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COMPARITIVE ANALYSIS FOR RCC AND STEEL FLEXURAL MEMBERS ON INDUSTRIAL BUILDING

R.A. Prabu shankar, A.Yacop raja, M.E.,(ph.D)

[1]*PG Scholar, Structural Engineering, Oxford Engineering College, Trichy, Tamil Nadu, India.*
[2]*Assisttant Professor, Department of Civil Engineering, Oxford Engineering College, Trichy, Tamil Nadu, India.*

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Abstract - Design of the Industrial Building flexural members on RCC Slab, Beam, Column, Footing in the cases of structural analysis for Staad.pro analysis for the building comparative the analysis steel member for truss, beam, column, footing the cases of the structural analysis for Staad pro calculating industrial building

Plan, Elevation, Section, column and beam structural design in the cases for the dead load and live load, As far as possible, for industrial buildings, the same column size and concrete grade should be used for at least two stories so as to avoid frequent changes in column size and concrete mix to facilitate easy and quick construction. Minimum grade of concrete to be adopted for structural members at all floors is M20 for Non Coastal Region and M30 for Coastal region.

***Key Words*: COMPARITIVE ANALYSIS FOR RCC AND STEEL FLEXURAL MEMBERS ON INDUSTRIAL designRCC Beam & column & slab ,truss, angle design.**

1. INTRODUCTION

The analysis and designing was done according to the standard specification to the possible extend. The analysis of structure was done using the software package STAAD PRO.V8i. All the structural components were designed manually. The detailing of reinforcement was done in AutoCAD 2013. The use of the software offers saving in time.

RCC beams are cast in cement concrete reinforced with steel bars. Beams resist compression and tensile forces and add rigidity to the structure. Dead load Deal load refers to loads that relatively don't change over time, such as the weight of. All permanent components of a building including walls, Beam, columns, flooring material etc.,) Fixed permanent equipment and fitting that are an integral part of the structure.(like plumbing, HVAC Live load Refers to loads that do, or can, change over time, such as people walking around a building (occupancy) or movable objects such as furniture.

2. ANALYSIS

2.1 Dead&Live Analysis

To achieve a practical knowledge on structural analysis, design and detailing of structural components using principles of Earthquake resistant design SI (i.e.. Whenever reference to the clause of an Indian standard is made, it will be written as IS 456:2000 for structural design. Also some of clauses are written from the IS 1893:2002, SP-16 and other important factors from our book other reference books The loading is applied to the slab elements directly. The load on slab is taken as per the requirement stated in IS875:1987(Part I & II).The uniformly distributed dead and live load acting on the slab are transferred to the beam sholding the slab.

2.2 Wind Analysis

As the wind blows against a building, the resulting force acting on the elevations is called the 'wind load'. The building's structural design must absorb wind forces safely and efficiently and transfer them to the foundations in order to avoid structural collapse. Wind speed in the atmospheric boundary layer increases with height from zero at ground level to a maximum height called the gradient height. As the windmill is of grater height and normally situated in open terrain category the wind load is major affecting factor. This effect of wind on structure as a hole was determined by the combined action of external and internal pressure acting on it. The Wind analysis was done by using IS-875 (Part-3) code. As per code wind speed considered for proposed site was 39 m/s. Due to the high rise of the structure the wind speeds also increasing. So, the greater effect produced on the Windmill. Therefore, wind load (F) on windmill structure acting in a direction normal to the individual structural element was calculated by:

$$F = C_f A P_z$$

Where,

Cf = Force coefficient;

Pz = design wind pressure.

