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Design of a Duplex House by using STRUD Software

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ABSTRACT: *The aim of our work is to design the given DUPLEX HOUSE according to Indian Standard codes. The design of a building can be done manually or with the help of Software. We have selected to do our project with Software because designing manually consumes a lot of time, effort and can contain mistakes whereas by using software we can save time and obtain results without errors. Now a days there are several software's are available in market for analysis and design of 'Civil Engineering structures' like ETABS, STAAD Pro and STRUDS etc., At present work we used software named "STRUDS'' abbreviated as "Structural Analysis Design and Detailing Software". By using the software is that it is user friendly and has exceptional features like it designs the structural components individually along with their Analysis and Results. Additional useful feature of this software is that we can view the Shear force, Bending moment, Torsion diagrams at each level of the building. We prepared the drawing plans along with its specifications for the construction area. After preparing the Plan and its criteria we have commenced our project by designing the structural components of building namely slabs, beams, columns and footings. The design of slab was designed by us as mentioned in the plan after which we have placed the columns in their desired locations. Then we have given the material properties along with their grades to beams and columns.*

Keywords: *Shear Force, Bending Moment, Deflection, Slabs, Beams, Columns, Footings, BBS, Struds, Auto-Cad*

I. INTRODUCTION

In a simple building can be define as an enclose space by walls with roof, food, cloth and the basic needs of human beings. In the early ancient times humans lived in caves, over trees or under trees, to protect themselves from wild animals, rain, sun, etc. as the times passed as humans being started living in huts made of timber branches. The shelters of those old have been developed nowadays into beautiful houses. Rich people live in sophisticated condition houses. Buildings are the important indicator of social progress of the county. Every human has desire to own comfortable homes on an average generally one spends his two-third life times in the houses. The security civic sense of the responsibility. These are the few reasons which are responsible that the person do utmost effort and spend hard earned saving in owning houses. Nowadays the house building is major work of the social progress of the county. Daily new techniques are being developed for the construction of houses economically, quickly and fulfilling the requirements of the community engineers and architects do the design work, planning and layout, etc.,of the buildings. Draughtsman is responsible for doing the drawing works of building as for the direction of engineers and architects. The draughtsman must know his job and should be able to follow the instruction of the engineer and should be able to draw the required drawing of the building, site plans and layout plans etc., as for the requirements.

A building frame was Rectangular in shape and Duplex building. Duplex building, multi-paneled frame is a complicated statically intermediate structure. A design of R.C building of **G+4**frame work is taken up. The building in plan consists of columns built monolithically forming a network. The area of building is 236.6sq m. The numbers of columns are **18**, it is Duplex house. The design is made using software on structural analysis design (STRUDS). The building subjected to both the vertical loads as well as horizontal loads. The vertical load consists of dead load of structural components such as beams, columns, slabs etc. and live loads. The horizontal load consists of the wind forces thus building is designed for dead load, live load and wind load as **per IS 875**. The building is designed as two dimensional vertical frame and analyzed for the maximum and minimum bending moments and shear forces by trial and error methods as per **IS456-2000**. The help is taken by software available in institute and the computations of loads, moments and shear forces and obtained from this software.

II. OBJECTIVE AND SCOPE OF WORK

The main Aim of our present study is to analyze and design the duplex house by using the software STRUDS and to produce various Detailings like.., BMD, SFD, BBS, Quantities of Steel & Concrete etc..,

III. STUDY AREA

Our proposed site is located at Muralinagar, Visakhapatnam, Andhra Pradesh. The main road which is near to site leads to kamineni hospital. A branch road of 10m which is near is existing WBM road connected very near to the plot. The total area of the site is about 236.6sq m. the residential building consists of two bed rooms.

