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A PARAMETRIC STUDY ON PRE-ENGINEERED BUILDING

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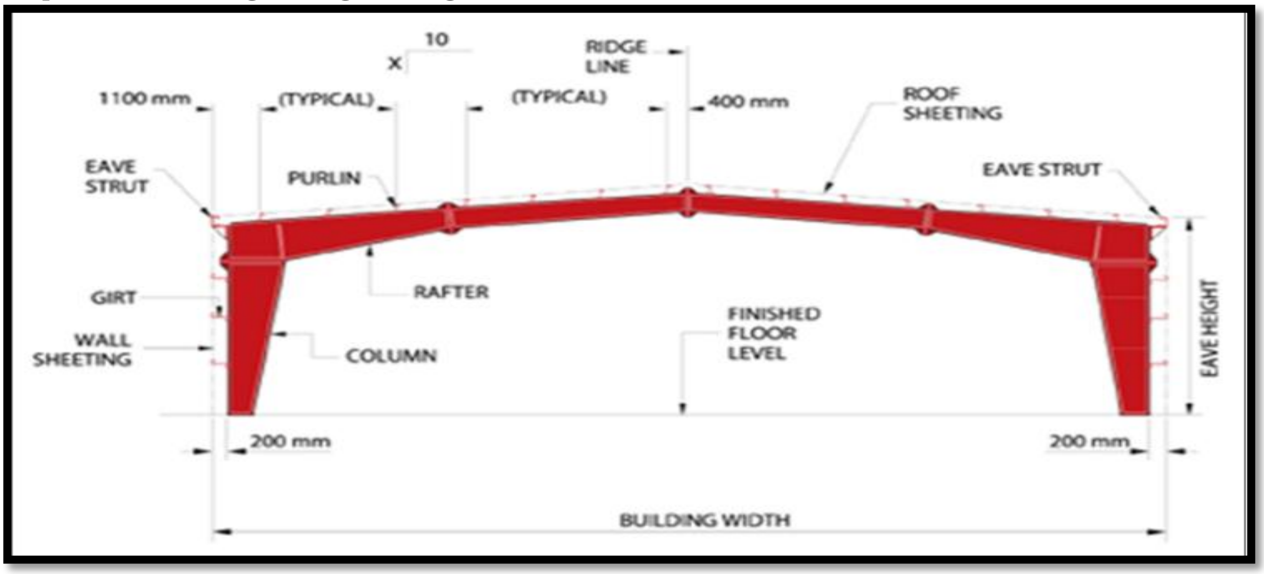
Abstract-** Pre Engineered Steel Buildings fulfil all the requirements of industrial structures along with reduced time ,speed in construction and cost as compared to Conventional Steel Building. This methodology is modern not only due to its quality in designing and prefabrication, but also due to its light weight and economy. The present work involves study of structural analysis and design of Multi-storey Pre Engineering Building (PEB) by using IS 800-2000 .A modelling, analysis and design of the PEB building is carried out in staad pro (2007) by changing its bay spacing and joist spacing to find most economical structure. Also find out most economical beam spacing in mezzanine floor. Also analyse G+1 & G+2 building to find most economical bay spacing. And to check in which case it achieve most economy in steel quantity. Load cases considered in modelling are Dead load, Live load, Seismic load and Wind load as per Indian Standard code. Also load combinations are considered. Wind load calculation is to be done manually. Analysis is observed for the most economical steel quantity by changing bay spacing and also for changing joist spacing (secondary beam) in mezzanine floor.

Key words: Pre-engineering Building, Bay Spacing, Joist spacing, beam spacing, economy, stadd-pro software.

I. INTRODUCTION

Pre-Engineering Building system is mostly used now-a-days and it is manufacturing for residential and other non-residential construction .it is comparatively new technology in market. With the possibility of more economy, PEB manufacturing concept is coming late in Indian market. The possibly market growth of PEB is 1.2 million tonnes and the current capacity on PEB manufacturing is 0.35 million tonnes per annum. The industry is growing at the rate of 25-30%.
Indian manufacturer are way behind with respect to design of the Pre Engineering Building and they are trying to comparatively take up. In other area of PEB India is good. With respect to other country Indian code for design are safe and it is follow.
Pre-engineering steel buildings are fitted with the different accessories like, mezzanine floor, canopies, interior partition etc as per requirement. Filler floor covering and trims are used to make building waterproof. This concept of design is very versatile and can achieve attractive and unique construction. It is less economical for high rise building but it is more help-full for low-rise building construction.
The height of the PEB steel structure can go up to 25 to 30 m. and generally it is low-rise buildings. It is mostly used for offices, shops, show rooms, house, etc. the use of PEB for low rise building is economical and speedy in construction and it takes less time in construction than Conventional Steel Building.
The top of building can be flat or slop. Mezzanine floor is intermediate floor in structure which is made in low rise buildings. We can extended the PEB structure at any time as per requirement and we can use it repeatedly.

