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Analysis and Design of G + 4 Building Using STAAD Pro.

Babitha rani.H[1], Nagendra Babu[2]
[1,2] *Department of Civil Engineering, SET, Jain University, Bangalore, India*

Abstract- **The principle objective of this research is to analyse and design a multi-storeyed building [G + 4 (3 dimensional frame)] using STAAD Pro. The design involves load calculations and analyzing the whole structure by STAAD Pro. The design methods used in STAAD-Pro analysis are Limit State Design conforming to Indian Standard Code of Practice. STAAD.Pro features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. Initially we started with the analysis of simple 2 dimensional frames and manually checked the accuracy of the software with our results. The results proved to be very accurate. We analysed and designed a G + 3 storey building [2-D Frame] initially for all possible load combinations [dead, live, wind loads and seismic loads]. We considered a building at PENAMALURU SITE, in which the structure was designed for stlit+5 floors. The total site area was 1500 sq.yds. Setbacks are provided to the structure. Set back of 5m on north, 7m on east, 3m on south, 4m on west were provided. Each floor consists of 5 flats. The structure was subjected to self-weight, dead load, live load, and wind load under the load case details of STAAD.Pro. The wind load values were generated by STAAD.Pro considering the given wind intensities at different heights and strictly abiding by the specifications of IS 875. The materials were specified and cross-sections of the beam and column members were assigned. The supports at the base of the structure were also specified as fixed. The codes of practise to be followed were also specified for design purpose with other important details. Then STAAD.Pro was used to analyse the structure and design the members. In the post-processing mode, after completion of the design, we can work on the structure and study the bending moment and shear force values with the generated diagrams. We may also check the deflection of various members under the given loading combinations. The design of the building is dependent upon the minimum requirements as prescribed in the Indian Standard Codes. The minimum requirements pertaining to the structural safety of buildings are being covered by way of laying down minimum design loads which have to be assumed for dead loads, imposed loads, and other external loads, the structure would be required to bear. Strict conformity to loading standards recommended in this code, it is hoped, will ensure the structural safety of the buildings which are being designed. Structure and structural elements were normally designed by Limit State Method. Complicated and high-rise structures need very time taking and cumbersome calculations using conventional manual methods. STAAD.Pro provides us a fast, efficient, easy to use and accurate platform for analysing and designing structures.**

Index Terms- **STAAD.Pro, G+4 storey, ISI**

I. INTRODUCTION

Our research involves analysis and design of multi-storeyed [G +4] using a very popular designing software STAAD Pro. We have chosen STAAD Pro because of its advantages like easy to use interface, conformation with the Indian Standard Codes, versatile nature of solving any type of problem, accuracy of the solution. STAAD.Pro is the professional's choice for steel, concrete, timber, aluminium and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more. STAAD.Pro consists of *the STAAD.Pro Graphical User Interface and the STAAD analysis and design engine*. *In this study, G+1 storey residential building is analyzed using E-Tabs. Conventional building material are replaced by green material thereby making the building eco-friendlier, energy efficient and self-sustainable.(* IJCMS,ISSN 347- 8527, Volume 6, Issue 9 Sep 2017)

LOAD CALCULATIONS involves DEAD LOADS, IMPOSED LOADS and WIND LOAD

Design Wind Speed (V_Z)

a) Risk level;
b) Terrain roughness, height and size of structure and Local topography.

It can be mathematically expressed as follows: Where: $V = V_b * k_l * k_2 * k_3$

V_b = design wind speed at any height z in m/s;
k_l = probability factor (risk coefficient)
k_2 = terrain, height and structure size factor
k_3 = topography factor

II. MATERIALS AND METHODS

WIND PRESSURES AND FORCES ON BUILDINGS/STRUCTURES:
The wind load on a building shall be calculated for the building as a whole, individual structural elements as roofs and walls and individual cladding units including glazing and their fixings. The pressure coefficients are always given for a particular surface or part of the surface of a building.

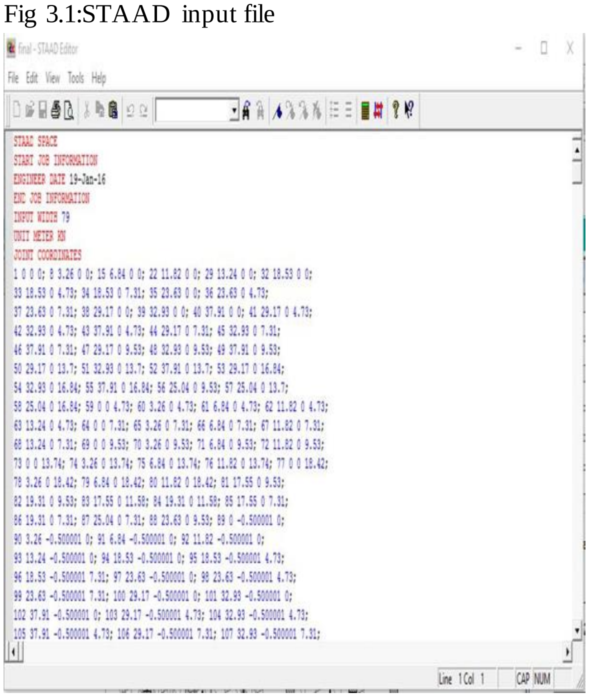
$F= (C_{pe} – C_{pi})$ A Pd

Where,

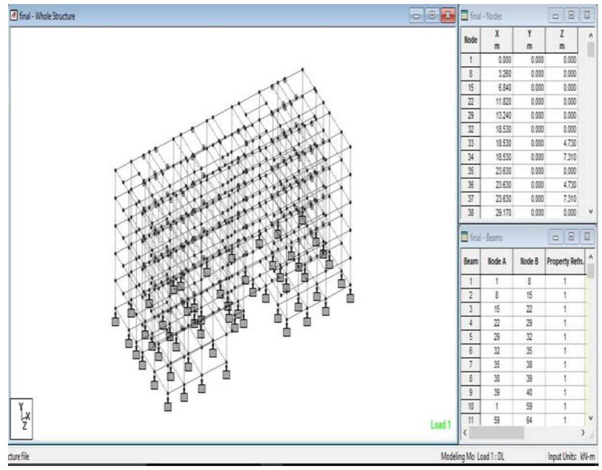
Cpe = external pressure coefficient, Cpi = internal pressure- coefficient, A = surface area of structural or cladding unit, and Pd = design wind pressure element

WORKING WITH STAAD.Pro: The GUI (or user) communicates with the STAAD analysis engine through the STD input file.