IV. METHODOLOGY

Most of the work completely based on software and it is essential to know the details about these software's.
List of software's used
1. STRUDS
3. AUTO CAD

STRUDS'' abbreviated as "STRUCTURAL ANALYSIS DESIGN AND DETAILING SOFTWARE'' as per IS code norms. This software performs structural analysis for vertical as well as horizontal [seismic/wind] loads for RC framed structures and performs design as per IS norms. The purpose of using the software is that it is user friendly and has unique features like it designs the structural components individually along with their Analysis and results. Another useful feature of this software is that we can view the Shear force, Bending moment, Torsion diagrams at each level of the building.

Now a day's most of the high rise buildings and duplex buildings are designed by Struds which makes a compulsion for a civil engineer to know about this software. This software can be used to carry RCC, steel structures, bridges, trusses etc., according to various country codes.

AUTOCAD" is powerful software licensed by auto desk. The word auto came from auto desk Company and cad stands for computer aided design. AutoCAD is used for drawing different layouts, details, plans, elevations, sections and different sections can be shown in auto cad. It is very useful software for Civil Engineer.

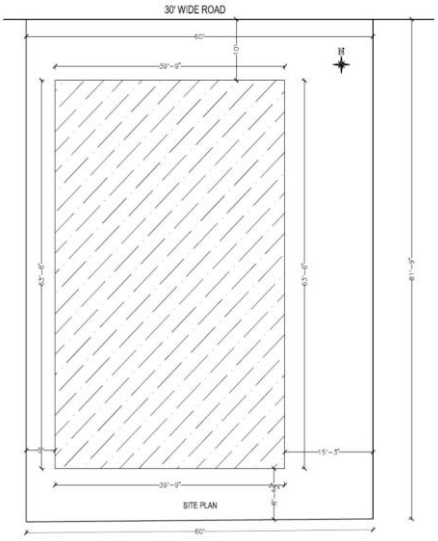
We used AutoCAD for drawing the plan, elevation of a residential building. We also use AutoCAD to show the reinforcement details and design details of a stair case. AutoCAD is very easy software to learn and much user friendly for anyone to handle and can be learn quickly learning of certain commands is required to draw in AutoCAD.

Set Backs: The all-round side setbacks depending on the height of the structure and area of a plot as given below.

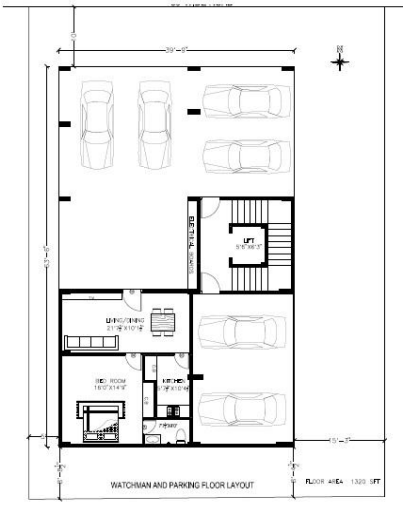
For Residential, Commercial, Educational, Institutional building except group housing schemes.

Plot size in Sq.m	Maximum permissible coverage
Below 500	As per minimum setback to be left in and around the building.
500 to below 2000	50% of plot area.
2000 and above	1000 Sq. meters or 40% of plot area whichever is higher.

