

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Design and Analysis of Auditorium by Using STAAD Pro

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ABSTRACT: The Auditorium allows for huge conferences, displays and performances. Auditorium consists of assembly halls, show off halls, auditoriums and theatres. This thesis is about designing an auditorium using STAAD pro tool. This tool saves time for calculations and studying the structure.

Project is primarily based on limit state concept, the structure shall be designed to resist, it must bare all loads liable to act on it at some point of its lifestyles; it shall additionally satisfy the serviceability requirements, including limitations on deflection and cracking. The suited limit for the protection and serviceability necessities before failure happens is known as a —limit state. The aim of design is to achieve appropriate chances that the structure will not unfit for the use. For which it's indented, that it's going to not attain a limit state.

I. INTRODUCTION

The Auditorium space types are areas for large meetings, presentations, and performances. Auditorium space type facilities may include assembly halls, exhibit halls, auditoriums, and theaters. Auditorium space types do not include such features as sound reinforcement systems, audiovisual systems and projection screens, food service facilities, proscenium stages with heights greater than 50'- 0" or fly gallery, orchestra pits, revolving or hydraulic stage platforms, Flying balconies, movable seating, or billboard systems. Auditorium spaces are designed to accommodate large audiences. As such, they tend to have wide spans and are multiple-stories high in order to accommodate seating, sightline, and acoustical requirements. Raised stage/dais floors and special lighting equipment are often required as well. Typical features of Auditorium space types include the list of applicable design objectives elements as outlined below.

- **Auditorium:**

An auditorium is a room built to enable an audience to hear and watch performances at venues such as theatres. For movie theatres, the number of auditoriums is expressed as the number of screens. Auditoria 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.

Features of Auditorium:

- i. **Etymology:**

The term is taken from Latin (from auditorium, from auditōrius (“pertaining to hearing”)); the concept is taken from the Greek auditorium, which had a series of semi-circular seating shelves in the theatre, divided by broad 'belts', called diatomite, with eleven rows of seats between each.

Auditorium Structure:

The audience in a modern theatre is usually (citation needed) separated from the performers by the proscenium arch, although other types of stage are common.

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The price charged for seats in each part of the auditorium (known in the industry as the house) usually varies according to the quality of the view of the stage. The seating areas can include some or all of the following:

- a) Stalls, orchestra or arena
- b) Balconies of gallery
- c) Boxes
- d) Seating arrangement

Sloped floors

Sloped floors, with level terraces for each row of seating, help provide the proper sightlines from the audience to the stage. Note that the bottom and intermediate rows should be directly accessible from entry levels to allow for Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) compliant accessible seating positions.

- a) Fixed seats
- b) Special Lighting
- c) Occupancy

Productive

a) Special Acoustical Design

Quality acoustical characteristics are important in Auditorium spaces so that performances and presentations can be clearly heard and understood. For performance spaces and general presentation spaces, recommended noise criteria (NC) rating ranges from NC-20 to NC-30; recommended sound transmission class (STC) rating ranges from STC 40 to STC 50. Strategies to achieve the recommended NC and STC ranges include, for example: Type II vinyl wall covering and fabric covered acoustical wall panels for the interior wall finish in the auditorium; Type II vinyl wall covering for the stage area; Type II vinyl wall coverings for 1/3 of the front of the orchestra (audience) sidewalls and fabric covered acoustical panels for 2/3 of the back of the orchestra (audience) sidewalls; fabric covered acoustical panels for rear walls; and a plaster and plywood combination—because of their reverberation characteristics—for the ceiling. For more information, see WBDG Productive—Provide Comfortable Environments.

b) Sustainable:

Increased cooling capacity:

Heating, ventilating, and air-conditioning (HVAC) systems for Auditorium spaces are sized and zoned to accommodate varying internal loads, which are a function of audience sizes, performance lighting loads, and projection equipment. Particularly, air handling units (AHUs) with increased cooling capacity should be zoned separately for the auditorium, lobby, projection spaces, stage areas, and audience seating areas.

Raised Floor:

The recommended system for distribution of HVAC in auditorium spaces is ducted supply through floor vents with ducted ceiling return air vents in auditorium and lobby. In other 9 spaces, ducted ceiling supply with return air ceiling plenum is recommended. Note that there should be transfer ducts at all acoustically rated partitions.

a) Safe / safe

Fire and life safety:

Proper notification systems, lighting, and signage are required to facilitate safe and speedy evacuations during an emergency in the Auditorium spaces. Step lights recessed into floor risers at each seating tier and wall mounted low light level sconce lights along side walls are typical. Sprinklers should be provided per code and under stage platforms to suppress fires.

• Objectives:

- i. The objective of the project is to design an auditorium with a large span without compromising safety.
- ii. The seating is done considering acoustics.

