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Effect of Bracings on the Behaviour of Industrial Buildings with Different Framing Configuration Subjected to Wind Load

Gajjala Tagore Panish Chandra[1], Chethan Gowda R K[2]
[1, 2]*Department of Civil Engineering, M.S. Ramaiah University of Applied Sciences, Peenya, Bangalore - 560058*

Abstract: ***Steel structures are the best and smartest choice for industrial building construction, mainly because of their capability of creating large spans at lower costs. Usually, a different frame configuration along with effect of bracings has an effect on the behaviour of industrial buildings under wind load, along with PEB, truss, inclined, flat, curved roof. The methodology followed in PEBs is purely composite not only because of quality in pre-fabrication and pre-designing but also because of light weight outcome and economic sounding factor. In present study, Staad Pro is used for designing different sections such as k bracing, X bracing, Diagonal bracing and V bracing.***

The most economic truss chord sections are used for the designing of industrial building. So, the industrial buildings are designed for wind analysis with various bracings such as V bracing, X- bracing, k- bracing and diagonal bracing. Therefore, the most optimized structure is further compared to the PEB structure with the same parameters.

Keywords: Steel Structure, PEB, TRUSS, INCLINED, FLAT, CURVED, Bracing Systems, Wind Analysis, Diagonal Bracing, K-Bracing, X-bracing & V-bracing

I. INTRODUCTION

Building structures used by industry to store raw materials or to manufacture industry products are known as industrial buildings. Industrial buildings are classified into ordinary industrial buildings and special industrial buildings. A common type of industrial building is a shed type building with a simple roof structure on an open frame. These buildings are used for workshops, warehouses, etc. These buildings require large, clear areas that are not obstructed by columns. The large floor space provides plenty of flexibility and facilities to change the production layout later without significantly changing the building. Industrial buildings are constructed with sufficient headroom for the use of overhead travelling cranes. A special type of industrial building is a steel mill building used to build heavy equipment, produce electricity, etc. The functionality of an industrial building determines its sophistication.

A. Bracing Structure

The braced structure is strong framing system basically it is constructed in seismic prone areas. The bracing member is commonly manufactured with steel, which is more effective in tension and compression.

1) In bracing structure columns and beams withstand the vertical loads and bracings resist the lateral loads. And also, bracings work in axial stress which introduces stiffness against the horizontal shear.

2) There are different types of bracings used in construction, in this study we have considered bracings is as follows

- X bracing at all the face of the structure
- X bracing only at the corners of the structure
- Chevron bracing (inverted V) all the face of the structure
- Chevron bracing (inverted V) only at the corners of the structure
- Diagonal bracings at all the face of the structure
- Diagonal bracings only at the end of the structure

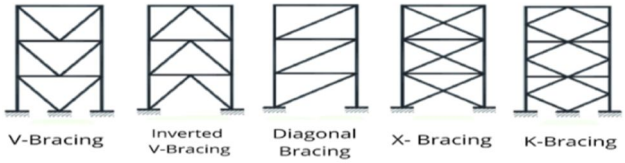


Fig-1.2

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II. METHODOLOGIES

We are considering types of configuration & types of structures industrial building with dimension 30mts span, 10 mts baying space ,height 10mts.here find economical, passing ratio, displacement for different types configuration without bracing & different types configuration with different types bracing by using staad pro analysis.

A. Structure Modelling

This table explains about structural span and dimensions

Table 2.2

Type of building	Industrial building
Building dimension	30 x10 x100 m
Area of the building	504m
Type of building	GI sheet
Location of the building	Vishakhapatnam
Bay spacing	1m
Wind speed	50m/s
Roof slope	1 m 3
Riser height	2m
Height of the column	10
Purlin space	1.4m
Girt spacing	1/m
Column Section	CC section
Truss chord sections	SHS and RHS
Column Section(PEB)	Tapered Plates
Ratter Of PEB	Tapered Plates

