COST EFFECTIVENESS OF MULTI STOREY CSB & PEB INDUSTRIAL STEEL BUILDING

[1]Monika Nakum, [2]Jigar Zala, [3]Darshan Shah
[1]M.E Student Structure engineering, Arham Veerayatan Institute of Engineering and Research, Mandvi, India
[2]Assistant Professor civil Engineering Department, Arham Veerayatan Institute of Engineering and Research, Mandvi, India
[3]Structure Designer, Jaydipdarshan Consultants Pvt. Ltd. Ahmedabad, India

Abstract*— PEB systems are extensively used in industrial and many other constructions worldwide, it is relatively a new concept in India. That concept includes the technique of providing the best possible section according to the optimum requirement & cost effectiveness. In the present work, the study of PEB with CSB has been carried out; the observations made based on this study are very much useful to the practicing structural engineers. In this paper, CSB (Conventional steel building) & PEB (Pre engineered steel building) were compared after analysed in STAAD-pro & design using IS: 800:2007 Here, we have taken 5 different plan area & different material specifications for that plans for study of cost effectiveness. After the study results of PEB & CSB Structure observed that the high material strength reduces the cost of building.

***Index Terms*—PEB, CSB, IS 800:2007, multi storey, Cost effectiveness**

I. INTRODUCTION

Homosapiens has always tried to innovative new things to meet his changing needs. Making the construction very quick is a needful step in the corporate world, manufacturing sector, residential and institutional sectors. As it is said that “time is money”, here also in corporate giants considers “Time" as the prime deciding factor in terms of profitability. Once time is gone, no one can rewind it but money once lost money can be regained. Pre-engineered buildings are constructed in such a manner that helps in efficient use of time and money. Thus the study of cost effectiveness of PEB structures against traditional steel structures is very important.

II. OBJECTIVE & SCOPE OF WORK

Objective of present work is as follows:

- Design primary & secondary element of P.E.B & C.S.B and to study the optimized section of structure.
- Compare the weight of normal CSB structures to PEB structures.
- Compare the bill of Quantity & cost of building.

Scope of present work is as follows:

- Keeping same configuration of Storey Height 20 meter, Fifteen Models prepared of area covered approx. 3600,4320,6300,7220,9720 m^2 respectively, for both Pre Engineered building & Conventional Steel Building.
- Load analysis & Design carried out using Software STAAD Pro.
- Design of Main & Secondary Members like Joist, Beam, Column of steel Building Using IS:800:2007

III. CONCEPT OF PRE-ENGINEERED BUILDING

"A Pre-Engineered an industrial steel building is shop fabricated & site bolted structure". Hot rolled sections are used in conventional steel buildings. Today in this 21st century it is very important to find an alternate resource for civil construction technology, seeing through the depleting natural resources. With Pre-engineered steel building systems, multi-stories can now be made in possible shortest time, along with substantial cost savings and many more benefits: “Construction can be done as fast as to that of 6-8 times faster than the conventional RCC Construction”

- Cost minimized using PEB structures.
- Construction technology can be Dry & Mechanized.
- Use of shuttering is not required
- Design can be made Earthquake resistant.
- At a same time many floors can be laid together.

This is a very magnificent building system which can be finished at ease pace to serve any architectural style of required purpose and accessorized externally to achieve attractive and distinctive styles. Pre-Engineered steel construction market is increasing at a 100% pace year by year and also it would certainly not be a hyperbole if we say the industry is catching-up very rapidly. In fact, pre-engineered building is well renowned now a day’s in construction sector and as an alternative construction methodology in India today.