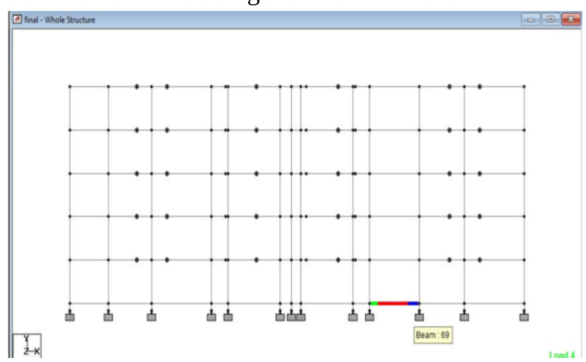
Fig 3.1:STAAD input file



```
STAAD SPACE
START JOB INFORMATION
ENGINEER DATE 19-Jan-16
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
1 0 0 0; 8 3.26 0 0; 15 6.84 0 0; 22 11.82 0 0; 29 13.24 0 0; 32 18.53 0 0;
33 18.53 0 4.73; 34 18.53 0 7.31; 35 23.63 0 0; 36 23.63 0 4.73;
37 23.63 0 7.31; 38 29.17 0 0; 39 32.93 0 0; 40 37.91 0 0; 41 29.17 0 4.73;
42 32.93 0 4.73; 43 37.91 0 4.73; 44 29.17 0 7.31; 45 32.93 0 7.31;
46 37.91 0 7.31; 47 29.17 0 9.53; 48 32.93 0 9.53; 49 37.91 0 9.53;
50 29.17 0 13.7; 51 32.93 0 13.7; 52 37.91 0 13.7; 53 29.17 0 16.84;
54 32.93 0 16.84; 55 37.91 0 16.84; 56 25.04 0 9.53; 57 25.04 0 13.7;
58 25.04 0 16.84; 59 0 0 4.73; 60 3.26 0 4.73; 61 6.84 0 4.73; 62 11.82 0 4.73;
63 13.24 0 4.73; 64 0 0 7.31; 65 3.26 0 7.31; 66 6.84 0 7.31; 67 11.82 0 7.31;
68 13.24 0 7.31; 69 0 0 9.53; 70 3.26 0 9.53; 71 6.84 0 9.53; 72 11.82 0 9.53;
73 0 0 13.74; 74 3.26 0 13.74; 75 6.84 0 13.74; 76 11.82 0 13.74; 77 0 0 18.42;
78 3.26 0 18.42; 79 6.84 0 18.42; 80 11.82 0 18.42; 81 17.55 0 9.53;
82 19.31 0 9.53; 83 17.55 0 11.58; 84 19.31 0 11.58; 85 17.55 0 7.31;
86 19.31 0 7.31; 87 25.04 0 7.31; 88 23.63 0 9.53; 89 0 -0.500001 0;
90 3.26 -0.500001 0; 91 6.84 -0.500001 0; 92 11.82 -0.500001 0;
93 13.24 -0.500001 0; 94 18.53 -0.500001 0; 95 18.53 -0.500001 4.73;
96 18.53 -0.500001 7.31; 97 23.63 -0.500001 0; 98 23.63 -0.500001 4.73;
99 23.63 -0.500001 7.31; 100 29.17 -0.500001 0; 101 32.93 -0.500001 0;
102 37.91 -0.500001 0; 103 29.17 -0.500001 4.73; 104 32.93 -0.500001 4.73;
105 37.91 -0.500001 4.73; 106 29.17 -0.500001 7.31; 107 32.93 -0.500001 7.31;
```



GENERATION OF THE STRUCTURE: The structure may be generated from the input file or mentioning the co-ordinates in the GUI. The figure below shows the GUI generation method.



The Plan of G+4 was created by creating nodes on the x-z plane and the nodes are joined by using add beam tool

Total no. of columns = 58

Column Dimensions:

There are two types of column dimensions

For all columns until ground floor =0.45m*0.23m

For columns in ground floor =0.45m*0.3m

Beam Dimensions:

Plinth beam=0.3m*0.23m

From first slab beams are of different dimensions

Type 1=0.38m*0.23m

Type 2=0.3m*0.23m

Internal beams are placed which transfers the wall load to the columns

Dimension of internal beam=0.23m*0.23

All slabs = 0.15 m thick

After completion of plan all the node points are selected and by using translation.Repeat paste the nodes in the direction of y at a distance of -0.5m.

By using translation repeat 4 repeated floors were created with a distance between any two floors be 3m. Internal beams are created from 1st floor which bears the wall load and transfers the load to the columns.

