COMPARITIVE STUDY OF EFFECT OF FLOATING COLUMNS ON THE COST ANALYSIS OF A STRUCTURE DESIGNED ON STADD PRO V8i.

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ABSTRACT

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which (due to architectural design/ site situation) at its lower level (termination Level) rests on a beam which is a horizontal member. The beams in turn transfer the load to other columns below it. There are many projects in which floating columns are adopted, especially above the ground floor, where transfer girders are employed, so that more open space is available in the ground floor. These open spaces may be required for assembly hall or parking purpose. The transfer girders have to be designed and detailed properly, especially in earth quake zones. The column is a concentrated load on the beam which supports it. As far as analysis is concerned, the column is often assumed pinned at the base and is therefore taken as a point load on the transfer beam. STAAD Pro V8I can be used to do the analysis of this type of structure. Floating columns are competent enough to carry gravity loading but transfer girder must be of adequate dimensions (Stiffness) with very minimal deflection.

KEYWORDS: Hanging columns, types of loadings, stress distribution, weight of concrete, weight of steel, Practical applications.

INTRODUCTION:

In this present era of 21st century due to huge population the no. of areas in units are decreasing day by day. Few years back the populations were not so vast so they used to stay in Horizontal system(due to large area available per person).But now a day's people preferring Vertical System(high rise building due to shortage of area).In high rise buildings we should concern about all the forces that act on a building ,its own weight as well as the soil bearing capacity .For external forces that act on the building the beam, column and reinforcement should be good enough to counteract these forces successfully. And the soil should be good enough to pass the load successfully to the foundation. For loose soil we preferred deep foundation (pile).If we will do so much calculation for a high rise building manually then it will take more time as well as human errors can be occurred. So the use of STAAD-PRO will make it easy. STAAD-PRO can solve typical problem like Static analysis, Seismic analysis and Natural frequency. These type of problem can be solved by STAAD-PRO along with IS-CODE. Moreover STAAD-PRO has a greater advantage than the manual technique as it gives more accurate and precise result than the manual technique.

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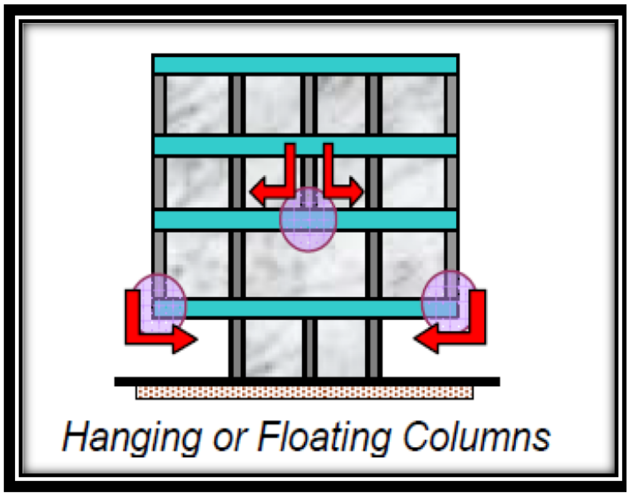
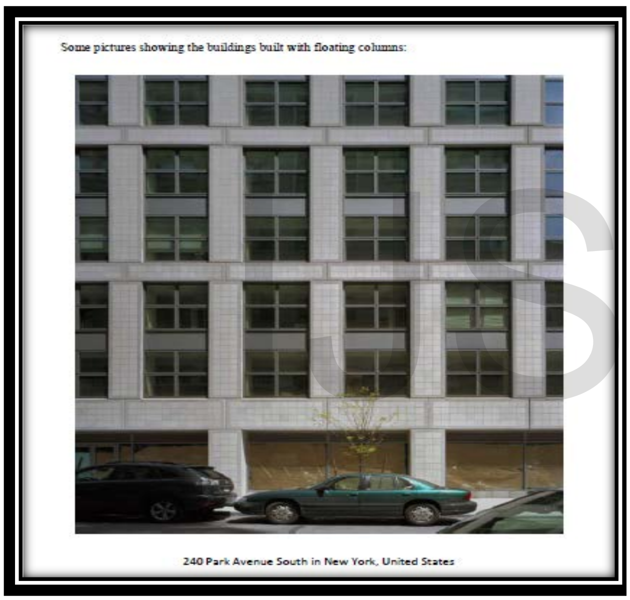

Hanging or Floating Columns

Looking ahead, of course, one will continue to make buildings interesting rather than monotonous. However, this need not be done at the cost of poor behaviour and earthquake safety of buildings. Architectural features that are detrimental to earthquake response of buildings should be avoided. If not, they must be minimized. When irregular features such as floating columns are included in buildings, a considerably higher level of engineering effort is required in the structural design and yet the building may not be as good as one with simple architectural features.



