Effect of Wind Load on Industrial Structure and Post Cyclone Important Structure as per IS 875(part 3):2015

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Abstract— The aim of the study is to analyse the " lean to roof " type steel truss according to IS 875(part 3):2015 in which cyclone impact factor K4 and area averaging factor Ka, directionality factor Kd , combination factor Kc area introduced. With the likelihood of increasing cyclonic conditions in coastal regions and exceeding of basic wind speeds during cyclone, Anew K4 factor is introduced to check the impact on industrial structures as well as post cyclone importance structures. In this paper an attempt is made to compare the methodology of wind load calculation as per IS 875(part3):1987 and IS 875(part3):2015 for industrial and post cyclonic importance structures. The analysis of steel roof truss is carried out in STAAD Pro software for 9m and 12m span considering roof slope 1 in 3, 1 in 4, and 1 in 5.

Key words: Truss, K4 Factor, Lean to Roof

I. INTRODUCTION

The wind direction factor K_d recognize that the fact of reduced the probability of maximum wind coming from any direction and reduced probability of the maximum pressure coefficient occurring for any given wind direction.

It is well recognized that the incoming wind become increasingly uncorrelated as the area considered increased. Such that, the reduced correlation is deemed to be accounted for introducing the area reduction factor Ka.

When taking wind loads on frames of clad buildings it is reasonable to assume that the pressures or suctions inside and outside the structure shall not be fully correlated. Therefore the combined effect of wind loads on the frame, a reduction factor of Kc (Combination factor) may be used over the building envelope when roof is subjected to pressure and internal pressure is suction, or vice-versa.

In this study, Analysis of lean to roof type steel truss has been carried out considering following parameters :

- Span of Trusses: 9m and 12m
- Spacing of Trusses: 4.5m
- Roof slopes: 1 in 3, 1 in 4 and 1 in 5.
- Permeability: Normal, Medium and High.
- Basic wind speeds (m/s) : 33
- Column height : 9m

II. METHODOLOGY

A. DEAD LOAD CALCULATION

The self-weight of roof truss is calculated by formula: ((span/3) +5)*10 N/m^2.
Weight of roofing sheet (AC, GI sheet) is taken 131 N/sq m. (as per IS – 875 (part 1): 1987.

B. LIVE LOAD CALCULATION

The design of live load should be done by IS: 875 (part 2): 1987.

$$\text{Live load} = 2/3 * (750\text{-}20(\alpha\text{-}10)) \quad \ldots. [1]$$

C. WIND LOAD CALCULATION are as per IS 875(part 3): 2015

$$V_z = V_b \times K_1 \times K_2 \times K_3 \times K_4 \quad \ldots. [2]$$

Where,
V_z = design wind speed at any height z in m/s
V_b is the basic wind speed for the zone.
K_1= probability factor/risk coefficient,
K_2= terrain roughness(Category2) and height factor varies according to the height of a structure,
K_3= topography factor and
K_4 = Importance factor for cyclonic region are adopted.
After finding the design wind speed, the pressure due to wind at that point is found out by the Eq

$$P_z = 0.6 \times Vz^2 \quad \ldots [3]$$

Here, P_z is the wind pressure at a height ''z", in N/sqm.
Then the design wind pressure (P_d) is computed with the Eq (3).

$$P_d = K_d \times K_a \times K_c \times P_z \quad \ldots [4]$$

Where,
P_d is the design wind pressure at a height ''z", in N/sqm.
K_d =wind directionality factor
K_a = area averaging factor,
K_c = combination factor
Then the Force F is calculated

$$F = (C_{pe}\text{-}C_{pi}) \times A \times P_d \quad \ldots..[5]$$

Where,
C_{pe}=external pressure coefficient.
C_{pi}=Internal pressure coefficient.
A= Area on which the lateral wind force acts.

