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"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 thebestmethodsforlateralloadresistingsystems.This systemprovidedtominimizethelateral deflection of structure. In this thesis industrial shed is analysed for the rectangular plan of 48mx16 m by considering Zone-VI for soiltype-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.

I. BASIC INFORMATION:

Ashedistypicallyasimple,single-storyroofedstructurethatisusedforstorage,workshop. Structuralshedusedinindustriestostorerawmaterials orforproductmanufacturing,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.Itisthereforeimportanttocarefullyevaluatewindloads.Usually,theendspansarethe 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 longitudinalwinds.

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.

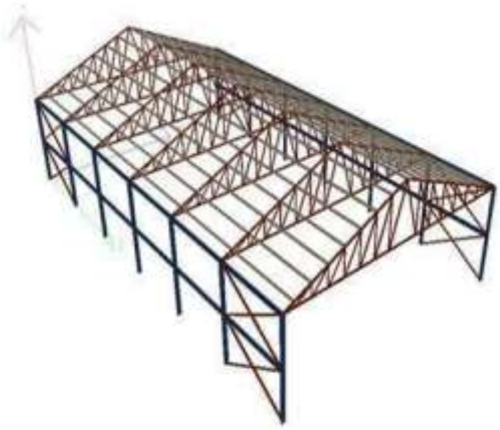

Fig.1. Basic model of Industrial Shed

Components of Industrial Shed:
The elements of industrial buildings are listed below.

1) RoofTruss
2) PrincipalRafters
3) Purlins
4) GantryGirders
5) Bracket
6) Column and Columnbase
7) Girts
8) Bracings
9) Foundation

The elements are briefly explained as below.

- **RoofTrusses**

Rooftrussesareelementsofthestructure.Themember saresubjectedtodirectstresses.Truss membersaresubjectedtodirecttensionanddirectcom pression.Differentmembersofthetruss are shown as in the followingfigure.

- **PrincipalRafter**

The top chord member of a roof truss is called as a principal rafter. They mainly carry compressionbuttheymaybesubjectedtobendingifpur linsarenotprovidedatpanelpoints.

- **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 andrests 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 componentof forces.

- **GantryGirder**

Gantrygirdersaredesignedaslaterallyunsupportedbe ams.Overheadtravelingcranesareused inindustrialbuildingstoliftandtransportheavyjobs,m achines,andsoon,fromoneplaceto another.Theymaybemanuallyoperatedorelectrically operatedoverheadtravellingcrane.A craneconsistsofabridgemadeupoftwotrussgirdersw hichmoveinthelongitudinaldirection. To facilitate movement, wheels are attached to the ends of crane girders. These wheelsmove over rails placed centrally over the girders which are called gantrygirders.

- **Brackets**

Bracketstypesofconnectionsaremadewhenevertwo memberstobesecuredtogetherdonot intersect.

- **Column and ColumnBase**

Acolumnisastructuralmemberwhichisstrai ghttotwoequalandoppositecompressiveforces applied at the ends. Stability plays an important role in the design of compression member because in columns buckling isinvolved.The problem of determining the column load distribution in an industrial building column is staticallyindeterminate.Tosimplifytheanalysistheco lumnisisolatedfromthe spaceframe and is analyzed as a column subjected to axialloadAn industrial building column is subjected to following loads in addition to its self-weight.

1) Deadload
2) Liveload
3) Craneload
4) WindLoad
5) SeismicLoad
6) TemperatureLoad

- **Girts**

A girt is a horizontal structural member in a framed wall that provides lateral support to the wallpaneltoresistwindload.Purlinsperformthesames ervicefortheroofpanels.Girtsand Purlins may also be called sheeting rails. It is only provided when we used vertical wall sheeting.