Components of Pre Engineering Building



Fig, 1: PEB Frame

- **Primary Frame**: Framing of a steel building is built up section which is I-Shaped steel members & that framing consist trusses or beams, etc.
- **Secondary Structural Elements**: It is actually Cold Formed steel Members which can be in different shapes like 'Z', 'C' etc. In general known as 'Purlin'.
- **Roof & Wall Panels**: Shades and Wall of truss made up of Glass and Roll-formed steel sheet typically comes in this category.
- **Other Accessories**: Mezzanine floors, Bolts, Insulation, etc

II. OBJECTIVE OF THE STUDY

1) To find most economical joist (secondary beam) spacing in mezzanine floor.
2) To find most economical beam spacing in mezzanine floor.

III. METHODOLOGY AND LOAD ON THE MODELS

Structural analysis depends upon structures location. Situation, environment condition, architectural layout, parameters, usage, client requirement etc.

(A) For main frame

Dead load: 3.125 Kn/m^2
Live load: 3.75 Kn/m^2
Collateral load: 1.25 Kn/m^2
Wind load (As per IS 875 part-III)
$Pz= 0.6*Vz^2$
Vz= k1*K2*k3*Vb
Vb= Basic wind speed = 39 m/s
K1 = Risk factor = 1
K2 = Terrain, straight height & size factor =0.8
K3 = Topography factor = 1
Vz = Design wind speed = 31.2 m/s
Pz = Design wind pressure = 0.58 Kn/m^2
Cpi = Internal pressure co-efficient = 0.5
Because: openings not more than 5% of wall area =0.2
Openings between 5% to 20% of wall area = 0.5
Openings larger than 20% of wall area = 0.7
Cpe = External pressure co-efficient

(B)For mezzanine floor

Dead load = 0.50 Kn/m^2
Live load = 3.75 Kn/ m^2
Collateral load = 0.3125 Kn/ m^2

Table 1: External Pressure Coefficient (Cpe) For Pitched Roofs of Rectangular Clad Buildings

Roof Angle	Wind Angle = 0^o		Wind Angle = 90^o	
	EF	GH	EG	FH
5	-0.90	-0.40	-0.80	-0.40
10	-1.20	-0.40	-0.80	-0.60
5.71	-0.94	-0.40	-0.80	-0.43

CPE-EXTERNAL PRESSURE COEFF FOR PITCHED ROOF OF SINGLE SPAN BLDG

Table No.5 IS 875 (Part3) -1987
Roof Angle in degree =5.71
Wind load is calculated for 5m beam spacing

Table 2: wind pressure and suction on left, right & front side

Sr no	WLPL	WLPR	WLSL	WLSR
1	0.921	-3.22	5.526	1.38
2	6.63	4.14	2.06	-0.46
3	4.14	6.63	-0.46	2.06
4	3.22	-0.921	-1.38	-5.526

