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A Review study on the Design of Wind Screen Using Finite Element Approach

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Abstract - The reason of the present study is to get the result of wind screen screen/mesh supported by steel structures on the coal mining area. To evaluate the performance of the wind screen screen/mesh , is checked by performing analysis on STAAD Pro by providing wind speed data, gravity, seismic factors, steel loads . In this investigation it will be considered the worst wind speed on mesh and loads on the steel structures. Analysis results expected to show that when there is maximum wind pressure then there is chances of wear and tear to the wind mesh so reduction in height and increasing the steel structure depth can handle the wind speed. Variation can occurs when there is difference in heights. Therefore Comparison of the results will be present and STAAD Pro is used for construction and analysis.

Key Words: Steel Structure, Load, wind screen, mesh

1. INTRODUCTION

Lots of coal at NTPC Banadag Railway Siding, Hazaribagh (Jharkhand) have became threat to the nearby villagers and farmers. Hundreds of coal carrying trucks and hywa supply coal regularly between badkagon coal mining to banadag stockyard at banadag railway siding. Many deep bore wells has been also made for the sprinkling of water to stop the dust , but due to deep bore wells the local villages water level has been decreased.

Locals claims that the dirty water coming out of the coal cheap mostly in rainy season , flows directly into near by farm lands and due to this the agriculture is becoming worst and lands are also damaged. Apart from this a lot of farmers are migrating and are suffering from airborne disease due to constantly exposed to polluted water and air.

As per the guidelines of coal stock yard regular spraying of water, planting of trees along the boundary sides and at least 3meters boundary has to be provided and are being followed also , but after all this construction still the dust is spreading out of boundary. The villagers have demanded that NTPC authorities should take steps as soon as possible to stop the pollution. So for that Wind screen of 8 Meters height has been constructed and is effectively in use has minimized the air pollution. According to the speed of wind the wind screen has to be designed so that I should not fail. The wind speed has to be taken for the short term period. According to the speed of wind the material for the screen mesh has to be placed. The heavy steel sections will be provided for the screen mesh according to the analysis of wind speed and height of mesh, weight of mesh. Steel frames are usually the choice when constructing a larger building that needs a big open space because of the economical aspect and efficiency of building a single-storey unit.

The use of steel in the development structure has become a common practice, which determines the weight of the structural material, gravitational forces, compressive strength, the stability potential of the structure, and its architectural capabilities.

