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ANALYSIS AND DESIGN OF (G+3) NEW ENGINEERING BUILDING, ALIET USING STAAD PRO

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Abstract: Structural planning and design is an art and science of designing with economy and elegance, serviceable and durable structure. . The main objective of the project is to compare the design and analysis of the building along span lengths 3m and 4.5m.This project is to understand the structural behavior of various components in the multi-storied building. The frame analysis is done for the design of columns and beams according to the building by laws and design as per IS 456-2000 code. Design ,analysis and estimation of multi-storied building has been taken up for (G+3) Building of an area 463.25m^2 located behind the Ramesh hospital. Dead loads and live loads are considered according to the code IS 456-2000, footings are designed based on safe bearing capacity of soil. The design of slab is done by using the end conditions like adjacent edges discontinuous, one long edge discontinuous and one short edge discontinuous. We have used Staadd.pro software tool to design structural elements like design of beams and columns.

Key Words: IS:456-2000, Frame analysis, STAAD Pro Software

1. INTRODUCTION: The main aim of structural engineer is to design the structures for safe technology in the computing field. The structural engineer can dare to tackle much more large and complex structure subjected to various type of loading conditions. The loads acting on the structure are considered as static, but with the exception of the self weight (dead load) no structure load is static one. Now a day's large number of application software's are available in the civil engineering field all these software's are developed as the basis of advance. Finite element analysis which include the effect of dynamic load such as wind effect, earth quake effect etc. In this project work, an attempt has been made to study the efficiency of certain civil engineering application software's. For these purpose an on-going project has been selected.

2. STATEMENT OF THE PROJECT:

Utility of the building	: commercial
No of stories	: G+3
No of staircase	: 1
Type of construction	: R.C.C frame structure
Types of walls	: Brick wall
Ground floor height	: 3m
Floor to floor height	: 3m
Walls (externals)	: 250mm thick brick masonry
Walls internal	: 250mm thick brick masonry

MATERIALS:

Concrete grade:	M30
All steel grades:	HYSD bars of Fe415 grade

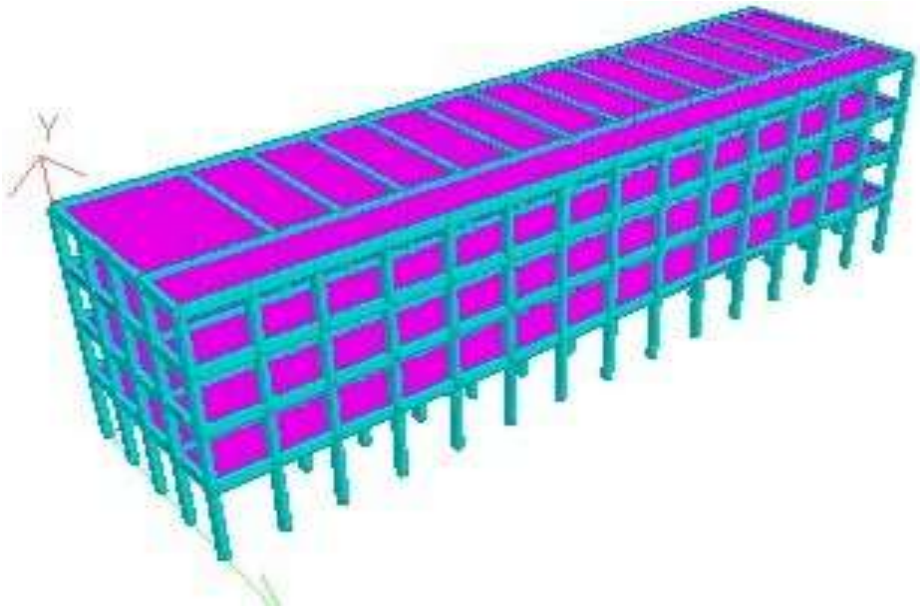


Fig1: Geometric design For 3 m building

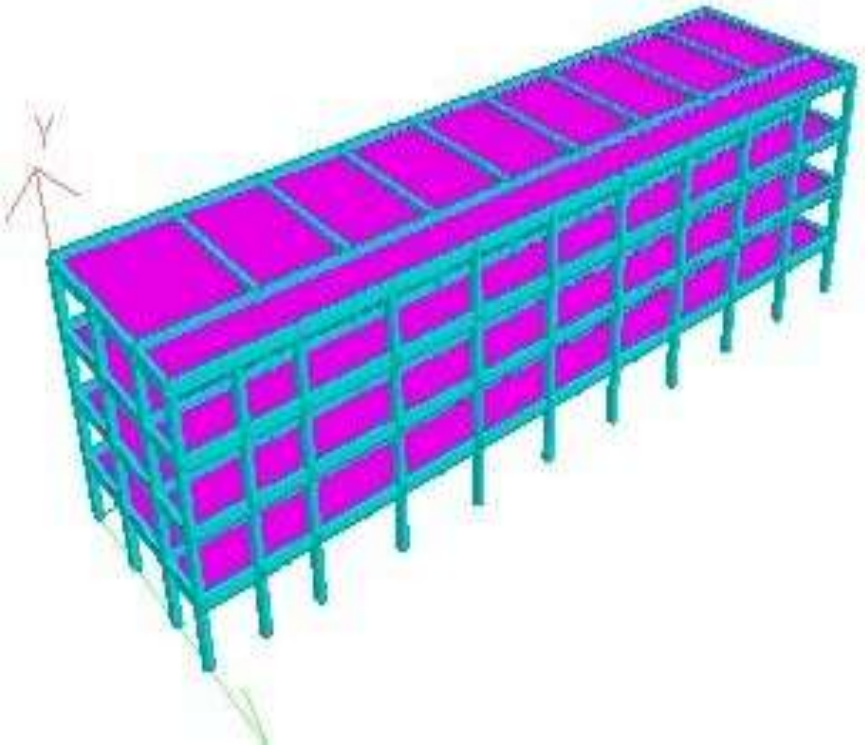


Fig 2: Geometric design For 4.5 m building

3. PLAN: Our building plan consists of G+5 floors of all are commercial. It is having an area of 463.25sq.m. Now we are showing the figures of floor plan, centre-line diagram, beam layout, column layout.

