# COMPARISON BETWEEN VARIOUS STEEL SECTION BY USING IS CODE AND EURO CODE

**R.G. MASKE, A.V. BHANDEKAR, S.S. PHALPHALE, S.Y. SHINGADE, R.M. KAMBLE, R.A. SHIVASHARAN**

[1] *Assistant Professor, Dept. of Civil Engineering, N.K. Orchid college of engineering and technology, Solapur, Maharashtra, India*
[2,3,4,5,6] *Student, Dept. of Civil Engineering, N.K. Orchid college of engineering and technology, Solapur, Maharashtra, India*

---

**Abstract -** Now days in civil field industrial development are massively growing so for that steel structure are one of the most preferable option at it has several benefits such as recyclability, prefabrication, greater strength to weight ratio, economic, time saving, and high flexural strength. For industrial shed, a roof truss of 16m x 28m having a bay spacing of 4 m with a column height of 11m is well analyzed and designed. By taking Two code reference Indian standard code 875-1987 part (I, II and III) and European standard code EN3 1993-1-1-2005 calculation for dead load, live load and wind load are carried out manually. After the determination of load at panel and nodal point then values of load entered in software STAAD pro for analysis and design. Also along with estimation was carried out for used section. By considering Tabular section and angular section with respect to IS code and European code. After that cost comparison are performed for these sections. The aim of the project is to provide which section is economical.

***Key Words***: STAAD Pro, Roof truss, IS code, EN code, Economical.

## 1.INTRODUCTION

Trusses are Triangular Frame Works, consisting of Axially Loaded Members. They are more efficient in resisting external loads. They are extensively used for long spans.

**USES:-**

Roofs of Industrial Buildings Long Span Floors and Roofs of Multistory buildings, to resist gravity loads, Long span bridges etc.

## 2. LOAD CALCULATION

**Design of Howe Houss**

**Geometry of truss :-**

1. Span of truss = 16 m

Pitch = (1 / 5 )
Pitch = (Rise)/(Span)
(1 / 5) = (Rise / 16)
Rise = 3.0m

2. tan α = 3.2/(span / 2)
A = $\tan^{-1}$ x ( 3.2 /8 )
A = 21.80

3. Sloping length.
L = SQRT($8^2 + 3.2^2$ )
L = 8.61 m

Divide Sloping length.

Panel length = 8.61 / 6
= 1.44 m

**IS CODE**

**A. Dead load Calculation :-**

Self weight of GI Sheet = 171 $KN/m^2$

Weight of purlin = 320 $N/m^2$ (200-400 $N/m^2$ )

Weight of bracing = 13 $N/m^2$ (12-15 $N/m^2$)

Now,

a) self wt. of truss = ((L/ 3)+5) x 10

= ((16/ 3)+ 5) x 10

= 103.33 $N/m^2$

b) Dead load per $m^2$ of plain area

=Wt. of GI Sheet + wt. of bracing + self wt. of truss.

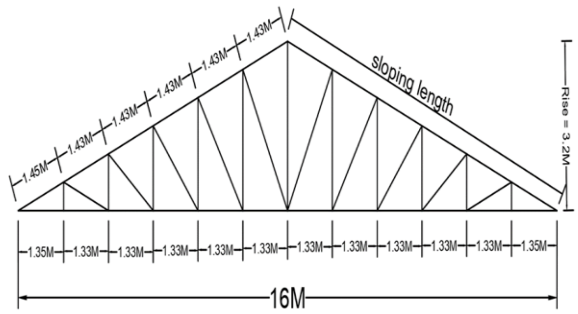
= 171 +13 + 103.33

= 287.33 $N/m^2$ of plain area

Panel length = 1.44m

α = 21.80α

Panel in length in plan = 1.44 x cos 21.80




HOWE TRUSS

= 1.33m

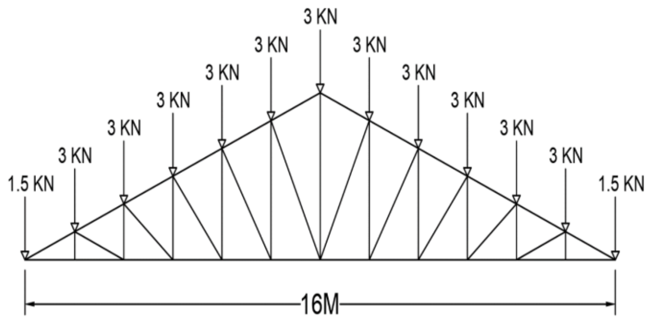
= 1.5 m

∴ Dead load on intermediate panel point

= [ Dead load per $m^2$ x Panel length in plan x Spacing ] + [ Wt. of purlin x spacing of truss ]

