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# Analysis and Design of G+1 Pre-Engineered Building Using Concept Based on Is800:2007 And AISC Code

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**ABSTRACT:** Pre Engineered Buildings (PEB) are steel structures prefabricated and built in a very short period of time. Steel structures are preferred for industrial buildings due to their higher strength-to-weight ratio as compare to RCC structures and steel structures also give more free internal space by allowing a long clear span between columns. In this report, the comparison is made between IS800:2007 and ASIC code.

This paper aims to analyze and design a G+1 Pre-engineered building using Staad Pro software in two different codes IS800-2007 and AISC. As per the design result obtained during this dissertation work, it is noted that the weight of the structure is reduced by as compared to IS800:2007.

**KEYWORDS:** PEB, Analysis, Design, LSM, ASD, AISC, IS800-2007, Staad pro software.

## I. INTRODUCTION

Steel structures are considered as most durable and fast-setup structures around the world, these structures are more advantageous than general RCC structures. These structures are used not only in industrial or commercial places but even in residential projects. Buildings with long spans, arch building and for proper elevations where high strength is required steel structures are utilized. Pre-engineering building currently most preferred structure where steel sections are assigned together to setup a proper building structure. Ware houses, industrial buildings with gantry crane setups and other high load bearing structures need such setups. In Pre-engineered structure came into existence in 1960's. It had roof, floor, outline and so forth These parts were assembled to make the entire structure. This made development simpler. Steel structures are utilized in a wide range of uses and their interest is expanding. There are basically two classifications in steel structures.

### 1.1 PEB CONCEPT

Steel structures constructed over a structural idea of main members, secondary members, roof and wall sheets linked to one other, and numerous other building components are known as pre-engineered steel buildings (PEB). Skylights, wall lights, turbo vents, ridge ventilators, louvres, roof monitors, doors & windows, trusses, mezzanine levels, fascias, canopies, crane systems, insulation, and other structural and non-structural improvements may be added to these structures dependent on the customer's needs. All of the steel structures have been specifically engineered to be lower in weight and more durable. Over the past four decades, steel building designs have grown more versatile, resilient, and adaptable, making steel one of the most popular building materials. The I beams used in pre-engineered structures are normally constructed by welding steel plates together to create the I section. The I beams are then field-assembled (e.g., bolted connections) to create the pre-engineered building's whole frame. According to the local loading effects, some manufacturers taper the frame members (changing in web depth). In places with greater load effects, larger plate diameters are employed. Secondary structural components such as cold-formed Z- and C-shaped members might be employed to attach and support the exterior cladding.

### 1.2 COMPONENTS OF PEB

The major components of pre-engineered buildings are as follows

1. Primary Components or Main is framing
2. End wall framing
3. Secondary Components
4. Sheeting and insulation



5. Mezzanine system
6. Crane system
7. Anchoring
8. Building Accessories
9. Paints and finishes

## II. RELATED WORK

The analysis and design of 3D G+1 Pre- engineered building using staad pro v8i software. For analysis and design the structure in different code IS800-2007 and AISC.

### 2.1 Problem Statement

The G+1 Pre-engineered structure of detail parameters are given in the table 2.1.

Table no. 2.1 Structure detail parameters

Location	Amravati, Maharashtra
Length	50m
Width	45m
Height	9.27m
Bay spacing	6.25m
No. of floor	2
Floor height	4.5m
No. of bays	8
Roof slope	1in10
Purlin spacing	1.5m
Main beam spacing	7.5m
Secondary beam spacing	1.25m
Wind speed	39m/s
Seismic zone	III (0.16)
Importance factor	1
Response reduction factor	5
Dead load (for rafter)	0.12 kN/m <sup>2</sup>
Dead load (for floor)	3 kN/m <sup>2</sup>

Live load (for rafter)	0.75 kN/m <sup>2</sup> 0.57 kN/m <sup>2</sup>
Live load (for floor)	5 kN/m <sup>2</sup>

### III. METHODOLOGY

The design codes are being updated and modified incorporating the results from the various researches and developments being carried out at the various R & D Centres in the country. Considering that the current practice all over the world is based on Limit State Method (LSM) or Load and Resistance Factor Design Method, it was found essential during the year 2002 – 2003 that the code of practice for use of steel in general construction should be modified to LSM while maintaining Allowable Stress Design as a transition alternative. The IS800:2007 was thus prepared and published by the Bureau of Indian Standards. The introduction of Pre Engineered Building (PEB) concept in the design of structures has helped in optimizing design. In this project work, an industrial structure (Pre-engineered Building) with loading as per Indian Standard codes will be analyzed and will be designed according to the various standards, i.e. IS 800-2007 (LSM), IS 800-2007 (ASD), AISC ASD & design results will be compared in terms of steel consumption.