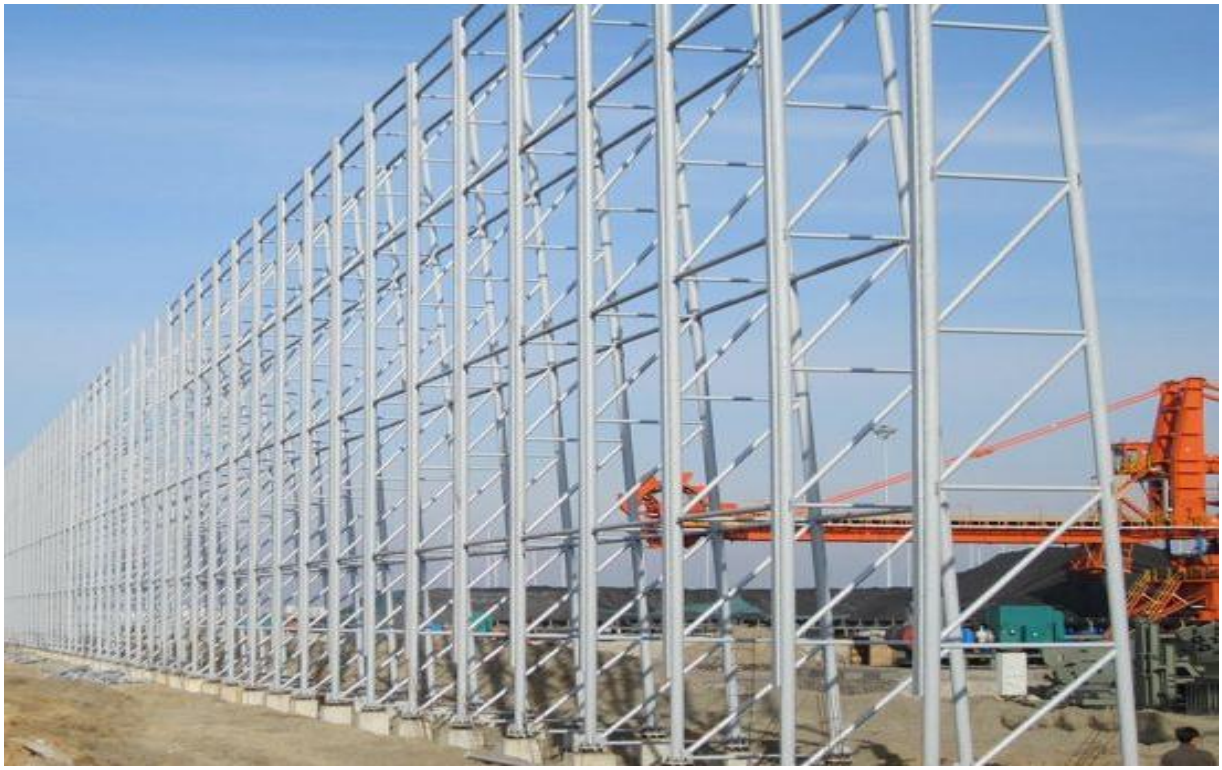

Figure 1: Wind screen frame

1.1 Wind Screen/Mesh: Windscreens are deflectors used to reduce wind speed. They redirect the wind in another direction. It usually consists of trees, shrubs, grasses and various types of fences or other materials. The environmental conditions behind the wind divisions known as the protected area become more effective as the wind speed is reduced by screens. When the wind blows at high speed against the screen, the pressure builds up on the windward side (windward side) and most of the air rises on or around the ends of the screen.

1.2 The effectiveness of the wind screen: The effectiveness of the screen depends on how it is designed. There are several criteria when considering the design of the screen. Parameters include: partition height, distance from coal yard, partition area density, partition length and direction. These parameters help to reduce the wind speed and change the weather conditions.

1.3The effect of density: Partition density is the term used for the ratio of the solid portion of the entire barrier to the total area of the barrier. When the wind blows through the open side, more winds will pass through it. If the screens are too dense, then low pressure will appear on the side of the screen. This low pressure area behind the windscreen pulls down the air that passes over the windshield, creating turbulence and reducing wind protection. As the density decreases, the amount of air passing through the screen increases, relieving the low pressure and turbulence and thus increasing the length of the sheltered area downstream of the wind.

The gaps in the windward areas turn into paths that concentrate the wind flow, creating areas on the windward side of the gap where the wind speed often exceeds the wind speed in the country. The effectiveness of the screen is lost if there are gaps.

