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Analysis of Warehouse Building having High bending Strength using ETABS

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ABSTRACT

As India's manufacturing sector expands rapidly, there is a growing need for warehouse space to keep finished items in transit or for further processing. The findings of this research may be used as inspiration for the layout of a real-life industrial storage facility. With the aid of a literature research, this area of work was chosen so that designers of industrial warehouses would have a better understanding of the various force/load impacts that need to be taken into account. IS 800:2007 is suggested for the design of this building, while IS 875:1987 is used for the dead, live, and wind load analyses (Part-I, Part- II, Part-III). When one member is loaded, the surrounding members experience a corresponding force, and the moment and force created are also acquired and reported, as are the excess stress & ratios induced in such linked members. Then, the various warehouse components, such as truss members, columns, etc., were developed, and the finished product was achieved. Warehouses, it is concluded, may be created quickly and simply using a straightforward design method and IS standards.

Keywords: Bending strength, ETABS, Base reaction, Shear force, Bolt design.

1. Introduction

Simply said, an industrial facility that's any structure that is used by the industrial sector in the production of industrial goods. The absence of an internal floor, walls, or partitions characterizes buildings of this kind, which are often made of steel. which often have no more than one story, Warehouses, assembly plants, warehouses, garage, small-scale industries, etc., are typical tenants of industrial buildings. So are steel mills, automotive factories, utilities & processing industries, thermal power stations, and utility and process factories. These structures need plenty of open space without any columns. As a result, the roof system of these structures often consists of a truss with a roof covering, and the number of inner columns, walls, and partitions is typically reduced to a minimum. It's not difficult to design the roof deck, purlins, girders, columns, and girts that make up a building, but it is complicated to put them all together in a way that maximizes efficiency and minimizes costs. The members of a truss, which is a triangular steel sectional development, are subjected to an axial force from outside. Steel framed industrial buildings often have cladding made of GI sheets/precast concrete, masonry, or summarized/plain sheets. The wall's strength should be high enough to withstand the side pressure from the wind.

1.1 General:

Steel is the predominant material in the construction of factories and warehouses. With the longer span so when concrete is not in a workable condition or when time is of the essence during building. These buildings are low-rise steel constructions, so named because of their modest heights and the relative absence (or scarcity) of upper-level rooms and hallways. Steel columns form the building's walls, which are covered in steel — either traditional cladding or more modern profiled steel or G.I. sheets.

An industrial building is any structure used by industry for the purposes of manufacturing, warehousing, and distribution. Roof trusses provide protection and cover for the inhabitants of a factory. Roof trusses of this kind are ideal for use in commercial structures. According to the requirements of the Indian Standards standards, a roof truss must take into account dead load, live load, wind load, and any combination thereof while developing the structural design. Its formation of structure determines how much it will cost to construct an industrial building. Factors that affect how much it will cost to construct an industrial building include the kind of roof truss utilized, the pressures operating on the building, and the steel sections used for the roof truss. Steel constructions are increasingly in demand because of the rising use of steel in industrial building, which has led to a rise in steel demand in India. As a consequence of its superior tension and compression properties, which allow for lighter construction, steel has steadily surpassed concrete as the material of choice. Structural steel is often bigger than its concrete equivalent because it makes use of trusses in three dimensions. Since steel has more elastic characteristics than concrete, it accurately obeys hooks law. The primary function of both vertical and horizontal bracings, used in both single- and multi-story structures, and trusses is to withstand wind as well as other lateral stresses. In addition to improving the building's bending strength, the horizontal supply they provide to columns is essential. Common structural roof systems for industrial buildings include sheeting, purlin, and roof trusses supported by columns.

2. Literature Review

SWAPNIL D. BOKADE, based on what he observed while researching different kinds of factories. This presentation takes a deep dive into the many different kinds of manufacturing facilities. Steel truss buildings constructed with pipe section & PEB are found to be less costly than those constructed with angle section, as shown by the design, which makes use of the former for the truss and the latter for the purlins. An Industrial Steel truss Building saves money over a PEB structure due to the economical nature of its material selection.

LAXMI R. GUPTA, according to the author on Analysis of an Industrial Building, The bars having higher yield strength more than 500N/mm2whichtends to possess less elongation which is not suitable for Seismic area. Here sectional properties for ISMB 900 section are not in design parameters of Staad.pro 2007 so by the use of these sections which is ISMB 600 resist the permissible stresses and the individual bending moments in beam sections.

ALOK PATEL Within its pages, he details the steps involved in doing a Structural Design and Analysis for an Industrial Building. His goal is to create a cost-effective design for an industrial building utilizing both traditional and modern design techniques and computer-aided design software. Information about structural design and analysis flaws in an industrial building project are highlighted in the Project Report. The current project's primary objective is to choose a demonstration truss and analyze it under various loading scenarios.

K. PRABIN KUMAR This is according to his STAAD PRO report on the design and analysis of an industrial building. Hangars were constructed in this project employing PEB segments, which together comprise a ductile material and the toughest possible hangars. To do this, a bracing was installed in the hangar during the off hours. There are seven hangar bays. The distance between the first and last cove is 7.5 meters. The length of hangar is 50 meters, and the width is 15 meters. There are a total of 5 coves. Moreover, he used codal provision as per the IS code in his calculation for different kinds of loads that operate on the building structure.

3. Objectives

1. Key focus of research is providing study of warehouse building having high bending strength, more load carrying capacity. Under the action of all loads & load effects.
2. Main purpose is to find a simple way for a preliminary design of typical industrial buildings.
3. The purpose of this exercise is to pinpoint the many forces operating on the structure.
4. That all of the building's members are precisely as shown in the plans and that the construction complies with the IS code.