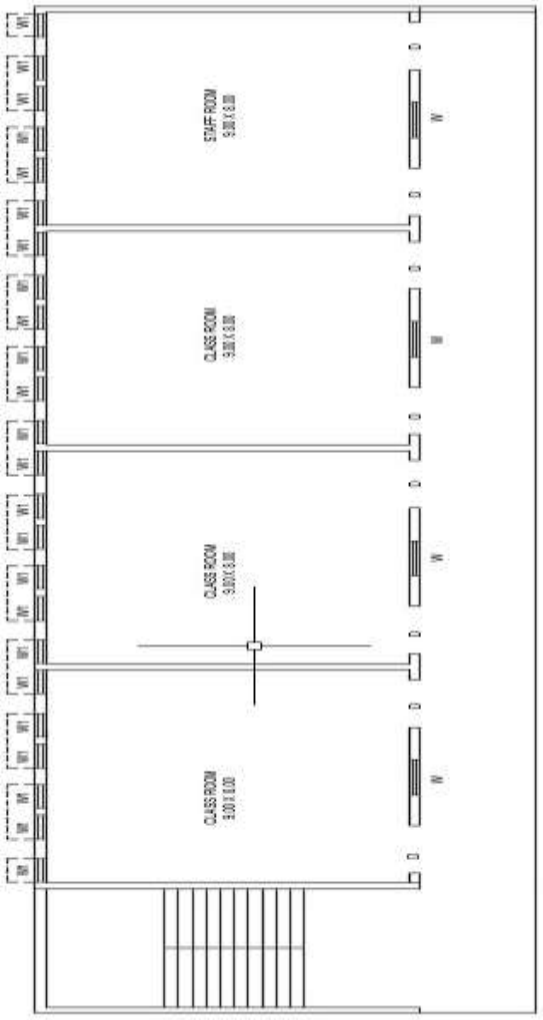


FIG 1:PLAN

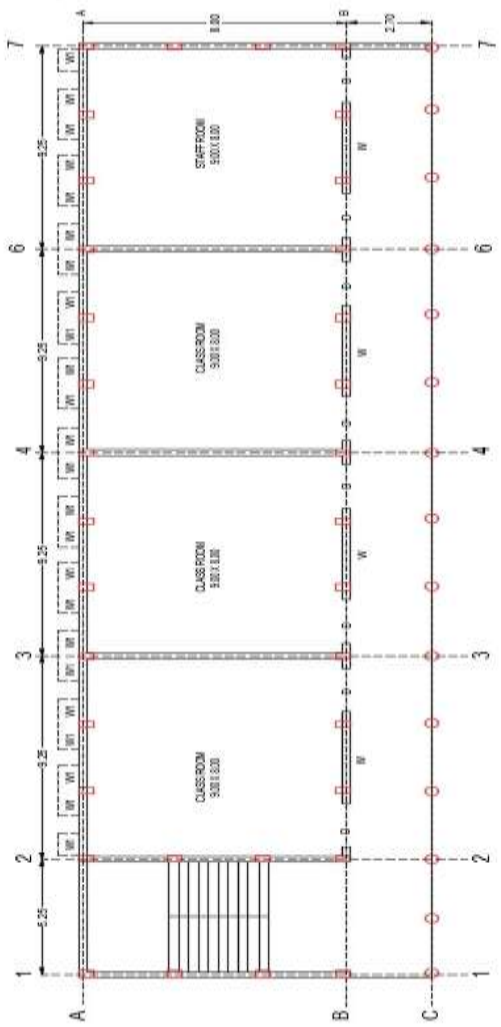


FIG 2: CENTER LINE DIAGRAM

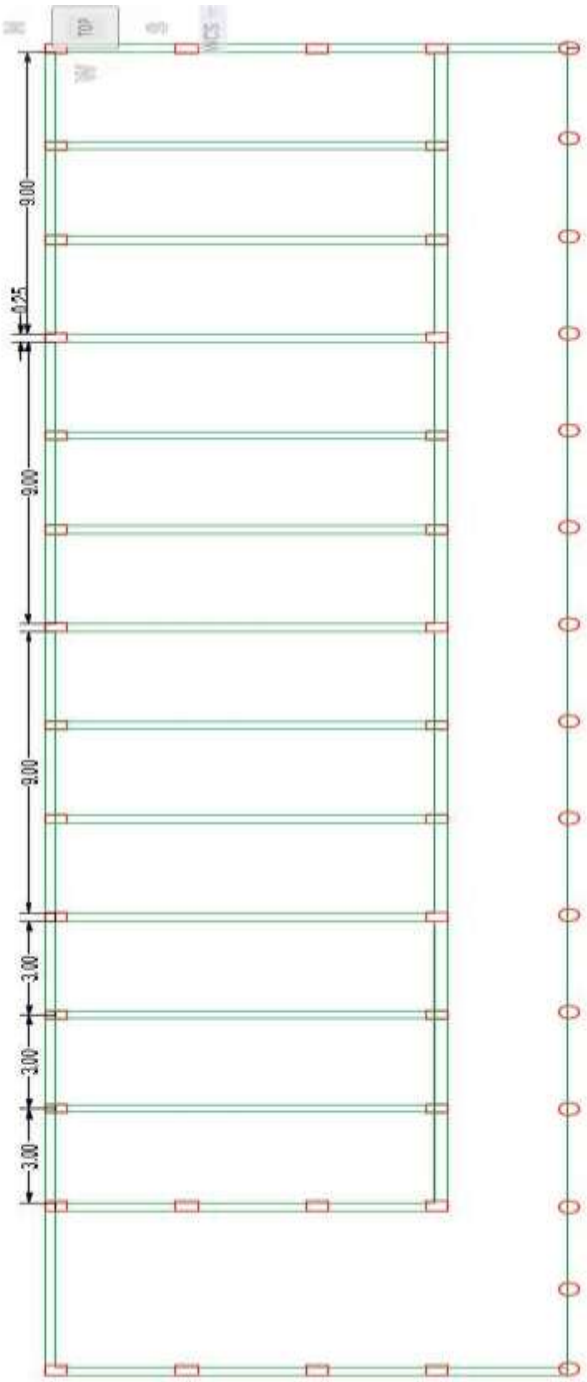


FIG 3: BEAM LAYOUT FOR 3M BEAM

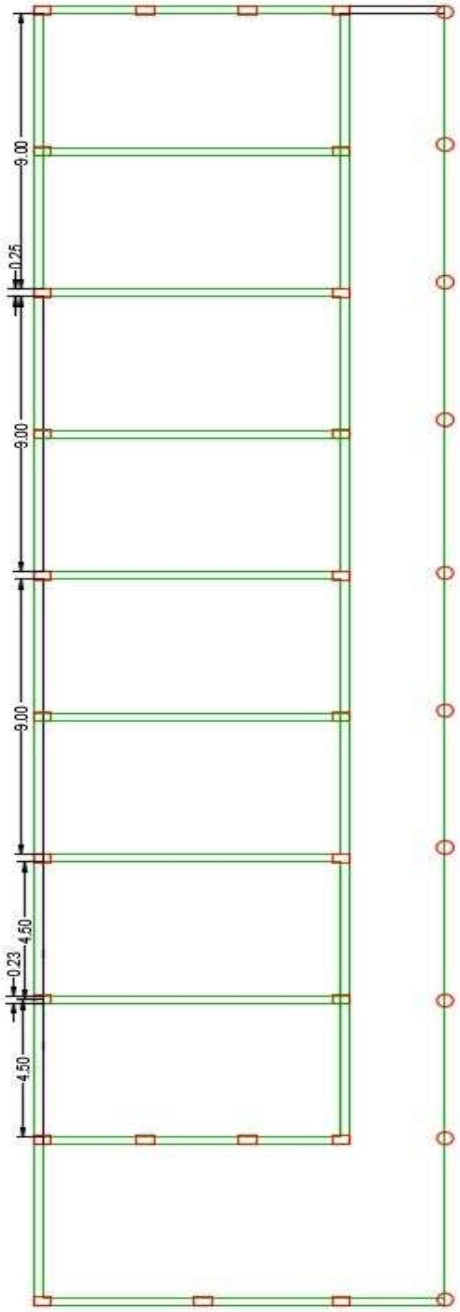


FIG 4 : **BEAM LAYOUT AT 4.5M**

