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Design of Movie Theatre by STAADD Pro Analysis and LSM - A Study

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Abstract: *The design of a modern movie theatre is very complicated and it should be done very methodically keeping in mind the innumerable number of details that it should be attended to. A certain degree of price discrimination can be seen at movie theatres. There is a different and varied price not only for when but also for where one sits in a movie theatre. This is to say that one is charged more for the same movie and the same experience based on from where he or she sits. As by norm, the seats in front are charged lesser than the seats at the back. The comfort of viewing, i.e. physical comfort is the best at the back, and worst in the front, but the last few 'expensive' rows may not be the most 'ideal' place to watch the movie from. In this paper includes the design of an ideal movie theatre such that one can have the best possible angle of vision using STAADD PRO ANALYSIS and LSM*

Keywords: *Movie theatre, Beams, Purlins , Footing, STAADD PRO ANALYSIS , LSM.*

I. Introduction

Cinema is most popular and cheapest entertainment for the people. For screening the movies to the audience a fully fledged movie theatre is necessary. Hence, though the movie theatre is a commercial entertainment structure, it should provide maximum facilities and comforts to the audience at a reasonable prize. The designer will need many and varied skills – drawing, painting, construction, draftsman-ship, sewing, budgeting, self promotion, communication, are all skills which are needed in various degrees. The designer also needs to have an understanding of the text and of the human figure in space. So the following four principles are Theatre design can be a lifetime study.

- The audience must feel closely linked with the performers and each other
- The audience should be clustered around the performers, within the limits of good sightlines
- The auditorium must be scaled to sustain and enhance the performance.
- The architecture should encourage a sense of excitement and community

II. Structure of a Movie Theatre

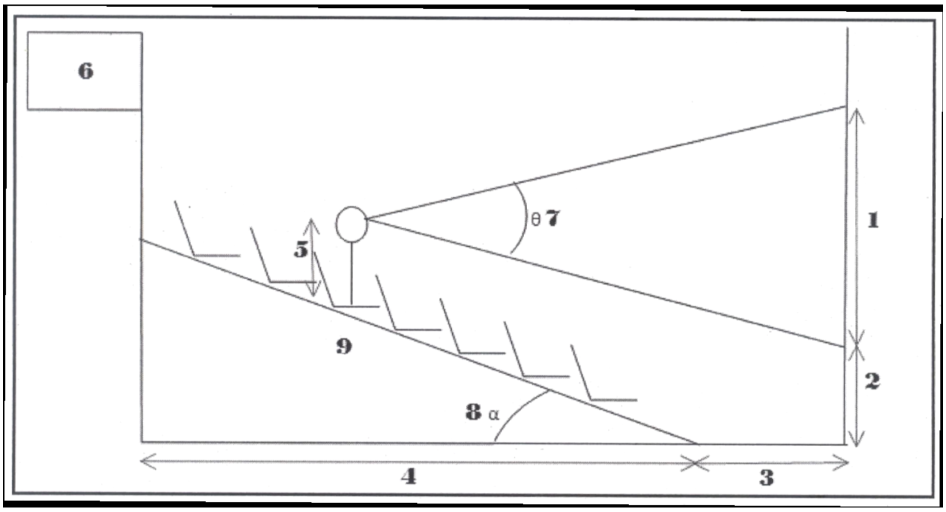

Fig 1. A simplified drawing of movie theatre

The above figure is a drawing representation of a movie theatre which depicts the following:
1. THE SCREEN
2. HEIGHT OF THE SCREEN ABOVE THE GROUND

3. DISTANCE BETWEEN SCREEN AND FIRST ROW
4. HORIZONTAL DISTANCE BETWEEN FIRST ROW AND THE END OF SEATING AREA
5. THE HEIGHT OF THE INDIVIDUAL
6. PROJECTOR ROOM
7. θ-THE ANGLE SUBTENDED BY SCREEN ON INDIVIDUALS EYE
8. α- THE ANGLE OF INCLINATION OF THE SEATING AREA
9. THE SEATING

III. Room Design And Accoustics

The shape of the room is one of the important factors affecting its acoustical properties. Hence the determination of most desirable shape is a problem that the architect should know how to solve. The optimum ratio of length to width for a room is not a fixed number, but varies with the size and shape of the seating area. For most rooms, ratio of the length to width between 1.2:1 and 2:1 has been more satisfactory.

IV. Design of Theatre

Length of 4 seats = 2.54 m , wall thickness= 0.23 m
Let us provide 25 rows each having 24 seats , 12 each on either side of ramp 2m wide.
Total length occupied by 12 seats = 3*2 54 = 7.62 m
Allow passage of 1 m at the end of seating on both sides.
Total internal breadth of theatre= 1+7.62+2+7.62+1 = 19.24m
External breadth = 19.24+ 2*0.23 = 19.7 m
From the above data,

a) Screen dimensions = 13m * 5.5m
b) Height of screen above the ground= 3 m
c) Distance between screen and first row = 8 m
d) Distance between first row and last row:

Provide 3 classes with landings of 1.5 m between each class.
Class A = 8 rows, Class B = 8 rows, Class C = 9 rows
Width of each row= 1 m
Distance between 1st and last rows = 9+1.5+8+1.5+8 = 28 m
Total length of theatre = 8+28 = 36 m

Aspect ratio = 36/19.24 = 1.87 < 2

Therefore acoustic dimensions are satisfied.

e) Let angle of inclination of seating area = 9^0

The inclination starts at a distance of 7.8 m from the screen.
Height of last row from the floor near screen = 4.04 m
Total height of columns = 3+5.5+0.5 = 9 m
As the breadth of theatre is 19.24 m it will be difficult to provide beams. So roof truss should be designed for this theatre.

V. Staad Analysis – Determination of Forces In Truss Members

```
**************************************************
*                                *
*        S T A A D - III                *
*        Revision 22.0W                   *
*        Date=   Oct, 2016             *
*        Time=     0: 4: 20             *
*                                *           *
**************************************************
```

