e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:02/Issue:05/May-2020 www.irjmets.com

DESIGN AND ANALYSIS OF PRE ENGINEERING BUILDING

Rakesh Shambharkar[*1], Amit Patankar[*2], Ankit Helonde[*3], Gunjan Samarth[*4], Nirantar Borkar[*5], Shubham Wath[*6], Sunil Sahare[*7]

[*1]Assistant Professor, Department of Civil Engineering, DBACER, Nagpur, Maharashtra, India.

[*2,3,4,5,6,7]Student of Department of Civil Engineering, DBACER, Nagpur, Maharashtra, India.

ABSTRACT

In recent years, civil engineers found many new construction techniques and Pre Engineering Building (PEB) is the one of it. Nowadays, PEB structures are mostly used in construction of industrial buildings. The study carried for designing and analysing a pre-engineering building for residential building having a plot area of 1500 sq. ft. The residential PEB structure compared with RCC building. The economy of the structure is discussed in terms of its cost and weight of structures

KEYWORDS: PEB, Design, Analysis, RCC, Cost.

I. INTRODUCTION

The definition of Pre-engineering Building (PEB) is a metal building frame which design and fabricated steel member in industry, then all components transport on site and assemble steel member with nut-bolts. This structure are mostly used in warehouses, industrial sheds, temporary structures, etc. The quantity of steel in this type of structures is greatly reduced due to the analysis and design of structure in STAAD pro before the actual execution of work. The study give a brief of analysis and design made for a residential structure. PEB residential structure is then compared with RCC structure.

II. METHODOLOGY

2.1 Analysis and Design of RCC Residential Building:

2.1.1 Analysis - A plot area of 1500 sq. feet is taken and developed plan and centre line plan is drawn in AutoCAD software. Analysis is then carried out in STAAD Pro.V8i software. The step by step procedure for analysis of RCC residential structure is given below:

1) Geometry of building is drawn by using center line plan.
2) The material used for RCC building is concrete.
3) Property size of beam and column is taken as 230×450 mm.
4) In this structure fixed supports are used.
5) Load and Definition:

a) **Seismic definition:** It is assumed that the site is situated in Nagpur region. Thus, the seismic definition by IS 1893:2002 is as follows:

Sr. No.	Parameter	Value
1.	Seismic Zone 2	0.1
2.	Response Reduction Factor (RF)	3
3.	Importance factor (I)	1.2
4.	Rock and Soil Site factor (SS)	2

Table 2.1

b) Load case details: There are three loads taken (i.e.) seismic loads, dead load, and live load. The dead load is taken as per IS 875 (Part-I) and live load is taken as per IS 875 (Part-II).

Dead load of the building is as follows:

1.	Member load	15 kN/m
2.	Floor load	3.75 kN/m^2
3.	Parapet wall load	5 kN/m

Table 2.2

Live load of the building is as follows:

1.	Ground floor	2 kN/m^2
2.	Floor finish	1.5 kN/m^2

Table 2.3

c) Load combinations: The load combination are as follows from IS 875 (Part III) 1987:

Sr. No.	Load Combination
1.	1.5 (DL+LL)
2.	1.2(DL+LL+EQX)
3.	1.2(DL+LL-EQX)
4.	1.2 (DL+LL+EQZ)
5.	1.2 (DL+LL-EQZ)
6.	1.5(DL+EQX)

7.	1.5(DL-EQX)
8.	1.5(DL+EQZ)
9.	1.5(DL-EQZ)
10.	0.9 DL+1.5EQX
11.	0.9 DL-1.5EQX
12.	0.9 DL+1.5EQZ
13.	0.9 DL-1.5EQZ

Table 2.4

After putting all parameters, analysis is completed following the RUN ANALYSIS command.

2.1.2 Design - The analysis gives the required quantity of steel reinforcement and concrete. As per requirement the design of building is completed. The grade of steel is taken as Fe 415 and grade of concrete is taken as M_{25}. Fig.1 shows the 3D Rendered View of RCC Building in STAAD Pro V8i.

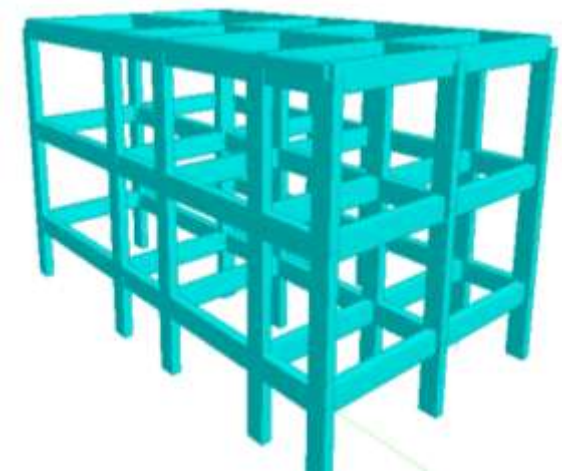

Fig-1

2.2 Analysis and Design of PEB Residential Structure:

2.2.1 Analysis - The analysis of PEB residential structure is carried out in STAAD Pro V8i software for the same plot area at 1500 sq. feet which is used for analysis and design of RCC residential building. The following is the procedure of analysis in software are similar to RCC building with minor changes.