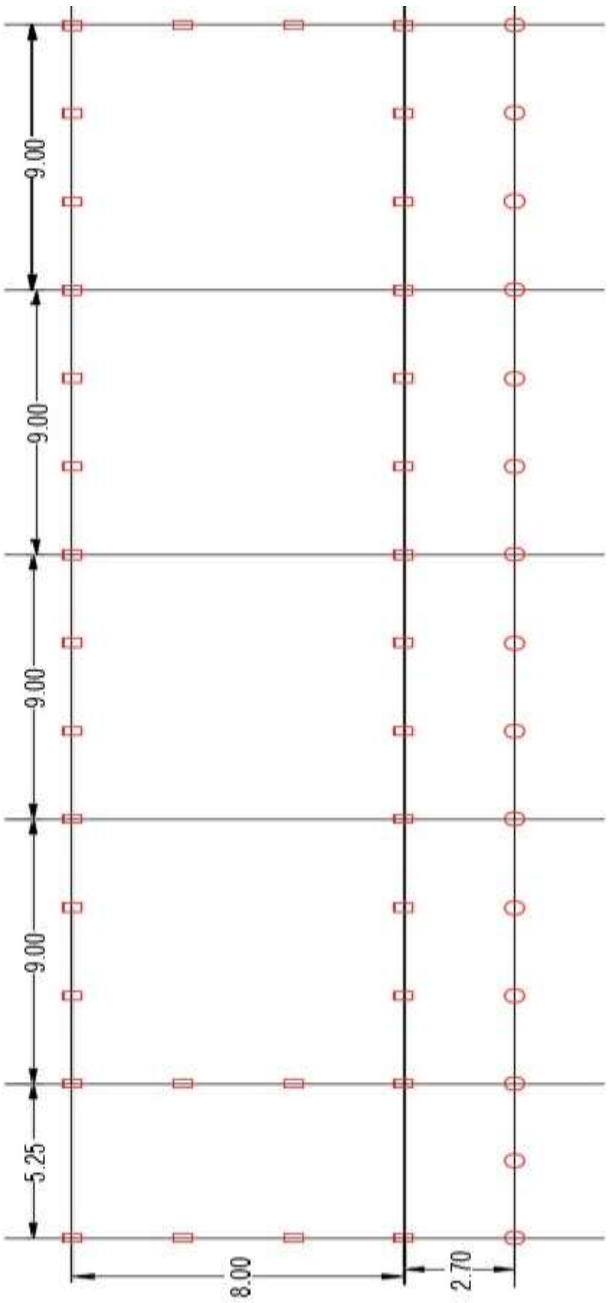


FIG 5:COLUMN LAYOUT AT 3M

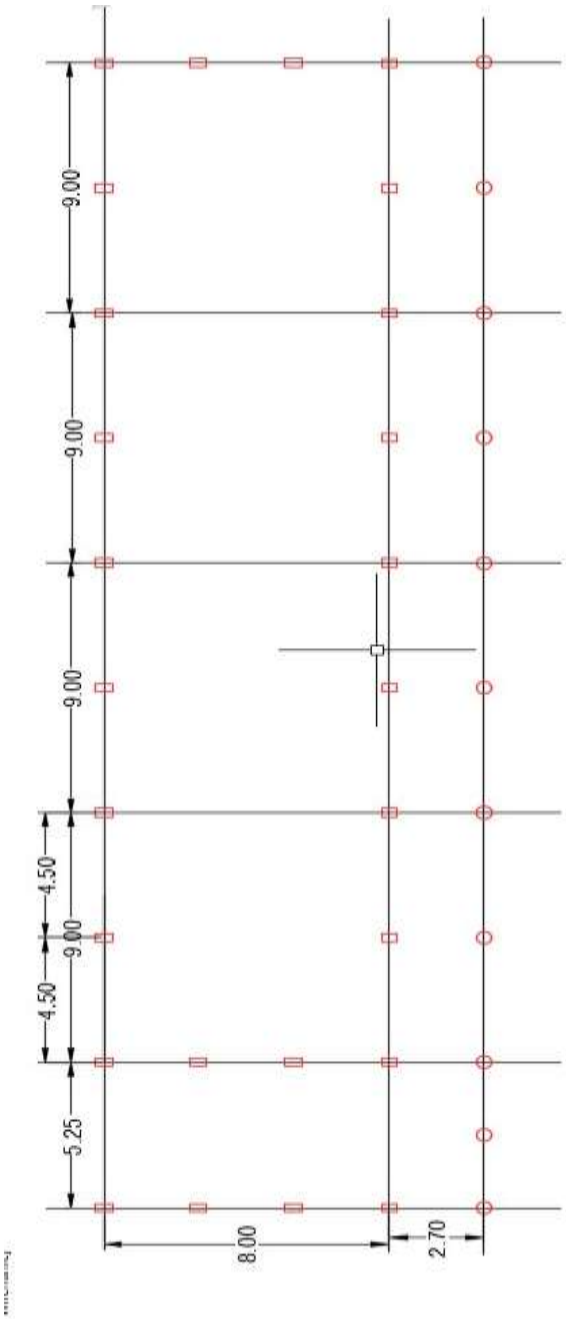


FIG 6:COLUMN LAYOUT AT 4.5M

5.Loading data:

- ✓ Dead Load 3KN/m²-for 3 & 4.5 span (for all

Live Load 3 KN/m²- for 3 & 4.5m span Conventional (for all stories)