1. STAAD TRUSS DESIGN OF TRUSS FOR THEATRE.
2. INPUT WIDTH 72
3. UNIT METER KNS
4. JOINT COORDINATES
5. 1 .000 .000 .000
6. 2 9.820 .000 .000
7. 3 19.640 .000 .000
8. 4 9.820 4.910 .000

```
5     2.455     .000     .000
6     4.910     .000     .000
7     7.365     .000     .000
8    12.275     .000     .000
9    14.730     .000     .000
10   17.185     .000     .000
11    2.455    1.227     .000
12    4.910    2.455     .000
13    7.365    3.683     .000
14   17.185    1.227     .000
15   14.730    2.455     .000
16   12.275    3.683     .000
MEMBER INCIDENCES
    1     1     5
    2     2     8
    3     1    11
    4     2     4
    5     3    14
    6     5     6
    7     6     7
    8     7     2
    9     8     9
   10     9    10
   11    10     3
   12    11    12
   13    12    13
   14    13     4
   15    14    15
   16    15    16
   17    16     4
   18     5    11
   19    11     6
   20     6    12
   21    12     7
   22     7    13
   23    13     2
   24     2    16
   25    16     8
   26     8    15
   27    15     9
   28     9    14
   29    14    10
MEMBER PROPERTY INDIAN
1 TO 3 5 TO 17 TABLE ST TUBE TH .006 WT .075 DT .075
4 18 TO 29 TABLE ST TUBE TH .005 WT .05 DT .05
CONSTANT
E STEEL ALL
DENSITY STEEL ALL
POISSON STEEL ALL
SUPPORT
1 3 FIXED
LOAD 1 DL
SELFWEIGHT Y -1.
MEMBER LOAD
3 5 12 TO 17 UNI Y -2.
LOAD 2 LL
MEMBER LOAD
3 5 12 TO 17 UNI Y -4.
LOAD COMB 3 DL+LL
```

```
68. 1 1.5 2 1.5
69. PERFORM ANALYSIS PRINT ALL

  P R O B L E M   S T A T I S T I C S
  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    16/   29/    2
 ORIGINAL/FINAL BAND-WIDTH =   14/    3
 TOTAL PRIMARY LOAD CASES  =    2,
 TOTAL DEGREES OF FREEDOM =    28
 SIZE OF STIFFNESS MATRIX =     224 DOUBLE PREC. WORDS
 REQRD/AVAIL. DISK SPACE =  12.04/ 6545.8 MB,  EXMEM = 1958.9 MB
 LOADING    1   DL
 SELF WEIGHT  Y   -1.000
 ACTUAL WEIGHT OF THE STRUCTURE =       8.121 KNS
 MEMBER LOAD - UNIT KNS  METE
 MEMBER     UDL      L1     L2      CON      L     LIN1     LIN2
  3    -2.000 Y     .00    2.74
  5    -2.000 Y     .00    2.74
 12    -2.000 Y     .00    2.74
 13    -2.000 Y     .00    2.74
 14    -2.000 Y     .00    2.74
 15    -2.000 Y     .00    2.74
 16    -2.000 Y     .00    2.74
 17    -2.000 Y     .00    2.74

***TOTAL APPLIED LOAD ( KNS  METE ) SUMMARY (LOADING    1 )
   SUMMATION FORCE-X =         .00
   SUMMATION FORCE-Y =      -47.40
   SUMMATION FORCE-Z =         .00
  SUMMATION OF MOMENTS AROUND THE ORIGIN-
  MX=00 ,  MY=00 , MZ= -465.48
LOADING    2   LL
 MEMBER LOAD - UNIT KNS
 MEMBER     UDL      L1     L2      CON      L     LIN1     LIN2

  3    -4.000 Y     .00    2.74
  5    -4.000 Y     .00    2.74
 12    -4.000 Y     .00    2.74
 13    -4.000 Y     .00    2.74
 14    -4.000 Y     .00    2.74
 15    -4.000 Y     .00    2.74
 16    -4.000 Y     .00    2.74
 17    -4.000 Y     .00    2.74

***TOTAL APPLIED LOAD ( KNS  METE ) SUMMARY (LOADING    2 )
   SUMMATION FORCE-X =         .00
   SUMMATION FORCE-Y =      -78.56
   SUMMATION FORCE-Z =         .00
  SUMMATION OF MOMENTS AROUND THE ORIGIN-
  MX=           .00  MY=           .00  MZ=        -771.4
++ Processing Element Stiffness Matrix.             0: 4:20
++ Processing Global Stiffness Matrix.              0: 4:20
++ Processing Triangular Factorization.             0: 4:20
++ Calculating Joint Displacements.                 0: 4:20
++ Calculating Member  Forces.                      0: 4:20

***TOTAL REACTION ( KNS  METE ) SUMMARY
LOADING    1

SUM-X=        .00  SUM-Y=       47.40  SUM-Z=        .00
```

SUMMATION OF MOMENTS AROUND ORIGIN-

MX= .00 MY= .00 MZ= 465.48

EXTERNAL AND INTERNAL JOINT LOAD SUMMARY-

JT	EXT FX/ INT FX	EXT FY/ INT FY	EXT FZ/ INT FZ	EXT MX/ INT MX	EXT MY/ INT MY	EXT MZ/ INT MZ
1	1.23	-2.79	.00	.00	.00	.00
	-36.57	-20.91	.00	.00	.00	.00
2	.00	-.79	.00	.00	.00	.00
	.00	.79	.00	.00	.00	.00
3	-1.23	-2.79	.00	.00	.00	.00
	36.57	-20.91	.00	.00	.00	.00
4	.00	-5.43	.00	.00	.00	.00
	.00	5.43	.00	.00	.00	.00
5	.00	-.35	.00	.00	.00	.00
	.00	.35	.00	.00	.00	.00
6	.00	-.49	.00	.00	.00	.00
	.00	.49	.00	.00	.00	.00
7	.00	-.56	.00	.00	.00	.00
	.00	.56	.00	.00	.00	.00
8	.00	-.56	.00	.00	.00	.00
	.00	.56	.00	.00	.00	.00
9	.00	-.49	.00	.00	.00	.00
	.00	.49	.00	.00	.00	.00
10	.00	-.35	.00	.00	.00	.00
	.00	.35	.00	.00	.00	.00
11	2.45	-5.40	.00	.00	.00	.00
	-2.46	5.40	.00	.00	.00	.00
12	2.46	-5.46	.00	.00	.00	.00
	-2.46	5.46	.00	.00	.00	.00
13	2.45	-5.54	.00	.00	.00	.00
	-2.46	5.54	.00	.00	.00	.00
14	-2.45	-5.40	.00	.00	.00	.00
	2.45	5.40	.00	.00	.00	.00
15	-2.46	-5.46	.00	.00	.00	.00
	2.46	5.46	.00	.00	.00	.00
16	-2.45	-5.54	.00	.00	.00	.00
	2.45	5.54	.00	.00	.00	.00

LOADING 2

SUM-X= .00 SUM-Y= 78.56 SUM-Z= .00

SUMMATION OF MOMENTS AROUND ORIGIN-

MX= .00 MY= .00 MZ= 771.46

EXTERNAL AND INTERNAL JOINT LOAD SUMMARY-

JT	EXT FX/ INT FX	EXT FY/ INT FY	EXT FZ/ INT FZ	EXT MX/ INT MX	EXT MY/ INT MY	EXT MZ/ INT MZ
1	2.45	-4.91	.00	.00	.00	.00
	-59.55	-34.37	.00	.00	.00	.00
2	.00	.00	.00	.00	.00	.00
	.00	.00	.00	.00	.00	.00
3	-2.45	-4.91	.00	.00	.00	.00
	59.55	-34.37	.00	.00	.00	.00
4	.00	-9.82	.00	.00	.00	.00
	.00	9.82	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00
	.00	.00	.00	.00	.00	.00

6	.00	.00	.00	.00	.00	.00
	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00
	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00
	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00
	.00	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00
	.00	.00	.00	.00	.00	.00
11	4.91	-9.82	.00	.00	.00	.00
	-4.91	9.82	.00	.00	.00	.00
12	4.91	-9.82	.00	.00	.00	.00
	-4.91	9.82	.00	.00	.00	.00
13	4.91	-9.82	.00	.00	.00	.00
	-4.91	9.82	.00	.00	.00	.00
14	-4.91	-9.82	.00	.00	.00	.00
	4.91	9.82	.00	.00	.00	.00
15	-4.91	-9.82	.00	.00	.00	.00
	4.91	9.82	.00	.00	.00	.00
16	-4.91	-9.82	.00	.00	.00	.00
	4.91	9.82	.00	.00	.00	.00

