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Design & Analysis of Auditorium Using Staad Pro

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ABSTRACT :

This project entails the comprehensive design and analysis of an auditorium for a college, integrating architectural design, structural engineering, and acoustic optimization. The primary goal is to create an efficient, safe, and aesthetically pleasing space that accommodates lectures, performances, and events, with a focus on user comfort and sustainability. The auditorium design includes seating for a large audience, an optimally placed stage, and provisions for accessibility. Structural analysis evaluates load-bearing design is implemented to optimize sound quality, minimizing reverberation and ensuring clarity across all seating areas. The HVAC system is designed to provide thermal comfort while maintaining energy efficiency, and the lighting system is planned to support both general and stage lighting needs.Using industry-standard software, the project combines architectural modeling, structural safety assessments, acoustic simulations, and environmental considerations. The final design will be a well-engineered, sustainable, and acoustically optimized auditorium, ready to serve as a multi-purpose facility for the college.

Keywords: Auditorium Design, Structural Analysis, Acoustics, HVAC, STAAD.Pro, AutoCAD, Sustainability

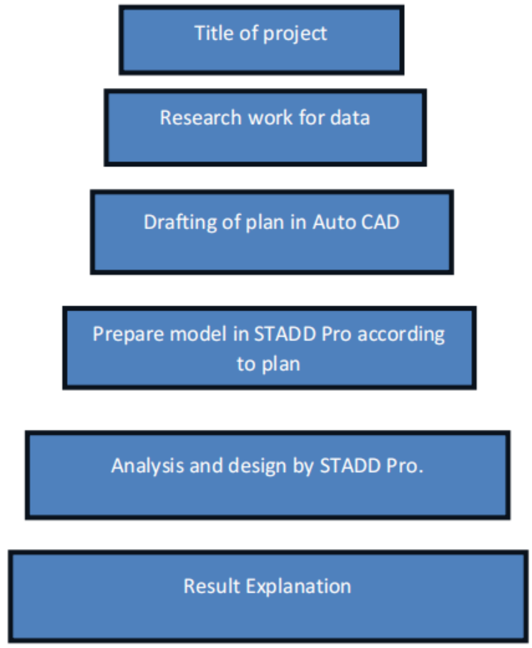
1. INTRODUCTION

Auditoriums are essential components of educational institutions, serving as hubs for lectures, cultural performances, and formal ceremonies. Designing such a space requires a multi-disciplinary approach that integrates structural engineering, acoustical optimization, and efficient mechanical systems. This paper outlines a detailed design process to achieve safety, aesthetic appeal, and functionality.

2. OBJECTIVE

- Design a structurally sound auditorium using AutoCAD and STAAD.Pro
- Achieve optimal acoustical performance
- Ensure thermal comfort and visual clarity
- Incorporate energy-efficient and sustainable technologies
- Comply with Indian Standard codes and accessibility norms.

3. METHODOLOY



The 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

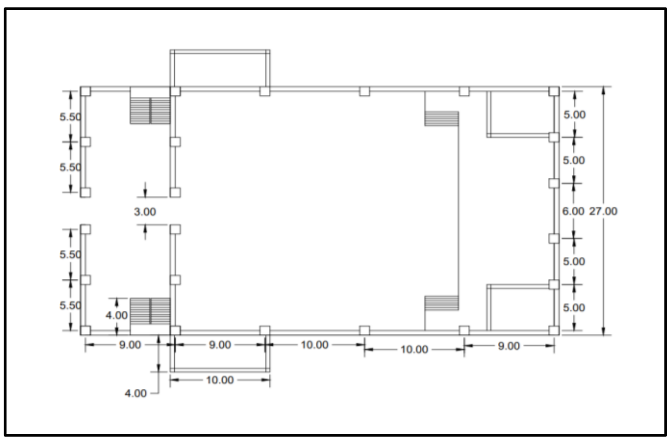
Uniform distributed load terrace = 1.0 KN/m2

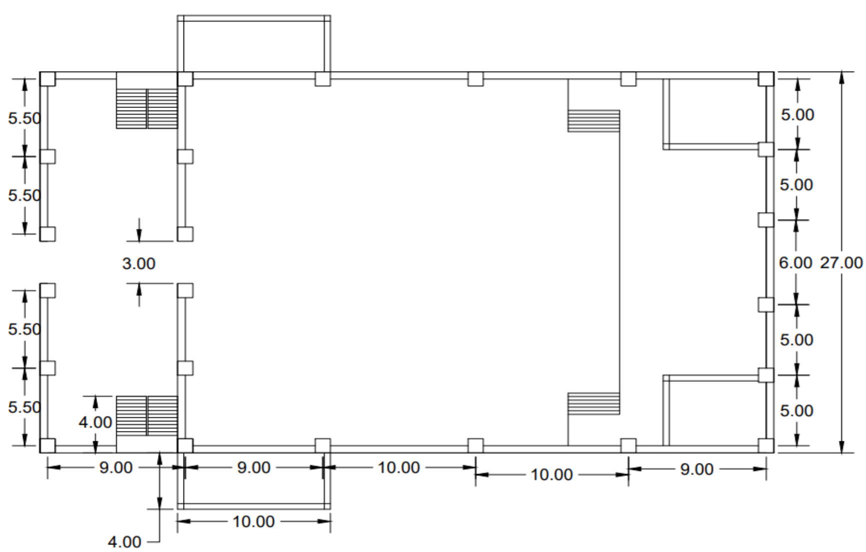
Geometry of structure

The geometry of the structure as a whole is defined by the nodes at the ends of the various structural Members and each node has a unique number.