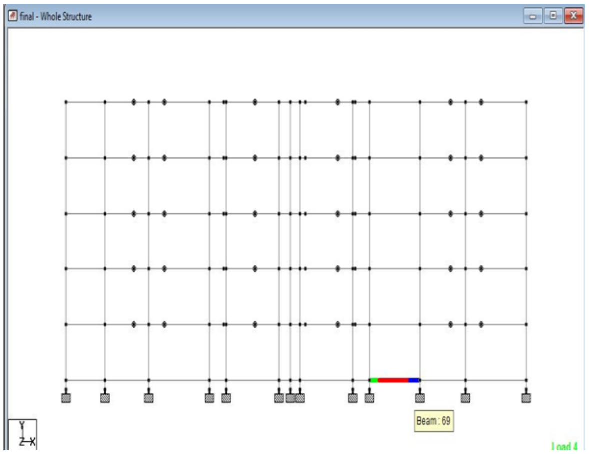


Fig : elevation of the G+4 storey building

Physical Parameters of Building:

Length along x axis = 37.91m

Width along z axis

= 18.42m (from 0-11.82m in x direction)

= 9.53m (from 11.82m-25.02m in x direction)

=16.84m (from25.02m-37.91m in x axis)

Height along y axis = (0.5m for foundation + ((G+4) height 15m)) = 15.5m

Live load on the floors is 3 kN/m2

Grade Of Concrete And Steel Used: Used M25 concrete and Fe 415 steel

GENERATION OF MEMBER PROPERTY:

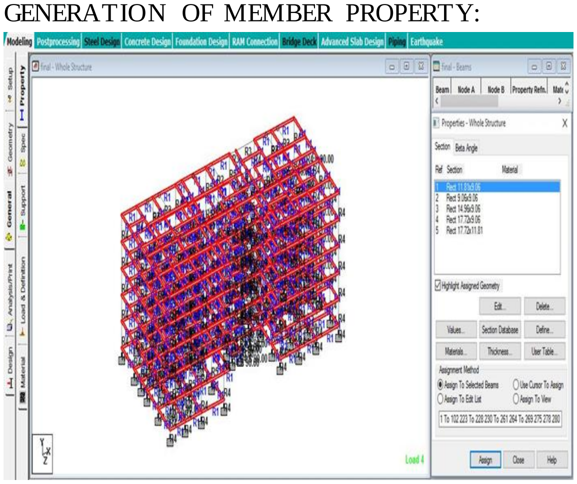


Fig : Generation of member property

Generation of member property can be done in STAAD.Pro by using the window as shown above. The member section is selected and the dimensions have been specified. The plinth beams dimension was 0.3m*0.23m. The beams from the first floor have a dimensions of 0.3m*0.23, 0.23m*0.23m, 0.38m*0.23 and the columns are having a dimensions of 0.45m*0.23 m until ground floor, for ground floor 0.45m*0.3m was specified.

LOADING: The loadings were calculated partially manually and rest was generated using STAAD.Pro load generator. The loading cases were categorized as:

- Self Weight
- Dead Load From Slab
- Floor Load
- Wind Lad
- Seismic Load
- Load Combinations

Self-Weight: The self weight of the structure can be generated by STAAD.Pro itself with the self weight command in the load case column.

Dead load from slab: Dead load from slab can also be generated by STAAD.Pro by specifying the floor thickness and the load on the floor per sq m. The load was found to be: 3.75 kN/m2

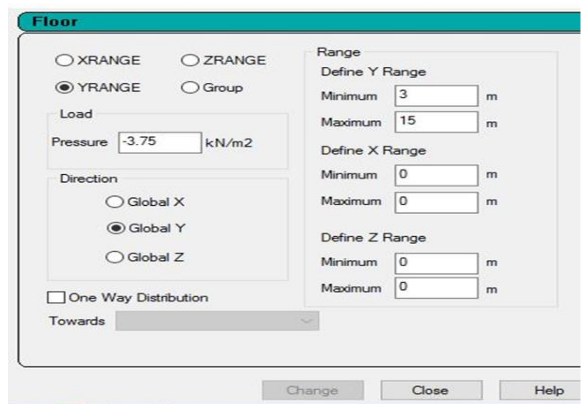


Fig : Input window of floor load generator

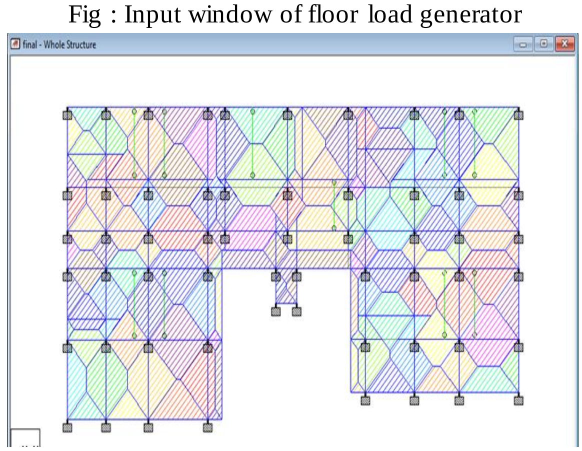


Fig: Dead floor load distribution

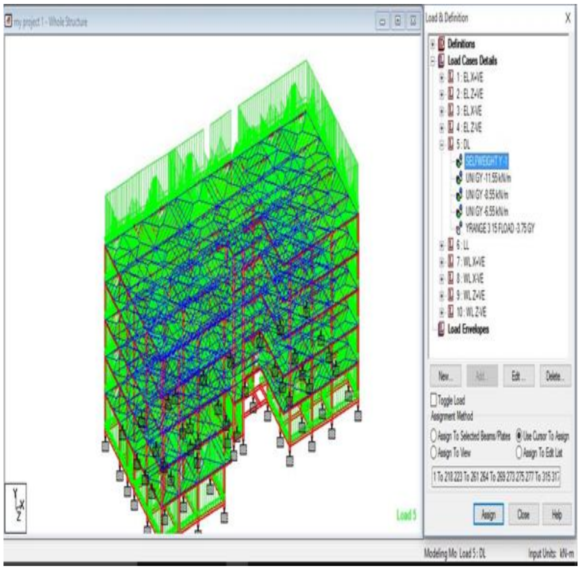


Fig : structure under DL from slab

LIVE LOAD:

The live load considered in each floor was 3 KN/sq m. The live loads were generated in a similar manner as done in the earlier case for dead load in each floor. This may be done from the member load button from the load case column.

