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Development of Multi-Storeyed RCC Building Model with Soft Storey in STAAD PRO

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Abstract

After Gujarat Earthquake and other earthquakes in India, there is a nation-wide attention to the seismic vulnerability assessment of existing buildings. The fundamental design concept of earthquake resistance design of structures is to make strong column-weak beam construction to ensure safety of user means during earthquake beams yield before columns collapse. Many buildings that collapsed during the past earthquake exhibited exactly the opposite strong beam weak column behaviour means columns failed before the beams yielded mainly due to soft storey effect. The buildings with soft storey are very susceptible under earthquake load which create disasters. Due to uses of vehicles and their movements at ground levels infill walls are generally avoided in parking plot, which creates soft storey effect. It should be noted that 70 to 80 % of buildings of urban areas in India fall under the classification of soft storey structure according to IS 1893 (2002) Part-I. The open ground storey or soft storey is both a soft and a weak storey. For proper assessment of the storey stiffness of buildings with soft storey, different models G+5 and G+11 will be analyzing using software. Evaluation of the storey stiffness due to soft storey of multi storied building considering various models will be presented in final phase of project.
Keyword- Soft Storey, Static Analysis, Time History Analysis, Seismic Analysis, Storey Drift

I. INTRODUCTION

A significant research has been devoted for the study of various strengthening techniques to enhance the seismic performance of reinforce concrete frame member and structure and some of the research are able to perform effectively improve the lateral stiffness and resistance of the existing structure. Seismic analysis with time history is necessary for structure to with stand minor earthquakes elastically without any structural damage, and major earthquake with acceptable level of damage depending of importance of the building. The present study is makes an effort to evaluate distinct magnitude earthquake and hence increase strengthen structure of building.

The methodology adopted for this report is having following different step as discussed below:

- Using different methods such as time history, Response spectrum analysis, considering different earthquake intensities to analyses the RC framed building (G+5 and G+11 storeys).
- To study the behavior of structure during Earthquake.
- Considering soft storey effect and solving the problems due to the same.
- By using time history analysis, comparison of seismic behavior of multi-storeyed RC building can be done for different earthquake intensities in terms of various responses like base shear and storey displacements.
- To study the relationship between different method of seismic analysis and seismic responses by time history.
- To study the effect of seismic zone on performance of Multi-storeyed RC building in terms of seismic response.

II. STUDY OBJECTIVES

The soft storey irregularity is the most hazardous irregularities. The main objectives of the study are given below:

- To study the behaviour of structure during Earthquake.
- Considering soft storey effect and solving the problems due to the same.
- To compare seismic behaviour of multi-storeyed RC building for different earthquake intensities in terms of various responses like base shear by using time history analysis.

III. FRAMEWORK METHODOLOGY

Here, the study is directly based on the analysis of building structure on Software STAAD PRO. All the analysis work is taken as the result given from the software. It should be checked that its results of analysis is matching with our manual work or not.

A. Problem Statement

Given Data for multistoried G+5 building which shown in given table:

CITY	*AHMEDABAD (ZONE = III)*
SOIL TYPE	*MEDIUM SOIL*
NOS OF BAYS	*4 x 4*
SIZE OF BAY	*5 x 5 m*
HEIGHT OF FLOOR	*3 m*
UNIT WEIGHT OF CONCRETE	*25 KN/m^3*
UNIT WEIGHT OF WALL	*20 KN/m^3*
BEAM SIZE	*0.23*0.30 m^2*
COLUMN SIZE	*0.45*0.45 m^2*
SLAB THICKNESS	*0.18 m*
FLOOR FINISH	*1 KN/m^2*
LIVE LOAD	*2 KN/m^2*
WALL THICKNESS	*0.23 m*

B. Model Development

The various steps involved in modelling are as follows.