= [281.33 X 1.5 X 4] + [320 X 4 ]

=3003.98




DEAD LOAD

= 3 m

∴ Dead load on end panel = (3/ 2)

= 1.5 KN

**B. Live Load Calculation :-**

As α = 21.80 > 10

for this truss access in not provided.

As per table 2, page no.14 of IS 875 part II 1987

∴ Live load per $m^2$ = 0.75 – 0.002 (α – 10)

= 0.75 – 0.002 (21.80-10)

= 0.72 $KN/m^2$ > 0.4 $KN/m^2$

∴ Live load of roof truss = (2/ 3) x L.L per $m^2$

= (2/ 3) x 0.72

= 0.48 $KN/m^2$

∴ Live load on intermediate panel point

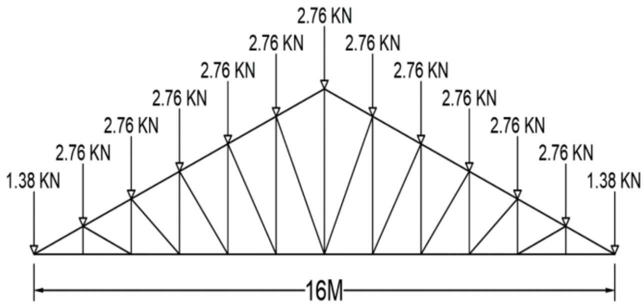
= [ Live load x Panel length in plan x spacing of truss ]

= 0.48 x 1.44 x 4

= 2.76 KN

∴ Live load at end panel Length = ( 2.76/ 2 )

= 1.38 KN




LIVE LOAD

**C. Calculation of wind load :-**

1. Basic Wind speed (Vb)

(As per IS 875 Part III, Appendix A, Page No. 53)

As building situated in pune MIDC area

∴ Vb= 39 m/ s

2. Risk coefficient (K1)

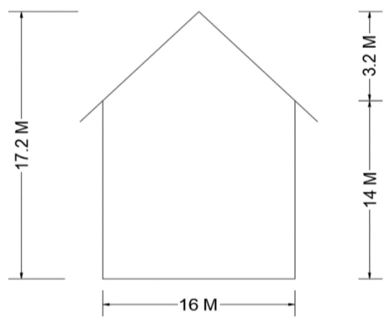
(As per table No. 1 Page No. 11 of IS 875 part III)

for all general buildings having mean probable life of 50 years.

For, Vb= 39 m/ s

K1 = 1

3. Terrain, Height, Structure size factor




As per clause No. 5.3.2 Page No.8 (IS:815 part III)

For pune MIDC area. It is terrain category III

Greatest dimension of structure is 24m

∴ It is class B

As per table No. 2 Page No. 12 (IS: 875 Part III)

| ***Height*** | ***$K_2$*** |
|---|---|
| **15** | 0.94 |
| **20** | 0.98 |
| **17.2** | ? |

$K_2$ 0.957

4. Topography factor ($K_3$) :-

As per clause No 5.3.3.1 Page No. 12 (IS: 875 Part III)

$K_3 = 1.0$

5. Design wind speed ($V_z$) :-

$Vz = V_b \times K_1 \times K_2 \times K_3$

$= 39 \times 1 \times 0.957 \times 1$

$Vz = 37.323$ m/ s

6. Design wind pressure ($P_z$)

As per clause No. 5.4 Page No.12 (IS: 815 Part III)

$P_z = 0.6 \times V_z^2$

$= 0.6 \times 37.323^2$

$P_z = 835.80$ N/m$^2$

7. Internal wind pressure coefficient (Cpi) :-

Assume,

Permeability of shed is High

∴ Cpi = + 0.7

Cpi = - 0.7

8. External wind pressure coefficient (Cpe) :-

As per Table No. 5 Page No.16 (IS: 875 Part III)

