Analysis and Design of Pre-engineered Building Using IS800:2007 and AISC code

Sanket Y. Bhoyar [1], Dr. Vaishali Mendhe[2], Er. Nitin B. Salve[3]
[1,2,] Department of Civil Engineering,
Yeshwantrao Chavan college of engineering, Nagpur, India
[1] sanketbhoyar52@gmail.com
[2] N.S Construction, Nagpur, India
Author Emails
[a)] sanketbhoyar52@gmail.com [b)] vaishalimendhe@gmail.com

Abstract. Steel structures that are prefabricated and constructed quickly are known as pre-engineered buildings, or PEBs. Because steel structures have a greater strength-to-weight ratio than RCC structures and provide more interior area by permitting a lengthy unobstructed space between columns, they are chosen for industrial buildings. This study compares and contrasts the ASIC code with IS800:2007.

Keywords: LSM, ASD, AISC, IS800-2007, PEB, Analysis, Design, and Software called Staad Pro.

1. Introduction

Steel constructions are more favorable than standard RCC constructions and are thought to be the most robust and quick to erect globally.These buildings are utilized in residential projects as well as commercial and industrial settings.Steel structures are used for long-span buildings, arch buildings, and appropriate heights where considerable strength is needed.Steel pieces are placed together to create a proper building structure in pre-engineering buildings, which are currently the most popular construction.Such configurations are necessary for gantry crane-equipped warehouses, industrial buildings, and other high-load bearing structures.Pre-engineered structures first appeared in the 1960s.It had an outline, a roof, a floor, etc.The complete building was constructed by assembling these components.Development became easier as a result.There are many applications for steel structures, and interest in them is growing.Steel structures can be broadly divided into two categories.

1.1 PEB Concept

Pre-designed steel structures (PEBs) Are structures made of steel on a conceptual framework of main members, subsidiary members, wall, and roof sheets linked to one another, and many additional building elements.These constructions may have skylights, wall lights, ridge ventilators, turbo vents, louvres, roof monitors, doors and windows, trusses, mezzanine levels, fascias, canopies, crane systems, insulation, and other structural and non-structural features, depending on the client's requirements enhancements. The steel structures have all been specially designed to be more robust and lighter.Steel has become one of the most widely used building materials over the last forty years due to its increased adaptability, durability, and versatility. Construction supplies. In pre-engineered constructions, I beams are often made by welding steel plates together to form the I section.The entire frame of the pre-engineered building is subsequently created by field-assembling the I beams (for example, by bolting connections). Some manufacturers taper the frame members (changing the web depth) in accordance with the effects of local loading. Larger plate diameters are used in locations where load effects are greater. To attach and support the external cladding, secondary structural elements like It is possible to use cold-formed Z- and C-shaped members.

1.2 PEB Components

The following are the main elements of pre-engineered buildings:
1. The main or primary components are the frames.
2. The end wall frames.
3. The secondary components.
4. Insulation and sheeting.

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5. The system of mezzanines.
6. Anchoring.
7. Crane system.
8. Building Accessories.
9. Finishes and paints.

2. Connected Work

Staad pro v8i Software is employed for the evaluation and layout of 3D pre-engineered buildings. AISC And IS800-2007 are two distinct codes used for structure analysis and design.

2.1 Problem Description

Table 2.1 provides the pre-engineered structure of detail parameters.

Table 2.1: Parameters for structure details

The place	Amravati, Maharashtra
Length	50 m
The width	45 m
Height	9.27 m
Bay spacing	6.25 m
Floor number	2
Height of floor	4.5 m
Number of bays	8
Slope of the roof	1 in 10
Purlin distance	1.5 m
The main beam spacing	7.5 m
spacing of secondary beams.	1.25 m
wind velocity	39 m/s
The seismic zone	III [0.16].
Relevance factor	01
factor for response decrease	05
The dead weight on the rafter	0.12=KN/m2
The floor's dead load	3=KN/m2
Live load (for rafter)	0.75 KN/m2 0.57= KN/m2
The floor's live load	5= KN/m2

3. Methodology

The results of the numerous studies and advancements being conducted at the various R&D Centers across the nation are being included into the updating and modification of the design codes. It was determined in 2002–2003 that the guidelines for the Steel's application in general construction needed to be changed to the Limit State Method (LSM) while keeping Allowable Stress Design as a transitional option, given that the current practice worldwide is based on the method known as LSM, or load and resistance factor design. Thus, the Bureau of Indian Standards created and released IS800:2007.Design optimization has been aided by the launch of the PEB stands for pre-engineered building.concept into structural design. In this project, a Pre-engineered structure (industrial structure) when loading according to We'll examine and create Indian Standard codes. using a variety of standards, including LSM's the IS 800-2007, ASD's the IS 800-2007 , and ASD AISC. The design outcomes will happen contrasted with respect to steel usage.

