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Analytical study on north light roof truss with and without solar panel

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***Abstract*—For structural design to be satisfactory, generally four major constraints – utilities, safety, economic and elegance must be fulfilled. Industrial building are low rise structure characterized by their comparatively low height lack of interior floors, walls and partitions. A single storey or a single storey with mezzanine type of steel structure is most suitable. To enclosure of an industrial building may be brick masonry, concrete walls or G.I sheet covering, glazed roof covering.The walls are usually non bearing but these must be adequately strong to resist lateral forces due to wind or an earthquake.The present work is based on design of north light roof truss with and without solar panel with different intensity of wind speed are modelled and analysed using the software tool STAAD PRO V8i S55 and the load combination available in IS 800-2007 and steel table. The theoretical data are calculated using Indian Standard code IS 875-1975 (part III), using limit state method. The different bracings are provided and find out the effective bracing system for north light roof truss.**

I. INTRODUCTION

Steel building structures can be classified into shell structure and framed structures. A framed structure can further be classified as a single story structure and multi storey high-rise steel structure. Industrial buildings are low rise steel structures characterised by their comparatively low height and lack of interior floors, walls and partitions. Invariably, the roofing system for such buildings is truss with roof coverings. A single storey or a single storey with mezzanine type of steel steel structure is most suitable. To provide a free working space, the lockers, cabins, tool counter and rest rooms for the staff may be located on the mezzanine floor as they will not interfere with the production layout. Mezzanine floors are usually cast in situ slabs which rest on steel joints supported by girders of the building frame. Sometimes rolled floor plates 5-20mm thick are also provided. The enclosure of an industrial building may be brick masonry, concrete walls are G.I. sheet coverings. The walls are usually non-bearing but these must be adequately strong to resist lateral forces due to the wind or an earthquake. Some examples of such buildings are workshops, steel mills, machine plants, ware houses, hangars, etc... A truss is essentially a triangular system of straight interconnected structural elements. The most common use of trusses is in buildings, where support to roofs, floors and internal loadings such as services and suspended ceilings are readily provided. The main reasons for using trusses are Long span, Lightweight, Reduced deflection (compared to plain members), Opportunity to support considerable loads.

North light trusses are traditionally used for short spans in industrial workshop-type buildings. They allow maximum benefit to be gained from natural lighting by the use of glazing on the steeper pitch which generally faces north, facing north-east will reduce solar gain. On the steeper sloping portion of the truss, it is typical to have truss running perpendicular to the plane, to provide large column-free spaces.

The use of north lights to increase natural daylighting can reduce the operational carbon emissions of buildings although their impact should be explored using dynamic thermal modelling. Industrial buildings are low rise steel structures characterised by their comparatively low height and lack of interior floors, walls and partitions. Invariably, the roofing system for such buildings is truss with roof coverings. A single storey or a single storey with mezzanine type of steel structure is most suitable. Although north lights reduce the requirement for artificial lighting and can reduce the risk of overheating, by increasing the volume of the building they can also increase the demand for space heating. Further guidance is given in the War Target Zeroehouse buildings design guide

II .LOAD CALCULATION

Dead Load Calculation

Dead weight of GI sheet =300 N
Dead weight of purlin =100 N
Spacing of the truss =5 m
Total dead load on purlin =100x5
=500 Nm

Self weightof truss(W) =((span/3)+5)x10
=((30/3)+5)x10
=150 N/mm²
Weight of bracing =13N/m²
Panel length =3.3 m
Panel length in plan =3.3xcos 11.30
=3.23 m
Total dead load on each intermediate panel =
((300+150+13)x(5x2))+500
=7977.45 N
=7.97 kN
Load on end panel points of the raft =7.97/2
=3.985 KN

Live Load Calculation

Angle of the truss =11.30
Imposed load for 10 degree slope=0.75 Kn/m²
=750 N/m²
Live load =750-20(11.30-10)
=724 N/m²
load on intermediate panel=load x truss spacing x panel length in plan
=724x5x3.23
=11692.6 N/m²
=11.69 kN/m²
Load on end panel =11.69/2
=5.84 kN/m²