4. METHODOLOGY

STEP 1: Open E-tabs 2015

STEP 2: Open new project Naming the project. Using grid prepared a model

STEP 3: General Assigning the properties . .Assigning the supports. Assigning the load and load combination

STEP 4: Design of steel

STEP 5: Analysis

STEP 6: Result

4.1 Limit State Method (LSM)

The structure must be built to safely bear all loads that are anticipated to act on it during the course of its life, as specified by the Limit State Design technique (IS800:2007). Moreover, it must be able to withstand unintended loads, including those caused by explosions, impacts, or the results of human mistake, to a greater degree than was initially anticipated.

A limit state is the maximum level of risk that may be tolerated before the system fails. Design is to produce a structure that will not deteriorate to the point where it is no longer useful while yet meeting the desired level of dependability. In other words, it should have a very minimal chance of reaching a limit state over its lifespan. The most severe limit state should be used as a starting point for the design process, and the structure should be tested for all possible limit states. Stability, strength, serviceability, brittle fracture, fatigue, fire, and durability are all aspects of design that must be taken into account while working with steel. If all the criteria are met, then the design may be trusted.

4.2 Design Procedure: -

When it comes to modeling, analyzing, and planning the structure, E-tab software package is invaluable. The E-tab program is compatible with various different national standards, including the Indian norm. The process entails creating a model of the structure, then applying its attributes, requirements, load, and load combinations in order to analyze and design it. For 3D model creation, analysis, and multi-material design, this program is a powerful and intuitive tool.

4.3 Data for Analysis & Design

Data for the steel warehouse is as follows:-

- Type of truss :- Howe Truss
- Span of truss :- 14m
- Rise of truss :- 1.5m
- Eave height :- 6m
- Spacing between two columns :- 4m
- Height of Column :- 6m
- Location of Building :- Kalaburagi
- Type of sheeting :- Asbestos Sheets
- Number of frames :- 7
- Wind Speed :- 33m/s

4.4 Loads & Load Combination upon Steel Industrial Shed:

Dead load, live load, wind load, seismic load, etc. are only some of the stresses placed on shed structures.

Dead Load (DL):

Roofing materials, purlins, the truss itself, and the bracing system all contribute to the truss's dead load.

Live Load (LL):

Up to a 10 degree roof pitch, the live load is calculated as 0.75KN/m2 of the roof area. The Live load is calculated as 0.75 N/m2 (or 0.02 N/m2 for each additional degree of roof slope over 10 degrees), with a minimum of 0.4KN/m2

For this project, as the sloping of roof is 12^o which is greater than 10 therefore Live load is taken: 0.75-(12-10)*0.02 = 0.71KN/m2

Wind Load (WL):

Unless the roof slope is very steep, the suction action of the wind blowing over the roof will cause the wind load on the roof trusses to be an uplift force perpendicular to the roof. As a result, the forces in the truss members are reversed due to the fact that the wind load on the roof truss normally works in the opposite direction of the gravity load and its magnitude might be greater than gravity loads. These reinforcements are installed in industrial buildings to reduce the amount of lateral movement between the various frames caused by crane surge. Columns in both low and high-rise structures benefit from their lateral support, which increases the columns' resistance to buckling. The wind is the most dangerous burden on a factory. Calculations of wind load are made in accordance with IS: 875 (Part 3) - 1987. The average speed of the wind at the site of construction is determined to be 33 meters per second.

Wind force (F) = (Cpe – Cpi)*A*Pd

Where, Cpe and Cpi are the force coefficients for the exterior and interior of the building.

Earthquakes forces (IS 1893:2002(part-1)) (EQ):

The earthquake's strength and magnitude determine the speed with which the waves travel from the epicenter to the rest of the world. How much an earthquake shakes a building depends on how rigid it is. In IS 1893:2002, the seismic forces are outlined.

Analysis of seismic was done by using E-tabs 2015. The design base shear is computed by E-tab in accordance with the IS: 1893(part-1)-2002.

Load Combinations

From IS 800-2007, we find load factor is 1.5 for case (i) whereas for load case (ii) it is 0.9 for DL and LL and 1.5 for WL. Hence the factored force in the member is to be found for

i) 1.5(DL+LL)

ii) 0.9(DL+LL)+1.5WL at 0°

iii)0.9(DL + LL)+1.5WL at 90°

From IS 800-1984, Load combinations for design purposes shall be the one that produces maximum forces and effects from the following combinations of loads.

(i). DL+LL

(ii). DL+LL+WL/EL

(iii). DL+WL/EL

(iv). DL+LL+CL

(v). DL+LL+CL+WL/EL

(vi). 0.75*(DL+LL+WL/EL)