240 Park Avenue South in New York, United States

Hence, the structures already made with these kinds of discontinuous members are endangered in seismic regions. But those structures cannot be demolished, rather study can be done to strengthen the structure or some remedial features can be suggested. The columns of the first storey can be made stronger, the stiffness of these columns can be increased by retrofitting or these may be provided with bracing to decrease the lateral deformation.

FINITE ELEMENT FORMULATION

Stadd-pro basically works upon the finite element method (FEM), which is sometimes also referred as finite element analysis (FEA), is a computational technique which is used to obtain the solutions of various boundary value problems in engineering, approximately. Boundary value problems are sometimes also referred to as field value problems. It can be said to be a mathematical problem wherein one or more dependent variables must satisfy a differential equation everywhere within the domain of independent variables and also satisfy certain specific conditions at the boundary of those domains. The field value problems in FEM generally has field as a domain of interest which often represent a physical structure. The field variables are thus governed by differential equations and the boundary values refer to the specified value of the field variables on the boundaries of the field. The field variables might include heat flux, temperature, physical displacement, and fluid velocity depending upon the type of physical problem which is being analysed.

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1. FORMULATION OF THE PROBLEM

A 15mt x 20mt ,2 storey regular structure is considered for the study. Modeling, analysis, estimation and design of the structure is done separately on STAAD pro software. Plan of the building and numbering of columns is considered is shown in Figure 1.

