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# Study on Analysis of tubular roof truss for cricket stadium

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**ABSTRACT:** In this paper presents a study on behaviors and economical of tubular roof truss for cricket stadium and providing the purlin, top chord bottom chord, vertical, diagonal member. The cricket stadium roof truss span is maximum and height of structure also maximum than other structure. The tubular hollow section member it is the best alternative solution for economical point of view. It can analysis and design of tubular truss we can consider as per span length 'Howe type' of roof truss can be selected. They also consider the dead load, live load, wind load and other parameters. Using some Indian standards and American concrete standards) and SP-38(S&T).and also calculated the manually as per Indian standards and compare results with staad pro. Analysis of trusses knows N-shaped truss is addressed.

**KEYWORDS:** Tubular truss, large span, staad pro**.**

## I. INTRODUCTION

The cricket stadium structure height is maximum than other structure, and many more structural parameters can be considered like pitch, ground area, seating area, players and official rooms and etc. In case of cricket stadium structure mainly divided into three parts first is substructure and second is superstructure and superstructure is divide into two parts first is building frame structure and second is top roof truss structure. The building structure constructed in reinforces concrete frame structure and top roof portion of building is erected in steel material. In case of top roof truss analysis and design the tubular section can be used, The tubular roof truss are elements composed of members subject to direct stresses sometimes the tubular truss is also called as open web beam structure. It considering the different-different arrangement can be taken as per requirement and patterns of trusses selection and basis of compression and tension members. The tubular truss provide to support roof covering, load transformation system is sheeting to purlin and purlin to top chord member then incline and vertical member to bottom chord member to the column. This load acting act the downward direction on the structure and these joint loads cause axial forces and produce tension and compression. All the joints of tubular truss are considered to be hinged and all loads including self weight are transferred to the column through the joints at column or support. In case of cricket stadium design to selected 'Howe type' of truss, the Howe type of truss can be used for long span (6 to 24m) and also economical for long span. That's why the arrangement of bracing system is N-type. The N-type bracing system is consider the axial forces acting at the member to transfer the load is properly without any obstruction and load is distributed is node to node. The N-type bracing pattern is very stronger than other. They are more capable to resist external forces as the section. The hollow tubular section is more stronger and maintains cost also minimum, the hollow tubular section analysis and design problem is depends upon the dimension, environment, convince and versatility the analysis and design of tubular roof truss considering the dead load, live load, and wind load and other combinations as per Indian standers. The present work including the designing for the cricket stadium using conventional steel structure. The tubular steel section are rectangular hollow sections, square hollow section and circular hollow sections as per suitable type of sections as per advantages and disadvantages as per is-800-2007, is-806-1968, sp-38(S&T)- and IS-4923:1997. The analysis and design for cricket stadium is done with computer software program named 'STAD-PRO'. The total area of stadium is 39471.71$m^2$ and seating capacity of stadium 30,000 specters. Some study the response of the tubular truss is considering deflection, axial force, bending moments and etc.

## II. OVERVIEW OF CRICKET STADIUM

The cricket stadium is located at Nanded city, total area of stadium is built-up 39471.71$m^2$. And seating capacity of stadium 30,000 specters. The stadium provide proper drainage facility, providing proper slope on the playing area, the cricket it is the live sport event to be part of those occasion, to attach every person emotionally . Stadium it is the extremely milestone landmark of structure. so international stadium should be provided completely modern facility, the stylish modern stadium should be provided comfort and abounded or wonderful dressing room and also providing the proper arrangement of furniture for kitbags and other accessory settlement or placing. Its means the perfect faculties can be providing without ant disturbance and also providing the facilities to ensure for players and other officials room carry out their enterprise in convenience and safety point of view. Cricket stadium should be converted to protect spectator from the rain and blinding light for strong sunlight. The design stadium freeform the obstruction or blockages and complete view of field to play line of sight quality can be maintained that all parameter are essentially comfortable and secure. The perfect view of the each an every person of pitch to the seating and easily accessible vision to toilets and snack zone. Access and exit to and from the seas both In normal and emergency situation. It is to maintain the whole entry process is not stressful slow arriving at an unfamiliar stadium.