(h/w) = 14/ 16 = 0.87

As (h/w) lies in between 1/2 < h > 3/2

A = 21.8 deg

| | Wind word | | Lee word | |
|---|---|---|---|---|
| ***Wind ANGULAR*** | 0 | 90 | 0 | 90 |
| ***Face*** | EF | EG | GH | FH |
| ***Cpe*** | -0.538 | -0.8 | -0.5 | -0.638 |

∴ max Cpe = 0.8

∴ Max [Cpe - Cpi]

Cpe- Cpi = -0.8 - 0.7

= -1.5

Cpe- Cpi = -0.8 – (-0.7)

= -0.1

Max [Cpe - Cpi] = -1.5

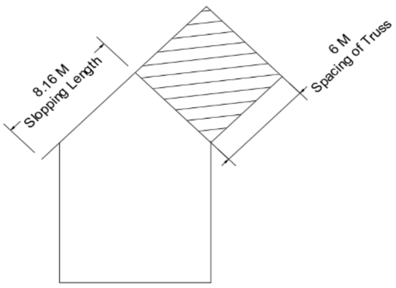
9. Wind load on indiviual member

As per clause 6.2.1 Page No. 13 (IS: 875 Part III)

F = [Cpe - Cpi] A x $P_z$

Where,

A = exposed surface area.




A = slopping length x spacing of Truss

=8.61 X 6

A = 51.66 m

∴ F= [Cpe -Cpi] A x $P_2$

F = 1.5 x 51.66 x 835.8

F = 64.76 KN (uplift)

On one side of roof truss for intermediate panel points and two end Panel point

∴ Wind load on intermediate Panel Point.

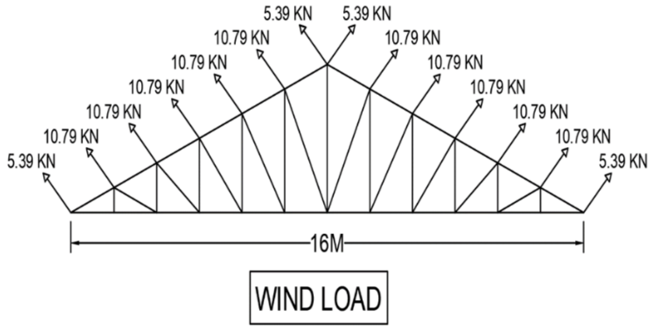
(W1/2) + W1 + W1 + W1 + W1 + W1 + (W1/ 2) = 64.76

6 W1 = 64.76

W1 = 10.79 KN

Wind load on end panel point

(W1/ 2) = (10.79/ 2) = 5.39 KN




**EURO CODE**

**A. Dead load :-**

Self-weight of long span aluminium roofing Sheet (0.55m guage thickness) =0.019 $KN/m^2$

Weight of ceiling cadopt 10 mm

Insulation fibre board = 0·077 $KN/m^2$

Weight of services =0.1 $KN/m^2$

Weight of purlin ( assume CH 150x75x18 kg/m)

=(8x4) / (1.33x4)

= 13 $kg|m^2$

= 0.132 $KN/m^2$.

Self weigh of truss (assume) = 0.2 $KN/m^2$.

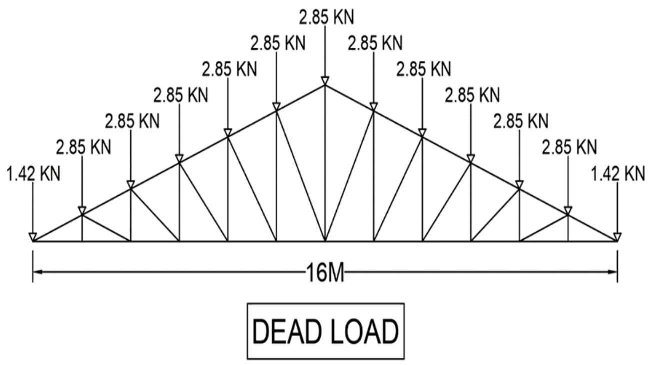
Total dead load ($q_v$) = 0.536 $KN/m^2$