(vii). 0.75*(DL+LL+CL+WL/EL

5. Modelling Models

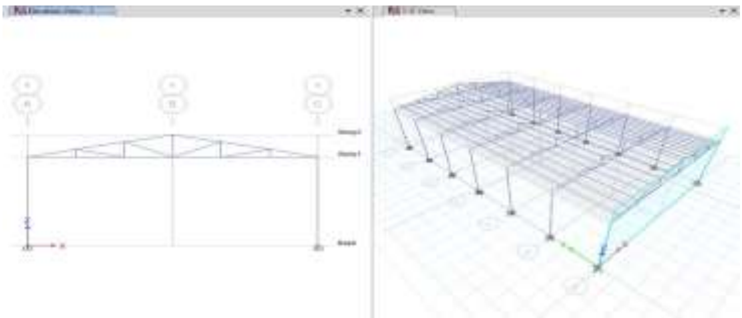

Fig.1:Model

Plan modelling

3D MODELS

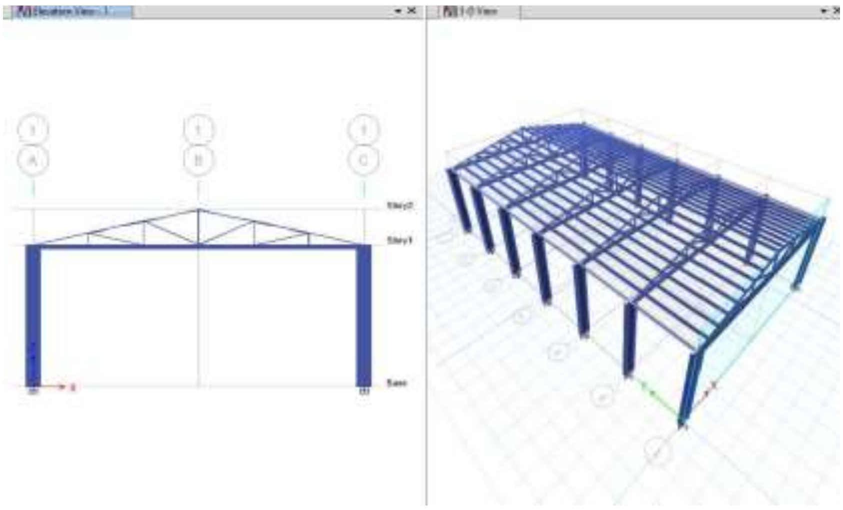

Fig.2: 3d modelling

Assigning loads:

1. **Live Load:**

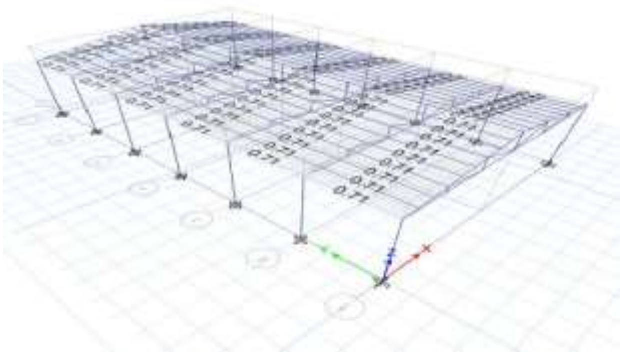

Fig.3: Assigning Live Load

2. **Wind Load:**

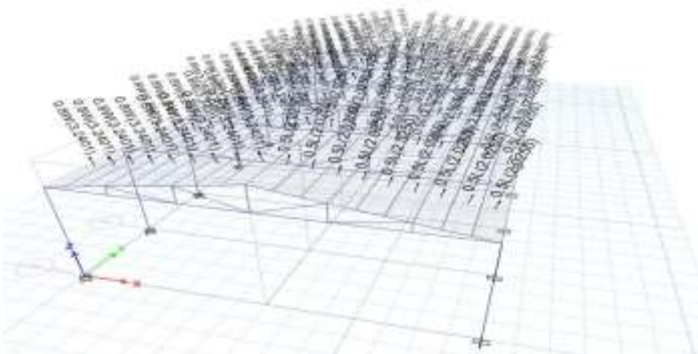

Fig.4: Assigning Wind Load

Support

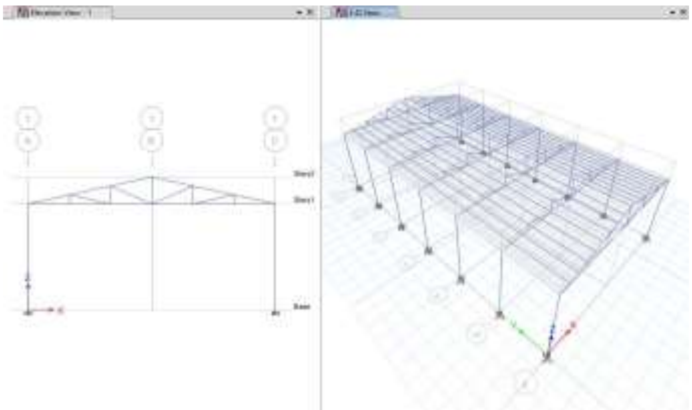

Fig.5: Assigning support

6. Results And Discussion

- From the above analysis and design, for the given industrial building size details the following parameters are designed.
- For Purlin: - ISB 72 x 72 x 3.2 is used.
- Bottom Chord:- ISA 200 x 200 x 25 is used
- Top Chord :- ISA 75 x 75 x 10 is used
- Webs :- ISA 65 x 65 x 5 is used
- Column: - ISWB600-2 is used

Bending moment:

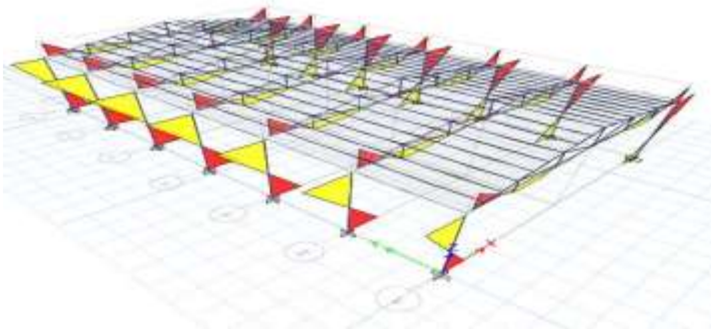

Fig.6: Bending moment

Shear force:

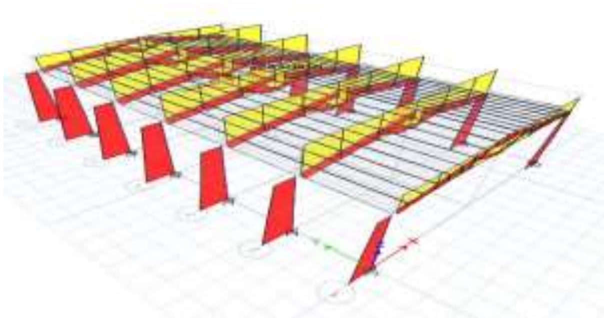

Fig.7: Shear force:

Displacement:

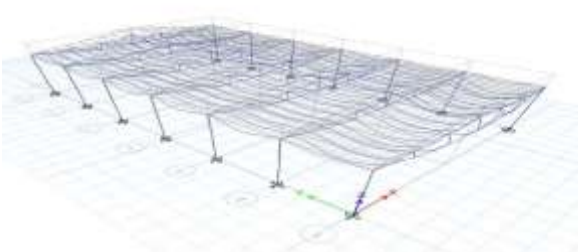

Fig.8: Displacement due to dead load

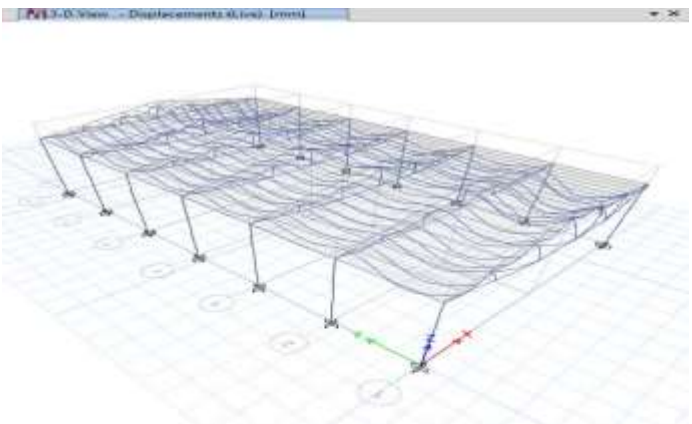

Fig.9: Displacement due to live load

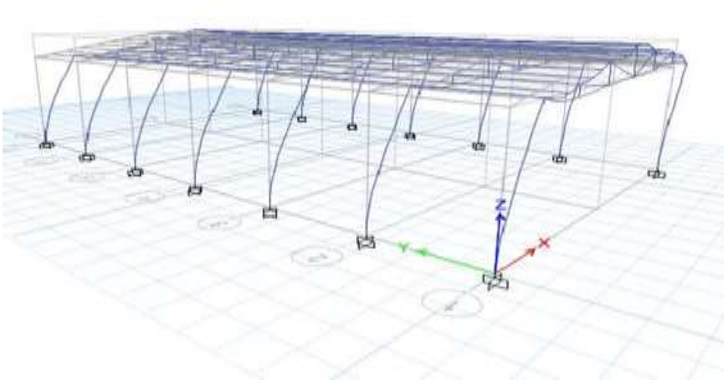

Fig.10: Displacement due to earthquake load

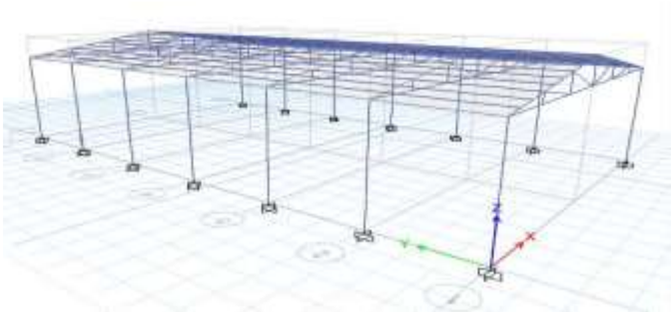

Fig.11: Displacement due to wind load

Base Reactions

Table 1 : Base Reactions

Load Case/Combo	FX	FY	FZ	MX	MY	MZ	X	Y	Z
	kN	kN	kN	kN-m	kN-m	kN-m	m	m	m
Dead	0	0	274.46	3293.6	-1921.4	0	0	0	0
Live	0	0	239.09	2869	-1673.6	0	0	0	0
EQx	-31.8	0	0	0	-200.48	381.592	0	0	0
EQy	0	-28.11	0	177.25	0	-196.83	0	0	0
Windx 1	0	0	0	0	0	0	0	0	0
Windx 2	0	0	0	0	0	0	0	0	0
DStlS1	0	0	411.69	4940.4	-2882.1	0	0	0	0
DStlS2	0	0	770.32	9244	-5392.5	0	0	0	0
DStlS3 Max	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS3 Min	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS4 Max	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS4 Min	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS5 Max	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS5 Min	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS6 Max	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS6 Min	0	0	616.26	7395.2	-4314	0	0	0	0
DStlS7 Max	0	0	411.69	4940.4	-2882.1	0	0	0	0
DStlS7 Min	0	0	411.69	4940.4	-2882.1	0	0	0	0
DStlS8 Max	0	0	411.69	4940.4	-2882.1	0	0	0	0
DStlS8 Min	0	0	411.69	4940.4	-2882.1	0	0	0	0

DStlS9 Max	0	0	247.02	2964.3	-1729.3	0	0	0	0
DStlS9 Min	0	0	247.02	2964.3	-1729.3	0	0	0	0
DStlS10 Max	0	0	247.02	2964.3	-1729.3	0	0	0	0
DStlS10 Min	0	0	247.02	2964.3	-1729.3	0	0	0	0
DStlS11	-38.16	0	616.26	7395.2	-4554.6	457.911	0	0	0
DStlS12	38.158	0	616.26	7395.2	-4073.4	-457.91	0	0	0
DStlS13	0	-33.74	616.26	7607.9	-4314	-236.19	0	0	0
DStlS14	0	33.74	616.26	7182.5	-4314	236.191	0	0	0
DStlS15	-47.7	0	411.69	4940.4	-3182.8	572.388	0	0	0
DStlS16	47.698	0	411.69	4940.4	-2581.4	-572.39	0	0	0
DStlS17	0	-42.17	411.69	5206.3	-2882.1	-295.24	0	0	0
DStlS18	0	42.17	411.69	4674.6	-2882.1	295.239	0	0	0
DStlS19	-47.7	0	247.02	2964.3	-2030	572.388	0	0	0
DStlS20	47.698	0	247.02	2964.3	-1428.6	-572.39	0	0	0
DStlS21	0	-42.17	247.02	3230.1	-1729.3	-295.24	0	0	0
DStlS22	0	42.17	247.02	2698.4	-1729.3	295.239	0	0	0
DStlD1	0	0	274.46	3293.6	-1921.4	0	0	0	0
DStlD2	0	0	513.55	6162.7	-3595	0	0	0	0

