"STUDY OF PRE-ENGINEERED BUILDING"

Nitin K. Dewani[1], Sanjay Bhadke[2]

[1](Mtech Scholar) 2nd year Tulsiramji Gaikwad-Patil college of Engineering and Technology, Nagpur, Maharashtra
[2]Professor,Dept of Civil Engineering, Tulsiramji Gaikwad-Patil college and Technology, Nagpur, Maharashtra.

Abstract - *Pre Engineered Building (PEB) concept in the design of structures has helped in optimizing design. Steel is the basic material that is used in the Materials that are used for Pre-engineered steel building. The latest version of the Code of Practice for general construction in steel IS 800:2007 is based on Limit State Method of design . The adoptability of PEB in the place of Conventional Steel Building (CSB) design concept resulted in many advantages, including economy and easier fabrication. Long Span, Column free structures are the most essential in any type of industrial structures and Pre Engineered Buildings (PEB) fulfills this requirement along with reduced time and cost as compared to conventional structures. PEB methodology is versatile not only due to its quality pre-designing and prefabrication, but also due to its light weight and economical construction. In this study, an industrial structure (Ware House) is analyzed and designed according to the Indian standard, IS 800-2007. The study of Pre Engineering Building with Conventional Steel Building has been carried out and the observations made based on this study are very much useful to the practicing structural engineers*

1. INTRODUCTION

The design of industrial building is governed mainly by functional requirements and the need for economy of construction. In cross-sections these buildings will range from single or multibay structures of larger span when intended for use as warehouses or aircraft hangers to smaller span buildings as required for factories, assembly plants, maintenance facilities, packing plants etc. The main dimensions will nearly always be dictated by the particular operational activities involved, but the structural designer's input on optimum spans and the selection of suitable cross-sections profile can have an important bearing on achieving overall economy. An aspect where the structural designer can make a more direct contribution is in lengthwise dimensions i.e. the bay lengths of the building. Here a balance must be struck between larger bays involving fewer, heavier main components such as columns, trusses, purlins, crane beams, etc. and smaller bays with a large number of these items at lower unit mass.

2. Planning For Pre-Engineered Building for Industrial Purpose

The planning of an Industrial building is based on functional requirements i.e. on the operations to be performed inside the building. In the planning of an Industrial building, due consideration should be given to factors such as wide area of primary frames, large height, large doors and openings, large span of primary frames , consistent to give minimum weight of primary frames, purlins, girts , eave struts etc. and lighting and sanitary arrangement. The site for a proposed plant is in general, pre-selected before it comes for design. But it is better to discuss with the designer the preliminary plans in advance. This gives the designer an opportunity to choose a suitable site giving due consideration to future developments. Some of the factors governing the site selection are as listed below:

1. The site should be located on an arterial road.

2. Facilities like water, electricity, telephone, etc.

3. Topography and water drainage.

4. Soil condition with reference to foundation design.

5. Sufficient space should be available for storage of raw materials and finished products.

6. Sufficient space should be available for transportation facilities to deliver raw materials and collect the finished products.

7. Water disposal facilities.

2.1 Primary Pre-engineered frame

Assuming that a Pre-engineered building system is selected for the project at hand, the next milestone is choosing among the available types of Pre-engineered primary frame. Proper selection of the primary framing, the backbone of Pre-engineered buildings, goes a long way toward a successful implementation of the design steps to follow. Some of the factors that influence the choice of main framing include:

• Dimensions of the building: width, length, and height.

• Roof slope.

• Required column-free clear spans. 20

• Occupancy of the building and acceptability of exposed steel columns.

• Proposed roof and wall materials.

At present five basic types of pre-engineered frame are currently in the market:

• Tapered beam.

• Single-span rigid frame.

• Multi-span rigid frame.

• Lean-to frame.

• Single span and continuous trusses.

"Frame width" is measured between the outside surfaces of girts and eave struts. "Clear span" is the distance between the inside faces of the columns. "Eave height" is measured between the bottom of the column base plate and eave strut. "Clear height" is the distance between the floor and the lowest point of the structure.

2.2 Secondary framing

Secondary structural members span the distance between the primary building frames of the Pre-engineered building systems. They play a complex role that extends beyond supporting roof and wall covering and carrying exterior loads to the main frame. Secondary structural, as these members are sometimes called, may serve as flange bracing for primary framing and may function as a part of the building's lateral load-resisting system. Roof secondary members, known as purlins, often form an essential part of horizontal roof diaphragms; wall secondary members, known as girts are frequently found in wall bracing assemblies. A third type of secondary framing, known by the names of eave strut, eave purlin, or eave girt, acts as part purlin and part girt its top flange supports roof panels, its web, wall siding. Girts, purlins, and eave struts exhibit similar structural behavior.