B. Different Model of structural configuration

1) PEB Roof

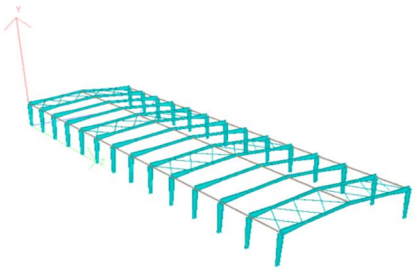


Fig 2.1

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2) Flat Roof

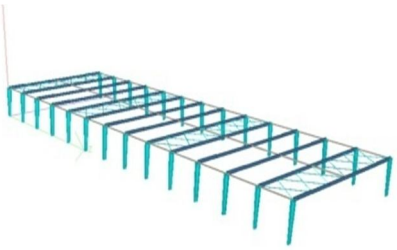


Fig 2.2

3) Inclined Roof

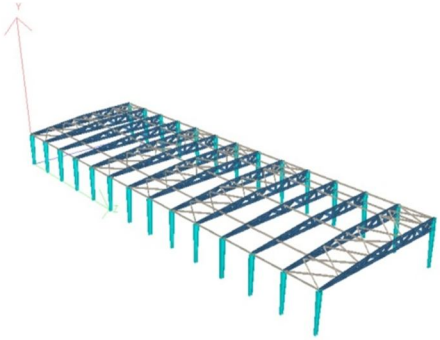


Fig 2.3

4) Truss Roof

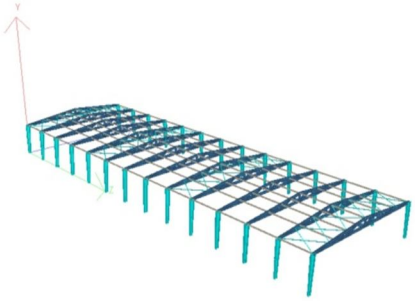


Fig 2.4

5) Curved Roof

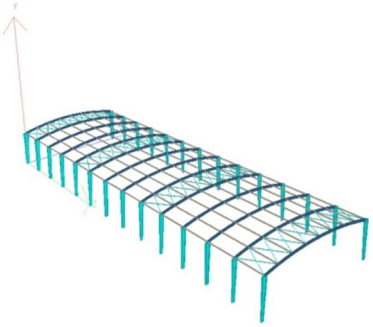


Fig 2.5

C. Different types of bracing

They are

1) X-Bracing
2) Diagonal Bracing
3) V-Bracing
4) K-Bracing

III. RESULTS AND DISCUSSION ANDCOMPARISON

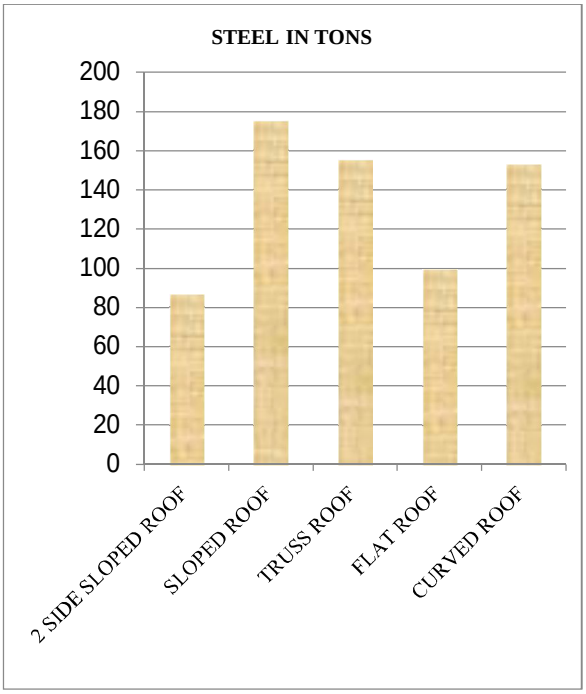
A. Economical Analysis

Bracings are those structural elements which functions under stress loads. The way lateral loads act on it and bring it to foundation depends upon the types of bracing we choose and their implementations are subjected to requirements about functionality as well as economical parameter .Keeping the deflection limits IS800-2007, the deflection when optimized the weight of the structure is noted to find the economical analysis.Foreconomicalanalysisthetotalweightofthestructurewitheach configuration was considered