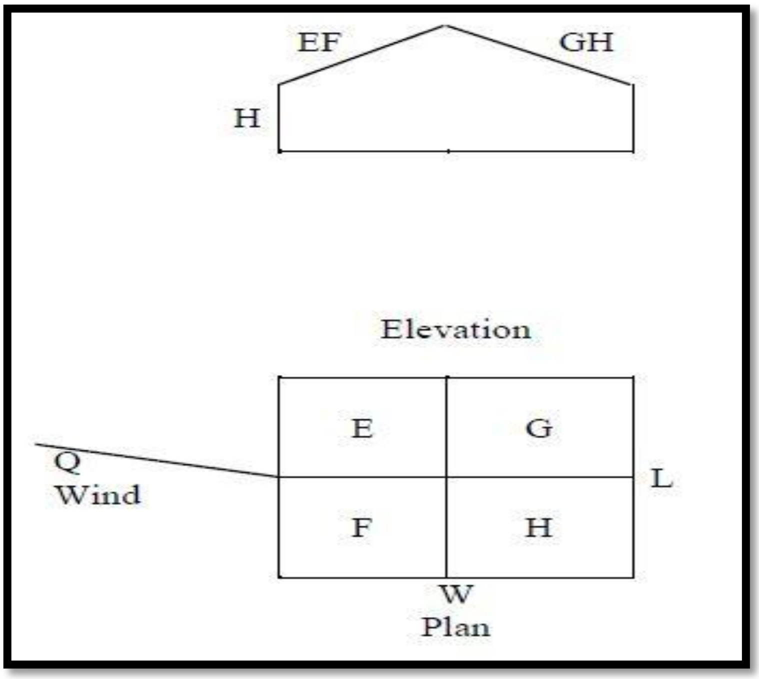


Fig. 2: Roof angle

IV. Design Summary

The institutional building is analyzed in staad pro. Following are its dimensions:

(A)For main frame
Length: 20m
Width: 30m
Eave height: 10m
Roof slope: 1:10
Purlin spacing: 1.5m
Location: Vadodara, India
Soil type: Medium
Seismic zone: 3
Life span: 50 year
Importance factor: 1
Response reduction factor: 4

(B) For mezzanine floor
Slab type: RCC
Thickness of slab: 125 mm
Mezzanine beam spacing: 4.28m, 5m, 6m, 7.5m
Mezzanine joist spacing: 0.7m, 1.2m

