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ANALYSIS & DESIGN OF AUDITORIUM BY USING STAAD PRO SOFTWARE

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Abstract:-

This project deals with the design of a multi-purpose auditorium so as to accommodate 900 persons. The main concept design of auditorium building vision & acoustical purpose. The dimensions auditorium building is 55*22 mts with out include of compound wall & balcony arena. Required area is calculated as per NBC. This includes planning, analysis of loads and designing of structural elements based on the loads coming on them (live loads, dead loads, wind loads as per IS:875 part-1,2,3). The shape of the auditorium is linear (rectangular). Auditorium consists of assembly halls, show off halls, concert halls, auditoriums and theatres .This is so because the plan is based on acoustic and vision point of view, which are taken from NBC part-VIII, for which linear shape is best suitable . The design pattern of seating arrangements, floor height, celing ,stair case & remain parameters necessary for design of auditorium interior part by using ADA code book. The drafting of auditorium planning by using auto-cadd tool & design of rcc building by using Staad Pro software.

Key words:- Concert Halls, Acoustical, ADA(Federal Code Book),Design Of Roof Truss

Introduction:-

Our project involves analysis and design of multi-purpose of auditorium using a very popular designing software STAAD Pro. It is the easy to use interface, conformation with the Indian Standard Codes, versatile nature of solving any type of problem, Accuracy of the solution. It can used as two ways design by entry of data measurements & normally draw dimensions using auto-cadd plan details to analyze structure of building by Staad Pro software tool. The Auto-Cadd software is easy to identify design of auditorium building, by suitable representation like elevations, top-view, front-view, side-view, & 3d diagrams. Area and other specifications are taken from IS 2526:1963 (Code of practice for acoustical design of Auditorium and conference halls) and NBC (National Building Code). The limit state method of collapse using IS: 456-2000, (concrete design) and SP-16 (R.c.c design members) have been adopted for the design of structural components like slabs, beams, columns and foundations.

1. Specification:-

It explains about design of interior & exterior part of auditorium arrangements like doors, seating dimensions, stair case, slab thickness, beam , columns & footings part are necessarily to maintain proper design using different code books. The different materials are also used for acoustical purpose & sound revibrations for auditorium to not disturb sustain building.

s.no	Items	Standard Sizes Nbc Code Part-Viii	Design Sizes Are Used
1	Chair Size	0.45*0.45	0.50*0.50
2	Steps: Trade Rise	0.9 &0.3 0.15	1.2&0.6 0.15
3	Distance Between Stage And First Row	6 mts	6 mts
4	Changing Room	–	9mts*3.35mts
5	Distance B/N Two Chairs	0.9	0.9
6	Floor Height-I Auditorium	7 mts	7 mts
7	Floor Height-II Dinning Area	–	4 mts
8	Column Size Rectangular Shape	0.5*1.0 mts	0.3*0.8 mts
9	Beam R.C.C	0.5*1.5 mts	0.3*1.5 mts
10	Isolated Footing	0.45*0.45 mts	0.45*0.45 mts

Table 1:-Dimensions For Auditorium

2.Planning of auditorium :-

The cross-section of auditorium is linear structure & seating pattern is designed as slope with a 0.5 mt. seating capacity of our auditorium is 900 persons & stage dimensions are 20*7.5 mts & height of building with out roof truss membrane is from ground level to top surface 16mts. The parking area is allowed for heavy vehicles like car spacing is 3.3*3.0 mts & bike parking spacing is given 2.0mts*1.0 mts. Above dimensions are followed by using Nbc code . The dimensions of auditorium is 20*55 mts.

