"COMPARATIVE STUDY OF DIFFERENT BRACING PATTERN FOR INDUSTRIAL SHED STRUCTURE AT DIFFERENT LOCATION"

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Abstract: Now a day, Bracings in steel structure are commonly used because it can withstand lateral loads due to earthquake, wind as well as minimizes effect of temperature. It is one of the best methods for lateral load resisting systems. This system provided to minimize the lateral deflection of structure. In this thesis industrial shed is analysed for the rectangular plan of 48mx16 m by considering Zone-VI for soil type-Medium.

The analyse were done by using the STAAD PRO software. In this Study models are compared for different types of bracing such as X, A, and diagonal bracing by placing in different locations like Outer Edge, Inner Edge and at centre in X and Z-directions for the bracing. Results are obtained by considering the parameters like storey displacement, storey deflection and storey shear.

Key words:- STAAD PRO, Displacement Storey Shear, Diagonal Bracing.

1. Basic Information:

A shed is typically a simple, single-story roofed structure that is used for storage, workshop. Structural shed used in industries to store raw materials or for product manufacturing, known as industrial Sheds. These industrial sheds are used for warehouse, factories, godowns, workshops, storage plants etc. Industrial sheds can be small or big in size depending on the requirement.

Wind load is the main load effect in the design of industrial buildings, even in low wind areas. It is therefore important to carefully evaluate wind loads. Usually, the end spans are the critical area of wind design. This is because the end spans not only have higher bending moments and higher deflections for a given uniform loads, but also higher loads because external suctions including load pressure effects are highest at the windward end under longitudinal winds.

As steel bracing is economical, easy to set up, occupies minimum space and also have flexibility in nature to design for meeting the required strength and stiffness. Braced framed structures are usually considered to resist the lateral forces (Wind and earthquake loads). Braced system provides due to their strength, stiffness to the structures. They provide more stiffness against the horizontal shear because the diagonal member elements work in axial stress.

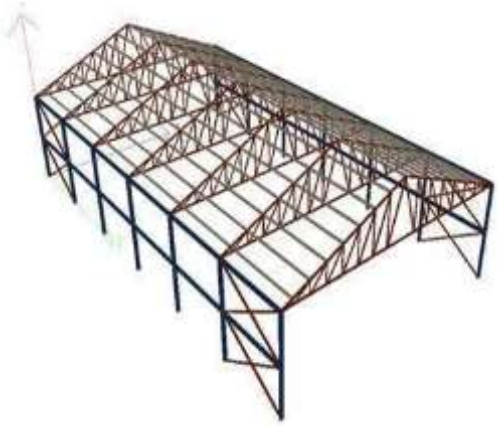

Fig.1. Basic model of Industrial Shed

Components of Industrial Shed:

The elements of industrial buildings are listed below.

1) Roof Truss

2) Principal Rafters

3) Purlins

4) Gantry Girders

5) Bracket

6) Column and Column base

7) Girts

8) Bracings

9) Foundation

The elements are briefly explained as below.

- **Roof Trusses**

Roof trusses are elements of the structure. The members are subjected to direct stresses. Truss members are subjected to direct tension and direct compression. Different members of the truss are shown as in the following figure.

- **Principal Rafter**

The top chord member of a roof truss is called as a principal rafter. They mainly carry compression but they may be subjected to bending if purlins are not provided at panel points.

- **Purlins**

Beams provided over trusses to support roof coverings are known as Purlins. Purlins spans between top chords of two adjacent roof trusses. When purlin supports the sheeting and rests on rafter then the purlins are placed over panel point of trusses. Purlins can be designed as simple, continuous, or cantilever beams. Purlins are often designed for normal component of forces.

- **Gantry Girder**

Gantry girders are designed as laterally unsupported beams. Overhead traveling cranes are used in industrial buildings to lift and transport heavy jobs, machines, and so on, from one place to another. They may be manually operated or electrically operated overhead travelling crane. A crane consists of a bridge made up of two truss girders which move in the longitudinal direction. To facilitate movement, wheels are attached to the ends of crane girders. These wheels move over rails placed centrally over the girders which are called gantry girders.

- **Brackets**

Brackets types of connections are made whenever two members to be secured together do not intersect.