- Selection of suitable Units.
- Define the properties of various material used in the models
- Define the section properties of various structural element of the model
- Model making
- Define and Assign the different loads acting on system
- Assign section properties to the model
- Assign the various loads on the structure
- Static analysis
- Comparison of Base shear result with manual calculation

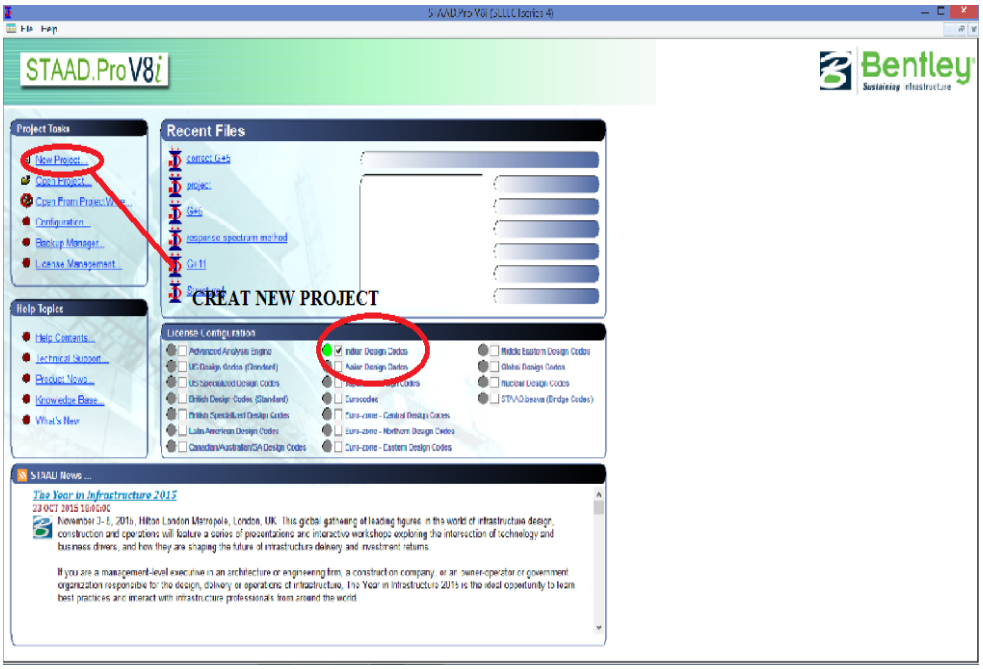

Fig. 1: home page of software

The main window of STAAD PRO software is as shown in figure 1. Select FILE > NEW PROJECT for new project and selection of necessary data's as shown in figure.

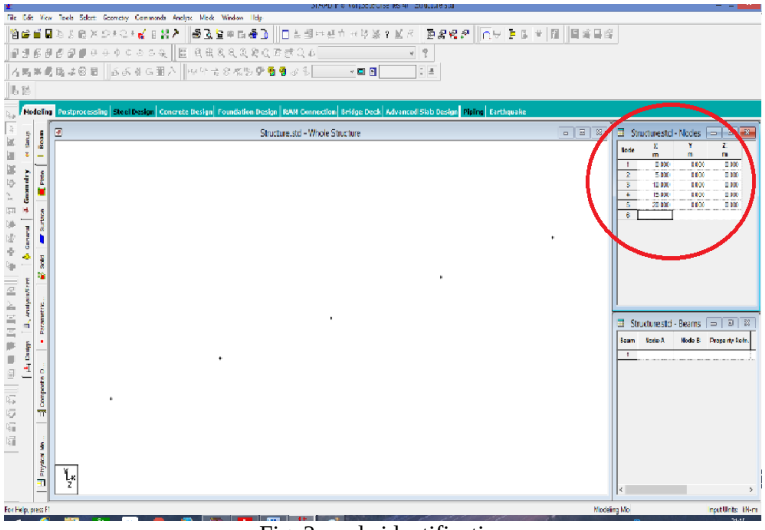

Fig. 2: node identification

Entre the node value in the table which is shown in figure.

