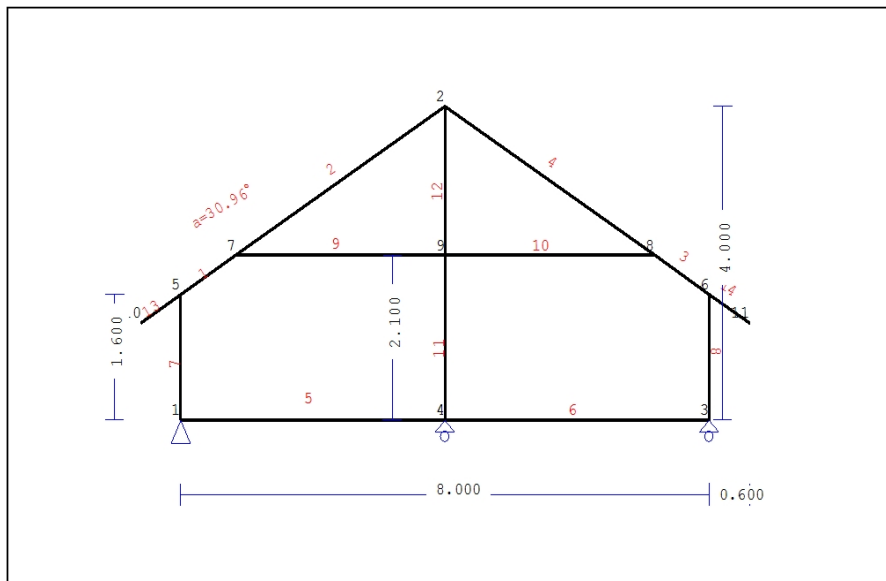


1. TETTO-02

Tetto ad assito su travetti



1.1. Descrizione tecnica

1.1.1. Tipologia costruttiva

Tetto in legno C22. La tipologia della capriata è illustrata nel disegno soprastante.

Luce della capriata 8.000m, altezza 4.000m, inclinazione 30.96°, interasse delle capriate 1.100m

Travetti in legno di classe C22, con dimensioni 75x100 mm, ad interasse 0.300 m

Sezione degli elementi della capriata BxH [mm]

Elementi 1, 2, 3, 4, sezione 63x200 [mm]

Elementi 5, 6, sezione 75x225 [mm]

Elementi 7, 8, sezione 63x200 [mm]

Elementi 9, 10, sezione 63x200 [mm]

Elementi 11,12, sezione 63x200 [mm]

Volume della capriata =0.441 m³, peso proprio della capriata =1.470 kN

1.1.2. Normative di calcolo

Norme Tecniche per le Costruzioni (DM2008)

UNI EN1990-1-1:2004, Eurocodice 0 Parte 1-1, Basi di calcolo

UNI EN1991-1-1:2004, Eurocodice 1 Parte 1-1, Azioni sulle strutture

DM2008, §3.4, Azioni della neve

DM2008, §3.3, Azioni del vento

UNI EN1995-1-1:2009, Eurocodice 5 Parte 1-1, Progettazione delle strutture di legno

1.1.3. Metodo di calcolo

Gli sforzi interni alla capriata sono calcolati mediante analisi ad elementi finiti. La capriata è considerata come un elemento trave reticolare a due dimensioni. La rigidezza delle unioni è modulata secondo il grado desiderato di rigidezza. Per calcolare il valore di progetto degli sforzi interni, gli sforzi interni sono dapprima calcolati come sforzi unitari e successivamente, dalle loro combinazioni si ottengono gli sforzi interni nelle varie condizioni di carico. Tutte le combinazioni di carico previste dall'Eurocodice 5 sono considerate, e le verifiche sono svolte nelle condizioni di carico più sfavorevoli, per le combinazioni di carico, allo stato limite ultimo di progetto, secondo EN1995-1-1, §6. Le giunzioni sono considerate come unioni con viti con piastre metalliche e sono dimensionate secondo EN1995-1-1, §8. In aggiunta le deformazioni sono verificate nello stato limite di servizio, secondo UNI EN1995-1-1:2009, §7.

1.1.4. Proprietà dei materiali (capriata, travetti) (NTC-DM2008, §4.4)

Classe del legno : C22

Classe di servizio : Classe 1, umidità $\leq 12\%$ (DM2008 §4.4.5)

Coefficiente del materiale $\gamma_M = 1.50$ (DM2008 T.4.4.III)

Valori caratteristici del legname

$f_{mk} = 22.0$ MPa, $f_{t0k} = 13.0$ MPa, $f_{t90k} = 0.4$ MPa

$f_{c0k} = 20.0$ MPa, $f_{c90k} = 2.4$ MPa, $f_{vk} = 3.8$ MPa

$E_{0m} = 10000$ MPa, $E_{005} = 6700$ MPa, $E_{90m} = 330$ MPa

$G_m = 630$ MPa, $\rho_k = 340$ Kg/m³

1.1.5. Carichi distribuiti sulla copertura

Carico permanente del manto di copertura $G_e = 0.500$ kN/m² (Tegole)

Travetti, assito, isolamento $G_t = 0.100$ kN/m² $G_e + G_t = 0$

Peso del controsoffitto del tetto $G_c = 0.100$ kN/m²

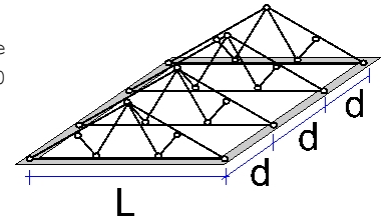
Carico della neve sul terreno $S_k = 1.500$ kN/m²

Pressione del vento sulle superfici vert. $Q_w = 0.754$ kN/m²

Peso permanente sul solaio del sottotetto $G_f = 0.500$ kN/m²

Carico utile sul solaio del sottotetto $Q_f = 2.000$ kN/m²

Carico (categoria H) $Q_i = 0.500$ kN/m²

**1.2. Azioni della neve (DM2008, §3.4)**

Carico neve al suolo S_k (DM2008, §3.4.2)

Classe di importanza 1, vita utile 50 anni, periodo di ritorno 500 anni (§3.3.2)

Zona climatica : I , altitudine del suolo sul livello del mare = 200 m

$q_{sk} = 1.500$ kN/m² ($a_s = 200 \leq 200$ m)

Valore di riferimento del carico neve al suolo: $s_k = q_{ref}(T) = 1.500$ kN/m²

Carico neve sulla copertura (DM2008, §3.4.5)

Inclinazione del tetto : $\alpha = 30.964^\circ$

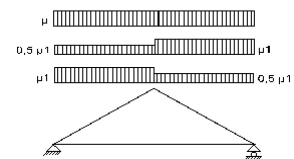
Coefficiente di esposizione : $C_e = 1.000$ (DM2008 §5.2(7))

Coefficiente termico : $C_t = 1.000$ (DM2008 §5.2(8))

Fattori di forma, $\alpha_1 = \alpha_2 = 30.96^\circ$, $\mu_1(\alpha_1) = \mu_1(\alpha_2) = 0.774$ (Tab. 3.4.II)