The nodal dead load = 0.536x1.33x 4

=2.85 KN

∴ At end = 2.85 / 2

= 1.42 KN



**B. Calculation of live load :-**

Span of roof truss = 16m

Spacing of the truss = 4m

Nodal spacing of the truss = 1.33 KN

Category of roof :- Category H-roof not accessible except for normal maintenance and repairs ( table 6.9 EN 1991-1-1:2001)

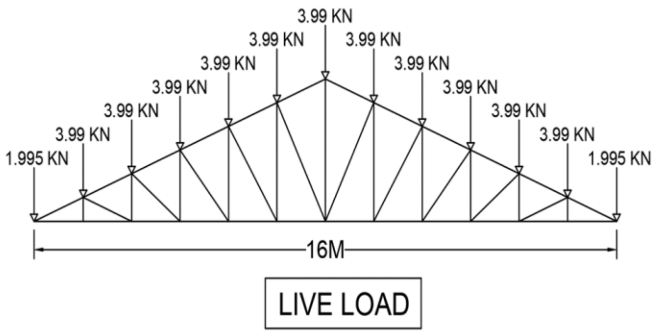
Live load on = 0.75 KN/m$^2$.

The nodal variable load (QK) = 0.75 x 1.33 x 4

= 3.99

Live load at end = 3.99 / 2

= 1.995 KN




**C. WIND LOAD CALCULATIONS :-**

Basic wind velocity = Vb = 27 m/s

Terrain category = III

Reference height from ground of the

Examined part of the structure. = Ze = 31.6m Grze

Orography factor at reference heigh (ze) = (aze) = 1.0

Terrain roughness length =Z0 = 0.5m

minimum height = Zmin = 7.0m

Air density =P = 1.25 kg/m$^3$

Calculation of peak velocity pressure :-

1.Basic wind velocity :-

Vb = Cdir. Cseason. Vb,0

Where,

Cdir & Cseason = 1.0 ...As per EN1991-1-4

Vb,0 = 22.5 m/s

qb,0 = 0.47 KN/m$^2$

2. Mean wind velocity :-

∴ Vm = Cr(ze).Co(ze). Vb

For

Ze > Zmin

31.6 > 7.0

Cr (ze) = Kr.In ( Ze/Zo)

=0.19 ( Zo/ Zo2 ) ^0.07 x In ( Ze / Zo)

= 0.19 (0.5 / 0.05 )^0.07 x In ( 31.6 / 0.5 )

Cr (ze) = 0.926

∴ Vm = 0.926 x 1 x 22.5

Vm = 20.83 m/s

3. Wind turbulence ( Iv(Ze) ) :-

For Ze > Z min

Iv(Ze) = K1 / ( CO (Ze) x In(Ze/Zo) )

= 1.0 / ( 1.0 x In(31.6/0.5)

In(Ze) =0.241

4. Basic velocity pressure :-

qb = (1/2)x P x Vb2

= (1/2) x 1.25 x22.52x10-3

qb = 0.316 KN/m$^2$.

5. Peak velocity pressure :-

qp(ze) = ( 1 +7 x In(ze) )x (1/2) x P x Vm2

= ( 1+7x0.241) x (1/2) x 1.25x10-3 x 20.832

qp(ze) = 0.728 KN/m2

The calculated value of qp(ze) corresponds to an exposure factor Cp(ze) :-

Ce(ze) = qp(ze) / qb

= 0.728 / 0.47

Ce(ze) = 1.54

Calculation of wind forces and pressure on the structure

a) Wind pressure on surfaces

We = qp(ze) Cpe

For Cpe ( Refer section 7.2.3 to 7.2.10 and 7.3 of EN1991-1-

4)

For a > 0 = 21.80 > 0

| A | ZONE F | | ZONE G | | ZONE H | | ZONE I | | ZONE J | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -Cpe | +Cpe | -Cpe | +Cpe | -Cpe | +Cpe | -Cpe | +Cpe | -Cpe | +Cpe |
| **15** | -0.9 | 0.2 | -1.5 | 0 | -0.3 | 0.2 | -0.4 | 0 | -1.5 | 0 |
| **30** | -1.5 | 0.7 | -1.5 | 0.7 | -0.2 | 0.4 | -0.4 | 0 | -0.5 | 0 |
| **21.80** | -1.17 | 0.427 | -1.5 | 0.317 | -0.25 | 0.291 | -0.4 | 0 | 1.047 | 0 |