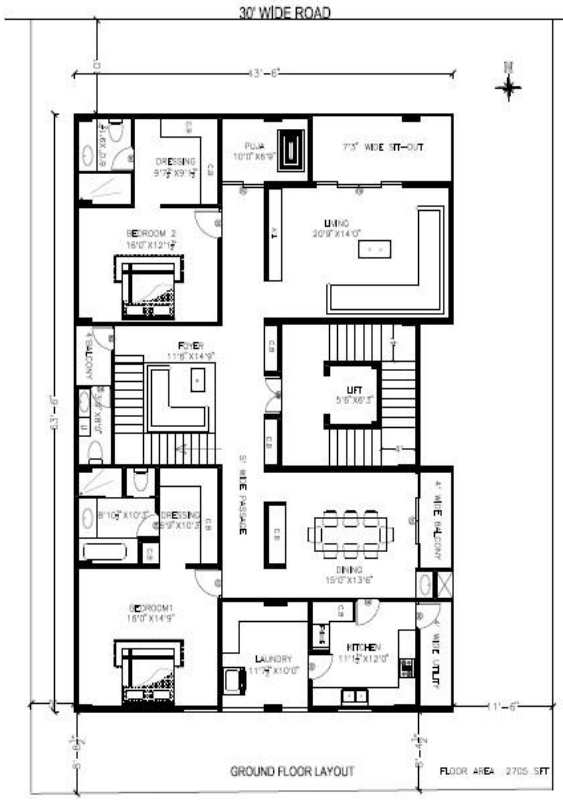
V. Figures and Tables



LAYOUT

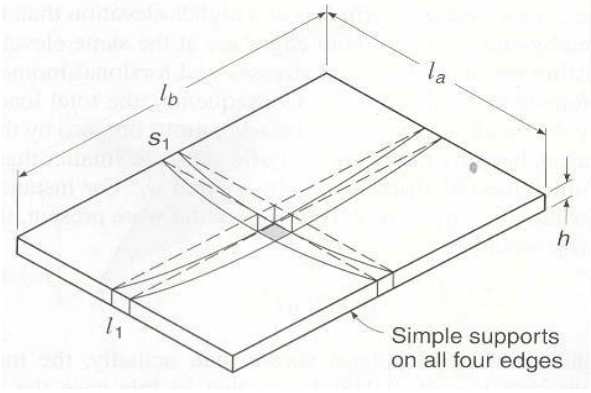


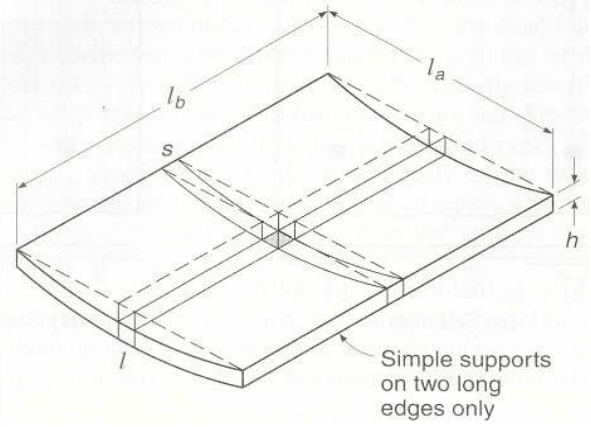
PARKING FLOOR LAYOUT



FIRST FLOOR LAYOUT

SECOND FLOOR LAYOUT





Design of Slab:

Loading on Slab

Total DL = (1) + (2) + (3)

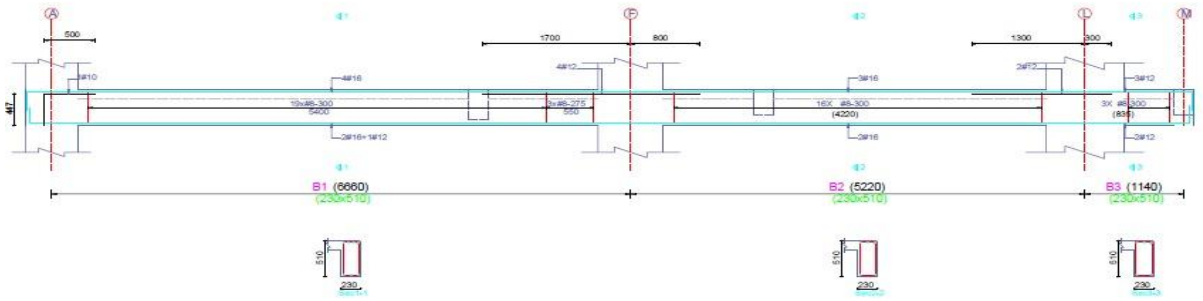
Self Weight (1) kN/m²	Floor Finish (2) kN/m²	Sunk Load (3) kN/m²	Total DL (4) kN/m²	Live Load (5) kN/m²	Total LL (6) kN/m²	Total Design Load 1.5 x [(4)+(6)] kN/m²
3.250	2.000	0.000	5.250	2.000	2.000	10.875

