.

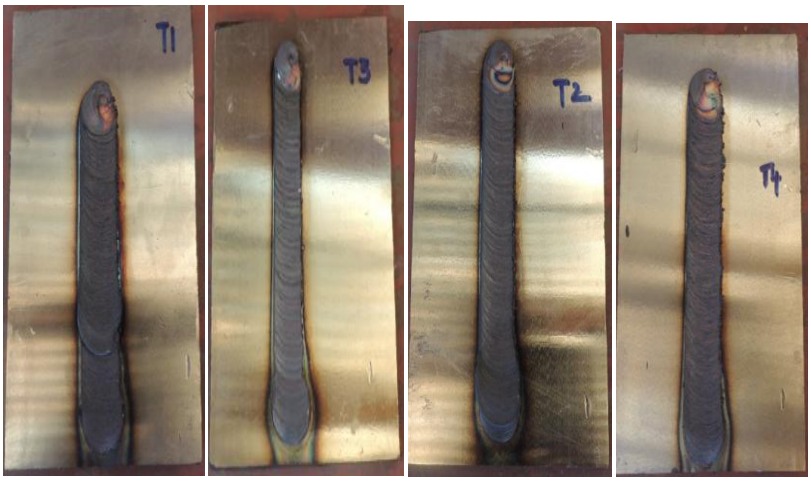
V.Result and Discussion

Fig 4.3 Experimental setup of friction surfacing machine

VI.Experimental Work with Friction Surfacing Machine
Mechatrode stainless steel is fitted in a mechatrode holder, which consists of splines at its outside surface along with its axis to allow the movement in the axial direction while doing friction surfacing. The mechatrode holder is fixed in a spindle and locked by using threading. In this condition the mechatrode can move along with the axis and simultaneously rotate with the spindle. Bush is fitted at the end of the spindle with locking screws to allow the mechatrode to rotate the axis of the spindle perfectly, under axial load.
The process parameters as per treatment combination are set on the computer of the machine. Dwell time of 5 seconds is found to get the mechatrode reach plastic state as per the initial trials conducted before start of experimental trials.

Machine is started and, once the consumable is sufficiently heated to acquire forging temperature, the welding speed is automatically switched on. The hot consumable material flows plastically over the substrate to form a coating. Since the machine is designed to deposit the consumable material in one direction of table, after completion of required length of the weld, the consumable which is fitted in the spindle automatically detach from the substrate by moving spindle in upward direction by stopping immediately the spindle rotation and welding speed.

VII Friction Surfaced Sample Photos



4.7.1 Coating Thickness (C_t) on Deposit Geometry

Table 4.3

S. No	Substrate	Mechatrode	Coating Thickness c_t (mm)
1	Sg Iron	Stainless Steel 304	2.9
2			2.36
3			1.45
4			2.73
5			2.21
6			2.36
7			2.33
8			2.55
9			1.95

In stainless steels, the coating thickness is inversely proportional to the traverse speed.
In higher traverse speed, the time of deposition of plasticized material on the work piece is less. Hence gives less coating thickness and less heat affected zone in work piece.
Coating with minimum thickness is more advisable automobile parts applications. Higher coating thickness will give increase in weight of the component.

4.7.2 Coating Width (C_W) on Deposit Geometry

Table 4.4

S. No	Substrate	Mechatrode	Coating Width c_t (mm)
1	Sg Iron	Stainless Steel 304	19.72
2			16.83
3			14.49
4			18.9
5			17.29
6			16.14
7			19.23
8			19.44
9			16.02

The width of the flash formed in the substrate is usually 0.9 times the diameter of the mechatrode used.
Our results show approximately the same value.

4.7.3 Length of Mechatrode

Fig 4.4 Length of mechatrode after friction surfacing

Mechatrode	Set No	Length	
		Before(mm)	After(mm)
Stainless Steel 304	1	100	69
	2	100	67

	3	100	79
	4	100	72
	5	100	71
	6	100	65
	7	100	70
	8	100	62
	9	100	69

According to the machine specification the length of the mechatrode rod must be in 90-120mm.
Difference in mechatrode length before and after experiment shows the material consumption during the process.
The loss of volume of material during the process is equal to the volume of coating.

4.7.4 Diameter of Mechatrode

Fig 4.5 Diameter of mechatrode after friction surfacing

Table 4.6

Mechatrode	**Set No**	**Diameter**	
		Before(mm)	**After(mm)**
Stainless Steel 304	1	20	38
	2	20	33
	3	20	35
	4	20	34
	5	20	33
	6	20	35
	7	20	35
	8	20	36
	9	20	34

According to the machine specification the diameter of the mechatrode rod must be in 16-24mm.
During the process material temperature reaches above 700^0C
In that high temperature plasticization occurs. Some material melts and deposited on the work piece called coating.
The remaining material stick around the mechatrode edge, after some time in the atmospheric air get cooled and looks bigger in diameter than the initial diameter.

III. INSPECTION AND TESTING RESULTS

5.1 Hardness Measurement

Hardness of the obtained samples is tested using a micro Vickers hardness tester. The specifications of which are as follows

Machine Name : Micro Vickers Hardness Tester
Testing load range : 10 grams to 1 Kg Load
Make : Wilson Wolpert – Germany
Micrometer least count : 0.01 mm
Hardness testing Scales : HV, HR"A", HR"B", HR"C", 15N, 30N & 45N, 15T, 30T & 45T
Hardness Values in H.V. @ 0.5 Kg load.

Fig 5.1 Micro hardness test apparatus

Hardness measurements were carried out in the samples sectioned in transverse direction.
Diamond intender is used in this machine. Tests were carried at a load of 0.5 Kg and the following results were obtained.

Table shows the hardness results

Trial 1 Table 5.1

From the Weld	Weld Ss side	S.g Iron Side
Edge	197.5	155.9
0.1	225.4	152.0
0.2	223.3	141.8
0.3	220.9	149.8
0.4	225.0	147.1
0.5	223.0	149.1
0.6	218.2	149.1
0.7	214.8	149.6
0.8	213.2	148.2
0.9	210.3	148.2
1.0	200.2	151.2
1.1	197.5	164.3
1.2	207.6	150.4
1.3	208.1	149.6
1.4	208.1	151.3

Trial 2
Table 5.2

From the Weld	Weld Ss side	S.g Iron Side
Edge	201.6	153.4
0.1	227.2	151.8
0.2	227.3	148.1
0.3	224.3	148.8
0.4	225.9	147.6
0.5	224.5	146.7
0.6	225.7	147.8
0.7	219.8	146.1
0.8	215.9	147.7
0.9	215.5	147.4
1.0	212.4	148.7
1.1	215.9	147.1
1.2	212.8	150.9

Trial 3
Table 5.3

From the Weld	Weld Ss side	S.g Iron Side
Edge	200.4	158.4
0.1	225.8	153.2
0.2	226.6	152.2
0.3	227.4	151.9
0.4	225.7	152.2
0.5	225.1	149.5

0.6	222.7	148.5
0.7	219.4	147.2
0.8	218.8	147.0
0.9	216.3	148.8
1.0	214.8	147.8
1.1	112.6	146.0
1.2	203.5	156.8

Trial 4
Table 5.4

From the Weld	Weld Ss side	S.g Iron Side
Edge	270.7	174.9
0.1	271.9	168.3
0.2	249.2	143.8
0.3	236.5	159.6
0.4	239.9	163.3
0.5	229.7	158.8
0.6	231.1	154.1
0.7	229.4	1598
0.8	225.8	166.4
0.9	221.1	153.7
1.0	226.3	159.4
1.1	203.8	154.2
1.2	201.7	149.6

Trial 5
Table 5.5

From the Weld	Weld Ss side	S.g Iron Side
Edge	271.4	170.4
0.1	271.4	160.2
0.2	244.6	141.2
0.3	239.8	151.9
0.4	235.3	161.2
0.5	224.5	156.5
0.6	222.0	156.5
0.7	221.8	155.2
0.8	220.9	160.0
0.9	216.5	154.8
1.0	204.4	154.8
1.1	199.9	157.0
1.2	200.8	156.8

Trial 6
Table 5.6

From the Weld	Weld Ss side	S.g Iron Side
Edge	275.1	172.4
0.1	273.3	165.2
0.2	247.8	140.2
0.3	232.5	151.9
0.4	239.7	149.2
0.5	224.1	156.5
0.6	219.5	141.5
0.7	229.0	151.2
0.8	212.5	150.0
0.9	221.3	158.8
1.0	238.9	151.8
1.1	197.3	155.0
1.2	216.6	152.8

Trial 7
Table 5.7

From the Weld	Weld Ss side	S.g Iron Side
Edge	231.4	136.3
0.1	134.7	153.4
0.2	232.7	154.8
0.3	229.4	155.4
0.4	217.7	157.6
0.5	216.3	153.5
0.6	206.7	152.8
0.7	209.5	155.4
0.8	204.3	151.7
0.9	202.5	155.2
1.0	200.3	153.3
1.1	198.2	158.2

Trial 8
Table 5.8

From the Weld	Weld Ss side	S.g Iron Side
Edge	235.3	135.3
0.1	138.6	156.8
0.2	234.3	157.1
0.3	229.6	155.4
0.4	217.4	154.6
0.5	202.8	153.3
0.6	205.4	151.8
0.7	207.8	151.3
0.8	200.2	152.6
0.9	201.5	152.2
1.0	194.3	155.4
1.1	196.2	156.3

Trial 9
Table 5.9

From the Weld	Weld Ss side	S.g Iron Side
Edge	233.0	138.1
0.1	133.1	152.9
0.2	233.2	153.3
0.3	229.5	154.8
0.4	214.3	153.7
0.5	206.9	153.0
0.6	204.5	151.3
0.7	207.8	150.8
0.8	201.9	151.0
0.9	200.8	152.4
1.0	197.3	154.1
1.1	198.0	156.5

Hardness is the property of a material that enables it to resist plastic deformation, usually by penetration. Hardness value of material is directly proportional to the strength of that material

5.2 Bend Test

Mechanical testing machine is used for this purpose. The point to be noted is that the test is carried out as per ASTM E-8. Here the sample is cut to the required dimensions so that it can be held. The sample is placed at the top of the support. Following which uniform load is applied at its centre. The sample starts bending. The point where it is about to break is noted and the corresponding load is the maximum that it can withstand. The following is a mechanical testing machine.

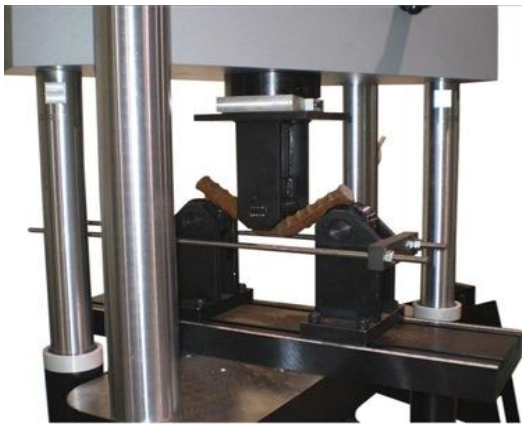


Fig 5.2 Bend test apparatus

T1

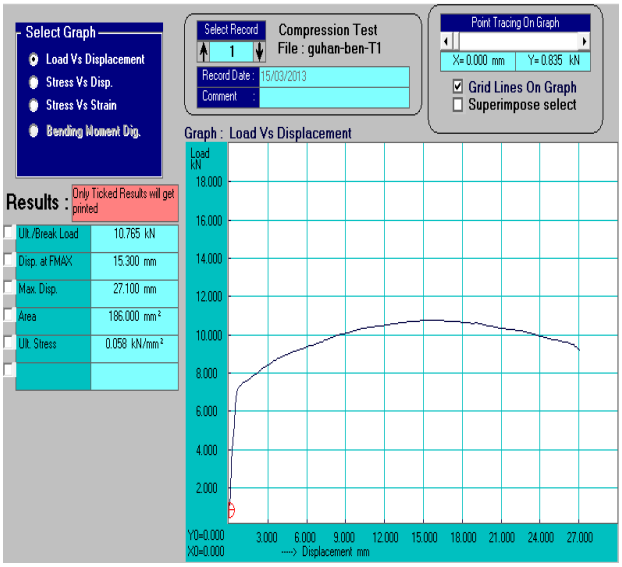


Fig 5.3 Load Vs Displacement Graph for Bend Test

Table shows the bend test results
Table 5.10

S. No	Max Load (kN)	Max Displacement (mm)
1	10.765	27.1
2	10.825	26.9
3	10.729	26.6
4	10.211	23.1
5	10.195	24.3
6	10.301	24.0
7	10.002	27.1
8	10.114	27.4
9	10.065	26.8

Bend testing determines the ductility or the strength of a material.
Experiment results show that the strength of a work piece has increased after the coating. Because coating surface provide resistance towards bending.

Fig 5.4 Sample before the bend test

Fig shows the work piece before the load acted on it while under-going the bending test.

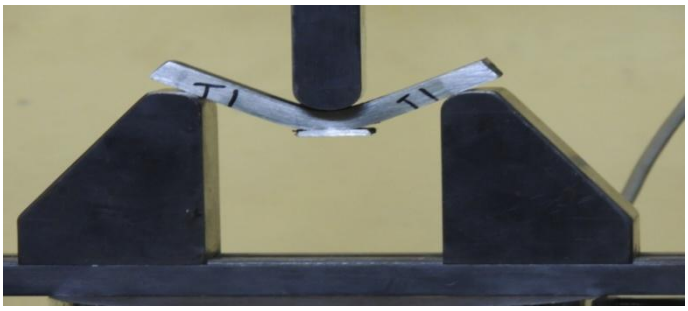


Fig 5.5 Sample after the bend test

Fig shows the work piece after the load is acted on it.

5.3 Microstructure
Sample T1

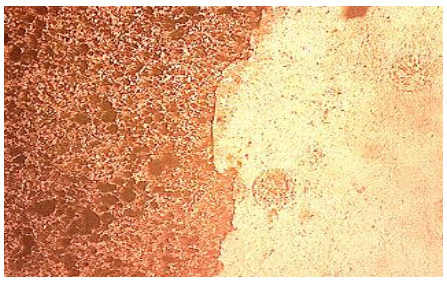


Image 1

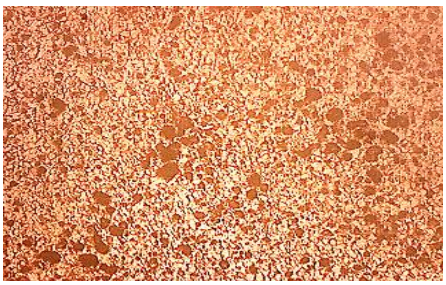


Image 2

Image 1: shows the base metal SG iron with surfaced SS by friction. The base metal shows fine spheroidal graphite's in ferrite-pearlite matrix.
Image 2: shows the base metal microstructure (SG Ir on).

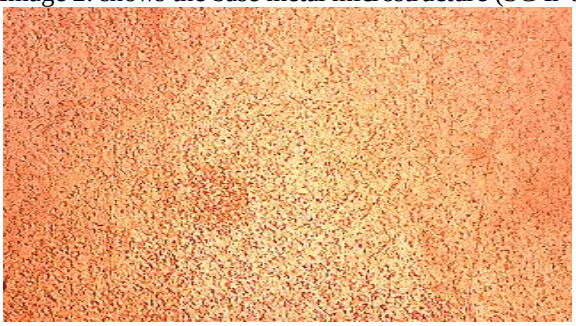


Image 3

Image 4

Image 3: shows the etched surfaced SS matrix with fine austenite grains.
Image 4:shows the same SS matrix at higher magnification.

Sample T5

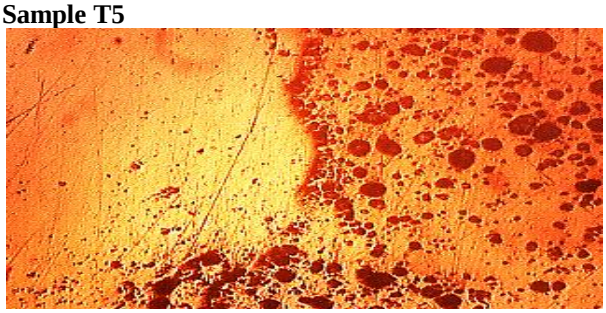


Image 1

Image 2

Image 1: shows the base metal SG iron with surfaced SS by friction. The base metal shows fine spheroidal graphite's in ferrite-pearlite matrix.
Image 2: shows the base metal microstructure (SG Iron).

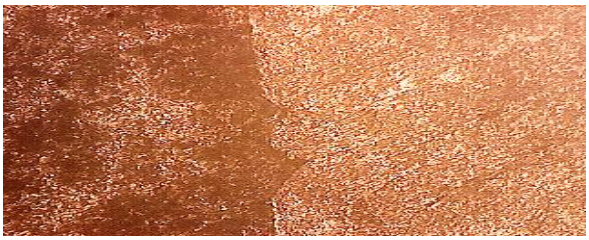


Image 3

Image 4

Image 3: shows the base metal SG iron with surfaced SS by friction. The base metal shows fine spheroidal graphite's in ferrite-pearlite matrix. The surfaced metal shows fine austenite grains.
Image 4: shows the same SS matrix at higher magnification.

Sample T9

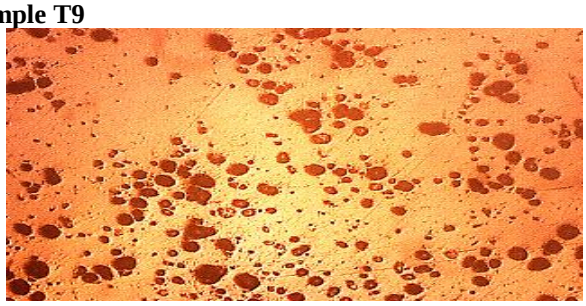


Image 1

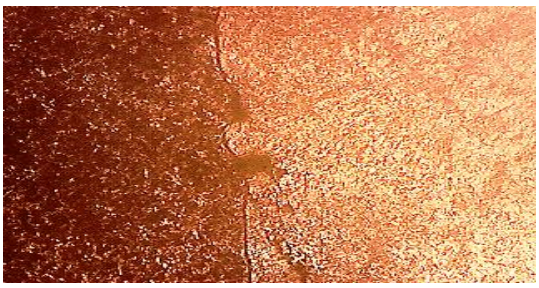


Image 2

Image 1: shows the base metal SG iron with surfaced SS by friction. The base metal shows fine spheroidal graphite's in ferrite-pearlite matrix. Surfaced metal not etched.
Image 2: shows the base metal microstructure (SG Iron).

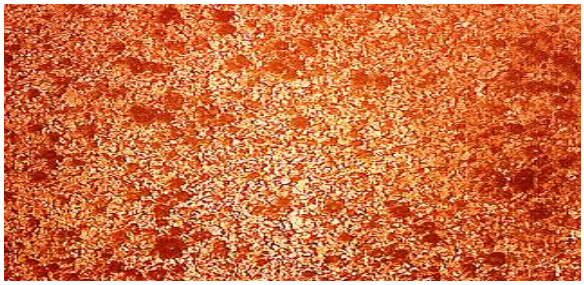


Image 3

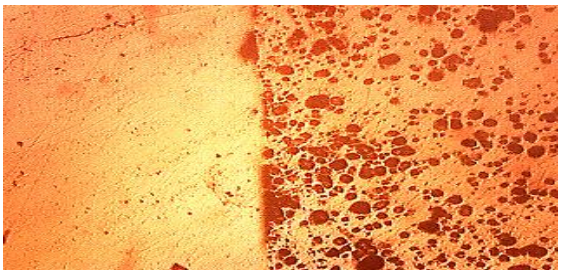


Image 4

Image 3: shows the base metal SG iron with surfaced SS by friction. The base metal shows fine spheroidal graphite's in ferrite-pearlite matrix. The surfaced metal shows fine austenite grains.
Image 4: shows the base metal microstructure (SG Iron) with ferrite-pearlite matrix.

5.4 Corrosion Test: As per ASTM B117M (Salt Spray fog test)

Fig 5.6 Salt spray test chamber apparatus

5.4.1 Salt Spray Apparatus

Specimens are first cut to the size as specified by ASTM. Holes are drilled at the top of each specimen so that they could be held steadily. The weight of the individual specimens are noted before the test starts. The chamber has a provision at the side for spraying NaCl. Sodium chloride is sprayed in the form of fine droplets similar to fog. The purpose of spraying NaCl is because the chlorine atoms react with the coating material of individual specimens and causes its removal. It is sprayed for about 48hours. Following which the specimen is carefully removed and washed with distilled water. Now it is stirred in alcohol on a warm base. After the residues are dissolved it is once again weighed. Comparison of weights before and after the test is now done. The following satisfactory results were obtained.

5.4.2 Salt Spray Test Parameters

Temperature of the test:	33 degrees Centigrade.
Concentration of the Salt solution:	1.0M
Air pressure:	2.0 Kg per Sq. Centimeters.
Ph of the Solution followed :	7.0
Humidity of the chamber:	95% to 98%.
Exposure Time:	48 Hours.
Post cleaning:	Cleaned in distilled water followed
by rinsing in alcohol	

5.4.3 Weight Details for Corrosion Test

Table 5.11

	T1	**T5**	**T9**	**S.g Iron**
Initial Weight	42.51	38.74	47.18	67.80
Final Weight	42.49	38.68	46.99	67.50
Weight Loss	0.02	0.06	0.19	0.30
Corrosion Rate Loss/Day	0.000948	0.00233	0.00916	0.0083

5.4.4 Corrosion Rate Conversion

The most used expression for corrosion rate in the US is the mpy (Miles per year).

To convert corrosion rate (corrosion rate conversion) between the mpy and the equivalent in the metric unit mm/y (millimeter per year).

1 mpy= 0.024 mm/y =22.4 microns/year

To calculate the corrosion rate from metal loss:

Mm/y=87.6*(W/DAT)

Where:

W=weight loss in milligrams

D=metal density in g/cm^3

A=area of sample in cm^2

T=time of exposure of the metal sample in hours

IV. CONCLUSION

Experimental results show that the friction surfacing could be used as a method for obtaining coatings of dissimilar materials. Friction surfacing is the best method for obtaining deposits of stainless steel over ductile

iron for critical applications. Adequate bond strength and good coating integrity of deposit is obtained by optimizing of process parameters The microstructure reveals good bond between stainless steel and ductile iron which is obtained by the results of the combined forging and shear action of mechatrode at the plastic state with ductile iron. The interface layer zone is the intermixed materials of substrate and mechatrode.The deposit observed by the microscope showed dense, clear and fine microstructure of ferrite and pearlite on ductile iron side which clearly proves the superiority of the process Corrosion test and bend tests results proved that this method is can be for manufacture of petrochemical vessels, pumps for chemicals and other corrosion resistant applications. There is tremendous scope to extend this process to other dissimilar metal combinations for protection against wear and corrosion.

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Variation of Stress Range Due to Variation in Sea States – An Overview of Simplified Method of Fatigue Analysis of Fixed Jacket Offshore Structure

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Abstract: - In this paper the simplified method of fatigue analysis of fixed offshore structure was considered. For the purpose of this study, the model was analyzed using ANSYS, and by progressively stepping the regular wave through the structure, a range of stress, S, was identified for each critical point on the structure as the nominal stress range, which was then multiplied by SCF of 1.07 to obtain the actual stress range for six different sea states for time intervals, t = 0, T/4, T/2, 3T/4 and T.

Keywords: - Fatigue *Analysis, Fixed Jacket Structure, Stress Range, S-N Curve*

I. INTRODUCTION

Offshore structures of all types are generally subjected to cyclic loading from wind, current, earth-quakes and waves acting simultaneously, which cause time-varying stresses in the structure. The environmental quantities are of a random nature and are more or less correlated to each other through the generating and driving mechanism. Offshore structures, regardless of location, are subject to fatigue degradation. In many areas, fatigue is a major design consideration due to relatively high ratios of operational sea states to maximum design environmental events [1].

The simplified fatigue analysis is also called allowable stress range method. This method is based on the premise that it is possible to evaluate a long term stress range and compare its maximum value with the allowable stress limit. For this reason the simplified method is classified as an indirect method, as it is not necessary to obtain the fatigue life and damage for each point of the structure in order to perform a fatigue design check [2].

1.1 An Overview of Fatigue in Offshore Structures

Generally speaking, fatigue is the gradual deterioration of materials and welded connections when subjected to cyclic stresses caused by variable loads experienced by the structure during its life, and accounts for about 90% of failures in welded structures. Failure can occur due to repeated loads (even) below the static yield strength, and can result in an unexpected and catastrophic failure in use if these connections are not designed to resist the fatigue damage. Locations in the structure most prone to fatigue are:

- Intersection of tubular members because of Hot Spot stresses
- Hatch corners in ship decks
- Deck house endings
- Tank boundaries due to sloshing of liquids, and
- Structural connections, especially where weld details are poor

Fatigue under random loading conditions experienced offshore is a complex subject and the following comments are accepted to be true for welded steel structures [3].

- Welded connections are most susceptible to the development of fatigue cracks.

- Small sharp defects inevitably exist in welds and act as crack initiators; hence fatigue in offshore structures is predominantly a matter of crack propagation.
- In as welded connections, stresses of yield strength magnitude in tension exist due to residual stresses.
- Stress fluctuations are therefore, from tension yield downwards and the range of the fluctuation only is the governing parameter.
- In welded structures fully tensile stress cycles and wholly or partially compressive stress cycles are equally damaging.
- The fatigue strength of welded connections is independent of the yield strength of the currently used structural steels.
- Crack propagation and consequently fatigue damage in an offshore environment will continue at some range , that is there is no endurance limit as is found above $2x10^6$ cycles, and
- Shear stress may be neglected in fatigue life calculations.

In offshore structures, stress fluctuations due to variable loading occur predominantly as a result of wave loads. Studies indicate that fatigue in offshore structures is a typical high cycle phenomenon. Most damage, by far, is caused by the occurrence of many cycles of stress ranges. The occurrence of a few exceptionally severe storms, with return periods of more than one year is unimportant in fatigue damage considerations. Consequently the response of structure in sea states of relatively low wave height and short mean wave period is of prime concern.

Steel jacket structures commonly used for exploration and production of oil and gas composed of steel tubular members, which are interconnected by welded joints. The joints may cause large stress concentrations, which severely affect the fatigue life. For offshore structures, which are subjected to considerable dynamic loading from waves, fatigue is in many cases a dominating design criterion [4].

The subject of fatigue in structures is very broad and varied. So many papers, reports and books have been written on the subject, although most of the material is highly specialized and not readily available to the general public. Detailed history of fatigue which started in the early 19th century as a by-product of the industrial revolution can be found in [5].

The vast amount of literature on the subject testifies to the fact that numerous research programs were carried out on it in the past. The research was stimulated by the need for information on designing against fatigue as well as by the scientific interest to understand the phenomenon of fatigue. An important stimulus for fatigue research also came from catastrophic accidents due to fatigue problems [5].

Many different approaches are available for analyzing offshore jacket platforms in order to compute the fatigue life of the structure. The correct choice of approach depends on a number of factors, such as whether the structure is linear or nonlinear, or whether dynamic response is significant or not. In general, there are three methods for the determination of fatigue damage: the Spectral Method, the Deterministic Method, and the Simplified Method.

II. METHODOLOGY AND MATERIALS

In this study, Simplified method was chosen to determine the fatigue life of the jacket structure as the jacket will be operating in a shallow water (27.8m depth) and, the Simplified method of approach is often undertaken for shallow water (statically responsive) structures subject to some nonlinearities [6].

With this method, the fatigue damage caused by the representative set of regular waves is used, along with the probability of occurrence (See TABLES I & III) for each regular wave, to find the fatigue life of the structure. Each wave was separately applied to the structure. A wave loading analysis, incorporating Morrison's loading calculation and the linear (Airy) wave theory.

The jacket was model in ANSYS and part of the structure under water was discretized in to (264) Beam elements. The material type used was BEAM4 (3D) which is a uniaxial element with tension, compression, torsion, and bending capabilities. The element has six degrees of freedom at each node: translations in the nodal x, y, and z directions and rotations about the nodal x, y, and z axes. Stress stiffening and large deflection capabilities are also included. The part of the structure under water was divided in to 32 members (See Fig. 8 as one of the model sample) and all the loads were computed based on the number of these members. All the members were then subdivided in to elements and the loads were applied on the elements at the nodes as pressure on beam and for each element, i, stands for pressure at first node and j, stands for pressure at second node while the loads from the super structure were applied as point loads at the node (top) of each vertical member.

By progressively stepping the regular wave through the structure, a range of stress, S, was identified for each critical point on the structure as the nominal stress range, which was then multiplied by SCF of 1.07 to obtain the actual stress range [7].

Based on this stress range, the allowable number of cycles to failure, N, for this given stress level was obtained from the appropriate (S – N) fatigue strength curve. The S – N curve (Fig. 1) [8] contains three curves thus, for tubular joints in Air (A), in sea water with cathodic protection (CP), and in sea water for free corrosion (FC) but the former was neglected because of the consideration of only part of the structure under water. Therefore, values of N for the two curves (i.e. NCP and NFC) was then computed and sum up together to get the total number of cycle to failure which was then compared with n, the actual number of waves (equivalent to cycles), which would be available from environmental measurements in order to compute the fatigue damage increment. This was repeated for the other wave heights in order to accumulate the fatigue damage for all the sea wave conditions thus,

$$D = \sum_{i=1}^{j} \frac{n_i}{N_i}$$ "equation 1"

Where n_i is the number of cycles the structural detail endures at stress range S_i, N_i is the number of cycles to failure at stress range S_i, as determined by the appropriate S-N curve, and j is the number of considered stress range intervals. Hence the fatigue life was evaluated from;

$$m = \frac{1}{D}$$ "equation 2"

where m = fatigue life in years, D = fatigue damage

The fatigue life of the jacket structure then computed based on the stress range obtained from the previous tables by multiplying the stresses by a stress concentration factor of 1.07 [8] to get the number of cycles to failure N from the S-N Curve. The number of cycles per year n can also be computed from the data in the wave scatter table of global statistics of area 58 in West Africa. Table III, presents the summary of the probability of occurrences in the data available from the environmental measurements.

III. MATHEMATICAL DEVELOPMENT

The long term stress range distribution may be presented as a two parameter weibull distribution;

$$F_s(S) = \exp\left[\left(-\frac{S}{\delta}\right)^{\gamma}\right] \quad S > 0$$ "equation 3"

Where;
$F_s(S)$ = is the probability that the value S will be exceeded
S = is the random variable representing the stress range
Γ = is the weibull shape factor
δ = is the weibull scale factor
This equation is used in the simplified fatigue analysis, which is based on the cumulative damage rule (Palmgren-Miner), taking in to account also the fatigue strength defined by S-N curves. A closed expression for the fatigue damage can be found, based on it.
The weibull distribution parameters are given below:
Let S_R = a reference stress range be the major stress range that can occur on a certain number N_R of cycles.

$$\delta = \frac{S_R}{(lnN_R)^{1/\gamma}}$$
"equation 4"

3.1 Fatigue Damage
It can be shown that the closed solution for the fatigue damage considering a two segment S-N curve is as given below:

$$D = \frac{N_T \cdot \delta^m}{A} \cdot \Gamma\left(\frac{m}{\gamma} + 1, z\right) + \frac{N_T \cdot \delta^{\gamma}}{C} \cdot \Gamma_0\left(\frac{r}{\gamma} + 1, z\right)$$
"equation 5"

Where;
N_T = the total number of cycles during the design life
A, m = parameters obtained from first segment of the S-N curve
C, r = parameters obtained from second segment of the S-N curve
Γ = the weibull shape factor
δ = the weibull scale factor

$\Gamma\left(\frac{m}{\gamma}+\ 1,z\right)$ and $\Gamma_0\left(\frac{r}{\gamma}+\ 1,z\right)$ = are incomplete gamma functions

Incomplete gamma functions are defined as;

$\Gamma(a,z) = \int_0^{\alpha} t^{a-1}.e^{-1}\,\mathrm{dt} = \Gamma_0(a,z)$

$\Gamma_0(a,z) = \int_0^{z} t^{a-1}\ .e^{-t}\,dt$

Where;

$Z = \left(\frac{S_Q}{\delta}\right)^{\gamma}$

S_Q = is the stress range value at which the change of slope of the S-N curve takes place.

3.2 Allowable Stress Range

An alternative way to characterize fatigue stress is in terms of a maximum allowable stress range. This can be done to include consideration of the fatigue design factors (FDF), define 1/3.2. Letting D = Δ = 1/FDF in (6) the maximum allowable stress range, $\hat{S_R}$, at the probability level corresponding to N_R is found as

$$\hat{S_R} = \left[\frac{(\ln N_R)^{N/\gamma}}{FDF.N_T\left[\frac{\Gamma\left(\frac{m}{\gamma}+1,z\right)}{A}\right]+\delta^{r-m}\frac{\Gamma_0\left(\frac{r}{\gamma}+1,z\right)}{C}}\right]^{1/m} \qquad \text{“equation 6”}$$

The reference stress range SR is usually set to that related to the storm conditions, so the limiting fatigue life is used as a starting point to determine what the highest allowable SR value would be, so that the given fatigue life is guaranteed.

IV. RESULTS

The outcomes of this research are presented in Fig. 2 to 7 and TABLE IV.

V. CONCLUSIONS

1. The magnitude (value) of stress range (s) is/are directly proportional to the increase in sea states i.e the higher the probability of occurrence, the higher the stress range.
2. The overall fatigue life at joint 33 (element 253) is just 1.1times greater than the service life of the structure despite the failure of the element at sea state No.2 which is about 58.13 % of the total damage caused by the six sea states. The probability that the joint will not fail during its service life is 100.6 %.

VI. ACKNOWLEDGEMENT

This work was successful through the able guidance of Dr. H. S. Chan and Dr. Yongchan Pu, School of Marine Science and Technology, Newcastle University, United Kingdom.

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Figures and Tables

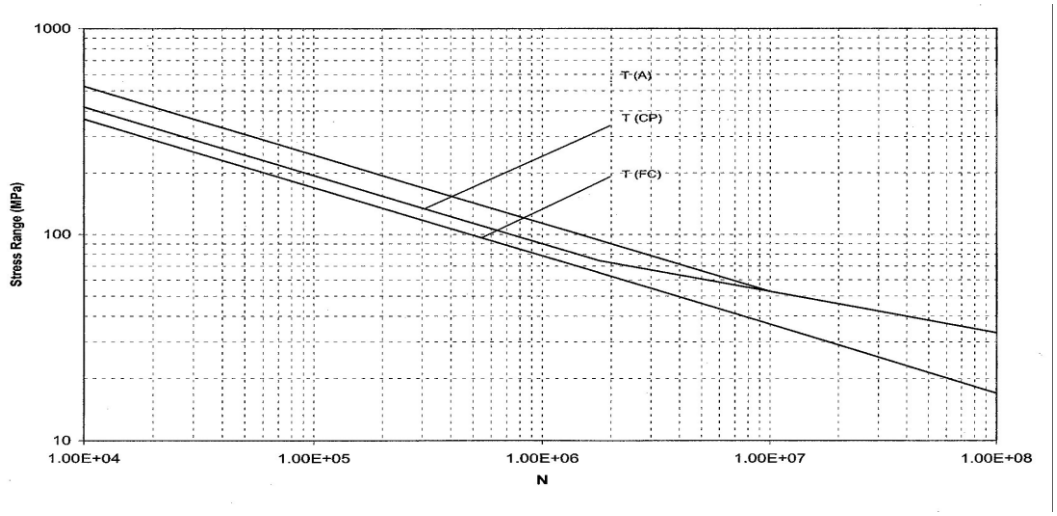

Figure 1: S-N curves for tubular joints in air, in seawater with cathodic protection, and in seawater with free corrosion [8].

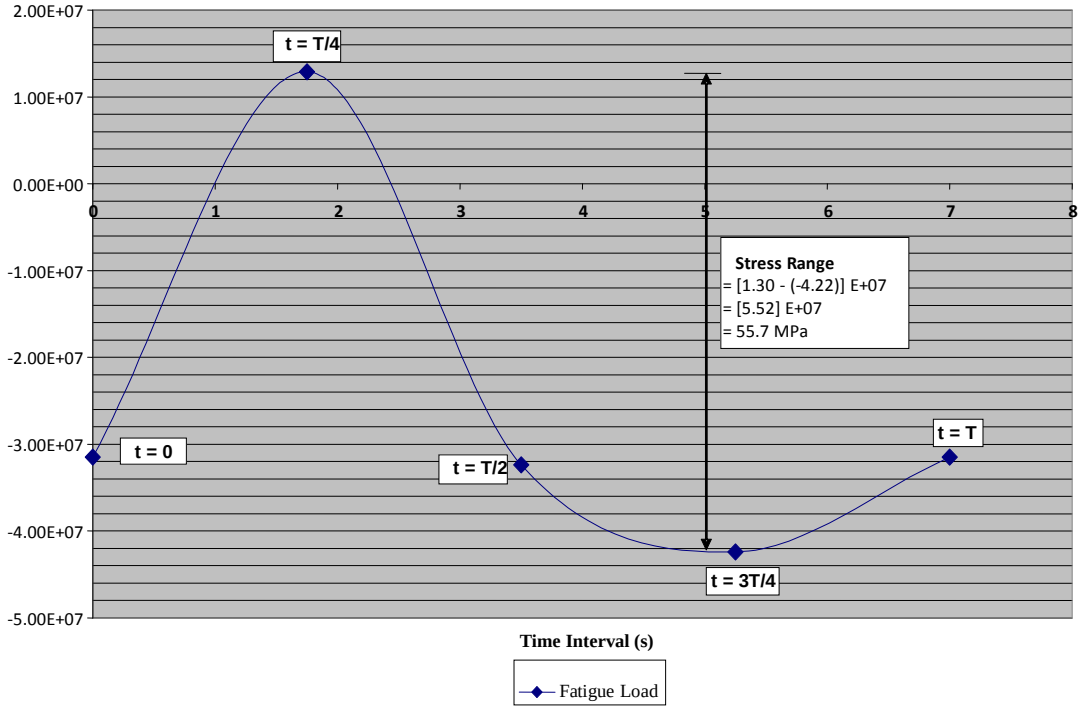

Figure 2: stress range for element 253 at sea state 1

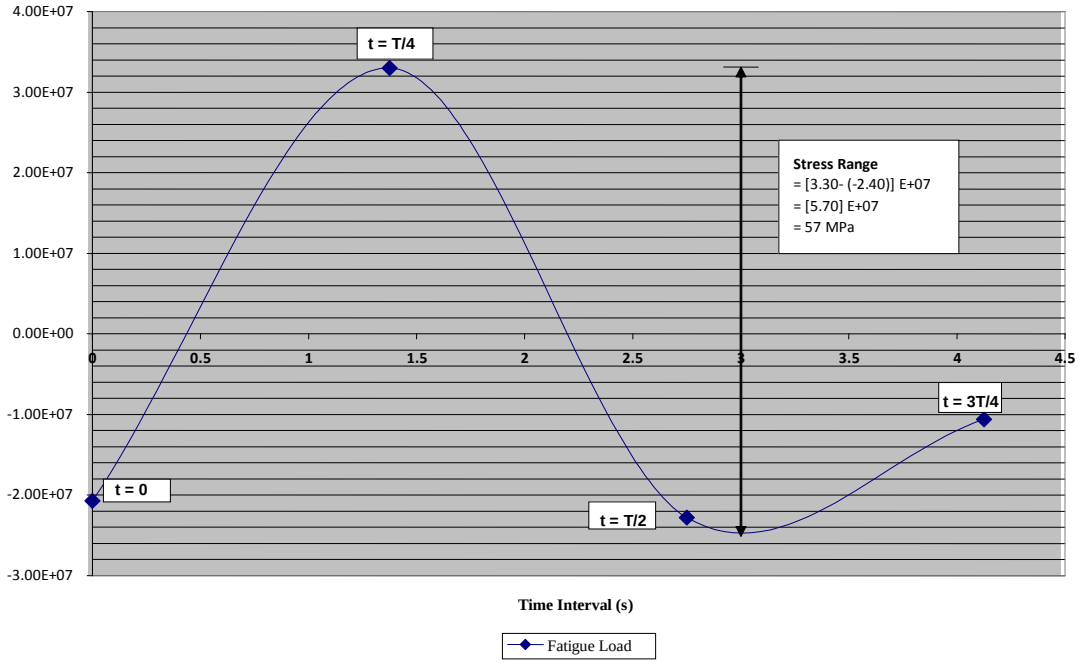

Figure 3: stress range for element 253 at sea state 2

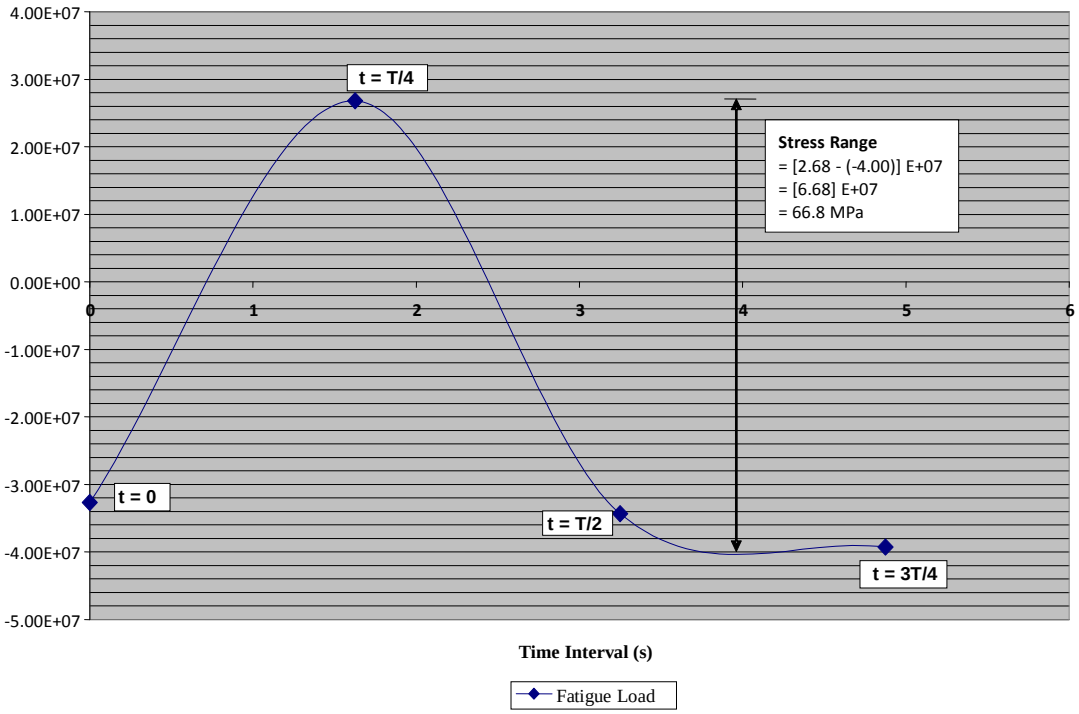

Figure 4: stress range for element 253 at sea state 3

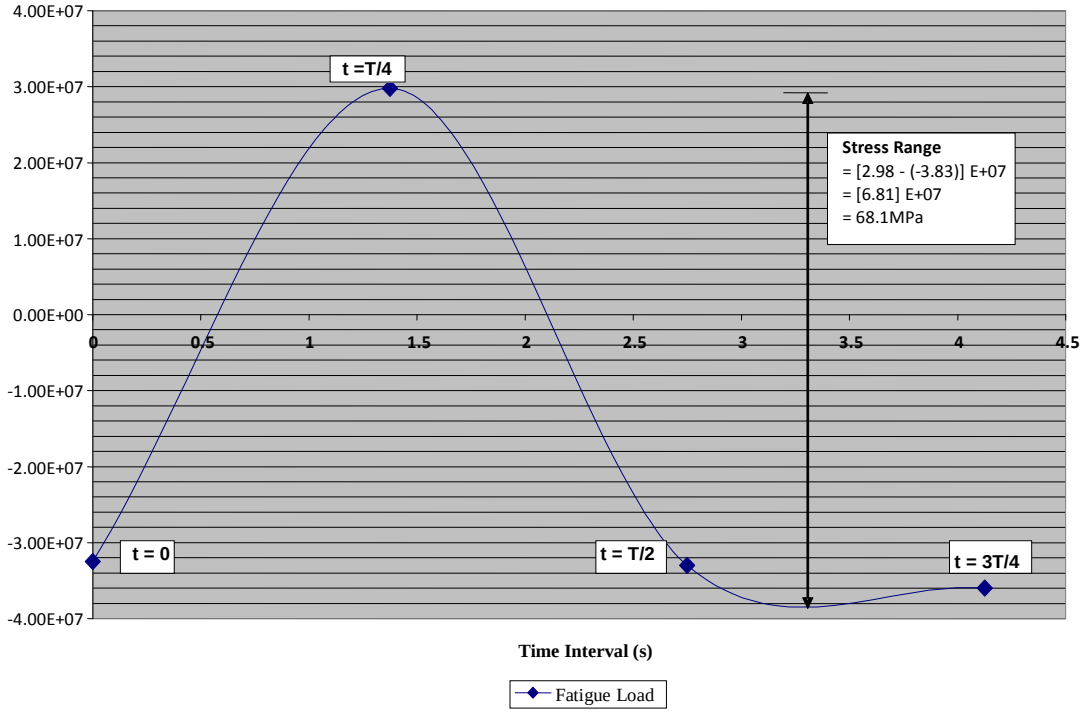

Figure 5: stress range for element 253 at sea state 4

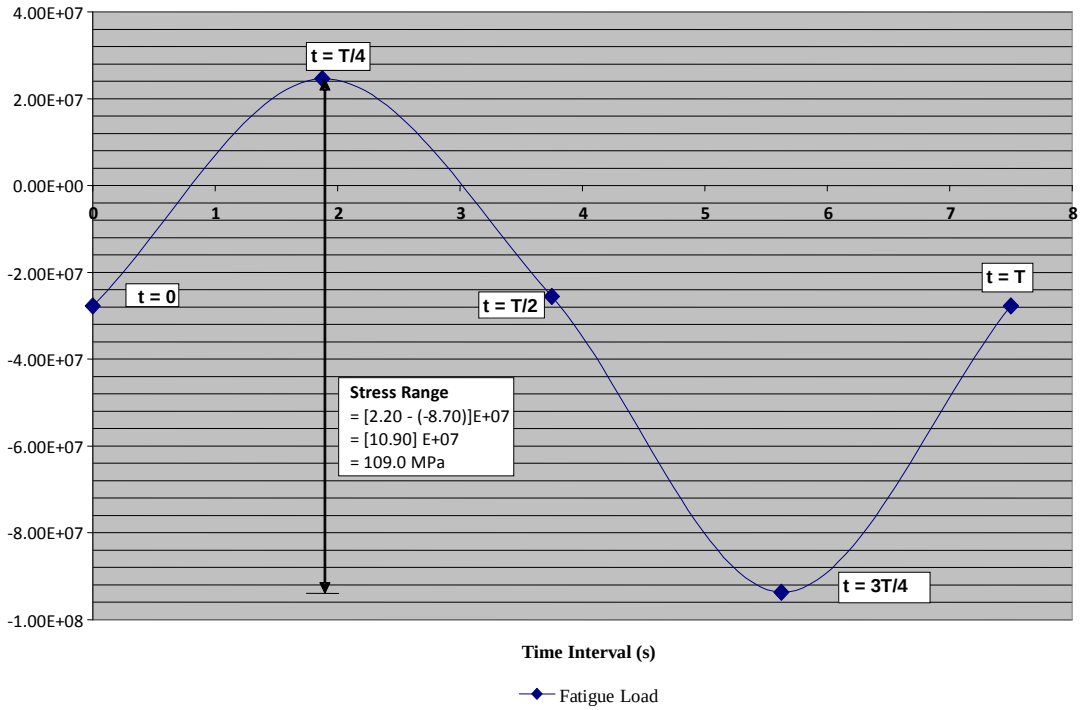

Figure 6: stress range for element 253 at sea state 5

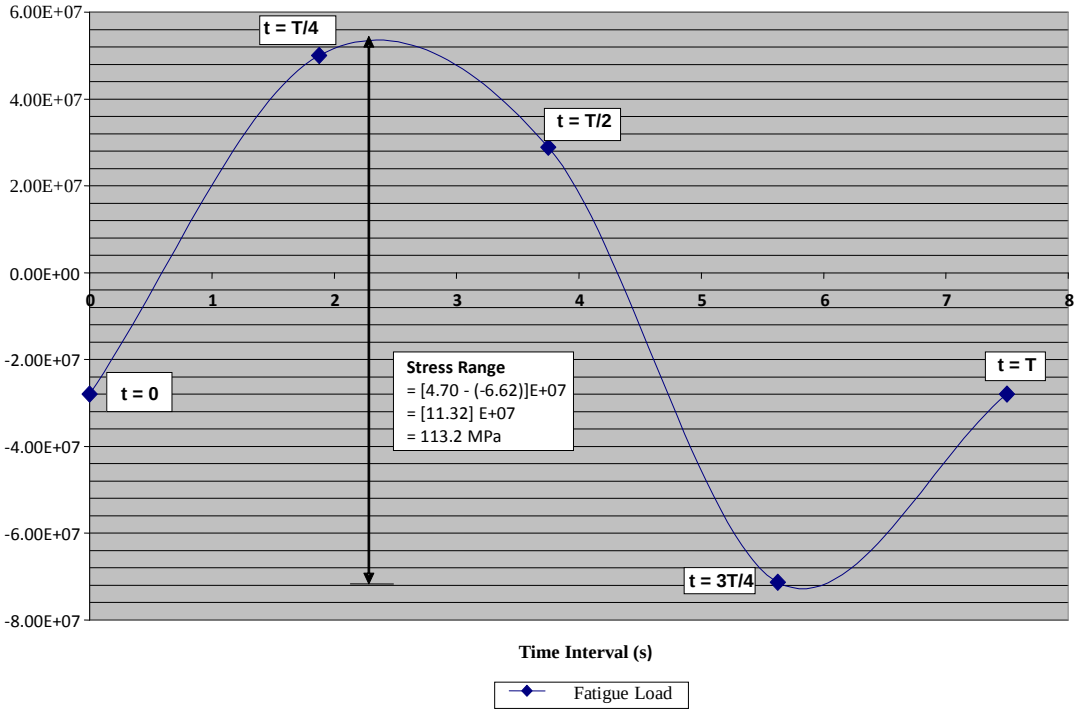

Figure 7: stress range for element 253 at sea state 6

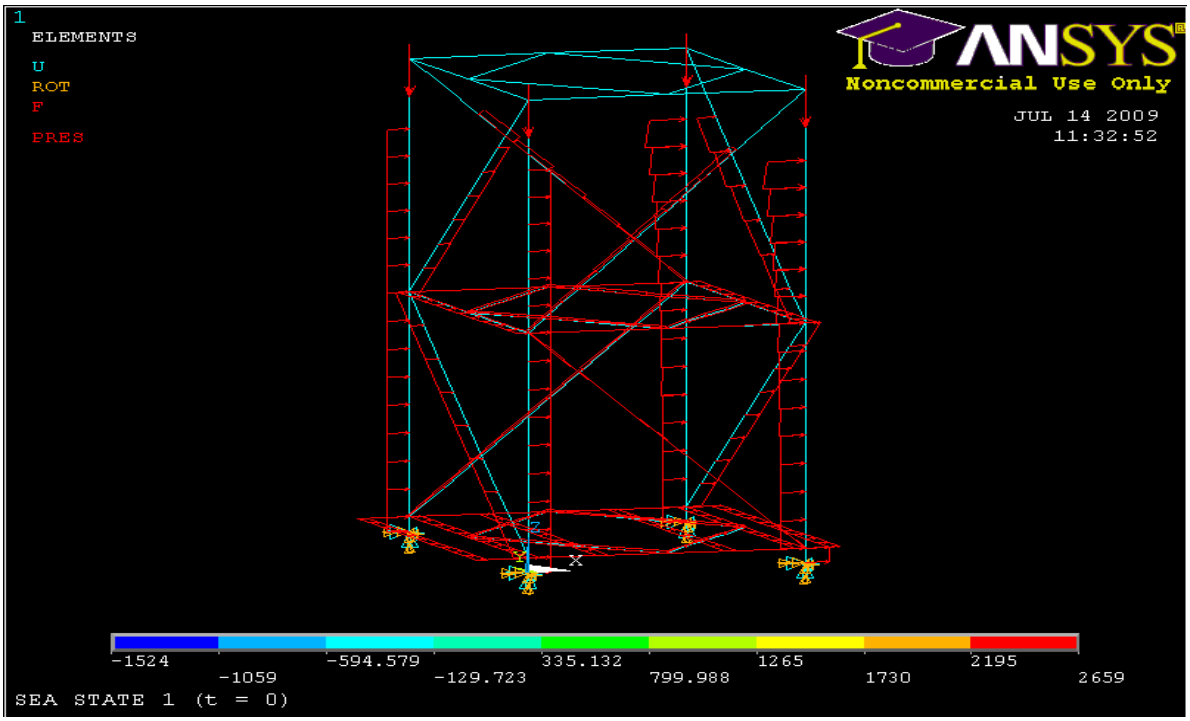

Figure 8: model with applied pressure loads, sea state no.1, t = 0

Table I: Environmental Data

			Return periods (yrs)	
			1	100
Max. wave height in the sea state Hs	H_{max}	m	4.8	7.1
Expected associated or spectral peak wave period	T_p	sec	15.3	15.7
1 hour average mean wind speed	U(1hr)	m/sec	12.0	16.3
1 minute average mean wind speed	U (1min)	m/sec	19.6	32.3
Highest 3 seconds gust in the hour	U (3sec)	m/sec	21.5	35.5
Surge		m	0.25	0.5
Surface current		m/sec	1.04	1.44
Current at mid-depth		m/sec	0.87	1.21
Current at 1m above sea level		m/sec	0.50	0.69

Table II: Most Probable Wave Heights and Time Periods for Different Sea States (Area 59)

Sea State	Hs (m)	Tp (sec)	ζa (m)	t (sec)	k
1	1	5.5	0.5	4.125	0.133
2	2	5.5	1	4.125	0.133
3	3	6.5	1.5	4.875	0.0961
4	4	7	2	5.25	0.08371
5	5	7.5	2.5	5.625	0.0739
6	6	7.5	3	5.625	0.0739

Table III: Wave Scatter of Area 58, Jan - Dec, ALL DIRECTIONS

Sig Hgt (m)	31	169	311	270	143	54	16	4	1			Obs 1000
> 14												
13 to 14												
12 to 13												
11 to 12												
10 to 11												
9 to 10												
8 to 9												
7 to 8												
6 to 7												
5 to 6												1
4 to 5			1	1	1	1						5
3 to 4		1	6	11	10	6	2	1				36
2 to 3	1	12	46	64	46	21	7	2				198
1 to 2	8	78	176	156	75	24	6	1				524
0 to 1	23	78	83	39	11	2						236
	< 4	4 ~ 5	5 ~ 6	6 ~ 7	7 ~ 8	8 ~ 9	9 ~ 10	10 ~ 11	11 ~ 12	12 ~ 13	> 13	
	Zero Crossing Period (s)											

Table IV: Fatigue Life of joint 33 of Element 253

Sea State	Stress Range x SCF (N/mm^2)	No. of cycle per year (n)	No. of cycle to failure in Seawater with Cathodic Protection $N_{(cp)}$	No. of cycle to failure in Seawater with Free Corrosion $N_{(FC)}$	Total number of cycle to failure, N	Fatigue Damage (D)	Estimated fatigue life (m)
1	59.60	1354108	1.50E+06	1.12E+06	2.62E+06	0.5168	1.93
2	61.00	3006579	1.50E+06	1.20E+06	2.70E+06	1.1135	0.90
3	71.50	961293	1.26E+06	1.12E+06	2.38E+06	0.4039	2.48
4	72.90	162296	1.21E+06	1.10E+06	2.31E+06	0.0703	14.23
5	116.60	21038	1.50E+04	1.30E+04	2.80E+04	0.7514	1.33
6	120.90	4208	1.25E+04	1.18E+04	2.43E+04	0.1732	5.77
					Total number of years =		**26.65**

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Robust Control of Welding Robot for Tracking a Curved and Straight Welding Line combined 3D

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Abstract: - This paper highlights a welding robot (WR) for its end effector to track a curved and straight welding line combined (CSWLC). The WR includes five actuators which use a DC motor as a power source. Two controllers are proposed to control the WR's end effector: a main controller and a servo controller. Firstly, based on WR's kinematic equations and its feedback errors using backstepping method the main controller is proposed to design the reference-inputs for the WR's actuators in order that the WR's end effector tracks the CSWLC. Secondly, based on the dynamic equation of WR's actuator, the servo controller is designed using an active disturbance rejection control method. Finally, a control system incorporated with the main controller and the servo controllers make the WR's end effector robustly track a CSWLC in the presence of the modeling uncertainty and disturbances during the welding process. The effectiveness of the proposed control system is proven through the simulation results.

I. INTRODUCTION

Nowadays, the robotic systems become widely used in welding applications which are harmful and dangerous for the welders. Furthermore, a robotic welding is very practical and useful in the industrial applications in the views of increasing the welding quality, productivity and reducing the welding cost. For example, Jeon, Park and Kim (2002) proposed a welding mobile robot for Lattice Type of Welding; Bui, Chung, Nguyen and Kim (2003) proposed an Adaptive Tracking Control of Two-Wheeled Welding Mobile Robot with Smooth Curved Welding Path; Santos, Armada and Jimenez (2000) developed a four-legged welding robot for welding a straight and smooth curved welding line which is applied in naval construction process; Ngo Manh Dung, Vo Hoang Duy, Nguyen Thanh Phuong and Sang Bong Kim (2006) proposed a welding robot for its end effector to track a rectangular welding line. The problem of these proposed welding systems is that they cannot perform their ability in a Curved and Straight type of welding line combined.

II. SYSTEM MODELING

This paper deals with the WR to weld a CSWLC which is shown in Figure 1-2. The WR's end effector is controlled by five mechanism actuators which use a DC motor as a power source. The movement of the WR's end effector can divide into three motions. One is a motion that makes the WR's end effector precisely track a vertical and horizontal welding line. Another changes the welding torch's direction as a value 90^0 at the corners for the welding torch to be perpendicular to the welding line. For improving the welding quality, the last one regularly and slightly shakes the welding torch for making the WR's end effector weave around a welding line with small amplitude. Moreover, during changing torch's direction at the corners, the welding signal, the first motion and the third motion are interrupted. Furthermore, before practical welding process, two welded base material parts are prewelded. So the opened straight welding line that is not a fillet type is usually distorted. The welding path is discontinuous with two edge corners. In spite of a straight line type in each continuous section, the total shape is a three dimensional one. When the practical welding is processed, the problem for measuring of the welding line is very complicated. To overcome this problem, a type of sensor detecting the tracking errors should be considered. In this paper, a control system for precisely tracking a reference three dimensional CSWLC even in the presence of the system's modeling uncertainty and the unknown disturbance is proposed. The

control system consists of a main controller and a servo controller. The main controller is based on backstepping method and the servo controller is based on Proportional Integral Derivative (PID) or Sliding Mode Control (SMC) method. The effectiveness of the proposed control system which is incorporated with the main and servo controllers is shown by simulation results.

■ Angle of torch's direction:

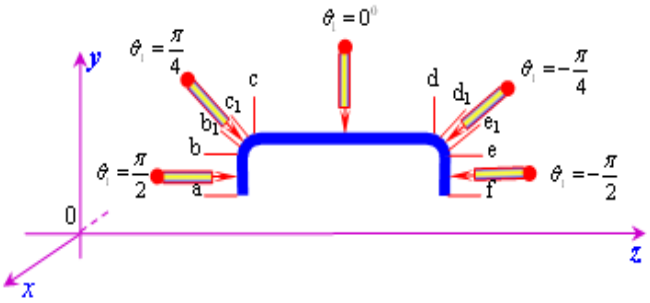

Fig 1. Welding line 2D and angle θ_1

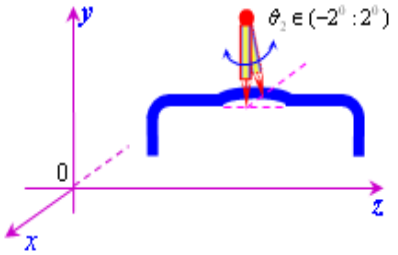

Fig 2. Welding line 3D and angle θ_2

The direction of the welding torch is assumed to be perpendicular to the welding line. The rotational angle of the torch holder's motor is assumed to be changed only at the corners. So while the WR's end effector is tracking a vertical and a horizontal welding lines the values of θ_1 are:

- $\theta_{1[a,b]} = \frac{\pi}{2}$ • $\theta_{1[b_1,c_1]} = \frac{\pi}{4}$; • $\theta_{1[c,d]} = 0^0$;
- $\theta_{1\_i+1[b,b_1]} = \theta_{1\_i[b,b_1]} - \frac{\pi/4}{b_1 - b}$;

where $i = 0,1,2,\ldots,n$ and $\theta_{1\_0[b,b_1]} = \theta_{1[a,b]}$

- $\theta_{1\_i+1[c_1,c]} = \theta_{1\_i[c_1,c]} - \frac{\pi/4}{c - c_1}$;

where $i = 0,1,2,\ldots,n$ and $\theta_{1\_0[c_1,c]} = \theta_{1[b_1,c_1]}$

- $\theta_{1[d,d_1]} = -\theta_{1[c,c_1]}$; $\theta_{1[d_1,e_1]} = -\frac{\pi}{4}$;
- $\theta_{1[e_1,e]} = -\theta_{1[b_1,b]}$ and $\theta_{1[e,f]} = -\frac{\pi}{2}$

■ The x axis tracking motor is designed to control the WR's end effector to track the welding line precisely. So the bound of θ_2 is assumed to be as follows $\theta_2 = \left(-2^0 \quad 2^0\right)$.

2.1 Configuration of the developed welding robot

The developed WR has five mechanism actuators which use a DC motor as a power source. The system's actuators are a vertical slider, a horizontal slider, a mechanism for x axis tracking motion which is shown in Fig 3, a mechanism of torch holder and a mechanism of weaving torch. Theses actuators above are operated by a vertical slider motor, a horizontal slider motor, a x axis tracking motor, a torch holder motor and a weaving motor, respectively. The function of each actuator is as follows: To weld vertical welding lines, the vertical slider is used to lip up and down the WR's end effector. To weld a horizontal welding line, the horizontal slider is used to shift the WR's end effector horizontally. To move the WR's end effector toward the directions perpendicular to the two sliders for tracking a distorted RWL precisely, the mechanism for x axis tracking motion is used. To keep the direction of the welding torch to be perpendicular to the welding line, the mechanism of the torch holder is used. The mechanism of the torch holder is a torch holder fixed on the axis of the gear box of the torch holder's motor. To improve the welding quality, the mechanism of the weaving torch is used as shown in Figure 3-4.

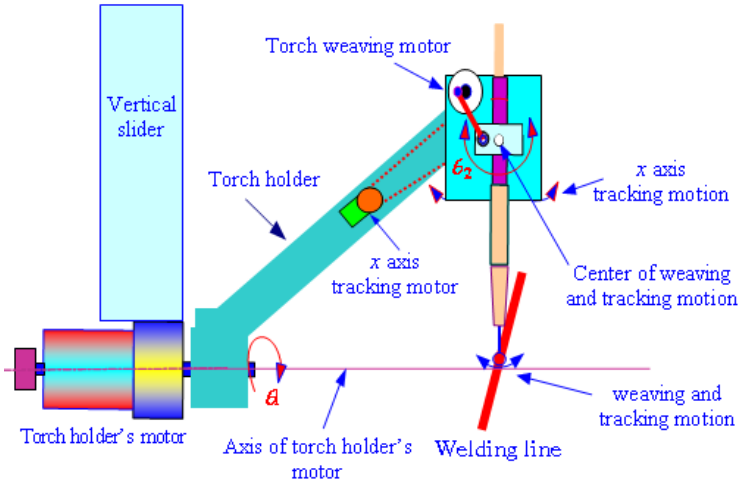

Fig 3. Mechanism of the torch holder and mechanism of the weaving torch

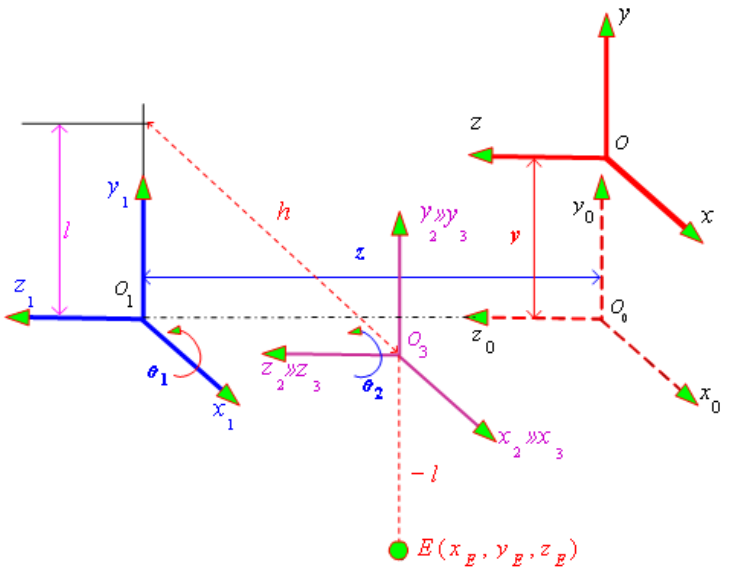

Fig. 4. Coordinate frames of the welding robot

2.2 Controllers Design.

2.2.1 Main controller

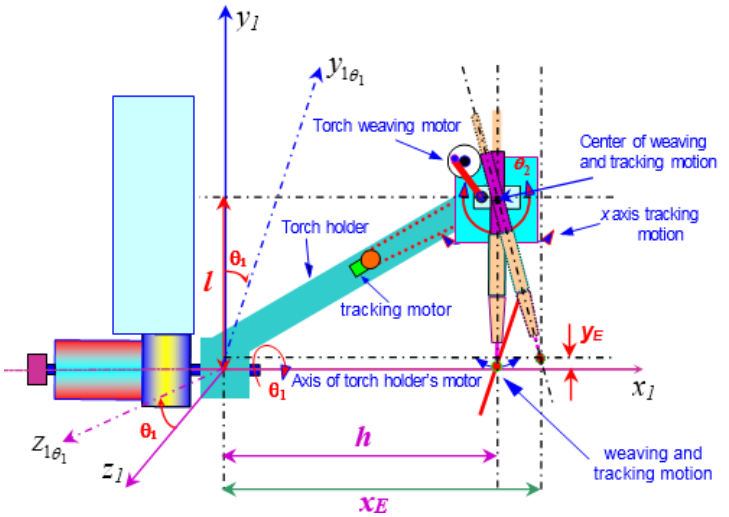

Fig 5. Mechanism of the torch holder and mechanism of the weaving torch

$$\begin{bmatrix} x_E \\ y_E \\ z_E \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta_1 & -\sin\theta_1 \\ 0 & \sin\theta_1 & \cos\theta_1 \end{bmatrix} \begin{bmatrix} l\sin\theta_2 + h \\ l\cos\theta_1(1-\cos\theta_2) + y \\ l\sin\theta_1(1-\cos\theta_2) + z \end{bmatrix} \quad (1)$$

The tracking errors e_i $(i = 1,2,3)$ are defined as follows:

$$\begin{bmatrix} e_1 \\ e_2 \\ e_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta_1 & \sin\theta_1 \\ 0 & -\sin\theta_1 & \cos\theta_1 \end{bmatrix} \begin{bmatrix} x_R - x_E \\ y_R - y_E \\ z_R - z_E \end{bmatrix} \quad (2)$$

(x_R, y_R, z_R) are the position coordinates of a reference point R moving along the CSWLC at a constant velocity $\mathbf{v}_r$ as shown in Figure 6. The projections of $\mathbf{v}_r$ on the x, y and z axes are v_{xr}, v_{yr} and v_{zr}, respectively.

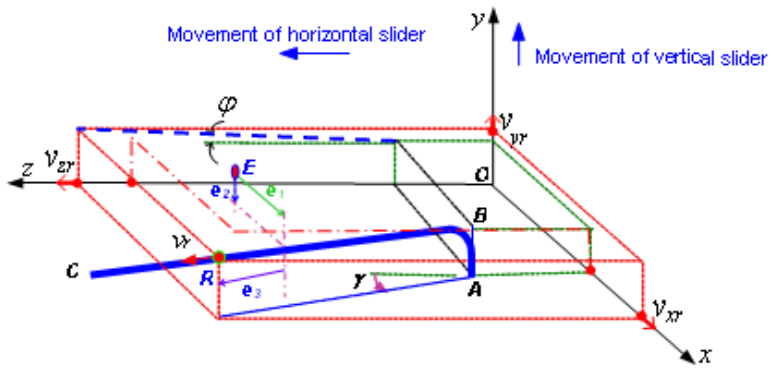

Fig 6. Reference point and tracking errors

$$\begin{cases} v_{xr} = v_r \cos\varphi \sin\gamma \\ v_{yr} = v_r \sin\varphi \cos\gamma \\ v_{zr} = v_r \cos\varphi \cos\gamma \end{cases} \quad (3)$$

γ Angle between projection of $\mathbf{v}_r$ on the plan (x, z) and the z axis , φ Angle between projection of $\mathbf{v}_r$ on the plan (y, z) and the z axis.

Based on the WR's kinematic equations, the first derivative of the tracking errors is obtained as follows:

$$\begin{bmatrix} \dot{e}_1 \\ \dot{e}_2 \\ \dot{e}_3 \end{bmatrix} = \begin{bmatrix} v_{rx} - \omega_2 l\cos\theta_2 \\ \cos\theta_1(v_{ry} - \dot{y}) + \sin\theta_1(v_{rz} - \dot{z}) + \omega_2 l\sin\theta_2 \\ -\sin\theta_1(v_{ry} - \dot{y}) + \cos\theta_1(v_{rz} - \dot{z}) \end{bmatrix} \quad (4)$$

where $\omega_1 = \dot{\theta}_1$ is zero during welding the vertical and horizontal welding line.

The Lyapunov function is chosen as follows:

$$V = \frac{1}{2}e_1^2 + \frac{1}{2}e_2^2 + \frac{1}{2}e_3^2 \geq 0 \quad (5)$$

The derivative of V yields:

$$\dot{V} = e_1\dot{e}_1 + e_2\dot{e}_2 + e_3\dot{e}_3$$

$$\begin{aligned} \dot{V} = {} & e_1(v_r\cos\varphi\sin\gamma - \omega_2 l\cos\theta_2) + \\ & + e_2[\cos\theta_1(v_r\sin\varphi\cos\gamma - \dot{y}) + \sin\theta_1(v_r\cos\varphi\cos\gamma - \dot{z}) + \omega_2 l\sin\theta_2] \\ & + e_3[-\sin\theta_1(v_r\sin\varphi\cos\gamma - \dot{y}) + \cos\theta_1(v_r\cos\varphi\cos\gamma - \dot{z})] \end{aligned} \quad (6)$$

As we know, the velocities of the vertical and horizontal sliders are controlled by angular velocities of DC motor. The relationship between them is as the following:

$$\begin{cases} \dot{y} = k_y\omega_y \\ \dot{z} = k_z\omega_z \end{cases} \quad (7)$$

An obvious way to take the control outputs of the main controller, ω_2, ω_y, ω_z, θ_1, ω_w are chosen as follows

$$\begin{cases} \omega_2 = (v_r \cos\varphi \sin\gamma + k_1 e_1)/(l\cos\theta_2) \\ \omega_y = \dfrac{1}{k_y}\left[v_r \sin\varphi\cos\gamma + \cos\theta_1(l\omega_2 \sin\theta_2 + k_2 e_2) - k_3 e_3 \sin\theta_1\right] \\ \omega_z = \dfrac{1}{k_z}\left[v_r \cos\varphi\cos\gamma + \sin\theta_1(l\omega_2 \sin\theta_2 + k_2 e_2) + k_3 e_3 \cos\theta_1\right] \\ \theta_1 = \left\{-\dfrac{\pi}{2} \quad 0 \quad \dfrac{\pi}{2}\right\} \end{cases} \quad (8)$$

From Eq. (6) and Eq. (8), the following equation is obtained.

$$\dot{V} = -k_1 e_1^2 - k_2 e_2^2 - k_3 e_3^2 \quad (9)$$

Clearly if $k_i > 0$ ($i = 1,2,3$) and Eq. (8) are chosen,

$V \geq 0$ and $\dot{V} \leq 0$. It means that $e_i \rightarrow 0$ ($i = 1,2,3$) as $t \rightarrow \infty$ by Lasalle's invariance theorem and Lasalle-Yoshizawa theorem *(Utkin, Guldner, and Shi, 1999).* That is, the system is stable in the sense of the Lyapunov under the conditions of $k_i > 0$ ($i = 1,2,3$) in Eq. (9).

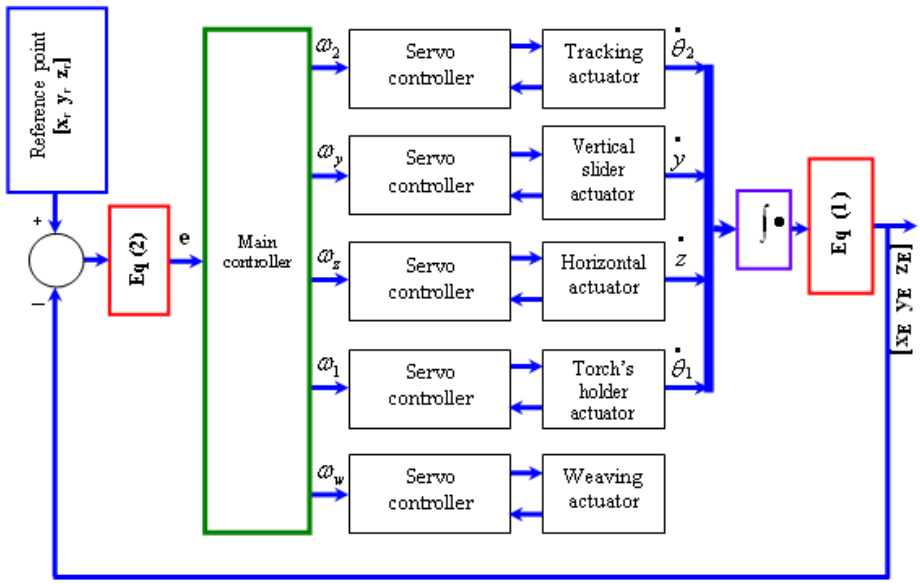

Fig 7. Block diagram incorporated with the main and servo controllers

2.2.2 Servo controller design

PID controllers have a simple control structure, inexpensive cost, many proposed systematic tuning methods, and have been used for more than half a century. However, when the system is nonlinear but known or where there are bounded uncertainties in the system, PID controllers are not perfectly able to stabilise the system, particularly, when the nonlinearity is very high or the bound of uncertainty is large.

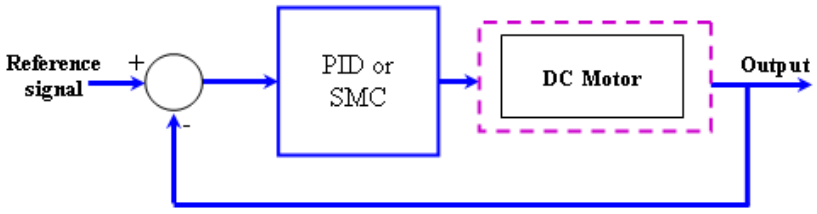

Fig 8: The block diagram a DC motor with PID or SMC system

The PID algorithm is:

$$u(t) = K_p e(t) + K_i \int e(t)dt + K_d \frac{de(t)}{dt} \qquad (10)$$

Proportional gain, K_p, Integral gain, K_i *and* Derivative gain, K_d

Sliding mode control, or SMC, is a form of variable structure control (VSC). It is a nonlinear control method that alters the dynamics of a nonlinear system by application of a high-frequency switching control. The state-feedback control law is not a continuous function of time. Instead, it switches from one continuous structure to another based on the current position in the state space.

A state space representation of The dynamics of a DC motor may be expressed as:

$$\begin{bmatrix} \dot{\omega} \\ \dot{I}_a \end{bmatrix} = \begin{bmatrix} -\frac{B_m}{J_m} & \frac{K_i}{J_m} \\ -\frac{K_b}{L_a} & -\frac{R_a}{L_a} \end{bmatrix} \begin{bmatrix} \omega \\ I_a \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{1}{L_a} \end{bmatrix} E_a \qquad (11)$$

Let

$$x_1 = \omega,\ x_2 = I_a,\ a_1 = -\frac{B_m}{J_m},\ a_2 = \frac{K_i}{J_m},$$

$$a_3 = -\frac{K_b}{L_a},\ a_4 = -\frac{R_a}{L_a},\ b = \frac{1}{L_a},\ u = E_a$$

Then the system (11) can be written as:

$$\begin{cases} \dot{x}_1 = a_1 x_1 + a_2 x_2 \\ \dot{x}_2 = a_3 x_1 + a_4 x_2 + bu \\ y = x_1 \end{cases} \qquad (12)$$

Select the sliding surface:

$$s = c(r - x_1) + a_1 x_1 + a_2 x_2 \quad \text{where } c < 0 \qquad (13)$$

The sliding mode control is:

$$u = -Ksign(s) \quad \text{where K > 0} \qquad (14)$$

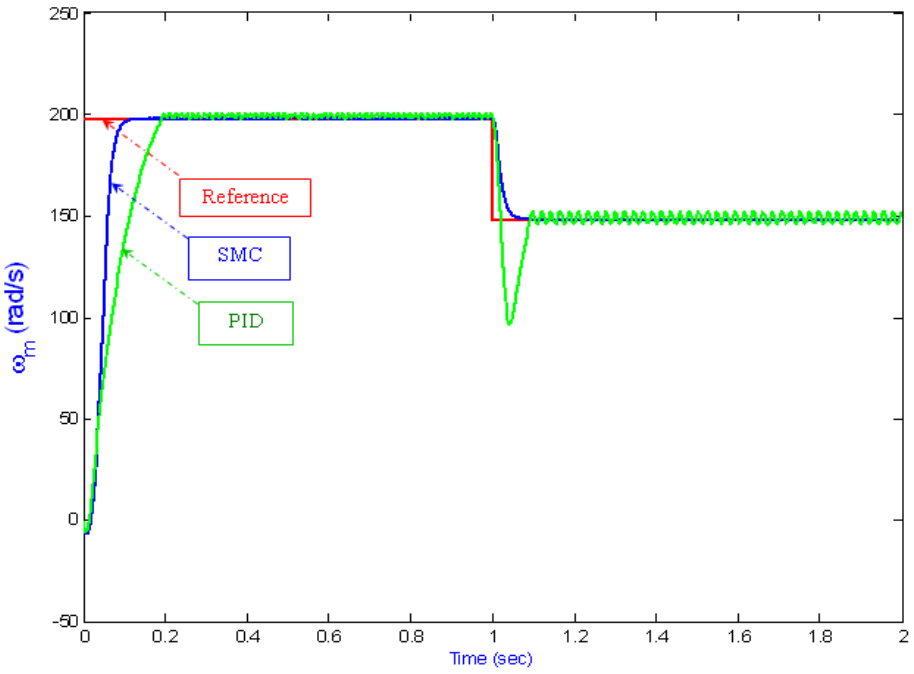

Fig 9. Simulation results of angular velocities of the actuator's DC motor

III. SIMULATION RESULTS

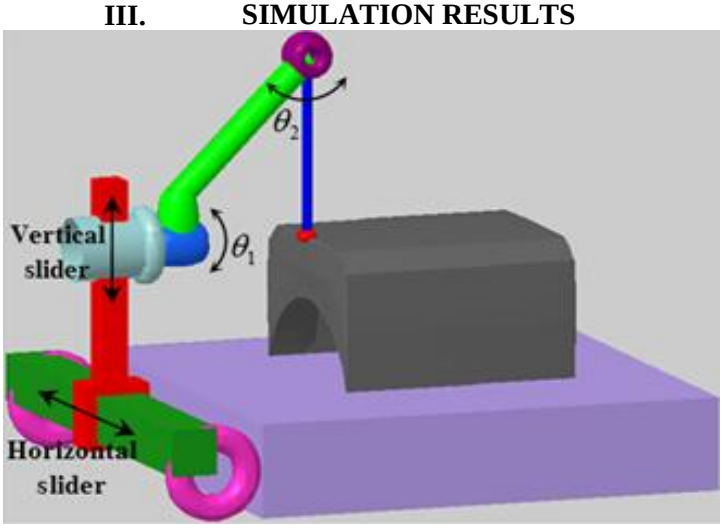

Fig 10. Welding robot

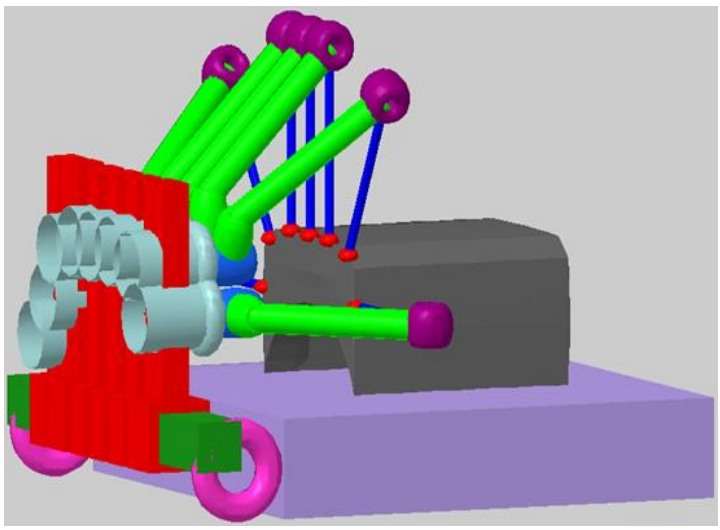

Fig 11. The WR is tracking along the welding path

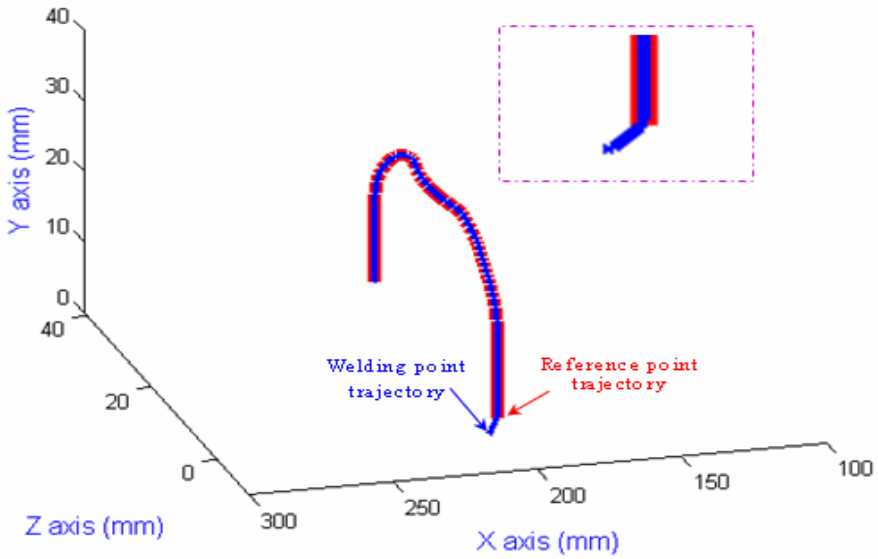

Fig 12. Results of trajectories of the end effector and its reference

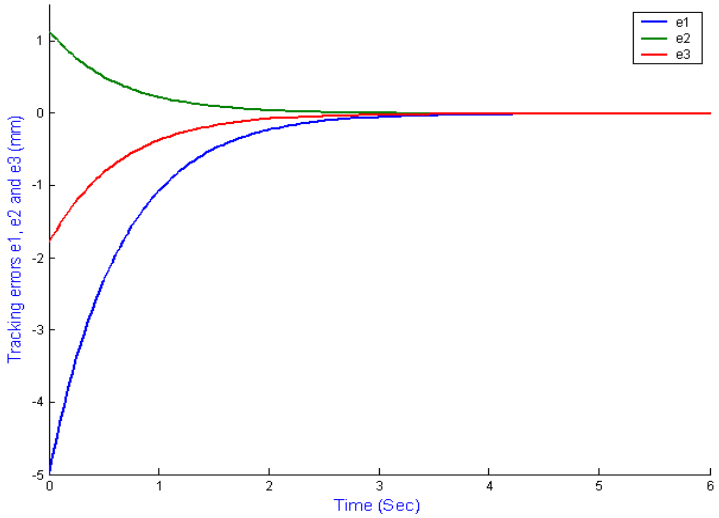

Fig 13. Results of the tracking errors at the beginning

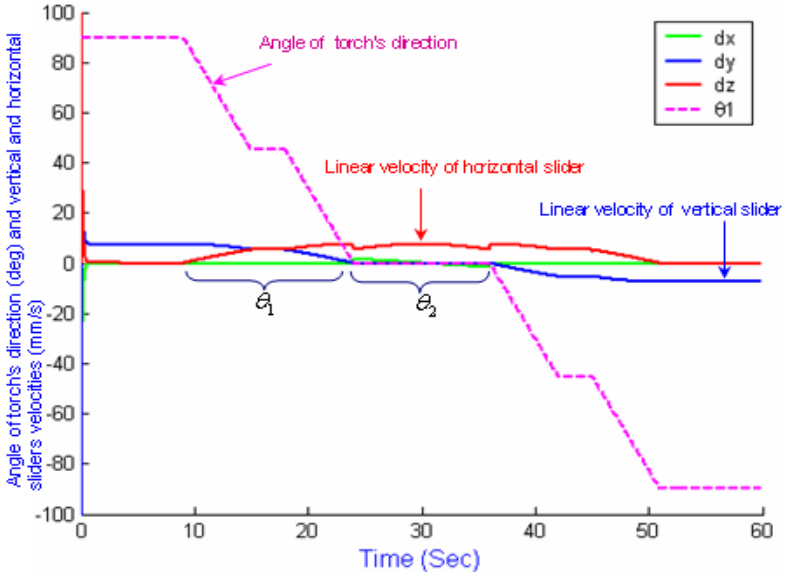

Fig 14. Linear velocities of sliders and rotational angle of the torch holder motor

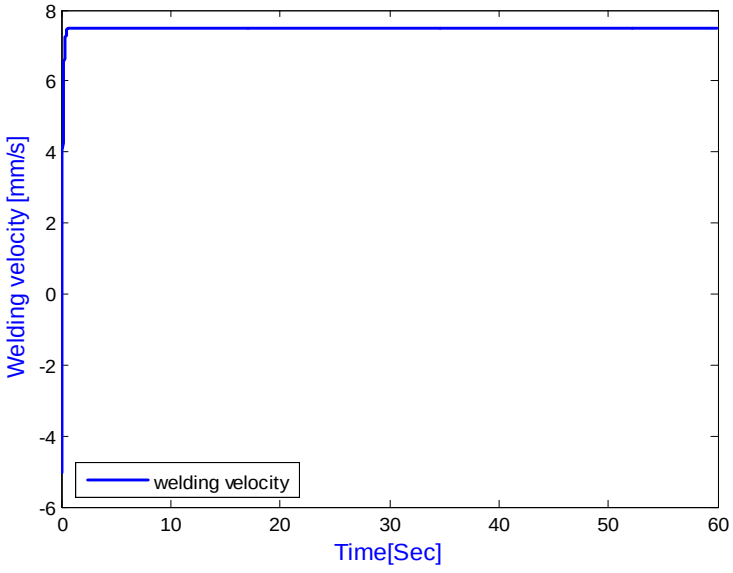

Fig 15. The velocities of the welding point

In Figure 10, Configuration of the developed welding robot. Figure 11-12, the trajectory of WR's end effector tracking the RWL with the initial values of errors e_1 = -5*mm*, e_2 = 1.1*mm* and e_3 = -1.8*mm* is shown. Figure 13, the simulation results of tracking errors of e_1 , e_2 , e_3 at beginning is shown. All the tracking errors converge to zero after three seconds. So it is shown that this result can apply to welding process. Figure 14 shows the whole movement process of vertical slider and horizontal slider and the rotational angle of the torch's holder. Figure 15 shows the end effector track along a welding trajectory with a constant velocity 7.5mm/s in the whole welding process.

IV. CONCLUSION

In this paper, a robot for welding a CSWLC is developed. A control system incorporated with the main and servo controllers is proposed to control the WR's end effector for tracking a CSWLC. The main controller is designed based on backstepping control method using Lyapunov function. The servo controller is designed for using SMC control method. The incorporation of two controllers makes the WR's end effector track CSWLC robustly. The system is stable in the sense of Lyapunov. The simulation results show that proposed control system has good performance.

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Process Constraints and Integrity Evaluation of Quasi-Structured Composites In High-Strength Steel Welded Joints

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***Abstract*: -** In this study, weld integrity has been viewed in terms of ability to withstand load transmission and distribution in post weld heat treatment conditions. This concern is necessitated by the fact that some industrial applications require metals that can be used in continuous elevated temperature conditions. Sometimes these metals are joined together by various forms of welding alternatives. The key issue in this constraints evaluation has to do with the integrity profile of the welded joints on prolonged engagement under elevated temperatures. Evaluation of this feat has been understood to be achievable by the weld process constraints optimization as analyzed below.

Keywords: *- weld integrity, characteristic heterogeneities, compromised integrity, energy matrix, reactive diffusibility, metallic composites*

I. INTRODUCTION

Process constraints with respect to welding conditions has to do with critical specifications and technical requirements in the areas of heating and temperature control, rate of heat application, thermal properties of base and filler metals (which controls and enhance temperature distribution in the joint). In this list are also, infrastructure and grain size of welded joint, degree of prior cold work on the metals; rate of cooling and solidification after welding, operational and technical requirements relative to specified weld type and operations. Thus, process constraints define the operational limits allowable for the achievement of standardized weld design that is responsive to the adopted weld strategy.

It should therefore be pointed out that the high point of welding practice has to do with fracture toughness which is dependent on the extent of microstructure and non-metallic inclusions [1]. Further, other thermodynamic and chemical agents such as segregated metallic microphases, nitrogen, and hydrogen and impurity elements can result embrittlement of the welded joint. In view of the foregoing, it is imperative to state that the principal essence of these process constraints enunciated above is quality and consequent *weld integrity*. Therefore, the extent of this integrity can only be ascertained by conscious evaluation of performance characterizations and indices of the defined parameters of interest. Thus, integrity evaluation for welded joints would be greatly influenced by geometrical and matrixial co-ordinates, which would instructively reveal the presence of cracks, residual stress, non-metallic inclusions, metallic oxides films and voids due to gas entrapments [2] [3].

It is therefore important to note that when these process constraints are optimized, the tendency for enhanced weld integrity is highly significant. This implies that weld profile integrity is crucially dependant on the ability to exercise relative and extended control over these constraints [2]. Conversely, failure to keep these constraints within defined limits would result the emergence of quasi-structured bi-, tetra-, and poly- metallic composites with *characteristic heterogeneities* resulting varying nucleation, grain boundaries and thermodynamically defective grain orientations [3].

In view of the foregoing assertions, suffice it to mention that while weld joints are intended to be alloys with improved mechanical and thermal properties (that are supportive of load transmission and distribution); *compromised integrity* resulting quasi-structured metallic orientations fall below this requirement and thus restructures the energy flow matrix at such joints. The cumulative effect of such grain boundary redefinition is a weld joint with *marginal* metallic and thermal properties, which upon integrity evaluation can be better referred to as quasi-structured metallic composites, rather than characteristic weld joints. It should be noted that this

study is based on high-strength steel welded joints referred to as H_{factor} steel. This imply that the characterization of H_{factor} weld metals are critically dependant on their metallic composition, microstructural orientation and proclivities in the forms for non *metallic singularities*, (as in silicate contaminations), aggregates and clusters (as in aluminum content inclusions), [4], [5] .

As would be seen later, these quasi-structured metallic orientations are also the result of anti-bonding gaseous presence entrapped within orbital delineations. Characteristically, the diffusibility of these gases is significantly low and this account for their ability to assume partially empty spaces within the *weld energy matrix* of the lattice structure of the weld. These voids are component by-products of chemical reactions between alloying agents of filler metals in contact with base metals [2].

However, these voids contribute to the problems of porosity in the sense that during solidification of the molten weld, gases resulting from high temperature chemical reactions find ways to exit the complex structures where liquid metal solubility does not encourage *reactive diffusibility*. When this happens, voids occupied by these gases aggregately contribute to uneven complicated structural dispositions, considered in this paper as quasi-structural composites of weld microstructure. The structural effect of these developments is low profile weld integrity that is not supportive of the H_{factor} internal stress requirement in high tension steel fabrications.

II. EXPERIMENTAL EVALUATION OF WELD PROCESS CONSTRAINTS

Process constraints in weld situations have been viewed as *allowable tolerance limits in the area of temperature control, thermal and mechanical property specificities*, etc. A test case pursuant to ASME B31.3-2006 for 5% Cr-0.5% Mo weld joint has been analyzed [6] based on the position that the sequestration of the constituents of martensite in exchange for a structure with significant plasticity defines a better applicable material [7] in terms of toughness as indicated by a depleted internal stress which also reduces hardinability. The requirement for this comparative treatment revolves around material behavioral studies that have been conducted under varying degrees of thermal exposure of 5%Cr -0.5% Mo steel. The unserviced specimen as indicated in Fig. 1 below show raw Cr-Mo weld, that is yet to be heat treated.

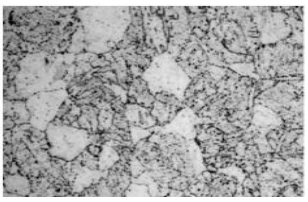


Figure 1: Unserviced cutout of Cr-Mo steel

A careful study of Fig. 1 would reveal a microstructure of ferrite bounded with carbides having clearly defined mixture of ferrite and carbides of SiC, TiC, Mo_2C, etc. It should be noted that the heterogeneous nature of these scattered carbides constitute metallic inclusions which in the view of this study tantamount to *derivative quasi-structured metallic composites* in varying grain sizes and shapes.

2.1 Post-weld microstructure (temperatures ranging: 400°C-500°C)

Further, as could be observed in the specimen below i.e. Fig. 2; the specimen is the result of solid 5%Cr -0.5% Mo steel weld deposit with controlled post-weld heating operation. It shows structural arrangements akin to *ocicular shapes* that are degrades of austenite and have undergone structural transmutation to martensitic profiles and patterns. The location of carbides could be noticed around the ocicular patterns in the form of dark plate-like patches. This figure further illustrate the integrity profile of Cr-Mo steel when exposed to post-weld temperatures between 400°C and 500°C for time limits between 1hr - 2 hrs.

Figure 2: structural ambivalence of weld joint under post-weld heating (T = 400°C - 500°C)

A comparison of Fig. 1 and Fig. 2 would reveal a partially bleached pattern indicative of the effect of temperature in creating a passive alignment of metallic inclusions in the form of carbides. Thus, thermal characterization of the foregoing implies a process constraint intended to sequestrate the composite structure. In this regard, Fig. 2 therefore is a structural refinement process that reduces the integrity of the microstructured weld deposit and also reduce its hardinability.

2.2 Post-weld microstructure (temperatures ranging: 500°C-700°C)

The third stage of this process constraints evaluation to define relative weld integrity conditions requires an increase in temperature from 500°C to 700°C. The remarkable structural implication of this increment in the refinement process is phenomenal as could be seen in Fig. 3 below. In this figure, thermodynamic and chemical reaction forces results same structure alignment and thus has occasioned an undefineable orientation for the metallic inclusions.

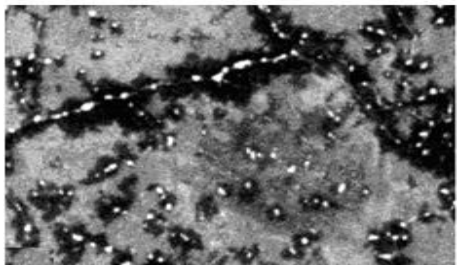


Figure 3: Structural ambivalence of weld joint under post-weld heating (T = 500°C - 700°C)

Thus, a thermal forcing function on the post-weld molten deposit material has resulted a transformation of martensite into a material with better thermal and mechanical properties. As could be seen, the ferrite grains have been sequestrated from the carbides which have formed lines, curves and inclusion sites within ferrite matrixes.

2.3 Post-weld microstructure (temperatures ranging: 700°C-800°C)

In the last stage of this test, temperature was raised from 700°C to 800°C for an extended period of about 8 hours and Fig. 4 emerged indicating clearly defined boundaries of carbides enclosing ferrite grains.

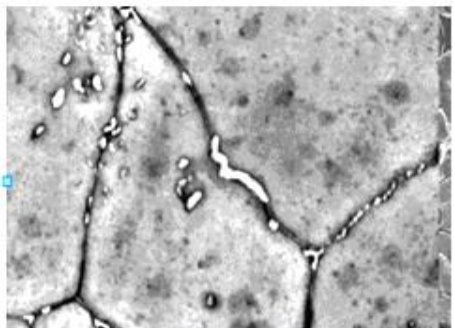


Figure 4: structural ambivalence of weld joint under post-weld heating (T = 700°C - 800°C)

Thus, the formation of chain and branch network of inclusions that are irregularly distributed along and around the steel material establishes the fact that the refinement process results a restructuring of the grain boundary and re-alignment of the metallic inclusions. The gross effect of this re-orientation being a reduction in hardinability due to cumulative depletion of internal stress, which are contributed by the unevenly distributed presence of the inclusion materials. Conversely, toughness increases per μm^2 of the refined weld profile, thus impinging on the integrity of the solid weld deposit.

III. DISCUSSIONS

The study shall therefore correlate the relative influence of elevated temperatures on the weld inclusions and how this influence compromises and affects the integrity of the weld in terms of design serviceability. It is therefore imperative to note that, inclusions were originally intended to enhance the strength and hardinability of the welded joints. Bearing this in mind, the result of the assessment could then be used to predict a possible failure time or rate of such welds when exposed to constant temperature operations.

3.1 Analysis: Structural integrity implication of unserviced specimen

As mentioned earlier, Fig. 1 represent the unserviced cutout piece of ASTM A387 5% Cr- 0.5% Mo alloy whose chemical composition as detailed in Table 1, below favor reactivity within the *p* and *d-orbitals.*

Table 1: Chemical Composition of ASTM A387 H_{factor} Steel

Elements	C	Mn	P	S	Si	Ni	Cr	Mo	V
Composition in % wt	0.33-0.43	0.20-0.50	0.030	0.030	0.80-1.20	0.30	4.75-5.50	1.10-1.60	0.30-0.60

In the said Fig. 1, the circulation of the carbide particles on the general surface of the Cr-Mo alloy indicate evenly distributed internal stress which generated hardinability but with reduced toughness. In addition, the presence of varying degrees and types of inclusion further creates boundaries and delineations around the ferrite particles. These boundaries are signs of insolubility of the inclusion particles in the alloy metal microsturcture. This microstructure thus supports the requirement for austenitic formation under volume fraction relativity [8] expressed as;

$$V = \frac{\pi d^3}{6} . N_v \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where the harmonic mean of inclusion diameter, *d* and the number of inclusions per unit volume, N_v were found by a proposed model, and which further yields [9]:

$$Nv = \frac{2}{\pi} . \frac{N_A}{d} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\frac{1}{d} = 1/n \sum 1/d_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where d_i is the apparent diameter of the i^{th} inclusion among the *n* inclusions, N_A is the number of inclusion per unit area. Pursuant to the foregoing, it is imperative to state that the utilization of scanning election microscopy (SEM) revealed inclusion sizes between 0.2 µm and 6.0µm in diameter and as such explains the reason for the nucleation of intragranular ferrites.

Further, the profound presence of non-metallic inclusions in this specimen also implies a significant density when compared with purer materials. Thus, these inclusion locations can better be seen as nucleation sites for voids on the event of thermodynamically induced migration based on *surface potentiations* and differences. Hence, weld integrity under the consideration of high internal stress is higher under post-weld operational regimes devoid of post-weld heating conditions.

3.2 Analysis: Structural integrity implication for specimen at: $T \leq 500^0C$

In Fig. 2, structural rearrangements due to temperature at $T \leq 500^0C$ resulted a more evenly distributed pattern of extended white patches bounded by dark patterns of irregular orientations. In this regard, the chemostructrial consequence of elevated temperature implies an increased mobility condition for the inclusion particles; with migrations from areas of low density to areas of high or accumulated density. Thus, while anti-bonding conditions (except for partial affinities) are prevalent between particles of inclusion and the alloying metals (the Cr-Mo particles); bounding conditions are widespread among the inclusion particles and this is achieved by a thermodynamically propelled coagulation of inclusion particles. The implication of Fig. 2 to the integrity of the welded joint is that the thermodynamic migration and consequent *limited dispersed coagulation* streamlines the hardnability of the welded joint in such a disequilibrium of internal stress, characterized by strength profile segmentations, thus reducing the overall weld profile integrity.

3.3 Analysis: Structural integrity implication for specimen at: $T \geq 500^0C \leq 700^0C$

It has been observed that phenomenal structural result accompany an increased temperature profile above 500^oC but not exceeding 700^oC. Thus, Fig. 3 depicts a strength demographic sequence of inclusion outlay indicating scattered sites and network of chains formed; this formation is in line with earlier stated reasons. The network of chains thus implies, areas of marginal strength for which, the weak Cr-Mo/inclusion affinity exposes the microstructure to failure due to reduced internal stress.

If should be pointed that while toughness has improved, hardinability has reduced. The possible explanation for this condition is that during the rising temperature from 500^oC to 700^oC, the *nucleation sites* of the inclusion constitute areas of lower energy potentials, due to thermal conductivity along matrixial lines. Thus,

inclusion distribution sites with aggregate higher energy potentials due to density of inclusion particles exert energy drag on the scattered inclusion particles adjourning those aggregates. Further, due to the weakness in the bonding between inclusion and metallic orbitals of the Cr-Mo complex, temperature rise breaks the affinity and the inclusion particles find their way to the aggregate locations where they further re-characterize the weld strength profile.

The implication of the foregoing is that, since the presence of inclusions increases melting point and hardinability, the absence of inclusion reduces tensile strength due to compromised internal stress of the alloy. This also means that the more there is increase in the number of inclusions the more there is increment in the melting point due to varying contributions of the various inclusions to the melting points of the alloy.

3.4 Analysis: Structural integrity implication for specimen at: $T \geq 700^0C \leq 800^0C$

As the test progressed, it should be noted that for period exceeding 7hrs but less than 8hrs, and constant temperature above 700°C but not below 800°C, the microstructure in Fig. 4 was noticed. In this figure, the network of chains indicating inclusion coagulations are more defined and looking much like defined fault lines. Further, this paper is of the view that the network of inclusion sites are energy sinking locations since a weak affinity exist between inclusion particles and the particles of Cr-Mo. Thus, the weakest point in the outlay of the microstructure is the boundary between inclusion particles and the Cr-Mo orbitals.