LOAD COMBINATION NO. 3
DL+LL
LOADING- 1. 2.
FACTOR - 1.50 1.50;-

VI. Design of Truss For Theatre

JOINT DISPLACEMENT (CM RADIANS) STRUCTURE TYPE = TRUSS

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	.0000	.0000	.0000	.0000	.0000	.0000
	2	.0000	.0000	.0000	.0000	.0000	.0000
	3	.0000	.0000	.0000	.0000	.0000	.0000
2	1	.0000	-.3421	.0000	.0000	.0000	.0000
	2	.0000	-.5645	.0000	.0000	.0000	.0000
	3	.0000	-1.3599	.0000	.0000	.0000	.0000
3	1	.0000	.0000	.0000	.0000	.0000	.0000
	2	.0000	.0000	.0000	.0000	.0000	.0000
	3	.0000	.0000	.0000	.0000	.0000	.0000
4	1	.0000	-.2824	.0000	.0000	.0000	.0000
	2	.0000	-.4666	.0000	.0000	.0000	.0000
	3	.0000	-1.1234	.0000	.0000	.0000	.0000
5	1	.0038	-.2224	.0000	.0000	.0000	.0000
	2	.0067	-.3691	.0000	.0000	.0000	.0000
	3	.0157	-.8873	.0000	.0000	.0000	.0000
6	1	.0076	-.3185	.0000	.0000	.0000	.0000
	2	.0133	-.5267	.0000	.0000	.0000	.0000
	3	.0315	-1.2678	.0000	.0000	.0000	.0000
7	1	.0064	-.3566	.0000	.0000	.0000	.0000
	2	.0111	-.5888	.0000	.0000	.0000	.0000
	3	.0263	-1.4181	.0000	.0000	.0000	.0000
8	1	-.0064	-.3566	.0000	.0000	.0000	.0000
	2	-.0111	-.5888	.0000	.0000	.0000	.0000
	3	-.0263	-1.4181	.0000	.0000	.0000	.0000
9	1	-.0076	-.3185	.0000	.0000	.0000	.0000
	2	-.0133	-.5267	.0000	.0000	.0000	.0000
	3	-.0315	-1.2678	.0000	.0000	.0000	.0000

10	1	-.0038	-.2224	.0000	.0000	.0000	.0000
	2	-.0067	-.3691	.0000	.0000	.0000	.0000
	3	-.0157	-.8873	.0000	.0000	.0000	.0000
11	1	.0688	-.2222	.0000	.0000	.0000	.0000
	2	.1150	-.3691	.0000	.0000	.0000	.0000
	3	.2756	-.8870	.0000	.0000	.0000	.0000
12	1	.0766	-.3132	.0000	.0000	.0000	.0000
	2	.1277	-.5185	.0000	.0000	.0000	.0000
	3	.3064	-1.2475	.0000	.0000	.0000	.0000
13	1	.0576	-.3412	.0000	.0000	.0000	.0000
	2	.0960	-.5643	.0000	.0000	.0000	.0000
	3	.2304	-1.3583	.0000	.0000	.0000	.0000
14	1	-.0688	-.2222	.0000	.0000	.0000	.0000
	2	-.1150	-.3691	.0000	.0000	.0000	.0000
	3	-.2756	-.8869	.0000	.0000	.0000	.0000
15	1	-.0766	-.3132	.0000	.0000	.0000	.0000
	2	-.1277	-.5185	.0000	.0000	.0000	.0000
	3	-.3064	-1.2475	.0000	.0000	.0000	.0000
16	1	-.0576	-.3412	.0000	.0000	.0000	.0000
	2	-.0960	-.5643	.0000	.0000	.0000	.0000
	3	-.2304	-1.3583	.0000	.0000	.0000	.0000

SUPPORT REACTIONS -UNIT KNS METE STRUCTURE TYPE = TRUSS

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	35.34	23.70	.00	.00	.00	.00
	2	57.09	39.28	.00	.00	.00	.00
	3	138.65	94.47	.00	.00	.00	.00
3	1	-35.34	23.70	.00	.00	.00	.00
	2	-57.09	39.28	.00	.00	.00	.00
	3	-138.65	94.47	.00	.00	.00	.00