1.4 The types of loads acting on the structure are:

Dead loads

Imposed loads

Wind loads

Seismic loads

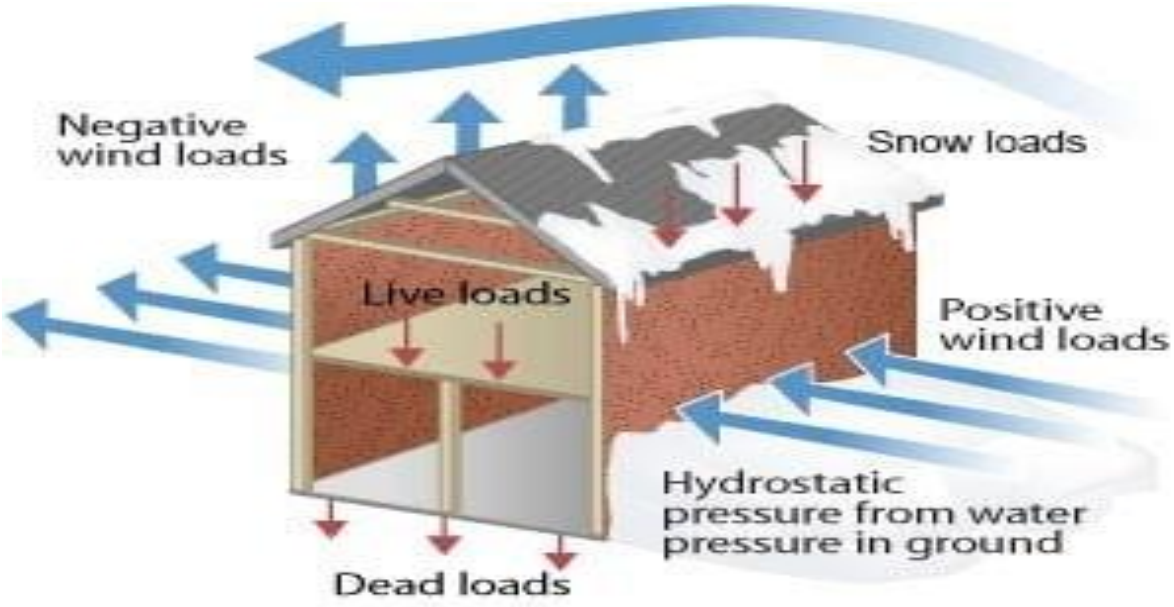

Figure 2: wind load directions

2. LITERATURE REVIEW

Renuka G M et al (2020)

- They have studied that by using optimal steel cross-section, the cost can be reduced.
- Shown that PEB is found to be more economical than CSB for low-rise construction. They inferred from their studies that CSB is approx 25.60 percent heavier than PEB and therefore 30 percent more economical than PEB.

Anuj Chandiwala et.al

- The authors research paper presented that In the structural design, corpses must be taken into account, imposed and wind loads and forces such as those caused by Earthquakes and the effects of shrinkage, creep and heat, etc., if necessary. There are different types of tasks that work On the dome, as permanent load (DL), direct load (LL) , seismic load (EQ), snow load, wind load (WL) and other tasks.
- Dome diameter was used as 20, 25, 30, 35, 40 and 45 m The size of the pipe sections was used according to the diameter 20, 25, 30, 35, 40, 45 as horizontal section 0.20, 0.15, 0.18, 0.20, 0.23, 0.25 m and for the vertical section 0.15, 0.14, 0.15, 0.18, 0.20 and 0.23 respectively. The plate thickness is 0.008m.

M.A.Dar, N.Subramanian et. al. 2017

- The structure studied in this article was complex the situation, because it was neither economical nor feasible Remove struggling farms and create new farms.
- Rehabilitation of hard-to-satisfy beams the requirement for solidity and functionality without large dimensions financial loss was the best solution complex problem.
- Truss was mostly tireless Suffered a severe loss of stiffness of 95.7% accompanied by Loss of strength of 17.17%. The pilot study indicated This only uses 5% more hardware (additional limbs support), the hardness of this truss has increased in difficulty by 126.35% and its load capacity by 97.94%.

Ajay Kumar, Rajeev Kumar et. al.

- The authors research paper presented, the various publications on the analysis of steel structures have been briefly discussed. After reviewing this previously published article, it can be concluded that the structure consisting of different steel sections is more stable. These steel structures can be effectively used for modern and fast urban construction works. Various modern steel partitions have proven to be the most economical and safest compared to traditional partitions.

Thomas Heaton et al. (2007)

- Simulation of the response of six- and twenty-story high-strength steel-framed buildings (US 1994 UBC) to ground motions (recorded during the 2003 Tokachi-Oki earthquake). The author considered that the building also had perfect welds and weak welds, which was observed during the Northridge earthquake in 1994. The 2003 Tokachi-oki could have caused large displacements between floors in a short time. flexible - heavy duty steel framed structures according to USA - designed 1994., University of British Columbia.

Joghataie and M. Takalloozadeh (2009)

- In their paper proposed a new penalty function which has superior affinity properties, as the combined external and internal penalty function does not have such superior properties. They used the new and old indoor and outdoor penalty function and the method of descending three columns and ten steep pillars, and then compared the results. It was concluded that the convergence rate and the accuracy of the result improved.

Pr Prashant Topalakati et al.

- In this paper Structural analysis with tall steel framing with and without sheet steel shear walls (SPSW) using STAAD PRO software. The main focus of the study was different thicknesses (6 mm to 18 mm) of shear walls made of steel plates. The parameters considered for the results were deformation, shear strength, bending moment, axial force. An equivalent static seismic analysis was performed according to IS 1893:2002.