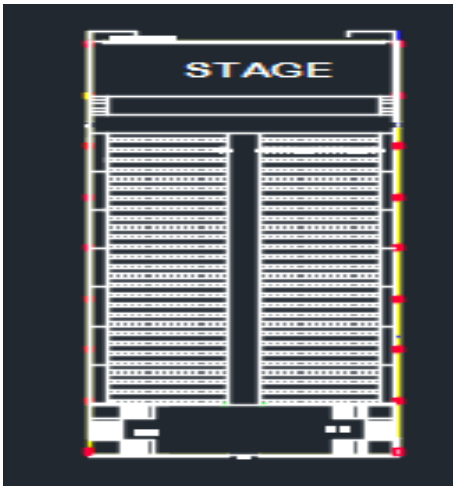
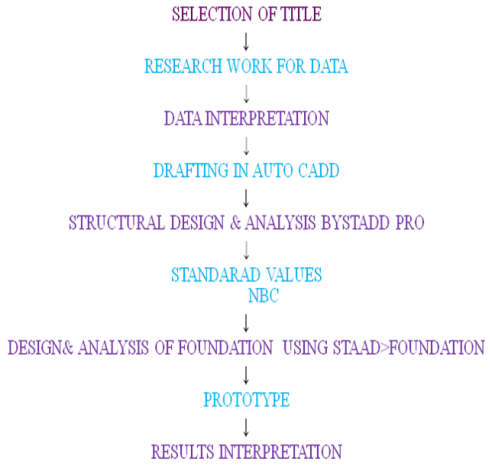


Figure 1:- plan of auditorium

3. Methodology :-



4.Structural Analysis:-

Material

Grade of concrete :- M30

Grade of reinforcement :- Fe415

Density of concrete:- 2500kg/m3

4.1The load calculation :-

Dead load:-

Dead loads are taken from IS-875 part 1.

Floor finishes =1.0 K N/m2

Partions (terrace) = 0.23*1*20 =4.60 KN/m2

Partions first floor = 0.23*7*20 = 32.2 KN/m2

Loads from slabs =0.3*25 = 7.5 KN/m2

Floor finishes terrace = 2 KN/m2

Live load:-

Live loads are taken from IS-875 Part2.

Uniform distributed load (ground floor) = 1.5*3 = 4.5 KN/m2

Uniform distributed load (first floor) = 1.5*2 =3.0 KN/m2

Uniform distributed load terrace = 1.0 KN/m2

Wind load:-

The wind load can be calculated using calculated using the Indian standards Is: 875(Part 3)- 1987.

The basic wind speed corresponding normal locality region in low altitude.

The designing wind speed is calculated in that are velocity of wind calculated frequency through out the year. Then average value wind velocity is consider in terms of M/s.

- Local Topography
- Terrain co-efficient

4.2 LOAD COMBINATIONS:-

- 1* DL +1* LL
- 1* DL +1* WL (+X)
- 1* DL + 1* WL (-X)
- 1* DL + 1* WL (+Z)
- 1* DL + 1* WL (-Z)
- 0.5* DL + 0.5* LL + 0.5 *WL (+X)
- 0.5* DL + 0.5* LL + 0.5*WL (-X)
- 0.5* DL + 0.5* LL+0.5* WL (+Z)
- 0.5*DL +0.5* LL +0.5* WL (-Z)