Load combination: 1x DL+1x LL

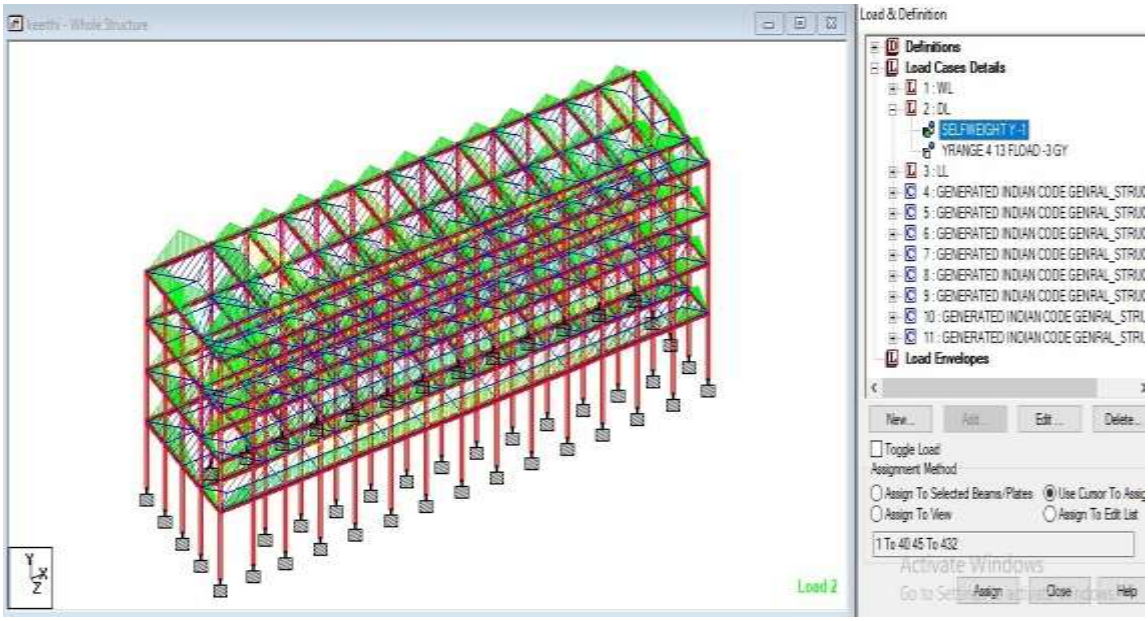


Fig 1: Dead load at 3m spacing

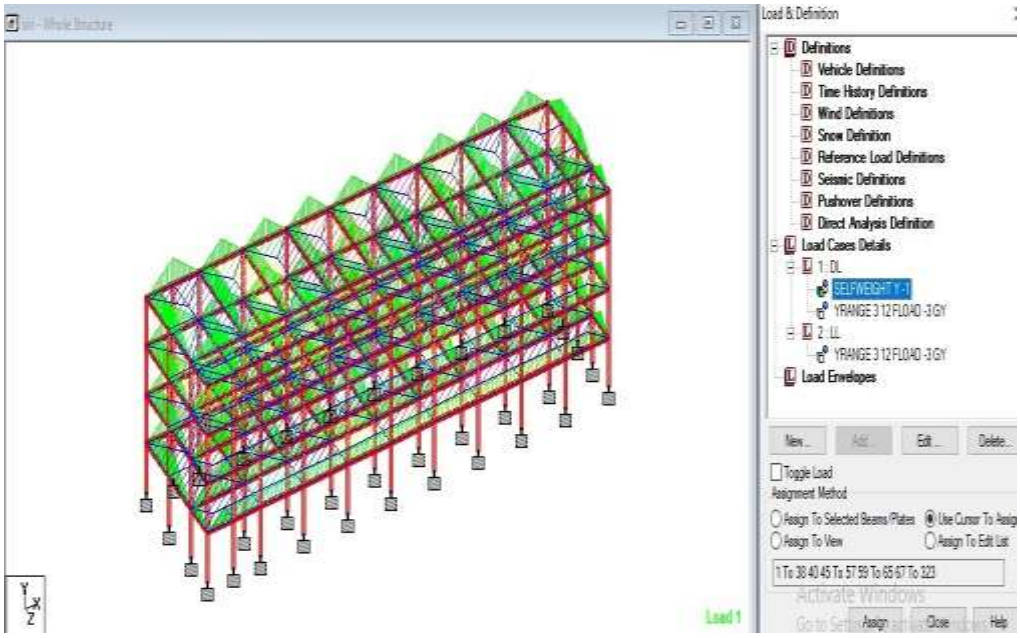


Fig 2:Dead load at 4.5m spacing

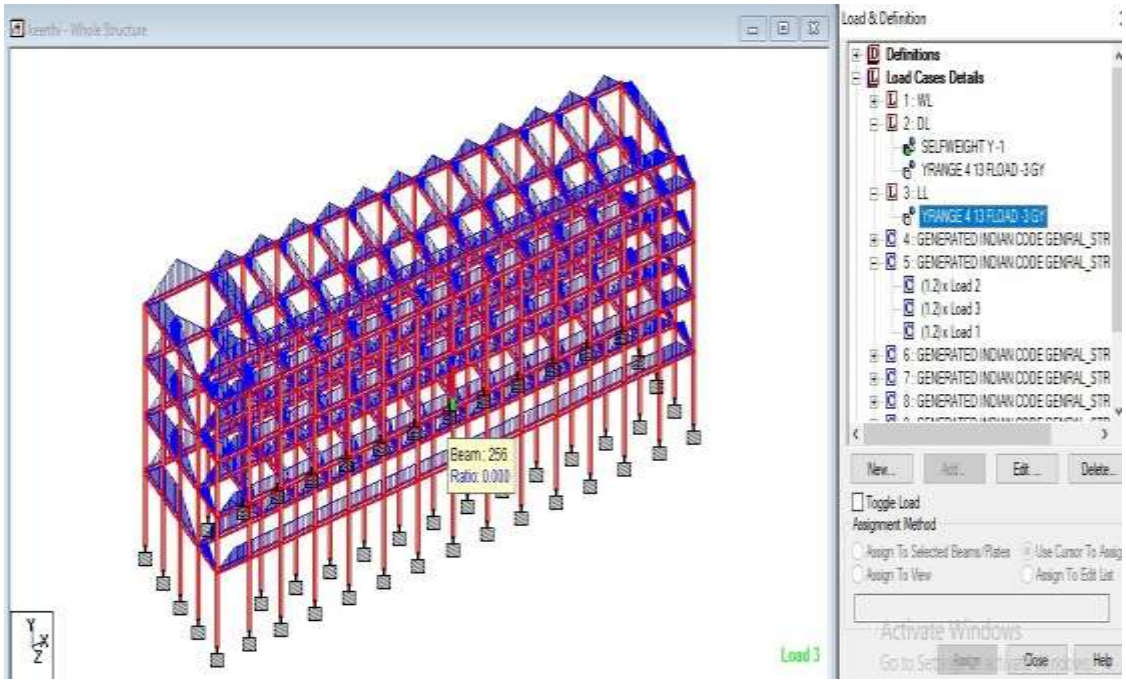


Fig 3: Live load at 3m spacing

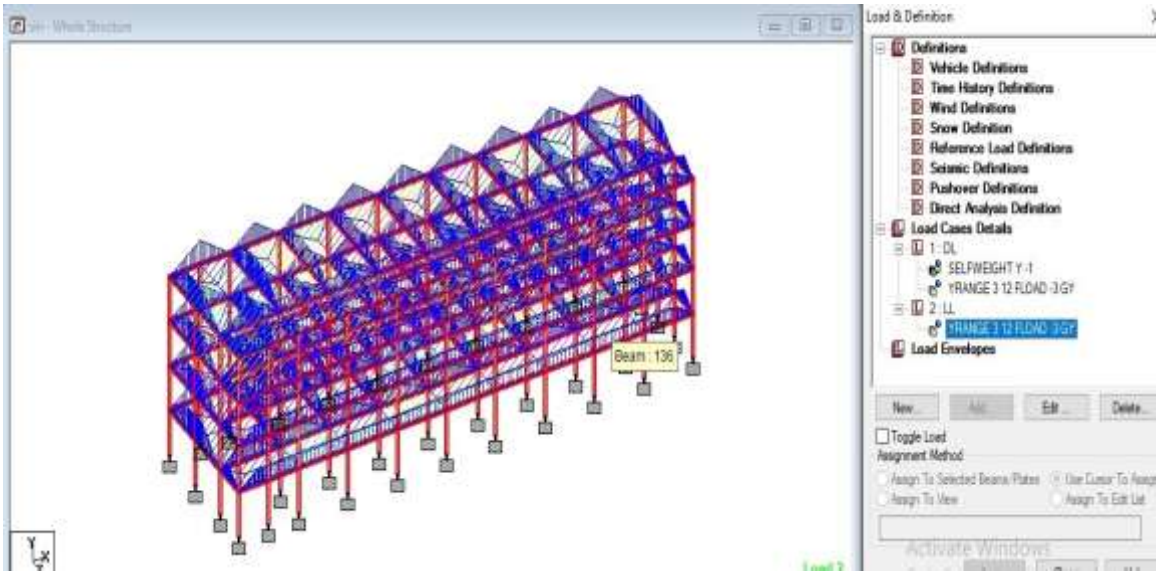


Fig 4:Live load at 4.5m spacing

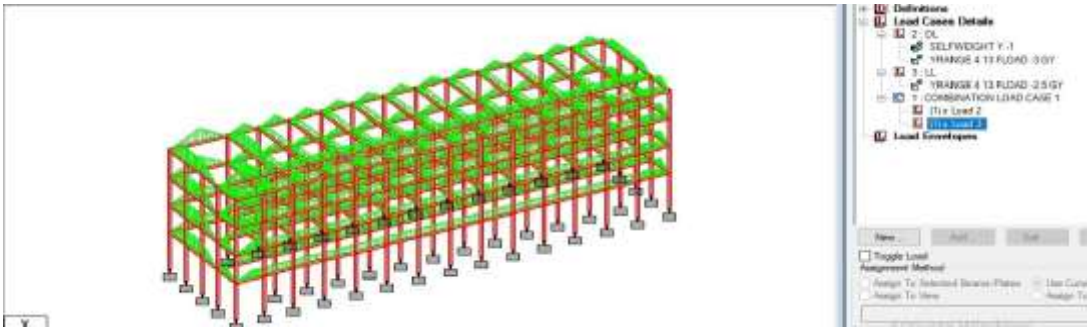
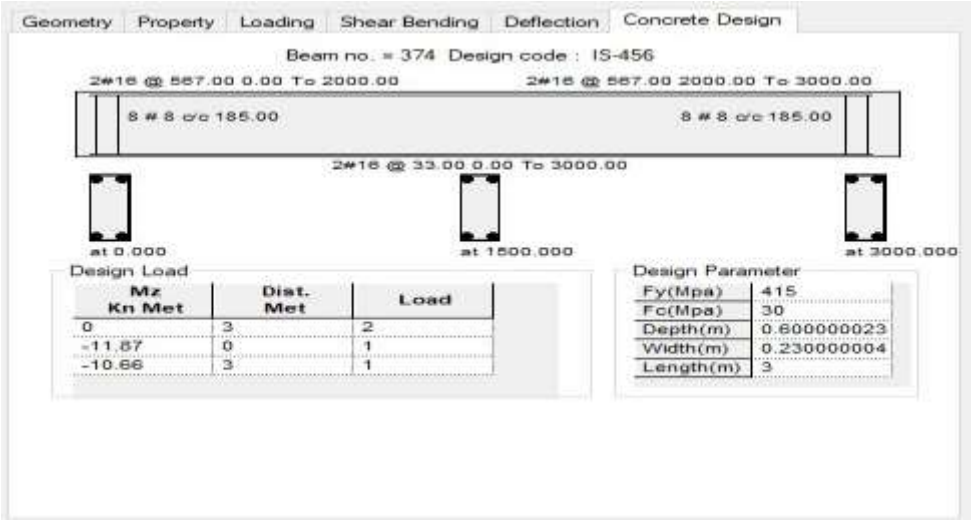


