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A REVIEW PAPER ON ALTERNATE DESIGN OF ROOFING SYSYTEM

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ABSTRACT
This paper presents a study on behaviour and economical of roof trusses and purlins by truss provided along large span due to material saving as compare roof truss provided along width. Roof trusses and purlins are therefore an integral part of an industrial building and the like for supporting the roofing system. This paper presents a study on behaviour and economical of fink type roof trusses, This study involves in examination of theoretical investigations of specimens in series. Overall two truss were designed and comparison of all the internal force, economical, and hence, to evaluate the co-existing moments and shear forces at the critical cross-section with same configuration area by keeping all other parameters constant. The specimens are designed under uniformly distributed loading with simply supported condition. The research project aims to provide which span of truss is economical, high bending strength, more load carrying capacity and high flexural strength. The studies reveal that the theoretical investigations roof truss provided along large span design is high bending strength, high load caring capacity, save material, economical as compare truss provided along small span.

KEYWORDS: Roof Truss, purlins,bending strength, cost of roof trusses.
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INTRODUCTION
Industrial buildings are low rise steel structures, characterized by their low height, lack of interior floors, walls and partitions. Roof trusses are elements of the structure composed of members subjected to direct stresses. Sometimes the truss is also called an open web beam. It consists of a triangular network of compression and tension members. On the basis of structural behaviour, roof trusses can be classified a simple roof trusses supported over masonry walls, and roof trusses supported over columns and connected to it with knee braces. Theoretically, truss members are subjected only to direct tension and direct compression. Purlins are beams provide over trusses to support the roofing between the adjacent trusses .these are placed in a tilted position over the principal rafters of the trusses. Channel and angle sections are commonly used purlins. Cold formed steel purlins are the widely used structural elements in India. Trusses are triangular frame works, consisting of essentially axially loaded members which are more efficient in resisting external loads since the cross section is nearly uniformly stressed. They are extensively used, especially to span large gaps. Trusses are used in roofs of single storey industrial buildings, long span floors and roofs of multistory buildings, to resist gravity loads. Further, the loads may be applied in between the nodes of the trusses, causing bending of the members. Such stresses are referred to as secondary stresses. The secondary bending stresses can be caused also by the eccentric connection of members at the joints. The analysis of trusses for the secondary moments and hence the secondary stresses can be carried out by an indeterminate structural analysis, usually using Computer software. The specimens are designed under uniformly distributed loading with simply supported condition. The research project aims to provide truss along length is economical, high bending strength, more load carrying capacity and high flexural strength as compare to width. Trusses are mainly triangulated framed structures resisting loading by developing axial forces, either tension or compression in the component members. A truss performs the same functions as a beam; hence it is also called open web beam. Individually they are also in tension and compression, the exact arrangement of forces will depend on the type of truss and on the direction of loading.

High cost of construction
Steel structures have relatively higher cost of construction in comparison to R.C.C. structures. In some countries steel structures are even more costly due to less availability.

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Aim of The Study

As per researches, truss is used as a roofing system. In recent year truss provided along width it means spacing of truss should be minimum. It should be required more material it means cost of construction is high. By this project truss are provided along length. Span of truss is large and spacing of truss also large.it should be require may be less material as compare to truss provided along width.So that it can be used as a roofing system and economy should be achieved.

LITERATURE REVIEW

Dr. S.K. Dubey The main purpose of this study is to analyse the steel roof truss under the normal permeability condition of wind according to Indian Standard Code IS: 875(Part 3)-1987, in which, intensity of wind load is calculated considering different conditions of class of structure ,Terrain, height and structure size factor, topography factor, permeability conditions and compare the results so obtained with the calculations made in SP-38(S&T):1987; Handbook for typified designs for structures with steel roof trusses, in which there is no consideration for different conditions as mentioned above. Because of this, there are large variations in calculated results for wind loads and design forces in members of truss. [1]

A.Jayaraman work on the structural design to be satisfactory, generally four major objectives utility, safety, economical and elegance must be fulfilled. This paper presents a study on behaviour and economical of roof trusses and purlins by comparison of limit state and working stress method. Roof trusses and purlins are therefore an integral part of an industrial building and the like for supporting the roofing system. The specimens are designed under uniformly distributed loading with simply supported condition. The research project aims to provide which method is economical, high bending strength, more load carrying capacity and high flexural strength.[2]

Donald Friedman. Philadelphia's Wagner Institute has a long-span roof completed in 1864, consisting of wood-and-iron arched trusses supporting wood purlins. This paper includes a review of the possible mechanisms that could have been used at the time of construction incorporating the visible materials, including various forms of truss and tied arch. This review provided the key to analysis and interpretation of the damage. [3]

A. I. EI-Sheikhwork on the space truss system newly developed with the main objective of achieving a larger reduction in the overall cost of space trusses without compromise in the structural reliability or the common ease of construction. To achieve this goal, the new truss has a simple jointing system that requires no expensive member splicing system that has almost no adverse effect on the truss's performance. The paper includes an introduction to the system's features and an experimental assessment of the claim that the new jointing system of the truss does not entail any compromise in its structural efficiency or reliability. Although space trusses have been in continuous development since the 1950s, their share in the market of large-span structures is still quite small. [4]

Robert H. Durfeework on the structural advantages and aesthetics of a triangular cross-section truss have long been recognized by structural engineers and architects alike. Until recently, however, but with recent advances in welding techniques, the use of computer analysis methods, and the increased availability of structural tubing for truss members, the triangular cross-section truss has seen a wide range of new applications. This paper discusses the analysis and design of this type oftruss to carry highway loadings..[5]