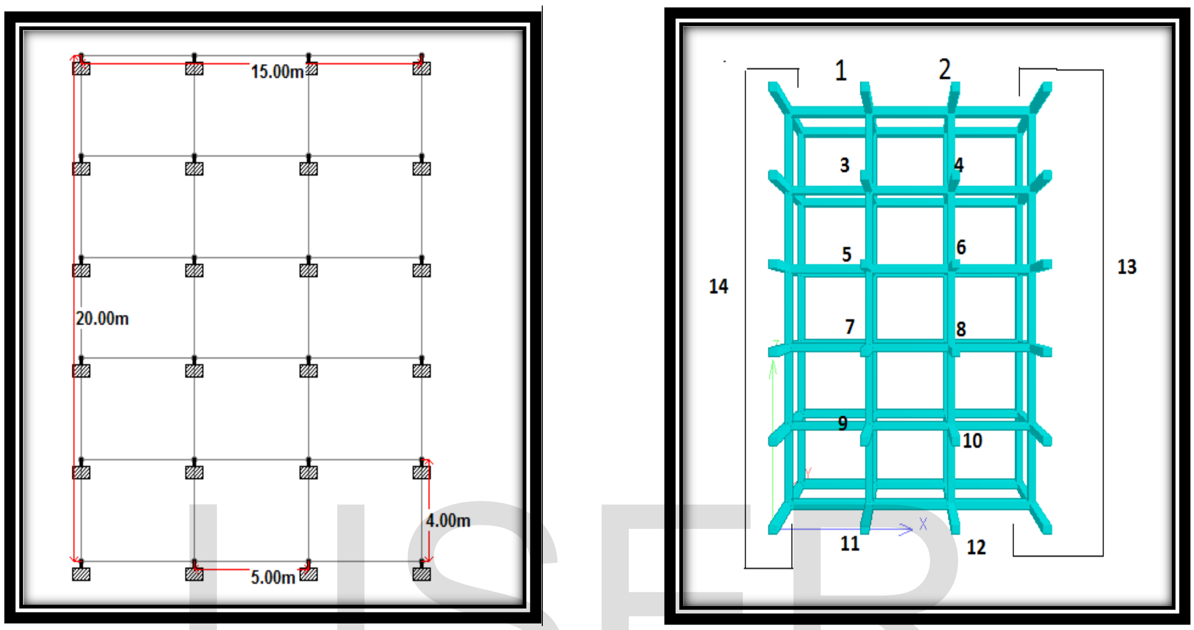


Figure. 1

1.1 TYPES OF LOAD USED

DEAD LOAD (DL):- DEAD LOAD is defined as the the load on a structure due to its own weight (self-weight). It also added other loads if some permanent structure is added to that structure.
LIVE LOAD (LL):- LIVE LOAD or IMPOSED LOAD is defined as the load on the structure due to moving weight. The LIVE LOAD varies according to the type of building. For example generally for a Residential Building the LIVE LOAD is taken as 2 kn/m^2.
SEISMIC LOAD (SL):- SEISMIC LOAD can be calculated taking the view of acceleration response of the ground to the super structure. According to the severity of earthquake intensity they are divided into 4 zones.

1. Zone I and II are combined as zone II.
2. Zone III.
3. Zone IV.
4. Zone V.

2 CALCULATION OF LOADS

2.1 DEAD LOAD CALCULATION:

MAIN WALL LOAD (From above plinth area to below the Roof) should be the cross sectional area of the wall multiplied by unit weight of the brick. (unit weight of brick is taken as 20 kn/m3).
According to the IS-CODE PLINTH LOAD should be half of the MAIN WALL LOAD. Internal PLINTH LOAD should be half of the PLINTH LOAD. PARAPATE LOAD should be the cross sectional is multiplied by unit weight. SLAB LOAD should be combination of slab load plus floor finishes. SLAB LOAD can be calculated as the thickness of slab multiplied by unit weight of concrete (according to IS-CODE unit weight of concrete is taken as 25 kn/m^3).and FLOOR FINISHES taken as 0.5--0.6 kn/ m^2.

2.2 LIVE LOAD CALCULATION:

LIVE LOAD is applied all over the super structure except the plinth .Generally LIVE LOAD varies according to the types of building. For Residential building LIVE LOAD is taken as ------ 2kn/m^2 on each floor and -1.5 kn/ m^2 on roof. Negative sign indicates its acting on downward direction.

2.3 SEISMIC LOAD CALCULATION:

According to the IS-CODE 1893(part 1) the horizontal Seismic coefficient Ah for a structure can be formulated by the following expression:

$$Ah=\frac{ZI\ (Sa)}{2R\ (G)}$$

WHERE ; Z=Zone factor depending upon the zone the structure belongs to.
For Zone II (z=0.1)
For Zone III (Z=0.16)
For Zone IV (Z=0.24)
For Zone V (Z=.36)
I=Importance factor.
For important building like hospital it is taken as 1.5 and other for other building it is taken as 1.
R=Response reduction factor.
Sa/g=Average Response Acceleration coefficient.
However it should be notice that the ratio of I and R should not be greater than 1.

2.4 LOAD COMBINTIONS

For seismic load analysis of a building the I.S. code refers following load combination.

- 1.5(DL + IL)
- 1.2(DL + IL ± EL)
- 1.5(DL ± EL)
- 0.9 DL ± 1.5 EL

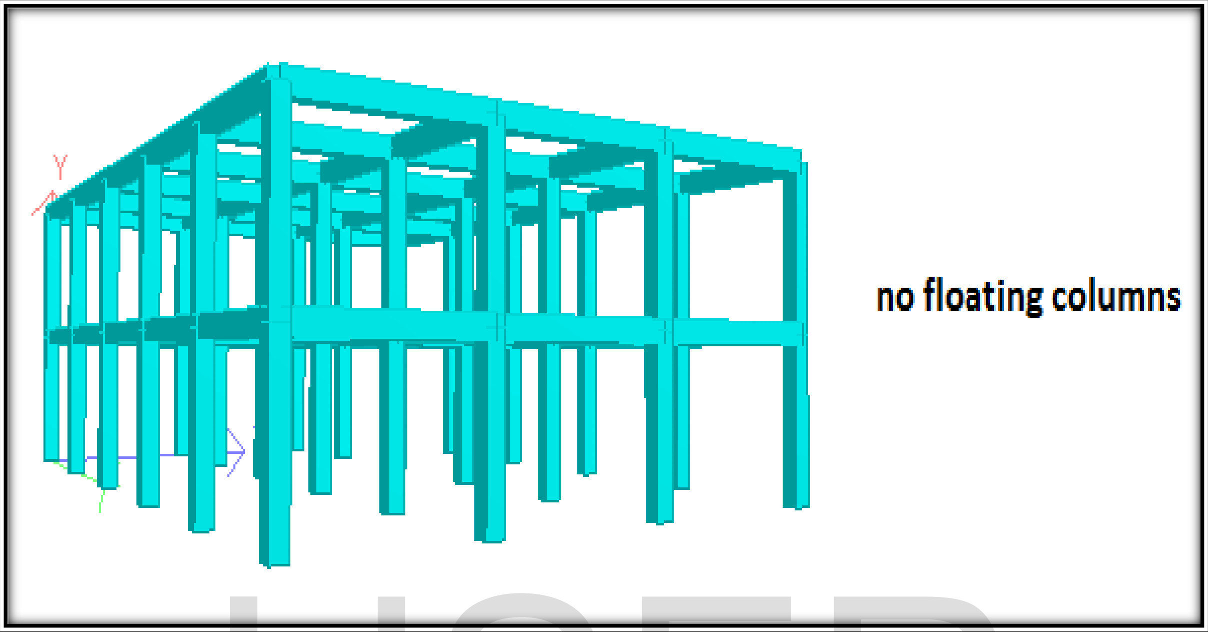
The EL are applied in X and Z direction. These loads are also applied further in negative X and Z direction. So for Seismic analysis there are 18 load combinations.