Fig 5: LOAD COMBINATIONS

6.**DESIGN OF BEAM**: STAAD OUTPUT OF A BEAM FOR 3mSPAN



.FIG 6: BEAM DESIGN FOR 3 m Span

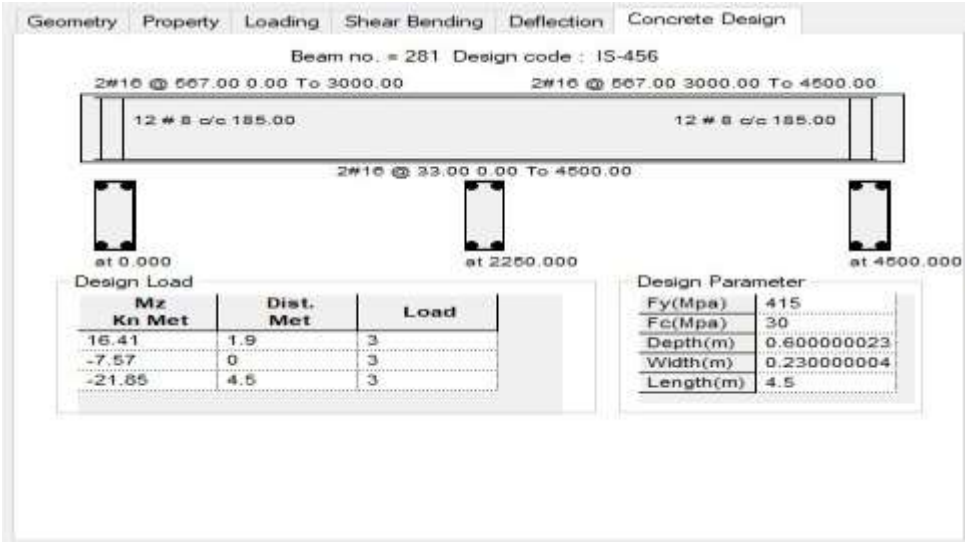


FIG 7: BEAM DESIGN FOR 4.5 m Span

7. DESIGN OF COLUMN:

FIG 8: COLUMN DESIGN FOR 3 m Span