- **Column and Column Base**

A column is a structural member which is straight to two equal and opposite compressive forces applied at the ends. Stability plays an important role in the design of compression member because in columns buckling is involved. The problem of determining the column load distribution in an industrial building column is statically indeterminate. To simplify the analysis the column is isolated from the space frame and is analyzed as a column subjected to axial load An industrial building column is subjected to following loads in addition to its self-weight.

1) Dead load

2) Live load

3) Crane load

4) Wind Load

5) Seismic Load

6) Temperature Load

- **Girts**

A girt is a horizontal structural member in a framed wall that provides lateral support to the wall panel to resist wind load. Purlins perform the same service for the roof panels. Girts and Purlins may also be called sheeting rails. It is

only provided when we used vertical wall sheeting.

- **Bracing**

A bracing is structural member commonly used in structures subject to lateral loads such as wind and seismic forces. The bracing member is generally made of structural steel which can work effectively in tension and compression. Bracing transfer the lateral forces axially and reduce sway of structure and structure will be economical. It is observed that lateral movement decreases up to 80% due to the incorporation of the bracing system.By (Nayanmoni Chetia, 2016). The beam and columns that form a frame carry vertical loads and bracing system carries lateral loads.

- **Foundation**

A well-designed foundation is particularly important for any metal building. It ensures durability and prevents most forms of building deterioration in the future, such as leaking or flooding, shifting or tilting walls, and structural damage. For a steel building, the design of the foundation determines the rest of the planning and construction process and is therefore put into motion long before the actual building is available.

Different Type of bracing Pattern:

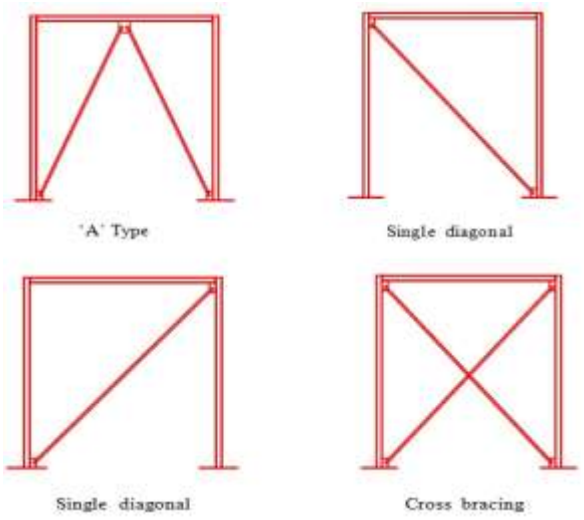

Fig. 2: Different Type of bracing Pattern

Objective:

In the present study, Following Objectives were set:

- To investigate the best bracing location for industrial steel structure.
- To reduce the cost of structure by reducing the tonnage and foundation size of structure.
- To study the different loads and their behavior on structure.
- To reduce the effect of horizontal loads on structure.
- To reduce the effect of temperature on structure.

Reasons to Provide Bracing?

- Bracing provides stability and resists lateral loads.
- Braced frames are economic to construct and simple to analyses.
- Reduces the overall section size in whole structure.
- Hence, the total cost of the steel structure reduces.
- As per multiple research paper I have found that there was only work done on bracing patterns and its effect.
- There is need to work on bracing at different locations in Industrial Shed and its effect on loading as well as economy in structural members with its cost.
- As well as I am working on suitable bracing pattern and its location for lateral loads and temperature load.

2. METHODOLOGY

Industrial Steel Structure Problem:

Standard guideline provided for Industrial shed:- Design Criteria and data sheet required for Modelling, Analysing & Designing of industrial shed was provided by VASTUKALA PLANNERS, Pune.
The primary data required for detailed

development of a industrial shed:-

1. Plot Plan
2. Design Criteria.
3. Client Specification.
4. Construction Materials.
5. Fire proofing requirements.
6. Indian Codes.

