

## Planning, Analysis, and design of a Steel Structure Auditorium

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### ABSTRACT

Auditorium roof is covered by Tapered Section. A curved roof of steel structure is made in place of dome which can be easily extended whenever required with good strength. In order to increase the audience capacity inside the hall and to reduce the number of columns in between the audience for clear visibility as columns inside hall creates hindrance for visibility. A prototype is made in STAAD.Pro and the total project includes designing of structural members like slab, beams, columns, footings. The software AutoCAD is used for drawings (planning) and for drawing reinforcement details of slabs, columns, beams, footings, etc.

**Keywords - Footing, purlin, base plate, connection plate, sag rod, Auditorium, dead load, analysis, design, detailing, shear force, bending moment, AutoCAD, STAAD.Pro.**

### 1. INTRODUCTION

An auditorium is a room built to enable an audience to hear and watch performances. For Movie theater the number of auditoria (or auditoriums) is expressed as the number of screens. Auditorium can be found in entertainment venues, community halls, and theaters, and may be used for rehearsal, presentation, performing arts productions, or as a learning space. The audience in a modern theatre are usually separated from the performers by the proscenium Arch, although other type of stages are common. In this project work we are planning, analyzing and designing an auditorium building. We are using limit state method for design of various members. The analysis of the structure is to be done using STAAD Pro software. A design of RC building work is taken up. The design is made using software on structural analysis and design (STAAD Pro). The building is subjected to both vertical loads as well as horizontal loads. The vertical load consists of dead load of structural components such as beam, columns, slabs etc and live loads. The horizontal load consists of wind forces, thus building is designed for dead load, live load and wind load as per IS 875. The building is designed and analyzed for the maximum and minimum bending moments and shear forces as per IS 456-2000. The help is taken from software available in institute and computations of loads, moments and shear forces is obtained from this software.

Utility of building	:	Auditorium
No of stories	:	1
Shape of the building	:	Rectangular Shape
Concrete grade	:	M20
All steel grades	:	Fe415 grade
Plan area	:	1008 m <sup>2</sup>
Seating requirements	:	400 persons
Height of building	:	7 m

### 2. PLANNING

AutoCAD is computer graphics application package developed in 1980 by Autodesk U.S.A. The word Auto itself derives from the corporation of Autodesk while the CAD stands for computer added drafting AutoCAD is an application package cum programming language in their advance version

from 1990. As an application package it suited for the engineering purpose designing of almost of the stream of the engineering such as civil, mechanical, electrical etc.

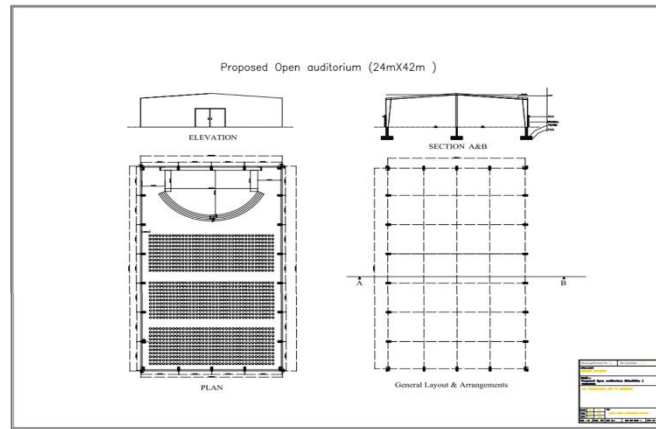


Fig.1 Plan

### 3. ANALYSIS

**Types of Loads :** The various loads considered for analysis were: -

#### Dead Loads

These are the self-weights of the structure to be designed. The dimensions of the cross section are to be assumed initially which enable to estimate the dead load from the known unit weights of the structure. The values of the unit weights of the materials are specified in IS875:1987(Part I).

#### Live Loads

They are also known as imposed loads and consist of all loads other than the dead loads of the structure. The values of the imposed loads depend on the functional requirement of the structure. Commercial buildings will have comparatively higher values of the imposed loads.