- **Bracing**

A bracing is structural member commonly

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used in structures subject to lateral loads such as windandseismicforces.Thebracingmember isgenerallymadeof structuralsteelwhichcan work effectively in tension and compression. Bracing transfer the lateral forces axially and reduceswayofstructureandstructurewillbeeconomical.Itisobservedthatlateralmovement decreases up to 80% due to the incorporation of the bracing system.By (Nayanmoni Chetia, 2016).Thebeamandcolumnsthatformaframecarryverticalloadsandbracingsystemcarrieslateral 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 orflooding,shiftingortiltingwalls,andstructuraldamage.Forasteelbuilding,thedesignofthe foundation determines the rest of the planning and construction process and is therefore put into motion long before the actual building isavailable.

Different Type of bracingPattern:

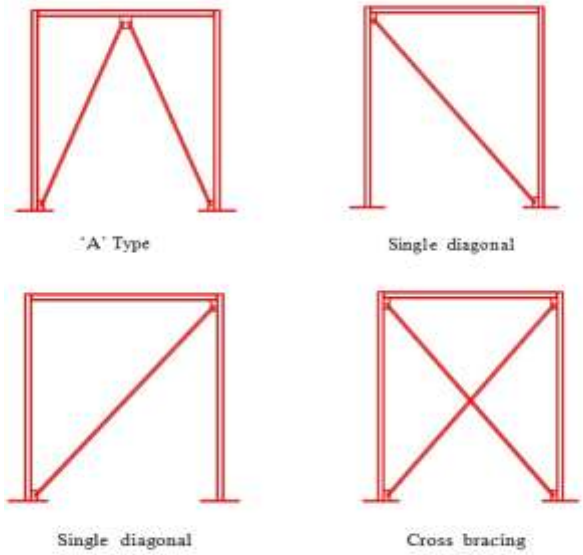

Fig. 2: Different Type of bracing Pattern

Objective:
In the present study, Following Objectives were set:

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

Reasons to ProvideBracing?

- Bracing provides stability and resists lateralloads.
- Braced frames are economic to construct and simple toanalyses.
- Reduces the overall section size in wholestructure.
- Hence, the total cost of the steel structurereduces.

- AspermultipleresearchpaperIhavefoundthatthere wasonlyworkdoneonbracing patterns and itseffect.
- Thereisneedtoworkonbracingatdifferentlocations inIndustrialShedanditseffect on loading as well as economy in structural members with itscost.
- As well as I am working on suitable bracing pattern and its location for lateral loads and temperatureload.

II. METHODOLOGY

Industrial Steel StructureProblem:
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. PlotPlan
2. DesignCriteria.

3. ClientSpecification.
4. ConstructionMaterials.
5. Fire proofingrequirements.
6. IndianCodes.

StructuralDetails:-

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 ofbracings:-

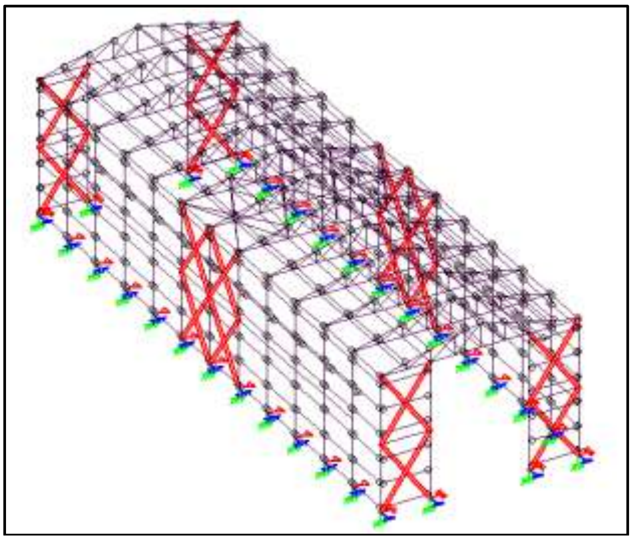

Fig3: X bracing (center)