2.5 Loading consideration

Loads acting on the structure are dead load (DL), Live Load (IL) and Earthquake Load (EL)

☐ DL: Self weight of the structure, Floor load and Wall loads
☐ LL: Live load 3 kn/ m^2 is considered
☐ Response reduction factor: 5
☐ Importance factor: 1
☐ Damping: 5%
☐ Time period: 0.246 sec (calculated as per IS 1893: 2002)
☐ Type of structure--> multi-storey fixed jointed plane frame.
☐ Seismic zone II (IS 1893 (part 1):2002)
☐ Number of stories 2, (G+2)
☐ Floor height 3.5 m
☐ No of bays and bay length as per plan.
☐ Imposed load 3kn/ m^2 on each floor and 1.5 kn/ m^2 roof.
☐ Materials Concrete (M 30) and Reinforcement (Fe 415).
☐ Size of column as per case
☐ Size of beam as per case
☐ Depth of slab 0.125m thick
☐ Specific weight of RCC 25 kn/ m^2.
☐ Specific weight of infill 20kn/ m^2
☐ Type of soil is Medium soil.

Case 1

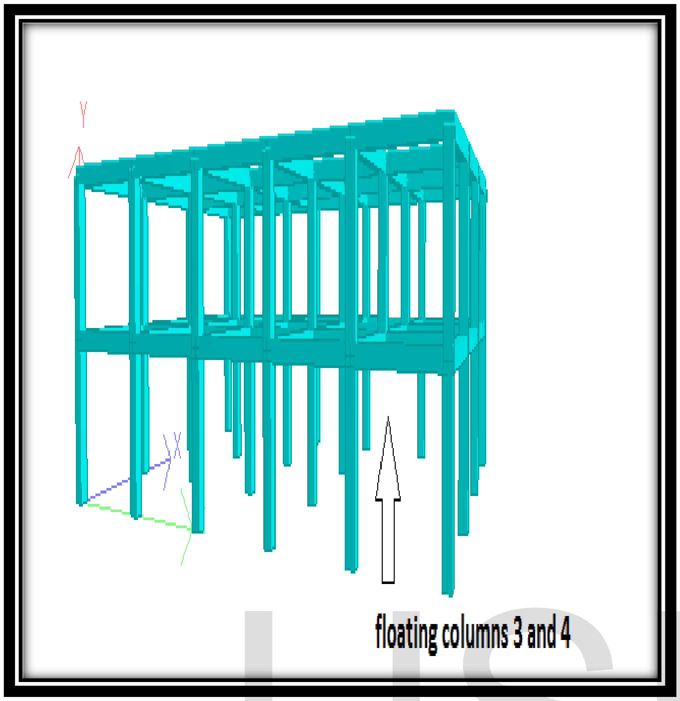


TOTAL VOLUME OF CONCRETE = 53.3 CU.METER

BAR DIA (in mm)	WEIGHT (in New)
--------	--------
8	13338
10	6385
12	19584
16	9477
20	1845
25	832