COMPUTED ANALYSIS
3.1 Design and Analysis Staad Pro's pre-engineered building
3.1.1 3D Geometry of Structure

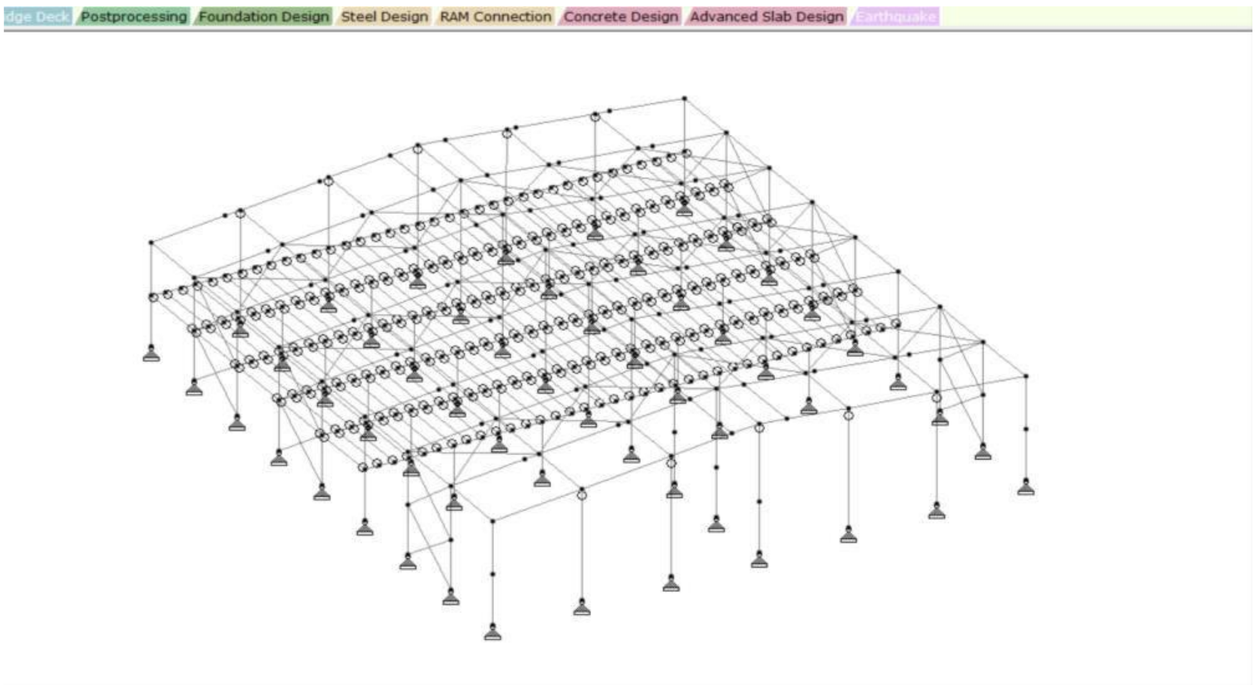


Figure 3.1: PEB structural geometry

3.1.2 Calculating Load and Load Assigning

1. Assign load to the rafter

- For rafter DL=0.75kN, the dead load N/m2
  • Rafter live load For Indian code, LL=4.69kN/m2, while for American code, LL=3.56kN/m2.

