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Analysis and Design of G+6 Residential Building using STAAD PRO

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Abstract: ***Analysis of a structure deals with the determination of behaviour of structures in order to predict the responses of real structures such as buildings, bridges, trusses etc. Under the influences of expected loading and external loading during the service life of a structure. The results of the analysis are then used for structural health monitoring.***
Computer software are also used for the calculation of forces, bending moments for a complex structural system. The principle objective of this study is the analysis and design of G+ 6 residential building using STAAD PRO software
Keywords: structural health monitoring, calculation of forces and bending moment, STAAD PRO

I. INTRODUCTION

The world's urban population is growing at very faster rate. Currently, about half of the world's population is living in urban areas. In the coming decades, urban dwellers will make up roughly 60 to 70 percent of the world's population. Though the urban population is growing at an alarming rate, the land available for construction is limited. Increasing population coupled with urbanization has made the construction of multi-storey buildings a necessity to house the millions. Housing the millions is possible only by constructing multi-storey buildings.

As the height of building increases, the behavior of the structure becomes more complex, these are more sensitive to wind and earthquake loads and hence, we need to be very careful to design them. Reinforced concrete is the best suited for multi-storey buildings.

It has occupied a special place in the modern construction due to its several advantages. Owing to its flexibility in form and superiority in performance, it has replaced the earlier materials like stone, timber and steel. It has helped the engineers and architects to build pleasing structures. However, its role in several straight line structural forms like, multi-storey building and bridges etc. is enormous.

II. METHODOLOGY

1) *Step 1* - Collection of data
2) *Step 2*- Planning and drawing in AUTOCAD
3) *Step 3* – Manual analysis of structure
4) *Step 4* – Design of concrete members
5) *Step 5* – Analysis in STAAD PRO
6) *Step 6* – Conclusion

III. SOFTWARE USED

A. *STAAD PRO*

It allows structural engineers to analyze and design virtually any type of structure through its flexible modeling environment, advanced features and fluent data collaboration.

The main advantages are advanced automatic load generation facilities for wind , moving loads.

Isomeric and perspective views with 3D shapes, joints, members or elements can be obtained.

B. *Autocad*

Computer aided design which are computer based tools used to assist designers, engineers, architects in their design activities.

CAD is used as preparing architectural drawings and interior design and modeling.

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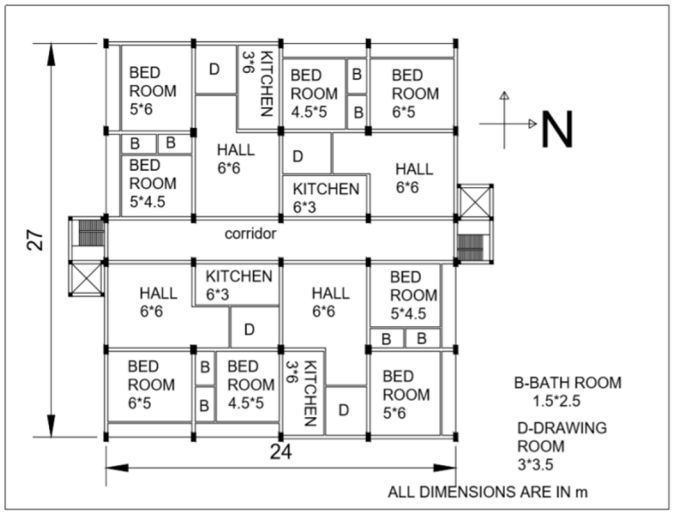
IV. BASIC DATA AND FLOOR PLAN



Floor plan

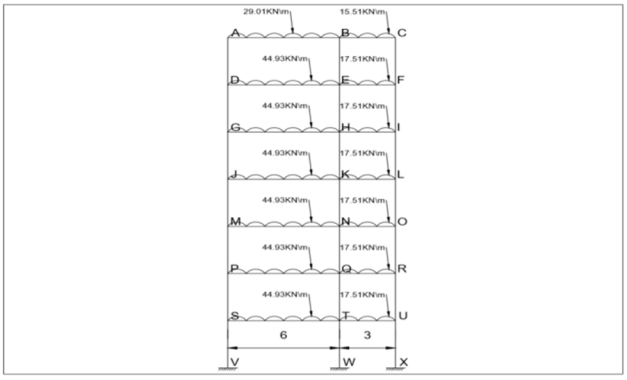
Total height of building = 22.4m
Height of each floor = 3.2m
Plot area = 648 sq.m
No of flats (per floor) = 4
Total no of flats = 24
Number of columns = 30
Numbers of beams (per floor) = 68