A = surface area of structural or cladding unit;

The windmill experiences both compression and a bending moment about its footing. The compression is due to the weight of the nacelle and rotor whilst the bending moment is induced by the thrust caused by drag forces on the blade of windmill. The tower itself also experiences an unevenly distributed force due to the drag forces created by the oncoming wind. This drag force or thrust due to wind was calculated as per IS-875 Part-3 as below:

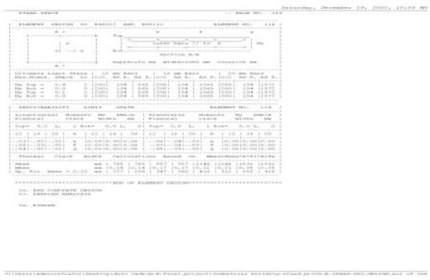
$F = C_f A P_z$

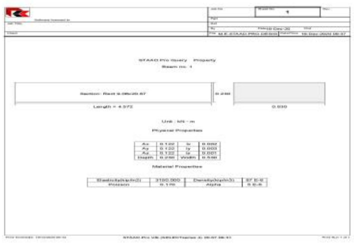
2.3 METHODOLOGY OF THE WORK

After the study of architectural drawing and preliminary design, load calculations were done using the IS 875:1987 as reference. The exact value of unit weights of the materials from the code was used in the calculation. The thickness of materials was taken as per design requirement.

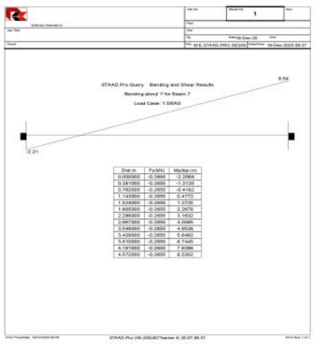
3. RCCFORM ANALYSIS

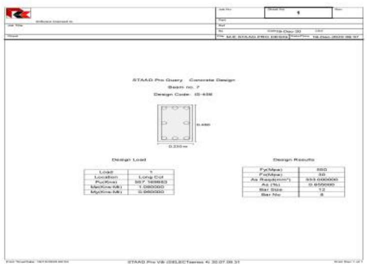
3.1 BEAM DESIGN



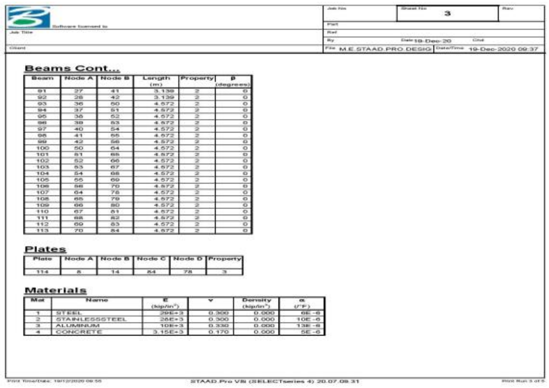


3.2 COLUMN DESIGN





3.3 RESULT AND DISCUSSION



Beams Cont...

Beam	Node A	Node B	Length (m)	Property	β (degrees)
91	27	41	3.139	2	0
92	28	42	3.139	2	0
93	36	50	4.572	2	0
94	37	51	4.572	2	0
95	38	52	4.572	2	0
96	39	53	4.572	2	0
97	40	54	4.572	2	0
98	41	55	4.572	2	0
99	42	56	4.572	2	0
100	50	64	4.572	2	0
101	51	65	4.572	2	0
102	52	66	4.572	2	0
103	53	67	4.572	2	0
104	54	68	4.572	2	0
105	55	69	4.572	2	0
106	56	70	4.572	2	0
107	64	78	4.572	2	0
108	65	79	4.572	2	0
109	66	80	4.572	2	0
110	67	81	4.572	2	0
111	68	82	4.572	2	0
112	69	83	4.572	2	0
113	70	84	4.572	2	0

Plates

Plate	Node A	Node B	Node C	Node D	Property
114	8	14	84	78	3

Materials

Mat	Name	E (kip/in²)	ν	Density (kip/in³)	α (/°F)
1	STEEL	29E+3	0.300	0.000	6E-6
2	STAINLESSSTEEL	28E+3	0.300	0.000	10E-6
3	ALUMINUM	10E+3	0.330	0.000	13E-6
4	CONCRETE	3.15E+3	0.170	0.000	5E-6