IV. BUILDING CONFIGURATION:

BUILDING CONFIGURATION			"PLAN 1"	"PLAN 2"	"PLAN 3"	"PLAN 4"	"PLAN 5"
Building Length	L	m	36	43.2	50.4	57.6	64.8
Building Width	B	m	20	20	25	25	30
Building height	H	m	20	20	20	20	20
Numbers of floor	N	m	5	5	5	5	5
Floor height	H	m	4	4	4	4	4

Area	A	m^2	3600	4320	6300	7200	9720
Bay spacing along Length	L_s	m c/c	7.2	7.2	7.2	7.2	7.2
Bay numbers along Length	L_n	nos.	5	6	7	8	9
Bay spacing along width	B_s	m c/c	4	4	5	5	6
Bay numbers along width	B_n	nos.	5	5	5	5	5

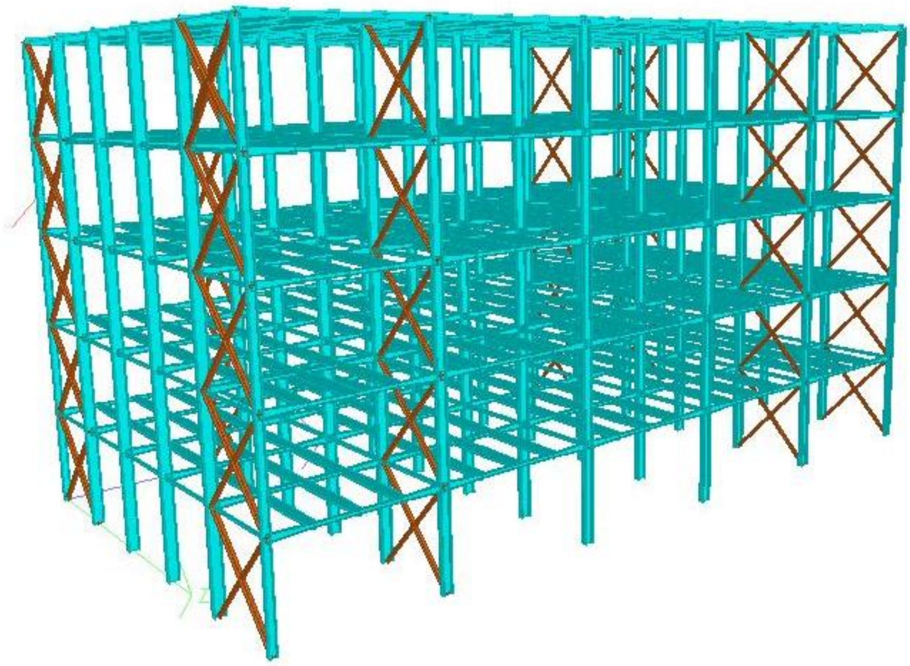

FIG: 3D GEOMETRY OF TYPICAL STRUCTURE

V. LOAD DATA:

Referring to the Clause 3.2 of IS 800:2007 specifies the various loads and forces that has to be considered while performing the design of steel structures.

Table 1 Dead Load: (As per IS:875- part 1, 1987)

DEAD LOAD		
Floor load:-		
Deck sheet (0.8 mm thick)	0.083	kN/m^2
R.C.C Slab (100 mm thick)	2.5	kN/m^2
R.C.C Slab Corrugation (40 mm thick)	1	kN/m^2
Floor finish:-		
Floor finish	1	kN/m^2
Uniform distributed load :-		
Cladding sheet load	0.15	kN/m^2

Table 2 Live Load: (As per IS:875- part 2, 1987)

LIVE LOAD		
On Typical floor:-		
Live load	3	kN/m^2
On roof floor:-		
Roof live load	1.5	kN/m^2

Table 3 Wind Load: (As per IS:875- part 3, 1987)

WIND LOAD		
Location	Ahmadabad	
Wind speed	39	m/s
Building height	20	m
design life of structure	50 years	

Table 4 Earthquake Load: (As per IS:1893-part 1, 2002)

EARTHQUAKE LOAD	
Location	Ahmadabad
Zone factor	III
Importance factor	1
Type of frame	SMRF
Response reduction factor	5
Type of soil	Medium

VI. RESULTS:

Weight of Frame:-

Following graphs shows all plans Main Frame weights (in metric tonne) include beam, columns and connections.