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- **Necessity:**

- To provide a stage for performing arts.
- To accommodate an audience of large members for seminars and lectures.

- **Scope of thesis:**

This project includes analysis, design and detailing of:

- R:C:C: columns, beams, slab and footing
- Steel roof truss: top chord, bottom chord, bracings and connections.
- Seating of auditorium for proper acoustics.

II. LITERATURE REVIEW

- **Sullivan and Adler**

Designed a tall structure with load-bearing outer walls, and based the exterior appearance partly on the design of H.H. Richardson's Marshall Field Warehouse, another Chicago landmark. The Auditorium is a heavy, impressive structure externally, and was more striking in its day when buildings of its scale were less common. When completed, it was the tallest building in the city and largest building in the United States.



- **Denver Auditorium Arena**

Was an indoor arena located at the corner of 13th and Champak Streets in Denver, Colorado. It was constructed as the Denver Municipal Auditorium in 1908 during the administration of Denver Mayor Robert W. Speer. The building was opened on July 7, 1908, and was the site of the 1908 Democratic National Convention.



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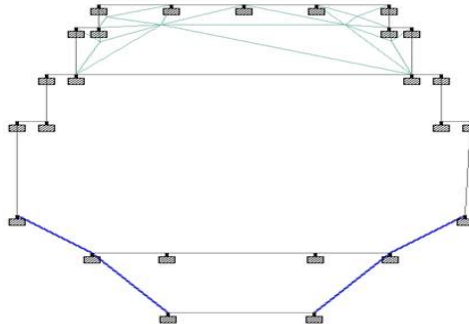
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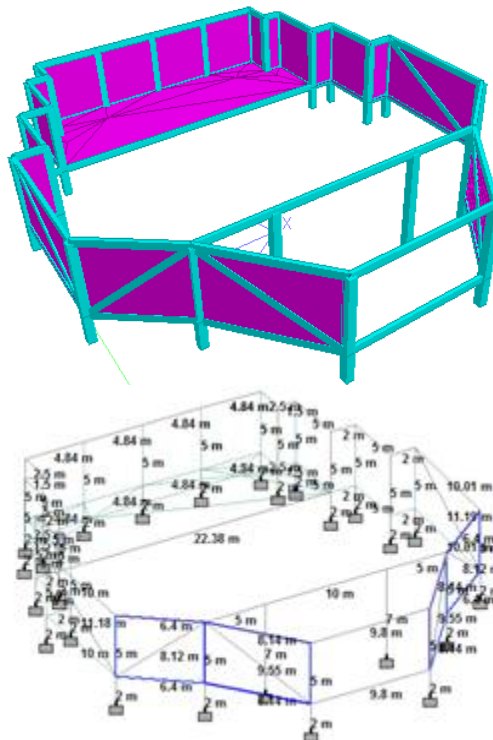
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PLAN:

Top View:



3D View:



Dimensions of auditorium

STRUCTURAL DESIGN

• Methods of Design:

Reinforced Cement Concrete structures and structural parts could also be manner anybody f the following methods

- Working Stress method
- Limit State Method
- Methods based on Experimental investigations

Limit State Methods

In this, the tactic of style supported limit state conception, the structure shall be designed to withstand it shall safety all hundreds prone to act on that throughout its life; it shall conjointly satisfy the serviceability necessities, resembling

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limitations on deflection and cracking. The appropriate limit for the protection and serviceableness necessities before failure happens is termed a Limit State

The aim of design is to attain acceptable possibilities that the structure will not unfit for the utilization. For which it's meant, that is, that it will not reach a limit state.

Assumptions for Design of Members

- i. Place sections traditional to the axis stay plain after bending.
- ii. The maximum strain in concrete at the outer compression fiber is taken as 0.0035 in bending.
- iii. The durability of the concrete is neglected.
- iv. The stresses within the reinforcement are derived from representative stress. Strain curve for the type of steel used, for design functions the partial factor of safety f_m , equals to 1.5 shall be applied.
- v. The maximum compressive strain in concrete in axial compression is taken as 0.002.
- vi. The most compressive strain at the extremely compressed extreme fiber in concrete subjected to axial compression and bending and once there is no tension on the section shall be 0.0035 minus 0.75 times the strain at the smallest amount compressed extreme fiber.