IV. YIELD STRENGTH DETERMINATION

In view of the foregoing, an empirical determination is necessary to validate the position that weld integrity in terms of hardinability reduces with prolonged constant temperature over a period of measured time. In this regard, a temperature (T) and time (t) dependant calculation using equation (4) [10] expressed as:

$$P = T\,(20+\lg t) \times 10^{-3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

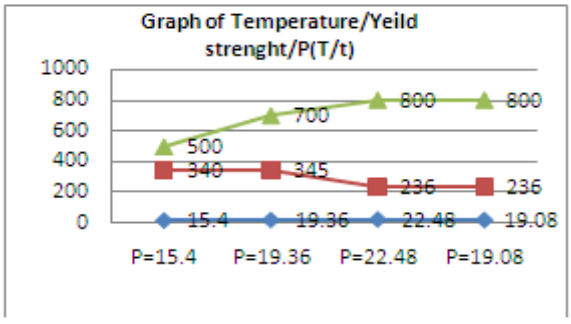
and defined for the three temperature ranges (that has been discussed), resulted the following table which are fundamentally in agreement with other related studies [6], [7], though with negligible disparities.

Table 1 Temperature / Time Parameter Evaluation

Test Stages	Heating per hour °C	Cooling per hour °C	Temp. range °C	Exposure time hrs	P (T/t)	Yield strength Mpa (approx)
Test :1	50	100	400	1 - 2	15.40	340
Test :2	50	100	500 - 700	≤ 7 ≤ 8	19.36	345
Test :3	50	100	700 - 800	≤ 8	22.48	236

From Table 1 above and Fig. 7 below, it could be seen that increase in temperature and time facilitated the formation of carbide inclusions at the irregular boundary locations delineating the alloys and this also implies that the sequenced structure of the Cr-Mo alloy wherein the inclusion particles have aligned themselves away from the original evenly scattered situations has a direct impact on the yield strength of the weld. This is observable from Fig. 7 where the center line (yield strength) indicates a downward trend as the upper line (temperature) rises. And when temperature was kept constant at 800°C the Yeild strength was also seen to maintain a straight line at 236 Mpa, implying that the integrity of the weld joint is directly affected by rise in temperature.

Figure 5: Graph of T/Ys/P(T/t)



V. CONCLUSION

The *P(T/t)* parameter line at the lower end of Fig. 7 appears evenly spread out, due to the closeness of the values. The difference would have been more noticeable if more test exposures were recorded, implying that as heating and temperature rise progresses, the austenitic profile of the weld transforms into other composite microstructures that over a period of operational life would not be able to sustain the load transmitting and distribution capacity it was designed to support. Thus, increasing temperature is reducing weld integrity due to re-alignment of internal stress factors of the intermediate microstructures of inclusion. Hence, further analysis of Fig. 7 at the extended point of T= 800^{o}C and Ys=236 MPa, shows that for every 3.4^{o}C rise in temperature, 1 MPa of weld integrity (strength) is lost.

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Chemostructural Conditionalities for Welderbility in Nickel-Chromium Sequenced Dual Nucleation

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***Abstract*: -** The structural conditions required to form and sustain a weld is dependent on the dynamics of chemical combinations using heat as a catalyst in some instances and weld types. The relevant combinatorial for this to happen in the Nickel-Chromium complex have been considered and results have shown that internuclear forces are principally critical in order to sustain the chemostructural equilibrium required to maintain a weld. Thus, a weld is degraded in value and strength when, due to a rise in temperature, this balance is compromised and the valence space factor μ is *depotentiated above its existential ambivalence*. Consequently, welderbility conditions require that the chemical compositions of a weld remain within the limits of allowable tolerance.

Keyword: *- thermochemical forces, contributory strength, solid fluids, electron cloud, valence space factor, nucleation*

I. INTRODUCTION

Chemostructural conditionalities in relation to welding and weldability results from the fact that welding revolves around the practice of chemical reactions and bonding between constituent metallic elements or alloys at elevated temperatures; while subjecting the entire process to predetermined conditions that are structurally supportive to the intendment of the design. The foregoing implies that an understanding of the reactivity or chemical combinations of these constituent elements is principally critical to a better application of fusion welding. Thus, chemostructural conditionalities with respect to this paper refers to the intrinsic values and characteristics required for the reversible equilibrium of reacting elemental combinations, that are dependent on temperature rise and the fluidized properties of metals and their alloys.

As the study would reveal, the essence of temperature in welding conditions borders on the thermochemical requirements for dislocation of intermolecular binding energies; which upon achievement is a very instrumental conditionality in terms of reactivity with other elements.

The study shall consider the relative nature of these reactions that are dependent on temperature rise and how this requirement enhances the manufacture of engineering materials with multi-attribute capabilities and characteristics-being contributory framework of their constituent components. This study is about the nature of the bonding of these metals in conditions of temperature rise and how this bonding results metallic fluids with varying fluidity indices that are relatively relevant to various engineering applications.

II. NATURE OF THERMOCHEMICAL BONDS IN WELDING PROCESSES

It has been stated that thermochemical bonds are complementary results of fusion energies observed during high temperature activities where metals bond with each other, based on specific conditions such as the Hume-Rothery Rule on chemical bonding in the case of *substitutional solid solutions* [1]. Thus, the rule requires that:
(i) the two metals must be of similar crystal structures and,
(ii) the difference in their atomic radii should be less than 15%.

It should be emphasized that this solute-solvent relationship also extend to *interstitial solid solutions* where the size of the solute atom is much smaller than that of the solvent atom, thus enabling the solute atoms to occupy interstitial positions. Consequently, two conditions apply, namely:
(i) the solvent atom must have more than one valence
(ii) the atomic radius of the solute must be less than 59% of the atomic radius of the atom.

In view of the foregoing, these rules guide the bonding requirements for alloys as in the case of steel where carbon atoms occupy interstitial positions between iron atoms in the sizes that are compliant with the stated rules. This is illustrated in the FeC combination, where the atomic radius of carbon is 0.071nm, that of iron atom is 0.124nm radius; the radius of carbon being less than 59% radius of iron. Considering this fact of chemical bonding and reactivity, it is safe to posit that, beside these identified *solid fluids*, there exist another group of solid fluids that are alloys in nature and they are referred to as *intermetalic compounds* and their type of bonds may range from metallic to ironic. Thus, weld electrodes and fluxes fall within these materials.
Further, these intermetallic compounds consist of electrons arrayed between cations such that internuclear forces of attraction of individual atoms exerts forces on these electrons based on affinity considerations resulting from their electropositivity relativities and thus binds them to one another in sequential and symmetrical dimensions that they impart and retain their structures. This determines the various properties associated with such materials.

Consequent on these rules, these chemical combinations are only made possible because the metal elements posses bonding orbitals that responds to the *Pauli exclusivity* correlations which asserts that, 'no more than two electrons may occupy any orbital and if two do occupy it, their spin directions must be opposed'. [2] In the line of this argument, a careful study of the *Aufbau principle* [2] draw attention to the fact that even though the *Pauli exclusivity principle* has made a categorical statement, the bonding of multiple atoms only distort the orbital resolutions which has no direct consequence to the exerting force of the nucleus on the electrons aligning the orbitals. Thus, the more contribution of electrons from individual atoms, the more the exerting pulls of the nucleus of all the atoms on all the electrons in the shared and distorted orbitals. This valence bond theory can be illustrated in the thermochemical bonding arrangement of stainless steel type 330; where composition is as follows: Ni-36%, Cr – 16%, Fe-52% [3]. The chemostructural conditions supporting this stainless steel material is as follows:

Cr: $(Ar)^{18}$	$3d^5\ 4s^1$	= 24 mobile valence electrons
Fe: $(Ar)^{18}$	$3d^6\ 4s^2$	
Ni : $(Ar)^{18}$	$3d^8\ 4s^2$	

Figure 1: Valence bonding electrons

A proper view of Fig. 1 would indicate that, the *Ligand Field Theory* would be more appropriate explanation in determining the combinatorial dynamics of the complex bonding and symmetrics resulting electrostatic and cris-crossing overlapping interactions that are characteristic of molecular orientations in metallic conditions. This implies that the strength of any bond depends on the degree to which the orbitals overlap each other. Relatively, for the Ni-Fe-Cr structure, the molecular overlap can be defined as:

$$S = \int \psi_A(r)\, \psi_B(r)\, \psi_C(r) d\tau \quad \ldots\ldots\ldots\ldots \quad (1)$$

Thus, this equation resolves the aggregate interdependences of the *thermochemical force vectors* and their energy components in the Ni-Fe-Cr lattice. Further, a careful observation of Fig. 1 reveals that all the reacting metals belong to the transition *d-orbital* group of metals, implying that their strength lies in the binding energies contained in their *d-orbitals*. Further, a total of 24 valence electrons are noticed to constitute an *electron cloud* and pictorially could be viewed as follows:

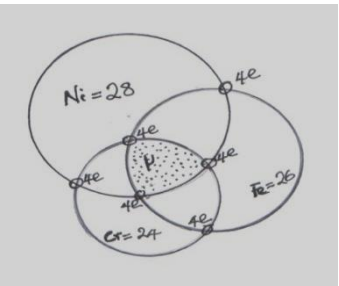

Figure 2: Molecular Overlap for Ni-Fe-Cr complex

It should be noted that the valence electron located at the *d and s* overlap, maintains a tetrahedral shape as in Fig. 2 above. The electron cloud of 24 *d and s* electrons are found to be arranged into four electrons (i.e. 4e) for every point of orbital overlap in the tetrahedral structure. It could be seen that these points of overlap are 6 in number representing 24 electrons. Atkins [2] observed that in a tetrahedral structure of this nature, some point of overlap are identifiable, having both positive and negative poles which this study observe, enables axial orientation during mobility and bonding. Further, it could also be noticed that while there are internal bonding due to the overlap of orbitals, there is also evidence of external bonding giving rise to a structure whose surface tensions are protective to the internal bonding. Thus, it would require a higher secondary external influence to depotentiate this internal bond. The paper views this constraint as a proclivity towards *dual nucleation.*

In view of the findings of this study, mobility and bonding are occasioned by temperature rise and chemical reactions. This paper therefore is of the view that, if the doted energy zone in Fig. 2 is geometrically analyzed, the area of a triangle enclosed by the overlap of the individual atoms is a unity, or an approximated unity within a bounded region $S \leq 1$ or $S \geq 1$. It should therefore be noted that the length of the sides of this triangle is dependent on the bond length of the constituent elements. This forms the basis for the approximation in the area of the triangle enclosed by the *valence space factor*, $\boldsymbol{\mu}$. Thus;

$$S = \int \psi_A(r)\, \psi_B(r)\, \psi_C(r) d\tau \geq 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The implication of Fig. 2 and its derivative equation (2) is that while the individual atoms in the combination exert nuclear forces of attraction on their valence electrons to maintain the required shape and strength, a defined zone, $\boldsymbol{\mu}$ (referred to as the valence space factor) exist where standard equilibrium conditions resulting the stability of the metal is guaranteed. Thus, $\boldsymbol{\mu}$ is the highest point of stability and strength, since it constitute a zone where *contributory strength* is in the order of (10:8:6)e; and definitive of the structural requirements of stainless type steel 330. Hence, the bonding conditions in this reaction results the following properties of this alloy [3]:

Table 1: Weldability Properties of Stainless steel type 330 (Ni-Fe-Cr)

Material	Nominal Composition (essential elements)	Yield strength 1000lb./ sq.in	Tensile strength 1000lb./ sq.in	Hardness, Brinell	Density, lb/cu.in	Specific gravity	Melting point,°F	Specific heat, B.t.u/(lb) (°F)	Thermal expvty. Coef.	Thermal cond. (sq.ft)(hr) (°F/in)
Stainless steel type 330	Ni 36,Cr 16, Fe bal	55	100 (hot) 80(annealed) 150 (cold)	200	0.284	7.86	2515	0.11	6.3 8.3	90

It should further be mentioned that the properties stated in Table 1 above enhances the weldability of stainless steel type 330 and as could be seen, the melting point of 2515°F implies an aggregate heating value necessary to cleave the Ni-Fe-Cr binding effects of the interposed bonds of Fig. 2 to the point where engaged molecular forces resulting $\boldsymbol{\mu}$ are broken and associated bond energies are released to enhance further reactivity with other elements within the reactivity range of the alloy. Further, effect of temperature could be seen in the fact that while tensile strength of the cold drawn material is 150 lb/sq.in, that of hot drawn is 100 lb/sq.in, implying that the binding energies in the bonds and most especially within the *valence space factor* $\boldsymbol{\mu}$**,** are broken to achieve the new structure after reaction.

III. DISCUSSIONS :BASE – FILLER COORDINATION IN WELDING CONDITIONS

Base-filler coordination has to do with molecular interactions between base metals or alloys and filler metals or alloys. Thus, the strength of welded joints depends on these thermochemical conditions. As could be seen in Table 1 above, 2,515°F of temperature is required to melt the Ni- Fe-Cr- alloy. This fluidity condition entails the use of heat from elevated temperatures to break metallic bonds and thus, occasion the release of the energies stored in those bonds. When this is achieved, atomic combinations between molecules become possible. In view of this possibility, it should be noted that nickel and nickel based alloys do not require pre-heating; but base metal temperature should be raised to 16°C or more to avoid moisture condensates that could result porosity at the weld joint [4].

In furtherance of the foregoing position, it is imperative to state that, filler metals do not have the same melting point as the base metals. This implies that, at the melting point of the filler metal, the base metal structure has been affected by the same heat and metallic bonds (of the base metals) at that point have been made weaker or broken. This thermodynamic condition is very critical to bond formation during welding. Thus,

if the orbital overlap in Fig. 2 above represent a welding point that has been affected by weld temperature (HAZ) and the filler metal is nickel based alloy or metal, valence electrons of the filler material thus proceeds to attach itself to the Nickel atom of the base material, and also attach itself to the other non-nickel atoms of the base material by donating its valence electrons to be shared in the coordination.

The bonding forces from these orbitals still utilize the *d-orbital* as discussed previously. As Table 2 below indicates, while the melting point of Cr is 1857^{o}C that of Fe is 1537^{o}C and Ni is 1455^{o}C, it would be more appropriate to use Nickel metal or alloy for the filler metal. This is because the melting point of the stainless steel type 330 Ni-Fe-Cr is 2515^{o}F.

Table 2: Constituent bonding and reactivity properties of Ni- Fe-Cr- alloy

Element	Cr	Fe	Ni
Electron Configuration	$3d^5\ 4s^1$	$3d^6\ 4s^2$	$3d^8\ 4s^2$
First Ionization energy (kJ/mol)	653	759	737
Bonding Atomic Radius (A)	1.27	1.25	1.21
Density (g/cm^3)	7.9	7.9	8.9
Melting Point (^{o}C)	1857	1537	1084

However, in an experiment to determine percentage availability of ferrite and austenite in the welded joint of Ni based alloy, it was suggested [4] that filler metals should be carefully selected to fall within the range of the base metal. This implies that temperature range should not be too far apart as to enhance chemical bonding between the orbitals of the combining or reacting metals. Regard therefore should be made to ensure that *thermal diffusibility* does not abolish the joint in the sense that a particular metal can completely diffuse in another as the case where Tin is the filler metal and Titanium is the base metal during temperature rise condition [1]. Studies have also reinforced the position that filler metals should be close ranged on base metals to achieve better results as this improved the *acicular ferritic conditions* (AFC) of the weld, [5,1] thus increasing its mechanical properties as indicated in the Fig. 4 and Fig. 5 below :

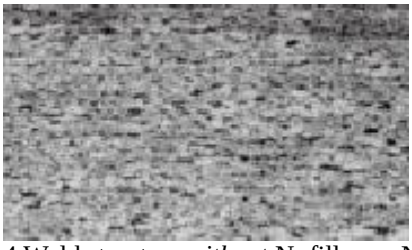

Figure 4 Weld structure *without* N_1 filler on Ni base

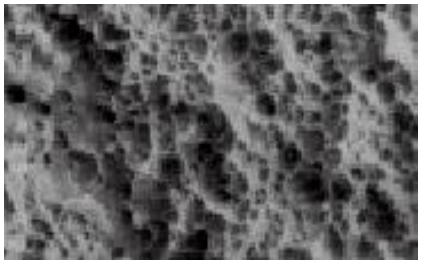

Figure 5 Weld structure *with* Ni filler on Ni base

From Fig. 5 above, the coarse fracture surface indicate additional bonding characteristics mainly due to Ni interactions as has been explained previously.

IV. CONCLUSION

As have been stated, the relevance of the *d-orbital* in the determination of bond strength indicates the application of both valence bond theory and the ligand band complexes. The interplay resulting from the overlapping is very critical to the bond strength which directly defines the strength of the welded joint. It is therefore instructive to mention, that temperature play a key role in this development, since it is the means of making the orbital respond to external combinatorials, especially where the base metal is chemically compatible with the filler metal as have been seen in Fig. 5 above. Thus, bond strength has to do with the individual nucleus

potentials of the ligands or complexes; for which an attractive pull exerted on the electrons creates stability and equilibrium which by extension influences the entire strength of the weld.

Thus, the value of $\boldsymbol{\mu}$ in Fig. 2 has direct consequence on the strength of the weld joint, which can be determined by various impact and NDT assessment. The study finds that the failure of $\boldsymbol{\mu}$ is the failure of the welded joint. However, it should be noted that beside the critical relevance of $\boldsymbol{\mu}$, other factors also enhances joint strength, such as temperature, hydrogen presence, defective fluxing, etc. Though, all these constitute physical conditions for welderbility, the microstructural and chemostructural relativities are more critical as they addresses the molecular origin of the bonds and thus influences the bonding parameters and structural mechanics of the possible chemical combinations during welding and other heat treatment conditions required for orbitals to bond.

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Centered establishment quantitative analysis of administrative uses on metropolitan area traffic (Case Study: Babol City)

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Abstract: - Urban land uses Because of the nature of urban system are continuous communication and interactions. Through the communication network and traffic flows and therefore has considered as important tools in urban development and formulation to its environment. Babol city include central range that is a busy area, high traffic and traffic problems are the main causes of these disorders absorbing uses of travel (administrative uses) on the one hand and the position of this area in the direction path Tehran - Mashhad is the other. Methodology has been descriptive-analytical based on field observation. This study presents quantitative analysis of user centered absorbing journey (administrative user) on the central area of Babol. The technique used in this study is the use of the software is AIMSUN that with its application has analyzed confounding influence factors rate (administrative username and transition trips) on traffic in the study area.

Keywords*: - centralized establishment, administrative use, transportation, urban congestion, Babol.*

I. INTRODUCTION

Today, the problems associated with affairs of transportation into new cities and towns of the industrialized world, have publicly and show off openly with the everyday life of most citizens. Although these problems are not new, however, along with population growth of cities, and faster increase rather than car ownership and its use during the past twenty-five years, now have more determinative aspects. In this period, while has been used of all types of vehicles entirely, also were taken steps to alleviate this problem that has brought in the total development of the transportation planning process (Ghasemi: 2012; 52). What decade ago to improve urban transport in cities to adopt a policy or program is generally based on personal preferences and knowledge of the relevant entries have been done without the least specialized studies and academic and so urban planning and transportation in like two twin and two components are inseparable from each other and actually redirected to the citizens in conflict with the new problems imposed. (Intra-city Transportation and traffic system improvement projects within the city of Babol city, 2005).

1.1. Problem definition

Today, Metropolises of the world face many challenges, one of the biggest problems, especially in developing countries, has been transportation traffic problems caused by urban land unevenly distribution. (Transportation and Traffic Studies of Tehran metropolitan, 2008). A large amount of trips will be to the central area of the city of Babol that can be the main reason for the high volume of trips focusing on business administrative uses (Education and Up bring Department, Crescent office, department, the Government, the municipality, of Youth and Sports Department of Justice) as well as pass trips through this area due to lack of proper belt as in Babol city. In addition, current area has range of other problems such as the limited capacity of some passages of the width of streets, high population density, lack of good public transport system, lack of adequate parking for the cars to stop, not a pedestrian overpass crossing the dam the sidewalk. These problems can be sought cost lot of time and money for both the people and the city manager. Present problem needed Comprehensive planning to address these issues, using appropriate administrative and management strategies based on factual information accounting office uses to transport and traffic in the area to be covered. This

research has tried to work each office uses located in this area to quantify the analysis. This quantitative analysis can to help manage user and administrative Babol city in organizing transportation issues in the area.

1.2. Goals

This study seeks to achieve the goals that are as follows:

1 - Check the status condition of daily reference rates to the administrative uses of communication network connected to intended range.

2 - Quantitative analysis of each of the administrative uses on traffic in the intended range.

3 - Provide a new way to measure the impact of urban land use on the city traffic.

1.3 Methodology

Research Methodology is descriptive - analytical study is based on field observations. In order to analyze the data collected in this study, previous studies reviewed, then considering the current situation administration uses and trails connected to the central area of Babol, and finally by software AIMSUN, is analyze the impact of each of the scenarios intervention on study area traffic.

II. LITERATURE

After doing research on the research studies we find that it has been associated with that is as follows:

1 - Ebrahimi, A. and M. Shahriar Afandi in his article entitled " presents a methodology to determine the absorption rate of travel for urban applications " have tried to compare the transport parameters (absorption, or a trip) , and land use indicators (floor area, land surface or condensation) to reach conclusions regarding the relationship between these two categories so that presented the most suitable location for the construction of various applications. This paper presents a method that does not actually influence each of the two categories (land use and transportation) clearly indicate on each other (Ebrahimi , 2007).

2 - Shoar, K. and A. Javadi an article entitled "Study of the interactions impact between urban transport and development policies and land use" presented that results can be decentralization of large cities, involving land price effect on the determination or modification anticipated uses of land, cost of transport and urban development, urban level to develop and coordinate the provision of urban transport and urban development policies noted (Shoar, 2007).

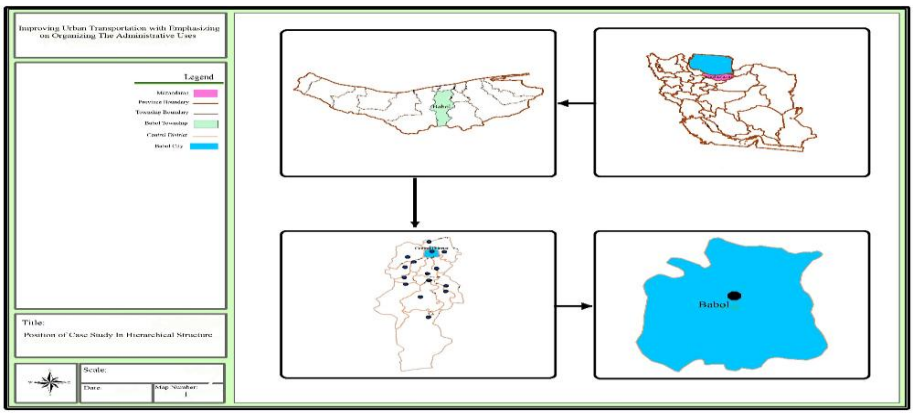
3 - Regional Planning Association Strafford in 2003 an article entitled how to communication and transportation - land use plan has done. In this article, three strategies "node - Zoning development," "community walk" and "Management access " expressed as the three major strategies for efficient communication between land use and urban transport.

4 - Cervero survey conducted in 1989 showed that about 57 activity centers in a suburban business that was home its employees and working in the vicinity each other, in contrast, business center without residential houses near work group concluded that 3 to 5 percent of daily trips by walking, ride a bike will be done to public transportation (Cervero, 1989, 429).

III. STUDIED AREA

The core of the first millennium before Islam reached Babol, about emerging Babol taking the first typing the name "Barforoosh" is named. Geographically, 52°44' 20"E, and 36°34'15"N geographically located in north of Iran and its area is 1431 square kilometers (Tabari, 2000). The average amount of annual average precipitation 7/738 mm is (www.mazandaran.met.ir). The city's population according to the 2012 census, 200,303 people will have a growth rate of /16 (Census of Population and Housing, 1390).

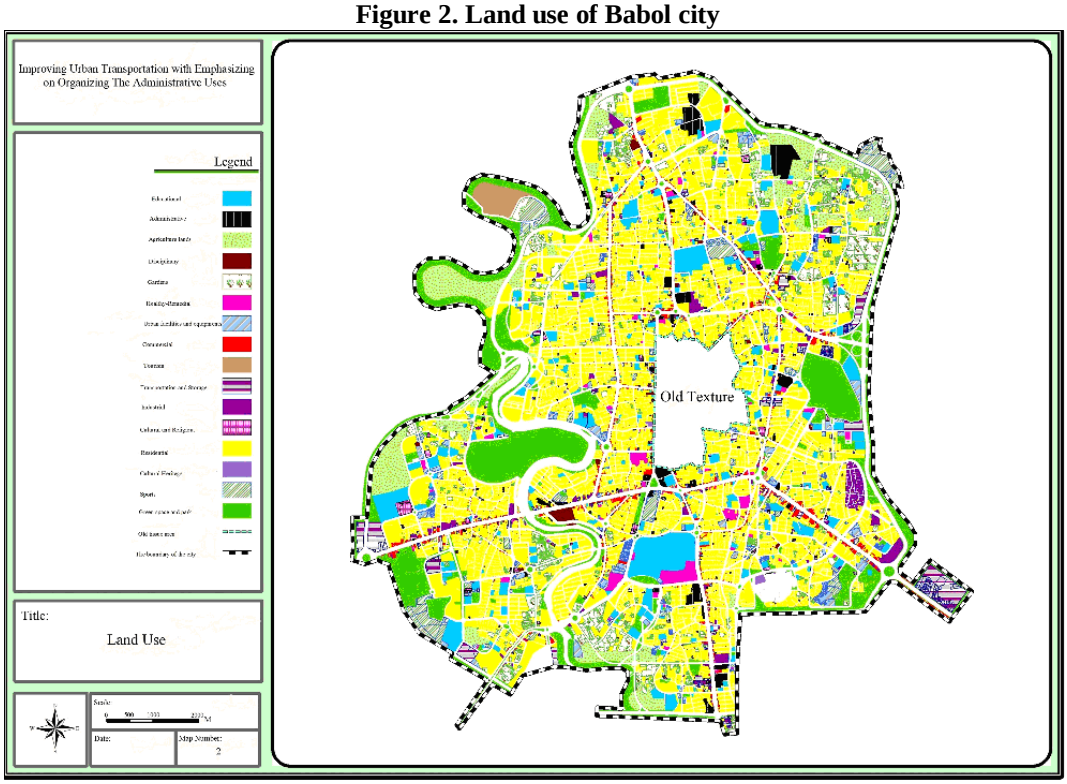
Figure 1. Study area position in hierarchical structure



IV. LAND USE IN BABOL

Map 2 shows the status of land use in the city of Babol. State land use (area, percent and per capita) is obtained in the city of Babol in Table 1.

Figure 2. Land use of Babol city



Source: (Author)

Table 1.Matrix of trip hour's distribution (all time) according to riding in the desired ranged

Land use	Area(hectare)	percent	Per capita(m^2)
residential	1033/1275	34/88	51/57
commercial	41/9426	1/44	2/09
agriculture	131/6269	4/44	6/57
gardens	166/0999	5/60	8/29
sanitary	33/3290	1/12	1/66
educational	180/7122	6/10	9/02
Religious-cultural	19/1445	/64	/95
administrative	38/8960	1/31	1/94
industrial	36/8632	1/24	1/84
transportation	61/8813	2/08	3/08
disciplinary	8/067	/27	/04
Urban Facility and equipment	44/8360	1/51	2/23
tourism	16/8879	/57	/8
sports	61/9278	2/09	3/09
Park and green space	345/7462	11/67	17/26
Streets Network	740/2718	24/99	36/95

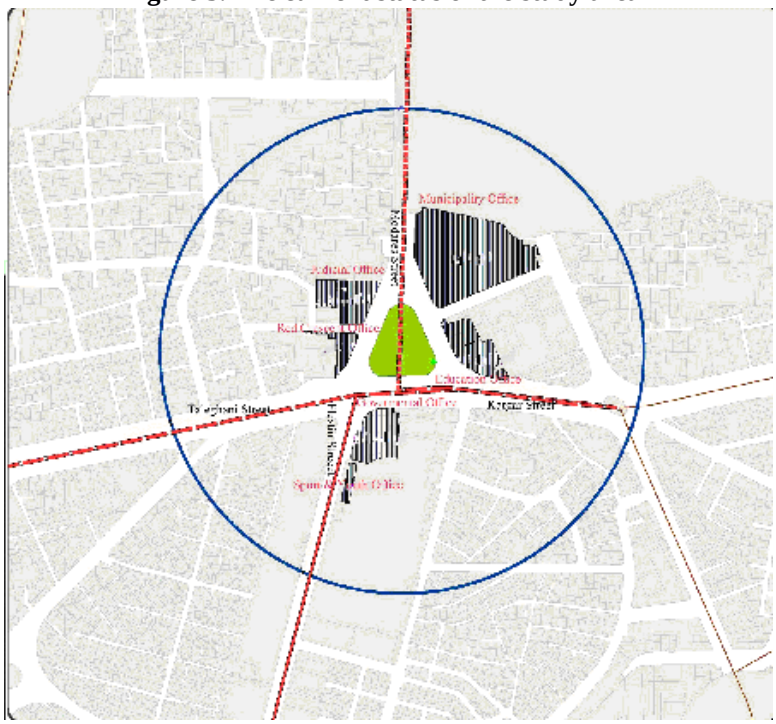
Source: (Author)

4.1. Current situation description of the central area of Babol city

Babylon, is like most cities have a busy area the central area. Studies show that the large amounts of the absorber land and trip generator uses (including important part administrative uses of the city) is located in this area. citizens and villagers who have traveled to the city to conduct their affairs, often to meet the social, economic, health and education and are forced to travel in this area due to special attractions this area has

always insisted development activities in this area, and there is pressure on the most requests for administrative and financial affairs directed to this area of the city.

Figure 3. The current status of the study area



V. LAND USE AND TRANSPORTATION EFFECTS

Land use on the one hand, are influenced transport and the other hand effects on transportation. Major impact on the land use affects transportation includes:

- Overuse of marginal land areas.
- Changes in the climate system.
- Creation of contaminated land used as a burial place of old cars.
- Loss of green space and agricultural land -use for the benefit of other uses.
- Effects result in disorder of environmental balance.
- Urban regions creep into the natural habitats.
- Problems caused by air pollution in cities and reduce visibility.
- Creation of incompatible land uses in the city (Jahanshahi , 2009, 33) .

VI. THE IMPACT OF LAND USE ON TRANSPORT DEMAND

The impact of land use on transport demand is considered from three perspectives.

1 – Spatial discipline: through the physical design of micro and macro scale location and style arrangement of major activity centers to support specific practices to be transported.

2 – Land use density (density zoning) compression and land use density also reduces cost of all services provided by the server.

3 - Urban Design (neighborhood scale)

Through optimal design aesthetic the station and surrounding area, sidewalks and connecting it to the streets, the kind of neighborhood units and guiding it towards the station, and generally creating an environment pleasant it to encourage the impact of transit (Vatankhah, 2008).

VII. FINDING

7.1 - Effect analysis of referrals on a range of traffic

Effect analysis of referrals on a range of traffic based on the number of referrals into riding a different route has calculated and this calculation to be done that referred to any office referred to the total divided to referred total into number offices within to be located and obtained result amount is multiplied in the number of cars on various lines and obtained result amount show in the effect of the number of visits to each department based on the ride (each way) on within traffic area.

Table 2 the number of referrals to offices

Education and bringing up	municipality	government	Crescent office	judiciary	Sports and youth office	Total average
2000	1283	170	297	1234	19	5003

Source: (Author)

Table 3. Number of cars in each direction

Felestin	Taleghani	Kargar	Modares
8074	7350	8776	4457

Source: (Author)

(Pcu / Veh)= (T / ΣT× C)equal rides visits to the office, where T equals the number of trips or attending a specific route; ΣT total travel; C is the number of cars in each direction.

Table 4. Converting the number of visits to a number of cars in a day's work

Option	Taleghani	Kargar	Felestin	Modares
Education and bringing up	3508	2938	1781	3227
municipality	2250	1884	1143	2071
government	298	249	151	274
Crescent office	521	436	265	479
judiciary	2164	1813	1099	1991
Sports and youth office	33	28	17	37

Source: (Author)

7-2 - trip distribution matrix

Trip distribution matrix 10 × 10 in this range based on an average journey time of one hour (12 to 1) 6 offices (respectively are Municipal, Education and Bringing up Office, Government, Office of Sports and Youth, Crescent office and Justice office) and 4-path, make up 10 pillars the matrix. Reciprocating has considered trips in the matrix. We make to converting daily trips to the office hours, the number of trips divided by 8 (the amount of work time) and we pass to travel into the area of travel based on hours, multiple total travel times in ratio 1/0 (ratio of peak hour trips) said.

Table 5. Distribution matrix according of rides in study area

Go / Back	Municipality	Education	government	Sports and youth	Crescent	judiciary	A	B	C	D	Total(rides)	The Total return
1	0	0	0	0	0	0	281	236	338	143	997	
2	0	0	8	0	0	4	439	367	403	223	1444	
3	0	3/8	0	0	0	0	37	31	34	19	122	
4	0	0	0	0	0	0	4	4	5	2	15	
5	0	0	0	0	0	0	65	55	60	33	213	
6	0	0	0	0	0	0	271	227	137	249	883	
A	281	439	37	4	65	271	0	501	376	247	2226	
B	236	367	31	4	55	227	595	0	533	0	2046	
C	238	403	34	5	60	137	342	304	0	0	1624	
D	143	223	19	2	33	249	0	367	253	0	893	
Total(cars)	997	1436	130	14	213	888	2034	2090	1886	916	0	10604
Total number											10462	

Source: (Author)

7-3 - Combine uses data for production of access options

Production options in this step are done using AIMSUN software. Present software is including two-dimensional and three-dimensional simulation software that applications in urban traffic as well as traffic that is

used in non-urban traffic in the countries which are advanced in the field of traffic is considered one of the requirements for approval of projects. This software can be used in all cases before the state (status quo) and the state (after the change) compared with each other. The software is consists of an input matrix travel distribution (Table 3). This software is based on available data for each option calculate 6 parameters options time delay, number of vehicles per hour, the average speed of vehicles in the network, the total distance traveled by vehicle according to km/h of travel time, The total travel time of all vehicles and average total vehicle, which defines each of them in the Appendix. Based on the above three options to be considered. first option that dedicated 6options,is relating to the elimination of any office land uses (absorbing journey centers), and its impact on network traffic or other two alternatives, will be one of the other transit travel deleting remove all the land (for office use) and its impact on traffic in the area is. It is important to note explaining that values obtained for each component based on the elimination of factors influencing traffic within a small improvement on the desired component gives.

Table6. Compares the various alternatives based on six components of the traffic

Scenarios	Scenario	The time delay	Number of Vehicles	Average vehicle speed	Total distance traveled	Total travel time	Average travel time
		(Seconds/Km)	(Veh/h)	(Km/h)	(Km)	(Hours)	(Seconds/Km)
A	Elimination of municipality	373/47	5009	16/92	2724/60	355/84	455/52
	Elimination of Educational office	83/57	6911	31/5	4171/66	189/67	160/52
	Elimination of Government	691/37	4271	10/15	2340/77	509/48	769
	Elimination of Sports and youth	750/03	4060	10/11	2160/73	505/7	827/4
A	Elimination of Crescent	673/34	4166	9/85	2282/30	480/54	750/49
	Elimination of Judiciary	722/6	4057	9/98	2132/91	473/15	799/69
B	Elimination of transit demand	541/8	4112	13/21	2149/88	392/85	62/8
C	Elimination of absorb centers	10/11	3555	42/62	2168/24	52/36	86/6
Status quo		715/79	4146	10/26	2257/18	507/1	793/45

7-4 - percentage of traffic each option

Comparison the mentioned options based on travel volume indicated that option B (removal of transit demand) at a rate of 41.62% is involved in the traffic reduction Velayat Square. Also the displacement or land uses concentrations that are associated with each other (municipalities, government, and judiciary) to 23.26% play role in the amount of square traffic. It is necessary to note that rate of trip volume concern to each option, is obtained from the total travel trip matrix.

Table (7) percent of the different options traffic loads for improving transportation within the city of Babol.

Scenarios	Scenario	Trip volume	Traffic load percentage
Scenario A	Elimination of Educational office	1994	9/46%
	Elimination of municipality	2880	13/67%
	Elimination of Government	252	1/19%
	Elimination of Sports and youth	28	0/13%
Scenario A	Elimination of Crescent	426	2/02%
	Elimination of Judiciary	1771	8/40%
Scenario B	Elimination of transit demand(Taleghani-Kargar ax)	8768	41/62%
Scenario C	Elimination of absorb centers(administrative uses)	7351	34/90%

Source: (Author)

VIII. CONCLUSIONS

Organized and efficient design uses a coordinated transportation appropriate with transportation system cause increases the number of non- motorized travel and public transportation systems in day trips are citizens.

This case addition to help reducing air pollution and congestion in cities can make manage demand reducing the number and length of trips by private vehicles and during the trips. The duty of a good transportation include system creation of linking between the major land uses of the trip generators (residential areas) and areas of trip attraction (shopping, industrial, administrative centers). Garlic thought to achieve research results that are based on steps that start from codification research general principles and eventually leads to a conclusion. In the present study, a new approach for linking between urban transport network the categories of office trips (number of trips to the administrative uses on a working day) and consider effects on establishment of on the land uses the area under study of traffic .

The results show that the purpose of this study was to determination of quantities effective ratio bit about each of the factors influencing has been made (for office use located in the study area and the passing travel) on traffic the study area. In this section, the research questions will be answered.

First question: what method will be suitable for quantitative analysis of establishment each of the office land uses on traffic in the area of the city of Babol (central area of Babol)?

Re: The way to achieve these results need to method which is able to use their influence to give in form quantity. Thus, one of the most accurate methods to achieve this was to use the software AIMSUN able to answer the research questions.

The second question is how to improve traffic handling administrative user metropolitan area contributes to Babylon?

The results show that eliminating all administrative land uses that is involved attractive places to travel in this area are based on the amount of traffic to the 34.90 % in traffic volume reduction range of study area in the study. Also play role concentration and urban office displacement as well as government and the judiciary are correlated to the amount of 23.26 % of the traffic study area.

epilogue: there is a status quo in the area impossible of mobility of land uses due to constraints of costs and lack of suitable land, thus it can decreased by operation procedures such as work time changes of lookup office, manage parking, creation park ride, necessitate offices worker making a trip to the march and …negative effects of centralized establishments on the traffic study area.

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The consideration of high-rise building role in utilization of urban open space (Case study: region 1 of Tehran metropolitan)

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Abstract: - The late twentieth century experienced an unprecedented demographic shift. The world population more than doubled in the last 40 years. An immediate solution an addressing population growth problem in cities is supporting high-density buildings. Iran such other countries turned to high-rise buildings for saving expensive earth; but it has not experience in this field as the owners of high-tech industry over the time passed. Tall buildings playing as important index in compared with other component of structure spatial -physical of cities in shaping and improving the visual quality of spaces.

Urban space is as group and social public space take influence of tall buildings. The relation between tall building and urban space the main goal is to improve and betterment of space quality. This connectivity must be way that not only prevent of creation the negative effects in urban space but also caused of space enhance and promote. the purpose of this study to considerate of role high-rise building in utilization of urban open space and analysis of its effects in creation the urban open space appropriate with tall buildings. Methodology of this research is descriptive-analytical that hence considers identification of the district and analysis the state of high-rise building and current open space of the district, and after than identification of strengths and weakness by SWOT technique and facilities and dilemmas of the case study district considered to provide useful guidelines for improve of high-rise building with respect key element of open space.

Generally, it may be said that to achieve main goal that is improving urban open space, require considering rational and systematic manner inward location of tall buildings construction and height so that is not caused the aesthetic and visual quality of the area and to create the ideal form of urban image.

Key words: - *high-rise building, building density, urban open space, SWOT technique, Shemiranat*

I. INTRODUCTION

During the second half of the eighteenth century, based on technical, economic, social and industrial changes which occurred by industrial revolution, it's caused developments led to the creation of new towns and cities were expanding rapidly with the increase over the population size of cities, merging of contemporary urbanism in the nineteenth century. It passes more of one century from the high rise residential and commercial buildings (including towers, high rises and skyscrapers). In the beginning, these structures were recognized as a sign of community's technological and technical progress. The introduction of modern methods advanced design and architecture, the use of new and advanced materials, emerging technologies, new facilities such as central air conditioning systems, fire fighting, garbage disposal, pumping water to the upper floors, elevators, and even introduces new patterns of life this modern urban architecture, including some that were not being provided for each tall building could be considered as part of the construction industry. Thus were the first high rises and skyscrapers, in advanced industrial societies - particularly the United States of America – which have tall proudly.

High-rise building is a phenomenon in the world that have registered his face at the late 19th and early 20th centuries and first manufacturing steps were taken in Chicago skyscrapers from around 1880 to 1900 (Daneshpur, 2010, 38-29). Thought of high-rise building and construction of towers during his life has been

analyzed and criticized from vision experts on economic issues, social and physical. (Daneshpur,2010, 38-29). Tall building from the early stages of design to the final stages of construction and implementation requires to detailed work and efforts on issues such as excessive use of latest technology and modern, responsive structures built environment, urban and considering the perspective and image in field of urban texture and also into masonry and respecting to use rate of energy, refutes current buildings and welfare of its residents will be very important issues in the current era. In addition, and perhaps its head (tall building) administration issues of megalopolis on high-rise buildings and office management also other issues that should be considered.
We hope that effort to improve by valuing all the beauty and positive characteristics and increased density of high-rise building inward improvement of disorders having desirable open space.

1.1. Problem

The second half of the nineteenth century, beginning with the vertical growth of buildings (tall building) has been associated with the West. Since nineteenth century to now, the high-rise building phenomenon has registered his face as one of the dominant figures in the world of architecture and urbanism. High-rise building during his lifetime, although by some scholars, experts have always been on social issues, economic ... and urbanism have been criticized and on application it have viewed with doubt, but it enable always according to its application requirements, has registered successfully demonstrated his continued presence and has increased on activity field and his expansion. In during 1/5 century of tall buildings was common in cities expanded, the tall building as an important and problematic phenomenon has been discussed. On the one hand, this phenomenon could be many issues such as lack of urban land, housing shortages and ... answer, but the other problems and inadequacies of their creator. Western countries are trying to take advantage of the benefits of tall building and control problems caused by laws and regulations applicable to the operation and effect to bring it under control. However, these regulations have been greatly expanded and continued the tall building in the areas of physical adverse effects of environmental, social ... stop and make optimum utilization of the benefits of it.

Proper implementation high-rise buildings, causing an increased level of open space, prevent the horizontal development of urban landscape (horizontal growth has been and it provide from security dimension background social unrest and unstable and atrocious) to resolve the housing problem, reducing trips into the city, reduce urban traffic and the resulting energy savings and further increase the beauty the image of the city and urban body and also create favorable and attractive environment for residents, as result, it will continue the sustainability of the environmental.
Overall, the present study is the first to explore role of high-rise building to improvement of urban open space and then examine the bottlenecks and opportunities in the area and finally has been paid on the analysis of the existing strengths to provide useful guidelines to improve the urban open space and providing positive space with consideration of construction rules.

1.2. Methodology

Methodology is descriptive-analytical that hence considers identification of the district and analysis the condition of high-rise building and urban image of the district, and after than identification of strengths and weakness by SWOT technique and facilities and dilemmas of the case study district considered to provide useful guidelines for improve the having suitable open space respect to location of high-rise building.

II. LITERATURE

In general the literature can be said as regards the argument that the tall building in the world in recent decades as one of the key issues in building cities, especially cities have long been and in our country in three decades, the main building has been a key element in increasing building density that we observed the growth this phenomenon which metropolitan Tehran despite Tehran's classes for about two decades ago, the average class has been but today, especially in the area of Tehran, this phenomenon is growing upward.
Hence, a number of different issues, tall building is made of various aspects of this issue is not so much of that research is also related to the early '90s and earlier it's unfortunately, this urban landscape and urban open space of the main issues highlighted in the tall building are interconnected with a special case has been found; In this paper, the interdisciplinary nature of modern research and new and so far this is not the case study in a particular place.

2.1. Tall building

When talking about tall buildings, it may be assumed that people have similar attitudes about it, but this is not true. There is no unique approach in this respect not only among the public but also among expert. The following different approaches about tall buildings are:
- According to the regulations of Danish, German and some other European countries,

The 72ft. (21.6m = 8 stories buildings), having fire-fighting equipment, are known as tall buildings, Ref.
- Definitions represented by the U.S. Council on tall buildings and urban settlement refers to tall buildings as these in which the height, influences the planning, construction and spaces application aspects of the building considerably without specifying the number of storages, Ref.
- The national land planning committee in Switzerland refers to tall buildings, those buildings which are considerably higher than their adjacent buildings. This definition might seem logical but is not useful for applied research because in an urban texture with four densities (1story), 4 and 5 stories buildings are assumed as tall buildings.
- Urban planners and designers in Iran, refer to tall buildings as those with more than 10 stories. Although this measure is not taken valid by economic, engineering and technical studies, but it is an attempt towards defining tall buildings. This definition is accompanied by a supplementary phrase, adding that the main feature of a tall building is that full design of one of its faces reveals total number of stories. In other words, an exhibition, factory and any other high-rise building is not covered by this definition.
Definition of tall buildings in the world is very different, so that in some cities, such as 40 -story buildings in America are known as short buildings. (Dept, 1999) or even in some UK cities such as London high-rise buildings have different definitions based on location. For example it has considered elevation 75 meters for London city and 30 meters on other locations such as peripheral area.
Ada Luis Hakstebel tall building is defined as:
" Skyscrapers of the twentieth century are simultaneously ... skyscrapers is fantastic instruments that make up the boundaries of normal human longing swept across the sky , strange phenomenon is present century architecture , tall buildings embody the best and worst of our era ... Skyscraper this is the place where art and city come together . "
Fire equipment at facilities is in many European countries and Scandinavia height of 22 to 25 meters. (Figure1). Table 1 shows the minimum height of the tallest buildings in such countries.

(Table 1)Tall building height minimum

country	Height(meters)
Austria	25
Belgian	25
Denmark	22
Germany	22
Finland	28
Netherlands	13
Norway	22
Sweden	23
Switzerland	22
England	24

There is important topic that tall buildings define in developed countries. It is concern which is not defining this type of buildings according height but it based on the height of qualitative variables. Tall Building is a relative concept that, in addition of height, must be pay attention to other things. For this reason, the definition of tall buildings in regarding with urban issues can be a combination of qualitative and quantitative variables.

2.2. Density

One of the major problems faced by many people living in the city's congestion problem. We hear every day, many times density keyword but we don't know its true meaning, which is used in architecture and urbanism. After hearing the density word in the sense that everyone thinks in his mind, is the accumulation and compaction. As a measure of density, position and extensive urban planning decisions.
Definition and classification of application types deal with directly dependent on application and target. In general, some experts believe that three different species can be interpreted as the density of related studies offered:
1 – Density should be interpreted merely as a number, or the number of exist residential units on site.
2 – Density must be interpreted as an indicator and different rate and cultural gap between rich and poor classes as a barrier that prevents social mobility disadvantaged within society.
3 – Density should be interpreted of view national indifference, lack of attention to an important issue (lack of national policies on urban growth and population distribution (Azizi, 21:2004).

2.3. Building density (coefficient of Infrastructure)

In the urbanism literature, floor area ratio of all floors divided to total land area say be building density. (Sampyer; 16:2012).

2.4. Floor area ratio

When we say occupancy area, indeed meaning permitted floor area ratio level of for construction with regard to area of divided total lot. Based on the present index by dividing the total area occupied proportion to area of divided total. For example, when floor area ratio is 60% occupied for a plot of 400 square meters, this means that is 60% of the area 400 square meters (240 meters), the Construction and construction. Occupies a floor area ratio in model construction in urban infrastructure has a direct impact on per capita. But if you make more than one class of common patterns, the impact of the occupation on the basis of the offered rate will be decreased. At present, the most commonly used factor occupancy level is 60% in urban projects. However, some areas may decrease the occupancy rate to 50 or 40 %. The index is particularly important in the field of urban design and more attention to urban design.

2.5. Land use Intensity

To the construction and population density, use from better indicator as land- use intensity. This indicator control measures the rate of development and construction simultaneously and population density or residential population. In other words, land use intensity, controls the simultaneous number of housing units and residential area level. In addition, it determine the minimum amount of parking, open space and residential space requirement. Basically, land use intensity index, the floor area ratio divided to total area of Earth. It is Numerical scale to measure the land use intensity exponentially. As land use intensity, equal with building density, 2.5 % to reaches 2%, building density would be 5%. And whenever land use intensity to be 3%, Building density is equal 2 and reaches 10%.

2.6. Urban open space

Urban open space, and crystallization of the collective life of their citizens, and shall be responsive to the needs and social life of their community. In these spaces people are face to face with each other in social encounters. Image of the citizens of these spaces and their scale is such that the spatial diversity and the full event expect. Audience, these spaces range of social classes, age groups and the like form.

Outdoor urban spatial context of social interactions people have since long. Although quantitative and qualitative characteristics of urban open space has changed over time due to several different factors, but consistently citizens and other users of such spaces were required. Today, despite the widespread phenomena of modern communication media such as satellite TV and the Internet, the use of urban open space, not only did not lose its importance but after some time, little attention has re-opened its actual position is considered. Required to attend a face to face relationship with other citizens and urban areas derived from the psychological characteristics of human beings, Such as the need for conscious communication and interaction with the built environment, the need to express and communicate ideas and opinions presented in the context of the complex biological and psychological need to create a center of species. Urban outdoor space refers to all of its citizens to freely enjoy and be in touch with each other.

2.7. Open space

It is part of the city that was surrounded and readability, aesthetic quality, urban landscape and its performance has led the outdoor areas of the city as an urban space to be read. Building up the relationship between urban space and the main objective, to improve the quality of the environment. This relationship should be such that not only creates a negative impact on the urban space must be avoided, but also the tallest structure will strengthen and enhance the space.

The urban space as the space for social life of the people is influenced by the existence of tall buildings. Many experts emphasize on three main characteristics of the urban space, as follows*:*

- The space being confined.
- The aesthetic quality of the space.
- Social functions and activities being executed in that space.

The overall situation analysis of skeletal and spatial organization

Descriptive methods of analysis based on the decomposition of elements and components relationships and the reasons they are relying on the quality of the environment arises. In line with this aim, bone area and the constituent elements of " identity and justified " and "cohesion" has been assessed and the overall analysis of all these factors come into operation in the area.

III. STUDIED AREA

Tehran Municipality 1 region 3604.894 acres has considered northernmost point which its border of northern matches on Tehran northern border (line elevation of 1800 m). This area has limited from south area to Sadr, Modares, Chamran and Babaei highways, from east to Lashkarak Road and Ghuchak forest park, and from West to Darakeh River.

Tehran Municipality 1 region is consisting of 10 districts and 26 neighborhoods. It has been encompass area of 45KM without its legal border, which including the privacy policy area of approximately 210 and a population of about 445,449 people. The population of the study area has taken approximately 47397 people which including about 6215174 km.

3.1. Cohesion and continuous

• Bahonar Street As the creator of cohesion and coherence of scattered collections and other elements in only main ax of east-west has been unit role.

• Darban ax, between Asr and Shariati Avenue, Elahieh north, Velenjak, have more open space and the openness of space and a sense of openness and good condition are more valuable , and often dissimilar elements of harmony and gradually promoted and thus the sense of continuity and coherence in this context is maintained

• Elahieh, between the Evin old quarter and the Evin, Chamran Highway northern limit, Velenjak river East, old neighborhood Darabad Western Range, north of Modares highway between Valiasr and Tabnak streets: presence in the context of high rise buildings and monuments sudden juxtaposition of dissimilar heights and volume resulting in massive disruption, has caused confusion and lack of cohesion in these areas textured.

• Ancient tissues such as the Qeitarieh, Jafarabad, Tajrish, Darban, Baghe shater, Velenjak, Evin - Darake cores of ancient and historic: Old and worn textures of the garden alleys, passages, seem to cohere .

3.2. Tall building impact on the physical transformations

A large part of the pattern area has the status of a non- uniform texture and variety. New developments are also due to being fresh and different, especially in the eastern and western limits of the open area is somewhat different. Affect of this development on urban patterns and neighborhood units that are sometimes desirable, but most of these resolutions are often necessary when renovations are subject to change and transformation. Often associated with new development, large-scale, scale, location and size of the building site and surrounding tissue without undergraduate studies are conducted.

that are inherent in the development and design of new buildings , often in balance and harmony with no scale has been good .city , buildings, and other elements of the urban form of the face is no coordination .

3.3. Examples of high-rise buildings in the elected limits:

- Sudden change in body-centered Iranian Revolutionary Guards, resulting in high visibility buildings housing construction often undermines the quality of the visual environment, such as the Sky Tower are visible from long distances, as the sign at the neighborhood level are recommended.

Below are examples of high-rise buildings in the area and they will be analyzed: abrupt change in altitude buildings Zaferanieh and Elahieh body axis and thus visibility hull construction , which often undermines the quality of the visual environment , such as the Sky Tower are visible from long distances , as a sign at the neighborhood level are recommended.

Body building heights around Ghods and Shariati create confinement some parts of the body. Erosion and contamination of building facades and signs of multiple business units with different shapes and sizes and sometimes inconsistent views of the visual quality is factors that demolish environmental.

Chamran as a rim surrounding tissue in different parts of the visual diversity is important.

Chamran surrounding tissue is as part of an edge of visual diversity important. Different styles and architectural patterns dents and bumps in facades total land position in the construction sector, building height difference, behind walls topped Sadr body unknown without a face and without undesirable visual identity have been created.

Dividing and defining space and thus strengthen the sense of place and confinement axis, see the natural landscapes and steep, land slow meander and building's facade that are also a variety of Screw as a unified body, enjoy the coordination of relatively good-based and added identify and Readability Pesian St.

Moghadasi Ardebili Street as the street that the natural slope of the specific topographic conditions, with bodies is undesirable.

In some parts of the canyon street protests against the construction of identity -based natural environment and reduces its structural identity. In fact, the size and height of buildings as a barrier that has blocked the view of the landscape and the building height and materials, and colors are a factor that undermines the quality of the visual axis.

closing vision of the neighborhood landscape for illegal construction Zafaranieh the variation in height, size , facade materials and architectural pattern and the remaining part of the body axis are entitled to have some hill, and the natural soil ruins and reduces wear on the center of the visual identity .

Body Velenjak Street on the west side Zafaranieh due to placement in one of the neighborhoods have a relatively new area of visual quality is fairly good. Height, style and shape of the openings and dents and bumps, colors and materials of the building facade street housing a large variety of instruments, but this variation is due to the relatively good visual quality and visual and spatial structures, causing confusion is not. See the natural scenery along the street, another factor is the identity.

Block the view of landscape heterogeneity and unfinished construction and housing by not viewing Velenjak South Street in this part reduces the visual quality of the street.

Axis Parkway - Zafaranieh one of the axes of identity that are of historical significance and structural Tajrish of the shaft near the openness of space and increase green space and reduce congestion is a Ghanaian business units. However, due to the high antiquity of the buildings , pollution and exhaustion , their facades and structures , as well as a variety of commercial signs in color , size and ... Also seen .

Body business units adjacent to each other, in part, unfortunately Valiasr creates space integrated pollution such as air duct removal and painting of facades and extensions in different colors so detract from the integrity.

There inappropriate residential complexes, tall and bulky and lacks human scale blocking the view of the landscape is in conflict with the other bodies.

3.4. Analysis of the positive effects of high-rise buildings on utilization of desirable open space in the study area

Because of distributed construction of tall buildings in the region we are observe the loss of continuity and open space are concentrated in the north Shemiranat and the its central part does not have reasonable open space and favorable. The trending of high-rise building in the area has been mostly in the northern area in form of the garden. The present of most important natural corridors (valleys) with a trend to increase has led to utilization of existing corridors of tourism. The present of the natural, historical and cultural elements as urban landmarks and focal points absorbent have followed cross-regional focus and physical elements as the identity of the region. In the study area there are strengths in the area of open land for green space development, the public and semi-public green spaces as parks or government agencies, hospitals, embassies, enabling the reconstruction and development spaces. Take advantage of the terrain and the Lobby area and open spaces for optimal visibility, streets, alleys, gardens and open spaces as part of the identity element. Alborz Mountains and foothill elevations, and palaces, palace yard and a large blank area. Accounted for the vast moorland in the West area of open space and green spaces that provide good views of the surrounding elements is possible.

The tower in the area, mostly in the northern area of the garden. The most important natural corridors (valleys) with a trend has led to increased utilization of existing corridors and tourism. Elements of the natural, historical and cultural city as landmarks and focal points absorbent cross- regional focus and physical elements as the identity of the region have followed. In the study area there are strengths in the area of open land for green space development, the public and semi-public green spaces as parks or government agencies, hospitals, embassies, enabling the reconstruction and development spaces.

Take advantage of the terrain and the Lobby area and open spaces for optimal visibility, streets, alleys, gardens and open spaces as part of the identity element id. Alborz Mountains and foothill elevations, and palaces, palace yard and a large blank area.

Accounted for the vast moorland in the West area of open space and green spaces that provide good views of the surrounding elements is possible.

IV. SWOT

SWOT analysis is one of the effective ways to identify and know the capabilities and limitations is contained in the region that respect to application in the analysis and conclusions of the study area weaknesses and strengths, it can be identified and a reasonable balance in terms of regional integration can create opportunities and possibilities that it has the potential to be viewed as an advantage, and the pitfalls and dangers that may threaten the future of the region in an effort to identify and solve problems and finally, to create a new route and provide useful and fruitful strategies to improve and grow the region.

4.1. Region analysis with application SWOT technique

4.1.1. Strengthen

- Take advantage of bare land required for construction applications.
- There are open spaces in order to aid when accrue catastrophe in western and eastern parts of the region.
-Green belt plan of the region.

- There are hills and valleys and landscape and visual corridors in the region.
- High interest rates on green space and landscaping.
- Streets, alleys, gardens and open spaces as part of regional identity and the recognition.
- establishing of renovation company of region with the goal of organizing ancient tissue.
- Diversity and variety in terms of color, shape and other features of the new buildings with the surrounding environment.
- There are large structures (cooperatives) in a semi-natural upland destroying mountains blocking the view of the natural elements.
- Create buildings to large complexes in large sites without considering the effects of a wide range of physical-space.
- Disability and aging issues of vagueness physical axes.
- Reduce the rate of inflation, due to the development of masonry in within street.

4.1.2. Weaknesses

- Incompatibility between vast military lands with other urban land uses adjacent.
- Not defined urban edge and discontinuity of bodies and walls.
- Lack of proper distribution of urban open and green space.
- Not recorded many outstanding monuments, natural, historical and cultural and ambiguity about their privacy.
- Lack of a comprehensive plan for open and green space.
- Occlusion and visual corridors blocked due to inappropriate localization tall buildings.
- Deviating from the proposed master plan and detailed rules about building density.
- Lack of supervising the implementation of laws and regulations.
- Poor legibility and identity in new developments.
- Lack of coordination and visual connection between the old and new buildings.
- Obstruction or narrowing of visual corridors due to improper positioning Buildings
- There is a high density residential and compressed texture worn in the historic core of the area.
- Illegal Demolition and renovation in parts of the region
- Tall building in the wrong places for the topography, access and public service

4.1.3. Opportunities

- Ability to convert military barracks land to public land area required.
- Supporting of mountain, river and gardens which are supported by public bodies.
- Assignment problems of urban green open space to the private sector.
- Willingness to invest in the area because there are economic advantages.
- Promotion of Public Participation
- Use of high quality materials in construction zone.
- The Alborz mountain and foothill elevations as the main aspects of Tehran metropolitan.
- Ability to design and organize recreational areas in the region as a center of recreation and the collective memory of the inhabitants of Tehran metropolitan.
- The desire to repair worn tissues with respect to profitability and economic benefits.
- Ability to earn legitimacy of the tall building demolition and modernization in the region.

4.1.4. Threats

- Construction without permits and coordination with the municipality of region from, the institutions, organizations, and… the north lands of the region.
- Destruction of gardens and urban change land use in green spaces**.**

- Lack of appropriate laws and regulations and lack of enforcement of these rules to ensure the protection of the environment**.**
- Tall building in the wrong places for the topography, access and public service**.**
- Indiscriminate construction and urban development rules.
- Inconsistencies in the regulations Picks.
- Loss of cultural and historical sites of the lack of maintenance.
- Construction of residential units in the privacy of faults and watercourse.
- Creation of economic rents due to the sale of land and housing markets and foster concentration and profitability intermediation promotion in this sector**.**

V. CONCLUSIONS

Urban background check in big cities such as Tehran, which is now more than 60% of the housing, is worn out tissues, indicating the benefit senior policy-making to improve the conditions of dense. Besides providing these cases, the need to improve the quality of life, enabling the improvement of open spaces and communication channels is provided in the areas covered and In addition has effected to the overall situation improvement of the city by helping complement of communication chain within the city and creation of suitable space for the expansion of the urban services.

One of the key items on the tall building, and most importantly, is considered open space. To identification and provision of services in these kind of buildings should be designed and arranged open spaces in the neighborhood that lead to sustainable communities. Strengthen and establishment of appropriate view corridors landscape should be strengthened and the body of such buildings and making space is a key issue, in fact we need to create a harmony between tall buildings and urban open space. If we intend to pose one of the advantage of tall buildings, it is creation of open space which carry out with respecting to vertical construction for creating open and green space for neighborhood residents. On constructions of tall buildings in the neighborhood must be neighborhood organization, according to the old tissue that remains. The pedestrian network should expand green space in the tissue and surrounding neighborhoods. The wedge space should be given to human scale. Recent debate about open space, building and strengthening the visibility and connectivity corridors and other open spaces in the neighborhood, there are a variety of ways.

These spaces are typically filled with a vision of soft and hard sharpen those elements that contributed to the creation of public spaces. According to what was said in order to provide design and planning of public spaces and opportunities providing situation and occasion for urban and social contributions is essential that today should be an urban focus of attention the urban custodians.

Due to the possibilities and limitations that exist in the area to be open space goals and strategies for optimal productivity with the following rules of construction stated**:**

5.1. Suggested strategies

- Parts of the neighborhood are great potentials that do not exist in the city, planning to add density to allocate places that have such potential.

- Increased building density only in urban land provision and standards is confirmed.
- How to establish high-rise on urban space from urban proportional view image and perspective must be distributed.
- Tall buildings to be constructed due annihilating of location spatial hierarchical.
- In relation design of public and semi-public this such as buildings with aim to prevention of the congestion, noise and noise pollution, should be done need measures.
- In relating with architectural design of tall building components should be avoided of similar components elements high frequency.
- In terms of both aesthetic and functional aspects (impact on surrounding tissue) than narrow and tall buildings are preferred types of bulking up.
- The establishment of high-rise was not suitable on historic texture, because it cause that be decrease texture value and its historic landmarks.
- Urban areas are not only surrounded by tall buildings, but these buildings are better buildings in the scale of being human.
- How establishment of high-rise to due creation of shadows on buildings and adjacent spaces to help with the environmental regulations should be accurate.
- To determine the critical wind speed up body tissues and deal with them, we can create undesirable speeds in urban areas and passageways prevented. These points can also intensify wind flow can be exploited to eliminate air pollution.

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Survey on Human Motion Detection In Static Background

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***Abstract*: -** Nowadays, computer vision has increasingly focused on building systems for observing humans and understanding their looks, activity, and behavior providing advanced interfaces for interacting with human beings, and creating models of humans for various purposes. For any of the system to function, it requires methods for detecting people from a given input video or a image. Visual analysis of human motion is presently one of the most active research topics in computer vision. Here the moving human body detection is the most important part of the human body motion analysis, thus the need of human body motion detection is to detect the moving human body from the background image in video sequences, and for the follow-up treatment like target classification, human motion tracking and behavior understanding and its effective detection plays an important role. Human motion analyses are concerned with the detection, tracking and recognition of human behaviors. According to the result of human motion detection research on video sequences, this paper presents a new algorithm for detecting human motion from a static background based on background subtraction.

***Index Terms*: -** *Human body tracking, Behaviors understanding, Human motion analysis.*

I. INTRODUCTION

One of the important streams of research within computer vision that has gained a lot of priority in the last few years is the understanding of human activity from a video. The increasing interest in human motion analysis is effectively motivated by recent improvements in computer vision that is according to the availability of low-cost hardware such as video cameras and a variety of new promising applications such as personal identification and visual surveillance. The aim is to automatically guess the motion of a human or a body part from monocular or multi-view video images. The interesting research for various application in human body motion analysis are physical performance, evaluation, virtual reality, and human machine interface. Thus in general, three aspects of research directions are considered in the analysis of human body motion: tracking and estimating motion parameters, analyzing of the human body structure, and recognizing of motion activity.

Figure 1. Motion Detection over Time

II. LITERATURE SURVEY

Xiaofei Ji, Honghai Liu[5],proposed that view-invariant human motion analysis can be characterized by two classes of methods.The former class is view-invariant pose representation and estimation and the later one is view invariant action representation and recognition. The difference between the two classes are the first class

gives priority to the problems of how to estimate 3-D pose from individual image in a sequence and the second class focused on the problems of how to understand and infer human activity patterns.

Adrien Descamps, Cyril Carincotte, and Bernard Gosselin[4], address the problem of human detection in indoor video surveillance information. Here they introduce a new method which is based on the state of the art integral channel features. This method is extended to allow the use of temporal features other than the appearance based features.The robust background subtraction method is integrated by the temporal features. Thus their method is then evaluated on several datasets for presenting various and challenging conditions those are typical of video surveillance context. Finally the evaluation result that the additional temporal features are efficient and improve strongly the performance of the detector.

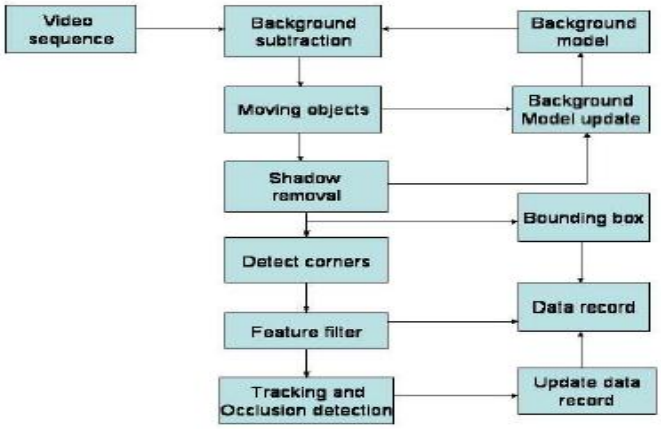

Fig:Flow chart for the proposed approach

Qi Zang and Reinhard Klette[2] gives the idea about video surveillance system, in which the system combines three phases of data processing.The three phases of data processing are moving object extraction, recognition and tracking, and decisions about actions. The former one that is the extraction of moving objects are followed by the object tracking and recognition and can often be defined in general terms. The final component which is largely depended upon the application context,such as the traffic monitoring or pedestrian counting .And in this paper, they focus on moving object tracking techniques and then they analyze some experimental results finally they provide conclusions for improved performances of traffic surveillance systems.For this they use stationary camera.

Murat Ekinci,Eyup Gedikli[3] they suggested that the real-time background modeling and maintenance based human motion detection and analysis in an indoor and an outdoor environments . To detect foreground objects, first the background scene model need to be statistically learned by using the redundancy of the pixel intensities in a training stage.Then this redundancy information of the each pixel is separately stored in a history map, that shows how the pixel intensity values can change.And they also describe about automated surveillance systems. Understanding human behavior from motion imagery involves four steps,which includes extraction of visual information from a video and their representation of information in a convenient way and interpretation of visual information for the purpose of recognition and learning about human behavior.

Sumer Jabri, Zoran Duric, Harry Wechsler[1],proposed new method of finding humans in video images. Detection is based on background modeling and subtraction approach. For the detection purpose they used both color and edge information. They also introduce confidence map or gray-scale images whose intensity is a function of their confidence where a pixel has changed to fuse intermediate results and then to represent the results of background subtraction. Thus the background subtraction is used to delineate a person's human body by guiding contour collection to segment the human from the background. Thus this method is tolerant to image/video clutter, illumination changes, and camera noise, and then runs in near real time on a standard platform.

Fig:Collected contours for frames

III. MODULES

1.Background Image Initialization

There are many civilizations to obtain the initial background image. For instance, with the first frame as the background or the average pixel brightness of the first few frames as the background or using a background image sequences without the hope of moving objects to approximate the background model parameters. From these average method is commonly used for background image initialization , but there are many shadow problems will occur which can be removed by median method, So the median method is selected in this paper to initialize the background

2.Moving Object Mining

Background subtraction is a popular technique to fragment out the interested objects in a frame. This technique involves subtracting an image that contains the object, with the former background image that has no foreground objects. The area of the image plane where there is a significant difference within these images indicates the pixel location of the moving objects. These objects, which are represented by groups of pixel, are then separated from the background image by using threshold technique.

3.Noise Removal

Since the difficulty face due to the background details , the discrepancy image obtained contains the motion region as well as large number of noise. These noises might be included in the image due to some environmental facts and illumination changes, which occurvduring the transmission of video from the camera to the further processing. Therefore the noise need to be avoided. Here we adopts median filter with the 3 X 3 window for filtering noise

4.Extraction of Moving Human Body

Some accurate edge regions will be got after median filtering, corrosion and expansion operations, but the region belongs to the moving human body could not be determined. Through inspection, we can find out that when human motion detected, shadow will appear in some regions of the scene. Accurate mining of the moving object affected by the presence of shadow. By analyzing the characteristics of human motion detection, we can merge the projection operator with the previous methods.

IV. CONCLUSION

Thus our proposed method of human motion detection will help us to detect the human motion perfectly in the approved manner. To avoid or minimize the problem that are approaching in human motion detection, we use the threshold method to detect human, background initialization and update the background in real time. Then at last, the shadow effect are removed by combining projection analysis with shape analysis. This method also has an impact on the elimination of noise and shadow, and can be able to extract the complete and accurate picture of moving human body.

V. FUTURE IMPROVEMENT

According to this paper, we have considered static background. We hope in future the human motion detection can be improved for changing or non-static background.

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Simulating the Impact of Climate Change and Land use on Groundwater Percolation Rate

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Abstract: **-** This study produced a background methodology used to model the impact of climate change/land use on groundwater percolation rate on Kaduna River. The model was first calibrated to obtain the most sensitive parameters used in the analysis to determine which parameter have the greatest impact on the model results, rainfall and soil-water content were identified as the most sensitive. The magnitude of the percolation rates was reduce significantly from 2 ARI through to 100 ARI resulting in a practical upper limit and a lower limit of the percolation rates considered under observed and climate change conditions. The changecan be adduced to be based on the antecedent moisture conditions

Keywords: *- Simulation, groundwater, infiltration, percolation, climate change, land use*

I. INTRODUCTION

Groundwater is one of the most important resources that are available to man, occupying about 0.6% by volume, it is the third most important resources in the hydrologic circle. In many countries of the world, the uses of groundwater resources for public water supply constitute the central pillar of drinking water supply. (Hiwot 2008) observed that quantitative understanding of the process of groundwater research is fundamental to the sustainable management of groundwater resources. (Hiwot 2008) further demonstrated that the recharge magnitude directly affects the amount of water that can be extracted from an aquifer.(Jyrkama et al 2002) observed that groundwater flow models are used for numerous hydrologic investigation purposes such as vulnerability assessment, remediation design and water quality and quantity estimations. Groundwater recharge according to (Jyrkama et al 2002) is influence by many parameters including climate, land use/cover and hydraulic properties of the underlying soils.

In estimating groundwater recharge using soil moisture balance approach, (Kumar 1993) presented a methodology involving step by step procedure of estimating groundwater recharge based on soil moisture balance approach. In the approach, the theory of Soil Conservation Service (SCS) number method of finding the storage index was incorporated. In predicting the climate change impact on sub- surface hydrology, (Garba et al 2013) applied the use of a stochastic weather generator to simulate the impact of climate on sub-surface hydrological response of Kaduna River as a basis for sustainable groundwater resources development plan. Land use and land cover data sets are important for watershed assessment and runoff modeling. Accurate land use and land cover data sets are use to parametize the physical system being simulated.

Approaches to simulating the impact of climate on groundwater resources using the application of a simple linear function including temperature and rainfall to simulate recharge was considered by (Hsu et al 2001).

II. MATERIALS AND METHODS

The Study Area.

Kaduna River is the main tributary of Niger River in central Nigeria. It rises on the Jos plateau south west of Jos town in a North West direction to the north east of Kaduna town. It then adopts a south westerly and southerly course before completing its flow to the Niger River at Mureji. Most of its course passes through open savanna woodlands but its lower section cut several gorges including the granite ravine at Shiroro above its entrance into the extensive Niger flood plains (fig 1).

Data used

The historical data used for the calibration were recorded rainfall and gauge height levels at gauging point (Datum at 582.96 m) located in the study area at Kaduna south water works for 26 years (1975-2000). The data are totals on monthly basis spanning the calibration period. The steps of the data collection process involve the following;

- The daily stream flow was read as gauge height while the daily rainfalls were read for each of the stations.
- The monthly maximum stream flow values and rainfall values were extracted from the daily values.
- The gauged levels measured were used to scale the flow to runoff volume of the watershed by using the expression below (Nandala) 2010).

$$Q = ICA \quad (1)$$

Where

Q =calculated runoff

I = gauged water levels

C = a factor (distribution coefficient) the ratio maximum gauge level at a point to the mean gauge levels of Kaduna river.

A = drainage area of Kaduna river.

In determining the moisture content at saturation, soil samples were obtained at four different locations along the river bank representing four land use pattern. The method of undisturbed sampling was employed in obtaining the samples for testing. The samples were taken using cylindrical core cutters (100mm by 130mm). The recharge to ground water was simulated under observed, and climate change condition, while simulations at completely unsaturated condition (0%) moisture serves as control by adjusting the most sensitive parameters of rainfall and soil- water content.

The modeling tool

Hydrognomon is an open sources software tool used for the processing of hydrological data. Data are usually imported through standard text files, spread sheets or by typing. The available processing techniques for the tool includes time step aggregation and regularization, interpolation, regression analysis and infilling of missing values, consistency test, data filtering, graphical and tabular visualization of time series. Hydrognomon support several time step from the finest minutes scales up to decades. The programme also include common hydrological application such as evapotranspiration modeling, stage discharge analysis, homogeneity test, areal integration of point data series, processing of hydrometric data as well as lumped hydrological modeling with automatic calibration facilities (fig 2)

III. GROUND WATER MODELING SYSTEM

The impact of climate change on the ground water system is simulated by applying the hydrognomon rainfall-runoff, recharge- discharge lumped based distributed hydrological model. The forecasted future climate variable parameters of rainfall for 2, 5,10,20,50 and 100 yearly time step was applied a forcing into the ground water recharge for 100×130 mm model cell in the watershed. Prior to the simulation process, the intensity measurement of gauge level at Kaduna South Water works was used for scaling the flow to watershed volume.

IV. FORECASTED FUTURE CLIMATE VARIABLES

The procedure for estimating variables of rainfall and temperature on the hydrological behavior of Kaduna River catchment consist of the following steps as applied by Gleik (1986); first parameters of the hydrological model were calibrated by Garba et al (2013) (fig 3), secondly, monthly historical time series of rainfall and temperature for the hydrological year 2010 were perturb according change scenario by using the expression below.

$$\sum(R,T) - \text{T (max)} = \{2,5,10,20,50,100\}Y$$

Where $\sum(R,T)$ is summation of all the rainfall or temperature data under consideration, T(max) is the maximum return period, and Y is the expected value of the forecasted variable.

V. RESULTS AND DISCUSSIONS

The influence of climate change was used to correlate between physical parameters at catchment scale level to process parameters for continuity of flow. In developing the rainfall-runoff relationship used in the SCS method Mackus (1972) observed that infiltration occurring after runoff begins is control by the rate of infiltration at the soil surface or by the rate of transmission in the soul profile or by water storage capacity of the profile served as a limiting factor. However succession of storms reduces the magnitude of percolation rate because the limiting factor does not have the chances to recover its rate or capacity through weathering, evapotranspiration or drainage. Mackus (1972) further observed that in such a situation, the magnitude of the

percolation rate remains virtually the same as the period progresses even if the rains are large resulting in a practical view point, a lower limit of percolation rate for a particular soil cover complex and a similar practical upper limit of percolation rate also depending on the soil cover complex. From this hypothesis by (Mackus 1972), it can be adduced from table 1 that the magnitude of the percolation rate have reduced significantly from the 2 years ARI through to 100 years ARI. Also, the practical upper limit of percolation rate under observed condition was 1365.00m^3/s and a practical lower limit of 859.95m^3/s while under climate change conditions, the practical upper limit was 906.30m^3/s and the practical lower limit of 900.90m^3/s. This change in magnitude of percolation rate is based on the antecedent moisture condition.

VI. CONCLUSIONS

As a basis for groundwater resources development, the influence of climate change and land use was applied to simulate the percolation rate of groundwater storage of Kaduna River. It was observed that the magnitude of the percolation rates reduces from 2 ARI to 100 ARI. This reduction could lead to reduction in soil moisture storage throughout the summer and autumn months for the chatchment.This assessment conform to (Conor and Charlton 2006) that the lower the capacity of a catchment to store water the greater the sensitivity to climate change.

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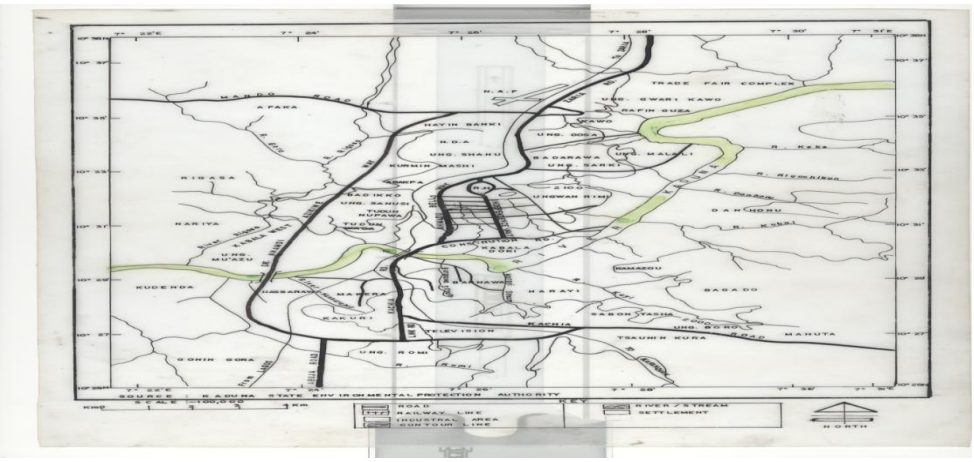

Fig 1 Drainage map of Kaduna River

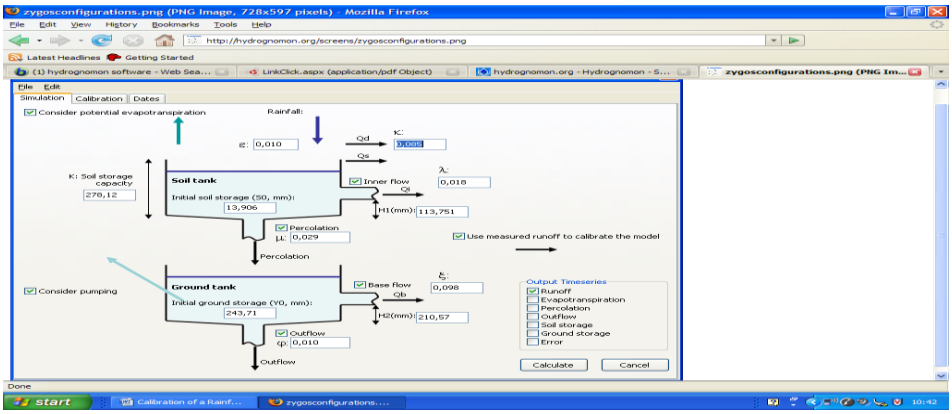

Fig 2 Sructure of simulation module

Fig 3 Predicted and simulated monthly flow of Kaduna River

Table 1 Monthly discharge percolation rate of Kaduna River

ARI (Years)	2		5		10		20		50		100	
Climate scenario	Observed (m^3/s)	Climate change (m^3/s)	Observed (m^3/s)	Climate change (m^3/s)	Observed (m^3/s)	Climate change (m^3/s)	Observed (m^3/s)	Climate change (m^3/s)	Observed (m^3/s)	Climate Change (m^3/s)	Observed (m^3/s)	Climate change (m^3/s)
1	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
2	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
3	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
4	1356.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
5	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
6	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
7	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
8	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
9	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
10	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
11	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90
12	1365.00	900.90	863.65	900.90	859.95	900.90	859.95	904.30	859.95	900.90	859.95	900.90

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A Review of Reversible Gates and its Application in Logic Design

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Abstract: - Reversible logic has become one of the most promising research areas in the past few decades and has found its applications in several technologies; such as low power CMOS, nanotechnology and optical computing. The main purposes of designing reversible logic are to decrease quantum cost, depth of the circuits and the number of garbage outputs. The purpose of this paper is to give a frame of reference, understanding and overview of reversible gates **.**In this paper various logic gates and its applicability on logic design have been discussed. Also a brief framework of comparisons between various reversible circuits is presented on the basis of various parameters.

Keywords: - *Reversible logic, Reversible gate, Power dissipation, Garbage, Quantum cost, Reversible Computing.*

I. INTRODUCTION

Energy dissipation is one of the major issues in present day technology. Energy dissipation due to information loss in high technology circuits and systems constructed using irreversible hardware was demonstrated by R. Landauer in the year 1960. According to Landauer's[1] principle, the loss of one bit of information lost, will dissipate kT*ln (2) joules of energy where, k is the Boltzmann's constant, T is the absolute temperature . In 1973, Bennett [2], showed that in order to avoid kTln2 joules of energy dissipation in a circuit it must be built from reversible circuits. According to Moore's law the numbers of transistors will double every 18 months. Thus energy conservative devices are the need of the day. The amount of energy dissipated in a system bears a direct relationship to the number of bits erased during computation. Reversible circuits are those circuits that do not lose information. The current irreversible technologies will dissipate a lot of heat and can reduce the life of the circuit. The reversible logic operations do not erase (lose) information and dissipate very less heat. Synthesis of reversible logic circuit differs from the combinational one in many ways.
Firstly, in reversible circuit there should be no fan-out, that is, each output will be used only once.
Secondly for each input pattern there should be unique output pattern. Finally, the resulting circuit must be acyclic. Any reversible circuit design includes only the gates that are the number of gates, quantum cost and the number of garbage outputs.

II. OVERVIEW

Gordon. E. Moore [3] in 1965 predicted that the numbers of components on the chip will double every 18 months. Initially he predicted only for 10 years but due to growth in the integrated-circuit technology his prediction is valid till today. His work is widely recognized as the Moore's law. The effect of Moore's law was studied carefully and researchers have come to the conclusion that as the number of components in the chip increases the power dissipation will also increase tremendously. It is also predicted that the amount of power dissipated will be equal to the heat dissipated by the rocket nozzle. Hence power minimization has become an important factor for today's VLSI engineers.
Landauer [1] stated that the amount of energy dissipated to erase each bit of information is at least kTln2 (where k is the Boltzmann constant and T is the room temperature) during any computation the intermediate bits used to compute the final result are erased. This erasure of bits is one of the main reasons for the power dissipation.

C. H. Bennett [2] in 1973 revealed that the power dissipation in any device can be made zero or negligible if the computation is done using reversible model. He proved his theory with the help of the Turing machine which is a symbolic model for computation introduced by Turing. Bennett also showed that the computations that are performed on irreversible or classical machine can be performed with same efficiency on the reversible machine. The research on the reversibility was started in 1980's based on the above concept.

In the year 1994 Shor [4] did a remarkable research work in creating an algorithm using reversibility for factorizing large number with better efficiency when compared to the classical computing theory. After this the work on reversible computing has been started by more people in different fields such as nanotechnology, quantum computers and CMOS VLSI.

Edward Fredkin and Tommaso Toffoli [5, 6] introduced new reversible gates known as Fredkin and Toffoli reversible gates based on the concept of reversibility . These gates have zero power dissipation and are used as universal gates in the reversible circuits. These gates have three outputs and three inputs, hence they are known as 3*3 reversible gates.

Peres [7] introduced a new gate known as Peres gate. Peres gate is also a 3*3 gate but it is not a universal gate like the Fredkin and Toffoli gate. Even though this gate is not universal gate it is widely used in much application because it has less quantum cost with respect to the universal gate. The quantum cost of the Peres gate is 4.

H Thalpliyal and N Ranganathan [8] invented a reversible gate known as TR gate. The main purpose of introducing this reversible TR gate was to decrease the garbage output in a reversible circuit.

H Thalpliyal and N Ranganathan [9] introduced the reversible logic to sequential circuits. Implementation of the sequential circuit such as D-latch, T latch, JK latch and SR latch using Fredkin and Feynman gate has been done. After this work more research has been done on sequential circuits using reversible gates.

Using the combination of Fredkin and Feynman gate a new gate known as Sayem gate was proposed by Sujata S. Chiwande Prashanth R. Yelekar [10] sayem gate is a 4*4 reversible gate and is used in designing sequential reversible circuits.

M.L. Chuang and C.Y. Wang [11] proposed that the numbers of gates, the number of garbage output were reduced in implementing the Latches and when the results will be compared [9] with 25% improvement was achieved.

Even though some significant works ([12], [13], [14]) have been already done in the field of reversible sequential logic design, research on reversible counters has not been done.

V. Rajmohan and Dr. V. Ranganathan in [15] implemented counters using reversible logic. The synchronous and asynchronous counter designs have the applications in building reversible ALU, reversible processor etc. This work forms an important move in construction of large and complex reversible sequential circuits for quantum computers **.**

III. BASIC DEFINITIONS PERTAINING REVERSIBLE LOGIC

1. The Reversible Logic

The n-input and k-output Boolean function $f(x_1, x_2, x_3 \ldots x_n)$ (referred to as (n, k) function) is called reversible if:

1) The number of outputs is equal to the number of inputs

2) Each input pattern maps to unique output patterns

1.1Reversible Logic Gate

Reversible Gates are circuits in which number of outputs is equal to the number of inputs .And there is a one to one mapping between the vector of inputs and outputs [13][16][17]. It helps to determine the outputs from the inputs as well as helps to uniquely recover the inputs from the outputs.

1.2 Ancilla inputs/Constant inputs

This can be defined as the number of inputs that are to be maintain constant at either 0 or 1 in order to synthesize the given logical function [18]. \

1.3 Garbage Outputs

Additional inputs or outputs can be added so as to make the number of inputs and outputs equal whenever required. This also indicates the number of outputs which are not used in the synthesis of a given function. In certain cases these become mandatory to attain reversibility. Therefore garbage is the number of outputs added to make an n-input k-output function ((n; k) function) reversible.

Constant inputs are used to denote the present value inputs that are added to an (n; k) function to make it reversible. The following simple formula shows the relation between the number of garbage outputs and constant inputs.

Input + constant input = output + garbage. [19]

1.4 Quantum Cost

Quantum cost may be defined as the cost of the circuit in terms of the cost of a primitive gate. It is calculated by the number of primitive reversible logic gates (1*1 or 2*2) required to realize the circuit. The quantum cost of a

circuit is the minimum number of 2*2 unitary gates to represent the circuit keeping the output unchanged. The quantum cost of a 1*1 gate is 0 and that of any 2*2 gate is the same, which is 1 [20].

2. Reversible Gates

Some of the important reversible logic gates are:

2.1 NOT Gate

The simplest Reversible gate is NOT gate and is a 1*1 gate [21]. The Reversible 1*1 gate is NOT Gate with zero Quantum Cost is as shown in the Figure 1.

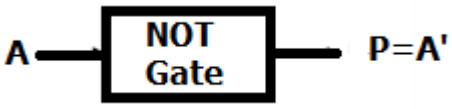

Fig 1: NOT Gate

2.2 CNOT Gate

CNOT gate is also known as controlled-not gate. It is a 2*2 reversible gate. The CNOT gate can be described as: Iv = (A, B) ; Ov = (P= A, Q= A^B) Iv and Ov are input and output vectors respectively. Quantum cost of CNOT gate is 1[22]. Figure 2 shows a 2*2 CNOT gate and its symbol.

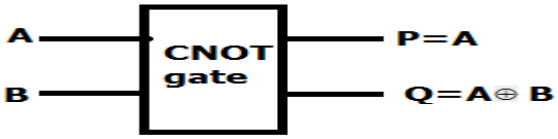

Fig 2: CNOT gate

2.3 Feynman Gate

The Feynman gate which is a 2*2 gate and is also called as Controlled NOT and it is widely used for fan-out purposes. The inputs (A, B) and outputs P=A, Q= A XOR B. It has quantum cost one [23].

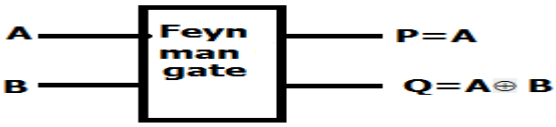

Fig 3: Feynman gate

2.4 Toffoli Gate

Fig 4 shows a 3*3 Toffoli gate. The input vector is I (A, B, C) and the output vector is O(P,Q,R). The outputs are Fig 4 shows a 3*3 Toffoli gate. The input vector is I (A, B, C) and the output vector is O(P,Q,R). The outputs are defined by P=A, Q=B, R=AB ⊕C. Quantum cost of a Toffoli gate is 5[5].

Fig 4: Toffoli gate

2.5 Fredkin Gate

Fig 5 shows a 3*3 Fredkin gate. The input vector is I (A, B, C) and the output vector is O (P, Q, R). The output is defined by P=A, Q=A′B⊕AC and R=A′C⊕AB. Quantum cost of a Fredkin gate is 5[6].

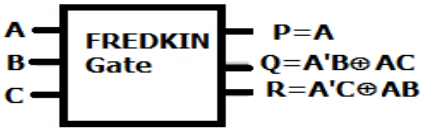

Fig 5: Fredkin Gate

2.6 Peres Gate

Fig 6 shows a 3*3 Peres gate. The input vector is I (A, B, C) and the output vector is O (P, Q, R). The output is defined by P = A, Q = A⊕B and R=AB⊕C. Quantum cost of a Peres gate is 4[7].

Fig 6: Peres Gate

IV. COMPARATIVE STUDY

To Various reversible gates and different circuits associated with these gates are discussed here. And also comparisons have been made among the existing circuit in terms of various parameters such as quantum cost, garbage output, constant input, gate count and delay. Comparison between existing reversible gates is shown in Table 1.

Table 1. Comparison Between Reversible Logic Gates

Reversible gates	Quantum cost	Types
Feynman gate[23]	1	2*2
Toffoli gate[24]	5	3*3
Fredkin gate[6]	5	3*3
Peres gate[7]	4	3*3
TSG gate[25]	4	4*4
URG gate[26]	unknown	3*3
System gate[27]	unknown	4*4
TR gate[26]	6	3*3
NFT gate[26]	5	3*3
BJN gate[26]	5	3*3
MTSG gate[25]	6	4*4
BME gate[26]	5	4*4
Sayem gate[13]	unknown	4*4
VB-1 gate[28]	unknown	4*4
VB-2 gate[28]	unknown	4*4
MKG gate[29]	unknown	4*4

A comparison has been drawn among the existing reversible full adders shown in Table 2.In the study of [29], a new reversible full adder circuit has been designed that requires only one reversible MKG gate and produces two garbage outputs. In the paper [25], the proposed TSG gate has been used to work singly as a reversible full adder unit producing two outputs. The design in [30] requires five reversible Fredkin gate and produces five garbage outputs. In the paper [31], a reversible full adder circuit have been implemented by two Toffoli and two Feynman gates with 2 garbage outputs. Again, in [32], a new reversible DKG gate has been used to design a reversible full adder. The reversible full adder circuit in [33] requires three reversible gates (two 3*3 new gate and one 2*2 Feynman gate) and produces three garbage outputs. In [34], a single HNG gate has been used to work as a reversible full adder circuit.

Table 2. Comparison between existing Full adders

Name of the circuits	Quantum Cost	Garbage Output	Gate Count	Constant Input
MKG gate based full adder[29]	Not specified	2	1	1
TSG gate based full adder[25]	Not specified	2	1	1
Fredkin gate based full adder[30]	20	3	4	2
Toffoli and Feynman gate based full adder[31]	10	2	4	1
DKG gate based full adder[32]	11	2	Not specified	Not specified
Toffoli, New and Feynman gate based full adder[33]	11	3	3	1
HNG gate based full adder[34]	Not specified	2	1	1

Comparison between existing reversible Full adder/subtractor is shown in Table3.In [32], a new reversible logic gate DKG gate works singly as a reversible full adder circuit with two garbage outputs. In [35], one of the implementations is designed with 3 Feynman gates, 2 Peres gates, 2 TR gates and one Fredkin gate with 7 garbage outputs. Another design is by utilizing 3 TR gates and 6 Feynman gates producing 7 garbage outputs. the third implementation is by using 2 Feynman, 1 Tr and 5 Fredkin gates with 5 garbage outputs. In [37], three designs have been proposed. The first one is by using five Fredkin gate, two Feynman and a TR gate and produces 5 garbage outputs. The second design is by utilizing two Feynman and two TR gates producing 3 garbage outputs. The third is by two FG, two PG gates and produces 3 garbage outputs.

Table3. Comparison between existing Full adder/subtractor

Name of the circuits	Quantum Cost	Garbage Output	Gate Count	Constant Input
DKG gate based full adder/subtractor[32]	Not specified	2	1	1
Fredkin, Feynman, Peres and TR gate based Full adder/subtractor[35]	28	7	8	5
Fredkin and TR gate based full adder/subtractor[35]	24	7	9	5
Feynman, Fredkin and TR gate based full/subtractor[35]	21	5	8	3
Full adder/subtractor circuit 1[36]	Not specified	3	2	2
Full adder/subtractor circuit 2[36]	Not specified	2	1	1
Feynman, Fredkin and TR gate based full adder/subtractor[37]	21	5	8	3
Feynman and TR gate based full adder/subtractor[37]	14	3	4	1
Feynman and Peres gate based full adder/subtractor[37]	11	3	4	1

Comparison between existing reversible BCD adders are made in Table 4.In[38], 8 TSG gates and 3 NG gates are utilized for designing a BCD adder producing 22 garbage outputs. The reversible carry select BCD adder has been designed using 12 TSG, 8 Feynman, 3 NG, 4 Fredkin gates. In the study of[43], a BCD adder has been implemented using 5 HNG gates, 1 Feynman, 1 SCL, and 1 Peres gate.

Table 4. Comparison between existing BCD adders

Name of the circuit	Quantum Cost	Garbage Output	Gate Count	Constant Input	Delay
TSG and NG gate based BCD adder[38]	Not specified	22	11	11	10
BCD adder[22]	70	5	Not specified	1	57
BCD adder[39]	Not specified	22	14	17	13
BCD adder[40]	Not specified	22	23	17	14
BCD adder[41]	55	11	10	7	10
Carry select BCD adder[42]	Not specified	39	27	27	Not specified
BCD adder[43]	Not specified	10	8	6	Not specified
BCD adder[44]	169	8	Not specified	4	Not specified
BCD adder[45]	Not specified	11	9	7	9

Comparison between existing reversible BCD to Excess-3 converters is shown in Table 5.BCD to Excess-3 code converter has been implemented in two different methods in paper [46]. In one method, four HNG gates are used that produces 6 garbage outputs, whereas in the second method, three HNG and one Feynman gates producing 7 garbage outputs. In [47], BCD to Excess-3 code converter has been designed by four TSG gates producing 9 garbage outputs.

Table 5. Comparison between existing BCD to Excess-3 converters

Name of the circuits	Quantum Cost	Garbage Output	Gate Count	Constant Input	Delay
HNG gate based BCD to Excess-3 code converter[46]	24	6	4	6	Not specified
Feynman and HNG gate based BCD to Excess-3 code converter[46]	19	7	4	7	Not specified
TSG gate based BCD to Excess-3 code converter[47]	52	9	4	9	4

Comparison between existing reversible Binary to Gray code converters is shown in Table6.The paper [46] depicts two methods for binary to gray code converter. The first design uses one Feynman and two double Feynman gates producing 3 garbage outputs. The second design utilizes three Feynman gates without any garbage outputs.

Table6. Comparison between existing Binary to Gray code converters

Name of the circuits	Quantum Cost	Garbage Output	Gate Count	Constant Input
Feynman gate based binary to gray code converter[46]	3	0	3	0
Feynman and Double Feynman gate based gray code converter[46]	5	3	3	2

Comparison between existing Comparators by reversible gates is shown in Table 7.

Table 7. Comparison between existing Comparators

Name of the circuits	Quantum Cost	Garbage Output	Gate Count	Constant Input
Feynman, Peres and HNG gate based comparator[46]	42	15	10	11
Comparator[48]	Not specified	23	25	17
Comparator 8 bit[49]	124	36	29	23
Comparator 8 bit[50]	135	42	72	59
Comparator 8 bit[51]	321	64	40	27
Comparator 64 bit[49]	1014	316	253	191
Comparator 64 bit[50]	1143	378	576	Not specified
Comparator 64 bit[51]	2505	512	320	Not specified

Comparison between existing Carry skip adders by reversible gates is shown in Table 8.The Four bit carry skip adder has been implemented using four TSG and four fredkin gates with 12 garbage outputs in the paper [25]. In the study of [52], it is seen that the carry skip adder is designed using two Double Feynman gate, four NFT gate, eight MIG gates producing 19 garbage outputs. In [30], Fredkin gates have been used to produce a carry skip adder with 3 garbage outputs.

Table 8. Comparison between existing Carry skip adders

Name of the circuit	Quantum Cost	Garbage Output	Gate Count	Constant Input
Carry skip adder[52]	Not specified	19	14	15
Carry skip adder[53]	Not specified	22	24	21
Carry skip adder[54]	Not specified	27	22	22
TSG and Fredkin Gate based Carry Skip Adder[25]	Not specified	12	8	7
Fredkin, Peres and MTSG gate based Carry skip adder[55]	Not specified	12	8	7
Fredkin gate based carry skip adder[30]	20	3	4	2

Comparison between existing reversible SR Latches is made in Table 9. In the study of [9], it is seen that the SR latch has been designed by two Peres gates producing two garbage outputs. In the paper [56], SR latch have been designed by using two Fredkin gates producing 2 garbage outputs and also by using two Toffoli gates producing 2 garbage outputs.

Table 9. Comparison between existing SR Latches

Name of the circuits	Quantum Cost	Garbage Output	Gate Count	Constant Input	Delay
Fredkin Gate based SR Latch[56]	10	2	2	Not specified	10
Toffoli Gate based SR Latch[56]	10	2	2	Not specified	10
Peres Gate based SR Latch[9]	8	2	2	2	8

Comparison between existing reversible D Latches is shown in Table 10**.** In the paper [9], the D latch is designed by one Feynman and one Fredkin gate with two garbage outputs. In the paper[28], VB-1 gate works

singly as a D latch. Also, using one VB-1 gate and a Feynman gate, a T Latch have been designed in this paper. In the same paper, JK Latch has been proposed by one VB-1 gate and VB-2 gate producing two garbage outputs. In [57], two Fredkin gates are used to design D Latch.

Table 10: Comparison between existing D Latches

Name of the circuit	Quantum Cost	Garbage Output	Gate Count	Constant Input	Delay
Feynman and Fredkin gate based D latch[9]	7	2	2	1	7
Fredkin gate based D latch[57]	47	6	2	2	25
D latch[58]	10	2	Not specified		10
D latch using VB-1 gate[28]	Not specified	1	1	1	Not specified
T Latch[58]	Not specified	2	2	Not specified	Not specified
T Latch using VB-1 and Feynman gate[28]	Not specified	1	2	1	Not specified
JK Latch[58]	Not specified	3	3	Not specified	Not specified
JK Latch using VB-1 and VB-2 gate[28]	Not specified	2	2	2	Not specified

Comparison between existing reversible Flip Flops is drawn in Table 11.In the paper [28], two VB-1 gates, and a Feynman gate have been used to propose a master slave D Flip-flop. Here, two VB-1 gates and two Feynman gates are utilized to design a master slave T flip-flop, and two VB-1 gates and one VB-2 gate have been used to make a master slave JK flip-flop.

Table 11: Comparison between existing Flip Flops

Name of the circuit	Quantum Cost	Garbage Output	Gate Count	Constant Input	Delay
Master Slave D FF[59]	47	12	Not specified	Not specified	35
Master Slave D FF[60]	13	3	5	2	13
Master Slave D FF[58]	13	4	Not specified	Not specified	13
Master Slave D FF using Fredkin and Feynman gates[18]	12	3	4	2	12
Master Slave D FF using VB-1 and Feynman gate[28]	Not specified	2	3	3	Not specified
Master Slave T FF[60]	83	3			13
Master Slave T FF[58]	17	4			17
Master Slave T FF using Fredkin, Feynman and Peres gate[18]	11	3	4	2	11
Master Slave T FF using VB-1 and Feynman gate[28]	Not specified	2	4	3	Not specified
Master Slave JK FF[60]	39	4			39
Master Slave JK FF[59]	23	5			22
Master Slave JK FF using Fredkin and Feynman gate[18]	18	4	5	2	18
Master Slave JK FF[28]	Not specified	3	3	2	Not specified

Comparison between existing reversible Counters is shown in Table 12. In the study of [61], it is seen that the asynchronous counter had been proposed by using 4 Peres gates and 11 Feynman gates producing 3 garbage outputs. Also, four Peres, six Feynman and two TG have been used to design a synchronous counter have been

Table 12: Comparison between existing Counters

Name of the circuit	Quantum Cost	Garbage Output	Gate Count	Constant Input
Peres and Feynman gate based asynchronous counter[61]	23	4	11	7
Peres, Feynman and Toffoli gate based synchronous counter[61]	32	4	12	7
Asynchronous counter[62]	55	12	8	Not specified
Synchronous counter[63]	35	4	Not specified	Not specified

V. APPLICATIONS OF REVERSIBLE GATES

Reversible computing may have applications in computer security and transaction processing, but the main long-term benefit will be felt very well in those areas which require high energy efficiency, speed and performance .it include the area like

- Low power CMOS.
- Quantum computer.
- Nanotechnology.
- Optical computing.
- DNA computing.
- Computer graphics.
- Communication.
- Design of low power arithmetic and data path for digital signal processing (DSP).
- Field Programmable Gate Arrays (FPGAs) in CMOS technology.

The potential application areas of reversible computing include the following

- Nano computing
- Bio Molecular Computations
- Laptop/Handheld/Wearable Computers
- Spacecraft
- Implanted Medical Devices
- Wallet “smart cards”
- “ Smart tags” on inventory
- Prominent application of reversible logic lies in quantum computers.
- Quantum gates perform an elementary unitary operation on one, two or more two–state quantum systems called qubits.
- Any unitary operation is reversible and hence quantum networks also.
- Quantum networks effecting elementary arithmetic operations cannot be directly deduced from their classical Boolean counterparts (classical logic gates such as AND or OR are clearly irreversible).
- Thus, Quantum computers must be built from reversible logical components.