$S(\alpha_1) = \mu_1(\alpha_1) \cdot C_e \cdot C_t \cdot S_k = 0.774 \times 1.00 \times 1.00 \times 1.500 = 1.161$ kN/m² (§3.4.1)

$S(\alpha_2) = \mu_1(\alpha_2) \cdot C_e \cdot C_t \cdot S_k = 0.774 \times 1.00 \times 1.00 \times 1.500 = 1.161$ kN/m²



Azioni della neve (DM2008, §3.4.1)

Combinazione di carico (I), $S(\text{Sinistra}) = S(\alpha_1) = 1.161$ kN/m², $S(\text{Destra}) = S(\alpha_2) = 1.161$ kN/m²

Combinazione di carico (II), $S(\text{Sinistra}) = 0.5 \times S(\alpha_1) = 0.581$ kN/m², $S(\text{Destra}) = S(\alpha_2) = 1.161$ kN/m²

Combinazione di carico (III), $S(\text{Sinistra}) = S(\alpha_1) = 1.161$ kN/m², $S(\text{Destra}) = 0.5 \times S(\alpha_2) = 0.581$ kN/m²

1.3. Azioni del vento (DM2008 §3.3)

Pressione del vento $q_b(z) = C_e(z) \cdot V_b^2 / 1.6$ (DM2008 §3.3.6)

Classe di importanza 1, vita utile 50 anni, periodo di ritorno 500 anni (§3.3.2)

Zona: 1, $V_b = 25.00$ m/s ($a_s = 500 < a_o = 1000$ m), $V_b = 25$ m/s, $a_o = 1000$ m, $K_a = 0.012$ (1/s) (Tab. 3.3.I)

Velocità di riferimento, $T_r = 500$ anni (§3.3.2)

Classe di rugosità del terreno = D, $10 \text{ km} < \text{distanza costa} < 30 \text{ km}$, altitudine di riferimento = 500 m

Categorie di esposizione del sito: II, $k_r = 0.19$, $z_o = 0.05$ m, $z_{min} = 4.00$ m (Tab. 3.3.II)

Coefficiente di topografia : $C_t = 1.000$ (§3.3.7)

Coefficiente di esposizione: $C_e = 0.19^2 \times 1.000 \times \ln(5/0.05) \times [7 + 1.000 \times \ln(5/0.05)] = 1.929$ (§3.3.7)

Pressione del vento sulla superficie verticale: $Q_{ref} \cdot C_e = 0.001 \times (25.00^2 / 1.6) \times 1.929 = 0.754$ kN/m²

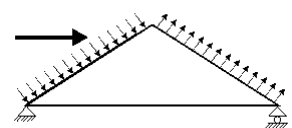
Pressione del vento $p_f = C_p \cdot q_b$ (DM2008, §3.3.7.1)

Coefficiente di forma C_p (DM2008 §3.3.7.1)

Con inclinazione $\alpha = 30.96^\circ$, $C_p(+) = -0.07$, $C_p(-) = -0.40$

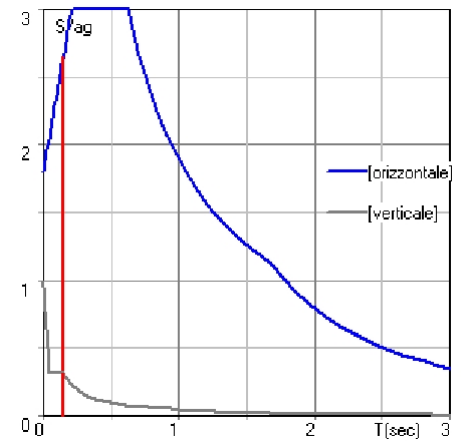
Pressione del vento $p_f(\text{Sinistra}) = -0.054$ kN/m²

Pressione del vento $p_f(\text{Destra}) = -0.302$ kN/m²



1.4. Azione sismica (DM2008, §3.2)

Accelerazione orizzontale (§3.2.3.2.1)	$a_g/g=0.02$
Fattore d'importanza (§3.2.1)	$\gamma_i=1.00$
Fattore di suolo [orizzontale] (§3.2.3.2.1)	$S_o=1.80$
Fattore di suolo [verticale]	$S_v=1.00$
Fattore di struttura [orizzontale] (§7.3.1)	$q_o=1.50$
Fattore di struttura [verticale]	$q_v=1.50$
Fattore di spettro [orizzontale] (§3.2.3.1)	$\beta_o(T)=2.21$
Fattore di spettro [verticale] (§3.2.3.2.2)	$\beta_v(T)=0.48$
Fattore di correzione (§7.3.3.2)	$\lambda=1.00$
Distribuzione della forza $\zeta=z_i W_i / \sum z_j W_j$ (§7.3.3.2)	$\zeta=1.00$
Primo periodo di vibrazione (§7.3.3.2)	$T(\text{sec})=0.15$
Fattore di combinazione carichi accidentali	$\psi_2=0.30$
Fattore di combinazione carico da neve	$\psi_2=0.20$
Periodi di spettro [orizzontale]: $T_b=0.21\text{sec}$, $T_c=0.63\text{sec}$, $T_d=1.68\text{sec}$	
Periodi di spettro [verticale] : $T_b=0.05\text{sec}$, $T_c=0.15\text{sec}$, $T_d=1.00\text{sec}$	



Orizzontale : $F_o = a_g \cdot \gamma_i \cdot S_o \cdot \beta_o(T) \cdot \lambda \cdot \zeta / q_o$
 $F_o = g \times 0.02 \times 1.00 \times 1.80 \times 2.21 \times 1.00 \times 1.00 / 1.50 = 0.053 \times g$ (DM2008 §3.2.3.2.1)

Verticale : $F_v = a_g \cdot \gamma_i \cdot S_v \cdot \beta_v(T) \cdot \lambda \cdot \zeta / q_v$
 $F_v = g \times 0.02 \times 1.00 \times 1.00 \times 0.48 \times 1.00 \times 1.00 / 1.50 = 0.006 \times g$ (DM2008 §3.2.3.2.2)

1.5. Progettazione dei travetti

Sistema strutturale dei travetti

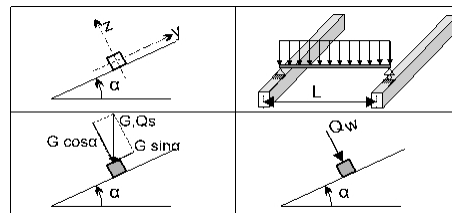
I travetti sono progettati come travi semplicemente appoggiate con luce $L=1.100\text{m}$ che è la distanza tra le capriate. Essi sono sottoposti ad un carico di superficie di larghezza $L_1=0.300\text{m}$ (interasse tra i travetti). L'asse dei travetti ha un'inclinazione $\alpha=30.96^\circ$ sulla verticale. I carichi verticali (peso proprio, neve, peso del carpentiere) sono scomposti in due componenti nelle direzioni z-z $P \cdot \cos\alpha$, e y-y $P \cdot \sin\alpha$, la pressione del vento agisce nella direzione z-z.