MEMBER END FORCES STRUCTURE TYPE = TRUSS

ALL UNITS ARE -- KNS METE

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	-5.28	.16	.00	.00	.00	.00
		5	5.28	.16	.00	.00	.00	.00
	2	1	-9.22	.00	.00	.00	.00	.00
		5	9.22	.00	.00	.00	.00	.00
	3	1	-21.75	.23	.00	.00	.00	.00
		5	21.75	.23	.00	.00	.00	.00
2	1	2	8.84	.16	.00	.00	.00	.00
		8	-8.84	.16	.00	.00	.00	.00
	2	2	15.36	.00	.00	.00	.00	.00
		8	-15.36	.00	.00	.00	.00	.00
	3	2	36.30	.23	.00	.00	.00	.00
		8	-36.30	.23	.00	.00	.00	.00
3	1	1	46.86	2.90	.00	.00	.00	.00
		11	-46.70	2.90	.00	.00	.00	.00
	2	1	76.88	5.49	.00	.00	.00	.00
		11	-76.88	5.49	.00	.00	.00	.00
	3	1	185.61	12.58	.00	.00	.00	.00
		11	-185.37	12.58	.00	.00	.00	.00
4	1	2	-22.27	.00	.00	.00	.00	.00
		4	22.61	.00	.00	.00	.00	.00

```
       2    2    -36.81       .00      .00      .00      .00       .00
 4    36.81       .00      .00      .00      .00       .00
       3    2    -88.62       .00      .00      .00      .00       .00
 4    89.13       .00      .00      .00      .00       .00

    5    1    3    46.86     2.90     .00      .00      .00       .00
 14    -46.70     2.90     .00      .00      .00       .00
       2    3    76.88     5.49     .00      .00      .00       .00
 14    -76.88     5.49     .00      .00      .00       .00
       3    3   185.61    12.58     .00      .00      .00       .00
 14   -185.37    12.58     .00      .00      .00       .00

    6    1    5    -5.28      .16     .00      .00      .00       .00
 6     5.28      .16     .00      .00      .00       .00
       2    5    -9.22      .00     .00      .00      .00       .00
 6     9.22      .00     .00      .00      .00       .00
       3    5   -21.75      .23     .00      .00      .00       .00
 6    21.75      .23     .00      .00      .00       .00

    7    1    6     1.72      .16     .00      .00      .00       .00
 7    -1.72      .16     .00      .00      .00       .00
  MEMBER END FORCES    STRUCTURE TYPE = TRUSS
  ALL UNITS ARE -- KNS  METE

 MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

       2    6     3.08      .00      .00      .00      .00       .00
            7    -3.08      .00      .00      .00      .00       .00
       3    6     7.20      .23      .00      .00      .00       .00
            7    -7.20      .23      .00      .00      .00       .00

    8    1    7     8.84      .16     .00      .00      .00       .00
 2    -8.84      .16     .00      .00      .00       .00
       2    7    15.36      .00     .00      .00      .00       .00
 2   -15.36      .00     .00      .00      .00       .00
       3    7    36.30      .23     .00      .00      .00       .00
 2   -36.30      .23     .00      .00      .00       .00

    9    1    8     1.72      .16     .00      .00      .00       .00
 9    -1.72      .16     .00      .00      .00       .00
       2    8     3.08      .00     .00      .00      .00       .00
 9    -3.08      .00     .00      .00      .00       .00
       3    8     7.20      .23     .00      .00      .00       .00
 9    -7.20      .23     .00      .00      .00       .00

   10    1    9    -5.28      .16     .00      .00      .00       .00
 10     5.28      .16     .00      .00      .00       .00
       2    9    -9.22      .00     .00      .00      .00       .00
 10     9.22      .00     .00      .00      .00       .00
       3    9   -21.75      .23     .00      .00      .00       .00
 10    21.75      .23     .00      .00      .00       .00

   11    1   10    -5.28      .16     .00      .00      .00       .00
 3     5.28      .16     .00      .00      .00       .00
       2   10    -9.22      .00     .00      .00      .00       .00
 3     9.22      .00     .00      .00      .00       .00
       3   10   -21.75      .23     .00      .00      .00       .00
 3    21.75      .23     .00      .00      .00       .00
```

```
 12    1    11     41.79      2.90       .00        .00        .00         .00
12    -41.63      2.90      .00        .00        .00        .00
        2    11     68.62      5.49       .00        .00        .00         .00
 12    -68.62      5.49      .00        .00        .00        .00
        3    11    165.62     12.59       .00        .00        .00         .00
 12   -165.39     12.59      .00        .00        .00        .00

    13    1    12     36.58      2.90       .00        .00        .00         .00
13    -36.42      2.90      .00        .00        .00        .00
        2    12     60.38      5.49       .00        .00        .00         .00
13    -60.38      5.49      .00        .00        .00        .00
        3    12    145.44     12.59       .00        .00        .00         .00
  13   -145.20     12.59      .00        .00        .00        .00

    14    1    13     31.25      2.90       .00        .00        .00         .00
  4    -31.09      2.90      .00        .00        .00        .00
 MEMBER END FORCES    STRUCTURE TYPE = TRUSS
  ALL UNITS ARE -- KNS  METE
  MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z
TORSION     MOM-Y      MOM-Z

        2    13     52.15      5.49       .00        .00        .00         .00
   4    -52.15      5.49      .00        .00        .00        .00
        3    13    125.09     12.58       .00        .00        .00         .00
4   -124.86     12.58      .00        .00        .00        .00

    15    1    14     41.79      2.90       .00        .00        .00         .00
15    -41.63      2.90      .00        .00        .00        .00
        2    14     68.62      5.49       .00        .00        .00         .00
15    -68.62      5.49      .00        .00        .00        .00
        3    14    165.62     12.59       .00        .00        .00         .00
15   -165.39     12.59      .00        .00        .00        .00

    16    1    15     36.58      2.90       .00        .00        .00         .00
16    -36.42      2.90      .00        .00        .00        .00
        2    15     60.38      5.49       .00        .00        .00         .00
16    -60.38      5.49      .00        .00        .00        .00
        3    15    145.44     12.59       .00        .00        .00         .00
            16   -145.20     12.59      .00        .00        .00        .00

    17    1    16     31.25      2.90       .00        .00        .00         .00
4    -31.09      2.90      .00        .00        .00        .00
        2    16     52.15      5.49       .00        .00        .00         .00
 4    -52.15      5.49      .00        .00        .00        .00
        3    16    125.09     12.58       .00        .00        .00         .00
 4   -124.86     12.58      .00        .00        .00        .00

    18    1     5      -.31       .00       .00        .00        .00         .00
11       .40       .00      .00        .00        .00        .00
        2     5       .00       .00       .00        .00        .00         .00
11       .00       .00      .00        .00        .00        .00
        3     5      -.47       .00       .00        .00        .00         .00
11       .60       .00      .00        .00        .00        .00

  19    1    11      7.78       .08       .00        .00        .00         .00
 6     -7.86       .08      .00        .00        .00        .00
        2    11     13.76       .00       .00        .00        .00         .00
 6    -13.76       .00      .00        .00        .00        .00
        3    11     32.30       .13       .00        .00        .00         .00
```

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6    -32.43      .13      .00       .00       .00       .00

    20    1   6     -3.90      .00      .00       .00       .00       .00
              12     4.07      .00      .00       .00       .00       .00
          2     6     -6.15      .00      .00       .00       .00       .00
              12     6.15      .00      .00       .00       .00       .00
          3    6    -15.08      .00      .00       .00       .00       .00
              12    15.33      .00      .00       .00       .00       .00

    21    1    12      9.98       .08      .00       .00       .00       .00
7    -10.15      .08      .00       .00       .00       .00
 MEMBER END FORCES    STRUCTURE TYPE = TRUSS
   ALL UNITS ARE -- KNS  METE
  MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

          2    12     17.37      .00      .00       .00       .00       .00
 7    -17.37      .00      .00       .00       .00       .00
          3    12     41.03      .13      .00       .00       .00       .00
  7    -41.29      .13      .00       .00       .00       .00

    22    1     7     -7.55      .00      .00       .00       .00       .00
13      7.81      .00      .00       .00       .00       .00
          2     7    -12.28      .00      .00       .00       .00       .00
13     12.28      .00      .00       .00       .00       .00
          3     7    -29.75      .00      .00       .00       .00       .00
13     30.13      .00      .00       .00       .00       .00

    23    1    13     12.88      .08      .00       .00       .00       .00
2    -13.14      .08      .00       .00       .00       .00
          2    13     22.12      .00      .00       .00       .00       .00
2    -22.12      .00      .00       .00       .00       .00
          3    13     52.50      .13      .00       .00       .00       .00
2    -52.88      .13      .00       .00       .00       .00

    24    1     2     13.14      .08      .00       .00       .00       .00
 16    -12.88      .08      .00       .00       .00       .00
          2     2     22.12      .00      .00       .00       .00       .00
16    -22.12      .00      .00       .00       .00       .00
          3     2     52.88      .13      .00       .00       .00       .00
16    -52.50      .13      .00       .00       .00       .00

    25    1    16     -7.81      .00      .00       .00       .00       .00
 8      7.55      .00      .00       .00       .00       .00
          2    16    -12.28      .00      .00       .00       .00       .00
8     12.28      .00      .00       .00       .00       .00
          3    16    -30.13      .00      .00       .00       .00       .00
8     29.75      .00      .00       .00       .00       .00

26    1     8     10.15      .08      .00       .00       .00       .00
15     -9.98      .08      .00       .00       .00       .00
          2     8     17.37      .00      .00       .00       .00       .00
              15    -17.37      .00      .00       .00       .00       .00
          3     8     41.29      .13      .00       .00       .00       .00
              15    -41.03      .13      .00       .00       .00       .00

    27    1    15     -4.07      .00      .00       .00       .00       .00
  9      3.90      .00      .00       .00       .00       .00
          2    15     -6.15      .00      .00       .00       .00       .00
9      6.15      .00      .00       .00       .00       .00
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      3    15    -15.33       .00      .00       .00       .00        .00
  9    15.08       .00      .00       .00       .00       .00