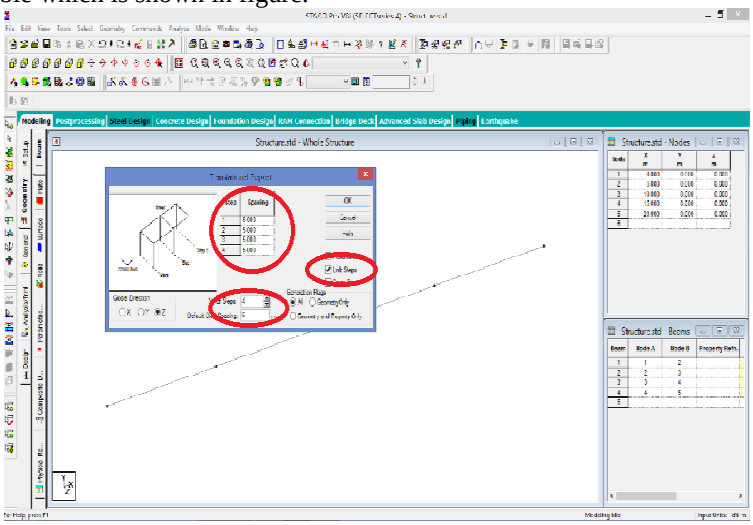

Fig. 3: Generation of frame

Now Fill up the spacing which is given in the table and select Nos of steps 4 and select the link steps which are shown in figure.

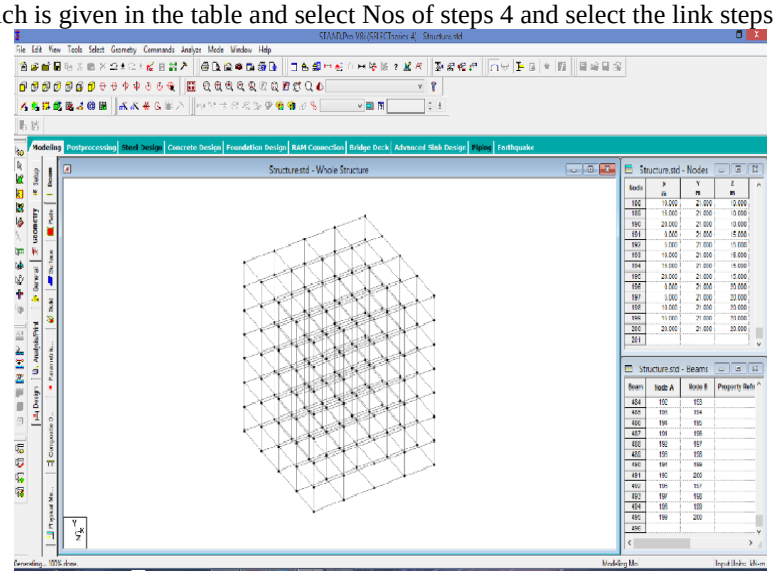

Fig. 4: Generate building frame

Using Translation repeat tool generate building frame which is shown in figure.

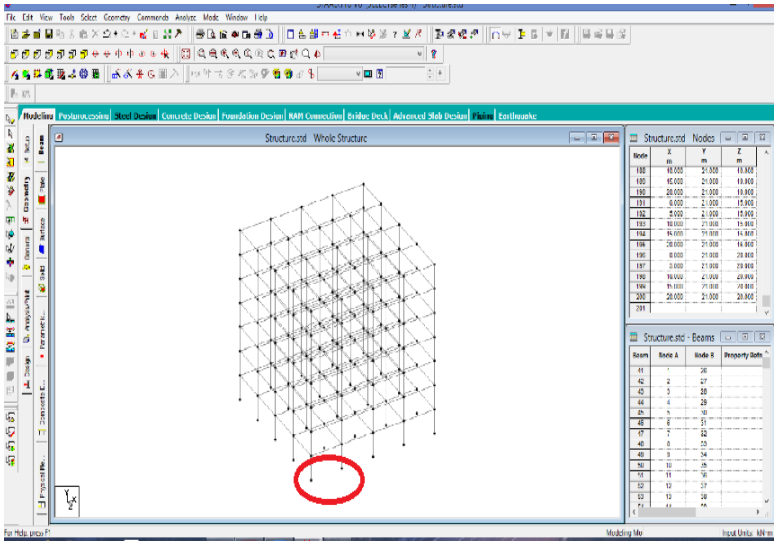

Fig. 5: Removal of bottom beam

Now select the bottom beams and remove it because at foundation level cannot provide beams which are shown in figure.