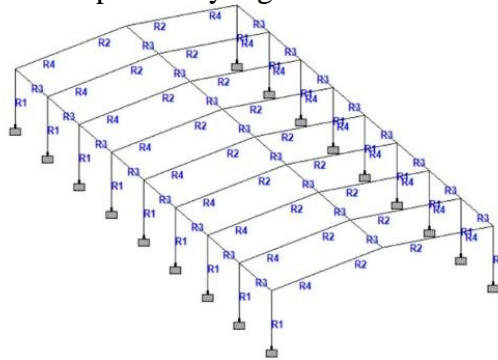


Fig.2 Auditorium

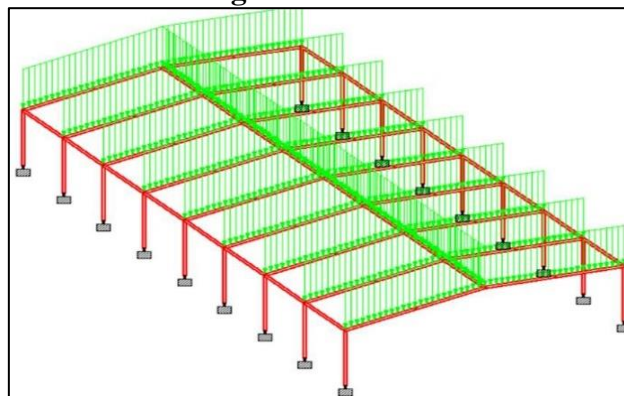
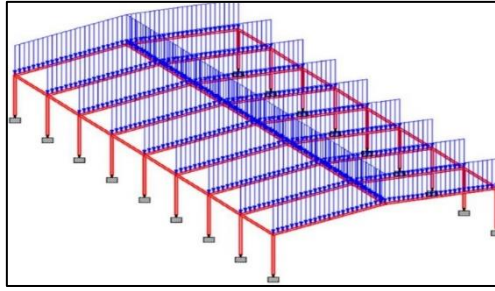
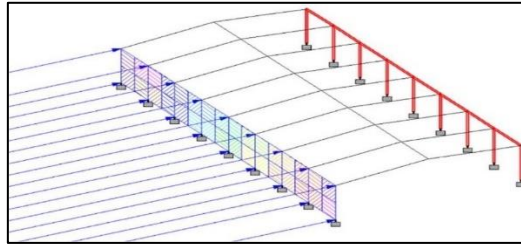