Dimensioni dei travetti

Specie legnosa dei travetti: C22, Classe 1, umidità $\leq 12\%$, sezione dei travetti BxH: 75x100mm
Interasse dei travetti 0.300m, inclinazione della falda $\alpha=30.96^\circ$, interasse delle capriate 1.100m.

Carico uniformemente distribuito sui travetti kN/m^2

Manto di copertura $G_e = 0.500 \text{ kN/m}^2$
Assito+peso proprio $G_l = 0.100 \text{ kN/m}^2$
Carico neve $Q_s = 1.161 \text{ kN/m}^2$
Carico da vento $Q_w = -0.054 \text{ kN/m}^2$
Peso del carpentiere $Q_p = 1.200 \text{ kN}$



Carico lineare sui travetti (kN/m) in z-z e y-y

Manto di copertura+peso proprio $G_k = 0.180 \text{ kN/m}$, $G_{kz} = 0.154 \text{ kN/m}$, $G_{kez} = 0.093 \text{ kN/m}$
Carico neve $Q_{ks} = 0.348 \text{ kN/m}$, $Q_{ksz} = 0.299 \text{ kN/m}$, $Q_{ksy} = 0.179 \text{ kN/m}$
Carico da vento $Q_{kw} = -0.016 \text{ kN/m}$, $Q_{kwz} = -0.016 \text{ kN/m}$, $Q_{kwy} = 0.000 \text{ kN/m}$
Peso del carpentiere $Q_{kp} = 1.200 \text{ kN}$, $Q_{kpz} = 1.029 \text{ kN}$, $Q_{kpy} = 0.617 \text{ kN}$

Sforzi interni nei travetti (luce $L=1.100 \text{ m}$, BxH: 75x100 mm)

Carico	Azione	γ_g	γ_q	ψ_0	$Q_z [\text{kN}]$	$Q_y [\text{kN}]$	$M_y [\text{kNm}]$	$M_z [\text{kNm}]$	
(Gk) Permanente	$G_k = 0.180 [\text{kN/m}]$	Permanente	1.30	0.00	1.00	0.085	0.051	0.023	0.014
(Qk1) Neve	$Q_{ks} = 0.348 [\text{kN/m}]$	Breve	0.00	1.50	0.70	0.164	0.099	0.045	0.027
(Qk2) Vento	$Q_{kw} = -0.016 [\text{kN/m}]$	Breve	0.00	1.50	0.60	-0.009	0.000	-0.002	0.000
(Qk3) Carpentiere	$Q_{kp} = 1.200 [\text{kN}]$	Istantaneo	0.00	1.00	0.00	0.514	0.309	0.283	0.170

1.5.1. Stato limite di servizio (UNI EN1995-1-1:2009, §2.2.3, §7)

Deformazione a flessione (EC5 §7.2)

Carico $[\text{kN/m}]$	$u [\text{mm}]$	Azione	ψ_0	ψ_1	ψ_2	K_{def}
(Gk) Permanente $G_k = 0.154 [\text{kN/m}]$	0.020	Permanente	1.00	1.00	1.00	0.60
(Qk1) Neve $Q_{ks} = 0.299 [\text{kN/m}]$	0.038	Breve	0.70	0.50	0.20	0.60
(Qk2) Vento $Q_{kw} = -0.016 [\text{kN/m}]$	-0.002	Breve	0.60	0.20	0.00	0.60

Combinazione di carico	w.inst	w.fin [mm]
1 Gk	0.020	0.031
2 Gk + Qk1	0.057	0.074
3 Gk + Qk2	0.020	0.031
4 Gk + Qk1 + $\psi_0 \cdot Qk2$	0.057	0.074
5 Gk + Qk2 + $\psi_0 \cdot Qk1$	0.046	0.062

$w_{fin, g} = w_{inst, g}(1 + k_{def})$, $w_{fin, q} = w_{inst, q}(1 + \psi_2 \cdot k_{def})$ (EC5 §2.2.3, Eq.2.3, Eq.2.4)

Massimi valori della freccia

$w_{inst} = 0.057 \text{ mm}$, $w_{fin} = 0.074 \text{ mm}$

Verifica secondo UNI EN1995-1-1:2009 §7.2, Tab.7.2Deformazioni finali

$w_{inst} = 0.057 \text{ mm} < L/300 = 1100/300 = 3.667 \text{ mm}$

$w_{net,fin} = 0.074 \text{ mm} < L/250 = 1100/250 = 4.400 \text{ mm}$

$w_{fin} = 0.074 \text{ mm} < L/150 = 1100/150 = 7.333 \text{ mm}$

La verifica è soddisfatta

1.5.2. Verifica dei travetti, Stato limite ultimo di progetto (UNI EN1995-1-1:2009, §6)

L.C.	Combinazione di carichi	classe di durata	kmod	Qz/Kmod	Qy/Kmod	My/Kmod	Mz/Kmod
1	yg.Gk	Permanente	0.60	0.184	0.110	0.051	0.030
2	yg.Gk + yq.Qk1	Breve	0.90	0.397	0.238	0.109	0.065
3	yg.Gk + yq.Qk2	Breve	0.90	0.123	0.074	0.034	0.020
4	yg.Gk + yq.Qk3	Istantaneo	1.00	0.625	0.375	0.313	0.188
5	yg.Gk + yq.Qk1 + yq.ψo.Qk2 + yq.	Breve	0.90	0.397	0.238	0.109	0.065
6	yg.Gk + yq.Qk2 + yq.ψo.Qk1 + yq.	Breve	0.90	0.314	0.189	0.086	0.052
	Valori massimi			0.625	0.375	0.313	0.188

Travetto, combinazione di carico No 4**Taglio, Fv=0.625 kN** (EC5 §6.1.7)

Sezione rettangolare, bef=0.67x75=50 mm, h=100 mm, A= 5 000 mm²

Coefficiente di correzione Kmod=1.00 (Tab.3.1), coefficiente del materiale γM=1.50 (Tab. 2.3)

fvk=3.80 N/mm², fvd=Kmod·fvk/γM=1.00x3.80/1.50=2.53N/mm² (EC5 Eq.2.14)

Fv=0.625 kN, tv0d=1.50Fv0d/Anetto=1000x1.50x0.625/5000=0.19N/mm² < 2.53N/mm²=fv0d (Eq.6.13)

La verifica è soddisfatta

Travetto, combinazione di carico No 4**Taglio, Fv=0.375 kN** (EC5 §6.1.7)

Sezione rettangolare, bef=0.67x100=67 mm, h=75 mm, A= 5 025 mm²

Coefficiente di correzione Kmod=1.00 (Tab.3.1), coefficiente del materiale γM=1.50 (Tab. 2.3)

fvk=3.80 N/mm², fvd=Kmod·fvk/γM=1.00x3.80/1.50=2.53N/mm² (EC5 Eq.2.14)

Fv=0.375 kN, tv0d=1.50Fv0d/Anetto=1000x1.50x0.375/5025=0.11N/mm² < 2.53N/mm²=fv0d (Eq.6.13)

La verifica è soddisfatta

Travetto, combinazione di carico No 4**Flessione, Myd=0.313 kNm, Mzd=0.188 kNm** (EC5 §6.1.6)