Deflection Check
As per clause 23.2.1 of IS 456:2000:

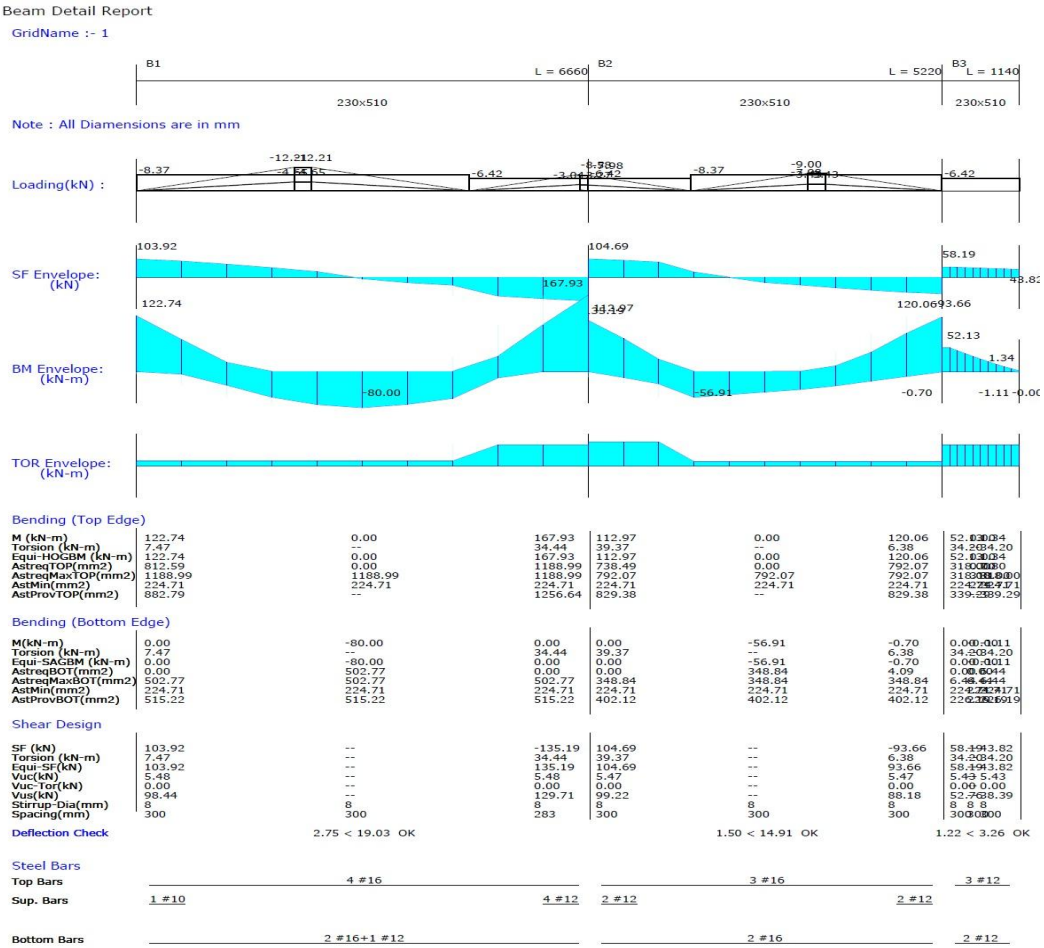
(Span/Depth) Ratio	Modification Factor	Basic Factor	Permissible Ratio (a x b)	Status
42.273	1.735	26.000	45.101	OK