Figure3.1 - Sections used for purlin, girts and eave strut

2.3 Metal roofing

Structurally, roof covering may resist wind and live loads and may serve as bracing for roof purlins.

The various seam configurations used for roofing panels are described as follows:

1. Lapped seam.

2. Flat seam.

3. Batten seam.

4. Vertical seam.

Figure3.3- Majorly used Trapezoidal profiled sheeting

3. LITERATURE REVIEWS

3.1. D.Duthinh; J.A.Main; A.P.Wright & E.Simiu;

This paper presents a methodology for estimating the mean recurrence interval of failure under Wind loads that accounts for non-linear structural behavior and the directionality of the Wind speeds and the aerodynamic affects, and uses databases of Wind tunnel test results as well as Wind speed data from the NIST hurricane Wind speed database augmented by statistical methods. Under the assumption that uncertainties with respect to the parameters governing wind loading and material performance are negligible, our methodology results in a notional probability of failure during a 50-year period of the order of 1/2,000. This result was obtained for one particular low-rise steel structure at one particular location, but the method is general and can be applied to any structure anywhere provided the relevant meteorological and Wind tunnel data exist and non-linear finite element analysis is accessible. As different structures fail by different mechanisms, good engineering judgment is required to identify potential critical load cases and to limit non-linear analysis to a manageable number of cases.

3.2 D.Mahaarachi, M.Mahendran

This paper described an advance finite element model that accurately predicts the true behaviour of Crest-fixed steel claddings under Wind uplift. The results from the FEA and experiments agreed well for the trapezoidal steel claddings with wide pans used in this investigation. This demonstrates that non-linear finite element analysis can be used with confidence to carry out extensive parametric studies into the structural behaviour of profiled steel claddings, which undergo local pull-through failures associated with splitting or local dimpling failures. Once the use of finite element analysis to determine the most important pull-through failure load was validated using large scale two-span experiments, it was used to investigate the behaviour of trapezoidal steel claddings with varying geometry and material properties. Based on these FEA, improved design formulae have been developed for the local failures of trapezoidal steel claddings with wide pans. This paper has also discussed the disadvantages of using the Conventional one rib FEA model for multispan steel Cladding assemblies.

3.3 Dale C. Perry; James R. McDonald and Herbert S. Saffir

During the past decade the engineered metal building has emerged as a competitive form of low-rise construction. The structural performance of these buildings is well understood and, for the most part, adequate code provisions are currently in place to ensure satisfactory behavior in high winds. It would be comforting if more full-scale measurements on buildings were available to corroborate wind tunnel data on which the code provisions are based-but this will come. While recently an improvement in field performance has been noted, the additional steps alluded toin this paper should be implemented in order to protect fives and reduce wind damage to a minimum.

2.4 Dat Duthinh & William P. Fritz

This paper presented an improved version of the Non-linear data assisted technique method for estimating ultimate capacity under wind loads. The paper also showed how NLDAD can be used to substantially increase the safety level of the frame under wind loads with only modest or no increase in material consumption or save material & energy embodied there in while maintaining wind resisting capacity. The method consists of using databases of pressures measured in wind tunnel tests and applying these pressures in non-linear structural analysis.

2.5 Timothy Wayne Mays

The purpose of this study is to show that elastic design of metal building systems for seismic forces is a feasible, economical and safe alternative to inelastic design and detailing. Even if the structural system is excited by an earthquake of a magnitude greater than the design earthquake only a small amount of inelastic deformation if any will occur.

3. CONCLUSION

By increasing the area of Industrial building material and cost of the building is minimized in case of PEIB while in case of Convention building the material and cost is not optimized if we increase the area of building.

REFERENCES

[1] L.S.Negi "Design of steel structures" by Tata Mc graw hill.

[2] Dr.B.C.Punmia, Ashok Jain, Arun Kumar Jain "Design of steel structures" by Laxmi publications.

[3] Insdag publications "Design handbook for cold-formed steel sections-part1: section properties.

[4] Insdag publications "Design guidebook for portal type pre-engineered building.

[5] Alexander Newman "Metal buildings systems" Mc graw hill.

[6] SP: 38(S&T)-1987 "Bureau of Indian standards".

[7] s I.S.800:1984 "Indian standard code of practice for general construction in steel" (Second revision)