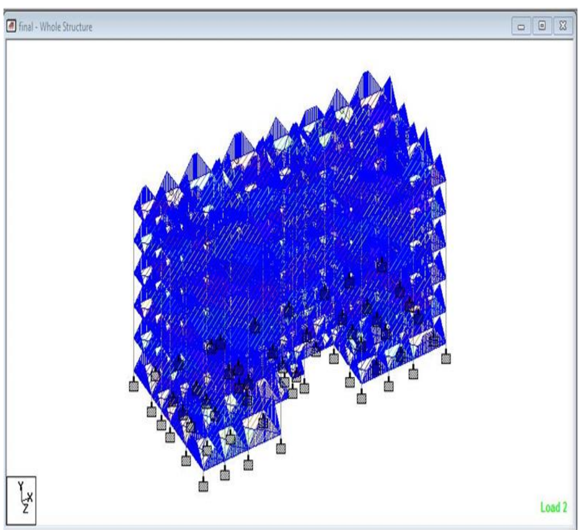


Fig: Structure under live load

WIND LOAD: The wind load values were generated by the software itself in accordance with IS 875. Under the define load command section, in the wind load category, the definition of wind load was supplied. The wind intensities at various heights were calculated manually and feed to the software. Based on those values it generates the wind load at different floors.

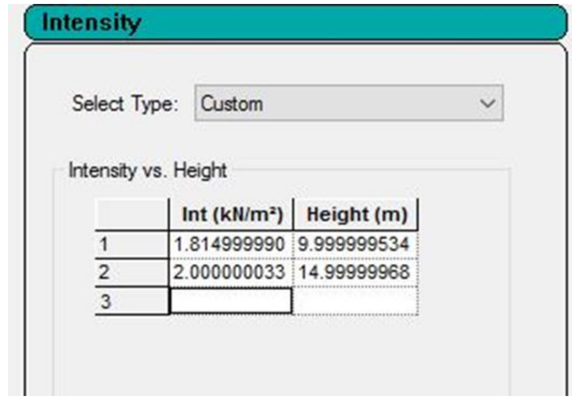


Fig : Design wind pressure at various heights

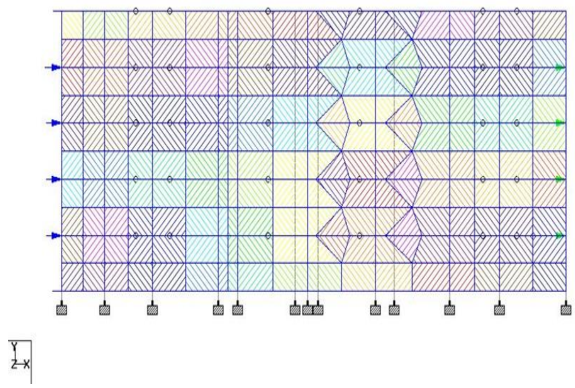


Fig: Wind load effect on structure in ELEVATION

Seismic Load: The seismic load values were calculated as per IS 1893-2002. STAAD.Pro has a seismic load generator in accordance with the IS code mentioned.

Description: The seismic load generator can be used to generate lateral loads in the X and Z directions only. Y is the direction of gravity loads. This facility has not been developed for cases where the Z axis is set to be the vertical direction using the "SET Z UP" command.

Methodology: The design base shear is computed by STAAD in accordance with the IS: 1893(Part 1)-2002.

V=Ah*W   Where, Ah = (Z*I*Sa)/ (2*R*g)

General format:

DEFINE 1893 LOAD

ZONE f1 1893-spec

SELFWEIGHT

JOINT WEIGHT

Joint-list WEIGHT w

1893-Spec= {RF f2, I f3, SS f4, (ST f5), DM f6, (PX f7), (PZ f8), (DT f9)}

Where, Zone f1 = Seismic zone coefficient.

RF f2 = Response reduction factor, f3 = Important factor depending upon the functional use of the structures, characterized by hazardous consequences of its failure, post-earthquake functional needs, historical value, or economic importance, SS f4 = Rock or soil sites factor (=1for hard soil, 2 for medium soil, 3 for soft soil). Depending on type of soil, average response acceleration coefficient Sa/g is calculated corresponding to 5% damping. ST f5 = Optional value for type of structure (=1 for RC frame building, 2 for Steel frame building, 3 for all other buildings). DM f6 = Damping ratio to obtain multiplying factor for calculating Sa/g for different damping. If no damping is specified 5% damping (default value 0.05) will be considered corresponding to which multiplying factor is 1.0. PX f7 = Optional period of structure (in sec) in X direction. If this is defined this value will be used to calculate Sa/g for generation of seismic load along X direction. PZ f8 = Optional period of structure (in sec) in Z direction. If this is defined this value will be used to calculate Sa/g for generation of seismic load along Z direction. DT f9 = Depth of foundation below ground level. It should be defined in current unit. If the depth of foundation is 30 m or below, the value of Ah is taken as half the value obtained. If the foundation is placed between then ground level and 30 m depth, this value is linearly interpolated between Ah and 0.5Ah.