Structural Details:-

Table 1: Structural details

Type of building:	**Industrial Building**
Building dimension	16 m x 48 m
Area of the building	768 m^2
Type of roofing	Aluminum sheet
Location of the building	Gujrat
Bay spacing	4 m
Wind speed	50 m/s
Roof slope	1 in 3
Riser height	2 m
Height of the column	11 m
Purlin spacing	1.33m
Girt spacing	1.458m

Location of bracings:-

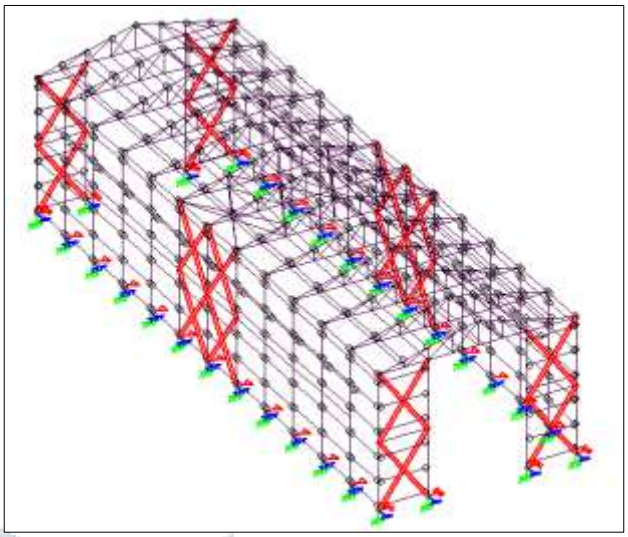

Fig 3: X bracing (center)

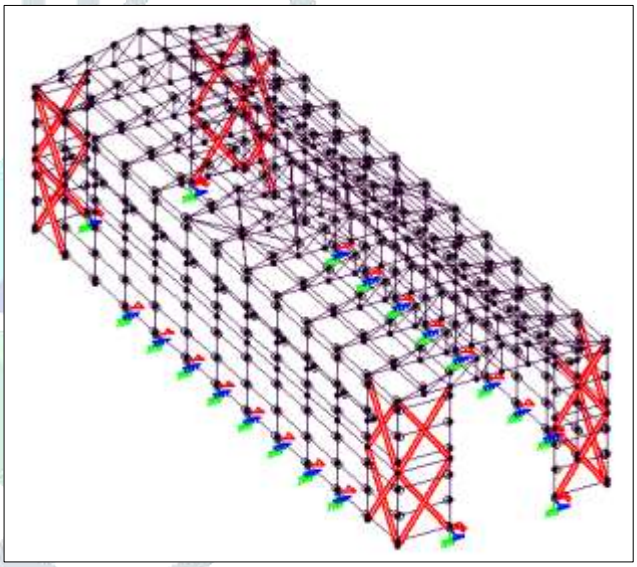

Fig 4: X bracing (Edge)

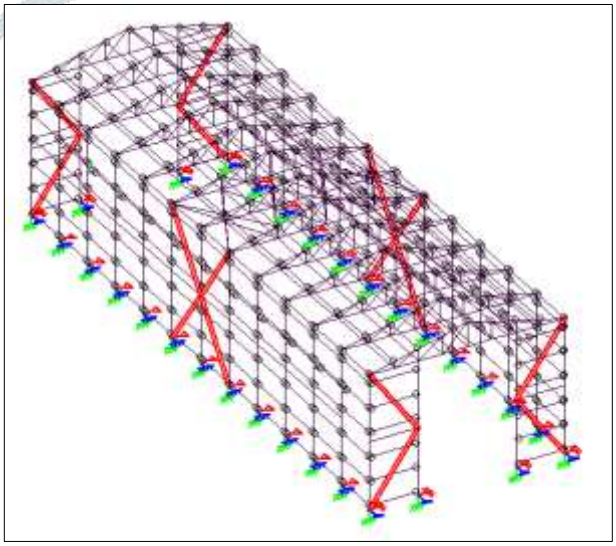

Fig 5: Single Diagonal bracing (center)