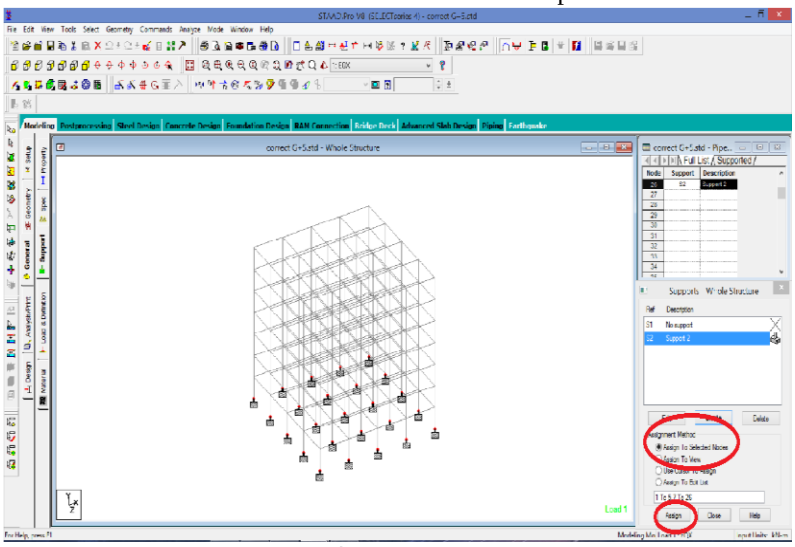

Fig. 6: assign supports

Now give supports condition and assign the supports which are shown in figure.

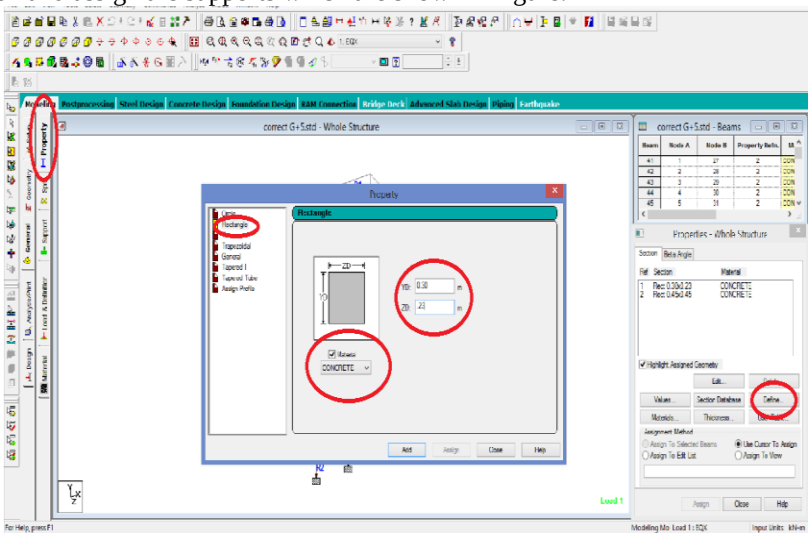

Fig. 7: Selection of material for beam

Now give size, width of beam and depth of beam which are shown in figure.

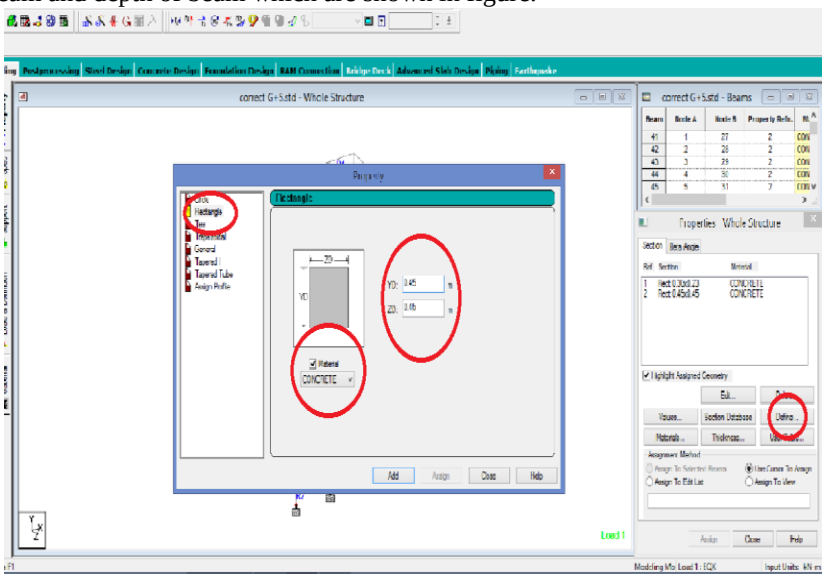

Fig. 8: Selection of material for column

Now give size, width of beam and depth of beam which is shown in figure.