Table 2: Steel Beam Envelope

Label	Story	Section	PMM Combo	Class	Conn. V I- End	Conn. V J- End
					kN	kN
B9	Story2	ISA35X35X5	DStlS2	Seismic	0.0432	0.0458
B16	Story2	ISA35X35X5	DStlS2	Seismic	0.0422	0.0481
B18	Story2	ISA75X75X10	DStlS2	Seismic	0	4.76
B19	Story2	ISA80X80X10	DStlS2	Seismic	5.1053	5.1816
B20	Story2	ISA80X80X10	DStlS2	Seismic	5.0013	5.3113
B21	Story2	ISA65X65X5	DStlS11	Seismic	0.0912	0.0808
B25	Story2	ISA75X75X10	DStlS2	Seismic	0	4.7639
B26	Story2	ISA80X80X10	DStlS2	Seismic	5.1143	5.17
B27	Story2	ISA80X80X10	DStlS2	Seismic	4.9828	5.3161
B28	Story2	ISA65X65X5	DStlS12	Seismic	0.0913	0.0809
B32	Story2	ISA80X50X10	DStlS2	Seismic	0	4.0876
B33	Story2	ISA75X75X10	DStlS2	Seismic	4.4247	4.4849
B34	Story2	ISA75X75X10	DStlS2	Seismic	4.3413	4.5492
B35	Story2	ISA65X65X5	DStlS2	Seismic	0.0948	0.079
B39	Story2	ISA80X50X10	DStlS2	Seismic	0	4.0871
B40	Story2	ISA75X75X10	DStlS2	Seismic	4.4254	4.4857
B41	Story2	ISA75X75X10	DStlS2	Seismic	4.3458	4.5535
B42	Story2	ISA65X65X5	DStlS2	Seismic	0.0949	0.079
B46	Story2	ISA80X50X10	DStlS2	Seismic	0	4.2751
B47	Story2	ISA75X75X10	DStlS2	Seismic	4.6252	4.6867
B48	Story2	ISA75X75X10	DStlS2	Seismic	4.5487	4.771
B49	Story2	ISA65X65X5	DStlS2	Seismic	0.0952	0.0788
B53	Story2	ISA80X50X10	DStlS2	Seismic	0	4.2753
B54	Story2	ISA75X75X10	DStlS2	Seismic	4.6247	4.686
B55	Story2	ISA75X75X10	DStlS2	Seismic	4.5478	4.7703
B56	Story2	ISA65X65X5	DStlS2	Seismic	0.0952	0.0789

B60	Story2	ISA80X50X10	DStlS2	Seismic	0	4.0868
B61	Story2	ISA75X75X10	DStlS2	Seismic	4.4246	4.4848
B62	Story2	ISA75X75X10	DStlS2	Seismic	4.3444	4.5518
B63	Story2	ISA65X65X5	DStlS2	Seismic	0.0948	0.079
B67	Story2	ISA80X50X10	DStlS2	Seismic	0	4.087
B68	Story2	ISA75X75X10	DStlS2	Seismic	4.4263	4.4865
B69	Story2	ISA75X75X10	DStlS2	Seismic	4.3449	4.552
B70	Story2	ISA65X65X5	DStlS2	Seismic	0.0949	0.079
B74	Story2	ISA75X75X10	DStlS2	Seismic	0	4.7639
B75	Story2	ISA80X80X10	DStlS2	Seismic	5.114	5.1728
B76	Story2	ISA80X80X10	DStlS2	Seismic	4.9942	5.3119
B77	Story2	ISA65X65X5	DStlS11	Seismic	0.091	0.081
B81	Story2	ISA75X75X10	DStlS2	Seismic	0	4.7628
B82	Story2	ISA80X80X10	DStlS2	Seismic	5.1114	5.1698
B83	Story2	ISA80X80X10	DStlS2	Seismic	4.9925	5.313
B84	Story2	ISA65X65X5	DStlS12	Seismic	0.0907	0.081
B88	Story2	ISA65X65X5	DStlS2	Seismic	0	1.7564
B89	Story2	ISA60X40X8	DStlS2	Seismic	1.9034	1.8408
B90	Story2	ISA65X65X5	DStlS2	Seismic	1.8316	1.8725
B91	Story2	ISA35X35X5	DStlS2	Seismic	0.042	0.0488
B95	Story2	ISA65X65X5	DStlS2	Seismic	0	1.7583
B96	Story2	ISA60X60X8	DStlS2	Seismic	1.9294	1.8603
B97	Story2	ISA65X65X5	DStlS2	Seismic	1.8333	1.871
B98	Story2	ISA35X35X5	DStlS2	Seismic	0.0422	0.0485
B99	Story2	ISA65X65X5	DStlS2	Seismic	0	0
B100	Story2	ISA65X65X5	DStlS2	Seismic	0	0
B101	Story2	ISA65X65X5	DStlS2	Seismic	0	1.779
B102	Story2	ISA60X40X8	DStlS2	Seismic	1.8322	0
B103	Story2	ISA65X65X5	DStlS2	Seismic	0	0
B104	Story2	ISA60X40X8	DStlS2	Seismic	0	1.9015
B105	Story2	ISA60X60X8	DStlS2	Seismic	1.8687	0
B106	Story2	ISA45X45X6	DStlS2	Seismic	0	0
B107	Story2	ISA60X60X8	DStlS2	Seismic	0	1.8713
B108	Story2	ISA65X65X5	DStlS2	Seismic	0	0
B109	Story2	ISA65X65X5	DStlS2	Seismic	0	0
B110	Story2	ISA65X65X5	DStlS2	Seismic	0	1.7617
B111	Story2	ISA60X60X8	DStlS2	Seismic	1.9379	0
B112	Story2	ISA65X65X5	DStlS2	Seismic	0	0
B113	Story2	ISA60X40X8	DStlS2	Seismic	0	1.8117
B114	Story2	ISA65X65X5	DStlS2	Seismic	1.7985	0
B115	Story2	ISA65X65X5	DStlS2	Seismic	0	0
B116	Story2	ISA55X55X8	DStlS2	Seismic	0	1.9274
B123	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8255	2.092
B124	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9955	1.922
B125	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9425	1.975
B126	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9749	1.9426
B127	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9226	1.9949