• Design of slabs

Clear span along short span, $l_x = 4.295\text{m}$

Clear span along long span, $l_y = 6.480\text{m}$

Live load $= 2 \frac{\text{KN}}{\text{m}^2}$

Floor finish $= 1.1 \frac{\text{KN}}{\text{m}^2}$

$f_{ck} = 20 \frac{\text{N}}{\text{mm}^2}$

$f_y = 415 \frac{\text{N}}{\text{mm}^2}$

Support conditions: Support on all four edges over all depth is assumed as 125mm

Effective depth: d

$d_x = D - \text{cover} = 125 - 25 = 100 \text{ mm}$

$d_y = 100 - 8 = 92 \text{ mm}$

Effective span: Effective span is the least of the following

l_x

(1) Clear span + bearing $= 4.295 + 0.225 = 4.520\text{m}$

(2) Clear span + effective depth $= 4.295 + 0.10 = 4.395\text{m}$

\therefore Take $l_x = 4.395\text{m}$

l_y

(1) Clear span + bearing $= 6.480 + 0.225 = 6.705\text{m}$

(2) Clear span + effective depth $= 6.480 + 0.10 = 6.580\text{m}$

\therefore Take $l_y = 6.580\text{m}$
 $= 1.497 \leq 2$

Hence, the slab is to be designed as a two way slab.

Load calculations: Per unit area of slab

Self weight of the slab $= 0.125 \times 25$
 $= 3.125 \text{ KN/m}^2$

Live load $= 2.0 \frac{\text{KN}}{\text{m}^2}$

Floor finish $= 1.5 \frac{\text{KN}}{\text{m}^2}$

Total load (W) $= 6.625 \frac{\text{KN}}{\text{m}^2}$

Factored load $= 1.5 \times W$
 $= 1.5 \times 6.625$
 $= 9.9375 \frac{\text{KN}}{\text{m}^2}$

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Design moments and shear forces:

This slab corresponds to Case-4 of Table-26 of IS: 456-2000 as two adjacent edges are continuous.

$$\begin{aligned}\alpha_x(-ve) &= 0.074 \\ \alpha_x(+ve) &= 0.055 \\ \alpha_y(-ve) &= 0.047 \\ \alpha_y(+ve) &= 0.035 \\ M_{ux}(-ve) &= \alpha_{x(-ve)} W l_x^2 \\ M_{uy}(-ve) &= \alpha_{y(-ve)} W l_x^2 \\ &= 0.047 \times 9.9375 \times 4.395^2 \\ &= 9.021 \text{ KNm} \\ M_{uy}(+ve) &= \alpha_{y(+ve)} W l_x^2 \\ &= 0.035 \times 9.9375 \times 4.395^2 \\ &= 6.718 \text{ KNm}\end{aligned}$$

Minimum depth required

The minimum depth required to resist bending moment.

$$\begin{aligned}M_u &= 0.138 f_{ck} b d^2 \\ d &= \sqrt{14.204 \times 10 / (0.138 \times 20 \times 1000)} \\ &= 71.738 \text{ mm} < 100 \text{ mm}\end{aligned}$$

Hence provided depth is adequate.

REINFORCEMENT

Along x-direction (shorter span)

$$\begin{aligned}M_{ux,(-ve)} &= 0.87 \\ \text{Using 8mm diameter bars, spacing of bars} \\ S &= (a_{st} / A_{st}) \times 1000 = (8 / 431.953) \times 1000 \\ &= 116.367 \text{ mm}\end{aligned}$$

Maximum spacing:

- (i) $S = 3d = 3 \times 100 = 300 \text{ mm}$
- (ii) 300 mm whichever is less

Hence, provide 8 mm bars at 110 mm c/c

$$\begin{aligned}M_{ux(+ve)} &= 312.684 \text{ mm}^2 \\ \text{Using 8mm diameter bars, spacing of bars} \\ S &= (a_{st} / A_{st}) \times 1000 = (8 / 312.684) \times 1000 \\ &= 160.750 \text{ mm}\end{aligned}$$

Maximum spacing:

- (i) $S = 3d = 3 \times 100 = 300 \text{ mm}$
- (ii) 300 mm whichever is less

Hence, provide 8 mm bars at 160 mm c/c

Along y-direction (longer span):

These bars will be placed above the bars in x-direction

$$\begin{aligned}M_{uy,(-ve)} &= 290.631 \text{ mm}^2 \\ \text{Using 8mm diameter bars, spacing of bars} \\ S &= (a_{st} / A_{st}) \times 1000 = (8 / 290.631) \times 1000 \\ &= 172.951 \text{ mm}\end{aligned}$$

Maximum spacing:

- (i) $S = 3d = 3 \times 100 = 300 \text{ mm}$
- (ii) 300 mm whichever is less

Hence, provide 8 mm bars at 170 mm c/c

$$\begin{aligned}M_{uy(+ve)} &= 212.425 \text{ mm}^2 \\ \text{Using 8mm diameter bars, spacing of bars} \\ S &= (a_{st} / A_{st}) \times 1000 = (8 / 212.425) \times 1000\end{aligned}$$