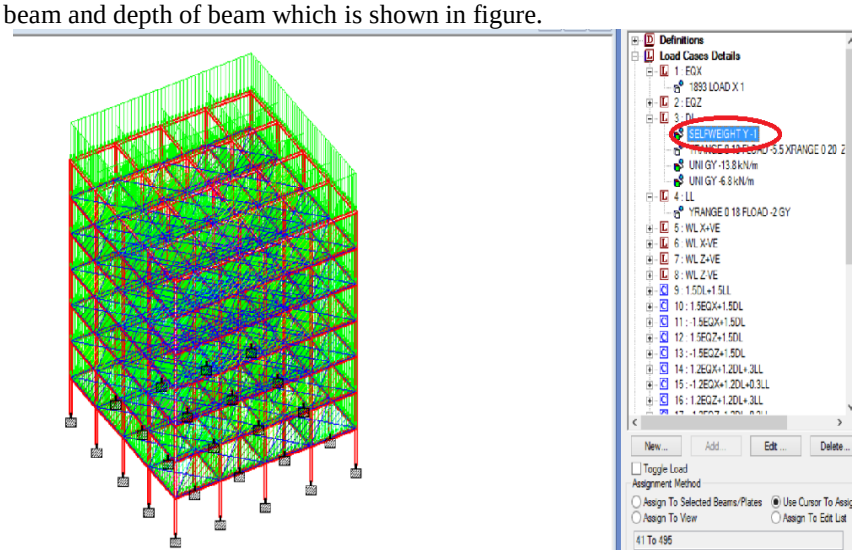

Fig. 9: Apply self-weight

Now apply self-weight of structure in vertical direction which is shown in figure.

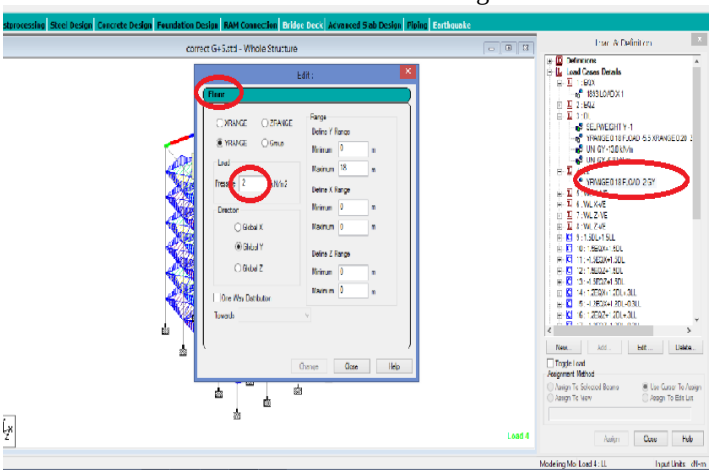

Fig. 10: Application of live load

Now apply live load on the structure which is shown in figure.