Wind Load Calculation

Design wind speed(Vz)=VbxK1xK2xK3
Assume the life of the industrial structure=50 years
Basic wind speed=39 m/sec
K1
For 50 yrs of building , for wind speed =30
K2
Consider no obstruction or few because
the structure loacatedouside city=1.03
K3
Assume it is plain ground level=1
So, design wind speed **(Vz)=**39x1x1x1.03x1
=31.93
Design wind pressure (Pz) =0.6xVzxVz
= 611.7 N/m²
= 0.61 Kn/m²
Wind load (F) = (Cpe-Cpi)xAxPz
Hence , height/width = 0.4

Truss angle	Wind angle	Cpi	Cpe	
11.30	0	0.7	-1.1	-0.4
		-0.7	-1.1	-0.4
	90	0.7	-0.7	-0.6
		-0.7	-0.7	-0.6

Wind ward side:
F1 =(-0.7-1.1)xPdxA
=17.73 kN (for end panel)
=17.73/2
=8.86Kn (For intermediate panel)

III DESIGN OF COMPRESSION MEMBER

FORCE: 653 KN
LENGTH : 3.49 m
SOLUTION
STEP1
let us assume the allowable compressive stress for strut member between 60-85 N/mm²
so that, the allowable compressive stress:70 N/mm²
Required C/S area: 653x10^3/70
: 9328.571 mm²
Effective length : 1.0Xl
: 1.0x1.6
: 1.6
STEP 2
choose the section ISA 200200
Thickness: 25mm
Area : 18760 mm²
Iz : 6872.6 x 10^4 mm4
Section modulus : 486.6x10^3 mm3
Radius of gyration: 60.5 mm
STEP 3
SLENDERNESS RATIO: (1.6x10^3)/60.5
26.44 < 250 For slenderness ratio 26.44, Fy 250 steel,
Table 5.1,IS 800,
Allowable compressive stress : 89
Allowable compressive stress calculated : (650x10^3)/18760
: 69.61
Allowable compressive stress > compressive stress calculated
So,
LOAD CARRYING CAPACITY
Load carrying capacity: compressive stress cal x area
: 89x18760
: 834.84 KN
Load carrying capacity > load acting on a member
HENCE SAFE

IV DESIGN OF TENSION MEMBER

Length of the member : 3.39 m
force : 1597.09 KN
solution
Axial force : 1597.09 kN
Effective length : 3.39 m
Assume the fy =250 N/mm2 for MILD STEEL,
Allowable tensile strength: 0.66x250: 165 N/mm²

STEP 1
CALCULATION OF NET AREA
NET AREA: LOAD/ALL. COMPRESSIVE STRESS

: (1597x10^3)/165
: 10647.28 mm²
STEP 2
CALCULATION OF GROSS AREA
Gross area: 1.4xnet effective area
: 1.4x10647.28
: 14906.19 mm²
Hence choose the appropriate section from the steel table,
ISMB 600
Area: 1226 cm²
Depth : 600 mm
Width of the flange: 210 mm
Thickness of the flange: 20.8 mm
Thickness of the web : 12 mm
Mom of inertia Ixx : 648936x10^4 mm4
Iyy : 1883.8x10^4 mm4
Radius of gyration Rxx : 22.16 mm
Ryy : 3.73 mm
STEP 3
CALCULATION OF NET EFFECTIVE AREA PROVIDED,
In case of I section connected through only flanges , the web found to be partially ineffective in resisting the applied load.
So,
Anet: Total area – (0.5xweb area)
NET EFFECTIVE AREA PROVIDED > NET EFFECTIVE AREA REQUIRED
1558750 mm2 > 14906.19 m
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STEP 4
LOAD CAPACITY
load capacity : (Net Areaxall compressive stress)
: 1558750x150
: 2338.1244 KN
2338.1244 > 1597.092
Load capacity > Axial force
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V RESULTS

Fig.1.Lateral Displacement of Different Bracing System Under Wind Intensity of 33m/S (Bangalore)

