COMPARISON BETWEEN HINGE AND FIXED SUPPORT IN PRE-ENGINEERED BUILDING

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Abstract-

Pre-Engineered building concept is a new conception of single story industrial building construction. This methodology is versatile not only due to its quality pre-design and prefabrication, but also due to its light weight and economical construction. The concept includes the technique of providing the best possible section according to the optimum requirement. This project is a comparative study of PEB concept with different support (i.e pinned and fixed). The study is achieved by designing a typical frame of proposed Industrial building using design software STAAD.Pro

In the present study PEB frame are analysed and designed for different supports condition using STAAD-pro. PEB building layout of length 60m and differents span widths is 10m, 20m, 30m. Bay length is maintained 6m along the length. The height (H) to Width (W) ratio varied i.e H/W= 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7 etc for each span. Slope of pitch is constant for every span and height to width ratio is 50. Purling spacing is also constant for all span Load calculation are carried out from IS code and applied it on model created on STAAD-pro and some hand calculation is done to verify the result obtained by STADD-pro.

Key Words:

Pre-Engineered Building , Hinge Support,Fixed Support,Spans 10m ,20m,30m, Staad.Pro

1.INTRODUCTION

Steel industry is growing rapidly in all over the world. The use of steel structures is not only economical but also eco friendly at the time when there is a threat of global warming. Here, "economical" word is stated considering time and cost.

Steel is material which has high strength per unit area. Hence it is used in construction of structures with large column-free space. Most of the industrial structures require this criterion. The industrial structures enclosures may be brick masonry, concrete wall or GI sheet coverings. The wall generally non bearing but sufficiently strong enough to withstand lateral force caused due to wind and earthquake. The design of industrial building including of structural frame, column base, foundation, purloins, sag road, tie road, gantry girder, bracing, connection of member etc. A combination of standard hot-rolled section, cooled form section, profiled sheet, steel rod etc. are used for the construction of industrial structures.

1.1 Steel building:

Now day's steel is widely used for industrial building because steel is inherently ductile and flexible. Structural steel low cost, strength, durability, design flexibility adaptability and recyclability continue to make it the material of choice in building construction. Today structural steel framing is bring is brining grace, art and function together in almost limitless ways and is offering new solutions and opportunities to create challenging structures, which were once thought impossible. Steel structure has reserve strength. Simple stick design in the steel framings allows construction to proceed rapidly from the start of erection. When we choose steel structure for any fast track construction project, two options are available:

1 Conventional steel building

2 Pre-engineered building

1.1.1 Conventional steel building

For large pitch, Fink type truss can be used; for medium pitch, Pratt type truss can be used and for small pitch, Howe type truss can be used. Skylight can be provided for day lighting and for more day lighting, quadrangular type truss can be used. The selection criterion of roof truss also includes the slope of the roof, fabrication and transportation methods, aesthetics, climatic conditions, etc.

1.1.2 Pre- engineered building

Pre engineered buildings (PEB) are nothing but steel buildings in which excess steel is avoided by tapering the sections as per the bending moment's requirement. Saving of material on low stress area of the primary framing members makes PEB more economical than CSB especially for low rise buildings spanning up to 60 m with eave heights up to 30 m.

Generally in PEB building pinned support are used. Bending moment at support is shown in fig 1.1 bending moment at support is zero hence there is stress concentration is minimum hence there section modulus is also required minimum. At eves level rigid connection is provided hence their bending moment concentration is maximum and section modulus required is maximum. In fixed support frame at support some moment is occurred as shown in fig. 1.2 due to this moment constant cross section is required

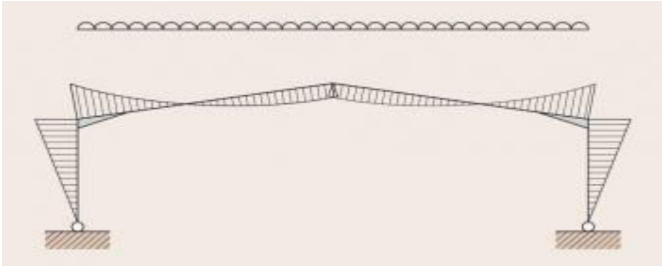

Fig. . 1.1 Bending moment diagram for hinged support

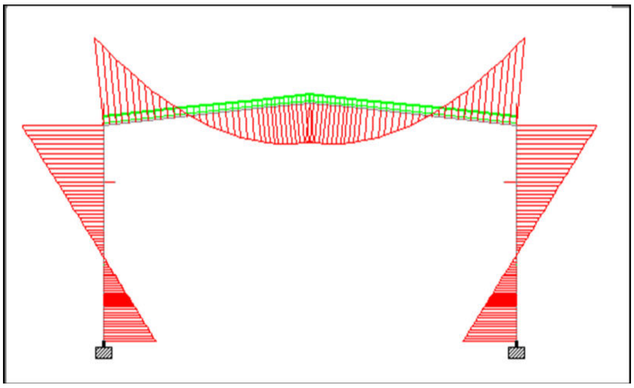

Fig.1.2 Bending moment diagram for fixed support

1. 2 Objectives:

1. To determine the quantity of R.C.C for pinned support and fixed support for different spans and H/W ratios.
2. Overall cost comparison of pinned support and fixed support for different spans and H/W ratios.
3. To determine up to which H/W ratios pinned support and fixed support is economical.
4. Validation to STADD-pro result with manual design is done.

2. SYSTEM DEVELOPMENT

In the present study PEB frame are analysed and designed for different support condition using STAAD-pro.

PEB building layout of length 60m and different spans widths is 10m, 20m, 30m. Bay length is maintained 6m along the length. The height (H) to Width (W) ratio varied i.e H/W= 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7 etc for each span. Slope of pitch is constant for every span and height to width ratio is 50. In fig 3.1 shown each parameter. Purling spacing is also constant for all span. Load calculation are carried out from IS code and applied it on model created on STAAD-pro. Procedure of STAAD-pro analysis is shown in fig. 4.5 and some hand calculation is done to verify the result obtained by STADD-pro.

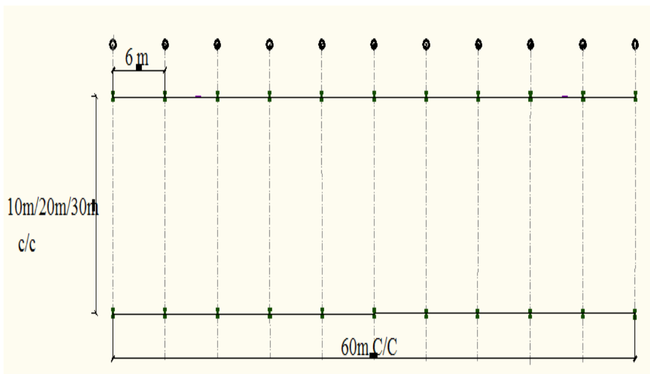

Fig 3.1. Building Plan

2.1 Specification of Design loads.

All dead load, Live load, Wind load will be conforming to IS: 875-1987 and design will be conforming to IS: 800-2007.

2.2 Dead load calculation of all spans.

Dead load (Including sheeting and purlin) = 0.1 kn/m2

Dead load on roof = 0.1 x bay spacing

= 0.1 x 6 = 0.6 kN/m

2.3 Live load calculation of all spans.

Imposed load = 0.75 kN/m2

Let us assume that no access is provided to the roof the live load is reduced by 20N/M2 for each one degree above 100 slope (As per IS 875-II) [8]

Live load = 0.75 kN/m2

Live load on roof = 0.75 x 6 = 4.54 kN/m.

3 .SAMPLE DESIGN CALCULATION

Configuration of building:

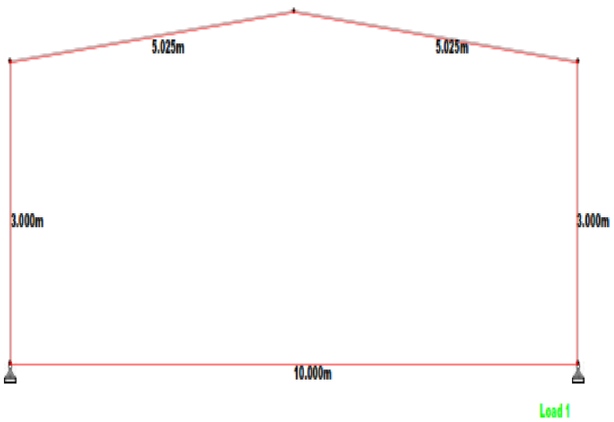

Fig.3.1 Elevation of 10 m span frame

Analysis of frame.