## III. STUDY OF TUBULAR TURESS

The first application of tubular truss is believed to have been conceived by Alexander Graham Bell from 1898 to 1908 devoted space frame based on tetrahedral geometry for tubular truss. The frequently used method in use has individual tubular truss member connected at node to node joint and variations such as the space deck system, act tubular truss system and hollow truss system. The tubular truss is used extensively in bridges, auditoriums, workshops, high-rise complex, stadiums, industry, warehouse, airport etc. the tubular truss are features in modern construction, the tube frame chassis predate space frame development of the earlier new technic. The tubular trusses are generally used in long span, and also economical. The main advantages of tubular truss is the resistance to stress it means the high tensile strength. It can resist the external load or forces as well as internal stress very effectively resist. The tubular truss can be easily constructed with low time periods. The tubular truss maintainer cost also minimum than other structure and also the tubular truss structure resist to corrosion efficaciously. The tubular truss asset their stadium usages in the construction of roof top portion. They can also applicable greater strength as of weight ratio which means the weight of section is less due to this cost is minimum.

## IV. OBJECTIVES

- To analysis and design the tubular roof truss for cricket stadium
- To optimize the cost of roof truss.
- Making model of tubular truss for stadium and verifying results with the help of Stadpro software.
- To design a tubular truss for stadium under wind condition.

## V. PROBLEM STATEMET

The steel truss has been designed as a simply supported on column, the analysis of N- type truss has been done on the basis of relative Indian standards and SP for the flowing parameters:-

## VI. GEOMERTY OF TUBULAR TRUSS

- Span of truss (meters) = 12.95m
- Spacing between truss (meters) = 5.163m
- Roof slope = 1:6
- Height of long column = 11m
- Height of short column = 6m
- Wind zone = II
- Type of roof covering material = Polycarbonate Honeycomb Sheet-18mm thick@29.42N/m$^2$
- Location = Nanded
- Basic wind speed = 39m/s
- Height = B
- Wind Zone = II (As per IS 875-(part-3):2015)
- Rise = 1 /6 x 12.95 = 2.1626m
- Let ἀ the inclination of the roof (ἀ) =

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Tan (α̇) = rise / half of span = 2.1626 / 6.475 = 0.33

$Tan^{-1}$ = (0.33) = 18.26$^{O}$

- Length of rafter =$\sqrt{(rise)^2 + (span/2)^2}$ = 6.826m

Truss Configuration – The tubular truss configuration is selected for stadium roof is 'Howe truss' can be used.

## Analysis and Design:

The truss has been analyzed and design as per Indian standards and SP. The support of column at one end is assumed to be hinged and other end to as assumed roller for the purpose of analysis. The tubular truss has been analyzed for dead load, live load, and wind load according to IS- 875(Part-3): 2015.

**Load Calculations:**

**Dead load calculation (As per 875 (Part-I))**

Weight of Sheeting = 29.42N/m$^2$ = 0.02942 KN/m$^2$

Weight of truss = (12.95 /3+5) x 10 = 93.167 N/m$^2$

Self Weight of Truss = (wt of truss x span of truss x spacing)

= (93.167 x 12.95 x 5.163) = 6229.23 N

Dead Load on Sheeting (wt. of sheeting x spacing of truss x span of truss/Cos (θ))

= (0.02942 x 5.163 x 12.95) / cos (18.26) = 2135.2301 N

Weight of Purlin (wt of Purlin x spacing of truss x span of truss)

(Assuming Assuming the RHS-122 X 61 X 4.5mm @ 117N/m)

= (117 x 5.163 x 12.95) = 7822.71 N

Wt. of Bracing (wt of bracing x span x spacing)

(Assuming the SHS - 45 X 45 X3.6@ 43.36N/m$^2$)

= (43.36 x 12.95 x 5.163) = 2899.086 N

Total dead load on truss = (2135.2301 +7822.71+2899.086 +6229.23) = 19086.25N = 19 KN

