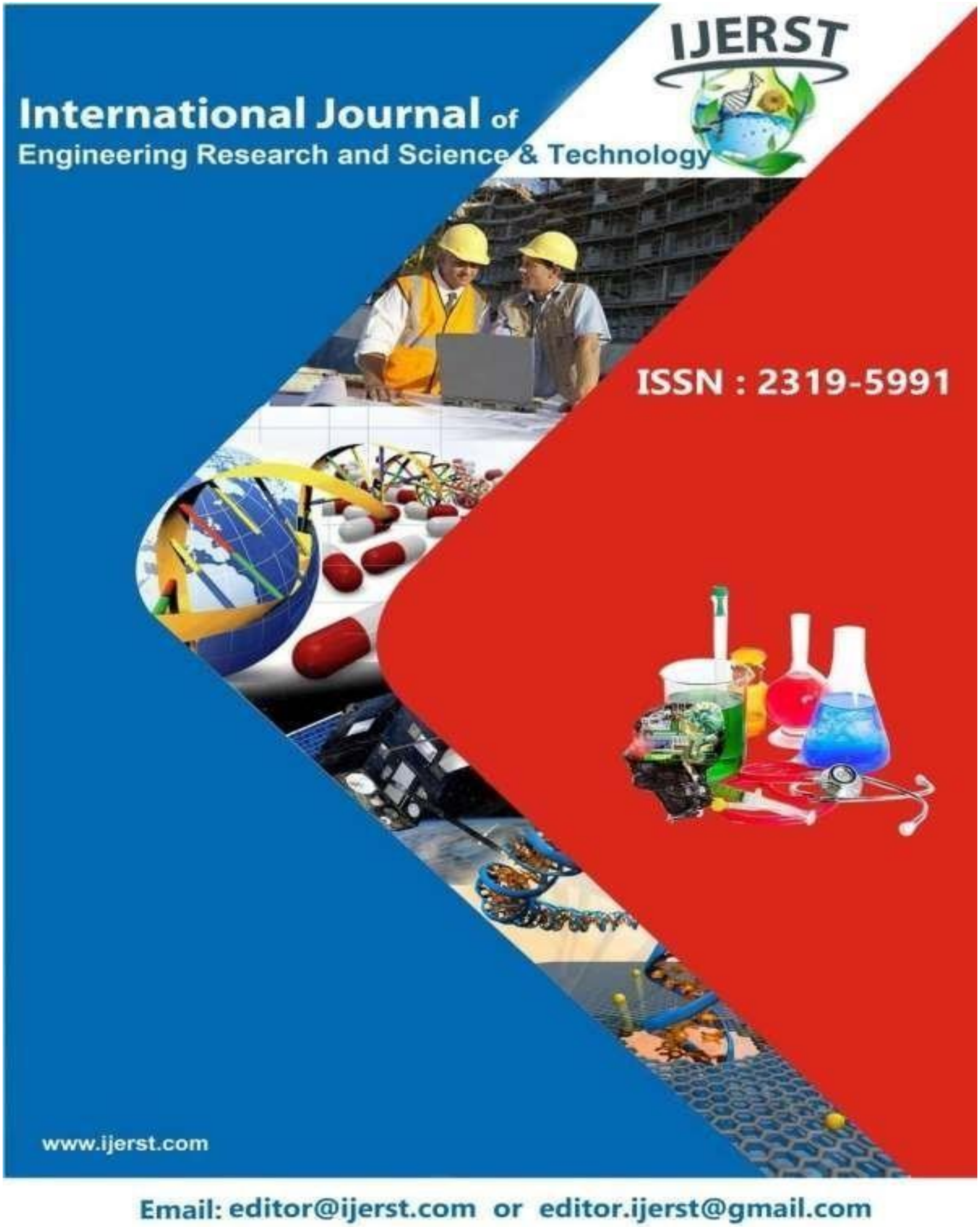

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DESIGN AND ANALYSIS OF G+12 WITH AND WITHOUT FLOATING COLUMNS

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ABSTRACT

In present scenario buildings with floating column is a typical feature in the modern multi-storey construction in urban India. Such features are highly undesirable in building built in seismically active areas. This study highlights the importance of explicitly recognizing the presence of the floating column in the analysis of g+12 building. Alternate measures, involving stiffness balance of the first storey and the storey above, are proposed to reduce the irregularity introduced by the floating columns. The component backbone modelling for the concrete columns also had to change so that convergence could be reached in the STAAD PRO and the Perform-3D models. To prevent a backbone with negative stiffness, a conservative backbone was used, in which the nominal capacity was taken at the onset of steel yielding, and then a line was drawn to the peak moment capacity. At this point, the column was assumed to have lost any significant capacity Because the rotational demand was relatively small for the columns in this project, this ultimate point of rotation was never reached FEM codes are developed for 2D multi storey frames with and without floating column to study the responses of the structure under different earthquake excitation having different frequency content keeping the PGA and time duration factor constant. The time history of floor displacement, inter storey drift, base shear, overturning moment are computed for both the frames with and without floating column.

KEYWORDS: Floating Columns, Staad Pro, Bending Moment, Shear Force, Sesimic Zone, Shear Pannel

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INTRODUCTION:

Many urban multi-storey buildings in India today have open first storey as an unavoidable feature. This is primarily being adopted to accommodate parking or reception lobbies in the first storey. Whereas the total seismic base shear as experienced by a building during an earthquake is dependent on its natural period, the seismic force distribution is dependent on the distribution of stiffness and mass along the height.