Sezione rettangolare, b=75mm, h=100mm, A=7.500E+003mm², Wy=1.250E+005mm³, Wz=9.375E+004mm³

Coefficiente di correzione Kmod=1.00 (DM2008 T.4.4.IV), coefficiente del materiale γM=1.50 (DM2008

fmyk=22.00 N/mm², fmyd=Kmod·fmyk/γM=1.00x22.00/1.50=14.67N/mm²

fmzk=22.00 N/mm², fmzd=Kmod·fmzk/γM=1.00x22.00/1.50=14.67N/mm²

Sezione rettangolare Km=0.70 (EC5 §6.1.6.(2))

omyd=Myd/Wmy,netto=1E+06x0.313/1.250E+005= 2.51 N/mm²

omzd=Mzd/Wmz,netto=1E+06x0.188/9.375E+004= 2.01 N/mm²

omyd/fmyd+Km. omzd/fmzd=0.171+0.096= 0.27 < 1 (EC5 Eq.6.11)

Km.omyd/fmyd+omzd/fmzd=0.120+0.137= 0.26 < 1 (EC5 Eq.6.12)

La verifica è soddisfatta

Travetto, combinazione di carico No 4**Stabilità laterale, Myd=0.313 kNm, Mzd=0.188 kNm** (EC5 §6.3.3)

Sezione rettangolare, b=75mm, h=100mm, A=7.500E+003mm², Wy=1.250E+005mm³, Wz=9.375E+004mm³

Coefficiente di correzione Kmod=1.00 (DM2008 T.4.4.IV), coefficiente del materiale γM=1.50 (DM2008

fc0k=20.00 N/mm², fc0d=Kmod·fc0k/γM=1.00x20.00/1.50=13.33N/mm²

fmyk=22.00 N/mm², fmyd=Kmod·fmyk/γM=1.00x22.00/1.50=14.67N/mm²

fmzk=22.00 N/mm², fmzd=Kmod·fmzk/γM=1.00x22.00/1.50=14.67N/mm²

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))
 $\sigma_{myd} = M_{yd}/W_{my, netto} = 1E+06 \times 0.313 / 1.250E+005 = 2.51 \text{ N/mm}^2$
 $\sigma_{mzd} = M_{zd}/W_{mz, netto} = 1E+06 \times 0.188 / 9.375E+004 = 2.01 \text{ N/mm}^2$

Lunghezza libera di inflessione S_k

$S_{ky} = 1.00 \times 1.100 = 1.100 \text{ m} = 1100 \text{ mm}$

$S_{kz} = 1.00 \times 1.100 = 1.100 \text{ m} = 1100 \text{ mm}$

Snellezza

$i_y = \sqrt{I_y/A} = 0.289 \times 100 = 29 \text{ mm}$, $\lambda_y = 1100 / 29 = 37.93$

$i_z = \sqrt{I_z/A} = 0.289 \times 75 = 22 \text{ mm}$, $\lambda_z = 1100 / 22 = 50.00$

$\sigma_{m, crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 75^2 \times 6700 / (100 \times 990) = 296.93 \text{ N/mm}^2$ (EC5 Eq.6.32)

$\sigma_{m, crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 100^2 \times 6700 / (75 \times 990) = 703.84 \text{ N/mm}^2$ (EC5 Eq.6.32)

Tensioni critiche

$\sigma_{m, crity} = 296.93 \text{ N/mm}^2$, $\lambda_{rel, my} = \sqrt{f_{myk} / \sigma_{m, crity}} = 0.27$ (EC5 Eq.6.30)

$\sigma_{m, critz} = 703.84 \text{ N/mm}^2$, $\lambda_{rel, mz} = \sqrt{f_{mzk} / \sigma_{m, critz}} = 0.18$ (EC5 Eq.6.30)

$\lambda_{rel, my} = 0.27$, ($\lambda_{rel} \leq 0.75$), $K_{crity} = 1.00$ (EC5 Eq.6.34)

$\lambda_{rel, mz} = 0.18$, ($\lambda_{rel} \leq 0.75$), $K_{critz} = 1.00$ (EC5 Eq.6.34)

$\sigma_{myd} / (K_{crity} \cdot f_{myd}) + K_m \cdot \sigma_{mzd} / (K_{critz} \cdot f_{mzd}) = 0.171 + 0.096 = 0.27 < 1$ (EC5 Eq.6.33)

$K_m \cdot \sigma_{myd} / (K_{crity} \cdot f_{myd}) + \sigma_{mzd} / (K_{critz} \cdot f_{mzd}) = 0.120 + 0.137 = 0.26 < 1$ (EC5 Eq.6.33)

La verifica è soddisfatta

1.6. Progettazione della capriata

Caratteristiche geometriche della capriata

Lunghezza $L=8.000$ m, altezza $H=4.000$ m, interasse capriate $d=1.100$ m

Inclinazione $=60.00\%$, angolo $\alpha=30.96^\circ$, $\tan\alpha=0.600$, $\sin\alpha=0.514$, $\cos\alpha=0.857$

Numero dei nodi = 11, numero degli elementi = 14, numero degli appoggi = 3

Coordinate dei nodi

Caratteristiche degli elementi della capriata

Nodo	x[m]	y[m]	Sup.	Elemento	K1	K2	b x h [mm]	L [m]	A [mm ²]	Iy [mm ⁴]	Wy [mm ³]
1	0.000	0.000	11	1	5	7	63x200	0.972	1.260E+004	4.200E+007	4.200E+005
2	4.000	4.000		2	7	2	63x200	3.693	1.260E+004	4.200E+007	4.200E+005
3	8.000	0.000	01	3	8	6	63x200	0.972	1.260E+004	4.200E+007	4.200E+005
4	4.000	0.000	01	4	2	8	63x200	3.693	1.260E+004	4.200E+007	4.200E+005
5	0.000	1.600		5	1	4	75x225	4.000	1.688E+004	7.119E+007	6.328E+005
6	8.000	1.600		6	4	3	75x225	4.000	1.688E+004	7.119E+007	6.328E+005
7	0.833	2.100		7	1	5	63x200	1.600	1.260E+004	4.200E+007	4.200E+005
8	7.167	2.100		8	6	3	63x200	1.600	1.260E+004	4.200E+007	4.200E+005
9	4.000	2.100		9	7	9	63x200	3.167	1.260E+004	4.200E+007	4.200E+005
10	-0.600	1.240		10	9	8	63x200	3.167	1.260E+004	4.200E+007	4.200E+005
11	8.600	1.240		11	4	9	63x200	2.100	1.260E+004	4.200E+007	4.200E+005
				12	9	2	63x200	1.900	1.260E+004	4.200E+007	4.200E+005
				13	10	5	63x200	0.700	1.260E+004	4.200E+007	4.200E+005
				14	6	11	63x200	0.700	1.260E+004	4.200E+007	4.200E+005

Carico lineare per capriata

Massa volumica del legname $=340.00$ kg/m³, peso proprio della capriata $=1.470$ kN

Interasse delle capriate $d=1.10$ m, peso delle unioni delle capriate $=0.147$ kN