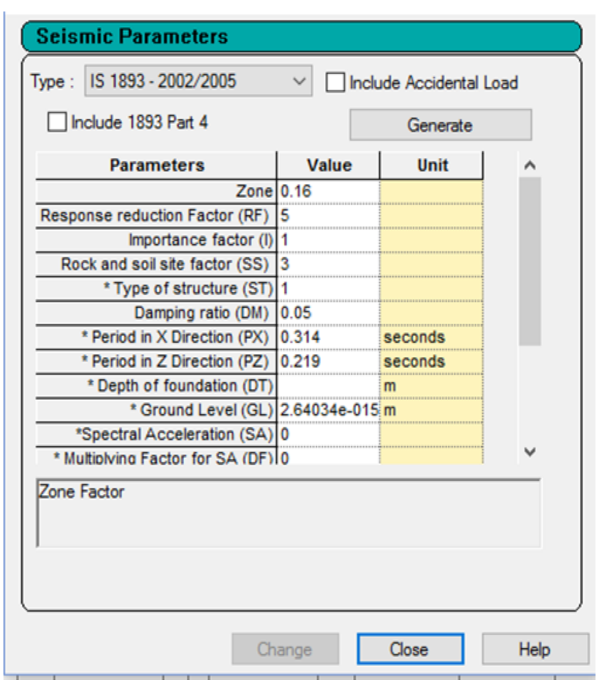


Fig : seismic load definition

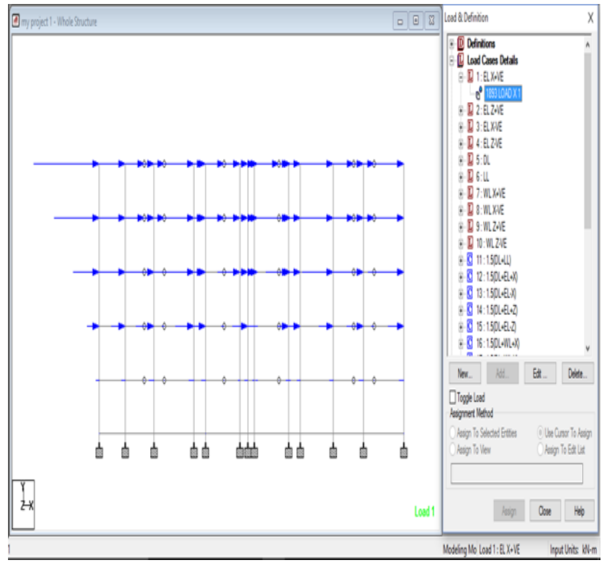


Fig: structure under seismic load

LOAD COMBINATION: The structure has been analyzed for load combinations considering all the previous loads in proper ratio. In this combination cases a combination of self-weight, dead load, live load, wind load and seismic load was taken in to consideration. Load combinations assigned for the structure are mentioned in below figure.

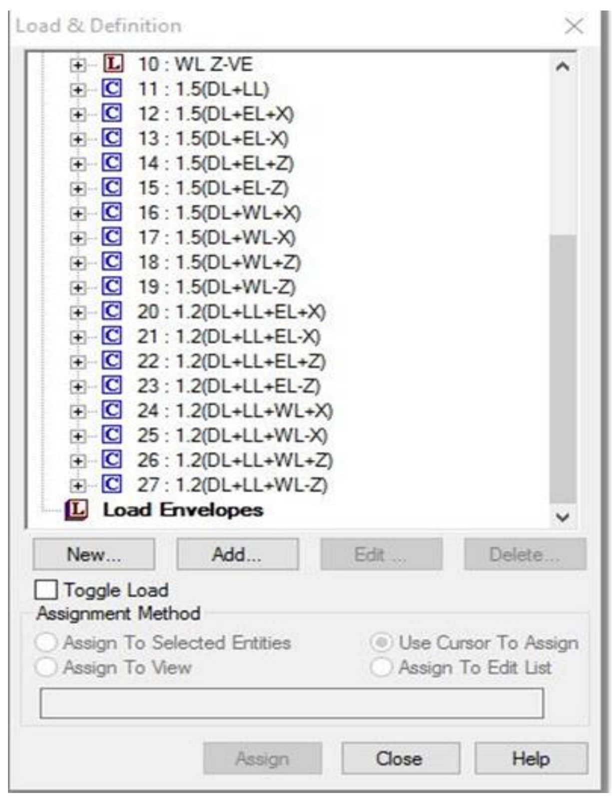


Fig: Load combinations

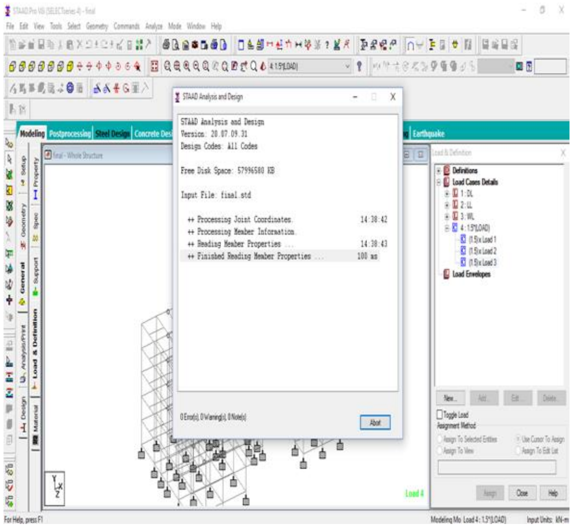


Fig 4.13: GUI showing the analyzing window

If zero errors were found in the analyzing Window, then go to post processing mode for further design of the structure.

III. DESIGN OF G + 4 RCC FRAMED BUILDING USING STAAD.Pro

The structure was designed for concrete in accordance with IS code. The parameters such as clear cover, Fy, Fc, etc were specified. The window shown below is the input window for the design purpose. Then it has to be specified which members are to be designed as beams and which member are to be designed as columns.