- **COMPUTATIONAL ANALYSIS**

#### 3.1 Analysis and Design Pre-engineered building in staad pro software

##### 3.1.1 Structure Geometry in 3D

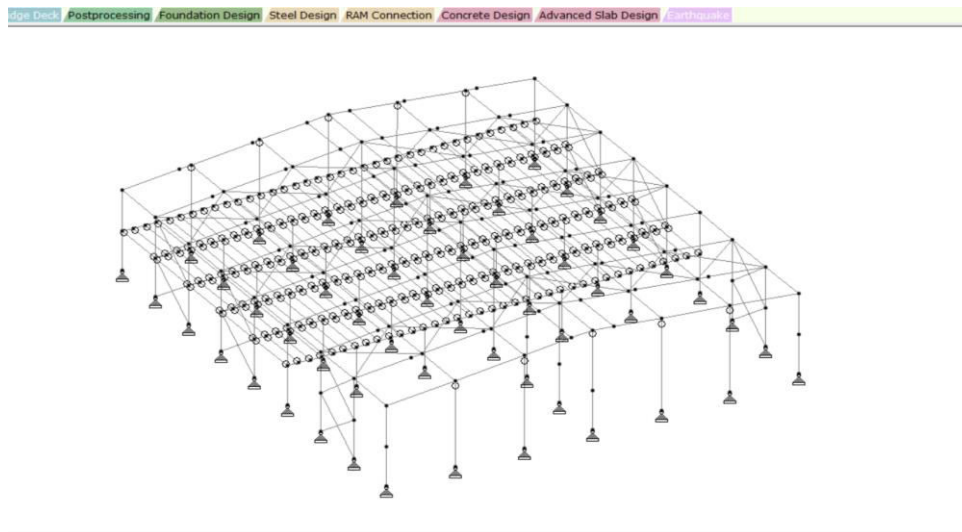


Fig. 3.1 Geometry of G+1 PEB structure

##### 3.1.2 Load Calculation and Load Assigning

###### 1. Load assign in rafter

- Dead load for rafter  
DL=0.75kN/m<sup>2</sup>
- Live load for rafter  
LL=4.69kN/m<sup>2</sup> (for Indian code)  
LL=3.56kN/m<sup>2</sup> (for American code)
- Collateral Load  
CL=1.25kN/m<sup>2</sup>

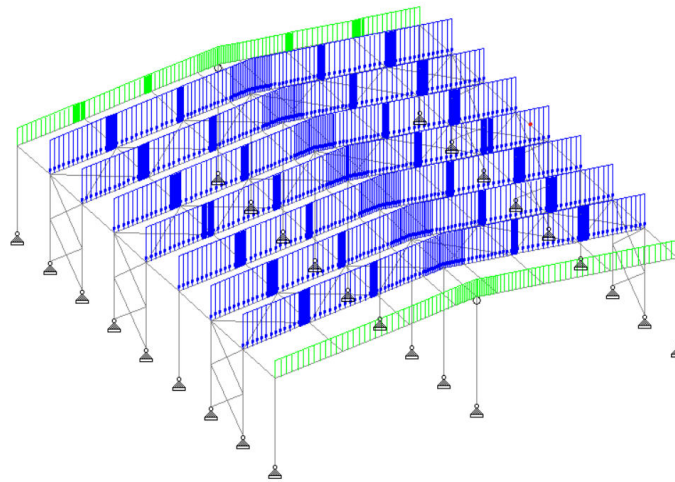


Fig. 3.2 Load on Rafter

### 2. Load assign in a mezzanine floor

- Dead load for mezzanine floor  
DL=3.75kN/m<sup>2</sup>
- Live load for mezzanine floor  
LL=6.25kN/m<sup>2</sup>

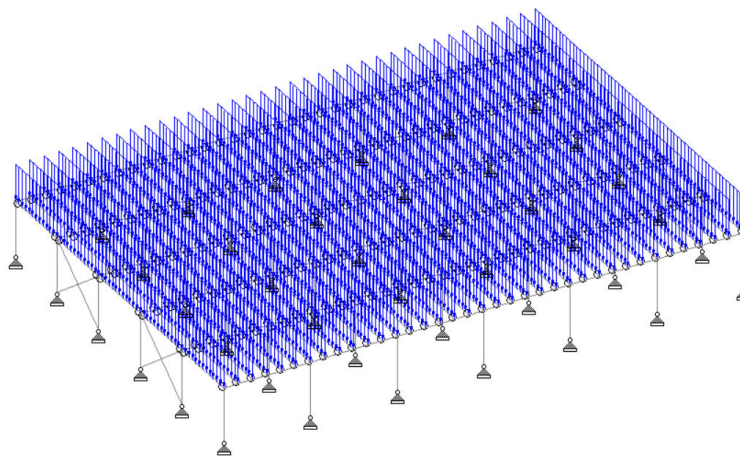


Fig. 3.3 Lode on a mezzanine floor

### 3. Wind Load

- Wind Load as per IS875(Part3)-2015

Table 3.1 Wind Load Calaulation

Case	Side wall (kn/m <sup>2</sup> )		PEB Rafter (kn/m <sup>2</sup> )	
	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