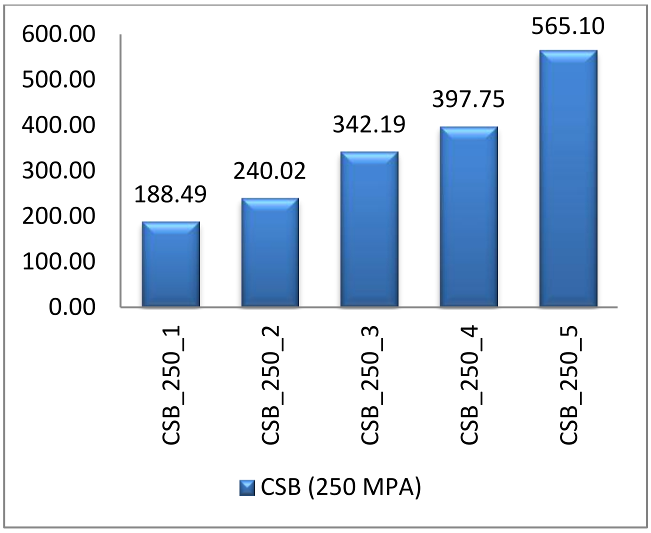

FIGURE 1: MAIN FRAME WEIGHT OF CSB-250 MODELS.

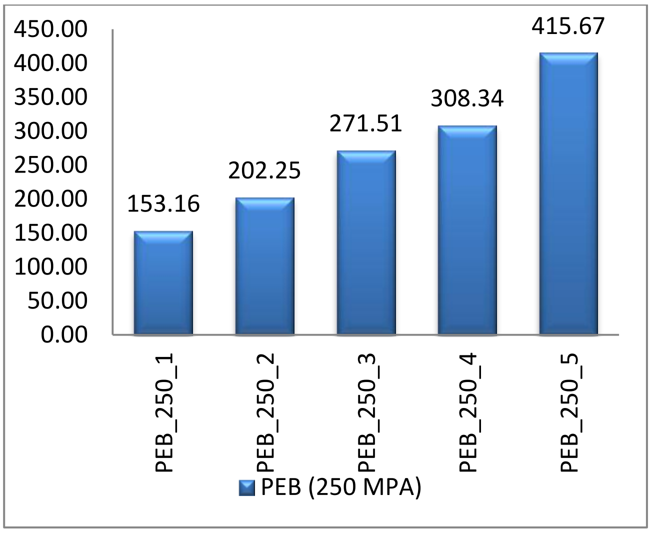

FIGURE 2: MAIN FRAME WEIGHT OF PEB-250 MODELS.

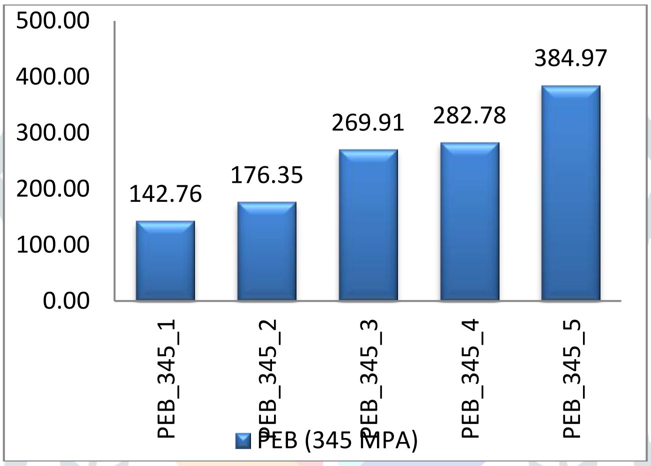

FIGURE 3: MAIN FRAME WEIGHT OF PEB-345 MODELS.

Total cost of building in lacs:

Following graphs shows all plans total building cost, in which cost of main frame, bracing, cladding sheet, deck sheet, & connections included.