V. MANUAL ANALYSIS BY KANI'S METHOD

Kani's Method was developed by Dr. Gasper Kani of Germany in 1947. The method is named after him. This is an indirect extension of slope deflection method .this is an efficient method due to simplicity of moment distribution. This method offers an iterative scheme for applying slope deflection method. It is also known as Rotation Contribution Method. This is a good iterative procedure avoiding the mistakes during the execution of the process error is self-eliminative. All this effort can be cut short very considerably by using this method.

Frame analysis is carried out by solving the slope-deflection equations by successive approximations Useful in case of side sway as well.

Operation is easy, as it is carried out in a specific direction. If some error is occurred it will be eliminated in subsequent cycles if the restraining moments and distribution factors have been determined correctly. That is why in this project Kani's method is used for the analysis of structure for gravity loads.



Frame in X - Direction

Final Moments

HORIZONTAL MEMBERS	
FINAL MOMENTS	END MOMENTS VALUES
Mab	-64.56
Mba	88.17
Mbc	-35.35
Mcb	4.57
Mde	-118.03
Med	134.23
Mef	-34.4
Mfe	6.38
Mgh	-117.83
Mhg	133.55
Mhi	-36.7
Mih	4.87
Mjk	-117.79
Mkj	133.84
Mkl	-35.85
Mlk	5.49
Mmn	-117.7
Mnm	133.78
Mno	-36.03
Mon	5.55
Mpq	-118.04
Mqp	134.099
Mqr	-34.79
Mrq	6.02
Mst	-115.2
Mts	133.08
Mtu	-41.27
Mut	2.9

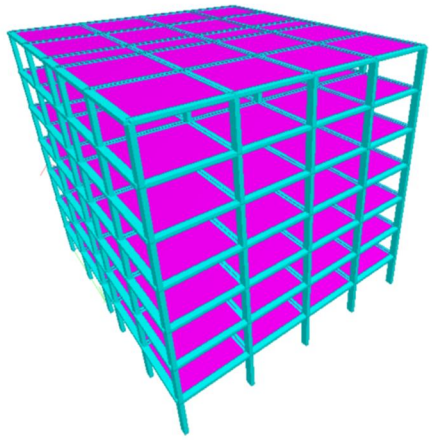
VERTICAL MOMENTS	
FINAL MOMENTS	END MOMENTS VALUES
Mad	61.89
Mda	56
Mbe	-53.51
Meb	-51.98
Mcf	-5.82
Mfc	-6.58
Mdg	53.64
Mgd	54.31
Meh	-48.62
Mhe	-49.59
Mfi	-4.71
Mif	-4.94
Mgj	54.97
Mjg	54.84
Mhk	-50.2
Mkh	-49.84
Mil	-4.93
Mli	-4.81
Mjm	54.64
Mmj	54.71
Mkn	-49.86
Mnk	-50
Mlo	-4.83
Mol	-4.73
Mmp	54.29
Mpm	53.63
Mnq	-49.6
Mqn	-48.88
Mor	-4.75
Mro	-4.84
Mps	56.74
Msp	60.99
Mqt	-51.92
Mtq	-55.2
Mru	-5.34
Mur	-9.95
Msv	45.35
Mtw	-37.17
Mvx	-1.92

VI. BASE SHEAR CALCULATIONS

CALCULCULATIONS OF BASE SHEAR					
STOREY NO	hi	SIESMIC WEIGHT	wihi^2	k=wihi^2/sum of(wi*hi^2)	Qi=Vb*k
6	22.4	4430	2222796	0.225	461.2
5	19.2	8200	3022848	0.306	656.43
4	16	8200	2099200	0.212	454.78
3	12.8	8200	1343488	0.136	291.74
2	9.6	8200	755712	0.076	163.03
1	6.4	8200	335872	0.034	72.93
GF	3.2	8200	83968	0.008	17.16
TOTAL BASE SHEAR					2117.27