*** TOTAL=	51459

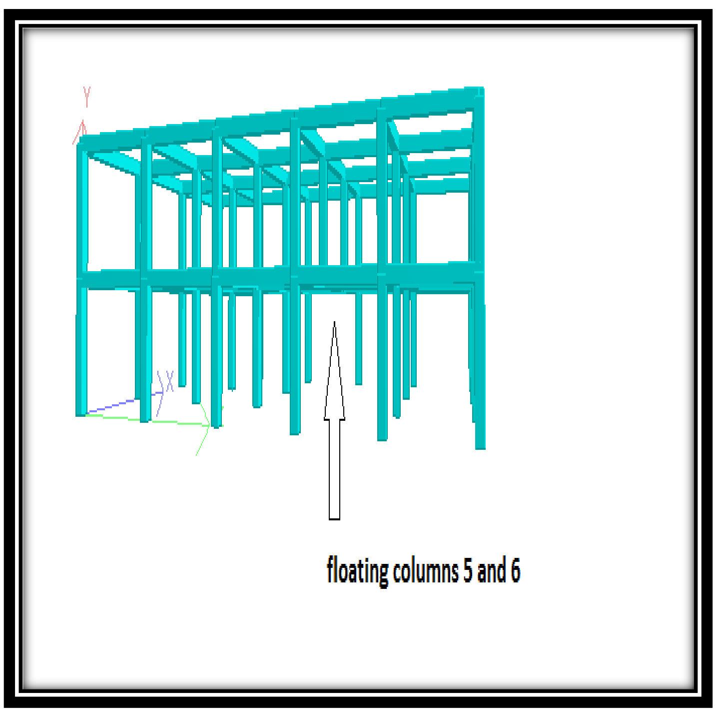
Case 2



TOTAL VOL. OF CONC. = 80.2

BAR DIA (in mm)	WEIGHT (in New)
8	13124
10	09664
12	20138
16	19842
20	14885
25	01058
32	01610
*** TOTAL=	80322

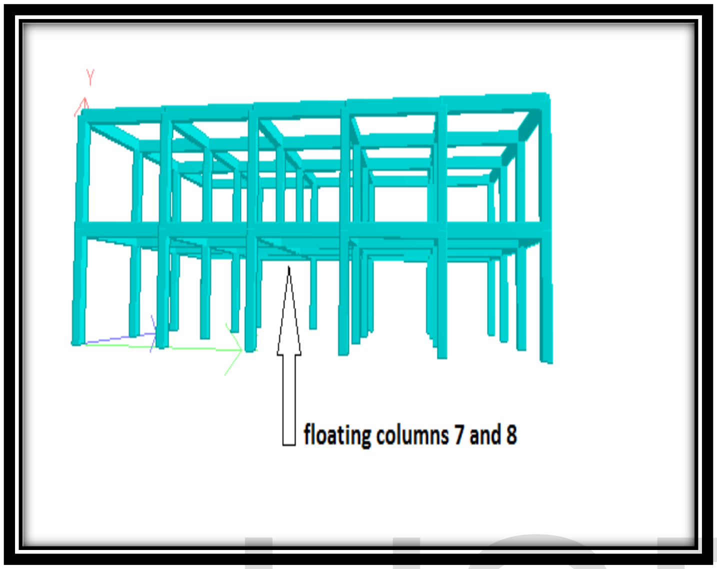
Case 3



TOTAL VOL. OF CONC. =70.1 m^3

BAR DIA (in mm)	WEIGHT (in New)
8	12932
10	9144
12	13891
16	15857
20	15038
25	9774
32	3179
TOTAL =	79815