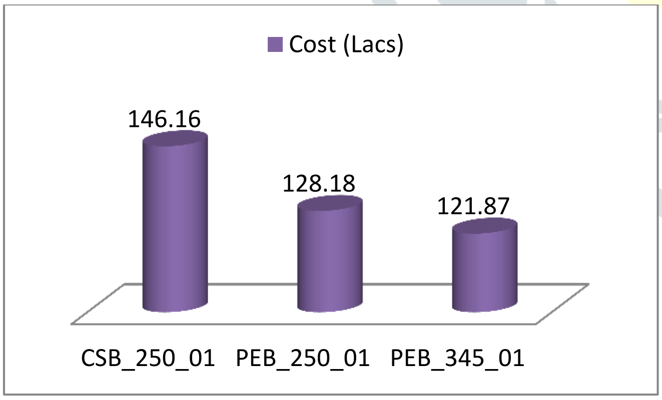

FIGURE 4: COMPARISON TOTAL COST OF PLAN -1

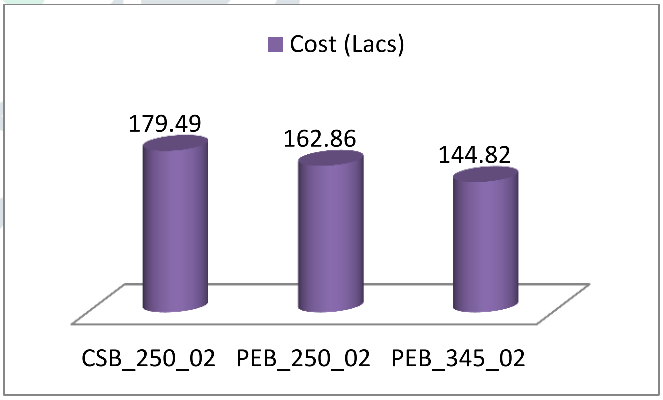

FIGURE 5: COMPARISON TOTAL COST OF PLAN -2

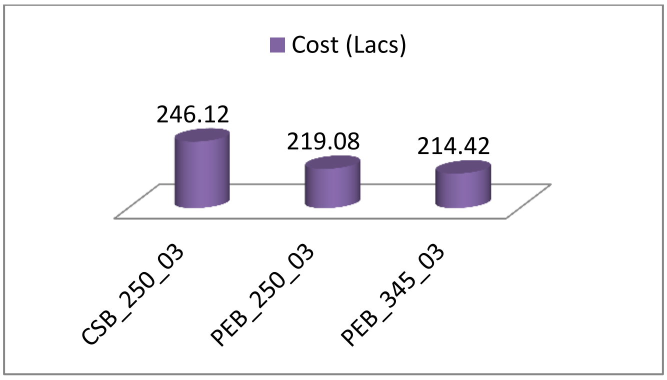

FIGURE 6: COMPARISON TOTAL COST OF PLAN -3

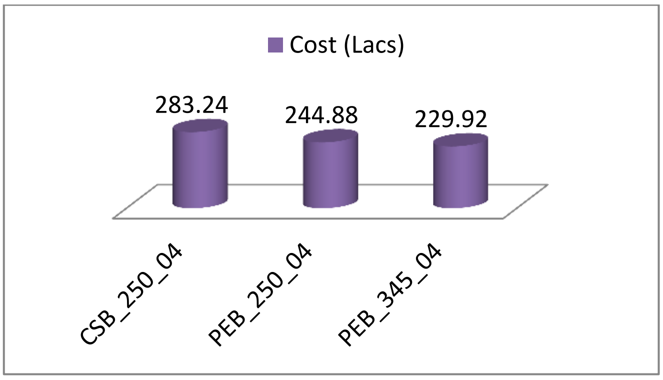

FIGURE 7: COMPARISON TOTAL COST OF PLAN -4

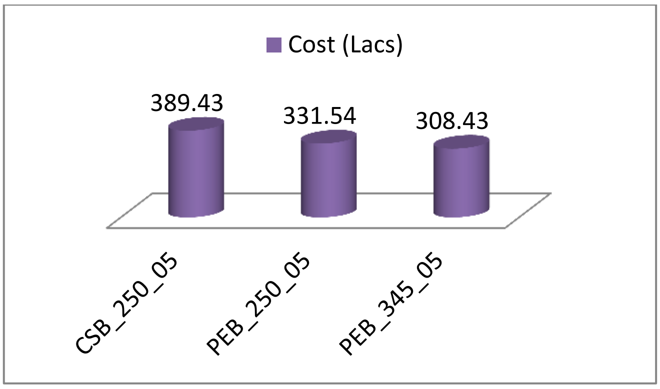

FIGURE 8: COMPARISON TOTAL COST OF PLAN -5

Table 5 Cost efficiency achieved in study

Sr. No.	Cost of CSB 250 (lacs)	Cost of PEB 250 (lacs)	Cost of PEB 345 (lacs)	% COMPARISON OF CSB 250 & PEB 250	% COMPARISON CSB 250 & PEB 345	% COMPARISON PEB 250 & PEB 345
PLAN 1	146.15	128.18	121.87	**14.0%**	**19.9%**	**5.2%**
PLAN 2	179.49	162.86	144.82	**10.2%**	**23.9%**	**12.5%**
PLAN 3	246.12	219.07	214.42	**12.3%**	**14.8%**	**2.2%**
PLAN 4	283.24	244.88	229.92	**15.7%**	**23.2%**	**6.5%**
PLAN 5	389.43	331.54	308.42	**17.5%**	**26.3%**	**7.5%**

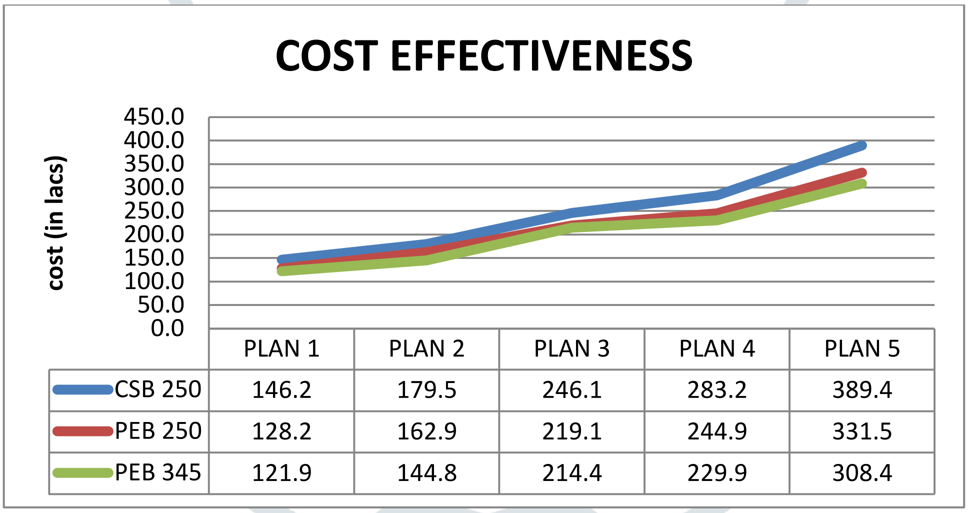

FIGURE 9: COST EFFECTIVENESS OF ALL PLAN

VII. CONCLUSION

Considering the overall material quantity & cost of building observation are as under,

- Considering same material specification (F_y = 250 MPa) in CSB 250 & PEB 250, we found that PEB 250 plan 5 (having area of 9720 m^2) is 17.5% less than CSB 250.
- Changing F_y from 250 to 345 MPa yield strength, in CSB 250 & PEB 345 models we achieved for plan 5 (having area of 9720 m^2) is 26.3% less in PEB 345. So, from that we observed that the high material strength reduce the cost of building.
- Comparing to PEB 250 & PEB 345 models we found that PEB 345 plan 5 (having area of 9720 m^2) is 8% less than PEB 250.

We observed that as the area increasing of the building leads to the cost effectiveness in pre engineered building.

Going through the overall study and results leads to the use of F_y = 345 MPa material to achieved best cost effectiveness.

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