VI. CONCLUSION

The reversible circuits form the basic building block of quantum computers. This paper presents the primitive reversible gates which are gathered from literature and this paper helps researchers/designers in designing higher complex computing circuits using reversible gates. The paper can further be extended towards the digital design development using reversible logic circuits which are helpful in quantum computing, low power CMOS, nanotechnology, cryptography, optical computing, DNA computing, digital signal processing (DSP), quantum dot cellular automata, communication, computer graphics.

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Synthesis and characterization of Bismuth oxide nanoparticles via sol-gel method

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Abstract: - Bismuth oxide nanopowders were prepared by the sol gel method. The overall process involves three steps: formation of homogeneous sol, formation of gel and decomposition of the gel to obtain raw powders. The nanocrystalline materials were obtained after calcination the powders at 500°C which is lower than the sintered temperature of the conventional solid-state method. As-prepared bismuth nanopowders were characterized by x-ray diffraction (XRD), FT-IR and FESEM (scanning electron microscopy analysis).Transmission electron microscope (TEM) investigations revealed that the average particle size is less than 20 nm.

Keywords: *Bismuth oxide; Sol-gel; Nanopowders; Electron microscopy*

I. INTRODUCTION

Bismuth oxide (Bi_2O_3) has been investigated extensively due to its optical and electrical properties such as refractive index, large energy band gap, dielectric permittivity as well as remarkable photoluminescence and photoconductivity. These properties make bismuth oxide an interesting candidate for applications in the fields such as optoelectronics, optical coatings, and gas sensors [1]. The synthesis of bismuth nanoparticles has been recently reported by using a chemical method [2].There exists five polymorphs of bismuth oxide (Bi_2O_3) named: α-Bi_2O_3 (monoclinic), β- Bi_2O_3 (tetragonal), γ- Bi_2O_3 (BCC), δ-Bi_2O_3 (Cubic), ε-Bi_2O_3 (triclinic). α-Bi_2O_3 transforms in to δ-Bi_2O_3 at 729°C [3-4]. The cooling of the δ-Bi_2O_3 phase gives rise to the β-Bi_2O_3 at 650 °C or the γ- Bi_2O_3 at 639 °C. The low-temperature α-phase and high-temperature δ-phase are stable, and the others are high-temperature metastable phases such as β-Bi_2O_3 and γ-Bi_2O_3, these can be stabilized to exist at room temperature by doping with impurities. N.Cornei et al. have recently reported the synthesis of a new phase named ε-Bi_2O_3 by using the so called hydrothermal method [5].The authors found that this polymorph is an ionic insulator in contrast to β-, γ-, δ-Bi_2O_3 (ionic conductors). In the present work we report new results of the synthesis of Bi_2O_3 polymorphs using a sol–gel procedure [6].This method is commonly used for preparation of oxides [7].

Using chemical methods, e.g. co-precipitation, sol–gel, hydrothermal technique have been confirmed to efficiently control the morphology and chemical composition of prepared powders and it can reduce the sintering temperature[8].This process involves of metal ions by poly functional carboxyl acids, such as citric acid that was used in this work.

II. EXPERIMENTAL

2.1. Raw materials

Bi $(NO_3)_3.5H_2O$ (98% in purity), HNO_3 (67.5% in purity), citric acid (AR grade), PEG600 H $(OCH_2CH_2)_n$ OH, were purchased from Merck and used as received.

2.2. Devices

XRD diffraction studies were carried out by Philips (PW3710) diffractometer with CuKα
Radiation source (λ=0.151478 nm).The TEM picture was recorded with Zeiss EM 10C instrument at the accelerating voltage of 100 kV. IR transmittance and absorption spectra were measured on the two samples prepared by KBr pellet technique in the wave number range of 400–4000 cm^{-1} on (FTLA 2000-100) model.
Field emission scanning electron microscopy measurements studies were performed using Hitachi S4160 model.

2.3. Synthesis

Bismuth nitrate and citric acid were used for the preparation of Bi_2O_3 are of AR grade. A known quantity of $Bi(NO_3)_3.5H_2O$ was dissolved in nitric acid solution and mixed with citric acid in a 1:1 molar ratio. In order to prevent agglomeration, a small amount of PEG600 was added as a surfactant. The pH value of the solution was adjusted to 3.
The above solution was stirred for 2 h, and then a sol formed. The sol solution was heated to 80 °C for 3h to form a yellowish gel. This gel was decomposed at 120°C in oven .The gel initially started to swell and filled the beaker producing a foamy precursor. This foam consists of homogeneous flakes of very small particle size.

III. RESULTS AND DISCUSSION

XRD were employed to characterize these powders. The sample was scanned in the 2θ range of 4˚-60˚ for a period of 5 s in the step scan mode. The diffraction pattern (Fig.1) presents peaks corresponding to reflection planes of the monoclinic structure of metallic bismuth.A small fraction of unidentified phase(s) was observed.
The average crystallite size which has been determined by Debye-Scherrer formula:

Where L is coherence length, related to spherical particle diameter D=4/3L, λ is the wavelength of X ray (nm), k is a constant (= 0.9 assuming that the particles are spherical), β is the full width in radius at half-maximum (FWHM) of the Highest peak (rad) and θ is the Bragg angle of the highest peak. The particle size obtained from XRD data is 40 nm. The calculated lattice parameters by least square fit are a=5.8400 Å, b= 8.16600 Å, c = 7.5100 Å.

Figure 2(a-c) shows SEM images of the bismuth samples treated at 200, 500 and 800 ºC, respectively. Figure 2a exhibits a pseudospherical morphology; however these particles begin to form agglomerates when the temperature within the thermal treatment increases up to 800 ºC (Fig. 2c). After a thermal treatment at 800 ºC the size of the particles has changed to micro-spheroid as can be clearly seen in figure 2. The grain sizes estimated from SEM observations were different from those done by means of Scherrer's equation. This equation assumes that all the crystallites are of the same size, but in an actual specimen, the size range and distribution affect β.

The fine powders were dispersed in acetone and were put on a carbon coated TEM copper grid. The TEM image of the superfine Bi_2O_3 powder (Fig. 3) shows that Bi_2O_3 nanoparticles are spherical-like shape, and the average particle size are less than 50 nm, which was in good agreement with the XRD result.

The IR spectra of the dried gel and calcined powders of bismuth oxide are shown in Figure 4(a, b). After drying at 120°C, the spectrum is complex due to the existence of lots of organic compounds. Band at 3500 ~ 3200 cm^{-1} is a characteristic group frequency from the stretch vibration of O-H [9]. The broad band at 2800~ 3200 cm^{-1} comes from C-H stretch vibration and the stretch -CH_2 of located at 2930 cm^{-1}. The peak of 1386.02cm^{-1} is the characteristic ones of NO_3^- group. The broad one around 700 ~ 400 cm^{-1} originates from the metal-oxygen (Bi-O) vibration. After annealing at 500°C, many vibration lines disappear because of the evaporation of most solvents and decomposition of the organic ingredient. Samples before or after anneal have the same absorption positions but different intensity.

IV. CONCLUSIONS

In summary, homogeneous bismuth oxide nanopowders have been prepared by sol gel method. The single α-phase is obtained at a temperature lower than that prepared by conventional solid state method. The average size of these nanoparticles ranges less than 20 nm.

Figures

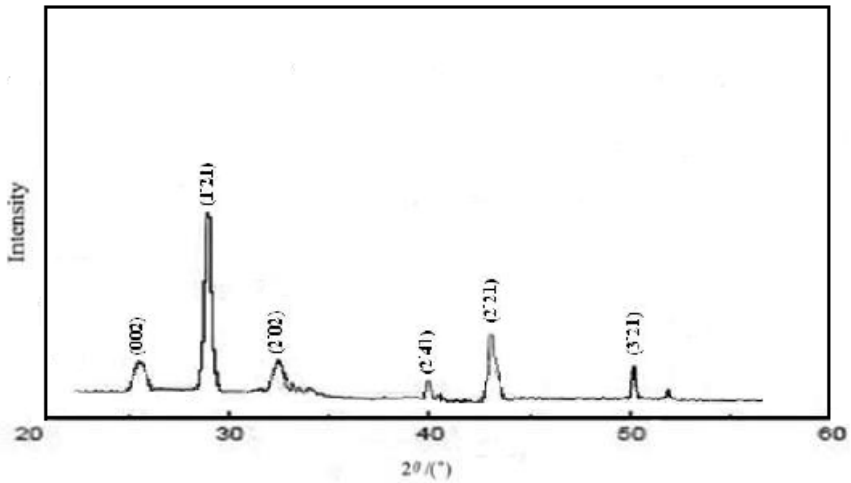

Fig 1. XRD of the bismuth particles calcined at 500 ºC

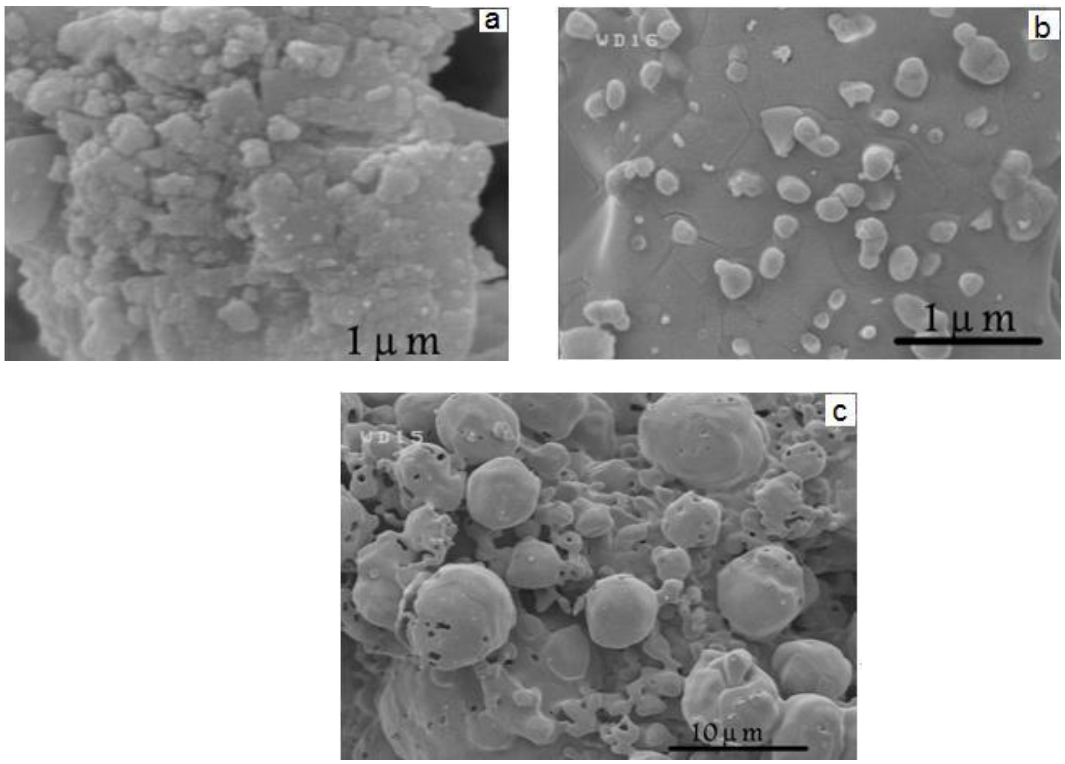

Figure 2. SEM micrographs of thermal treated bismuth particles at (a) 200 ºC (b) 500 ºC (c) 800 ºC

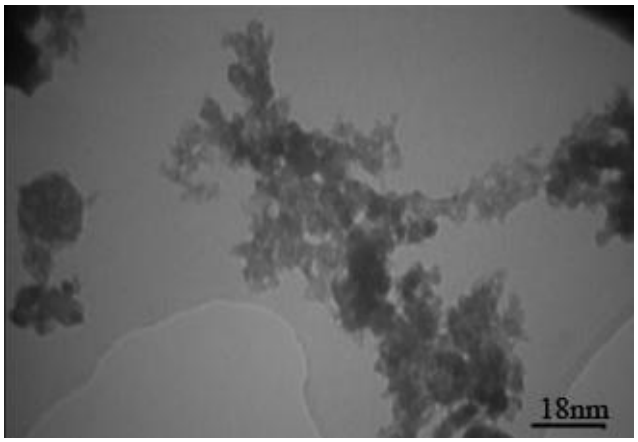

Figure 3. TEM images of the nanoparticles calcined at 500 °C

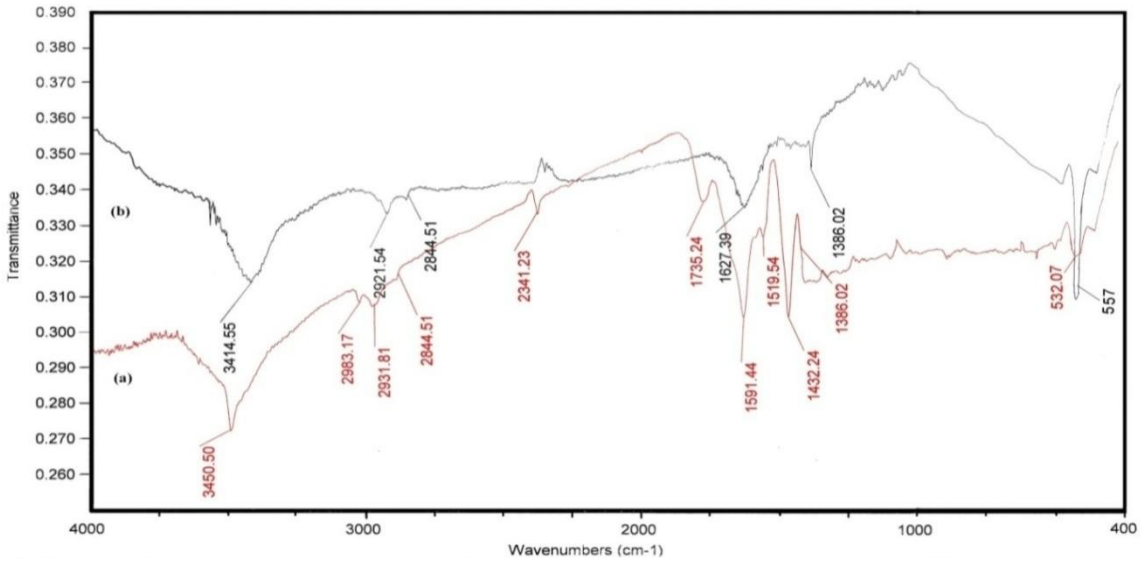

Figure 4. IR spectra of the as-synthesized powders: (a) dried gel at 120°C (b) after calcination at 500°C

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Some Physico-Chemical and Bacteriological Characteristics of Soil Samples around Calabar Metropolis, Cross River State, Nigeria

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Abstract : - Physico-chemical and bacteriological parameters of soil samples around Calabar Metropolis, Cross River State, Nigeria were examined to determine the pollution status of the soil quality. Results of the physico-chemical analysis showed that the soil samples had pH range of 4.4 – 5.2. Tinapa soil has the highest value of Copper (39.63mg/kg) and Nickel (11.36mg/kg) and Anantigha has the highest value of Zinc (14.59mg/kg), Iron Fe (78.19mg/kg) and Manganese (47.42mg/kg). The results revealed a high total count of $23.5x10^{6}$ cfu/g in Anantigha and $24.5x10^{-3}$ cfu/g in Tinapa for bacteria and fungi respectively. Some bacteria isolates found during the study includes, Escherichia coli, Bacillus subtilus, Clostridium sp, Arthrobacter sp, Streptomyces sp, Nocardia sp, Pseudomonas sp and Micrococcus sp., and Fungal isolates includes, Actinomycete sp, Verticullium sp, Aspergillus sp, Mucor sp, Nigospora sp and Paecilomyces sp. From the result, soil sample from Anantigha have comparatively the highest Total Bacterial Counts compared to the other two locations. The health implications of this work is that Anantigha and Tinapa areas being low lying were likely, because of the presence of Escherichia coli, to experience gastro-intestinal diseases such as dysentery and cholera than the Ediba environments.

Keywords: *- Physico-chemical, Microbial, Soil Samples, Calabar Metropolis, Nigeria*

I. INTRODUCTION

Soil is the part of the earth crust where geology and biology relate. Soil surface provides home for plants, animals and microbial life. However, soil contamination by heavy metals and toxic elements due to parent or point sources often occurs on a limited area and is easy to identify (He *et al*., 2001).The soil environment may be divided into layers called horizons. It comprises of four major layers, the top soil, sub soil, parent material and bedrock (Asikong and Udofia, 2005). The top soil may act as carriers of pollutants and other contaminants. Several studies have indicated that industrial discharges and municipal wastes are the major sources of environmental pollution. A major path way of soil contamination is through atmospheric deposition of heavy metals from point source such as metaliferous metal smelting and industrial activities (Singh, 2001). Other sources of contamination affecting soil include inputs such as, fertilizers, pesticides, sewage sludge and microbial activities. Several studies have indicated that vegetables, particularly leafy crops, grown in heavy metal contaminated soil have higher concentrations of heavy metal than those grown in uncontaminated soil (Dowdy and Larson, 1995). It has been reported that movement of these chemical in plant and water bodies depends on the extent of soil contamination and may endanger human health through consumption of sea food and vegetable crops or directly through skin contact and inhalation of dust particles (Ayodele and Gaya, 2003). Leafy vegetables occupy a very important place in the human diet, but unfortunately constitute a group of foods which contributes maximally to nitrate and other anions as well as heavy metals consumption. The excessive application of nitrogen and other inorganic fertilizers and organic manures to these vegetables can accumulate high levels of nitrate and other anions as well as heavy metals (Akan *et al*., 2010). This study is aimed at assessing the physico-chemical parameters of soil in the three different locations that represent the ecological area of Calabar Metropolis in view of determining the pollution status.

II. MATERIALS AND METHODS

2.1 DESCRIPTION OF STUDY AREA

The study areas comprises of Tinapa (5º3'12"N, 8º19'5"E), Ediba (4º58'44"N, 8º20'43"E) and Anantigha (4º55'3"N, 8º19'5"E) areas located within Calabar Metropolis in Cross River States, Nigeria. Calabar can be described as being nearly level to gently undulating slopes which provide a very stable physiographic environment for relatively uniform parent materials.

2.2 SAMPLE COLLECTION

Soil samples were taken in the surface soil at a distance away from the flow of traffic at a depth of 0-15cm with a trowel. The depth of 0-15cm was used because it is believed that pollution decreases with increase in soil depth. The soil samples were collected into labeled sterile polyethylene bags and taken in ice-packed cooler to the laboratory for bio-component and physico-chemical analysis.

2.3 PREPARATION OF SAMPLES FOR ANALYSIS

Samples collected in each location were divided into two parts, one part for physico-chemical analysis while the other for microbial analysis. Each sample meant for physico-chemical analysis was air dried for five days, and then sieved to ensure homogeneity using a 2mm size sieve.

2.3.1 PHYSICO-CHEMICAL ANALYSIS

Physico-chemical analysis was carried out in Soil Science Department laboratory, University of Calabar. The particles size analysis was determined using hydrometric method (Bouyoucos, 1962). 100g of each soil sample was analyzed, in which 50ml of calgon was used as a dispersing agent. 200ml of water was added, stirred and kept for 24 hours so that the dispersion in circulating the soil particle can be completed. Then it was pulled into a measuring cylinder of 1000ml for the particles to settle for reading. Soil pH was determined in water and 0.1 M KCl solution at 1:2.5 Soils. Organic carbon content was found by the modified $K_2Cr_2O_7$ digestion of Walkley-Black method (Nelson and Sommers, 1996). Effective cation exchange capacity was determined by adding the 1 *M* KCl extractable acidity to cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) exchanged by neutral 1 *M* $NH_4C_2H_3O_2$ as described by (Thomas, 1982). The exchangeable acidity was determined by titration and the cation exchange capacity (CEC) was obtained by summation of exchangeable cations and exchange acidity. The available phosphorus was determined by the Bray P-1 method. 3g of each soil sample was measured into a100ml conical flask.15g of the extractor (0.03 NH_4 and 0.025 HCl) was added for 1min and then filtered. Ascorbic acid solution was added to 2ml of the filtrate and the available phosphorus was determined by the blue calorimetric method as also described by (Bray and Kutz, 1945). The total nitrogen was determined on 5g of each soil sample using Micro-kjel Dahl digestion procedure, using Sodium Sulphate ($NaSO_4$), Copper Sulphate ($CuSO_4$) and Concentration Sulphuric acid (H_2SO_4) as also described by (Bremner, 1965).

2.3.2 HEAVY METALS ANALYSIS

All reagents used were of analytical grade and from which standard solutions were prepared. Glassware were thoroughly washed with detergent and rinsed with distilled water. The digestion method previously described by Francek *et al*., (1994) was adopted for the extraction of trace metals in this study. One gram each of air-dried soil sample was crushed to fine powder in an agate mortar and digested in 10 ml of 1:1 concentrated HNO3. The mixture was evaporated to near dryness on a hot plate and then cooled. This procedure was repeated with a 15 ml solution of 1:1 concentrated HCl. The extracts were filtered with Number forty (40) Whatman filter paper and then made up to 100 ml volume with 2% HNO3. Solutions of the sample and blanks were run using Atomic Absorption Spectrometer (AAS) (200A Model).

2.3.4 MICROBIAL ANALYSIS

2.3.4 1 SERIAL DILUTION

Ten-fold Serial dilutions of the soil samples were made as described by (Collins and Lyne, 1976; Harrigan and McCance, 1976).

2.3.4.2 INOCULATION AND INCUBATION

One milliliter of appropriate ten-fold serial dilutions of the soil sample were Inoculated onto Nutrient agar (Oxoid CM 314), Reinforced Clostridial Agar Oxoid CM 149, 151), Malt Extract Agar (Oxoid) and Sabouraud Dextrose Agar plates in triplicates using pour plate methods as described by (Collins and Lyne, 1976; Harrigan and McCance, 1976) and spread plates methods by (Demain and Davies, 1999). Soil plate techniques as described by (Eka and Fogathy, 1972; Cruickshank et al., 1976) were also used for the isolation of Actinomycetes using the Starch Nitrate Agar. Inoculated plates were incubated at 28+2oC for 18-24 hours and

48-72 hours for the enumeration of total heterotrophic bacteria, fungi and Actinomycetes respectively. Visible discrete colonies in incubated plates were counted and expressed as colony forming units per gram (cfu/g) of soil samples.

2.3.4.3 PURIFICATION AND MAINTENANCE OF ISOLATES

The isolates obtained were purified by repeated sub-culturing on fresh agar medium and incubated under normal condition for growth. Pure colonies isolated were inoculated on agar slants using Maconey bottles to serve as stock cultures, incubated at 37ºC and were stored in the refrigerator at 6ºC ± 2ºC for future research.

2.3.4.4 CHARACTERIZATION AND IDENTIFICATION OF MICROBIAL ISOLATES

Pure cultures of microbial isolates were identified based on cultural parameters, microscopic techniques and biochemical tests including carbohydrate utilization (Cruickshank *et al*., 1976). Identification of the bacterial isolates was accomplished by comparing the characteristics of the cultures with that of known taxa as in (Holt *et al*., 1994). Characterization and identification of fungal isolates was carried out as described by (Domsch *et al*., 1980; Barnet and Hunter, 1987). Actinomycetes were characterized and identified as described by (Eka and Fogathy, 1972).

III. RESULTS

4.1 PHYSICO-CHEMICAL PARAMETERS

The particle size of the soils varies from the sand, clay and a silt fraction around Calabar Metropolis is shown in Table 1 and variation in percentage distribution of particle size of the soil within the sampling locations is shown in Figure 1. The results of the determination of heavy metals in the soil samples from different sampling locations around Calabar Metropolis are shown in Table 2 and Variation in Heavy metals concentration of different sampling locations around Calabar Metropolis is shown in Figure 2. The values and percentages of the physico-chemical parameters of soils recorded from sampling locations around Calabar Metropolis during the Study period is shown in Table 3. Table 4 shows the Total Bacteria Count (TBC), Isolates and their Biochemical Characteristics found in soil samples from the Sampling location around Calabar Metropolis after been view under the microscope.

IV. DISCUSSION

The study revealed high percentage content of sand and low clay and silt contents at the various study areas. Anantigha (89.6%) has the highest percentage of sand particle sizes when compared with Ediba (72.6%) and Tinapa (65.6%). Aggressive weather conditions might equally be responsible for the soil texture observed as reported by (Jungerius and Levellt, 1964). The values obtained for cations calcium, magnesium, sodium and potassium except exchangeable acidity revealed increase in values in the studied sample collected at Anantigha, compared with those of Ediba and Tinapa. These increase in the cations especially calcium and magnesium in this sample could have been caused by the plants effluent. The result for the samples analyzed all indicated soil pH that were acidic with a range of pH 4.4-5.2. Soil pH controls the available phosphorus. In acid soil, available Phosphorous concentration increases as pH increases, while in alkaline soil, available Phosphorous concentration decreases as pH increasing (Holford and Mattingly, 1975). The result also shows Heavy metals of Calabar Metropolis during the study. Anantigha has the highest value of Zinc (14.59mg/kg), Iron (78.19mg/kg) and Manganese (47.42mg/kg). Although some heavy metals such as Copper, Zinc, Manganese and Iron are essential in plant nutrition, many of them do not play any significant role in plant physiology. The uptake of these heavy metals by plants especially leafy vegetables is an avenue of their entry into human food chain with harmful effects on health (Barnet and Hunter, 1987). Tinapa soil has the highest value of a Heavy Metal, Copper (39.63mg/kg) and Nickel (11.36mg/kg). It is probable that the nickel is by-products from the industries situated in the Exporting Processing Zone (EPZ) industrial area, some few kilometres from away. The nickel level is above the permissible level set by world health organisation (WHO) which is 10mg/kg. Excess level of nickel in the soil has been reported to be toxic and can affect soil fauna such as earthworm which are adjuncts to the microflora inorganic matter decomposition. The lungs, nasal cavity and tissues are the target organs affected by respiratory carcinogen when human are exposed to Nickel poisoning (Ayodele and Gaya, 2003). From the result, soil sample from Anantigha have comparatively the highest Total Bacterial Counts compared to the other two locations. Nine bacterial organisms were isolated in all from the Anantigha, Ediba and Tinapa; *Escherichia coli, Azomomas* sp, *Bacillus subtilus, Clostridium* sp, *Arthrobacter* sp, *Streptomyces* sp, *Nocardia* sp, *Pseudomonas* sp *and Micrococcus* sp.This result also revealed that *Micrococcus* sp and *Bacillus subtilus* were found in all the three sampling locations. Total Bacterial Count of the sample collected Anantigha was significantly higher than that of Tinapa. Also, there was significant difference between count result of sample collected at Tinapa and Ediba. Sample collected at Tinapa recorded the least average bacterial count value of 5 x

10^6cfu/g and the highest average fungal count value of 24.5 x 10^{-4}cfu/g compared to samples collected at Anantigha and Ediba. This higher fungal count could be attributed to the more robust nature of fungi which enables them to withstand the more acidic environment of the location than bacteria. This ability of fungi to thrive better than bacteria in acid soils had been reported (Rangaswami and Bargyaraj, 1993). Eight fungal organisms were isolated in all from the Anantigha, Ediba and Tinapa; *Actinomycete* sp, *Verticullium* sp, *Aspergillus* sp, *Diplosporium* sp, *Mucor* sp, *Hormodendrium* sp, *Nigospora* sp and *Paecilomyces* sp. The result from the table revealed that *Actinomycete* sp, *Hormodendrium* sp and *Paecilomyces* sp were found in all the three locations. Microbial biomass can reflect soil quality (Brookes, 2001). The health implications of this work is that Anantigha and Tinapa areas being low lying were likely, because of the presence of *Escherichia coli*, to experience gastro-intestinal diseases such as dysentery and cholera than the Ediba environments.

V. CONCLUSION

The results of the study have revealed the values or percentages of physico-chemical parameters, and some bacterial and fungal isolates that can be found in soil within Calabar, Cross River state. Long-term development prospects of countries all over the world appear to have been threatened by severe environmental degradation, particularly in the developing countries. Land pollution is a major cause of environmental degradation. Most times, water pollution occurs when pollutants from adjoining uplands flow into water bodies through run–off or when carried by wind into the water bodies. Calabar is surrounded by important rivers and streams that serve for both domestic and industrial purposes to the inhabitants of the city. The sampling locations are subjected to different levels of Urban Developments that could lead to the release of some pollutants that could impact the soil. It is quite obvious that when the soil is polluted, the nearby water body would be affected. This is true because when it rains, the pollutant would be washed into the surface water (river, stream, etc) while some peculate into the underground water. Chemicals applied on land can evaporate into the atmosphere and increase atmospheric pollution. All these contribute to environmental degradation which invariably results to hampering long-term development. The research is focused on environmental degradation via land pollution which forms a link to both water and atmospheric pollution. While it notes that a careful management of land as a resource is essential for meeting a major demand created by accelerated urbanization, industrialization and agricultural development. It is also important to note that loss of revenue and declining health-care as some of the economic implications could be accrued to land pollution.

Table (1): Particle Size Distribution of Soils in Encountered within the Sampling Locations

Sampling locations	SAND (%)	CLAY (%)	SILT (%)
Anantigha	89.6	2.7	7.4
Ediba	72.6	10.7	16.4
Tinapa	65.6	22.7	11.7

Table (2): Heavy Metals Concentration of Soil Samples within the Sampling Locations

Sampling location	Copper (mg/kg)	Zinc (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Nickel (mg/kg)
Anantigha	35.31	14.59	78.19	47.42	5.33
Ediba	35.55	11.51	75.12	45.61	8.14
Tinapa	39.63	11.34	70.15	39.15	11.36

Table (3): The Physico-Chemical Parameters of Soils around Calabar Metropolis

Sampling location	pH	Org.C (%)	T.N (%)	Avail.P (mg/kg)	(mol/kg)						
					Ca	Mg	K	Na	H	Al	ECEC
Anantigha	5.2	1.4	0.12	6.00	4.6	1.2	0.09	0.05	0.4	0.04	6.38
Ediba	4.5	2.3	0.19	12.75	3.2	1.0	0.07	0.04	1.1	1.1	6.51
Tinapa	4.4	1.3	0.11	13.25	1.4	1.0	0.05	0.04	0.9	0.7	4.09

AN = Anantigha, ED = Ediba, TI = Tinapa, Org.C = Organic Carbon, Avail.P = Available Phosphorus, Ca = Calcium, Mg = Magnesium, K = Potassium, Na = Sodium, H = Hydrogen, Al = Aluminum, T.N = Total

Nitrogen, ECEC = Effective Cation Exchange Capacity

Table (4): Total Bacterial Counts Isolates and their Biochemical Characteristics found Around Calabar Metropolis

			FERMENTATION				BIOCHEMICAL TEST							
Sampling locations	**Isolate colony count**	**Gram Reactions**	**Lactose**	**Mannitol**	**Glucose**	**Sucrose**	**Citrate**	**Methyl Red**	**Voges Proskauer**	**Catalase**	**Oxidase**	**Coagulate**	**Motility**	**Probable Isolates**
ANANTIGHA	**23.5 X10⁶ cfu/g**	Gram –ve rods singly	AG	AG	AG	A	-ve	-ve	-ve	-ve	+ve	-ve	-ve	*Escherichia coli*
		Gram +ve rods in pairs	–	A	–	–	-ve	-ve	-ve	-ve	-ve	+ve	+ve	*Clostridium* sp.
		Gram +ve cocci	A	–	A	A	+ve	-ve	-ve	+ve	+ve	-ve	-ve	*Micrococcus* sp.
		Gram variable singly or pairs	AG	AG	AG	AG	+ve	-ve	-ve	+ve	+ve	-ve	-ve	*Azomomas* sp.
		Gram +ve hyphae	–	–	A	–	-ve	+ve	-ve	+ve	-ve	+ve	-ve	*Streptomyces* sp.
		Gram +ve rods in chains	A	A	–	A	+ve	+ve	+ve	+ve	+ve	-ve	-ve	*Bacillus subtilus*
EDIBA	**18 X10⁶ cfu/g**	Gram +ve cocci	A	–	A	A	+ve	-ve	-ve	+ve	+ve	-ve	-ve	*Micrococcus* sp.
		Gram variable	A	–	–	–	-ve	-ve	+ve	+ve	+ve	+ve	-ve	*Nocardia* sp.
		Gram +ve rods in chains	A	A	–	A	+ve	+ve	+ve	+ve	+ve	-ve	-ve	*Bacillus subtilus*
		Gram –ve rods	–	A	A	–	-ve	+ve	-ve	+ve	-ve	-ve	+ve	*Pseudomonas* sp.
		Gram +ve rods or coccids or variable	–	–	A	–	-ve	-ve	-ve	+ve	-ve	-ve	+ve	*Arthrobacter* sp.
TINAPA	**5 X10⁶ cfu/g**	Gram +ve rods in chains	A	A	–	A	+ve	+ve	+ve	+ve	+ve	-ve	-ve	*Bacillus subtilus*
		Gram +ve cocci	A	–	A	A	+ve	-ve	-ve	+ve	+ve	-ve	-ve	*Micrococcus* sp.
		Gram +ve hyphae	–	–	A	–	-ve	+ve	-ve	+ve	-ve	+ve	-ve	*Streptomyces* sp.
		Gram –ve rods singly	AG	AG	AG	A	-ve	-ve	-ve	-ve	+ve	-ve	-ve	*Escherichia coli*
		Gram variable	A	–	–	–	-ve	-ve	+ve	+ve	+ve	+ve	-ve	*Nocardia* sp.

A = Acid, AG = Acid and Gas, +ve = Positive, -ve = Negative, − = No Reaction, *spp* = species, cfu/g = colony forming unit per gram

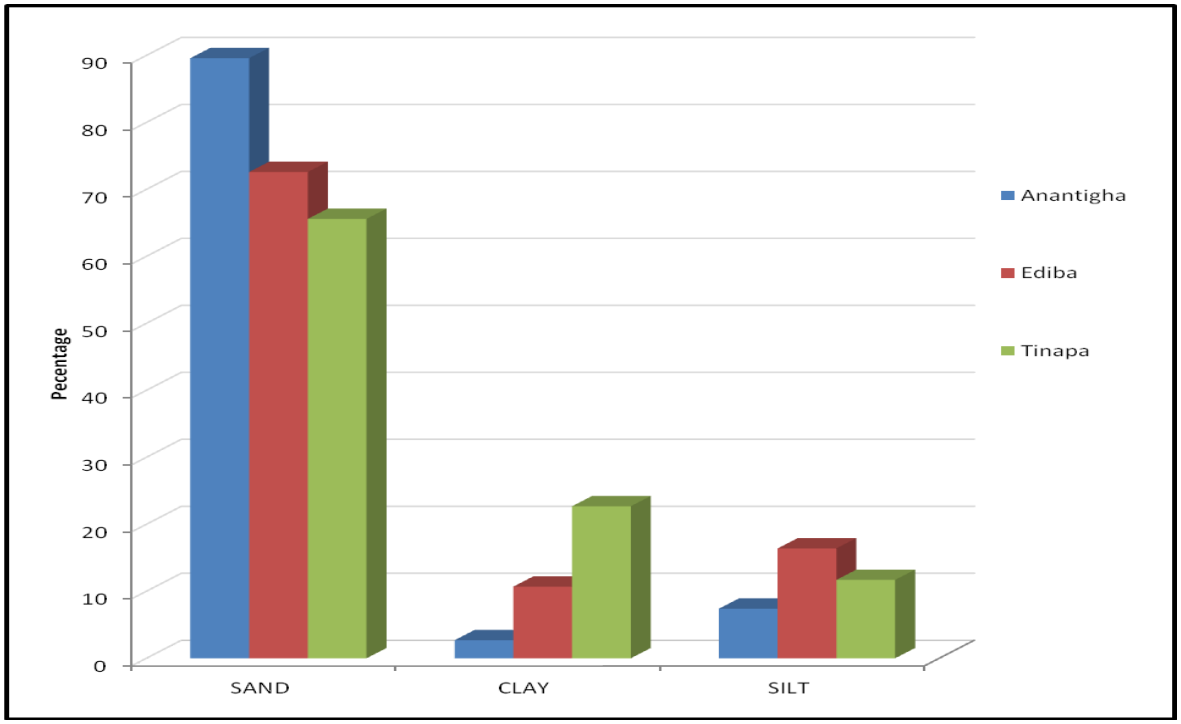

Figure (1): Variation in Percentage Distribution of Particle Size of the Soil within the Sampling Locations

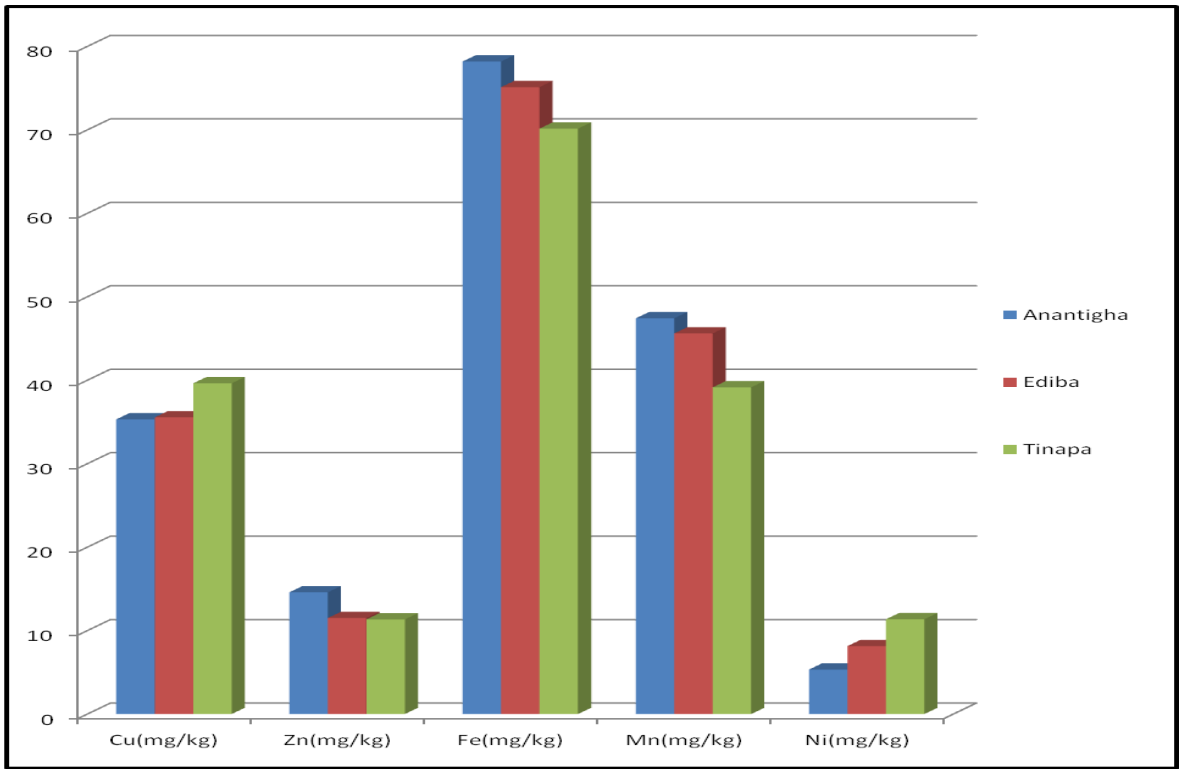

Figure (2): Variation in Heavy Metals Concentration of Different Sampling Locations around Calabar Metropolis during the Study Period

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Heat Reduction FromIc Engine By Using Al_2o_3Nanofluid In Engine Cooling System

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Abstract: -Cooling system plays important roles to control the temperature of car's engine. One of the important elements in the car cooling system is cooling fluid. The usage of wrong cooling fluid can give negatives impact to the car's engine and shorten engine life. An efficient cooling system can prevent engine from overheating and assists the vehicle running at its optimal performance. With the development of new technology in the fields of 'nano-materials' and 'nano-fluids', it seems very promising to use this technology as a coolant in the internal combustion engines. In this study, a nano-fluid (Al2O3-Water/Ethylene Glycol (EG)) is used as an engine coolant along with an optimized heat exchanger to reduce the warm-up timing. The effect of nano-fluid concentration is considered here by using their corresponding governing equations, such as momentum and energy. The engine coolant thermal behaviour calculation is carried out based on the lumped method. The obtained results indicated that using different percentage of nano-fluid mixtures (by volume), such as Al2O3-Water/EG as engine coolant enhances the heat transfer coefficient and reduces the warm-up timing which, in turn, results in reduced emissions and fuel consumption.

Keywords: *-Ethylene Glycol, Nanofluid, Aluminium Oxide, Internal Combustion Engine, Emission.*

I. INTRODUCTION

Conventional oils shows poor heat transfer characteristics compared to coolants and engine oil. It has been investigated that their performance can be increased by adding nanoparticles and these nanomaterial based oils have great potential to meet out the lubrication and cooling requirements of the given system. The concept of Nano fluid was proposed by Choi and his team by dispersing nanoparticle of higher thermal conductivity in to the base fluid [1]. Earlier investigations shows that dispersion of millimetre or micrometre size particles in to the base fluid which causes particle agglomeration and settling, block the channels in which such type of fluid are used. Moreover, their pumping power is increased and because of these problems with a mixture millimetre or micrometre based fluids was never been a good choice for heat transfer applications. Investigations on Nano fluids show that they have potential to overcome these problems. Main function of the Nano transformer oil is to avoid excessive heating caused by overloading conditions on transformer. It is required that in addition to good heat transfer properties transformer oil should have good electrical insulating property which insulate the primary winding from secondary winding. Agglomerations and settling of Nano fluids which is a major challenge to make stable Nano fluid can be avoided by using proper dispersing techniques and by adding surfactants which thereby help in improving the stability of nano-transformer oil. Few Studies have already been performed on oil based Nano fluids. Xie.H et al. [2] measured thermal conductivity of Nano fluids containing Al2O3, nanoparticles with two different base fluids: ethylene glycol and pump oil. Results showed a 30 % & 40 % improvement in the thermal conductivity as compared to the corresponding base fluids for 5 vol. % of nanoparticles and the size of the nanoparticles used with both the fluids is 60 nm.

Investigations are carried out by various researchers at different temperatures to see the effect on thermal conductivity of Nano transformer oil by using CuO, A12O3, Cu, Al nanoparticles of 45, 31, 80, 60 nm sizes respectively. Conductivity enhancement was found to be by 7.5, 6, 5, 3, and 4 % respectively [3]. Xie et al. [7] had also investigated the thermal conductivity of pump-oil by using A12O3 nanoparticles. The size of nanoparticle used was 60 nm and the conductivity enhancement was found to be 11 %. Xuan et al. [8] studied thermal conductivity of Cu and Transformer oil at 100 nm size and found a 6% enhancement in the thermal conductivity. A limited literature is available about viscosity of oil based Nano fluids. Therefore, our attempt is to see the performance of oil based Nano fluids. Reported research shows that water and ethylene glycol have been used widely as a host/ base fluids in making Nano fluids. The objective of this experimental study is to discuss the dependence of thermal conductivity and viscosity of Al2O3–nanotransformer oil in temperature ranges from (20-500 C) under different weight fractions of nanoparticles from 0.1, 0.3 & 0.5 % (vol.) in subsequent sections the preparation and characterization of Nano fluids along with results have been discussed in detail.

II. OBJECTIVES AND SCOPE OF WORK

The use of Nano fluids has the potential to improve the engine cooling rates. These improvements can be used to remove engine heat with a reduced size cooling system. Smaller cooling system lead to use of smaller and lighter radiators which in turn will lead to better performance and increased efficiency. Alternatively, improved cooling rates can be used to remove more heat from higher horsepower engines with same size of cooling system.

The IC engine temperature in an automobile is maintained by circulating a cooling fluid through the cooling circuit. Ethylene glycol and water mixture, the nearly universally used automotive coolant, is a relatively poor heat transfer fluid compared to water alone. Aim is mainly to maintain the coolant in single-phase throughout the cooling system. So engines with higher horsepower will lead to heavier and bigger cooling systems which may hamper the overall efficiency.

III. EXPERIMENTAL SETUP AND PROCEDURE

Nano Fluid Preparation

Nano fluid is a fluid in which Nano-meter sized particles are suspended.

- Argonne National Laboratory.

Nanoparticles are a class of materials that exhibit unique physical and chemical properties compared to those of larger physical and chemical properties compared to those of larger particles of same material. Experiments remain the primary source of information when complex flow situations such as multiphase flows, boiling or condensation are involved. The two-step method employs a two-step process to make Nano fluids in which Nanoparticles are first produced as a dry powder and the as-prepared Nanoparticles are then dispersed into a base fluid in a second processing step. A certain degree of agglomeration may occur in the Nanoparticle preparation, storage and dispersion processes, it is well known that these agglomerates require very little energy to break up into smaller constituents. And thus it is possible that even agglomerated Nanocrystalline powders can be successfully dispersed into fluids and result in good properties. This two-step process works well in many cases, especially for oxide and nonmetallic Nanoparticles.

In this experimentation a two step procedure was used for preparing the Nanofluid.A measured quantity of nanoparticle was taken. It was mixed thoroughly in the 50/50 water-ethylene glycol. Mechanical stirrer was used to mix it uniformly. It was kept in the sonicator and subjected to vibrations so as to reduce to problem of agglomeration. It Nanofluid was kept still for two days to check for sedimentation. Even after two days there was no appreciable sedimentation and the important fact is that the moment it was stirred again it turned into a uniform fluid with evenly suspended nanoparticles in it.

Block Diagram of Experimental Setup

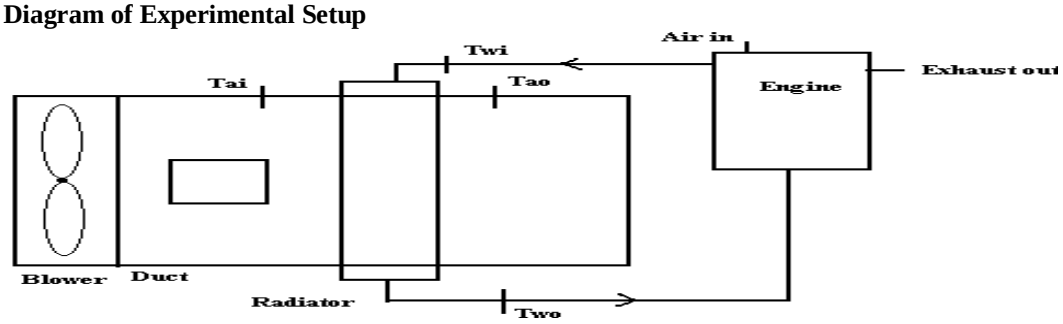


Figure-1

Specifications

The specification of the equipments used in the experiment are:

Engine	4-strock, 4-cylinder petrol engine	Thermocouple	4 in number of range 0-200 oC
Make	Maruti 800	Volume of coolant	3.5 litre
Radiator size	335mm x 300mm x 17mm	Dynamometer	Eddy current
Tube side area	330905.3mm^2	Dynamometer constant	2000
Fin side are	2310000mm^2	Nanoparticles	Al2O3 nano powder dispersible in water
Blower	Axial fan with 3 speeds	Purity	80 %
Duct	335mm x 300mm x 1500rpm	Water dispersibility	more than 95 %

System Assembly

- The apparatus is assembled following the schematic of the apparatus setup.
- The open circuit of the engine cooling system is converted to closed circuit by first disconnecting the calorimeter.
- The outlet those of the engine is connected to the inlet of the radiator and the outlet pipe of the radiator is connected to inlet of the coolant circulating pump of the engine.
- All the thermocouples are properly installed according to the apparatus set up and tested to be in good condition.
- One thermocouple gives the air temperature before the radiator and another gives the air temperature after the radiator. Similarly one thermocouple gives the water temperature entering the radiator and another gives the water temperature leaving the radiator.
- The blower is mounted on the duet and fixed properly. Electrical connections to the blowers are given.
- The radiator is mounted on the duct as per the schematic of experimental set up.

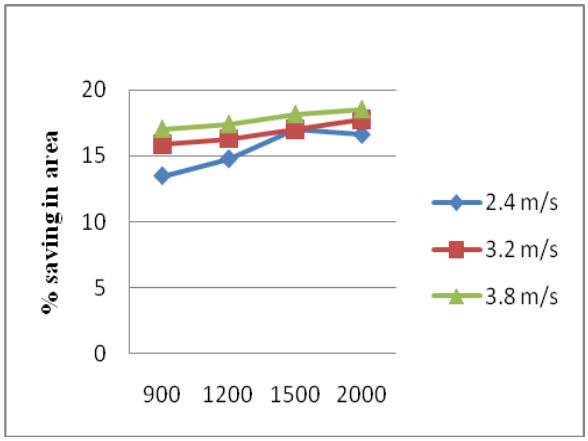
Sample Filling

- In all three coolants, viz water, 50/50, water-ethylene glycol mixture and Nanofluid are used.
- The required quantity of coolant is filled in the radiator.
- Precaution is taken to avoid any air pocket in the cooling system.
- After loading the coolant the radiator cap is to be closed tightly.
- Thereon, all the pipes, hoses etc are checked for leakages and problems, if any are resolved before proceeding with the experimentation.

IV. RESULTS AND DISCUSSIONS

At 20% Load

N	u m/s	Re	Nu	h	Area	Saving in area	%
900rpm	**2.4**	**441.18**	**9.16**	**8.266**	**2.284**	**0.356**	**13.48**
	3.2	**590**	**10.94**	**99.65**	**2.221**	**0.419**	**15.87**
1200rpm	**2.4**	**439.9**	**9.14**	**83**	**2.25**	**0.39**	**14.77**
	3.2	**588.24**	**10.94**	**99.29**	**2.21**	**0.43**	**16.3**
1500rpm	**2.4**	**438.6**	**9.12**	**82.73**	**2.23**	**0.41**	**17.04**
	3.2	**586.25**	**10.9**	**98.91**	**2.19**	**0.45**	**17.04**
2000rpm	**2.4**	**437.34**	**9.11**	**82.44**	**2.21**	**0.43**	**16.3**
	3.2	**584.8**	**10.88**	**98.65**	**2.17**	**0.47**	**17.8**



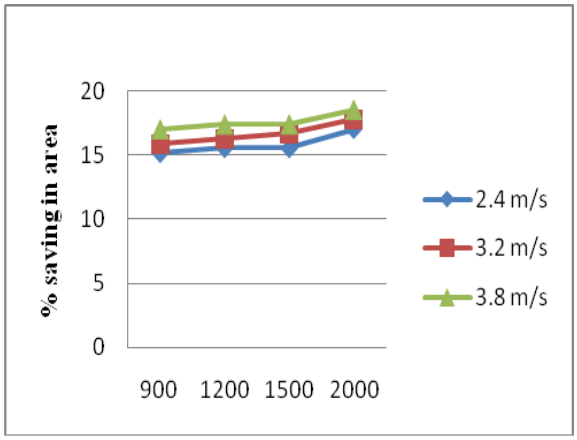


Figure 2: Speed vs % Saving in Area at 20% Load Figure 3: Speed vs % Saving in Area at 40% Load

There is an appreciable savings in surface area when Nanofluid is used instead of 50/50 water ethylene glycol mixture. When compared to 50/50 water ethylene glycol mixture, the % saving in area at higher speeds of the Nanofluid is considerably more.

V. CONCLUSIONS

- A savings of 12-18 % of surface area can be seen by use of Nanofluids.
- As the load on the engine and the speed of the engine increases the percentage savings of surface area also increases.
- The thermal conductivity of Nanofluid is temperature dependent. As the temperature increases at higher load and speeds the heat carrying capacity of Nanofluids increases. This is advantageous when engine is running at high speed and load.
- At higher air velocity the % savings in surface area is more.It means that at higher vehicle speed the use of Nanofluid has a lot of advantage.
- The use of Nanofluid makes it possible to design the system with higher power- size ratio.
- With increase in air velocity the dimensionless numbers and heat transfer coefficient increases.
- For the same air velocity, the dimensionless numbers and the heat transfer coefficient go on decreasing with increase in load and speed of engine.
- The heat carrying capacity of Nanofluids as compared to 50/50 water-ethylene mixture is more but relatively less compared to water alone.
- The surface area required for the given amount of heat to be transferred is less when Nanofluid is used as a coolant in comparison to the 50/50 water-ethylene glycol mixture but when compared to water the surface area required is more.As the surface area required in case of Nanofluid is less, the volume occupied by the cooling system also reduces.
- It is seen that the heat carrying capacity of the Nanofluid increases with increase in engine speed. This is advantageous particularly when the engine is running at high speed and more heat is to be rejected out. The use of Nanofluid helps to use a smaller cooling system.
- To increase the boiling point, normally the entire cooling system is maintained at positive pressure. Use of Nanofluids allows the cooling system to be operated at atmospheric pressures and the advantages associated with it.
- The weight of the heat transfer equipment and the entire cooling system as such will be reduced when Nanofluid is used as coolant.
- As less coolant is needed to be circulated, due to the enhanced heat carrying capacity of the Nanofluid, the pumping power required will also be reduced.
- In case of vehicles, the reduced weight, reduced volume, reduced pumping power, will eventually increase the engine efficiency.
- When the radiator size, volume and weight is reduced, it will reduce the drag force experienced by the frontal area of the vehicle.
- All these factors give the designers additional versatility from the ergonomic and aesthetic point of views when designing the vehicle.
- Reduction in size or the simplification in designing the cooling system decreases the manufacturing and also the maintenance cost of the cooling system equipments.
- It was also seen that the metallic Nanoparticles in the coolant helped to warm-up the engine quickly when started from cold condition.

VI. FUTURE SCOPE

Studying the Nanofluids to validate their properties from theoretical point of view is fine but the focus should beto try to extract whatever advantage can be had by their use. It will be worthwhile to workout with various permutationsand combinations of the Nanoparticles and base fluids which might help to develop the science related to Nanofluid.

Many glycol based coolant base have merits but there are a few out there in the market that are more aboutmarketing than science. New fanciful coolants such as 50/50 mixture of water ethylene glycol are good regions heretemperature below 0oC. But as we can understand, other than a few northern states, in most part of India atmospherictemperature rarely goes below 0oC. So with addition of corrosion inhibitors it will be quite beneficial to go for water to beused in the cooling system. So it becomes important to study the behavioral characteristics of the water based Nanofluidsmore extensively

VII. CHALLENGES AND BARRIERS

By using the Nanofluids the general trends for an enhanced heat transfer were observed but also areas of discrepancies do exist. The inaccuracies encountered are mainly due to poor characterization of Nanofluids which are experimented upon. It is difficult to measure and quantify the size, shape and distribution of Nanoparticles in fluids. Viscosity measurement of Nanofluids could be a important parameter which will be helpful when comparing Nanofluid results. A major apprehension while using any particle laden flow is the effect of erosion of the material surfaces due to the fluid motion. The Nanoscale of the particles involved in Nanofluidstend to mitigate the particle erosion problems. Also Nanoparticles tend to follow the fluid streamlines better than larger particles in flows.

Nanofluids have been mainly produced in small quantities. This is adequate for research work, but large scale production of well dispersed Nanofluids at low cost is required for commercial applications. This is a serious barrier for use of Nanofluids in cooling system of vehicles.

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Working conditions for welders

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Abstract: - *This research examines from the point of view of ergonomics, the possibilities of intervention onimprovements in working conditions of industrial welders. We raised the main factors leading todifficulties and constraints in this activity, especially with regard to biomechanical conditions. Inaddition, the study presents a structured approach as the requirements of ergonomics Frenchconfronting the real problems of welders, which are not in work, performed by outsideconsultants who, in a sense, hide real conditions of work. It was through a case study, the majority ofwork in both the scientific literature on the work of external consulting expertise. The constraints of thewelders are characterized as postural and behavioral risks, not showing that behind these, there arecharacteristics of requirements the solder that force the worker to adopt efforts biomechanical posture to which they are unable to behave properly as stated in the research.*

Keywords: *–ergonomics, risk analysis, safety and health to welders, working conditions*

I. INTRODUCTION

For this research, it takes the analysis and discussion of theworking situations of industrial welder and likely proposedergonomic intervention in a mechanical assembly of industry,from internal demands and pre-existing work carried out byexternal consultants. The analysis begins in the field informing a support group (called in this work-force task) thatassists the researcher in the analysis and understanding ofactivities, this group composed by the welders. Differenttechniques are used in research, such as direct observation,statistical observation record of biomechanical variables(physiological and Kinesiology), building on a collection ofdata related to information of the object under study.

The activity of the welding industry in question the need forresearch, in a first level of formulation, process of respondingto that in industrial activities of welders, is understood as aprocess of work necessary for the conduct of their duties.

Thus, given these explanations, a second question for theresearch comes to establishing the company under study, whatare the factors that related to rates of accidents and diseasesfrom the activities of industrial welding and that the companyis doing to manage these issues, beginning of course. The establishment of harmfulness that are submitted the subject intheir work processes and what the previous work that mayhave contributed or not the assessment of the difficulties andconstraints of the biomechanical welders. A company in thearea of mechanical assembly, inside a steel factory inPindamonhangaba, São Paulo, Brazil, selected as the unitof study.

II. THE COMPANY'S INITIAL RESEARCH

The demand

The company contacted and received the attention ofthe Medical Professional, who started the initial schedule forthe discussion of the work. In this discussion, theproposal presented to the completion of an ergonomicanalysis of work in order to care for a demand to given bythe company, which coincided with the current needs of thesame conduct in this work. The Medical Review of Laborshows that the company has invested in studies of occupationalhygiene and ergonomics and has no satisfactory return of thiswork, because the rate of absenteeism by musculoskeletaldisorders has been growing gradually in recent years.According to him, given the analysis of this function, morethan half of the company assessed, as the existing manualprocess is now completely dependent on this activity.

It found that the vast majority of searches came fromoutpatient welders. Of these, the most frequent related tomusculoskeletal disorders.
Even as demand, the company say that the future possibilityof extending the work of ergonomics research in the otheractivities of the organization in a proactive vision, as thecompany moves to the process of certification to OHSAS18001:1999 [1] and need for job analysis proactive risk to meetthis certification.
It is for this research to investigate the causes of, seeking thestatus of work to explain them. As the posture is a dependentvariable (not free) the constraint can found in the posturaldemands of the task in your product and obtained, theequipment and tools, etc.

The stages of progress of research

The basic steps established by the methodology used in thisresearch is proposed on the formation of a participatory group(task force) in order to collectively analyze the work, coveringthe prescribed task and analysis of activity in different stagesof the real work and the analysis of work of advice onergonomics developed by the company.Through this method, the contacts established by a group ofwelders used to systematize the observations to identify thespecific requirements of the processes related to ergonomics.The group studied includes the experience of a group of 08pre-selected by officials of the area supervisors, based on theirexperience of more than five years in office.
Accordingly, there were interviews with: group of welders, coordination of operations, safety engineering, chosen at time of field research on a random, asexercising their duties, with observations open the work ofwelders, followed by verbalizations about the activity, totalingover 450 hours of fieldwork settings and reports.We also collected information on official documents on theorganization of work and on the population under study, buthave not found (or supplied) detailed flow of production. The researcher a plan of systematic observation of the activity of work, which allowed reaching the final diagnosis and recommendations to overcome the problems identified later defined this.
The data for analyzing the characteristics of the populationof workers were in general, scattered among several locations(sectors) in the company, and filled in various forms and codedaccording to their nature. Some, such as indicators ofproductivity, health problems and accidents at work weredifficult to obtain.

The task of welding in the company

A striking feature of the activities of welders in theindustrial enterprise is its wide range of tasks, which, in manycases in which maintenance activities conducted outsidethe warehouse, customers in industries, even in open sky, as inthe case the maintenance of cookers. In each project there aresignificant number of activities, each project generates aunique final product, most times not exactly, an activity issimilar to another in their working conditions and humanvariables. This entails various problems, hindering theestablishment of a standard solution related to the organizationdevelopment of measures for the protection and physicalintegrity of the employee.

The activity linked to human factors that need large amount of workers and the physical strength of theoperator feeds the manipulation of pieces by the interface withthe brazier and the assembler. The labor of the worker is upalmost exclusively in the handling and use of tools (weldingequipment, mallets, keys, etc.).The tasks delegated to employees, according to the companydocumentation, are: the manufacture of light and heavy piecesof steel, consisting of mapping, cutting, notch, bend, mangle,bridge, build, weld, test, wash, paint, inspect, packaging andstorage, and repair parts in the various sectors of the steel millcustomers. Given individual protection equipment for theactivities in the company, such as coat of scraper, safetyfootwear, gloves scraper, welding mask, safety glasses, earprotection, gaiter to shave and others.

The productivity of the sector given by the relationshipbetween indicators. Efficiency, which combines indicators ofratting security (score proposed by the work safety inpercentage that ranks the performance of the sector in relationto work safety and environment), productivity, costs and hasthe limit considered acceptable if over 1.0% (not given accessto the type of calculation in any of the indicators).Another feature of the company is recruiting people withtechnical training in methods of welding, as required specifictraining. Consultations the department of human resources ofthe company to demonstrate the systematic recruitment ofemployees from the removal of technical courses for industrialwelder's SENAI (National Services of Industrial Learning) orschools for that purpose. The tasks require specialized almostmore rigorous selection, which is the practical application oftest relevant to the function requested, held opposite points ofsoldering. There are also courses in business development ofthe workforce, usually directed to the most qualifiedprofessionals.

The day's work distributed in three-fixed shift of 8 hours, in anon-rotating. In peak periods, where there is increasedproduction and effective temporary, an accumulation of tasks,with imposition of accelerated rhythms and overtime (onaverage 3 hours per week) for better utilization of each stageof the process. These peaks are given in construction ofhydroelectric power plants and particularly, but not have a characteristic average pre-set time. The rest breaks and lunchare fast (about 15 minutes), in the workplace, with

longerintervals for lunch (1 hour) in the company gym work (15minutes at the beginning of the shift) and 10 minutes ofdialogue Security (DDS) as always in the early rounds. It alsohas enough time to voluntarily the physiological needs.

The organization of production

The order for the manufacturing sector of the weldingengineering sector of production, then, is the materials sector,which through budgets and purchases, provides the necessaryexpenses. The engineering of production defines the design ofthe piece and the service sector. In general, theplanning of production varies according to the request andtakes a day to 3 months, depending on the size of the project.

The welding industry depends on the punctuality of othersectors, such as heating, planning and warehouse, as is mostoften the last activity in the production of a play, as timebegins to run before the play reaches the welding. In general,there are no delays. To set the time that will employed witheach order, the planner makes an estimate of the timepreviously used with similar items and with the completion ofthe piece, computed the time spent in its completion.When the order reaches the manufacturing sector in chargeof this welder that will define the service, depending on theamount of tasks for each. The welder should then follow theprocedures prescribed for their work, which delivered byresponsible for the shift, which received the same area ofproduction planning. The worker must record all events (timeand code) for its work in the play of note in the bulletin of theworkforce. After their work, the pieces are for quality controlto verify the need or not to rework due to possible failures thatoccur in the solder joints that often occurs with the reworkto remove the solder, cutters, hammer and the new process ofwelding and inspection.

The Engineer of Work Safety, the number of employees inthe company declined in recent years due to societal changesin the company that reduced production and consequently theeffective. However, in the case of welders, the renewal of themanagement of staff is difficult because not if you think theworkforce available due to the growth of construction industryin recent years.The company's installations do not have a proper state ofrepair. The noise of the environment is intense, said the changein the PPRA 2006 (Prevention Environmental Program) are 82to 95 decibels (93 dB on average) that sometimes comesfrom other sectors, or grinding equipment. The operation ofequipment depends directly on demand. Therefore, the noise may be lower or higher, varying accordingto the number and type of activities in operation. From a briefanalysis of the results of noise monitoring carried out by anexternal consultancy in 2005, concluded that the vast majorityof employees exposed to noise levels that require the use ofprotection equipment and other measures to control noise.

Workers already use the ear protectors and the department of occupational health now identified conduct periodic audiometry, with no cases of hearing loss.The risks of smoke present in the welding industry regarded as the most critical condition in the literature. For thesake of direct exposure of the worker and the daily livingenvironment in the sector which is minimized by fans andexhaust. However, not out the characteristic of an unfavorableenvironment for the health of those who develop theiractivities there. Also in the environmental monitoring carriedout by external consultants, the levels are within limits and theEPI's (Individual Equipment Protection) listed are sufficient tominimize the impacts to human health.The lighting is good and efficient as well as the ventilation,due to large openings in walls. The floor is uneven in the shed covered by waste, grease, and dust particles that areslippery, making walking workers. There was large number ofpieces of different sizes and work equipment scattered on thefloor throughout the length of the sector, hindering themovement of workers and allowing sometimes accidents andfalls pieces. There are a few boxes of welding in the industry(4 existing), with quarters of work for small parts. At this point,the lighting is poor. The boxes have shelves, but there is notsufficient to house parts and tools.

Support activities in the areas of steel mill customers, thereis an activity of high criticality, the welding of resistance ofpots and ovens. Here the activity performed in open air or inimprovised sheds with canvas. In the solder pots, the operatoris common to spend two days in the development of a piece,with a daily demand service.With respect to tools, there is a routine preventivemaintenance for these vehicles and most of them are outdatedand extremely heavy. The wheels of the carts have no welding and specific lubrication carts with wheels locked wherethe operators have to drag the equipment.The EPI's are used for specific purposes indicated, however,for the helmet, it is poorly preserved, heavy and sometimes wecan hardly see through it, allowing it only to see sparks fromwelding.

As the organization of equipment on the desktop, it wasobserved that the sector does not provide safe workingconditions according to the improper disposal and the largevolume of inputs and other instruments deposited in theworkplace, there are risks of injuries and falls in handlingsector. Accordingly, the issues are out of the clutter of trafficof people and in particular the workers, as well as thereduction of physical dimensions for the assembly ofequipment, thus characterizing a condition of employmentwith sufficient potential to cause accidents and damage tophysical integrity of the worker and the other operating inplaces.Regarding safety, all staff said that the company providesand ensures the replacement of individual protectionequipment (EPI)

necessary to carry out their duties and saidthat the company requires the use of EPI's, agreeing with theofficials the need of them, but feel uncomfortable.
In searching the internet, we found several suppliers ofequipment for welding, not the same distribute (sell) moreexisting models in the company (the models in this study).Today, a helmet can found around 60% lighter than thoseused in the company can and the advances in technology to combatthe inhalation of smoke from welding are great. It seems thatthe company did not have to worry about updating theequipment and insists on staying with the same old and evenwith improvisations.

When asked about the dangers of the work they perform themajority of workersconsidered dangerous due to the verynature of work. In addition, in the field trip, it noted that inattempting to store the materials in the optimization of space,to occupy the smallest space possible. There are shelves onwhich the welding carts are stored at times not recommendedfor the proper handling postural therefore require that thewelder stay the same weight to save on the shelves.This shows the great concern ofthe firm on the issue of workplace accidents due to the rigor ofthe Brazilian labor legislation [2].

In explanation of what the most critical and uncomfortableto work, all were unanimous in citing the pans. The pans take alonger time, because cracks have to weld whichsometimes have more than 1 m in length and up to 10 cm in diameter. This makes it more difficult to weld and takespositions that require more time. For no specific locations forthis activity, it is the entry of customers or sectors in theexternal area opposite the hangar for maintenance and do nothave a suitable cover, with characteristics of a specific sectorof solder. During the afternoon, or when the midday sun, thereis activity being carried out in these parts, which are veryuncomfortable to welders. The head of the industry claims thatthis activity carried out sporadically and recently, moreexactly 3 years ago had an increase in demand and not yetadapted to a specific sector that. Says that the company has not yet approved a specific location, but there areprojects for that. I question where they are and he laughs saysthe head of personnel.

III. ERGONOMICS ANALYSIS

Comparison of initial findings with the task force

For a comparison of findings at first examination, the researcher workers throughout their working day (480 minutes) in various tasks observed three. These comments thenfollowed in the chronic form of activities, which enabled thedevelopment of the steps below:
- Preparations start in the industry - Before starting theirduties, the welding part of a DDS (Security Dialogue)where they discussed issues of production, the company'smanagement, health, work safety, with activities in gymwork;
- Receipt of instructions - with the leadership, the welderreceives instructions from work orders through theservice and by informal means;
- Displacements - Walk throughout the company in searchof parts, materials, equipment, instructions, amongothers;
- Meals - Food Main and coffee;
- Preparation of materials - Adjustment on equipment,materials and parts;
- Physiological needs - Bathrooms, water, among others;
- The consultation procedures - the consultation documents,orders of service, boilermakers and leaders;
- Inspections in the service - Verification of the serviceperformed in the play and equipment;
- Welding - Output of solder in itself;
- Standby Time - Time spent waiting and other features inwhich the employee performs breaks from the process

In general, it perceived that the tasks of the welder doesnot restrict the solder itself. The welder most often performstasks such as preparation of welding, soldering, sanding,inspection and marking, which are inherent duties in this role.One of the most important constraints in this task is that thereis great variability in posture due to the diversity of parts,creating static postures moments specific to each piece orpoint of solder, which maintained for periods that aredetermined by the characteristic point of welding. For example,the higher the place to welded, the greater the residencetime in a static posture.The errors considered hazardous by characteristicrelevant to welding. One example is that the official in anattempt to weld a fast can cause lack of fusion and penetrationin the weld and this leads to cracks and reduce the resistance ofthe solder. This then is one of the reasons that makes theemployee is in a long position or holding a piece, because if itis fast, no fusion of solder.Improvisation of the seats also occurs due to variability ofpostures necessary tasks. In certain moments, there is a needfor support or to sit, to which no specific equipment for suchbehavior, because the engineering processes do not provide them and supervision, where the welder improvisesomething to support or to sit and this improvisation for it isoften useful and begin to developed / used by other welders.

The observation in working highlights the rigidity of posture,muscle contraction, the extreme angles, environmental risks,and the discomfort of EPI's. Employees perceive the negativeimpacts mainly of posture and environmental conditions. Thephysical burdens, with forced postures are stores in almost allactivities of the

welder, whether in the handling of parts, use ofmachinery and tools, among others. Complaints of pain in thearms, pain in the body and physical fatigue are the mostcommon reports of physical overload. The worst condition given according to the reports of the solder pots, to requiremuch time in the same posture and sky.

The distance from the electrode to the piece influences theposture for long periods of trunk flexion in order to close thewelding, because the greater the distance, the greater are theproblems of fusion and low resistance of the solder, whichleads also to crack and cracks that lead the future rupture of thepiece.The loads with significant professional standing or movingparts andcharacterized by the welding equipment duringthe operation of final selection of the piece and at its assembly.Of comments, most of them stop and carries a maximum 15 kg.Loads above 30 kg cannot be handled individually, accordingto company rules, but what you see is the individual handlingof up to 60 kg at times, but low frequency of approximately 10to 15 times per turn (as reported the welders). Hydraulic equipment, forklift, and traveler usually transport higher volumes or carving, depending on the location is ready, butthey are all moving in the same place.

Regarding the prevalence of musculoskeletal pain, thewelders used expressions such as back pain, problems in thespine, back pain and arthritis of the knee. Complaints ofshoulder are also common, as several times adopt the posturefor lifting the arms into position above the static level of theshoulders.One of the constraints is the most typical disruptionthroughout the industry. Inobserving the layout of the sector there has, in most cases, thearea available for storage of material and equipment isinsufficient obstructing the movement of work from the sector.Thus, the trader uses to stock immediately, close to their placeof welding, which require everyone to move constantlybetween pieces. There is also a need for welder's frequenttravel in search of tools, which are not always available onyour desktop, because according to them, no one keeps theequipment in part exchange. This is because the lack of placesfor this organization.

The production process is very dynamic. Several operatorsworking at the same time in different parts of the samemachine as the determinations of the supervisor, except in theactivities of the solder pot, which is fixed. Notes from the field,variability of time pressure and does not note the time ofproduction during the field research.

The pre-diagnosis as the target of systematic observation

As such, maintenance of postures for a long period identified as the main difficulty of welders, since these lead tofatigue, leading to accidents and musculoskeletal pathologies.They stay for a long period in the play needed for thesolder does not present problems of fusion and escape thecontrol of the operator. For more to try to maintain goodposture it is not possible for the necessary condition for goodfusion of solder, which requires that the welder stay longerand closer to solder.

The cases of removal by musculoskeletal disorders isincreasing in recent years, mainly for symptoms related to thespine and shoulder. Among the reported activities, requiringmuscular discomfort there is a solder in pots, which willgenerate uncomfortable postures for long periods, held in theopen. This increase has been a common feature the work ofwelding, which require efforts of biomechanical welders. Thispre-testing provides an explanation for the probleminitially in demand. From this point will be chosen the mostappropriate methods to work in the clippings will be made inthe activity.

The systematic observation of the condition inbiomechanical analysis of activitiesthe systematic observations made based onpre-diagnosis. It outlined a plan based on a cutting remark. Forthis initial phase was chosen stock variable time to understandhow they are distributed along a weld. The task identified asthe most critical positions in the maintenance of thesestructures forced by long period is the maintenance of cookers.In general, is to hold patches cracks in the pots used insteelworks and forge the steel industry customers. Theoperator who performs the solder remains for days in thisactivity. The solders have large diameters and thicknesses,requiring more time in carrying out activities. According to thereports, the welder stays by 2 to 3 days in one piece, but thedemand for parts is continuing and the client needs this pieceroutinely repaired. This activity is even avoided by theoperators, but generally end up with more experience are betterconsidered and more time in the company because it is a pieceof risk of the customer and a service of welding accidents cantrigger bad run with the casting of liquid steel pan, or even tobreak the pot.

There was the analysis of actual activity of work,considerable gap between job requirements and work. Thesolder pots, it was noted that not all employees enjoy this task.Traders attributed that to "know" that this activity takes longerto pay, more time to remain in static position. The reason related to the care that the welder must have finished in each ofthe cracks (the local soldiers are). Then perform some typeof voluntary pause, because if he weld "part" of the crack, theplace can cool until even if it exposed to air and dust,making it possible to crack occurring in this region. Countingwhich usually presents a pan 3 to 4 cracks and that each crackcan take up to 3 hours to welded, the welder is to remain fordays in the piece.Thus, while other activities of lead solder and less time tocomplete and therefore less time in static position, are theoldest in the task involved in this activity. This fact leads himto understand that this activity by having to move less, is lesstiring, without

thinking whether it is in this pot, it requiredmore time in prolonged static posture and the risk of quality ofwelding (cannot stop not to generate cracks) is higher in thistask.

The times in a welding of pans obtained through theobservation of five welders in five times of each operator and theaverage obtained. Systematic observation of a spreadsheet wasprepared to be able to monitor the transition from one action toanother and the interval between them. All actions confronted with the demand and given by the removal ofvariables that relate to the growing number of injuries andcomplaints of symptoms related to shoulder and lumbar spineduring the welding activities. Posture of flexion ofthe lumbar spine during the execution of activities andposture andmotion in flexion of the shoulder during the execution ofactivities.

Generally, this occurs by specific requirements and the taskof welding and not misconduct of the welder as shown. Thesemovements and postures adopted by welder repeatedly, foryears, can affect your muscles and even itsconstitution-articular bone, especially the spine and limbs,resulting in short term, in which pain extends beyond officehours and long term, can result in permanent injuries anddeformities. Many authors studied in this work, the welder's areparticularly susceptible to injuries in the back by the fact thatthey remain in this position for long periods. In the case of thewelder of pans, this period may be even greater.

A systematic analysis given on an observation of 30minutes, which is the average time that the operator remains inthe activity without pause. Extrapolating these data to theaverage time for completion of the welding activities ofsystematic observation (124 minutes in the day), whichrepresents 26% of the total time of the day. Thus, given thesample refers to 25% of the total time of welding. For theevaluation of variables, were used the necessary footage andinterviews in an attempt to identify the main constraints. Thetemporal data recorded, as shown in the related itemsbelow.

- Sequential welding: weld the part, inspect the weld,welding electrode exchange, get the helmet to view theweld, get the helmet to continue welding, cleaning of thepart / welding, no action;
- Changes in the lumbar spine: standing, sitting andcrouching down (all positions examined in lumbarflexion and neutral position);
- Movement of the shoulder: the act of welding, a bendingof the shoulder against resistance in which they wereassessed as in flexion and in neutral position.

Based on these findings we can observe that:

- Helmet - This activity performed with amovement of flexion of neck motion in acceleration andstop, making the weight of the helmet by the kinetics ofthe movement close up. The stride can cause long-termpain in the neck and can be harmful if the individual hasdegenerative pathologies in the cervical region. Wereperformed 20 movements in the sampling period, wherethis extrapolation on the total day, up to 160 movementsper day;
- Lift the helmet - This activity carried out with theopening of the helmet with the upper limb, most often theleft and presents no significant risk. Are carried out inorder to display the (inspection) of the welded area isreduced when the helmet is closed due to the blurringlens of the worker protection.
- Operators perform these activities in the inspection of thewelding helmet that is handled (open and close), it doesnot display automatically (already available and low costin current technology) and that was not acquired by thecompany due to ever be asked (and leader of the secondarea) to the general direction. It is worth highlighting that:the greater the time to stop to inspect the weld betweenan electrode and another, the greater the risk of formingcracks, but this parade is physiologically beneficial to thewelder so he can get out of a static posture for longperiods. This inspection is performed to stop constantlyto "see if it does not bubble," according to the operator.The leader also said that when asked if have to do this,because if you play the bubble can generate and weldcrack, predisposing to accidents. This does not occur asdetermined by the company and, yes, but securitystrategy adopted by operators.
- Inspection or cleaning - are made in cleaning burrssporadically. Among the range of an electrode andanother is a visual inspection done quickly. The absence of suchfavors the corrosion of solder.Exchange of lead - in period of observation were 19exchanges of electrodes, in which extrapolation of theworking day on average represent 76 trade. You couldsay that the exchange considered beneficial, becausenow there is that both the shoulder and the spine remainsin neutral position. The mean change observed was 04seconds, with minimum of 02 seconds and maximum of07 seconds. Several precautions must take withelectrodes. It begins the same size as your gauge varies asthe size of crack or notch to weld. This difference insize is also with the welder change constantly accordingto the gauge thickness where the crack in time. Otherscare about the storage and handling should made tohave a good weld.
- Welding - The welding activities are the main riskassociated with musculoskeletal disorders in the spineand shoulder in this work. The welder when weldingremains in long period with flexion of the spine andshoulder flexion (bending motion in the shoulder againstresistance). A prolonged stay in this position may thenlead to the tables above. The posture of the shoulderflexion maintained by 21 times, representing 70% ofthe time of the sample (then totaling 21 minutes).Whereas throughout the day, remains so forapproximately 01 hours and 20 minutes. The minimumobserved was 02 seconds and a maximum of 01 minutesand 03 seconds with an average of 25 seconds. In lumbarspine, the activity of solder integrated part of otheractivities such as bending in standing

posture, in sittingposture and posture under knees, which togetherrepresent the same period observed in posture associatedwith the shoulder;
- Postures - There is a predominance of crouching downposition (52% of the time), followed by sitting (44% ofthe time) and standing (4% of the time). The sittingposture may adapted by an improvised seat by thewelders. In the standing posture, the worker stayed forless time, but depending on the place of welding, thismay be higher. Have the attitude under knees, in additionto load spine, may also pose risks of injury associatedwith knee joint. All the above positions observed inneutral and flexed postures. Welders should forceinto positions that do not even want because he is closerto the weld. The extreme distance of the electrode canalso generate the problem of fusion and penetration thatleads to cracks in the solder. The distance also favorsexaggerated the asperson of solder, which thencomplicate the cleaning of the garment and can be thestarting points of corrosion.The angle of solder influences the quality of welding. If thewelder does not use proper angles according to the places ofwelding, the weld can become fragile, and have difficultieswith porosities of fusion. To ensure these angles, forcedpostures as the trunk and upper limbs are required for longperiods.The positions of flexion of shoulder and lumbar spine arealways associated with muscle tension is maintained by thesame, whether the context of apprehension in performing anactivity in a solder point. Furthermore, the static posture isone of the staff responsible for the development of pain(musculoskeletal).

To show fatigue in the shoulder, was held in the collectionelectromyography welder, which were used two electrodespositioned in the deltoid muscle, the middle portion, in theirpoints of origin and insertion.We observed a decrease in initial median frequency whencompared to end, from 652.98 in the initial collection (held to09:00 pm) and 572.98 in the second collection (held at 11:00pm the same day). Index clearly the presence of fatigue fromthe second collection, made 2 hours after the initial collection.In flexion of the shoulder evaluated, could observed inflexion associated with abduction of the shoulder than 45. Theopening of the arms considered excessive since graduationgo beyond this to be a contraction of the muscles andsupra-spinous upper trapezius, which undermines the cervicalspine and scapular waist.

After reviewing the positions, it was possible to identify thekey attitudes that adapted during welding. Deflection with abduction of shoulder, Deflection of thelumbar and cervical spine, more pronounced in thelumbar region leading to lack of support for the lumbar spine,tilt the head to visualize the solder, inadequate support andinadequate seating.These postures trigger pain, discomfort, fatigue andpredispose to acquire the professional musculoskeletaldiseases. The welder does not perform scheduled breaksduring the day, but takes voluntarily ranges between a solderand another to chat, reflect on the work performed (options tobetter point of solder) and when required for the activity forcoffee, a water and achieve physiological needs.
Work performed with both hands and this choice leads thewelder to adopt a position of work where he must be near thepiece of equipment and materials. This makes it a lead solderwith a higher degree of tension due to static posture of thetrunk and shoulders. The welder has to move to differentpoints depending on the point or path that needs to welded.This system of work will be stressful to work on the workingtime, but may encourage the breaks in static postures held forlong periods.

A risk factor, skeletal muscle can defined operationallyas a generic term for the factors of work that have associationwith musculoskeletal diseases. The main determinants ofthese factors work disorders are fixed postures, repetitivemovements, and use of excessive force, vibration and lowtemperatures. Thus, the ill are related to several factors thatact of working together, not allowing the workers to adapt tophysically and mentally for situations at work and that,therefore, any preventive action should consider the capacityof all persons involved to seek strategies for transformation ofworking conditions. The nature of the work of the welderrequires the adoption of positions away from the central axisthat regulates the field vertically and horizontally. This ismore important where the duration of the task is a factor ofaggravation. In the case study identified as unfavorablepositions on these.

The welder adopts positions that are static, withshort movements, and it can take a certain position for half anhour or even a whole day, which represents a factor ofphysical stress. Most studies on the problems of themusculoskeletal welders focuses on problems related to theshoulder joint complex, for the most part receive the loadfrom both the posture and the maintenance of the hand tool,with a consequent increase in time on the shoulder, thewas evidenced in this study. The welders have highprevalence of musculoskeletal symptoms and signs because,first, that the load on the shoulders, neck and lumbar region.Thus, the work of welders can described as "a work withstatic postures typically characterized by specific patterns ofmovement of the articular complex of the shoulder andspine." For each general posture of the body, there arevariations in the positioning of the arms and hands, for whichthe task of the welder requires their position and attitude inspace is of high precision. The muscle fatigue characterizedas the fatigue experienced in regional muscles in response tostress and posture, and manifest as pain, has also decreasedengines.

To demonstrate the findings, elements of the activity couldthen be broken down again, now taking into account thesystematic observations given in the activities, with their mainproblems and considerations that lead us to the diagnosis. Theactivity of welding presents biomechanical requirements asstatic posture of shoulder in

flexion with support of the helmet;static posture of the trunk flexion (lumbar and cervical),uncomfortable postures of legs in the squatting position (heldin a few moments, given the flexibility posture), requiringconcentration and attention to avoid rework and solderingproblems.Given the findings of the validation and confrontation withthe players, the activity of weld itself still needs care as:

- The arc length directly affects the width of the pool thatshould fill the crack. You must be the shortest arc possible, soyou get as near the weld. This control of the length of the arcvoltage is to be done so carefully, observing the otherparameters such as contamination of the electrode, improperfeeding of material addition, changes in temperature in theelectrode and the electrode erosion;
- The speed of progress affects the penetration and width inthe process, the latter much more affected. Itsimportance lies in the fact it determined the cost of theprocess to closely link to the speed of the process.However, many times the speed it is only a consequence fromthe definition of quality standards and uniformity. In the caseof speed, cookers may not be high because it cannot fill thevoids properly. Is increasing the speed of feeding the wiresolder it produces less penetration and decreasing convexprofiles to increase speed to penetrate, which is not the case of pans. The low speed alsofavors the posture of the welder, favoring the tablesof postural fatigue in low back pain;
- The shape of the feed material for the addition is anotherimportant parameter. In manual processes, the way thematerial added influences the number of passes and theappearance of the finished weld. The more electrodes USA isin the same weld, the greater the chance of cracks and flaws,as the composition of the material may be slightly different. Ittries to end a piece when it starts to work on it.
- The contamination must be avoided, but more a factor tostay for long in one piece. The contamination occurs when theelectrode welder accidentally dip the electrode in the pond orplaying the lead with the addition of metal. An improperprotection can also cause oxidation of the electrode andconsequent contamination of the solder. Other sources ofcontamination: vaporization of metals in the arc, oreruptions of aspersion pond caused by trapping the gas andevaporation of surface contamination. Contamination canaffect the characteristics of the arc and cause inclusions in theweld metal. If this occurs, the operation should discontinued and the contaminated portion of the electrodeshould remove, with new grind in accordance with therequired characteristics at the tip. This creates even morework to the welder. The atmosphere on the side opposite the solder can also contaminate the solder. To avoid thisproblem, try the same welder at low speed; not stopping until they finish the face welded and it may take up to 3 hours.
- It must take not to be too much pressure, especially inthe last five centimeters, to prevent blowing of the pond orconcavity of the root, which is losing the solder in pots.
- Any stop in the filling of a crackpot of (pond) generatesdiscontinuity. When these discontinuities lead tothe material does not meet the requirements of the work to done they are classified as defects. The typical causes of theseinclusions are in contact with the electrode tip pool, theaddition of material contact with the heated tip of theelectrode, the electrode contamination by aspersion of thepond; extension of the electrodes beyond the torch, resultingin overheating; Electrode improperly arrested; inadequaterates of gas or excessive winds, defects as cracks and broken.Along with these factors, the age of the welders considered in the research on the effects of work on themusculoskeletal system, as older workers to remain in solderpots. Despite complaints of shoulder, pain had been associatedwith the worker's age, characteristic of older workers are not,and however, a phenomenon solely dependent on age, may appear in younger welders. The main difference lies in the factthat in most new welders, relaxation and exchange of workcan result in regression of symptoms that, in older, tend tobecome chronic. Thus, in addition to the experience of thewelder does not guarantee immunity against localized musclefatigue, you should consider also that the cumulative effect offatigue can affect the body's response to the continued workin inappropriate positions.

The exercise of the profession of welding leads then to usethe same intense way of the upper limbs and spine, which cancause musculoskeletal pathologies. However, in addition tofixed posture, stress as a component that can enhance theconditions of work. Allied to this are also the hereditarycharacteristics and lifestyle adopted by each.The issues driving the activity of work presented in theaspect of physical and cognitive work. The cost of upper limbposture and spine in the activities of solder pots (major causeof complaints among welders) are due to the size of parts,length of stay and they need to see well the solder to avoidcracks and rework other. Therefore, that contrary to what you think inthe activity of soldering (handwork) is very prompt andintellectual attention. Thus, the questions turned to broaderissues related to technology and distribution of employees inthe company.

Terms of conduct ergonomic

For the recommendations suggested in the workplaceevaluated, it considered for both the views of socialactors involved in the task force. Now, it added because of the inter-relationships and by selecting somerecommendations that deemed important, emphasizing thecritical points that observed. Some ergonomic proposalsare impractical and costly in the short term and others in theface conditions under which the work

executedare independent of the emergency core charges.As can see on visits to the achievement of this research, there are factors that converge in the technology andinsecurity in the activity as a whole, starting with the locationof buildings, always in the open areas and lack of technologyto support the pieces. This deficiency of technology used atthe solder pots causes of accidents and injuries amongworkers. The data collected in the field through interviewsand footage on video, along with the assessment of attitudescertify this disability, requiring improvements in layout andequipment support.

These simple factors preventing a valuable aid to reducingthe physical constraints of the worker: the use of hydraulicturn in support for the piece, allowing the lifting equipment,displacement, and lateralization of the movement against theoperator pans and placing this activity in a sector covered.For tools, you should seek EPI's more comfortable and,through testing, replace the existing ones. This not doneuntil today according to the company (director responsible) for the request get no leadership, because if no one evercomplained formally, this information has validatedamong welders.

Studies should focus on trying to improve the quality andregular maintenance of equipment, with the current market ofequipment more comfortable and lightweight for use in thecompany. It also observed that workers improvise banks, stairs, supports, where equipment that even more sophisticated improvised, mended with wire, ladders and stools made bythe officials. In general, to avoid improvisation shouldmade available more tools and equipment for the tasks (seats, ladders, platforms, etc.). In addition, closets for better organization ofthe sector (to prevent a lack of local materials are scattered).In relation to redefine the layout of the workplace, it isproposed to resize the physical plant of the hall is locatedwhere all the activities related to the assembly of equipmentin the management of parts and materials to improve theopportunities for work and display the same. The greaterpurpose is to ensure the movement of workers in safety, whenthe activities, being necessary to rearrange the tools availableon shelves, to the rational use of space, to increase the areapassable and facilitate the procedures for cleaning. Theactivities carried out in pots, it is necessary to establish aspecific area for this activity where the welder not exposedto weather, building a shed where the tasks performed.

The floor of the site must kept free from cables to ensuresafety. Thus, the entire supply for the equipment, such aselectricity, gas and wire, it came up. In cleaning the office andorder must remain, the only recommended equipment reallyneeded to work.Says nothing to guide the employee,require a good attitude, if it generated because ofensuring a good weld without aspersion, broken, points thatfacilitate the corrosion and porosity. It is important to notethat the phenomena of oxidation depend operativeconditions and the length of the arc, which provided whenthe operator approaches the piece, tilting the trunk andpushing your posture. A long range (long distance operator inhandling the equipment) will lead to oxidation reactions moreimportant than a short arc (uncomfortable posture).

Adopt the true concept of work for four hands is certainly asolution to reduce the stress and increase productivity, but theadjustments to reduce fatigue, exposure to occupational risksand to work with two hands in the current context arefollowing:

- Insert basis of turning water to drive the parts to weld. In the case of pots, a large hydraulic equipmentshould developed, because the pots have commoncharacteristics and are frequently performed maintenance.These equipment spin, usually called positioners, devicesare controlled by electric or automatic controls that allowthe turning of the piece in both horizontal and vertical,allowing various combinations and greater control of thepositioning of the joint. The nice (sort of platformpantographic mechanical) can elevate the piece to weld to a certain height. This will relieve the worker toclimb the structure or to maintain uncomfortable posturesfor long periods and reducing the risk of accidents.
- Insert chairs, ladders and platforms from variousaccording to a bank of suggestions given by welders,official projects of accessories to replace theimprovisations of welders;
- Replace the helmet used for lighter equipment andautomatic display, which avoids that the employee has tolower and raise the helmet in order to repeat each need todisplay;
- It must seek to reduce musculoskeletal efforts through theplacement of tools and work plan, to ensure that thewelder can perform their tasks with the hand in optimalposition (between the waist and the level of theshoulders), no need to assume postures that twisted ortilted forward;

When it comes to lifting weight, you should establish thatany object that is handling heavier than 10 kg should beloaded with about the use of balance's, tables, hoists orsimilar aids. The torch of the weight bearing on the staticmuscle load, and recommended that the welding torches havereduced weight to reduce the risk of fatigue ormusculoskeletal disorders, occurring also affected the shapeof the torch, as it also affects the degree of muscle activation.

The format depends on the correct grip size, but also withattention to the design of its cross section and surface textureof the handle, so to facilitate comfortable and firm grip of thetool, with a minimum of effort. The trigger for activation ofthe torch should also receive special attention, for thatrequires little under pressure. Furthermore, it is important thatthe welding torches are flexible cables and capacity to absorbvibration. The weight of the tool is dependent, also the sizingof cables and the electrode. There are welding torches thathave a

system of extraction of fumes generated during theprocess, which can influence on your weight. These torchesare a result of an evolution whose initial attempts at removalof smoke near the source consisted of the addition of productsfrom the extraction of smoke flares. This system contributesto the weight of the tool and is responsible for extraction of upto 40% of the smoke generated in this case, the suggestionshould suspended, and the welding cables.

If existing technologies found in other companies, andused on a small scale in the company evaluated can see thatresources exist to reduce the physical constraintsof the worker. Starting with the weight of the equipment, thedisplay of welding by spinning gear, the hall covered withexhaust systems.Obviously, these technologies are not an end. You cannotspecify whether the postures assumed by workers in thesefacilities are ideal. As can be seen in the posture review, someof the worst postures performed with the employee bentforward or crouching down. These positions are the points ofwelding also located at the base of pans. Therefore, a goodproject as a hydraulic gyro for example, must allowshareholders in areas close to the floor, to reduce constraintson the spine and legs of the worker.

The cost factor is one of the obstacles to improving this type.It is natural that entrepreneurs want to reduce your operatingcosts and these costs include an inexpensive equipment. This,then, is one of the reasons why are still focusing on how theimplementation of solders constructs and equipment inmaintenance and hinders the implementation of improvementsin this case.Recommended to pay attention to these issues, thecreation of operational seminars. These seminars designedto promote discussion of the problems of the sector betweenofficials working in the field with management and leadership.Such actions promote the enrichment of the task by the staffand facilitate the understanding of real working situations.

IV. TO THE DIAGNOSIS OF REAL ACTIVITY

A case study research method also applied on this work [3]. The diagnosis as the factors to considered enabling a transformation of the work situation [4]. Independent ofthe parts to be welded are present the static postures held forlong periods because they provide conditions for the focuspoint for soldiers and support to increase the precision manual.This fact leads the welder to position so that it can beuncomfortably close to the piece, hold and maintain the toolsand parts required. This position requires a professionalabducted and flex the left shoulder to position the uppermember, perform a bending of trunk (lumbar and cervical) forthe direct view of the face to weld. Connected to this, isthe weight of the helmet that it is obsolete, outdatedtechnological front of the product.

Associated with these factors is the organization of workthat leads to the professional conduct many shifts andmovements necessary to find the desired material that seems tocause physical fatigue, but may facilitate the maintenance ofpauses for long periods in static contraction.Because different parts, the variability of posture requiresgreat constraints, to the maintenance of forced postures thatmay compromise the physical integrity of workers. In the caseof solder in pots, the maintenance of posture is more criticaland required longer on this constraint intensifies it. Thesupport of the same static posture for long period’s causesmuscle fatigue and musculoskeletal pathologies.The task of welding allows postures with lumbar solicitationdegrees because the successive postures in flexion of trunk,aggravated by handling of heavy loads during the operations tohandle the pieces. Contrary to what said inmany literature and research on the biomechanical conditionsof welding required for activity, escapes the control of weldingto maintain the so-called "correct posture" in the activities. Because they are kept independent of the control of weldingbecause it is required to obtain a good fusion of the solder,good arc welding, the lack of aspersion and porosities in theweld. If these positions not forced to approximate the parts,such items are impossible to guarantee and no currenttechnology available to ensure this.In addition, these factors contribute negatively on theappearance of signs and symptoms related to musculoskeletalsystem. Thepoor sector about the organization and layout, the discomfortof the EPI's, environmental risks, the dissatisfaction bymaintenance of low wages and bad postures for long periods instatic muscle contraction.

You can say, before the observed reality, that workers aresubject to a variety of types of risk, which varies in relation tofrequency, the intensity and time of exposure, to ensure thequality of welding.The bending of the spine and shoulder highlighted as theactivities of greater risk in contributing to the generalframework of reports of musculoskeletal disorders, but thisposture is difficult to avoid in the variability of industrialwelding postures required by different types of parts and theneed to ensure good fusion and penetration of the solder.

The precarious conditions of space and poorly organizedtools intensify the constraints of the welders. For welding tomaintenance, work, such as cookers, held in open sky, withthe welder exposed to excessive weather in a region dominatedthe heat, besides the difficulty of moving material to the areawith the client, as mentioned in pre-diagnosis.

V. CONCLUSION

All these factors, alone or in interaction, requiring theoperator to adopt new methods and leave the settings usedduring daily activities, without incident, to ensure the controland management of risks of mistakes and accidents at work.This behavior, which is outside the control of the welder,reduces the margin of an attitude of prevention, submitting to asituation of physical constraint, with the results achievedthrough changes in the internal state of workers, which canlead to, over time, attacks on health.

The construction of an ergonomic analysis of work andfocus on the activity of workers was crucial to understandingthe real situations at work. There were not only risks related tobiomechanical postures adopted to meet the demands of workas well as cognitive to the "good weld". The difficultiesencountered by operators in performing their tasks contributedto the emergence of postural constraints the procedure adoptedby them, characterized by the submission of requirements forinspection and attention to welding and other developmentnecessary for the completion of the activity.

The action of all these factors indicates the presence ofidentified risk factors for the development of musculoskeletaldisorders arising from work activity, especially ofmuscle-skeletal disorders of the lumbar spine and shoulder.

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Spectral Analysis of Biosignals to Evaluate Heart Activity due to the Consumption of Energy Drinks

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Abstract: *-* The heart activity is clearly evaluated in this study by analyzing spectral or frequency components of three Biosignals such as ECG, PPG and blood perfusion signal. This study is done with several healthy human subjects who are totally free from any type of cardiovascular diseases. ECG and PPG recordings were performed with electrode lead set and pulse transducer respectively connected to the same MP36 (Biopac, USA) data acquisition unit. LDF measurements were performed with skin surface probe connected to LDF100C module on middle finger tip. This LDF module was connected to MP150 (Biopac, USA) data acquisition unit. ECG, PPG and blood perfusion signal recordings were performed before and after having energy drinks available in Bangladesh. After consuming energy drinks, it is observed that the spectral or frequency components for ECG as well as PPG signal decreases with a significant rate from the instant of having ED. That is, the spectral parameters of heart activity decrease due to the consumption of energy drinks. The spectral analysis of LDF signal also results similar type of decrement in their spectral parameters for same type of energy drinks consumption. These results reflect adverse impacts of energy drinks consumption on heart activity.

Keywords: *- Biosignals, energy drinks, frequency spectrum, heart activity, spectral analysis.*

I. INTRODUCTION

Biosignals are defined as a summarizing term for all kinds of signals that can be measured and monitored from biological beings. The term Biosignal is often used to mean bio-electrical signal related to biological beings. Among the best-known bio-electrical signals or Biosignals are the Electroencephalogram (EEG), Electrocardiogram (ECG), Electromyogram (EMG), Electrooculogram (EOG), Photo Plethysmogram (PPG), Blood Perfusion Signal, Magnetoencephalogram (MEG), etc. Using differential amplifier EEG, ECG, EOG, PPG and EMG are measured that registers the difference between two electrodes attached to the skin. Blood Perfusion is measured with amplifier which uses Laser Doppler Flowmetry technique. This study is confined to three Biosignals- ECG, PPG and Blood Perfusion Signals.

Electrocardiography (ECG) is the electrical activity of the heart which is detected by using electrodes placed on skin. An ECG is used to measure the heart's electrical conduction system [1]. Heart activity means the function of the heart which is examined applying different conditions over a period of time. A typical ECG consists of a P wave, a QRS complex, a T wave, and a U wave, which is normally invisible. A photo plethysmogram (PPG) is an optically obtained plethysmogram, a volumetric measurement of an organ. A PPG is often obtained by using a pulse oximeter/transducer which illuminates the skin and measures changes in light absorption [2]. With each cardiac cycle the heart pumps blood to the periphery. The change in volume caused by the pressure pulse is detected by illuminating the skin with the light from a light-emitting diode (LED) and then measuring the amount of light either transmitted or reflected to a photodiode. In biomedical engineering, spectral analysis of ECG and PPG is essential to evaluate heart activity.

Laser Doppler Flowmetry (or simply "LDF") is an established and reliable method for the measurement of blood perfusion in microvascular research. Periodic oscillations in the microvasculature are detected by the noninvasive technique of LDF. The spectral analysis of the signal (ECG, PPG and blood perfusion) from human skin has revealed five characteristic frequencies [3]-[4]. In addition to the cardiac and

respiratory rhythms around 1 and 0.3 Hz, respectively [4]-[5], three frequencies have been detected in the regions around 0.1, 0.04, and 0.01 Hz in human skin [3]-[5]. It is suggested that periodic oscillations with a frequency of around 0.1 Hz (a-waves) reflect intrinsic smooth muscle (myogenic) activity of blood vessels [6], whereas the frequency around 0.04 Hz (b-waves) represents neurogenic stimulation of resistance vessels [7]. Golenhofen suggested that oscillations of around 0.01 Hz (minute-rhythm) resulted from changes in metabolism of the perfused tissue [8]. The different spectral components are thought to modulate vascular smooth muscle cell activity. This results in a specific level of vascular tone, which in combination with the rheological properties and the active dilator activity, determines vascular resistance.

Energy drinks (ED) are a group of beverages used by consumers to provide an extra boost in energy, promote wakefulness, maintain alertness, and provide cognitive and mood enhancement [9]. These beverages have stimulant effects on the central nervous system (CNS) and their consumption is accompanied by an expectation of improving user's performance physically and mentally [10]. "Magical" ingredients of these drinks have one thing in common: all of them contain a lot of caffeine. These could be considered the "active ingredients" [11]. Energy drinks have added caffeine and other ingredients that their manufacturers say increase stamina and "boost" performance. Caffeine is one of the most commonly consumed alkaloids worldwide in the form of coffee, tea, or soft drinks, and in high doses may cause abnormal stimulation of the nervous system [12], as well as adverse effects in the cardiovascular, hematologic, and gastrointestinal systems [13]. The market and degree of consumption of energy drinks is increasing every year, but only few have global knowledge of their ingredients and actual physiological and psychological effects [14]. Although energy drinks have been sold worldwide for more than a decade, only a few published studies have examined their effects on health and well-being. Steinke and Lanfear investigated the effects of energy drink consumption on hemodynamic and electrocardiographic parameters in healthy young adults, and reported a significantly increased heart rate and blood pressure within 4 hours [15]-[17]. All the above studies are related with physical performance analysis but a very few studies on heart activity due to the consumption of energy drinks. The aim of the present study is to evaluate heart activity due to having energy drinks by analyzing spectral components of different Biosignals which are related to heart function. We hypothesized that having energy drinks changes microvascular control mechanisms of the skin which would result in differences in the spectral components.

II. MATERIALS AND METHODS

2.1 Subjects specification

Ten healthy young Subjects between 19 and 27 years old were enrolled for this study. The Subjects had not taken any medication during the week prior to the study. None of the Subjects were smokers and they refrained from alcohol and caffeine containing drinks and performed heavy exercise at least 6 hours prior to the study. The Subject had not any disorder, hypertension, heart surgery, stroke, or any history of cardiovascular degeneration. After being informed of the study design, they gave their written consent. The study was approved by the local Ethics Committee. Each participant had an initial visit to the experimental laboratory for a physical examination and a medical history assessment. Details about the Subjects are listed in Table I.