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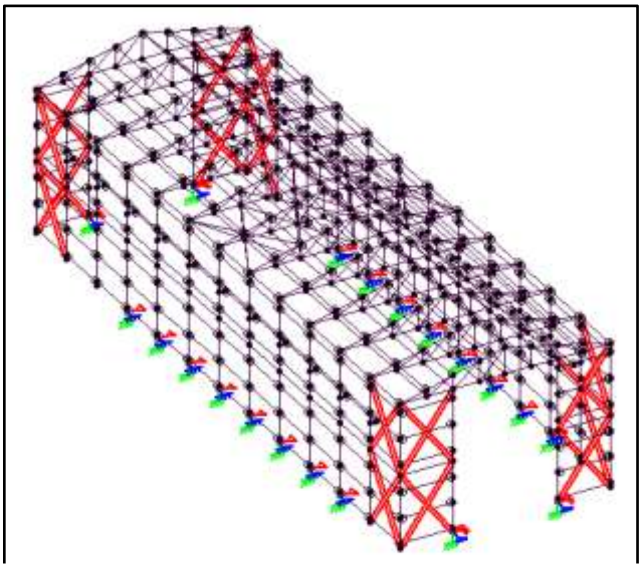

Fig4: X bracing (Edge)

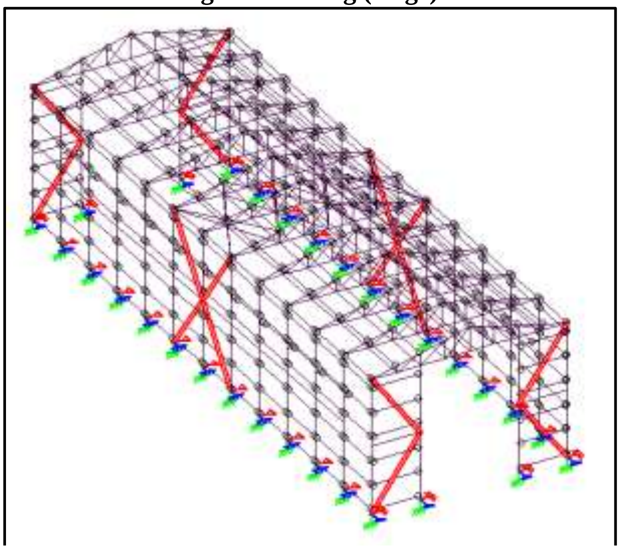

Fig 5: Single Diagonal bracing (center)

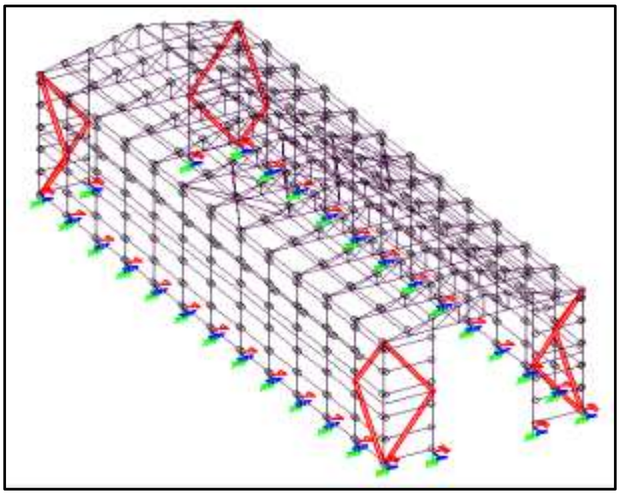

Fig 6: Single Diagonal bracing (Edge)

