# AIRCRAFT HANGERS - A LITERATURE REVIEW

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## ABSTRACT

Aircraft hangers are closed large-span structures, used to protect aircraft from the weather, direct sunlight, and facilitate the space for the maintenance, repair, manufacture, assembly, and storage of aircraft on airfields, aircraft carriers, and ship aircraft. Various studies have shown that the use of timber, masonry, and concrete to build hangers is uneconomical and inefficient in comparison to steel structures. This research focuses to review the different planning configurations and systems that have been evolved over time for cost-effective and optimized design of aircraft hangers.

## 1. INTRODUCTION

Airlines all over the world have been inducting larger and larger sizes of aircraft on a regular basis in recent years to meet the ever-increasing demands of air traffic. The provision of matching ground services frequently necessitates significant investment, the majority of which is accounted for the cost of long-span hangers. As a result, much thought has recently been given to make them more functionally efficient and cost-effective by -

(a) Arriving at dimensions that optimize the use of the area and volume required for servicing a specific aircraft.

(b) Choosing efficient structural forms to roof them, such as space frames, and optimizing these to minimize weight.

This review paper investigates the planning configuration which optimizes the area and volume requirement and secondly about the structural papers

## 2. LITERATURE REVIEW

2.1.1 Dimension

G.S. Ramaswamy: In the paper "Review of Recent Trends in the Planning, Analysis, Design, and Construction of Space Frame Roofs for Aircraft Hangars" has specified the standard dimension of various aircraft. The dimension of aircraft is a very crucial parameter to decide the span of the aircraft hanger. The following table of different aircraft and airbuses -

**Table - 1 Measurement of several Airbuses**

| Airbus | 300-600 | 320-200 | 310-200 |
|--------|---------|---------|---------|
| Length | 54.08 | 37.57 | 46.66 |
| Span | 44.84 | 33.91 | 43.89 |
| Height | 16.62 | 11.8 | 15.8 |

Rudolph - In the paper "A three-dimensional concept for multi-form hangars" has compared the efficiencies for 'Nose-in' and 'Tail in' parking position to park the aircraft. Nose in configuration means, aircraft will enter the hanger from its nose whereas in the tail in position aircraft will enter the hanger in reverse position i.e. Tail-in first. He concluded that the alternate way of parking one tail-in and other nose-in configuration is efficient for parking side by side of the plans in the hanger. It will occupy less space and give high utility to the area and volume.

2.2 Computer-aided Structural design and analysis

**K. N. Kadam and A. J. Limbage**

In this research, the relationship between the dimension of the truss and the wind forces is predominant for the calculation of the forces of the member. In this comparative study between the truss design according to the revised provisions of the wind load calculation in IS 8751987 and the design according to the calculation according to SP38 (S&T): 1987. The analysis is carried out in a 12 meter span, A type frame and forces are calculated using ANSYS 11.0, IS 875: 1987 (part 3). The terrain class of the structure, topographic factor, takes into account different states of permeability depending on the inclination of the structure, which is not taken into account in SP38 (S&T): 1987. The calculation shows that the forces of the member vary greatly with increase. The span of the rafters. The percentage of variation of the member forces in a truss with a 24 m span is almost twice as high in a truss with a 12 m span. The maximum percentage variation of the member force is 9.68 for the 12 M member trusses due to the different

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calculations of the wind load according to IS 875: 1987 and SP38 (S&T): 1987 and for the 24 M member the maximum percentage of member forces is 19.60. In this study, the author concludes that the percentage of variation in the forces of the member increases as the span of the truss increases.

### Yash Patel, Yashveersinh et. al.

In this paper, conventional steel truss is compared with tubular steel truss to achieve economy while keeping economy as the main goal. Comparison between conventional steel truss girders with tubular steel truss girders is compared in kilogram weight of all profiles with current market price information for a cost comparison. Cost savings of INR 10,729 per roof structure of up to 15-25% are achieved using the tubular profile instead of the conventional steel profile. Truss calculation is based on dead load, traffic load, wind load with reference to IS 875 Part 1, Part 2, and Part 3 or with the help of STAAD pro v8i computer software, and sizing is done with reference to IS 800 for conventional steel profiles and for steel tube profiles with the help of Microsoft EXCEL software. In this study, the author concludes that the steel tube profile has proven to be a more economical profile than the conventional steel profile.

### Goraviyala Yogesh and Prof. K. C. Koradiya

In this research paper, different types of trusses were analyzed such as Howe, Fan, Fink Fan, and N-type with different spans 9m, 12m, 15m, 18m, and 21m with different inclinations of 12,14,16 degrees with different wind zones, different spacing was analyzed and designed according to SP: 38 and IS: 8002007. In this research, the author has examined various research papers by various authors. In this article, the author concludes that SP: 38 should be compared to IS: 875, even if tubular sections are used for the long covered and cantilevered lengths, an overall economy is achieved. They conclude that WSM is economical than LSM. Therefore, the author concluded all investigations from his point of view. In this research, the author concluded that it is necessary to verify SP: 38, pipe profiles are cheaper than conventional steel profiles, and WSMs are economical than LSMs.

### Ankush Limbage and Kshitija Kadam

A detailed comparative study is carried out on a truss with a span of 9 m using the Indian standard code IS875 (part 3): 1987 and SP38: 1987. In IS875 (part 3): 1987 the intensity of the wind load is calculated taking into account the different conditions of the building class, the terrain, the building height and size factor, the topography factor, and the permeability condition. The comparative study is carried out with the help of commercial software ANSYS 11.0. The result shows that the calculated member forces differ from the calculations in SP (S&T): 381987 and IS 875: 1987 (Part 3). As span increases, the tension rod forces increase, but the compression rod forces decrease slightly. From this, it can be concluded that the calculation performed in SP38 cannot be applied directly without taking into account the structural class, topology, terrain factor, risk coefficient, and permeability mentioned in IS: 8751987. The maximum percentage variation available in member strength is found in the second member of each field.  In this article, the author concludes that the calculations in SP38: 1987 should be carried out taking into account the structural class, topology, terrain factor, risk coefficient, and permeability according to IS 875: 1987.