B128	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0911	1.8264
B129	Story2	ISB72X72X3.2	DStlS2	Seismic	1.6418	2.2761
B130	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0298	1.8891
B131	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9392	1.9803
B132	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9771	1.9425
B133	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9084	2.0105
B134	Story2	ISB72X72X3.2	DStlS2	Seismic	2.1799	1.7383
B135	Story2	ISB72X72X3.2	DStlS2	Seismic	1.5993	2.3209
B136	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0414	1.8788
B137	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9376	1.9826
B138	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9827	1.9375
B139	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8787	2.0415
B140	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3217	1.5985
B147	Story2	ISB72X72X3.2	DStlS2	Seismic	1.7445	2.1737
B148	Story2	ISB72X72X3.2	DStlS2	Seismic	2.009	1.9099
B149	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9439	1.9757
B150	Story2	ISB72X72X3.2	DStlS2	Seismic	1.976	1.9436
B151	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9087	2.0102
B152	Story2	ISB72X72X3.2	DStlS2	Seismic	2.1797	1.7385
B153	Story2	ISB72X72X3.2	DStlS2	Seismic	1.5995	2.3207
B154	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0413	1.8789
B155	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9376	1.9826
B156	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9827	1.9375
B157	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8787	2.0415
B158	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3218	1.5984
B159	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.389
B160	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0693	1.853
B161	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9295	1.9929
B162	Story2	ISB72X72X3.2	DStlS2	Seismic	1.993	1.9294
B163	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8527	2.0697
B164	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3898	1.5326
B165	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3815
B166	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0647	1.8576
B167	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9319	1.9905
B168	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9906	1.9318
B169	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8573	2.065
B170	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3819	1.5405
B171	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.38
B172	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0652	1.8572
B173	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9307	1.9917
B174	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9916	1.9308
B175	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8578	2.0646
B176	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3791	1.5433
B177	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3816
B178	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0659	1.8565
B179	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9302	1.9921
B180	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9923	1.9301

B181	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8558	2.0665
B182	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3823	1.5401
B183	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3889
B184	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0733	1.849
B185	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9282	1.9942
B186	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9938	1.9285
B187	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8518	2.0706
B188	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3868	1.5356
B189	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3824
B190	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0716	1.8507
B191	Story2	ISB72X72X3.2	DStlS2	Seismic	1.929	1.9934
B192	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9931	1.9292
B193	Story2	ISB72X72X3.2	DStlS2	Seismic	1.853	2.0694
B194	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3831	1.5393
B195	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3896
B196	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0696	1.8527
B197	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9294	1.993
B198	Story2	ISB72X72X3.2	DStlS2	Seismic	1.993	1.9294
B199	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8527	2.0697
B200	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3897	1.5326
B201	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3819
B202	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0649	1.8574
B203	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9318	1.9905
B204	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9905	1.9318
B205	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8574	2.065
B206	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3819	1.5405
B207	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.378
B208	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0638	1.8585
B209	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9311	1.9913
B210	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9912	1.9312
B211	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8591	2.0633
B212	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3775	1.5449
B213	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.382
B214	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0661	1.8562
B215	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9303	1.9921
B216	Story2	ISB72X72X3.2	DStlS2	Seismic	1.992	1.9304
B217	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8572	2.0652
B218	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3809	1.5415
B219	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3864
B220	Story2	ISB72X72X3.2	DStlS2	Seismic	2.07	1.8523
B221	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9288	1.9936
B222	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9936	1.9287
B223	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8521	2.0703
B224	Story2	ISB72X72X3.2	DStlS2	Seismic	2.3866	1.5357
B225	Story2	ISB72X72X3.2	DStlS2	Seismic	0	2.3788
B226	Story2	ISB72X72X3.2	DStlS2	Seismic	2.0676	1.8548
B227	Story2	ISB72X72X3.2	DStlS2	Seismic	1.9297	1.9927

B228	Story2	ISB72X72X3.2	DStlS2	Seismic	1.993	1.9294
B229	Story2	ISB72X72X3.2	DStlS2	Seismic	1.8531	2.0693
B230	Story2	ISB72X72X3.2	DStlS2	Seismic	2.383	1.5394
B3	Story1	ISA200X200X25	DStlS2	Seismic	10.0896	0
B4	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B5	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B10	Story1	ISA200X200X25	DStlS2	Seismic	0	10.3286
B11	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B12	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B1	Story1	ISA200X200X25	DStlS2	Seismic	15.5221	0
B2	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B17	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B22	Story1	ISA200X200X25	DStlS2	Seismic	0	15.4746
B23	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B24	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B29	Story1	ISA200X200X25	DStlS2	Seismic	14.9016	0
B30	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B31	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B36	Story1	ISA200X200X25	DStlS2	Seismic	0	14.9097
B37	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B38	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B43	Story1	ISA200X200X25	DStlS2	Seismic	15.1937	0
B44	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B45	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B50	Story1	ISA200X200X25	DStlS2	Seismic	0	15.1876
B51	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B52	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B57	Story1	ISA200X200X25	DStlS2	Seismic	14.9094	0
B58	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B59	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B64	Story1	ISA200X200X25	DStlS2	Seismic	0	14.9093
B65	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B66	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B71	Story1	ISA200X200X25	DStlS2	Seismic	15.4646	0
B72	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B73	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B78	Story1	ISA200X200X25	DStlS2	Seismic	0	15.4559
B79	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B80	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B85	Story1	ISA200X200X25	DStlS2	Seismic	10.3026	0
B86	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B87	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B92	Story1	ISA200X200X25	DStlS2	Seismic	0	10.3054
B93	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B94	Story1	ISA200X200X25	DStlS2	Seismic	0	0
B117	Story1	ISB49.5X49.5X2.6	DStlS17	Seismic	-0.2742	0.2735
B118	Story1	ISB38X38X2.6	DStlS18	Seismic	-0.1418	0.1415