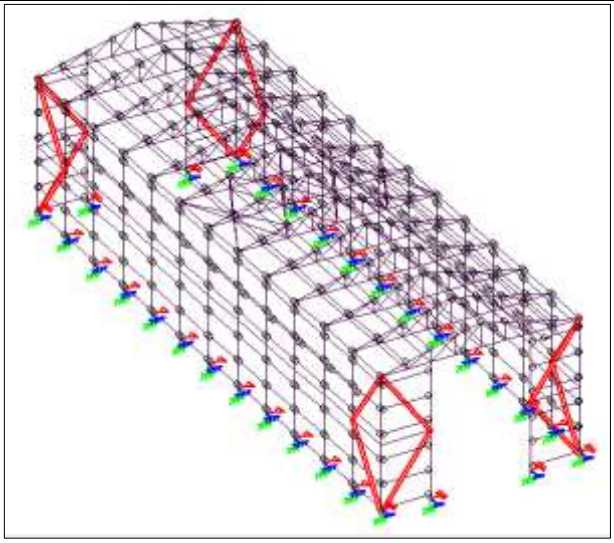

Fig 6: Single Diagonal bracing (Edge)

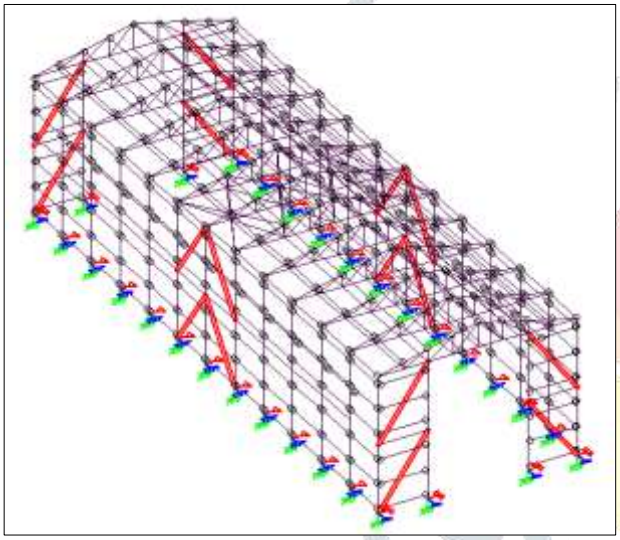

Fig 7: A bracing (center)

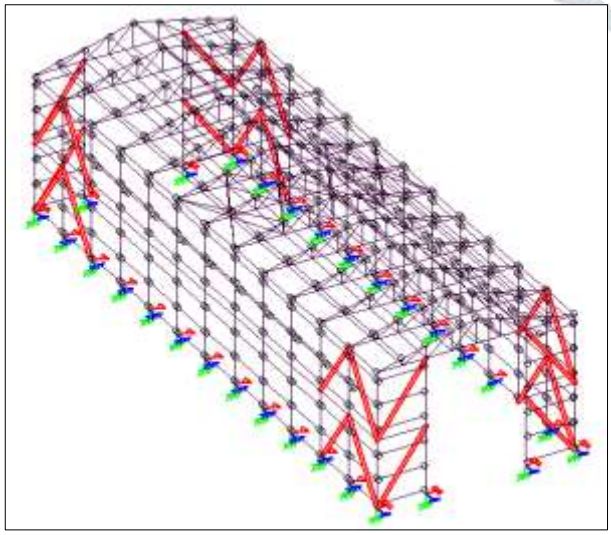

Fig 8: X bracing (Edge)

3. RESULT AND DISCUSSION

General

A comparative study and analysis is performed between a different bracing pattern with different position as per the specifications in IS- 800. A detail study is carried parameters like maximum displacements, Beam end Forces.

In the Study total 6 number of model are prepared and compare with different parameters.

Result comparison

Maximum displacements

Table 2: Maximum displacements for X bracing (center)

Sr. No	Member	Property	Displacement (mm)
1	Beam	ISMC250	7.211
2	Column	ISMB550	7.200

Table 3: Maximum displacements for X bracing (Edge)

Sr. No	Member	Property	Displacement (mm)
1	Beam	ISMC250	9.246
2	Column	ISMB550	9.246

Table 4: Maximum displacements for Single diagonal bracing (center)

Sr. No	Member	Property	Displacement (mm)
1	Beam	ISMC250	7.200
2	Column	ISMB550	7.212

Table 5: Maximum displacements for Single diagonal bracing (Edge)

Sr. No	Member	Property	Displacement (mm)
1	Beam	ISMC250	14.167
2	Column	ISMB550	14.167

Table 6: Maximum displacements for A bracing (center)