Carico lineare permanente (kN/m) sulle capriate

Manto di copertura + peso proprio $G_{k1} = 0.862$ kN/m

Controsoffitto del tetto $G_{k2} = 0.110$ kN/m

Carico permanente del solaio del sottotetto $G_{kf} = 0.550$ kN/m

Carichi lineari variabili di media durata (kN/m) sulla capriata

Carico di esercizio del solaio del sottotetto $Q_{kf} = 2.200$ kN/m

Carichi lineari variabili di breve durata (kN/m) sulla capriata

Sovraccario $Q_{ki} = 0.50 \times 1.100 = 0.550$ kN/m

Neve (Sinistra) $Q_{k1l} = 1.278$ kN/m (Destra) $Q_{k1r} = 1.278$ kN/m

Neve (Sinistra) $Q_{k2l} = 0.639$ kN/m (Destra) $Q_{k2r} = 1.278$ kN/m

Neve (Sinistra) $Q_{k3l} = 1.278$ kN/m (Destra) $Q_{k3r} = 0.639$ kN/m

Vento (Sinistra) $Q_{k4l} = -0.059$ kN/m (Destra) $Q_{k4r} = -0.332$ kN/m

Vento (Sinistra) $Q_{k5l} = -0.332$ kN/m (Destra) $Q_{k5r} = -0.059$ kN/m

Azioni sismiche dovute alle azioni accidentali (kN/m), sulle capriate

AeX Sismica $q_h = 0.053 \times (G + 0.30 \times Q_{kf} + 0.20 \times Q_{k1})$

AeY Sismica $q_v = 0.006 \times (G + 0.30 \times Q_{kf} + 0.20 \times Q_{k1})$

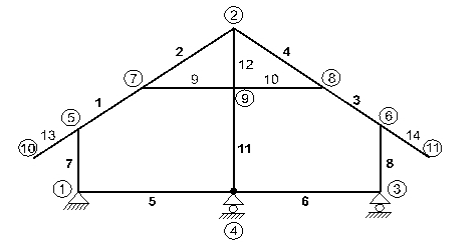
Combinazioni di carico di progetto

($\gamma_g=1.30$, $\gamma_q=1.50$, $\psi_0(\text{di esercizio } Q_f)=0.70$, $\psi_0(\text{neve } Q_1, Q_2, Q_3)=0.70$, $\psi_0(\text{vento } Q_4, Q_5)=0.60$)

L.C.	Azioni permanenti-Variabili	Classe di durata
1	$\gamma_g.G$	Permanente
2	$\gamma_g.G+\gamma_q.Q_1$	Breve
3	$\gamma_g.G+\gamma_q.Q_2$	Breve
4	$\gamma_g.G+\gamma_q.Q_3$	Breve
5	$\gamma_g.G+\gamma_q.Q_4$	Breve
6	$\gamma_g.G+\gamma_q.Q_5$	Breve
7	$\gamma_g.G+\gamma_q.Q_f$	Media
8	$\gamma_g.G+\gamma_q.Q_i$	Breve
9	$\gamma_g.G+\gamma_q.Q_1+\gamma_q.\psi_0.Q_4+\gamma_q.\psi_0.Q_f$	Breve
10	$\gamma_g.G+\gamma_q.Q_1+\gamma_q.\psi_0.Q_5+\gamma_q.\psi_0.Q_f$	Breve
11	$\gamma_g.G+\gamma_q.Q_2+\gamma_q.\psi_0.Q_4+\gamma_q.\psi_0.Q_f$	Breve
12	$\gamma_g.G+\gamma_q.Q_2+\gamma_q.\psi_0.Q_5+\gamma_q.\psi_0.Q_f$	Breve
13	$\gamma_g.G+\gamma_q.Q_3+\gamma_q.\psi_0.Q_4+\gamma_q.\psi_0.Q_f$	Breve
14	$\gamma_g.G+\gamma_q.Q_3+\gamma_q.\psi_0.Q_5+\gamma_q.\psi_0.Q_f$	Breve
15	$\gamma_g.G+\gamma_q.Q_4+\gamma_q.\psi_0.Q_1+\gamma_q.\psi_0.Q_f$	Breve
16	$\gamma_g.G+\gamma_q.Q_4+\gamma_q.\psi_0.Q_2+\gamma_q.\psi_0.Q_f$	Breve
17	$\gamma_g.G+\gamma_q.Q_4+\gamma_q.\psi_0.Q_3+\gamma_q.\psi_0.Q_f$	Breve
18	$\gamma_g.G+\gamma_q.Q_5+\gamma_q.\psi_0.Q_1+\gamma_q.\psi_0.Q_f$	Breve
19	$\gamma_g.G+\gamma_q.Q_5+\gamma_q.\psi_0.Q_2+\gamma_q.\psi_0.Q_f$	Breve
20	$\gamma_g.G+\gamma_q.Q_5+\gamma_q.\psi_0.Q_3+\gamma_q.\psi_0.Q_f$	Breve
21	$\gamma_g.G+\gamma_q.Q_f+\gamma_q.\psi_0.Q_1+\gamma_q.\psi_0.Q_4$	Breve
22	$\gamma_g.G+\gamma_q.Q_f+\gamma_q.\psi_0.Q_1+\gamma_q.\psi_0.Q_5$	Breve
23	$\gamma_g.G+\gamma_q.Q_f+\gamma_q.\psi_0.Q_2+\gamma_q.\psi_0.Q_4$	Breve
24	$\gamma_g.G+\gamma_q.Q_f+\gamma_q.\psi_0.Q_2+\gamma_q.\psi_0.Q_5$	Breve
25	$\gamma_g.G+\gamma_q.Q_f+\gamma_q.\psi_0.Q_3+\gamma_q.\psi_0.Q_4$	Breve
26	$\gamma_g.G+\gamma_q.Q_f+\gamma_q.\psi_0.Q_3+\gamma_q.\psi_0.Q_5$	Breve
27	$\gamma_g.G+\gamma_q.Q_i+\gamma_q.\psi_0.Q_1+\gamma_q.\psi_0.Q_4+\gamma_q.\psi_0.Q_f$	Breve
28	$\gamma_g.G+\gamma_q.Q_i+\gamma_q.\psi_0.Q_1+\gamma_q.\psi_0.Q_5+\gamma_q.\psi_0.Q_f$	Breve
29	$\gamma_g.G+\gamma_q.Q_i+\gamma_q.\psi_0.Q_2+\gamma_q.\psi_0.Q_4+\gamma_q.\psi_0.Q_f$	Breve
30	$\gamma_g.G+\gamma_q.Q_i+\gamma_q.\psi_0.Q_2+\gamma_q.\psi_0.Q_5+\gamma_q.\psi_0.Q_f$	Breve
31	$\gamma_g.G+\gamma_q.Q_i+\gamma_q.\psi_0.Q_3+\gamma_q.\psi_0.Q_4+\gamma_q.\psi_0.Q_f$	Breve
32	$\gamma_g.G+\gamma_q.Q_i+\gamma_q.\psi_0.Q_3+\gamma_q.\psi_0.Q_5+\gamma_q.\psi_0.Q_f$	Breve
33	G + $\psi_2.Q_f+\psi_2.Q_1$ +Aex	Accidental
34	G + $\psi_2.Q_f+\psi_2.Q_1$ +Aey	Accidental

