Calculations for timber post/stud to BS EN1995 using C16 timber

Location: Draycott example 2.10: Timber post, offset load

PosDur	Load	kN	Factored load 6.10a	Factored load 6.10b	Offset	Moment y-y 6.10a	Moment y-y 6.10b	Moment z-z 6.10a	Moment z-z 6.10b
1 G	Axial load	20.0/1.35 = 14.81	20.00		-22.	1.01			
Total load		14.81	**20.00**			**1.01**		**0.00**	

Load offsets are measured in mm. from faces of member; moments in kNm
Load durations: G: Dead

Member length = 3.5 m

Use: **97 x 145 C16**

Cross sectional area = 14,065 mm^2 Z_{yy} = 339.9 cm^3

Timber grade: C16

Loading duration factor, k_{mod} = 0.8 [EC5 Table 3.1] K_{sys} (load sharing factor) = 1.0
Material partial factor, γ_m = 1.3 [EC3 NA Table NA.3]
Grade compression stress, $f_{c.0.k}$ = 17.0 N/mm²
Design compressive strength, $f_{c.0.d} = k_{mod}.k_{sys}.f_{c,0,k}/\gamma_m$ = 0.8 x 1.0 x 17.0/1.3 = 10.46 N/mm^2
Grade bending stress, $f_{m.k}$ = 16.0 N/mm^2
Design bending strength, $f_{m.d} = k_{mod}.k_{sys}.f_{m.k}/\gamma_m$ = 0.8 x 1.0 x 16.0/1.3 = 9.85 N/mm^2
Depth factors, $k_{h.y}$ = (150/145)^0.2 = 1.01; $k_{h.z}$ = (150/97)^0.2 = 1.09 [EC5 3.2]
Applying k_h depth factors $f_{m,y,d}$ = 1.01 x 9.85 = 9.91 N/mm^2 $f_{m,z,d}$ = 1.09 x 9.85 = 10.74 N/mm^2

Compression y-y axis

Applied compressive stress, $\sigma_{c.0.d}$ = 20.0 x 1000/(97 x 145) = 1.42 N/mm^2
Effective length = L_{Ey} = 1.0L = 3.5 m
Slenderness, λ_y = 3.5 x 1000/(145/√12) = 83.6 $\lambda_{rel,y}$ = 1.49
k_y = 1.73 $k_{c.y}$ = 0.382
Permissible compressive stress = $k_{c.y}.f_{c.0.d}$ = 0.382 x 10.46 = 4.00 N/mm^2
Ultimate axial load capacity = 4.00 x 97 x 145 = 56.2 kN

Compression z-z axis

Applied compressive stress, $\sigma_{c.0.d}$ = 20.0 x 1000/(97 x 145) = 1.42 N/mm^2
Effective length = L_{Ez} = 1.0L = 3.5 m
Slenderness, λ_y = 3.5 x 1000/(97/√12) = 125 $\lambda_{rel,z}$ = 2.23
k_z = 3.18 $k_{c.z}$ = 0.183
Permissible compressive stress = $k_{c.z}.f_{c.0.d}$ = 0.183 x 10.46 = 1.92 N/mm^2
Ultimate axial load capacity = 1.92 x 97 x 145 = 27.0 kN <<< OK

Bending about y-y axis:

Elastic section modulus, W_{yy} = 97 x 145^2/(6 x 1000) = 339.9 cm^4

Applied moment = 1.01 kNm
Design bending stress, $\sigma_{m.y.d}$ = 1.01 x 1000/339.9 = 2.97 N/mm^2
Moment capacity = 9.91 x 339.9/1000 = 3.37 kNm OK

Bending about z-z axis:

N/A

Combined compression and bending

Ratios: Buckling y-axis : 1.42/4.00 = 0.356
Buckling z-axis : 1.42/1.92 = 0.742
Bending y-axis : 2.97/9.91 = 0.300
Bending z-axis : 0.00/10.74 = 0.000

Check 1: 0.356 + 0.300 + 0.7 x 0.000 = 0.655 <= 1.0 OK

Check 2: 0.742 + 0.7 x 0.300 + 0.000 = 0.952 <= 1.0 OK