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$$= 236.624 \text{ mm}$$

Maximum spacing:

$$(i) \quad S = 3d = 3 \times 100 = 300 \text{ mm}$$

$$(ii) \quad 300 \text{ mm whichever is less}$$

Hence, provide 8 mm bars at 230 mm c/c

Reinforcement in edge strip:

$$A_{st} = 0.12\% \text{ of gross area}$$

$$A_{st} = 150 \text{ mm}^2$$

Using 8 mm dia bars, spacing of bars

$$S = (a_{st} / A_{st}) \times 1000 = (8 / 150) \times 1000$$

$$= 335.10 \text{ mm}$$

$$() \quad 5d = 5 \times 100 = 500 \text{ mm}$$

$$(i) \quad 450 \text{ mm whichever is less}$$

Hence, provide 8 mm bars at 330 mm c/c in edge strips in both directions

Torsion reinforcement:

Area of reinforcement in each layer

$$A_t = \frac{3}{4} A_{stx} = \frac{3}{4} \times 312.684 = 234.513 \text{ mm}^2$$

Distance over which torsion reinforcement is to be provided = $1/5$ short span

$$= \frac{1}{5} \times l_x = 4395 / 5 = 879 \text{ mm}$$

Using 6 mm bars, spacing

$$S = (a_{st} / A_{st}) \times 1000 = (6 / 234.513) \times 1000$$

$$= 120.566 \text{ mm}$$

Hence, provide 6 mm bars at 120 mm c/c in four layers at corner A where both edges are discontinuous.

At the corners where one edge is discontinuous and one edge is continuous

$$A_t = \frac{3}{8} A_{stx} = \frac{3}{8} \times 312.684 = 117.256 \text{ mm}^2$$

Using 6 mm bars, spacing

$$S = (a_{st} / A_{st}) \times 1000 = (6 / 117.256) \times 1000$$

$$= 241.133 \text{ mm}$$

Hence provide 6 mm bars at 240 mm c/c at corners where the one edge is discontinuous and one edge is continuous.

CHECK FOR DEFLECTION

For simply supported slabs Basic value of ratio = $\%P_t = 100 \times (a_{st} / s \times d)$

$$= 100 \times ((8)^2 / 160 \times 100)$$

$$= 0.314 \% f_s$$

$$= 0.58 \times f_y$$

$$= 0.58 \times 415$$

$$= 240 \text{ N/mm}^2$$

$$\text{Maximum permitted ratio} = 26 \times 2 = 52$$

$$\text{Provided} = 43.95 < 52$$

Hence deflection control is safe.

• Beams:

Beam may be a support subjected to transfers load on beams are provided to transfer the load from slab and walls to the columns to that they're connected.

Position of beam:

Beam position in a very structure depends on the position of walls and spanning of the slabs.

Every beam carries triangular load.

Types of Beams:

i. Main beams

ii. Secondary beams

Shapes of beams

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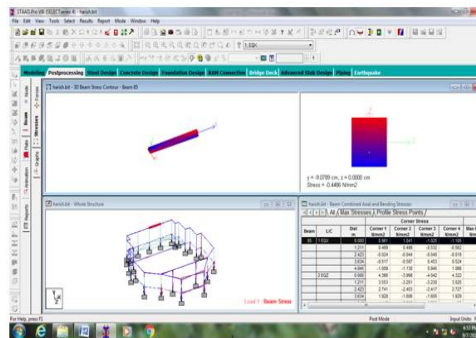
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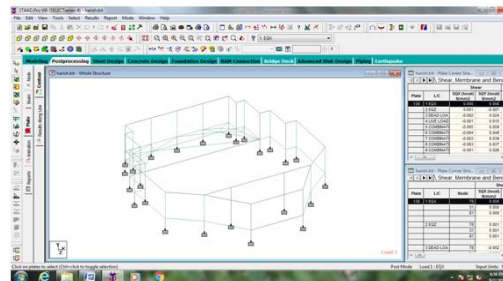
- i. Rectangular Beam
- ii. T- Beam
- iii. L – beam

The Rectangular Beams are any divided into

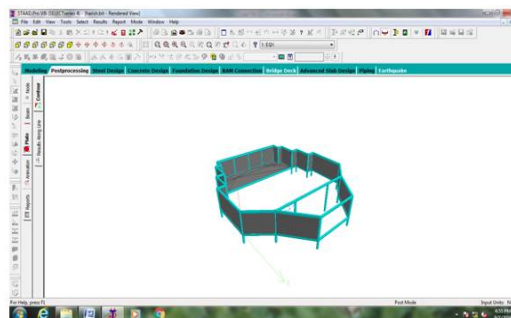
- i. Singly reinforced rectangular beam
- ii. Doubly reinforced beams
- iii. T – Beams