Table I: Demographic Characteristics of Study Participants

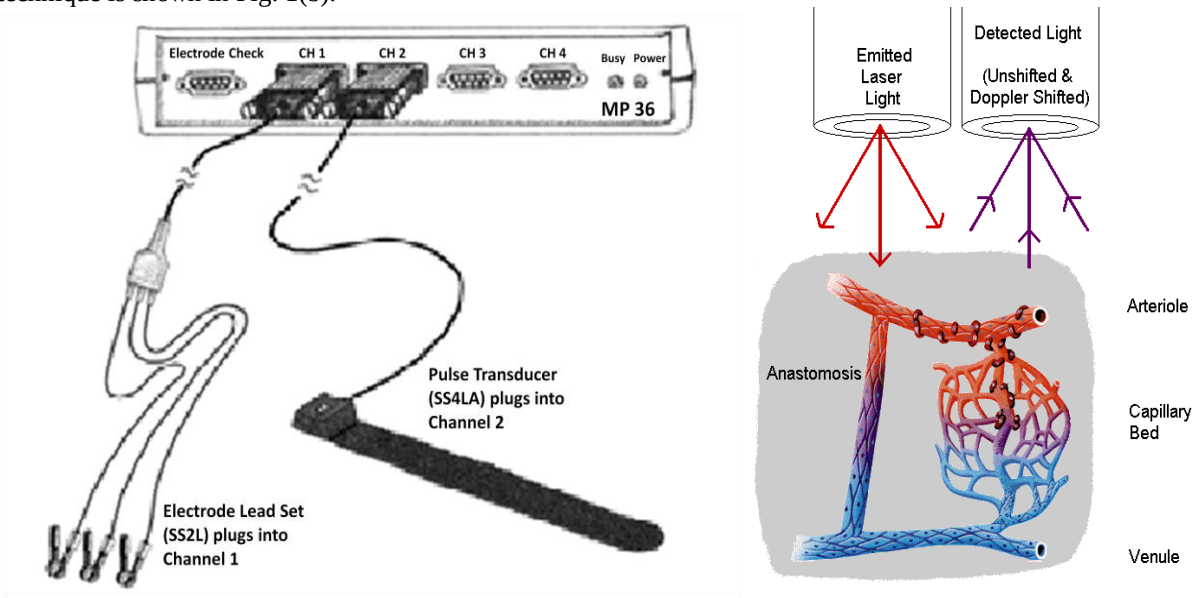
Parameters	***Value (N=10)***[a]
Age (yrs)	22.6 ± 3.04
Weight (kgs)	66 ± 7.92
Height (cms)	171.70 ± 2.99
BMI (kg/m^2)	22.44 ± 3.11

[a]Values are Mean ± Standard Deviation

2.2 Experimental setup

The study was performed in a quiet room with the temperature kept at 25°C (24-26). The subjects were resting in the supine position throughout the whole experimental period. ECG, PPG measurements were performed with electrode lead set (plugs into channel 1), pulse transducer (plugs into channel 2) respectively connected to the same MP36 (Biopac, USA) data acquisition unit as shown in Fig. 1(a). LDF measurements were performed with skin surface probe connected to LDF100C module on middle finger tip. This LDF module was connected to MP150 (Biopac, USA) data acquisition unit. The LDF100C Laser Doppler microvascular perfusion module works by illuminating tissue with low power laser light using a probe (TSD140 series) containing optical fiber light guides. Laser light from one fiber is scattered within the tissue and some is scattered back to the probe. Another optical fiber collects the backscattered light from the tissue and returns it to the module. The light is scattered by the static tissue structures and moving blood cells; the moving blood cells impart a Doppler Shift; an adjacent fiber detects light returned from the tissue; this light contains Doppler

shifted and unshifted light. Most of the light is scattered by tissue that is not moving but a small percentage of returned light is scattered by moving red blood cells. The light returned to the module undergoes signal processing to extract the signal related to the moving red blood cells. The principle of laser Doppler flowmetry technique is shown in Fig. 1(b).



(a) (b)

Figure 1: (a) Setup for ECG and PPG recording, (b) Principle of Laser Doppler Flowmetry [18]

2.3 Spectral Analysis

Spectral analysis is referred to as frequency domain analysis or spectral density estimation, is the technical process of decomposing a complex signal into simpler parts. Many physical processes are best described as a sum of many individual frequency components. Any process that quantifies the various amounts (e.g. amplitudes, powers, intensities, or phases), versus frequency can be called spectral analysis as shown in Fig. 2. The Fourier transform of a function produces a frequency spectrum which contains all of the information about the original signal, but in a different form. A common technique in signal processing is to consider the squared amplitude, or power; in this case the resulting plot is referred to as a power spectrum. A fast Fourier transform (FFT) is an algorithm to compute the discrete Fourier transform (DFT) and it's inverse. A Fourier transform converts time (or space) to frequency and vice versa; an FFT rapidly computes such transformations. As a result, fast Fourier transforms are widely used for many applications in engineering, science, and mathematics. Fast Fourier transforms have been described as "the most important numerical algorithm of our lifetime" [19].

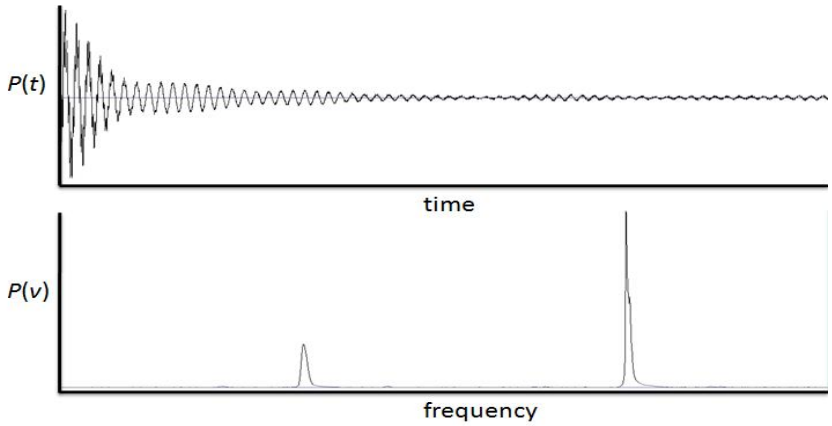


Figure 2: Frequency and time domain for the same signal [20]

The Power Spectral Density (PSD) describes how the power of a signal or time series is distributed over the different frequencies, as shown if Fig. 2. Here, power can be the actual physical power, or more often, for convenience with abstract signals, can be defined as the squared value of the signal. The total power *P* of a signal *x(t)* is the following time average:

$$P = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} x(t)^2 \, dt$$

The power spectral density can be defined as [21]-[22]:

$$S_{xx}(\omega) = \lim_{T\to\infty} \mathrm{E}[|x_T(w)|^2]$$

Here E denotes the expected value and $x_T(w)$ is a truncated Fourier transform, where the signal is integrated only over a finite interval [0, T]:

$$x_T(\omega) = \frac{1}{\sqrt{T}} \int_{0}^{T} x(t) e^{-j\omega t} \, dt$$

Spectral analysis of Biosignals collected from skin is performed by means of Biopac AcqKnowledge software in this study. The frequency spectrum of Biosignals is analyzed by Fast Fourier transform (FFT) and Power Spectral Density (PSD). For obtaining better spectral resolution in FFT and PSD we have used hamming window function. Following recent studies [3]-[4], the frequency interval studied (from 0.009 to 1.6 Hz) was divided into five subintervals as shown in Table II.

Table II: Frequency Interval of Biosignals Collected from Skin

Origin of Oscillation (Activities)	*Frequency Range (Hz)*
Metabolic	0.0095-0.02
Sympathetic	0.02-0.06
Myogenic	0.06-0.20
Respiratory	0.20-0.60
Heart/Cardiac	0.60-1.60

III. RESULTS AND DISCUSSIONS

3.1 Measurements of Biosignals

A typical recording of ECG and PPG for a subject are shown in Fig. 3 and Fig. 4 respectively. These recordings are performed at both normal (before having energy drinks) and energized (after having energy drinks) condition to evaluate heart activity due to the consumption of energy drinks by analyzing spectral components of different Biosignals. To compare the results of ECG and PPG analysis 2 subjects from above 10 subjects have been selected and their LDF signal is recorded before and after having ED. Applying same conditions LDF recordings have been done as before. At least 10 min were allowed for acclimatization before the LDF measurements were performed on the skin of middle finger tip. Skin blood perfusion was measured immediately before and after 30 minutes of having energy drinks. Blood perfusion recording for a typical subject at before and after having energy drinks are shown in Fig. 5 and Fig. 6 respectively. From LDF or Blood perfusion recording it is seen that, due to having ED the maximum, minimum and average flows are increasing but the peak to peak flow decrement is more significant.

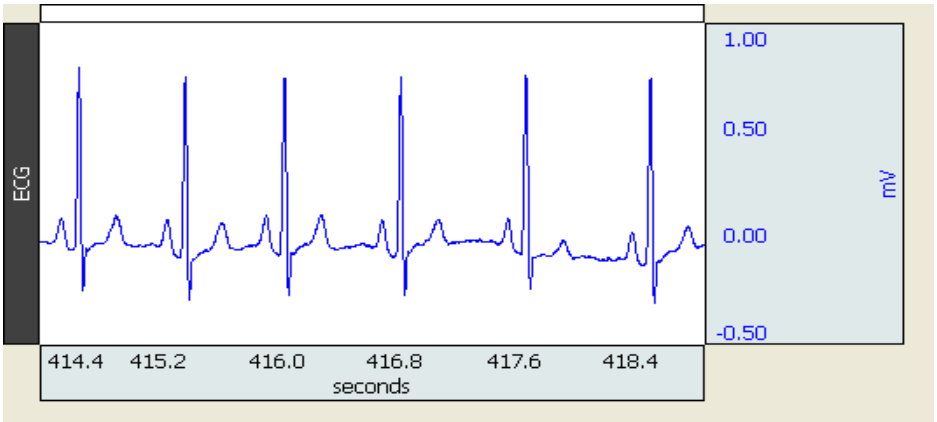


Figure 3: Recording of Electrocardiogram (ECG)

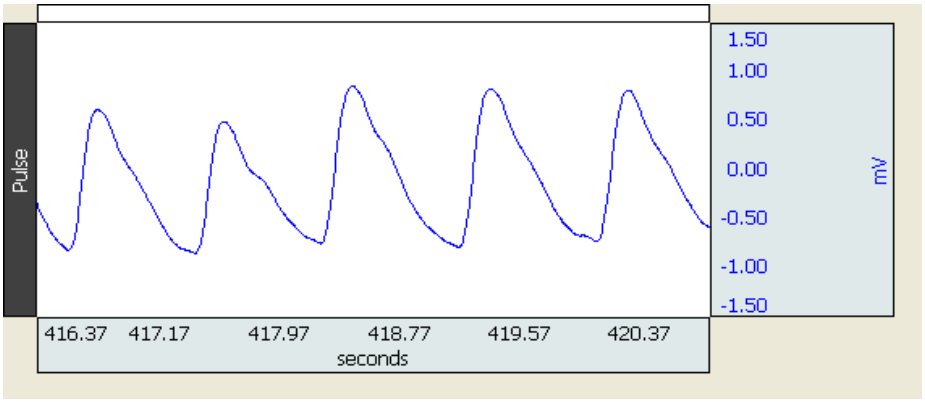


Figure 4: Recording of Photo Plethysmogram (PPG)

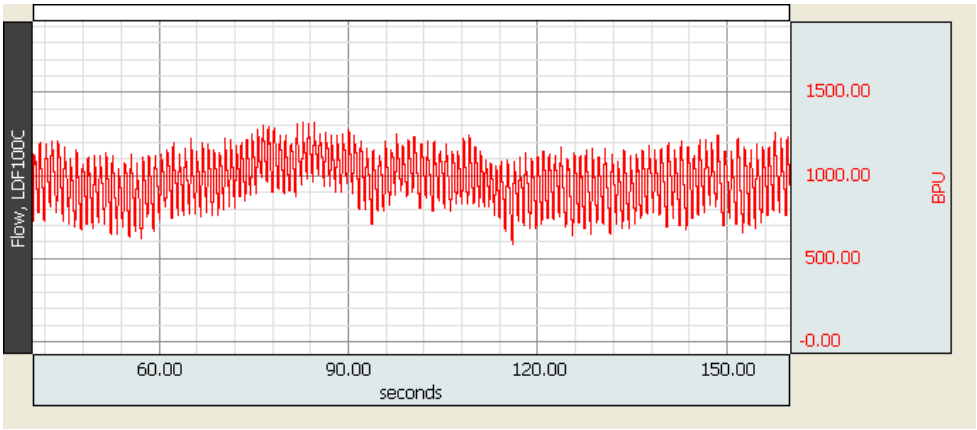


Figure 5: Recording of Blood Perfusion Signal before having ED

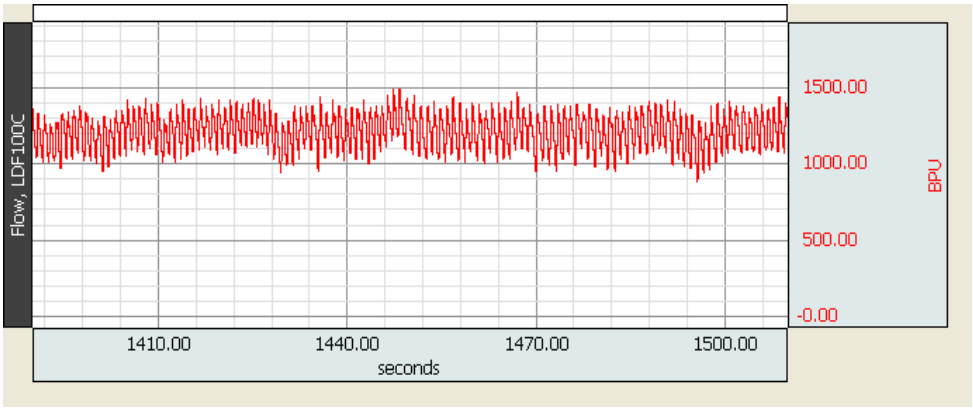


Figure 6: Recording of Blood Perfusion Signal after having ED

3.2 Spectral Analysis of Biosignals

In this study, spectral analysis of blood perfusion signal is shown only and the results are compared with spectral analysis of ECG and PPG because spectral analysis of ECG and PPG are already done in previous works. FFT analysis of blood perfusion signal before and after having ED for a typical subject is shown in Fig. 7 and Fig. 8 respectively. Before having ED the peak magnitude of FFT within cardiac activity is 17.37 BPU, occurs at 1.04 Hz. After having ED the peak magnitude of FFT within cardiac activity is 13.52 BPU, occurs at 0.96 Hz. PSD analysis of blood perfusion signal before and after having ED for a typical subject is shown in Fig. 9 and Fig. 10 respectively. Before having ED the peak power of PSD is 111.8 $(BPU)^2$/Hz occurs at 1.04 Hz which is also within cardiac frequency range. After having ED the peak power of PSD is 67.77 $(BPU)^2$/Hz occurs at 0.98 Hz which is also within cardiac frequency range. It is seen that, due to having ED the amplitude of FFT and the peak power of PSD within cardiac activity is decreasing. The reason behind this decrement may be the decrement in peak to peak flow of LDF signal.

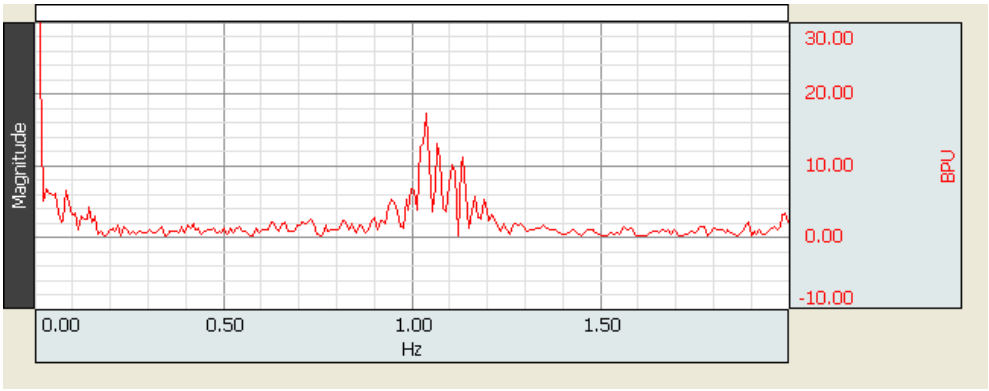


Figure 7: Fast Fourier Transform of Blood Perfusion Signal before having ED

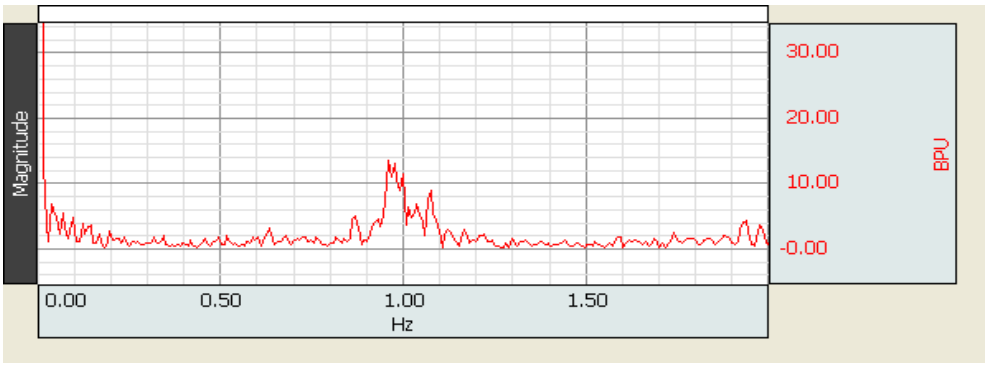


Figure 8: Fast Fourier Transform of Blood Perfusion Signal after having ED

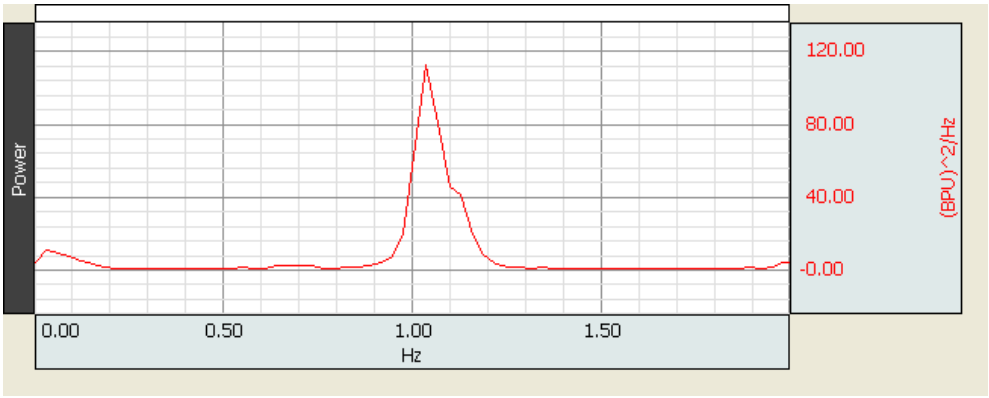


Figure 9: Power Spectral Density of Blood Perfusion Signal before having ED

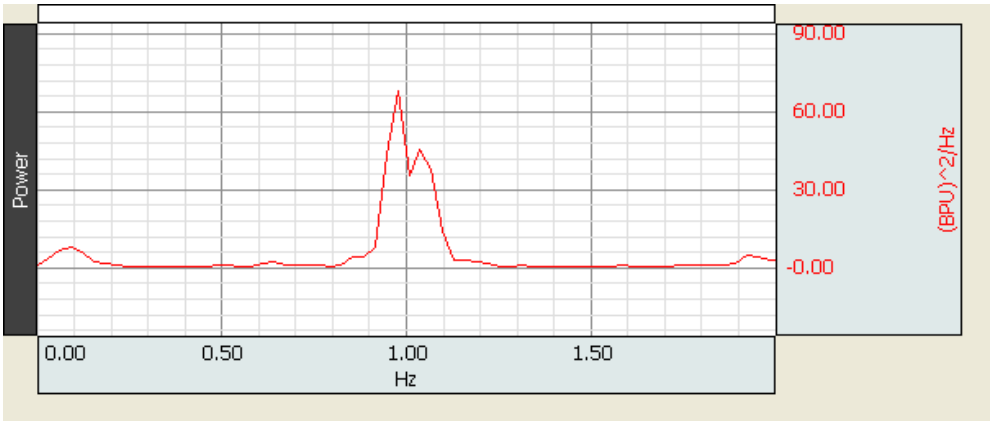


Figure 10: Power Spectral Density of Blood Perfusion Signal after having ED

3.3 Heart Activity Evaluation

The changes in average spectral components of blood perfusion signal due to having ED are listed in Table III. It is seen that for both FFT and PSD, frequency parameters of blood perfusion signal decreases within frequency range of heart activity due to having ED. The frequency spectrum related results of ECG and PPG signals have been compared with the frequency spectrum related results of blood perfusion signal which is shown in Table IV. Frequency spectrum analysis of blood perfusion signal shows that about 34% decrement in FFT and PSD parameters due to the consumption of ED. In previous chapter we have got about 40% decrement in FFT and PSD parameters for PPG signal and about 15% decrement in FFT and PSD parameters for ECG signal. For ECG, PPG and blood perfusion signal, the net change is negative which is also identical (approximately) in some cases. The blood perfusion signal analysis also shows similar results as in case of ECG and PPG signal analysis. Since the nature of signals is different, it is impossible to get 100% identical results.

Table III: Average Changes in Spectral Components of Blood Perfusion Signal

Type of Spectral Analysis	*Frequency band*	*Before having ED*		*After having ED*	
		Peak occurs at (Hz)	*Peak magnitude (BPU) or Power ((BPU)^2/Hz)*	*Peak occurs at (Hz)*	*Peak magnitude (BPU) or Power ((BPU)^2/Hz)*
FFT	Heart (0.6-1.6 Hz)	1.06	17.95	1.02	11.81
PSD		1.06	97.6	1.00	63.79

Table IV: Comparison of Spectral Components of Different Biosignals

Signal type	*Type of Spectral Analysis*	*Frequency band*	*Peak magnitude (BPU) or Power ((BPU)^2/Hz) before having ED*	*Peak magnitude (BPU) or Power ((BPU)^2/Hz) after having ED*	*% Change due to having ED*
ECG	FFT	Heart (0.6-1.6 Hz)	0.01016	0.00830	- 18.30%
	PSD		1.08E-05	0.97E-05	- 10.19%
PPG	FFT		0.15267	0.09693	- 36.51%
	PSD		0.00799	0.00429	- 46.31%
LDF	FFT		17.95	11.81	- 34.21%
	PSD		97.60	63.79	- 34.64%

The heart activities are clearly evaluated due to the consumption of ED analyzing spectral components of different Biosignals. Consumption of ED affects heart activity that is determined in this study using ECG, PPG and blood perfusion signal. The spectrum or frequency components for PPG signal decreases with a significant rate from the instant of being energized. Also a net decrement in spectrum components is noticed for ECG signal due to the consumption of ED. By analyzing spectrum components of blood perfusion signal, approximately same results are found as in case of ECG and PPG. Thus the results of this study are verified with the analysis of spectral components of blood perfusion signal.

IV. CONCLUSION

In this work, ECG, PPG and blood perfusion signal acquisition were performed using Biopac equipments in before and after the consumption of energy drinks. By analyzing spectral components of Biosignals (ECG, PPG and blood perfusion) it is clear that the consumption of ED affects Biosignals which in turns reduces the spectral components. The result of this study reflects negative impacts on heart activity that are not in favor to the human being. It is the time to be concern about the negative aspects of energy drinks consumption.

V. ACKNOWLEDGEMENTS

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Performance of Saw-Dust in Low Cost Sandcrete Blocks

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Synopsis: **-** This paper presents the salient features of an experimental study on sandcrete blocks prepared by partially replacing sand with saw dust. Influence on compressive strength, water absorption capacity and density characteristics are studied by varying replacement percentage of sand with sawdust.
Saw dust, the Industrial waste obtained from sawdust refuse dump form Timber shade & saw-mills, if used for partially replacing sand can reduce the density of block to a considerable extent.

In framed structure the principle function of wall is that of cladding. Hence light weight blocks will reduce the dead load of masonry on beam, giving light section of beam and blocks thereby saving in construction material resources.

Keeping this in view an experimental study has been carried out to test the performance of saw dust in cement sand create blocks. Effect of type of curing on compressive strength, density etc. have been carried out on various proportions of cement and ordinary sand partially replaced with varying % of saw dust by weight. Blocks of 100* 100* 100 mm are considered for test report.

The result of the various tests are sufficiently encouraging and author suggest to manufacture sandcrete block prepared in proportion of 1:6 cement: (85% sand +15% saw dust)since compressive strength for this ratio is found to be 4.5 N/MM^2 under gunny bag curing condition and provides optimum & desired result.

Keyword: *- Saw dust, sandcrete blocks, compressive strength, water cement ratio, Density.*

I. INTRODUCTION

India is experiencing an unprecedented growth of its urban center due to its developing economy and industrialization. The characteristic feature of urbanization has been heavy concentration of urban population in large cities demanding economical and efficient housing layout with vertical expansion in short period.
The rapid progress and research over recent past, leads the engineers to accept framed structures as against conventional load bearing structures
In frame structure walls are simply to serve as a screen for privacy of various rooms. They support their self weights only. Hence in such structures for masonry component low density low strength material can be used to reduce dead load.
The higher density conventional concrete blocks gives heavy self weight of masonry, thereby increasing the cost of frame structure. Mud bricks consumes fertile soil as also wood for burning bricks exhausting CO2 thereby creating environmental pollution issues.
Saw dust is industrial waste material which is obtained from sawdust refuse dump from timber shade & saw mills, in various shapes and sizes as shown in fig. 1. This main by product of saw mills, unless reprocessed in to particle board, are burned in a saw dust burner and are use to make heat for other milling operation, saw dust may collect in pipes and add harmful leachates in to local water systems, creating an environmental hazard. In India proper utilization of saw mill waste has not been given due attention. This saw dust there by constitutes an environmental nuisance as they form refuse heaps in the premises of saw mills and shades. Similarly sand is naturally occurring granular material composed of finely divided rock and minerals particles obtained from Perennial River. Huge consumption of sand in concrete structures also facing a acute shortage of sand. According to the environmentalist removal of sand from river may create environmental problems in future to come.

Fig. 1 : Sawdust particle Size and shape

Density of saw dust varies from 650 kg/m^3 to 1650 kg/m^3. if this is used partially in manufacturing the morter blocks as a replacement to sand can reduce the density to considerable extent. [1]

Compressive strength of blocks is a measure of their resistance to load application when placed in the crushing machine. I.S./ B.S recommends 3.45 N/mm^2 mean strength of 2.59 N/mm^2 lowest individual strength.[2] No. of research have been carried out on sawdust and agricultural waste to provide solution of getting low cost masonry blocks.

S.T. Tyagher,(2011) used saw dust ash to partially replace cement in the production of sandcrete hollow blocks.[3]

According to Adebakin I. H. (2012) The percentage replacement of sand should not be 10 % to achieve better results in production of sand create blocks. [4]

L.O.Ettu,(2013) investigated the variation of strength of OPC – RHA- SDA cement composites with mix proportion and found that for all percentage replacement of OPC with RHA-SDA at 28 and 50 days of curing at a given water cement ratio, the compressive strength increased with leanness of mix up to some level of leanness after which the strength reduced.[5]

Keeping all the above issues in mind object of the study was to

i. Investigate the performance of saw dust as partial replacement of sand in manufacturing cement sandcrete blocks in order to reduce overall construction cost and to minimize the environmental issues created due to excessive use of sand
ii. To suggest a rational proportion of cement: sand: sawdust: w/c ratios based on experimental observation which will effectively produce light weight low cost sand create blocks.

Various test carried out are cube compressive strength for various proportions, density relationship, water absorption etc.

However, fire resistance, weather, resistance, thermal and sound insulation though important are beyond the scope of this study and needs separate investigation.

II. MATERIALS & METHOD

The materials used to manufacture light weight cement sandcrete mortar block consist of

i. Cement (OPC)
ii. Local sand (fineness modules 3.69)

iii. Sawdust (mix of teak, nim, babool and mango and other species trees etc.) obtained from saw mills of Pusad (India) town (fineness modules 3.63.)

100x100x100 mm solid blocks were produced under laboratory condition. The mix ratio used was 1:4 to 1:8 with different replacement percentage of sand with saw dust. For each replacement percentage 30 blocks sample were casted. The replacement percentage and water cement ratio to make workable mix at each level used is shown in table 1.

Mixing: - The required quantities of material were weighted out as per proportions and mixing was done as per IS specification. Drum type mixer was used for mixing the material.

Moulding: - Casting was affected as per IS specification and compacted with the help of electrically operated vibrating machine. Size of block used was 100mm* 100mm. various mix proportions providing (cement: fine aggregate (sand + sawdust) tested were:

1:4 (0%, 5%, 10%, 15% & 20% sawdust replacement)
1:6 (0%, 5%, 10%, 15% & 20% sawdust replacement)
1:8 (0%, 5%, 10%, 15% & 20% sawdust replacement)

Curing: Specimens were divided into two sets for curing under sprinkling method and wet gunny bag method and was affected up to 6 days, 13 days & 27 days, for testing the blocks for 7 days, 14 days & 28 days. De molding was affected after 24 hours Specimen containing higher replacement % of sawdust, the mould bases were left a little longer period.

Testing: - Blocks were tested for compressive strength separately and density of block at7 days, 14 days and 28 days. Effect of type of curing on compressive strength, effect of sawdust on water observation % has also been tested.

Materials used for preparing sandcrete blocks were tested as per IS specification and following are the observations.

a. Fineness modulus of saw dust was found to be 3.69.
b. Fineness modulus of sand was found to be 3.63.
c. Moisture content of sawdust was found to be 9.3% which is within the permissible limit.
d. Silt content in local sand was found to be only 3%.

Curing and its types plays vital role on the effect of compressive strength. The main objective of curing is to keep concrete / mortar saturated or nearly saturated so as to support the hydration of cement, eliminating problem likes plastic shrinkage cracking.[6] The cement sandcrete blocks with varying percentage replacement of sand with sawdust under, Sprinkler curing and Gunny bag curing are tested for compressive strength at 7,14 and 28 days.

III. RESULT AND DISCUSSION

The variation of compressive strength with curing age for different cement sand ratio with partially replacement of sand with saw dust under above curing conditions are presented in Table 1. The result of compressive strength of cement sandcrete blocks and its trend with reference to proportion, age of curing and type of curing are represented in fig. 2 to7.

Table 1: Compressive strength on various proportions of cement :Sand: Saw dust.

Sr.	Proportions				Compressive strength N/mm^2			Type of curing
	Cement	Sand % + sawdust %		w/c Ratio	7 days	14 days	28 days	
	1:4							
1	1	4 (100%)	0%	0.5	7.68	8.00	8.00	S.C.
					9.34	9.00	1.30	G.C.
2	1	4 (95%)	5%	0.6	7.10	7.00	8.00	S.C.
					9.01	9.00	9.00	G.C.
3	1	4 (90%)	10%	0.6	7.00	7.00	7.00	S.C.
					8.30	9.00	9.30	G.C.
4	1	4 (85%)	15%	0.7	5.80	5.00	5.00	S.C.
					6.30	7.00	7.00	G.C.
5	1	4(80%)	20%	0.87	4.50	5.00	5.00	S.C.
					6.00	6.00	6.00	G.C.
	1:6							
6	1	6 (100%)	0%	0.5	5.00	5.00	6.50	S.C.
					5.00	6.00	6.50	G.C.

7	1	6(95%)	5%	0.6	5.00	5.00	5.00	S.C.
					5.00	5.00	6.00	G.C.
8	1	6 (90%)	10%	0.7	4.00	4.00	5.00	S.C.
					5.00	5.00	5.00	G.C.
9	1	6 (85%)	15%	0.7	2.00	2.00	3.00	S.C
					3.00	4.00	4.00	G.C.
10	1	6 (80%)	20. %	0.8	1.00	2.00	1.00	S.C.
					2.00	2.00	2.00	G.C.
	1:8							
11	1	8 (100%)	0%	0.6	2.00	2.00	2.00	S.C.
					2.00	2.00	2.00	G.C.
12	1	8 (95%)	5%	0.7	1.00	1.00	1.00	S.C.
					1.00	1.50	2.00	G.C.
13	1	8 (90%)	10%	0.8	1.00	1.00	1.00	S.C.
					1.00	1.50	1.00	G.C.

❖ S.C. – Sprinkler curing, G.C. – Wet Gunny bag curing.

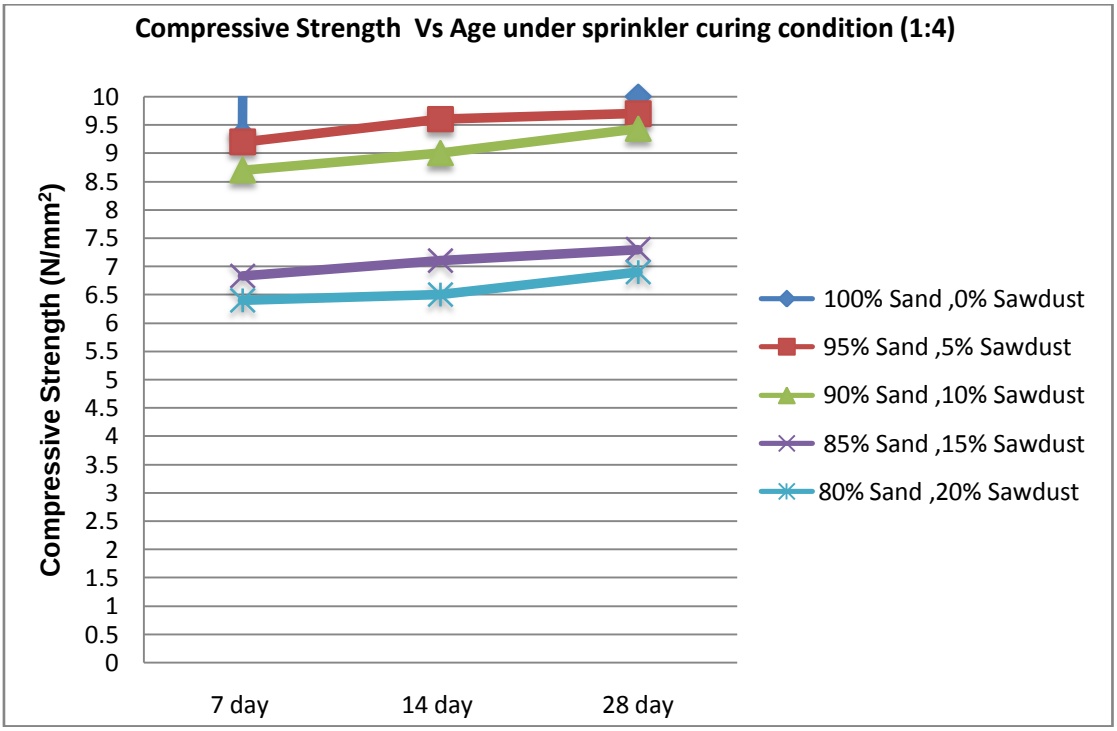


Fig. 2: Compressive Strength Vs Age under sprinkler curing condition (1:4)

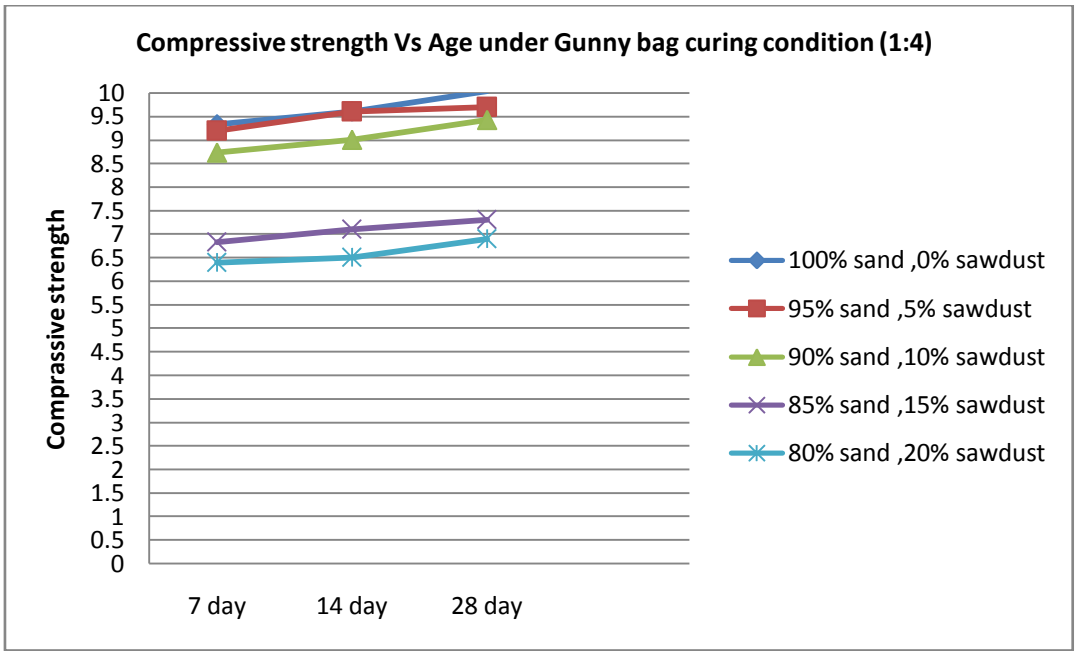


Fig. 3: Compressive strength Vs Age under Gunny bag curing condition (1:4)

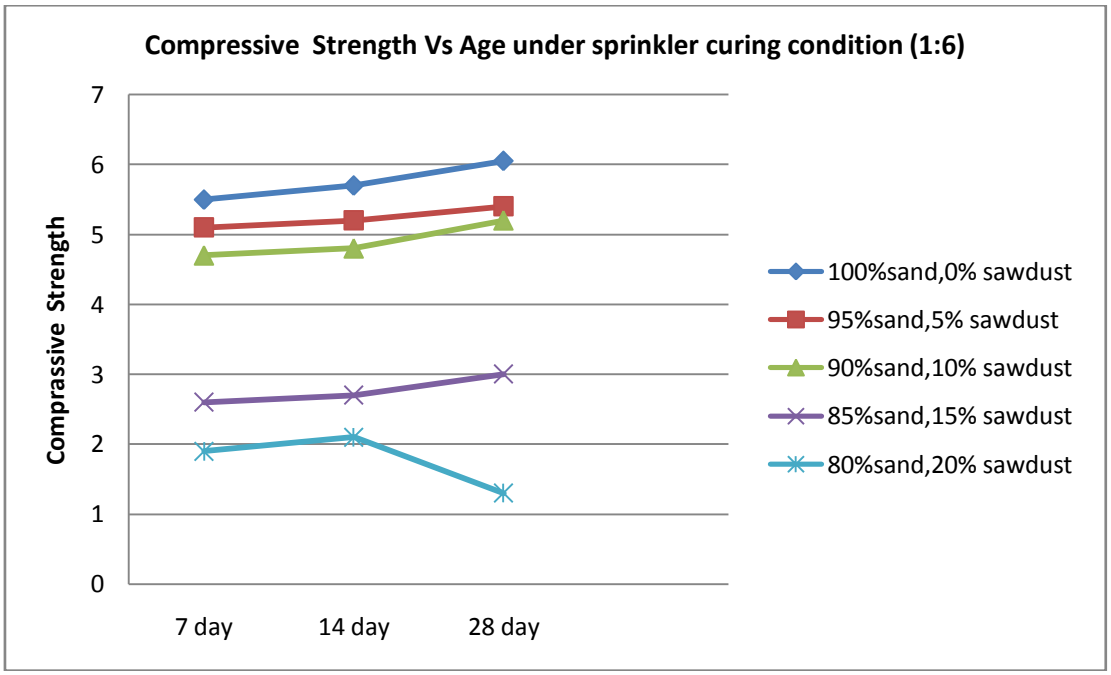


Fig. 4: Compressive Strength Vs Age under sprinkler curing condition (1:6)

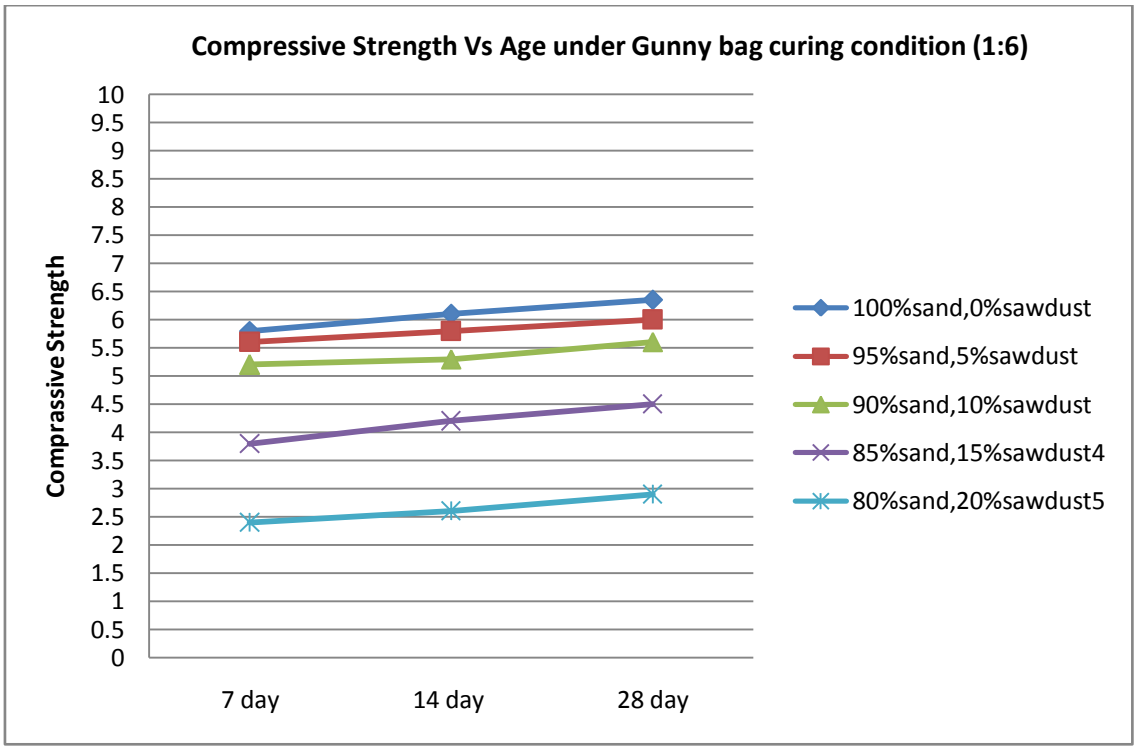


Fig. 5: Compressive Strength Vs Age under Gunny bag curing condition (1:6)

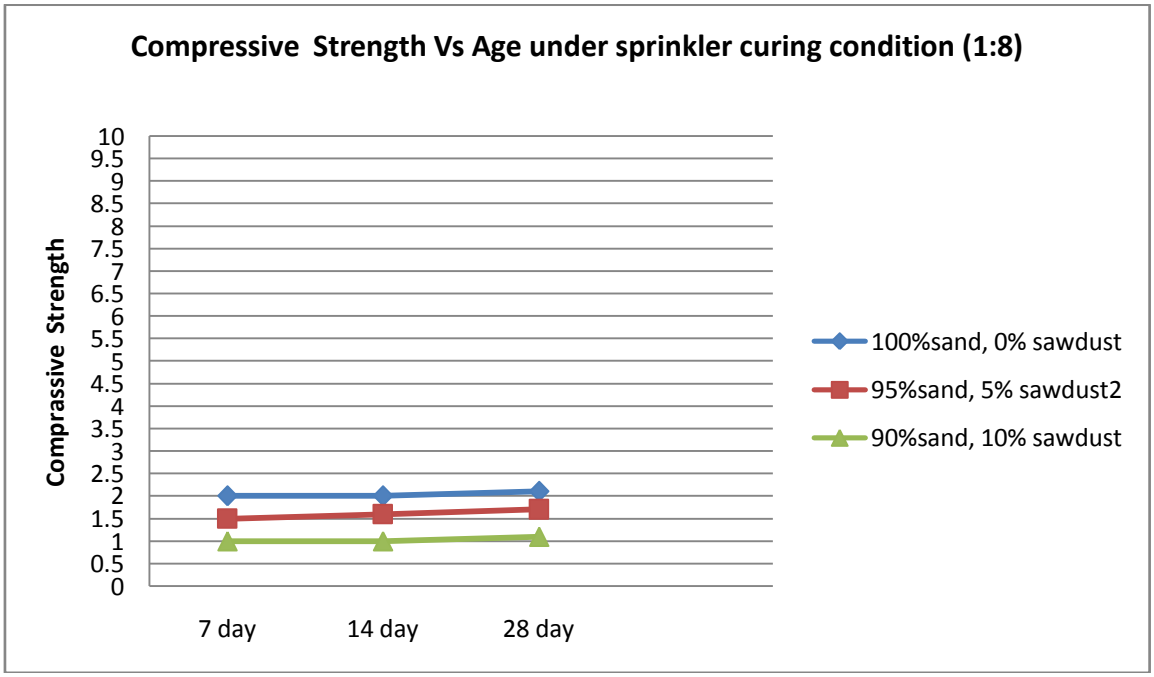


Fig. 6: Compressive Strength Vs Age under sprinkler curing condition (1:8)

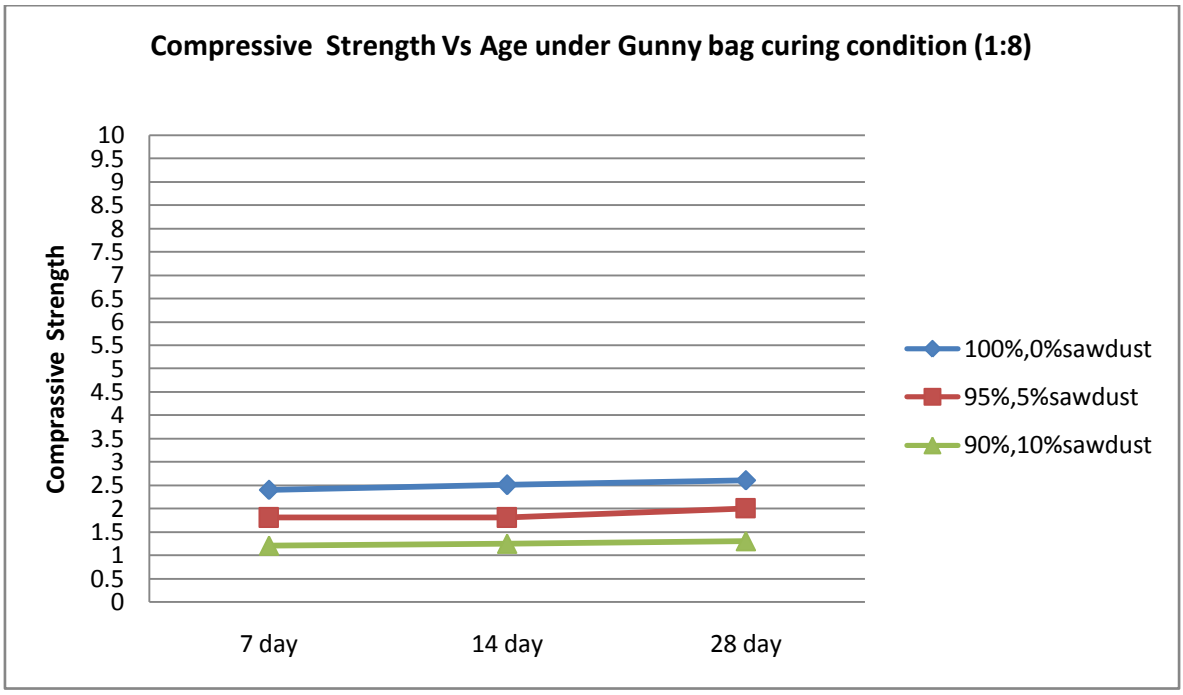


Fig. 7: Compressive Strength Vs Age under Gunny bag curing condition (1:8)

IV. DENSITY

Density depends upon the sand and sawdust ratio. It is observed that density decreases with increase in percentage saw dust in sandcreate blocks. The variation of density for varying percentage of saw dust replacement is presented in Table 2 and partial replacement of sand, with sawdust has a significant effect on the density of mortor. For zero percentage replacement density remain constant for different percentage of cement, sand, however for more % of sawdust replacement density reduces significantly. The trend is shown in Fig. 8

Table: 2 Density – Sawdust content relationship.

Sr.no.	Proportions			Density kg/m^3		
	Cement	Sand	%sawdust	7 days	14days	28days
	1:4					
1	1	100%	0%	2400	2400	2400
2	1	95%	5%	2300	2200	2100
3	1	90%	10%	2200	2100	2000
4	1	85%	15%	2100	2000	1950
5	1	80%	20%	2000	1900	1800
	1:6					
6	1	100%	0%	2400	2400	2400
7	1	95%	5%	2400	2300	2200
8	1	90%	10%	2200	2150	2100
9	1	85%	15%	2200	2100	2000
10	1	80%	20%	2000	1900	1800
	1:8					
11	1	100%	0%	2400	2400	2400
12	1	95%	5%	2400	2350	2300
13	1	90%	10%	2300	2200	2100
14	1	85%	15%	2200	2100	2000

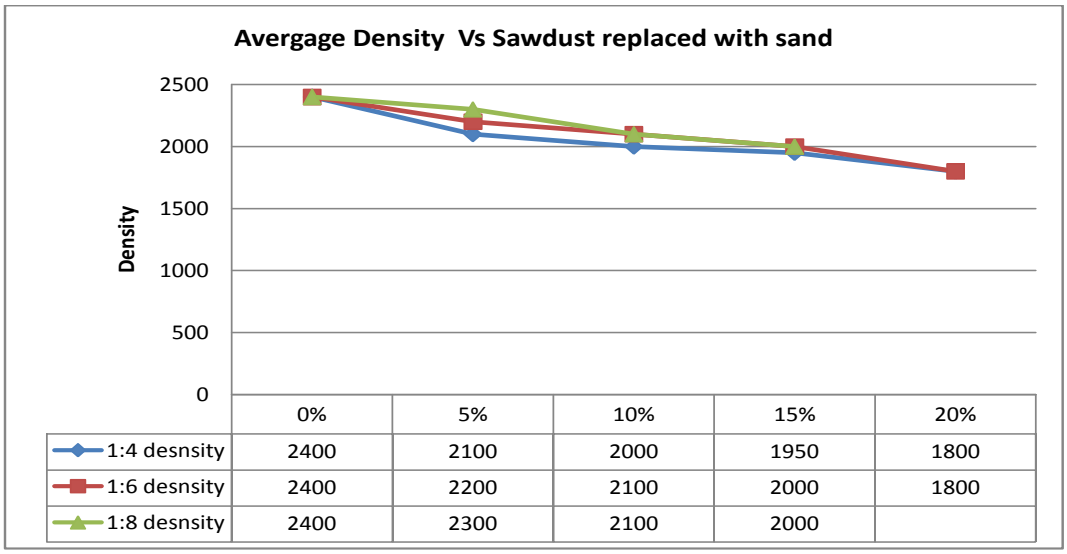


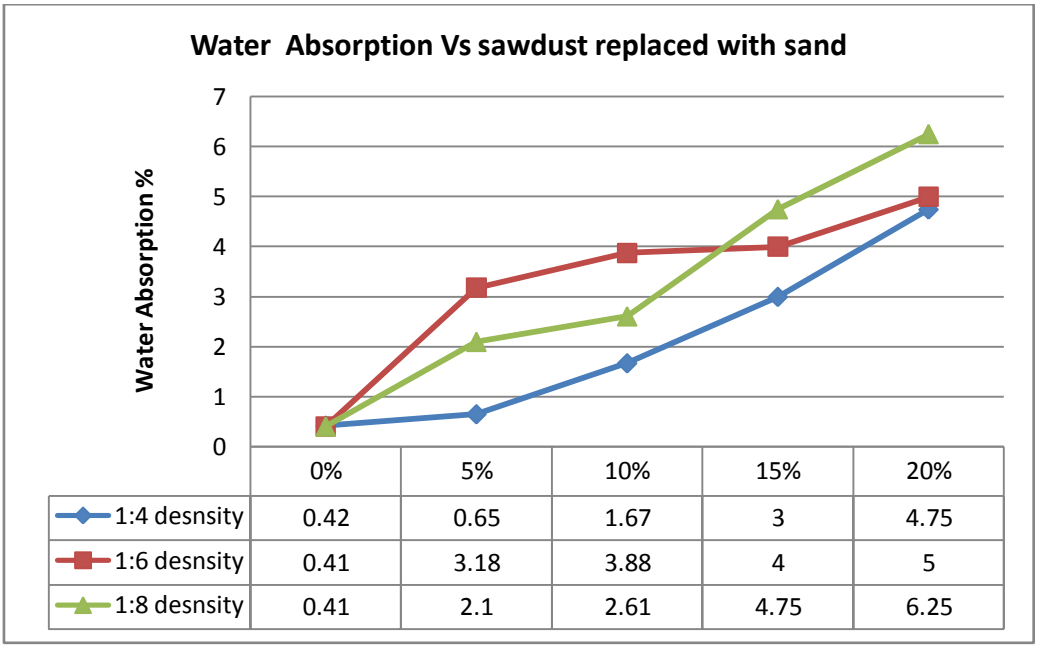
Fig. 8: Average Density Vs Sawdust replaced with sand

Water Absorption:-

Sawdust is more susceptible to moisture and hence water absorption test on each blocks was carried at 28 days and the result are presented in Table 3 and water absorption trend is represented in Fig. 9. For higher % of sawdust replacement, water absorption increases significantly. However up to 20% replacement water absorption is within reasonable limit.

Table 3: Water absorption of sawdust sandcrete block.

Sr.no.	Proportions			Water absorption(%)
	Cement	Sand	Saw dust	
	1:4			
1	1	100%	0%	0.42
2	1	95%	5%	0.65
3	1	90%	10%	1.67
4	1	85%	15%	3.00
5	1	80%	20%	4.75
	1:6			
6	1	100%	0%	0.41
7	1	95%	5%	3.18
8	1	90%	10%	3.88
9	1	85%	15%	4.00
10	1	80%	20%	5.00
	1:8			
11	1	100%	0%	0.41
12	1	95%	5%	2.10
13	1	90%	5%	2.61
14	1	85%	10%	4.75
15	**1**	80%	**15%**	**6.25**



	0%	5%	10%	15%	20%
1:4 desnsity	0.42	0.65	1.67	3	4.75
1:6 desnsity	0.41	3.18	3.88	4	5
1:8 desnsity	0.41	2.1	2.61	4.75	6.25

Fig. 9: Water Absorption Vs sawdust replaced with sand

V. ANALYSIS OF RESULT AND DISCUSSION

To introduce the use of sawdust in sandcrete blocks, the experimental analysis has been carried out. All experimental data and their results has been presented in the form of Tables and Graphs.

The Table 1 and typical nature of graph shown in Fig. 2 to 7 shows that as the percentage of sawdust increases, there is reduction in compressive strength significantly. As the study emphasizes on the partition wall of the framed structure, the reasonable low compressive strength blocks can also be used in the construction work. The behavior of block in compression as shown in fig. 2 to 7 reveals that compressive strength is more under gunny bag curing as compared to sprinkler curing. This may be due to the fact that, the gunny bag provides higher range of hydration to the block, that lead to desirable results. .

The average value of the strength required for partition wall varies from 3 to 5 N/mm^2 [2]. It is worth noting here that the gunny bag curing to 1:6 (1 part of cement to 6 part (85% sand + 15% S.D.)) provides sufficient compressive strength (4.5.N/mm^2)to meet practically any requirement in the partition wall construction in framed structure multistoried building.

Density analysis shows that as % of sawdust increases, the density is greatly reduced. The results are shown in Table 2. As sawdust % increases in the sandcrete blocks density of the mortar decreases. The proportions of 1:6 cement and sand with 15% replacement of sawdust the observed valued of density is 2000 kg/m^3.

The absorption of water to some extent is appreciable and advisable, but excessive of it causes various defects in the block. Seepage of rain water, shrinkage of block after drying, thus cracking of blocks, opening of the joints are few points to be taken in to consideration. The addition of sawdust to the block rises the limit of its water absorption to significant extent. Test results are mentioned in Table 3. Experimental results show that water absorption % of various proportions of cement, sand for a various proportion of sawdust % ranges from 0.41% to 6.21%. The block without the sawdust has not shown any change in the absorption capacity with change in the proportion of cement, sand. It is noted that it is the % of sawdust causing the increase in water absorption capacity and not the proportion of cement: sand. For 1:6 cement and sand with 15% sawdust, water absorption capacity was found to be only 4%, which is within permissible limit.

As compared to conventional concrete blocks, 15 to 20% saving in terms of cost of material is possible if saw dust sandcrete blocks are used as masonry material in frame structure building .

VI. CONCLUSION

The objective of this study was to focus the attention on performance of sawdust in sandcrete blocks in the construction.

Detailed study was carried out and experimental work was done. Final conclusions of the study are as below.

1. Compressive strength of the block is the major factor to be taken into account for the construction purpose. It varies with the addition of the sawdust. As the present study emphasizes on the partition wall of the framed structure, so the reasonable strength of the block is sufficient. The 1:6 cement sand mix. with 15% sawdust

replacement gives strength of 4.5 N/mm^2 /cm^2 which is reasonable and economical to be used for the partition walls in frame structure.

2. Density of block reduces with increase in the % of sawdust. 1:6 cement sand with 15% sawdust replacement is found to be suitable from the point of view of strength as well as density, Since for this ratio density is 2000 kg/m$^{3.}$
3. Water absorption capacity increases with increase % of sawdust. Larger absorption of water causes the reduction in the strength. However for 1:6 proportions with 15% sawdust replacement, water absorption found to be within reasonable limit.
4. Two types of the curing method were adopted for the experimental work. (Sprinkler & gunny bag curing). The result of latter method of curing was appreciable. This was due to the fact that sawdust contained blocks required light but regular moisture content for hydration purpose.

It was unpresidently noted that complete submergence provided negligible strength. This was due to fact that sawdust caused more voids in the block thus rejecting the cement from it.

It is observed that the result of the tests are sufficiently encouraging to advocate a full scale production of sawdust sandcrete blocks with 1:6 cement sand with 15% sawdust replacement for use in masonry work having its own advantages in terms of thermal property too. The saving in terms of materials are appreciable.

Fire proof, thermal resistance properties, quality of saw dust and its effect on compressive strength, bending strength, statics hardness and shear strength require further study. Scope of the study can further be extended on hollow sandcrete block.

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Evaluation of properties of Self-Compacting Concrete specimenshaving Rice Husk Ash and Shell Lime Powderas fillers

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Abstract: *- Self-CompactingConcrete (SCC) isthe one thatcanbeplaced in the form and compactedunderitsownweightwithlittle or no vibration effectwithsuitable bond to behandledwithoutsegregation or bleeding. The highlyfluid nature of SCC makesitsuitable for placing in difficult conditions and in sections withcongestedreinforcement.SCCusuallyrequireshighpowder content and lesscoarseaggregates. This studyhighlights the initial results of a researchprojectaimedatproducing and comparing SCCincorporatingRiceHuskAsh (RHA) and Shell Lime Powder (SL), bothlocallyavailablemineraladmixtures,as an additionalcementingmaterial, in terms of itspropertieslike Compressive strength, Split Tensilestrength and FlexuralStrength. The freshSCCsweretested for fillingability (Slump flow), passing ability (L box) and segregationresistance.*

Keywords: *- Self-Compacting Concrete, Rice Husk Ash, Shell Lime Powder, Split Tensile strength, Compressive strength, Flexural Strength, Locally available mineral admixtures, Modified Nan Su method*

I. INTRODUCTION

Self-Compacting Concrete (SCC) was developed in Japan during the later part of the 1980s to be mainly used for highly congested reinforced structures in seismic regions. The main characteristics of SCC are the properties in the fresh state. The mix design is focused on the ability to flow under its own weight without vibration, the ability to flow through heavily congested reinforcement, and the ability to retain homogeneity without any segregation.

SCC consists of the same materials as of the conventional concrete, i.e., cement, fine aggregates, coarse aggregates, and water. But it also contains additional materials of chemical and mineral admixtures. SCC contains less coarse aggregates so as to minimize the blockage of passing through spaces between steel bars. This results in higher cement content which is expensive and causes temperature rise due to heat of hydration. Therefore, cement should be replaced by high volume of mineral admixture like Rice Husk Ash and Shell Lime Powder.

Rice husk ash (RHA)has been used as a highly reactive pozzolanic material to improve the microstructure of the interfacial transition zone between the cement paste and the aggregate in SCC. Research shows that the utilization of rice husk ash in SCC mix produced desired results, reduced cost, and also provided an environment friendly disposal of the otherwise agro-industry waste product [1].

Before cement was developed, lime was used asbinding material in the casting of lime concrete. This was obtained from naturally occurring lime stone deposits in the earth's crust. The naturally occurring resource is depleting fast and hence for sustainable development it needs to be conserved. Naturally occurring mollusks like shell fish in the oceans have protective shells that contain $CaCO_3$ or lime. This resource can be tapped, as an alternative for the limestone deposits [2].

II. EXPERIMENTAL PROCEDURE

2.1 Materials

2.1.1 Cement: Ordinary Portland cement of 43 grade is used in this experiment, Table 1 shows the test results on cement.

Table 1: Test results on cement

Test	Results
Normal Consistency	30%
Specific Gravity	3.15
28-days Compressive Strength (MPa)	45.79
Setting Time (minutes)	
1. Initial	58
2. Final	185

2.1.2 Rice Husk Ash (RHA): Rice husk ash is produced by incinerating the husks of rice paddy at a temperature range of 500° to 800°C. It has 90% to 95% of amorphous silica, which is the reason why it has excellent pozzolanic properties. Specific gravity and normal consistency values are 2.13 and 36% respectively. Rice Husk is available in abundance locally inManipal, the coastal region of Karnataka, India [1].

2.1.3 Shell Lime (SL): Shell Lime powder is obtained by incinerating a combination of shell lime and coal in a furnace. It blends in the mix easily and forms a very good cohesive mix and also acts as a good viscosity modifier for fresh concrete paste. It is obtained from naturally occurringmollusks like shell fish in the oceans which have protective shells that contain $CaCO_3$. Specific gravity and normal consistency values are 3.09 and 49% respectively. Shell Lime is also locally available in abundance [2].

2.1.4 Aggregates: Gravels were used as coarse aggregates of uniform quality with respect to shape and grading having 12mm downsize. River bed sand of size less than 125 micron were used as fine aggregate [3], Table 2 shows the test results on aggregates.

Table 2: Test results on aggregates

Property	Results	
	Coarse Aggregate	Fine Aggregate
Bulk density (kg/m^3)	1402	1502
Specific Gravity	2.64	2.63

2.1.5 Super plasticizer (SP): It is a chemical compound used for increasing the workability of concrete mix without adding additional water. Cera Hyper plasticizer HRW 40 was used in the experiment.

2.1.6 Water: Water should be potable and free from alkalinity.

2.2 Mix Proportioning

The mixture proportion is one of the important aspects in SCC. So far the proper mix design procedure to get the proportion of all the ingredients in the SCC is not standardized. No method specifies the grade of concrete in SCC except the Nan Su method. The limitation of Nan Su method is, that it gives the required mix proportions for the grades which are not less than M50, this was observed during experimental work on normal grade of concrete in SCC (grade less than M50). An attempt has been made to modify the Nan Su method and obtain a mix design in normal grades with two admixtures (Rice Husk Ash & Shell Lime Powder). With all the two mineral admixtures incorporated, the compressive strength and flow properties of the SCC were studied [4], Table 3 shows the contents of all materials used in kg/m^3.

Table 3: Mix proportion in kg/m^3 of SCC.

Mix	Cement	RHA	SL	Coarse aggregate	Fine aggregate	Water	SP
SL based SCC	360.71	-	147.24	744	961	221.77	9.14
RHA based SCC	360.71	111.2	-	744	961	190.04	8.49

2.3 Tests Conducted

2.3.1 Fresh concrete tests: Rheological properties of the fresh concrete mixes were tested using theSlump flow apparatus, V-funnel, L- box and U-box, as per the EFNARC guidelines [5].

Slump flow test is done to assess the horizontal flow of concrete in the absence of obstructions. This also indicates the resistance to segregation. The higher the flow value, the greater is the ability to fill formwork under its own weight.

V-funnel test is conducted to determine the filling ability (flowability) of the concrete with a maximum size of aggregate being 20mm.

L-box test assesses the flow of concrete and also the extent to which the concrete is subjected to blocking by reinforcement.

U-box test is used to measure the filling ability of SCC.

Table 4 shows the rheological properties of the mixes, against the acceptance criteria of the tests as laid down by EFNARC [5].

The SCC mixes prepared were tested for filling ability (Slump flow and V-funnel) and passing ability (L-box and U-box). The test results satisfied the criteria laid down by EFNARC as seen from Table 4.

Table 4: SCC Acceptance Criteria& Rheological Properties of the mixes

Test	Unit	Acceptable Range of values	RHA based SCC	SL based SCC	Remarks
Slump flow	mm	650-800	710	670	Acceptable
V-funnel	sec	6-12	6.2	6.1	Acceptable
L-box	h_2/h_1	0.8-1.0	0.92	0.89	Acceptable
U-box (h_2-h_1)	mm	0-30	16	23	Acceptable

2.3.2 Hardened concrete tests:Compressive strength (cube size: 150mm side), Split Tensile strength (cylinder size: length 300mm and diameter 150mm), and Flexural strength (prism size: 100x100x500mm) were the tests included for both SCC mixes for a period of 7, 14, and 28 days of curing. The tests were carried out as per the relevant IS Codes [6, 7]. Table 5 shows the hardened concrete test results. Fig. 1 through Fig. 3 show the strength relation between SL based SCC and RHA based SCC in graphical form.

III. RESULTS AND DISCUSSIONS

Table 5: Test results on hardened SCC mixes

Strength (MPa)	Age in Days	SL based SCC	RHA based SCC
Compressive Strength	7	12.25	21.27
	14	20.06	28.34
	28	28.78	30.52
Split Tensile Strength	7	1.944	1.568
	14	1.89	1.797
	28	2.51	2.53
FlexuralStrength	7	1.48	3.92
	14	4.16	4.28
	28	4.87	4.31

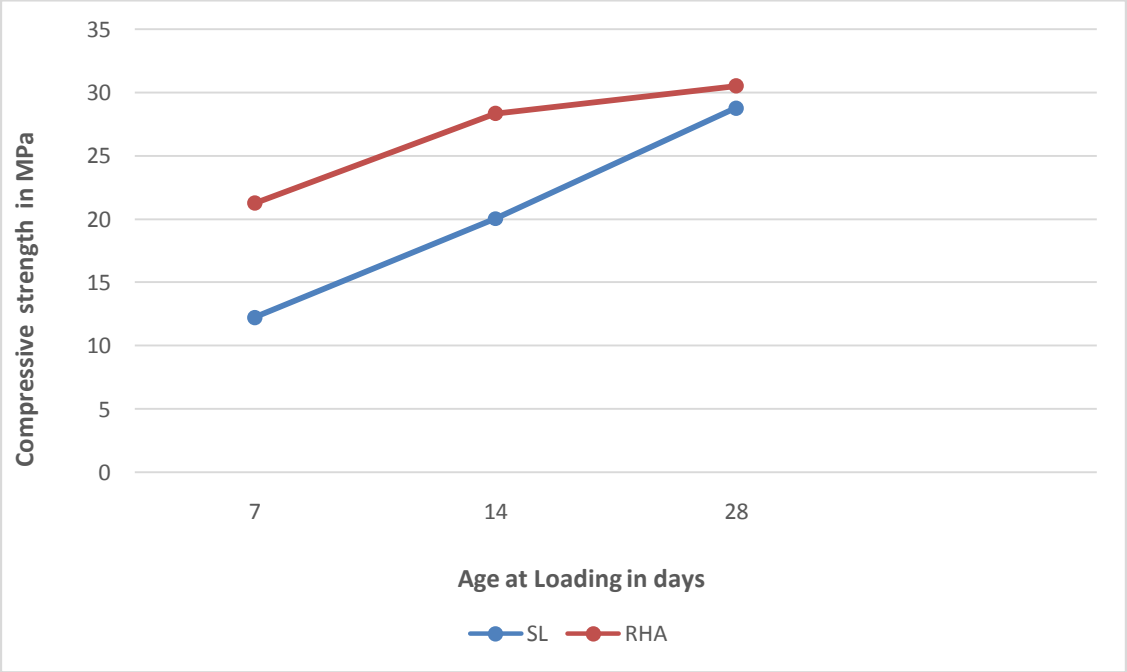

Fig.1. Compressive Strength v/s Age at loading

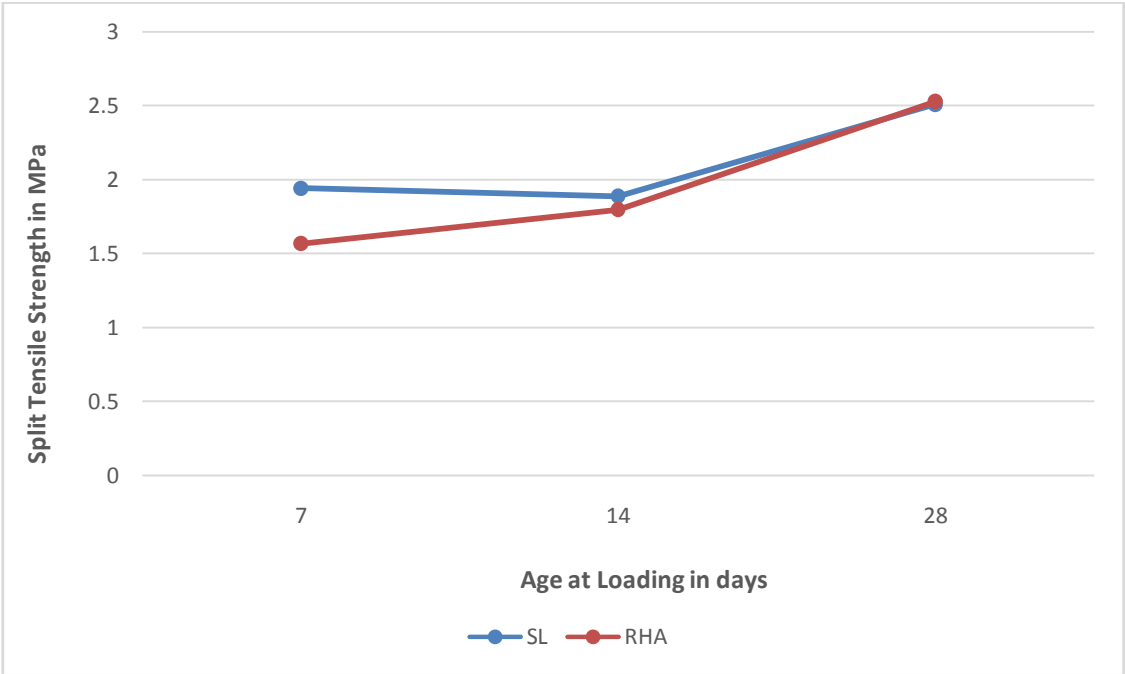

Fig.2. Split Tensile Strength v/s Age at loading

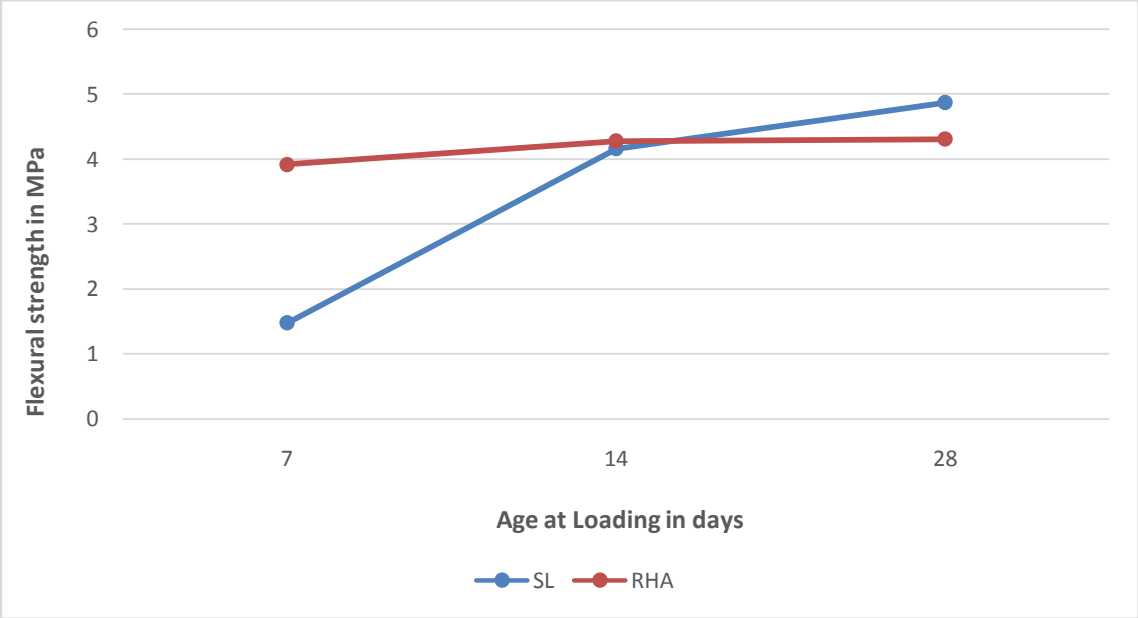

Fig.3. Flexural Strength v/s Age at loading

Compressive strength of RHA when compared to SL gave a higher strength by 73.6% for 7 days of curing. For 14 days of curing, the strength of RHA was 41.27% higher than that of SL. For 28 days of curing, the strength of RHA was 6.04% higher than that of SL.
Split Tensile strength of SL when compared to RHA gave a higher strength by 23.98% for 7 days of curing. For 14 days of curing, the strength of SL was 5.2% higher than that of RHA. For 28 days of curing, the strength of RHA was 0.8% higher than that of SL.
Flexural strength of RHA when compared to SL gave a higher strength by 164.8% for 7 days of curing. For 14 days of curing, the strength of SL was 2.88% higher than that of RHA. For 28 days of curing, the strength of SL was 13% higher than that of RHA.

IV. CONCLUSION

Based on EFNARC criteria for SCC, fresh and hardened concrete tests were conducted on both the specimens and satisfactory results were obtained. The Compressive strength of curing period of 28 days was found to be 6.04% higher in RHA when compared toSL.Split Tensile strength of RHA when compared to SL was higher by 0.8% for 28 days curing. Flexural strength though was higher by 13% in SL when compared to RHA for 28 days curing; it was observed that RHA had a much better strength when compared to that of SL as a whole.
Since RHA contains silica contents and SL contains calcite contents, the silica contents react better with cement compared to that of calcite contents, as cement contains lime, which in turn consist of calcite contents. Thus, this probably explains the higher strength in RHA when compared to SL.

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Case study on the profit margin model of multi-site testing technology for semiconductors.

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Abstract: - Profit is the main goal of every business. Hence, investment on technology in a manufacturing firm ultimately aims at improving manufacturing efficiency to reduce manufacturing cost, thereby contributing to the profit of a firm. In this research, the author studied multi-site testing technology in the semiconductor testing industry to determine the contribution of technological advancements to profit. A profit model was developed based on economic theory with multi-site testing variables. The multi-site technology employed in this work was the pick and place handler, which is a popular technological approach. Five multi-site configurations were applied. These configurations were single-site, quad-sites, octal-sites, ×16-sites, and ×32-sites. A hypothesis was analyzed by using one-way ANOVA.

Keywords: *-profit margin, multi-sites testing, cost of test, testing technology, theory of the firm*

I. INTRODUCTION

The selling price of computers has decreased by 47% over the past 20 years. Profit margin during this period was maintained by reducing fabrication cost. However, from early 2012 onwards (Bao, 2003), fabrication cost has ceased to be the deciding factor for profit margin in semiconductor manufacturing. Fabrication cost has been replaced by testing cost, as shown in Figure 1. The cost of testing increases with the number of transistors in each chip. Thus, testing cost should be reduced in the future. The selling price of electronic devices continues to decline, thereby hindering manufacturers from maintaining profit margins and remaining competitive in the market. Thus, testing cost has become a major concern requiring urgent attention.

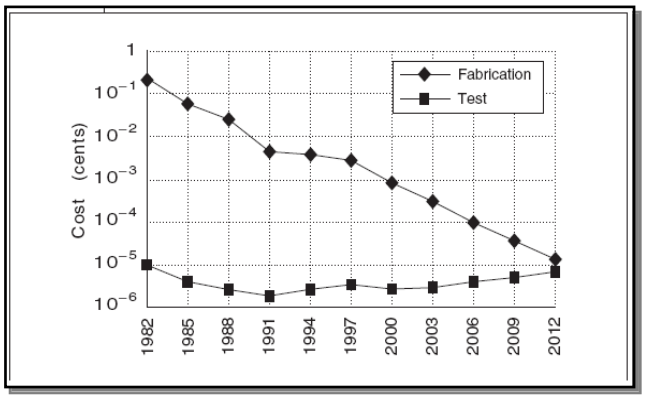

Figure 1 Cost of Testing a Transistor Approximates the Cost of Fabricating It (Bao G., 2003)

Consequently, a reduction in testing cost has become the common goal of semiconductor manufacturers worldwide. Failure to reduce testing cost can cause a semiconductor chip manufacturing company to lose its competitiveness in the market. An effective method by which to reduce testing cost is to decrease testing time. Decreasing testing time also increases testing throughput. To achieve this objective, the performance and speed of the test equipment have to be improved. Therefore, the chip-transfer time and chip-testing sequence should be developed to test semiconductor chips rapidly.

To improve the testing process, numerous new technologies have been developed. However, the advancement of technology increases capital investment in equipment. The failure of a new technology to provide the expected throughput outcome increases testing costs. Therefore, studying the efficiency of equipment in relation to capital investment is vital in ensuring that the semiconductor industry is geared toward the right direction and incurs lower costs in testing while maintaining adequate profit margins.

Numerous models for testing cost have been previously developed to calculate the capability of technology to increase testing throughput as well as to determine the actual cost involved in testing a semiconductor chip. However, these models do not consider profit margin in the calculation. Profit margin is crucial in determining the amount to spend on testing. Thus, this factor should be included in the calculation. The inclusion of profit margin in the calculation of testing cost determines the capability of the test equipment to achieve the expected testing cost. Therefore, as an initial effort to address the aforementioned research gap, this study presents a testing cost model that considers profit margin in the calculation.

II. DEVELOPMENT OF PROFIT MARGIN MODEL

Cost of Test Model

The cost-of-test model in this research was developed based on average cost theory, as shown in Equation 1. Average cost theory involves two elements: total cost and production output.

$$\text{Average Total Cost (ATC)} = \frac{\text{Total Cost (TC)}}{\text{Output (Q)}} \quad (1)$$

A. Total Cost

According to the average total cost theory, the total cost included of fixed cost and the variable cost. For the multi-sites testing aspect, the variables which affected the total cost are shown in table 1 as below.

i. Fixed Cost

Whereby the fixed cost included of equipment depreciation cost (Dep) which contain of the tester cost and the test handler cost. Equation 2 was developed to calculate the equipment depreciation cost which span over five years from it purchase value to zero-cost.

$$\text{Dep} = \left(\frac{\text{Tester Cost} + \text{Handler Cost}}{5} \right) \div 12. \quad (2)$$

Table 1: MULTI-SITES TESTING VARIABLE FOR TOTAL COST.

Total Cost	
Fixed Cost	**Variable Cost**
Depreciation Cost i. Tester Cost ii. Test Handler Cost	**Bad Parts Cost**
Direct Labor Cost i. Operator Salary ii. Technician Salary	
Overhead Cost i. Management Cost - Manager's salary - Supervisor's salary - Engineer's salary ii. Facility cost - Electricity cost, - compress air cost etc iii. Floor space cost iv. Maintenance cost - Wear and tear parts - Consumable parts etc v. Test accessories cost - Test socket/contactor - Test Load board	

The second variable which affecclted the fixed cost is the direct labor cost (DL). The direct labor (DL) cost is the monthly salary of employees who directly contributes to the production output, such as operators and technicians. Direct labor cost is expressed in Equation 3:

$$\text{Direct Labor Cost per month} = \left(\text{Operator salary per month} \times 3\right) + \left(\text{Technician salary per month} \times 1.5\right) \quad (3)$$

For the operator variable, each test-equipment setup requires one operator, and thus, three operators are needed each day to cover three production shifts. For one shift, only one operator is required. To standardize the equation for ease of understanding, three shifts are used in this study.

For the technician variable, one technician can support two test-equipment setups. Therefore, only a half the cost is needed per test-equipment setup. To cover three production shifts, only 1.5 technicians are needed.

Operator and technician wages are based on a report published by JobStreet.com. (Cited: 11 April 2012). In this study, the average wage is used as a reference for the aforementioned positions.

In addition, the Overhead (OH) cost is the cost incurred during production aside from equipment depreciation and direct labor costs. Overhead cost includes the following.

- Management Cost includes the monthly wages of the manager, supervisor, and engineer, which are considered as indirect labor costs. Wages data are based on a JobStreet.com report (cited: 11 April 2012). Equation 4 shows management cost calculation:

$$\text{Management cost} = \text{Manager's Salary} + \text{Supervisor's Salary} + \text{Engineer's Salary} \quad (4)$$

- Facility Cost is the monthly utility cost of electricity, compressed air, and so on.
- Floor-Space Cost (FPS) is the cost of the area occupied by the test-equipment setup. Equation 5 shows the calculation of floor space cost:

$$\text{FPS} = \left(\frac{\text{(Selling Price)}}{3000}\right) \text{X} \begin{matrix}\text{Test Equipment}\\ \text{floor space area}\\ \text{(Sq-Ft)}\end{matrix} \quad (5)$$

In this study, the calculation of floor-space cost is based on the Malaysian Government Valuation and Property Service Department Report 2011. The 2011 "Detached House Pricing" is adopted as a reference for calculating price per sq. ft. Test equipment setup floor space costs are then calculated as the X number of area sq. ft. needed multiplied by the per sq. ft. pricing, as shown in Equation 5.

- Maintenance Cost is the cost spent in one month to maintain the test equipment, such as wear-and-tear part cost, consumable part cost, and so on. The study estimates maintenance cost at 5% per year of the test equipment cost.
- Cost-of-Test Accessories includes the test contactor and load board, which are described as follows:
- Load Board/Probe Card is the electronic printed circuit board used for interfacing between the tester and the test handler.
- Test Contact Socket is the mechanism used to connect the semiconductor device to the load board.

ii. Variables Cost

Another factor identified as part of the total cost calculation that has an effect on the test yield is the variable cost. From the research point of view, the variable cost is categorized as a changeable cost because it is not fixed, and it will change when the testing yield is modified.

The variable cost that needs to be included is the bad-part cost based on the test cost model developed by Rivoire (2003). The bad-part cost is imperative in this research, particularly when dealing with multi-site configurations, because the developed model will be validated using this configuration. When changes are implemented during testing, they may affect the consistency of the testing yield, which depends on multi-site repeatability efficiency.

To include the bad-part cost into the total cost equation, an equation has to be derived to calculate the cost of bad parts. The first step in deriving the bad-part cost equation is to imply the appropriate equation that can calculate the quantity of bad parts. Equation 6 is derived for this purpose.

$$\text{Number of bad part} = \text{Total Input X } \left[100\% - (\text{Testing Yield})\right] \quad (6)$$

Based on Equation 6, total incoming chip quantity is multiplied by the bad part yield, which can be obtained by deducting the testing yield from 100%. The testing yield is the tested good part percentage that can be obtained from Equation 7:

$$\text{Testing yield \%} = \left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \text{ X } 100 \right) \quad (7)$$

Finally, to calculate the cost of the tested bad parts, the ASP of a particular type of semiconductor chip is multiplied with the number of bad parts obtained from Equation 6. Therefore, Equation 8 is derived to determine the total cost of tested parts.

$$C_{Pkg} = \text{ASP} \left[\text{Total Input X} \left(\text{ Bad part \% } \right) \right] \quad (8)$$

where:
- CPKg is the cost of bad parts;
- ASP is the average selling price;
- Total Input is the total input of semiconductor chips; and
- Bad Part % is the tested bad chips obtained by deducting the testing yield from 100%.

All costs have been discussed thoroughly to facilitate total cost calculation. Therefore, by putting together all the equations, Equation 9 is derived to demonstrate how the total cost has been integrated:

$$\text{Total Cost} = \text{Dep} + \text{DL} + \text{OH} + C_{Pkg.} \quad (9)$$

Another element incorporated in average cost theory for the developed model is production output. A detailed discussion of this element is provided in the following subsection:-

B. Production Output

Production output consists of three fundamentals: testing output (throughput), testing yield, and the equipment utilization percentage. Detailed explanations for these fundamentals are as follows.

$$UPH_{good} = \frac{3600 \text{ X N}}{((1\text{-MSE})(N\text{-}1)(t_1+i_1) + (t_1+i_1))} \text{ X } \left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \text{ X } 100 \right) \quad (10)$$

Equation 10 was developed to calculate the production throughput whereby the throughput obtained is the tested good product by take into account the testing yield whereby the testing yield mean that the percentage of tested good. The equation of testing yield % is shown in equation 7 in this paper.

The equation 10 was integrated with the Multi-sites efficiency (MSE) as well so that the comparison between the multi-sites versus the multi-sites efficiency (MSE) can be obtained, but in this paper will not analyze of this hypothesis and will reserve for next paper publication.

To integrate the MSE into the equation, the throughput equation from Evans (1999) as shown in equation 11 need to further enhance. Following discuss step by step on how the MSE was integrated into the throughput equation.

$$UPH_{insertions} = \frac{3600 \text{ x n}}{t_{ms} + i_{ms}} \quad (11)$$

where:
- tms is the multi-site test time, that is, the time spent to complete the testing of a semiconductor chip.
- ims is the multi-site indexing time, that is, the semiconductor chip exchange time within the tested chip replaced with a new untested chip.
- n is the number of test sites, that is, the number of semiconductor chips tested in a single contact.

To achieve the integration with the MSE, the throughput equation developed by Evans (1999), shown as Equation 11, is enhanced by integrating the MSE model developed by Kelly (2008). The MSE proposed by Kelly is presented as Equation 12:

$$MSE = \left(1 - \frac{\Delta t}{\Delta N(t_1)}\right).100\% \qquad (12)$$

where:
- Δt is the change in testing time between single-site and multi-site testing; and
- ΔN is the number of different test sites between single-site and multi-site testing.

Equation 12 is further derived, as shown in Equation 13.

$$MSE = \left(1 - \frac{(t_{MS} - t_1)}{(N-1)(t_1)}\right).100\% \qquad (13)$$

where:
- t_{MS} is the multi-site test time, and t1 is the single-site test time; and
- N is the number of test sites for multi-site testing.

The test handler affects testing throughput. Therefore, the test handler indexing time has to be included as part of the MSE equation. In doing so, Equation 14 is derived by including the indexing time (i), as follows:

$$MSE = 1 - \left(\frac{((t_{MS}+i_{MS}) - (t_1+i_1))}{(N-1)(t_1+i_1)}\right).100\% \qquad (14)$$

For the integration of the equations to work, one must have prior understanding of the relationship between the throughputs and MSE. To determine the relationship between MSE and multi-site, the variables of MSE, which is related to the throughput, need to be understood. Equation 11 and Equation 14 show that the multi-site test time (t_{ms}) and multi-site indexing time (i_{ms}) are common variables in both equations.

In Equation 14, t_{MS} and i_{MS} represent multi-site test time and indexing time. Therefore, to clearly derive the relationship between t_{ms} and i_{ms} in relation to MSE, the integration process shown in Figure 2 is carried out.

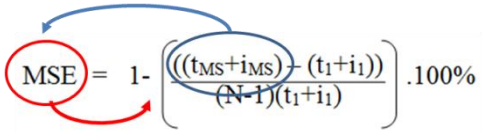

Figure 2 Deriving the Relationship between t_{ms} and i_{ms} with MSE

As Figure 2 illustrates, t_{ms} and i_{ms} move to the left side of the equation, whereas MSE moves to the right side. The final computation for the equation of t_{ms} and i_{ms} in relation to MSE is derived and shown in Equation 15.

$$(t_{MS} + i_{MS}) = (1\text{-}MSE)(N-1)(t_1+i_1) + (t_1+i_1). \qquad (15)$$

Finally, Equation 15 is integrated into Equation 11 to obtain the computation for testing throughput, which includes MSE as part of the calculation. Figure 3 below shows the computation of the integration, and the

complete integration is illustrated in Equation 16:

$$UPH_{insertions} = \frac{3600 \times n}{t_{ms} + i_{ms}}$$

$$(1\text{-}MSE)(N\text{-}1)(t_1+i_1) + (t_1+i_1)$$

Figure 3 The Computation of the Integration of Equation 15 into Equation 11

$$UPH_{insertions} = \frac{3600 \text{ X } N}{((1\text{-}MSE)(N\text{-}1)(t_1+i_1) + (t_1+i_1)),} \qquad (16)$$

where:
$UPH_{insertions}$ are represented by the testing output in one hour.

C. Equipment Utilization (U)

Equipment utilization percentage refers to the percentage by which the test equipment is used in producing output. When the test equipment is 100% utilized, then no cost is lost. The aforementioned cost refers to the total cost, as indicated in Equation 9. When equipment utilization achieves a higher percentage, the cost becomes cheaper. By contrast, when utilization percentage begins to decrease, then the cost increases (Horgan, 2004).

Given that equipment utilization percentage affects the total cost, then the former must be included in Equation 9. Therefore, the total cost equation, which involves equipment utilization percentage, is depicted in Equation 17.

$$\text{Total Cost per month} = \frac{(Dep + DL + OH + C_{Pkg})}{U} \qquad (17)$$

The total cost obtained from Equation 17 is the monthly testing expenditure. However, the testing throughput is calculated based on the hourly production output. Therefore, to obtain the total cost per hour, Equation 17 has to be further derived, as shown in Equation 18.

$$\text{Total Cost per hour} = \frac{\left(\frac{Dep + DL + OH + C_{Pkg}}{729.6}\right)}{U} \qquad (18)$$

Where the total cost is divided by 729.6 to obtain the hourly cost; and 729.6 is the total number of production hours in one month.

After all the equations and variables for average cost theory are defined, the next step is to integrate all the equations into average cost theory to derive the cost of the model. The integration is illustrated in Figure 4:

$$\frac{\left(\frac{Dep + DL + OH + C_{Pkg}}{729.6}\right)}{U}$$

Equation 18

$$\text{Average Total Cost (ATC)} = \frac{\text{Total Cost (TC)}}{\text{Output (Q)}}$$

Equation 2.1

$$\frac{3600 \text{ X } N}{((1\text{-}MSE)(N\text{-}1)(t_1+i_1) + (t_1+i_1))} \text{ X } \left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \text{ X } 100\right)$$

Equation 10

Figure 4 The Integration of Equations 18 and 10 into Equation 1.

As shown in Figure 4, the average cost in Equation 1 is integrated with Equation 18, which is the total cost in one hour, and Equation 10, which is the total number of good chips tested in one hour.

The final cost of test model is then integrated, as shown in Equation 19:

$$CPU_{GOOD} = \frac{\left(\frac{\left(\frac{Dep + DL + OH + CPkg}{729.6}\right)}{U}\right)}{\left(\frac{3600 \times N}{((1-MSE)(N-1)(t_1+i_1) + (t_1+i_1))}\right) \times \left(\frac{Total\ Good\ Device}{Total\ Incoming\ Device} \times 100\right)} \quad (19)$$

Cost of Test Profit Model

Following further discuss of the cost of test into the Profit Theory whereby the Economic Profit Theory is shown in equation 20:

$$Profit = Total\ Revenue\ (TR) - Total\ Cost(TC) \quad (20)$$

As shown in Equation 20, two elements are incorporated in profit calculation, namely, total cost and total revenue. Total cost can be derived from the cost of test model (Equation 19). Total revenue is discussed in this section. To clearly explain the profit margin model, the discussion is divided into three subsections. The first subsection explains how total cost is derived from Equation 19. A discussion of the total revenue follows in the second subsection. The final section discusses the development process of the cost-of -test profit margin model.

i. Total cost from Equation 19

As indicated in ***Equation 1***, the total cost is one of the elements of the average cost. The average cost equation is used to derive the relationship of the total cost with the cost of test because the cost of test equation is based on average cost theory. The derivation process is shown in Figure 5.

$$Average\ Total\ Cost\ (ATC) = \frac{Total\ Cost\ (TC)}{Output\ (Q)}$$

Figure 5 Derivingthe Total Cost through Equation of Average Cost.

As shown in Figure 5, to derive the total cost equation through average cost theory, the output has to move from the left side of the equation to its right side, and the dividend becomes the multiplier. The total cost formula in the relation to the average is derived and shown in ***Equation 21***.

$$Total\ Cost = Average\ Total\ Cost \times Output. \quad (21)$$

As discussed earlier, the cost of test is equal to the average cost; therefore, Equation 21 is further derived and expressed as Equation 22.

$$Total\ Cost = Cost\ of\ Test \times Output. \quad (22)$$

The total cost is equal to the cost of test multiplied by the production output, which, in this case, is the testing throughput. The variables in Equation 19 and Equation 10 are integrated with Equation 22, as illustrated in Figure 6, and further derived as shown in Equation 23.

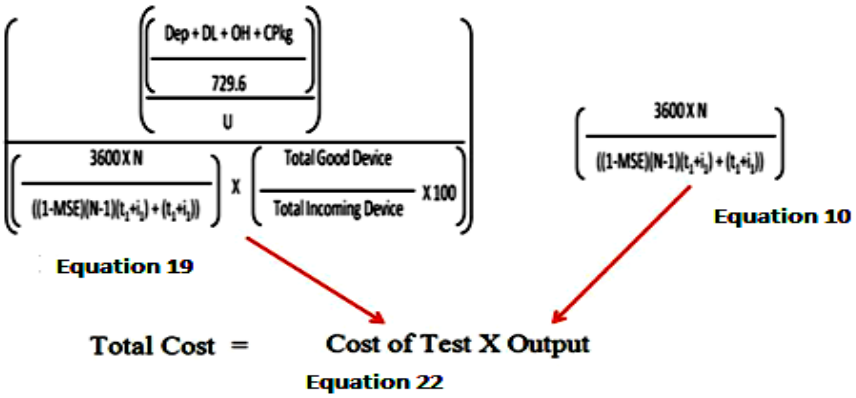

Figure 6 The Integration of Equation 19 and Equation 10 into Equation 22

$$\text{Total Cost} = \left(\frac{\left(\frac{\text{Dep} + \text{DL} + \text{OH} + \text{CPkg}}{729.6} \right)}{U} \Big/ \left(\frac{3600 \times N}{((1-MSE)(N-1)(t_1+i_1) + (t_1+i_1))} \times \left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \times 100 \right) \right) \right) \times \left(\frac{3600 \times N}{((1-MSE)(N-1)(t_1+i_1) + (t_1+i_1))} \right) \quad (23)$$

Equation 23 is further simplified by canceling the unit per hour (UPHinsertion) equation, as shown in Equation 24.

$$\text{Total Cost} = \left(\frac{\left(\frac{\text{Dep} + \text{DL} + \text{OH} + \text{CPkg}}{729.6} \right)}{U} \Big/ \left(\frac{3600 \times N}{((1-MSE)(N-1)(t_1+i_1) + (t_1+i_1))} \times \left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \times 100 \right) \right) \right) \times \left(\frac{3600 \times N}{((1-MSE)(N-1)(t_1+i_1) + (t_1+i_1))} \right) \quad (24)$$

The final equation for the total cost calculation is shown as Equation 25.

$$\text{Total Cost} = \left(\frac{\left(\frac{\text{Dep} + \text{DL} + \text{OH} + \text{CPkg}}{729.6} \right)}{U} \Big/ \left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \times 100 \right) \right) \quad (25)$$

Equation 25 indicates that the equipment utilization percentage and the good unit yield influence the total cost. After deriving the total cost equation, the discussion of total revenue theory in the following section:-

ii. Total Revenue

Base on theory of the firm, total revenue is derived from market demand quantity multiplied by product selling price (McKenzie, 2006). This relationship is expressed in Equation 26.

$$\text{Total Revenue} = \text{Demand} \times \text{Selling Price}. \quad (26)$$

Demand refers to the quantity of semiconductor chips needed by the market, and the selling price is the ASP for a particular semiconductor chip. For this study, demand is determined as the same value of the testing throughput for easy calculation.
Both elements that influence profit have been discussed, and the following section describes in detail the development process of the cost of test profit margin model.

iii. Development Process of the Cost-of-Test Profit Margin Model

Profit is the difference between the total cost and the total revenue (Kling, 2005). The profit equation can be expressed as Equation 20 where the profit is equal to the total revenue minus the total cost.
Based on Equation 20, Equation 25 and Equation 26 are integrated, as shown in Figure 10; and the final test profit margin model is developed, as shown in Equation 27.

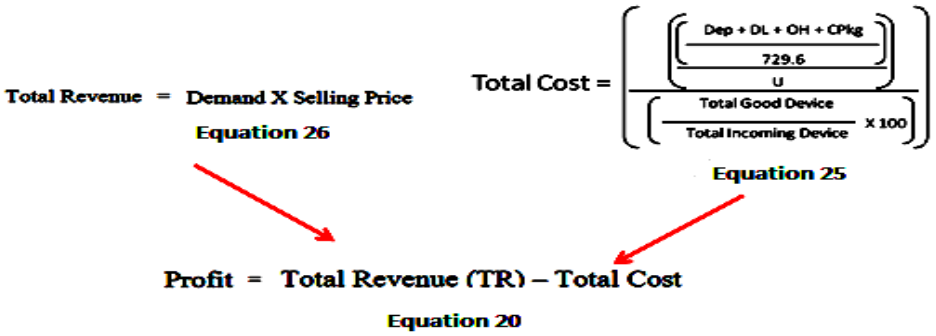

Figure 10 The Integration of Equation 26 and Equation 25 into Equation 20.

$$\text{Profit} = \left[\text{Demand X Selling Price}\right] - \frac{\left[\frac{\left[\frac{\text{Dep + DL + OH + CPkg}}{729.6}\right]}{U}\right]}{\left[\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \text{ X } 100\right]} \quad (27)$$

The integration is successfully shown in Equation 427, thus enabling calculation of the profit margin of the cost of testing for research hypothesis.
Changing the demand and testing throughput to produce the required demand affects the test equipment utilization percentage and the required test equipment to produce that demand, therefore Equation 27 needs to be further improved to solve this problem. The following discussion of the equations considers the utilization percentage and the change in the number of test equipment when the required demand is modified.

To simulate different production outputs or required demands, calculating the equipment utilization percentage based on testing output increment across different test-site setups is necessary.
The total cost is affected by the equipment utilization percentage and good unit yield. Therefore, the equipment utilization percentage for the different testing throughputs can be calculated using Equation 28.

$$\text{U\% for Production Output (U\%O)} = \frac{\text{Production Output}}{\text{UPH}_{\text{insertion}}\text{ (Perfect Condition)}} \times 100, \quad (28)$$

where:
The production output (required market demand) is divided by $UPH_{insetion}$ in perfect condition. $UPH_{insertion}$ in perfect condition indicates that the maximum testing throughput that the test equipment can produce in one hour can be obtained with Equation 16 via 100% MSE.
However, Equation 16 cannot provide an accurate calculation because when the test equipment is 100% utilized, it requires an additional setup to produce the additional testing throughput. To solve this problem, the utilization percentage equation in Equation 28 should be further enhanced, as shown in Equation 29.

$$\text{Actual U\% for Production Output (AU\%O)} = \frac{\text{U\%O}}{\text{Number of Test Equipment}} \quad (29)$$

where the actual utilization percentage (AU%O) can be calculated by dividing the utilization percentage per output (U%O) with the number of test-equipment setups needed to produce the required testing output so that the actual utilization percentage per test-equipment setup can be obtained.
When the first test equipment reaches 100% utilization, additional test equipment is needed to produce the additional testing output, and the increment of the number of test equipment depends on the required output.
To obtain the cost of good unit based on the increment of testing output demand, the actual utilization percentage (AU%O) and the required number of test equipment (NOTE) have to be integrated into the total cost in Equation 25. The integration shown in Figure 7 and the new total cost equation, which considers the AU%O and NOTE, are derived in Equation 30.

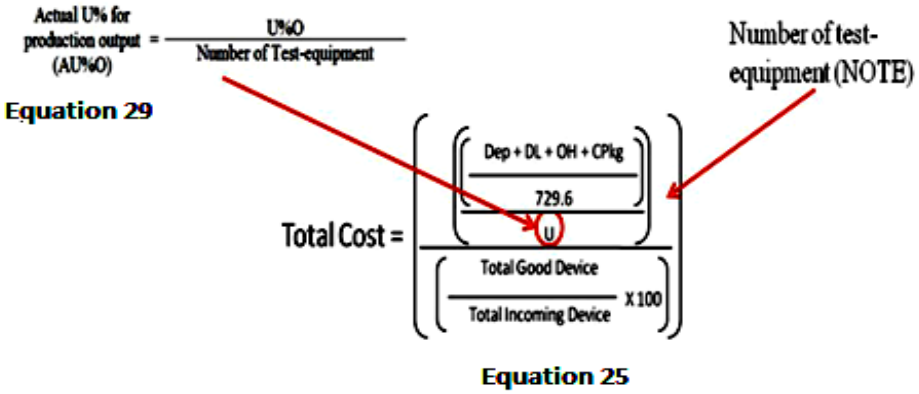

Figure 7 The Integration of Actual Utilization Percentage and NOTE into Equation 25.

$$\text{Total Cost} = \left(\frac{\left(\frac{\left(\frac{\text{Dep + DL + OH + CPkg}}{729.6} \right)}{\text{AU\%O}} \right) \text{X NOTE}}{\left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \text{ X 100} \right)} \right), \quad (30)$$

where NOTE is the number of test-equipment setups needed for a particular production output, and the utilization percentage (U) is replaced with the actual utilization percentage based on the required output (AU%O).
Finally, the profit margin equation, which includes AU%O and NOTE, is derived, as shown in Equation 31:

$$\text{Profit} = \left[\text{Demand X Selling Price} \right] - \left(\frac{\left(\frac{\left(\frac{\text{Dep + DL + OH + CPkg}}{729.6} \right)}{\text{AU\%O}} \right) \text{X NOTE}}{\left(\frac{\text{Total Good Device}}{\text{Total Incoming Device}} \text{ X 100} \right)} \right) \quad (31)$$

III. PICK AND PLACE TEST HANDLER

Pick-and-place testing handling is one of the widely used methods of testing multi-sites. In this process, the semiconductor chip is already singulated from the lead frame to become an individual chip. The chip is placed on a Jedec tray to be carried from the assembly equipment to the test equipment. Figure 8 shows a photograph of Jedec trays.