4.3 STAAD Modelling And Analysis:-

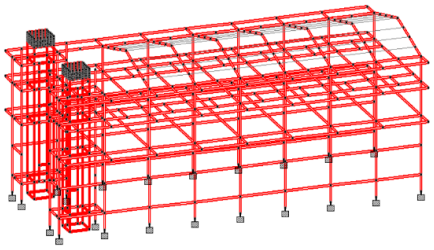


Figure 2:- Dead Load Of Auditorium

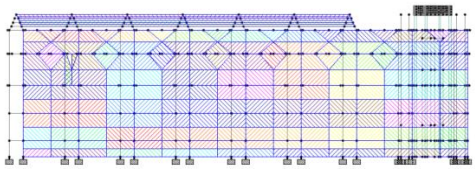


Figure 3:- wind load X direction

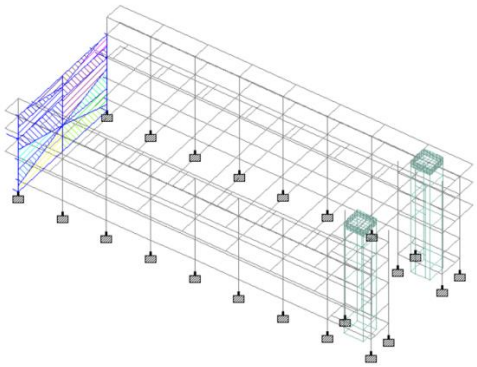


Figure 4:- wind load Z

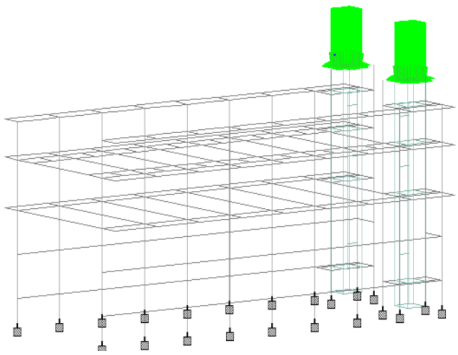


Figure 5:- Hydrostatic Load

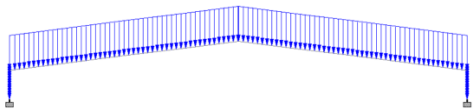


Figure 6:- Roof Truss

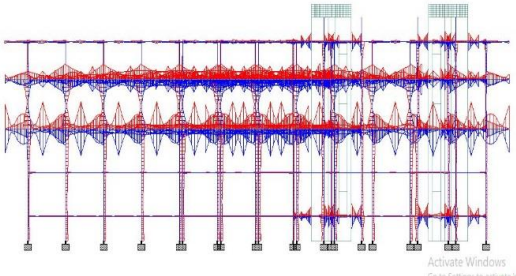
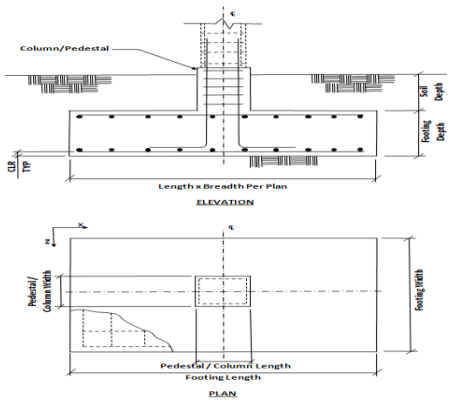


Figure 7:- bending moment

Figure 8:-Isolated Footing



4.4 STRCTURAL DESIGN :-

Design Of Beam :-

From the STAAD Pro Analysis done we obtain the maximum positive moment, maximum negative moment & shear force

Negative moment = -592.50 Kn

Positive moment = 582.30 Kn

Maximum shear force Vu= 415MPa

Width of beam =0.3m

Over all depth of beam = 1.5 m

Thickness of slab, Df = 0.15

Length of beam L = 22.27m

Results :-

Provide 6 no's of bars # 16 at the top face at support of span sections.

Provide 6 no's of bars #16 at the bottom tension face at centre of span section.

Provide 16 mm bars @ 2 legged vertical stirrups at 255 mmc/c.

Design of column:-

From the STAAD Pro Analysis done we obtain the maximum positive moment, maximum negative moment & maximum shear force.

Factored load Pu =1500 Kn

Factored moment Muz = 95.23 Kn.m

Factored moment Muy = 95.23 Kn.m

Columns were designed as bi-axially loaded

Results :-

Breadth of column = 0.3 m

Depth of column = 0.8 m

Main reinforcement:-

Provide 8 no's of 25 mm bars

Lateral reinforcement :-

Provide 8 mm # 250 mm c/c as lateral ties.

Design Of Foundation :-

The column footings are designed as isolated footings. From the STAAD Pro analysis done we obtain the axial load for the designing of footing.

Axial load = 1500 KN

Moment Mx = 2.5 KN.m

Moment Mz = 2.5 KN.m

Safe bearing capacity of soil = 350 KN/m2

Area required = 1500/350 = 4.3 m2

Length required = 4m

Breadth required = 4 m

Depth of footing below @ face of column = 1.5m

Total load = 2500 kn

Maximum bending moment @ face of column = 450 KNm

Result :-

Thickness of base slab = 500 mm

Provide 25 mm dia bars 10 nos in both X- direction

Provide 25 mm dia bars 10 nos in both X- direction

Conclusion :-

The building was analyzed & designed using STAAD Pro. The dimensions of column is 0.3*0.8 m & beam 0.3 *1.5 m are challenge think to sustain with an maximum bending moment with an critical section of beam & column . Actually beam design for long span construction should be prefer PT beams instead of R.c.c beam. Normally if we use PT beam is size should be reduce half of the depth of beam size. In this case our project deals R.C.c beam 1.5 m depth of beam but PT beam size is 0.75 m. The maximum footing size is 4.0*4.0 mts with deep of 1.5 m. STAAD Pro give satisfactory results when checked with manual design also.

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