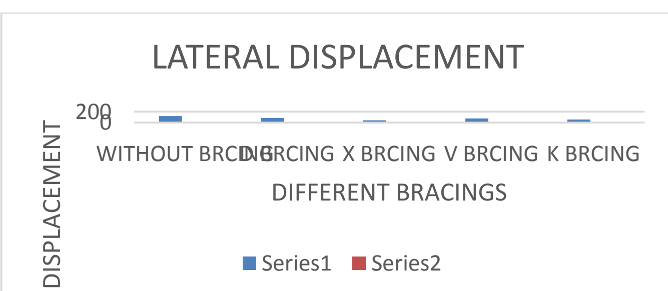

Fig.1.Lateral Displacement of Different Bracing System Under Wind Intensity of 39m/S (Coimbatore)

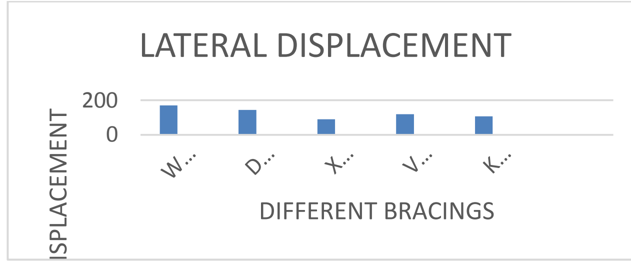

Fig.1.Lateral Displacement of Different Bracing System Under Wind Intensity of 50m/S (Chennai)

VI CONCLUSION

In this research work ,the design based on IS 800:2007 and the study is carried out to wind load code book IS 875 part 3 and analysis done by taking industrial structure with various bracing systems under different wind intensity. parameters such as mainly focused in this study is lateral displacement of the industrial structure with various bracing systems are compared,

The following are the conclusion obtained from this study,

- The industrial structure with bracing systems gives less lateral displacement compared to the industrial structure without bracing system under wind intensity is maximum.
- Hence provision of bracing system gives less lateral displacement in the industrial structure under wind load.
- By comparing the X bracing with without bracing systems used in industrial structure gives 47 % less lateral displacement under different wind intensity.
- By comparing the different types of bracing in this study X bracing gives less lateral displacement compared to the D bracing , K bracing, V bracing.
- By the provision of X Bracing 43.4 %, 22.1, 18.1 less lateral displacement compared to the D bracing, V bracing, K bracing with intensity of 33m/s.
- By the provision of X Bracing 37.7 %, 11.9%, 18.1% less lateral displacement compared to the D bracing V bracing , K bracing with intensity of 39m/s.
- By the provision of X Bracing 34.8% , 7.9%, 10.5 % less lateral displacement compared to the D bracing, V bracing, K bracing with intensity of 50m/s.

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REFERENCES

[1] Aijaz Ahmad Zende (2013) "Comparative Study of Analysis and Design of Pre-Engineered Buildingsand Conventional frames" IOSR Journal of Mechanical and Civil Engineering (2013) 2278-1684

[2] Anbuchezian .A, Dr. Baskar.G (2013) "Experimental study on cold formed steel purlin sections" Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol.3, No.2, April 2013 276

[3] Brice Schmits, Design Considerations for Parallel Chord One-Way Long-Span Steel Trusses in 2008 at B.S. Kansas State University.

[4] Jatin D. Thakar (2013) "Comparative Study of Pre-Engineered Steel Structure by Varying Width ofstructure" International Journal of Advanced Engineering Technology (2013) 0976-3945

[5] Joshua Heath, Economical Design Considerations for One-Way 300 Foot Span,Steel, Parallel Top & Bottom Chord Warren Trusses in 2012 at B.S. Kansas State University

[6] M. Meiyalagan , M.Anbarasu and Dr.S.Sukumar.(2010) "Investigation on Cold formed C section Long Column with Intermediate Stiffener & Corner Lips – Under Axial Compression." International journal of applied engineering research, dindigul , Volume 1, No1, 2010

[7] C. M. Meera (2013) "Pre-Engineered Building Design of an Industrial warehouse" InternationalJournal of engineering sciences & Emerging Technologies (2013) 2231-6604

[8] Sunil. M.Hardwani, A.V.Patil (2012) "Study, test and designing of cold formed Section as per AISI code." Int. Journal of Applied Sciences and Engineering Research Vol. 1, Issue 3, 2012.

[9] Sanchita.S.Nawale, Sangram Chalukya, and Dr.S.V.Admane "Comparative Analysis and Bending Behavior of Cold form Steel with Hot Rolled Steel Section." American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-03, Issue-05, pp-255261(2013)