The behaviour of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path; any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks (like the hotel buildings with a few storey wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake. Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path

What is floating column

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.

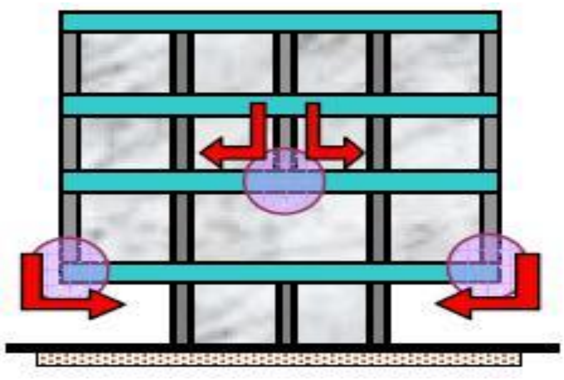

Fig 1.1 **Hanging or floating columns**

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

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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, STAAD PRO and SAP2000 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.

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 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.

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.

Some pictures showing the buildings built with floating columns:

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Fig 1.2 240 Park Avenue South in New York, United States

Fig 1.3 Polestar in London, United Kingdom

LITERATURE REVIEW:

1. **Maison and Neuss (1984)** Members of ASCE have performed the computer analysis of an existing forty four story steel frame high-rise Building to study the influence of various modelling aspects on the predicted dynamic properties and computed seismic response behaviours. The predicted dynamic properties are compared to the building's true properties as previously determined from experimental testing. The seismic response behaviours are computed using the response spectrum and equivalent static load methods.
2. **Maison and Ventura (1991)** Members of ASCE computed dynamic properties and response behaviours OF THIRTEEN-STORY BUILDING and this result are compared to the true values as determined from the recorded motions in the building during two actual earthquakes and shown that state-of-practice design type analytical models can predict the actual dynamic properties.