Beam stress



View of beam stress



3D view

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Design Code: IS-456



Design Load

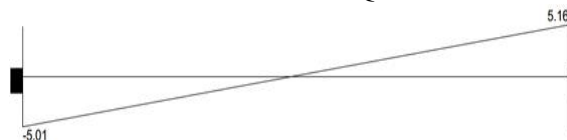
Mz(Kn Met)	Dist.et	Load
20.629999	2.400000	9
-37.060001	0.000000	9
-43.279999	4.800000	9

Design parameter

Fy(Mpa)	415.000000
Fc(Mpa)	25.000000
Depth(m)	0.450000
Width(m)	0.230000
Length(m)	4.844999

Bending about Z for Beam 91

Load case: 1:EQX



Dist.m	Fy(kN)	Mz(kNm)
0.000000	-2.1000	-5.0102
0.403750	-2.1000	-4.1624
0.807500	-2.1000	-3.3145
1.211250	-2.1000	-2.4667
1.615000	-2.1000	-1.6188
2.018750	-2.1000	-0.7710
2.422500	-2.1000	0.0769
2.826250	-2.1000	0.9248
3.230000	-2.1000	1.7726
3.633749	-2.1000	2.6205
4.037499	-2.1000	3.4683
4.441249	-2.1000	4.3162
4.844999	-2.1000	5.1640

Shear along Y for Beam 91

Load Case: 1:EQX



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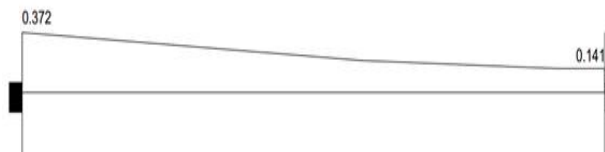
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Dist.m	Fy(kN)	Mz(kNm)
0.000000	-2.1000	-5.0102
0.403750	-2.1000	-4.1624
0.807500	-2.1000	-3.3145
1.211250	-2.1000	-2.4667
1.615000	-2.1000	-1.6188
2.018750	-2.1000	-0.7710
2.422500	-2.1000	0.0769
2.826250	-2.1000	0.9248
3.230000	-2.1000	1.7726
3.633749	-2.1000	2.6205
4.037499	-2.1000	3.4683
4.441249	-2.1000	4.3162
4.844999	-2.1000	5.1640

Deflection in Global Z axis load Case 3



Dist.m	X(mm)	Y(mm)	Z(mm)
0.000000	0.3256	-0.1628	0.3721
0.403750	0.3262	-0.2272	0.3436
0.807500	0.3269	-0.3455	0.3159
1.211250	0.3275	-0.4759	0.2891
1.615000	0.3281	-0.5865	0.2637
2.018750	0.3288	-0.6550	0.2398
2.422500	0.3294	-0.6688	0.2178
2.826250	0.3301	-0.6249	0.1980
3.230000	0.3307	-0.5302	0.1805
3.633749	0.3314	-0.4009	0.1659
4.037499	0.3320	-0.2632	0.1542
4.441249	0.3327	-0.1530	0.1458
4.844999	0.3333	-0.1155	0.1411

• Column:

The structural members whose magnitude relation of effective lengths to its least lateral dimensions more than three times is thought as Columns. The members whose effective length is less than 3 times the least lateral dimensions are referred to as pedestals.

Types of columns

- Short columns
- Long columns

Classification of columns

- Circular columns
- Square columns
- Rectangular columns

As per material of the columns

- Masonry Column
- Timber column
- Steel column
- RCC column

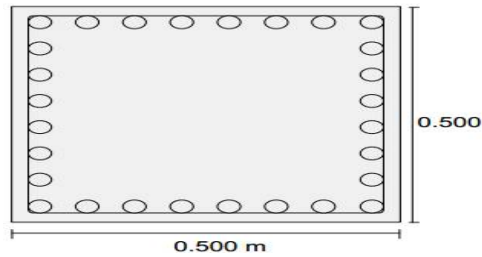
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Grouping of columns



Design load

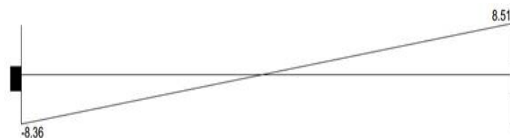
Load	9
Location	End 2
Pu(Kns)	67.809998
Mz(Kns-Mt)	10.440000
My(Kns-Mt)	203.910004

Design results

Fy(Mpa)	415
Fc(Mpa)	25
As Reqd(mm ²)	2767.000000
As (%)	1.267000
Bar Size	12
Bar No	28