    28    1     9      7.86       .08      .00       .00       .00        .00
  14     -7.78       .08      .00       .00       .00       .00
MEMBER END FORCES    STRUCTURE TYPE = TRUSS
ALL UNITS ARE -- KNS  METE
 MEMBER  LOAD  JT     AXIAL   SHEAR-Y  SHEAR-Z   TORSION     MOM-Y      MOM-Z

      2     9     13.76      .00      .00       .00       .00       .00
           14    -13.76      .00      .00       .00       .00       .00
      3     9     32.43      .13      .00       .00       .00       .00
           14    -32.30      .13      .00       .00       .00       .00

    29    1    14      -.40       .00      .00       .00       .00        .00
10       .31       .00      .00       .00       .00       .00
      2    14       .00       .00      .00       .00       .00       .00
 10       .00       .00      .00       .00       .00       .00
      3    14      -.60       .00      .00       .00       .00       .00
10       .47       .00      .00       .00       .00       .00

  ************** END OF LATEST ANALYSIS RESULT **************
   71. PLOT BENDING FILE
   72. FINISH
         *************** END OF STAAD-III ***************
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VII. Calculations For Truss

Clear span of the truss=19.24m
Assume a bearing of 20cm on either side
Effective span=19.24+0.2+0.2=19.64m
According to hand book based on IS codes,

<u>Dead load/m^2</u>

1. Galvanian sheeting =16Kg/m^2
2. Purlins (6 to 9 kg/m^2) =8Kg/m^2
3. Truss weight (10 to 14kg/m^2) =12 Kg/m^2
4. Weight of wind bracings =<u>1.3Kg/m^2</u>

=37.3Kg/m^2 =375N/m^2

Adopting c/c of truss=4m , Let pitch=1 in 4

Load/Panel=w*l/8 = $\frac{375*4*19.64}{8}$ =367KN

Live Load:

As per IS-875,For roof sloping>10^0, LL=75Kg/m^2-(1 Kg/m^2 for 1^0 increase in slope)
>20^0, LL=75 Kg/m^2-(2 Kg/m^2 for 1^0 increase on slope) ,Up to minimum of 40 kg/m^2
Rise of span=19.64/4=4.91m
Slope of truss=tan^{-1}(4.91/9.82) =26.565^0
LL=75-(6.565*2)-(10*1) =52Kg/m^2=520 KN/m^2

Wind load:

Basic wind pressure at Anantapur, P=100Kg/m^2

1. External wind pressure as per IS-875

	Wind ward slope	Leeward slope
20^0	-0.4P	-0.5P
26.565^0	-0.218P (interpolation)	-0.5P
30^0	-0.1P	-0.5P

2. **Internal wind pressure:-**Assuming normal permeability, internal wind pressure = ±0.2P
3. **Total wind pressure:**

WIND PRESSURE	WIND WARD SIDE	LEE WARD SIDE
a) External	-0.218P = 218 Kg/m^2	-0.5P = -50 Kg/m^2
b) External + Internal(-0.2P)	(-0.218-0.2)P = -41.8 Kg/m^2	(-0.5-0.2)P = -70 Kg/m^2
c) External + Internal(+0.2P)	(-0.218+0.2)P = -1.8 Kg/m^2	(-0.5+0.2)P = -30 Kg/m^2

Maximum is in case (b)
Diagonal length of truss = sqrt $(9.82^2 + 4.91^2)$ =10.98m
Length of each panel = 10.98/4 =2.745m
Spacing of trusses = 4 m c/c
LOAD PER PANEL:
Due to DL = 366.3 Kg
LL = 52*4*2.455 = 510.64 Kg
Wind load a) wind ward side = -42*4*2.745 = -461 Kg
b) lee ward side = -70*4*2.745 = -769 Kg

VIII. Design of Truss

DESIGN OF TOP CHORD (COMPRESSION MEMBER):
Maximum load = 185.61 KN
Factored load = 1.5*185.61 = 278.415 KN
Length = 2.745 m
Let us assume effective slenderness ratio to be 100
For tubular section, for the buckling curve b, the design compressive stress corresponding to effective slenderness ratio 100 is 118 N/mm^2
Therefore Area= $(278.415*10^3/118)$ =2355.9 mm^2
From IS handbook (or) from S.K Duggal, pg 786, try steel tube of 160 mm Nominal bore and heavy section of 5.4 mm thickness
A = 2760mm^2,Z=109cm^2,R=5.76 cm
Effective slenderness ratio= $\frac{2.745*1000}{57.6}$ =47.65 < 180 [SAFE]
For $\lambda = 47.65; f_y = 250 N/mm^2$ and buckling curve 'b' the design compressive stress from table 7.6.
$F_{cd} = 186.5 N/mm^2$
Design compressive load $P_d = A_c * f_{cd}$ =2700*186.5
=514.74 KN > 278.415 KN [SAFE]
Hence provide steel tube of 160 mm nominal bore and heavy section of 5.4 mm thickness
DESIGN OF WELDING:-
a)Design strength of weld in tension{ $l_w = \pi d = 500m$}
$T_{dw} = \frac{f_y\, l_w\, t_e}{\gamma_{mw}} = \frac{250*500*((5/8)*5.4)}{1.25}$ = 506.25KN > 278.415KN [SAFE]
b)Design strength of weld in compression
$V_{dw} = \frac{(410/\sqrt{3})*500*((5/8)*5.4)}{1.25}$ =319.563 KN > 278.415 KN [SAFE]
DESIGN OF TRUSS MEMBERS (COMPRESSION MEMBER):
Maximum load = 52.5 KN
Factored load = 1.5*52.5 = 78.75 KN
Length = 4.5 m
Let us assume effective slenderness ratio to be 100
For tubular section, for the buckling curve b, the design compressive stress corresponding to effective slenderness ratio 100 is 118 N/mm^2
Therefore Area= $(78.75*10^3/118)$ =667.4 mm^2
From IS handbook pg 786, try steel tube of 90 mm Nominal bore and light section of 3.6 mm thickness
A = 1110mm^2, Z=26.2cm^2, R=3.47 cm
Effective slenderness ratio= $\frac{4.5*1000}{34.7}$ =130 < 180 [SAFE]
For $\lambda = 130$; $f_y = 250 N/mm^2$ and buckling curve 'b' the design compressive stress from table 7.6.
$F_{cd} = 88.3 N/mm^2$
Design compressive load $P_d = A_c\, f_{cd}$=1110*88.3=98.013 KN > 78.75 KN [SAFE]

Hence provide steel tube of 90 mm nominal bore and light section of 3.6 mm thickness

DESIGN OF WELDING

a)Design strength of weld in tension { $l_w = \pi d = 283m$}

$T_{dw} = \frac{250*283*((5/8)*3.6)}{1.25} = 159.043$ KN > 78.75KN [SAFE]

b) Design strength of weld in compression

$V_{dw} = \frac{(410/\sqrt{3})*283*((5/8)*3.6)}{1.25} = 120.6$ KN > 78.75 KN [SAFE]

DESIGN OF TRUSS MEMBERS (COMPRESSION MEMBER):