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3. **Arlekar, Jain & Murty, (1997)** said that such features were highly undesirable in buildings built in seismically active areas; this has been verified in numerous experiences of strong shaking during the past earthquakes. They highlighted the importance of explicitly recognizing the presence of the open first storey in the analysis of the building, involving stiffness balance of the open first storey and the storey above, were proposed to reduce the irregularity introduced by the open first storey.
4. **Awkar and Lui (1997)** studied responses of multi-story flexibly connected frames subjected to earthquake excitations using a computer model. The model incorporates connection flexibility as well as geometrical and material nonlinearities in the analyses and concluded that the study indicates that connection flexibility tends to increase upper stories' inter-storey drifts but reduce base shears and base overturning moments for multi-story frames.
5. **Balsamoa, Colombo, Manfredi, Negro & Prota (2005)** performed pseudo dynamic tests on an RC structure repaired with CFRP laminates. The opportunities provided by the use of Carbon Fibre Reinforced Polymer (CFRP) composites for the seismic repair of reinforced concrete (RC) structures were assessed on a full-scale dual system subjected to pseudo dynamic tests in the ELSA laboratory. The aim of the CFRP repair was to recover the structural properties that the frame had before the seismic actions by providing both columns and joints with more deformation capacity. The repair was characterized by a selection of different fiber textures depending on the main mechanism controlling each component. The driving principles in the design of the CFRP repair and the outcomes of the experimental tests are presented in the paper. Comparisons between original and repaired structures are discussed in terms of global and local performance. In addition to the validation of the proposed

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technique, the experimental results will represent a reference database for the development of design criteria for the seismic repair of RC frames using composite materials.

METHODOLOGY:

INTRODUCTION TO STAAD PRO:

STAAD Pro is powerful design software licensed by Bentley. Staad stands for structural analysis and design. Any object which is stable under a given loading can be considered as structure and To calculate SFD and BMD of a complex loading beam it takes about an hour.

Now a days most of the highrise buildings are designed by staad which makes a compulsion for a civil engineer to know about this software. These software can be used to carry rcc, steel, bridge, truss etc according to various country codes.

Staad Editor:

Staad has very great advantage to other software's i.e., staad editor. staad editor is the programming

Limitations of Staad pro:

1.Huge output data

2.Even analysis of a small beam creates large output.

3.Unable to show plinth beams.

Staad foundation:

Staad foundation is a powerful tool used to calculate different types of foundations. It is also licensed by Bentley software's. All Bentley software's cost about 10 lakhs and so all engineers can't use it due to heavy cost.

SHALLOW (D<B)

1. Isolated (Spread) Footing
2.Combined (Strip) Footing
3.Mat (Raft) Foundation

DEEP (D>B)

i. Pile Cap
ii. Driller Pier

So depending on the soil at type we has to decide the type of foundation required.

After input data is give software design the details for each and every footing and gives the details regarding,

1. Geometry of footing
2. Reinforcement
3. Column layout
4. Graphs
5. Manual calculations

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These details will be given in detail for each and every column.

BASIC ANALYSIS OF THE BUILDING:

The analysis of post-tensioned floor systems differs from a reinforced concrete design approach owing to the positive effect that the tendons have on the structure. In RCC, the reinforcement is initially unstressed; the stress in the reinforcement results from the deformation and cracking of the structure under applied load. On the other hand, the tendons in a post-tensioned floor are actively stressed by the jacks so that they are loaded before the application of other loads. The force in the tendon is chosen by the designer and does not vary much with the application of serviceability Limit state dead and live loads.

Structural layout:

This has already been discussed. It is the most important decision in the design process. Unless previous experience or over riding factors dictate the exact form & section, several possibilities should be studied although the designer should be able to limit the possible solutions by considering the various constraints and by rough design and costing exercises.

Loading:

The loading for serviceability Limit State should consider the dead load and post-tensioning effects acting with those combinations of live loads which result in maximum stresses. At transfer of prestressing only the dead loads present during stressing, together with the post-tensioning effects before losses due to creep, shrinkage and relaxation should be considered in obtaining stresses.