4. STEELFORM ANALYSIS

4.1 Dead Analysis

The loading is applied to the slab elements directly. The load on slab is taken as per the requirement stated in IS875:1987(Part I & II).The uniformly distributed dead and live load acting on the slab are transferred to the beam sholding the slab. The slab load is distributed on the floor beams as shown in figure below. The smaller beam holds the triangular load and the longer beams hold the trapezoidal load as shown in figure. The beam element also resists the self-weight and the wall load including all the finish loads on wall such as external and internal plaster.

4.2 Wind Analysis

As the wind blows against a building, the resulting force acting on the elevations is called the 'wind load'. The building's structural design must absorb wind forces safely and efficiently and transfer them to the foundations in order to avoid structural collapse.

1. Wind load (WL)

2. Dead load (DL)

Following load combination are adopted for design

4.3 Limit state method

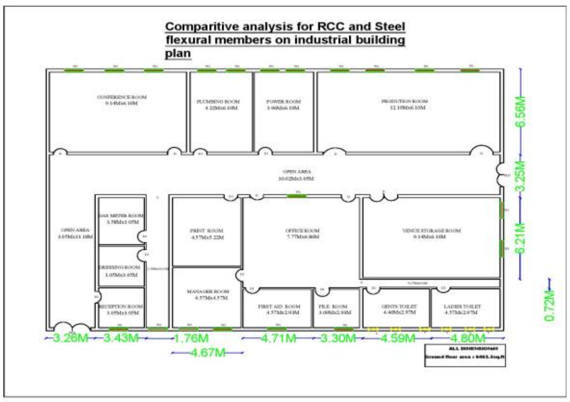
It uses the concept of the probability and based on the application of method of statistic to the variation that occurs in the practice in the loads acting in the structures or in the strength of material. The structures may reach a condition at which it becomes unfit for use for one of many reasons e.g. collapse, excessive deflection, cracking, etc., and each of these conditions is referred to a limit state condition

The aim of limit state design is to achieve an acceptable probability that the structure will not become unserviceable in its life time for the use of which it has been intended i.e. it will not reach a limit state. It means the structure should be able to withstand safely all loads that are liable to act on it throughout its life and it would satisfy the limitations of deflection and cracking.

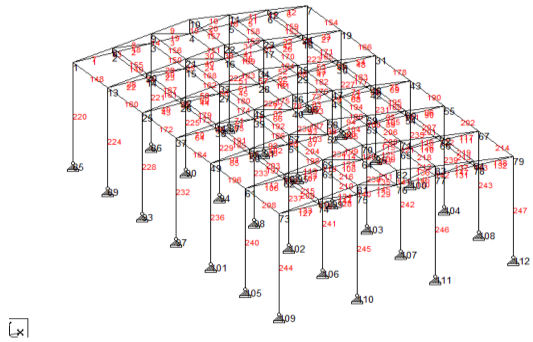
4.4Assumptions for flexural member

Plane sections normal to the axis of them ember remain plane after bending. The maximum strain in concrete at the outermost compression fiber is 0.0035.The relationship between the compressive stress distribution in concrete and the strain in concrete may be assumed to be rectangle, trapezoidal, parabola or any other shape which results in prediction of strength in substantial agreement with the result of test. For design purposes, the compressive strength of concrete in the structure shall be assumed to be 0.67 times the characteristic strength. The partial safety factor γm = 1.5 shall be applied in addition to this. The tensile strength of concrete is ignored. The maximum strain in the tension reinforcement in the section at failure shall not