Section 7.2.9 of EN 1991-1-4 states that cpi can be taken as the more onerous of +0.2 and -0.3

1.17-(-0.3) = 1.47

OR

1.17-02 = 0.97

∴ We = qp(ze) .Cpe

= 0.728 x 1.17

We = 0.852

∴ Wi = qp(ze) .cpi

= 0.728 x 1.47

= 1.070

b) Total wind force on structure

Fw = CsCd. Cf . qp(ze) . Aref

Where,

value CsCd is generaly taken as 1.0

Aref = sloping length x spacing of truss.

= 8.61 X.6

∴ Aref = 51.66 m

∴ cf = 0.463

∴ Fw = 1 x 0.463 x 0.728 x 51.66

= 17.41 KN

load on intermediate point.

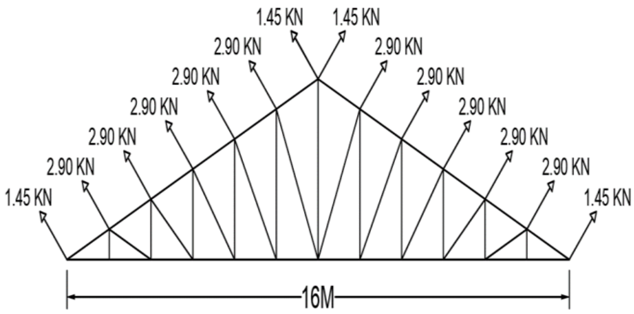
W = 17.41 / 6

= 2.90 KN

load on end point

= 2.90 / 2

= 1.45 KN




WIND LOAD

## 3. RESULTS

**INDIAN STANDARD CODE**

**BY USING ANGULAR SECTION**

Table no. 3.1 (Estimation of angular section )

| SR. No. | Section | Weight (KN/m) | Total price (Rs.) |
|---|---|---|---|
| **1** | 2 ISA 100X75X6 | 1.726 | 125780.32 |
| **2** | 2 ISA 80X8X06 | 0.791 | 26810.809 |
| **3** | 2 ISA 70X70X6 | 0.33 | 5615.3604 |
| **4** | 2 ISA 75X50X6 | 0.293 | 5105.4176 |
| **5** | 2 ISA 75X50X5 | 0.247 | 4270.2604 |
| **6** | 2 ISA 100X65X8 | 0.555 | 10476.278 |
| **7** | 2 ISA 125X75X6 | 0.515 | 9419.7974 |
| **8** | 2 ISA 90X60X6 | 0.382 | 7043.0088 |
| **9** | ISA 20X20X3 | 0.009 | 54.008411 |
| **10** | ISA 35X35X3 | 0.033 | 404.96213 |
| **11** | ISA 50X50X4 | 0.095 | 1751.4367 |
| **12** | ISA 65X65X5 | 0.205 | 4802.1578 |
| **13** | ISA 80X80X6 | 0.678 | 35794.988 |
| **14** | ISA 110X110X8 | 0.418 | 7842.7166 |
| **15** | ISA 60X60X5 | 0.127 | 2007.0204 |
| **16** | ISA 70X70X5 | 0.178 | 3507.252 |
| **17** | ISA 100X100X6 | 0.451 | 12954.032 |
| **18** | ISA 125X95X8 | 0.778 | 27187.303 |
| | **Total Weight** | | **290827.13** |

**BY USING TUBULAR SECTION**

Table no. 3.2 ( Estimation of tubular section )