B. Wind Load Analysis Different Types Of Configurations Without Bracings

Table 3.3

TYPES OF ROOFS	STEEL IN TONS
PEB ROOF	86.125
SLOPED ROOF	172.867
TRUSS ROOF	153.905
FLAT ROOF	97.27
CURVED ROOF	150.57



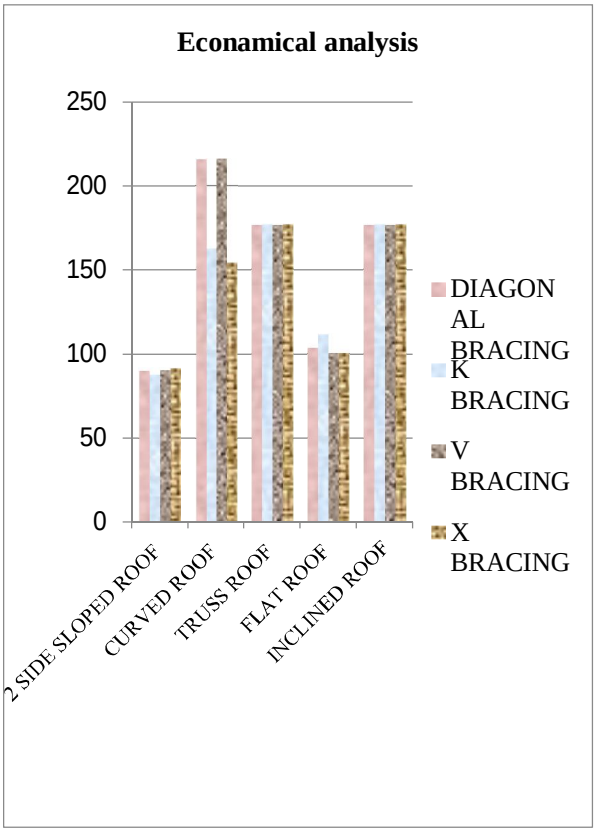
D. Graphical presentation

Without bracing steel weight minimum is 86.125.

E. With Different Types of Bracings

Table3.6

TYPES OF BRACING	PEB ROOF	CURVED ROOF	INCLINED ROOF	TRUSS ROOF	FLAT ROOF
DIAGONAL BRACING	90.415	216.137	176.729	156.767	103.591
K BRACING	88.119	163.15	177.221	157.259	111.79
V BRACING	90.553	216.275	176.867	156.905	100.731
X BRACING	91.801	154.57	177.001	157.04	100.722



3.7 Graphical presentation

Minimum steel weight for k- bracing is 88.119.

F. Technical Analysis

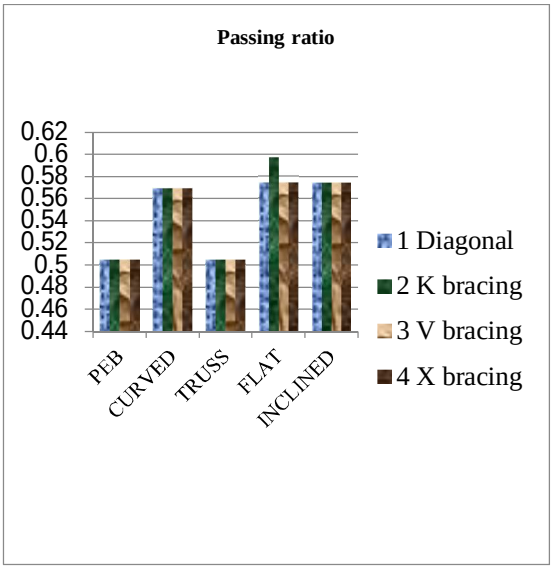
Maximum passing ratio or utilization

Table 3.9

SL.NO	TYPES OF BRACING	PEB	CURVED	TRUSS	FLAT	INCLINED
1	DIAGONAL	0.504	0.569	0.504	0.574	0.574
2	K-BRACING	0.504	0.569	0.504	0.574	0.574
3	V-BRACING	0.504	0.593	0.504	0.574	0.574
4	X-BRACING	0.504	0.569	0.504	0.574	0.504

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Passing ratio of one selected beam is maximum 0.504mm for PEB, 0.569mm for Curved, 0.504mm for truss, 0.574mm for flat, 0.574mm for inclined is less than 1. It's safe



