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

Location: Draycott example 2.10: Timber post, axially loaded

Pos	Dur	Load	kN	Factored	Offset	Moment y-y	Moment z-z
				6.10		6.10	6.10
1	G	Axial load	20.0/1.35 = 14.81	20.00	-22.5	1.00	
Total load			14.81	20.00		1.00	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

Grade properties:

Loading duration factor, k_{mod} = 0.8 [EC5 Table 3.1] K_{sys} (load sharing factor) = 1.0
Material partial factor, g_m = 1.3 [EC3 NA Table NA.3]
Grade compression stress, $f_{c,0,k}$ = 17.0 N/mm^2
Design compressive strength, $f_{c,0,d} = k_{mod}.k_{sys}.f_{c,0,k}/g_m$ = 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, $f_{m,d} = k_{mod}.k_{sys}.f_{m,k}/g_m$ = 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

Design compressive stress, $s_{c,0,d}$ = 20.00 x 1000/(97 x 145) = 1.42 N/mm^2
Effective length = L_{Ey} = 1.0L = 3.5 m
Slenderness, $l_y = 3.5 \times 1000/(145/\sqrt{12})$ = 83.6
$l_{rel,y} = (l_y/p)\sqrt{(f_{c,O,k}/E_{0.05})} = (83.6/p)\sqrt{(17.0/5,400)}$ = 1.49 [EC5 6.3.2 Eq.(6.21)]
$k_y = 0.5(1+ B_c(l_{rel,y} - 0.3) + l_{rel,y}^2) = 0.5 \times (1+ 0.2 \times (1.49 - 0.3) + 1.49^2)$ = 1.73 [EC5 6.3.2 Eq.(6.27)]
B_c is 0.2 for solid timber, 0.1 for glulam and LVL [EC5 6.3.2 Eq.(6.29)]
$k_{c,y} = 1/(k_y + \sqrt{(k_y^2 - l_{rel,y}^2)}) = 1/(1.73 + \sqrt{(1.73^2 - 1.49^2)})$ = 0.382 [EC5 6.3.2 Eq.(6.25)]
Design compressive strength = $k_{c,z}.f_{c,0,d}$ = 0.382 x 10.46 = 4.00 N/mm^2
Design axial load resistance = 4.00 x 97 x 145/1000 = 56.2 kN OK

Compression z-z axis

Design compressive stress, $s_{c,0,d}$ = 20.00 x 1000/(97 x 145) = 1.42 N/mm^2
Effective length = $L_{e,z}$ = 1.0L = 3.5 m
Slenderness, $l_z = 3.5 \times 1000/(97/\sqrt{12})$ = 125
$l_{rel,z} = (l_z/p)\sqrt{(f_{c,O,k}/E_{0.05})} = (125/p)\sqrt{(17.0/5,400)}$ = 2.23 [EC5 6.3.2 Eq.(6.22)]
$k_z = 0.5(1+ B_c(l_{rel,z} - 0.3) + l_{rel,z}^2) = 0.5 \times (1+ 0.2 \times (2.23 - 0.3) + 2.23^2)$ = 3.18 [EC5 6.3.2 Eq.(6.28)]
B_c is 0.2 for solid timber, 0.1 for glulam and LVL [EC5 6.3.2 Eq.(6.29)]
$k_{c,z} = 1/(k_z + \sqrt{(k_z^2 - l_{rel,z}^2)}) = 1/(3.18 + \sqrt{(3.18^2 - 2.23^2)})$ = 0.183 [EC5 6.3.2 Eq.(6.26)]
Design compressive strength = $k_{c,z}.f_{c,0,d}$ = 0.183 x 10.46 = 1.92 N/mm^2
Design axial load resistance = 1.92 x 97 x 145/1000 = 27.0 kN <<< OK

Bending about y-y axis:

Design bending strength, $f_{m,y,d}$ = 9.91 N/mm^2
Elastic section modulus, $W_{yy} = 97 \times 145^2/(6 \times 1000)$ = 340 cm^4

Design bending moment = 1.00 kNm
Design bending stress, $s_{m,y,d}$ = 1.00 x 1000/340 = 2.94 N/mm^2 OK

Moment resistance = 9.91 x 340/1000 = 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 : 2.94/9.91 = 0.297
Bending z-axis : 0.00/10.74 = 0.000

Check $(s_{c,0,d}/f_{c,0,d})^2 + (s_{m,y,d}/f_{m,y,d}) + k_m(s_{m,z,d}/f_{m,z,d}) <= 1$ [EC5 6.2.4 Eq.(6.19)]
and $(s_{c,0,d}/f_{c,0,d})^2 + k_m(s_{m,y,d}/f_{m,y,d}) + (s_{m,z,d}/f_{m,z,d}) <= 1$ [EC5 6.2.4 Eq.(6.20)]
For rectangular solid wood, glulam and LVL sections k_m = 0.7 [EC5 6.1.6]

Check 1: 0.356 + 0.297 + 0.7 x 0.000 = 0.652 <= 1.0 OK

Check 2: 0.742 + 0.7 x 0.297 + 0.000 = 0.949 <= 1.0 OK

Notes

You can add your own notes if desired