Maximum load = 88.62 KN

Factored load = 1.5*88.62 = 132.3 KN

Length = 4.91 m

Area= $T\gamma_{mo}/ f_y = (132.3*10^3*1.1/250) = 582.12\ mm^2$

From IS handbook (or) from S.K Duggal, pg 786, try steel tube of 65 mm Nominal bore and medium section of 3.6 mm thickness

Area provided = $820mm^2$, $Z=14.2cm^2$, R=2.57 cm

IX. Check For Gross Section Yeilding

$A = T*\gamma_{m1} / f_y \Rightarrow$ 820 = T*1.1/250 => T = 186.36 KN > 132.3 KN [SAFE]

CHECK FOR NET SECTION RUPTURE:

$T_{dn} = A_n f_u / \gamma_{m1}$ =820*410/1.25 = 268.9 KN > 132.3 KN [SAFE]

Hence provide steel tube of 65 mm nominal bore and heavy section of 3.6 mm thickness

DESIGN OF WELDING:

a) Design strength of weld in tension { $l_w = \pi d = 204.2m$}

$T_{dw} = \frac{250*204.2*((5/8)*6)}{1.25} = 153$ KN > 132.3 KN [SAFE]

b) Design strength of butt weld in shear

$V_{dw} = \frac{(410/\sqrt{3})*204.2*((5/8)*6)}{1.25} = 145$ KN > 132.3 KN [SAFE]

DETAILS OF TRUSS:

NOMINAL BORE (mm)	CLASS	THICKNESS (mm)	WEIGHT (kg/m)	AREA OF C/S (cm^2)	Z (cm^3)	R (cm)	WELD (mm)
160	Heavy	5.4	21.200	27.10	109.0	5.76	3.375
90	Light	3.6	8.760	11.10	26.20	3.47	2.25
65	Medium	3,6	6.490	8.20	14.20	2.57	3.75

X. Design of Purlin

Since the slope of roof truss is less than 30^0 , tubular section can be used as purlin.

According to hand book based on IS codes .

DEAD LOAD:

Galvanian sheeting = 16 Kg/m^2

Purlins = <u>8 Kg/m^2</u>

24 Kg/m^2

Total DL = 24*2.455*4 = 235.68 Kg = 2360 N

LIVE LOAD:

Live load as calculated earlier = 520 N/ m^2

Total LL = 520*2.455*4 = 5106.4 N

WIND LOAD:

Wind load normal to roof truss = 1500 N/ m^2

Total wind load = 1500*2.745*4 = 16470 N

Fig 2: Purlins

TOTAL LOAD = 16470+(2360+5106.4)cos26.565^0 =23150 N = 23.15 KN
Maximum Bending Moment = w*l/10 =23.15*4/10 = 9.26 KNm

SECTION MODULUS:
Z = M / (1.33*0.66*f_y) =9.26*10^6 / (1.33*0.66*415) = 25.419 cm^3
Provide medium tubular section of 90 mm nominal bore having thickness of 4mm whose sectional modulus Z= 28.8 cm^3

BOLT CONNECTIONS:
Use 2- 16 mm diameter bolts,A_{nb} = 2*0.785*π*16^2/4 = 315.66 mm^2
Strength of bolt in single shear = V_{sb}= 315.66*400 / $\sqrt{3}$*1.25 = 58.308 KN > 23.15 KN [SAFE]
Strength of bolt in bearing =2.5*0.5*(2*16)*4*400*10^{-3}/1.25 = 51.2 KN > 23.15 KN [SAFE]

XI. Analysis And Design of Frames

X-AXIS:
Loading area = 2*(½* (5+1)*2) = 12 m^2
Slab load= 12((0.15*25) +2) = 69 KN
Load on beam = 69/5 =13.8 KN/m
Self-weight of beam = 0.23*0.6*25 = 3.45 KN/m
Total load = 13.8 + 3.45 = 17.25 KN/m

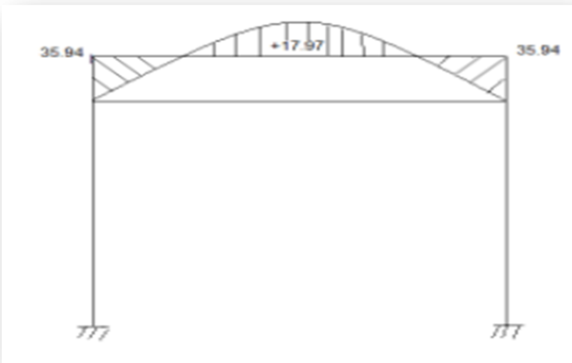

Fig 3 : bmd in X - axis

Y- AXIS:
Loading area = 2*(½* (5+1)*2) = 12 m^2
Slab load= 12((0.15*25) +2) = 69 KN
Load on beam = 69/5 =13.8 KN/m
Self-weight of beam = 0.23*0.6*25 = 3.45 KN/m
Total load = 13.8 +3.45 = 17.25 KN/m