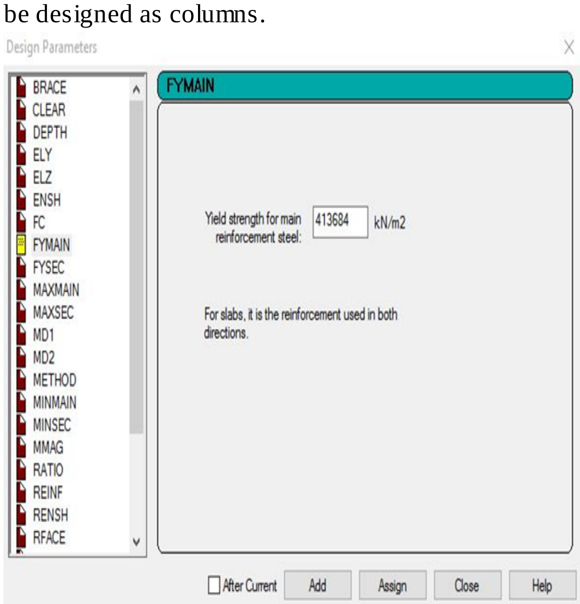


Fig : Input window for design purpose.

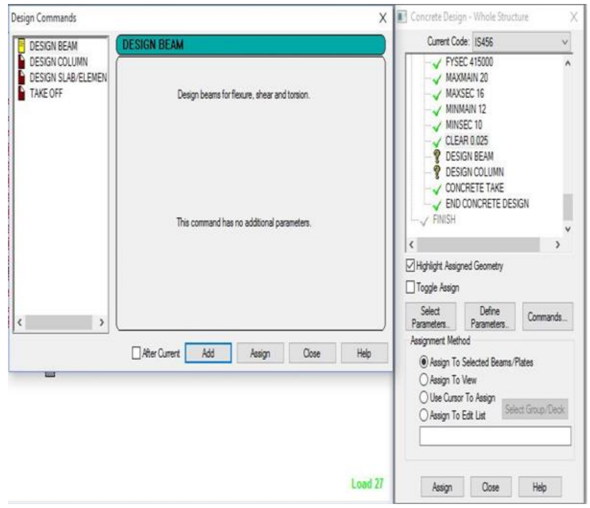


Fig: Design specifications in STAAD.Pro

IV. ANALYSIS AND DESIGN RESULTS

Some of the sample analysis and design results have been shown below for beam number

BEAM NO.1 DESIGN RESULTS
M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3260.0 mm SIZE: 230.0 mm X 300.0 mm
COVER: 25.0 mm
SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0mm	815.0mm	1630.0mm	2445.0mm	3260.0 mm
TOP REINF.	353.66 (Sq.mm)	126.72 (Sq.mm)	126.72 (Sq.mm)	126.72 (Sq.mm)	379.95 (Sq. mm)
BOTTOM REINF.	126.72 (Sq.mm)	126.72 (Sq.mm)	126.72 (Sq.mm)	126.72 (Sq.mm)	126.72 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0mm	815.0mm	1630.0mm	2445.0mm	3260.0mm
TOP REINF.	2-16í 1 layer(s)	2-16í 1 layer(s)	2-16í 1 layer(s)	2-16í 1 layer(s)	2-16í 1 layer(s)
BOTTOM REINF.	2-12í 1 layer(s)	2-12í 1 layer(s)	2-12í 1 layer(s)	2-12í 1 layer(s)	2-12í 1 layer(s)
SHEAR	2 legged 10í	2 legged 10í	2 legged 10í	2 legged 10í	2 legged 10í

REINF. @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c

----

SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT

SHEAR DESIGN RESULTS AT 490.0 mm AWAY FROM START SUPPORT
VY = 30.59 MX = 0.20 LD= 13
Provide 2 Legged 10í @ 100 mm c/c

SHEAR DESIGN RESULTS AT 490.0 mm AWAY FROM END SUPPORT
VY = -31.83 MX = 0.25 LD= 12
Provide 2 Legged 10í @ 100 mm c/c