Figure 8 Sample Jedec trays.

The Jedec tray is loaded with semiconductor chips and then placed into the pick-and-place handler in Area 1, as shown in Figure 9.

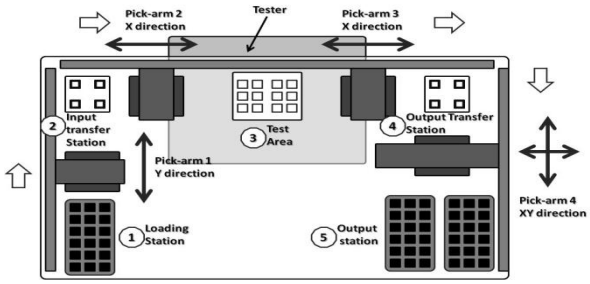

Figure 9 Process flow of pick-and-place testing handling.

Pick-arm 1 transfers the chips from the tray to the input transfer station. From the input transfer station, pick-arm 2 moves the chips to the test area for testing. The pick-and-place testing handling method is different from the two previous methods, in which the tester is at the bottom and the test socket/contactor is facing up. Moreover, pick-arm 2 punches the device down instead of up to connect it with the test socket/contactor. The tested chips are then placed on the output transfer station by pick-arm 3. Finally, pick-arm 4 removes the tested chips from the output transfer station and sends them to the output station. The good and bad chips are sorted according to the test results. Figure 10 displays the test area for pick-and-place testing handling.

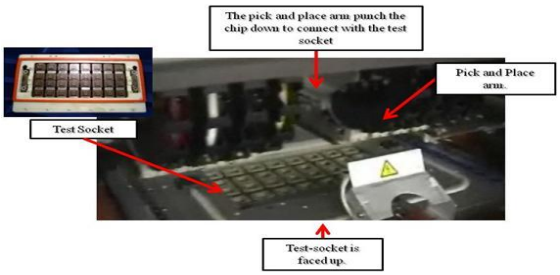

Figure 10 Test area for pick-and-place testing handling.

The test site configuration setup for the case study is explained in the subsequent section.
The pick-and-place test equipment can be configured from single-site to X32-sites. The test sites are configured to obtain data for the case study from single-site to X32-sites. Figure 11 displays a photograph of the pick-and-place test equipment test sites that can support X32-sites.

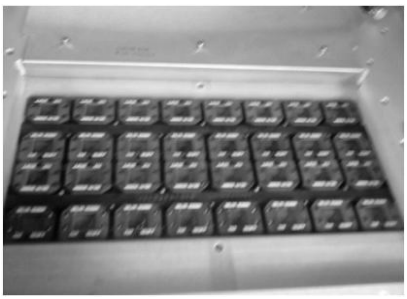

Figure 11 Pick-and-place test sites.

The standard layout of the test site for the pick-and-place test equipment is configured in four columns and eight rows to obtain X32-sites. With such flexibility, the test site can be configured to single-site, quad-sites, octal-sites, X16-sites, and X32-sites. The details of the configurations are described below. From the standard test site configuration (Figure 12), the experiment first configures the test handler to pick up only one chip and to perform single-site testing to simulate the indexing and test times of the conventional testing method. Figure 13 depicts the single-site configuration (gray color indicates the test site used for testing).

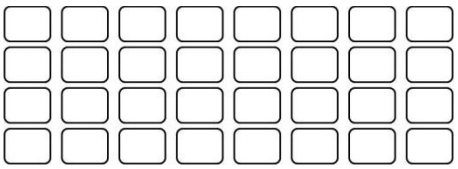

Figure 12 Standard layout of X32-sites.

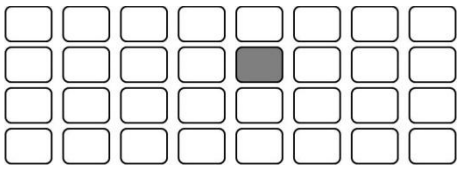

Figure 13 Layout of single-site.

Figures 14 and 15 show the configuration of quad-sites and octal-sites, respectively.

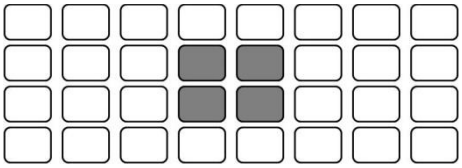

Figure 14 Layout of quad-sites.

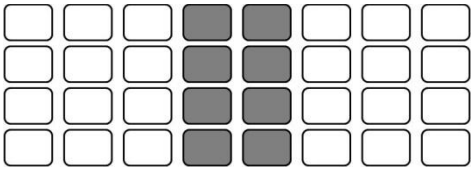

Figure 15 Layout of octal-sites.

The test handler is configured to X16-sites (Figure 16) and X32-sites (Figure 17) when the quad-site and octal-site tests are completed.

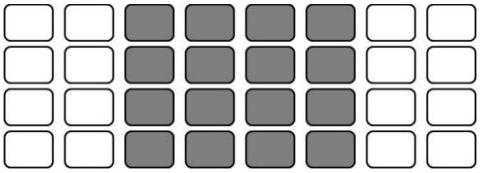

Figure 16 Layout of X16-sites.

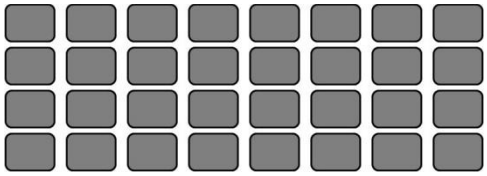

Figure 17 Layout of X32-sites

The configurations of test sites are defined. The results of the analysis are discussed in the section that follows.

IV. ANALYSIS RESULT

Cost of Good Unit

This study considers pure indexing time only and rejects any indexing time slowed down by external factors, including the carrier transfer process, loading and unloading process, equipment jamming, and delay caused by slowing of pick-arm 1. Production data are only accepted if no external factor, including handler and tester downtimes, is identified.

This study focuses on only the area shown within the circle in Figure 18.

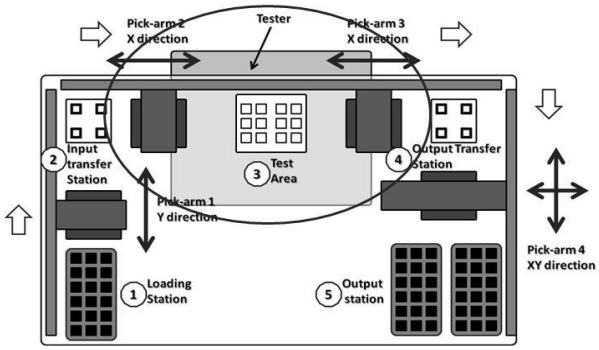

Figure 18 Focus area of this research.

The indexing time is considered valid if no waiting time exists between the exchange times for the device being tested as it is replaced with a new device before testing. However, the indexing time is considered invalid given external factors that cause immediate replacement of a new chip after the device is completely tested.
The test time is considered valid if no external factors, including tester downtime and chip contacting problems, cause a high rejection rate of the tested chip.
The data size of the 30 sets of production lots for each test site configuration (single-site, quad-sites, octal-sites, X16-sites, and X32-sites) must be collected to gather sufficient data for the cost-of-test study. Each data set contains 100 trial runs of the test equipment setup. Thus, the 30 data sets contain 3,000 test equipment trial runs. Five test site configurations are employed in both case studies. Therefore, 30 sets are used for each test site setup. The five test site configurations contain 150 data sets, including 15,000 trial runs on test equipment.

The fixed costs for this case study are tabulated in Table 2.

Table 2: FIXED COSTS

Variables	Cost (RM)
Depreciation cost/month	49500
Direct labor cost/month	7843
Overhead cost/month	181999

The cost of bad parts is calculated by using Equation 8, which involves an ASP of RM4.95 for the logic device. The cost of bad parts is affected by the testing yield. Table 3 depicts the summary of the cost of bad parts.

Table 3: COST OF BAD PARTS

Test site configurations	Cost of bad parts (RM)
Single-site	63.61
Quad-sites	110.29
Octal-sites	141.61
X16-sites	192.55
X32-sites	163.45

The results of testing throughput for pick-and-place test equipment are summarized in Table 4.

Table 4: TESTING THROUGHPUT FOR PICK-AND-PLACE TEST EQUIPMENT

Test site configurations	Throughput
Single-site	2659
Quad-sites	4126
Octal-sites	4447
X16-sites	4576
X32-sites	3825

Testing yield is one of the factors that affect testing cost. Table 5 shows the testing yield percentage data collected from the pick-and-place test equipment setup.

Table 5: AVERAGE TESTING YIELD PERCENTAGES

Test site configurations	Average Testing Yield (%)
Single-site	99.52
Quad-sites	99.46
Octal-sites	99.36
X16-sites	99.15
X32-sites	99.14

After all the required variables are obtained, the cost of good units is calculated by using Equation 19. The summary is tabulated in Table 6.

Table 6: COST OF GOOD UNIT.

Test site configurations	Cost of Good Unit (RM)
Single-site	0.0670
Quad-sites	0.0436
Octal-sites	0.0410
X16-sites	0.0409
X32-sites	0.0488

Cost of Test Profit

After obtaining the cost of testing for the entire test-site setup, the next step is to calculate the profit margin for the pick-and-place test equipment.

The main elements involved in the profit-margin calculation are total revenue and total cost, as shown in Equation 20. Total revenue is calculated by the selling price multiplied by the selling output. In this study, the ASP list published by the World Semiconductor Trade Statistics and identified by Turley (2009) is used in the total-revenue calculation. The device-type used in this Case Study is the logic semiconductor, and the selling price is USD 1.50, which is equivalent to RM4.95 per chip.

As stated in the previous chapter, the study needs to simulate mass production cost to obtain the profit margin for the test-equipment setup. To achieve this, the total cost of the production output from 1,000 to 23,000 chips per hour is calculated based on Equation 31.

In the first step in simulating the mass production cost of test, this study determines the number of test equipment needed to test the required production output across all test-site configurations. The number of test equipment is determined by referring to the utilization percentage of the test equipment. Once the utilization percentage reaches more than 100%, then additional test equipment is needed. The utilization percentage based on the production output is calculated using Equation 28. An example of the calculation for single-site testing is shown as follows:-

$$\text{U\% for production output (U\%O)} = \frac{1{,}000}{2{,}659} \text{ X } 100$$

$$= 38\%.$$

From the aforementioned example, the utilization percentage is 38%. Thus, only one test equipment setup is needed.

To obtain the actual utilization percentage for the test equipment, Equation 29 is developed. An example of the calculation is shown using single-site testing with 6,000 production output units, as follows:-

$$\text{Actual U\% for production output (AU\%O)} = \frac{226\%}{3}$$

$$= 75\%.$$

From the given example, the utilization percentage for a single-site pick-and- place equipment is 226% to produce 6,000 units. Three test equipment units are required to produce 6,000 units of output given that the utilization percentage is over 200%. Only one test-equipment is required when the utilization percentage is below 100%. Two tests equipment are required when the utilization percentage is below 200%.Three tests equipment are required when the utilization percentage is below 300%.

Table 7 shows the utilization percentage and the number of test equipment units needed for a production output of 1,000 to 23,000 units across all test site configurations.

After obtaining the number of handlers and actual utilization percentages, this study calculates the total cost for the entire production output across all test-site configurations.

Equation 30 issued to calculate the total cost. An example of the calculation for a single-site testing with 9,000 unit production outputs is shown as follows:-

$$\text{Total Cost} = \left(\frac{\left(\frac{129372.43}{729.6} \right) \text{X } 4}{85\%} \right) \Bigg/ 100\%$$

$$= \text{RM838}.$$

Table 7 shows that four test-equipment units are required to produce an output of 9,000 units per hour, and that the utilization percentage per test equipment is 85%. For a fair comparison, good-unit yield percentage is fixed at 100%.

The given example shows a cost of RM838 per hour to produce 9,000 chips.Table 8 shows the total cost of the entire production output across all test-site configurations for the pick-and-place test equipment.

To determine the cost of good units using simulation from 1,000 to 23,000 chips per hour, this study divides the total output of 27,600 by the grand total cost to obtain the average cost per unit. An example of the calculation for single-site testing is shown as follows:-

$$\text{Cost of Good Units} = \frac{23,\ 353.11}{27,600}$$

$$= \quad 0.0846.$$

As shown in Table 8, the single-site setup requires RM0.0846 to test a semiconductor chip, and quad-site setup requires RM0.0612. Octal-site expense per chip is RM0.0606. The cost is RM0.0607 for the X16-site testing, and RM0.679 for the X32-site testing.

After obtaining the total cost of the simulation of production output shown in Table 8, this study calculates the profit margin of the simulation using Equation 31. The calculation of the profit is summarized in Table 9:-

Hypothesis: Multi-site versus Profit Margin Improvement

Refer to Table 9 for the pick-and-place test-equipment profit summary for the production output simulation from 1,000 to 23,000. Analysis for the hypothesis is provided in the following sections:-

The hypothesis for the profit-margin analysis is as follows.

H0: Improvement of the test site has no effect on the improvement of the profit margin.

H1: Improvement of the test site has an effect on the improvement of the profit margin.

Table 10: ANOVA Results for Profit Margin

ANOVA Table

	SS	df	MS	F
Between	0.40	4.00	0.10	0.04
Within	287.57	110.00	2.61	
Total	287.97	114.00	2.53	

For the profit margin ANOVA, the degree of freedom between is 4 and 110, with an alpha level of 0.05. The critical value obtained is 2.4542 (www.danielsoper.com/statcalc3/calc.asp.cited: 8 September 2012).The F-value obtained from the analysis is 0.04, which is lower than the critical value. In this case, the null hypothesis is accepted; and the study concludes that improvements on test sites for pick-and-place test-equipment setups have no significant effect on the profit-margin improvement.

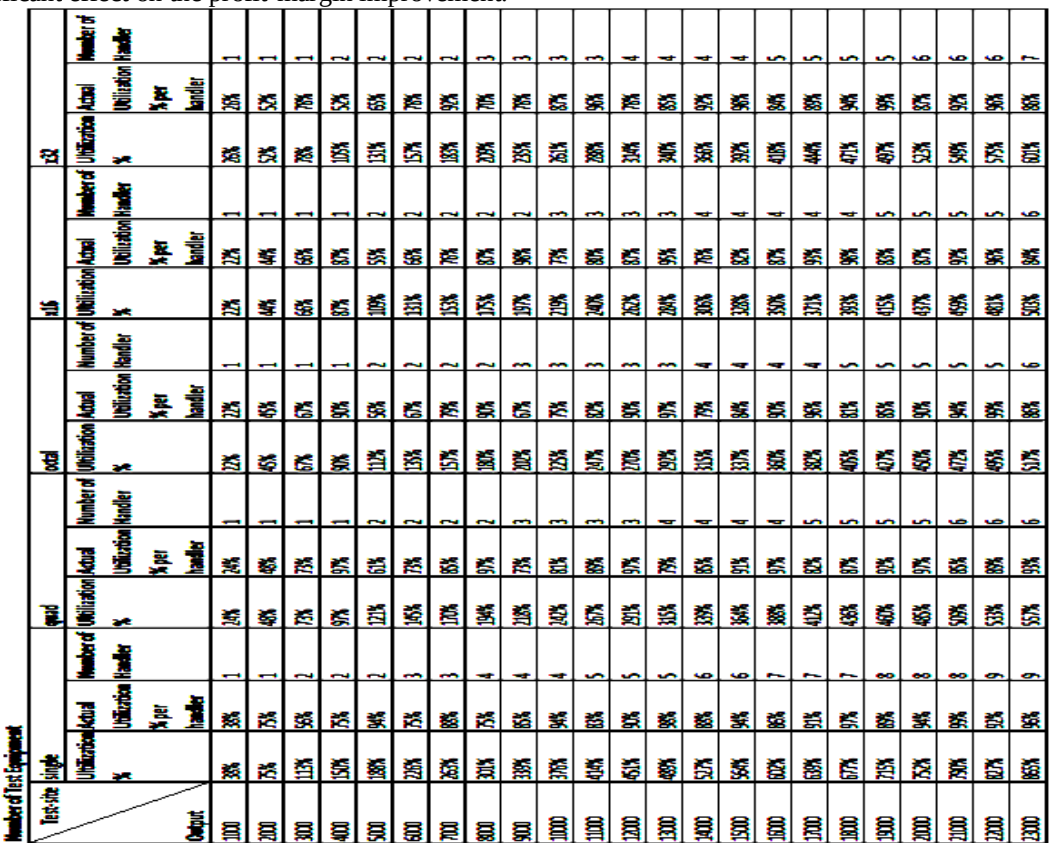

Table 7: Increment of Test Equipment Units Based on

Total Cost

Output	single-site	Average Cost	quad-sites	Average Cost	octal-sites	Average Cost	x16-sites	Average Cost	x32-sites	Average Cost
1000	MYR 471.46	MYR 0.47	MYR 738.42	MYR 0.74	MYR 805.56	MYR 0.81	MYR 849.12	MYR 0.85	MYR 707.18	MYR 0.71
2000	MYR 235.73	MYR 0.12	MYR 369.21	MYR 0.18	MYR 402.78	MYR 0.20	MYR 424.56	MYR 0.21	MYR 353.59	MYR 0.18
3000	MYR 628.61	MYR 0.21	MYR 246.14	MYR 0.08	MYR 268.52	MYR 0.09	MYR 283.04	MYR 0.09	MYR 235.73	MYR 0.08
4000	MYR 471.46	MYR 0.12	MYR 184.61	MYR 0.05	MYR 201.39	MYR 0.05	MYR 212.28	MYR 0.05	MYR 707.18	MYR 0.18
5000	MYR 377.16	MYR 0.08	MYR 590.74	MYR 0.12	MYR 644.45	MYR 0.13	MYR 679.30	MYR 0.14	MYR 565.75	MYR 0.11
6000	MYR 707.18	MYR 0.12	MYR 492.28	MYR 0.08	MYR 537.04	MYR 0.09	MYR 566.08	MYR 0.09	MYR 471.45	MYR 0.08
7000	MYR 606.16	MYR 0.09	MYR 421.95	MYR 0.06	MYR 460.32	MYR 0.07	MYR 485.21	MYR 0.07	MYR 404.10	MYR 0.06
8000	MYR 942.91	MYR 0.12	MYR 369.21	MYR 0.05	MYR 402.78	MYR 0.05	MYR 424.56	MYR 0.05	MYR 795.58	MYR 0.10
9000	MYR 838.14	MYR 0.09	MYR 738.42	MYR 0.08	MYR 805.56	MYR 0.09	MYR 377.39	MYR 0.04	MYR 707.18	MYR 0.08
10000	MYR 754.33	MYR 0.08	MYR 664.58	MYR 0.07	MYR 725.00	MYR 0.07	MYR 764.21	MYR 0.08	MYR 636.46	MYR 0.06
11000	MYR 1,071.49	MYR 0.10	MYR 604.16	MYR 0.05	MYR 659.09	MYR 0.06	MYR 694.73	MYR 0.06	MYR 578.60	MYR 0.05
12000	MYR 982.20	MYR 0.08	MYR 553.82	MYR 0.05	MYR 604.17	MYR 0.05	MYR 636.84	MYR 0.05	MYR 942.91	MYR 0.08
13000	MYR 906.65	MYR 0.07	MYR 908.83	MYR 0.07	MYR 557.69	MYR 0.04	MYR 587.85	MYR 0.05	MYR 870.38	MYR 0.07
14000	MYR 1,212.31	MYR 0.09	MYR 843.91	MYR 0.06	MYR 920.64	MYR 0.07	MYR 970.42	MYR 0.07	MYR 808.21	MYR 0.06
15000	MYR 1,131.49	MYR 0.08	MYR 787.65	MYR 0.05	MYR 859.26	MYR 0.06	MYR 905.73	MYR 0.06	MYR 754.33	MYR 0.05
16000	MYR 1,443.83	MYR 0.09	MYR 738.42	MYR 0.05	MYR 805.56	MYR 0.05	MYR 849.12	MYR 0.05	MYR 1,104.97	MYR 0.07
17000	MYR 1,358.90	MYR 0.08	MYR 1,085.91	MYR 0.06	MYR 758.17	MYR 0.04	MYR 799.17	MYR 0.05	MYR 1,039.97	MYR 0.06
18000	MYR 1,283.41	MYR 0.07	MYR 1,025.58	MYR 0.06	MYR 1,118.83	MYR 0.06	MYR 754.77	MYR 0.04	MYR 982.20	MYR 0.05
19000	MYR 1,588.06	MYR 0.08	MYR 971.61	MYR 0.05	MYR 1,059.95	MYR 0.06	MYR 1,117.26	MYR 0.06	MYR 930.50	MYR 0.05
20000	MYR 1,508.66	MYR 0.08	MYR 923.03	MYR 0.05	MYR 1,006.95	MYR 0.05	MYR 1,061.40	MYR 0.05	MYR 1,272.93	MYR 0.06
21000	MYR 1,436.82	MYR 0.07	MYR 1,265.86	MYR 0.06	MYR 959.00	MYR 0.05	MYR 1,010.86	MYR 0.05	MYR 1,212.31	MYR 0.06
22000	MYR 1,735.81	MYR 0.08	MYR 1,208.32	MYR 0.05	MYR 915.41	MYR 0.04	MYR 964.91	MYR 0.04	MYR 1,157.21	MYR 0.05
23000	MYR 1,660.34	MYR 0.07	MYR 1,155.79	MYR 0.05	MYR 1,260.87	MYR 0.05	MYR 1,329.06	MYR 0.06	MYR 1,506.60	MYR 0.07

Total Output	Average Cost per Chip				
276000	single-site	quad-sites	octal-sites	x16-sites	x32-sites
	MYR 0.0846	MYR 0.0612	MYR 0.0606	MYR 0.0607	MYR 0.0679

Table 8: Summary of Total Cost of the Production Output Simulation

Profit

Output	single-site	Profit per chip	quad-sites	Profit per chip	octal-sites	Profit per chip	x16-sites	Profit per chip	x32-sites	Profit per chip
1000	MYR 4,478.54	MYR 4.48	MYR 4,211.58	MYR 4.21	MYR 4,144.44	MYR 4.14	MYR 4,100.88	MYR 4.10	MYR 4,242.82	MYR 4.24
2000	MYR 9,664.27	MYR 4.83	MYR 9,530.79	MYR 4.77	MYR 9,497.22	MYR 4.75	MYR 9,475.44	MYR 4.74	MYR 9,546.41	MYR 4.77
3000	MYR 14,221.39	MYR 4.74	MYR 14,603.86	MYR 4.87	MYR 14,581.48	MYR 4.86	MYR 14,566.96	MYR 4.86	MYR 14,614.27	MYR 4.87
4000	MYR 19,328.54	MYR 4.83	MYR 19,615.39	MYR 4.90	MYR 19,598.61	MYR 4.90	MYR 19,587.72	MYR 4.90	MYR 19,092.82	MYR 4.77
5000	MYR 24,372.84	MYR 4.87	MYR 24,159.26	MYR 4.83	MYR 24,105.55	MYR 4.82	MYR 24,070.70	MYR 4.81	MYR 24,184.25	MYR 4.84
6000	MYR 28,992.82	MYR 4.83	MYR 29,207.72	MYR 4.87	MYR 29,162.96	MYR 4.86	MYR 29,133.92	MYR 4.86	MYR 29,228.55	MYR 4.87
7000	MYR 34,043.84	MYR 4.86	MYR 34,228.05	MYR 4.89	MYR 34,189.68	MYR 4.88	MYR 34,164.79	MYR 4.88	MYR 34,245.90	MYR 4.89
8000	MYR 38,657.09	MYR 4.83	MYR 39,230.79	MYR 4.90	MYR 39,197.22	MYR 4.90	MYR 39,175.44	MYR 4.90	MYR 38,804.42	MYR 4.85
9000	MYR 43,711.86	MYR 4.86	MYR 43,811.58	MYR 4.87	MYR 43,744.44	MYR 4.86	MYR 44,172.61	MYR 4.91	MYR 43,842.82	MYR 4.87
10000	MYR 48,745.67	MYR 4.87	MYR 48,835.42	MYR 4.88	MYR 48,775.00	MYR 4.88	MYR 48,735.79	MYR 4.87	MYR 48,863.54	MYR 4.89
11000	MYR 53,378.51	MYR 4.85	MYR 53,845.84	MYR 4.90	MYR 53,790.91	MYR 4.89	MYR 53,755.27	MYR 4.89	MYR 53,871.40	MYR 4.90
12000	MYR 58,417.80	MYR 4.87	MYR 58,846.18	MYR 4.90	MYR 58,795.83	MYR 4.90	MYR 58,763.16	MYR 4.90	MYR 58,457.09	MYR 4.87
13000	MYR 63,443.35	MYR 4.88	MYR 63,441.17	MYR 4.88	MYR 63,792.31	MYR 4.91	MYR 63,762.15	MYR 4.90	MYR 63,479.62	MYR 4.88
14000	MYR 68,087.69	MYR 4.86	MYR 68,456.09	MYR 4.89	MYR 68,379.36	MYR 4.88	MYR 68,329.58	MYR 4.88	MYR 68,491.79	MYR 4.89
15000	MYR 73,118.51	MYR 4.87	MYR 73,462.35	MYR 4.90	MYR 73,390.74	MYR 4.89	MYR 73,344.27	MYR 4.89	MYR 73,495.67	MYR 4.90
16000	MYR 77,756.17	MYR 4.86	MYR 78,461.58	MYR 4.90	MYR 78,394.44	MYR 4.90	MYR 78,350.88	MYR 4.90	MYR 78,095.03	MYR 4.88
17000	MYR 82,791.10	MYR 4.87	MYR 83,064.09	MYR 4.89	MYR 83,391.83	MYR 4.91	MYR 83,350.83	MYR 4.90	MYR 83,110.03	MYR 4.89
18000	MYR 87,816.59	MYR 4.88	MYR 88,074.42	MYR 4.89	MYR 87,981.17	MYR 4.89	MYR 88,345.23	MYR 4.91	MYR 88,117.80	MYR 4.90
19000	MYR 92,461.94	MYR 4.87	MYR 93,078.39	MYR 4.90	MYR 92,990.05	MYR 4.89	MYR 92,932.74	MYR 4.89	MYR 93,119.50	MYR 4.90
20000	MYR 97,491.34	MYR 4.87	MYR 98,076.97	MYR 4.90	MYR 97,993.05	MYR 4.90	MYR 97,938.60	MYR 4.90	MYR 97,727.07	MYR 4.89
21000	MYR 102,513.18	MYR 4.88	MYR 102,684.14	MYR 4.89	MYR 102,991.00	MYR 4.90	MYR 102,939.14	MYR 4.90	MYR 102,737.69	MYR 4.89
22000	MYR 107,164.19	MYR 4.87	MYR 107,691.68	MYR 4.90	MYR 107,984.59	MYR 4.91	MYR 107,935.09	MYR 4.91	MYR 107,742.79	MYR 4.90
23000	MYR 112,189.66	MYR 4.88	MYR 112,694.21	MYR 4.90	MYR 112,589.13	MYR 4.90	MYR 112,520.94	MYR 4.89	MYR 112,343.40	MYR 4.88

Total Output	Profit per Chip				
276000	single-site	quad-sites	octal-sites	x16-sites	x32-sites
	MYR 4.87	MYR 4.89	MYR 4.89	MYR 4.89	MYR 4.88
	98.29%	98.76%	98.77%	98.77%	98.63%

Table 9: Profit Summary for the Production Output

V. CONCLUSION

The validation process provides evidence that increments in the number of test sites do not necessarily result in reduction in cost-of-test and improvement of the profit margin. The case study show that increasing the number of test sites does not guarantee an improvement to throughput, cost of testing, and profit margin. The main reasons for such this scenario are presented in Figures 19 below:-

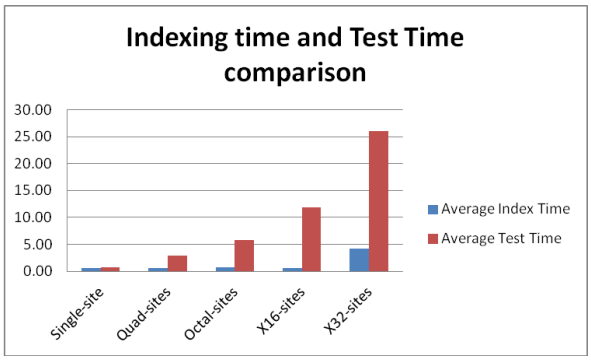

Figure 19: Comparison of the Indexing Time and Test Time for the Pick-and-Place Test equipment.

Testing throughput is the main contributor to the cost of testing and profit margin. Testing throughput is affected by the indexing time and test time. Figures 19 above show that although the indexing time for the pick and place test-equipment setup steadily increases but the test time for the test equipment increases significantly once it reaches higher test-site configuration. Therefore, the test time is the root cause of the decrease in testing speed and the reduction in testing throughput, which result in an increase in testing cost, and consequently, a decrease in profit margin.

Thus, this study concludes that simply increasing the number of test sites is not sufficient to improving testing throughput. Instead, the test time should also be reduced. The test time can be reduced in a number of ways, such as reduced pin-count testing and concurrent test among others.

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Fabrication and Testing of a Combined Groundnut Roaster and Oil Expeller Machine

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Abstract: - This paper presents the fabrication and testing of a combined groundnut roaster and oil expeller machine. The machine which was fabricated using locally available materials is portable and efficient. The combination of the roasting and expelling units into one single unit led to an efficient and effective production of groundnut oil, because it reduces drudgery, saves time and improves the quality of the oil produced compared to when there are separate units of these operations. The performance evaluation shows that the roasting and expelling efficiencies were 66.9% and 66.7% respectively.

Keywords: *-Roaster, expeller, groundnut, combined machine, fabrication, groundnut oil*

I. INTRODUCTION

Groundnuts are a stable food in many developing countries. Also called peanut, groundnuts are a protein rich tuber that grows well in semi-arid regions. There are two main types of groundnut: the America groundnut (*Arachis hypogea*), and the Africa groundnut, the Bambara nut (*Voandzeia subterranean*). Both are grown in Western Africa as a protein source. Groundnuts also contain sufficient quantity of carbohydrates and fats. The America groundnut grow 30-40cm high and do not spread. The West Africa groundnut is shorter and run along the ground from 30-60cm. Yields of kernels generally range from 0.5-4.0 tons/hec. In the developing countries, where 80 % of the crop is produced, the average yields are around 1 tons/hec [1, 2].

The production of oil from groundnut involves a post processing of groundnut which includes shelling, roasting and pressing. Several groundnuts shelling machines has been fabricated [3, 4]. Roasting reduces moisture content and develops a pleasant flavour which makes the products more acceptable for consumption [5]. Roasting also enhances better extraction as it reduces the oil's viscosity, releases oil from intact cells and reduces the moisture content. The amount of oil produced will be much if it is properly roasted. However, excess heating during roasting results in low nutritional quality of protein. It also reduces the quantity of oil as well as it makes the colour of the oil extracted to be dark [6]. Roasting of groundnut and extraction of oil from it has however been a serious issue to its processing. In some rural parts of the country, roasting and extraction of the oil is achieved by traditional method.Olaniyan A. M. [7] recently carried out the developmentof a manually operated expeller machine for groundnut oil extraction. This machine was designed to be used in rural communities in developing countries like Nigeria. However, using manually operated machine makes the process of extraction very slow, tedious and time consuming considering the present level of production. In order to sustain the increase in oil production from groundnut, there is the need to improve on the technology especially at the rural level. Ajoa et al [8] carried out the development and performance evaluation of groundnut oil expelling machine and stress the need to have a heating chamber incorporated into the expelling machine. Other similar designs have been developed [9, 10].

The problem with these designs is that it is a single unit of oil expelling machine.Machines which could combine roasting of the nut and expelling of the oil from the nut are not commonly available.There is usually a problem when several units of the oil processing operations are separated. The time taken to move the raw materials from one unit to another is sometimes enormous. Apart from that, the labour required to man these separate unit also add to the cost of production. However, if some of these units can be integrated it can generally enhance the efficiency of the entire process. Just recently, Olatunde et al [11] designed and fabricated

groundnut roaster cum expeller machine with an efficiency of 41.6% oil extraction. Heat loss in this machine was very high as it was not properly lagged and has heavy gears. Okegbile et al [12] designed a combined groundnut roaster and expeller units within a single machine.The machine will reduce heat loss as it is well lagged and have very few components. This paper present the fabrication and performance evaluation of the combined groundnut roaster and expeller machine.

II. FABRICATION PROCESS

Angle bar

This serves as a base for the entire unit, a holder for the roasting unit and housing for the expeller unit. The angle bar is made up of mild steel. The steel was cut into accurate dimensions and welded using a welding machine to get the required shape and size.

Galvanized steel

This was used mainly for the body of the roasting chamber. Galvanized steel was cut using a cutting machine to get the required shape and size for the hopper, top, sides and bottom of the roasting chamber. Rivets were used to hold the edges together. Galvanized steel was also chosen because some parts needed to be bent without breaking and it is very flexible. The body of the unit was made hollow and filled with foam to serve as an insulating material.

Mild Steel pipe

Mild steel pipe was used to get the frame of the roasting chamber before galvanized steel was placed on it. The mild steel pipes were cut into dimensions with a hack saw and welded at each end to get the perfect shape and size required.

Aluminium Sheets

Aluminium sheets were used for the roasting trays. Aluminium is a good conductor of heat and is very flexible. The roasting trays were inclined at an angle so as to help the groundnut travel faster when they are vibrated.

Flexible Metal sheets

4 Thin flexible metal sheets were cut using a hack saw and filed to dimension, they were then riveted at four different positions to the tray holder and the main body of the roasting unit.

Vibrator motor

The vibrator motor was initially situated inside the roasting chamber to aid faster vibration of the trays, but while testing, the heat from the chamber caused the coil of the motor to expand and this hampered the vibration. The motor was then moved outside the chamber. A hole was drilled at the edge for insertion of the shaft of the motor to vibrate the trays. An offset was welded to the top of the tray holder and a load was also welded to the end of the motor's shaft, therefore, while rotating, the contact of the load and the offset caused the required vibration of the trays. An attachment was placed on top of the roasting chamber to hold the motor using bolts and nuts. The motoris electrically powered.

Glass

Transparent glass was placed on the side of the roasting chamber to enable visuals of the roasting process. The glass was cut to dimensions using a hack saw and the edges were filed using a file. Rubber was placed between the glass and the metal in order to avoid cracking. A metal frame was riveted on the edges of the glass to prevent it from falling.

Heating Filament

Heating filament was placed at the bottom of the roasting unit. The heating filament heats up the roasting unit to promote an even roast. It is powered by electricity. An Insulator was placed at the end of the filament to avoid shock.

3 inch round pipe

This serves as housing for the auger and the threaded pipe. It is located on the angle bar. It was attached by welding.

Threaded Shaft

This was inserted at one end of the round pipe. It helps push the auger. The handle of the threaded shaft was welded to it using a welding machine.

Auger

This was coiled inserted at the other end of the round pipe. When powered by the motor, it squashes the groundnuts which have been fed into the expelling chamber from the roaster.

The expelling chamber was tied to the frame and had bearings which ensured easy rotation of the parts. A mesh was inserted to filter the oil from cake. The holes were cut using a hack saw. All the edges were filed to accurate dimensions using a flat file. Bolts, nuts and rivets were used to hold parts together where necessary and parts that needed to be placed permanently, such as the edges of the mild steel pipe and edges of the angle frame and base were welded together using a welding machine.

III. OPERATION OF THE MACHINE

3.1 Roasting Unit

The roasting unit consists of the hopper, conveyor trays, vibrator motor, cabinet (casing), lagging materials, bearings, heating filament, frame and exhaust. The hopper serves as an inlet for the roaster and accommodates oil seeds before being transferred into the roaster. The conveyor trays are incorporated in the heating chamber with a vibrator motor attached to it. The continuous roaster moves groundnut through the heating chamber on a conveyor tray by gravity. In this system, the groundnut is agitated to ensure that air passes the individual kernels to promote an even roast. The downhill movement of groundnut is due to the force of gravity and is resisted by friction. The forces of gravity and friction are in balance at the angle of repose which is the maximum slope angle that unconsolidated materials can maintain.

3.2 Oil Expelling Unit

The expeller unit extracts the oil contained in the groundnut cells. It is powered by an electric motor through a pulley, belt and a gear box. The screw shaft inside the casing will transport roasted groundnut fed from the roasting unit through the hopper from a larger area to a smaller area of the auger, bringing about increase in pressure which raptures the groundnut oil cells to release the oil. The oil is collected beneath the cylinder, and the cake through the discharge outlet of the casing.

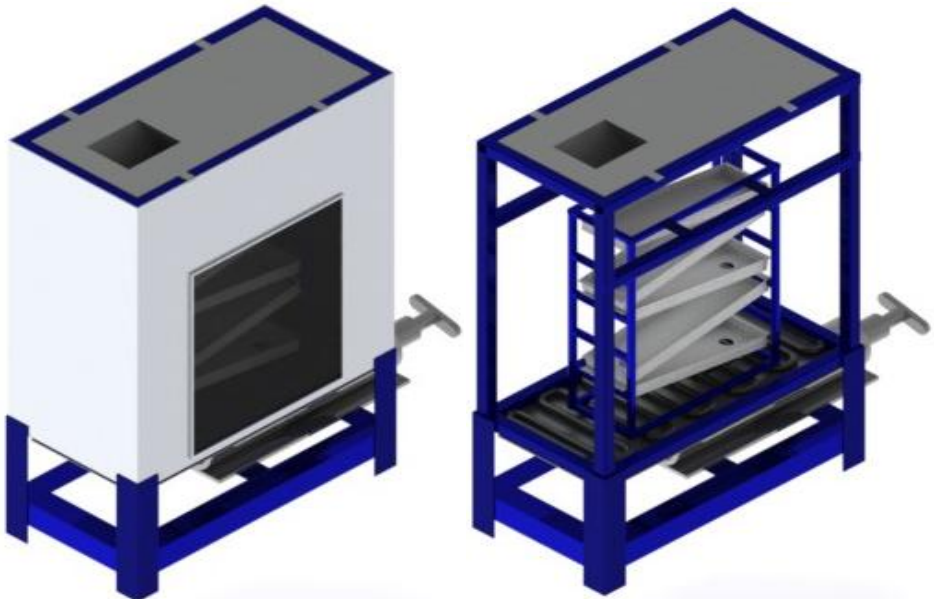

Figure 1. Combined groundnut roaster and oil expeller machine when lagged and un-lagged

IV. COMPONENT DESCRIPTION OF THE MACHINE

4.1 Features of Roasting Unit

Hopper

The hopper serves the purpose of feeding the groundnut into the machine. It has dimensions of 180mm by 200mm at the top and 80mm by 120mm at the bottom. It is embedded in the casing of the roasting unit and is made of mild steel material.

Conveyor trays

The conveyor trays are made of aluminium sheet to enhance good heat conduction and resist corrosion. Each tray has a dimension of 600mm by 150mm.

Casing
The casing has three openings in which one is for the hopper, another for the exit and the third for the discharger. The casing houses the trays, vibrators, heating filaments with a dimension of height by breath by length of 650mm by 300mm by 700mm respectively. It was lagged so as to reduce heat loss. At the bottom of the casing is the collector channel for the exit of the roasted groundnut. The casing was made of mild steel to reduce heat loss.

Discharge Outlet
The discharge outlet is located at the base of the casing for the discharge of the roasted groundnut.

Lagging Materials
This serves the purpose of preventing heat loss to the environment. It helps to retain the temperature within the heating chamber it is made of foam.

Flexible Metal Sheets
The metal sheets are flexible supports which serve as a damper to allow flexible connection between the tray holder and the main body of the unit.

Vibrator Motor
The vibrator motor serves the purpose of agitating the groundnut as they conveyed by the tray. This is to ensure that air passes through the individual kernels so as to promote an even roast. It has small electric motor and an unbalanced mass of 1.4kg.

Heating Filament
This is located in the roasting chamber of the groundnut roaster. It serves the purpose of supplying the heat needed to roast the groundnut. It is made of composite material. A heating filament of 1800Watts was selected.

4.2 Features of the Oil Expelling Unit
Electric Motor
This is the prime mover that provides the power required. It provides the rotational motion and power needed to rotate the shaft transmitted by the belt. The remaining components of the expeller are also powered by the motor. The selection was based on the power analysis made. An electric motor of 5HP was selected.

Oil Extractor Barrel
The oil extractor barrel houses the shaft that carries the conveyor. It has two openings; one for collecting the groundnut from the roaster and the other for the discharge. Mild steel was selected for the fabrication of the casing because it is easy to harden and to temper, and it can withstand shock and vibration. The dimensions of the casing were selected to be length 350mm and a diameter of 65mm and 55mm at the big end and small end respectively. The perforated bottom of the casing collects and drains the oil by force of gravity downward. The diameter of the perforated holes was selected to be 3mm.

Expeller Shaft
The expeller shaft serves as a conveyor, transporting groundnut (roasted) fed the tapered end where it is pressed. It is made of mild steel. It is supported by two bearings which are selected based on the calculation on the bearing. The total length of the screw is 300mm and the total length of the shaft is 450mm. Mild steel was selected because of its ability to withstand shock and impact load. It was also selected because it is easily forged and welded.

Discharge outlet
The discharge outlet is forced open at a given pressure. Steel was used in fabricating the discharge outlet because of its ability to withstand shock and vibration. From literature, the maximum pressure which a continuous expeller can discharge cake when oil would have been fully extracted is 13.6Mpa [13].

Gear Box
This is a speed reduction mechanism that serves the purpose of reducing the speed of the motor to that expected to operate the shaft. The gear box is made of composite materials.

Control Lever
This is used in adjusting the shaft while expelling the oil from the kernel. It is made of mild steel so as to withstand high pressure.

Pulley and Belt Drive

These components will serve the purpose of transmitting power from the pulley attached to the electric motor to that attached to the gear box. The rim of the drive pulley was V-grooved, and the belt was equally wedged sectioned (v-belt).

V. TESTING AND PERFORMANCE EVALUATION

The testing and performance evaluation of the fabricated machine is made up of a roasting unit and an expelling unit. The evaluation of the efficiencies of each unit is determined using equations (1) to (3) below.

The efficiency of the roaster is given as:

$$\eta_r = \frac{G_o}{G_i} \times 100 \quad \textbf{(1)}$$

The efficiency of the oil expeller unit is given as:

$$\eta_e = \frac{Q_E}{Q_T} \times 100 \quad \textbf{(2)}$$

The total quantity of oil in groundnut is given as:

$$Q_T = 45\% \times G_o \quad \textbf{(3)}$$

Where, η_r is the efficiency of the roaster (%), G_o is the quantity of roasted groundnut (kg), G_i is the quantity of groundnut fed into the hopper (kg), η_e is the efficiency of the oil expeller (%), Q_E is the quantity of oil extracted (kg) and Q_T is the total quantity of oil in groundnut (kg).

5.1 Testing Roasting and Expelling Units

5kg of groundnut was fed into the machine through the hopper to the conveyor trays which transport the groundnut through the roaster. The groundnut spends 30 minutes travelling in the roaster which is at temperature of 90^0C and is discharged through the discharge outlet at the bottom of the casing into the expelling unit. Before transferring into the expelling unit, the roasted groundnut was separated from the unroasted or partially roasted ones and weighed. The efficiency of the roasting unit was calculated using equation (1) above.

The roasted groundnut was poured into the expeller through the collector from the roaster in order to push it into the casing. The roasted groundnut was gradually conveyed to the tapered end by the rotating screw auger where it was pressed due to the built-up pressure. The pressed discharger opens to discharge the cake and oil was drained through the perforation on the casing. The oil was collected through the oil collecting trough directly into a container and weighed. The efficiency of the expelling unit was determined using equation (2) above. The procedure was repeated for 10kg and 15kg of groundnut.

5.2 Results and Discussion

The results of the roasting and expelling units are shown in Figures 2 and 3 below. The roasting unit gave an efficiency of 66.9%. This value of efficiency must have been due to heat lost by the heating filament. The groundnut spends 20 minutes travelling through the roasting chamber at which the groundnut was roasted satisfactorily. The temperature of the roasting chamber was 60℃. A total of 30kg of groundnut was fed through the hopper; 20kg was completely roasted while 10kg was partially roasted. The expelling unit had an efficiency of 66.7%. A pressure of $13.6 \times 10^6 N/m^2$ was exerted by the expeller, in which 6kg of oil was expelled within 10 minutes. The low efficiency of the roasting unit was as a result of heat loss through the walls of the roaster. If the machine is properly handled, it is a great prospect to our growing economy, thereby making roasting of groundnut less tedious.

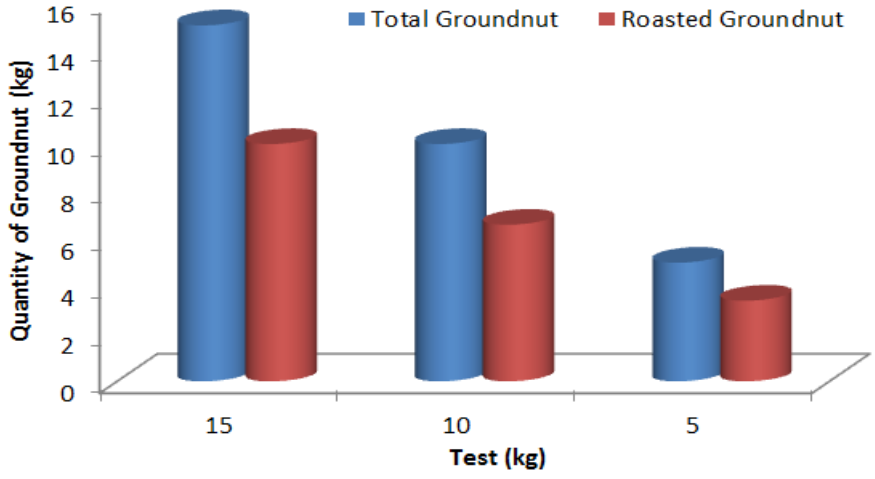

Figure 2. Groundnut Roaster

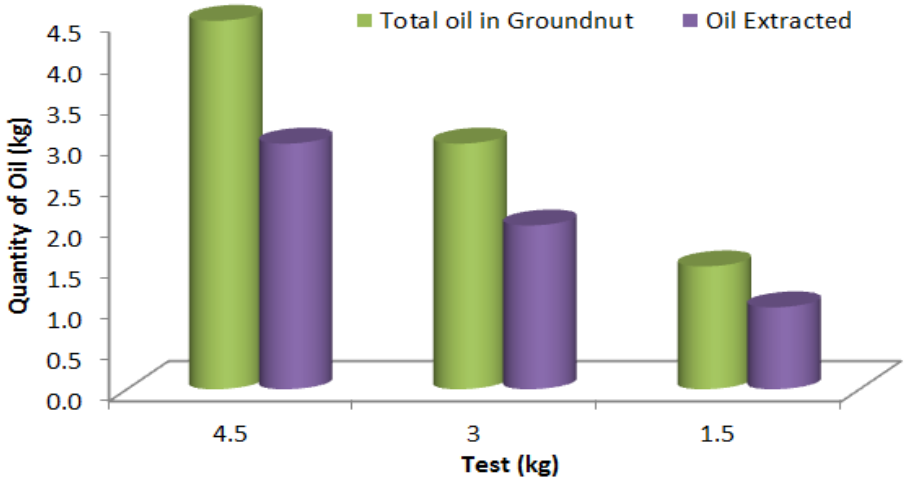

Figure 3. Groundnut Oil extraction

VI. CONCLUSION

The unit operations involved in extracting groundnut oil was combined and a performance test was carried out on the fabricated machine. Efficiencies of 66.9% and 66.7% were recorded for the roasting and expelling units respectively. The combination of the roasting and expelling units into one single unit led to an efficient and effective production of groundnut oil because it reduced drudgery, saved time and improved the quality of the oil produced compared to when there are separate units of this operation. The average performance efficiency of the machine is 66.8%.

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Development of Mechanistic-Empirical Pavement Design for Tropical Climate Using Cement-Treated Base Layer

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Abstract: - A mechanistic-empirical pavement design method is developed characterising cement-treated base layers for pavement design in Nigeria or other similar tropical and subtropical countries. Asphalt Concrete surface, Subbase and Aggregate base were characterised based on back calculation data from Claros et al (1986) while cement-treated base layer was based on modulus tests that had been conducted by past researchers. Failure criteria for the Asphalt Concrete fatigue failure and the subgrade rutting failure were based on those by Claros and Ijeh (1987) for Nigerian pavements. Cracking criterion used for the cement-treated layer was that developed by Otee *et al*. (1982). The comparison between the Soil-Cement and Aggregate base showed that at a low Equivalent Single Axle Load (ESAL) (0.5 million repetitions was considered), the use of Aggregate base was better than Soil-Cement base. That for Aggregate base and Cement-Treated Gravel Base showed that the Cement-Treated Gravel Base was better than the Aggregate base at high ESAL (2.5 million repetitions was considered)

I. INTRODUCTION

Many pavement design methods have been developed for different countries to suit different climatic conditions. Most of the design methods used today in the tropical countries were adapted from those developed for the European temperate climate (Gichaga and Parker, 1988). These design methods were developed based on the performance of existed or existing roads. An example of such is the American Association of State Highway and Transportation Officials AASHTO method of pavement design and Road Test. Because the Road Tests cannot be conducted for all variations of pavement design parameters, it therefore means that adaptation of such designs is extrapolations and thus poses serious risks.

The mechanistic-empirical pavement design involves the use of mechanics laws to explain the behaviour of pavements. This is done by computing for stresses and strains and comparing them with the allowable computed from the failure of the material been used. The mechanistic-empirical method makes use of mathematical models unlike the purely empirical methods which makes use of physical models like the Road Test.

Some works have been done by different researchers in developing the mechanistic-empirical method for tropical climate. Most have been based on unbound base layer. The aims of this paper are therefore:

- ✓ To develop the mechanistic-empirical design method for tropical climate when a cement-treated base layer is used; and
- ✓ To promote the use of cement-treated base layer in the tropical countries.

The scope of work involves the characterisation and analysis of two materials - Soil-Cement (SC) and Cement-Treated Gravel Base (CTGB). The analyses of these materials were then compared to that for the Aggregate base.

II. MECHANISTIC-EMPIRICAL APPROACH TO PAVEMENT DESIGN

Various mathematical models are in use for the mechanistic approach. Most are based on the elastic theory and inelastic properties of the pavement materials. The most common of these is the Layered Elastic Model.

2.1 Layered Elastic Model

Layered Elastic Model assumes that each pavement structural layer is homogeneous, isotropic and linearly elastic and upon this theory all stresses and strains are evaluated. These assumptions mean that each layer is the same everywhere and the pavement will rebound to its original form once the load is removed.

Because the mathematical models supporting the layered elastic approach is simple some basic assumptions are required, these are:

- ✓ Pavement layers extend infinitely in the horizontal direction;
- ✓ The bottom layer (usually the subgrade) extends infinitely downwards; and
- ✓ Materials are not stressed beyond their elastic ranges.

Due to the amount of computations involved in the mechanistic approach, several computer programs have been written to perform the stress analysis.

To adequately characterise a pavement structure and its response to loading in a layered elastic approach, the following inputs are desired for the computer programs

1) Material properties of each layer (modulus of elasticity and Poisson's ratio);
2) Pavement layer thicknesses; and
3) Loading conditions (magnitude, geometry - radius and contact pressure of load).

The outputs of layered elastic model are stresses, strains and deflections.

2.2 Failure Criteria

This is the empirical aspect of the mechanistic-empirical method. The relationship between physical (outputs) and pavement failure is described by empirically derived equations that compute the number of loading cycles to failure; this is called the failure criterion. Many equations have been derived for several climatic conditions based on road performances. An example is that developed by Claros *et al*. (1986) for the Nigerian environment.

2.3 Advantages of the Mechanistic-Empirical Approach

The basic advantages of the M-E approach over a purely empirical one (according to Washington State Department of Transport (WSDOT), 1998) are

1) It can be used for both existing pavement rehabilitation and new pavement construction;
2) It accommodates changing load types;
3) It can better characterise materials allowing for.
- ✓ Better utilization of available materials;
- ✓ Accommodation of new materials; and
- ✓ An improved definition of existing layer properties.

4) It uses material properties that relate better to actual pavement performance;
5) It provides more reliable performance predictions;
6) It better defines the role of construction; and
7) It accommodates environmental and aging effects on materials.

III. METHODOLOGY

The method used in this study is first the characterization of the materials used. The materials used are Asphalt Concrete (AC), Cement-Treated Gravel Base (CTGB), Soil-Cement (SC) base, Aggregate Base (AB) and soil subbase. Each base material was used for the analysis and comparison was made for all the materials. The CTGB was compared to the AB first and then SC base was also compared to the AB. This was done because the most prominently used material in Nigeria is the Aggregate Base (crushed stone). The analysis of the CTGB was based on Equivalent Single Axle Load ESAL of 2.5 million while that of the SC was based on 0.5 million Equivalent Single Axle Load (ESAL). The flow chart used for the analyses is shown in Figure 1.

3.1 Material Characterisation

This deals with the properties of the materials used. Several past work on each material were considered for this study.

3.1.1 Asphalt concrete

The modulus of the Asphalt Concrete is highly dependent on the air temperature which makes its measurement difficult. The most recent effort has been to measure it through back calculation.

Back calculation performed by Claros *et al.* (1986) for the Nigerian environment showed values between 2000MPa and 6000MPa. Another consideration is the empirical equation given by AASHTO (1993) as:

$\text{Log}(E_{AC}) = 6.451235 - 0.000164671T^{1.92544}$ ---------- (1)
where T is the temperature (degree centtigrade), and
E_{AC} is the Modulus of the Asphalt Concrete

This has been used by Adeniyi (2005) for Nigerian environment. Values ranging from 2000 to 3000MPa were derived by using average temperatures of some selected towns for all the climatic regions of Nigeria. These climatic regions are also those prevailing in other tropical countries. This means values such as 6000MPa are only achievable during the cold months of the tropical climate. From this, therefore the values of 2000MPa, 4000MPa and 6000MPa were used as the modulus of the AC surface.

3.1.2 Soil-cement base
Ola (1983) reported that 3% of cement was adequate in lateritic soils because they had CBR of about 120 which exceeded the requirement of 80% CBR. Jimoh's (1987) work on the resilient modulus of soil-cement gave values in the range of 500MPa to 2000MPa. The values used were therefore 500MPa, 1000MPa and 2000MPa.

3.1.3 Aggregate base
Back calculation values from Claros *et al.* (1986) were considered for aggregate base. Values presented were 413MPa to 689MPa.The moduli used for the base were therefore 413MPa and 689MPa.

3.1.4 Cement-treated gravel base
Ola (1983) found that 3% of cement in lateritic gravels was adequate as base course material because they had California Bearing Ratio (CBR) of about 90% which exceeded the minimum requirement of 80% (FMW, 1973). Also Fossberg (1970) Suggested a gravel treated with 5.5%. He gave modulus of 7000MPa – 21000MPa for the CTGB; which was considered as heavily bound CTGB, while 3% gave a modulus of 2000MPa and 3500MPa and been used before by the Australian Stabilisation Guidelines (2001). Values 2000MPa, 3500MPa and 5000MPa were used for the lightly bound CTGB, while 2000MPa represents a value that continues from values quoted for SC in subsection 3.1.2, 5000MPa represents values near to the heavily bound CTGB.

3.1.5 Subbase
Back calculation values by Claros *et al.* (1986) were used. The values presented were 138MPa to 483MPa and the same values were therefore adopted.

3.1.6 Subgrade
Subgrade value of 100MPa was used corresponding to 10% CBR according to the equation by Heukelom and Klomp (1962), see Equation (2).
$Mr\ (MPa) = 10CBR$ ---------- (2)

3.1.7 Input parameters
A summary of the input parameters for the mechanistic analysis is shown in Table 1. Also, shown is the type of materials with the modulus used as well as the Poisson ratios.

3.2 Pavement Layer Thickness
The analysis started with 150mm for both the base and subbase and 50mm for the AC surface. The method applied was to first increase the subbase until it became important to increase the base; the base too was increased until it became important to increase the AC surface.

Table 1: Summary of Input Parameters used in Mechanistic Analysis

MATERIAL	MODULUS	POISSON'S RATIO
Asphalt Concrete	2000, 4000, 6000MPa	0.40
Soil-Cement	300, 1000, 2000MPa	0.20
Lightly Bound CTGB	2000, 3500, 5000MPa	0.25
Heavily Bound CTGB	7000, 10000, 14000MPa	0.30
Aggregate Base	413, 689, 873MPa	0.40
Natural Material (subbase)	138, 310, 483MPa	0.40
Subgrade	100MPa	0.45
Tyre Load	40kN	
Tyre Contact Pressure	560kPa	
Radius	150mm	

3.3 Loading Conditions

Full axle loading on dual wheels as shown in Figure 2 was used. Eighty kilo Newton (80kN) spread on two wheels gave 40kN on each wheel. A contact pressure of 560kPa was used for the analysis.

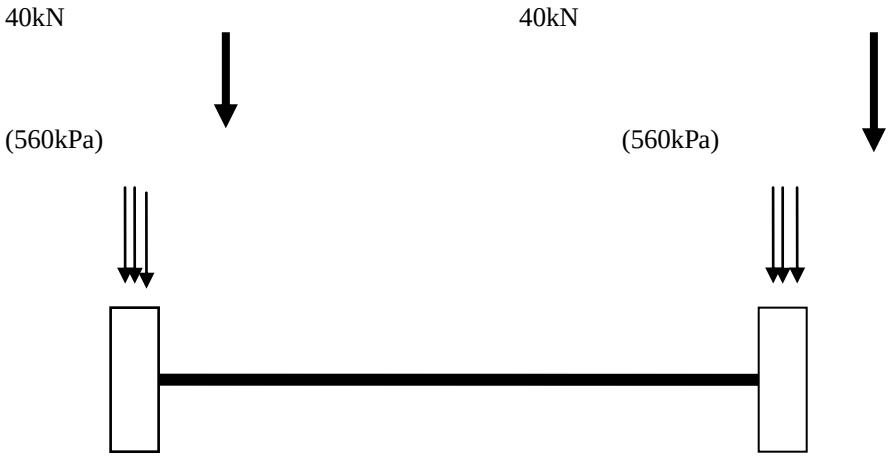

Figure 1: Standard axle load distribution for the analysis

3.4 Layered Elastic Computer Program

Due to the amount of computations involved, a layered elastic computer program was used. The program used is the *EVERSTRESS* developed by Sivaneswarem, Pierce and Mahoney for the Washington State Department of Transportation (WSDOT).

3.5 Failure Criteria

3.5.1 Asphalt concrete fatigue failure criterion

Claros and Ijeh (1987) presented a failure criterion model for the asphalt concrete as

$\text{Log } N_f = 15.947 - 3.291\text{Log } (Є_t/10^{-6}) - 0.854\text{Log } (E/10^3)$ ---------- (3)

Where:

N_f =failure criterion for asphalt concrete.

$Є_t$ =Horizontal tensile strain

E =Young Modulus of elasticity

This is computed using the horizontal strain at the bottom of the asphalt concrete

3.5.2 Subgrade rutting failure criterion

Also Claros and Ijeh (1987) presented a model for vertical compressive strain (Єv) at the top of the subgrade layer. This is determined by the relationship

$Єv = 1.36\ (10^{-2})\ (N)^{-0.2126}$ ---------- 4

Where terms are as defined previously.

3.5.3 Cemented layer cracking failure criterion

Otee et al (1982) developed a failure criterion model for cement-treated gravels (see Equation (5)).

$$Є/Є_b = 1 - 0.11LogN \quad \text{----------} \quad 5$$

Where
Є = allowable tensile strain
$Є_b$ = Strain at break
N =
The diagrams showing the strain at break to modulus can be found in Otee *et al*. (1982) or Aderinola (1999). Table 2 shows the allowable strains for all the failure criteria, also shown in brackets is the amount of ESAL considered.

Table 2: Allowable strains for all failure criteria

MATERIAL	MODULUS	ALLOWABLE STRAINS
Asphalt Concrete	2000MPa	183 (2.5m ESAL), 300(0.5m ESAL)
	4000MPa	152 (2.5m ESAL), 249 (0.5m ESAL)
	6000MPa	138 (2.5m ESAL), 224 (0.5m ESAL)
Soil-Cement	300MPa	78 (0.5m ESAL)
	1000MPa	58.5 (0.5m ESAL)
	2000MPa	47.4 (0.5m ESAL)
Lightly Bound CTGB	2000MPa	47.4 (2.5m ESAL)
	3500MPa	41.4 (2.5m ESAL)
	5000MPa	40.0 (2.5m ESAL)
Heavily Bound CTGB	7000MPa	38.5 (2.5m ESAL)
	10000MPa	35.5 (2.5m ESAL)
	14000MPa	32.6 (2.5m ESAL)
Subgrade	100MPa	593(2.5m ESAL), 835 (0.5m ESAL)

IV. RESULTS AND DISCUSSION

This section is the analysis of the results obtained for various characterization of the materials used. These materials are Asphalt Concrete (AC), Cement-Treated Gravel Base (CTGB), Soil-Cement (SC) base, Aggregate Base (AB) and soil subbase. Each base material was used for the analysis and comparison was made for all the materials. Table 4.1 to 4.4 show the various characterization of materials with Sub-grade of 100MPa for 0.5m ESAL.

Table 4.1: Mechanistic Analysis of Soil-Cement Base for subgrade of 100MPa for 0.5m ESAL

SUBGRADE			100 MPa			0.45		
MODULUS			Layer Thickness (cm)			STRAINS		
AC	SC	SB	AC	SC	SB	AC Fatigue	SC Cracking	SG Rutting
2000	500	138						
4000	500	138	15	45	30	112	71	99
6000	500	138	15	40	30	95	74	103
2000	500		10	58		161	76	161
4000	500		10	56		141	76	159
6000	500		10	55		123	75	156
2000	1000		10	57		76	55	118
4000	1000		10	55		79	55	116
6000	1000		10	54		75	55	115
2000	2000		10	50		26	45	99
4000	2000		10	47		35	46	100
6000	2000		10	48		38	47	101

Table 4.2: Mechanistic analysis of Aggregate Base for Subgrade 100MPa for 0.5m ESAL

SUBGRADE				100	MPa	Poisson Ratio 0.45	
MODULUS			Layer Thickness (cm)			STRAINS	
AC	AB	SB	AC	AB	SB	AC Fatigue	SG Rutting
2000	413	138	5	15	15	172	717
4000	413	138	5	15	10	155	753
6000	413	138	5	15	10	204	814
2000	413	483	5	15	10	205	774
4000	413	483	5	10	15	176	751
6000	413	483	5	10	15	176	671
2000	689	138	5	10	15	89	824
4000	689	138	5	10	15	145	757
6000	689	138	5	10	15	160	718
2000	689	483	5	10	12	65	785
4000	689	483	5	10	10	111	808
6000	689	483	5	10	10	125	771

Table 4.3: Mechanistic analysis of Cement-Treated Gravel Base for Subgrade 100MPa for 2.5m ESAL

SUBGRADE			100	MPa	Poisson Ratio	0.45
MODULUS		Layer Thickness (cm)		STRAINS		
AC	CTGB	AC	CTGB	AC Fatigue	CTGB Cracking	SG Rutting
2000	2000	10	50	26	45.0	99
4000	2000	10	47	35	46.0	100
6000	2000	10	48	38	46.8	101
2000	3500	10	43	8.2	39.4	89.8
4000	3500	10	40	15.5	40.4	91.5
6000	3500	10	38	19.2	41.3	92.9
2000	5000	15	33	-1.37	38.6	90.3
4000	5000	10	35	5.07	40.0	93.5
6000	5000	10	33	9.3	39.4	91.6

Table 4.4: Mechanistic analysis of Aggregate Base for Subgrade 100MPa for 0.5m ESAL

SUBGRADE				100	MPa	0.45	
MODULUS			Layer Thickness (cm)			STRAINS	
AC	AB	SB	AC	AB	SB	AC Fatigue	SG Rutting
2000	413	138	5	20	20	161	497
4000	413	138	15	20	15	148	257
6000	413	138	15	20	20	120	204
2000	413	483	5	15	20	153	476
4000	413	483	15	15	15	139	270
6000	413	483	15	15	10	117	238
2000	689	138	5	15	20	61	510
4000	689	138	10	20	15	138	313
6000	689	138	10	20	20	125	255
2000	689	483	5	15	15	61	525
4000	689	483	10	15	10	137	419
6000	689	483	10	15	15	120	322

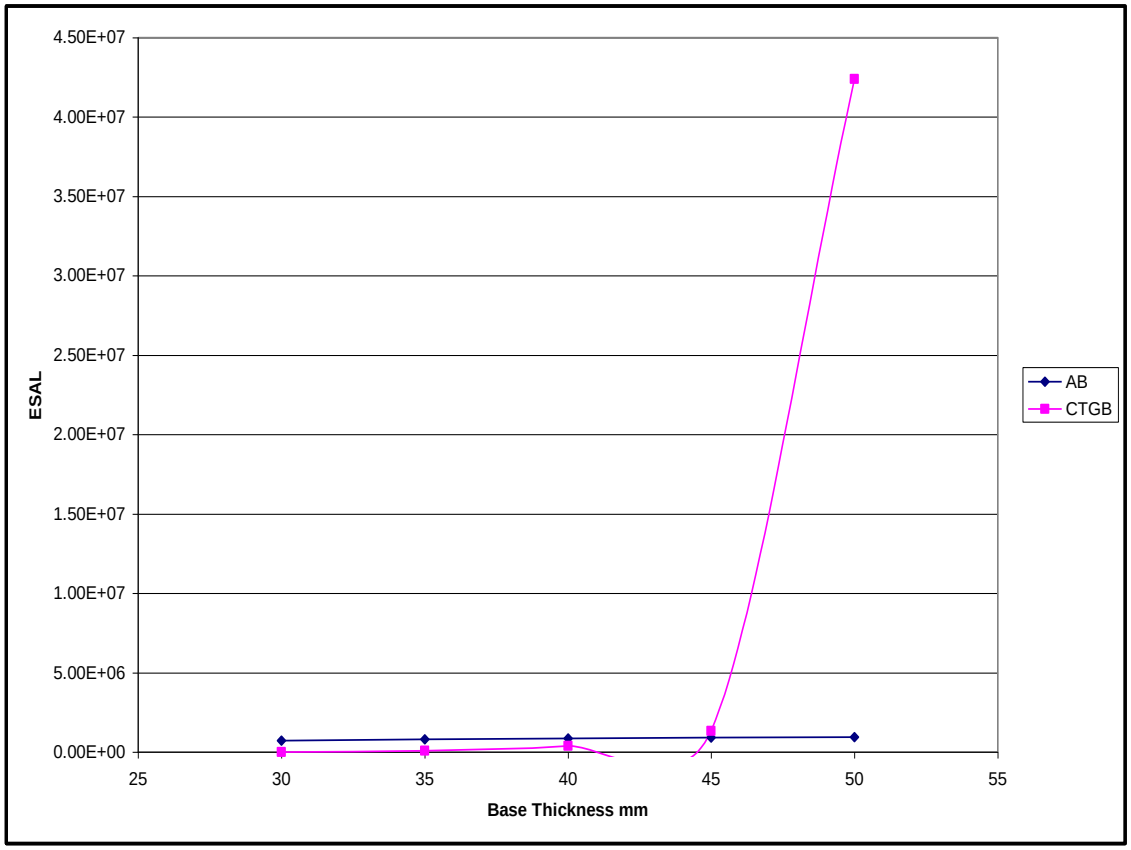

Figure 4.1: Comparison of varying thickness of base for CTAB and AB under 100mm of AC surface

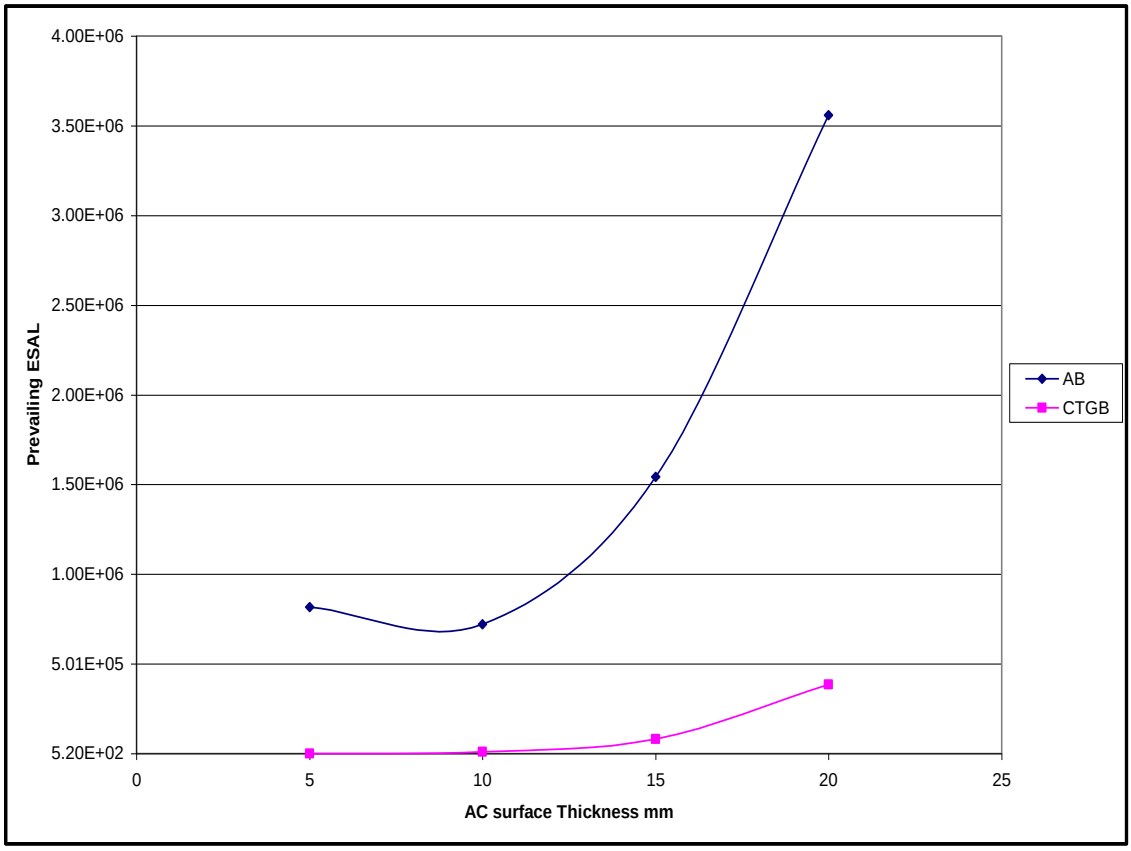

Figure 4.2: Comparison of varying thickness of the AC surface over 300mm of base (CTGB and AB)

Table 4.1 shows mechanistic analysis for the soil-cement (SC) base for an ESAL of 0.5 million with subgrade modulus 100MPa. From this table, the use of subbase with the SC base could not produce results with the 2000MPa AC surface and 500MPa SC base and this was therefore avoided. The use of subbase did not produce results with 100mm of AC surface; the AC surface thickness was therefore increased to 150mm before tangible results were obtained. Another series of analyses were run without the subbase and it was observed that tangible results were obtained with the 100mm of AC surface. This is because the prevailing failure criterion (that of SC base layer) which meant that the presence of subbase has no tangible influence on the pavement. This also did not allow the increase of the SC base thickness. For the analysis of SC base, the subbase was avoided. Increase in the AC surface modulus as well as that of the SC base modulus, brought about a decrease in the thickness of the pavement. 6000MPa of AC surface with 2000MPa of SC base gave the best results of 100mm AC surface with 450mm SC base. The worst result obtained was 100mm AC surface over 580mm SC base from 2000MPa AC surface over 500MPa SC base.

Table 4.2 shows mechanistic analysis of aggregate base, AB (crushed stone) for an ESAL of 0.5 million. The results were consistent with only a difference of 50mm from the base and subbase. Increase in any of the modulus brought about decrease of the pavement thickness. The worst results obtained were from 2000MPa AC, 413MPa AB, 138MPa SB with 50mm AC, 150mmAB, 150mm SB; while the best came from 6000MPa AC, 689MPa, 483MPa with 50mm AC, 100mm and 100mm SB.

Cost analysis of SC base and AB on Table 4.3 shows N5678/m^2 and N3285/m^2 respectively. This shows that the AB is far cheaper than SC base and therefore better for use when a low ESAL is involved (say ESAL 0.5 million).

Table 4.4 shows mechanistic analysis for the CTGB for an ESAL of 2.5 million. From Table 4.3, the use of subbase with CTGB was avoided; this was done because the modulus of the SB was far less than that of CTGB, thereby making its presence irrelevant. The analysis of SC on Table 4.1, also attest to this method. The worse result obtained was with 100mm AC over 430mm CTGB. An unexpected result occurred at 5000MPa CTGB overlaid by 2000MPa of AC which gave horizontal compressive strains instead of tensile strains. This occurred because the AC surface modulus was far lower than the CTGB modulus, thereby making the AC surface behaves as lean under the base. Australian Stabilisation Association in its guidelines provided that when a lean AC surface with low modulus is underlain by cemented layer with high modulus, the analysis is likely to show that the AC surface will not act normally. The best case analysed was with 100mm and 380mm CTGB at 6000MPa AC over 5000MPa CTGB.

Figures 4.1 and 4.2 show that adequate improvement of the pavement cannot be achieved with the increment of the base for the AB but at 400mm, further increase in the CTGB base brings about appreciable increase in the pavement structure. Increase in the AC surface brings about appreciable increase in the properties of the pavement with AB while it does not improve a pavement with CTGB. This implies that the CTGB would provide a better pavement structure since the AC surface is more expensive than other pavement materials.

V. CONCLUSION

A mechanistic-empirical pavement design method for the cement-treated base has been developed for use in Nigeria. Also, proper characterization has been done to compare both the cement-treated materials (soil-cement and Cement Treated Gravel Base) and Aggregate Base (crushed stone). The mechanistic-empirical design has proved that any material could be characterised for pavement design thereby allowing for the flexibility of choice of materials by the designer. The Cement-Treated Gravel Base proves to be a better material than the Aggregate Base for heavily trafficked roads.

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Swelling Properties of Expansive Soils Treated with Chemicals and Flyash

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***Abstract*: -** Expansive soil shows recurrent volume changes with the changes moisture content, causing serious problems to the civil engineering structures such as road pavements resting on them. Several attempts are being made all over the world to control the swell shrink behavior of expansive soils. Flexible Pavements constructed on these soil shows signs of damage continuously during the service life of the pavement causes an increase in the maintenance costs. Numerous methods are available in the stabilization of expansive subgrade soil. Many researchers have made an attempt with the chemical stabilization technique, it has gained prominence due to its easy applicability and adaptability. Flyash is freely available waste product which has little cementing property can be used for altering the characteristics of expansive soil. The main objective of this work is to study the swelling properties of the expansive subgrade soil treated with chemicals like Magnesium Chloride ($MgCl_2$), Aluminum Chloride ($AlCl_3$) and also by adding flyash in varying percentages. The swelling properties of the collected expansive soil samples were determined based on the parameters like Free Swell Index, Swell Potential and Swell Pressure. The results obtained from the experimental study indicate that the measured Free Swell, Swell Potential and Swelling Pressure are reduced substantially with the increasing percent of chemicals and flyash and remain stable after reaching certain concentration. This paper discusses the results of the testing.

***Keywords*: -** *Expansive soil, Swell Pressure, Swell Potential, Chloride Compound Chemicals, Flyash*

I. INTRODUCTION

Expansive soils generally called as Black Cotton Soils covers nearly twenty percent of the geographical area in India. Differential Thermal Analysis and X-ray diffraction pattern analysis have shown that montmorillonite mineral is predominant in expansive soil [1]. These soils contain high percentages of clay with predominant montmorillonite mineral in it causing the soil to swell and shrink during drying and wetting. The nature of these soils creating a problem to the civil engineering structures particularly flexible pavements constructed on them. Many Highway agencies, private organizations and researchers are doing extensive studies on this problem and its remedial measures. Calcium based stabilizers such as lime is used widely throughout the world for the treatment of expansive soils [2]. Chemicals like Potassium Chloride (KCl), Calcium Chloride($CaCl_2$) and Ferric Chloride($FeCl_3$) can be used effectively in place of lime, because these chemicals are dissolvable in water making it to mix easily with soil and supply adequate cations [3] [4]. There is an increase in strength and reduction in swelling is observed with the addition of CaCl2 & KOH to the expansive soil [5]. The properties of black cotton soils in place can be altered by treating with aqueous solution of KOH [6]. There is a hypothesis that if the aluminum is introduced into the soil it will precipitate into the pore space, thus strengthening the soil [7] [8]. CBR, UCS and indirect tensile strength of expansive soil are greatly improved with the addition of Sodium Chloride (NaCl) as a stabilizer [9]. When ammonium chloride is added to the expansive soil, it removes ionized water and draws the lattice together, but the ammonium ions reduces the capillarity in the soil requiring more thorough mixing of the soil [10]. Increase in max dry density and the corresponding reduction in Optimum Moisture Content values were observed with the addition of varying percentages of Magnesium Chloride ($MgCl_2$) and Sodium Chloride (NaCl) chemicals [11]. Oedometer free swell tests conducted on the flyash mixed specimens, confirmed that the plasticity index, activity and swelling

potential of the samples decreased with the increasing percent stabilizer and curing time and the optimum content of flyash in decreasing the swell potential was found to be 20% [12]. The variation of CBR of flyash and black cotton soil mixes can be attributed to the relative contribution of frictional or cohesive resistance from flyash or black cotton soil respectively {13]. The undrained shear strength of of the expansive soil blended with flyash increases with the increase in the flyash content [14]. The tests carried out with different proportions of flyash added with the soil having high plasticity indicated that the workability is maximum and the dry density observed is maximum with the addition of 25% flyash [15]. Keeping in view of the influence of various chemicals and flyash in the stabilization of expansive soil an attempt is made in this work to study the swelling properties of the expansive soil with the addition of chemicals like Magnesium Chloride ($MgCl_2$), Aluminum Chloride ($AlCl_3$) and flyash in varying percentages.

II. MATERIALS AND METHODS

Expansive Soil: In this study expansive soil sample having high degree of swelling and shrinkage is collected from Komaragiripatnam village, Amalapuram mandal of Andhra Pradesh, India. Soil is collected at a depth of 1.5 mt below the ground level. The color of the soil is black and when tested in the laboratory it has a Differential Free Swell of 140%. The soil lies above the A-line of Unified Soil Classification System (USCS) and is classified as Inorganic Clay of High Plasticity. Hydrometer analysis indicates that the clay content is very high of nearly 70%. The Properties of the soil are presented in Table 1.

Chemicals: Chloride Compound Chemicals chosen in the present study are Magnesium Chloride ($MgCl_2$) and Aluminum Chloride ($AlCl_3$). These chemicals are easily soluble in water and uniform mixing can be easily achieved. These chemicals are added to the expansive soil samples in varying percentages of 0.5%, 1.0%, 1.5%, 2.0% of dry weight of soil.

Flyash: The Flyash used in this work is collected from Thermal Power Station, Vijayawada, A.P., India. The properties obtained from the laboratory testing are furnished in the Table 2.

Experimental Study: Laboratory experimentation is carried out as per the procedures given in the Indian Standard Codes. Free Swell Index as per IS2720(Part XL)–1977, Max Dry Density & OMC as per IS2720(Part 7&8)-1983, Swell Pressure Testing as per IS2720(Part XLI)-1977.

Free Swell Index: The determination of free swell index also known as differential free swell of soil helps to identify the potential of a soil to swell which might need further detailed investigation regarding swelling and swelling pressures under different field conditions. In this method 10 grams of oven-dried soil sample passing through 425 Micron sieve is poured in two graduated cylinders of 100 ml capacity. One cylinder shall then be filled with kerosene oil and the other with distilled writer up to the 100 ml mark. After removal of entrapped air by stirring with glass rod, the soils in both the cylinders shall be allowed to settle. Sufficient time (not less than 24 hours) shall be allowed for the soil sample to attain equilibrium state of volume.

Free Swell Index = $[(V_d - V_k)/V_k] \times 100$

Where V_d and V_k are the final volumes of soil sample in water and kerosene.

Swell Potential: Swell Potential of a soil specimen is the ratio of the increase in thickness to the original thickness of a soil specimen compacted at OMC in a consolidation ring, soaked under a surcharge load of 7 KPa and is expressed as a percentage.

Swelling Pressure: Swelling Pressure is the pressure at which the expansive soil exerts if the soil is not allowed to swell or the volume change of the soil is arrested. In this study it is determined as per IS2720 (Part XLI)-1977 using the Consolidometer method. Samples of diameter of 60mm and thickness 20 mm are used. Samples are prepared at Max Dry Density and Optimum Moisture Content. During testing sample was kept always submerged in water. Free swell of the sample is allowed for 6 days under the seating load of 5 KPa. The swollen sample shall then be subjected to consolidation under different pressures till the specimen attains its original volume. A plot of change in thickness of expanded specimen as ordinate and applied consolidation pressure as abscissa in semi-logarithmic scale shall be made. The swelling pressure exerted by the soil specimen under zero swelling condition shall be obtained by interpolation and is expressed in KPa.

III. RESULTS AND DISCUSSION

Effect of Additives on Differential Free Swell:

The influence of additives on the values of Differential Free Swell is shown in Fig 1 & 2. Untreated soil sample is having a DFS value of nearly 140 which shows that the potential of soil for free swell is very high and the soil can be treated as highly expansive. With the addition of chemicals Magnesium Chloride (MgCl2) and Aluminum Chloride (AlCl3) separately, it is observed that there is a considerable reduction in the DFS values. For both the chemicals the reduction is significant up to the addition of 1% chemical and is nominal afterwards. The reduction in the value of DFS at 1% chemical and 0% flyash are of the order of 54% and 46% for AlCl3, MgCl2 respectively. Whereas the reduction in the values of DFS at 1% chemical+10% flyash are of the order of 64% and 54% for $AlCl_3$ and $MgCl_2$ treatments respectively.

Effect of Additives on Swell Potential:

The variation of the swell potential with the addition of the chemicals and flyash is shown in Fig 3 & 4. Samples are prepared at max dry density and optimum moisture content. Untrated sample is having a swell potential of 20.6% and is gradually reduced to 9.4% and 10.5% with the addition of 2% $AlCl_3$, $MgCl_2$ respectively. And addition of flyash has its effect in reducing the swell potential. Addition of 1% chemical and 10% flyash is considered as optimum and the swell potential reduced to 6.5% and 7.6% for $AlCl_3$, $MgCl_2$ respectively.

Effect of Additives on Swell Pressure:

Swell pressure testing is carried out on the samples prepared at Max Dry Density of 1.551 g/cc and Optimum Moisture Content of 24.70%. Consolidometer method of testing is used. Samples are allowed to swell under a seating load of 5 KPa and then the swollen sample is subjected to consolidation under different pressures. Fig 5 & 6 depict the variation of Swell Pressure with the addition of increasing percent of chemicals and flyash to the expansive soil samples. It is observed that the swell pressure values are reduce by 44% and 52% with the treatment of 1% $MgCl_2$, and $AlCl_3$ respectively. Similarly these values reduced to 69% and 73% with addition of 1% chemical and 10% flyash for $MgCl_2$ and $AlCl_3$ respectively and are considered as the most approving combination.

IV. FIGURES AND TABLES

Table 1:Properties of Expansive Soil

Field Data	
Field Moisture Content (%)	46.40 %
Field Bulk Density (g/cc)	1.820 g/cc
Field Dry Density (g/cc)	1.243 g/cc
Specific Gravity	2.613
Differential Free Swell (%)	140 %
Sieve Analysis	
Fine Sand	2 %
Silt	28 %
Clay	70 %
Consistency Limits	
Liquid Limit (LL)	85.23%
Plastic Limit (PL)	33.10%
Plasticity Index (PI)	52.13%
Shrinkage Limit (SL)	12.00%
Compaction Properties	
Max Dry Density (γd)	1.551 g/cc
Optimum Moisture Content	24.70 %
Unconfined Compressive Strength	94 KPa
Cohesion (c)	0.32
Angle of Internal Friction (φ)	$3^0 40'$
CBR (soaked)	2.02
Swell Pressure	295 KPa
Soil Classification	CH

Table 2:Properties of Flyash

Specific Gravity	1.950
Liquid Limit (LL)	25%
Max Dry Density (γd)	1.35 g/cc
Optimum Moisture Content	24.20 %
CBR (soaked)	8
Sieve Analysis	
Fine Sand	25 %
Silt	70 %
Clay	5 %

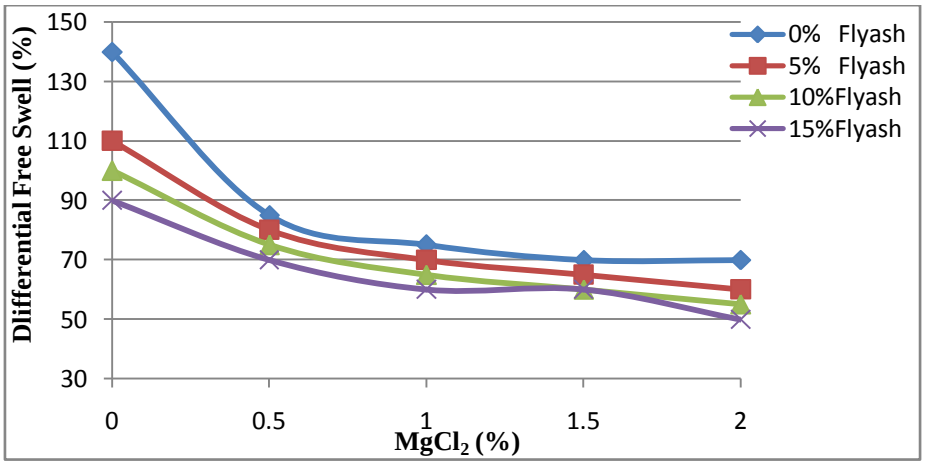

Fig.1 Variation of DFS for Soil+MgCl2+Flyash Mixes.

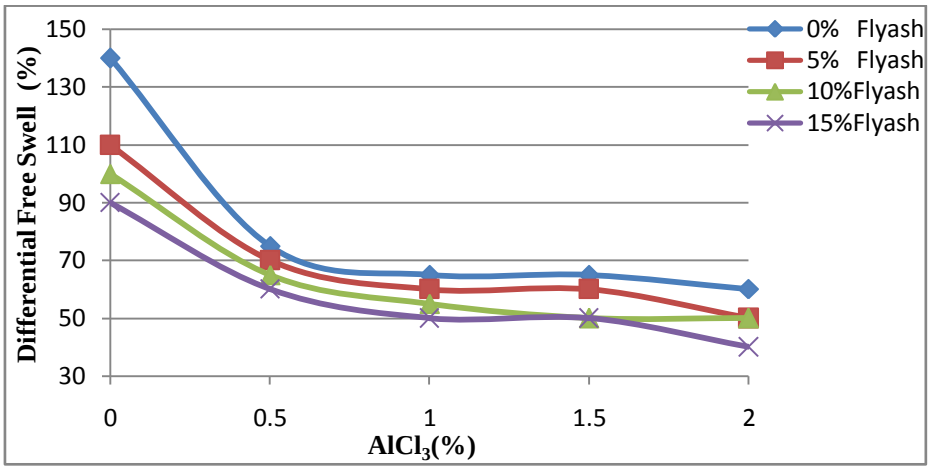

Fig.2 Variation of DFS for Soil+AlCl3+Flyash Mixes

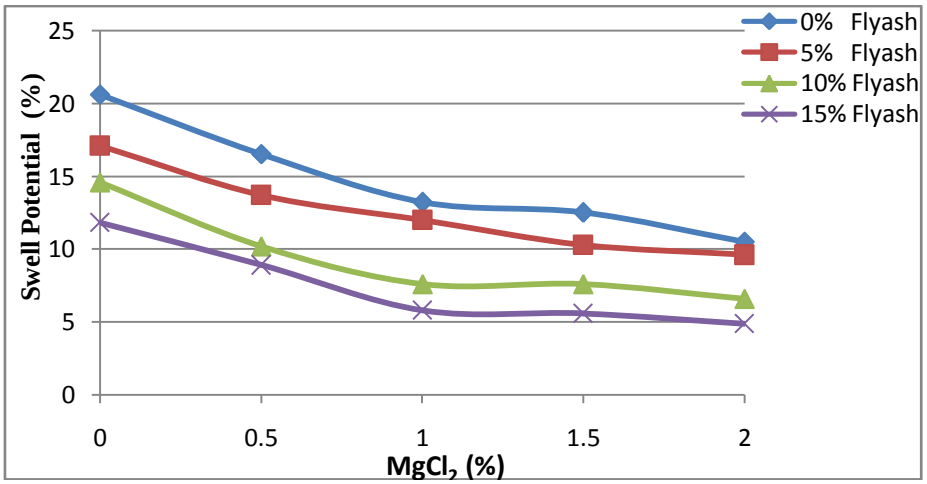

Fig.3 Variation of Swell Potential for Soil+$MgCl_2$+Flyash Mixes.

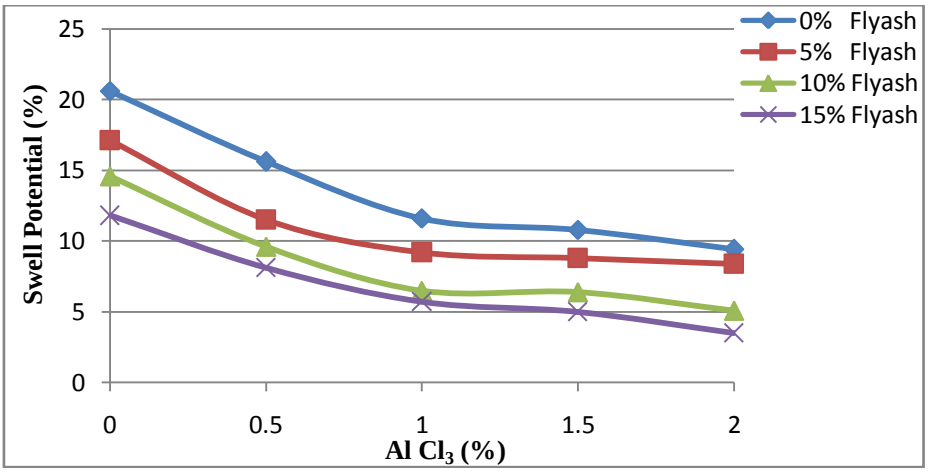

Fig.4 Variation of Swell Potential for Soil+$AlCl_3$+Flyash Mixes

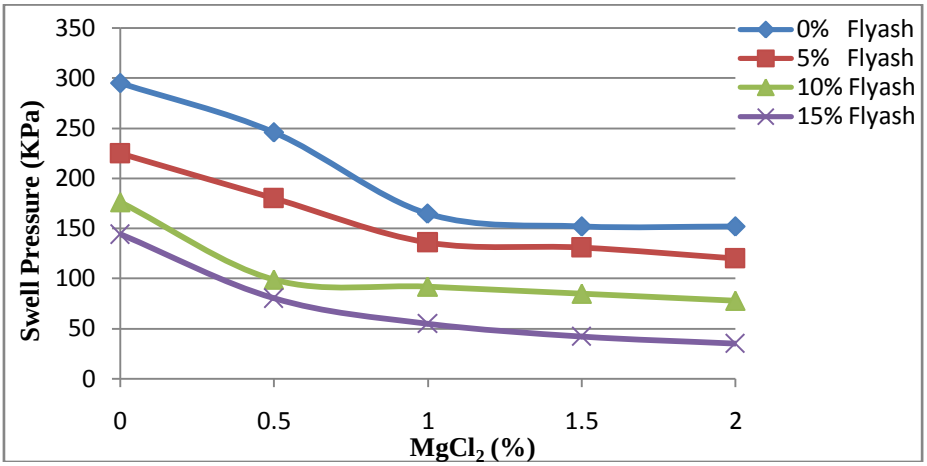

Fig.5 Variation of Swell Pressure for Soil+$MgCl_2$+Flyash Mixes.

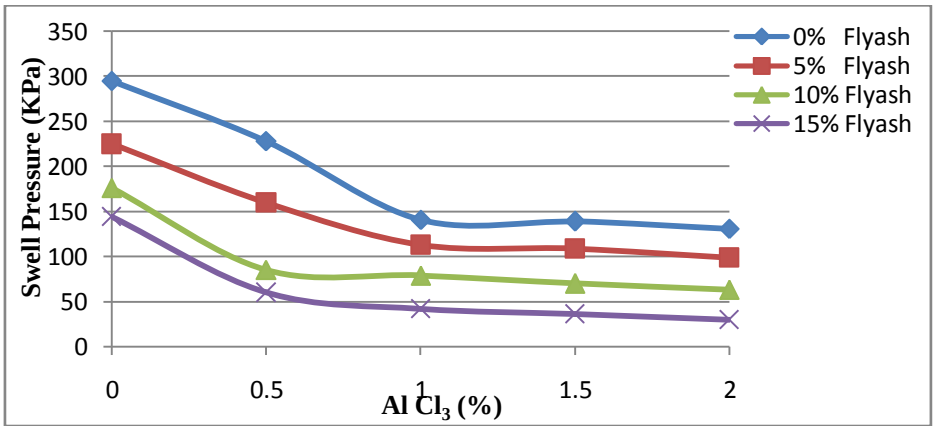

Fig.6 Variation of Swell Pressure for Soil+$AlCl_3$+Flyash Mixes

V. CONCLUSIONS

The following conclusions are drawn based on the present laboratory study. Engineering Properties of the collected expansive soil samples indicate that soil samples comes under CH group. The Differential Free Swell value of the soil is 140%, indicating that the soil is highly expansive. Consistency limits indicate that the soil is high plasticity. The Swelling Pressure value is very high of the order of 295 KPa. From the experimental study it is observed that the treatment of the expansive soil with Aluminum Chloride ($AlCl_3$) and flyash at 1% and 10% respectively is more effective than the other. There is a steep reduction in the DFS value of the expansive soil in the beginning, up to 1% addition of chemicals and is nominal afterwards. The percentage reduction in DFS value for the addition of 1% chemical and 10% flyash is 54% and 64% respectively for $MgCl_2$

and $AlCl_3$ chemicals. The reduction in swell potential and swell pressure is significant upto the addition of 1% chemical and 10% flyash. The percentage reduction in swell potential is 63%, 68% and swell pressure is 69%, 73% respectively for $MgCl_2$, $AlCl_3$ chemicals with flyash. Finally a conclusion can be made that the selected chemical and flyash combination is very effective in reducing the swell pressure, swell potential of the expansive soil considered.

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A Two Step Data Mining Approach for Amharic Text Classification

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Abstract: - Traditionally, text classifiers are built from labeled training examples (supervised). Labeling is usually done manually by human experts (or the users), which is a labor intensive and time consuming process. In the past few years, researchers have investigated various forms of semi-supervised learning to reduce the burden of manual labeling. In this paper is aimed to show as the accuracy of learned text classifiers can be improved by augmenting a small number of labeled training documents with a large pool of unlabeled documents. This is important because in many text classification problems obtaining training labels is expensive, while large quantities of unlabeled documents are readily available. In this paper, intended to implement an algorithm for learning from labeled and unlabeled documents based on the combination of Expectation- Maximization (EM) and two classifiers: Naive Bayes (NB) and locally weighted learning (LWL). NB first trains a classifier using the available labeled documents, and probabilistically labels the unlabeled documents while LWL uses a class of function approximation to build a model around the current point of interest. An experiment conducted on a mixture of labeled and unlabeled Amharic text documents showed that the new method achieved a significant performance in comparison with that of a supervised LWL and NB. The result also pointed out that the use of unlabeled data with EM reduces the classification absolute error by 27.6%. In general, since unlabeled documents are much less expensive and easier to collect than labeled documents, this method will be useful for text categorization tasks including online data sources such as web pages, e-mails and news group postings. If one uses this method, building text categorization systems will be significantly faster and less expensive than the supervised learning approach.

Keywords: - *Text Classification, Expectation Maximization, Naïve Bayes, LWL.*

I. INTRODUCTION

In recent times, there has been an explosive growth in the amount of data that is being collected in the business and scientific area. Data mining techniques can be used to discover useful patterns that in turn can be used for classifying new instances of data (Cherkassky and Mulier, 1998).

Knowledge discovery as a processis depicted in Figure 1 and consists of an iterative sequence of the following steps:

1. Data cleaning (to remove noise and inconsistent data).
2. Data integration (where multiple data sources may be combined).
3. Data selection (where data relevant to the analysis task are retrieved fromthe database).
4. Data transformation (where data are transformed or consolidated into forms appropriatefor mining by performingsummary or aggregation operations, for instance).
5. Data mining (an essential process where intelligent methods are applied in order toextract data patterns).
6. Pattern evaluation (to identify the truly interesting patterns representing knowledgebased on some interestingness measures).
7. Knowledge presentation (where visualization and knowledge representation techniquesare used to present the mined knowledge to the user).

Steps 1 to 4 are different forms of data preprocessing, where the data are preparedfor mining. The data mining step may interact with the user or a knowledge base. Theinteresting patterns are presented to the user and may be stored as new knowledge inthe knowledge base.

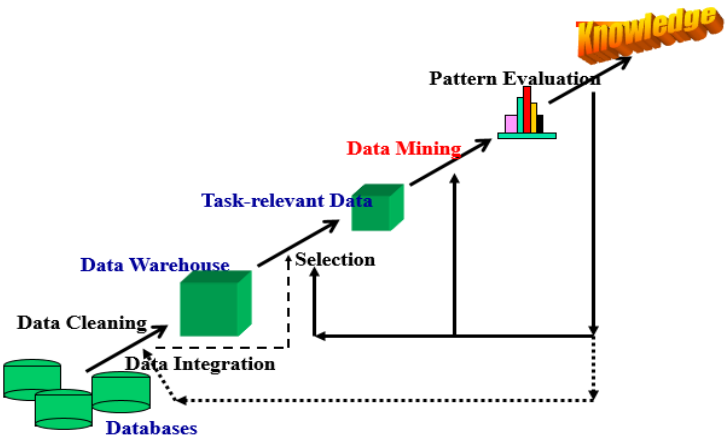

Figure 1. Knowledge Discovery (KDD) Process.

Classification is an important problem for machine learning and data mining research communities. The basic idea of a classification algorithm is to construct a classifier according to a given training set. Once the classifier is constructed, it can predict the class value(s) of unknown test data sample(s).Suppose we work for a web site that maintains a public listing of job openings from many different companies. A user of the web site might find new career opportunities by browsing all openings in a specific job category. However, these job postings are speared from the Web, and do not come with any category label. Instead of reading each job post to manually determine the label, it would be helpful to have a system that automatically examines the text and makes the decision itself. This automatic process is called *text classification*. Text classification systems categorize documents into one (or several) of a set of pre-defined topics of interest.

Text classification is of great practical importance today given the massive volume of online text available. In recent years, there has been an explosion of electronic text from the World Wide Web, electronic mail, corporate databases, chat rooms, and digital libraries. One way of organizing this overwhelming amount of data is to classify it into descriptive or topical taxonomies. For example, Yahoo maintains a large topic hierarchy of web pages. By automatically populating and maintaining these taxonomies, we can aid people in their search for knowledge and information.

The classic approach to build a text classifier is to first (often manually) label a set of training documents, and then apply a learning algorithm to build the classifier. Manual labeling of a large set of training documents is a bottleneck of this approach as it is a time consuming process. To deal with this problem, (Nigam *et al.*, 2000; Blum & Mitchell, 1998) propose the idea of using a small labeled set of every class and a large unlabeled set for classifier building. These research efforts aim to reduce the burden of manual labeling.

This paper uses Expectation-Maximization (EM) to learn classifiers that take advantage of both labeled and unlabeled data. EM is a class of iterative algorithms for maximum likelihood or maximum a posteriori estimation in problems with incomplete data (Dempster, Laird, & Rubin, 1977). In our case, the unlabeled data are considered incomplete because they come without class labels. The algorithm first trains a classifier with only the available labeled documents, and uses the classifier to assign probabilistically weighted class labels to each unlabeled document by calculating the expectation of the missing class labels. It then trains a new classifier using all the documents both the originally labeled and the formerly unlabeled and iterates. In its maximum likelihood formulation, EM-performs hill-climbing in data likelihood space, finding the classifier parameters that locally maximize the likelihood of all the data both the labeled and the unlabeled. We combine EM with Naive Bayes, and EM with LWL classifiers that are commonly used in text classification.

The data pre-processing carried out in this research involved developing and adopting tools for:

• Data cleaning which involves removal of repeated news items, manual classification ofunclassified news items, removal of entry errors, etc.
• Identifying and removing stop words and word affixes.
• Correcting for commonly missing letters in VG2 which sometimes occur during dataconversion.
• Normalizing the different letters of the Amharic script that have the same sound.
• Correcting major spelling variations in words focusing in transliteration problems.
• Analyzing compound words to correct for inconsistent usage of the compound words (the use of compound words sometimes as a single-word and sometimes as two or more words) as well as to give consideration for the semantics of the compound words. Moreover, the processed Amharic documents were collected in their pre-defined categories and the whole data were changed to arff (attribute reference file format) file format, which is suitable for the Weka open source application package used for the automatic classification.

The goal of this paper is to demonstrate that supervised learning algorithms using a small number of labeled examples and a large number of *unlabeled* examples create high accuracy text classifiers. In general, unlabeled examples are much less expensive and easier to come by than labeled examples. This is particularly true for text classification tasks involving online data sources, such as web pages, email, and news stories, where huge amounts of unlabeled text are readily available. Collecting this text can frequently be done automatically, so it is feasible to quickly gather a large set of unlabeled examples. If unlabeled data can be integrated into supervised learning, then building text classification systems will be significantly faster and less expensive than before.

II. PREVIOUS WORKS

Expectation-Maximization is a well-known family of algorithms with a long history and many applications. Its application to classification is not new in the statistics literature. The idea of using an EM-like procedure to improve a classifier by" treating the unclassified data as incomplete" is mentioned by R. J. A. Little among the published responses to the original EM paper (Dempster et al., 1977). A discussion of this "partial classification" paradigm and descriptions of further references are made by McLachlan and Basford (1988: p 29).

2.1. Comparison of the proposed method:

Different researches have been conducted on Amharic text categorization from supervised documents **(**Zelalem, 2001; Surafel, 2003; yohannes, 2007; Worku, 2009; Alemu 2010).

However, this paper is different since it deals with semi supervised learning approach.

Gebrehiwot (2011) conducted research on Tigrigna text categorization from unlabeled documents using repeated bisection and direct k-means for clustering and SVM techniques for classification. He showed that SMO support vector classifiers perform better than j48 and decision tree classifiers. He also pointed out the ambiguity of Tigrigna language which demands further research to apply ontology-based hierarchical text categorization. However, he used feature selection having high discriminative power which is not a simple task. This paper doesn't use any feature selection.