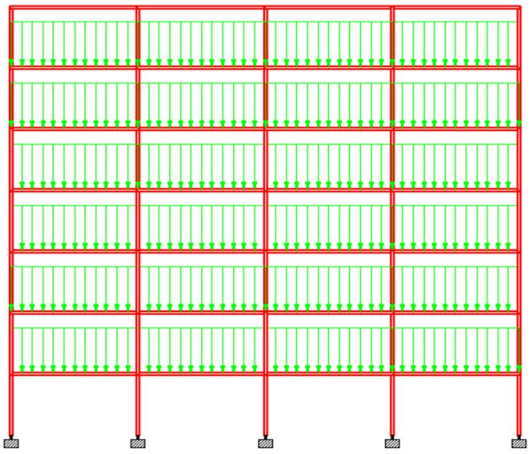
VII. STAAD PRO ANALYSIS

In our project we considered a G+6 residential building for planning design and analysis. The each floor consists of 4 no's of flats and we analysis total structure in STAAD PRO.

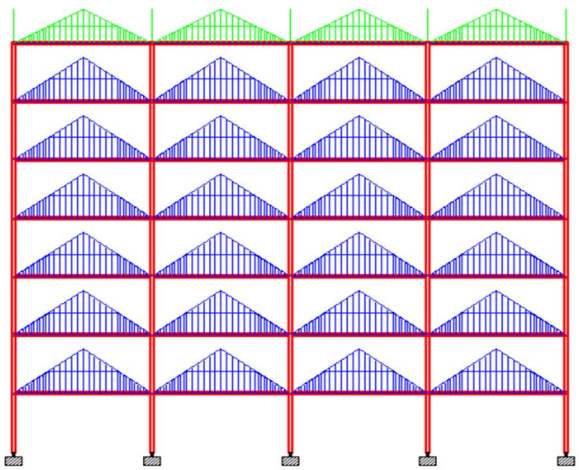


Loads Applied On Structure

Dead load



Live load



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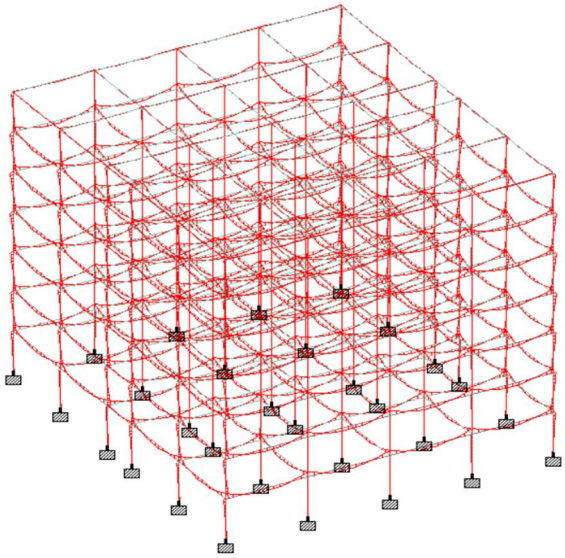
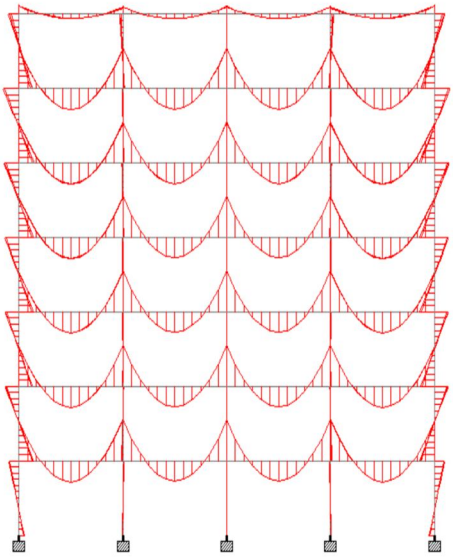
A. Bending Moment from STAAD PRO





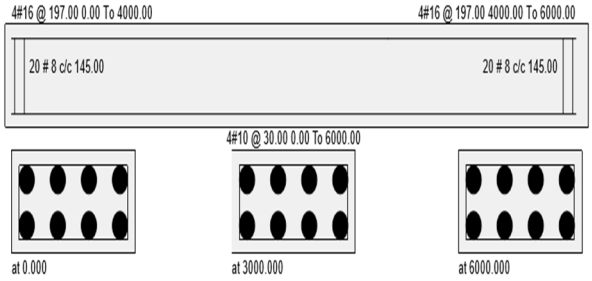
B. Design from STAAD PRO

Beam

STAAD.Pro Query Concrete Design

Beam no. 152

Design Code: IS-456



Design Load

Mz(Kn Met)	Dist.et	Load
20.879999	3.000000	3
-36.389999	0.000000	3
-37.369999	6.000000	3