III. ANALYSIS RESULTS

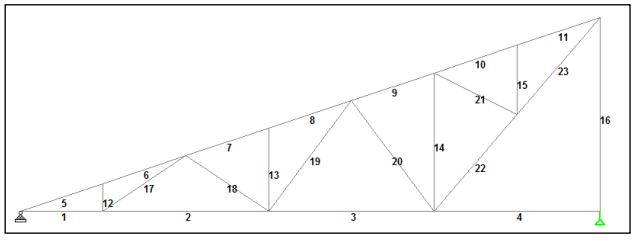


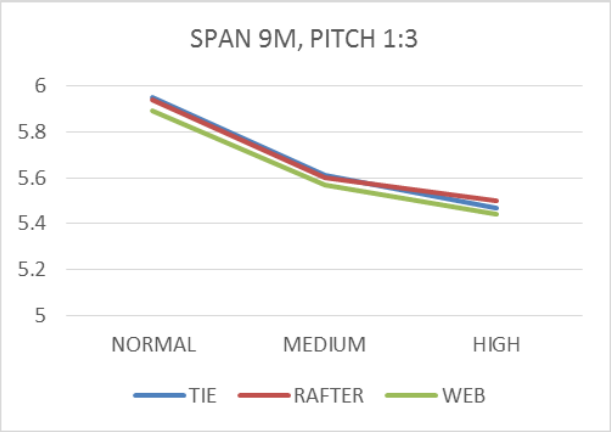
Fig. 1: Truss Configuration

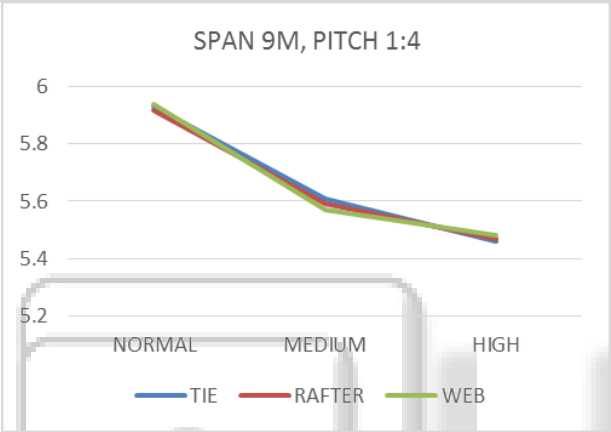
Variation in member forces of rafter, tie, and web, by considering wind load calculation as per IS 875: 1987 and IS 875: 2015 is found out by following formula:

$$\text{Percentage variation} = \frac{(\text{Axial force as per IS 875:2015}) - (\text{Axial force as per IS 875:1987})}{\text{Axial force as per IS 875:1987}} \times 100$$

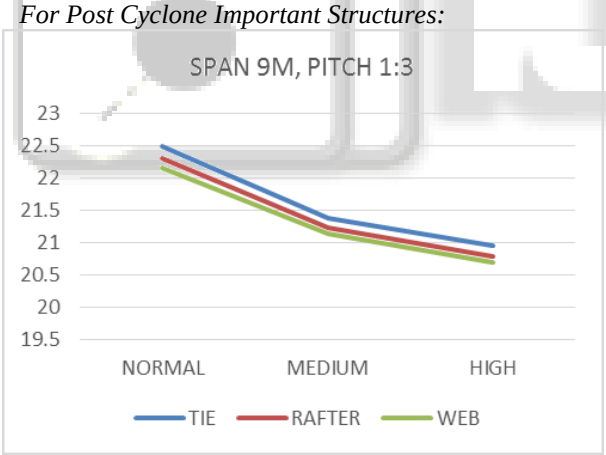
A. Variation in member forces for 9m span is as follows:

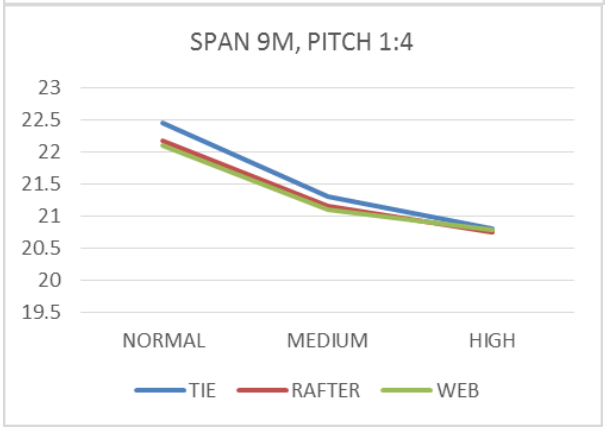
1) For Industrial structures:

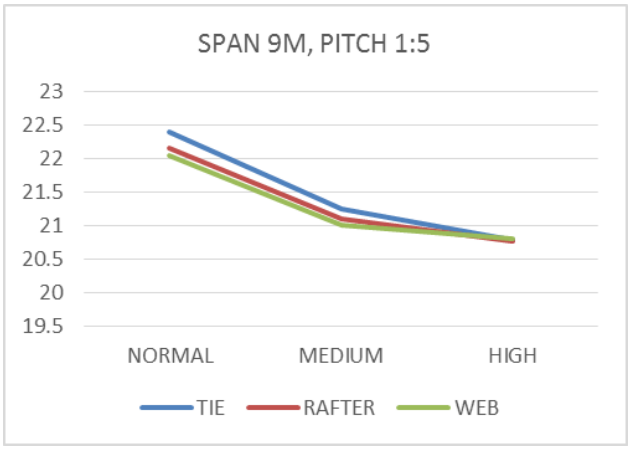




2) For Post Cyclone Important Structures:

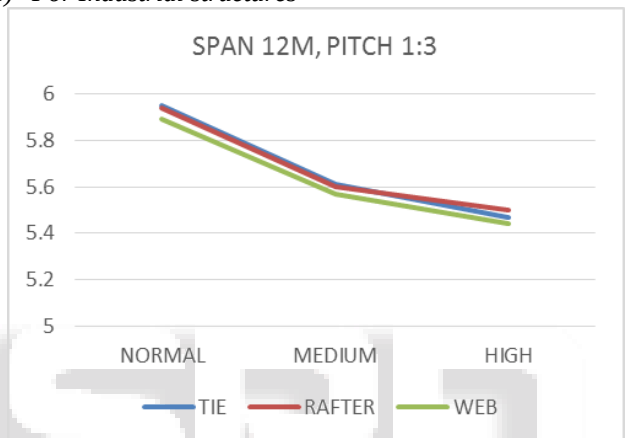


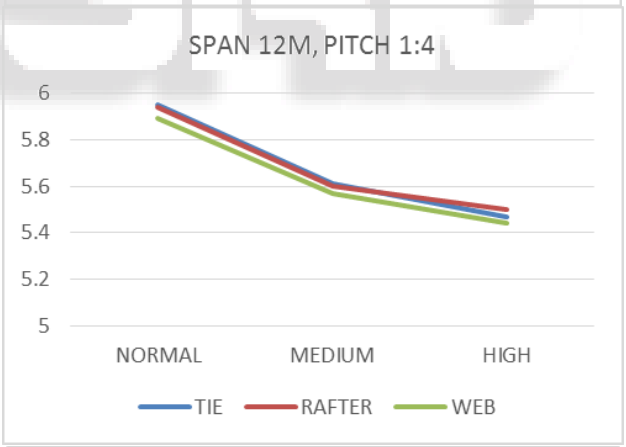


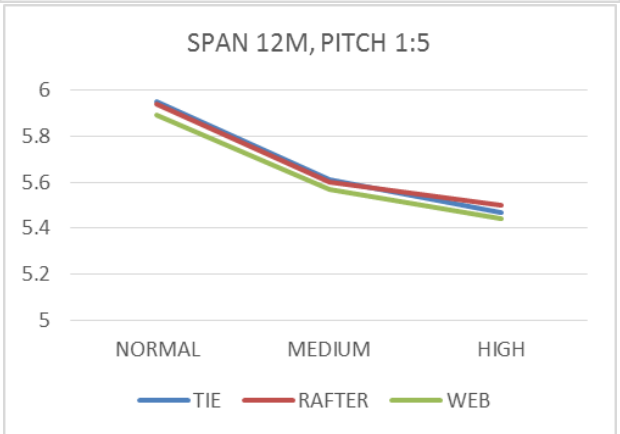


B. Variation in member forces for 12m span is as follows

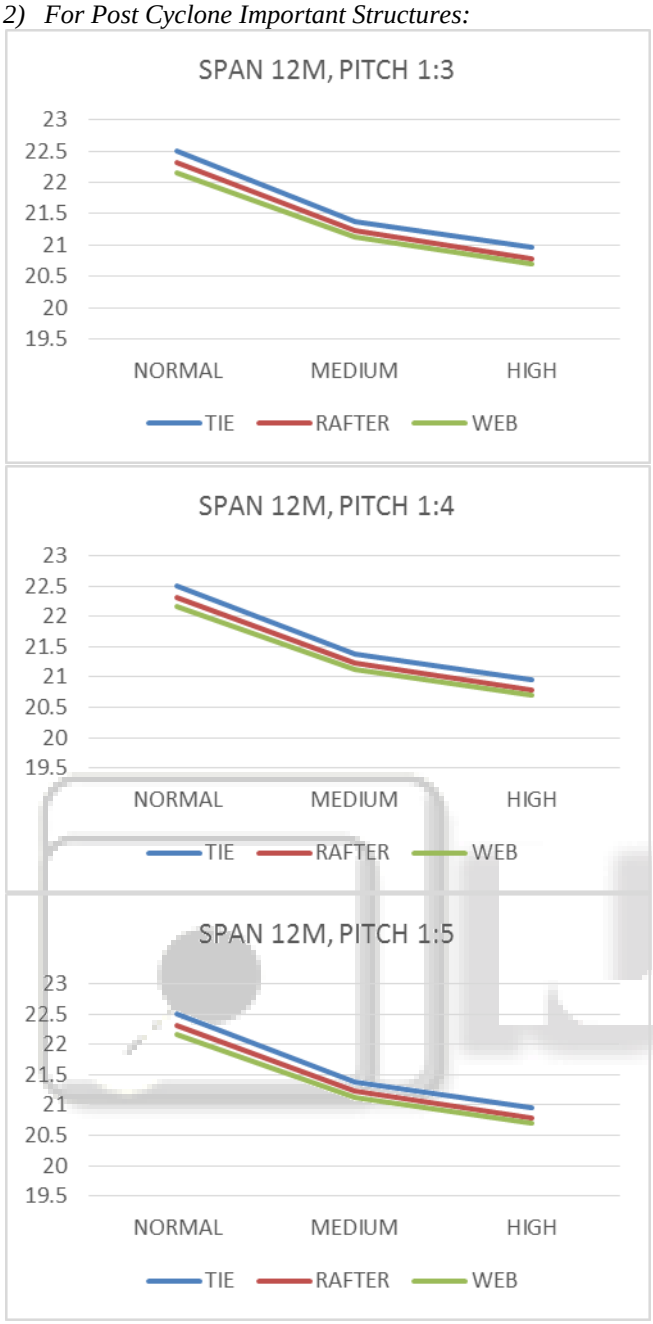
1) For Industrial structures







2) For Post Cyclone Important Structures:



IV. CONCLUSIONS

1) The variation in member force for industrial building is upto 6% and for post cyclone important building it is upto 20% according to IS 875: 2015.
2) The variation in the result is dependent on permeability condition.
3) With the increase in permeability condition variation decrease.
4) The variation in member forces is independent of span and pitch of truss.

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