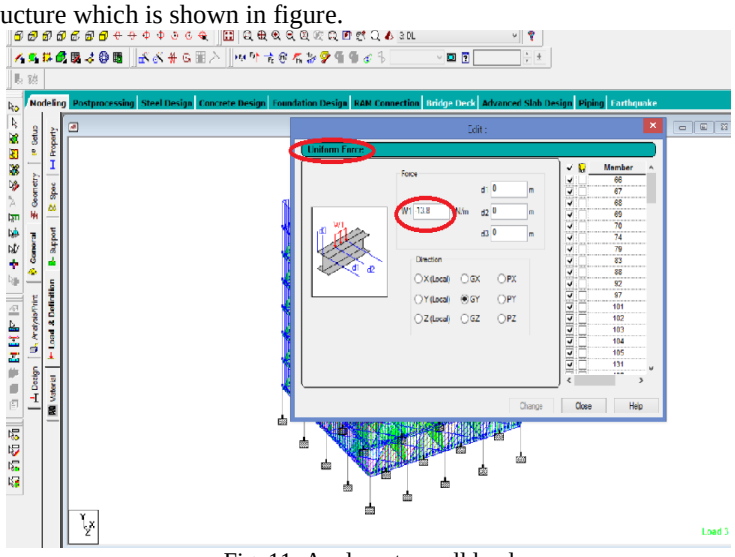

Fig. 11: Apply outer wall load

Select the Load and Definition> Definitions>Load cases Deatails>Floor load>Add, which shown in figure.

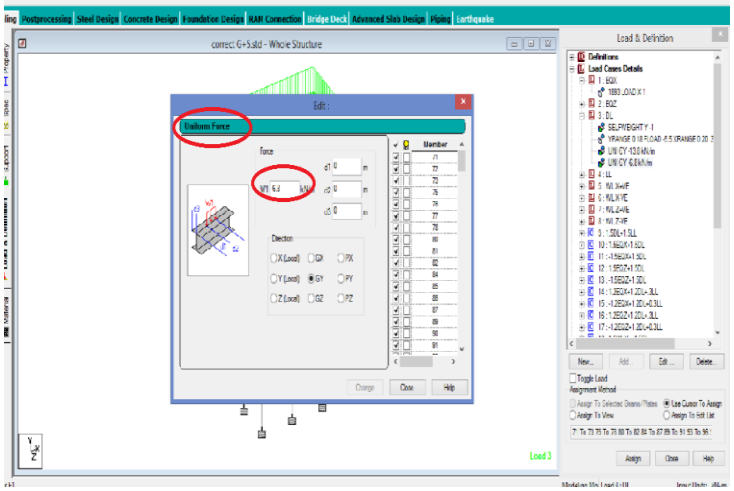

Fig. 12: Apply inner wall load

Select the Load and Definition> Definitions>Load cases Deatails>Floor load>Add, which shown in figure.

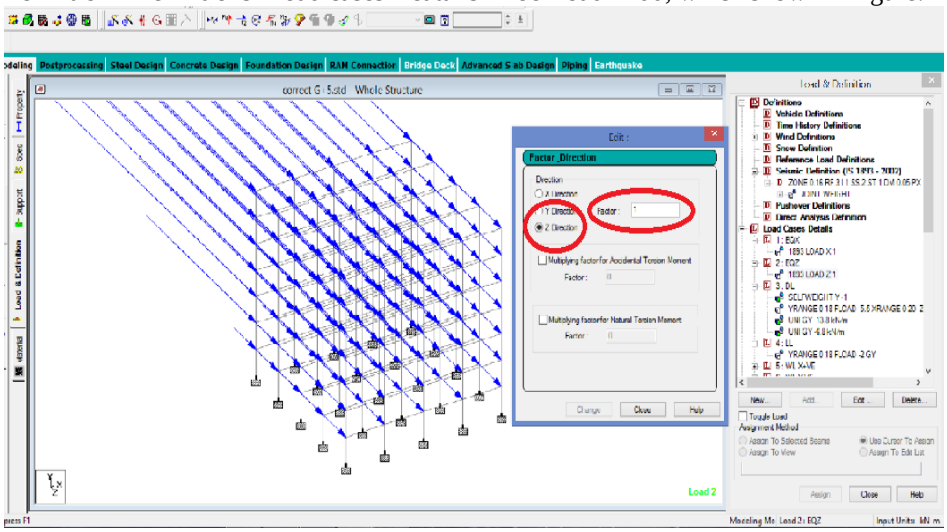

Fig. 13: Apply earthquake load in X, Y , Z-direction

EQX>X or Y or Z- direction>Factor=1> add > Assign, and the direction of earthquake load shown in the figure.