1.7. Analisi statica della capriata

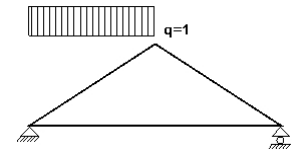
Progettazione di unioni con rigidezza ridotta (fattore 0.40)
 La capriata è progettata come struttura reticolare con una r di rigidezza delle unioni secondo il fattore sopraindicato.
 e la catena sono considerati come aste continue. La capriata viene calcolata dapprima per varie condizioni di carico unit e sulla base di questi sono calcolati gli sforzi interni per le varie condizioni di carico e combinazioni di carichi.
 Numero dei nodi = 11, numero degli elementi = 14, numero degli



1.7.1. Analisi statica per carichi unitari

Sforzi interni per carichi unitari (1 kN/m puntone sinistro verso il basso)

elem.	nodo-1	nodo-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]
1	5	7	-0.80	1.03	-0.72	-0.37	0.32	-0.06
2	7	2	1.39	1.38	-0.07	3.02	-1.33	0.02
3	8	6	0.36	0.88	-0.66	0.36	0.88	0.20
4	2	8	2.13	-0.17	-0.01	2.13	-0.17	-0.65
5	1	4	0.16	-0.06	0.29	0.16	-0.06	0.03
6	4	3	0.15	-0.12	0.04	0.15	-0.12	-0.43
7	1	5	-1.90	-0.16	-0.29	-1.90	-0.16	-0.54
8	6	3	0.94	0.15	0.20	0.94	0.15	0.43
9	7	9	-2.06	-0.01	0.01	-2.06	-0.01	0.00
10	9	8	-2.06	0.00	0.00	-2.06	0.00	-0.01
11	4	9	-3.64	0.01	-0.01	-3.64	0.01	0.01
12	9	2	-3.64	0.01	0.00	-3.64	0.01	0.02
13	10	5	0.00	0.00	0.00	0.31	-0.51	-0.18
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00



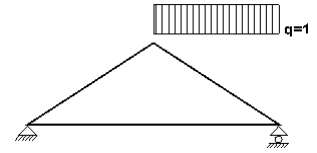
Sforzi alle estremità dell'elemento per carichi unitari (1 kN/m puntone sinistro verso il basso)

elem.	nodo-1	nodo-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.16	1.30	-0.72	-0.16	-0.47	0.06
2	7	2	-1.91	0.47	-0.07	1.91	2.70	-0.02
3	8	6	0.15	0.94	-0.66	-0.15	-0.94	-0.20
4	2	8	-1.91	0.95	-0.01	1.91	-0.95	0.65
5	1	4	-0.16	-0.06	0.29	0.16	0.06	-0.03
6	4	3	-0.15	-0.12	0.04	0.15	0.12	0.43
7	1	5	0.16	1.90	-0.29	-0.16	-1.90	0.54
8	6	3	0.15	0.94	0.20	-0.15	-0.94	-0.43
9	7	9	2.06	-0.01	0.01	-2.06	0.01	0.00
10	9	8	2.06	0.00	0.00	-2.06	0.00	0.01
11	4	9	-0.01	3.64	-0.01	0.01	-3.64	-0.01
12	9	2	-0.01	3.64	0.00	0.01	-3.64	-0.02
13	10	5	0.00	0.00	0.00	0.00	0.60	0.18
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi interni per carichi unitari (1 kN/m puntone destro verso il basso)

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]
1	5	7	0.36	-0.88	0.20	0.36	-0.88	-0.66
2	7	2	2.13	0.17	-0.65	2.13	0.17	-0.01
3	8	6	-0.37	-0.32	-0.06	-0.80	-1.03	-0.72
4	2	8	3.02	1.33	0.02	1.39	-1.38	-0.07
5	1	4	0.15	0.12	-0.43	0.15	0.12	0.04
6	4	3	0.16	0.06	0.03	0.16	0.06	0.29
7	1	5	0.94	-0.15	0.43	0.94	-0.15	0.20
8	6	3	-1.90	0.16	-0.54	-1.90	0.16	-0.29
9	7	9	-2.06	0.00	-0.01	-2.06	0.00	0.00
10	9	8	-2.06	0.01	0.00	-2.06	0.01	0.01
11	4	9	-3.64	-0.01	0.01	-3.64	-0.01	-0.01
12	9	2	-3.64	-0.01	0.00	-3.64	-0.01	-0.02
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.31	0.51	-0.18	0.00	0.00	0.00

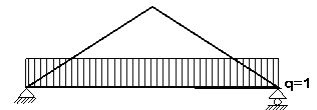
**Sforzi alle estremità dell'elemento per carichi unitari (1 kN/m puntone destro verso il basso)**

elem.	nodo-1	nodo-2	F1x [kN]	F1y [kN]	M1 [kNm]	F2x [kN]	F2y [kN]	M2 [kNm]
1	5	7	0.15	-0.94	0.20	-0.15	0.94	0.66
2	7	2	-1.91	-0.95	-0.65	1.91	0.95	0.01
3	8	6	0.16	-0.47	-0.06	-0.16	1.30	0.72
4	2	8	-1.91	2.70	0.02	1.91	0.47	0.07
5	1	4	-0.15	0.12	-0.43	0.15	-0.12	-0.04
6	4	3	-0.16	0.06	0.03	0.16	-0.06	-0.29
7	1	5	0.15	-0.94	0.43	-0.15	0.94	-0.20
8	6	3	0.16	-1.90	-0.54	-0.16	1.90	0.29
9	7	9	2.06	0.00	-0.01	-2.06	0.00	0.00
10	9	8	2.06	0.01	0.00	-2.06	-0.01	-0.01
11	4	9	0.01	3.64	0.01	-0.01	-3.64	0.01
12	9	2	0.01	3.64	0.00	-0.01	-3.64	0.02
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.60	-0.18	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi interni per carichi unitari (1 kN/m catena verso il basso)

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]
1	5	7	-0.70	0.12	-0.14	-0.70	0.12	-0.02
2	7	2	-0.89	0.01	-0.02	-0.89	0.01	0.00
3	8	6	-0.70	-0.12	-0.02	-0.70	-0.12	-0.14
4	2	8	-0.89	-0.01	0.00	-0.89	-0.01	-0.02
5	1	4	0.53	1.77	-0.72	0.53	-2.23	-1.64
6	4	3	0.53	2.23	-1.64	0.53	-1.77	-0.72
7	1	5	-0.46	-0.53	0.72	-0.46	-0.53	-0.14
8	6	3	-0.46	0.53	-0.14	-0.46	0.53	0.72
9	7	9	0.22	0.00	0.00	0.22	0.00	0.00
10	9	8	0.22	0.00	0.00	0.22	0.00	0.00
11	4	9	0.92	0.00	0.00	0.92	0.00	0.00
12	9	2	0.92	0.00	0.00	0.92	0.00	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00