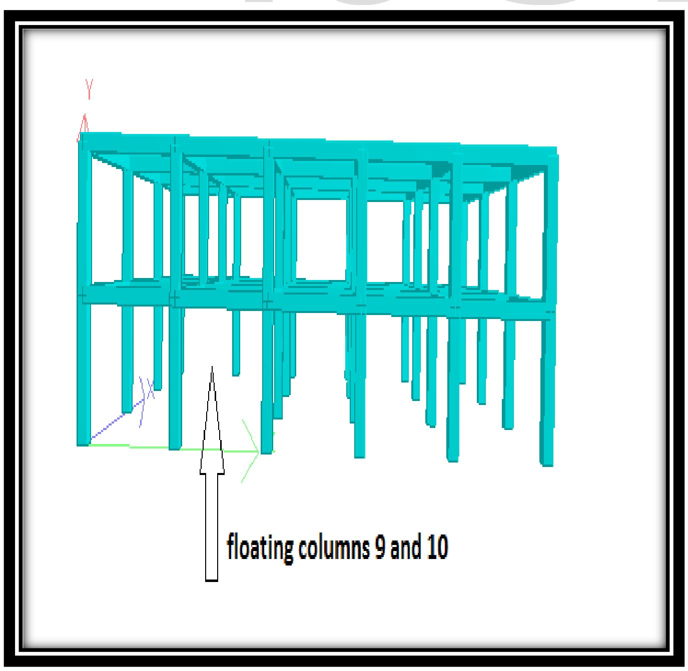
Case 4



TOTAL VOL. OF CONC = 70.1m^3

BAR DIA (in mm)	WEIGHT (in New)
8	12901
10	9144
12	13642
16	15882
20	15392
25	9931
32	3179
*** TOTAL=	80071

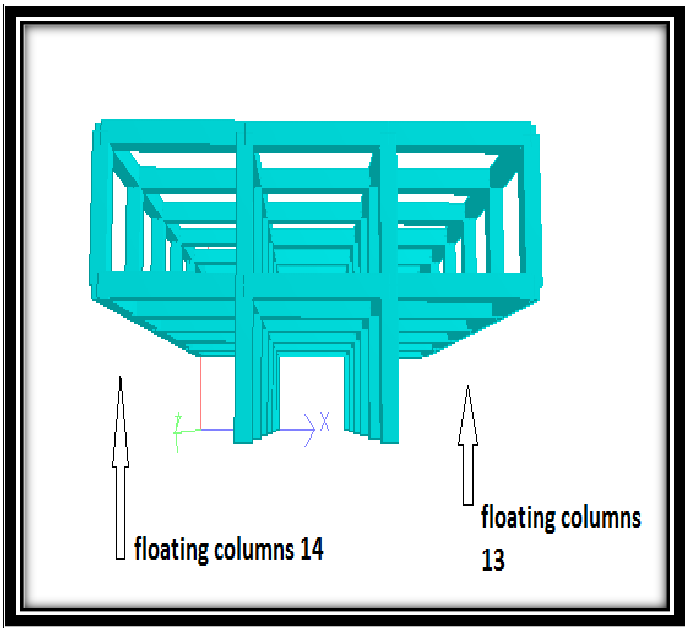
Case 5



TOTAL VOL. OF CONC. = 80.2 m^3

BAR DIA (in mm)	WEIGHT (in New)
8	13158
10	9664
12	20631
16	19761
20	14429
25	1058
32	1569
*** TOTAL =	80271

Case 6



TOTAL VOL. OF CONC. = 141.0 m^3

BAR DIA (in mm)	WEIGHT (in New)
--------	---------
8	14287
10	3067
12	27043
16	21724
20	58420
25	34767
32	10579

*** TOTAL=	169887

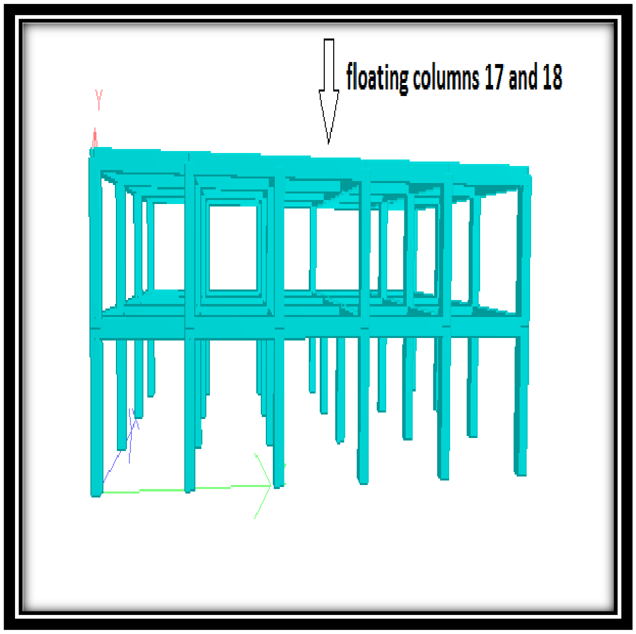
Case 7

TOTAL VOL. OF CONC. = 79.0 m^3

BAR DIA (in mm)	WEIGHT (in New)
--------	--------
8	13073
10	11787
12	15556
16	12426
20	13875
25	4926