3.10 Graphical presentation

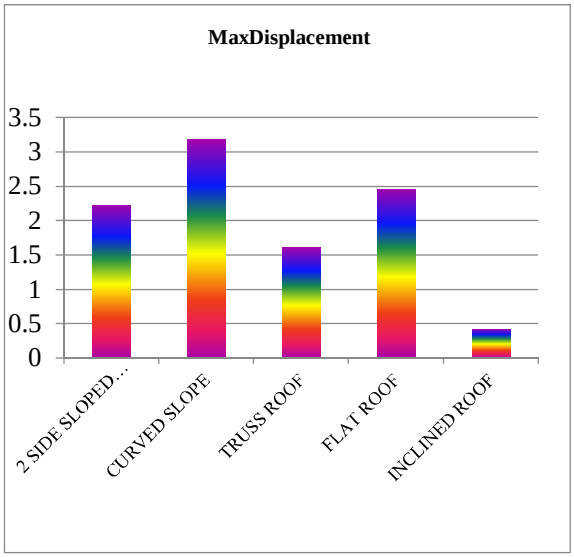
G. Maximum Displacement and Minimum Displacement

Types Of Roof With Out Bracings

Table 3.12

TYPES OF ROOF	Max Displacement
2 SIDE SLOPED ROOF(PEB)	2.233
CURVED SLOPE	3.181
TRUSS ROOF	1.614
FLAT ROOF	2.466
INCLINED ROOF	0.404

The maximum displacement without bracing is curved roof is 3.181mm & minimum displacement without bracing is inclined roof is 0.404mm



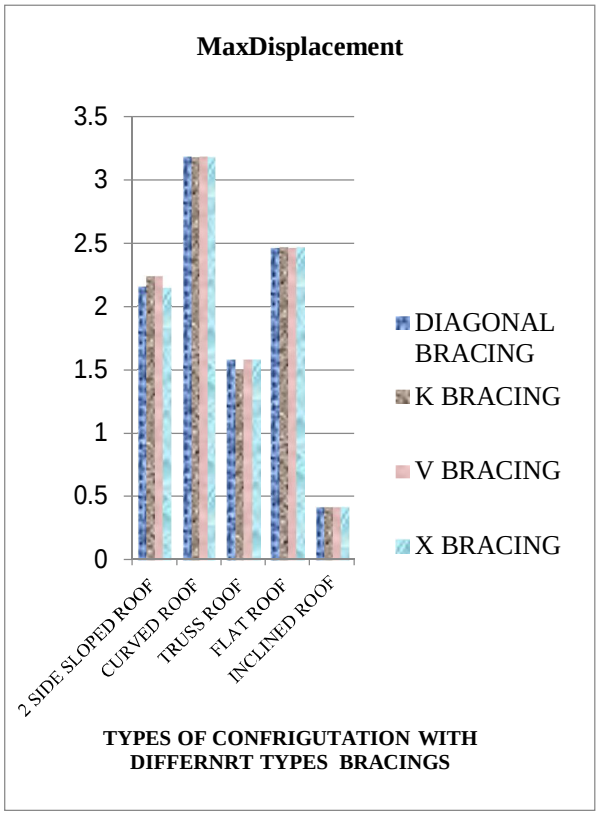
3.13 Graphical presentation

H. Types Of Configuration With Different Types Bracings

Table 3.15

TYPES OF BRACING	PEB ROOF	CURVED ROOF	TRUSS ROOF	FLAT ROOF	INCLINED ROOF
DIAGONAL BRACING	2.158	3.186	2	2.466	0.416
K BRACING	2.237	3.181	1.505	2.471	0.417
V BRACING	2.235	3.186	1.582	2.466	0.417
X BRACING	2.143	3.181	1.58	2.47	0.416

The maximum displacement with bracing is curved roof is 3.186mm & minimum displacement without bracing is inclined roof is 0.417mm



3.16 Graphical presentation

IV. CONCLUSION

After economic and technical analysis of the PEB, truss, inclined, curved, flat roof with span 30m and bay spacing 10m, when carried out wind analysis for the Vishakhapatnam zone.

1) It's been suggested that PEB with diagonal bracing gives the best suited result based on the economical feasibility.
2) When for a project if PEB is the preferred design then it is found that PEB with K-bracing comes out to be the best suited when economical.
3) The overall economic analysis shows that, PEB comes out to be economically less than truss, inclined, curved, flat roof.
4) Using of PEB instead of truss, inclined, curved, flat roof reduces the steel quantity.
5) The overall maximum displacement shows that, curved with Diagonal & X –Bracing comes out 3.186mm to be higher than truss, inclined, PEB, flat roof..