Bending about Z for beam 93

Load case3: Dead Load



Dist.m	Fy(kN)	Mz(kNm)
0.000000	-3.3743	-8.3617
0.416667	-3.3743	-6.9558
0.833333	-3.3743	-5.5498
1.250000	-3.3743	-4.1438
1.666667	-3.3743	-2.7378
2.083333	-3.3743	-1.3318
2.500000	-3.3743	0.0741
2.916667	-3.3743	1.4801
3.333333	-3.3743	2.8861
3.750000	-3.3743	4.2921
4.166667	-3.3743	5.6980
4.583333	-3.3743	7.1040
5.000000	-3.3743	8.5100

Shear along Z for Beam 93

Load case: 1:EQX



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Dist.m	Fz(kN)	My(kNm)
0.000000	0.3344	0.1229
0.416667	0.3344	-0.0164
0.833333	0.3344	-0.1558
1.250000	0.3344	-0.2951
1.666667	0.3344	-0.4344
2.083333	0.3344	-0.5737
2.500000	0.3344	-0.7131
2.916667	0.3344	-0.8524
3.333333	0.3344	-0.9917
3.750000	0.3344	-1.1311
4.166667	0.3344	-1.2704
4.583333	0.3344	-1.4097
5.000000	0.3344	-1.5490

Deflection in local Z axis, Load case 3



Dist.m	Y(mm)	Z(mm)
0.000000	-0.0000	-0.0000
0.416667	-0.0192	-0.0096
0.833333	-0.0276	-0.0194
1.250000	-0.0276	-0.0288
1.666667	-0.0212	-0.0372
2.083333	-0.0106	-0.0441
2.500000	0.0020	-0.0489
2.916667	0.0146	-0.0509
3.333333	0.0248	-0.0497
3.750000	0.0307	-0.0445
4.166667	0.0299	-0.0349
4.583333	0.0204	-0.0203
5.000000	-0.0000	-0.0000

• Footings:

Footing is that a part of the foundation that is in direct contact with the soil. Reinforced concrete is associate admirably appropriate material for footing and is extensively used for footing of building columns, towers, bridges etc.

Types of footings

- Continuous wall footings
- Isolated footings
- Combined footings
- Strap footings
- Raft foundation
- Pile foundation

• Acoustic Issues and Solutions

Reducing acoustic noise may be a matter of victimization sound-absorbing material at varied locations around the source of the sound. Once sound waves cross, the amplitude is accumulated. Sound waves are reflected from arduous surfaces, whereas soft surfaces absorb sound.

To reduce acoustic problems:

- Place rugs down initial to absorb the sound that reflects from the ground. Use shag rugs or other rugs with a fur-like quality.
- Diffuse the reflection from facet and back walls by hanging carpet and draperies from walls. Suspend these sound absorbers behind the source of the sound furthermore as on facet walls.
- Use bookshelves, storage cabinets and media racks to scale back acoustic noise. These complicated spaces part sound waves

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• Estimation and costing:

The process of knowing well earlier the probable price of all engineering structure is called Quantity measurement of Estimating.

III. STAAD PRO ANALYSIS

Support reactions

Node	L/C	Horizontal	Vertical	Horizontal	Moment		
		F_x K N	F_y K N	F_z K N	M_x KNm	M_y KNm	M_z KNm
1	1:Eqx	-10.099	0.030	-2.830	0.860	-1.913	0.848
	2:Eqz	-3.445	-0.063	-8.480	-0.131	0.170	-0.208
	3:Dead Load	13.492	29.320	10.522	11.949	0.713	6.637
	4:Live Load	0.000	0.000	0.000	0.000	0.000	0.000
	5:Combinatio	20.238	43.980	15.783	17.923	1.069	9.955
	6:Combinatio	4.071	35.221	9.231	15.370	-1.440	8.982
	7:Combinatio	12.056	35.108	2.450	14.181	1.060	7.715
	8:Combinatio	5.089	44.026	11.538	19.213	-1.800	11.227
	9:Combinatio	15.071	43.885	3.063	17.727	1.325	9.643
	10:Combinat	-3.006	26.434	5.225	12.044	-2.228	7.245
	11:Combinat	6.975	26.293	-3.250	10.557	0.897	5.661
	12:Combinat	-0.062	35.145	-0.946	15.213	-1.236	8.732

Static check results

L/C		F_x KN	F_y KN	F_z KN	M_x KNm	M_y KNm	M_z KNm
1:Eqx	Loads	516.181	0.000	0.000	0.000	7.33E+3	-283.60
	Reactions	-516.18	0.000	-0.000	-0.000	7.33E+3	283.604
	Difference	-0.000	0.000	-0.000	-0.000	-0.000	0.000