*** TOTAL=	71643

Case 8



TOTAL VOL. OF CONC. = 88.9 m^3

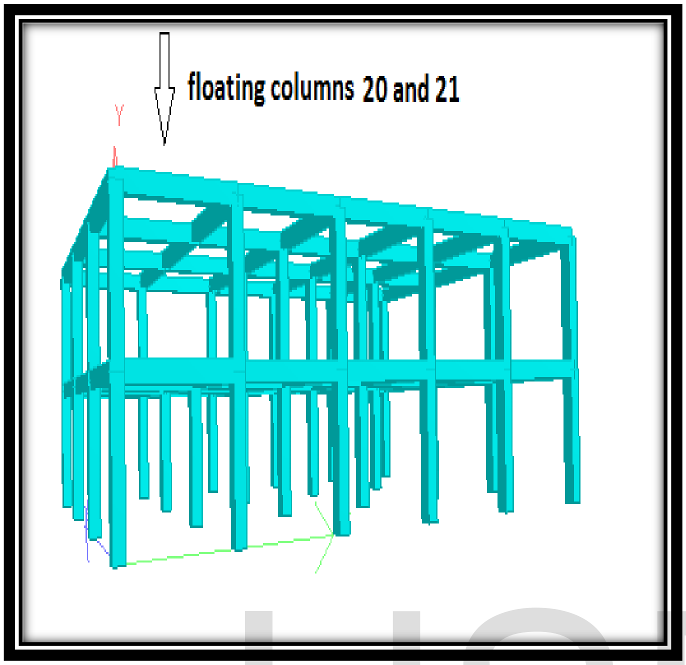
BAR DIA (in mm)	WEIGHT (in New)
8	14003
10	14286
12	7046
16	18621
20	1709
25	2221
*** TOTAL=	57886

Case 9

TOTAL VOLUME OF CONC. = 80.2 m^3

BAR DIA (in mm)	WEIGHT (in New)
8	13784
10	10785
12	22443
16	6632
20	5108
25	5329
*** TOTAL=	64080

Case 10



TOTAL VOL. OF CONC. = 90.2 m^3

BAR DIA (in mm)	WEIGHT (in New)
8	13257
10	12928
12	14362
16	18949
20	8063
25	2189
32	1693
*** TOTAL=	71441

Table: no.01 Comparison of weight of concrete and steel in different cases

	Weight of concrete (kg)	Weight of steel (kg)
Structure 1	12536.16	5250.91
Structure 2	18863.04	8196.12
Structure 3	16487.52	8144.38
Structure 4	16487.52	8170.51
Structure 5	18863.04	8190.912
Structure 6	33163.2	17335.40
Structure 7	18580.8	7310.51
Structure 8	20909.28	5906.74
Structure 9	18863.04	6538.76
Structure 10	21215.04	7289.89