### A.Jayaraman, R Geethamani et. al.

This paper performs a comparative study on the behavior and economic efficiency of roof trusses and purlins comparing  LSM and WSM. For this study, Fink-type roof trusses are used to compare the limit state and working stress method. In total, two models were developed and the comparison of all internal forces, moments, and shear forces in the critical cross-section with the same configuration is compared. Theoretical data is calculated according to IS 875-1975 (Part III), IS 800 - 2007 according to the limit state method, IS 800 1984 according to the limit stress method and the sectional properties of the specimens are determined using the steel table. The samples are designed under a uniformly distributed load with a single support condition. In this study, the author concludes that theoretical investigations in the limit state method show high flexural strength, high load capacity, minimal deflection, and minimal local deformation and torsion compared to the working stress method. . However, the working stress method is the most economical compared to the limit state method design.

### Sagar and Pajgade

In this paper, an industrial steel structure building of 14m x 31.50m, 20m x 50m, 28m x 70m, and a field spacing of 5.25m, 6.25m, or 7m with a column height of 6m is compared to buildings of pre-engineering of it. Dimension. The design is based on IS 800-2007 (LSM). The loads that are taken into account in the modeling are dead load, live load, wind load together with the combinations according to IS-875. The results of the steel frame industrial buildings are compared to the same dimensions of the pre-engineering building. The construction shows that the use of angle profiles, pipe profiles for trusses, and channel profiles for purlins in the construction of steel and PEB trusses is economical compared to the construction of steel trusses. The result clearly shows that the weight of a single truss with support and pipe is less compared to PEB, but due to the weight of the channel belt, the weight of the steel truss

structure is higher. In this article, the author concludes that pre-engineering construction is economical than building conventional steel structures.

### Soni Prabhat et al.

In this paper, the steel structure of the roof was analyzed with a span of 12 m through the construction of tubular sections of trusses. The analysis represents the comparison for the weight of the pipe support sections, with the help of which a comparative study was carried out between the dimensioning of the frame according to the revised provisions of the wind load calculations according to IS 875 (Part 3): 1987 and the designs obtained according to the calculations in SP 38 (C&T): 1987, IS 875 (Part 3) 1987 includes the consideration of different conditions of a class of structure, factor of topography, extended determinations of the conditions of permeability, terrain, height and size of factor structure and different wind zones or these determinations of the wind load calculations differ from the considerations in SP 38 (C&T): 1987, so there are deviations considerable in frame construction. A standard truss is a series of triangles with a stable geometric shape that is difficult to deform under load. Regardless of their overall size and shape, all tendons and webs in a truss form triangles. These triangles combine to distribute the load on each of the other elements, resulting in a lightweight structure that is stronger than the sum of the strength of its individual components. In this study, the author concludes that the weight of the designed tubular sections obtained by IS875 is greater than that of SP38: 1987.

### Kalyanshetti and Mirajkar

This research makes a comparison between conventional and tubular steel structures, taking into account economic efficiency as the main objective. This study is carried out using conventional steel profiles, square tubes, rectangular tubes, and round tubes. By way of comparison, the author replaces the profiles of various elements of the reinforcement, and the necessary weights for this element are calculated for a given section. The author considered Howe's truss for the design. The author used STAAD.Pro software for analysis and construction purposes. Based on the performance results, it is concluded that the tubular sections are economical for the truss. The authors conclude that the use of hollow sections as a substitute for conventional steel structures represents a cost saving of around 50-60%. In this study, the author concludes that hollow sections are cheaper compared to conventional steel sections.

### Dhanush J et. al.

In this paper "Design Optimisation of an Aircraft Hangar with Various Parameters" Using STAAD.Pro an Aircraft Hangar is designed for a clear span of 60m and is compared with PEB and conventional steel structures. Therefore, the most optimized structure is found by comparing different sections, support conditions, ridge angles, and bay spacing's for the same structure. This paper concludes as the pre-engineered buildings and the tubular section is the most economical and optimizes solution for the design of 60 aircraft Hanger.

### Ashwini and talikoti

In the paper "Aircraft Hangar Design Pre-Engineered Building" the Cost of steel is increasing day by day and the use of steel has become inevitable in the construction industry in general and in an industrial buildings in particular. Hence to achieve economic sustainability it is necessary to use steel to its optimum quantity. In this paper, an attempt has been achieved by studying the modeling and design of an Aircraft hanger and analyzing the frames using SAP2000 Software and ANSYS.

## 3. CONCLUSION

Designing large span structure is not a challenging task for structural engineers, but optimizing and giving a cost-effective solutions for megastructures like an airport hanger needs analytical, innovative and strong technical understanding is needed. The above literature is concluded as follow -

(1) For better usage of volume and area for service, the size of aircrafts, efficient configuration of parking is very important. The nose and tail parking system is best for maximum use of parking.

(2) The percentage of variation in member forces increases as the span of the truss increases.

(3) The tubular steel profile has proven to be a more profitable profile than a conventional steel profile.

(4) Working stress method is more economical compare to the limit state method design.

(5) Pre Engineering Building is more economical than conventional steel truss building.

(6) Weight of designed tubular sections obtained by IS-875 is greater than that of SP38:1987.

(7) Calculations made in SP38:1987 are have to implement with considering class of structure, topology, terrain factor, risk coefficient and permeability mentioned in IS 875:1987.

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