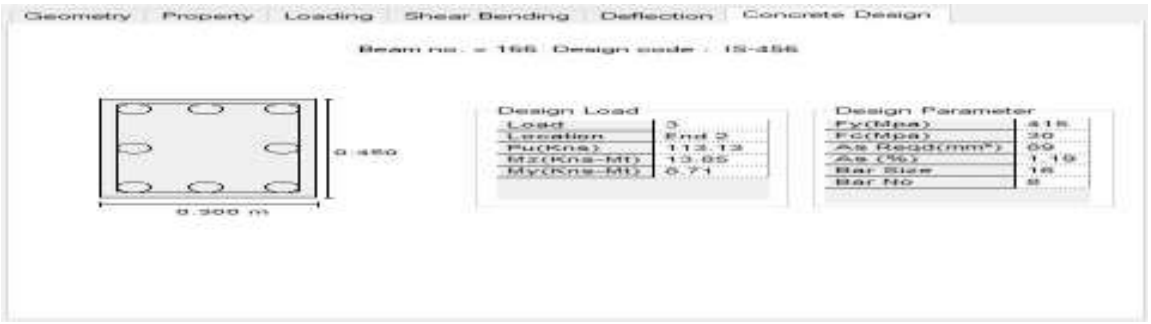


FIG 9: COLUMN DESIGN FOR 4.5 m Span

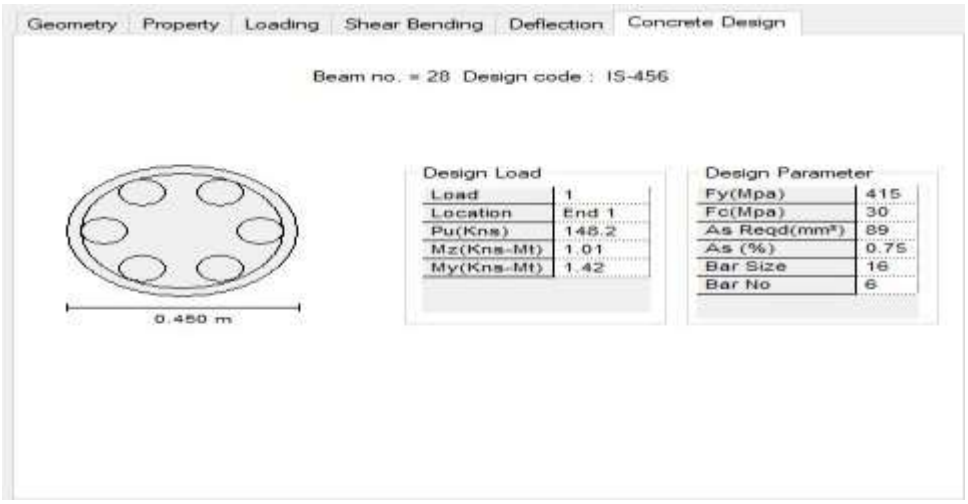


FIG 10: CIRCULAR COLUMN DESIGN FOR 3m Span

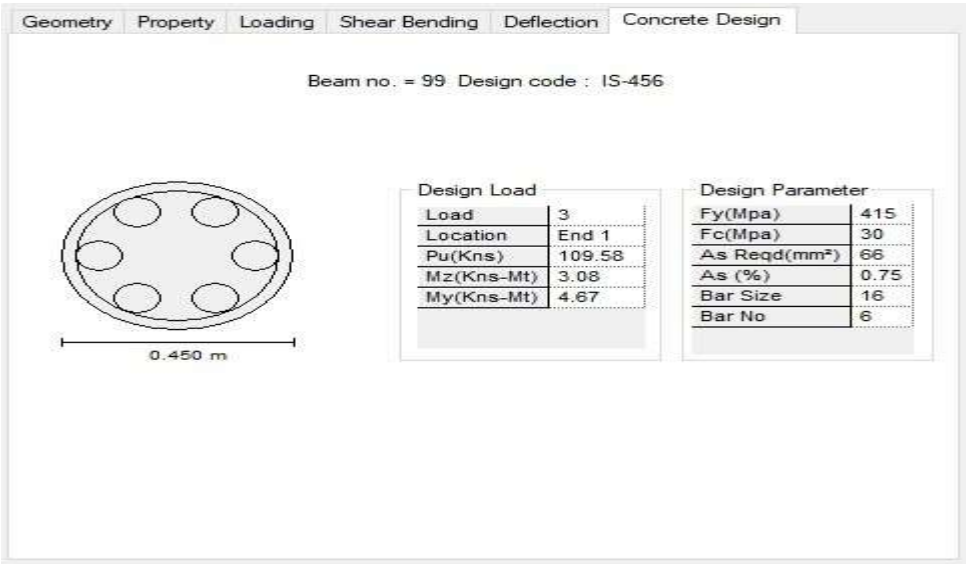
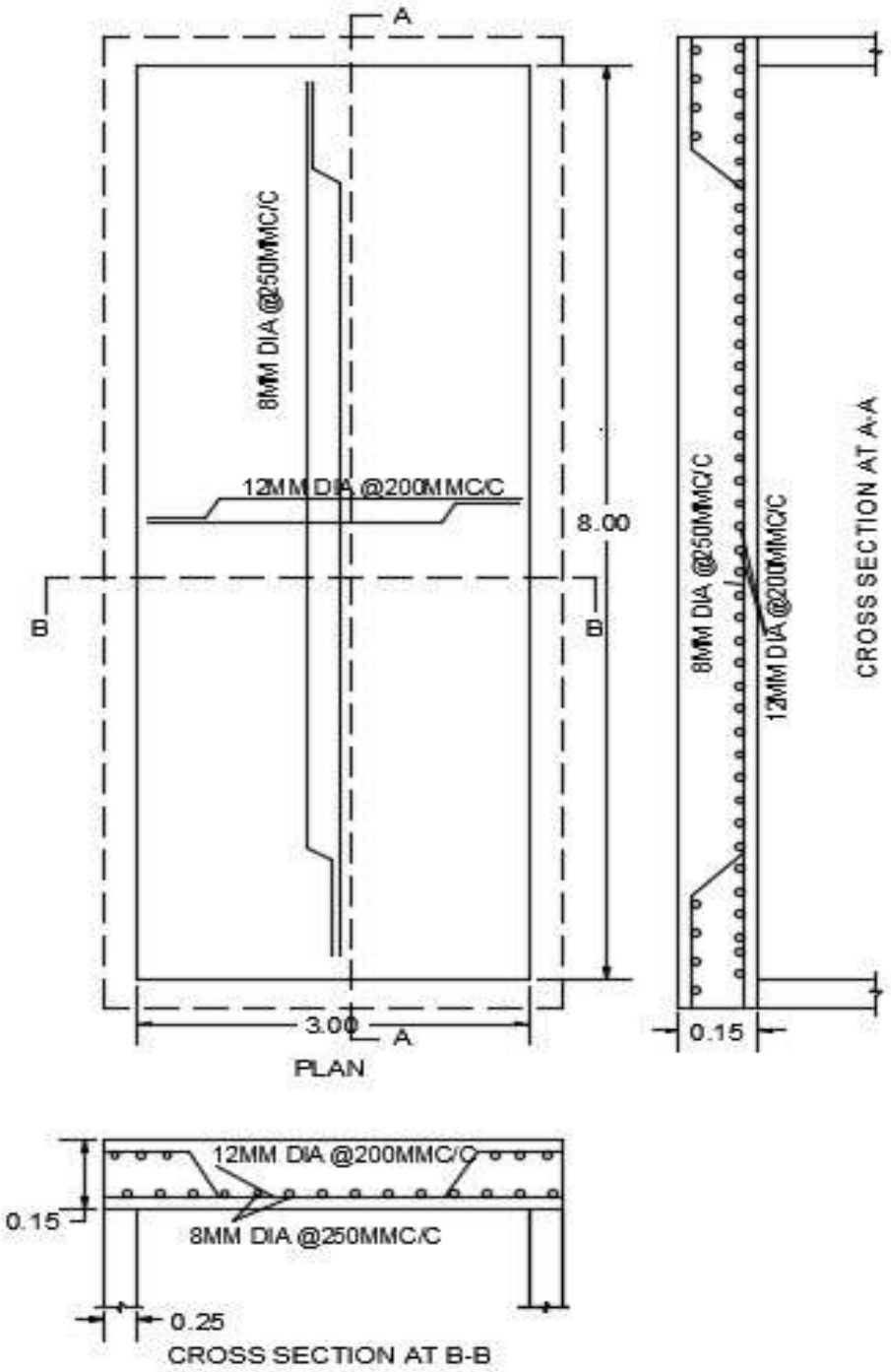
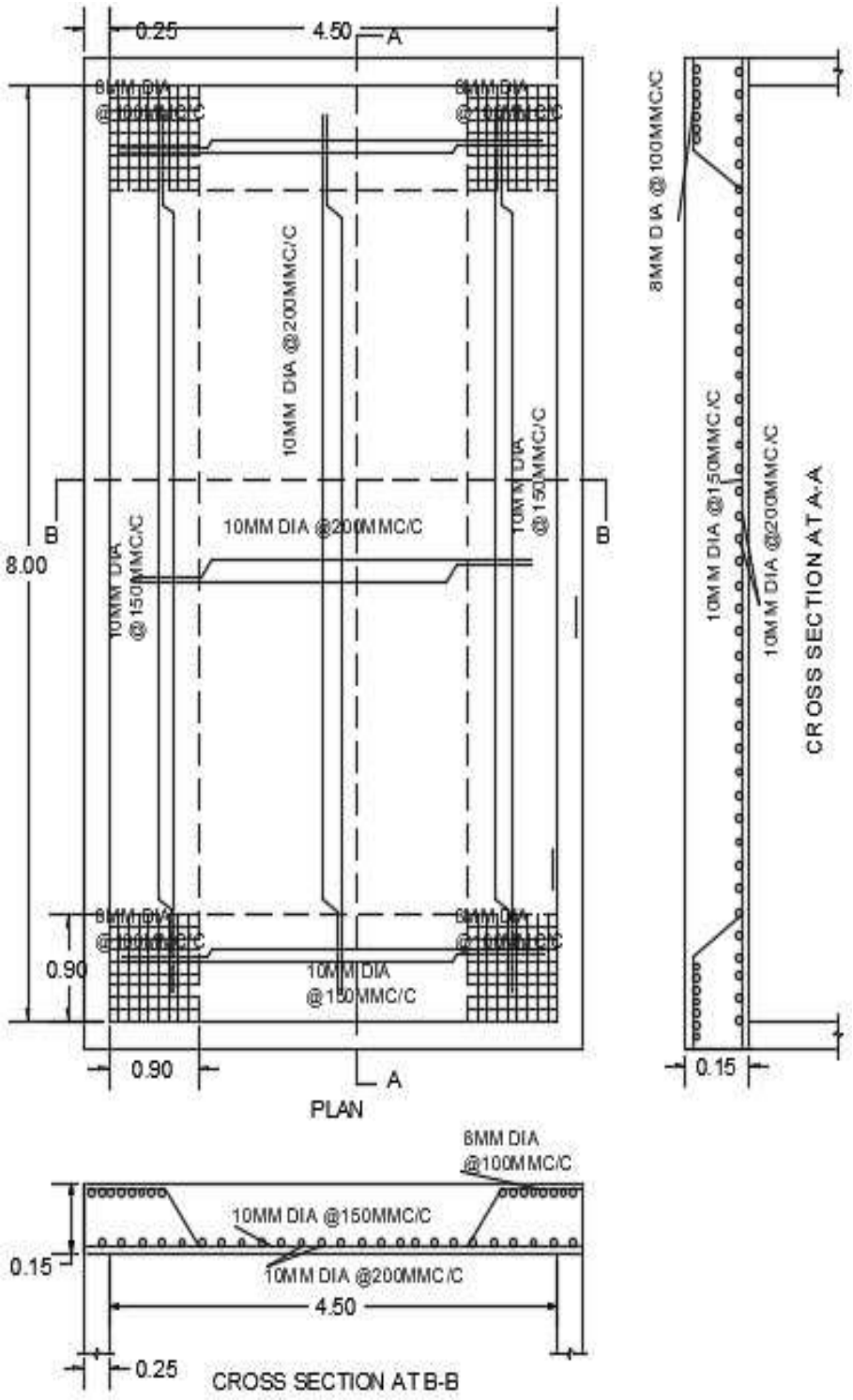