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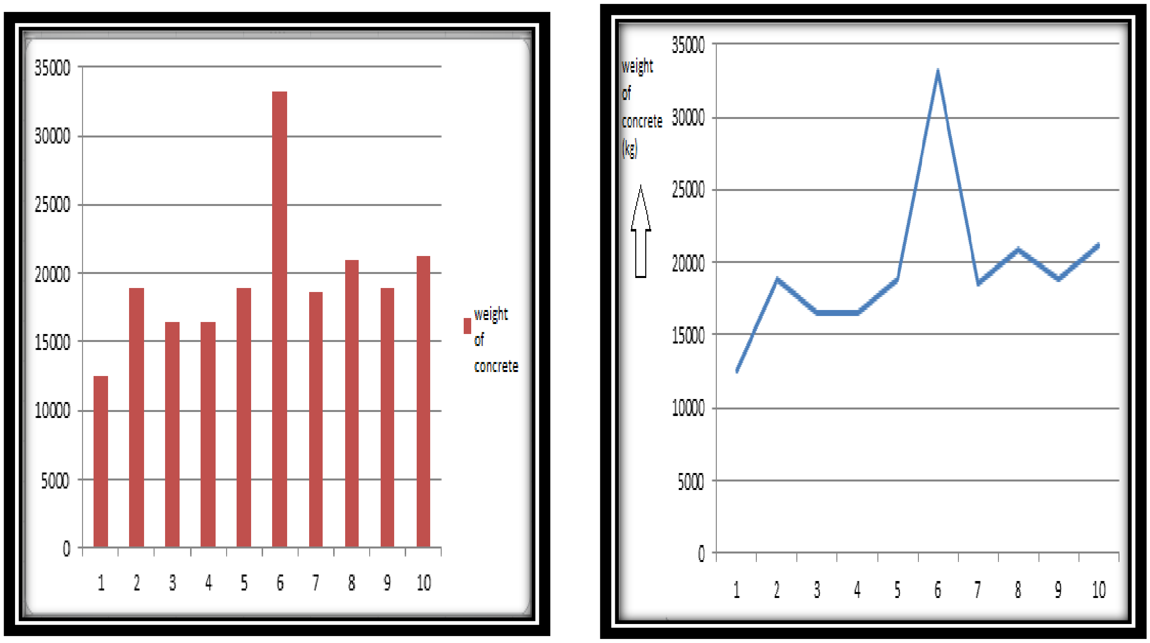
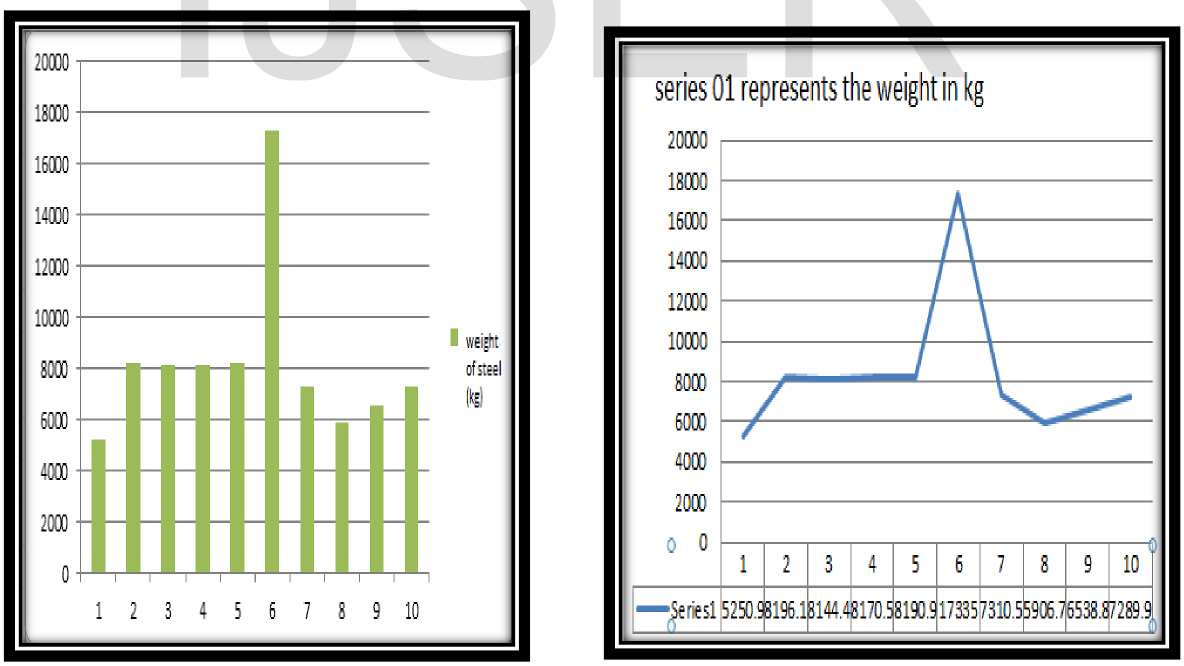


Comparison of the weight of concrete required in different cases.



Comparison of the weight of steel required in different cases.

CONCLUSIONS

1. In the framed structure with no floating columns the nodal displacements is minimum with uniform distribution of stresses at all beams and columns. As a result it is most economical.

2. For the case no. 6: i.e. the removal of the panels of columns numbered 13 and 14 as given in figure no. 1 there is maximum requirement of concrete and steel. This type of building is frequently used so as to avoid any external facility for parking of vehicles; so the analysis shows that it is not advisable to propose such structures.

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