  • Loading Collateral
  CL = 1.25 kN /m2

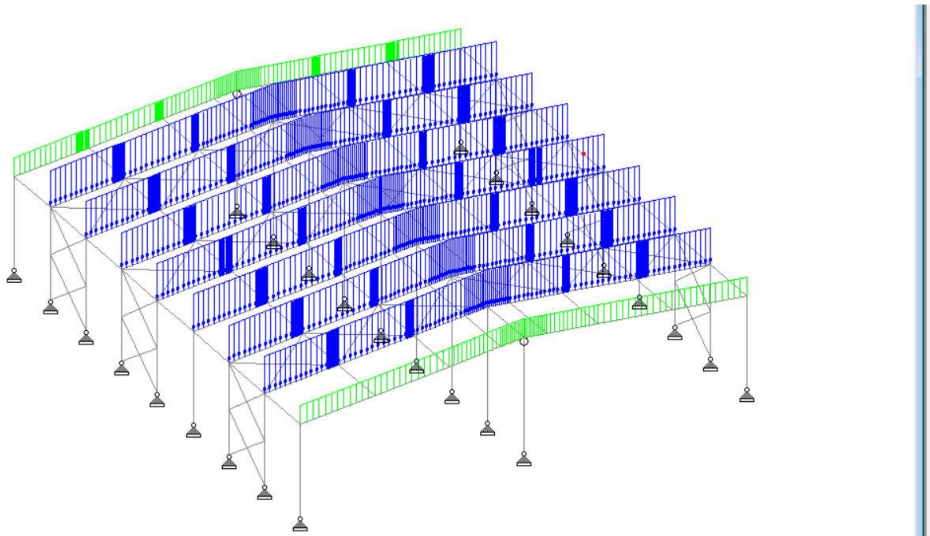


Figure 3.2: Rafter Load

4. Assign load to a mezzanine level

The mezzanine floor's dead load
DL = 3.75kN /m2
The mezzanine floor's live load
LL=6.25kN/m2

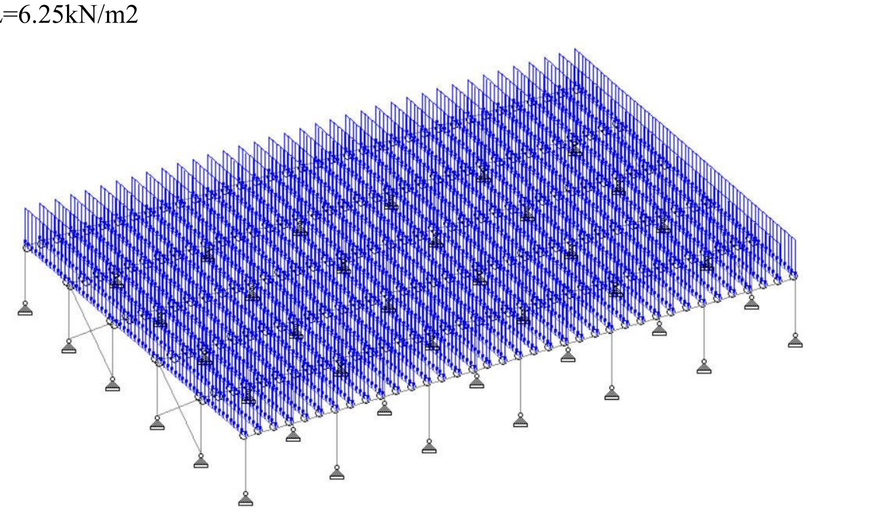


Fig. 3.3 Load on a mezzanine floor

5. Wind Load

- In compliance with IS875(Part3)-2015, wind load

Table 3.1 Wind Load Calculations

Case	Side wall (kn/m^2)		PEB Rafter (kn/m^2)	
	Left side	Right side	Windward	Leeward
WLP	2.19	1.97	4.99	2.63
WLS	3.94	0.22	3.94	0.88
WRP	-1.97	-2.19	2.63	4.99
WRS	-0.22	-3.94	0.88	3.24
WLEP	-3.06	3.06	4.38	4.38
WLES	-1.31	1.31	2.63	2.63