5. PLAN

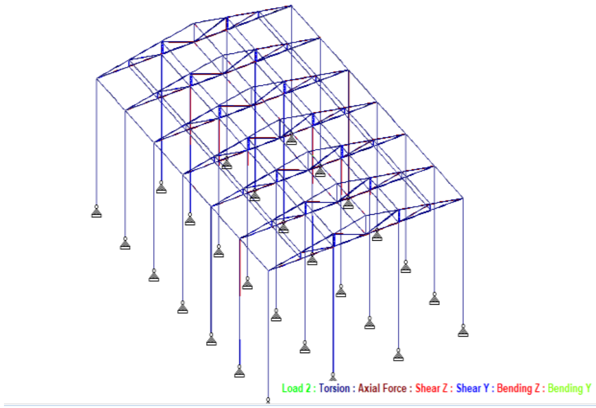


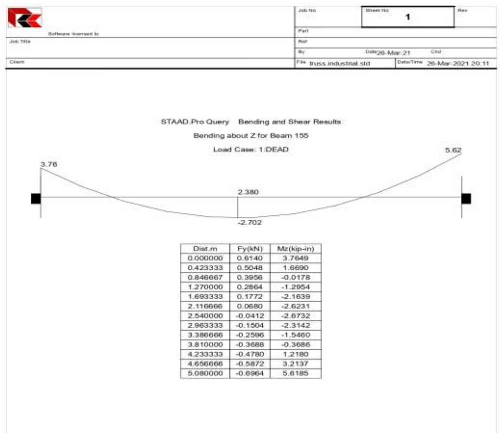
5. 1.STEELPLAN



6. STEELFORM ANALYSIS

6.1 BEAM DESIGN





Dist.m	Fy(kN)	Mz(kip-in)
0.000000	0.6140	3.7649
0.423333	0.5048	1.6690
0.846667	0.3956	-0.0178
1.270000	0.2864	-1.2954
1.693333	0.1772	-2.1639
2.116666	0.0680	-2.6231
2.540000	-0.0412	-2.6732
2.963333	-0.1504	-2.3142
3.386666	-0.2596	-1.5460
3.810000	-0.3688	-0.3686
4.233333	-0.4780	1.2180
4.656666	-0.5872	3.2137
5.080000	-0.6964	5.6185

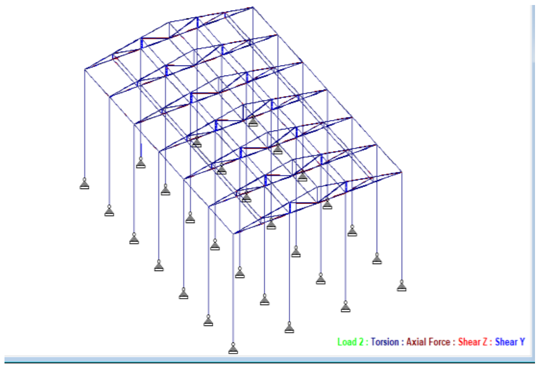
```
                                                                       Fri
  STAAD SPACE                                              -- PAGE NO.    41

ALL UNITS ARE - KN   METE  (UNLESS OTHERWISE Noted)

MEMBER      TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                           FX            MY             MZ       LOCATION
=======================================================================

   154 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.100          1
                          0.03 C         0.01           0.58       5.08
   155 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.120          1
                          1.86 C        -0.01           0.61       5.08
   156 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.108          1
                          0.85 C        -0.01           0.58       5.08
   157 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.104          1
                          0.71 C         0.00           0.57       5.08
   158 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.108          1
                          0.85 C         0.01           0.58       5.08
   159 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.120          1
                          1.86 C         0.01           0.61       5.08
   160 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.096          1
                          0.02 C         0.00           0.56       0.00
   161 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    7.1.2 BEND C       0.101          1
                          1.44 T         0.00           0.59       5.08
   162 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    7.1.2 BEND C       0.096          1
                          0.70 T         0.00           0.56       5.08
```