Equivalent Frame Analysis:

It is usual to divide the structure into sub-frame elements in each direction. Each frame usually comprises one line of columns together with beam/slab elements of one bay width. The frames chosen for analysis should cover all the element types of the complete structure. The use of the equivalent frame method does not take account of the two-dimensional elastic load distribution effects automatically.

DESIGNS:

- DESIGN OF SLABS
- DESIGN OF BEAMS
- LOADS OF COLUMNS
- DESIGN OF COLOUMNS
- DESIGN OF FOOTINGS

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DESIGN OF SLAB

Slabs are to be designed under limit state method by reference of IS 456:2000.

- When the slab are supported in two way direction it acts as two way supported slab.
- A two way slab is economical compared to one way slab.

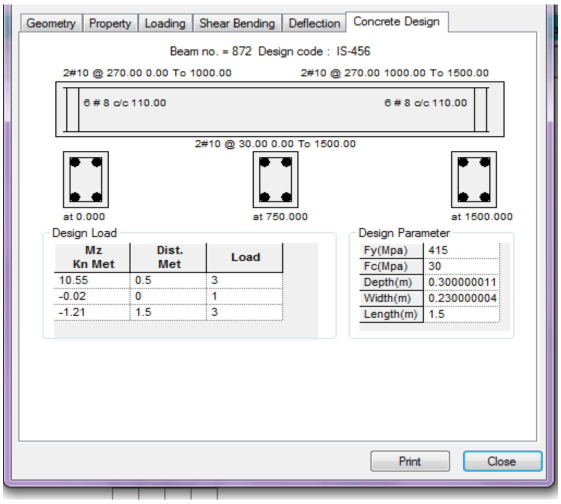

Figure shows Design of Beams without floating column

DESIGN OF BEAMS

- Beam is a member which transfers the loads from slab to columns and then foundation to soil.
- Beam is a tension member.
- Span of slabs, which decide the spacing of beams.
- Following are the loads which are acting on the beams.

➢ Dead load
➢ Live load
➢ Wind load

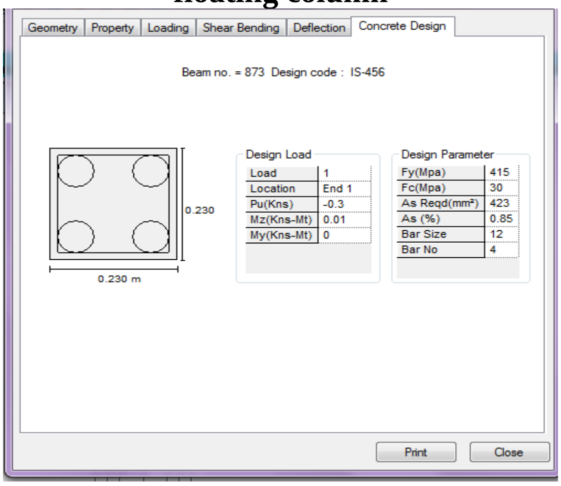

Figure shows Design of Beam with floating column

RESUL AND ANALYSIS:

WITHOT FLOATING COLUMNS

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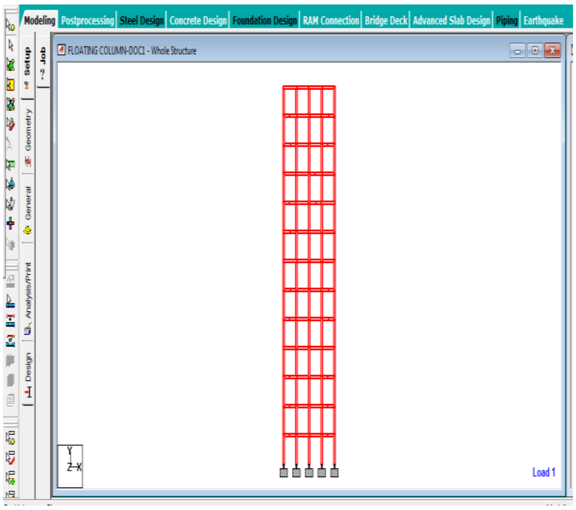