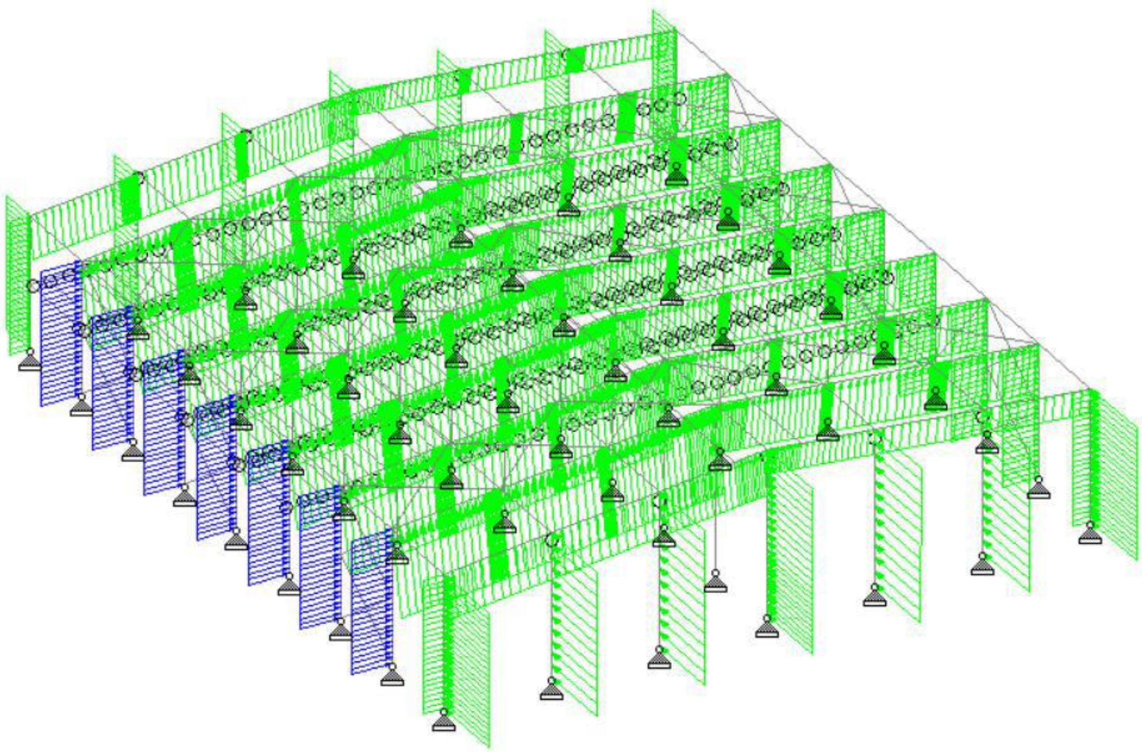


Fig.3.4: Wind load in

6. Seismic Load

PEB structure seismic load analysis in compliance with IS1893(Part1)-2016. The load exerted in the X and Z directions is displayed in Fig.

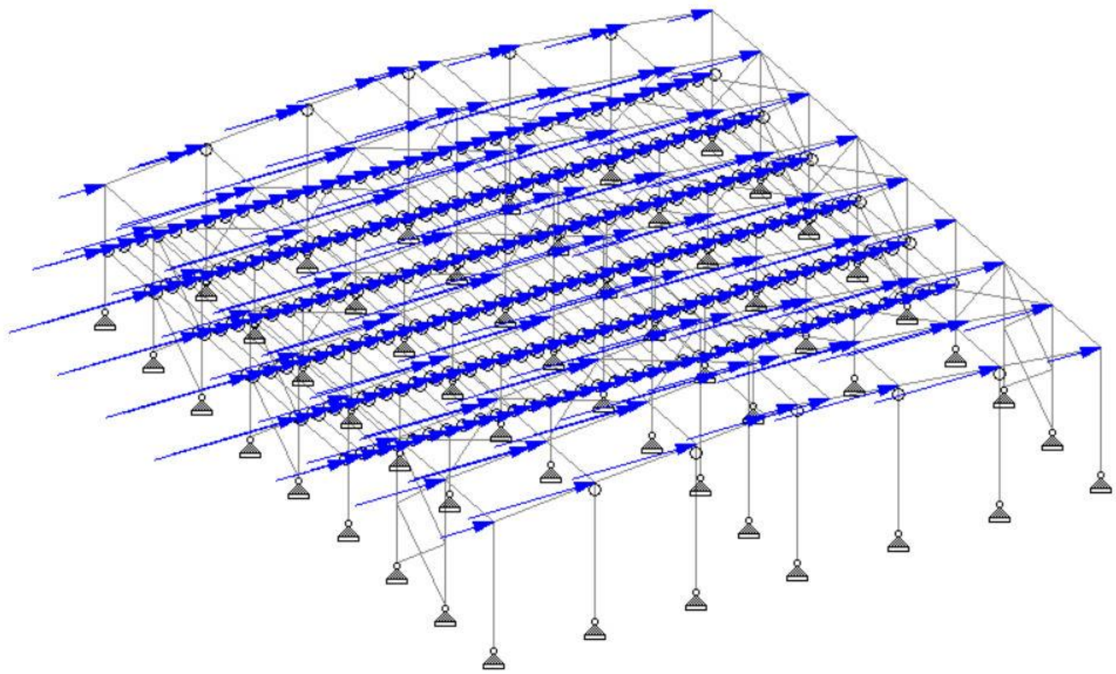


Fig. 3.5. The seismic load is allocated in the "direction of +X" in

3.1.3 Load Combination

The following These combinations are used for the frame analysis in both concepts in accordance with IS800-2007 and AISC-ASD:

Per IS800-2007

1.1 Strength

1. 1.05CL + 1.5DL + 1.5LL
2. 1.05CL + 0.6WL + 1.2DL + 1.2LL
3. 1.25CL + 1.2WL + 1.2DL + 1.LL
4. 1.5 DL + 1.5 WL
5. 1.5WL + 0.9DL
6. 1.05CL + 0.6EX + 1.2DL + 1.2LL
7. 0.53 CL + 1.2EX + 1.2DL + 1.2LL
8. 1.5/0.9DL + 1.5EX

1.2 ***Serviceability***

1. 1.0DL + 1.0WL
2. 1.0DL + 0.8LL + 0.8CL + 0.8EX
3. 1.0DL + 1.0LL + 1.0CL
4. 1.0DL + 0.8LL + 0.8CL + 0.8WL
5. 1.0DL + 1.0EX

Per AISC-ASD

1.1 Strength
1. DL+LL+CL
2. DL+CL+WL
3. 0.6DL+0.6CL+WL
4. DL+CL+0.75LL+0.75WL
5. DL+CL+0.7EX
6. 0.6DL+0.6CL+0.7EX
7. DL+CL+0.75LL+0.53EX

1.2 Serviceability
1. DL+CL+LL
2. DL+CL+WL
3. DL+CL+1.0LL+1.0WL
4. 1.0DL+1.0CL+0.7EX
5. 1.0DL+1.0CL+0.75LL+1.0WL

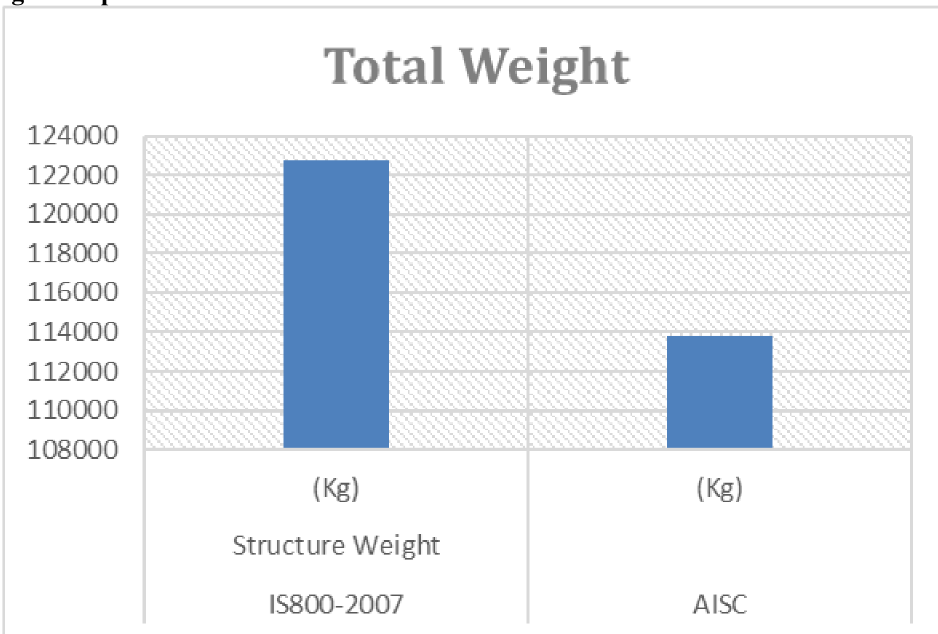
4. Results

Sr. no.	Description	IS800-2007	AISC
1.	Axial Force (KN)	656.893	513.823
2.	Shear Force (KN)	252.143	166.318
3.	Bending Moment (KNm)	495.195	299.933
4.	Steel Take Off (KN)	929.129	806.279

4.1 Design Weight of Structure

Description	IS800-2007	AISC
	Structure Weight	
	(Kg)	(Kg)
Framing	100403	93962
Bracing	9984	7457
Purlin and Grit	12343	12343
Total Weight	122730	113762

4.2 The Weight Graph



5. Conclusion

The following deductions are made in light of The design and analysis outcomes utilizing The two codes of design. 1.Adherence to American and Indian standards for structural steel design and construction is ensured while developing a pre-engineered building using the AISC code and IS800:2007. 2. It places a strong emphasis on design process dependability, efficiency, and safety. 3.The building's pre-engineered design can be built with sound structural integrity by following this code, fulfilling the requirements for stability, durability, and load-bearing capacity. 4.Different Indian and American codes are used in the pre-engineered building's study and design.The weight of the design is more than that of the American code since the pre-code Indian standard code is heavier.

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