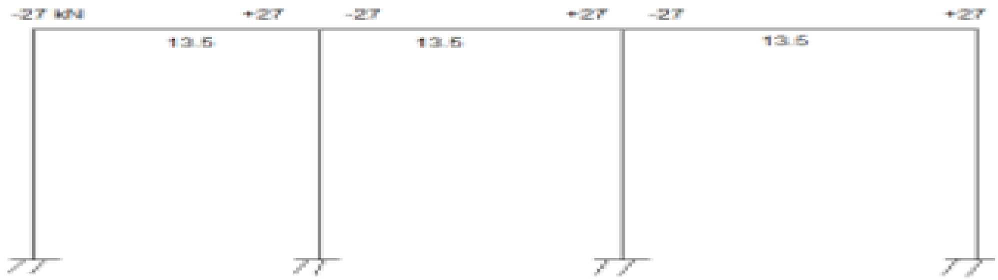

Fig 4 : Loads

DESIGN OF SLAB

Dimensions=4m * 5m, Slab thickness = 150mm
Self-weight=0.15*1*1*25=3.75kN/m
Superimposed load=2.8kN/m^2 then Total load =6.55 kN/m^2 => W_u=1.5*6.55=9.825 kN/m^2
D =150-20-8/2=126mm, l_x = 4+0.126 = 4.126m, l_y= 5+0.126=5.126m => l_y/ l_x = 1.0406
α_x = 0.039 , α_y=0.03 => $M_{ux} = \alpha_x w_u l_x^2$ = 0.039*9.825*4.126^2 = 9.298kNm
$M_{uy} = \alpha_y w_u l_x^2$ = 0.03*9.825*4.126^2 = 7.152kNm
Effective depth : d_{eff}=9.298*10^6/0.138*20*1000 =58.04 mm < 126mm (SAFE) Under R.F.
REINFORCEMENT: For short span (middle strip):
$A_{stx} = 0.36 f_{ck} b x_u / 0.87 f_y$ = 0.36*20*1000*0.48*126/0.87*415
A_{stx} = 904.56 mm2,Use 8mm Φ bars = spacing = π/4 *8^2*1000/904.56 = 55mm
Hence provide 8 mm Φ @ 55mm c/c
For long span (middle strip):-
7.152*10^6 = 0.87*f_{y*} A_{sty} (50-415A_{st}/20*1000) => A_{sty} = 500mm^2
Hence provide 8mm Φ @ 100mm c/c and 8mm Φ @ 280mm c/c in Min. area of steel
CHECK FOR SHEAR AND DEVELOPMENT LENGTHS
For shorter span :
S.F. @ longer edge = $w_u l_x r$/ (2+r) = 6550*4.926*1.0406/(2+1.0406) = 11.042 KN
Nominal shear stress @ longer edges = 1.5*11042/1000*126 = 0.131N/mm^2
A_{st} at support of short span = 1000 * π/4*8^2/110 = 456.9mm^2
M=0.87 * $f_y A_{st}$ (d-0.42x_u) = 0.87*415 *456.9(126-0.42*22.88) = 19.2 kNm
L_o = 230/2 -20 = 95mm => 1.3* M/V + L_0> 47 Φ
1.3*19.2/11.042*1.5 +95 = 1601 > 376 mm (SAFE)
For longer span: Factored SF=1/3 w_u l_x =1/3*(6550*1.5)*4.926=16131
Nominal shear stress,τ_v=16131/1000*126=0.128N/mm^2
a_{st}= 1000*/4*8^2/200 = 251.5mm^2
x_u = 0.87*415*251.5/0.36*20*1000 = 12.58mm
M=0.87*415*251.5(126-0.42*12.58) = 10.96kNm
1.3*10.96/16.131+95 = 978>47Φ = 376 (SAFE)
TORSIONAL REINFORCEMENT:
Size of mesh=lx/5=4.126/5=0.9852 m from centre of support
= (0.23/2) + 0.9852=1.1002 m from support
Area of torsional reinforcement= (3/4) Ast x = (3/4)904.56=678.42 mm^2
Use 8 mm Ø @ spacing = (1000*π/4*8^2)/678.42=74 mm/cc.
Check for development length:
M.R offered by 8 mm Φ bars @ 140 mm c/c
M_1= 0.87*415*(π/4)*8*2*1000/140(126-(4415*π/4882*8^2*1000/140)/20*1000)
M_1=15.367 KNM, V =30.11 KN
Ld≤1.3$M_{1/V}$ +L_O
=> (0.87X415Ø/4*1.2*1.6) ≤ (15.367*10^6/30.11*10^3)=510.36=>Ø≤14.11 mm **(SAFE)**
The code requires that bars must be carried into the supports by at least L_d/3 = 510/3=170 mm.
Check for deflection:
L/D =αβγδλ , α = 26 for continuous beam , β = 1 for L < 10 m
p_t = (A_{st}/bd)*100 = (100*π/4*8^2*1000/70)/1000*126 = 0.5790

ɤ = 1.15 for p_t = 0.57 % and σs = 240 MR, δ=1, λ=1
L/D =29.9 , Actual L/d = 4800/126= 38.09 [SAFE]

12. DESIGN OF BEAMS

T-BEAM

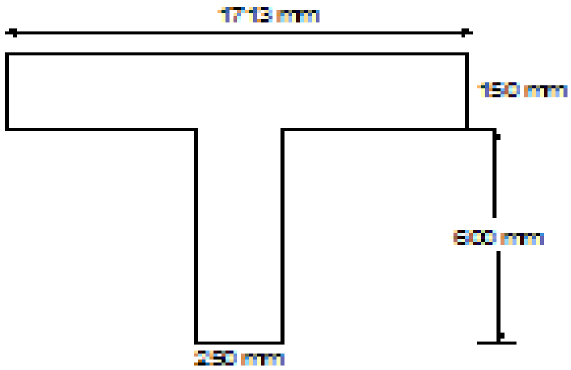

Fig 5 : T-beam

Applied movement =35.94 KNm
Factored movement = 1.5*35.94 = 53.91 KNm
L_0 = 0.7*5 = 3.5 m, d = 750 – 50 = 700 mm
b_f =(lo/6)+b_w+6D_f = 1713 mm
Assume x_u = D_f
M_u = 0.36*20*(1713)*150(700 – 0.42*150) = 1178.5 KNm
X_u<D_f
M_u = 0.87f_yA_s(d - $f_yA_{st}/f_{ck}b_f$) => 53.91*10^6 = 0.87*415*A_{st}[700 – (415*a_{st}/20*1713)] => A_{st} = 222.07 mm^2
use 12 mm Ø bars, No. of bars = (222.07/(π/4)*12^2) =2 bars.
Side face reinforcement: Deep beam (i.e D = 750 mm) provides 2-12 mm Ø bars on each face.
Check for shear:-
S_f = 43.125 kN, v_u = 1.5*43.125 = 64.687KN
T_u = v_u/b_wd = 64.6875*10^3/230*700 = 0.401N/m^2
100A_{st}/b_wd = 100*222.07/230*700 = 0.137 From $I_{s-456\text{ , pg 73 , Tc}}$ =0.26N/mm^2
T_v> T_c Shear reinforcement is necessary.
V_{us} = 64.687*10^3 – 0.36*230*700 =6.727 KN
Use 2 legged 8mm Ø stirrups
S_v = (0.87*415*100.53)/0.4*230 = 394.52 mm
Max spacing in y = 0.75d = 525mm (>394.52 mm) (safe)

L-Beam Design

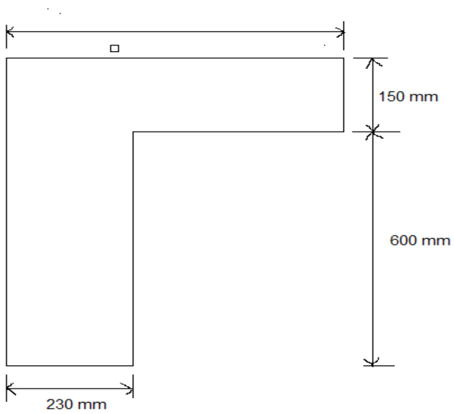

Fig 6 : L-Beam

D_f = 150 mm, b_w = 230 mm, Effective depth = 750-50 = 700 mm

Factored moment =53.91 KNm = m_v
$b_f = L_o /12 + b_w + 3D_f$
L_o =0.7(4.8) = 2.8 m, b_f = 972mm
Assume $x_v = D_f$
M =0.36*20*972*150(700-(0.42*150))=> 682.63*10^6 N mm = 682.63 N m > m_v
So $x_v < D_f$
53.91*10^6 = 0.87*415*A_{st}*700 (1- (415/20)*(A_{st}/700*971)) => A_{st} = 214.7 mm^2
Use 12 mm Ø , No. of bars = 214/((π/4)*12^2) = 2 , hence Use 2-12 mmØbars

Shear reinforcement:
Using 2 legged 8MM stirrups (max spacing = 0.75 d = 525 mm)
A_s = 2*π/4 *8^2 = 100.53
S V = (0.87*415*100.53) / 0.4*230 = 390 mm
SIDE FACE REINFORCEMET:
A_{st} provide@ 2-12 mmΦBars on each face