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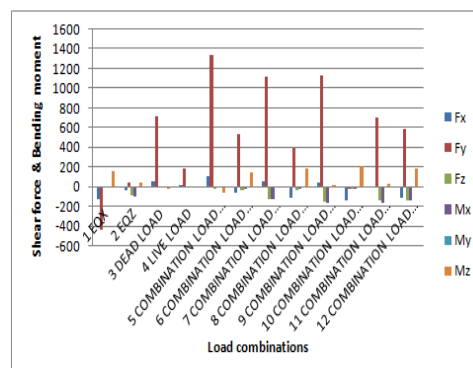
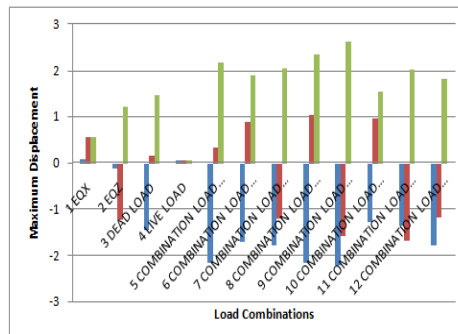
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Plate No.	L/C	Shear N/mm ²		Membrane N/mm ²			Bending Moment KNm		
		S _x	S _y	S _x	S _y	S _{xy}	M _x	M _y	M _{xy}
120	1 Eqx	0.008	0.026	0.017	0.001	0.018	6.164	1.191	0.688
	2 Eqy	0.034	0.053	0	0.058	0.046	0.071	-7.651	1.046
	3 Dead Load	0.196	0.311	0.007	0.111	0.083	7.421	13.003	40.52
	4 Live Load	0.079	0.11	0.002	0.039	0.028	2.717	-5.813	13.022
	5 Combination Load Case 5	0.413	0.631	0.014	0.226	0.167	15.206	28.225	80.313
	6 Combination Load Case 6	0.321	0.473	0.032	0.179	0.111	19.562	21.151	65.076
	7 Combination Load Case 7	0.371	0.568	0.011	0.25	0.189	12.08	31.761	65.506
	8 Combination Load Case 8	0.282	0.426	0.037	0.164	0.097	20.378	17.719	61.812
	9 Combination Load Case 9	0.345	0.546	0.011	0.254	0.194	11.025	30.981	62.349
	10 Combination Load Case 10	0.164	0.24	0.033	0.098	0.047	15.925	-9.917	37.5
	11 Combination Load Case 11	0.227	0.359	0.007	0.187	0.144	6.572	23.179	38.037
	12 Combination Load Case 12	0.361	0.536	0.032	0.249	0.167	19.477	30.332	66.332

Plates shear, membrane

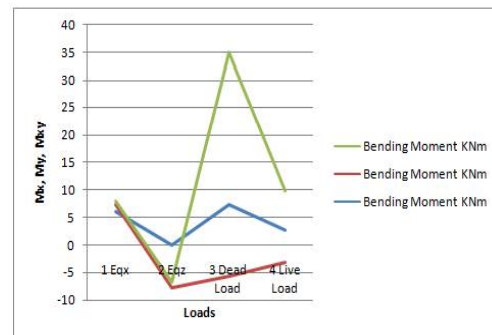
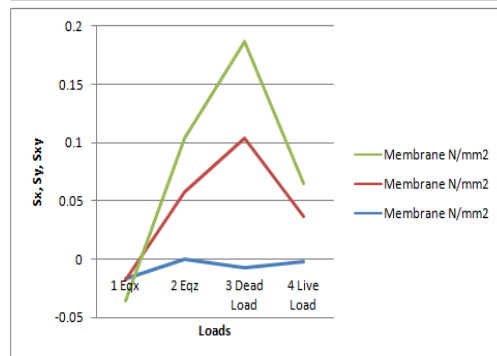
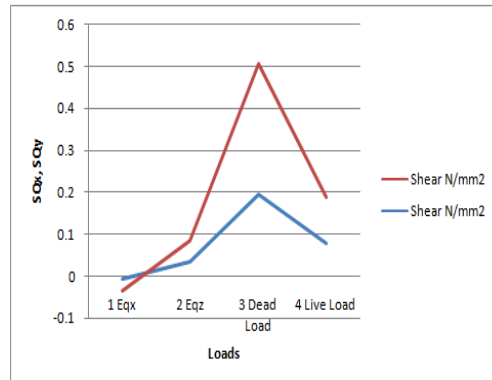


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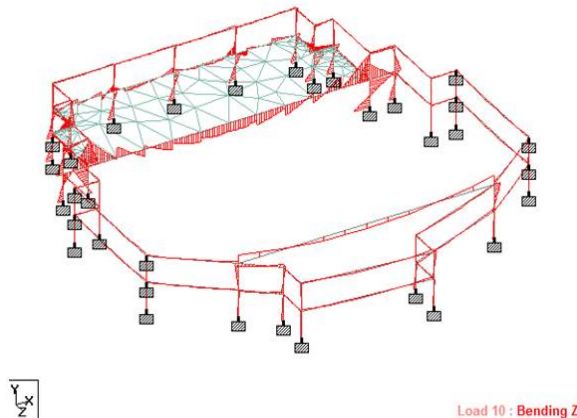
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Bending moment