Akshay Kunal W. Alabama. et al (2017)

- Presented that steel profile structures have always been the main choice of civil engineers for building on other types of structures. To date, there are a number of developments and achievements regarding steel structures. The development can be used effectively in the process of designing pressure elements in the design of various structural elements, such as axles, racks, gears and tires.

3. METHODOLOGY

The collection of wind speed at the coal yard data will be take for the prediction of coal dust flowing and maximum air flowing. The average wind speed will be taken from weather forecast. And the peak value will be taken into account and will be feeded on the software .Once the wind speed is determined then the material is chosen to resist the coal dust such as Agro-net of 90% GSM or light weight steel plates. And the load which will carry the wind mesh will be designed and determined by using software. Design and analysis will be done on different steel sections for carrying the load sufficiently. The last part will be analysis of all the parts including speed of wind. All the loads will be combined and analysis will be done till a economical and stable design is made.

Steps for the analysis:

Step-1: Selection of steel members and wind screen mesh .
Step-2: Assigning Sectional properties and members as per Steel Table.
Step-3: Assigning Support Condition
Step-4: Assigning load conditions:
Step-5: Analysis of structure

4. MODELING AND ANALYSIS

The following methods are used for the analysis of industrial buildings:
1. Equivalent Static Load Analysis Method (ESLA)
2. Response Spectrum Analysis (RSA)
3. Time-Date Analysis (THA)