Position	Moment Coeff α_x	Moment kN-m	A_{st_rqd} per metre mm^2	Steel Detail dia @ spc mm c/c	A_{st_prv} per metre mm^2	Remark
MidShort	0.038	8.887	231.893	#8 @ 200	251.327	Main
MidLong	0.035	8.230	214.146	#8 @ 200	251.327	Other
SuppDown	0.000	0.000	0.000	#8 @ 200	251.327	Extra at Top
SuppTop	0.050	11.841	312.914	#8 @ 160	314.159	Extra at Top
SuppLeft	0.000	0.000	0.000	#8 @ 200	251.327	Extra at Top
SuppRight	0.047	11.052	291.059	#8 @ 170	295.679	Extra at Top

CROSS SECTION OF A BEAM



SFD,BMD & DEFLECTIONS



VI. RESULTS AND DISCUSSIONS

Due to very huge and detailed explanation of STRUDS output for each and every column we have shown a column design results below showing the amount of load, moments, amount of steel required, section adopted etc. The main problem with STRUDS is it takes all columns also as beams initially before design and continue the same. So here output of column 1 which as actually 131beam as most of beams are used in drawing the plan.

Slab Schedule Report : (Default Level at 4.55 m)

Slab Group	Slab ID	Concrete Grade	Thk	Bottom Reinforcement(c/c)		Top Reinforcement Extra Steel(c/c)				Remark
				Main	Other	Left	Right	Up	Down	
SG1	S1	M25	130	#8 @ 200	#8 @ 200	#8 @ 200	#8 @ 170	#8 @ 160	#8 @ 200	TwoWay
SG2	S2	M25	130	#8 @ 200	#8 @ 200	#8 @ 170	#8 @ 200	#8 @ 200	#8 @ 200	TwoWay
SG3	S3	M25	130	#8 @ 200	#8 @ 200	#8 @ 200	#8 @ 200	#8 @ 200	#8 @ 200	TwoWay
SG4	S4, S8, S15,	M25	130	#8 @ 200	#8 @ 300	#8 @ 200	---			OneWay

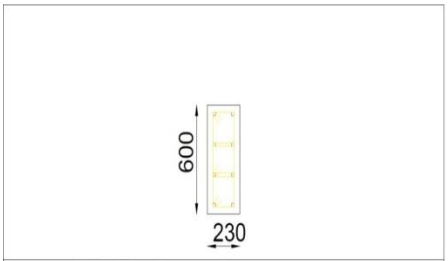
Beam Schedule Report

Beam Name	Size mm	Bottom Steel				Top Steel					Stirrups			Remark
		Straight	Bent/ Curt	Left At	Right At	Straight	Extra				Left Dia-Spc Nos	Mid Dia-Spc Nos	Right Dia-Spc Nos	
							Left	L1,L2 m	Right	L1,L2 m				
B1	230x510	2 - #16 + 1 - #12	---	---	--- ---	4 - #16 ---	1 - #10 ---	0.000,0.500 ---	4 - #12 ---	1.700,0.800 ---	--	#8-@ 300 20Nos	#8-@ 275 3 Nos	---
B2	230x510	2 - #16	---	---	--- ---	3 - #16 ---	2 - #12 ---	1.700,1.300 ---	2 - #12 ---	1.300,0.300 ---	--	#8-@ 300 18Nos (Total)	--	---
B3	230x510	2 - #12	---	---	--- ---	3 - #12 ---	--- ---	--- ---	--- ---	--- ---	--	#8-@ 300 5Nos (Total)	--	---