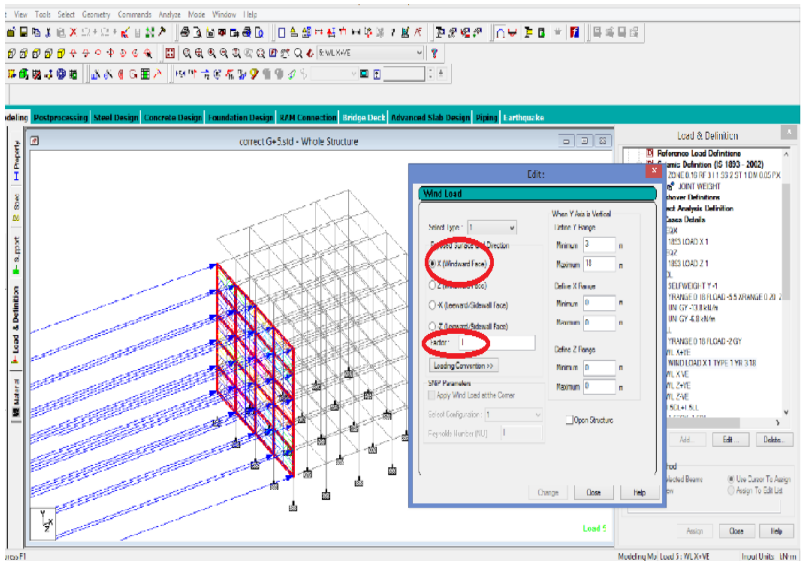

Fig. 14: Apply wind load in X and Z Direction

Apply Wind Load in X and Z direction which is shown in figure.

IV. MODEL ANALYSIS

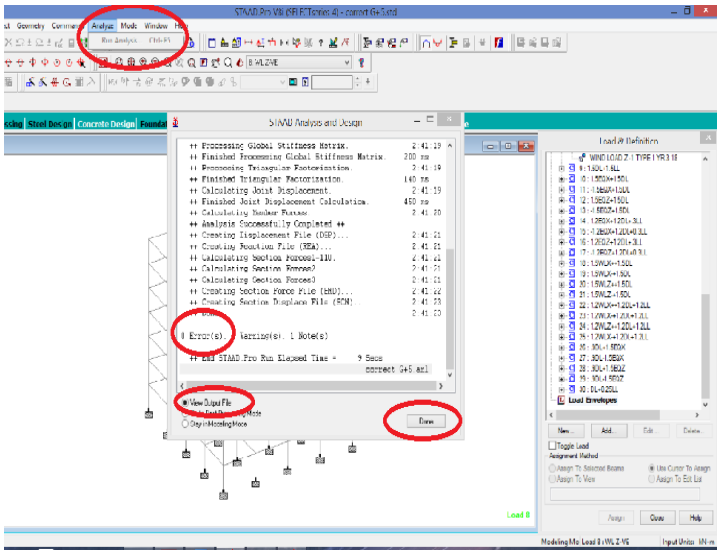

Fig. 15: Analyse model

Now select the Analyze>Run Analysis>View output File>Done, which is shown in figure.

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TIME PERIOD FOR X 1893 LOADING =    0.36200 SEC
SA/G PER 1893=    2.500, LOAD FACTOR= 1.000
     FACTOR V  PER 1893=    0.0667 X  33820.95

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TIME PERIOD FOR Z 1893 LOADING =    0.36200 SEC
SA/G PER 1893=    2.500, LOAD FACTOR= 1.000
     FACTOR V  PER 1893=    0.0667 X  33820.95

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Fig. 16: Base shear values

Compare the value of STAAD PRO Software Base Shear with Manual Calculation. The STAAD PRO Software value is shown in figure.

V. COMPARISON OF RESULTS

Category	*Manual calculation value*	*Software Calculation Value*
Total Weight(KN)	*33196.125*	*33820.95*
Base Shear (X-direction) (KN)	*2214.178*	*2255.85*
Base Shear (Z-direction) (KN)	*2214.178*	*2255.85*

Table 1: Comparison of Manual and Software Calculation

The comparison of the base shear and Total Weight from above table, it is clear that the results which were found by manual calculation and by software STAAD PRO are nearby same. So software is validated.

VI. CONCLUSION

From the above observation following conclusion are obtained:

- Over estimations are of displacements for all of the models and deformation levels by uniform lateral load pattern.
- When increase in height of storey nonlinear time history analysis required.
- The displacement estimation for multi-storey building linearly varies from bottom to top.

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