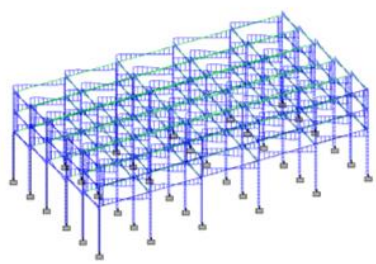
4. Plan Area: 1300m^2
5. Floor Height: 8m
6. Stage height: 1.5m
7. Wall Thickness: 230mn
8. column: 500mm x 400mm
9. Beams:400mm X 300mm
10. First floor slab height :3.5m
11. Second floor slab height : 3.5m
12. Used grade of Concrete: M30

13. Steel: Fy 415
14. Thickness of slab: 150mm
15. Basic wind speed: 35 m/s
16. Floor finish: 1.0kN/m2
17. Live load at all floor: 5 KN/m3
18. Density of concrete: 25 KN/m3
19. Density of brick: 20 KN/m3
20. Density of steel: 7850 Kg/m3
21. Beam cover: 30mm
22. Column cover:40 mm
23. Slab cover:25mm

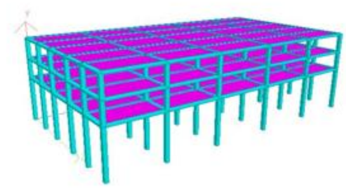




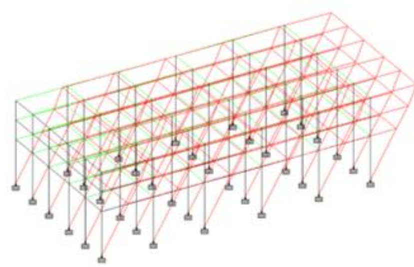
Planning of auditorium



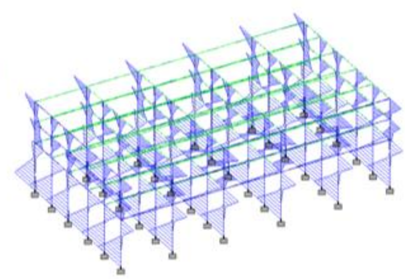
SHEAR FORCE



RENDERING VIEW



DISPLACEMENT



BENDING MOMENT

4. RESULT

For column:
Width of column= 500mm
Depth of column = 600mm
Main reinforcement:
Provide 8 no’s of 25 mm bars
Lateral reinforcement:
Provide 8mm #250mm c/c as lateral ties
For beam:
Width of beam= 300mm
Depth of beam = 400mm
Length of beam = 29.52 m
Provide 6 no's of bars # 16 at the top face at support of span sections.
Provide 6no’s of bars # 16 at the bottom tension face at centre of span section
Provide 16mm of bars @ 2 legged vertical stirrups at 255 mm c/

5. FUTURE SCOPE

The scope for future advancements in auditorium design is significant, particularly with the integration of Building Information Modeling (BIM) tools like Revit for improved coordination across architectural, structural, and MEP systems. Incorporating advanced seismic analysis methods, such as time-history or response spectrum analysis, can enhance structural resilience, especially in earthquake-prone areas. Enhanced acoustic and vibration simulations will further optimize sound quality and audience comfort. Sustainable design strategies, including the use of natural ventilation, daylighting, and eco-friendly materials, can improve energy efficiency. Additionally, parametric optimization and real-time structural health monitoring using smart sensors can refine design accuracy and ensure long-term safety. Adoption of AR/VR for design visualization and modular construction techniques can streamline project execution, while designing flexible, multipurpose spaces can increase the functional value of auditoriums.

6. CONCLUSION

The design and structural analysis of the auditorium successfully demonstrate the integration of architectural planning, engineering principles, and modern simulation tools to create a safe, functional, and sustainable public space. Using AutoCAD for drafting and STAAD.Pro for structural modeling and analysis, the project ensured that all structural components were designed within the permissible limits set by Indian Standard codes. The structure was found to be safe under various loading conditions, including seismic and wind forces, ensuring long-term durability and occupant safety. Acoustic performance, HVAC integration, and energy-efficient lighting were incorporated to enhance comfort and utility. Sustainable features such as solar panels and rainwater harvesting further contribute to environmental responsibility. With a seating capacity of 700, the auditorium meets institutional requirements while remaining adaptable for future expansion. Overall, the project exemplifies a multidisciplinary approach, combining structural safety, functional design, and environmental consciousness in a cohesive and efficient manner.

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