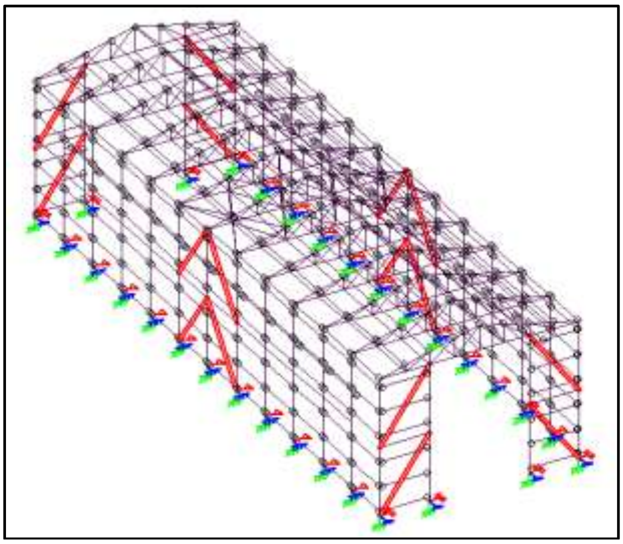

Fig7: A bracing (center)

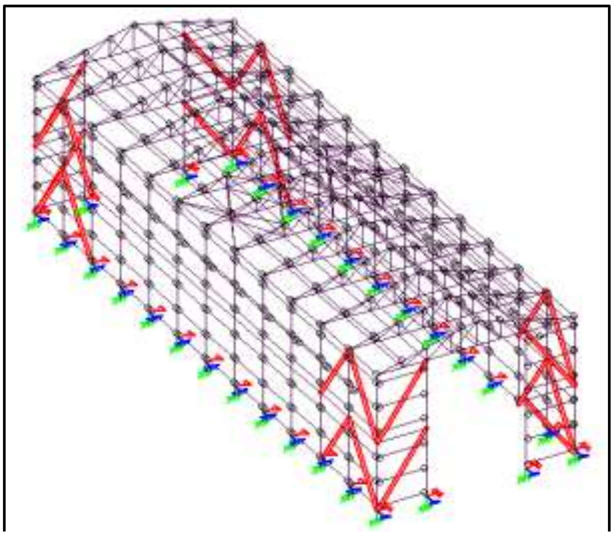

Fig8: X bracing (Edge)

III. 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

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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

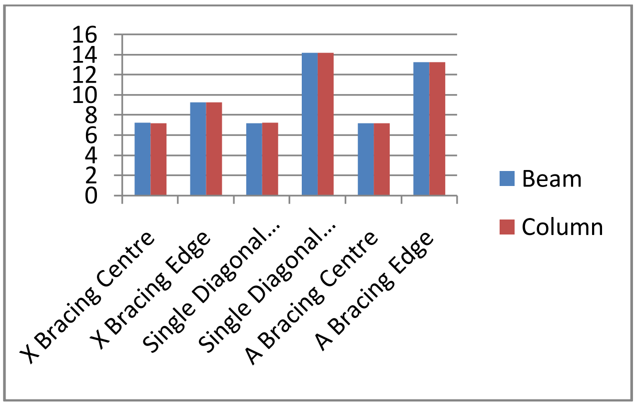

Fig 9: Graphical representation of maximum displacement

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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

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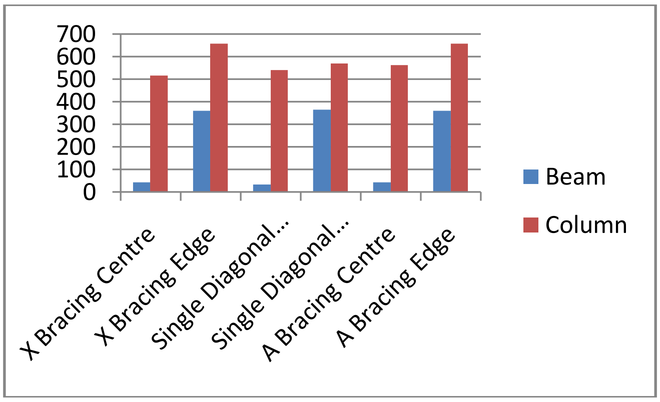

Fig 10: Graphical representation of Maximum Beam end Forces

IV. 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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