MATERIALS SPECIFICATIONS

Materials
Stainless Steel

Physical Properties

The following table lists the properties of steels based on the categories noted above.Properties determined at room temperature (77°F/25°C)

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Density of steel (ϱ)	7850 kg / m3
Modulus of elasticity , E	2 x 105 N / mm^2
Poisson ratio, μ	0.3
Modulus of rigidity , G	0.769 x 10 5 N / mm^2
CO efficient of thermal expansion (α)	12 x 10-6

Mechanical Properties of Steel
Other mechanical properties of structural steel that are important to the designer include:

- Modulus of elasticity, E = 210,000 N/mm^2
- Shear modulus, G = E/[2(1 + v)] N/mm^2, often taken as 81,000 N/mm^2
- Poisson's ratio, v = 0.3
- Coefficient of thermal expansion, α = 12 x 10-6/°C (in the ambient temperature range).

General Properties of Steels

Properties	Stainless Steels
Density (1000 kg/m3	7.75-8.1
Elastic Modulus (GPa)	190-210
Poisson's Ratio	0.27-0.3
Thermal Expansion (10-6/K)	9.0-20.7
Melting Point (°C)	1371-1454
Thermal Conductivity (W/m-K)	11.2-36.7
Tensile Strength (MPa)	515 - 827
Yield Strength (MPa)	207 - 552
Percent Elongation (%)	12-40
Hardness (Brinell 3000kg)	137-595

METHODOLOGY

Design step for roof truss:

Step 1: Selection of type of truss.

Step 2: Geometry of Roof Trusses

Pitch of Truss
Pitch of truss is a ratio of the truss to the span.
Galvanized Iron (GI) sheet roofing : 1/6
Asbestos Cement (AC) sheet roofing: 1/12

Spacing of truss
(Distance between two consecutive trusses).

Spacing of roof truss	Type of Steel Section
<15m	3m to 4.5m
15m-30m	4.5m to 6.0m
>30m	12m to 15m

Note: If spacing is more, cost of purlin increases.

Purlins
The function of a purlin is to support roofing sheets as well as to stiffen the entire roof structure. Purlins provide immediate support for the common rafters in a roof. Purlins are either supported by gable ends or by trusses. Generally the spacing of purlins varies from 1.35 m to 2.0 m.

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Sheeting

GI Sheet

- Available gauges are 16,18,20,22,25.Thickness = Gauge/25 mm
- Available lengths are 1.8 m, 2.2 m, 2.5 m, 2.8 m and 3.0 m

AC Sheet

- Available lengths are 1.75 m, 2.0 m, 2.5 m, and 3.0 m
- Available thickness: 6 mm (for 1.4 m spacing), 7 mm (for 1.6 m spacing)

Step 3: Load Calculations

The main loads on trusses are:

- Dead loads
  GI Sheet: 100-150 N/m2
  AC Sheet: 170-200 N/m2
  Purlin: 100-120 N/m2
  Truss
- Load Combinations
  • Dead Load + Imposed Load
  • Dead Load + Snow Load
  • Dead Load + Wind Load

Step 4: Design of Roof Truss Members (Tension & Compression Members)

a) Top Chord Members
b) Bottom Chord Members
c) Struts
d) Slings
e) Sag Tie

By using IS 800-2007 and IS 800-1974 and IS 808 design of members are calculated.
Arrangement of purlin

- Sloping length=√(Rise^2+Half of span^2)
- Length of each purlins = $\frac{slopinglength}{numberofpanels}$

Step 5: Load Calculations

Computations of dead load (using IS875-1987 Part I), Live load (using IS875-1987 Part I) and Wind load (using IS875-1987 Part III) should be carried out.

Step 6: Design of Members

Designs of members are listed below:

- Purlins
- Principal rafter
- Columns
- Slings
- Struts
- Main ties

Design of members can be carried out by using IS806-1968, IS1161-1998.

Step 7: Load Calculation and Load Combinations

The following load combinations have been considered in calculating the design forces for beam and column in accordance with IS: 875- 1964:

a) DL + LL,
b) 0.75 (DL + LL x WL_1)
c) 0.75 (DL + LL x WL_2)
d) 0.75 (DL + LL x WL_3)

Step 8: Design Loads

Dead load on plan area=AC sheet + purlin + Miscellaneous,
Live load and wind load are to be calculated by IS 3007(Part 1)-1964.

Step 9:Deflection Calculation

The maximum deflection in the frame occurs at joint D due to DL + WL, load case. Unit load method is used to obtain the deflection under this load. The unit load bending moment diagram (m) is for the reduced structure with hinge at nodes.
This integral can be obtained by multiplying the area of M diagram of each member by the diagram ordinate of m diagram in same member corresponding to the centre of gravity of M. Let Deflection=$(\Delta) = \int . \frac{Mmdx}{E}$

Step 10: Connections

Purlin Connection, Haunch and Crown Connection , Column Base, Expansion Joint, Bracing, Erection ,etc recommendations of IS:800-1984 and for laying asbestos cement sheets, recommendations of IS3007(Part I)-1964 shall be followed.

CONCLUSION

In this paper investigation, comparing the roof truss provided along length to truss provided along width of span. The studies reveal that the truss provided along length required less material as compare to truss provided along width of span. Due to this investigations cost of construction should be lass as compare to truss placed along width of span. This is new method of truss placing in roofing system.

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