Figure shows G+12 building without floating column

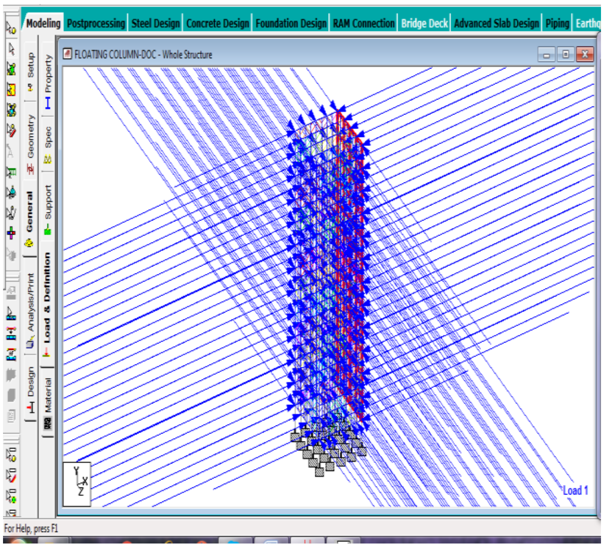


Figure shows Wind load acting on building

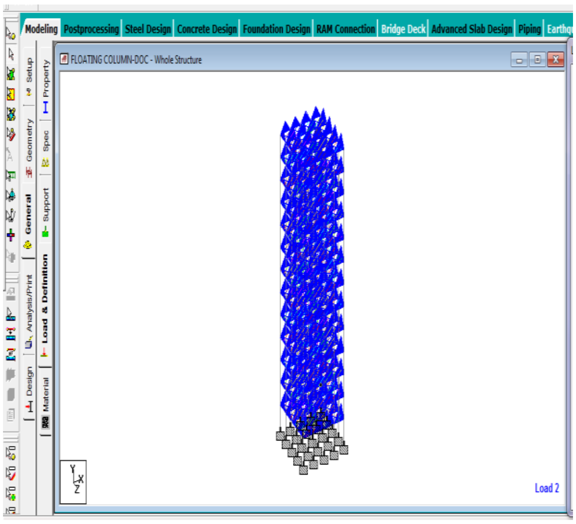
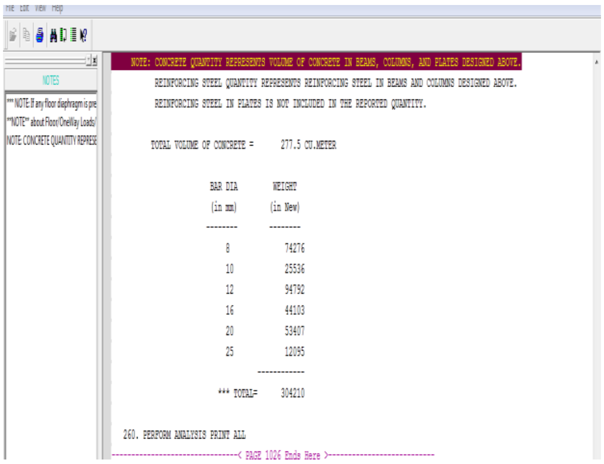


Figure shows Live load acting on building



NOTE: CONCRETE QUANTITY REPRESENTS VOLUME OF CONCRETE IN BEAMS, COLUMNS, AND PLATES DESIGNED ABOVE.
REINFORCING STEEL QUANTITY REPRESENTS REINFORCING STEEL IN BEAMS AND COLUMNS DESIGNED ABOVE.
REINFORCING STEEL IN PLATES IS NOT INCLUDED IN THE REPORTED QUANTITY.

