DATE : 21/01/16

PROJECT : 4 SLING STEEL LIFTING FRAME

Calculations done to BS2573-1-1983

Design Characteristics

Outcome

Steel Strength (Y_s)	**265**	N/mm^2
Container Load (CL)	**222.411**	kN
Steel Section	**305UKC118**	
Length of C_y	**6100**	mm
Length of C_x	**2500**	mm
Radius of Gyration of Section (R_y)	**77.7**	mm
Youngs Modulus E	**205**	Gpa
Area of section	**15000**	mm^2
Thickness of compression flange (T)	**18.7**	mm
Depth of section (D)	**314.5**	mm
Elastic Modulus X-X (z)	**1760000**	mm^3

Analysis and Design

Determining Tension in Cables

Cables will have an angle of 45 degrees to the crane hook from the quadrants

T = CL/sin45

T = 314.5366526 kN

Axial Compression in C_x : CL*Cos(67.71)

C_x = 84.35930778 kN

Axial Compression in C_y : CL*Sin(67.71)

C_y = 205.7915453 kN

Trying Steel Section : 305UKC118

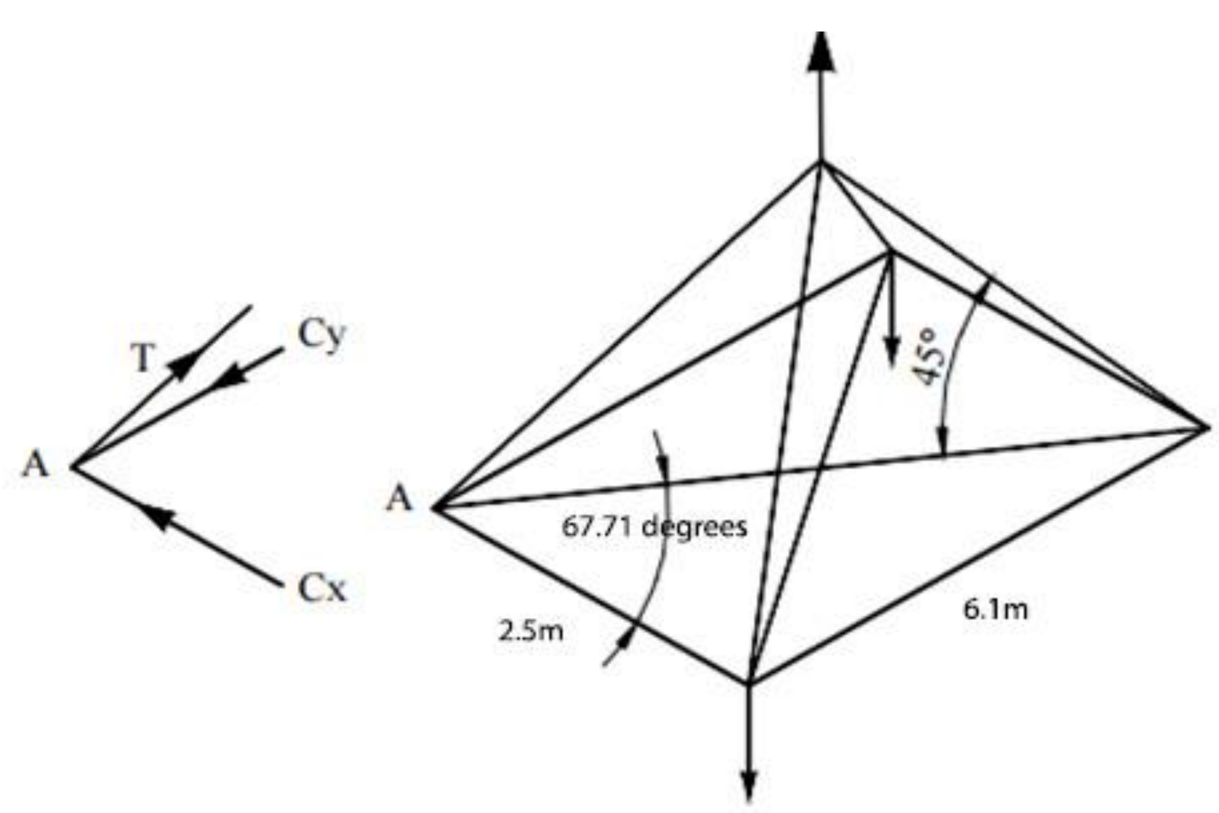


Figure 23 – Loading of Box Frame and Free body diagram

Calculating Compression Stress

According to BSI Members subjected to a combination of coexistent bending and axial compression, shall be so proportioned that:

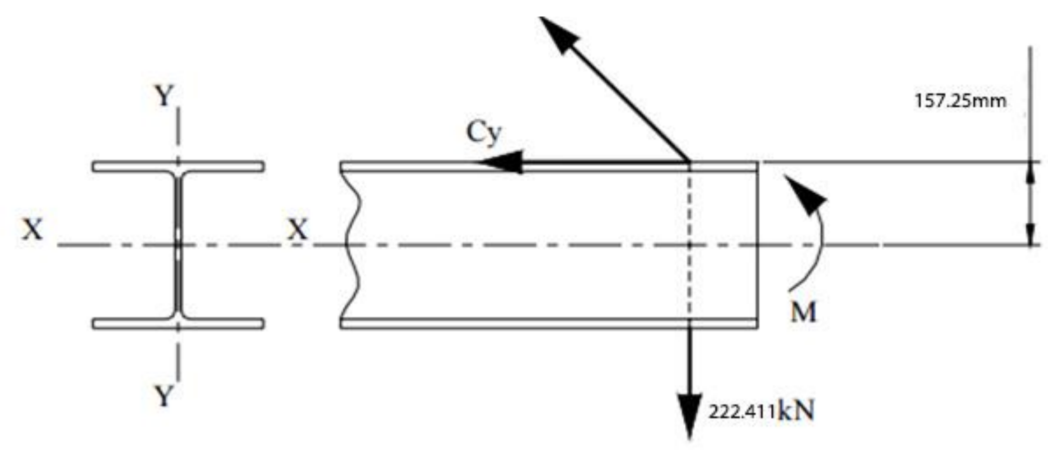
$(f_{ac}/P_{ac})+(f_{bc}/P_{bc}) \leq 1$

Where
fac is the calculated axial compressive stress
Pac is the permissible compressive stress in axially loaded compression members
fbc is the calculated maximum compressive stress in bending, using the lesser value when bending occurs about both axis

Axial compressive stress:

The axial compressive stress shall not exceed 60% of the yield strength or the value obtained from :
Pac = 0.6Fcrip

Where Fcrip is the applied stress at failure of a member subjected to overall flexural buckling due to axial compress as given by:



Where

*C_o is the Euler critical stress = (pi^2*E)/s^2*
Ys is the yield stress of the steel
E is the Youngs modulus
n is the Perry coefficient
α is the Robertson constant from BSI Table 11 (taking as 5.5)
s is the slenderness ratio
s_o is the limiting slenderness ratio for stub columns taken as 17.5
r is radius of gyration
leff is the effective length relative to the same axis

l_{eff} = 0.7*Length of Cy
= 4270 mm

s = l_{eff}/r
= 54.95495495

n = $\alpha(s-s_o) \times 10^{-3}$
= 0.206002252

$C_o = \pi^2 E/s^2$
= 669.9461474

F_{crip} = 204.40 ≤ Ys
Therefore:
$P_{ac} = 0.6 * F_{crip}$
= 122.64

f_{ac} = 13.72 N/mm^2

Calculating Bending Stress

The permissible compressive stress due to bending must not exceed 62% of the yield stress or the value of Pbcbas corresponding to Cs Section 5.1.4.2.3
The basic tensile bending stress Pbtbas shall not exceed 0.62Ys Section 5.1.4.1
Using formula for I beam sections outlined in section 5.1.4.2.3 of BSI 2573

Where
C_s is the critical stress in the compression element
l is the effective length of the compression flange
r_y is the radius of gyration about the y-y axis at the point of maximum bending moment
D is the overall depth of the member at the point of maximum bending moment.
T is the effective thickness of the compression flange

	1073.92	10.67715693	
C_s =	1330.04	N/mm^2	
Therefore P_{bc} =	0.62*Ys		
=	164.30	N/mm^2	
calculated bending stress f_{bc} =	M/z		
M =	32360720.50	Nmm	
z =	elastic modulus x-x		
f_{bc} =	18.39	N/mm^2	
Hence			
$(f_{ac}/P_{ac})+(f_{bc}/P_{bc}) \leq 1$			
=	0.22 ≤	1	PASS