6.2 COLUMN DESIGN



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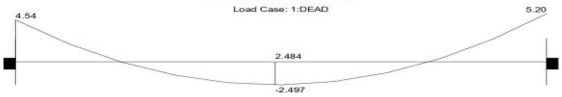
	Part			
Job Title	Ref			
	By	Date 26-Mar-21	Chd	
Client	File truss.industrial.std	Date/Time 26-Mar-2021 20:11		

STAAD.Pro Query Bending and Shear Results

Bending about Z for Beam 167

Load Case: 1:DEAD



Dist.m	Fy(kN)	Mz(kip-in)
0.000000	0.6407	4.5448
0.423332	0.5315	2.3489
0.846663	0.4223	0.5620
1.269995	0.3131	-0.8156
1.693327	0.2039	-1.7841
2.116658	0.0947	-2.3434
2.539990	-0.0145	-2.4936
2.963322	-0.1237	-2.2346
3.386653	-0.2329	-1.5665
3.809985	-0.3421	-0.4892
4.233317	-0.4513	0.9973
4.656649	-0.5605	2.8929
5.079980	-0.6697	5.1977

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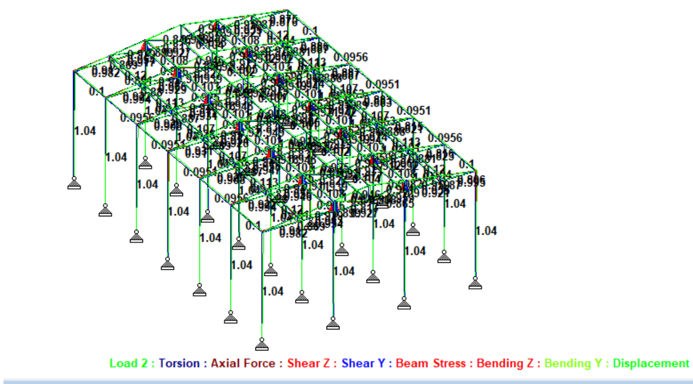
ALL UNITS ARE - KN   METE  (UNLESS OTHERWISE Noted)

MEMBER      TABLE        RESULT/   CRITICAL COND/     RATIO/     LOADING/
                           FX            MY             MZ       LOCATION
=======================================================================