B119	Story1	ISB38X38X2.6	DStlS17	Seismic	-0.1419	0.1418
B120	Story1	ISB38X38X2.6	DStlS18	Seismic	-0.1418	0.1419
B121	Story1	ISB38X38X2.6	DStlS17	Seismic	-0.1415	0.1417
B122	Story1	ISB49.5X49.5X2.6	DStlS18	Seismic	-0.2735	0.2737
B141	Story1	ISB49.5X49.5X2.6	DStlS17	Seismic	-0.2739	0.2734
B142	Story1	ISB38X38X2.6	DStlS18	Seismic	-0.1418	0.1415
B143	Story1	ISB38X38X2.6	DStlS17	Seismic	-0.1419	0.1418
B144	Story1	ISB38X38X2.6	DStlS18	Seismic	-0.1418	0.1419
B145	Story1	ISB38X38X2.6	DStlS17	Seismic	-0.1415	0.1417
B146	Story1	ISB49.5X49.5X2.6	DStlS18	Seismic	-0.2735	0.2737

Table 3: Steel Column Envelope

Label	**Story**	**Section**	**Moment Interaction Check**	**PMM Combo**	**V Ratio**	**Class**	**Cont.**	**Dbl.**
							Plate	**Plate**
							cm^2	mm
C1	Story2	ISA40X40X5	0.217 = 0.098 + 0.075 + 0.043	DStlS14	0.001	Seismic	-3.8	-40
C4	Story2	ISA20X20X3	0.283 = 0.025 + 0.146 + 0.112	DStlS2	0.002	Seismic		
C6	Story2	ISA40X40X5	0.793 = 0.065 + 0.434 + 0.293	DStlS2	0.019	Seismic		
C9	Story2	ISA20X20X3	0.293 = 0.029 + 0.133 + 0.131	DStlS2	0.002	Seismic		
C10	Story2	ISA65X65X5	0.594 = 0.057 + 0.261 + 0.276	DStlS2	0.04	Seismic		
C2	Story2	ISA40X40X5	0.302 = 0.213 + 0.044 + 0.046	DStlS13	0.001	Seismic	-3.8	-40
C3	Story2	ISA20X20X3	0.138 = 0.06 + 0.047 + 0.032	DStlS18	0.001	Seismic	-1.1	-20
C5	Story2	ISA35X35X5	0.694 = 0.502 + 0.118 + 0.073	DStlS2	0.01	Seismic		
C12	Story2	ISA20X20X3	0.139 = 0.059 + 0.032 + 0.048	DStlS18	0.001	Seismic	-1.1	-20
C13	Story2	ISA35X35X5	0.797 = 0.561 + 0.189 + 0.047	DStlS2	0.01	Seismic		
C15	Story2	ISA40X40X5	0.281 = 0.188 + 0.046 + 0.046	DStlS14	0.001	Seismic	-3.8	-40
C16	Story2	ISA20X20X3	0.155 = 0.058 + 0.056 + 0.041	DStlS18	0.001	Seismic	-1.1	-20
C17	Story2	ISA40X25X5	0.869 = 0.723 + 0.134 + 0.012	DStlS2	0.012	Seismic		
C19	Story2	ISA20X20X3	0.155 = 0.058 + 0.041 + 0.055	DStlS18	0.001	Seismic	-1.1	-20
C20	Story2	ISA40X25X5	0.92 = 0.784 + 0.134 + 0.001	DStlS2	0.012	Seismic		
C22	Story2	ISA40X40X5	0.284 = 0.195 + 0.045 + 0.045	DStlS14	0.001	Seismic	-3.8	-40
C23	Story2	ISA20X20X3	0.151 = 0.058 + 0.039 + 0.053	DStlS17	0.001	Seismic	-1.1	-20
C24	Story2	ISA40X25X5	0.877 = 0.74 + 0.136 + 0.001	DStlS2	0.012	Seismic		
C26	Story2	ISA20X20X3	0.151 = 0.058 + 0.039 + 0.053	DStlS18	0.001	Seismic	-1.1	-20
C27	Story2	ISA40X25X5	0.938 = 0.802 + 0.135 + 3.132E-04	DStlS2	0.012	Seismic		