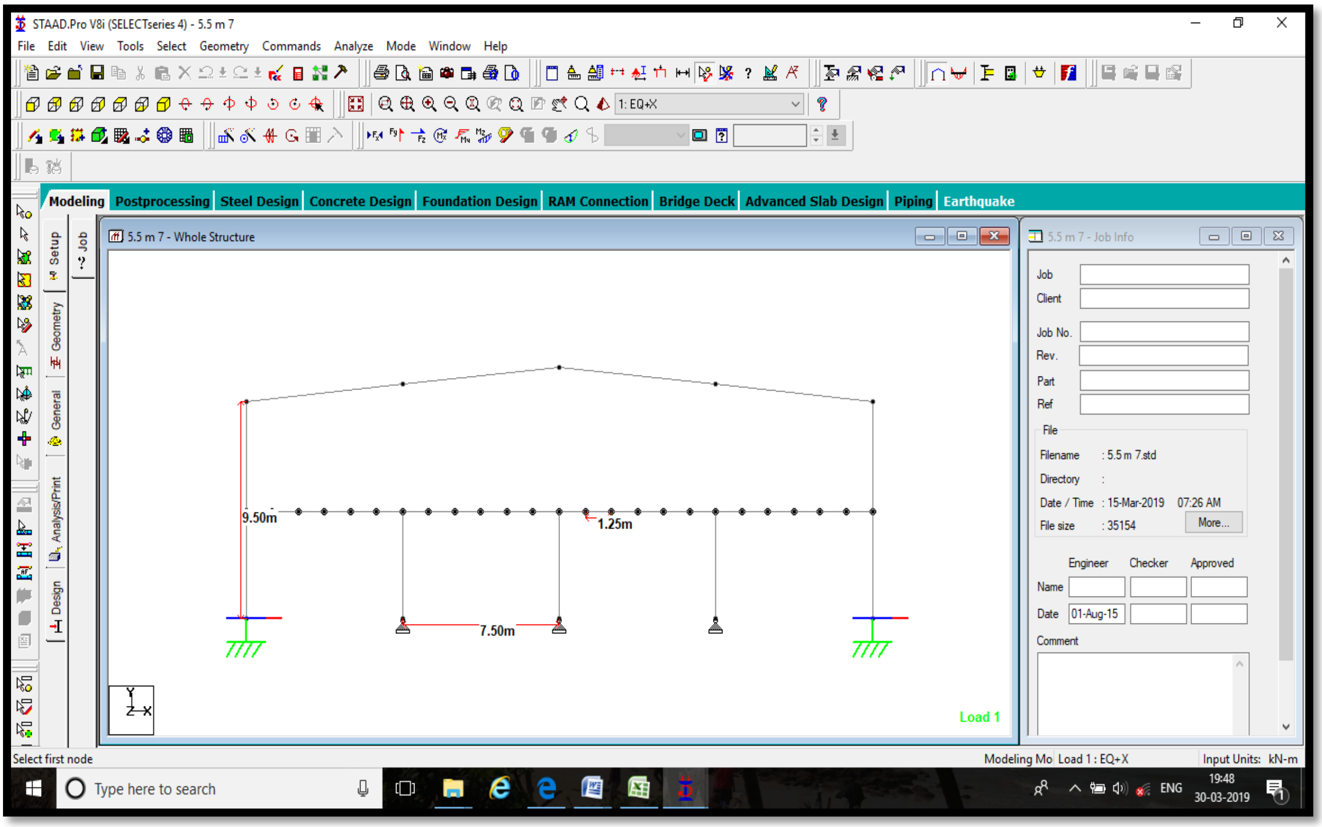


Fig. 3: PEB model frame

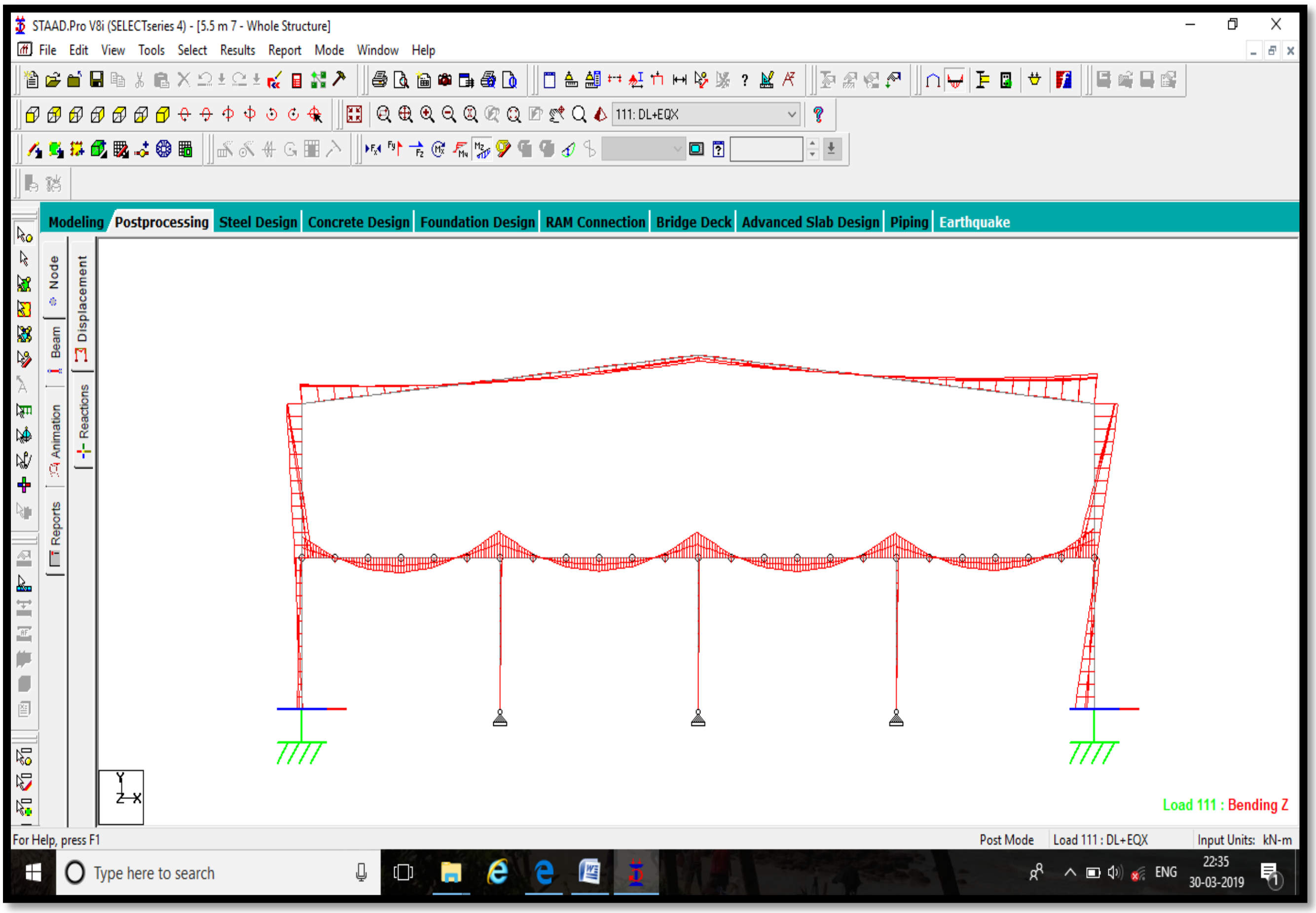


Fig. 4: Bending moment diagram of frame

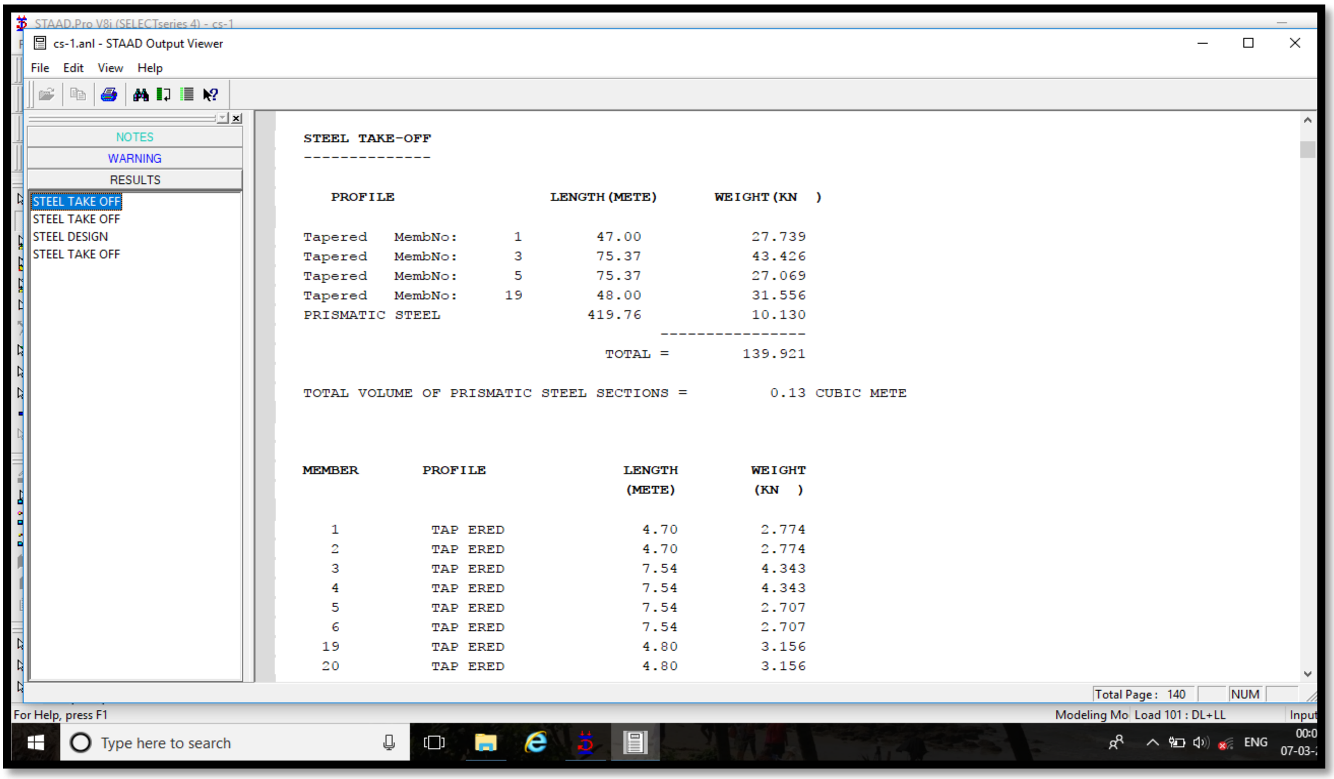


Fig. 5: Weight of steel

V. Result

(A) Joist spacing

Sr No.	Parameter	Weight in (KN)	Weight in (Kg)
1	8m ht 0.7m spacing	64.621	6591.342
2	8m ht 1.25m spacing	58.444	5961.288

(B) Beam spacing

Sr No.	Parameter	Weight in (KN)	Weight in (Kg)
1	10m ht 4.28m spacing	132.468	13511.736
2	10m ht 5m spacing	158.659	16183.218
3	10m ht 6m spacing	166.715	17004.93
4	10m ht 7.5m spacing	155.894	15901.188

VI. Conclusion

As per above analysis this paper convey that Pre Engineering Building is more advantageous in terms of cost effictivenes,speed in construction and easy erection. For PEB building 1.25m is most economical joist spacing (secondary beam).Most economical Beam spacing for 10m high building is 4.28m.

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