1 Wind load at 0º for +0.2 internal pressure (Cpi) and left sight of structure is consider as wind ward side.

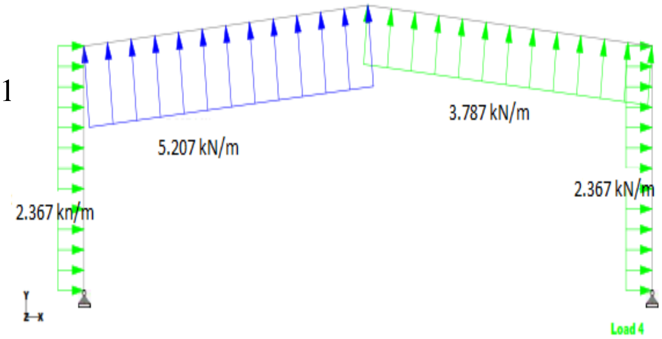

Fig 3.2: Wind load @0º for(Cpi =+0.2) Left side wind ward

2. Wind load at 0º for +0.2 internal pressure (Cpi) and right sight of structure is consider as wind ward side.

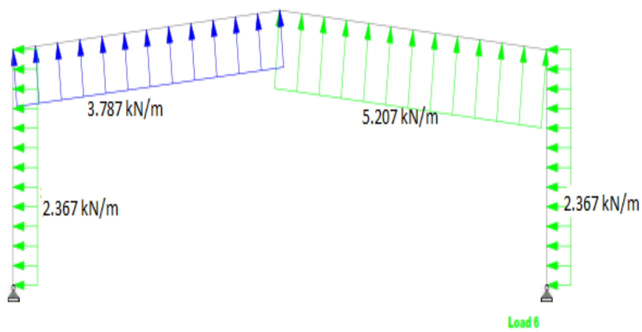

Fig 3.3 : Wind load @0º for(Cpi =+0.2) right side wind ward

3. Wind load at 0º for -0.2 internal pressure (Cpi) and left sight of structure is consider as wind ward side.

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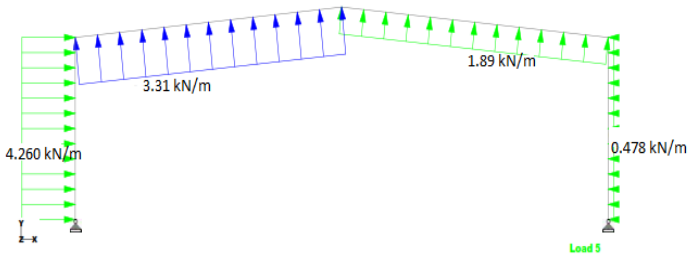

Fig 3.4 : Wind load @0º for(Cpi =-0.2) left side wind ward

4 Wind load at 0º for -0.2 internal pressure (Cpi) and right sight of structure is consider as wind ward side.

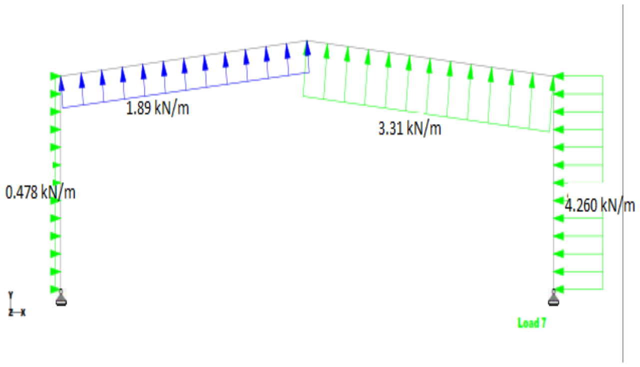

Fig 3.5 : Wind load @0º for(Cpi =-0.2) Right side wind ward

4. Conclusion:

In the present work an attempt is made to optimize the quantity of steel in PEB one storey gable industrial shed with pinned and fixed supports. Based on the analytical and design result the following conclusions are drawn.

- The total steel take off difference is negligible for pinned and fixed support up to 0.45 H/W ratio.
- Pinned support take 15% more steel than fixed support beyond 0.45 H/W ratio.
- For 10m span total quantity of R.C.C work required for fixed support is up to 3% less than pinned support.
- For 20m span total quantity of R.C.C work required for pinned support is up to 15% less than fixed support
- For 20m span total quantity of R.C.C work required for pinned support is up to 15% less than fixed support
- Result of STAAD-pro and manual design calculation is almost same.

Future scope:

- The present study is related to single story industrial steel building using PEB concept. So there is large scope for further study in future.
- Earthquake Analysis can be performed on the structure.

- Analysis and design of connection should be carried out.

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IS Codes:

[6]IS : 875 (Part 1) - 1987- Code of Practice for Design Loads (Other Than Earthquake) for Building and Structures- Dead Loads.

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