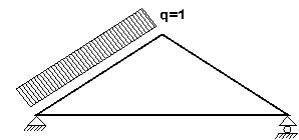
Sforzi alle estremità dell'elemento per carichi unitari (1 kN/m catena verso il basso)

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.53	0.46	-0.14	-0.53	-0.46	0.02
2	7	2	0.76	0.46	-0.02	-0.76	-0.46	0.00
3	8	6	0.53	-0.46	-0.02	-0.53	0.46	0.14
4	2	8	0.76	-0.46	0.00	-0.76	0.46	0.02
5	1	4	-0.53	1.77	-0.72	0.53	2.23	1.64
6	4	3	-0.53	2.23	-1.64	0.53	1.77	0.72
7	1	5	0.53	0.46	0.72	-0.53	-0.46	0.14
8	6	3	0.53	-0.46	-0.14	-0.53	0.46	-0.72
9	7	9	-0.22	0.00	0.00	0.22	0.00	0.00
10	9	8	-0.22	0.00	0.00	0.22	0.00	0.00
11	4	9	0.00	-0.92	0.00	0.00	0.92	0.00
12	9	2	0.00	-0.92	0.00	0.00	0.92	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi interni per carichi unitari (1 kN/m pressione nel puntone sinistro)

elem.	nodo-1	nodo-2	N1[kN]	V1[kN]	M1[kNm]	N2[kN]	V2[kN]	M2[kNm]
1	5	7	-0.06	1.06	0.17	-0.06	0.09	0.73
2	7	2	2.54	1.67	0.70	2.54	-2.03	0.04
3	8	6	-1.53	1.06	-1.81	-1.53	1.06	-0.78
4	2	8	1.05	-0.48	-0.02	1.05	-0.48	-1.79
5	1	4	1.90	-0.57	2.24	1.90	-0.57	-0.03
6	4	3	1.86	-0.55	0.02	1.86	-0.55	-2.20
7	1	5	-1.54	2.46	-2.24	-1.54	0.86	0.42
8	6	3	0.12	1.86	-0.78	0.12	1.86	2.20
9	7	9	-3.04	-0.01	0.03	-3.04	-0.01	-0.01
10	9	8	-3.01	-0.01	0.01	-3.01	-0.01	-0.02
11	4	9	-3.18	0.04	-0.05	-3.18	0.04	0.03
12	9	2	-3.18	0.01	0.02	-3.18	0.01	0.04
13	10	5	0.00	0.00	0.00	0.00	-0.70	-0.24
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

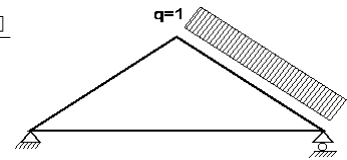
**Sforzi alle estremità dell'elemento per carichi unitari (1 kN/m pressione nel puntone sinistro)**

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	-0.50	0.94	0.17	0.00	-0.11	-0.73
2	7	2	-3.04	0.12	0.70	1.14	3.05	-0.04
3	8	6	1.86	0.12	-1.81	-1.86	-0.12	0.78
4	2	8	-1.15	0.13	-0.02	1.15	-0.13	1.79
5	1	4	-1.90	-0.57	2.24	1.90	0.57	0.03
6	4	3	-1.86	-0.55	0.02	1.86	0.55	2.20
7	1	5	-2.46	1.54	-2.24	0.86	-1.54	-0.42
8	6	3	1.86	0.12	-0.78	-1.86	-0.12	-2.20
9	7	9	3.04	-0.01	0.03	-3.04	0.01	0.01
10	9	8	3.01	-0.01	0.01	-3.01	0.01	0.02
11	4	9	-0.04	3.18	-0.05	0.04	-3.18	-0.03
12	9	2	-0.01	3.18	0.02	0.01	-3.18	-0.04
13	10	5	0.00	0.00	0.00	-0.36	0.60	0.24
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi interni per carichi unitari (1 kN/m pressione nel puntone destro)

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]
1	5	7	-1.59	-1.03	-0.81	-1.59	-1.03	-1.81
2	7	2	0.95	0.48	-1.79	0.95	0.48	-0.02
3	8	6	-0.12	-0.12	0.73	-0.12	-1.09	0.14
4	2	8	2.43	2.03	0.04	2.43	-1.67	0.70
5	1	4	-2.46	0.57	-2.23	-2.46	0.57	0.03
6	4	3	-2.42	0.56	-0.02	-2.42	0.56	2.21
7	1	5	0.07	-1.90	2.23	0.07	-1.90	-0.81
8	6	3	-1.60	-0.82	0.39	-1.60	-2.42	-2.21
9	7	9	-2.95	0.01	-0.02	-2.95	0.01	0.01
10	9	8	-2.98	0.01	-0.01	-2.98	0.01	0.03
11	4	9	-3.07	-0.04	0.05	-3.07	-0.04	-0.03
12	9	2	-3.07	-0.01	-0.02	-3.07	-0.01	-0.04
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.70	-0.24	0.00	0.00	0.00

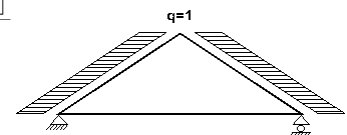
**Sforzi alle estremità dell'elemento per carichi unitari (1 kN/m pressione nel puntone destro)**

elem.	nodo-1	nodo-2	F1x [kN]	F1y [kN]	M1 [kNm]	F2x [kN]	F2y [kN]	M2 [kNm]
1	5	7	1.90	-0.07	-0.81	-1.90	0.07	1.81
2	7	2	-1.06	-0.08	-1.79	1.06	0.08	0.02
3	8	6	0.04	-0.16	0.73	0.46	1.00	-0.14
4	2	8	-1.04	2.99	0.04	2.94	0.18	-0.70
5	1	4	2.46	0.57	-2.23	-2.46	-0.57	-0.03
6	4	3	2.42	0.56	-0.02	-2.42	-0.56	-2.21
7	1	5	1.90	-0.07	2.23	-1.90	0.07	0.81
8	6	3	-0.82	-1.60	0.39	2.42	1.60	2.21
9	7	9	2.95	0.01	-0.02	-2.95	-0.01	-0.01
10	9	8	2.98	0.01	-0.01	-2.98	-0.01	-0.03
11	4	9	0.04	3.07	0.05	-0.04	-3.07	0.03
12	9	2	0.01	3.07	-0.02	-0.01	-3.07	0.04
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.36	0.60	-0.24	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi interni per carichi unitari (1 kN/m seismic load)

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]
1	5	7	5.11	0.55	2.83	4.27	0.05	3.12
2	7	2	4.36	0.13	3.07	1.19	-1.77	0.04
3	8	6	-4.12	0.12	-3.12	-4.96	0.62	-2.75
4	2	8	-0.92	-1.77	-0.04	-4.09	0.13	-3.07
5	1	4	5.37	-1.43	5.63	5.37	-1.43	-0.08
6	4	3	5.27	-1.40	0.04	5.27	-1.40	-5.55
7	1	5	2.15	5.36	-5.63	2.15	5.36	2.95
8	6	3	-2.01	5.27	-2.88	-2.01	5.27	5.55
9	7	9	-0.11	-0.02	0.05	-0.11	-0.02	-0.02
10	9	8	-0.03	-0.02	0.02	-0.03	-0.02	-0.05
11	4	9	-0.14	0.10	-0.12	-0.14	0.10	0.08
12	9	2	-0.14	0.01	0.04	-0.14	0.01	0.06
13	10	5	0.00	0.00	0.00	-0.60	-0.36	-0.13
14	6	11	0.60	-0.36	0.13	0.00	0.00	0.00