Assuming the total 8 no of panel

DL. of each intermediate panel point = 19 / 8 = 2.375 KN

DL. of each end panel point = 2.375 / 2 = 1.187 KN

**Live load calculation (As per 875 (Part-II))**

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Live load = (750-(18.26-10) x 20) = 584.8 N/m$^2$ = 2 /3 x L.L = 2/3 x 584.8 = 389.87 N/m$^2$

Live load for truss = 389.87 x 5.163 x 12.95 = 26067.04 N = 26.068 KN

Live load per panel = 26.068 / 8 = 3.258 KN

Live load per end panel = 3.258 / 2 = 1.63 KN

**Wind load calculation (As per 875 (Part-III))**

Basic wind speed = 39m/s (for Nanded city)

Design wind speed ($V_z$) = $V_b.K_1.K_2.K_3$.K4

Where, *Vz* = design wind speed at any height z in m/s,

$V_b$ = basic wind speed in m/s

$K_1$= probability factor (risk coefficient) given in Table 1 of IS: 875(Part 3)-2015,

$K_1$ = 1.06

$K_2$= terrain, height and structure size factor and

$K_2$ = 0.981

$K_3$= topography factor.

$K_3$ = 1.252

$K_4$ = Importance factor for cyclonic region

$K_4$ = 1.30

($V_z$) = 39 x 1.06 x 0.981 x 1.252 x 1.30 = 66 m/s

$P_z = 0.6 \times V_z^2$

$P_z$ = design wind pressure in N/m$^2$

$P_z = 0.6 \times 66^2$ = 2613.6 N/m$^2$ = 2.6136 KN/m$^2$

**Wind Pressures And Forces On Stadium Structures**

Force, acting in a direction normal to the individual structural element or cladding unitis:

$F= (C_{pe} – C_{pi}) .A. P_d$

$P_d = k_d . k_c . k_a. P_Z$

Where, $K_d$ = .90

$K_a$ = 0.8

$K_c$ = 0.9

$P_d$ = 0.9 x 0.8 x 0.9 x 2.6136 = 1.7 KN/m

F= ((-0.77 – (-0.7) x 88.176 x 1.7 = - 10.4929KN ( WINDWARD SIDE)