Recent work by some of the authors combines active learning with Expectation- Maximization (McCallum & Nigam, 1998). EM is applied to the unlabeled documents both to help inform the algorithm's choice of documents for labeling requests, and also to boost accuracy using the documents that remain unlabeled (as in this paper). Experimental results show that the combination of active learning and EM requires only slightly more than half as many labeled training examples to achieve the same accuracy as either active learning or EM alone. Our method is different since it doesn't need large number of training examples.

Our work is an example of applying EM to fill in missing values for which the missing values are the class labels of the unlabeled training examples. Work by Ghahramani and Jordan (1994) is another example in the machine learning literature of using EM with mixture models to fill in missing values. Whereas we focus on data where the class labels are missing, they focus on data where features other than the class labels are missing.

Recent work by (Basu, Banerjee & Monney, 2002, cited in Yu, et al., 2003) tries to bring clustering closer to classification by using a small number of labeled documents as seeds to initialize *k*-means clustering. The original *k*-means algorithm selects initial seeds randomly. Again, this paper is different. It only uses EM for categorizing classes to clusters and fill in the missing values from large unlabeled documents.

Yu, et al. 2003, propose a method to solve the problem of supervised learning by combining clustering with EM and feature selection. The technique can effectively rank the words in the unlabeled set according to their importance. The user then selects some words from the ranked list for each class. This process requires less effort than providing words with no help or manual labeling of documents. But this paper is different since it doesn't use any feature selection for classifying a mixture of labeled and unlabeled documents.

III. TECHNIQUES FOR AMHARIC TEXT CLASSIFICATION

We show an outline drawing about a whole flow of general text classification process in Fig. 2. A procedure of general text classification is as indicated below.

1. Data Selection: We extract training data and test data necessary for classification process from original data.

2. Preprocessing: In general, since training data and test data which we just extract include noises, we usually remove them. Especially in text classification, we carry out preprocessing for the data, which includes a removal of disabled words, a conversion from a plural form to a singular form, and conversion derivative words into ones with an original form.

3. Feature Selection: We carry out feature selection from preprocessed training data. In this process, there are some methods for feature selection due to difference of ways to express documents.

4. Making Vectors: We convert all the test data into document vectors based on selected features.

5. Text Classification: We apply text classification algorithms to the document-vectorized test data, and classify documents into categories. In this process, there are some methods for text classification due to difference of ways to build up documents and different machine learning algorithms are proposed.

6. Evaluation: We determine classification accuracy by using some measure for evaluation.

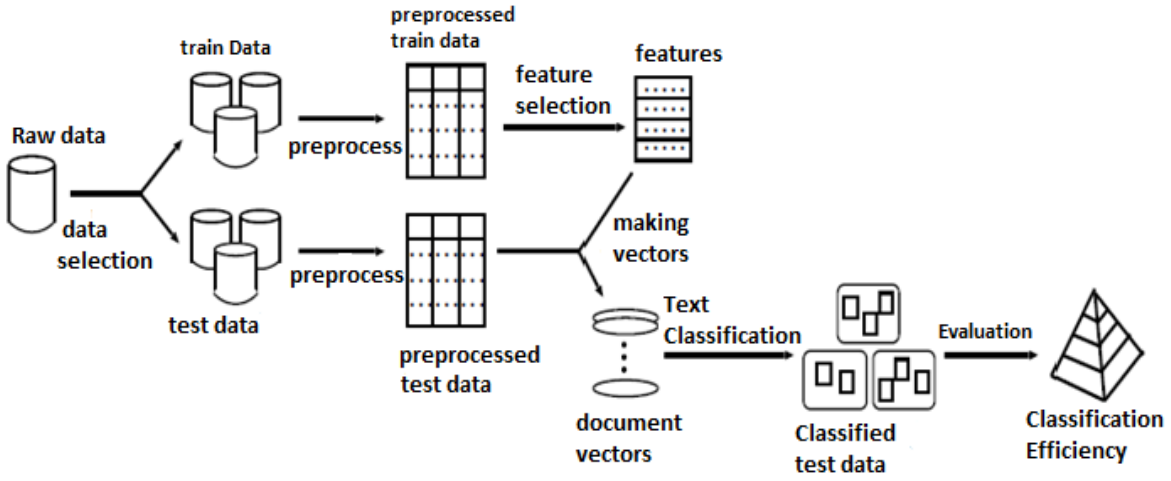

Figure 2. Flow diagram of text classification process.

The basic tools and techniques required to classify Amharic documents are text preprocessing, document clustering, and classifier model building. In order to preprocess the Amharic documents, different text preprocessing techniques such as tokenization, stemming, and stop word removal are used.

3.1.Document clustering:

Document clustering is used to discover natural groups in data set without having any background knowledge of the characteristics of the data in the documents. There are different document clustering algorithms. They are mainly divided in to hierarchical and partitioning clustering algorithms (Matthew, 2004). We used an expectation maximization(EM) a partitioning clustering algorithms to cluster a set of Amharic documents directly in to a set of groups (clusters) from a mixture of labeled and unlabeled documents.

3.1.1. The EM Algorithm:

An expectation-maximization (EM) algorithm is used in statistics for finding maximum likelihood estimates of parameters in probabilistic models, where the model depends on unobserved latent variables. EM alternates between performing an expectation (E) step, which computes an expectation of the likelihood by including the latent variables as if they were observed, and maximization (M) step, which computes the maximum likelihood estimates of the parameters by maximizing the expected likelihood found on the E step. The parameters found on the M step are then used to begin another E step, and the process is repeated (Dempster et al. 1997). The EM algorithm is a popular class of iterative algorithms for maximum likelihood estimation for problems involving missing data. It is often used to fill the missing values in the data using existing values (Li et al., 2004).

3.1.2. Assumptions of basic EM.

- The data is produced by a mixture model.
- There is a one-to-one correspondence between mixture components and classes.
- These assumptions are usually violated by real-world textual data.
- The benefits of unlabeled data are less clear when the assumptions don't hold.

3.2. Construction of Text Classifiers.

Many statistical classification algorithms and machine learning techniques have been successfully applied to text categorization. These include methods such as Naïve Bayes, SVM, Decision Tree, Linear Discriminant Analysis (LDA) (Hull, 1996), Neural Networks, KNN, and the likes (Pan, 2006). Here we introduce only those methods that are directly relevant to this work, as we apply them to our classification task.

The clustered documents using EM are used to classify Amharic documents using the naïve Bayes and locally weighted learning classifiers. As a result, the best classification scheme from the two above constructs a model from the cluster categories of the training collection.

3.2.1. Lazy methods

Lazy learning methods defer processing of training data until a query needs to be answered. This approach usually involves storing the training data in memory, and finding relevant data from the data base to answer a particular query. This type of learning is also referred to as memory-based learning. Relevance is often measured using a distance function with high points having high relevance. Locally Weighted learning that uses locally weighted training to average, interpolate between, extrapolate from, or otherwise combine training data (Vapnik, 1992 cited in Christopher G., 1999).

In most learning methods a single global model is used to fit all of the training data. Since the query to be answered is known during processing of training data, training query specific local models is possible in lazy learning. Local models attempt to fit the training data only in a region around the location of the query (the query point).

Learning process will be started on the stored examples only after when a new query instance is encountered (Mitchell, 1997). Nearest Neighbor algorithm is the one of the most basic instance-based methods. The instance space is defined in terms of Euclidean distance. However, since Euclidean distance is inadequate for many domains, several improvements were proposed to the instance-based nearest neighbor algorithm which are known as IB1 to IB5 (Martin, 1995).

The Locally Weighted Learning algorithm (LWL) is similar to other lazy learning methods; however it behaves differently when classifying a new instance. LWL algorithm constructs a new Naïve Bayes model using a weighted set of training instances (Frank et al., 2003). It empirically outperforms both standard Naïve Bayes as well as nearest-neighbor methods on most data sets tested by those authors. The study uses LWL as a classifier on the Amharic text data.

IV. THE PROPOSED METHOD

The specific approach we described here is based on a combination of three well-known learning algorithms: the Naive Bayes classifier (Lewis & Ringuette 1994; McCallum & Nigam 1998) and the Expectation-Maximization (EM) algorithm (Dempster, Laird, & Rubin 1977). The Naive Bayes algorithm is one of a class of statistical text classifiers that uses word frequencies as features. In addition to Naive Bayes, a lazy method called locally weighted learning (LWL) is also applied for classifying large unlabeled and few labeled documents.

A mixture of both labeled and unlabeled text documents collected from ENA are used to conduct the experiment on Amharic text classification. A two-step approach is used to classify Amharic documents. We first use EM clustering algorithm to group classes to clusters of the mixture document so that both labeled and unlabeled documents will be clustered to the predefined classes. The second step uses different text classifying algorithms to predict the documents to their predefined categories. The clustered data sets are used for training the text classifiers. Hence, the text classification model is developed from the training data sets using Naive Bayes (NB) and locally Weighted learner (LWL) classifying algorithms. Using the cross validation sampling method the model will be evaluated whether the unlabeled documents are correctly classified to their predefined classes or not.

4.1. The proposed System Architecture:

In the first stage the preprocessing makes the raw data ready for the experiment by removing irrelevant terms and stop words from the document. In the next stage, The EM technique applied to the case of labeled and unlabeled data with NB or LWL yields a straightforward and appealing algorithm. A schematic of this algorithm is shown in Figure 3. A NB (LWL) classifier is built in the standard supervised fashion from the limited amount of labeled training data. Then, we perform classification of the unlabeled data with the NB or LWL model.

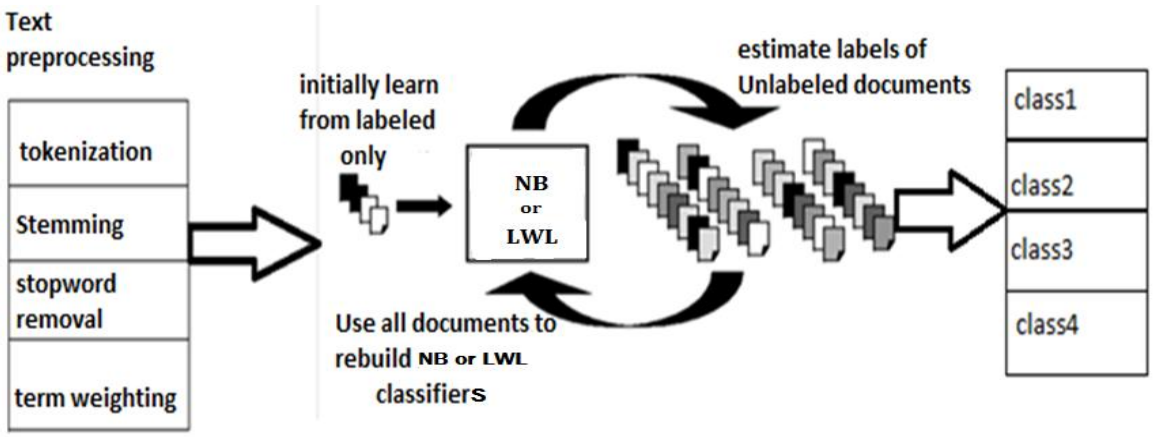

Figure 3. Text classifier from labeled and unlabeled data using EM.

4.2. Data Set for Text classification:

The data source for the study was the Ethiopian News Agency (ENA). The total number of Amharic news items randomly collected for this experiment is 1,952. Out of which 300 items are labeled by the expertise in ENA and 1,652 of them are unlabeled.

4.3. Clustering:

An expectation-maximization (EM) algorithm is used in statistics for finding maximum likelihood estimates of parameters in probabilistic models, where the model depends on unobserved latent variables. . EM alternates between performing an expectation (E) step, which computes an expectation of the likelihood by including the latent variables as if they were observed, and maximization (M) step, which computes the maximum likelihood estimates of the parameters by maximizing the expected likelihood found on the E step. The parameters found on the M step are then used to begin another E step, and the process is repeated (Dempster et al., 1997). The EM algorithm is a popular class of iterative algorithms for maximum likelihood estimation for problems involving missing data. It is often used to fill the missing values in the data using existing values (Li Xiaoli et al. 2004).

4.4. Classification:

Text classification is the process of assigning predefined category labels to new documents based on the classifier learnt from training examples, in which document classifier is first trained using documents with reassigned labels or classes picked from a set of labels, which we call the taxonomy or catalog. Once the classifier is trained, it is offered test documents for which it must guess the best labels.

In this paper two classifiers namely NB and LWL are used for classification purpose. An experiment is conducted on both traditional (without unlabeled documents) and with unlabeled documents (EM) as tabulated below.

V. RESULTS

The results of the classifiers on 120 labeled and 1,702 unlabeled documents can be summarized below.

	Traditional				Expectation Maximization			
Instances	NB		LWL		NB		LWL	
Correctly classified	54	45%	37	30.8%	1089	59.7%	1380	75.7%
Incorrectly classified	66	55%	83	69.1%	733	40.3%	442	24.3
Relative Absolute error	81.3%		81.4%		59.6%		53.8%	

Table 1. Summary table of the classifiers.

Disadvantage of supervised approach with expectation maximization algorithm is that, first of all the data should be labeled and hence increases the efforts and time consuming while the unlabeled data is useless here. In case the document fails to lie in pre-defined classes the approach is not able to classify that document and hence leading to decrease in efficiency of classifier.

In semi supervised approach unlabeled data is not useless; it has been used to train the classifier and in case the document fails to lie in pre-defined classes it leads to dynamically generation of new class to categorize that document and the database is updated automatically. This can be proved from the result of our experiment given

in table1. As we can understand from Table 1, EM decreases the absolute classification error for LWL (supervised) by 27.6% while for Naive Bayes by 21.7%.

On top of this, the LWL classifier with EM classifies 1,380 instances (75.7%) out of 1,822 correctly while NB-EM classifies 1,089 (59.7%) correctly. We can see that EM increases the accuracy of both supervised NB and LWL. On the other side, LWL with EM performs better than NB-EM for this Amharic text data. Hence the study uses LWL as the main classifier.

5.1 **Classification with and without unlabeled documents**

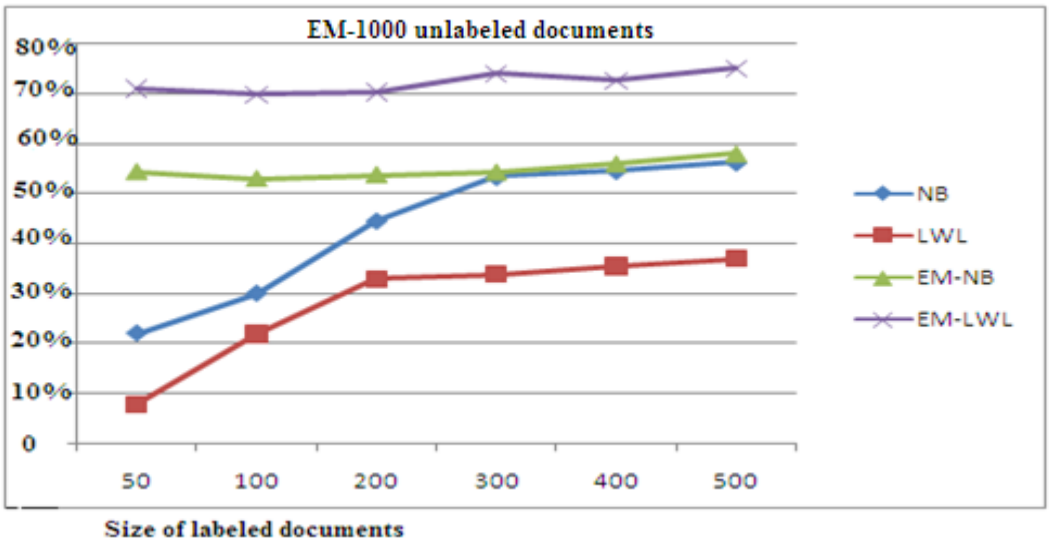

Figure 4. Classification accuracy with and with out 1,000 unlabeled documents

With small amounts of training data, using EM yields more accurate classifiers. With large amounts of labeled training data, accurate parameter estimates can be obtained without the use of unlabeled data, and the two methods begin to converge as can be seen in figure 4. Between NB and EM-NB. EM performs significantly better than traditional Naive Bayes and LWL as shown in figure 4. For example, with 200 labeled documents (20 documents per class), Naive Bayes reaches 44.5% accuracy while EM achieves 53.4%. For the same 200 labeled data, LWL reaches an accuracy of 33% while EM achieves 70.25%. Note that EM also performs well even with a very small number of labeled documents; with only 50 documents (five labeled document per class), Naive Bayes obtains an accuracy of 22%, while EM 53.8%. As expected, when there is a lot of labeled data, having unlabeled data does not help nearly as much, because there is already enough labeled data to accurately estimate the classifier parameters.

4.5. Testing Amharic Text Classification System:

Since the classes of the test documents are known, the researchers compare actual class label of each document with that of the predicted from the result shown in figure 4. as summarized in table 2.

Class name	Actual	Predicted	Accuracy
Adega	21	16	76%
Economy	11	7	63.6%
Bahlnaturism	8	4	50%
Heg	7	2	28.5%
Tena	14	10	71.2
Mahberawi	14	9	64.2%
Sport	14	10	71.2%
Temhrt	8	5	62.5%
Poletica	20	13	65%
Science	13	8	61.5%
Average Accuracy	**130**	**84**	**65%**

Table 2. Testing result of the Amharic text classification system

The current study predicts 84(65%) out of 130 instances as illustrated in table 2.

VI. CONCLUSION

In this paper, an attempt is made to design a system by which a collection of labeled and unlabeled documents could be categorized in a manner they are easily, quickly and systematically accessible to the users or news experts. This is important because in the 21st century there is a vast flowing of information across the globe. As a result, it deems necessary to classify growing information, particularly news text documents for the case of making them readily and quickly manageable as well as accessible to the experts. In this paper, experimented on how to propose an application of data mining techniques to Amharic text classification from labeled and unlabeled documents using EM.

One way to reduce the amount of labeled data required is to develop an algorithm that can learn from a small number of labeled examples augmented with a large number of unlabeled examples.The Web contains a huge amount of text data that can serve as unlabeled data for many classification tasks. Collecting this text is often cheap since web spiders and crawlers can be programmed to automatically do this task. Hence the need for classifiers that can learn from unlabeled examples is required. The second step uses two known classifiers: Naive Bayes and the lazy learner LWL to build the Amharic text classification system. As it is discussed on chapter five, the LWL classifier classifies 1,380 instances correctly (75.7%) decreasing the classification absolute error by 27.6% whereas the probabilistic classifier NB classifies 1,089 instances correctly (59.7%) decreasing the absolute error from the traditional by 21.7%. As a result, LWL with EM out performs better than NB in classifying Amharic text documents. Though, the performance of EM-NB is low in comparison to EM-LWL for 120 labeled and 1,702 unlabeled text documents, EM-NB shows good improvement in performance when the unlabeled document increases for a fixed size of labeled documents. As a result, for a few labeled and very large unlabeled documents we recommend to use EM-NB for classifying mixture text documents.A major concern with supervised learning techniques for text classification is that they often require a large number of labeled examples to learn accurately. Collecting a large number of labeled examples can be a very expensive process, thus emphasizing the need for algorithm that can provide accurate classifications after getting only a few labeled examples.

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Assessment and prioritization of business processes with the ability to outsource municipal fuzzy AHP approach(Case Study: Amir kola Municipality)

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Abstract: - In the past two decades, the ultra-competitive environment, and more dynamic, Shrek the force to focus on core competencies have mentored .In this situation, one of the efficient approaches for companies is outsourcing. Outsourcing the word go, word abbreviation of the phrase "Outside resource using" is. In recent yearsoutsourcing as a means of improving productivity in organizations and the administrators consider downsizing organizations areand has been implemented in different ways .This study aimed to evaluate the capability of processes, outsourcing was undertaken in municipality Babolusing questionnaires, Delphi method , and municipal experts about the processes by outsourcing the collection. In this study, the fuzzy analytic hierarchy process in order to take advantage of expert opinions and combine them to evaluate and prioritize its influential factors in municipal outsourcing capabilities were used .Based on AHP-FUZZY test to rank the factors and options, with the significance level of 0.4405 construction variables are important factors for outsourcing in the Cityand financial factors, and service are second and third respectively in priority., If it is known variables play a role in the development of the municipalities are outsourcing.

Keywords: - *outsourcing, Fuzzy AHP approach, municipalities*

I. INTRODUCTION

If the local organization of entities organized to definecharacteristics of the stateand the administrative and financial autonomy is not necessarily a political and aimed at providing public services to local people, with maximum efficiency and effectiveness.(poormoalem,2011)

To be given the breadth of services that offer outsourcing strategy requires the use of. Outsourcing is a form of predetermined external provisionto provide goods or services those were previously provided by the organization itself. The outsourcer literature further decisions "make or buy" are related. These resources can be organized into two options activity within the organization and governed by the hierarchy, and outsourcing and placing them under the rule of the market can be divided into. Outsourcing scholars (Hoffman and Shylsr, 2001) and (Chen, 2002), the degree of success in terms of achieving the goals of the outsourcer associated have with outsourcing (Al-Salim,2007)

The main goals of outsourcing include :1)competitive advantage ;2)access to key technologies ; 3)reduce operating costs;4)reduction of risk and risk sharing ;5)access to capital resources and6) focus on the goals., In recent years, outsourcing as a means of improving productivity in organizations and the administrators consider downsizing organizations and has been implemented in different ways.(khodaparast,2011)

Outsourcing or delegating some of the work out of the waylike any other manner as may be useful ,if defined and transparent criteria and standards programs have targeted and coherent, strategic, scientific or may not be accompanied by great losses .The purpose and objective of this researchby feature outsourced processes at the municipal level Amir Kolaconsidering theincreasing Productivityreduction in services andin general agility in decision making and implementation of other important issues related to the city.

II. LITERATURE REVIEW

Outsourcing

According to Corbett (Corbett, 1999) structuring the outsourcing organization's core competencies and external relations . From the perspective of AshnaydrjanzZvkhvylr (2004) Outsourcing is the provision of services outside the organization while producing goods and services that represent the rapidly relying on the resources within the organization . In other words, in terms of the Anna outsourcing as a management strategy can be considered the opposite of the strategy is outsourcing .Thus, generally speaking, outsourcing is the transfer of non-strategic processes and the organization to focus on key processes within the organization(Alamtabriz,2011)

In many cases, synonymous with the term outsourcing decisions of foreign affairs has been used . Expressions such as make or buy, merge or split refers to the outsourcing activities areand some writers refer to the outsourcing decisions have used Vertical Integration.(Motadel,2011)

Today, the term outsourcing contracts traditionally have replaced the traditional sense. However, some authors make the distinction between the two terms.(Mehregan,2010)

Contracts to acquire items (such as product, component or service) know his company can manufacture and outsourcing is to gain at least knows that the company could not produce more than acting.But people like Shaw and Fair (1997), Lasyty and Hyrshym (1993) Vrvtry and Rabytsvn (1995) show that outsourcing is a form of contracting activities previously carried out by the company, and now it's been given to others.The Kelly and Rashid (2000) is the outsourcing, contracting with external suppliers for activities that were previously performed by the company, or are entirely new activities.(Alamtabriz,2011)

Types of Outsourcing

In today's world, inland outsourcing - offshore company, offshore - offshore outsourcing company - the company as a key strategic activity are increasingly common .Inland outsourcing - outsourcing company, significant strategic utilization of company resources supply and service contractors for information technology or business processes are continuously. Inland outsourcing - offshore company and offshore outsourcing - outsourcing part in discussions, sometimes used interchangeablybut we must be careful of their differences . Outsourcing offshore outsourcing company, outsourcing services from outside the country provides .For example, some of the advanced functions such as call centers, software development, application and management abilities of low-cost countries such as India, the Philippines, Ireland, China, etc. provide. (Bayazit,2006).

History of Outsourcing

According to Andrew and Nada Kakabads·h(2003) devolution of taxes collected by the contractor (by the government), in Roman times, was the earliest form of outsourcing. In the eighteenth and nineteenth centuries, Britain maintenance of street lights, prison management, highway maintenance, and taxes collected, the activities of the contractors have been granted. At about the same time, the U.S. and Australia, and the French postal delivery, construction and management of the railway lines and the distribution of water resources outsourcing.(Bhattacharya,2003)

On the other hand we can say that outsourcing decisions are sort of "build - Order" in [10] and the oldest studies of outsourcing under this title. A later economic issue in the context of the theory of cost the transaction has been modeled, (Kahraman,2008)

And theoretical bases of all the outsource often referred to "the transaction cost economics (swap) » "Kavz" .(Mehregan,2010)Discussion of nature theory (Kavz) that the use and benefit of the market, the high cost is empty . When you purchase products or services, we will cause those costs if the cost is too high, relying on the "production" is appropriate. (Al-Salim,2007)

During the Industrial Revolution of the early 1980s, manufacturing strategy was based on a foundation of process and production requirements or orders received all the goods within the organization based on the facilities and the existing employees ,However, due to the face of many difficulties, the direction of movement during recent decades in the specialization of activities, allocating responsibilities and planning issues have been smarterin this way, strengthening core competencies, achieves the target markets provide a competitive advantage. Obviously, specialization and thus limiting the scope, if possible, reduces blood was tasks to be delegated part of the system, which indicates the beginning of a particular topic as it is the outsourcing .(Ellahi,2010)

Mehregan and colleagues (2012) in a research" offering a MADM model for outsourcing of business processes using analytic network process technique" showed; nowadays, outsourcings as one of the most effective strategies are known in the business world. In this context, the outsourcing of business processes as one of the most common forms outsourcing is considered .this paper presents a model for multiple attribute decision making processes outsourcing company is the main inflorescence .The presentation of this model, after

doing preliminary research and scientific documentation, 19 indicators that influence the supplier selection process outsourcing extracted Industry experts applying these criteria, four of compatibility, cost, quality and reputation of the supplier due to their high base and the strategy of the outsourcing company trunk Azin was used. Due to the specific characteristics of the analytic network processin such environments, the ability to usethe relationship between these methods and criteria to rank the three options closely outsourcing was not carried out as far .The results indicate that outsourcing as nearly as far towards outsourcing and the outsourcing of non-performance was rated higher priority.

III. RESEARCH HISTORY

In 2002 Ati et al &Tising, factors such as leadership, smart, good relationships and understanding the factors affecting aspects of strategic human resource outsourcing activities, considered. Ghily&Ghir&RashRaushee, in 2004, the harvest of outsourcing, which transferring part of the activities of companies and other organizations to reduce the burden of incumbency in the study were considered

Lory, in 2004, due to the failure of outsourcing maintenance activities an organization review and it gives the new tasks and to solve problems.The main problem was the fact that this excuse to reduce costs and increase the productivity of their core activities were outsourced . Another problem occurs due to loss of its dedicated and experienced staff that has many years of expertise in the specialty they retire or leave the organization. Categories selection of suppliers of the conditions for effective communication with and management of these relationships will be among the cases that have a significant effect on the outcome of outsourcing maintenance activities.

IV. MATERIALS AND METHODS

Study due to its nature, such research facto (causal - comparative) is considered .Because it has been tried it that causes an effect (silent treatment organization) understands . Methods of data collection and analysis in both theoretical study and evaluate the literature include:

1 - Studies library for data collection in the field of literature and the literature of library resources, articles, books, and related laws, and is used worldwide web.

2-The use ofquestionnaires and interviewsin order tocollectdatafrom the questionnairesand interviewswere usedfor data analysis. In this study,theidentificationof indicatorsandoptionssilenceOrganizationexpert opinionon thisitemquestionnairewithLikertasked, then the datain SPSSwas usedandthe factors thathavean averageof less than0.03were excluded.In the second phase, a questionnaire was designed according to the concept of hierarchical fuzzy and of 80 principals in the province has a government agency .The purpose of the questionnaire paired comparison of criteria in each level according to the criterion is at a higher level.

There are different methods in which their difference is on theory structure. Computation and complication of these methods leads to non-usability of these methods. Where change analysis method is easier than other FAHP method and is similar to traditional AHP. Wepreferred them to other methods in this study. Extent analysis method has been introduced by change in 1996 and is a Chinese researcher. Used numbers in this method are triangle phase numbers. (Bozbura, etal, 2006: 360) in extent analysis method, for every couple comparing matrix row, S_K value is a phase number and is computed as:

$$S_k = \sum_{j=1}^{n} M_{kj} \times [\sum_{i=1}^{m}\sum_{j=1}^{n} M_{ij}]^{-1} \quad (1)$$

Whereas:

$$[\sum_{i=1}^{m}\sum_{j=1}^{n} M_{ij}] = \left(\sum_{i=1}^{m}\sum_{j=1}^{n} l_{ij}, \sum_{i=1}^{m}\sum_{j=1}^{n} m_{ij}, \sum_{i=1}^{m}\sum_{j=1}^{n} u_{ij} \right) \quad (2)$$

By reversing above relation, we have:

$$[\sum_{i=1}^{m}\sum_{j=1}^{n} M_{ij}]^{-1} = \left(\frac{1}{\sum_{i=1}^{m}\sum_{j=1}^{n} l_{ij}}, \frac{1}{\sum_{i=1}^{m}\sum_{j=1}^{n} m_{ij}}, \frac{1}{\sum_{i=1}^{m}\sum_{j=1}^{n} u_{ij}} \right) \quad (3)$$

k indicates row number, I, j indicates chooser and indicators.

After computing $_{sk}$we should got their greatness ration to each other. in general, if M1, M2 were two phases number, their greatness ratio would be computed as:

$$V(M_1 \geq M_2) = 1 \qquad if \ \ m_1 \geq m_2$$

$$V(M_1 \geq M_2) = hgt(M_1 \cap M_2) \qquad o.w \tag{4}$$

in equation 4 , we have:

$$hgt(M_1 \cap M_2) = \frac{u_1 - l_2}{(u_1 - l_2) + (m_2 - m_1)} \tag{5}$$

The amount of number greatness of triangle phase number from k other fuzzy number would be achieved by equation here:

$$V(M_1 \geq M_2,..., M_k) = V(M_1 \geq M_2,..., M_1 \geq M_k) \tag{6}$$

In order to compute indicators weight in couple matrix comparing , we have:

$$W'(x_i) = \min\{V(S_i \geq S_k)\} \qquad k = 1,2,..., n \ , k \neq i \tag{7}$$

At last, indicator vector weight would be as:

$$W' = [w'(x_1), w'(x_2),..., w'(x_i)] \tag{8}$$

Normalized weight would be as:

$$W_i = \frac{W_i'}{\sum W_i'} \tag{9}$$

w is fuzzy number (Shojaee, 2009;34)

Data analysis

According to the steps listed weight of each index options and gain the weight each is calculated in the table below:

Coefficients relative importance Options	Weight Indicator	Weight options		Options / Index
0.1239		0.2813	*Cutback Asphalt city	Construction
0.0625		0.1418	*Sidewalks of the city	
0.0369		0.0837	*Tessellation city streets	
0.0593	0.4405	0.1346	*Execute work schedule and atmospheric alleys and streets of the city center	
0.0877		0.2013	*Repair pathway drilling and carving city	
0.0267		0.0606	*Implementation of planting lawns and parks	
0.0426		0.0967	*Run electrical and plumbing installations in the city	
0.1495		0.3807	*Purchase and transport of mixed sand and rock bass and municipalities	Financial
0.0607		0.1547	*Purchase 2 cm carrying rubble City	
0.413		0.1053	*Buy seasonal plants and seedlings for landscaping	
0.0832	0.3926	0.2119	*Buying Appliances for lighting the city	
0.0579		0.1474	*Buying oil paints for painting on street	
0.1216		0.7285	*Maintain and discharge of municipal green space	Service
0.0142		0.0853	*Run mural, tables and graphic design in the city	
0.0311	0.1669	0.1862	*Run the waterfront sculpture and statues of scholars in the fields	

The results show that , purchase and transport of mixed sand and rock bass and municipalities , foundations and asphalt city , storage and discharge of municipal green space , drilling and carving a path to restore the city , purchasing appliances for lighting the city , sidewalks of the city , shopping and transport rubble 2 cm to the municipality , implementing work schedule and Atmospheric middle of alleys and streets of

the city , buy color oil for painting the street , run electric utilities and pipelines in the city , buying flowers seasonal plants and seedlings for landscaping , parquetry city streets , enforcing the waterfront sculpture scholars in fields , lawns and planting run Park and city-wide mural , tables and graphics ratings first XV have won .

V. CONCLUSIONS

Based on AHP-FUZZY test to rank the factors and options, with the significance level of 0.4405 construction variables are important factors for outsourcing in the City ,important financial variables selected by 0.3926 andservices with the .1669 second and third variables are important.

Variables are development options to prioritize the chorus :

Cutback asphalt streets, digging and carving the path to restore the city, making the city sidewalks, alleys and streets of the center of Atmospheric implement work schedule and city-run electric and plumbing installations in the city, St. tessellation city and run parks, lawns and planting rank first and seventh, respectively, were acquired.

Prioritize financial variables as chorus options are :

Buying and carrying sand bass and mixed mountain municipalities, purchasing appliances for lighting the city, shopping and transport rubble 2 cm to the municipality, buy color oil for painting the street and buy flowers, plants and seedlings season for green areas ranked first and fifth, respectively, were acquired.

Prioritize services for chorus variable options are :

Storage and discharge of municipal green spacerun the waterfront sculpture ,statues and scholars in the fields of graphic design and implement a city-wide mural and tables respectively ranked first and third respectively.

And of those ,among all the sub-factors of buying and transporting sand and rock mixture to the Municipality of financial variableswere in the priority factors.

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Effect of Water Quality on the Distribution of Aquatic Entomofauna of Great Kwa River, Southern Nigeria

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Abstract : - Aquatic insects are very significant as indicators of water quality. The study was carried out between January and August, 2013 for both seasons. Sampling of aquatic insects of Great Kwa River was done with sampling nets in three stations: Unical Female Hostel, Unical Staff quarters and Obufa Esuk Beach. A total of 261.0 aquatic insects were collected with Unical Female Hostel accounting for the highest abundance. Unical Staff quarters had the highest Ephemenoptera, Plecoptera, Trichoptera (EPT) richness. The result of the study shows that the aquatic ecosystem health of the Great Kwa River varied significantly ($P<0.05$) along the course of flow with some areas slightly and moderately polluted while others are in useable conditions. The Diptera obtained during the study, are pollution tolerant species. They were more prevalent during the wet season than the dry season suggesting that the level of pollution was higher during the wet season.

Keywords: - *water quality, distribution, aquatic, entomofauna, Nigeria*

I. INTRODUCTION

Aquatic insects are a group of arthropods that live or spend part of their life cycle in water bodies (Popoola and Otalekor, 2011). Most importantly, aquatic insects are a good indicator of water qualities due to their various environmental disturbances tolerant levels (Arimoro and Ikomi, 2008). Anthropogenic activities of humans encourage discharge of untreated animal waste, such as releases from sewage and septic tanks, run-off from agricultural lands, laundering into Streams and Rivers. Most water bodies have been subjected to increasing pollution loads consequently, affecting greatly their quality and health status, this could result in changes of physico-chemical properties of water such as Temperature, Dissolved oxygen, Alkalinity, Biological oxygen demand, Nitrates and metal concentrations. Variations in these water properties greatly influence the distribution patterns of aquatic insects in the water, since some of them are highly sensitive to pollution while others are somewhat tolerant or completely tolerant to pollution and environmental disturbances (Bauernfeind and Moog, 200). This study was carried out to provide information on the effect of water quality on seasonal distribution of aquatic insects of Great Kwa River, Southern Nigeria as regards the state and quality of water bodies (Arimoro and Ikomi, 2008). Published works on the use of Aquatic insects for assessing health and water quality status of streams revealed that studied in tropical Africa is not extensive (Deliz-Quinones, 2005; Arimoro and Ikomi, 2008).

II. MATERIALS AND METHODS

2.1 DESCRIPTION OF STUDY AREA

The Great Kwa river, Cross River State is located between latitude 8^0 15'E and 8^0 30'E and longitude 4^0 45'N and 5^0 15'N. It has an estimated length of 56km and is about 2.8km wide at the mouth where it empties into the Cross River Estuary. Two climatic seasons wet and dry prevail in the study area. The wet season is characterized by high rainfall while the dry experiences occasional downpours. The shorelines are lined with dark mud plates usually exposed during low tides; the water at the shore is brackish and mostly rich in macroinvertebrates and debris. The banks are also surrounded by lush evergreen, forest vegetation with different species of trees, shrubs and grasses (Okorafor *et al*., 2012).

2.1.1 SAMPLING STATIONS

Three sampling stations (1-3) were chosen along the course of the River.

Station 1

The station is the control station; it is assumed to be unpolluted because activities are very minimal around the station. This station is located at Female Hostel within the University of Calabar community.

Station 2

The station is located at Obufa Esuk Beach, along the University of Calabar, Staff Quarters. The Substratum in the station is covered by mud and clay with average depth of 0.2m. It is swift-flowing and has a low transparency. The vegetation includes Fan palm (*Hyphaene petersiana*) and grasses grasses (Okorafor *et al*., 2012).

Station 3

The station is located at University of Calabar Staff Quarters, beside the Female Hostel along Obufa Esuk Beach. Substratum here is covered with coarse sand and clay with an average depth of 0.2m. It is also swift-flowing and his medium transparency. The vegetation included Elephant grasses, Palm trees and Fan palm (*Hyphaene petersiana*).

2.2 COLLECTION OF WATER SAMPLES AND ANALYSIS

Water samples were collected fortnightly from each sampled stations with 200ml plastic containers washed with nitric acid to remove any form of contaminants. The sampling period spanned from January to August for both wet and dry season. Sampling was usually carried out between the hours of 8:00 am and 12:00 noon. The water samples collected were then taken to the laboratory and analyzed immediately to ensure that the physical and chemical properties of the water were maintained. Surface water temperature was recorded with a Mercury-in-glass thermometer; pH was measured *insitu* with pH meter (Model pH-1), Dissolved oxygen was measured *in situ* with Dissolved oxygen meter (Model DO–5509) and the water sample were taken to the Postgraduate laboratory, Department of Zoology and Environmental Biology and incubated for five days at 20^0C, after five days the reading was taken. The Dissolved oxygen (DO) of day one minus the DO of day five (DO_1- DO_5) gave the Biological Oxygen Demand (BOD) as recommended by APHA, (1995)

2.3 AQUATIC INSECTS SAMPLING AND IDENTIFICATION

At each sampled station, adult insects were collected from water surface using a dip-net with Nytex® netting of 500m mesh. Adult insects and their nymph were also collected from the vegetation's around the river using a sweep net with a mesh size of 250m. The sweep net was passed over the area for at least two minutes. The contents collected were placed in a sorting bucket and the net was properly checked for insects clinging to the mesh. Other several insects were handpicked from specific microhabitats throughout the River. Insects collected were later preserved in 70% Ethanol in jars labelled according to sample station, description, and collection date. All samples collected were taken to the Department of Zoology and Environmental Biology laboratory where they were transferred to a large watch glass for a more detailed examination under the dissecting microscope. Subsequently they were identified to order and family using identification key guide (Bouchard, 2004).

III. RESULTS

4.1 WATER SAMPLE PHYSICO-CHEMICAL PARAMETERS

Result of the physico-chemical parameters of Great Kwa River is presented in Table 1. The spatial trend in the pattern of each physico-chemical characteristic was similar along the River, physico-chemical parameters during the study period between stations shows significant difference for both seasons ($p<0.05$). Correlation coefficient (r) values for Physico-chemical parameters and Aquatic Insects (Orders) abundance for both wet and dry season are presented in Table 2. Plecoptera and Ephemenoptera significantly correlated positively with Biological oxygen demand ($r = 0.99; 0.98$) respectively. Hemiptera significantly correlated positively with Temperature ($r = 0.98$) and diptera significantly correlated positively with pH ($r =0.99$) at $p<0.05$.

COMPOSITION AND DISTRIBUTION OF AQUATIC INSECTS ENCOUNTERED DURING THE STUDY PERIOD

Results of the composition and distribution of aquatic insects in Great Kwa River show a total of 261 aquatic insects belonging to seventeen (17) families, seven (7) Order, and Eighteen (18) genera. The orders, Plecoptera, Ephemenoptera, Trichoptera, Odonata, Hemiptera, Diptera and Coleoptera were collected during the

study (Table 3). *Hemiptera* was more prevalent 95.0, (45.0%) in Female Hostel and (27.0) in Staff quarters. This was followed by *Diptera* 41.0, (20.0%) from Hostel Female and (12.0%) in Obufa Esuk Beach. The least collection was recorded in *Coleoptera* with no collections in Hostel and Staff quarters but (5.0%) in Obufa Esuk. The result shows that the aquatic insects distribution during this study differ significantly between stations ($P<0.05$). The result also shows the seasonal distribution of aquatic insects for both wet and dry seasons in Great Kwa River (Table 4). They the number of aquatic insects recovered in the wet season were higher than that of dry season. Odonata and Hemiptera recorded higher values than Trichoptera and Coleoptera recorded in wet season. In dry season, Hemiptera and Plecoptera recorded higher values while Coleoptera was lower. Distribution of aquatic insect in Great Kwa River differed significantly ($P<0.05$) between seasons.

IV. DISCUSSION

According to Leska, (1998), the variety of aquatic insects likely to be found in an excellent station includes different types of Aquatic Insects such as Stoneflies, Mayflies and Caddisflies. This corresponds to the stations sampled during the dry season with Ephemenoptera, Plecoptera and Trichoptera (EPT) richness being recorded in Unical Female Hostel and Unical Staff Quarters. This indicates that these two Stations were in good (useable) condition during the dry season. This might be as a result of less human activities observed in these areas as compared to Obufa Esuk Beach. However, Obufa Esuk Beach had no species of Plecoptera collection during the wet season. The absence of this order of aquatic insect indicates that the station was in a poor condition (Leska, 1998) especially that the Odonates found in this area were deformed. Ephemenoptera species were more prevalent in Obufa Esuk and Unical staff quarters with no significant difference in female hostel station. Peckarsky (2006) observed that Mayflies are very sensitive to water quality which include both chemical and temperature attributes. This temperature is usual for slightly polluted to polluted rivers. Seasonal variation is directly attributed to the climate of the study area which is usually characterized by a hot dry season and cold wet season (Harper and Peckarsky, 2006). During the wet season, low number of Trichoptera (caddisfly) was recorded (3.7%). According to silsby (2001), the larva of caddisfly does not tolerate polluted water, so finding a large population is a good sign for any aquatic body but the reverse is the case for low number. This indicates that a higher level of pollution occurred during the wet season. The observed variation in location may not be unconnected to water velocity, canopy cover, Nature of bottom sediments and the amount of dissolved oxygen in each station. Temperature values recorded during the sampling period ranged from 23 to 30ºC for both seasons. This value falls within the optimal range for tropical fresh waters. This was also corroborated by Ayodele and Ajani (1999), but that tropical freshwaters had temperature values ranging from 21 to 32ºC. The variation in temperature observed was as a result of low solar heat radiation across the stations. Inundation by run-off water into the River also causes a reduction in temperature (Popoola and Otalekor, 2011). This temperature reading indicates a great impact on the distribution of aquatic insects as more species were collected at relatively high temperature than when there was a drop in temperature. Ajao (1990) cited by Oben (2004), recorded similar observation during their studies. Pearson's correlation coefficient (r) analysis between aquatic insect abundance and water temperature showed that Hemiptera correlated positively with water temperature. Possibly because this aquatic insect is temperature dependent, this favours their rate of feeding and metabolism. Dissolved oxygen (DO), concentration in Great Kwa River was inversely related to changes in temperature. The low values of DO concentration recorded during this study, is an indication of deterioration of the water quality as a result of various anthropogenic activities in the stations as observed. Yakub (2004) also attributed the low level of DO in his study could be as a result of human activities discharged into the River. The plausible reason for low dissolved oxygen could be attributed to the small surface area of the sampling stations and the less impact of organic waste in these stations. Great Kwa River pH during the study ranged from 7.0–8.0. Pearson's correlation coefficient showed that pollution tolerant species such as Diptera had relationship with pH. The pH value obtained from this study ranged from slightly acidic. Most aquatic insects such as Diptera, Hemiptera and Coleoptera are only slightly affected by acidification whereas others like Plecoptera, Ephemenoptera, Trichoptera and Odonata are acid-sensitive and they are mostly found in clean waters that are alkaline in nature. Biological oxygen demand (BOD), concentration in Great Kwa River was related to changes in temperature. Pearson's correlation coefficient (r) analysis confirmed the relationship between BOD and water temperature. This observation agreed with Arimoro and Ikomi (2008) findings, who reported that increase in water temperature brings about a decrease in BOD. This is because as water temperature increases, biological oxygen demand decreases, also it may be due to respiration and other processes such as breakdown of organic matters. Pearson correlation coefficient analysis showed a positive relationship of the aquatic insect such as Plecoptera and Ephemenoptera with biological oxygen demand ad also showed statistical significance at $p<0.05$ value . This observation is in accordance with Emere and Nasiru (2007), from their study carried out in an urbanized stream in Kaduna, Nigeria.

V. CONCLUSION

This study brings forth the evidence on some aquatic insects as indicators of the extent and severity of pollution in the aquatic body. A close study of these aquatic insects could led to the fact that Great Kwa River has some level of pollution., it should be continuously monitored to reduce this pollution level and this was greater during the wet season as against the dry season. Expected future developments will put increasing pressure on the self-purification capacity of the River with negative consequences on most water uses.

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Table (1): Mean Variations and F-values of Physico-chemical Parameters for Wet and Dry Seasons at Sampling Stations along Great Kwa River

Wet Season						
Parameters	**Station 1**	**Station 2**	**Station 3**	**F–value**	***P*-Probability**	**Inference**
Temperature (^{0}C)	25.7±0.58 (25-26)	25.5±2.18 (23 – 27)	25.7±1.15 (25-27)	1.12	P<0.05	(H_0 rejected)
pH	7.2±0.25 (7-7.5)	7.2±0.31 (6.9 -7.5)	7.3±0.31 (7 -7.6)	1.32	P<0.05	(H_0 rejected)
Dissolved oxygen (mg/L)	4.3±0.31 (4-4.6)	4.3±0.21 4.1 – 4.5)	4.3±0.06 4.3-4.4)	1.11	P<0.05	(H_0 rejected)
Biological oxygen demand (mg/L)	2.5±0.26 (2.3-2.8)	2.6±0.21 (2.4-2.8)	2.6±0.35 (2.3-3.9)	1.36	P<0.05	(H_0 rejected)
Dry season						
Temperature (^{0}C)	28.3±2.08 (26 – 30)	29.7±1.53 (28-31)	28.3±1.15 (27-29)	0.650	P<0.05	(H_0 rejected)
pH	8.4±0.38 (8 – 8.7)	8.8±0.51 (8.2-9.2)	8.6±0.68 (7.8-9.1)	0.320	P<0.05	(H_0 rejected)
Dissolved oxygen (mg/L)	3.7±0.58 (3 – 4.0)	4.7±0.29 (4.5-5.0)	4.6±0.72 (3.8-5.2)	0.530	P<0.05	(H_0 rejected)
Biological oxygen demand (mg/L)	1.8±0.72 (1 – 2.4)	2.5±0.25 (2.0-2.5)	2.7±0.81 (1.8-3.2)	0.340	P<0.05	(H_0 rejected)

Station 1=*Female Hostel*, ***Station 2***= *Obufa Esuk Beach*, ***Station 3***=*Unical Staff Quarters*

Table (2): Pearson Correlation (r) Values between the Physico-chemical Parameters and Aquatic Insects (Orders) for Wet and Dry Seasons at Great Kwa River.

Parameters / Aquatic Insects	Temperature (^{0}C)	pH	Dissolved Oxygen (mg/L)	Biological oxygen Demand (mg/L)
Plecoptera	-0.98	-0.99	-0.97	0.99*
Ephemenoptera	-0.99	-0.97	-0.98	0.98*
Trichoptera	-0.96	-0.95	-0.96	0.93
Odonata	-0.97	-0.96	-0.98	0.94
Hemiptera	0.98*	0.98	0.99	-0.97
Diptera	0.99	0.99*	0.90	-0.99
Coleoptera	0.98	0.97	0.92	-0.98

*Significant difference at p<0.05

Table (3): Composition and distribution of Aquatic Insects in Great Kwa River during the study period

Order	Family	Species	No. Collected	(%)
Ephemenoptera	*Baetidae*	*Afreobetodes Pusillus*	2	(0.8)
		Baetis sp.	4	(1.5)
	Caenidae	*Caenis* sp	11	(4.2)
	Ephemeridae	*Ephemera* sp.	17	(6.5)
Hemiptera	*Vellidae*	*Velia* sp.	18	(6.9)
	Gerridae	*Geris* sp.	27	(10.3)
	Belostomidae	*Belostoma* sp.	36	(13.8)
	Nepidae	*Nepa sp.*	14	(5.3)
Trichoptera	*Hydropsychidae*	*Hydropsychid* sp.	27	(10.3)
Coleopteran	*Gyrinidae*	*Gyrinus* sp.	5	1.9
Plecoptera	*Perlidae*	*Perlid* sp.	27	(10.3)
	Leuctridae	*Latelmis* sp.	6	2.3
Odonata	*Libellulidae*	*Pantata flarescens*	17	(6.5)
	Aeshnidae	*Aeshna* sp.	6	(2.3)
	Libelluidae	*Hemistigma* sp.	9	(3.5)
Diptera	*Chironomidae*	*Chironomus* sp.	9	(3.5)
	Culicidae	*Culex* sp.	30	(11.5)
	Culicidae	*Aedes* sp.	2	(0.8)

Table (4): Seasonal Distribution of Aquatic Insects (orders) in Great Kwa River.

Aquatic Insect (Order)	Wet Season		Dry Season	
	$\bar{X}$±S.D	%	$\bar{X}$±S.D	%
Plecoptera	7.33±0.33	(5.2)	25±0.58	(20.5)
Ephemenoptera	12.0± 0.58	(9.7)	20± 0.58	(16.5)
Trichoptera	6.0± 0.58	(3.7)	16± 0.58	(12.6)
Odonata	11.7±0.88	(48.5)	17.6± 0.89	(15.0)
Hemiptera	63.3±1.2	(48.5)	30.0± 0.58	(23.6)
Diptera	24.3±0.89	(19.5)	16. 0±0.58	(11.8)
Coleoptera	5.3± 0.33	(3.7)	2.7 ± 2.7	(0.00)

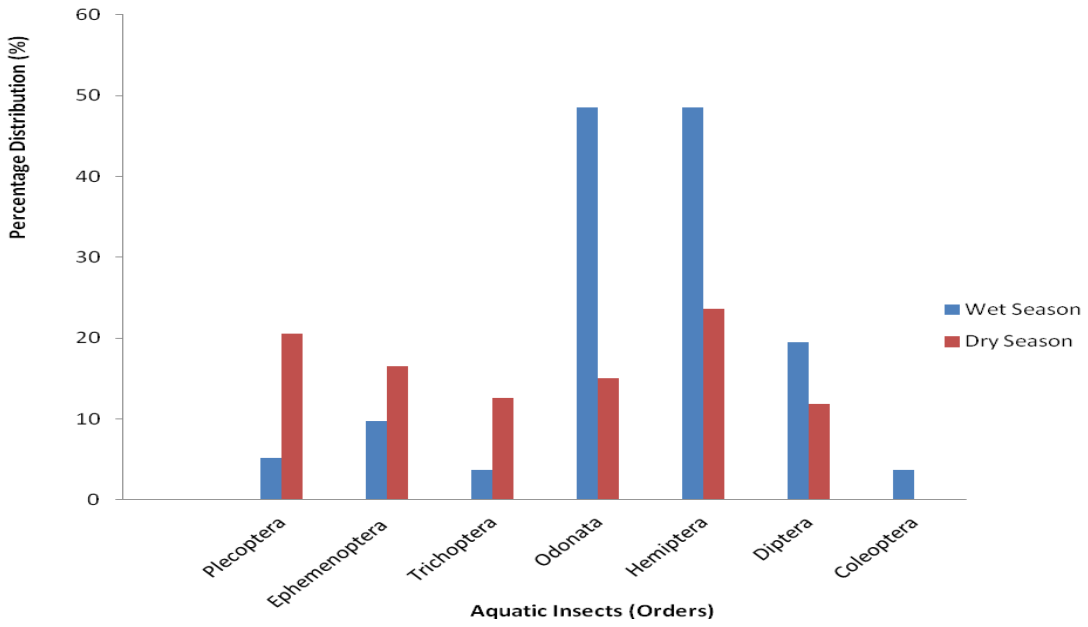

Figure (1): Seasonal distribution of Aquatic insects (orders) in Great Kwa River

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Short-term Load Forecasting of an Interconnected Grid by using Neural Network

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Abstract: - With the rapid growth of power system and the increase in their complexity of the networks, load forecasting plays a vital role in economic operation of power systems, network planning and infrastructure development. Electricity demand forecasting is concerned with the prediction of a very short term, short term, medium term and long term load demand, depending on the time horizon. This paper presents an application of neural network for real time short term load forecasting and has been compared with the conventional exponential smoothing technique. The daily load data of an inter connected grid Damodar Valley Corporation, operating under Eastern Regional Load Dispatch Centre, India were used as data sets for training and comparing the performance of different neural network topologies along with conventional exponential smoothing technique. The results obtained from Artificial Neural Networks were evaluated with the statistical parameters i.e., Mean Absolute Percentage Error (MAPE) and Mean Absolute Deviation (MAD). MATLAB has been used for simulation, performance and testing the data. Extensive testing shows that neural network based approach has better forecasting accuracy and robustness.

Keywords: - *Artificial Neural Network (ANN), Cascade Forward Neural Network (CASFNN), Chow's Adaptive Control Method (CACM), Mean Absolute Deviation (MAD), Mean Absolute Percentage Error (MAPE), Radial Basis Function Neural Network (RBFNN), Short Term Load Forecasting (STLF)*

I. INTRODUCTION

In the present complex power system network under deregulated regime, generating companies (GENCOs) must be able to forecast their system load demand and the corresponding price in order to make appropriate market decisions. The economy of power producers, market operators, transmission owners and other players associated with the electricity market is directly affected by the efficiency and the swiftness with which system load is forecasted. An underestimation of load is as severe as an overestimation of load and can bring about humongous losses. Accurate and precise future load estimation is, thus, a prerequisite. In this context, load forecasting emerges as a valuable tool. STLF is required by utility planners and electric system operators for critical operational planning and day-to-day decision making like unit commitment, spinning reserve, economic power interchange, load management etc. Although the time varying system load is influenced by social, metrological and financial factors, their effects are not generally considered in STLF. The success of the important existing STLF methods, such as using statistical techniques or artificial intelligence algorithms, which includes regression models, time series, neural networks, statistical learning algorithms, fuzzy logic or expert systems etc., depends not only on the approach chosen but also on the quality and choice of input data which would contain proper patterns representing the system dynamics. The main motivation for STLF originates from the fact that the loads are much less dependent on each other and the possibility of modeling the slowly varying dynamics of change in load using appropriate STLF techniques. Hence, there are sufficient reasons for continuing further investigations in the field of STLF.

The STLF anticipates very near future loads by analyzing historical data and plays a crucial role in efficient planning, operation, control and maintenance of a power system. Most of the existing techniques on STLF try to improve the performance by selecting different prediction models. But these different models suffer from different problems, like lack of self-learning capability, choice of suitable input, training data etc. Some of

the methods are vulnerable to dirty data and rely heavily on the quality and size of historical data. Several techniques have been developed over years to accomplish this challenging task [1-6]. The different methodologies not only differ in the techniques used for forecasting but also in the consideration of factors which influence load. The statistical load forecasting methods include regression method as given in [7], exponential smoothing in [8], time series modeling in [9], Box-Jenkins ARIMA in [10] and others which assume a linear relationship between load and the factors affecting the load. In case of a nonlinearity, such methodologies fail to reflect the appropriate load behavior and thus, are not reliable. Another attempt for load forecast is found in [11] which adopts an expert systems perspective to determine the relationship between historical load patterns and dry bulb temperatures. This system does not employ any specific load model for load prediction. Another similar approach is the development of an adaptive load model in [12] which successfully incorporates the stochastic behavior without utilizing the weather variables. Recently, the genesis of meta-heuristic techniques like Artificial Neural Networks (ANN), Particle Swarm Optimization (PSO), fuzzy logic, Genetic Algorithm (GA) and others have opened up this avenue for further exploration.

The main evolutionary algorithms such as Fuzzy Systems presented in [13] and Pattern Recognition Techniques in [14] have been proposed and used for short term load forecasting applications. Amongst these, artificial neural network is probably the most popular algorithm used for this purpose. The ability of neural networks to easily accommodate complex nonlinear relationships between electrical load and exogenous factors makes them attractive as a tool for load predictions. Besides, neural networks can make accurate predictions without having to select any specific load model [15-18].

This study exploits the capabilities of two different neural network topologies, viz., Cascade Forward backpropagation neural network and Radial Basis Function neural network in making short term load forecasts using historical data for Damodar Valley Corporation (DVC) grid operating under Eastern Regional Load Dispatch Centre (ERLDC), India. The neural networks are trained in the first phase with historical data. The prediction performance of both the neural networks is validated by comparing the predicted data for each day of a week with the actual load demand. Statistical parameters like Mean Absolute Percentage Error (MAPE) and Mean Absolute Deviation (MAD) have been used as performance indices to evaluate the efficacy of the proposed algorithm and to compare the two neural network topologies used with the traditional exponential smoothing method.

The content of this paper is organized in the following manner: Section 2 describes the statement of load forecasting problem and in Sect. 3, an overview of employed methods is offered. Sect. 4 presents the computational procedure of the aforesaid neural networks followed by results and discussions in Sect. 5. Section 6 concludes the work.

II. STATEMENT OF LOAD FORECASTING PROBLEM

Power system load forecasting can be classified in four categories, namely very short-term, short-term, medium term and long term forecasting. The periods for these categories are often not explicitly defined. Different authors use different time horizons to define these categories. STLF covers hourly to weekly forecasts which are often needed for day to day economic operations of GENCOs. Medium-term load forecasting deals with predictions ranging from weeks to a year. Outage scheduling and maintenance of plants and networks are often roofed in these types of forecasts. Long term forecasting on the other hand deals with forecasts longer than a year. It is primarily intended for capacity expansion plans, capital investments, and corporate budgeting. These types of forecasts are often complex in nature due to future uncertainties such as political factors, economic situation, per capita growth etc.

III. AN OVERVIEW OF EMPLOYED METHODS

When forecasts are needed for very large number of items, as is the case in power system load forecasting, smoothing methods are often the only conventional methods fast enough for acceptable implementation as compared to other sophisticated methods. The major advantages of widely used smoothing methods are their simplicity and low cost. The computational time needed for making necessary calculations is less with minimum of outside interference. Due to the above mentioned features, exponential method like Chow's Adaptive Control Method (CACM) has been considered.

III.1 CHOW'S ADAPTIVE CONTROL METHOD (CACM)

Forecasting situations vary widely in their time horizons. Several factors determine actual outcomes, types of load patterns and many other aspects. To deal with such diverse applications, several techniques have been developed. This falls into two major categories: Quantitative and Qualitative methods. Quantitative methods include regression analysis, decomposition method, exponential smoothing and Box-Jenkins methodology.

In this paper, one such exponential smoothing method has been considered. The philosophy is similar to Adaptive-response-rate single exponential smoothing (ARRSES) but has the additional feature that it can be used for non-stationary data. However the way a_t is adjusted in Chow's method is not at all similar to that used in the ARRSES equation.

$$F_{t+1} = \alpha X_t + (1-\alpha)F_t \quad (1)$$

in which α is replaced by α_t,

$$F_{t+1} = \alpha_t X_t + (1-\alpha_t)F_t \quad (2)$$

where

$$\alpha_{t+1} = |E_t / M_t| \quad (3)$$

$$E_t = \beta e_t + (1-\beta)E_{t-1} \quad (4)$$

$$M_t = \beta|e_t| + (1-\beta)M_{t-1} \quad (5)$$

$$E_t = X_t - F_t \quad (6)$$

α and β are parameters between 0 and 1 and | | denotes absolute values. Equation (1) indicates that the values of α to be used for forecasting period (t+2) is defined as an absolute value of the ratio of a smoothed error term (E_t) and a smoothed absolute error term (M_t). These two smoothed terms are obtained using Single Exponential Smoothing (SES) as shown in equations (3) and (4). Here we could have used $\propto_t$ in equation (1). We prefer $\propto_{t+1}$ because ARRSES is often too responsive to changes, thus using $\propto_{t+1}$ we introduce a small lag of one period, which allows the system to "settle" a little and forecast in a more conservative manner.
Rather, $\propto_t$ is 'adapted' by small increments (usually 0.05) so as to minimize the Mean Square Error. The equations of Chow's adaptive smoothing are

$$S_t = \alpha X_t + (1-\alpha)(S_{t-1}) \quad (7)$$

$$b_t = \alpha_t (S_t - S_{t-1}) + (1-\alpha_t)b_{t-1} \quad (8)$$

and

$$F_{t+1} = S + \left(\frac{1-\alpha_t}{\alpha_t}\right) b_t \quad (9)$$

Artificial neural network has proved its supremacy over traditional methods of load forecasting owing to its capability of learning and self-organizing, robustness in presence of noise, resilience to components failure and tremendous potential for massive computation. ANN can be perceived as multivariate, nonlinear and nonparametric methods. It can easily map a given input-output data pattern and nonlinearity is not a constraint for ANN. But ANN requires optimal network structure and unified training algorithms in order to improve the accuracy of the forecast as well as the performance of the networks. An insightful analysis of neural network structure and underlying operational principles facilitates the design of a better network.

III.2 Cascade Forward Backpropagation Neural Network

Cascade forward neural networks are a modified version of the simple feed-forward neural networks. Unlike in feed-forward neural networks, each layer is directly connected to the input. Weighted interconnections exist not only between the input and every layer but each layer is also connected to the successive layers. All the layers have biases. The additional connections amongst the different layers as compared to the feed-forward neural network improve the speed with which the network acquires the desired input-output relationship. Fig. 1 is an illustration of a three layered cascade forward neural network. Evidently, all the layers include a weighted connection with the input. In addition, the first layer is connected to the second layer and the second layer is linked to the third layer as in a feed-forward neural network. An additional connection exists between the first layer and the third layer, thereby imparting an increased learning speed. The weights of interconnection between the previous layers are called input weights while the weights between the layers are referred to as link weights. The hidden layer neurons in this study have been activated by tan-sigmoid transfer function whereas pure linear function has been used for the output layer.

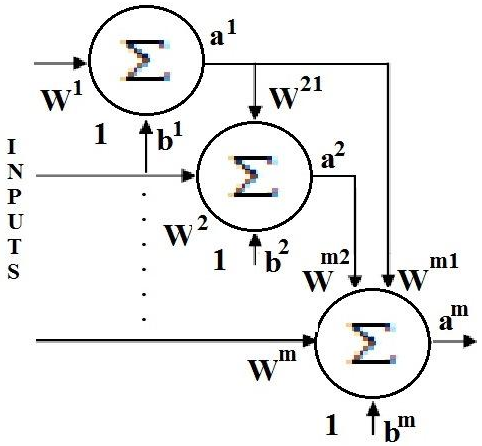

Fig. 1 Architecture of a Cascade Forward Neural Network

where,
p is the input vector.
$W^m$is the input weight matrix for layer 'm'.
$W^{m,k}$is the link weight matrix for layer m of layer 'k'.
B^m is the bias of neuron for layer 'm'.
$f^m$is the activation function used for layer 'm'.
a^m is the output of layer 'm'.

Once the network architecture is defined and the weights and biases of neurons are initialized, neural network training commences. The success of a neural network relies heavily upon the training of the network. The training is usually performed by a supervised algorithm like backpropagation learning algorithm. Backpropagation algorithm is an iterative process and consists of three steps.

i) The first step computes the output of the neural network for the given set of inputs.
ii) The variation between the expected output (target) and the predicted output of neural network is deemed as the error. This error is propagated backwards from the output node to the input node.
iii) Finally, the weights and biases associated with the neurons are adjusted by a multivariate nonlinear numeric optimization algorithm.

A cycle of these steps continues and the weights and biases of neurons are adjusted iteratively in order to minimize error and maximize system performance. Backpropagation is a gradient based approach where the gradient of the performance function given by equation (10) is evaluated to ascertain how the synaptic weights need to be adjusted to achieve the desired goal.

$$E = \frac{1}{2}\sum_p \sum_j (t_{pj} - o_{pj})^2 \qquad (10)$$

where, E is the sum of squared errors, t_{pj} and o_{pj} are the target outputs and actual outputs j for the p^{th}input pattern. In this work, a modified version of backpropagation algorithm called Levenberg-Marquardt Backpropagation is implemented to augment the speed of convergence. The Levenberg-Marquardt algorithm uses equation (11) to constantly adjust network weights and biases.

$$X(n+1) = X(k) - (J^T J + \mu I)^{-1} J^T e \qquad (11)$$

where,
X is the vector of all weights and biases.
J is the Jacobian matrix of the first derivatives of the network errors with respect to weights and biases.
'e' is a vector of network errors and 'μ' is a constant.

III.3Radial Basis Function Neural Network

Radial Basis Function (RBF) neural network was first introduced in 1988 by Broomhead and Lowe. Radial Basis Function is a special type of function the response of which either decreases or increases monotonically from a central point. RBFNN is usually characterized by the following features:

- They are two-layered feed-forward network.
- A set of radial basis functions is employed by the hidden layers.
- A linear summation function is engaged for the output layers.
- They are much faster during training/learning.
- Network training in RBFs is a two-step process. In the first step, the weights of the input to hidden layers are ascertained. The second step commences with the weight determination of the hidden to output layers.

Various basis functions have been used to model the architecture of RBFNN, such as

- Thin Plate Spine Function: $\phi(x) = x^2 \ln(x)$
- Gaussian Function: $\phi(x) = \exp\left(-\frac{\|x-\mu\|^2}{2\sigma^2}\right)$, where μ and σ are the mean and standard deviation of the distribution respectively.
- Multi-Quadratic Function: $\phi(x) = \sqrt{x^2 + \sigma^2}$
- Linear Function: $\phi(x) = x$

RBF network strives to find the best surface in a multi-dimensional space to ensure the best match to the training data. The general architecture of a RBFNN consists of input layer with as many input nodes as the number of independent input variables, a hidden layer of few neurons employing radial basis transfer function and output layer with as many nodes as the required number of outputs. RBF is prone to overfitting with too many hidden layer neurons and underfitting with too few hidden layer neurons. Fig. 2 exemplifies the architecture of RBF Neural Network. The network distribution density commonly called SPREAD is set at 0.08 in this study.

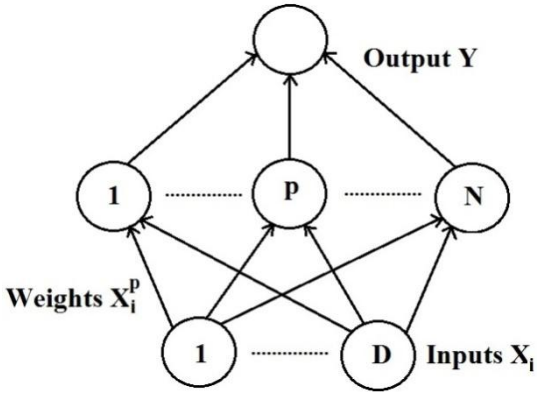

Fig. 2 Architecture of a Radial Basis Function Neural Network

IV. NN BASED PROPOSED METHODOLOGY OF LOAD FORECASTING

In order to accomplish an accurate and useful load forecast, a broad spectrum of associated parameters need to be ascertained.The proposed methodology shown in Fig. 3 for an efficient load forecast is developed in the following discussion in a sequential manner.

IV.1SELECTION OF INPUT DATA

The input variables in the present model come from historical data corresponding to the factors that affect the load. As inputs the past 96 blocks of each 15 minutes interval for 24 hours of a day are utilized. The proposed NN techniques (CASFNN and RBFNN) were applied for short term load forecast (STLF) in the electricity market forDamodar Valley Corporation (DVC) grid operating under Eastern Regional Load Dispatch Centre (ERLDC), India. DVC Grid consists of an installed capacity of 5000 MW and daily load demand of 3200 MW. The effect of exogenous variables in load variation may be assumed to be taken care of by the neural networks in the classification phase and predicted load demand.

IV.2CHOICE OF NEURAL NETWORKS PARAMETERS

Two variations of artificial neural networks in the form of Cascade Forward Neural Network and Radial Basis Function Neural Network are utilized for load forecasting. Different parameters like choice of activation functions for different layers, number of hidden layer neurons and the performance function used for quantifying prediction performance are pertinent for the successful implementation of any neural network. The network details for the different neural networks used in this study are drawn out in TABLE 1. The parameters are selected after rigorous trials for which the network prediction is most accurate. There does not exist any concrete mathematical formulation to facilitate the selection of these parameters.

TABLE1 SELECTION OF PARAMETERS FOR NEURAL NETWORKS

Network Parameters	*CASF NN*	*RBF NN*
Number of Hidden layers	2	2
Activation functions	Tan-sigmoid for hidden layer, Purelin for output layer	Thin Plate Spine Function for hidden layer, Purelin for output layer
Performance Parameters	MAPE, MAD	MAPE, MAD

IV.3DATA PREPROCESSING OR NORMALIZATION

The convergence of neural network output is ensured by normalizing the input data within suitable bounds before training. The neural network has been seen to perform better with normalized inputs than with the original data set, the range of which can be very large. Due to the nature of sigmoid function, the output of the neurons falls within -1 to 1. After rigorous simulations it has been observed that data normalization between 0 to 1 has a superior performance than with normalized data between -1 to 1.Hence, the input data bounds are set to 0 as the lower limit and +1 as the upper limit. Normalization is achieved in accordance with equation (12).

$$Y = (Ymax - Ymin) * \frac{X - Xmin}{Xmax - Xmin} + Ymin \qquad (12)$$

where $X_{min}$is the minimum value of original data set, $X_{max}$is the maximum value of original data set and X is the data point being normalized. Y_{min} and Y_{max} are the minimum and maximum values respectively of the interval boundaries. In this case, $Y_{min} = 0$ and $Y_{max} = 1$.

IV.4TRAINING AND VALIDATION

The neural network needs to be trained for faithful prediction of load under varying conditions. The proposed model uses the load patterns for the same days of the previous weeks for its initial training. Once the network has been trained properly, it is made to predict the load demand for the current week. This phase is often called validation. It is an indicator of the accuracy of the predictions.

V. RESULTS AND DISCUSSIONS

In this paper, different topologies of ANN along with conventional smoothing technique were applied to data sampled at 15 minutes interval for different days in a week (seven data sets from 3rd November, 2013-Sunday to 9th November, 2013-Saturday). The forecasting accuracy is ascertained using statistical indices like Mean Absolute Deviation and Mean Absolute Percentage Error. For 'N' number of data points, the following parameters can be defined as follows.

*Mean Absolute Percentage Error (MAPE):*The mean absolute percentage error (MAPE) which is a degree of accuracy in a fitted series value in statistics is expressed mathematically as

$$MAPE = \frac{\sum_{i=1}^{N} |\frac{E_i}{A_i}|}{N} X\ 100\% \qquad (13)$$

where A_i is the actual value, P_i is the predictedvalue and N is the number of data. A MAPE below 5% is the measure of a highly accurate prediction.

Mean Absolute Deviation (MAD): It is one of the robust statistical parameters used to quantify the variability associated with an invariant set of quantitative data. Mathematically, it is expressed as follows.

$$MAD = \frac{\sum_{i=1}^{N} |E_i|}{N} \qquad (14)$$

As described in Section 4, Cascade Forward Neural Network and Radial Basis Function Neural Network are trained using historical data for each day of the previous weeks. For instance, both the neural networks are trained with the load data for two consecutive Mondays of a month. After successful training, the neural networks are made to predict the load demand for the third Monday of the same month using the latest data for the past two Mondays. Effectively, the neural networks make the load forecast for one week in advance. Similar trainings andpredictions are performed for all the days of a week. Such an approach also makes considerations for the fact that load demand is entirely different for the weekends and other days of the week. A neural network trained with the load pattern for a weekday may yield poor results when used for making predictions for a weekend. The approach proposed here counters this deficiency by using load data of previous weekends to predict the load for the current weekend.

The performance of the applied techniques have been compared with more popular smoothing method of STLF namely CACM. The test results are presented in Fig. 4-10.

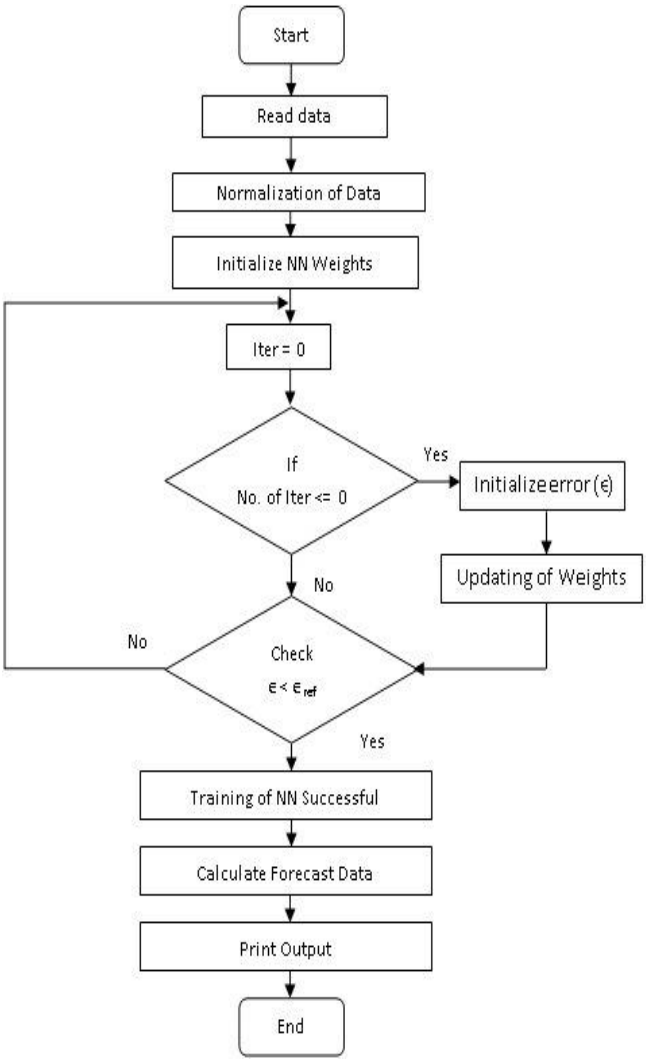

Fig. 3 Simplified flowchart for the proposed methodology

TABLE 2 portrays comparison of MAPE and it is revealed that RBFNN gives comparatively superior predictions and at almost all times predicts the load pattern similar to that of the actual load. The maximum values of MAPE are 0.4652% and 0.8895% for RBFNN and CASFNN respectively in comparison with a maximum MAPE of 0.9199% obtained with CACM. TABLE 3 depicts the comparison of MAD and this again substantiates that RBFNN has a better learning ability than CASFNN and CACM. A maximum MAD in the range of 10.6551 and 14.3792 for RBF NN and CASFNN respectively can be considered to be good and promising for future load prediction applications. From TABLE 4, it has been observed that the proposed application of ANN which does not require any enormous storage size, takes less computational time and memory.

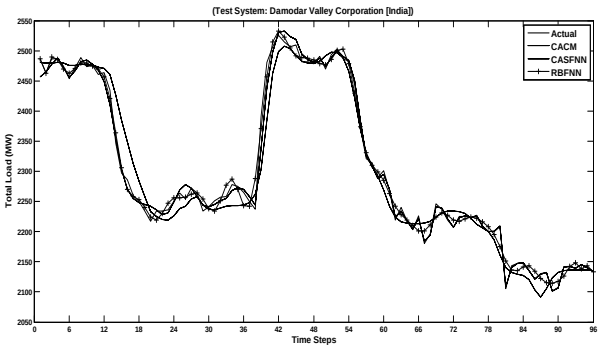

Fig. 4 Comparison of Predicted weekend system loads (Sunday)

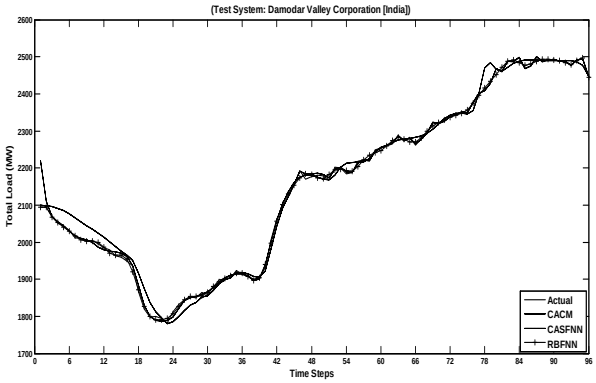

Fig. 5 Comparison of Predicted weekday system loads (Monday)

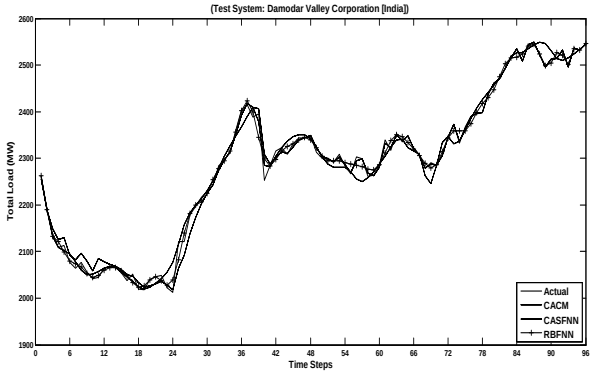

Fig. 6 Comparison of Predicted weekday system loads (Tuesday)

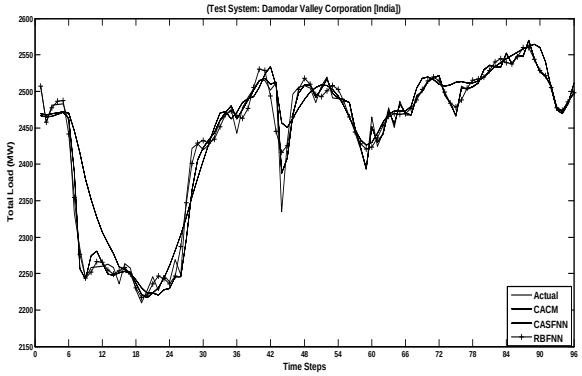

Fig. 7 Comparison of Predicted weekday system loads (Wednesday)

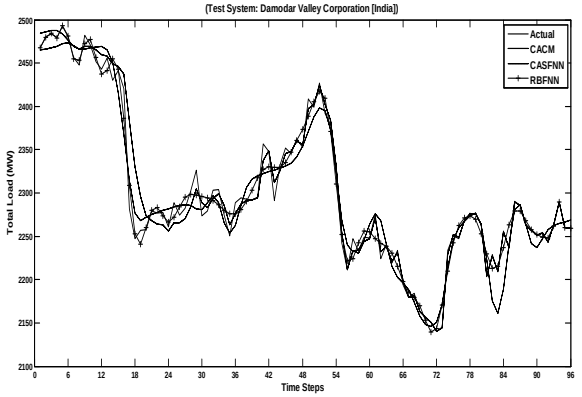

Fig. 8 Comparison of Predicted weekday system loads (Thursday)

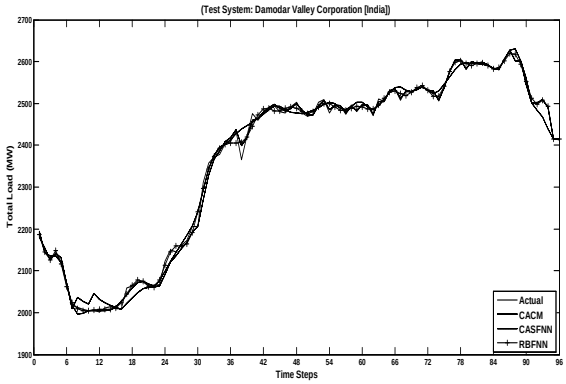

Fig. 9 Comparison of Predicted weekday system loads (Friday)

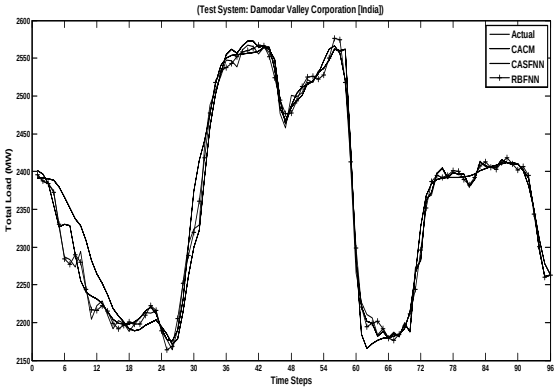

Fig. 10 Comparison of Predicted weekend system loads (Saturday)

TABLE 2 MEAN ABSOLUTE PERCENTAGE ERROR (MAPE) FOR DIFFERENT PREDICTION METHODS

	CACM	*CASFNN*	*RBFNN*
Sunday	0.5159	0.4073	0.4393
Monday	0.9199	0.8895	0.2564
Tuesday	0.7524	0.5529	0.4081
Wednesday	0.6329	0.5697	0.4311
Thursday	0.683	0.6260	0.4652
Friday	0.5910	0.4976	0.3269
Saturday	0.4079	0.3555	0.3599

TABLE 3 MEAN ABSOLUTE DEVIATION (MAD) FOR DIFFERENT PREDICTION METHODS

	CACM	*CASFNN*	*RBFNN*
Sunday	9.7119	9.3146	9.9816
Monday	10.2103	9.3320	5.5069
Tuesday	14.6408	12.5724	9.2883
Wednesday	14.9690	13.8394	10.4300
Thursday	16.5472	14.3792	10.6551
Friday	14.0303	13.6204	7.7507
Saturday	11.7080	8.3055	8.4940

TABLE 4 COMPARISON OF CONVERGENCE TIME (IN SECONDS) FOR DIFFERENT PREDICTION METHODS

	CACM	*CASFNN*	*RBFNN*
Sunday	0.7871	0.4655	0.0375
Monday	0.7795	0.4664	0.0278
Tuesday	0.7982	0.4726	0.0316
Wednesday	0.7799	0.4594	0.0285
Thursday	0.7637	0.4404	0.0279
Friday	0.8561	0.5309	0.0278
Saturday	0.8892	0.4699	0.0284

VI. CONCLUSION

The comparison of the test results shows the merit of Neural Network over the conventional smoothing technique CACM. Simulation test results reveal the following.

The prediction performance of the Neural Networks was very much effective and was able to forecast the load for the next 15 minutes reliably.The forecasting reliability of the proposed ANNs was evaluated by computing the performance indices (MAPE and MAD) and results are very encouraging. On detailed study of the proposed forecast technique, the minimum calculated MAPE of the forecast data is very small.The calculated MAD of the calculated data is very small, which is more reasonable.The application of the proposed ANN has less computational complexity and thus reduced execution time. Hence, proposed methodology is generic enough to be applied to forecasting problems of other power utilities/ load dispatchers for its novelty, simplicity, efficacy and accuracy.

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Probabilistic Stochastic Graphical Models With Improved Techniques

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Abstract: - The web may be viewed as a directed graph. A HTML page can be treated as node and hyperlink as an edge from one node to another this will form a directed graph. But the nature of this graph is evolving with time, so we require evolving graph model. The $G_{n,p}$ and $G_{n,N}$ are static models. In these models, graph G = (V,E) is not changing with time. Sometimes we need a graph model which is time evolving Gt = (V_t,E_t). There are two characteristic functions of evolving graph model [5] first gives the number of vertex added at time t+1, whereas second gives set of edges added at time t+1. Evolving copying model is different from traditional $G_{n,p}$ in the following:
1. Independently chosen edges do not show the results found on the web.
2. This model captures the evolving natures of web graph.
In this paper we review some recent work on generalizations of the random graph aimed at correcting these shortcomings. We describe generalized random graph models of both directed and undirected networks that incorporate arbitrary non-Poisson degree distributions, and extensions of these models that incorporate clustering too. We also describe two recent applications of random
graph models to the problems of network robustness and of epidemics spreading on contact networks. This paper studies the random graph models. Concentration is made over the paper stochastic models for web graph by Ravi Kumar et. al. [5]. During the proof of the results given in the paper some more precise results have been found. Some of results are here which can be compared with results of the papers. The improvements are presented here along with results in the original paper for comparison.

Keywords: *- Random Graph, Martingale, Web Graph.*

I. INTRODUCTION

Definition 1. *A HTML page can be treated as node and hyperlink as an edge from one node to another this will form a directed graph called web graph*.

At present this web graph has billion vertices [5], and an average degree of about 7. In this thesis we discuss different random graph models. These observation suggest that web is not well modelled by traditional models such as *Gn,p*. A lot of models for the random graph have been proposed like *Gn,p* and *Gn,N* models [6] etc. These models do not ensure the power-law for degree of vertices and do not explain the abundance of bipartite cliques observed in the web graph. The copying graph model [5] explains these and also covers the evolving nature of the web graph.
Evolving copying model is different from traditional Gn,pin the following:
(a) Independently chosen edges do not show the results found on the web.
(b) This model captures the evolving natures of web graph.
In this model during every time interval one vertex arrives. At time step t, a single vertex u arrives and the i-th out-link of u is then chosen as follows. With probability α, the destination is chosen uniformly at random from V_t, with remaining probability the outlink is taken to be the i^{th} outlink of prototype vertex p. where V_t is set of vertex at time t.

A. Problem Definition

The problem is to develop random graph model that explain the different nature of web graph. We have to study probabilistic techniques, different models for random graph and find more results based on the models

B. Related Work

The "copying" model analysed in this thesis were first introduced by Kleinberget. al. [4]. Motivated by observations of power-laws for degrees on the graph
of telephone calls, Aiello, Chung, and Lu [1] propose a model for "massive graph"(Henceforth the "ACL model"). In 2000, Ravi Kumar et. al. proposed a numberof models in his paper "Stochastic models for the web graph" [5]. This thesis hassome more precise results, and also the proof of different results available in thepaper "Stochastic models for the web graph".

C. Contribution

(1) The web graph is so large that the study of different nature of this graph is difficult without a good modeling.
(2) The evolution of different social networking site can be explained with the help of this modeling.

D. Results and Organization

Results in Paper	Mywork done
$\lvert E[N_{t,0}\lvert N_{t-k,0}]- E[N_{t,0}\lvert N_{t-(k+1),0}]\rvert \leq 2$	$\lvert E[N_{t,0}\lvert N_{t-k,0}]- E[N_{t,0}\lvert N_{t-(k+1),0}]\rvert \leq 1$
$\frac{t+\alpha}{1+\alpha}-\alpha^2-\ln t \leq E[N_{t,0}] \leq \frac{t+\alpha}{1+\alpha}$	$E[N_{t,0}] = \frac{t}{1+\alpha}$
$Pr\lvert N_{t,0} - E[N_{t,0}] \geq l\rvert \leq \exp(-\frac{l*l}{4t})$	$Pr\lvert N_{t,0} - E[N_{t,0}] \geq l\rvert \leq \exp(-\frac{l*l}{2t})$
	$E[N_{t,0}] = \sum_{j=0}^{t-1} Sj, 0 = \frac{t}{1+\alpha}\frac{t}{1+\alpha}$
	$P_t = \lim_{t\to\infty} \frac{E[Nt,0]}{t} = \frac{1}{1+\alpha}$
$\lvert E[N_{t,i}\lvert N_{t-k,i}N_{t-k,i-1}] - \lvert E[N_{t,i}\lvert N_{t-(k-1),i}N_{t-(k-1),i-1}]\rvert \leq 2$	$\lvert E[N_{t,i}\lvert N_{t-k,i}N_{t-k,i-1}] - \lvert E[N_{t,i}\lvert N_{t-(k-1),i}N_{t-(k-1),i-1}]\rvert \leq 1$ for $N_{t-k,I} = N_{t-(k+1),i}$

II. PROBABILISTIC TECHNIQUES

Preliminaries

We define a discrete probability space (Ω, p) where Ω is discrete (finite or countable infinite) set and p is probability such that
$P: \Omega \to [0,1]$means$\forall\ \omega \in \Omega\ \ p\ (\omega) \in [0, 1]$ and

$$\sum_{\omega} p(\omega) = 1$$

In this thesis we will discuss only discrete probability spaces.

Definition 2. *Given $(\Omega, p), B \subseteq \Omega$, Define conditional probability over $(\Omega, p(B))$as follows.*

$$p(\omega/B) = \begin{cases} 0 \ if\ \omega \notin B, \\ \frac{p(\omega)}{p(B)}\ if\ \omega \epsilon B \end{cases}$$

Where $p(\omega/B)$ is the probability of happening of ω when B has already happened?

Now the probability of happening of A when B has already happened is denoted by P(A|B) and is given by

$$P(A|B) = \sum_{\omega \epsilon A} p(\omega|B)$$

$$= \sum_{\omega \epsilon A \cap B^C} p(\omega|B) + \sum_{\omega \epsilon A \cap B} p(\omega|B)$$

$$= 0 + \sum_{\omega \epsilon A \cap B} p(\omega|B)$$

$$= \sum_{\omega \epsilon A \cap B} \frac{p(\omega)}{P(B)}$$

$$= \frac{1}{p(B)} \sum_{\omega \epsilon A \cap B} p(\omega)$$

$$\Rightarrow P(A|B) = \frac{p(A \cap B)}{p(B)}$$

Expectation of Random Variable

Expectation of a random variable is its basic characteristic. The expectationof random variable is weighted average of the values it assumes, where each valueis weighted by the probability that the variable assumes that value.

Definition 3. *A random variable X is a real-valued function over the sample space Ω; that is X :Ω → R. The expectation of random variable X is defined as*

$$E\{X\} = \sum_j X(\omega_j) p(\omega_j)$$

The expectation is finite If $\sum_j |X_{\omega_j}| p(\omega_j)$converges; otherwise, the expectationis unbounded.

For example:A random variable X that takes the values 2^j with probability $\frac{1}{2^j}$ for j = 1,2,……

The expectation of X

$$E[X] = \sum_{j=1}^{\infty} \frac{1}{2^j} 2^j \to \infty$$

Here the expectation is unbounded.

Conditional Expectation

Definition 4.*The conditional expectation [3] of X relative to B is defined whenP{B} > 0 as*

$$E(X|B\} = \sum_j X(\omega_j) p(\omega_j|B)$$

Definition 5.*Let (Ω_1; p1) and (Ω_2; p2) be probability distributions and (Ω; p) iscalled the joint distribution of them if the following conditions are satisfied.*

$$\sum_{(\omega_1,\omega_2)\epsilon\Omega} p(\omega_1, \omega_2) = 1$$

$$\sum_{\omega_1} p(\omega_1, \omega_2) = P_2\ \omega_2 = p(\omega_2)$$

$$\sum_{\omega_2} p(\omega_1, \omega_2) = P_1\ \omega_1 = p(\omega_1)$$

where

$$\Omega = \Omega_1 \times \Omega_2 = \{(\omega_1, \omega_2)|\omega_1 \epsilon \Omega_1, \omega_2 \epsilon \Omega_2\}$$

Definition 6.Two *random variable X and Y are independent if and only if*

$$Pr\big((X = x) \cap (Y = y)\big) = Pr(X = x).Pr(Y = y)$$

for a values of x and y. Similarly, random variables X_1,X_2,…,X_k are mutuallyindependent if and only if, for any subset I ⊆ [1, k] and any values x_i, i∈I,

$$Pr\left(\bigcap_{i\epsilon I} X_i = x_i\right) = \prod_{i\epsilon I} Pr(X_i = x_i)$$

If the events ξ_i and ξ_j are pairwise independent then

$$Pr[\xi_i|\xi_j] = Pr[\xi_i]$$

for all i≠j

Proof.

$$Pr[\xi_i|\xi_j] = \frac{Pr[\xi_i \cap \xi_j]}{Pr[\xi_j]}$$

$$= \frac{Pr[\xi_i|Pr[\xi_j]}{Pr[\xi_j]} = Pr[\xi_i]$$

Linearity of Expectation

$$E[X + Y] = E[X] + E[Y]$$

Proof.

$$E[X+Y] = \sum_{(x,y)\epsilon\mathbb{R}\times\mathbb{R}} (x+y)p(X,Y)$$
$$= \sum_x \sum_y (x+y)\Pr((X=x)\cap(Y=y))$$
$$= \sum_x \sum_y xPr\big((X=x)\cap(Y=y)\big) + \sum_x \sum_y yPr\big((X=x)\cap(Y=y)\big)$$
$$= \sum_x xPr(X=x) + \sum_y yPr(Y=y)$$
$$= E[X] + E[Y]$$

General form

$$E\left[\sum_{i=1}^{n} X_i\right] = \sum_{i=1}^{n} [X_i]$$
$$E[aX+b] = aE[X] + b$$

Proof.

$$E[aX+b] = \sum_{x\epsilon\mathbb{R}} (a(X=x)+b)\Pr(X=x)$$
$$= a\sum_{x\epsilon\mathbb{R}} (X=x)\Pr(X=x) + b\sum_{x\epsilon\mathbb{R}} \Pr(X=x)$$
$$= aE[X] + b.1$$
$$= aE[X] + b$$

If X and Y are two independent random variables, thenE[X,Y] = E[X].E[Y]

Bernoulli Random Variable

If we run an experiment such that it succeedswith probability p and fails with probability (1-p). Let Y be a randomvariable such that

$$Y = \begin{cases} 1\ if\ success\ wp\ p, \\ 0\ if\ fails\ wp\ (1-p) \end{cases}$$

Here the random variable Y is called a Bernoulli random variable.

Theorem 1. *The expectation of Bernoulli random variable is same as the probability of success of the random variable.*

Proof.

E[Y] = 1. p + 0. (1 - p) = p

$\Rightarrow$ *E[Y] =Pr[Y=1]*

Binomial Distribution Consider a sequence of n independent experiments,each of which succeeds with probability p. If we represents X as numberof successes in n experiments then X has a binomial distribution.

Definition 7*. A binomial random variable X with parameters n and p, denotedby $B(n,p)$is defined by following probability distribution on $j = 0,1,2,\ldots,n$:*

$$Pr(X=j) = \begin{cases} \binom{n}{j} p^j (1-p)^{n-j} & k\epsilon\{0,1,2,\ldots.n\} \\ 0\ otherwise \end{cases}$$

Theorem 2.*The expectation of binomial random variable is np.*

Proof. The binomial random variable X can be expressed as the sum of Bernoulli random variables.

$$X = \sum_{i=1}^{n} X_i$$
$$E[X] = E\left[\sum_{i=1}^{n} X_i\right] = \sum_{i=1}^{n} E[X_i]$$

from Linearity of expectation

$$\sum_{i=1}^{n} p$$

from expectation of Bernoulli random variable

$$= np$$

Geometric Distribution

Sequence of independent trials until the first success is found where each trialsuccess with probability p, This gives an example of geometric distribution.

A geometric random variable X with parameter p is given by following probabilitydistribution on $n = 0,1,2,\ldots$.

$$\Pr(X = n) = (1-p)^{(n-1)}.p$$

For geometric random variable X equals n there must be $n-1$ failures followedby a success.

Definition 8. $\sum_{i=1}^{n} \frac{1}{t} = \mathbb{H}(n)$*called the harmonic number* $= \ln n + \Theta(1)$.

Proof. Since $\frac{1}{i}$ is monotonically decreasing function, we can write $\ln n = \int_{x=1}^{n} \frac{1}{k} \leq \sum_{k=1}^{n} \frac{1}{k}$

$$\Rightarrow \sum_{k=2}^{n} \frac{1}{k} \leq \int_{x=1}^{n} \frac{1}{k} = \ln n$$
$$\Rightarrow \ln n \leq \mathbb{H}(n) \leq \ln n + 1$$
$$\Rightarrow \mathbb{H}(n) = n \ln n + \Theta(n)$$

Theorem 3.*The expectation of geometric random variable is* $\frac{1}{p}$

Proof.

$$E[X] = \sum_{i=1}^{\infty} i.(1-p)^{i-1}.p$$
$$= p.\sum_{i=1}^{\infty} i.(1-p)^{i-1}$$
$$= p.\sum_{i=1}^{\infty} i.t^{i-1} \quad (\because 1-p = t\ 0 < t < 1)$$
$$= p.(1 + 2t + 3t^2 + 4t^3 + \cdots)$$
$$= p.\frac{1}{(1-t)^2} = p\frac{1}{p^2} = \frac{1}{p}$$

$$\{\because f(x) = 1 + 2t + 3t^2 + 4t^3 + \cdots = \frac{1}{1-t} \quad sum\ of\ G.P.$$
$$f'(x) = 1 + 2t + 3t^2 + 4t^3 + \cdots = \frac{1}{(1-t)^2}\}$$

Markov's Inequality

Let X be a random variable assumes only non-negative values the for all $t > 0$

$$\Pr[X \geq t] \leq \frac{E[X]}{t}$$

Proof. $E[X] = \sum_{x\epsilon\mathbb{R}} xPr(X = x)$

$$\geq \sum_{x \geq k} xPr(X = x)$$
$$\geq \sum_{x \geq k} kPr(X = x)$$
$$E[X] \geq \sum_{x \geq k} kPr(X = x) = kPr(X \geq k)$$
$$E[X] \geq kPr(X \geq k)$$
$$Pr(X \geq k) \leq \frac{E[X]}{k}$$
$$\Rightarrow Pr(X \geq t) \leq \frac{E[X]}{t}$$

Chebyshev's Inequality

$$\Pr(|X - E[X]| \geq t) \leq \frac{Var[X]}{t^2}$$

Proof.

$$\Pr(|X - E[X]| \geq t) = \Pr((|X - E[X])^2| \geq t^2)$$
$$\leq \frac{(X - E[X])^2}{t^2}$$
$$= \frac{Var[X]}{t^2}$$

Since $(X - E[X])^2$ is a non-negative random variable, we can apply Markov'sinequality.

Jensen's Inequality

If f is a convex function, then $E[f(X)] \geq f(E[X])|$

Proof. Suppose f has a Taylor series expansion. Expending $\mu = E[X]$and usingthe Taylor series expansion with a remainder term, yields for some a.

$$f(x) = f(\mu) + f'(\mu)(x-\mu) + \frac{f''(a)(x-\mu)^2}{2}$$
$$\geq f(\mu) + f'(\mu)(x-\mu) \ \ (\because f''(a) \geq 0 \ by \ convexity.)$$
$$f(x) \geq f(\mu) + f'(\mu)(x-\mu)$$

Taking expectation on both sides

$$E[f(x)] \geq f(\mu) + f'(\mu)E[(x-\mu)] = f(\mu)$$
$$E[f(x)] \geq f(E[X])$$

Martingale

σ- field

Definition 9.*A σ- field$(\Omega, \mathbb{F})$ consists of a sample space and a collection ofsubsets $\mathbb{F}$ satisfying the following conditions [7].*

$$\phi \epsilon \mathbb{F}$$
$$\varepsilon \epsilon \mathbb{F} \Rightarrow \varepsilon' \epsilon \mathbb{F}$$
$$\varepsilon_1, \varepsilon_2, \ldots \epsilon \mathbb{F} \Rightarrow \varepsilon_1 \cup \varepsilon_2 \cup \ldots \epsilon \mathbb{F}$$

Partition of Ω

Definition 10.$\mathbb{F}$is a partition of Ω if $\mathbb{F} \subseteq 2^{\Omega}$ and

(i) $\cup_{F \epsilon \mathbb{F}} F = \Omega$

(ii) $F \neq \phi \ \forall \ F \epsilon \mathbb{F}$

(iii) $F \cap G = \phi \ \forall \ F \neq G \ where \ F, G \epsilon \mathbb{F}$

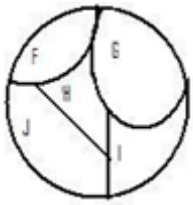

Figure 1: Partition of Sample space

Here $\mathbb{F}$ is partition of Ω then corresponding algebra of partition $\mathbb{A}(\mathbb{F}_1)$ is

$$\{\phi, F, G, H, \ldots, F \cup G, F \cup H, \ldots, F \cup G \cup H, \ldots\}$$

Where algebra is smallest set containing $\mathbb{F}$ that is closed under finite union, intersectionand complementation.

Definition 11. *If $\mathbb{F}_1, \mathbb{F}_2$ are partitions of Ω then $\mathbb{F}_1 \subseteq \mathbb{F}_2$ if $A \epsilon \mathbb{A}(\mathbb{F}_1)$implies $A \epsilon \mathbb{A}(\mathbb{F}_2)$. Where $\mathbb{A}(\mathbb{F}_1)$ and $\mathbb{A}(\mathbb{F}_2)$ are algebra of $\mathbb{F}_1$and $\mathbb{F}_2$ respectively.*

Filtration

Definition 12*. Given the σ- field $(\Omega, \mathbb{F})$ with $\mathbb{F} \subseteq 2^{\Omega}$, a filter (sometimes alsocalled filtration) is a nested sequence $\mathbb{F}_1 \subseteq \mathbb{F}_2 \subseteq \mathbb{F}_3 \ldots \subseteq \mathbb{F}_n$ of subsets of 2^{Ω}suchthat [7]* $\mathbb{F}_0 = \{\phi, \Omega\}$

$$\mathbb{F}_n = 2^{\Omega}$$
$$for \ 0 \leq i \leq n, (\Omega, \mathbb{F}_i) \ is \ a \ \sigma - \ field.$$

Definition 13. Let $(\Omega, \mathbb{F})$ be any $\sigma - \ field$, and Y any random variable that takeson distinct values on the elementary events in $\mathbb{F}$. Then $E[X|\mathbb{F}] = E[X|Y]$.

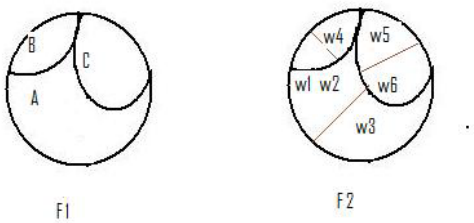

Figure 2: Filtration

Notice that the conditional expectation $E[X|Y]$does not really depend on theprecise value of Y on the specific elementary event. In fact, Y is merely an indicatorof the elementary events in$\mathbb{F}$. Conversely, we can write

$E[X|Y] = E[X|\sigma(Y)]$ where $\sigma(Y)$ is the $\sigma - field$ generated by the events of the type$\{Y = y\}$, i.e., thesmallest σ- field over which Y is measurable.

Definition 14. *A random variable X over σ- field* $(\Omega, \mathbb{F})$ *is well defined if*$X(\omega_1) = X(\omega_2)$*for all* $A \epsilon \mathbb{F}$ *where* $\omega_1, \omega_2 \epsilon A$ *and* $\mathbb{F}$ *is partition.*

It is also called $\mathbb{F}$ *-measurable. A random variable X is* $\mathbb{F}$ *-measurable if its valueis constant over each block in the partition generation* $\mathbb{F}$*. Since the partitions generating the σ- fields in a filter are successively more refined, it follows that if X,*$\mathbb{F}_i$ *-measurable, it is also* $\mathbb{F}_j$*-measurable for all* $j \geq i$*. i.e*

If $\mathbb{F}_1 \subseteq \mathbb{F}_2$ *and X is well defined over* $(\Omega, \mathbb{F}_1)$ *then X is well defined over*$(\Omega, \mathbb{F}_2)$ *Converse may not be true.*

Suppose X is well defined over $\mathbb{F}_2$. How to define a random variable over $\mathbb{F}_1$so that it is well defined.