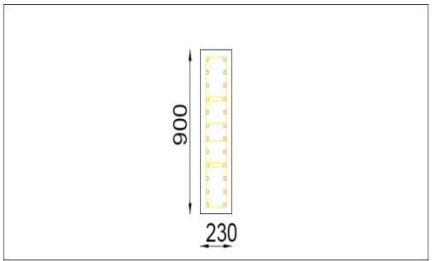
Detail Report of Column

SPACEFRAME STRUCTURE As Per **IS 456 : 2000**

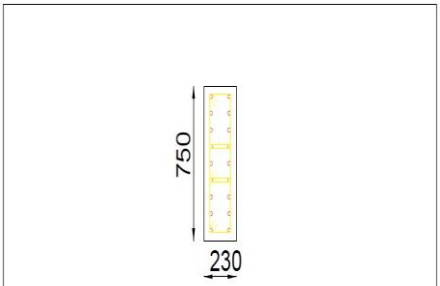
Column Group	Columns	Floor-Level	Column size (mm)	Axial Load (kN)	Mx (kN-m)	My (kN-m)	Concrete Grade	Main Steel Grade	Stirrup Steel Grade	Main Steel (mm)	Stirrup Steel (mm)	AstReq (mm^2)	AstProv (mm^2)	AstPerct	Load Combination
CG1	C1, C5, C14, C16, C17, C18	Cellar - Default Level	230 x 600	916.65	5.24	47.20	M25	Fe415	Fe415	#20 - 8	#8 @ 230	1295	2513	1.821	1.50 DL + 1.50 WL Y-
		ground - Default Level	230 x 600	861.68	48.38	57.17	M25	Fe415	Fe415	#20 - 8	#8 @ 230	2026	2513	1.821	1.50 DL + 1.50 WL Y-
		1f - Default Level	230 x 600	665.80	52.67	62.42	M25	Fe415	Fe415	#20 - 8	#8 @ 230	2087	2513	1.821	1.50 DL + 1.50 WL Y-
		2f - Default Level	230 x 600	472.05	49.58	53.10	M25	Fe415	Fe415	#20 - 6	#8 @ 230	1488	1885	1.366	1.50 DL + 1.50 WL Y-
		3f - Default Level	230 x 600	286.30	48.68	42.87	M25	Fe415	Fe415	#20 - 6	#8 @ 230	1430	1885	1.366	1.50 DL + 1.50 WL Y-
		terrace - Default Level	230 x 600	108.58	58.52	31.75	M25	Fe415	Fe415	#20 - 6	#8 @ 230	1533	1885	1.366	1.50 DL + 1.50 WL Y-



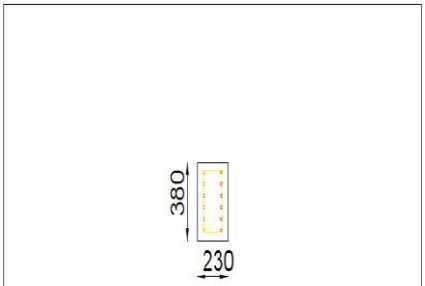
DIMENSION : 230 x 600
MAIN STEEL : 8 #20
TIES: 3-#8 @230
COLUMN ID : C1
COLUMN GROUP-NAME : CG1



DIMENSION : 230 x 900
MAIN STEEL : 24 #20
TIES: 4-#8 @230
COLUMN ID : C3
COLUMN GROUP-NAME : CG2



DIMENSION : 230 x 750
MAIN STEEL : 18 #20
TIES: 3-#8 @230
COLUMN ID : C4
COLUMN GROUP-NAME : CG3



DIMENSION : 230 x 380
MAIN STEEL : 12 #16
TIES: #8 @230
COLUMN ID : C9
COLUMN GROUP-NAME : CG8

VII CONCLUSIONS

1. We have designed the structure using STRUDS.
2. We are observed using this Software's like STRUDS reduces lot of time in design work.
3. Details of each and every member can be obtained using STRUDS.
4. While designing the structure if any failure occurs the software will be noticed immediately so we can correct the design immediately.
5. By using STRUDS we can analyze the structure very accurately and quickly when compared to the manual methods.
6. The analysis and design by using STRUDS software is given results with negligible difference with manual calculations. Thus the software is good for using analysis and the design of structure, simple and also providing other advantages to the users as specified.

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