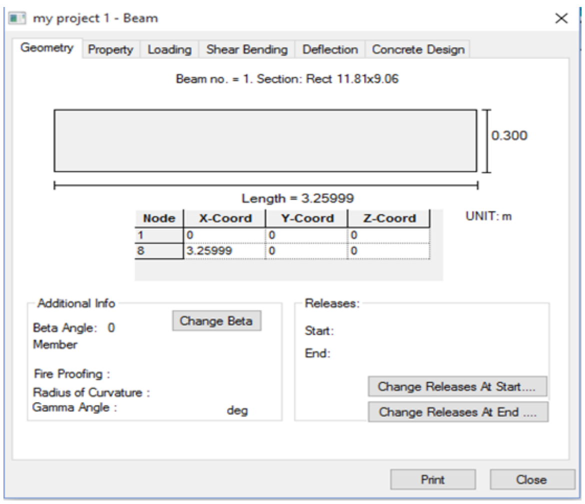


Fig : Geometry of beam no. 1

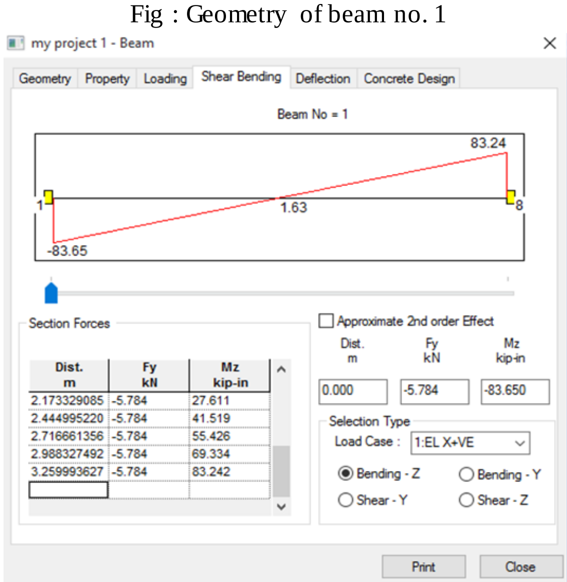


Fig: Shear bending of beam no. 1

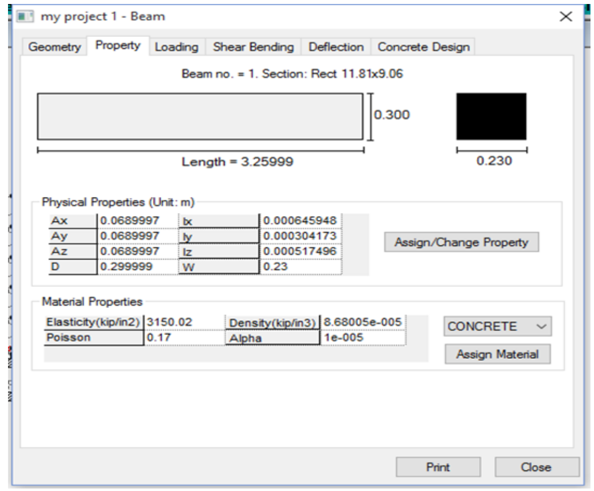


Fig: property of beam no. 1

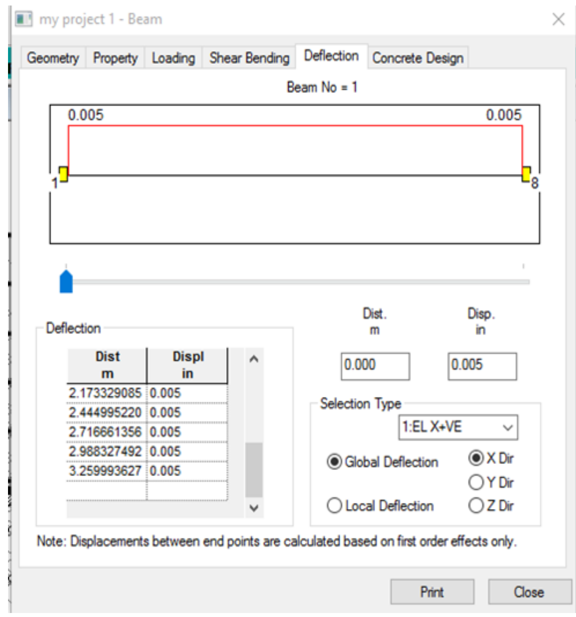


Fig: Deflection of beam no. 1

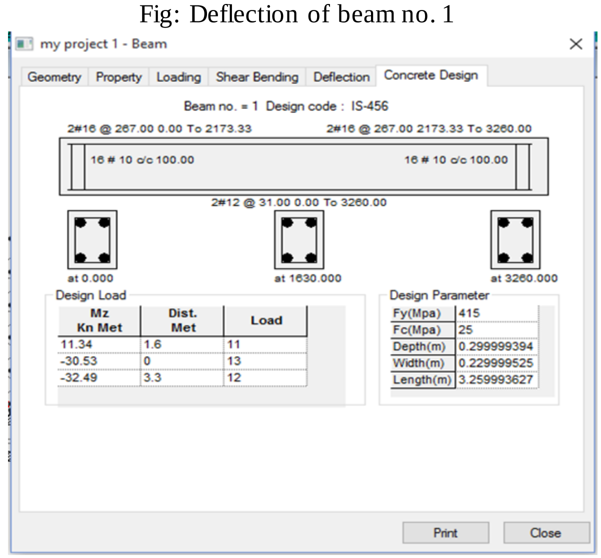


Fig: concrete design of beam no. 1

COLUMN NO. 103 DESIGN RESULT

M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 500.0 mm CROSS SECTION: 300.0 mm X 450.0 mm COVER: 40.0 mm

GUIDING LOAD CASE:1 END JOINT:1 TENSION COLUMN

REQD. STEEL AREA : 1080.00 Sq.mm.
REQD. CONCRETE AREA: 133920.00 Sq.mm.
MAIN REINFORCEMENT : Provide 12 - 12 dia. (1.01%, 1357.17 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT: Provide 10 mm dia. rectangular ties @ 190 mm c/c
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 1842.75 Muz1 : 55.52 Muy1 : 35.22
INTERACTION RATIO: 0.81 (as per Cl. 39.6, IS456:2000)
SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)

WORST LOAD CASE: 1
END JOINT: 89 Puz : 1925.90 Muz : 73.12 Muy : 45.62 IR: 0.76

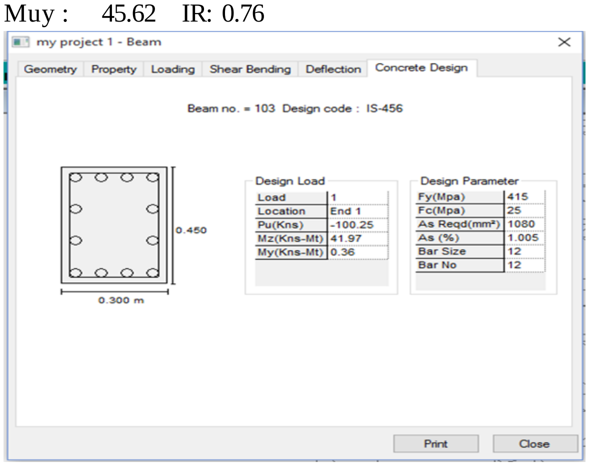


Fig : Concrete design of column no.103

BEAM NO.2 DESIGN RESULTS
M25 Fe415 (Main) Fe415 (Sec.)