Let random variable

$$Y(\omega) = \frac{\sum_{\omega \epsilon A} X(\omega)p(\omega)}{p(A)} \; where \; \omega \epsilon A \epsilon \mathbb{F}_1.$$

$$\Rightarrow Y(\omega) = \sum_{\omega \epsilon A} X(\omega)p(\omega|A)$$

Proof. $Y(\omega_i) = \sum_{\omega_i \epsilon A} X_i(\omega)p(\omega_i|A)$

$$= \frac{\sum_{\{i|\omega_i \epsilon A\}} x_i p_i}{\sum_{\{i|\omega_i \epsilon A\}} p_i}$$

$Y(\omega_i)$is same for a partition. So random variable is constant for a particularpartition. Similarly we can proof for other partitions. Here we assume that the Sample space has been partitioned, the points $\omega_1, \omega_2, \omega_3$with probability $p_1, p_2, p_3$and valuesx_1, x_2, x_3 respectively are in finer partition $\mathbb{F}_2$

Theorem 4. Defining Y as conditional expectation of X given $\mathbb{F}_1$ denoted by$E[X|\mathbb{F}_1] = Y$ then

$$E[Y] = E[X]$$

Proof. $E[Y] = \sum_{\omega \epsilon \Omega} Y(\omega)p(\omega)$

$$= \sum_{A \epsilon \mathbb{F}_1} \sum_{\omega \epsilon A} Y(\omega)p(\omega)$$

$$= \sum_{A \epsilon \mathbb{F}_1} Y(\omega) \sum_{\omega \epsilon A} p(\omega) \; As \; Y \; is \; well \; defined$$

$$\sum_{A \epsilon \mathbb{F}_1} Y(\omega)p(A)$$

$$= \sum_{A \epsilon \mathbb{F}_1} p(A) \sum_{\omega \epsilon A} X(\omega)p(\omega|A)$$

$$= \sum_{A \epsilon \mathbb{F}_1} p(A).\frac{\sum_{\omega \epsilon A} X(\omega)p(\omega)}{p(A)}$$

$$= \sum_{A \epsilon \mathbb{F}_1} \sum_{\omega \epsilon A} X(\omega)p(\omega)$$

$$= \sum_{\omega \epsilon \Omega} X(\omega)p(\omega)$$

$$= E[X]$$

From this result it is clear that for filter $\mathbb{F}_1 \subseteq \mathbb{F}_2 \subseteq \mathbb{F}_3 \ldots \subseteq \mathbb{F}_n$ overσ- *field* and corresponding random variables are $X_0, X_1, X_2, \ldots, X_n$then

$$\mu = E[X_0] = E[X_1] = E[X_2] = \cdots = E[X_n]$$

Martingale

Definition 15.*Let* $(\Omega, \mathbb{F}, Pr)$ *be a probability space with a fiter*$\mathbb{F}_0, \mathbb{F}_1, \mathbb{F}_2, \ldots$*Suppose* $X_0, X_1, X_2, \ldots$ *are random variables such that for all* $i \geq 0$*, Xi is* $\mathbb{F}_i$*-measurable. The sequence* $X_0, X_1, X_2, \ldots, X_n$*is a martingale provided, for all* $i \geq 0$*,*

$$E[X_{i+1}|\mathbb{F}_i] = X_i$$

Definition 16.*The set of random variables* $\{Z_n, n = 0,1,2 \ldots\}$ *is said to be amartingale [8] with respect to sequence* $\{X_n, n = 0,1,2 \ldots\}$ *if* Z_n *is a function of*$X_0, X_1, X_2, \ldots, X_n E[|Zn|] < \infty$,*and*$E[Z_{n+1}|X_0, X_1, X_2, \ldots, X_n] = Z_n$

If we say $\{Z_n\}$ *is a martingale [8] (without specifying* $\{X_n, n = 0,1,2 \ldots\}$ *whenit is a martingale with respect to itself. i.e.* $\{Z_n\}$ *is a martingale if* $E[|Zn|] < \infty$,and$E[Z_{n+1}|Z_0, Z_1, Z_2, \ldots Z_n] = Z_n$.

Note:-$\{Z_n\}$ is martingale with respect to $\{X_n\}$ then it is a martingale.

Theorem 5.$\{Z_n\}$is martingale with respect to $\{X_n\}$ then it is a martingale

$$E[Z_{n+1}|Z_0, Z_1, Z_2, \dots Z_n] = Z_n$$

*Proof.*we know the identity $E[X|U] = E[E[X|U,V]|U]$
$\{Z_n\}$is martingale with respect to $\{X_n\}$ then

$$\begin{aligned} &E[Z_{n+1}|Z_0 \dots Z_n] \\ &= E[E[Z_{n+1}|Z_0 \dots Z_n, X_0 \dots X_n]|Z_0 \dots Z_n] \\ &= E[E[Z_{n+1}|X_0 \dots X_n]|Z_0 \dots Z_n] \\ &= E[Z_n|Z_0 \dots Z_n] \\ &= Z_n \end{aligned}$$

Theorem 6. $E[Z_n] = E[Z_0]$

Proof. $Z_0 \dots Z_n$are functions of $X_0 \dots X_n$

$$E[Z_{n+1}|Z_0, Z_1, Z_2, \dots Z_n] = Z_n$$

Taking expectation on both the sides.

$$\begin{aligned} E[Z_{n+1}] &= E[Z_n] \\ E[Z_n] &= E[Z_0] \end{aligned}$$

$E[Z_0]$is called mean of the martingale.

Example: - Fair bet game:suppose X_i be the outcome of i^{th} game. $Z_n$is the fortune of gambler after n^{th}game. For given outcome of first n games the gambler's expected fortune after(n + 1)st game is equal to his fortune before the game. The gambler's expectedwinning on each game is equal to zero. Here $X_0, X_1, X_2, \dots, X_n$ is martingale.

Azuma's Inequality

Let $X_0, X_1, X_2, \dots, X_n$ be a martingale sequence such that for all k

$$|X_k - X_{k-1}| \le c$$

$$\Pr[|X_t - X_0| \ge l] \le 2\exp\left(-\frac{l^2}{2tc^2}\right)$$

Where c may depend on k for all t≥0 and for any l>0

Proof. Let $\mathbb{F}_1 \subseteq \mathbb{F}_2 \subseteq \mathbb{F}_3 \dots \subseteq \mathbb{F}_n$ be filter sequence and $X_0, X_1, X_2, \dots, X_n$ be martingalesequence where $X_0 = E[X_i]$ for $i\epsilon 0,1,2, \dots, n$. Also

$$E[X_j|\mathbb{F}_i] = X_i \quad for\ i < j$$

If X is $\mathbb{F}_i$ measurable (constant for particular partition) and Y is anotherrandom variable then we observe that

$$E[XY|\mathbb{F}_i] = XE[Y|\mathbb{F}_i]$$

Since $X_0, X_1, X_2, \dots, X_n$ is martingale and let $Y_i = X_i - X_{i-1}$ for $i = 1,2, \dots, t$.

$$\begin{aligned} E[Y_i|X_0, X_1, X_2, \dots, X_{i-1}] &= E[X_i - X_{i-1}|X_0, X_1, \dots, X_{i-1}] \\ &= E[X_i|X_0, X_1, \dots, X_{i-1}] - X_i = 0 \end{aligned}$$

Now consider, $Y_i = -c_i\frac{1-\frac{Y_i}{c_i}}{2} + c_i\frac{1+\frac{Y_i}{c_i}}{2}$

Using the convexity of the function $e^{\alpha Y_i}$

$$\begin{aligned} e^{\alpha Y_i} &\le \frac{1-\frac{Y_i}{c_i}}{2}e^{-\alpha c_i} + \frac{1+\frac{Y_i}{c_i}}{2}e^{\alpha c_i} \\ &= \frac{e^{\alpha c_i} + e^{-\alpha c_i}}{2} + \frac{Y_i}{2c_i}(e^{\alpha c_i} + e^{-\alpha c_i}) \end{aligned}$$

$$\begin{aligned} E[e^{\alpha Y_i}|X_0, X_1, \dots, X_{i-1}] &\le E\left[\frac{e^{\alpha c_i} + e^{-\alpha c_i}}{2} + \frac{Y_i}{2c_i}(e^{\alpha c_i} + e^{-\alpha c_i})\middle| X_0, X_1, \dots, X_{i-1}\right] \\ &= \frac{e^{\alpha c_i} + e^{-\alpha c_i}}{2} \end{aligned}$$

$\le e^{(\alpha c_i)^2/2}$ Using Taylor series

$$\Rightarrow E[e^{\alpha Y_i}|X_0, X_1, \dots, X_{i-1}] \le e^{(\alpha c_i)^2/2}$$

$$E\left[e^{\alpha(X_t - X_0)}\right] = E[\prod_{i=1}^{t} e^{\alpha Y_i}]$$

$$\begin{aligned} &= E[\prod_{i=1}^{t-1} e^{\alpha Y_i}]\, E[e^{\alpha Y_i}|X_0, X_1, \dots, X_{i-1}] \\ &\le E[\prod_{i=1}^{t-1} e^{\alpha Y_i}]\, e^{(\alpha c_i)^2/2} \end{aligned}$$

$$\leq e^{\alpha^2 \sum_{i=1}^{t} {c_i}^2/2}$$

$\leq e^{\alpha^2 t c^2/2}$ As $c_i = c \; \forall \; i$

$$\Pr[X_t - X_0 \geq l] = \Pr[e^{\alpha(X_t - X_0)} \geq e^{\alpha l}]$$

$$\leq \frac{E\left[e^{\alpha(X_t - X_0)}\right]}{e^{\alpha l}}$$

$$\leq e^{\alpha^2 t c^2/2 - \alpha t}$$

$$= e^{-l^2/(2tc^2)} \; where \; \alpha = \frac{l}{tc^2} \Rightarrow \Pr[|X_t - X_0| \geq l] \leq 2\exp(-\frac{l^2}{2tc^2})$$

III. A SURVEY OF RANDOM GRAPH MODEL FOR WEB MODELING

Random graphs

Random graph is a graph which is generated by some random process. Two basic models for generating random graphs are $G_{n,N}$and $G_{n,p}$ models. As we know there are many NP- hard computational problems defined on graphs: Hamiltonian cycle, independent set, Vertex cover, and so forth. One question worth asking is whether these problems are hard for most inputs or just for a relatively small fraction of all graphs. Random graph models provide a probabilistic setting for studying such questions.

$G_{n,N}$Model of Random Graph

In $G_{n,N}$model of random graph n is the count of vertices and N is number of edges in the graph. We consider all undirected graphs on n vertices with exactly N edges. Since, there are n vertices so possible number of edges are$\binom{n}{2}$. Out of$\binom{n}{2}$ many possible edges graph has N edges, this can be selected in$\binom{N}{\binom{n}{2}}$ manyways. So total possible graphs are$\binom{N}{\binom{n}{2}}$.

Generating graph using $G_{n,N}$model

One way to generate a graph from graphs in $G_{n,N}$ is to start with no edges. Choose one of the $\binom{n}{2}$ possible edges uniformly at random and add it to the edges in the graph. Now choose one of the remaining $\binom{n}{2} - 1$ possible edges independently and uniformly at random and add to the graph. Similarly, continue choosing one of the remaining unchosen edges independently at random until there are N edges.

$G_{n,p}$Model of Random Graph

In $G_{n,p}$ model of random graph n is the count of vertices and p is the probability of selection of an edge. We consider all undirected graphs on n distinct vertices v_1, v_2,…,v_n. A graph with a given set of m edges has probability $p^m(1-p)^{\binom{n}{2}-m}$.

Generating graph using $G_{n,p}$ model

One way to generate a random graph in $G_{n,p}$ is to consider each of the $\binom{n}{2}$ possible edges in some order and then independently add each edge to the graph with probability p. i.e. Corresponding to each edge out of $\binom{n}{2}$ throw a coin biased with outcome head with probability p. If outcome is head add the edge to the graph, don't add otherwise. The expected number of edges in the graph is therefore $\binom{n}{2}$p, and each vertex has expected degree (n-1) p.

The $G_{n,N}$ and $G_{n,p}$ models are related: when p = N/$\binom{n}{2}$. The $G_{n,p}$ and $G_{n,N}$ are static models. In these models, graph G = (V,E) is not changing with time. Sometimes we need a graph model which is time evolving $G_t = (V_t, E_t)$.

Evolving Model

Evolving Model of graph covers evolving nature of it. There are two characteristic functions of evolving graph model [5] first gives the number of vertex added at time t+1, whereas second gives set of edges added at time t+1, these are called characteristic function of evolving graph model.

Characteristic functions of evolving graph model $f_v(V_t,t)$ and $f_e(f_t,G_t,t)$. $f_v(V_t,t)$ gives number of vertex added at time t + 1 and $f_e(f_t,G_t,t)$ gives the set of edges added at time t + 1.

$$V_{t+1} = V_t + f_v(V_t,t)$$

$$E_{t+1} = E_t \cup f_e(f_t,G_t,t)$$

The evolving graph model is completely characterized by f_v and f_e.

Linear growth copying model

The Linear growth copying model is evolving model. In each time interval one vertex is added. This is linear growth, because at timestep t, a single vertex arrives and may link to any of the first t-1 vertices. This model describes web graph easily. Web graph is time evolving in nature where at timestep one web page may arrive and is connected to previous one, or a page may be deleted.

Generating graph using linear growth copying model [5]

In each time interval one vertex is added. Edges are added in following way: for a new vertex *u* out-degree *d* is constant. The i^{th} out-degree is decided as- With probability α destination is chosen uniformly from V_t and with remaining probability destination is chosen as the i^{th} outlink of prototype vertex p. Where α is copy factor α∈(0, 1) and the out-degree is d ≥ 1 and $f_v(V_t,t) = 1$. The prototype vertex is chosen once in advance.If $N_{t,i}$ represents number of vertices having in-degree i at time t, for simplicity $d = 1$ and $i = 0$.

In-degree $N_{t,0}$ distribution

Theorem 6. $E[Nt,0 \mid Nt\text{-}k,0] = Nt\text{-}k,_0S_{k,0} + \sum_{j=0}^{k-1} Sj, 0$.

Proof

$E[Nt,0 \mid Nt\text{-}k,0] = 1 + (1-\frac{\alpha}{t-1})+(1-\frac{\alpha}{t-1})(1-\frac{\alpha}{t-2})+\ldots$

$+(1-\frac{\alpha}{t-1})(1-\frac{\alpha}{t-2})\ldots.(1-\frac{\alpha}{t-k})N_{t\text{-}k,0}$

$\mathbf{S_{0,0}=1}$

$S_{k,0}=S_{k\text{-}1,0(1-\frac{\alpha}{t-k})}$

$E[N_{t,0} \mid N_{t\text{-}k,0}] =N_{t\text{-}k,0}S_{k,0}+\sum_{j=0}^{k-1} sj, 0$

$S_{k,0}= S_{k\text{-}1,0}(1-\frac{\alpha}{t-k})$

$E[N_{t,0} \mid N_{t\text{-}k,0}]=N_{t\text{-}k,0}S_{k,0}+\sum_{j=0}^{k-1} Sj, 0$

t-k=1

$E[N_{t,0} \mid N_{1,0}]=N_{1,0}S_{t\text{-}1,0}+\sum_{j=0}^{t-2} Sj, 0$

$E[N_{t,0}]=\sum_{j=0}^{t-1} Sj, 0$ (As $N_{1,0}=1$)

Theorem 7. $E[N_{t,0} \mid N_{t\text{-}k,0}] - E[N_{t,0} \mid N_{t\text{-}k+1),0}] \mid \leq 1$

Proof.

$\mid E[N_{t,0} \mid N_{t\text{-}k,0}] - E[N_{t,0} \mid N_{t\text{-}(k+1),0}] \mid = \mid N_{t\text{-}k,0}S_{k,0} +\sum_{j=0}^{k-1} Sj, 0 - N_{t\text{-}(k\text{-}1),0}S_{k+1,0}-\sum_{j=0}^{k} Sj, 0 \mid$

Case 1:

$(N_{t\text{-}k,0}=N_{t\text{-}(k+1),0}+1)$

$= \mid N_{t\text{-}(k+1),0}S_{k,0} + S_{k,0} - N_{t\text{-}(k+1),0}S_{k,0}\ (1 -\frac{\alpha}{t-(k+1)})\text{-}S_{k,0} \mid$

$= \mid S_{k,0}\text{-}S_{k,0}(1-\frac{\alpha N_{t-(k+1),0}}{t-(k+1)}) \mid \leq 1$

$(S_{k,o}(1-\frac{\alpha N_{t-(k+1,0)}}{t-(k+1)})\leq 1)$

From equations it is probability which is always ≤ 1 and $S_{k,0}\leq 1$.

Case 2.

$(N_{t\text{-}k}=N_{t\text{-}(k+1),0})$

$= \mid N_{t\text{-}(k+1),0}S_{k,0}\text{-}N_{t\text{-}(k+1),0}S_{k,0}(1-\frac{\alpha}{t-(k+1)})\text{-}S_{k,0} \mid$

$= \mid S_{k,o}(1-\frac{\alpha N_{t-(k+1),0}}{t-(k+1)}) \mid \leq 1$

$(S_{k,0}(1-\frac{\alpha N_{t-(k+1),0}}{t-(k+1)})\leq 1)$

From equations ,it is probability which is always ≤ 1 and as $S_{k,0}\leq 1$

$\mid E[N_{t,0} \mid N_{t\text{-}k,0}] - E[N_{t,0} \mid N_{t\text{-}(k+1),0}] \mid \leq 1$

This result is an improvement compared to the result given in the paper [5]

$\mid E[N_{t,0} \mid N_{t\text{-}k,0}] - E[N_{t,0} \mid N_{t\text{-}(k+1),0}] \mid \leq 2$

Theorem 8. $E[Nt;0] = \frac{t}{1+\alpha}$.

Proof. From equation

$$S_{k,0} = S_{k-1,0}\left(1-\frac{\alpha}{t-k}\right)$$

$$S_{k,0} - S_{k-1,0} = -Sk\text{-}1,0\ \frac{\alpha}{t-k}$$

$$(S_{k,0}-S_{k-1,0})(t-k) = -\propto S_{k-1,0}$$

$$(t-k)\,(S_{k-1,0} - S_{k,0}) = \propto S_{k-1,0}$$

$$(t-(k-1))\,(S_{k-1,0} - S_{k,0}) = (1+\alpha)\,S_{k-1,0}$$

$$(1+\alpha)\,S_{k-1,0} = (t-k)\,S_{k,0} - (t-(k+1))\,S_{k+1,0}$$

$$(1+\alpha)\,S_{0,0} = tS_{0,0} - (t-1)\,S_{1,0}$$

$$(1+\alpha)\,S_{1,0} = (t-1)\,S_{1,0} - (t-2)\,S_{2,0}$$

$$(1+\alpha)\,S_{2,0} = (t-2)\,S_{2,0} - (t-3)\,S_{3,0}$$

:

$$(1+\alpha)\,S_{t-2,0} = 2S_{t-2,0} - S_{t-1,0}$$

$$(1+\alpha)\,S_{t-1,0} = S_{t-1,0} - (t-t)\,S_{t,0}$$

$$(1+\alpha)\sum_{j=0}^{t-1} S_{j,0} = S_{0,0}$$

$$\Rightarrow E[N_{t,0}] = \frac{t}{1+\alpha}$$

This result is an improvement compared to the result given in the paper [5]

$\frac{t+\alpha}{1+\alpha}$–α^2lnt ≤ E[Nt,0] ≤$\frac{t+\alpha}{1+\alpha}$

Theorem 9. $\Pr[|N_{t,0} - E[N_{t,0}]| \geq l\,] \leq 2\exp(-\frac{l^2}{2t})$

Proof. Azuma's Inequality

Let $X_0, X_1, X_2, \ldots$ be a martingale sequence such that for all k

$$|X_k - X_{k-1}| \leq c$$

where c may depend on k.

Then for all t≥0 and any $\lambda > 0$

$$\Pr[|X_t - X_0| \geq l\,] \leq \exp(-\frac{l^2}{2t\,c^2})$$

From theorem 7

$$|E[N_{t,0}|N_{t-k,0}] - E[N_{t,0}|N_{t-(k+1),0}]| \leq 1$$

$$\Rightarrow \Pr[|N_{t,0} - E[N_{t,0}]| \geq l\,] \leq \exp(-\frac{l^2}{2t})$$

This result is an improvement compared to the result given in the paper[5]

$$\Pr[|N_{t,0} - E[N_{t,0}]| \geq l\,] \leq \exp(-\frac{l^2}{4t})$$

$$E[N_{t,0}] = \sum_{j=0}^{t-1} S_{j,0} = \frac{t}{1+\alpha}$$

$P_t = \lim_{t\to\infty} \frac{E[N_{t,0}]}{t} = \frac{1}{1+\alpha}$.

IV. DISTRIBUTIONS

In-degree $N_{t,i}$ distribution

$N_{t,i}$ represents number of vertices having in- degree i at time tfor simplicity d = 1 *Hence* $N_{t,i}$ *is*

$$\begin{cases} N_{t-1,i}-1 & \text{with } \dfrac{\alpha N_{t-1,i}}{t-1}+\dfrac{(1-\alpha)N_{t-1,i}}{t-1} \\ N_{t-1,i}+1 & \text{with } \dfrac{\alpha N_{t-1,i-1}}{t-1}+\dfrac{(1-\alpha)(i-1)N_{t-1,i-1}}{t-1} \\ N_{t-1,i} & \text{otherwise} \end{cases}$$

define $X_{t-k}=E[N_{t,i}|N_{t-k,i}N_{*,i-1}]$ where $N_{*,i-1}=N_{0,i-1},N_{1,i-1},N_{2,i-1},N_{3,i-1},\ldots,N_{t-1,i-1}$ for $0\le t-k\le t$

The sequence $X_0,X_1,X_2,\ldots X_t$ forms Doob's martingale [3]

$$E\left[N_{t,i}|N_{t-k,i}N_{*,i-1}\right]=N_{t-k,i}S_{k,i}+\sum_{j=0}^{k-1}S_{j,i}F_{j+1,i-1}$$

where

$$S_{0,i}=1$$

$$S_{k,i}=S_{k-1,i}\left(1-\frac{\alpha}{t-k}-\frac{(1-\alpha)i}{t-k}\right)$$

$$F_{k,i-1}=\frac{\alpha+(1-\alpha)(i-1)}{t-k}$$

Proof.

$$E[N_{t,0}|N_{t-1,i}=\beta,N_{t-1,i-1}=\gamma]$$

$$=(\beta-1)\frac{\alpha\beta}{t-1}+\frac{(1-\alpha)i\beta}{t-1}+(\beta+1)\frac{\alpha\gamma+(1-\alpha)(i-1)\gamma}{t-1}$$

$$+\beta-\left(\frac{\alpha\beta}{t-1}+\frac{(1-\alpha)i\beta}{t-1}\right)-\frac{\alpha\gamma+(1-\alpha)(i-1)\gamma}{t-1}$$

$$=\left(1-\frac{\alpha}{t-1}-\frac{(1-\alpha)i}{t-1}\right)\beta+\frac{\alpha+(1-\alpha)(i-1)}{t-1}\gamma$$

$$\Rightarrow E\left[N_{t,i}|N_{t-1,i}N_{t-1,i-1}\right]=\left(1-\frac{\alpha}{t-1}-\frac{(1-\alpha)i}{t-1}\right)|N_{t-1,i}+\frac{\alpha+(1-\alpha)(i-1)}{t-1}N_{t-1,i-1}$$

$$E\left[N_{t,i}|N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]=E\left[E\left[N_{t,i}|N_{t-1,i}N_{t-1,i-1}\right]|N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]$$

$$=\left(1-\frac{\alpha}{t-1}-\frac{(1-\alpha)i}{t-1}\right)E\left[N_{t-1,i}|N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]$$

$$+\frac{\alpha+(1-\alpha)(i-1)}{t-1}E\left[N_{t-1,i-1}|N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]$$

$$E\left[N_{t,i}|N_{t-2,i},N_{t-2,i-1}\right]=\left(1-\frac{\alpha}{t-1}-\frac{(1-\alpha)i}{t-1}\right)\{$$

$$\left(1-\frac{\alpha}{t-2}-\frac{(1-\alpha)i}{t-2}\right)N_{t-2,i}$$

$$+\frac{\alpha+(1-\alpha)(i-1)}{t-2}N_{t-2,i-1}\}+\frac{\alpha+(1-\alpha)(i-1)}{t-1}N_{t-1,i-1}$$

$$\because E\left[N_{t-1,i-1}|N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]=N_{t-1,i-1}\text{ and}$$

$$E\left[N_{t-1,i-1}|N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]=E\left[N_{t-1,i}|N_{t-2,i},N_{t-2,i-1}\right]$$

$$E\left[N_{t,i}|N_{t-3,i},N_{t-3,i-1}N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]$$

$$=E\left[E\left[N_{t,i}|N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]|N_{t-3,i},N_{t-3,i-1}N_{t-2,i},\right.$$
$$\left.N_{t-2,i-1},N_{t-1,i-1}\right]=\left(1-\frac{\alpha}{t-1}-\frac{(1-\alpha)i}{t-1}\right)$$

$$\{\left(1-\frac{\alpha}{t-2}-\frac{(1-\alpha)i}{t-2}\right)E\left[N_{t-2,i}|N_{t-3,i},N_{t-3,i-1}N_{t-2,i},N_{t-2,i-1},N_{t-1,i-1}\right]$$

$$+\frac{\alpha+(1-\alpha)(i-1)}{t-2}E\left[\begin{matrix}N_{t-2,i-1}|N_{t-3,i},N_{t-3,i-1}N_{t-2,i}\\,N_{t-2,i-1},N_{t-1,i-1}\end{matrix}\right]\}$$

$$+\frac{\alpha+(1-\alpha)(i-1)}{t-1}E\left[\begin{matrix}N_{t-1,i-1}|N_{t-3,i},N_{t-3,i-1}N_{t-2,i},\\N_{t-2,i-1},N_{t-1,i-1}\end{matrix}\right]$$

$$\Rightarrow E\left[N_{t,i}\,|N_{t-k,i}\,N_{*,i-1}\right] = N_{t-k,i}\,S_{k,i} + \sum_{j=0}^{k-1} S_{j,i}\,F_{j+1,i-1}$$

where

$$S_{0,t} = 1$$

$$S_{k,i} = S_{k-1,i}\,(1 - \frac{\alpha}{t-k} - \frac{(1-\alpha)i}{t-k})$$

$$F_{k,i-1} = \frac{\alpha + (1-\alpha)(i-1)}{t-k} \qquad for \quad k \geq 1$$

V. SURVEY INFERENCE

The synthesis

$$|E\left[N_{t,i}\,|N_{t-k,i}\,N_{t-k,i-1}\right] = E\left[N_{t,i}\,|N_{t-(k+1),i}\,N_{t-(k+1),i-1}\right]| \leq 2$$

Proof.

$$E\left[N_{t,i}\,|N_{t-k,i}\,N_{t-k,i-1}\right] = E\left[N_{t,i}\,|N_{t-(k+1),i}\,N_{t-(k+1),i-1}\right]|$$

$$= N_{t-k,i}\,S_{k,i} + \sum_{j=0}^{k-1} S_{j,i}\,F_{j+1,i-1} - N_{t-(k+1),i}\,S_{k+1,i} + \sum_{j=0}^{k} S_{j,i}\,F_{j+1,i-1}$$

$$= N_{t-k,i}\,S_{k,i} - N_{t-(k+1),i}\,S_{k+1,i} - S_{k,i}\,F_{k+1,i-1}$$

Case 1:

$$(N_{t-k,i} = N_{t-(k+1),i} - 1)$$

$$= |N_{t-(k+1),i}\,S_{k,i} - S_{k,i} - N_{t-(k+1),i}\,S_{k,i}\,(1 - \frac{\alpha}{t-(k+1)} - \frac{(1-\alpha)i}{t-(k+1)})$$

$$-S_{k,i}\left(\frac{\alpha + (1-\alpha)(i-1)}{t-(k+1)}\right) N_{t-(k+1),i-1}|$$

$$= |-S_{k,i} + S_{k,i}\{(\frac{\alpha N_{t-(k+1),i}}{t-(k+1)} + \frac{(1-\alpha)N_{t-(k+1),i}}{t-(k+1)})$$

$$-\left(\frac{\alpha + (1-\alpha)(i-1)}{t-(k+1)}\right) N_{t-(k+1),i-1}\}|$$

$$\leq 2$$

$$(\because \left(\frac{\alpha + (1-\alpha)(i-1)}{t-(k+1)}\right) N_{t-(k+1),i-1} \leq 1)$$

$$(\because \left(\frac{\alpha N_{t-(k+1),i}}{t-(k+1)} + \frac{(1-\alpha)N_{t-(k+1),i}}{t-(k+1)}\right) \leq 1)$$

Bound for Case 1 is same as that of paper [3].

Case 2:

$$(N_{t-k,i} = N_{t-(k+1),i} + 1)$$

$$= |N_{t-(k+1),i}S_{k,i} + S_{k,i}$$

$$-N_{t-(k+1),i}S_{k,i}(1 - \frac{\alpha}{t-(k+1)} - \frac{(1-\alpha)i}{t-(k+1)})$$

$$-S_{k,i}\left(\frac{\alpha + (1-\alpha)(i-1)}{t-(k+1)}\right) N_{t-(k+1),i-1}|$$

$$= |S_{k,i} + S_{k,i}\{(\frac{\alpha N_{t-(k+1),i}}{t-(k+1)} + \frac{(1-\alpha)N_{t-(k+1),i}}{t-(k+1)})$$

$$-(1 - \left(\frac{\alpha+(1-\alpha)(i-1)}{t-(k+1)}\right) N_{t-(k+1),i-1})\} \leq 2$$

Bound for Case 2 is same as that of paper [3]

Case 3:

$$(\because N_{t-k,i} = N_{t-(k+1),i})$$

$$= N_{t-(k+1),i}S_{k,i} - N_{t-(k+1),i}S_{k,i}(1 - \frac{\alpha}{t-(k+1)} - \frac{(1-\alpha)i}{t-(k+1)})$$

$$-S_{k,i}\left(\frac{\alpha+(1-\alpha)(i-1)}{t-(k+1)}\right)N_{t-(k+1),i-1}$$
$$=S_{k,i}\left(\frac{\alpha N_{t-(k+1),i}}{t-(k+1)}+\frac{(1-\alpha)N_{t-(k+1),i}}{t-(k+1)}\right)$$
$$-S_{k,i}\left(\frac{\alpha+(1-\alpha)(i-1)}{t-(k+1)}\right)N_{t-(k+1),i-1}$$
$$\leq 1$$

Bound for Case 3 obtained here is an improvement compared to the result givenin the paper [5]

Azuma's Inequality:

Let $X_0, X_1, X_2, \ldots$be a martingale sequence such that for all k

$$|X_k - X_{k-1}| \leq c$$

where$c$may depend on$k$.
Then for all t≥0 and any λ>0

$$\because |E[N_{t,i}|N_{t-k,i}N_{t-k,i-1}] = E[N_{t,i}|N_{t-(k+1),i}N_{t-(k+1),i-1}]| \leq 2$$
$$\Rightarrow \Pr[N_{t,i} - E[N_{t,i}| \geq l] \leq \exp(-\frac{l^2}{4t})$$

VI. CONCLUSION

This report studies random graph models using probabilistic techniques.Concentration is made over the paper Stochastic Model for Web graph by RaviKumar et.al. [5]. during the proof of the results given in the paper some moreprecise results have been found. Example- for i = 0 report proves $|E[N_{t,0}|N_{t-k,0}]- E[N_{t,0}|N_{t-(k+1),0}]|\leq 1$whereas in the paper it is $|E[N_{t,0}|N_{t-k,0}]- E[N_{t,0}|N_{t-(k+1),0}]|\leq 2$. It is also proved that the $E[N_{t,0}] = \frac{t}{1+\alpha}$. For general value of i, report proves that$|E[N_{t,i}|N_{t-k,i}N_{t-k,i-1}] - |E[N_{t,i}|N_{t-(k-1),i}N_{t-(k-1),i-1}]| \leq 1$for $N_{t-k,I} = N_{t-(k+1),i}$whereas result of the paper is $|E[N_{t,i}|N_{t-k,i}N_{t-k,i-1}] - |E[N_{t,i}|N_{t-(k-1),i}N_{t-(k-1),i-1}]| \leq 2$. In future one can find improvement in $|E[N_{t,i}|N_{t-k,i}N_{t-k,i-1}] - |E[N_{t,i}|N_{t-(k-1),i}N_{t-(k-1),i-1}]|$ for general value of $N_{t-k,i}$.

VII. APPENDIX

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Processor Design Using Square Root Carry Select Adder

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Abstract: **-** http://www.ajer.org/manuscript-submission.html*Index Terms*—Data processing, processors, gate level modification. Delay, power, area, speed.

I. INTRODUCTION

The saying goes that if you can count, you can control. Addition is a fundamental operation for any digital system, digital signal processing or control system. A fast and accurate operation of a digital system is greatly influenced by the performance of the resident adders. Adders are also very important component in digital systems because of their extensive use in other basic digital operations such as subtraction, multiplication and division. Hence, improving performance of the digital adder would greatly advance the execution of binary operations inside a circuit compromised of such blocks. The performance of a digital circuit block is gauged by analyzing its power dissipation, layout area and its operating speed.Generally in VLSI techniques we need to satisfy any two of the following criteria such as area, speed and power. The normal adders which we use are satisfying only one trade off but in this SQRT CSLA there is trade off in both area and power. Here we are using 6-Bit BEC(binary to excess-1 converter) to implement the adder element.

II. LITERATURE SURVEY

In this work we will review the implementation technique of several types of adders and study their characteristics and performance. These are

1. Ripple carry adder, or carry propagate adder,
2. Carry look-ahead adder
3. Carry skip adder,
4. Manchester chain adder,
5. Carry select adders
6. Square root Carry select adders

For the same length of binary number, each of the above adders has different performance in terms of Delay, Area, and Power.

Parallel adders are digital circuits that compute the addition of variable binary strings of equivalent or different size in parallel.

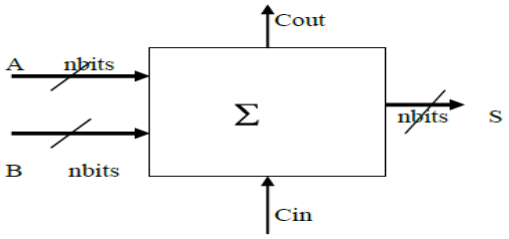


Fig. 1. Block Diagram Of Parallel adders

In ripple carry adders, the carry propagation time is the major speed limiting factorMost other arithmetic operations, e.g. multiplication and division are implemented using several add/subtract steps. Thus, improving the speed of addition will improve the speed of all other arithmetic operations. Accordingly, reducing

the carry propagation delay of adders is of great importance. Different logic design approaches have been employed to overcome the carry propagation problem. One widely used approach employs the principle of carry look-ahead solves this problem by calculating the carry signals in advance, based on the input signals. This type of adder circuit is called as carry look-ahead adder (CLA adder).

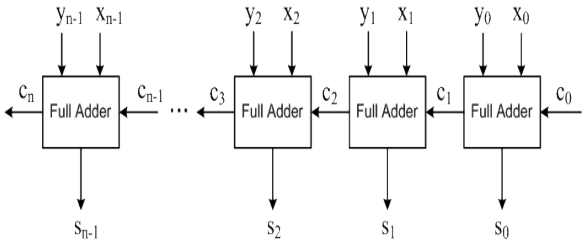


Fig. 2. Block Diagram Of Carry Look ahead adders

A carry-skip adder consists of a simple ripple carry-adder with a special speed up carry chain called a **skip chain**. This chain defines the distribution of ripple carry blocks, which compose the skip adder.

Carry Skip Mechanics

The addition of two binary digits at stage i, where i 0, of the ripple carry adder depends on the carry in, ***Ci*** , which in reality is the, in order to calculate the sum and the carry out, ***Ci+1*** , of stage i, it is imperative that the carry in, ***Ci***, be known in advance. It is interesting to note that in some cases ***Ci+1*** can be calculated without knowledge of ***Ci***.

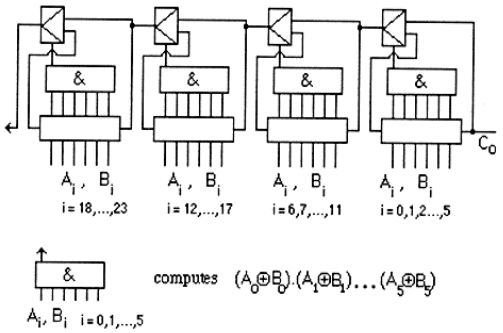


Fig. 3. Block Diagram Of Carry Skip adders

A ripple carry adder allows you to add two k-bit numbers. We use the half adders and full adders and add them a column at a time.Let's put the adder together one step at a time. Arithmetic operations like addition, subtraction, multiplication, division are basic operations to be implemented in digital computers using basic gates like AND, OR, NOR, NAND etc. Among all the arithmetic operations if we can implement addition then it is easy to perform multiplication (by repeated addition), subtraction (by negating one operand) or division (repeated subtraction).Half Adders can be used to add two one bit binary numbers. It is also possible to create a logical circuit using multiple full adders to add N-bit binary numbers.Each full adder inputs a Cin**,** which is the Cout of the previous adder. This kind of adder is a Ripple Carry Adder, since each carry bit "ripples" to the next full adder.

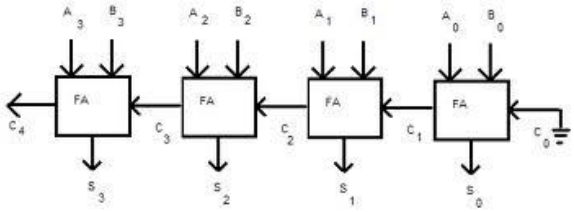


Fig. 4. Block Diagram Of Ripple Carry adders

The concept of the carry-select adder is to compute alternative results in parallel and subsequently selecting the correct result with single or multiple stage hierarchical techniques [8]. In order to enhance its speed performance, the carry-select adder increases its area requirements. In carry-select adders both sum and carry bits are calculated for the two alternatives: input carry “0” and “1”. Once the carry-in is delivered, the correct

computation is chosen (using a MUX) to produce the desired output. Therefore instead of waiting for the carry-in to calculate the sum, the sum is correctly output as soon as the carry-in gets there. The time taken to compute the sum is then avoided which results in a good improvement in speed.

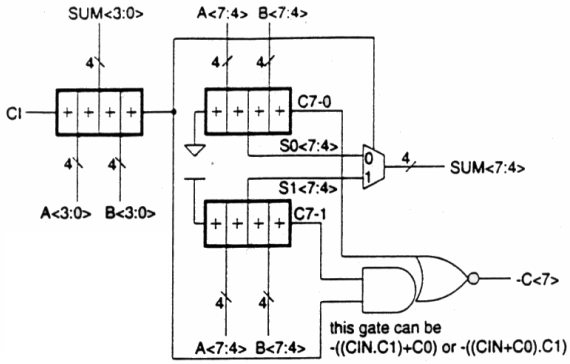


Fig. 5. Block Diagram Of Carry Select adders

The Manchester Carry-Chain Adder is a chain of pass-transistors that are used to implement the carry chain. During precharge, all intermediate nodes (e.g. $Cout_0$) are charged to Vdd. During the evaluation phase, Cout_k is discharged if there is an incoming carry Cin_0 and the previous propagate signals (P_0...P_{k-1}) are high. Only 4 diffusion capacitances are present at each node, but the distributed RC-nature of the chain results in a delay that is quadratic with the number of bits. Transistor sizing was performed to improve performance. The details are elaborated on in the design strategy section.

III. PROPOSED ALGORITHM

The basic idea of this work is to use Binary to Excess-1 Converter (BEC) instead of RCA with cin=1 in the regular CSLA to achieve lower area and power consumption [2]–[4]. The main advantage of this BEC logic comes from the lesser number of logic gates than the n-bit Full Adder (FA) structure. As stated above the main idea of this work is to use BEC instead of the RCA with Cin=1in order to reduce the area and power consumption of the regular CSLA. To replace the n-bit RCA, an n+1bit BEC is required. A structure and the function table of a 4-b BEC. Fig. 6 illustrates how the basic function of the CSLA is obtained by using the 4-bit BEC together with the mux. One input of the 8:4 mux gets as it input (B3, B2, B1, and B0) and another input of the mux is the BEC output. This produces the two possible partial results in parallel and the mux is used to select either the BEC output or the direct inputs according to the control signal Cin. The importance of the BEC logic stems from the large silicon area reduction when the CSLA with large number of bits are designed. The Boolean expressions of the 4-bit BEC is listed as (note the functional symbols ~NOT, & AND, ^XOR). The Modified CSLA architecture has been developed using Binary to Excess -1 converter (BEC). This paper proposes an efficient method which replaces a BEC using common Boolean logic. The result analysis shows that the proposed architecture achieves the three folded advantages in terms of area, delay and power.

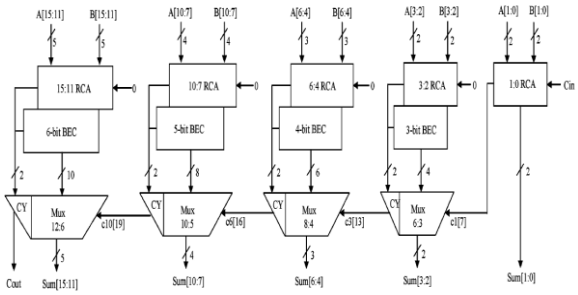


Fig. 6. Block Diagram Of proposed sqrt Carry Select adders

IV. 6-BIT BEC

A BEC (binary to excess-1 converter) is a converter which provides the excess 1 value of a corresponding code which is provided at the input.

B[3:0]	X[3:0]
0000	0001
0001	0010
⋮	⋮
1110	1111
1111	0000

Table.1. BEC input-output table

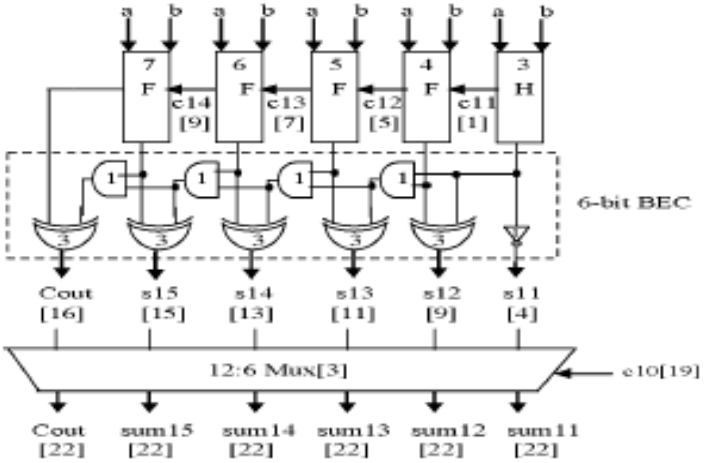


Fig. 7. Block Diagram Of 5 bit BEC

V. SIMULATION RESULTS

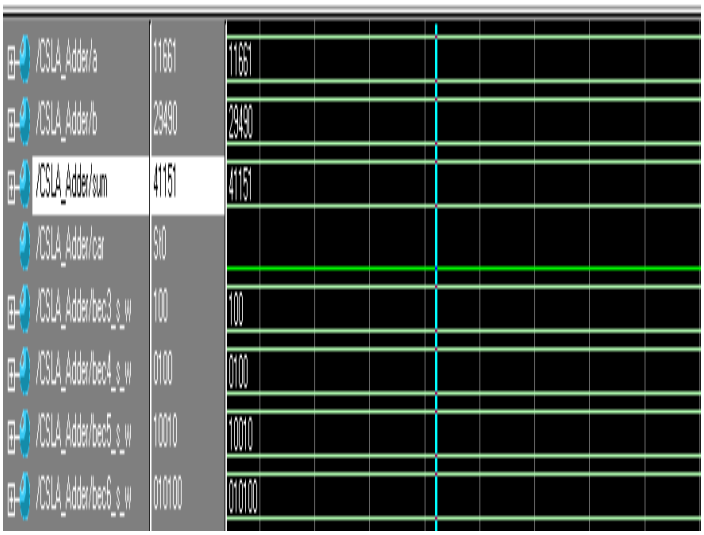


Fig. 8. Simulation Results for Proposed adder

VI. RTL SCHEMATIC LAYOUT & FLOOR PLAN IN FPGA

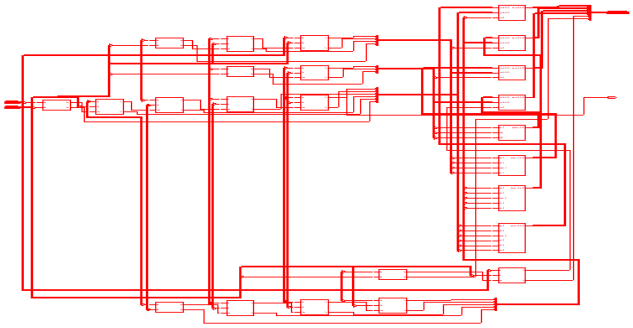


Fig. 9. RTL schematic layout

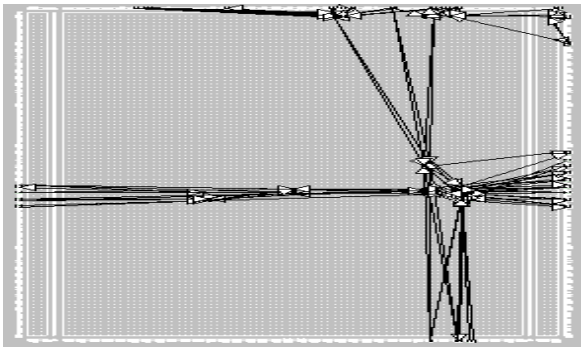
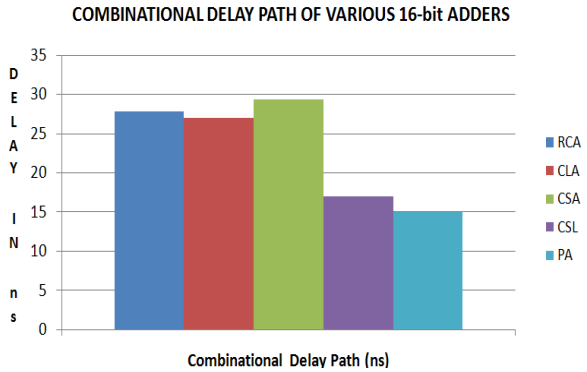
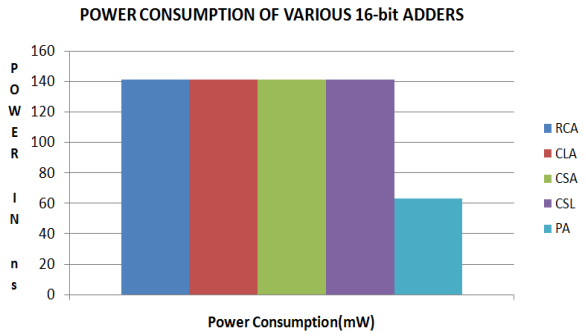


Fig. 10. Floor plan in FPGA

VII. COMPARISON OF AREA, SPEED AND POWER

S.No	Parameters	RCA	CLA	CSA	CSL	PA
1	2 Input Xor Gate	32	32	-	-	-
2	3 Input Xor Gate	-	-	16	48	41
	AFTER SYNTHESIS					
3	Number of Slices	19	18	22	18	25
4	4 input LUT	33	32	39	32	44
5	Bonded IOB	50	50	50	50	49
6	Combinational Delay Path (ns)	27.81	27.07	29.38	17.03	14.97
	AFTER MAPPING					
7	4 Input LUT	33	32	39	32	44
8	Number of Slices	24	24	25	21	25
9	Gate Count	198	192	234	192	267
	AFTER PLACE AND ROUTE					
10	External IOB	50	50	50	50	49
11	Number of Slices	24	24	25	21	25
	POWER CONSUMPTION					
12	Power Consumption(mW)	141	141	141	141	63





VIII. CONCLUSION

The Proposed adder is very faster when compared to other conventional adders. The proposed adder consumes low power when compared to other conventional adders. Hence a high speed low power adders is proposed. In this proposed adder a set of 20 bits will be evaluated in just 8 clock pulses.

IX. ACCKNOWLEDGEMENT

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Research Paper Open Access

Use of Advanced Plastic Materials in Nigeria: Performance Assessment of Expanded Polystyrene Building Technology System

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Abstract**:** - The provision of affordable residential houses for the masses in the developing nations has been a mirage over the years and the future does not portend good as the cost of adopting conventional concrete material technologies is escalating while so many environmental issues like climate change are being raised in the recent times.To circumvent this poor housing provision trend, some innovative construction materials and technologies are being introduced to facilitate unique modular designs, reduction of labour, decline in the depletion of exhaustible materials,savings of time and fund. One of such materials is the expanded polystyrene. The introduction of advanced plastic materials and in particular the expanded polystyrene building technologies in the Nigerian constructionindustry will be a very useful and brilliant initiative that will aid the reduction of cost of construction and facilitate access to affordable houses for the masses.This researchaims at studying the applications of this innovative plastic material in the Nigerian building industry with special regard to the performance perception by the clients and the end users. A building estate where expanded polystyrene building technology has been predominantly used in Abuja is considered as a case study. Questionnaires were distributed among clients and residents of the building estate and statistical tools were used to analyse the data collected. Great satisfaction verified among the clients and residents and the high ranking performance confirmed for recyclability, reliability, versatility and moisture resistance of EPS building products all herald a great future for the applications of this advanced building products in the Nigerian building industry.

Keywords: - *Advance Plastics, Expanded Polystyrene,Affordable Housing, Sustainability, Performance Perception.*

I. INTRODUCTION

Housing is a reflection of the cultural, economic and social evolution of a society. It is an expression of a people's ability to meet their needs of shelter (Gardi, 1973). The significance of shelter to man cannot be over emphasized as it is next in importance to air, water and food (Ede, 2011). The most obvious consequence of population growth is influx of multitudes from the rural areas to the cities which in many developing countries such as Nigeria has often led to rapid deterioration of housing setups and living conditions (Lewin, 1981, Olotuah, 2010). This rural-urban drift in search of greener pastures has brought about rapid increase in the residents of urban centers climaxing in higher demand for urban housings and general increase in the cost of living. The high cost of urban land and the consequent high cost of housing scheme in the presence of excessive demands and dearth of housing facilities have made access to comfortable homes out of the economic reach of the majority of the urban dwellers (Ede and Ogundiran, 2014). According to Olotuah and Ajenifujah (2009), most urban centers in Nigeria are characterized by high densities of buildings, overcrowding of most buildings, inadequate spaces for open air between houses, poor health, substandard housing, and acute environmental and sanitary problems. This shortage of decent and affordable accommodations for the urban low income earners is a major difficulty facing Nigeria today. To circumvent this housing problem, some rational constructive processes can be implemented with the introduction of new construction technologies that allow unique modular designs, high strength and load bearing capacity materials, reduction of labour, materials, mass, time and fund (Ogundiran and Adedeji, 2012). The introduction of advanced plastic materials and in particular the expanded

polystyrene building system in the building and construction industry of Nigeria will be a very useful and brilliant initiative that will aid the reduction of cost of construction and facilitate access to affordable houses to the masses.

In the most developed nations of the world, it has been verified that the conventional building technologies are inadequate and resource wasteful towards meeting the housing needs of the teaming population. This has led to futuristic researches towards the development of new building technologies. Many rational constructive researches were undertaken thereby propelling the introduction of new industrialized production technologies which gave birth to unique modular designs, high strength/high load bearing capacity materials resulting to saving in terms of materials, labour and time which ultimately translates to great savings of funds. As the construction materials have evolved over the years till the real breakthroughs in the construction industries of the 21st century through the development of versatile, easy to construct and economically viable materials, it is becoming easier worldwide to build sustainable homes. A building material that meets the safety standards (including seismic resistance) and the dweller‘s comfort requirements must also be thermally insulating, light weight and inexpensive (Lee et al., 2006).

All these requirements are made possible through the use of Expanded Polystyrene (EPS) initiative which represents one of such new materials that have found their way into the previously conservative construction industry(Ede and Ogundiran, 2014). For a developing nation like Nigeria, affordable and sustainable housing systems need to be provided for the rapidly growing population. EPS being one of the results of the innovative researches that gave birth to drastic reduction of cost of building affordable houses in the advanced nations appears to be a good option open to Nigeria for tackling housing problems.

Also, the world is becoming more concerned about the environment, and measures are being taken in every nation of the earth to reduce the impact of activities on environment (Ede and Oshiga, 2014). For the building and construction industries worldwide, these concerns are being addressed by the careful choice of building materials, and in particular, the selection of insulation (EPSASA, 2006). Therefore, the use of environmentally friendly material such as EPS for new and improved building technology system will go a long way to enhance the environmental quality of the Nigerian building industry.

Expanded Polystyrene (EPS) is a multipurpose plastic material made available for a multiplicity of applications. EPS has experienced wide range of applications owing to its lightweight, rigidity & thermal and acoustic insulating properties. Initially, EPS was mainly used for insulation foam for closed cavity walls, roofs and floor insulation. But ultimately, the application has extended vastly in the building and construction industry such that EPS is now used in road construction, bridges, floatation and drainages. EPS used for building construction are of various types and sizes with the most common ones being for wall panels and for slab. These panels are erected with steel meshes. The steel mesh serves as reinforcement. The EPS 3D reinforced wall system usually transfers shear and compression forces along the wall plane. The wall system is completed by applying concrete layers of acceptable thickness on both sides to perform the dual functions of protecting the reinforcements against corrosion and for transference of compressive forces (Ede and Ogundiran, 2014). With the proven strengths of plastic materials used in commercial and residential construction in the past 30 years, the adoption of plastic in civil constructions is dramatically on the increase due to improved material performance, efficient use of technologies in new applications, and the need for lightweight, durable materials and insulation purposes (Parker and Beitel, 2006; Papadopoulous, 2005).

On the economic side, the EPS material technology appears to be very enticing for the key players in the construction industry. Most often, the clients, designers, contractors and end users are always at logger heads over terms of establishing acceptable equilibrium on the major building industry concerns of cost, quality and time. Every client would want to construct a facility of the highest quality while minimizing cost and time (Aina and Wahab, 2011). End users are attracted to good quality houses at affordable cost. The most suitable way to achieve this is through suitable and careful choice of building materials. Expanded Polystyrene is one product that can contribute towards achieving good quality, low cost and record time completion of building product. At all stages of its life cycle, from manufacture, to application, to recycling or disposal, EPS has shown very good performance. The use of expanded polystyrene offers considerable cost and environment advantages since it contributes positively towards a better environment and at the minimal cost.

These are the facts that gave rise to this research as further researches and awareness are needed so that the performance of the existing applications can be ascertained and various ways of improving the applications can be established. This research is aimed at studying the applications of this advanced plastic material in the Nigerian building industry with special regard to the performance perception by the clients and the end users. A building estate where EPS has been predominantly used in Abuja will be the case study.

II. MATERIALS AND METHODS

2.1 Common plastics

Plastic materials are made up of a wide range of synthetic or semi-synthetic organic solids that most commonly derived from petrochemicals. They are typically organic polymers of high molecular mass with the addition of other substances (Wikipedia, 2012). The vast majority of these polymers are based on chains of carbon atoms alone or with oxygen, sulphur, or nitrogen. During the plastic production process and based on the properties required, copolymerization among the monomers is necessary for the desired properties to be achieved (Sabu and Visakh, 2011). The fine tuning of the properties of the polymer by repeating unit's molecular structure has allowed plastics to become an indispensable part of the 21st century. Due to relatively low cost, impermeability to water, versatility of use and ease of manufacture, plastics usage has experienced an enormous and expanding range of applications from paper clips to spaceships and ultimately vast presence in the conservative construction industry. Plastics have already displaced many traditional materials such as wood, leather, metal, glass, stone and ceramic in most of their former uses. In the developed nations, about a third of plastic is used in packaging, another third in buildings, while other uses include automobiles with up to 20% plastic parts, furniture and toys. The ratio of replacing conventional materials with plastics is greatly on the increase in the developing nations but still very far less its ratio in the developed nations.

2.2 Polystyrene

This is a synthetic aromatic polymer made from liquid petrochemical monomer styrene. Polystyrene can be rigid or foamed and is one of the most widely used plastics. General purpose polystyrene is naturally transparent, hard and brittle. It is a very inexpensive resin. As a thermoplastic polymer, polystyrene is in a solid state at room temperature but flows if heated above about 100°C, its glass transition temperature. This temperature dependent behavior is exploited for extrusion, and also for molding and vacuum forming. Chemically, polystyrene is a long chain hydrocarbon $(C_8H_8)_n$ wherein alternating carbon centers are attached to phenyl groups. The material's properties are determined by short-range Van der Waals attractions between polymer chains. Since the molecules are long hydrocarbon chains that consist of thousands of atoms, the total attractive force between the molecules is large. When heated, the chains are able to take on a higher degree of conformation and slide past each other. This intermolecular weakness confers elasticity and flexibility. The ability of the system to be readily deformed above its glass transition temperature allows polystyrene to be readily softened and molded upon heating. Some common forms produced are Sheets, or expanded polystyrene, oriented polystyrene and extruded polystyrene foam. Indebt studies on polystyrene can be found in (Sabu and Visakh, 2011).

2.3 Expanded Polystyrene

Expanded Polystyrene (EPS) is a thermoplastic material manufactured from styrene monomer, using a polymerization process which produces translucent spherical beads of polystyrene. As a material, EPS is formed by union of so many beads of polystyrene produced during a modelling process with supply of heat as water steam until full formation of the desired properties. For the production of EPS, a low boiling point hydrocarbon, usually pentane gas is added to the material to assist expansion during subsequent processing. EPS is produced in a three stage processes. In the first stage, polystyrene beads are expanded to between 40 and 50 times their original volume by heating to about 100˚C with steam in an enclosed vessel called a pre expander. During this process the beads are stirred continuously until the final density of EPS is determined. From the pre expansion stage, the expanded beads are cooled, dried and then conveyed to storage silos for maturing. During the maturing stage, the expanded beads are stabilized until equilibrium is reached. In the third processing stage, the beads are conveyed into a mold and the softened beads fuse together when correct temperature is reached within the mold. After cooling the mold, the molded product is ejected from the mold at the completion of the cycle.

After many years of trials and errors of advanced plastic materials in general and the EPS material systems in particular, their applications are becoming common place in the construction industry all over the world. Advanced plastic materials are used in many aspects of building work including large structures such as road constructions, bridges, railway lines, embankments, retaining walls, slope stabilization, basement construction, public buildings or even small family residences. One of the areas that advanced plastics have found wide applications is in the improvement of concrete materials. Concrete technology is growing and many advances and innovations have been made to cope with challenges of many construction aspects. Many productions of lightweight concrete had been designed and among them are by the use of lightweight aggregates and artificial aggregates such as EPS beads, fly ash and slag (Ismail *et al*, 2003; Bonacina et al., 2003; EUMES, 2002; Babu and Babu, 2002; Concrete Homes, 2012; Cook, 1973; Cen and Liu, 2004). EPS beads can be added to mixes either partially or fully replacing aggregates subject to the desired strength and properties. Light Weight Concrete is advantageous in many applications and is becoming increasingly used often in the form of cement-foam composites. EPS is commonly adopted as a permanent formwork just as composite construction materials with a sandwiched core are becoming a more common construction material. (Boni and De Almeida, 2008) states that this is usually to improve the unique properties through the combination of both. A common

core used in aerospace applications (which is the focus of Boni and De Almeida's work) is honeycombed with corrugated or cellular materials to produce sandwich construction material of thicker lower density intermediate layer bonded to external facings of a stiffer material. The high stiffness/low weight efficient structures is beneficial both in the aerospace industry and in the construction industry. The lightweight EPS is combined with other stronger materials to make it a viable structural material. Concrete is then used with EPS to create a strong composite structural system.

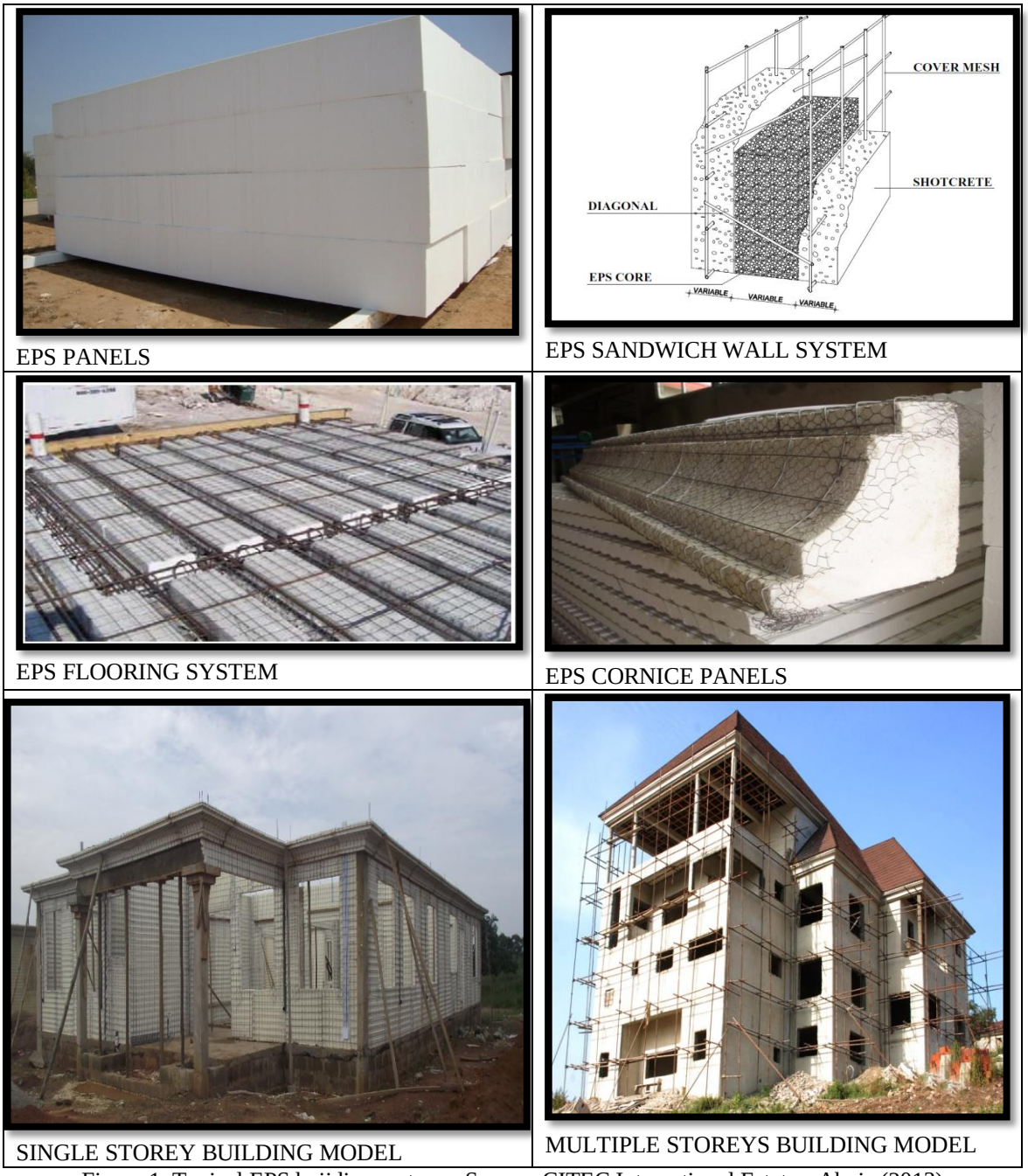

Figure 1: Typical EPS buiiding systems; Source: CITEC International Estates, Abuja (2013)

EPS panels, tailored for specific projects are used as walls panels for partitioning and for floor slabs. These are normally finished on-site by applying concrete/sand crate with pneumatic devices. On durability issues, strength tests performed on EPS which was first placed in the ground almost 30 years ago show that it is still strong today (BPF, 2009). Typical EPS building systems can be seen in figure 1.

From the previous paragraphs, the benefits of expanded polystyrene (EPS) in the building industry worldwide can be summed up as lifetime durability, moisture resistance, proven acoustic and excellent thermal

insulation, design versatility, cost-effective, easy installation leading to record time completion, flexible mechanical properties, good strength and structural stability. Specifically on the cost of production and time of construction, EPS material has an edge over conventional building materials. But despite all the merits and advantages of the EPS building system, the application by developers in the Nigerian building industry is very limited. This is due to relatively scarce knowledge of this innovative methods of construction and poor access to the material. Low level of awareness to the building professionals and the general public as well as its non-availability has hampered the diffusion of EPS in Nigeria. Because in Nigeria very few manufacturers of the EPS building material system exist, the EPS blocks or panels used for building processes are scarce and this leads to high cost of production which is transferred from client/contractors to end users. Based on these scenarios and the proven properties and applications of EPS, this research evaluates the performance of EPS construction technologies in the Nigerian construction industry just as the conventional construction materials technologies are rather becoming too expensive for building affordable houses for the low income earners. This will help to enhance the adoption of this innovative, cost effective and environmentally friendly construction technologies.

2.4 Research Methodology

For this research, primary data was collected through structured questionnaires directed to the clients and residents of a functioning estate in Abuja which used expanded polystyrene (EPS)as its major building material. Data were obtained using multiple choice structured questionnaire. The questionnaire wasdeveloped after going through an extensive review of the literature. The questionnaire consists of the degree of satisfaction of respondents affected by expanded polystyrene construction. The population considered consisted of the clients, represented by the construction professionals in CITEC International Estates Limited and the users, who are the residents of Mount Pleasant Estate. The total number of construction professionals in CITEC International Estates Limited as well as Polystyrene Industries Limited is 35. The main respondents were practicing professionals in CITEC International Estate Limited such as Architects, Engineers, Builders and Quantity Surveyors and residents of houses in Mount Pleasant Estate.A total of 110 questionnaires were administered and 94 were received. This results in a response rate of 85.45%.The returned questionnaires were therefore suitable for the analysis. The questionnaires were carefully examined and relevant information required to achieve the various objectives were extracted. The analysis of data and information obtained were done using standard statistical application software. The statistical package provided powerful statistical analysis and offered the representation data in various graphical forms. The procedures adopted for this research were based on (Alegiuno, 2014).

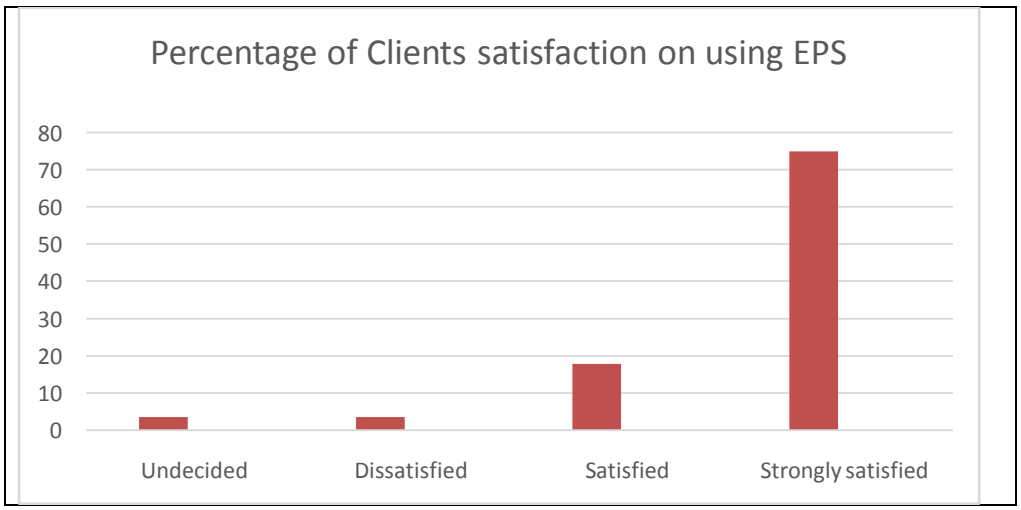

Figure 2: Client's satisfaction of using EPS as a principal building material.

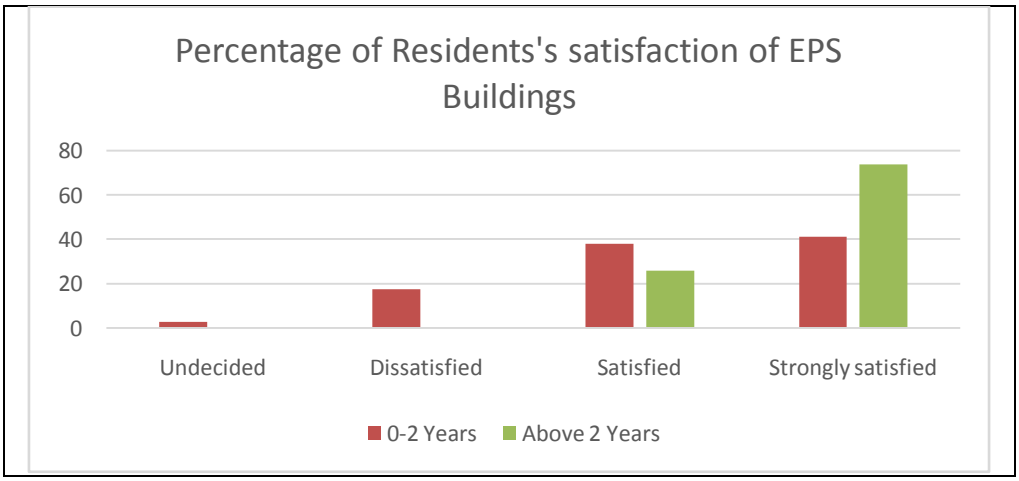

Figure 3: Residents satisfaction of EPS buildings.

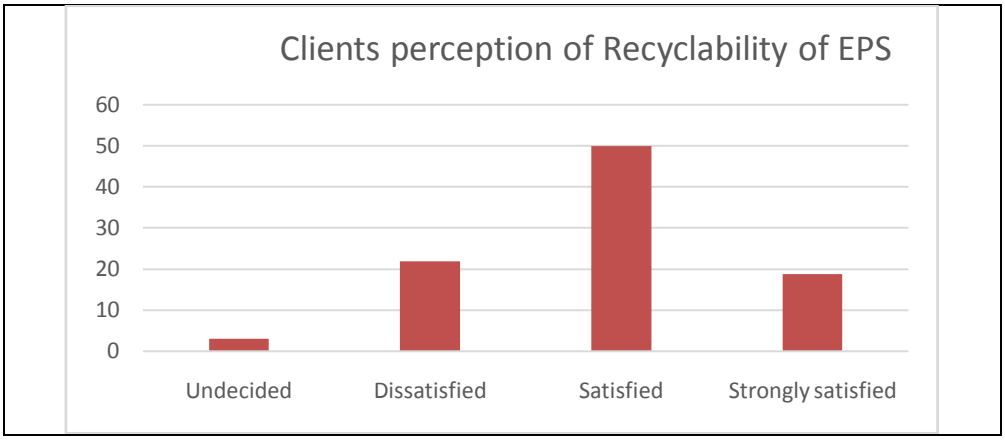

Figure 4: Client's perception of EPS recyclability

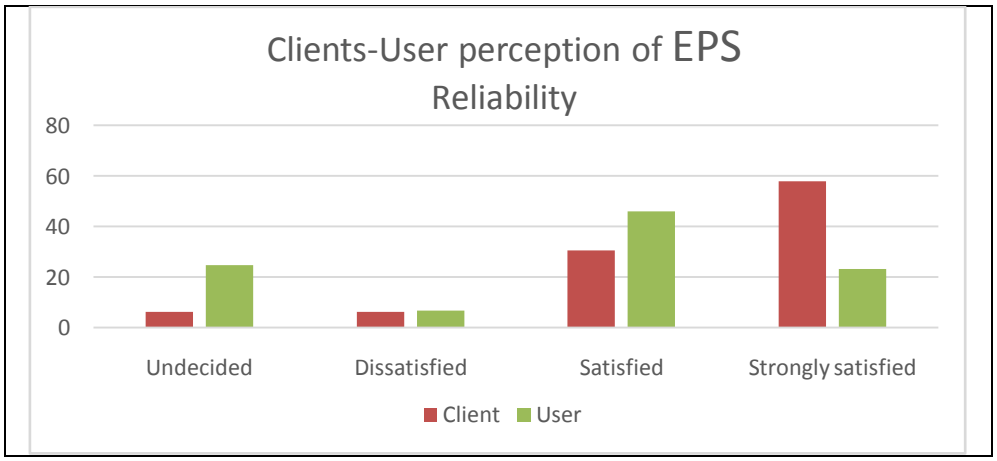

Figure 5: Clients-user's perception of EPS reliability

III. RESULTS AND DISCUSSIONS

The data collected from the questionnaires were analyzed with statistical tool. The information extracted from the collected data included client's satisfaction of using EPS as a principal building material, residents satisfaction of EPS buildings, client's perception of EPS recyclability, clients-user's perception of EPS reliability, client's perception of versatility of EPS products and user's perception of moisture resistance of EPS building products. Figure 2 captures the client's satisfaction of using EPS as a principal building material. The over 90% of satisfaction shown by the client justifies the adoption of EPS as a principal building material.

Figure 3 shows the residents' perception of EPS building products. In this case, residents that have lived in the EPS buildings for more than 2 years were more satisfied (99%) than those that lived in the building

for a shorter period (79%). That is a comforting news as the more one gets involved with EPS products, the more satisfied with the product. Figure 4 depicts the Client's perception of recyclability of EPS products. The 68.8% of satisfaction of recyclability of EPS building products is good. Figure 5 shows clients-resident's perception of EPS reliability. The 87.9%of satisfaction for the client and the 68.9%for the residents of the reliability of EPS building system is good both for the client and the end user. Figure 6 contains the client's perception of versatility of EPS products. The 96.6% of satisfaction for the client appears to be very good for the EPS building products. Figure 7 then shows the user's perception of moisture resistance of EPS building products. The 80.4% of satisfaction of user's perception of moisture resistance of EPS building products is good for the EPS building technology. Figure 8 sums up the result of the research as it depicts the positive aspects against the negative aspects.

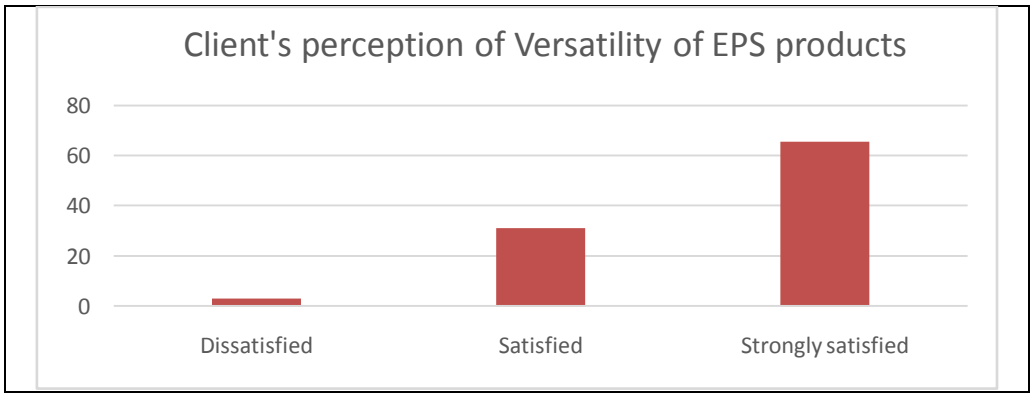

Figure 6: Client's perception of versatility of EPS products.

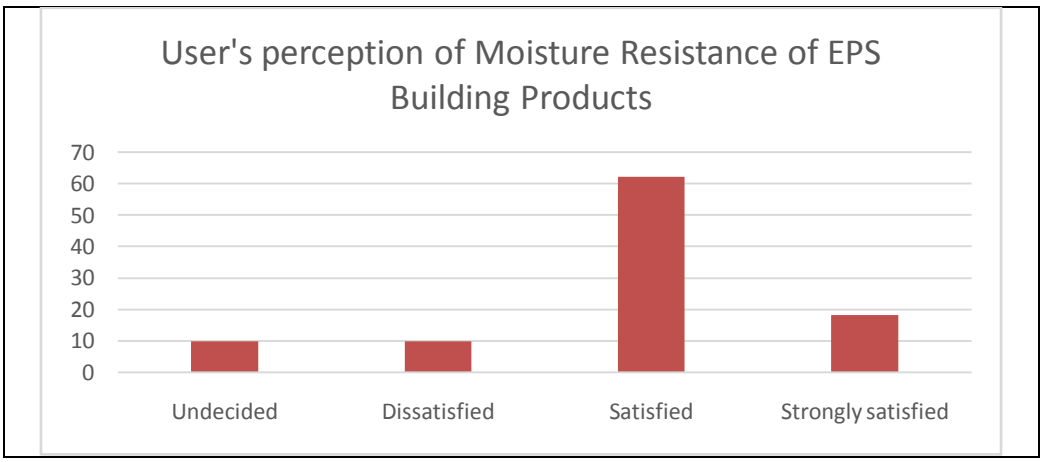

Figure 7: User's perception of moisture resistance of EPS building products.

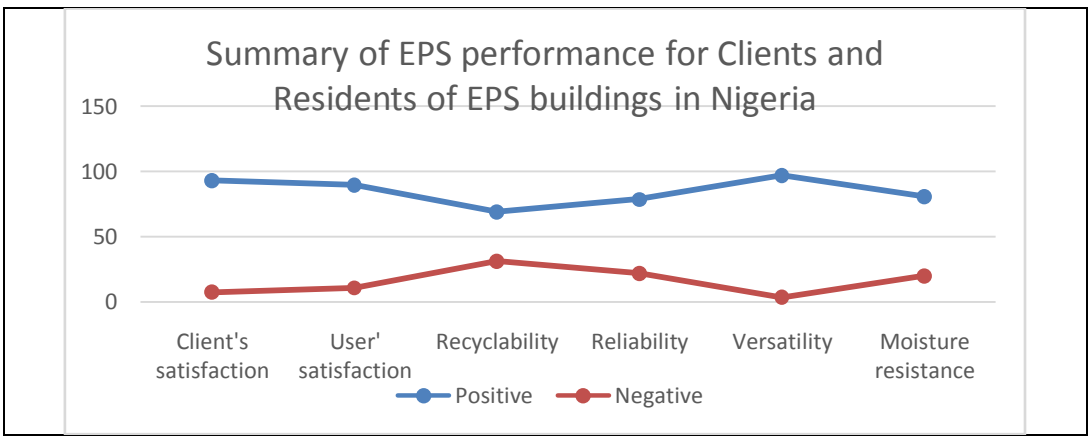

Figure 8: Summarizes the result of this research

IV. CONCLUSION

This study assessed the level of clients' and users' satisfaction with prefabricated expanded polystyrene (EPS) construction in Mount Pleasant Estate, Abuja. The study evaluated several factors that help to determinethe efficiency and the trend of acceptance of expanded polystyrene (EPS) building system in Nigeria as an alternative to the conventional building materialssuch as sand crate blocks. Great satisfaction for both client and residents and high ranking performances for recyclability, reliability, versatility and moisture resistance of EPS building products obtained from this research all herald a great future for the applications of this innovative building products in the Nigerian building industry. The research also showed that the residents who lived in houses constructed with EPS for longer periods are more satisfied with EPS construction than those who have spent shorter time in the EPS facilities.This research therefore concludes that more clients and residents will be interested in accepting EPS building products for future residential houses and this will facilitate the provision of affordable houses for low income earners in Nigeria.

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A Study on the Waste Water Treatment Technology for Steel Industry: Recycle And Reuse.

Sanjeev Kumar Sinha, Vikas Kumar Sinha, Samir Kr. Pandey, Anup Tiwari

Abstract: - The steel industry is one of the most important and vital Industry of the present and the future. It is the asset of a nation. Steel plants use a tremendous amount of water for waste transfer, cooling and dust control. The steel plants have sintering mills, coke plants, blast furnaces, chemical byproducts and chemical processes, water cooled rolls, pumps, extrusion experiment, transfer lines for sludges and slurries. All these plants use a tremendous amount of water to cool the products and flush the impurities away from the finished stock.
Wastewater is generated in huge quantity in steel industries. It contains many dissolved, undisclosed substances and chemicals in the wastewater. The steel industries produce wastewater and sludge during different industrial processes.
The development of innovative technologies for treatment of wastewaters from steel industries is a matter of alarming concern for us. Although many research papers have been reported on wastewater pollution control studies, but a very few research work is carried out for treatment of wastewater of steel industries, especially in reference to development of design of industrial effluent Treatment Plants (ETP) system. Another beneficial aspect of this research work will be recycling, reuse of water and sludge from steel industry
The whole technologies for treating industrial wastewater can be divided into four categories: - Chemical, Physical, Biological and mathematical approaches. Physical treatment methods include sedimentation, Floatation , filtering , stripping, ion – exchange, adsorption and other processes that accomplish removal of dissolved and undisclosed substances without necessarily changing their chemical structure. The mathematical approaches are very useful and more realistic for developing a well operating cost–effective treatment system for industrial wastewater treatment.

I. INTRODUCTION

The steel industry is one of the most important and vital Industry of the present and the future. It is the asset of a nation. Steel plants use a tremendous amount of water for waste transfer, cooling and dust control. The steel plants have sintering mills, coke plants, blast furnaces, chemical byproducts and chemical processes, water cooled rolls, pumps, extrusion experiment, transfer lines for sludges and slurries. All these plants use a tremendous amount of water to cool the products and flush the impurities away from the finished stock.
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The whole technologies for treating industrial wastewater can be divided into four categories: - Chemical, Physical, Biological and mathematical approaches. Physical treatment methods include sedimentation, Floatation , filtering , stripping, ion – exchange, adsorption and other processes that accomplish removal of dissolved and undisclosed substances without necessarily changing their chemical structure. The mathematical approaches are very useful and more realistic for developing a well operating cost–effective treatment system for industrial wastewater treatment.

The treatment of steel industrial wastewater requires a variety of strategies to remove different types of contaminants. These are:
1. Solid removal
2. Oil and Grease removal
3. Removal of biodegradable organics.
4. Activated sludge process
5. Trickling filter process
6. Treatment of toxic materials
7. Treatment of acid & alkalis
8. Treatment of other organics.

Technologies used in steel plants include cooling Tower, DM Plant, STP and river water treatment. The wastewater Treatment Plant (WWTP or STP) possesses conventional methods like primary Treatment, Secondary treatment and Tertiary treatment followed by ozonation method. In the last, River water treatment was done which contains chlorination, preozonation, Flocculation, Filtration / aeration, pH correction, Adsorption processes etc.

In the present study, the research work will be undertaken for characteristics of wastewater of steel industry, innovations in technology for wastewater treatment of steel industries and recycling and reuse of water and sludge of steel industries. Emphasis will be given on filtration, chlorination and adsorption technology in the light of mechanistic view for the steel industrial wastewater treatment.

A design of industrial wastewater treatment plant for steel industry will be undertaken. This technology will be very useful and efficient for the treatment of industrial effluents. It will be very fruitful for the development of sustainable environment. Water reuse and recycling of sludge is another beneficial aspect of this study. A proper plan for the reuse of water for various purposes and utilization of sludge for making (producing) different industrial byproducts will be given.

Recycling of wastewater is a mechanical process, which includes purification of wastewater upto the standard in a separate lagoon and internal circulation to the system for its water requirement.

Reuse of water implies following three important uses:-

(i) Cooling and processing water in industrial applications.
(ii) Irrigation for cropland, golf courses, water requirement for plant and grass growth.
(iii) Ground water recharge: reused water can be directly injected into aquifers or applied to land for percolation into the aquifer.

Reuse and recycling of water will inevitably be the essential strategies for protection and conservation of water resources, which are getting scarce and polluted day by day.

II. STATEMENT OF THE PROBLEM

A study on wastewater treatment technologies is very significant facet of water pollution studies. Different types of research works are carried out on water pollution studies, but a very few research is carried out on development of wastewater treatment technology in reference to steel industries. Such research works are very challenging for Research & Development.

III. REVIEW OF LITERATURE

Many research papers have been reported on waste water pollution studies and removal [1 – 8] but fewer papers are published on wastewater treatment in reference to steel industries using different technologies for control of different pollutants. Some research articles are contributed by the authors [9 – 13] on planning, control and protection from environmental pollution. A very few research papers are available on recycling and reuse of water and sludge [14 – 19]. The use quantitative analysis is much more effective in aspects of wastewater treatment [20 – 22]. Recently, more research attentions have been paid to develop the mathematical model for the biological treatment of industrial wastewater [23 – 25].

Objectives of the Study

The present study has following objectives:-

(I) Characterization of steel industrial effluent.
(II) Design of wastewater treatment system.
(III) Different types of treatment in different tanks.
(IV) Analysis of wastewater after treatment and generation of data.
(V) Quantitative analysis of generated data for cost effective treatment.
(VI) Recycling of wastewater of steel industries.
(VII) Reuse of wastewater and sludge in different industrial processes.

(VIII) Treatment objectives are needed to complete the development of design criteria for handling and treatment equipments.

IV. SIGNIFICANCE OF THE RESEARCH

This research work is very innovative and useful for steel industry. Wastewater is released from different units in Steel industry; need to be managed by treatment processes. Treatment of wastewater by different methods in designed tanks will produce clean and treated water, which will be utilized in different processes in steel industries. Treated wastewater may be used for agriculture, recreational activities and other purposes. A proper design of Industrial Effluent Treatment Plant (ETP) for treatment of wastewater from steel industry is very useful and innovative research work. It will add a momentum to industrial Research & Development (R & D). The reuse of sludge for making different products is another beneficial aspect of this research work.

Hypotheses of the Study

As per the direction of Central Pollution Control Board (CPCB), New Delhi and pollution control statutory bodies, there is a high demand to establish Effluent Treatment Plant (ETP) or Waste Water Treatment Plants (WWTP) in each industry So, there is an urgent need for innovations in wastewater Treatment research or Industrial Effluent Treatment research.

It is essential to develop such a wastewater treatment Plant which is efficient and cost –effective. We will develop a design of efficient wastewater Treatment System which will be fruitful for treatment of wastewater coming from steel industry. A plan for recycling and reuse of water is given. The sludge is used for making different products.

Research Methodology

The standard methodology is followed for analysis of different water quality parameters, pH of sample is measured by pH - meter, temperature is measured by thermometer, turbidity by nephalometer, conductivity is measured by conductivity meter. Other parameters like D.O., B.O.D., C.O.D., chloride, sulphate, total dissolved solids (T.D.S.) are measured by water sampling kit. Optimization techniques and differential equations for quantitative analysis of waste water pollutants may be used to minimize the bacterial growth & effect. We present a small example from the field of bacterial growth and decay as:

To describe the growth of a single organism on a single substrate in a batch reactor with no other growth limitations, we formulate a simple model,

$$\frac{dX}{dt} = \mu(S)X - bX$$

$$\frac{dS}{dt} = -\frac{1}{Y}\mu(S)X$$

Where, X = Concentration of microorganism (mg/l)

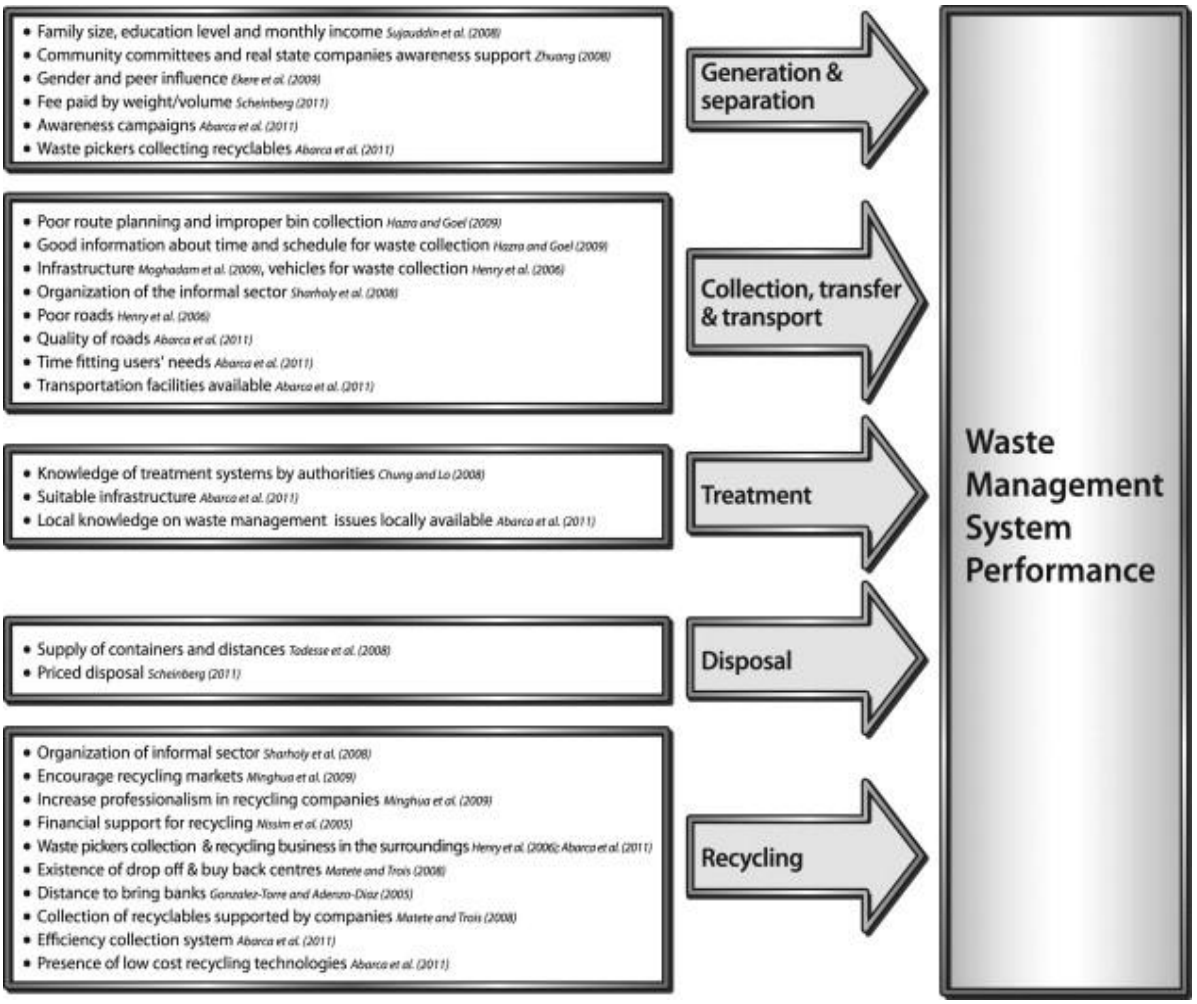
S = Concentration of growth – limiting substrate (mg/l)

μ (S) = Specific growth rate (per day)

b = Decay rate (per day)

Y = Yield factor (g cell COD formed / g COD oxidized)

Then we solve and simulate the model using numerical methods and MATLAB and discuss the stability of the system.



Biological treatment is an important and integral part of any wastewater treatment plant that treats wastewater from either municipality or industry having soluble organic impurities or a mix of the two types of wastewater sources. The obvious economic advantage, both in terms of capital investment and operating costs, of biological treatment over other treatment processes like chemical oxidation; thermal oxidation etc. has cemented its place in any integrated wastewater treatment plant. Biological treatment using aerobic activated sludge process has been in practice for well over a century. Increasing pressure to meet more stringent discharge standards or not being allowed to discharge treated effluent has led to implementation of a variety of advanced biological treatment processes in recent years. The title of this article being very general, it is not possible by any means to cover all the biological treatment processes. It is recommended that interested readers, for deeper reading and understanding, refer to well-known reference books e.g. Wastewater Engineering by Metcalf & Eddy etc. This article briefly discusses the differences between aerobic and anaerobic biological treatment processes and subsequently focuses on select aerobic biological treatment processes/technologies. Biological Wastewater Treatment This article briefly discusses the differences between aerobic and anaerobic biological treatment processes and subsequently focuses on select aerobic biological treatment processes/ technologies. By Arun Mittal Aerobic & Anaerobic Before we go in to the discussions of various aerobic biological treatment processes, it is important to briefly discuss the terms aerobic and anaerobic. Aerobic, as the title suggests, means in the presence of air (oxygen); while anaerobic means in the absence of air (oxygen). These two terms are directly related to the type of bacteria or microorganisms that are involved in the degradation of organic impurities in a given wastewater and the operating conditions of the bioreactor. Therefore, aerobic treatment processes take place in the presence of air and utilize those microorganisms (also called aerobes), which use molecular/free oxygen to assimilate organic impurities i.e. convert them in to carbon dioxide, water and biomass. The anaerobic treatment processes, on other hand take place in the absence of air (and thus molecular/free oxygen) by those microorganisms (also called anaerobes) which do not require air (molecular/ free oxygen) to assimilate organic impurities.

The final products of organic assimilation in anaerobic treatment are methane and carbon dioxide gas and biomass. The pictures in Fig. 1 and 2 depict simplified principles of the two processes.

Table I summarizes the major differences in these two types of processes. From the summary in Table 1, it can be concludedthat it is not anaerobic or aerobic treatment, but a combination of the two types of the technologies that give an optimum configuration for those wastewater treatment applications where the organic impurities are at a relatively higher concentrationIntegrated Fixed Film Activated Sludge (IFAS) System: There are several industrial installations where two stage biological treatment comprising stone or plastic media trickling filter (also known as packed bed biotower) followed by activated sludge process based aeration tank, followed by secondary clarifier have been in operation. Another modification of above configuration that has been implemented in newer industrial wastewater treatment systems is fluidized media bioreactor (also known as moving bed bioreactor (MBBR)) in lieu of biotower followed by activated sludge process. In some of the industries (e.g. refineries and petrochemical plants, where the existing wastewater treatment system was single stage conventional activated sludge process (based on aeration tank and clarifier unit), that underwent capacity expansion and/or faced stricter discharge regulations, the up-gradation of activated sludge process by addition of fluidized bio-media has been implemented to meet these requirements.This hybrid process of fluidized media and activated sludge process taking place in a single aeration tank is known as Integrated Fixed Film Activated Sludge (IFAS) process. The common advantages of all of the above described configurations are as follows:

- Fixed film media provides additional surface area for biofilm to grow on it and degrade the organic impurities that are resistant to biodegradation or may even be toxic to some extent.
- The overall efficiency of two stage biotreatment system is better than activated sludge process alone.
- Fixed film processes are more effective in nitrification of the wastewater than activated sludge process.
- The overall foot-print for a fixed film process based system is smaller than the activated sludge process system.
- Due to less sludge wastage, the sludge handling and dewatering facility is smaller compared to the activated sludge process. Comparing IFAS with other configurations i.e. biotower followed by activated sludge or MBBR followed by activated sludge, following advantages for IFAS can be highlighted:
- It can be easily incorporated in the existing activated sludge system to meet additional processing capacity requirement and/or stricter discharge regulations without the need of additional concrete tanks.
- Foot-print of IFAS is smaller.
- Capital and operating cost for IFAS is lower.

Membrane Bioreactor (MBR): Membrane Bioreactor (MBR) is the latest technology for biological degradation of soluble organic impurities. MBR technology has been in extensive usage for treatment of domestic sewage, but for industrial waste treatment applications, its use has been somewhat limited or selective. The MBR process is very similar to the conventional activated sludge process, in that both have mixed liquor solids in suspension in an aeration tank. The difference in the two processes lies in the method of separation of bio-solids. In the MBR process, the bio-solids are separated by means of a polymeric membrane based on microfiltration or ultrafiltration unit, as against the gravity settling process in the secondary clarifier in conventional activated sludge process. Therefore, the advantages of MBR system over conventional activated sludge system are obvious as listed below:

- Membrane filtration provides a positive barrier to suspended bio-solids that they cannot escape the system unlike gravity settling in activated sludge process, where the bio-solids continuously escape the system along with Treated Effluent clarified effluent and sometimes a total loss of solids is also encountered due to process upsets causing sludge-bulking in the clarifier. As a result, the bio-solids concentration measured as MLSS/MLVSS can be maintained at 3 to 4 times in an MBR process (~ 10,000 mg/l) in comparison to the activated sludge process (~2500 mg/l).
- Due to the above aspect of MBR, aeration tank size in the MBR system can be one-third to one-fourth the size of the aeration tank in an activated sludge system. Further, instead of gravity settling based clarifier, a much more compact tank is needed to house the membrane cassettes in case of submerged MBR and skid mounted membrane modules in case of non-submerged, external MBR system.
- Thus, MBR system requires only 40-60% of the space required for activated sludge system, therefore significantly reducing the concrete work and overall foot-print.
- Due to membrane filtration (micro/ultrafiltration), the treated effluent quality in case of MBR system is far superior compared to conventional activated sludge, so the treated effluent can be directly reused as cooling tower make-up or for gardening etc. Typical treated water quality from MBR system is:
- BOD5< 5 mg/L
- Turbidity < 0.2 NTU An external, non-submerged type MBR for industrial applications especially in refineries and petrochemical wastewater applications, is the Aqua-EMBR (Aquatech's Enhanced Membrane Bioreactor). Aqua-EMBR has been successfully piloted to treat wastewater from a petrochemical plant in middle-East. Aqua-EMBR filtrate was further processed through High Efficiency Reverse Osmosis (HEROTM) process to

recover 90% high quality permeate. The permeate quality was suitable for its recycle as feed to the demineralizer system.

The advantages of Aqua-EMBR over submerged MBR systems include:

• Aqua-EMBR system (membrane modules) has no membrane tank, it can be built much quicker with less risks for contractors:Installed as skid(s) on a flat concrete slab, no complex civil works required.Civil works and skid assembly are independent and parallel activities.

Less risk for contractors because of delays in civil works due to weather conditions, environmental or other local uncertainties.

• The system offers an operator friendly working environment as opposed to obnoxious environment in case of submerged systems:Operators don't see, smell or come in contact with the biosludge. Operators do not work on top of open membrane tanks where the air could contain harmful aerosols. In case of any maintenance issue, the membrane modules in Aqua-EMBR can be removed or replaced without any contact with the biosludge, whereas submerged membrane modules contaminated with sludge, have to be lifted out of tanks posing potential contact with the sludge.

• The flux is ~50% higher which equates to 50% less surface area of membrane needed per unit volume permeate production. This results in: Lowest membrane cost per unit volume filtrate, resulting in lower capital and operating costs. Smallest footprint (about 20% less). Lowest maintenance costs (chemicals, man-hours etc.).

• Electrical power consumption is 10 to 15% lower compared to submerged systems due to the use of airlift pump effect.

• Aqua-EMBR has the tightest membrane pore size: Pore size nominal / maximum: 30 nm / 50 nm Turbidity of permeate: < 0.2 NTU TSS levels: < 0.5 mg/l

Highest effluent quality is an important factor for re-use purposes and future regulations

Comparison Of Aerobic Biological Treatment Options

A detailed technical evaluation of various options of biological treatment processes for a given wastewater from a refinery and the treated effluent quality requirements has been carried out.

Based on this evaluation, Table 2 summarizes the pros and cons of each option.

Based on these comparisons, it can be inferred that CASSTM technology is superior to other aerobic biological treatment technologies in terms of overall life cycle cost and returns to the owner.

Objectives of the Study

The present study has following objectives:-

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(XVI) Treatment objectives are needed to complete the development of design criteria for handling and treatment equipments.

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Model of Quantum Computing in the Cloud: The Relativistic Vision Applied in Corporate Networks

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Abstract: - Cloud computing has is one of the subjects of interest to information technology professionals and to organizations when the subject covers financial economics and return on investment for companies. This work aims to present as a contribution proposing a model of quantum computing in the cloud using the relativistic physics concepts and foundations of quantum mechanics to propose a new vision in the use of virtualization environment in corporate networks. The model was based on simulation and testing of connection with providers in virtualization environments with *Datacenters* and implementing the basics of relativity and quantum mechanics in communication with networks of companies, to establish alliances and resource sharing between the organizations. The data were collected and then were performed calculations that demonstrate and identify connections and integrations that establish relations of cloud computing with the relativistic vision, in such a way that complement the approaches of physics and computing with the theories of the magnetic field and the propagation of light. The research is characterized as exploratory, because searches check physical connections with cloud computing, the network of companies and the adhesion of the proposed model. Were presented the relationship between the proposal and the practical application that makes it possible to describe the results of the main features, demonstrating the relativistic model integration with new technologies of virtualization of *Datacenters*, and optimize the resource with the propagation of light, electromagnetic waves, simultaneity, length contraction and time dilation.

Key-words: - *Virtualization, Datacenters, Relativity, Quantum Mechanics, Corporate Networks.*

I. INTRODUCTION

To offer companies the opportunity to dissociate their information technology needs and of your cloud computing infrastructure is able to offer, in the long run, savings companies, included the reduction of infrastructure costs and payment models based on the use of services (2009 ISACA). The low cost of cloud computing and its ability to dynamically resource expansion make it boost innovation for small business in development (VAJPAYEE, 2011). According to Fusco and Sacomano (2009), the network of companies and the importance of communications in environments of computer networks have been important in the world of modern business and social networks, because the reality is increasingly volatile and dynamic has brought the need to speed up processes, business and organizations, therefore internationalize should be the presence of competitive thinking and strategic alignment of that reality. According to Tonini, oak and Spinola (2009), for competitive advantage, companies must continually update themselves on technology; get maturity in processes and eliminating operational inefficiencies. This requires an involvement of people, processes and the Organization as a whole.

Currently the companies are organizing network format, and business processes among the organizations increasingly use the applications that process and provide information for the operation of this new arrangement. The new organization is a combination of various organizations, composed of interconnected

cells with several access points provided by the infrastructure of information technology (IT), while the central element of processing and storage of information and data in the cloud is the *Datacenter* (VERAS, 2009).

The present work aims to establish a model of integration in networks of alliances with companies applying the theories of physics and cloud computing virtualization to understand the basics of relativity and its application in the communication between companies as strategic business processes and relationships between organizations. The proposal introduces a relativistic and quantum model using the fundamentals of physics. In this context there is the possibility of alliances and resource sharing, to enter into multilateral agreements, involving organizational relationships, interpersonal and inter-organizational.

II. THEORETICAL FRAMEWORK

This section describes the main aspects and justifications for the construction of the system proposed in this paper and are related to: cloud computing, theory of relativity, alliances and corporate networks, propagation of light, optics, time dilation, length contraction, electromagnetic waves, field and magnetic forces, quantum mechanics and virtualization.

2.1. Service design principles

A design paradigm, in the context of business automation is considered the approach that governs the design of logic, which consists of set of rules (or principles) complementary that define collectively the broad approach represented by paradigm. The fundamental unit of service-oriented logic is the *"service"* and in itself represents a distinct design paradigm. Each service gets its own distinct functional context and has a set of capabilities related to this context via public service contract (ERL, 2009).