| Sr. No. | Section | Weight (KN/m) | Total price (Rs,) |
|---|---|---|---|
| 1 | TUBE 113X113X4.8 | 0.831 | 30486.27 |
| 2 | TUBE 100X100X5.0 | 0.781 | 29560.24 |
| 3 | TUBE 90X90X5.4 | 0.745 | 28618.53 |
| 4 | TUBE 89X89X4.5 | 0.624 | 23617.91 |
| 5 | TUBE 127X50X3.6 | 0.244 | 4318.04 |
| 6 | TUBE 125X125X5.0 | 0.515 | 9796.58 |
| 7 | TUBE 125X125X4.5 | 0.467 | 8883.50 |
| 8 | TUBE 110X110X4.85 | 0.437 | 8568.61 |
| 9 | TUBE 25X25X2.6 | 0.053 | 1124.11 |
| 10 | TUBE 32x32x2.6 | 0.071 | 1517.47 |
| 11 | TUBE 45x45x2.6 | 0.233 | 11026.55 |
| 12 | TUBE 49x49x3.6 | 0.257 | 9079.16 |
| 13 | TUBE 75x75x4.0 | 0.269 | 5880.97 |
| 14 | TUBE 48x48x2.9 | 0.132 | 3038.200 |
| 15 | TUBE 63x63x3.2 | 0.238 | 6729.876 |
| 16 | TUBE 63x63x3.6 | 0.320 | 10996.77 |
| 17 | TUBE 75x75x3.2 | 0.409 | 16653.93 |
| | **Total Weight** | | **209896.8** |

**EUROPEN STANDARD CODE**

**BY USING ANGULAR SECTION**

Table no. 3.3 ( Estimation of angular section )

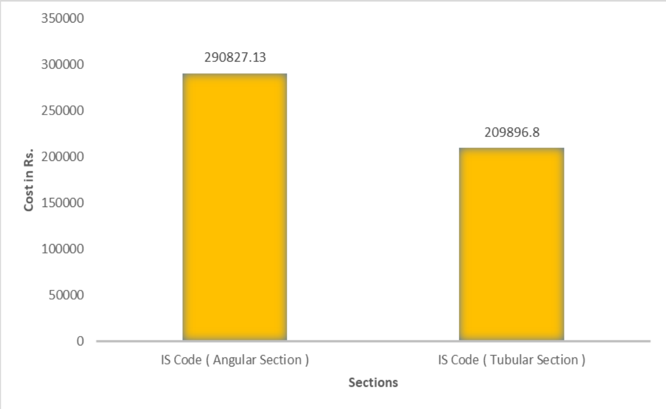
| SR No | Section | Weight (KN/m) | Total price (Rs.) |
|---|---|---|---|
| 1 | 2 L30X30X2.5 | 0.745 | 107222.36 |
| 2 | L20X20X2.5 | 0.023 | 322.12 |
| 3 | L25X25X2.5 | 0.029 | 406.15 |
| 4 | L35X35X2.5 | 0.056 | 1024.75 |
| 5 | L40X40X3 | 0.096 | 2122.82 |
| 6 | L55X55X4 | 0.273 | 8809.19 |
| 7 | L35X35X3 | 0.045 | 600.57 |
| 8 | L50X40X3 | 0.069 | 979.02 |
| 9 | L45X45X4 | 0.112 | 1916.33 |
| 10 | L60X60X5 | 0.267 | 6094.13 |
| | **Total Weight** | | **129497.48** |

**BY USING TUBULAR SECTION**

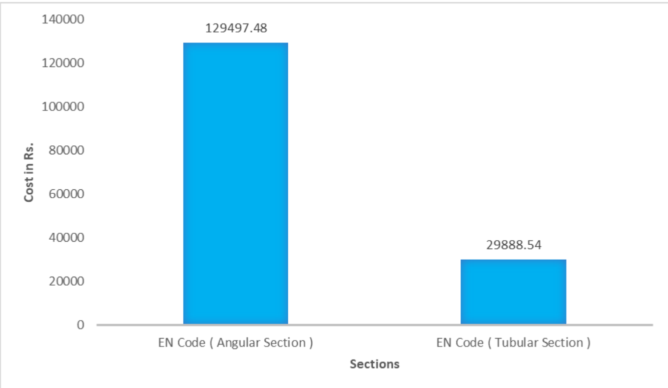
Table no. 3.4 ( Estimation of tubular section )

| Sr. No | Section | Weight (KN/m) | Total price (Rs.) |
|---|---|---|---|
| 1 | TUB 60X60X3 | 0.614 | 6004.06 |
| 2 | TUB 50X50X3 | 0.656 | 6373.40 |
| 3 | TUB 40X40X4 | 0.116 | 1169.87 |
| 4 | TUB 50X30X3 | 0.095 | 938.28 |
| 5 | TUB 40X40X3 | 0.373 | 4775.90 |
| 6 | TUB 90X50X3 | 0.375 | 3957.30 |
| 7 | TUB 40X40X2 | 0.784 | 6669.71 |
| | **Total Weight** | | **29888.54** |