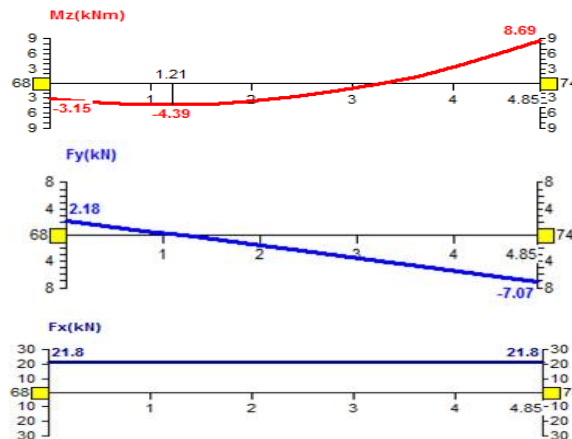
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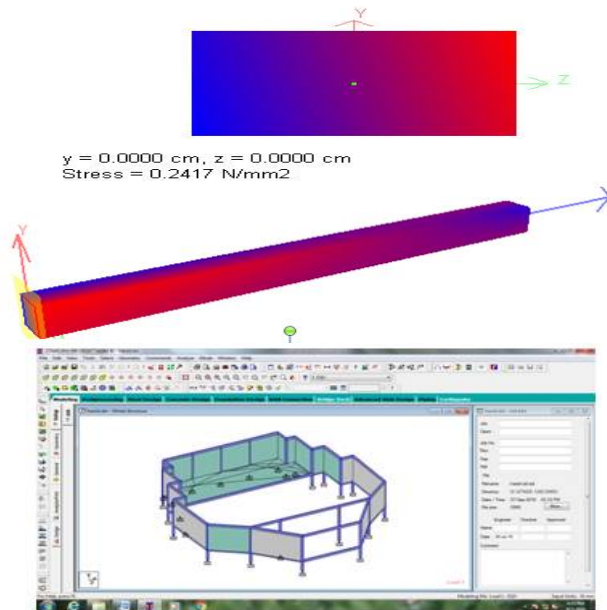
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**Graphs:
Beam-99**



Stress:



Section view

IV. CONCLUSION

The project is about “Designing and Planning of Auditorium”. As this is a prayer hall all the members of the staff assemble here. The total project includes designing of structural members like slab, beams, columns, footings. The designing has been done based on reference of IS code 456:2000 for concrete and SP 16 for steel. The software AutoCAD was used for drawings (plan, section, & elevation) and for drawing reinforcement details of slabs, columns, beams & footings.

Various load combinations as per IS code were used, considering seismic load as the major apart from other loads. The structure is stable under various load combinations. This project concludes that the moments and forces appearing in the structure were significantly lower than in case of plane frame under similar loading conditions. Also the project shows that for long spans structures are considerably cost effective than plane frame structures.

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REFERENCES

- [1] "National Register Information System". National Register of Historic Places. National Park Service. 2010-07-09.
- [2] Pitts, Carolyn (March 10, 1975). National Register of Historic Places Inventory/Nomination: Auditorium Building. National Park Service. Retrieved December 8, 2011.
- [3] "Auditorium Building". National Historic Landmark summary listing. National Park Service. May 15, 1975. Retrieved 2011-12-08.
- [4] "Auditorium Building". Commission on Chicago Landmarks. Chicago Department of Housing and Economic Development, Historic Preservation Division. Retrieved December 8, 2011.
- [5] "Some interior details were probably drawn by Frank Lloyd Wright, who started in Sullivan's office as a draftsman in 1887." Banister Fletcher. A History of Architecture. p. 1241.
- [6] Sarkowski, John (1956). The Idea of Louis Sullivan. Bulfinch Press. p. 22. ISBN 0-8212-2667-3.
- [7] Henning, Joel (September 6, 2008). "Form Follows Function, Elegantly: Louis Sullivan designed the Auditorium Theatre's interior to complement its acoustics-driven shape". The Wall Street Journal. Dow Jones & Company. Archived from the original on September 11, 2008. Retrieved 2008-09-07. Heidi Pawlowski (2005). "Auditorium Building". The Electronic Encyclopedia of Chicago. Chicago Historical Society. Retrieved 2008-09-07.
- [8] IS: 2526-1963 code for "Acoustical Design of Auditoriums and Conference Halls".