   163 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    7.1.2 BEND C       0.096          1
                          0.70 T         0.00           0.56       5.08
   164 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    7.1.2 BEND C       0.096          1
                          0.70 T         0.00           0.56       5.08
   165 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    7.1.2 BEND C       0.101          1
                          1.44 T         0.00           0.59       5.08
   166 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.096          1
                          0.02 C         0.00           0.56       0.00
   167 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.113          1
                          1.45 C        -0.01           0.59       5.08
   168 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.103          1
                          0.75 C        -0.01           0.56       5.08
   169 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.102          1
                          0.68 C         0.00           0.56       5.08
   170 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.103          1
                          0.75 C         0.01           0.56       5.08
   171 ST   ISA150X150X10           (INDIAN SECTIONS)
                            PASS    IS-7.1.1(A)        0.113          1
                          1.45 C         0.01           0.59       5.08
```

6.3 RESULT AND DISCUSSION



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	Part			
Job Title	Ref			
	By	Date 26-Mar-21	Chd	
Client	File truss.industrial.std	Date/Time 26-Mar-2021 19:50		

Job Information

	Engineer	Checked	Approved
Name:			
Date:	26-Mar-21		

Structure Type	SPACE FRAME

Number of Nodes	112	Highest Node	112
Number of Elements	247	Highest Beam	247

Number of Basic Load Cases	2
Number of Combination Load Cases	0

Included in this printout are data for:

All	The Whole Structure

Included in this printout are results for load cases:

Type	L/C	Name
Primary	1	DEAD
Primary	2	WIND

Nodes

Node	X (m)	Y (m)	Z (m)
1	0.000	10.000	0.000
2	3.327	10.000	0.000
3	6.653	10.000	0.000
4	9.980	10.000	0.000
5	13.307	10.000	0.000
6	16.633	10.000	0.000
7	19.960	10.000	0.000
8	3.327	10.500	0.000
9	6.653	11.000	0.000
10	9.980	11.500	0.000
11	13.307	11.000	0.000
12	16.633	10.500	0.000
13	0.000	10.000	5.080
14	3.327	10.000	5.080
15	6.653	10.000	5.080
16	9.980	10.000	5.080
17	13.307	10.000	5.080
18	16.633	10.000	5.080
19	19.960	10.000	5.080
20	3.327	10.500	5.080
21	6.653	11.000	5.080

Software licensed to	Job No	Sheet No
Job Title	Part	
	Ref	
	By	Date 26-M
Client	File truss.industrial.std	

Section Properties

Prop	Section	Area (in^2)	I_{yy} (in^4)	I_{zz} (in^4)	J (in^4)	Material
19	ISWB600H	28.675	127.285	2.78E+3	5.991	STEEL
20	ISA150x150x10	4.526	24.363	6.258	0.236	STEEL
21	ISA130x130x12	4.635	18.320	4.734	0.351	STEEL
22	ISA120x120x12	4.278	14.210	3.726	0.324	STEEL
23	ISA110x110x16	5.084	13.639	3.651	0.695	STEEL
24	ISA80x80x10	2.341	3.380	0.896	0.124	STEEL
25	ISA100x100x6	1.814	4.379	1.118	0.034	STEEL
26	ISA100x100x7	2.124	5.010	1.311	0.054	STEEL
27	ISA100x100x10	2.961	6.866	1.784	0.156	STEEL
28	ISA150x150x18	7.905	40.462	10.625	1.359	STEEL
29	ISA60x60x8	1.389	1.131	0.296	0.048	STEEL
30	ISA150x90x10	3.596	14.332	2.178	0.188	STEEL
31	ISA100x100x8	2.387	5.671	1.449	0.080	STEEL
32	ISA110x110x12	3.891	10.812	2.827	0.296	STEEL
33	ISA125x95x12	3.875	11.484	2.489	0.296	STEEL
34	ISA75x75x6	1.342	1.794	0.458	0.025	STEEL
35	ISA70x70x6	1.249	1.446	0.370	0.024	STEEL

Materials

Mat	Name	E (kip/in^2)	ν	Density (kip/in^3)	α (/°F)
1	STEEL	29E+3	0.300	0.000	6E -6
2	STAINLESSSTEEL	28E+3	0.300	0.000	10E -6
3	ALUMINUM	10E+3	0.330	0.000	13E -6
4	CONCRETE	3.15E+3	0.170	0.000	5E -6

Supports

Node	X (kip/in)	Y (kip/in)	Z (kip/in)	rX (kip ft/deg)	rY (kip ft/deg)	rZ (kip ft/deg)
85	Fixed	Fixed	Fixed	-	-	-
86	Fixed	Fixed	Fixed	-	-	-
87	Fixed	Fixed	Fixed	-	-	-
88	Fixed	Fixed	Fixed	-	-	-
89	Fixed	Fixed	Fixed	-	-	-
90	Fixed	Fixed	Fixed	-	-	-
91	Fixed	Fixed	Fixed	-	-	-
92	Fixed	Fixed	Fixed	-	-	-
93	Fixed	Fixed	Fixed	-	-	-
94	Fixed	Fixed	Fixed	-	-	-
95	Fixed	Fixed	Fixed	-	-	-
96	Fixed	Fixed	Fixed	-	-	-
97	Fixed	Fixed	Fixed	-	-	-

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STAAD SPACE                                              -- PAGE NO.   74

ALL UNITS ARE - KN   METE (UNLESS OTHERWISE Noted)

MEMBER     TABLE       RESULT/   CRITICAL COND/     RATIO/     LOADING/
                         FX            MY             MZ       LOCATION
=======================================================================

  154 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.100         1
                       0.03 C        0.01            0.58        5.08
  155 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.120         1
                       1.86 C       -0.01            0.61        5.08
  156 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.108         1
                       0.85 C       -0.01            0.58        5.08
  157 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.104         1
                       0.71 C        0.00            0.57        5.08
  158 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.108         1
                       0.85 C        0.01            0.58        5.08
  159 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.120         1
                       1.86 C        0.01            0.61        5.08
  160 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.096         1
                       0.02 C        0.00            0.56        0.00
  161 ST   ISA70x70x6             (INDIAN SECTIONS)
                         PASS     7.1.2 BEND C       0.970         1
                       1.44 T        0.00            0.59        5.08
  162 ST   ISA70x70x6             (INDIAN SECTIONS)
                         PASS     7.1.2 BEND C       0.925         1
                       0.70 T        0.00            0.56        5.08
```