F = (-0.77 –(0.7) x 88.176 x 1.7 = -220.351 KN

Wind load on each intermediate panel point =- 220.351 KN

Wind load on each end panel point =- 220.351 / 2 = - 110.1755 KN

**Leeward Side Pressures And Forces On Stadium Structures**

F= ($C_{pe}$ – $C_{pi}$) .A. Pd

F = (-0.8 –(0.7) x 88.176 x 1.7 = -105.729 KN

F = (-0.8-(-0.7) x 88.176 x 1.7 = 104.129 KN

Wind load on each intermediate panel point = -105.729 KN

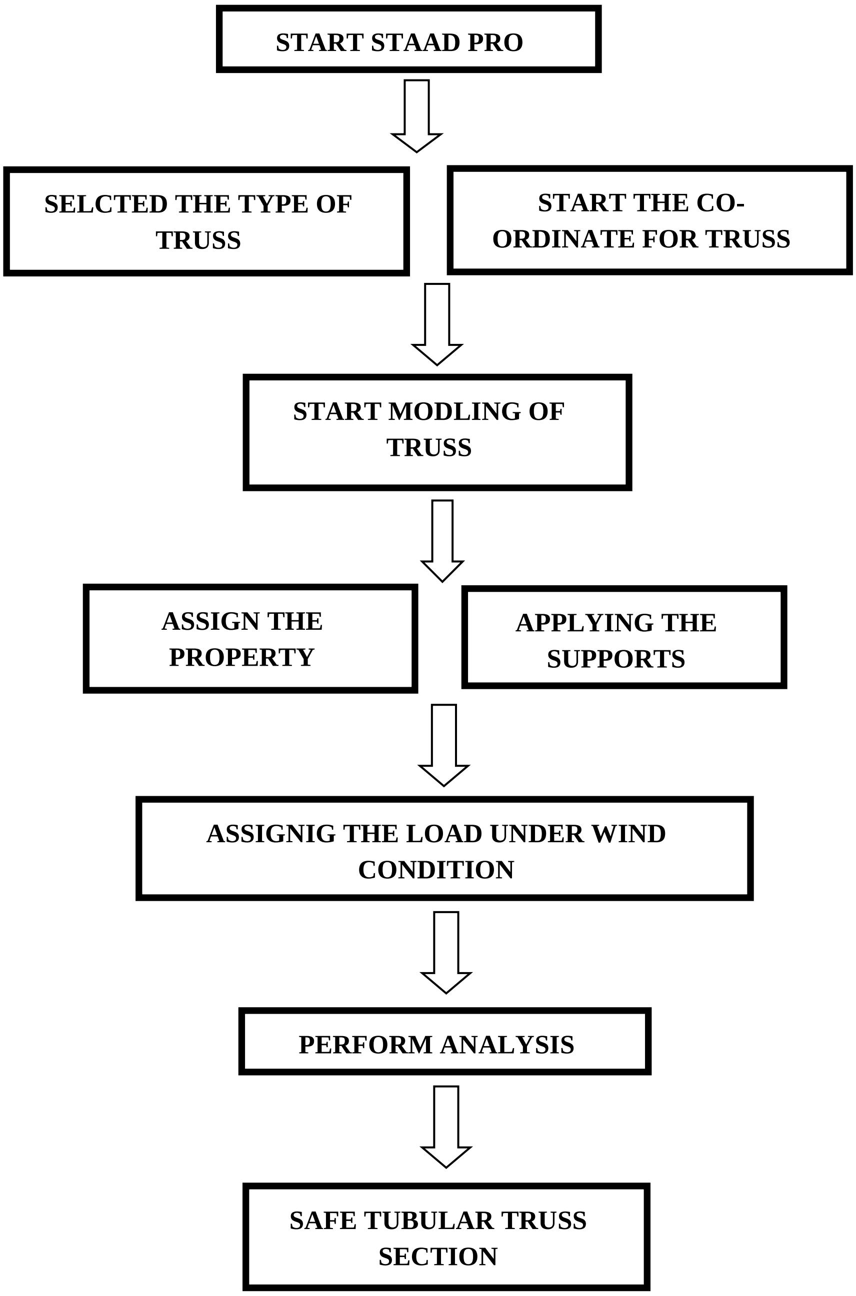
Wind load on each end panel point = -105.729 / 2 = 52.8645 KN

**Load combinations**

Following load combinations are considered in the design of the tubular roof truss :-

Load combinations 1:- (DL+LL)
Load combinations 2:- 1.5(DL+LL)
Load combinations 3:- 1.2(DL+LL+ wind load
Load combination 4:- (DL+ LL+ wind load in x+ direction)
Load combination 5:- (DL+ LL+ wind load in x- direction)
Load combination 6:- (DL+ LL+ wind load in z+ direction)
Load combination 7:- (DL+ LL+ wind load in z- direction)
Load combination 8:- (DL+ LL+ wind load in s x+ direction)
Load combination 9:- (DL+ LL+ wind load in s x- direction)
Load combination 10:- (DL+ LL+ wind load in s z+ direction)
Load combination 11:- (DL+ LL+ wind load in s z- direction)

## VII. METHODOLOGY



## VIII. CONCLUSION

In this paper we can seen the long span truss configurations and there analysis and investigation, comparison the tubular roof truss provide a long span to tubular truss of the structure design. The studies reveal that the tubular truss provides along span required less material as compare to manual calculation. This is the modern stadium can be the design as per continent facility. The response of the tubular steel structure under wind load as per IS code practice in studies. The tubular truss analysis and design IS: 800-2007, IS-4923:1997, and SP-38(S&T) codes respectively. The tubular truss 3D model in truss frame using STAAD. Pro software. The safety of the tubular truss is checks against the allowable deflections, bending moments, axial forces etc. as per code practices and some other references. The software thus design could also be easy understanding behaviours of the tubular truss. Observed on above the study of tubular truss is economical for long spans and strength wise also the more strong.

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