Following step by step procedure for analysis of PEB structure is given below:

1. Geometry of structure is drawn by using centre line plan.
2. Tapered section is used in this structure. Section properties are as follows:

a) ISHB 400 @77.4
b) ISHB 400 @77.4 is tapered to ISHB 200 @40.0
c) ISHB 250 @54.7 is tapered to ISHB 200 @40.0

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:02/Issue:05/May-2020 www.irjmets.com

d) ISHB 200 @40.0
e) Size of plinth beam is taken as 230 X 450 mm.

3. Pinned joint support is given to this structure.

4. Load and Definition:

a) Seismic definition: It is assumed that the site is situated in Nagpur region. Thus, the seismic definition by IS 1893:2002 is as follows:

Sr. No.	Parameter	Value
1.	Seismic Zone 2	0.1
2.	Response Reduction Factor	3
3.	Importance factor	1.2
4.	Rock and Soil Site factor	2

Table-2.5

b) Load case details: There are three loads taken (i.e.) seismic loads, dead load, and live load. The dead load is taken as per IS 875 (Part-I) and live load is taken as per IS 875 (Part-II)

Dead load of the building is as follows:

1.	Member load	0.8415 kN/m
2.	Floor load	1.1434 kN/m^2

Table-2.6

Live load of the structure is as follows:

1.	Live load	1.75 kN/m^2

Table-2.7

c) Load combination: The load combination are as follows:

Sr. No.	Load Combination
1.	DL+LL
2.	1.4DL+1.7LL
3.	1.05DL+1.275LL+1.275WL(+X)
4.	1.05DL+1.275LL+1.275WL(-X)
5.	1.05DL+1.275LL+1.275WL(+Z)

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:02/Issue:05/May-2020 www.irjmets.com

6.	1.05DL+1.275LL+1.275WL(-Z)
7.	1.05DL+1.275LL+1.275EQ(+X)
8.	1.05DL+1.275LL+1.275EQ(-X)
9.	1.05DL+1.275LL+1.275EQ(+Z)
10.	1.05DL+1.275LL+1.275WL(-Z)

Table-2.8

RUN ANALYSIS command gives the complete analysis of structure.

2.2.2 Design - The analysis provided quantity of steel, concrete and steel reinforcements required for designing the structure as per requirement designing is completed. Fig. 2 shows the 3D Rendered View of PEB Building in STAAD Pro V8i.

Fig.-2

III. RESULTS

1. Quantity of concrete and steel:

RCC Structure		PEB Structure	
Items	Quantity	Items	Quantity
Concrete	32.3 M^3	Concrete	3.9 M^3
Steel	23.33 kN	Steel	82.82 kN

Table-3.1

2. Cost of structure:

RCC structure	Rs. 12,00,249 /-
PEB Structure	Rs. 9,55,657 /-

Table-3.2

3. Weight of structure:

RCC Structure	785.611 kN
PEB Structure	176.968 kN

Table-3.3

IV. CONCLUSION

1. PEB structure cost is 20.37% lesser than the cost of RCC structure.
2. Quantity of concrete in PEB structure is less. Hence, the total weight of structure in PEB structure is found to be less than RCC structure.
3. Understand the concept of pre-engineered building and the advantages over RCC buildings.
4. PEB structures are preferable for large span structures up to a certain optimum span. For small span structures, use of PEB technology won't affect the overall performance.
5. In residential building construction, PEB structure can be adopted to replace RCC structure.

V. REFERENCES

[1] D. Kalantri, S. Deshpande, P. Gudi, *"A Comparative study on the Performance of PEB with CSB considering various parameters"*, International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 05 | May -2017

[2] R. D. Shambharkar, P. A. Deotale, *"A Case Study of Low Span Pre-Engineered Industrial Building"*, International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE), Vol 3, Issue 1, January 2018

[3] G. Sai Kiran, A. Kailasa Rao, R. Pradeep Kumar (2014), *"Comparison of Design Procedures for Pre Engineering Buildings (PEB): A Case Study"*, International Journal of Civil, Architectural, Structural and Construction Engineering Vol:8 No:4, 2014

[4] Jinsha M S, L. A. Mathew, *"Analysis of Pre –Engineered Buildings"*, International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064, (2016)

[5] IS 875 Part I

[6] IS 875 Part II

[7] www.google.com