FIG 11: CIRCULAR COLUMN DESIGN FOR 4.5 m Span

8. DESIGN OF SLAB:

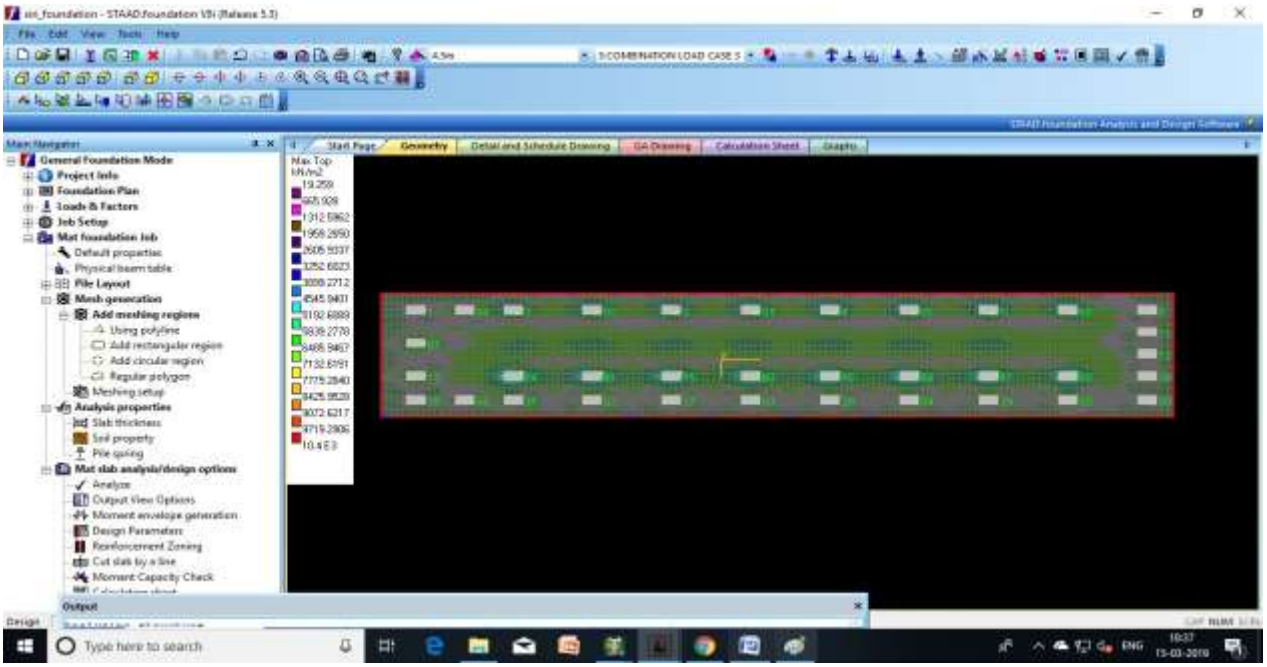


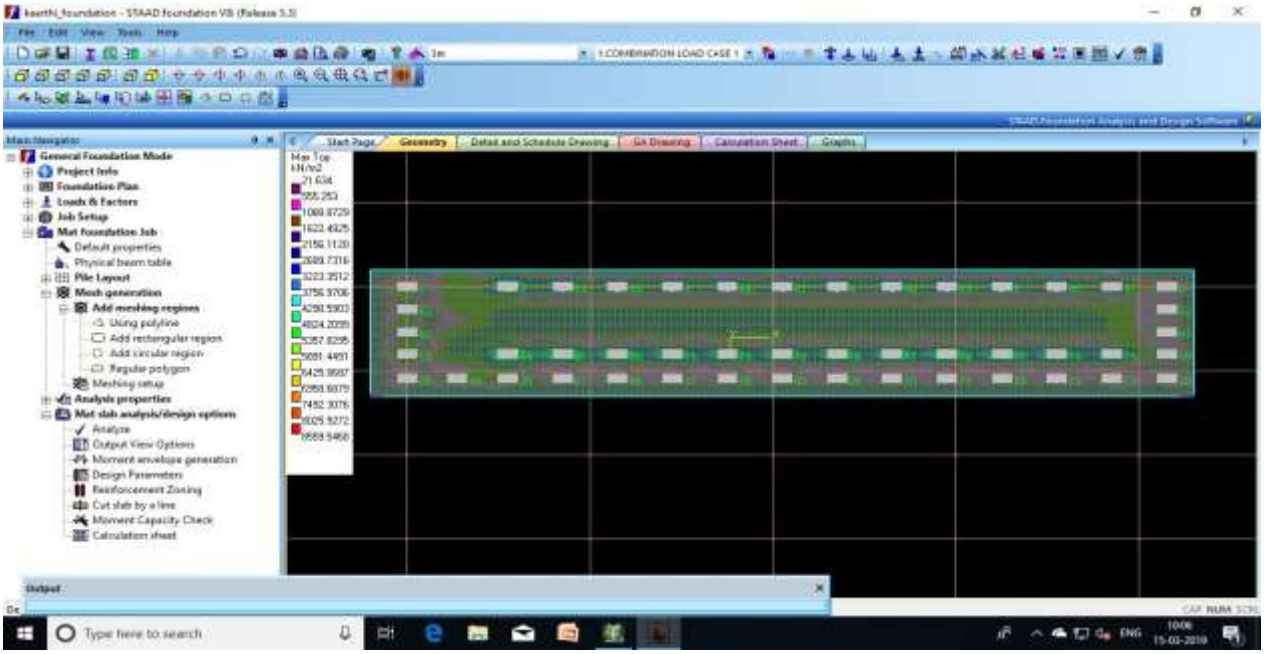
ONE WAY CONTINOUS SLAB



TWO WAY CONTINOUS SLAB

9. DESIGN OF FOUNDATION: Geometry of 3m span





Geometry of 4.5m span

Reactions

NODE NO.	Fx (kN)	Fy (kN)	Fz (kN)	Mx (kNm)	My (kNm)	Mz (kNm)
1	-2.797	-200.443	-0.623	-0.862	-0.062	3.748
2	1.264	-520.861	-14.473	-19.172	-0.011	-1.657
3	0.007	-396.286	-11.839	-15.501	-0.001	-0.018
4	0.048	-396.517	-11.839	-15.500	0.001	-0.096
5	0.075	-397.490	-11.882	-15.611	0.012	-0.158
6	1.035	-141.383	-0.671	-0.819	-0.011	-1.454
13	-4.033	-268.796	0.320	0.413	0.043	5.400
14	1.940	-659.139	14.064	18.651	-0.036	-2.548
15	0.009	-491.895	11.834	15.875	-0.001	-0.025
16	0.062	-492.123	11.834	15.875	0.001	-0.126
17	0.098	-493.068	11.789	15.763	0.014	-0.205
18	1.339	-195.141	0.339	0.536	-0.024	-1.880
25	-0.730	-148.200	1.074	1.422	0.015	1.010
26	-0.145	-178.319	0.019	-0.042	0.022	0.227
27	-0.021	-183.482	-0.005	-0.075	-0.011	0.042
28	0.007	-183.476	-0.002	-0.042	-0.002	-0.014
29	0.036	-183.541	-0.001	-0.034	-0.007	-0.072
30	0.728	-144.078	0.809	1.155	-0.067	-1.008
66	-0.031	-183.558	-0.006	-0.092	-0.010	0.062
67	-0.043	-183.506	-0.003	-0.094	0.000	0.085
68	-0.012	-183.474	-0.003	-0.058	-0.008	0.023
69	-0.002	-183.475	-0.002	-0.047	-0.005	0.005
70	0.017	-183.476	-0.002	-0.041	-0.000	-0.033
71	0.027	-183.470	-0.003	-0.042	-0.001	-0.053
72	0.048	-184.029	0.010	0.002	-0.019	-0.096
73	0.097	-182.042	0.063	0.112	-0.024	-0.169
74	0.120	-498.025	11.724	15.614	0.015	-0.246
75	0.567	-461.094	11.302	14.999	0.032	-0.849
76	0.093	-491.973	11.818	15.836	0.006	-0.187
77	0.077	-492.085	11.830	15.865	0.003	-0.157
78	0.047	-492.132	11.835	15.879	0.001	-0.096
79	0.033	-492.231	11.835	15.879	0.000	-0.067
80	0.003	-488.560	11.828	15.855	-0.008	-0.007
81	-0.021	-490.327	11.865	15.852	-0.015	0.035
82	-0.627	-231.562	-0.057	-0.098	0.065	1.024
83	-0.496	-217.198	-0.234	-0.344	-0.067	0.840
84	0.016	-398.335	-11.983	-15.756	-0.031	-0.015
85	0.003	-393.914	-11.851	-15.528	-0.005	-0.006
86	0.025	-396.588	-11.837	-15.497	0.000	-0.050
87	0.036	-396.519	-11.837	-15.497	0.001	-0.072
88	0.060	-396.499	-11.843	-15.511	0.003	-0.120
89	0.072	-396.440	-11.854	-15.540	0.006	-0.145
90	0.091	-402.065	-11.920	-15.724	0.023	-0.189
91	0.487	-370.344	-11.556	-15.297	-0.022	-0.722
92	0.205	-164.135	0.057	0.144	0.035	-0.398
93	0.254	-172.649	-0.026	0.046	-0.014	-0.482
94	-0.066	-173.059	0.103	0.117	0.025	0.129