C29	Story2	ISA40X40X5	0.28 = 0.188 + 0.046 + 0.046	DStlS13	0.001	Seismic	-3.8	-40
C30	Story2	ISA20X20X3	0.155 = 0.058 + 0.041 + 0.055	DStlS17	0.001	Seismic	-1.1	-20
C31	Story2	ISA40X25X5	0.859 = 0.723 + 0.134 + 0.002	DStlS2	0.012	Seismic		
C33	Story2	ISA20X20X3	0.154 = 0.058 + 0.055 + 0.041	DStlS17	0.001	Seismic	-1.1	-20
C34	Story2	ISA40X25X5	0.92 = 0.784 + 0.134 + 0.002	DStlS2	0.012	Seismic		
C36	Story2	ISA40X40X5	0.301 = 0.213 + 0.044 + 0.044	DStlS14	0.001	Seismic	-3.8	-40
C37	Story2	ISA20X20X3	0.14 = 0.059 + 0.033 + 0.048	DStlS17	0.001	Seismic	-1.1	-20
C38	Story2	ISA35X35X5	0.658 = 0.5 + 0.118 + 0.04	DStlS2	0.01	Seismic		
C40	Story2	ISA20X20X3	0.14 = 0.059 + 0.048 + 0.033	DStlS17	0.001	Seismic	-1.1	-20
C41	Story2	ISA35X35X5	0.696 = 0.539 + 0.117 + 0.04	DStlS2	0.01	Seismic		
C43	Story2	ISA40X40X5	0.182 = 0.098 + 0.042 + 0.042	DStlS13	0.001	Seismic	-3.8	-40
C44	Story2	ISA20X20X3	0.287 = 0.03 + 0.129 + 0.129	DStlS2	0.002	Seismic		
C45	Story2	ISA65X65X5	0.58 = 0.058 + 0.253 + 0.269	DStlS2	0.037	Seismic		
C47	Story2	ISA20X20X3	0.29 = 0.032 + 0.128 + 0.13	DStlS2	0.002	Seismic		
C48	Story2	ISA65X65X5	0.583 = 0.059 + 0.256 + 0.269	DStlS2	0.038	Seismic		
C8	Story1	ISWB600-2	0.141 = 0.065 + 0.014 + 0.062	DStlS14	0.005	Seismic	0	-600
C11	Story1	ISWB600-2	0.141 = 0.066 + 0.014 + 0.062	DStlS14	0.005	Seismic	0	-600
C7	Story1	ISWB600-2	0.186 = 0.1 + 0.023 + 0.063	DStlS14	0.007	Seismic	0	-600
C14	Story1	ISWB600-2	0.186 = 0.1 + 0.023 + 0.063	DStlS14	0.007	Seismic	0	-600
C18	Story1	ISWB600-2	0.185 = 0.1 + 0.023 + 0.062	DStlS14	0.007	Seismic	0	-600
C21	Story1	ISWB600-2	0.185 = 0.1 + 0.022 + 0.062	DStlS14	0.007	Seismic	0	-600
C25	Story1	ISWB600-2	0.186 = 0.101 + 0.023 + 0.062	DStlS14	0.007	Seismic	0	-600
C28	Story1	ISWB600-2	0.186 = 0.101 + 0.023 + 0.062	DStlS14	0.007	Seismic	0	-600
C32	Story1	ISWB600-2	0.185 = 0.1 + 0.023 + 0.062	DStlS13	0.007	Seismic	0	-600
C35	Story1	ISWB600-2	0.185 = 0.1 + 0.022 + 0.062	DStlS13	0.007	Seismic	0	-600
C39	Story1	ISWB600-2	0.185 = 0.1 + 0.023 + 0.062	DStlS13	0.007	Seismic	0	-600
C42	Story1	ISWB600-2	0.185 = 0.1 + 0.023 + 0.062	DStlS13	0.007	Seismic	0	-600
C46	Story1	ISWB600-2	0.142 = 0.066 + 0.014 + 0.062	DStlS13	0.005	Seismic	0	-600
C49	Story1	ISWB600-2	0.142 = 0.066 + 0.014 + 0.062	DStlS13	0.005	Seismic	0	-600

7. Bolt Design:

Table 4: Bolt Design

BOLT DESIGN					
RESULTANT SHEAR FORCE =			21		kn
MAXIMUM SHEAR FORCE COMING ON BOLT=			21		kn
DIA OF BAR=			12		mm

(min dia of bolt >=12mm					
DIA OF HOLE=			13.5		mm
(1.5+dai of bar)					
BOLT GRADE=			4.6		
ULTIMATE TENSuILE STRENGTH OF BOLT(Fu)=			400		Mpa
YIELD STRENGTH OF BOLT(Fy)=			240		Mpa
Fy=(0.6*Fu)					
MINIMUM PLATE THICKNESS=			5		mm
ULTIMATE TENSILE STRESS OF PLATE(Fu)=			410		Mpa
END DISTANCE (e)=			20.25	25	mm
(e =1.5*dia of hole)					
PITCH DISTANCE(Pe) =			30		mm
(P=2.5*dia of bolt)					
GROSS AREA OF BOLT(Asb)=			113.0973		mm^2
(pi/4*dia*dia)					
NET AREA OF BOLT(Anb)=			88.21592		mm^2
(Anb = 0.78 *Asb)					
SHEAR CAPACITY OF BOLT (Vdsb)=			16.29808		kn
(Vdsb = Vnb/gama mb)					
NOMINAL shear capacity OF BOLT(Vnpb)=			20.37259		kn
(Vnpb = (Fu/Sqrt3)*(nn*Anb+ns*Asb))					
nn=no of planes					
BEARING CAPACITY OF BOLT(Vdpb)=			24.14444		kn
(Vdpb=(Vnpb/gama mb)					
NOMINAL BEARING STRENGH OF BOLT(Vnpb)=			30.18056		kn
(Vnpb=2.5*kb*dt*fu)					
(kb is lesser of =			0.490741		
(e/3 do)		0.617284			
((p/3*do)-0.25)		0.490741			
(Fub/Fu)		0.97561			
one		1			
BOLT CAPACITY OF SHEAR FORCE=			16.29808		kn
NUMBER OF BOLT REQ(Nos)=			1.288496		Nos
(MAX shear force)/(min(Vdpb,Vdsb)					
NUMBER OF BOLT PROVIDED(Nos)=			2		Nos

FACTOR OF SAFETY=					
(Fs=(bolt capacity* no of bolt)/total SF)			1.552198		
UTILIZATION=					
(U=(total SF)/(bolt capacity* no of bolt)			0.644248		

8. Conclusion

- In this project, Analysis and Design of Warehouse was done considering Kalaburagi region, necessary and appropriate loads and loading combinations were adopted.
- Based on the Indian Design Codes various different members like truss members, purlins, columns are designed.
- The project successfully communicates the message that an industrial warehouse could be developed quickly and simply using a straightforward design process that is compliant with national requirements.
- By performing Bolt Design in MS Excel a lot of time and effort can be reduced.
- Structural Building structures may be simply designed by a straightforward design approach in compliance with national standards, as shown by the aforementioned design and analysis of industrial buildings.
- Research shows that structural building structures outperform traditional steel building structures in terms of cost, quality control, construction speed, and ease of installation.
- The research also provides elementary, cost-effective principles for structural construction preliminary design.
- The shown idea is useful in comprehending the design process of structural construction concept.

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