Design Parameter

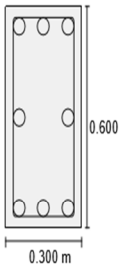
Fy(Mpa)	415.000000
Fc(Mpa)	25.000000
Depth(m)	0.230000
Width(m)	0.500000
Length(m)	6.000000

Column

STAAD.Pro Query Concrete Design

Beam no. 186

Design Code: IS-456



Design Load

Load	3
Location	End 1
Pu(Kns)	214.699997
Mz(Kns-Mt)	2.990000
My(Kns-Mt)	29.590000

Design Results

Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm²)	154.000000
As (%)	0.503000
Bar Size	12
Bar No	8

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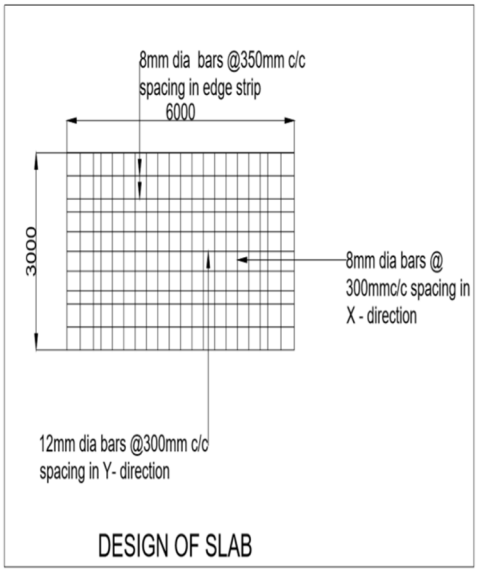
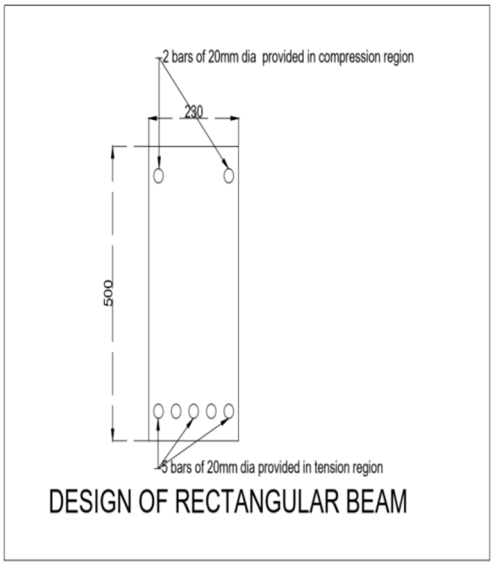
VIII. MANUAL DESIGN OF CONCRETE MEMBERS

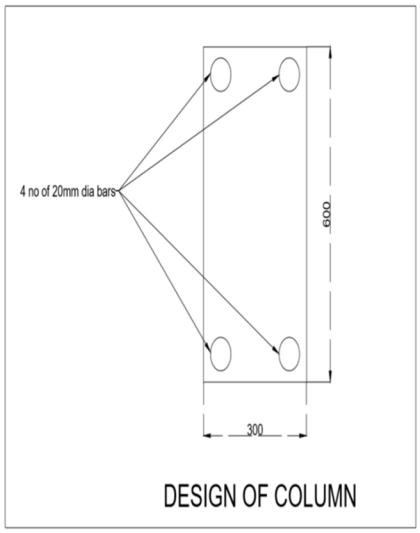
Slab



Beam



Column



A. Results

1) Details Of Two Way Slab Design

Overall depth = 150mm
Reinforcement 8mm dia@ 300mm c\c along short span
Reinforcement 12mm dia@ 300mm c\c along longer span

2) Details Of Beam Design

Dimensions of beam = 230mm * 500mm
Reinforcement 2 no of 20mm dia in compression zone
Reinforcement 5 no of 20mm dia in tension zone

3) Details Of Rectangular Column Design

Dimension of column = 300mm * 600mm
Reinforcement 4 no of 20mm dia

IX. COMPARISON OF MANUAL RESULTS AND STAAD PRO RESULTS

Structural element	Area of steel (manual) sq.m	Area of steel (STAAD PRO) sq.m	% variation
Beam	2227.78	1981.58	1.12%
column	1256.63	904.72	1.38%

It can be observed that maximum percentage of variation is 3%.