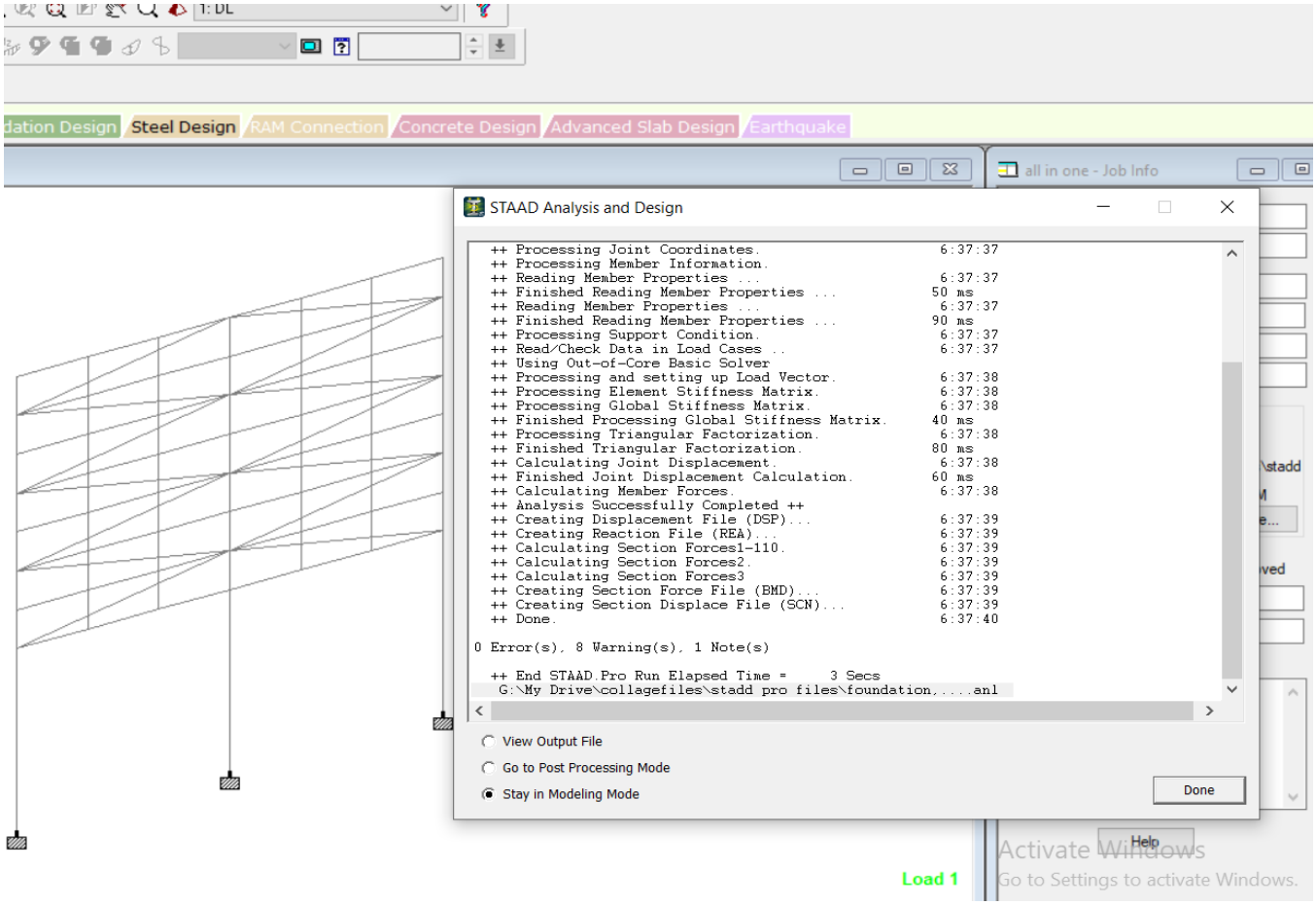

Figure 3: Analysis report of Industrial ware house

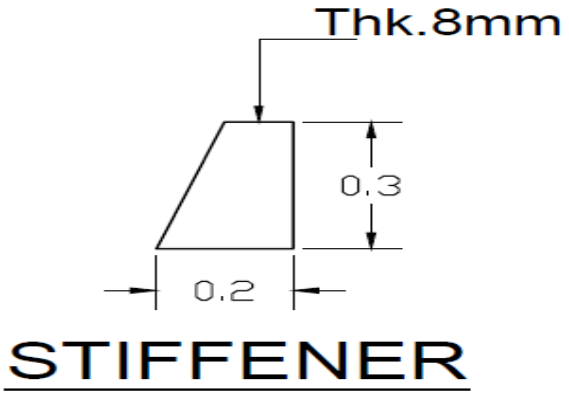

Figure 4: Stiffeners details

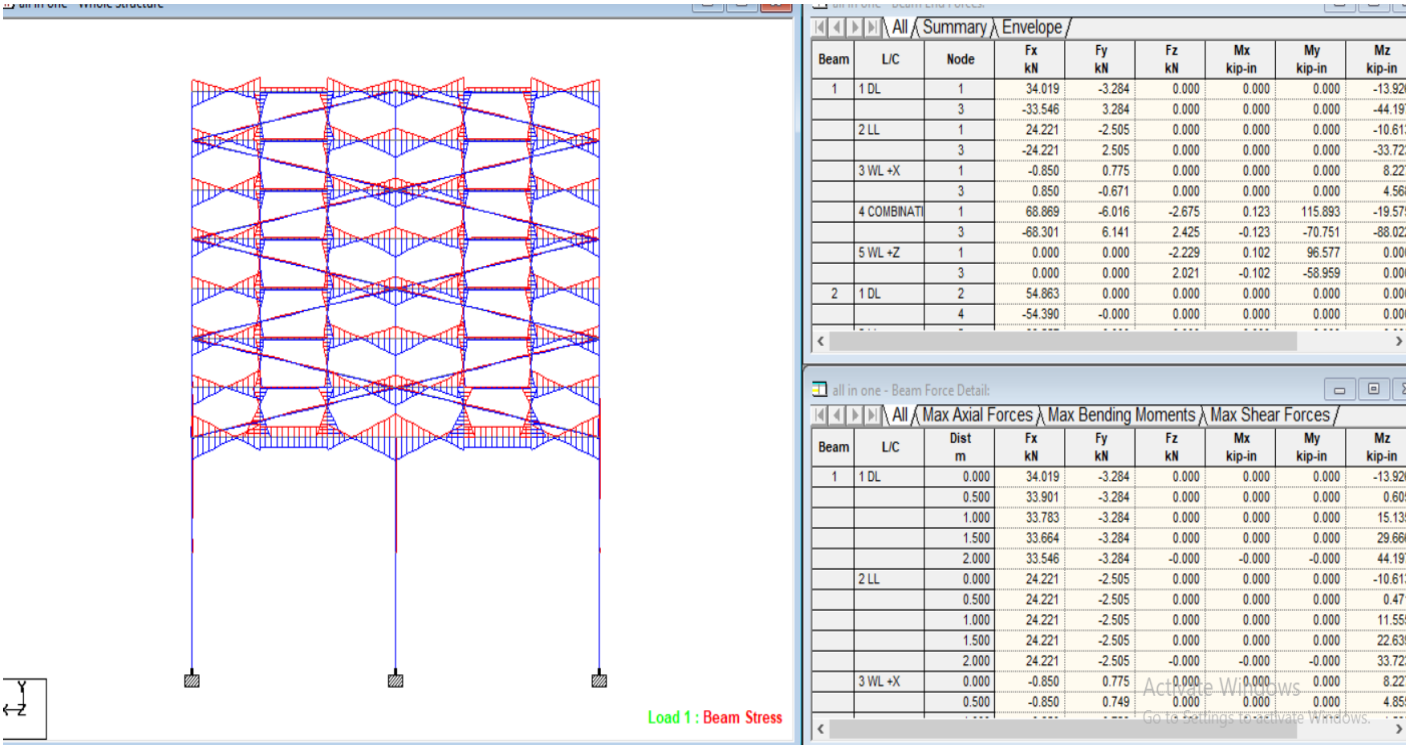

Figure 5: Beam stresses

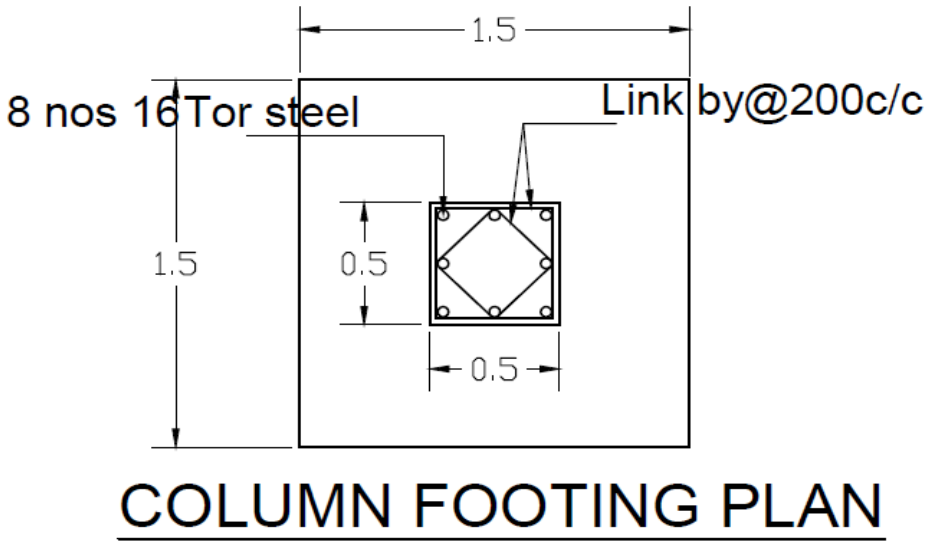

Figure 6:Column Footing details

5. CONCLUSION

- This project involved the analysis and design of wind breaks. Manual calculation, design and analysis of steel wind shield components using Staad Pro and autocaed software. This project is designed with a width of 4.5 meters and a length of 8 meters (height).
- Designing steel components using solution equations is complex and time consuming, so to save time, computer software should be used to design and process analyze these types of trusses and this software takes input from truss design and takes them. Perform calculations easily and quickly to save time and ensure design integrity.

- Straight elements were used at the beginning and at the end connected by triangles formed by positional welds, and this element is affected by the compression or tension force, at approximately the same time that the same average torque is excluded in the reinforcements, assuming that each joint in the armor there is a pin.

- This project deals with two design criteria (by manual calculation and by staad pro) in Staad pro two designs were used first by checking the adequacy of the selected section and second by the lightest weight design. There was a difference between all the design parameters depending on the section area which gives a different section.

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