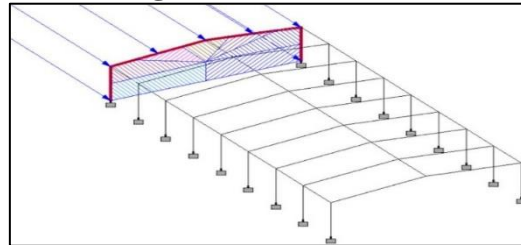
Fig.3 Dead Load



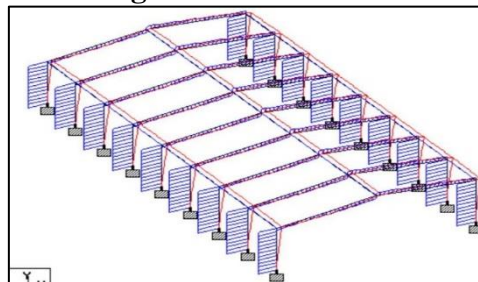
**Fig.4 Live Load**



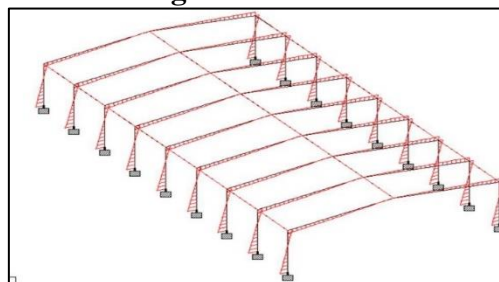
**Fig.5 WL X direction**



**Fig.6 WL Z direction**



**Fig.7 Shear force**



**Fig.8 Bending Moment**



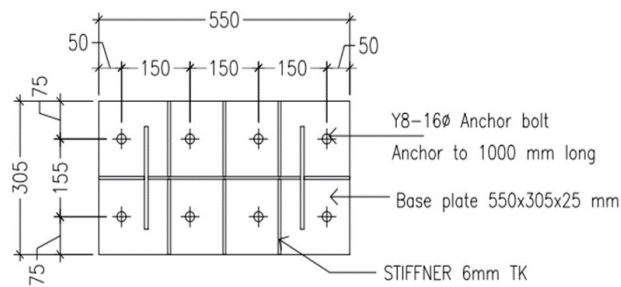
**Fig.9 3D view**

#### 4. DESIGNING

##### A. Design Calculation for Base Plate

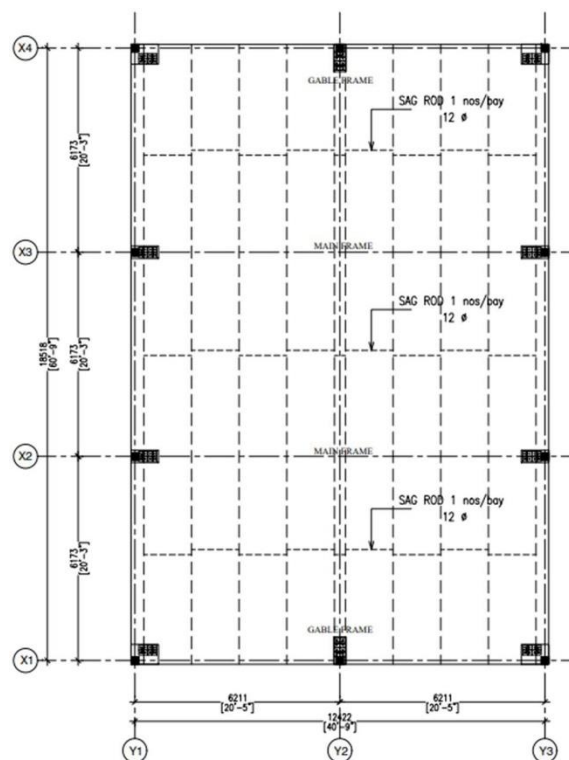
Provide 16mm thick base plate.

Provided base plate = 350 x 250 x 16 mm.



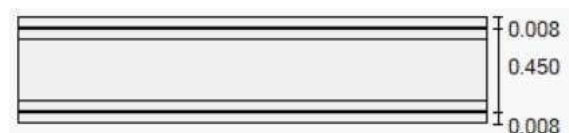
**Fig.10 Base Plate**

##### B. Design Calculation for Sag Rod



**Fig.11 Sag Rod**

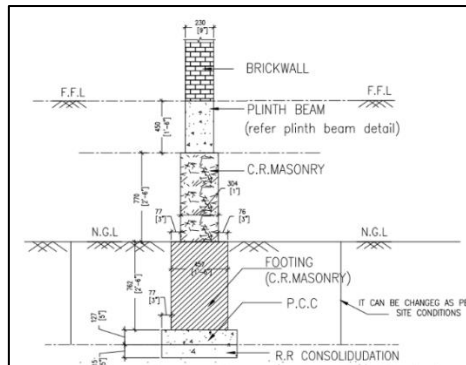
##### C. Design Calculation for Purlin



**Fig.12 Purlin**

#### D. Design Calculation for Footing

Footing size 2m x 2m.



**Fig.12 Footing**

#### CONCLUSION

Planning has been done for 1008m<sup>2</sup> with the specifications made by NATIONAL BUILDING CODE. This project Gives the brief Idea about how to analyze and design auditorium with minimum facilities required. Used AutoCAD 2010, STAAD.Pro V8i effective representation of drawings. Used IS-456:2000 & SP-16, for the design of the structural members. Materials used are M20 grade concrete and Fe 415 steel unless mentioned in the particular design elements. The construction of auditorium presents a solution of many cultural events programs being held in this project Seating Arrangement has provided. Used IS 800:2007 for the design of the Steel members.

#### References

1. IS 456 code year 2000 for plain and reinforced concrete.
2. SP 16 for Design ads for reinforced concrete to IS: 456-1978
3. Handbook on concrete reinforcement and detailing SP 34 1987
4. IS 800 : 2007 code book for steel.
5. Dead load from IS 875 Part 1 1987
6. Live load from IS 875 Part 2 1987
7. Wind loads from IS 875 Part 3 1987
8. Bhavikatti S.S., Design of Steel Structures by Limit State Method as per IS: 800- 2007, K. International Publishing, New Delhi.
9. Sharma, Neha, Mr Abhishek Singh, and Mr Atulya Kumar. "DESIGN OF STEEL STRUCTURE OF AN AUDITORIUM."
10. Dekker, D., S. Chung, and A. Palermo. "Carterton events centre auditorium pres-lam wall design and construction." New Zealand Society for Earthquake Engineering (NZSEE) Conference, Christchurch. 2012.
11. Jerzy, Tomasz P. Nowak, and Łukasz Bednarz. "Baroque structural ceiling over the Leopoldinum Auditorium in Wrocław University: tests, conservation, and a strengthening concept." International Journal of Architectural Heritage 8.2 (2014): 269- 289.
12. Chakraborty, Souvik, and Amiya K. Samanta. "ECONOMIC VIABILITY OF STEEL TUBE SECTION OVER STRUCTURAL STEEL IN DESIGN OF AN AUDITORIUM–A CASE STUDY."
13. Cairoli, Maria. "Architectural customized design for variable acoustics in a multipurpose auditorium." Applied acoustics 140 (2018): 167-177.
14. Pratyusha, Ch, and V. Vijaya Kumar. "Planning, Analysis and Design of Auditorium." International Journal for Technological Research in Engineering 4.12 (2017).
15. Manoj Nallanathel, Ramesh Bhaskar, B V Pavan Kumar, "Analysis & Design of Auditorium by Using STAAD Pro Software", International Journal of Pure and Applied Mathematics, Volume 119, 2018
16. Krishna Raju. N "Design of Reinforced Concrete Structures 3rd Edition,CBS Publishers", New Delhi.