X. CONCLUSION

It was observed that the bending moment values obtained from manual calculation is differ maximum of 2% percent of the bending moment values obtained from STAAD Pro.
It was observed that the Area of steel obtained from manual calculation is differ maximum of 3% percent of the Area of steel obtained from STAAD Pro.

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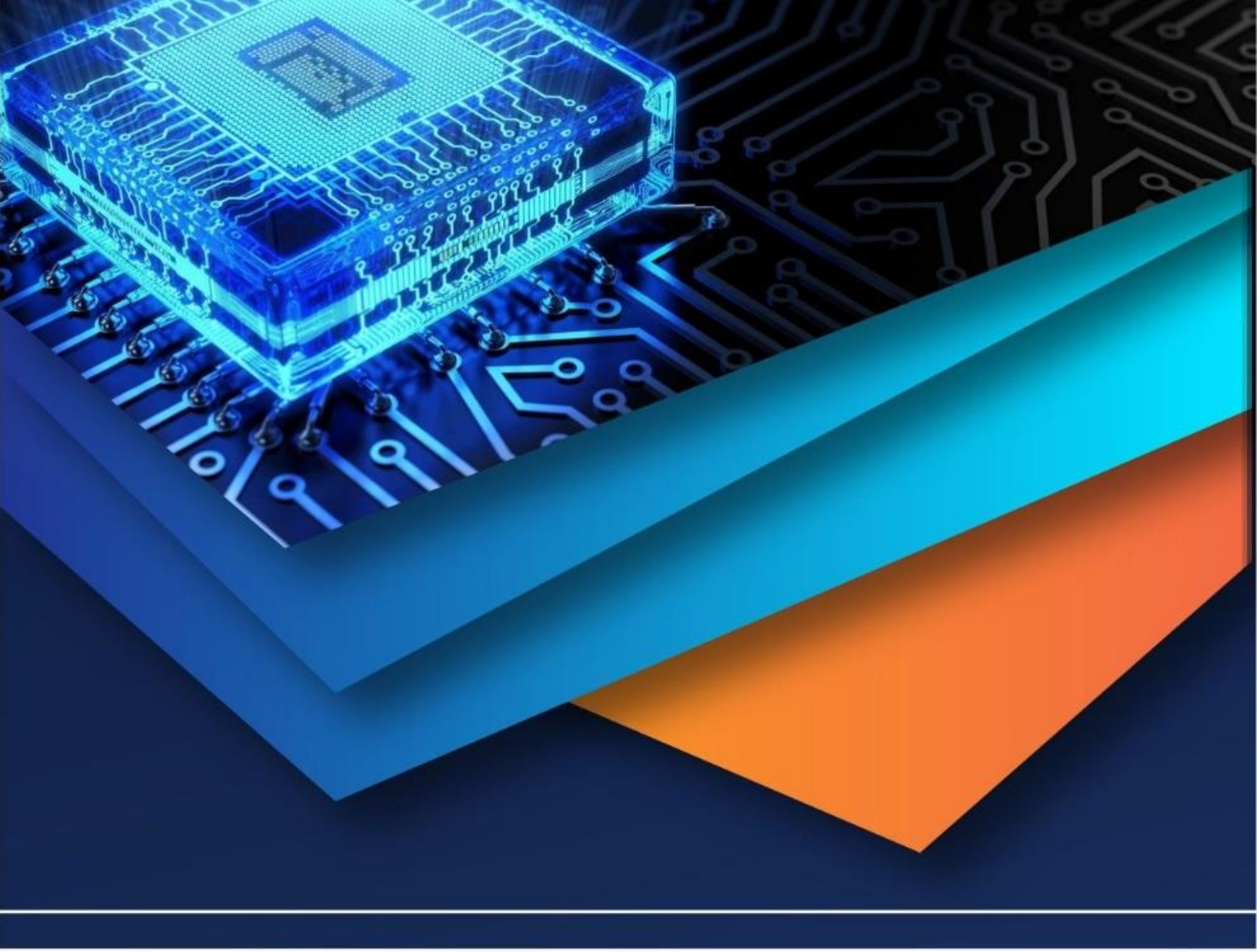

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