Reactions

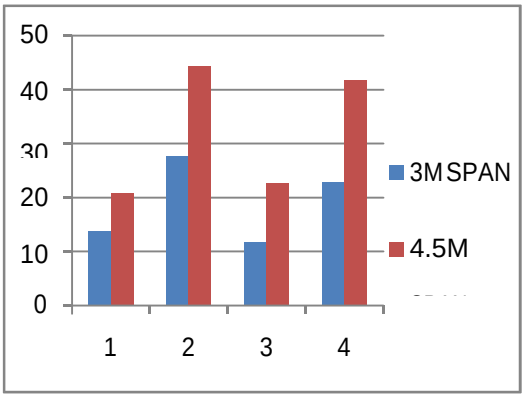
NODE NO.	Fx (kN)	Fy (kN)	Fz (kN)	Mx (kNm)	My (kNm)	Mz (kNm)
1	-0.841	-157.501	-2.632	-2.444	0.013	0.927
2	-1.777	-518.573	-26.943	-26.237	-0.026	1.841
3	-0.085	-580.378	-25.932	-25.081	0.007	0.124
4	0.010	-580.881	-25.957	-25.132	0.002	-0.015
5	0.074	-584.541	-26.014	-25.262	0.020	-0.124
6	2.870	-171.300	-1.137	-1.061	0.020	-2.926
13	-6.845	-331.300	2.313	2.451	0.011	6.881
14	1.859	-816.384	26.679	26.327	-0.034	-1.755
15	-0.007	-737.378	25.983	25.809	0.007	0.025
16	0.070	-737.341	25.957	25.757	0.002	-0.107
17	0.166	-741.080	25.879	25.606	0.014	-0.260
18	4.245	-246.500	0.447	0.518	-0.020	-4.343
25	-1.265	-145.522	1.853	2.015	0.054	1.342
26	-1.498	-219.111	0.027	0.013	0.036	1.557
27	-0.075	-260.186	-0.006	-0.078	-0.006	0.112
28	0.017	-260.167	-0.004	-0.061	0.002	-0.025
29	0.121	-260.247	-0.001	-0.058	-0.008	-0.176
30	2.959	-177.322	1.312	1.370	-0.062	-3.012
53	0.046	-590.221	-25.893	-24.997	-0.006	0.018
54	-0.031	-580.863	-25.955	-25.126	0.002	0.047
55	0.047	-580.644	-25.966	-25.151	0.004	-0.074
56	0.348	-574.024	-25.627	-25.045	-0.001	-0.418
58	0.388	-731.260	25.207	24.785	0.040	-0.511
59	0.115	-737.034	25.948	25.738	0.005	-0.180
60	0.009	-737.363	25.960	25.763	0.002	-0.019
61	-0.309	-732.763	26.059	25.929	-0.004	0.352
62	-0.021	-262.529	-0.006	-0.083	0.002	0.085
63	-0.024	-260.160	-0.004	-0.063	-0.003	0.038
64	0.058	-260.159	-0.006	-0.071	0.003	-0.089
65	0.008	-263.937	0.056	0.053	-0.021	-0.094
66	-0.156	-175.364	0.156	0.238	0.052	0.251
67	-0.598	-328.651	-0.155	0.000	-0.002	0.756
68	-0.827	-239.676	-1.507	-1.585	0.012	0.912
71	0.405	-205.337	-0.165	-0.108	0.035	-0.572
72	0.545	-216.586	0.072	0.136	-0.013	-0.736

Reactions for 4.5 m Span

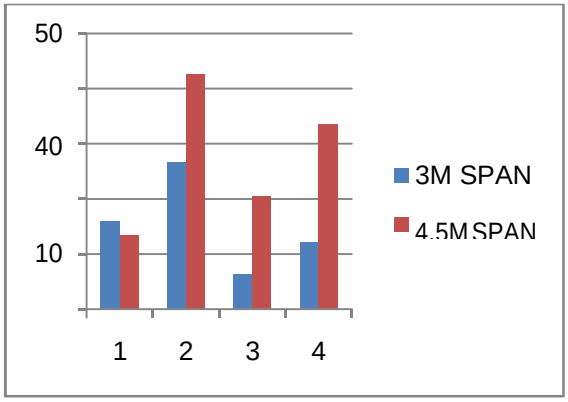
10. Results & Comparison: A college building with 3m and 4.5m frame spacing is designed and results are presented in this project.

Table-1 Comparison of maximum shear forces (Fy) and Bending Moments (Mz) in ground floor beams between 3m and 4.5m spans.

S.NO	BEAM NO	3M SPAN		4.5M SPAN	
		SHEAR FORCE	BENDING MOMENT	SHEAR FORCE	BENDING MOMENT
1	1	13.767	15.622	20.774	13.374
2	2	27.752	26.683	44.303	42.552
3	3	11.018	6.329	22.674	20.378
4	4	22.856	12.008	41.794	33.445



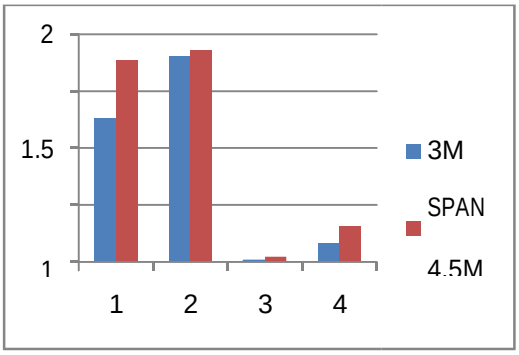
SHEAR FORCE



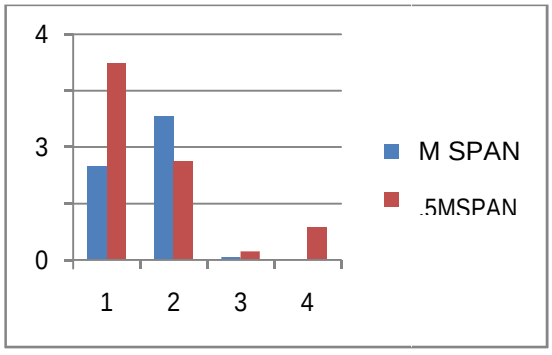
BENDING MOMENT

Table-2 Comparison of maximum shear forces (Fy) and Bending Moments (Mz) in ground floor columns between 3m and 4.5m spans.

S.NO	COLUMN NO	3M SPAN		4.5M SPAN	
		SHEAR FORCE	BENDING MOMENT	SHEAR FORCE	BENDING MOMENT
1	1	1.264	1.657	1.777	3.490
2	2	1.940	2.548	1.859	1.755
3	3	0.021	0.049	0.046	0.155
4	4	0.016	0.015	0.309	0.575



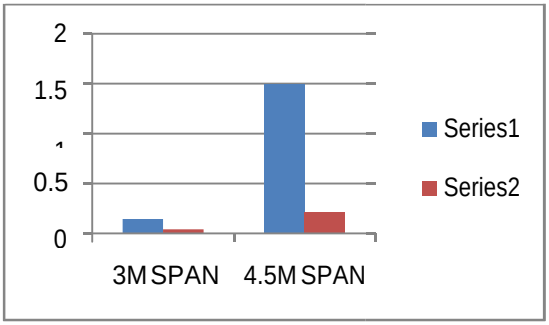
SHEAR FORCE



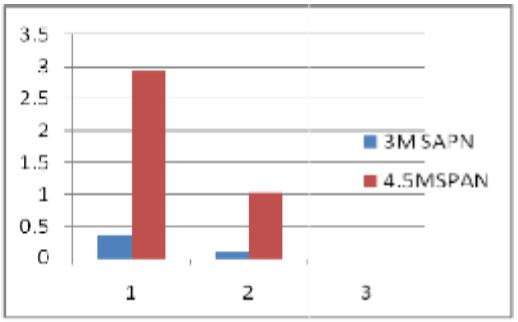
BENDING MOMENT

Table-3 Comparison of maximum shear forces (Fy) and Bending ground floor circular columns between 3m and 4.5m spans

S.NO	CIRCULAR COLUMN NO	3M SPAN		4.5M SPAN	
		SHEAR FORCE	BENDING MOMENT	SHEAR FORCE	BENDING MOMENT
1	1	0.145	0.352	1.498	2.938
2	2	0.043	0.086	0.021	1.021



SHEAR FORCE



BENDING MOMENT

11. CONCLUSION: In this study, it is observed the volume of concrete in 3m span & 4.5m span as follows.

SLABS: For 3m frames spacing slab is designed as one way continuous slab.
For 4.5m frame spacing the slab is designed as two way continuous slab.

CONCRETE: Total volume of concrete for 3m frame spacing 229.4m^3
Total volume of concrete for 4.5m frame spacing 181.7m^3

STEEL: Total weight of steel for 3m frame spacing 171875N
Total weight of steel for 4.5m frame spacing 136235N
From the above results the volume of concrete used is less when compared to 3m spacing. It is more economical when compared with the usage of steel.
from above results and comparison so one can adopt 4.5m frame spacing.

12.References:

1.Reinforced concrete design - n. krishna , r.n. pranesh
2.Reinforced concrete structures – s. ramamrutham
3.Reinforced concrete limit state design – ashok k jain
4.Is 456-2000 code : plain reinforcement concrete code of practice,bureau of is,new delhi.