In this context, the practice and the fundamentals of service contracts allow for greater interoperability, alignment of business and technology domain, greater organizational agility, greater diversification of suppliers, lower workload, low service coupling, service abstraction, and reuse of service and reduced amount of application-specific logic.

2.2. Alliances and networks of enterprises

The role of the Alliance will make the difference in getting the results of the companies involved in the business. Thus it is important to create solid alliances, but well developed, sufficiently flexible to include changes, as the market environment and corporate objectives change and the relationship evolve. The rings can be threatened only if the expected benefits of the relationship growing ever smaller, or if the behavior of any of the parties is deemed to be opportunistic, (FUSCO and SACOMANO, 2009).

In this context, the relationship and the types of relationships should establish the density, the centralization and fragmentation of the network, establishing measures of position of the actors in the network. A network can be coordinated by applying the concepts of network centralization.

A central actor joining several other actors who are not connected with other groups, this central actor then plays the role of coordinating and controlling other actors. This actor can add to the actors don't low density plants offering guidance to perform certain task. In this way the density and centralization indicate how the network (as a whole) is structured. Already fragmentations are disconnected subnets where the actors don't relate to other groups of actors. A high fragmentation means that there exists a strong cohesion, but locally the actors may be strongly cohesive (LAZZARINI, 2008).

2.3. Integration of relativistic model in enterprise networks

Computer networking computing is a set of virtual resources and accessibility of user-friendly *hardware* (physical), *software* (logical), and services development platform. Its resources can be configured easily to fit a workload (*Workload*) variable, allowing the optimization of the use of resources and replace it assets. These features and services are developed using new virtualization technologies, which are: application architectures and service-oriented infrastructure and technologies based on the internet as a means to reduce the resource usage costs of hardware and software you used for processing, storage and networking (ERL, 2009).

2.4. Fundamentals of physics

Physical descriptions of the chapters are based on the fundamentals of light, optics, relativity, electromagnetic waves, quantum mechanics, quantum physics and quantum computing, according to the authors Young and Freedman (2009), Knight, Randall (2009), Ernesto F. Galvão (2007), Herbert a. Pohl (1971) and Michael a. Nielsen and Isaac l. Chuang (2005).

2.4.1. Propagation of light and optics

The first evidence of the wave properties of light occurred around 1665. Only in 1873, James Clerk Maxwell predicted the existence of electromagnetic wave and calculated the speed of its spread, however the

work carried out by Heinrich Hertz (1887) showed that the light is actually an electromagnetic wave. However the wave nature of light to be understood should be linked to the emission and absorption of light so that it is revealed the corpuscular nature of that light. In addition, the energy carried by the light wave is concentrated in discrete packets known as photons or quanta. For the description of the propagation of light using the wave model, but your explanation is accomplished through the issuance and absorption of light (YOUNG and FREEDMAN, 2009).

Electromagnetic sources are accelerated electric charges, thus all bodies emit electromagnetic radiation known as thermal radiation, so any form of matter hot is a light source. The light can also be produced by electrical discharges in ionized gases, therefore light source uses the phosphor material to convert ultraviolet radiation of a mercury arc into visible light. In any light source these electromagnetic waves propagate in a vacuum to the speed of light (c = 2, 99792458 x 10^8 m/s) (YOUNG and FREEDMAN, 2009).

The wave properties of light can be dealt with through the wave optics. In this way are used models of rays of light to study the propagation of light in reflection and refraction. A wave of light when it reaches a smooth surface (split between two transparent media) frequently this wave is partially reflected and refracted. The refractive index of a material (n = c/v) plays a key role in geometrical optics and its propagation is slower through a material than in a vacuum. The letter "c" corresponds to the speed of light in vacuum, while "v" is the speed of light in the material. Therefore the propagation of light through any material has the value of "n" always greater than 1 and in vacuum your value is equal to 1 (YOUNG and FREEDMAN, 2009).

The direction of (A) ray of light varies when it passes from one material to another with different refractive index. Already in relation to frequency "f" (wave characteristics of light) the wave does not vary when this is just a material for another. Figure 1 shows the effects of rays of light.

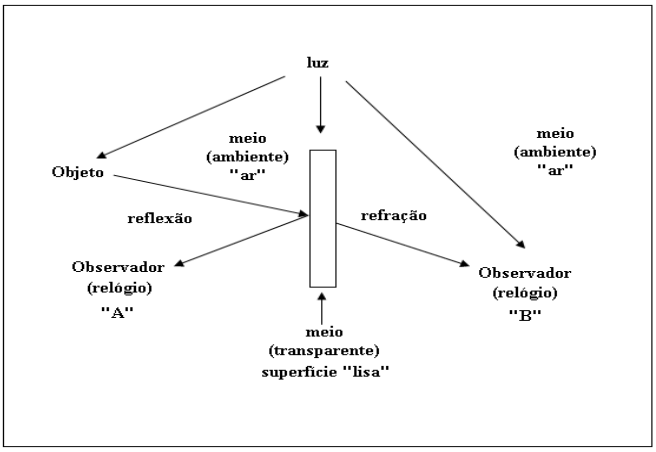

Figure 1-Propagation of light and optics, author.

Figure 1 represents a model that describes the wave properties of light. The main components are the objects, the air, the observers, the light spreads (reflection and refraction) and the light. According to Oliveira (2005), to focus on a surface separating two media with different refractive index, a beam of light is partially reflected and partially refracted. Faced with a smooth surface and a half transparent both the observer and observer B can view the object at the same time when this object receives the light, because according to Einstein's theory of relativity there is not a universal reference system. Considers that the physical phenomena (in same conditions), are identical in all inertial reference systems.

2.4.2. Relativity and light

At the beginning of this century, two theoretical systems that profoundly altered the foundations of classical physics were the theory of quanta, developed by Max Planck (1857-1947) and the history of relativity of Albert Einstein (1879-1955), because these theories together, interpret the universe from the microcosm to the macrocosm of the atom intergalactic spaces (RAMALHO, IVAN, NICHOLAS and TOLEDO, 1976).

Second Ramalho, Ivan, Nicholas and Toledo (1976), aspects and the notion of relativity were proposed by Galileo and Newton in their times ("the physical phenomena are relative to reference systems"). Space and time appear to be simple concepts as it is possible to measure distances by means of a ruler or a train. With a timer it is possible to record the time of occurrence of events. Einstein's theory already altered our understanding of some fundamental concepts of physics. Has real consequences for modern technology and understanding of the universe we live in (KNIGHT, 2009).

Einstein's theory of relativity the consequence there is a universal reference system. In their postulate of the theory of special relativity relates that "the laws of physics are identical in reference systems, in rectilinear

motion and uniform, some in relation to others". This postulate is of the opinion that the physical phenomena (in same conditions), are identical in all inertial reference systems, because there is no universal reference system. Therefore we do not know of the existence of any experience able to determine if a system is at rest or uniform rectilinear and moves against an arbitrary reference inertial system (RAMALHO, IVAN, NICHOLAS and TOLEDO, 1976). To Einstein: a) the speed of light is a universal constant, b) is the same in all inertial reference systems, c) in a vacuum does not depend on the motion of the light source and has equal value in all directions.

As Young and Freedman (2009), the theory of relativity has introduced significant changes, since it states that the laws of physics should be the same in any inertial reference system. Since the speed of light in vacuum should always be the same in any system of reference. The main consequences of these statements are:

a- An event that occurs simultaneously to another relative to an observer may not occur simultaneously in relation to another observer.
b- When there is relative motion between two observers and they effect measures of time and distance intervals, the results obtained may agree.
c- So that the law of conservation of energy and the law of conservation of linear momentum are valid in any inertial reference system, Newton's second law and the equations for the kinetic energy and momentum must be reworded.

It is known that the Faraday induction law is compatible with the principle of relativity, because all the laws of electromagnetism are the same in all inertial reference systems. Another important fact that must be cited is also the prediction of propagation velocity of electromagnetic waves in a vacuum, which were deducted from the Maxwell equations stating that light and all electromagnetic waves travel in a vacuum with a constant speed of 299,792,458 m/s (c = 3.0 x 108 m/s) which is the speed of light. According to Einstein's postulate, the speed of light in vacuum is always the same in any inertial reference system and does not depend on the speed of the source (YOUNG and FREEDMAN, 2009). According to Einstein's postulate, the movement of the light after that abandons the font cannot depend on the motion of the source, because an inertial observer cannot move with the speed of light.

On the relativity of simultaneity, it is known that the measure of the time and a time interval involves the concept of simultaneity. Concurrency is not an absolute concept, because if two events occur simultaneously or not, that depends on the reference system. Concurrency plays an important role in the measurement of time intervals. Thus we conclude that intervals of time between two events may be different in different reference systems, can also time dilation occurs. The distance between two points also depends on the reference system (not just the time interval between two events) and where is the observer. Can occur what we call length contraction, the relative velocity does not suffer contraction. There is no length contraction when two rules are arranged in directions perpendicular to the direction of relative velocity (YOUNG and FREEDMAN, 2009). The fundamental principal of relativity is named event. An event is an occurrence in a physical space set point and in a second set of time. Events can be observed and measured by observers who use different benchmarks, because an event is what actually happens. Concurrency is determined already inquiring when the event actually occurred, and not when it was seen or observed (KNIGHT, 2009).

According to the principle of relativity, all laws of physics are the same in any inertial frame of reference. All observers not matter how each move in relation to the other, realize that all the light waves (regardless of its sources) spread in relation to their respective benchmarks with the same speed of light ($c = 3 \times 10^8$ m/s). Any experiment conducted to compare the value of the speed of light in relation to different benchmarks reveals that propagates with the same speed of light in any inertial frame, is independent of how the frames move towards others (KNIGHT, 2009).

The special theory of relativity of Einstein (1905) is based on two assumptions: there is a reference to determine whether a body is in absolutely rest and the speed of light is independent of the speed of its source. This theory of special relativity Einstein invented the theory of general relativity, which describes gravity as geometrical property of space and time (GAZINELLI, 2013).

According to Knight (2009), Einstein's theory of relativity forced a review of the concepts of space and time, because the experiments revealed that the classical distinction between particles and waves there at atomic level. Already, it is known that light behaves as a particle, while the electrons (or entire atoms) behave as waves. While in theory of quantum physics (early 1920) Atomic particles are described as wave function.

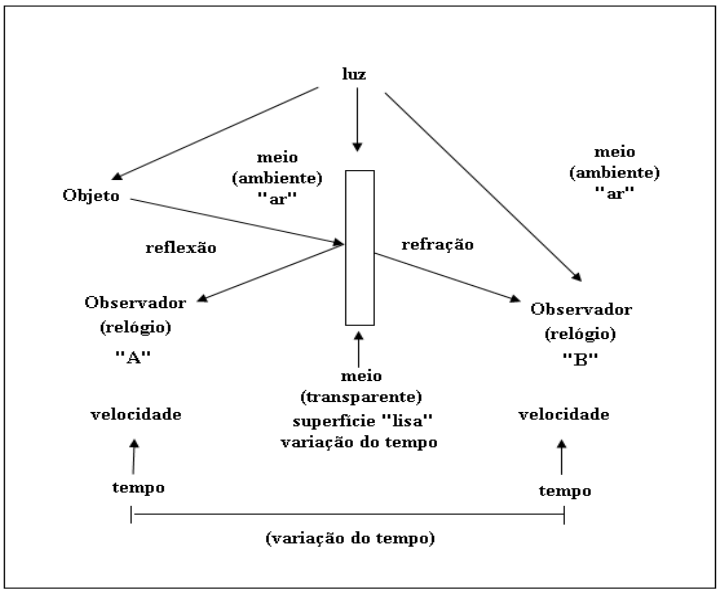

Figure 2-Relativity of simultaneity and time, author.

Figure 2 shows the light on the object according to the vision of observers A and B (standing) at the same time the incidence of light on a transparent medium. Time variation is established in relation to the observers, the reflection and refraction of light on the object and the trajectory of the light in relation to the smooth surface. It is observed that the light cannot depend on the motion of the source, because an inertial observer cannot move with the speed of light, the principle of relativity of simultaneity.

2.4.2.1. Time dilation and length contraction

The length $L = x_2 - x_1$ bar, measured in the frame R, is less than the length $L' = x'_2 - x'_1$ the same bar, measured in the frame R ´, excited about μ speed R, is called length contraction (RAMALHO, IVAN, NICHOLAS and TOLEDO, 1976).

The principle of relativity leads to the conclusion that the time is not the same for the two reference frames that move one to the other. A temporal dilation can be defined as $\Delta t=\Delta r/\sqrt{1-\beta^2} \geq \tau$. the main aspect of relativity is that all are equally valid and inertial everything we know about the referential is as they move towards others (KNIGHT, 2009). The concept of time dilation is used whenever they are compared the intervals between events compared to observers in different inertial reference systems. For a non-inertial reference system with high speed time is longer compared to inertial reference time is shorter (YOUNG and FREEDMAN, 2009).

In addition to the time interval, the distance between two events depends also on the reference system, where the observer is (also involves the concept of simultaneity). The length measured in the reference system in which the body is at rest is the length itself, already the length measured in any other reference system that moves is the length contraction (YOUNG and FREEDMAN, 2009). Shortening the distance between two objects, as measured by an observer moving relative to the objects is called the spatial contraction. The length of the object is maxim with respect to the reference in that the object is at rest. The length of the object is smaller when measured relative to any frame in which the object is in motion (KNIGHT, 2009).

2.4.3. Electromagnetic waves

Maxwell and Hertz and other established that light is an electromagnetic wave, interference, diffraction and polarization provide evidence of the wave nature of light. When observed closely the emission, absorption and scattering of electromagnetic radiation have completely different aspects of light, because the energy of a quantized electromagnetic wave. The light is emitted and absorbed in packets with defined energies, known as photons or quanta, and the energy of a single photon is proportional to the frequency of the radiation. The energy of an atom is also quantized, because its internal power cannot assume any value, only some values of energy known as energy levels (YOUNG and FREEDMAN, 2009). According to Pohl (1971), the unit of energy quanta was the first to introduce the concept of a quantum of energy, because it found that the energy was transferred into units or packages (called quanta) that became more evident by the photoelectric effect, played by Einstein.

Electromagnetic waves arise as a result of two effects: a variable magnetic field produces an electric field and a variable electric field produces a magnetic field. In this way these two fields constantly add in its

spread through space. As Maxwell, if at a point P is produced a variable electric field $\vec{E}$ so will induce a magnetic field variable $\vec{B}$ with time and with distance from point P. Furthermore, the vector $\vec{B}$ will induce a variable vector $\vec{E}$, which also varies with time and with distance from the variable magnetic field. This reciprocal induction magnetic and electrical fields, variables with the time and distance, it becomes possible to spread this induction sequence through space. Therefore, an electrical disturbance in the point P, due to oscillation of electrical charges, these travel to distant points through the mutual formation of electrical and magnetic fields variables (RAMALHO, IVAN, NICHOLAS and TOLEDO, 1976). The demonstration of the speed of propagation of an electromagnetic wave in vacuum, according to Maxwell is equal to the speed of light in vacuum (where v = 3 x 10^8 m/s), where v is the speed of propagation of an electromagnetic wave in vacuum.

On the airwaves, it is known that in frequency between 10^4 to 10^7 Hz, are very well reflected by the ionized layers of the upper atmosphere (known as the ionosphere). This reflection allows radio waves to be detected at large distances from the network, because it has a wavelength of tens to thousands of meters and useful for transmission of information. These waves can be transmitted from one continent to another by means of artificial satellites (RAMALHO, IVAN, NICHOLAS and TOLEDO, 1976).

2.4.4. Field and magnetic forces

The classical physics was formed for mechanics, electromagnetism and thermodynamics. The phenomena of electricity and magnetism were studied experimentally and its fundamental laws were discovered. Later, James Clark Mawell, Hans Christian Oesrsted and Michael Faraday, were able to gather in a single theory the phenomena of electricity, introducing the concept of electromagnetic field. The magnetic field continuously occupies a region of space that is characterized by two vector quantities (electric and magnetic fields). The speed of propagation of electromagnetic waves in vacuum is identical to the speed of light and it is concluded that the light is a kind of electromagnetic wave. They thus unify into a single optical phenomena and theory of electromagnetism. Then the thermodynamics completes the picture of classical physics, because it deals with the concepts of energy, temperature and heat. The theory of unification continued with Maxwell's electromagnetic theory, which United electrical, magnetic and optical phenomena (GAZZINELLI, 2013).

As Young and Freedman (2004), a magnetic interaction can be described as: a) a live load or an electric current creates a magnetic field in their neighborhoods (in addition to the electric field), b) the magnetic field exerts a force about any other current or load that moves within the field. The magnetic field is a vector field associated with each point in space.

Magnetic forces only act on moving charges and it turns out that the electrical and magnetic interactions are related. However the magnetic force depends on the speed of the particle, unlike electric force which is always the same is independent of charge be at rest or in motion. An electric charge in motion does not suffer from magnetic forces action, but creates a magnetic field when you're on the move, already the symmetry properties of the magnetic field can be related to ampere's law. That same electric field can also vary with time (known as displacement current) to produce a magnetic field (YOUNG and FREEDMAN, 2004).

Regarding the photo-electric effect it is known that an electromagnetic radiation, focuses on a surface of a metal, electrons can be expelled this surface and this phenomenon (discovered by Hertz in 1887), is called Photo-electric effect, which was explained later by Einstein in 1905. Einstein proposed that the photo-electric effect, one photon of radiation incident, when a metal is completely absorbed by a single electron, yielding your energy instantly, so the electron of metal with an additional power. Einstein suggests, so that the light is composed of photons and that this can be absorbed by the metal just one at a time, and there is no fractions of a photon. For Einstein "the energy of the electron must increase with the frequency and has nothing to do with the intensity of the radiation. However the energy received by an electron, by absorbing a photon is always the same (RAMALHO, IVAN, NICHOLAS and TOLEDO 1976).

2.4.5. Quantum mechanics

The quantum nature of light is used to explain properly the photo-electric effect is in contradiction with the wave nature of light, however allows you to justify the interference and diffraction phenomena of light. Despite that the two theories are completely different are also needed to explain a single physical phenomenon. To reconcile these facts was presented the "dual" nature of light, where in certain phenomena the light behaves as a wave nature and in other, particle nature. The same beams of light can deflator around an obstacle and focus on the surface of the metal, causing the photo-electron emission. To Louis De Broglie (1924), if the light has dual nature, also a particle could behave similarly, and then relates the wave characteristic with particle size. With it your chance other physicists have developed quantum mechanics who favored the exact description of Atomic phenomena, because it changed the way of looking at nature in terms of probability terms and not in terms of certainty (RAMALHO, IVAN, NICHOLAS and TOLEDO, 1976).

As Max Planck (1900), an electron oscillating with frequency "f", emit (or absorb) an electromagnetic wave of the same frequency, but energy is not emitted (or absorbed) continuously, and in discontinuous servings (particles that carry each a number of well-defined energy) called photons. The energy of each photon is called a quantum or quanta (in the plural). An oscillating electron cannot absorb (or issue) energy continuously (or an electron absorbs (or send) a quantum or anything).

In 1982 Richard Feynman published a work in which he argued the simulation of particles that behave according to quantum mechanics. He had observed that even simple problems of quantum physics seem to require an immense number of computational steps in its resolution seemed to be in the category of intractable problems. For him the quantum properties of the simpler system would help in more complex systems simulation, thus a quantum computer could be more efficient than a usual computer, the question is: "what kind of problem could be solved more quickly in a quantum computer than a classical computer?" (GALVÃO, 2007).

Today we know that the main problems that can be solved by quantum computers are the simulation of quantum systems proposed by Feynman (simulation of new devices and materials), factoring and search in a database. In 1984, Charles Bennett and Gilles Brassard developed the first absolute security protocol, which involves the exchange of quantum particles of light (photons), assuming only the quantum mechanics is an accurate description of nature. One of the main advantages has its origins in the phenomena of superposition and entanglement (GALVÃO, 2007).

2.5. Integration of relativistic computing and virtualization

The choice of measurement of properties chosen for the actors are "subject" that have two possible values (business or social) and "duration" which also have only two values (long and short). So, measuring these properties can determine the existing correlations of these results. The application of quantum mechanics, establish the superposition States of the objects (actors) and their behaviors (some aspects) as if they were in multiple positions at the same time, because in this state it is possible to be manipulated and measured. When measuring the properties "subject" and "duration" of the companies involved after the connection, it is possible to obtain by analogy the importance and the possible values that will determine the correlations of these properties.

With the application of relativity of simultaneity seeks to establish a measurement and time interval in the interaction between the actors of a company network in relation to systems of references and events. Through the theory of relativity applies the concept of space and time of cloud computing (virtualization), in addition to the exchange of services between the actors of a communication network with the use of the internet. The fundamentals applied in the construction of the proposed model will serve as the basis for the construction of the graphical interface of the classic model (space, time, speed) Newtonian and relativistic model (space, time, speed) of Einstein. Already the foundations of physics, structure the foundations for the construction of quantum computation.

III. METHODOLOGY AND MATERIALS

This research work is classified as applied, are proposing a model based on data collection and aims to generate possible knowledge of practical application to resolve specific problems of connection between corporate networks and cloud computing virtualization.

As for the approach, this research is quantitative, as it seeks to explain through quantifiable data, show relationships of phenomena observed with proof (or not) of the hypothesis established, delineated on the collection of data to prove systematically confirmation (or not) of this hypothesis. This work is an exploratory research, because of the importance of this study, aims to enhance the application of network model in companies with cloud computing virtualization, using the fundamentals of Physics in a relativistic view.

The surveys conducted have provided a better understanding of the matter proposed in this work and offered a clearer vision of the problem and of ideas. The research also involved bibliographic survey, interviews with other teachers in the areas of physics and computer science who had practical experience problems searched for a greater understanding and dimension of this study. In this context it was possible to better clarify about the subject, to then propose the model proposed. Technical procedures were already structured in: characterization of the study, data collection, data analysis, application of physics, simulation of the values and presentation (charts and graphs). We used the concepts of physics laws of reflection and refraction, reflection and the Huygens principle, interference of light, diffraction, wave-particle duality, electromagnetic phenomena, Galileo and Einstein relativity, simultaneity, time dilation, spatial contraction, mechanics and quantum physics. In addition, were supplemented with the fundamentals of corporate networks and cloud computing.

To obtain the data collected was used in a sample table with the following structure: date, time, machine, OS, connection time, processing speed, RAM, period, wavelength, connection speed, distance and frequency. Through this infrastructure was able to access and perform measurements of the environment offered by internet and cloud computing virtualization for verification of connections in distributed environment and

cloud computing virtualization. Then were formulated mathematical and physical expressions, generated from the data entries which resulted in the data presented in tables and charts. It was elaborated the relativistic model architecture of network of companies and of application of virtualization of computers based on the frequency of wave. As a constraint to the model presented adopted the magnetic wave velocity (speed of light), as a means of propagation for the connection between the actors of a network of companies in virtualization of *Datacenters*.

3.1. Scope of the experimental work

Models will be developed on the basis of the results generated by connections of computers in internet networks and cloud computing virtualization to deepen the knowledge and behavior of the virtual machines. Will be monitored and compared with the basics presented by Relativistic Physics. Then mathematical arguments will be constructed to validate the applications of Physics in computer network environment, using the registered virtual stopwatch. For the study and analysis of the results presented will use as a basis the mechanics and quantum physics for the deepening of quality of information. Through simulations and tests will be established the limits of Royal connections and relativist and show the results achieved and also the differences established by connections registered by machines available (beginning of tunneling between the network nodes).

3.2. Project Architecture

The relativity is space and time. The difficulty is that some aspects of relativity seem to be incompatible with the laws of electromagnetism, especially the laws that govern the propagation of light waves. Special relativity Einstein involves spatial contraction and time dilation (KNIGHT, 2009). Based on these strong foundations established the structure of architecture and the proposal of this work.

As Knight (2009) it is known that no object has a "true" speed, because its speed towards someone is moving or stopped. The most that is possible is the specification of the speed of an object relative to a coordinate system. However the definition of reference can be based on: the referential) extends infinitely in all directions, b) are observers at rest relative to its benchmark, c) the number of observers and the amount of equipment used is enough to measure the positions and the velocities with any level of accuracy established.

In the proposed architecture in this work, it is considered that all components (objects) belong to a single inertial frame, where all observers are at rest, in relation to the other and belong to the same benchmark.

The principle of Galilean relativity "the laws of mechanics are the same in all inertial reference frames". To the principles of relativity, all laws of physics are the same in any inertial frame (all results of the theory of relativity based on this postulate). And whereas Maxwell's equations of electromagnetism which are laws of physics, they are also true in any inertial frame and predict that electromagnetic waves (including light) propagate with the speed $c = 3.00 \times 10^8$ m/s, so the light propagates with the speed "c" in all inertial reference frames (KNIGHT, 2009).

According to the experiments performed in the laboratory to compare the value of the speed of light in relation to different benchmarks, reveal that light propagates with 3.00 x 108 m/s for any inertial, regardless of how the frames move towards others (KNIGHT, 2009). In this way the architecture (proposed), considers how inertial frame the principle of relativity to the components: actors, *Datacenter*s and quantum computations.

For the fundamental entity of relativity physics is the event (occurrence physics in a point set space and in a second set of time), which can be observed and measured by observers who use different benchmarks. It is also possible to quantify where and when an event occurs using coordinates (x, y, z) and the instant of time "t" which are known as space-time coordinates of the event, because an event is what actually happens. However when two events occur in different positions, but at the same time measured in some benchmark are known as simultaneous. Concurrency is determined inquiring when the event actually occurred, and not when it was seen or observed (KNIGHT, 2009). The observation of events of architecture proposal on simultaneity between the components (objects) located in layers (A), (B) and (C) because "t" is the second time in the event (communication) actually occurs between the components (objects) of architecture (considering the fact that light propagates the 300×10^8 m/s events occur simultaneously).

Physical studies reveal that the light travels equal distances in equal time intervals, because the light propagates at a speed "c" in relation to all the references independent of the motion of objects. According to the theory of relativity "two events that occur simultaneously in a referential S are not simultaneous in another frame S ´ in relative motion to S" (known as relativity of simultaneity). Therefore the proposed architecture is based on the propagation of light in all reference frames and all components (objects) represented by the layers (A), (B) and (C), in addition, it is considered just a benchmark as qualitative measurement. As Knight (2009), the principle of relativity concludes that the time is not the same for the two reference frames that move a in relation to the other, since the space is different from moving a referential in relation to another.

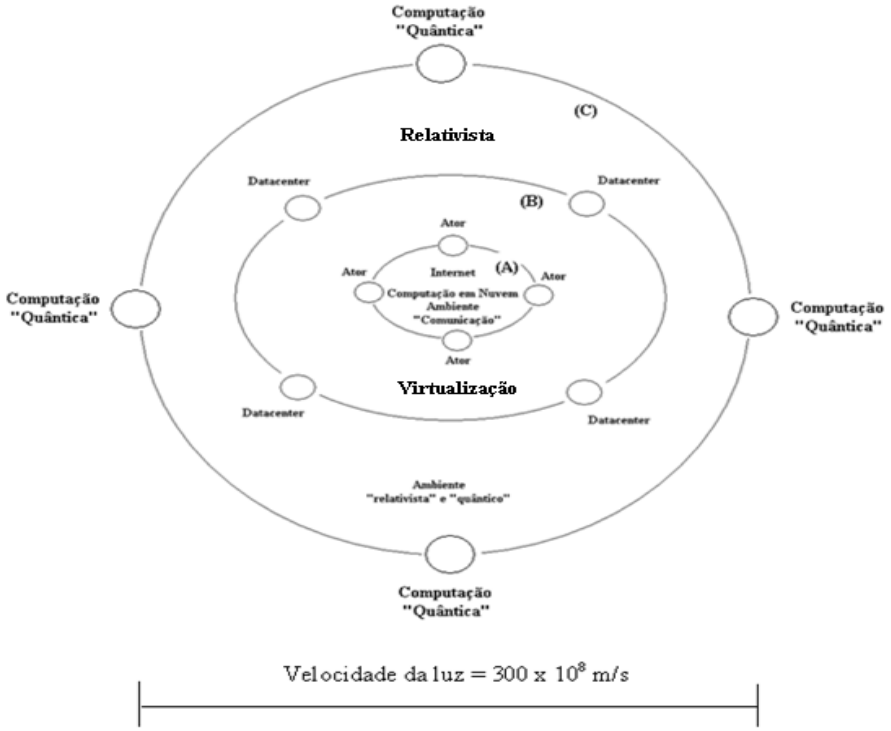

Figure3-relativistic model architecture business networks, author.

Figure 3 above shows how inertial reference the light for the connection between the components (objects) arranged in layers A, B and c. in the layer are the major features of the internet, cloud computing and communication protocols. B layer the components and features of virtualization provided by *Datacenters*, already in the C layer quantum computing resources (a new technology necessary for the application of the relativistic model).

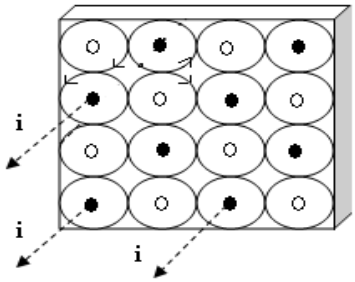

Figure 4 – array of circular motion of magnetic field and electric current, author.

Figure 4 above represents an array where the coils are located where they are traversed chains or not, in each one of these coils to generate electromagnetic fields. In addition, it also shows the meanings of the fields (clockwise or anti-clockwise) when currents are applied in their coils. When circulating current in a coil electromagnetic fields of their neighborhoods may be clockwise or counter-clockwise, because it depends on the intensity of the current that runs through each of their specific coils. The result of these movements are the records that identify the frequencies waves, which quantifies its corresponding value (can be considered the principle of quantum memory) of stored information and also possible to be recovered (through the specific frequencies).

The superposition is a technical term that describes one of the main features of microscopic objects that follow the rules of quantum mechanics. The quantum superposition is the possibility of a quantum object takes a peculiar combination of properties that would be mutually exclusive in accordance with our intuition. Quantum mechanics allows making predictions in terms of probabilities which can be described through the probability amplitudes. Can be manipulated and measured which usually alter the probability amplitudes associated with each position, because it depends on the probability amplitudes immediately before the measurement (GALVÃO, 2007).

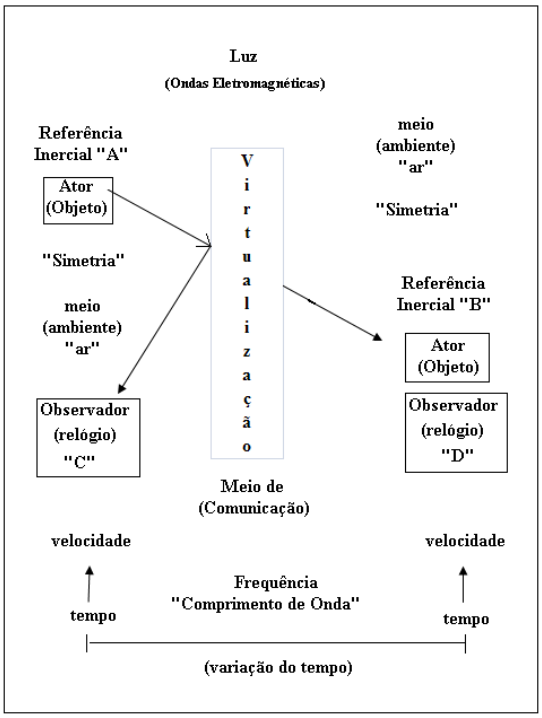

Figure 5 – relativistic Model and application of virtualization to cloud computing, author.

Based on the foundations of quantum mechanics in Figure 5 above, shows the superposition of the propagation speed of the media in relation to speed and time and the application of the frequency and wavelength. The transmission of the communication established between companies can be measured through its properties. Such properties can be the "subject" (social or business) or the "duration" (short or long) in the exchange of information between them, thus characterized the superposition that occurs on virtualization offered by quantum computation. Under these conditions the relativistic space and time are applied to connection speed or tunneling in relation to the speed of light.

One of the key concepts in relativity is the concurrency, and is associated with the relativity of time (OLIVEIRA, 2005). An exchange of information between the actor (or company) "A" frame with the frame "C" Observer are simultaneous events when they occur at the same time. For a connection speed with very high speeds (according to Einstein's theory of relativity) time under these conditions can dilate (known as time dilation), your route will be larger and thus the observer "C" will take longer to receive the connection and the information sent. The actor already inertial reference "D" will receive the connection before both of which (A and D Company) are running within the virtualization environment.

Light is an electromagnetic wave and its energy transported by the light wave is concentrated in discrete packets known as photons or quanta. Aspects of health and corpuscular of light apparently contradictory are explained were reconciled with the development of quantum electrodynamics (YOUNG and FREEDMAN, 2009). As Galvão (2009), distant quantum particles seem to be communicating, so that the measures of its properties are correlated. Figure 6 shows the correlation between the actors (or businesses) on a communication, exchange of information or services. These correlations are the measurements of the properties of the actors (or companies) that are: "subject" who own the business or social values and "duration" that have the values, long or short. These measures allow to quantify the correlations that exist between companies, which are monitored by the layer of cloud computing and virtualization are also represented by tables 1 and 6 figures below. The light has an undulating phenomenon (according to Maxwell electrodynamics) for this reason will always be an electromagnetic wave in any inertial frame (travel with the same speed of light, $c = 3 \times 10^8$ m/s), thus it can be concluded that the speed of propagation of the communication and exchange of messages between the companies has the same value in all inertial systems (maintains the integrity the sending and receiving such information)provided that use light waves on the connection between companies (principle of implementation of quantum computation).

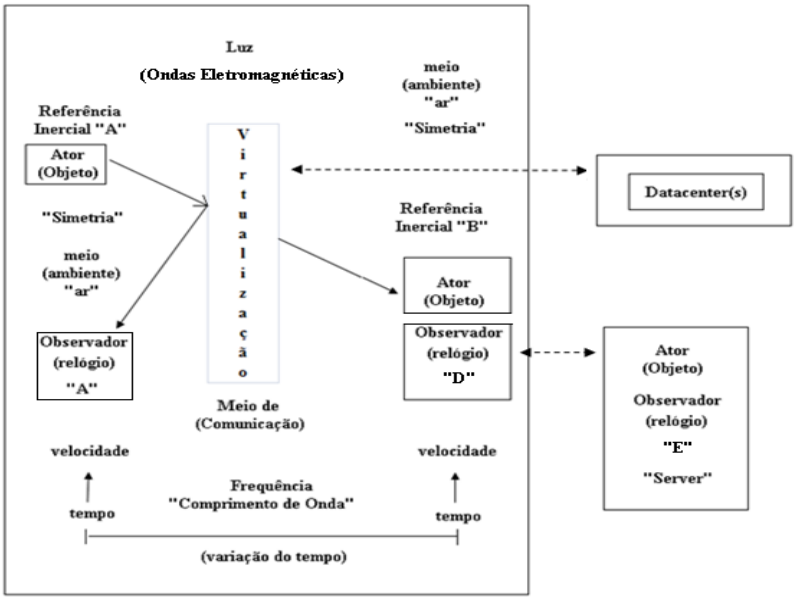

Figure 6 – Relativistic Model and the application of the wave frequency and virtualization in cloud computing, author.

Figure 6 shows the behavior of light and its undulating phenomenon (according to electrodynamics of Maxwell), for this reason will always be an electromagnetic wave in any inertial frame (travel with the same speed of light, $c = 3 \times 10^8$ m/s), thus it can be concluded that the speed of propagation of the communication and exchange of messages between the companies has the same value in all inertial systems (maintains the integrity and shipping receipt of this information), since that uses light waves on the connection between companies (principle of implementation of quantum computation). Established (first) the connection (using electromagnetic connections), to carry out the exchange of information, so the data can be packaged and transmitted by electromagnetic field (using the C layer of architecture proposal).

3.3. Details of the components

Will be developed an infrastructure model to test, simulating the connections with the virtualization tunneling with the *Datacenters* and using different computer speeds and models. In this way these components will extend the communication resources of educational institutions that are connected on the network to facilitate transactions and exchanges of services between these institutions.

In this project the main components are: the *Datacenters*, the doors of communication between the structures of clouds Computing Virtualization, networking organizations, service models, electromagnetism and the foundations of relativity.

3.4. Tools used

The main tools used are: the hosting cloud computing, *web* technologies, the models of enterprise network services, and the application of electromagnetism in communications transmissions.

3.5. Application environments

The environment for realization will be built using internet networks, cloud computing, virtualization, *Datacenters* and networks of educational institution as intra-organizational type. The infrastructure for the implementation of the case study should be built using computers of different sizes and characteristics, where they will be interconnected in a network of computers using virtualization of these machines. Aiming at the application and realization of this work is its implementation with the cloud computing and basics of relativity to be able to demonstrate its advantages.

4. Analysis of results

The tables below show the results of the data collected for the analysis of the implementation of the modifications of the Galilean relativity, time contraction, time dilation and the relativistic momentum.

1	Data	Hora	Máqui	Sistema Operacional	Tempo UOL	Velocidade	Memória RAM
70	21/1/2014	09h14	A	XP	8,56	2,67	3,00
71	21/1/2014	09h14	A	XP	2,31	2,67	3,00
72	21/1/2014	09h14	A	XP	2,72	2,67	3,00
73	21/1/2014	09h14	A	XP	3,00	2,67	3,00
78	21/1/2014	15h02	A	XP	9,21	2,67	3,00
79	21/1/2014	15h02	A	XP	2,84	2,67	3,00
80	21/1/2014	15h02	A	XP	2,91	2,67	3,00
81	21/1/2014	15h02	A	XP	3,13	2,67	3,00
86	22/1/2014	09h10	A	XP	24,32	2,67	3,00
87	22/1/2014	09h10	A	XP	3,88	2,67	3,00
88	22/1/2014	09h10	A	XP	2,84	2,67	3,00
89	22/1/2014	09h10	A	XP	2,84	2,67	3,00
94	22/1/2014	13h26	A	XP	31,91	2,67	3,00
95	22/1/2014	13h26	A	XP	3,13	2,67	3,00
96	22/1/2014	13h26	A	XP	2,82	2,67	3,00
97	22/1/2014	13h26	A	XP	2,97	2,67	3,00
106	23/1/2014	08h00	A	XP	9,06	2,67	3,00
107	23/1/2014	08h00	A	XP	2,79	2,67	3,00
108	23/1/2014	08h00	A	XP	3,09	2,67	3,00
109	23/1/2014	08h00	A	XP	2,84	2,67	3,00
114	23/1/2014	14h48	A	XP	30,25	2,67	3,00
115	23/1/2014	14h48	A	XP	3,25	2,67	3,00
116	23/1/2014	14h48	A	XP	2,93	2,67	3,00
117	23/1/2014	14h48	A	XP	2,75	2,67	3,00
123			A	XP	6,29	2,67	3,00

Table 1-Data collection of server and client environment computing, author.

Table 1 shows the results applied in a computer PC (*Personal Computer*) Intel processor speed of 2.67 GHZ, XP operating system (from *Microsoft*) with the amount of 3.00 GB RAM, where they were recorded: the dates, times and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main features of the machine used in the environment (client/server) on the internet and how tunneling was carried out of the connection with the *Datacenter*.

1	Data	Hora	Máqui	Sistema Operacional	Tempo UOL	Velocidade	Memória RAM
6	18/1/2014	11h45	B	XP	13,09	1,73	2,00
7	18/1/2014	11h45	B	XP	9,90	1,73	2,00
8	18/1/2014	11h45	B	XP	12,72	1,73	2,00
9	18/1/2014	11h45	B	XP	9,78	1,73	2,00
14	18/1/2014	11h59	B	XP	14,90	1,73	2,00
15	18/1/2014	11h59	B	XP	9,87	1,73	2,00
16	18/1/2014	11h59	B	XP	9,85	1,73	2,00
17	18/1/2014	11h59	B	XP	12,88	1,73	2,00
22	18/1/2014	22h20	B	XP	12,91	1,73	2,00
23	18/1/2014	22h20	B	XP	9,72	1,73	2,00
24	18/1/2014	22h20	B	XP	14,79	1,73	2,00
25	18/1/2014	22h20	B	XP	12,81	1,73	2,00
30	19/1/2014	16h13	B	XP	28,19	1,73	2,00
31	19/1/2014	16h13	B	XP	9,81	1,73	2,00
32	19/1/2014	16h13	B	XP	12,69	1,73	2,00
33	19/1/2014	16h13	B	XP	10,75	1,73	2,00
38	19/1/2014	18h15	B	XP	18,28	1,73	2,00
39	19/1/2014	18h15	B	XP	9,81	1,73	2,00
40	19/1/2014	18h15	B	XP	12,97	1,73	2,00
41	19/1/2014	18h15	B	XP	9,94	1,73	2,00
124			B	XP	12,78	1,73	2,00

Table 2-Data collection of server client environment computing, author.

Table 2 shows the results applied in a computer *Notebook* Intel processor 1.73 GHZ speed, operating system XP (from *Microsoft*) with the amount of 3.00 GB RAM, where they were recorded: the dates, times and the time required connecting to a site (UOL). At the end of the table is recorded the average time for the connections and the main features of the machine used in the environment (client/server) on the internet and how tunneling was carried out of the connection with the *Datacenter*.

1	Data	Hora	Máqui	Sistema Operacional	Tempo UOL	Velocidade	Memória RAM
61	20/1/2014	14h42	C	Windows 7	0,90	2,50	6,00
66	20/1/2014	20h42	C	Windows 7	35,56	2,50	6,00
67	20/1/2014	20h42	C	Windows 7	0,78	2,50	6,00
68	20/1/2014	20h42	C	Windows 7	1,25	2,50	6,00
69	20/1/2014	20h42	C	Windows 7	1,88	2,50	6,00
74	21/1/2014	09h16	C	Windows 7	5,69	2,50	6,00
75	21/1/2014	09h16	C	Windows 7	0,97	2,50	6,00
76	21/1/2014	09h16	C	Windows 7	0,68	2,50	6,00
77	21/1/2014	09h16	C	Windows 7	0,81	2,50	6,00
82	21/1/2014	15h03	C	Windows 7	5,44	2,50	6,00
83	21/1/2014	15h03	C	Windows 7	1,00	2,50	6,00
84	21/1/2014	15h03	C	Windows 7	0,97	2,50	6,00
85	21/1/2014	15h03	C	Windows 7	0,56	2,50	6,00
90	22/1/2014	09h12	C	Windows 7	5,84	2,50	6,00
91	22/1/2014	09h12	C	Windows 7	0,88	2,50	6,00
92	22/1/2014	09h12	C	Windows 7	0,85	2,50	6,00
93	22/1/2014	09h12	C	Windows 7	0,75	2,50	6,00
98	22/1/2014	13h28	C	Windows 7	6,32	2,50	6,00
99	22/1/2014	13h28	C	Windows 7	1,00	2,50	6,00
100	22/1/2014	13h28	C	Windows 7	1,06	2,50	6,00
101	22/1/2014	13h28	C	Windows 7	0,78	2,50	6,00
125			C	Windows 7	3,05	2,50	6,00

Table 3 — Data collection of server client environment computing, author.

Table 3 shows the results applied in a computer *Notebook* Intel processor 2.50 GHZ speed, operating system Windows 7 (from *Microsoft*) with the amount of 6.00 GB RAM, where they were recorded: the dates, times and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main features of the machine used in the environment (client/server) on the internet and how tunneling was carried out of the connection with the *Datacenter*.

1	Data	Hora	Máqui	Sistema Operacional	Tempo UOL	Velocidade	Memória RAM
102	22/1/2014	13h39	D	Windows 7	6,69	1,20	2,00
103	22/1/2014	13h39	D	Windows 7	7,81	1,20	2,00
104	22/1/2014	13h39	D	Windows 7	8,72	1,20	2,00
105	22/1/2014	13h39	D	Windows 7	5,00	1,20	2,00
110	23/1/2014	08h02	D	Windows 7	8,00	1,20	2,00
111	23/1/2014	08h02	D	Windows 7	10,73	1,20	2,00
112	23/1/2014	08h02	D	Windows 7	11,63	1,20	2,00
113	23/1/2014	08h02	D	Windows 7	8,41	1,20	2,00
118	23/1/2014	14h53	D	Windows 7	8,84	1,20	2,00
119	23/1/2014	14h53	D	Windows 7	3,38	1,20	2,00
120	23/1/2014	14h53	D	Windows 7	6,97	1,20	2,00
121	23/1/2014	14h53	D	Windows 7	12,50	1,20	2,00
126			D	Windows 7	8,22	1,20	2,00

Table 4 — Data collection of server client environment computing, author.

Table 4 shows the results applied in a computer *Notebook* Intel processor 1.20 GHZ speed, operating system Windows 7 (from *Microsoft*) with the amount of 2.00 GB RAM, where they were recorded: the dates, times and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main features of the machine used in the environment (client/server) on the internet and how tunneling was carried out of the connection with the *Datacenter*.

	E	F	G	H	I	J	K	L	M	N
1	Tempo UOL	Velocidade(GHZ)	Memória RAM(GB)	T(Periodo) seg	Comprimento de onda(cm)	Velocidade Conexão(cm/s)	Comprimento de onda(cm)	Distância(cm)	Tempo(seg)	Freqüência (GHZ)
110	8,00	1,20	2,00	0,000000000833	25,00	0,0313	0,000000000026	0,25	8,00	1,2
111	10,73	1,20	2,00	0,000000000833	25,00	0,0233	0,000000000019	0,25	10,73	1,2
112	11,63	1,20	2,00	0,000000000833	25,00	0,0215	0,000000000018	0,25	11,63	1,2
113	8,41	1,20	2,00	0,000000000833	25,00	0,0297	0,000000000025	0,25	8,41	1,2
114	30,25	2,67	3,00	0,000000000375	11,24	0,0037	0,000000000001	0,11	30,25	2,67
115	3,25	2,67	3,00	0,000000000375	11,24	0,0346	0,000000000013	0,11	3,25	2,67
116	2,93	2,67	3,00	0,000000000375	11,24	0,0383	0,000000000014	0,11	2,93	2,67
117	2,75	2,67	3,00	0,000000000375	11,24	0,0409	0,000000000015	0,11	2,75	2,67
118	8,84	1,20	2,00	0,000000000833	25,00	0,0283	0,000000000024	0,25	8,84	1,2
119	3,38	1,20	2,00	0,000000000833	25,00	0,0740	0,000000000062	0,25	3,38	1,2
120	6,97	1,20	2,00	0,000000000833	25,00	0,0359	0,000000000030	0,25	6,97	1,2
121	12,50	1,20	2,00	0,000000000833	25,00	0,0200	0,000000000017	0,25	12,50	1,2
122	Tempo UOL	Velocidade	Memória RAM	T(Periodo) seg	Comprimento de onda(cm)	Velocidade Conexão(cm/s)	Comprimento de onda(cm)	Distância(cm)	Tempo(seg)	Freqüência (GHZ)
123	13,93	2,67	3,00	0,000000000988	29,64	0,1081	0,000000000047	0,30	13,93	
124	38,50	1,73	2,00	0,000000002692	80,75	0,2938	0,000000000127	0,81	38,50	
125	14,39	2,50	6,00	0,000000001134	34,02	0,1563	0,000000000067	0,34	14,39	
126	12,97	1,20	2,00	0,000000001083	32,49	0,0548	0,000000000036	0,32	12,97	
127										
128						Veloc. Relat.		Dist. Relat.	Tempo Relat.	
129						0,108129243		0,296434695	13,931607143	
130						0,293844001		0,807545236	38,504000000	
131						0,156295539		0,340154494	14,392500000	
132						0,054835504		0,324906367	12,970000000	
133										
134						Variação Veloc. Relat.		Variação	Variação	
135						0,000029243		0,003565305	0,001607143	
136						0,000044001		0,002454764	0,004000000	
137						0,000004461		0,000154494	0,002500000	
138						0,000035504		0,004906367	0,000000000	

Table 5 – Time dilation and contraction of space, author.

Table 5 shows the results presented in the analysis of the connections established by physical machines of different characteristics, applying the concepts of virtualization, calculations of tunneling: period, wavelength, frequency, time and distance and time variations relativists. Table 6 shows the more detailed results and explains the time dilation and contraction of space in virtualization environment.

	0,0740	0,000000000062			
	0,0359	0,000000000030	0,25	6,97	
	0,0200	0,000000000017	0,25	12,50	
cm)	Velocidade Conexão(cm/s)	Comprimento de onda(cm)	Distância(cm)	Tempo(seg)	Fr
	0,1081	0,000000000047	0,30	13,93	
	0,2938	0,000000000127	0,81	38,50	
	0,1563	0,000000000067	0,34	14,39	
	0,0548	0,000000000036	0,32	12,97	
	Veloc. Relat.		Dist. Relat.	Tempo Relat.	
	0,108129243		0,296434695	13,931607143	
	0,293844001		0,807545236	38,504000000	
	0,156295539		0,340154494	14,392500000	
	0,054835504		0,324906367	12,970000000	
	Variação Veloc. Relat.		Variação	Variação	
	0,000029243		0,003565305	0,001607143	
	0,000044001		0,002454764	0,004000000	
	0,000004461		0,000154494	0,002500000	
	0,000035504		0,004906367	0,000000000	

Table 6 – Part of time dilation and contraction of space, author.

Table 6 shows the results of the calculations in relation to the values of the variations set out in simulations of virtualization connections compared to the speed of light. Are described the values of speeds, distances covered, time and variations in virtualization environment reached relativists. The wavelength for the computer operating system, XP, the tunneling period is 9, 88x10 $^{-10s}$ sec, the wavelength of 4, 7 x 10^{-13}m and frequency equal to 1.5 Ghz, which according to the classification of the electromagnetic spectrum is in the range of electromagnetic radiation. On computer B, XP operating system, the period of the tunneling is 26, 92x10 $^{-10}$sec, and the wavelength of 12, 7 x 10^{-13}m and frequency equal to 11.3 Ghz, which according to the classification of the electromagnetic spectrum is in the range of electromagnetic radiation. To computer C, the operating system Windows 7, the tunneling period is 11, 34x10 $^{-10}$sec, and the wavelength of 6, 7 x 10^{-13}m and frequency equal to 2.25 Ghz, which according to the classification of the electromagnetic spectrum is in the range of electromagnetic radiation. To computer D, operating system Windows 7, the tunneling period is 10, 83x10 $^{-10}$sec, and the wavelength of 3, 6 x 10^{-13}m and frequency equal to 0.71 Ghz, which according to the classification of the electromagnetic spectrum is in the range of electromagnetic radiation. Occurs, so a variation of the tunneling of computers A, B, C and D in the virtual environment in relation to the speed of light which are: for the computer to 0.000000000036% in relation to the speed of light; to computer B of 0.000000000098% in relation to the speed of light; to computer C of 0.000000000052% in relation to the speed of light; to computer D of 0.000000000018% in relation to the speed of light.

1	Data	Hora	Máqui	Sistema Operacional	Tempo Conexão	Tempo UOL	Velocidade	Memória RAM	Velocidade	Memória RAM
18	18/1/2014	11h27	A-->B	XP-->XP	5,50	2,60	2,67	3,00	1,73	2,00
19	18/1/2014	11h27	A-->B	XP-->XP	5,50	2,88	2,67	3,00	1,73	2,00
20	18/1/2014	11h27	A-->B	XP-->XP	5,50	2,85	2,67	3,00	1,73	2,00
21	18/1/2014	11h27	A-->B	XP-->XP	5,50	3,22	2,67	3,00	1,73	2,00
30	18/1/2014	11h50	A-->B	XP-->XP	1,50	1,12	2,67	3,00	1,73	2,00
31	18/1/2014	11h50	A-->B	XP-->XP	1,50	1,06	2,67	3,00	1,73	2,00
32	18/1/2014	11h50	A-->B	XP-->XP	1,50	1,21	2,67	3,00	1,73	2,00
33	18/1/2014	11h50	A-->B	XP-->XP	1,50	1,16	2,67	3,00	1,73	2,00
38	18/1/2014	22h15	A-->B	XP-->XP	1,50	32,81	2,67	3,00	1,73	2,00
39	18/1/2014	22h15	A-->B	XP-->XP	1,50	19,25	2,67	3,00	1,73	2,00
40	18/1/2014	22h15	A-->B	XP-->XP	1,50	18,84	2,67	3,00	1,73	2,00
41	18/1/2014	22h15	A-->B	XP-->XP	1,50	12,50	2,67	3,00	1,73	2,00
46	19/1/2014	16h18	A-->B	XP-->XP	1,69	18,82	2,67	3,00	1,73	2,00
47	19/1/2014	16h18	A-->B	XP-->XP	1,69	12,22	2,67	3,00	1,73	2,00
48	19/1/2014	16h18	A-->B	XP-->XP	1,69	17,62	2,67	3,00	1,73	2,00
49	19/1/2014	16h18	A-->B	XP-->XP	1,69	18,81	2,67	3,00	1,73	2,00
54	19/1/2014	18h17	A-->B	XP-->XP	1,68	16,88	2,67	3,00	1,73	2,00
55	19/1/2014	18h17	A-->B	XP-->XP	1,68	17,59	2,67	3,00	1,73	2,00
56	19/1/2014	18h17	A-->B	XP-->XP	1,68	17,35	2,67	3,00	1,73	2,00
57	19/1/2014	18h17	A-->B	XP-->XP	1,68	12,04	2,67	3,00	1,73	2,00
152			A-->B	XP-->XP	2,57	12,44	2,67	3,00	1,73	2,00

Table 7 – Computer data collection in virtualization environment, author.

Table 7 shows the results applied in a computer PC (*Personal Computer*) Intel processor speed of 2.67 GHZ, XP operating system (from Microsoft) with the amount of 3.00 GB RAM and another computer of processor speed of 1.73 GHZ, XP operating system (from Microsoft) with the amount of 2.0 GB RAM, where they were registered: dates, schedules and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main characteristics of the machines used in the virtualization environment of cloud computing.

1	Data	Hora	Máqui	Sistema Operacional	Tempo Conexão	Tempo UOL	Velocidade	Memória RAM	Velocidade	Memória RAM
22	18/1/2014	11h37	B-->A	XP-->XP	1,22	3,75	1,73	2,00	2,67	3,00
23	18/1/2014	11h37	B-->A	XP-->XP	1,22	3,38	1,73	2,00	2,67	3,00
24	18/1/2014	11h37	B-->A	XP-->XP	1,22	3,34	1,73	2,00	2,67	3,00
25	18/1/2014	11h37	B-->A	XP-->XP	1,22	3,35	1,73	2,00	2,67	3,00
26	18/1/2014	11h45	B-->A	XP-->XP	1,33	2,97	1,73	2,00	2,67	3,00
27	18/1/2014	11h45	B-->A	XP-->XP	1,33	0,97	1,73	2,00	2,67	3,00
28	18/1/2014	11h45	B-->A	XP-->XP	1,33	1,37	1,73	2,00	2,67	3,00
29	18/1/2014	11h45	B-->A	XP-->XP	1,33	1,10	1,73	2,00	2,67	3,00
34	18/1/2014	11h57	B-->A	XP-->XP	1,03	3,37	1,73	2,00	2,67	3,00
35	18/1/2014	11h57	B-->A	XP-->XP	1,03	4,22	1,73	2,00	2,67	3,00
36	18/1/2014	11h57	B-->A	XP-->XP	1,03	3,90	1,73	2,00	2,67	3,00
37	18/1/2014	11h57	B-->A	XP-->XP	1,03	4,15	1,73	2,00	2,67	3,00
42	18/1/2014	22h23	B-->A	XP-->XP	1,47	4,31	1,73	2,00	2,67	3,00
43	18/1/2014	22h23	B-->A	XP-->XP	1,47	3,38	1,73	2,00	2,67	3,00
44	18/1/2014	22h23	B-->A	XP-->XP	1,47	3,56	1,73	2,00	2,67	3,00
45	18/1/2014	22h23	B-->A	XP-->XP	1,47	3,37	1,73	2,00	2,67	3,00
50	19/1/2014	16h21	B-->A	XP-->XP	1,47	3,53	1,73	2,00	2,67	3,00
51	19/1/2014	16h21	B-->A	XP-->XP	1,47	3,19	1,73	2,00	2,67	3,00
52	19/1/2014	16h21	B-->A	XP-->XP	1,47	3,32	1,73	2,00	2,67	3,00
53	19/1/2014	16h21	B-->A	XP-->XP	1,47	3,28	1,73	2,00	2,67	3,00
58	19/1/2014	18h23	B-->A	XP-->XP	1,63	3,56	1,73	2,00	2,67	3,00
59	19/1/2014	18h23	B-->A	XP-->XP	1,63	3,25	1,73	2,00	2,67	3,00
60	19/1/2014	18h23	B-->A	XP-->XP	1,63	7,91	1,73	2,00	2,67	3,00
61	19/1/2014	18h23	B-->A	XP-->XP	1,63	3,32	1,73	2,00	2,67	3,00
153			B-->A	XP-->XP	2,09	3,46	1,73	2,00	2,67	3,00

Table 8 – data collection the virtualization environment computing, author.

Table 8 shows the results applied in a computer *Notebook* Intel processor 1.73 GHZ speed, operating system XP (from Microsoft) with the amount of 2.00 GB RAM and another computer PC (*Personal Computer*) speed of 2.67 GHZ processor, XP operating system (from Microsoft) with the amount of 3.0 GB RAM, where they were registered: dates, schedules and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main characteristics of the machines used in the virtualization environment of cloud computing.

1	Data	Hora	Máqui	Sistema Operacional	Tempo Conexão	Tempo UOL	Velocidade	Memória RAM	Velocidade	Memória RAM
89	20/1/2014	20h47	A-->C	XP-->Windows 7	0,94	1,31	2,67	3,00	2,50	6,00
94	21/1/2014	09h18	A-->C	XP-->Windows 7	1,25	1,19	2,67	3,00	2,50	6,00
95	21/1/2014	09h18	A-->C	XP-->Windows 7	1,25	1,07	2,67	3,00	2,50	6,00
96	21/1/2014	09h18	A-->C	XP-->Windows 7	1,25	0,81	2,67	3,00	2,50	6,00
97	21/1/2014	09h18	A-->C	XP-->Windows 7	1,25	1,56	2,67	3,00	2,50	6,00
102	21/1/2014	15h06	A-->C	XP-->Windows 7	1,25	0,46	2,67	3,00	2,50	6,00
103	21/1/2014	15h06	A-->C	XP-->Windows 7	1,25	1,21	2,67	3,00	2,50	6,00
104	21/1/2014	15h06	A-->C	XP-->Windows 7	1,25	1,72	2,67	3,00	2,50	6,00
105	21/1/2014	15h06	A-->C	XP-->Windows 7	1,25	1,63	2,67	3,00	2,50	6,00
110	22/1/2014	09h15	A-->C	XP-->Windows 7	0,62	0,75	2,67	3,00	2,50	6,00
111	22/1/2014	09h15	A-->C	XP-->Windows 7	0,62	1,00	2,67	3,00	2,50	6,00
112	22/1/2014	09h15	A-->C	XP-->Windows 7	0,62	0,94	2,67	3,00	2,50	6,00
113	22/1/2014	09h15	A-->C	XP-->Windows 7	0,62	1,09	2,67	3,00	2,50	6,00
118	22/1/2014	13h29	A-->C	XP-->Windows 7	1,34	0,72	2,67	3,00	2,50	6,00
119	22/1/2014	13h29	A-->C	XP-->Windows 7	1,34	0,59	2,67	3,00	2,50	6,00
120	22/1/2014	13h29	A-->C	XP-->Windows 7	1,34	0,47	2,67	3,00	2,50	6,00
121	22/1/2014	13h29	A-->C	XP-->Windows 7	1,34	1,06	2,67	3,00	2,50	6,00
154			A-->C	XP-->Windows 7	1,07	1,19	2,67	3,00	2,50	6,00

Table 9 – Data collection the virtualization environment computing, author.

Table 9 shows the results applied in a computer PC *(Personal Computer)* Intel processor speed of 2.67 GHZ, XP operating system (from Microsoft) with the amount of 3.00 GB RAM memory and other computer *Notebook* processor 2.5 GHZ speed, operating system Windows 7 (from Microsoft) with the amount of 6.0 GB RAM where were recorded: the dates, times and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main characteristics of the machines used in the virtualization environment of cloud computing.

1	Data	Hora	Máqui	Sistema Operacional	Tempo Conexão	Tempo UOL	Velocidade	Memória RAM	Velocidade	Memória RAM
90	20/1/2014	20h49	C-->A	Windows 7-->XP	0,91	3,54	2,50	6,00	2,67	3,00
91	20/1/2014	20h49	C-->A	Windows 7-->XP	0,91	3,44	2,50	6,00	2,67	3,00
92	20/1/2014	20h49	C-->A	Windows 7-->XP	0,91	2,25	2,50	6,00	2,67	3,00
93	20/1/2014	20h49	C-->A	Windows 7-->XP	0,91	3,41	2,50	6,00	2,67	3,00
98	21/1/2014	09h21	C-->A	Windows 7-->XP	1,13	3,38	2,50	6,00	2,67	3,00
99	21/1/2014	09h21	C-->A	Windows 7-->XP	1,13	3,31	2,50	6,00	2,67	3,00
100	21/1/2014	09h21	C-->A	Windows 7-->XP	1,13	3,28	2,50	6,00	2,67	3,00
101	21/1/2014	09h21	C-->A	Windows 7-->XP	1,13	3,12	2,50	6,00	2,67	3,00
106	21/1/2014	15h08	C-->A	Windows 7-->XP	1,25	3,19	2,50	6,00	2,67	3,00
107	21/1/2014	15h08	C-->A	Windows 7-->XP	1,25	4,21	2,50	6,00	2,67	3,00
108	21/1/2014	15h08	C-->A	Windows 7-->XP	1,25	3,44	2,50	6,00	2,67	3,00
109	21/1/2014	15h08	C-->A	Windows 7-->XP	1,25	3,57	2,50	6,00	2,67	3,00
114	22/1/2014	09h18	C-->A	Windows 7-->XP	0,94	3,47	2,50	6,00	2,67	3,00
115	22/1/2014	09h18	C-->A	Windows 7-->XP	0,94	3,50	2,50	6,00	2,67	3,00
116	22/1/2014	09h18	C-->A	Windows 7-->XP	0,94	3,19	2,50	6,00	2,67	3,00
117	22/1/2014	09h18	C-->A	Windows 7-->XP	0,94	3,28	2,50	6,00	2,67	3,00
122	22/1/2014	13h32	C-->A	Windows 7-->XP	1,06	3,60	2,50	6,00	2,67	3,00
123	22/1/2014	13h32	C-->A	Windows 7-->XP	1,06	3,25	2,50	6,00	2,67	3,00
124	22/1/2014	13h32	C-->A	Windows 7-->XP	1,06	3,37	2,50	6,00	2,67	3,00
125	22/1/2014	13h32	C-->A	Windows 7-->XP	1,06	3,41	2,50	6,00	2,67	3,00
155			C-->A	Windows 7-->XP	1,09	3,56	2,50	6,00	2,67	3,00

Table 10 – Data collection the virtualization environment computing, author.

Table 10 shows the results applied in a computer *Notebook* processor 2.5 GHZ speed, operating system Windows 7 (from Microsoft) with the amount of 6.0 GB RAM and another computer of type PC *(Personal Computer)* Intel processor speed of 2.67 GHZ, XP operating system (from Microsoft) with the amount of 3.00 GB RAM where were recorded: the dates, times and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main characteristics of the machines used in the virtualization environment of cloud computing.

1	Data	Hora	Máqui	Sistema Operacional	Tempo Conexão	Tempo UOL	Velocidade	Memória RAM	Velocidade	Memória RAM
126	22/1/2014	13h46	A-->D	XP-->Windows 7	3,10	8,84	2,67	3,00	1,20	2,00
127	22/1/2014	13h46	A-->D	XP-->Windows 7	3,10	17,16	2,67	3,00	1,20	2,00
128	22/1/2014	13h46	A-->D	XP-->Windows 7	3,10	13,85	2,67	3,00	1,20	2,00
129	22/1/2014	13h46	A-->D	XP-->Windows 7	3,10	20,12	2,67	3,00	1,20	2,00
134	23/1/2014	08h04	A-->D	XP-->Windows 7	2,06	6,28	2,67	3,00	1,20	2,00
135	23/1/2014	08h04	A-->D	XP-->Windows 7	2,06	4,81	2,67	3,00	1,20	2,00
136	23/1/2014	08h04	A-->D	XP-->Windows 7	2,06	12,03	2,67	3,00	1,20	2,00
137	23/1/2014	08h04	A-->D	XP-->Windows 7	2,06	4,47	2,67	3,00	1,20	2,00
142	23/1/2014	14h54	A-->D	XP-->Windows 7	1,91	8,28	2,67	3,00	1,20	2,00
143	23/1/2014	14h54	A-->D	XP-->Windows 7	1,91	3,47	2,67	3,00	1,20	2,00
144	23/1/2014	14h54	A-->D	XP-->Windows 7	1,91	4,50	2,67	3,00	1,20	2,00
145	23/1/2014	14h54	A-->D	XP-->Windows 7	1,91	4,09	2,67	3,00	1,20	2,00
156			A-->D	XP-->Windows 7	2,36	8,99	2,67	3,00	1,20	2,00

Table 11 – Data collection the virtualization environment computing, author.

Table 11 shows the results applied in a computer PC *(Personal Computer)* Intel processor speed of 2.67 GHZ, XP operating system (from Microsoft) with the amount of 3.00 GB RAM memory and other computer *Notebook* processor 1.2 GHZ speed, operating system Windows 7 (from Microsoft) with the amount of 2.0 GB RAM where were recorded: the dates, times and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main characteristics of the machines used in the virtualization environment of cloud computing.

1	Data	Hora	Máqui	Sistema Operacional	Tempo Conexão	Tempo UOL	Velocidade	Memória RAM	Velocidade	Memória RAM
130	22/1/2014	13h49	D-->A	Windows 7-->XP	1,71	4,06	1,20	2,00	2,67	3,00
131	22/1/2014	13h49	D-->A	Windows 7-->XP	1,71	3,63	1,20	2,00	2,67	3,00
132	22/1/2014	13h49	D-->A	Windows 7-->XP	1,71	3,38	1,20	2,00	2,67	3,00
133	22/1/2014	13h49	D-->A	Windows 7-->XP	1,71	3,41	1,20	2,00	2,67	3,00
138	23/1/2014	08h07	D-->A	Windows 7-->XP	1,84	3,37	1,20	2,00	2,67	3,00
139	23/1/2014	08h07	D-->A	Windows 7-->XP	1,84	3,18	1,20	2,00	2,67	3,00
140	23/1/2014	08h07	D-->A	Windows 7-->XP	1,84	3,37	1,20	2,00	2,67	3,00
141	23/1/2014	08h07	D-->A	Windows 7-->XP	1,84	3,22	1,20	2,00	2,67	3,00
146	23/1/2014	14h59	D-->A	Windows 7-->XP	2,12	3,54	1,20	2,00	2,67	3,00
147	23/1/2014	14h59	D-->A	Windows 7-->XP	2,12	3,21	1,20	2,00	2,67	3,00
148	23/1/2014	14h59	D-->A	Windows 7-->XP	2,12	3,50	1,20	2,00	2,67	3,00
149	23/1/2014	14h59	D-->A	Windows 7-->XP	2,12	4,03	1,20	2,00	2,67	3,00
157			D-->A	Windows 7-->XP	1,89	3,49	1,20	2,00	2,67	3,00

Table 12 – Data collection the virtualization environment computing, author.

Table 12 shows the results applied in a computer *Notebook* Intel processor 1.2 GHZ speed, operating system Windows 7 (from Microsoft) with the amount of 2.00 GB RAM and another computer PC (*Personal Computer*) speed of 2.67 GHZ processor, XP operating system (from Microsoft) with the amount of 3.0 GB RAM where were recorded: the dates, times and the time required to connect to a site (UOL). At the end of the table is recorded the average time for the connections and the main characteristics of the machines used in the virtualization environment of cloud computing.

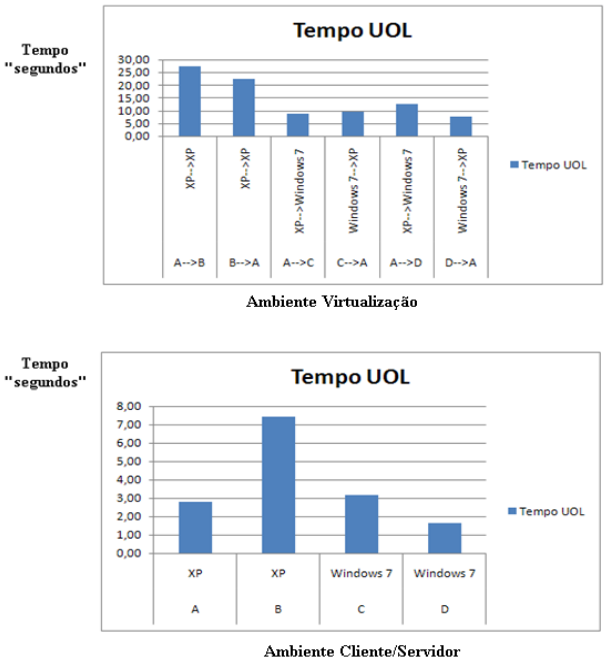

Figure 7-Graphical analysis of client/server environments and virtualization, author.

Considering the observations and graphical analysis of results presented in Figure 7, the machines and operating systems used have a speed rating and access to the site "UOL" in ascending order the computers: D, A, C and B. However, when running in the virtual environment the slower computers can be faster when run on faster computers or vice-versa.

Máquina	Sistema Operacional	Tempo Conexão	Tempo UOL	Velocidade	Memória RAM	Velocidade	Memória RAM
A-->B	XP-->XP	9,24	27,16	2,67	3,00	1,73	2,00
B-->A	XP-->XP	7,51	22,25	1,73	2,00	2,67	3,00
A-->C	XP-->Windows 7	3,62	8,87	2,67	3,00	2,50	6,00
C-->A	Windows 7-->XP	3,75	9,42	2,50	6,00	2,67	3,00
A-->D	XP-->Windows 7	4,25	12,48	2,67	3,00	1,20	2,00
D-->A	Windows 7-->XP	3,21	7,49	1,20	2,00	2,67	3,00

Máquina	Sistema Operacional	Tempo UOL	Velocidade	Memória RAM
A	XP	2,76	2,67	3,00
B	XP	7,44	1,73	2,00
C	Windows 7	3,15	2,50	6,00
D	Windows 7	1,65	1,20	2,00

λ=v*T(cm)	Velocidade de Conexão (cm/s)
16,69	13,68
13,23	12,36
12,81	11,97
0,13	11,97
0,00	0,00
0,00	0,00

Figure 8 – Analysis of the results of the client/server environments and virtualization, author.

Figure 8 shows the connection speeds of the machines tested and the average data transmission in the virtual environment. The results of their frequencies and wavelengths are within the ranges of UHF frequencies above, according to the table of frequency spectra in Figure 9 the standardization ITU (*International Telecommunications Union-Telecommunication*).

Alto frequência High frequency	HF	7	3–30 MHz	100 m – 10 m
Muito alta frequência Very high frequency	VHF	8	30–300 MHz	10 m – 1 m
Ultra alta frequência Ultra high frequency	UHF	9	300–3000 MHz	1 m – 100 mm
Super alta frequência Super high frequency	SHF	10	3-30 GHz	100 mm – 10 mm
Extra alta frequência Extremely high frequency	EHF	11	30-300 GHz	10 mm – 1 mm
			Acima dos 300 GHz	< 1 mm

Figure 9 – Table of frequency Spectra ITU-T (*International Telecommunications Union-Telecommunication*).

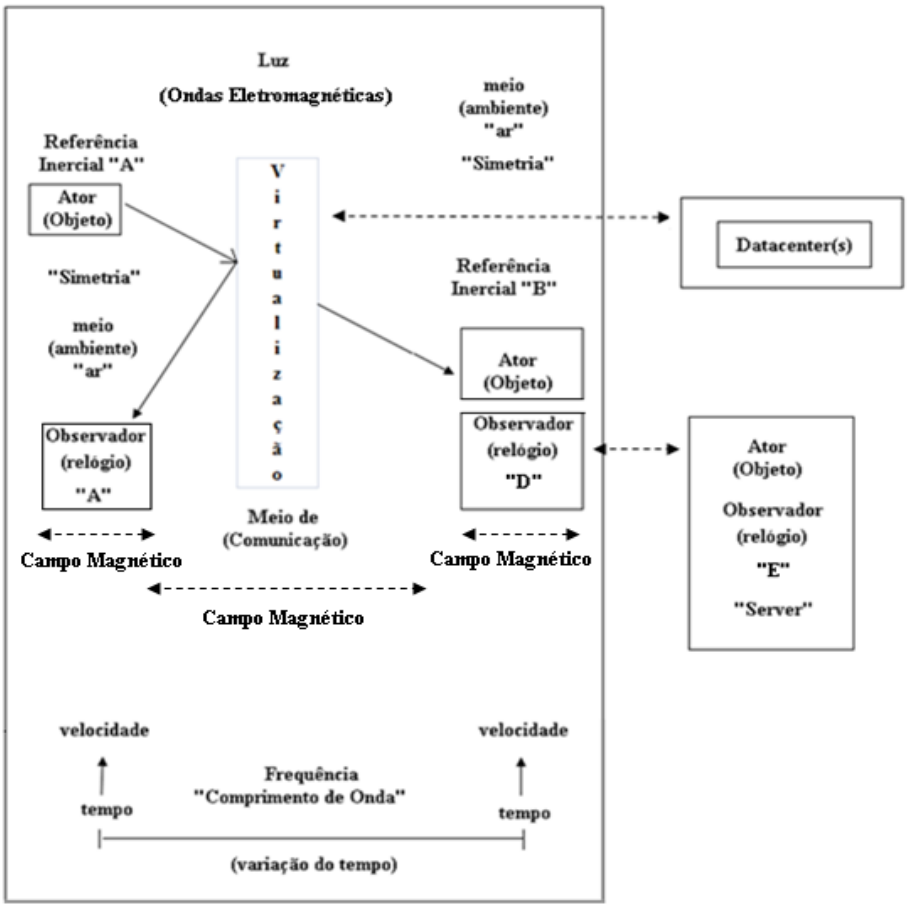

Figure 10 – Analysis of the magnetic field on the virtualization environments, objects and time, author.

Figure 10 shows the relationship and the results obtained in this work on the relativistic vision applied to virtualization in corporate networks using the principles of tunneling to connect and Exchange data on cloud computing. It is observed that the light and the magnetic field have a direct influence in relation to objects: actor, the observers, the time registered by watches, the frequency waves, the speed and the means of communication established by virtualization. Virtualization allows the resources of *Datacenters* are shifted to the virtualization environment, with this we can observe the concepts of relativity about the time relativity related concurrency.

Considering the evolution of semiconductor technology and its limits of *chips* CMOS (Metal Oxide Semiconductor), an issuer of waves from the 340 Mhz frequency, the UHF wave spectrum (*Ultra High Frequency*), thus going on to work in the field of the effects of quantum physics (JUNIOR, SAUVÉ and MC, 1996). At this frequency the behavior of the electrons becomes unpredictable (known as tunneling of electrons). In virtualization these limitations will not exist, because the tunneling and behavior in data exchange and

communications are under the responsibility only of the magnetic fields or speed of light. Because if notes that the displacement of objects horizontally about virtualization does not suffer from magnetic field deviation, however when moving horizontally virtualization the magnetic field points to the original position of the displacement, thus it is considered that the speed of light is a universal constant, is the same in all inertial reference systems in the vacuum, does not depend on the motion of the light source and has equal value in all directions, according to the postulate of Einstein's special theory of relativity. Under these conditions the length contraction may occur, but the relative speed does not suffer contraction. There is also the physical occurrence in a point set space and moment of time. In accordance with the principles of relativity, all the physical laws are the same in relation to any reference, because the speed of light is independent of how the references to move towards others.

IV. CONCLUSION

This work had as objective to analyze and propose a model and quantum relativistic vision with the possibility of being implemented with the principles of Physics in virtualization of *Datacenters* in corporate networks. On the basis of the comments of the applications and infrastructure and internet technologies the IT environment has reduced their costs with the use of virtualization of *Datacenters*. In physics light wave property in addition to being an electromagnetic wave is associated with the emission and absorption of light, also carries energy and light source, which are present in the electronic components in computers. So it is known that the direction of a ray of light varies as it passes from one material to another with different refractive index, but in relation to the wave frequency does not vary according to the laws of physics and theory of Einstein should be the same in any inertial reference systems. The theory of relativity and concurrency involves the main concepts of measure of time and time intervals and describes that concurrency is not an absolute concept, because two events occur simultaneously or not. Concurrency is important for the measurement of time intervals and length contraction may occur, while the relative velocity does not suffer contraction. An event is a fundamental principal of relativity and can be observed and measured by observers in different frames, whereas in concurrency, event is what actually happens. All the laws of physics are the same in relation to any reference and the value of the speed of light in different references propagate with the same speed of light in any inertial frame of reference. These concepts and fundamentals are parts of application virtualization of *Datacenters*.

The choice of measurements of the properties for the actors in the virtualization environment determines the correlations that exist for these results, because the application of quantum mechanics establishes the super positions of the actors (companies) and behaviors as if they were in multiple places simultaneously. However, the study and the results presented can serve as a basis for further work involving quantum computing vision applied in corporate networks and the presentation of the structure to the development of a quantum computer.

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Performance Evaluation of different Path Loss Models for Broadcasting applications

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Abstract: - In this paper we highlighted the performance evaluation of different path loss model and envisage the most suitable model for plane area in northern region of India i.e. border district of Punjab and Jammu. In this paper we compared the different path loss propagation models with measured field data and investigated the appropriateness of the model which gave us results closer to measured (field) data. In the present work we used many path loss models for comparative analysis. This research paper presents a comparative analysis of six empirical path loss models with respect to measured data for plane area in state of Punjab and Jammu (India). The preferred six models under investigation are COST- 231, Hata, Okumara, Free space model, Extention of Hata model and Hata Davidson model. For investigations and analysis purpose, firstly the measured field data has been taken in the Gurdaspur (State: Punjab) by using the 100w FM radio transmitter and transmitting antenna height of 45m, and in second case we used 10 kw FM transmitter at Kathua (State: Jammu) i.e. situated in bordering area of Punjab and Jammu at transmitting antenna height of 100m with fixed receiving antenna height of 4 meters. On analyzing the different results we found that Cost–231 model is best suited for plane area in norhen region of the border district of Punjab (India). Although in our investigations Hata Davidson model shows better results than the extension of Hata model for longer distances, but the mean square error of cost – 231 was found to be minimum as compared to other models.

Keywords: *- Path loss, free space model, Cost-231model, Hata mode, Okumara model, Extension of Hata model, Hata Davidson model.*

I. INTRODUCTION

Revolutionary exponential growth of communication devices leads to increased interest amongst the various scientists, researchers and engineers in the field of radio communication. In present days, more and more number of scientists are devoting a lot efforts to refine radio propagation path loss models for urban, suburban and other environmental conditions [1]. Propogation of the radio waves in urban areas is quite complex because it consists of reflected and diffracted waves produced by multipath propagation. In general, radio wave propagation consists of three main modes (a) Reflection : It occures when radio wave propagation in one medium impinges upon another medium with different electromagnetics properties. Part of radio wave energy may be absorbed or propagated through the reflecting medium, resulting [2, 3] in the reflected wave that is attenuated. (b) Diffraction : It is a phenomenon by which propagating radio waves bend or deviate in the neighborhood of obstacles. (c) Scattering : It occures when radio waves hits a rough surface or an object which is having a size much smaller than the signal wave length.

Prediction of path loss is an significant element of system design in any communication system. A reliable propagation model is one which calculates the path loss with small standard deviation. Suitable models must be chosen for measurements of field strength and path loss as well as other parameters. An accurate and reliable prediction methods helps to optimize the coverage area, transmitter power and eliminates interference problems of other radio transmitters as well. This will help network engineers and planners to optimise the coverage area and to use the correct transmitted powers. All the prediction methods are divided into empirical and deterministic/physical models [4]. The preference for the coverage prediction model depends on the

propagation environment and the area to be covered. Since it is clear from above discussion that the propagation takes place through multiple diffraction, reflection and scattering from the extremely large number of objects. Since it is very difficult to locate scatterers deterministically therefore characterisation of the signal within the coverage zone is done statistically. For this reason, prediction models have been developed using empirical or statistical methods [5].

The critical factor that affects path loss is the distance between the transmitter and receiver [6]. It is known that signal power decreases as distance increases. The path loss represents the mean signal attenuation at a certain distance from the transmitter and can be predicted by the distance and other macroscopic parameters [7, 8] such as carrier frequency, transmitter and receiver antenna heights, terrain contour and buildings concentration. In our present work, one of the main reason for understading the the various elements affecting radio signal path loss is to predict the coverage area that may be achieved for a particular broadcast station [9-13] and also to predict the suitability of model as well.

II. A BRIEF STUDY OF VARIOUS PROPAGATION MODELS

The two basic propagation models (Free-Space and Plane Earth Loss) have all the mechanisms which are encountered in macrocell prediction. Many researchers use these models and predict the total signal loss. Other models require detailed knowledge of the locations, dimensions and parameters for every tree or building and terrain feature in the area to be covered. The models are complex and yield an unnecessary amount of details as the network designer is not interested in the particular locations covered, but the overall extent of the coverage area. One appropriate way of removing these complexities is to adopt an empirical model. These models use all the parameters like the received signal strength, frequency, antenna heights and terrain profiles which were derived from a particular environment by the use of extensive measurements and statistical analysis as well. These models then can be used to design the systems which operates on similar environmental condition as the original measurements [14].

2.1 Free Space Propagation Model

The free space propagation model is used to predict received signal strength when the transmitter and receiver have a clear and unobstructed line-of-sight path between them (Friis 1946) [15]. Since in most large-scale radio wave propagation models, the free space model predicts that received power decays as a function of the separation distance between Transmitter-Receiver raised to some power (i.e. a power law function) (Saunders 2005). In this case free space power received by a receiver antenna which is separated from a radiating transmitter antenna by a distance d is given by the Friis free space equation (Friis 1946).

$$P_r(d) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2} \quad \ldots\ldots\ldots(1)$$

where P_t is the transmitted power, $P_r(d)$ is the received power, Gt is the transmitter antenna gain, Gr is the receiver antenna gain, d is the transmitter-receiver separation distance in meters and λ is the wavelength in meters.

$$PL(dB) = -10\log_{10}(G_t) - 10\log_{10}(G_r) - 20\log_{10}\left[\frac{(c\times10^3)}{4\pi\times f\times10^6}\right] - 20\log_{10}(1/d)$$

$$PL(dB) = -G_t(dB) - G_r(dB) + 32.44 + 20\log_{10}(d/km) + 20\log_{10}(f/MHz) \quad \ldots\ldots.(2)$$

Where c is the speed of light (3×10^8 ms^{-1})

2.2 Okumura model

The Okumura's model is an empirical model based on extensive drive test measurements made in Japan at several frequencies within the range of 150 to 1920 MHz and further extrapolated up to 3000 MHz. Okumura's models is developed for macrocells with cells diameters in range from 1 to 100 km. The height of the base station antenna is kept between 30-100 m [16]. The Okumura model has taken into account several propagation parameters such as the type of environment and the terrain irregularity.

Okumura developed a set of curves which gives the median attenuation relative to free space (Amu), in an urban area over a quasi-smooth terrain with a base station effective antenna height (hb) of 200m and a mobile antenna height (hm) of 3 meters. These curves were developed from extensive measurements using vertical omni-directional antenna at both the base and mobile. In this cas curves are plotted as a function of frequency in

the range of 100 MHz to 1920 MHz, and as a function of distance from the base station in the range from 1 km to 100 km. The path loss prediction formula according to Okumura's model is expressed as [17] :

$$L_{50}(dB) = L_F + Amu_{(fd)} - G_{(hb)} - G_{(hm)} - G_{AREA} \quad \text{.....(3)}$$

where $L_{50}(dB)$ is the median value (i.e. 50th percentile) of path (propagation) loss, L_F is the free space loss and can be calculated using either Equation (5) or Equation (6). The value of Amu is the median attenuation relative to free space, G(hb) is the base station antenna height gain factor, G(hm) is the mobile antenna height gain factor, and GAREA is the gain or correction factor owing to the type of environment. Amu(f; d) and G_{AREA} are determined by observing the Okumura curves.

The term G(hb) and G(hm) can be calculated by using these simple formulas :

$$G_{(hb)} = 20 \log_{10} 1000m > hb > 30m \quad \text{...}\text{.....(4)}$$

$$G_{(hm)} = 10 \log_{10} (hm/3) \;\; hm \leq 3m \quad \text{.....(5)}$$

$$G_{(hm)} = 20 \log_{10} (hm/3) \;\; 10m \leq hm \leq 3m \quad \text{...}\text{.....(6)}$$

Okumura's model is considered to be the simplest and most excellent in terms of accuracy in path loss prediction for mature cellular and land mobile systems in cluttered environment. The main disadvantage of the Okumura model is its sluggish response to rapid changes in terrain condition. Consequently the model is fairly good in urban and suburban areas but not as good (suited) for rural areas.

2.3 Okumura-Hata path loss model

The Okumura-Hata model (1980) is an empirical formulation of the graphical path loss data provided by Yoshihisa Okumura, and is valid from 150 MHz to 1500 MHz. The Hata model basically is a set of equations based on measurements and extrapolations from the curves derived by Okumura. Hata presented the urban area propagation loss as a standard formula, along with additional correction factors for application in other situations such as suburban and rural area. Only four parameters are required in the Hata model as a result the computation time is very short in this model. This is one of the main advantage of this model. However, the model neglects the terrain profile (condition) between the transmitter and receiver i.e. hills or other obstacles that exists between the transmitter and receiver were not considered. This is because both Hata and Okumura models have made the assumption that the transmitters would normally be located on hills.
The basic formula for the median propagation loss given by Hata is :

$$L(dB) = 69.55 + 26.16log_{10}f_{MHz} - 13.82log_{10}h_1 - a(h_2) + (44.9 - 6.55log_{10}h_1)log_{10}d_{km} - K \quad \text{.....(7)}$$

where f_c is the carrier frequency (in MHz) from 150 MHz to 1500 MHz, h_b is the base station antenna height (in metres) ranging from 30m to 200m, h_m is the mobile antenna height (in metres) ranging from 1 m to 10 m, d is the base station to mobile separation distance (in km), and $a(h_m)$ is the correction factor for effective mobile antenna height which is a function of the size of the coverage area.

Hata Model Parameters

Type of area	$A(h_2)$	K
Open	$(1.1log_{10}f_{MHz} - 0.7)h_2 - (1.56log_{10}f_{MHz} - 0.8)$	$4.78(log_{10}f_{MHz})^2 - 18.33log_{10}f_{MHz} + 40.94$
Sub urban		$2[log_{10}(f_{MHz}/28)]^2 + 5.4$
Medium –small city		0
Large city ($f_{MHz} > 300$)	$3.2(log_{10}11.75h_2)^2 - 4.97$	0
Large city ($f_{MHz} < 300$)	$8.29(log_{10}1.54h_2)^2 - 1.10$	0

2.4 Extension of Hata Model to Longer Distances

An empirical formula for extending the Hata Model range upto distances 20 to 100 km was developed by ITU-R and is given by

$$L_{ITU}(dB) = 69.55 + 26.16log_{10}f_{MHz} - 13.82log_{10}h_1 - a(h_2) + (44.9 - 6.55log_{10}h_1)(log_{10}d_{km})^b - K \quad \text{.....(8)}$$

where

$$b = \begin{cases} 1, & d_{km} < 20 \\ 1 + (0.14 + 0.000187f_{MHz} + 0.00107h_1')(log_{10}(d_{km}/20))^{0.8}, & d_{km} \geq 20 \end{cases}$$

$$h_1' = \frac{h_1}{1+7\times10^{-6}h_1^2}$$

2.5 The Hata-Davidson Model

The Telecommunications Industry Association (TIA) recommends in their publication TSB-88A the following modification to the Hata model to cover a broader range of input parameters. The modification consists of the addition of correction terms in the Hata model:

$$L_{HD} = L_{Hata} + A(h_1, d_{km}) - S_1(d_{km}) - S_2(h_1, d_{km}) - S_3(f_{MHz}) - S_4(f_{MHz}, d_{km}) \quad \text{.....(9)}$$

in which A and S_1 are the distance correction factors extended in the range upto 300 km, S_2 is a base station antenna height correction factor extended in the range of h_1 values upto 2500 Km, while S_3 and S_4 are frequency correction factors extendrd in the frequency range upto 1500 MHz.

distance	A(h1,dkm)	$S_1(d_{km})$
$d_{km} < 20$	0	0
$20 \leq d_{km} < 64.38$	$0.62137(d_{km} - 20)[0.5 + 0.15\log_{10}(h_1/121.92)]$	0
$20 \leq d_{km} < 64.38$	$0.62137(d_{km} - 20)[0.5 + 0.15\log_{10}(h_1/121.92)]$	$0.174(d_{km} - 64.38)$

$S_2(h_1, d_{km}) = 0.00784|\log_{10}(9.98/d_{km})|(h_1 - 300)$ for $h_1 > 300$

$S_3(f_{MHz}) = f_{MHz}/250 \log_{10}(1500/f_{MHz})$

$S4(f_{MHz}, d_{km}) = [0.112 \log_{10}(1500/f_{MHz})](d_{km} - 64.38)$ for $d_{km} > 64.38$

2.6 Extended COST-231 Hata model

This model (COST 231 Final Report 1999 cited in Tapan et al. 2003 and Zreikat and Al- Begain) is derived from the Hata model and depends upon four parameters for the prediction of propagation loss: frequency, height of a received antenna, height of a base station and distance between the base station and the received antenna. A model that is widely used for predicting path loss in mobile wireless system is the COST-231 Hata model. The COST-231 Hata model is designed to be used in the frequency band from 500 MHz to 2000 MHz. It also contains corrections for urban, suburban and rural (flat) environments. Although its frequency range is outside that of the measurements, its simplicity and the availability of correction factors has seen it widely used for path loss prediction at this paricular frequency band.

From equation (3), the urban model is given by:

$$L(urban)(dB) = 46.33 + 33.9logf_c - 13.82logh_{tx} - a(h_{rx}) + (44.9 - 6.55logh_{tx})\log d \quad \text{.....(10)}$$

The path loss in a suburban area is given by:

$$L(dB) = L(urban) - 2[\log(f_c/28]^2 - 5.4$$

where $a(h_{rx})$ is obtained from Hata model.
where, f is the frequency in MHz, d is the distance between AP and CPE antennas in km, and h_b is the AP antenna height above ground level in metres. The parameter cm is defined as 0 dB for suburban or open environments and 3 dB for urban environments.

The parameter ah_m is defined for urban environments as :

$ah_m = 3.20(\log(11.75hr)) - 4.97$, for $f > 400$ MHz
for suburban or rural (flat) environments,
$ah_m = (1.1 \log f - 0.7)h - (1.56 \log f - 0.8)$
where, h_r is the CPE antenna height above ground level.

III. COMPARSION IN TERM OF DIFFERENT MEASUREMENTS

3.1 Results and discussion

Field measurement data has been taken with the help of Anritsu site master and anritsu dipole antenna with fixed receiving antenna height of 4 meters. The Anritsu receiving antenna has isotropic gain of 2.15 dB. The measurements have been taken from two radio stations one is situated at Gurdaspur (State : Punjab) which is operating at RF power of 100w, transmitting frequency of 100.1 Mhz and transmitting antenna height of 45 m. In this case transmitting antenna gain is 2 dB which is referred as gain of dipole antenna. For this low power station, measurents have been taken at two radii route at the distance of Approx. 50 Km from transmitter as :

- Gurdaspur to Pathankot
- Gurdaspur to Talwara

For the second field strength measurements we have taken Kathua FM radio station situated in jammu i.e. at adjoining area of Punjab border. This is a high power (10 Kw) transmitter working at frequency of 102.2 Mhz at the transmitting antenna height of 100 m. In this case, the transmitting antenna gain of 5 dB referred as dipole antenna gain. The field strength measurements for Kathua (State: Jammu) has been taken only for one radial distance (approximately 50 Km from high power transmitter) and route is given below:

- Kathua (State: Jammu) to Dinanagar via Taragarh (State: Punjab)

Now from the measured values of field strength at different distances, the other parameters values can be calculated by using the available formulas.

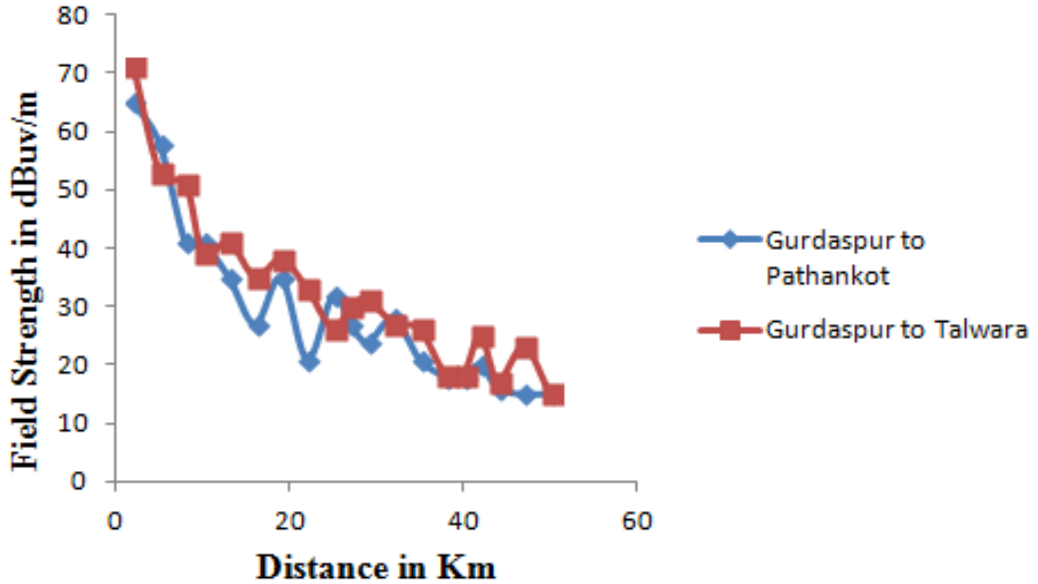

Fig 1. Field Strength v/s Distance for Gurdaspur FM 100 w Transmitter

Fig. 1 shows the measured field strength values for Gurdaspur FM 100 w Transmitter, this given field strength has been converted into path loss in dB by using formula as given below :

$$P_{iso} = 1/480(E^*\lambda/\pi)^2 \text{ Watts} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

Where P_{iso} is received power in watts

This received power in watts has been converted into dBm values and then path loss value is given as :
Path loss = Transmitted power + Transmitting antenna gain + Receiving antenna gain – Received power.
Fig. 1 clearly shows that due to low power (100 W) of this transmitter in both routes (Gurdaspur to Pathankot & Gurdaspur to Talwara) at approximately radial distance of 50 Km the field strength value decrease more drastically due to less power of the transmitter.
While Fig. 2 shows the measured field strength value for high power transmitter situated in Kathua (State: Jammu)

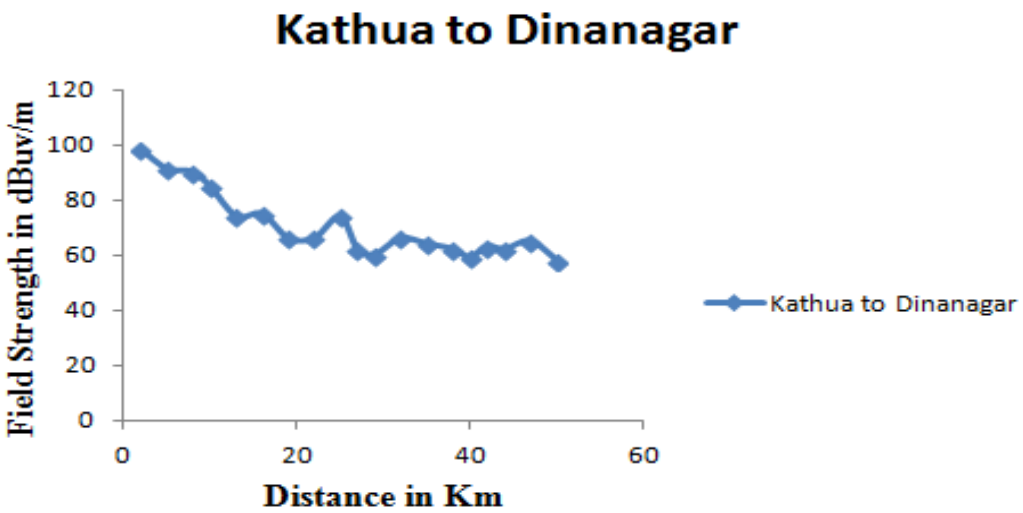

Fig 2. Field Strength v/s Distance for Kathua FM 10 Kw Transmitter

This figure 2 clearly shows that value of field strength with respect to distance (appr. 50 Kms) for high power transmitter situated in Kathua (State: Jammu) will decrease at much less rate as compared to low power transmitter (100 W). This will evidently due to high power of transmitter.

3.2 Suitablity of model for both high power and low power transmitter

Fig. 3 shown below gives the variation of path loss with distance for low power (100 W) for Gurdaspur FM station at transmitting antenna height of 45 meters. From the graph we have clearly seen that Cost – 231 model shows comparitively better results than the other models. Free space path loss model is also less accurate because it has taken only the consideration that RF wave becomes weak as the distance increases because of diffraction of signal. Apart from that fact there are so many other environmental factors that can effects the signal strength. Infact Hata Davidson model shows better results than Hata model but not better than cost – 231 model. Hence we conclude that Okumara model is not suitable for plane area like the border district of Punjab.

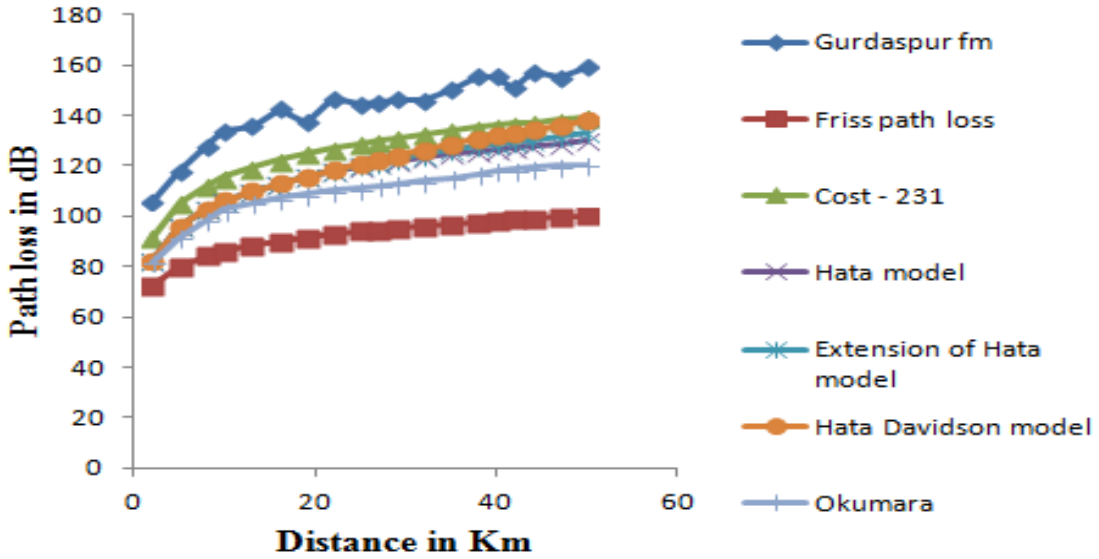

Fig 3. Path loss in dB v/s distance for Gurdaspur fm 100 w, transmitting antenna height of 45 meters

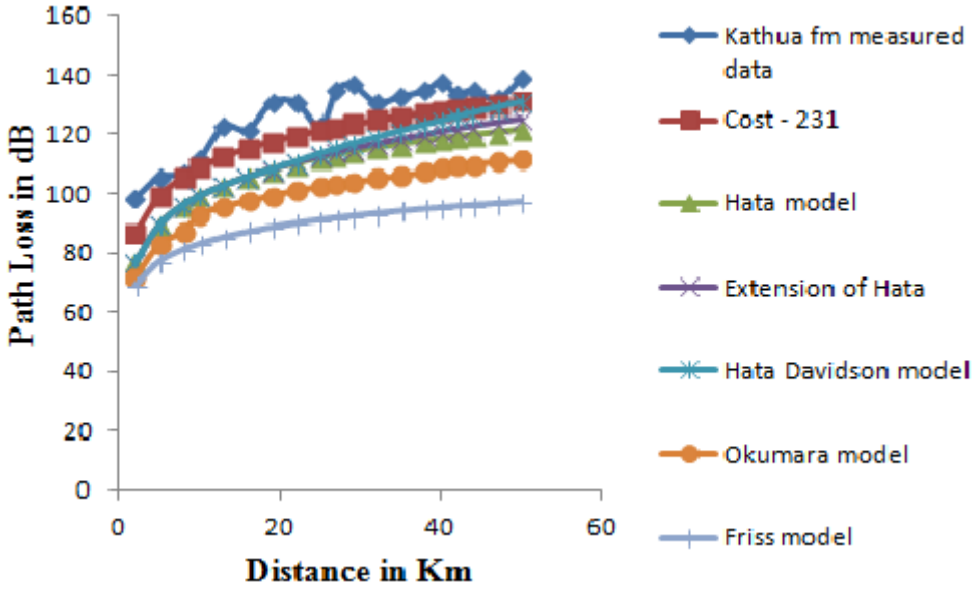

Fig 4. Path Loss in dB v/s Distance in Km for Kathua FM 10 kw, transmitter antenna height of 100 meters.

Fig. 4 shows ths measured value of path loss with respect to distance (appr. 50 Kms) for high power transmitter situated in Kathua (State: Jammu) at greater antenna height (100 meters) and hence has been compared with the available models. Here we are getting the same results as that of low power Gurdaspur FM station. But in contrast, we observed that for high power transmitter (Kathua, State: Jammu) the value of path loss of Cost – 231 model is very close to measured value of path loss as compared to Gurdaspur FM station.

IV. CONCLUSIONS

Here in present work, first we compared different available path loss models with the measured data for low power (100 w) FM RF transmitter working on 100.1Mhz at transmitting antenna height of 45m and used second high power RF FM transmitter (10kw) working at 102.2 Mhz at transmitting antenna height of 100 m. The path losses obtained is plotted graphically in order to achieve better results. By observing the different graphs we conclude that Cost – 231 has shown comparatively better results than other models. Although, we observe that Hata davidson model shows reasonably better results than the extension of hata and Hata models but the value of mean square error obtained in Cost – 231 found to be minimum. Therefore, lastly we conclude that for plane area like border district of Punjab Cost – 231 model is found to be best suited for broadcasting applications.

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