6) The overall maximum displacement shows that, curved without bracings come out 3.180mm to be higher than truss, inclined, PEB, flat roof.

7) Passing ratio of one selected beam is maximum 0.504mm for PEB, 0.569mm forCurved,0.504mmfor truss,0.574mmfor flat,0.574mm for inclined is less than 1 . It's safe .

8) Therefore, from above study we can conclude about the suitable types of industrial structure either PEB, truss, inclined, curved, flat roof when the span is 30m and with bay spacing 10m.

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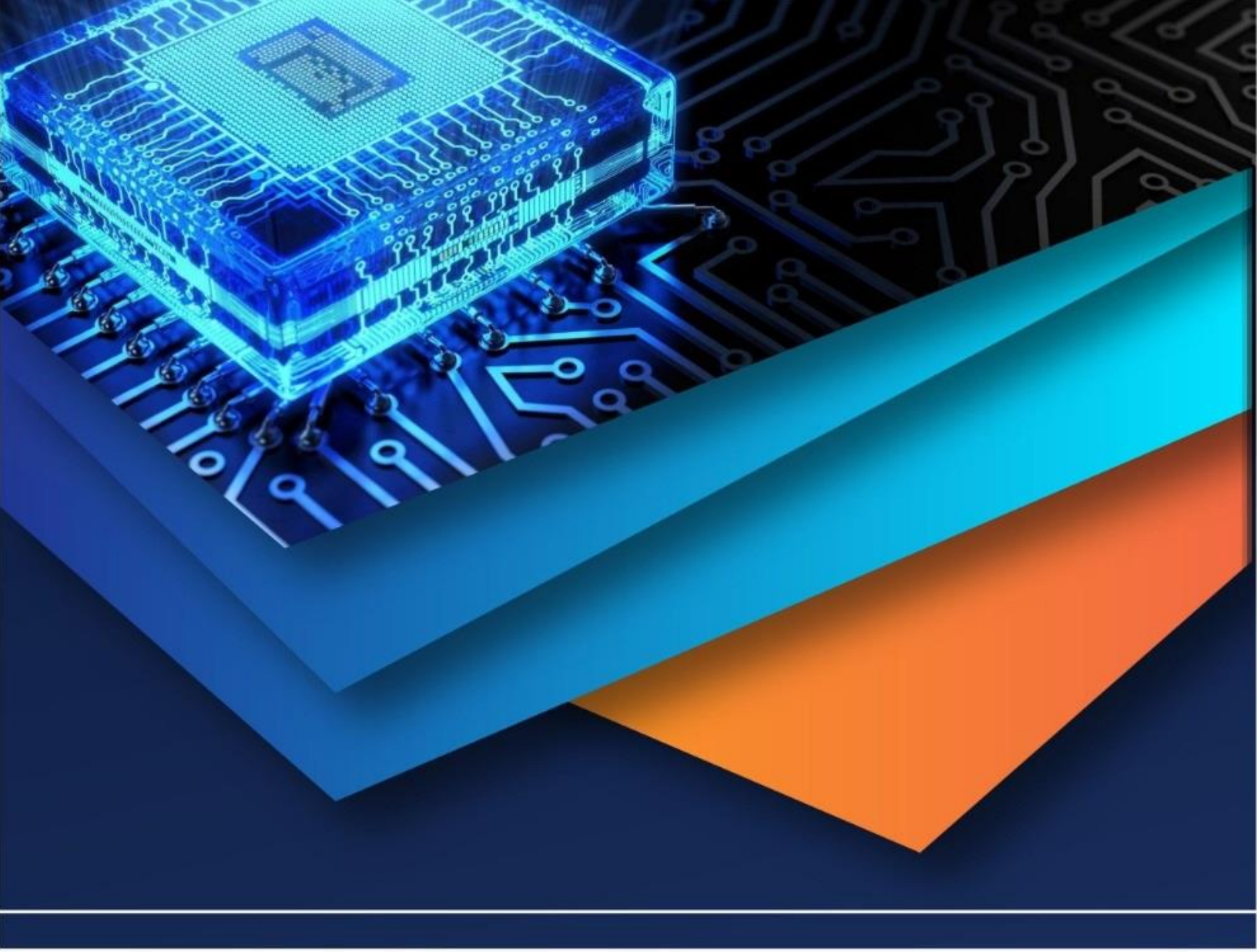
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