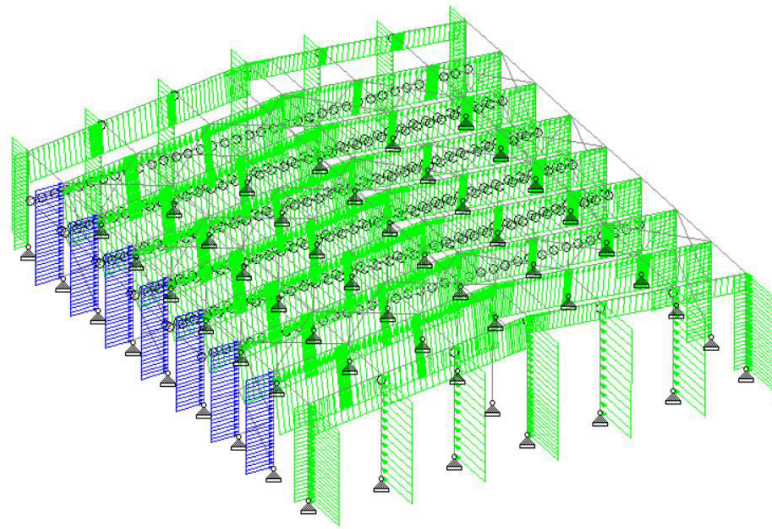


Fig. 3.4 Wind load

#### 4. Seismic Load

For PEB structure analysis seismic load as per IS1893(Part1)-2016. Load applied in X and Z direction Shown in Fig.

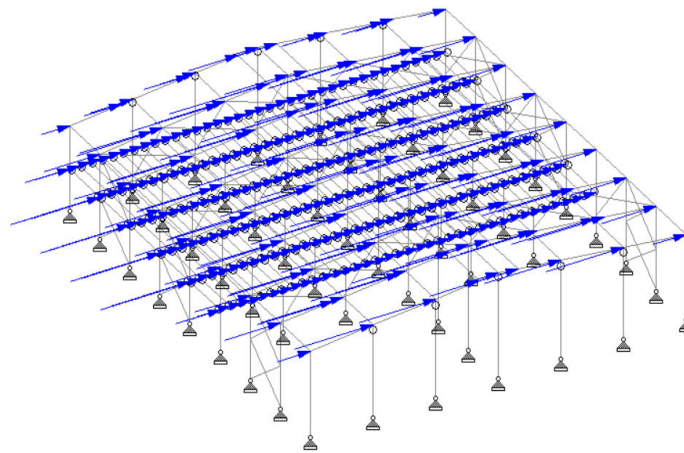


Fig. 3.5 Seismic load is assigned in '+X' direction

#### 3.1.3 Load Combination

Load combinations are adopted according to IS800-2007 and AISC-ASD for the analysis of the frame in both concepts and are listed as follows:

- As per IS800-2007

##### 1.1 Strength

- 1 1.5DL+1.5LL+1.05CL
- 2 1.2DL+1.2LL+1.05CL+0.6WL
- 3 1.2DL+1.1LL+0.53CL+1.2WL
- 4 1.5DL+1.5WL
- 5 0.9DL+1.5WL
- 6 1.2DL+1.2LL+1.05CL+0.6EX
- 7 1.2DL+1.2LL+0.53CL+1.2EX
- 8 1.5/0.9DL+1.5EX



1.2 Serviceability

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

- As 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

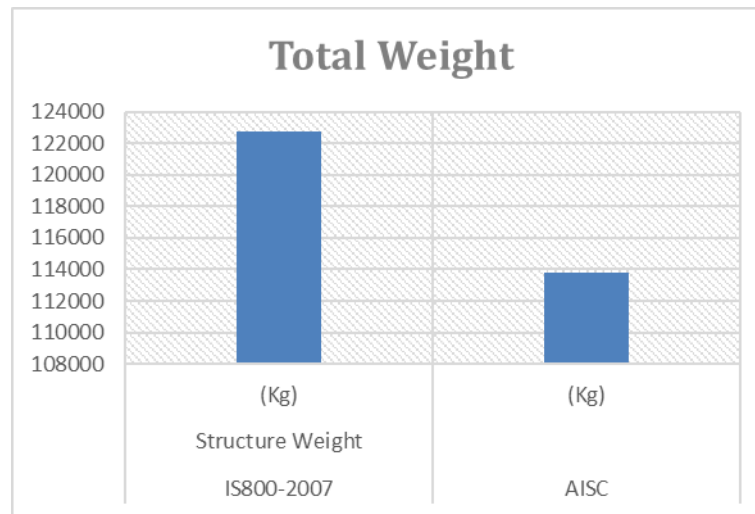
IV. RESULTS

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

3.2 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

### Weight Graph



### V. CONCLUSION

Based on the analysis and design results using the two design codes, the following conclusions are drawn.

1. Using the IS800:2007 and AISC code for designing a G+1 pre-engineered building ensures compliance with Indian and American standards for structural steel design and construction.
2. It emphasizes safety, efficiency, and reliability in the design process.
3. By adhering to this code, the G+1 pre-engineered building can be constructed with structural integrity, meeting the necessary criteria for load-bearing capacity, stability, and durability
4. The analysis and design of the G+1 Pre-engineered building uses different Indian and American codes. The design result in weight as pre-code Indian standard code weight is more than American code.

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