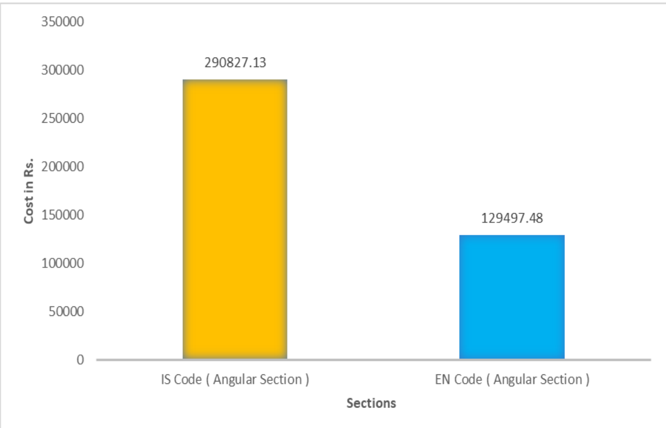
## 4. CONCLUSIONS



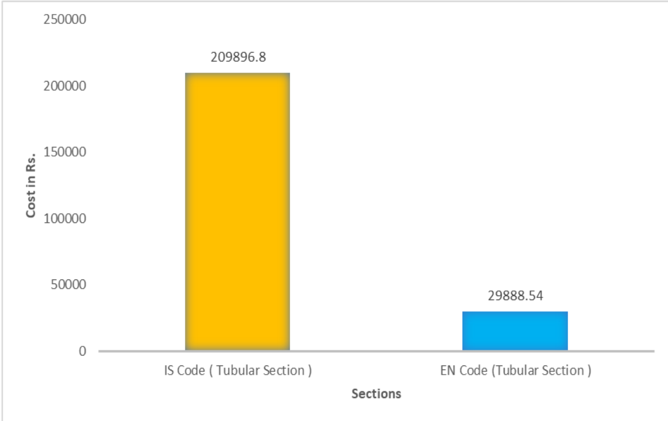

Graph 4.1 ( IS Code Angular Section vs IS Code Tubular Section )




Graph 4.2 ( Euro Code Angular Section vs Euro Code Tubular Section )




Graph 4.3 ( IS Code Angular Section vs Euro Code Angular Section )




Graph 4.4 ( IS Code Tubular Section vs Euro Code Tubular Section )

In the End of this project according to above graphs we made cost comparison with respect to sections and would like to conclude the following conclusions:

1. IS Code Angular Section vs IS Code Tubular Section
   From graph 4.1 we compared the IS code angular section with IS code Tubular section and we get the results that angular section is costly than the tubular section. So we can prefer tubular section.

2. Euro Code Angular Section vs Euro Code Tubular Section
   From graph 4.2 we compared the Euro code angular section with Euro code tubular section and we get the results that angular section is much more costly than the Euro tubular section. So we can prefer tubular section.

3. IS code angular section vs Euro code angular section
   From graph 4.3 we compared the IS code angular section with Euro code angular section and obtain results that Euro code angular section is more economical than the IS code angular section. So we can prefer Euro code angular section.

4. Is code tubular section vs Euro code Tubular Section

   From graph 4.4 we compared the IS code tubular section with Euro code tubular section and obtain results that Euro code angular section is much more economical than the IS code tubular section. So we can prefer Euro angular section.

   So we can conclude that tubular section is more economical then the angular section.

## REFERENCES

1. IS 875(Part I) – 1987: Dead Loads. Code for practice of design loads (other than earthquake) for buildings and structures.
2. IS 875(Part II) – 1987: Live Loads. Code of practice for design loads (other than earthquake) of buildings and structures.
3. IS 875(Part III) – 1987: Wind Loads. Code of practice for design loads (other than earthquake) of the buildings and structures.
4. IS 800:1984 Code of Practice (First Revision) for General Construction in Steel
5. EN 3: 1993 Code of Practice for design of steel structure
6. EN 1 (Part 1-1)-1991: Dead load and live load. Code for practice of design loads.
7. EN 1 (Part 1-4) -1991: Wind load. Code for design loads.