13. DESIGN OF COLUMNS AXIALLY LOADED COLUMN:
Total weight of column = 81Kn
Loads coming from the beam:
X-X Y-Y
43.125 + 83/2 84.05KN = 84.625KN
Total load = 1.5 (81 + 84.625 + 84.05) = 374.5125 KN
P_U=374.5125=. O.45*20(300*600-A_{ST}) + 0.67*415*A_{ST} => A_{ST} = 768MM^2
Min area of reinforcement =0.8/100*300*600 =1440m^2
Use 16 mm Φ bars then No. of bars =1440/(π/4*100)=8nos
Use 8-16mm Φ bars and 6mm Φ lateral ties @250 mm c/c
14. UNIAXIALLY LOADED COLUMN:
Size of the column =300*600, Height of the column=9m, Total weight of column=0.18*9*25=81KN
Load coming from beams:
X-X Y-Y
43.125KN 42.55KN
Total factored load=1.5*(43.125+42.55+81)=250.0125KN
Factored moment=1.5*35.94KNm=53.91KNm
$P_u/(f_{ck}*b*d)=(250.0125*10^3)/(20*300*600)=0.069$
$M_u/(f_{ck}*b*d^2)=0.024$, $p/f_{ck}=0.045$, % of steel =0.9%, 100A_{ST}/b*D=0.9 => A_{st}=1608.5mm^2
Provide 16mm Φ bars then No of bars =1608.5/π/4*16^2=8no
Provide 8-16mm Φ bars and Provide 6mm Φ @250mm c/c lateral ties.
15. DESIGN OF FOOTING:
SBC = 25 t/m^2 =250 kN/m^2, Load P =374.5 Kn, Self weight=10% , P =37.45 kN then Total load =411.95 kN
Footing area = total load/SBC = 411.95/250 =1.6475 m^2
Provide sides ≈ 1.3m*1.3m Column size =0.3*0.6 m^2
L_X=1.3-0.3=1 m , L_Y=1.3-0.6=0.7 m , Net upward pressure ,P=411.95/(1.3*1.3)=243.76kN/m^2
$M_X=P*B*(L_X)^2/8$ =243.76*1.3*1^2/8 =39.61 kNm
$M_Y=P*B*(L_Y)^2/8$=243.76*1.3*0.7^2/8 =19.041 kNm
M_{max}=39.61 kNm
Depth of footing:
d=√M/(0.138*f_{ck}*b) =√(39.61*10^6/(0.138*20*1000)) =119.79 mm => d ≈120mm
But min. Depth of foundation D=500mm,d=450mm.
Reinforcement:
M=0.87*fy*Ast*[d-(f_y*A_{st}/f_{ck}*b)]
39.61*10^6=0.87*415*A_{st}*[450-(415*A_{st}/20*1000)] => $A_{st=}$=246.6 mm2 ,hence use 12 mm Φ bars,
Spacing =Π*12^2/(4*247)=293.4mm then Use 12 mm Φ bars @ 300 c/c spacing.
Check for one way shear:

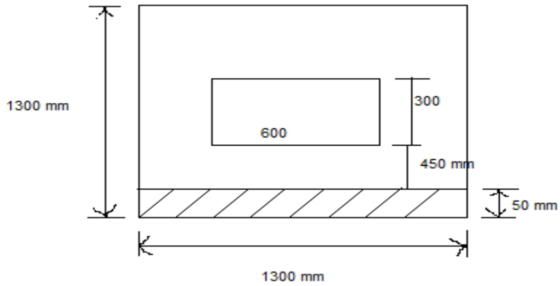

Fig 7 : One way shear

$V_u = q_0$(hatched area) => V_u=250*(0.05*1.3)=16.25 kN
$T_V=V_u/Bd$ =16.25/(1.3*0.450) => 0.27 kN/m^2
$100A_{st}/bd$ =0.42 ==> T_C=0.41 > T_V. SAFE in one way shear.

Check for two way shear:

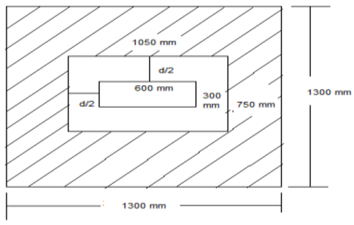

Fig 8 : One way shear

$V_u=q_0$(hatched area) = 250(0.9025) =225.625 kN
$T_V=V_u$/(perimeter Along dark line) => T_V=225.625/(2*(0.75*1.05)) =0.625 kN/m^2
$T_C=0.25\sqrt{f_{ck}}$ =1.118 > T_V safe in two way shear

XII. Results and Discussion

Actually movie theatre total height of columns is 9 m as the breadth of theatre is 19.24 m it will be difficult to provide beams. So roof truss should be designed for this theatre using analysis of STAADD PRO and checked all design of columns, beams, footings, portal frames using LSM.

17. CONCLUSIONS: Generally all cinema theatres should not be provided roof truss but based on the dimensions of hall we have to provide the roof truss.

18. FUTURE WORK: This work will be done extended for Estimation of costing, valuation and quantity survey.

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Nomenclature:

A - Area
b - Effective width of the slab
b_f - Effective width of the flange
b_w - Breadth of web or rib
D - Overall depth of beam or slab or diameter of column
D_f - Thickness of the flange

DL - Dead Load
d - Effective depth of beam or slab
d - Depth of compression reinforcement from the highly compressed face
E_C - Modulus of elasticity of concrete
EL - Earthquake Load
E_S - Modulus of elasticity of steel
e - Eccentricity
f_{ck} - Characteristic cube compressive strength of concrete
f_y - Characteristic strength of steel
f_α - Modulus of rupture of concrete (Flexural tensile strength)
f_{ct} - Splitting tensile strength of concrete
f_d - Design strength
H_w - Unsupported height of wall
H_{we} - Effective height of wall
I_{ef} - Effective Moment of Inertia
I_{gr} - Moment of Inertia of the gross section excluding reinforcement
I_r - Moment of Inertia of cracked section
K - Stiffness of member
k - Constant (or) Coefficient of factor
L_d - Development length
LL - Live load (or) imposed load
L_w - Horizontal distance between centres of lateral restrain
l - Length of column
l_{ef} - Effective span of beam or slab or effective length of column
l_{ex} - Effective length about x-x axis
l_{ey} - Effective length about y-y axis
l_n - Clear span, face to face of supports
l_n' - l_n for shorter of the two spans at right angles
l_x - Length of shorter side of slab
l_y - Length of longer side of slab
l_o - Distance between points of zero moments in a beam
l_l - Span in the direction in which moments are determined, centre to centre of supports
l_2 - Span transfer to l_1 , centre to centre of supports
l_2' - l_2 for the shorter of the continuous spans
M - Bending Moment
m - Modular ratio
n - Number of samples
P - Axial load on a compression member
q_{au} - Calculated maximum bearing pressure of soil
r - Radius
s - Spacing of stirrups (or) standard deviation
T - Torsional Moment
t - Wall thickness
V - Shear Force
W - Total load
WL - Wind load
w - Distributed load per unit area
w_d - Distributed dead load per unit area
w_l - Distributed live (imposed) load per unit area
x - Depth of neutral axis
Z - Modulus of section
z - Lever arm
α,β - Angle (or) ratio
Υ_r - Partial safety factor for load
Υ_m - Partial safety factor for material
τc - Shear stress in concrete
τc max - Maximum shear stress in concrete with shear Reinforcement
τv - Nominal shear stress
ϕ - Diameter of bar