LENGTH: 3580.0 mm SIZE: 230.0 mm X 300.0 mm COVER: 25.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION 0.0 mm 895.0 mm 1790.0 mm 2685.0 mm 3580.0 mm

TOP 382.62 126.72 126.72 126.72 408.96
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)
BOTTOM 126.72 126.72 146.40 126.72 126.72
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION 0.0 mm 895.0 mm 1790.0 mm 2685.0 mm 3580.0 mm

TOP 4-12í 2-12í 2-12í 2-12í 4-12í
REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)
BOTTOM 2-12í 2-12í 2-12í 2-12í 2-12í
REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)
SHEAR 2 legged 10í 2 legged 10í 2 legged 10í 2 legged 10í 2 legged 10í
REINF. @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c
----
SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT
SHEAR DESIGN RESULTS AT 490.0 mm AWAY FROM START SUPPORT
VY = 32.41 MX = -0.04 LD= 13
Provide 2 Legged 10í @ 100 mm c/c
SHEAR DESIGN RESULTS AT 490.0 mm AWAY FROM END SUPPORT
VY = -33.52 MX = -0.04 LD= 12
Provide 2 Legged 10í @ 100 mm c/c

BEAM NO. 3 DESIGN RESULTS
M25 Fe415 (Main) Fe415 (Sec.)
LENGTH: 4980.0 mm SIZE: 230.0 mm X 300.0 mm COVER: 25.0 mm
SUMMARY OF REINF. AREA (Sq.mm)

SECTION 0.0 mm 1245.0 mm 2490.0 mm 3735.0 mm 4980.0 mm

TOP 729.26 126.72 126.72 126.72 730.78
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)
BOTTOM 125.78 125.78 344.11 125.78 125.78
REINF. (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm) (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION 0.0 mm 1245.0 mm 2490.0 mm 3735.0 mm 4980.0 mm

TOP 7-12í 2-12í 2-12í 2-12í 7-12í
REINF. 2 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 2 layer(s)
BOTTOM 2-16í 2-16í 2-16í 2-16í 2-16í
REINF. 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s) 1 layer(s)
SHEAR 2 legged 10í 2 legged 10í 2 legged 10í 2 legged 10í 2 legged 10í
REINF. @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c @ 100 mm c/c
SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT
SHEAR DESIGN RESULTS AT 490.0 mm AWAY FROM START SUPPORT
VY = 52.94 MX = 0.35 LD= 11
Provide 2 Legged 10í @ 100 mm c/c
SHEAR DESIGN RESULTS AT 490.0 mm AWAY FROM END SUPPORT
VY = -52.83 MX = 0.35 LD= 11
Provide 2 Legged 10í @ 100 mm c/c
C O L U M N N O. 104 D E S I G N RESULTS
M25 Fe415 (Main) Fe415 (Sec.)
LENGTH: 500.0 mm CROSS SECTION: 300.0 mm X 450.0 mm COVER: 40.0 mm
GUIDING LOAD CASE: 2 END JOINT: 8 TENSION COLUMN
REQD. STEEL AREA : 1080.00 Sq.mm.
REQD. CONCRETE AREA: 133920.00 Sq.mm.
MAIN REINFORCEMENT: Provide 12 - 12 dia. (1.01%, 1357.17 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT: Provide 10 mm dia. rectangular ties @ 190 mm c/c
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 1842.75 Muz1 : 65.14 Muy1 : 41.04
SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)

WORST LOAD CASE: 12
END JOINT: 90 Puz : 1925.90 Muz : 135.10 Muy : 83.42 IR: 0.62
COLUMN NO. 105 DESIGN RESULTS
M25 Fe415 (Main) Fe415 (Sec.)
LENGTH: 500.0 mm CROSS SECTION: 300.0 mm X 450.0 mm COVER: 40.0 mm
GUIDING LOAD CASE: 2 END JOINT: 15 TENSION COLUMN
REQD. STEEL AREA : 1080.00 Sq.mm.
REQD. CONCRETE AREA: 133920.00 Sq.mm.
MAIN REINFORCEMENT : Provide 12 - 12 dia. (1.01%, 1357.17 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT: Provide 10 mm dia. rectangular ties @ 190 mm c/c
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)

Puz : 1842.75 Muz1 : 64.84 Muy1 : 40.86
INTERACTION RATIO: 0.49 (as per Cl. 39.6, IS456:2000)
SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)

WORST LOAD CASE: 12
END JOINT: 91 Puz : 1925.90 Muz : 126.04 Muy : 78.41 IR: 0.66

V. CONCLUSION

STAAD PRO has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters which are designed as per IS: 456(2000). Beams are designed for flexure, shear and torsion. Design for Flexure is maximum sagging (creating tensile stress at the bottom face of the beam) and hogging (creating tensile stress at the top face) moments are calculated for all active load cases at each of the above mentioned sections. Each of these sections are designed to resist both of these critical sagging and hogging moments. Where ever the rectangular section is inadequate as singly reinforced section, doubly reinforced section is tried.

Design for Shear, hear reinforcement is calculated to resist both shear forces and torsion moments. Shear capacity calculation at different sections without the shear reinforcement is based on the actual tensile reinforcement provided by STAAD program. Two-legged stirrups are provided to take care of the balance shear forces acting on these sections.

Beam Design Output is the default design output of the beam contains flexural and shear reinforcement provided along the length of the beam. Column Design are designed for axial forces and biaxial moments at the ends. All active load cases are tested to calculate reinforcement. The loading which yield maximum reinforcement is called the critical load. Column design is done for square section. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment. All major criteria for selecting longitudinal and transverse reinforcement as stipulated by IS: 456 have been taken care of in the column design of STAAD.

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