TOTAL VOLUME OF CONCRETE = 277.5 CU.METER

BAR DIA (in mm)	WEIGHT (in New)
8	74276
10	25536
12	94792
16	44103
20	53407
25	12095
*** TOTAL=	304210

260. PERFORM ANALYSIS PRINT ALL

Figure shows Concrete Quantity of Structure

WITH FLOATING COLUMNS:

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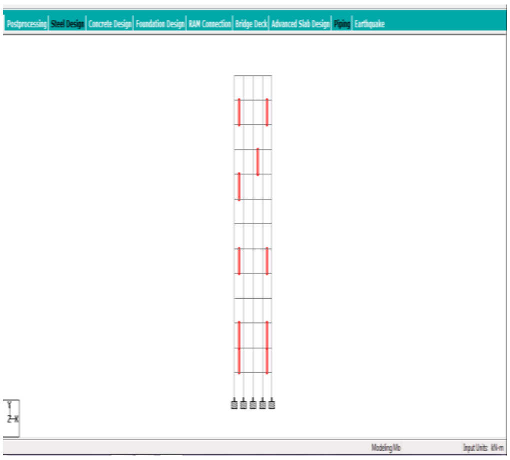

Figure shows g+12 building floating columns

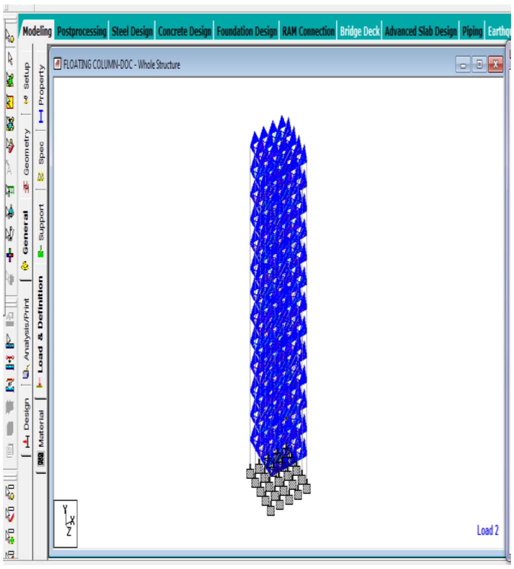

Figure shows Live load acting on building

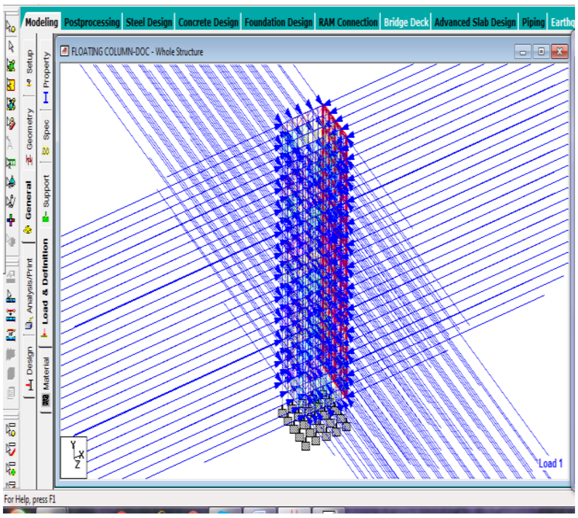

Figure shows Wind load acting on building

CONCLUSION:

- The behaviour of multi-storey building with and without floating column is studied under different earthquake excitation.
- The PGA of both the earthquake has been scaled to 0.2g and duration of excitation are kept same.
- The static and free vibration results obtained using present finite element code are validated.
- A finite element model has been developed to study the dynamic behaviour of multi -story frame.
- The STAAD PRO and Perform-3D models had similar results.

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- The effective period calculated from the Perform-3D model was in good agreement with the STAAD PRO model that utilized cracked section properties from moment-curvature analysis, only 1.7% longer.
- Because maximum rotations were of the greatest interest in this project, the maximum anticipated extent of hinging was decided to be a reasonable estimate for an appropriate rotation gage length.

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