Sr. No	Member	Property	Displacement (mm)
1	Beam	ISMC250	7.200
2	Column	ISMB550	7.200

Table 7: Maximum displacements for A bracing (Edge)

Sr. No	Member	Property	Displacement (mm)
1	Beam	ISMC250	13.270
2	Column	ISMB550	13.270

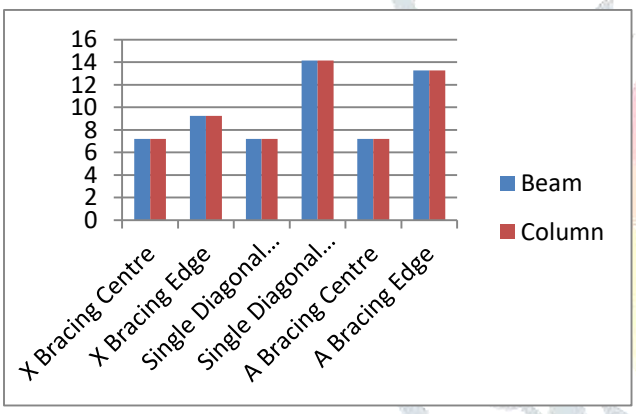

Fig 9: Graphical representation of maximum displacement

Maximum Beam end Forces

Table 8: Maximum Beam end forces for X bracing (center)

Sr. No	Member	Property	Beam End Forces
1	Beam	ISMC250	-43.989
2	Column	ISMB550	518.225

Table 9: Maximum Beam stresses for X bracing (Edge)

Sr. No	Member	Property	Beam End Forces
1	Beam	ISMC250	360.58
2	Column	]ISMB550	-658.23

Table 10: Maximum Beam end forces for Single diagonal bracing (center)

Sr. No	Member	Property	Beam End Forces
1	Beam	ISMC250	-34.81
2	Column	ISMB550	542.43

Table 11: Maximum Beam end forces for Single diagonal bracing (Edge)

Sr. No	Member	Property	Beam End Forces
1	Beam	ISMC250	364.75
2	Column	ISMB550	571.80

Table 12: Maximum Beam end forces for A bracing (center)

Sr. No	Member	Property	Beam End Forces
1	Beam	ISMC250	-43.98
2	Column	ISMB550	562.59

Table 13: Maximum Beam end forces for A bracing (Edge)

Sr. No	Member	Property	Beam End Forces
1	Beam	ISMC250	359.93
2	Column	ISMB550	658.03

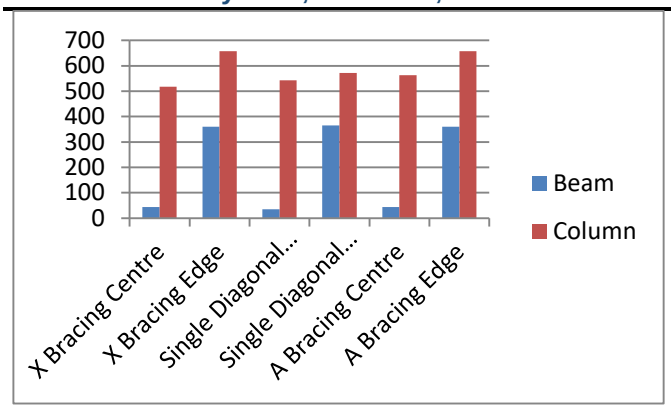

Fig 10: Graphical representation of Maximum Beam end Forces

4. CONCLUSION

- From this Graphs following points are concluded

1. For X type bracing at center, displacement is minimum as compared to bracing at edge.
2. For Single Diagonal type bracing at center, displacement is minimum as compared to bracing at edge.
3. For A type bracing at center, displacement is minimum as compared to bracing at edge.
4. For X type bracing at center, Beam End forces is minimum as compared to bracing at edge.
5. For Single Diagonal type bracing at center, Beam End forces is minimum as compared to bracing at edge.
6. For A type bracing at center, Beam End forces is minimum as compared to bracing at edge.

- From this Study following points are concluded

1. Location of bracing should be at center when temperature load will be there on steel structure
2. Out of all modeled bracing X type bracing will be more convenient type resisting displacement and member end forces
3. We can also conclude that when there is very minor temperature stress will act on structure we can g with edge location

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