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STAAD SPACE                                              -- PAGE NO.   75

ALL UNITS ARE - KN   METE (UNLESS OTHERWISE Noted)

MEMBER     TABLE       RESULT/   CRITICAL COND/     RATIO/     LOADING/
                         FX            MY             MZ       LOCATION
=======================================================================

  163 ST   ISA70x70x6             (INDIAN SECTIONS)
                         PASS     7.1.2 BEND C       0.925         1
                       0.70 T        0.00            0.56        5.08
  164 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     7.1.2 BEND C       0.096         1
                       0.70 T        0.00            0.56        5.08
  165 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     7.1.2 BEND C       0.101         1
                       1.44 T        0.00            0.59        5.08
  166 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.096         1
                       0.02 C        0.00            0.56        0.00
  167 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.113         1
                       1.45 C       -0.01            0.59        5.08
  168 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.103         1
                       0.75 C       -0.01            0.56        5.08
  169 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.102         1
                       0.68 C        0.00            0.56        5.08
  170 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.103         1
                       0.75 C        0.01            0.56        5.08
  171 ST   ISA150x150x10          (INDIAN SECTIONS)
                         PASS     IS-7.1.1(A)        0.113         1
                       1.45 C        0.01            0.59        5.08
```

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STAAD SPACE                                              -- PAGE NO.

STEEL TAKE-OFF
--------------

   PROFILE                  LENGTH(METE)        WEIGHT(KN  )

ST  ISA130x130x12               83.43             19.163
ST  ISA120x120x12               53.38             11.317
ST  ISA110x110x16               33.53              8.448
ST  ISA80x80x10                 47.86              5.552
ST  ISA100x100x6                47.10              4.233
ST  ISA100x100x7                23.55              2.478
ST  ISA100x100x10                7.00              1.027
ST  ISA150x150x18               14.00              5.485
ST  ISA60x60x8                  10.50              0.723
ST  ISA150x90x10                23.40              4.170
ST  ISA100x100x8                24.32              2.877
ST  ISA110x110x12               13.46              2.595
ST  ISA125x95x12                26.73              5.133
ST  ISA150x150x10              274.32             61.533
ST  ISA75x75x6                  10.16              0.676
ST  ISA70x70x6                  81.28              5.033
ST  ISWB600H                   280.00            397.923
                                           ----------------
                               TOTAL =           538.364

************ END OF DATA FROM INTERNAL STORAGE ************

132. FINISH

          *********** END OF THE STAAD.Pro RUN ***********

            **** DATE= MAR 26,2021   TIME= 19:50:56 ****
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7. CONCLUSIONS

The following conclusion were made

1. Industrial building for analysis and designing the RCC design for the Slab, Column, Beam, Dead Load, Live Load is provide the design.

2. Plan elevation and section design of Beam and Column Structural design for the Staad. Pro analysis used.

Based on the analysis result, the foundation design and steel design truss, Beam, Column, Foundation design is done by using STAAD PRO Software.

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