Sforzi alle estremità dell'elemento per carichi unitari (1 kN/m seismic load)

elem.	nodo-1	nodo-2	F1x[kN]	F1y[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	-4.66	-2.15	2.83	3.69	2.15	-3.12
2	7	2	-3.80	-2.13	3.07	0.11	2.13	-0.04
3	8	6	3.60	-2.01	-3.12	-4.57	2.01	2.75
4	2	8	-0.12	-1.99	-0.04	-3.57	1.99	3.07
5	1	4	-5.37	-1.43	5.63	5.37	1.43	0.08
6	4	3	-5.27	-1.40	0.04	5.27	1.40	5.55
7	1	5	-5.36	-2.15	-5.63	5.36	2.15	-2.95
8	6	3	5.27	-2.01	-2.88	-5.27	2.01	-5.55
9	7	9	0.11	-0.02	0.05	-0.11	0.02	0.02
10	9	8	0.03	-0.02	0.02	-0.03	0.02	0.05
11	4	9	-0.10	0.14	-0.12	0.10	-0.14	-0.08
12	9	2	-0.01	0.14	0.04	0.01	-0.14	-0.06
13	10	5	0.00	0.00	0.00	-0.70	0.00	0.13
14	6	11	-0.70	0.00	0.13	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

1.7.2. Forze interne**Forze interne, Carico, : (G) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55 [kN/m]**

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	-0.90	0.23	-0.61	-0.47	-0.49	-0.74	-0.77	0.00	-0.58
2	7	2	2.95	1.57	-0.75	4.59	-1.16	0.01	3.90	0.00	0.92
3	8	6	-0.47	0.49	-0.74	-0.90	-0.23	-0.61	-0.77	0.00	-0.58
4	2	8	4.59	1.16	0.01	2.95	-1.57	-0.75	3.90	0.00	0.92
5	1	4	0.66	1.22	-0.62	0.66	-1.42	-1.01	0.66	0.00	0.51
6	4	3	0.66	1.42	-1.01	0.66	-1.22	-0.62	0.66	0.00	0.51
7	1	5	-1.27	-0.66	0.62	-1.27	-0.66	-0.43	-1.27	-0.66	0.09
8	6	3	-1.27	0.66	-0.43	-1.27	0.66	0.62	-1.27	0.66	0.09
9	7	9	-4.00	0.00	0.01	-4.00	0.00	0.00	-4.00	-0.18	-0.13
10	9	8	-4.00	0.00	0.00	-4.00	0.00	0.01	-4.00	-0.17	-0.13
11	4	9	-6.72	0.00	0.00	-6.72	0.00	0.00	-6.72	0.00	0.00
12	9	2	-6.71	0.00	0.00	-6.71	0.00	0.00	-6.71	0.00	0.00
13	10	5	0.00	0.00	0.00	0.31	-0.52	-0.18	0.00	0.00	0.00
14	6	11	0.31	0.52	-0.18	0.00	0.00	0.00	0.00	0.00	0.00

(m punto del momento massimo per il carico permanente, o punto medio dell'elemento)

Forze interne, Carico, : (Q1) Neve QksL= 1.278, QksR= 1.278 [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	-0.57	0.19	-0.66	-0.02	-0.72	-0.92	-0.39	-0.10	-0.65
2	7	2	4.50	1.99	-0.93	6.58	-1.48	0.01	5.69	0.00	1.18
3	8	6	-0.02	0.72	-0.92	-0.57	-0.19	-0.66	-0.39	0.10	-0.65
4	2	8	6.58	1.48	0.01	4.50	-1.99	-0.93	5.69	0.00	1.18
5	1	4	0.39	0.07	-0.18	0.39	0.07	0.09	0.39	0.07	-0.06
6	4	3	0.39	-0.07	0.09	0.39	-0.07	-0.18	0.39	-0.07	-0.06
7	1	5	-1.22	-0.39	0.18	-1.22	-0.39	-0.43	-1.22	-0.39	-0.12
8	6	3	-1.22	0.39	-0.43	-1.22	0.39	0.18	-1.22	0.39	-0.12
9	7	9	-5.27	0.00	0.01	-5.27	0.00	0.00	-5.27	0.00	0.00
10	9	8	-5.27	0.00	0.00	-5.27	0.00	0.01	-5.27	0.00	0.00
11	4	9	-9.31	0.00	0.00	-9.31	0.00	0.00	-9.31	0.00	0.00
12	9	2	-9.30	0.00	0.00	-9.30	0.00	0.00	-9.30	0.00	0.00
13	10	5	0.00	0.00	0.00	0.39	-0.66	-0.23	0.00	0.00	0.00
14	6	11	0.39	0.66	-0.23	0.00	0.00	0.00	0.00	0.00	0.00

(m punto del momento massimo per il carico permanente, o punto medio dell'elemento)

Forze interne, Carico, : (Q2) Neve QksL= 0.639, QksR= 1.278 [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	-0.05	-0.47	-0.21	0.22	-0.92	-0.88	0.03	-0.61	-0.37
2	7	2	3.61	1.11	-0.88	4.65	-0.63	0.00	4.21	0.11	0.41
3	8	6	-0.25	0.16	-0.50	-0.80	-0.76	-0.79	-0.62	-0.46	-0.60
4	2	8	5.22	1.59	0.02	3.14	-1.88	-0.51	4.33	0.12	1.36
5	1	4	0.29	0.11	-0.37	0.29	0.11	0.07	0.29	0.11	-0.16
6	4	3	0.29	0.01	0.07	0.29	0.01	0.09	0.29	0.01	0.08
7	1	5	-0.01	-0.29	0.37	-0.01	-0.29	-0.09	-0.01	-0.29	0.14
8	6	3	-1.82	0.29	-0.56	-1.82	0.29	-0.09	-1.82	0.29	-0.32
9	7	9	-3.95	0.00	0.00	-3.95	0.00	0.00	-3.95	0.00	0.00
10	9	8	-3.95	0.01	0.00	-3.95	0.01	0.01	-3.95	0.01	0.01
11	4	9	-6.98	-0.01	0.01	-6.98	-0.01	-0.01	-6.98	-0.01	0.00
12	9	2	-6.98	-0.01	0.00	-6.98	-0.01	-0.01	-6.98	-0.01	-0.01
13	10	5	0.00	0.00	0.00	0.20	-0.33	-0.11	0.00	0.00	0.00
14	6	11	0.39	0.66	-0.23	0.00	0.00	0.00	0.00	0.00	0.00

Forze interne, Carico, : (Q3) Neve QksL= 1.278, QksR= 0.639 [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	-0.80	0.76	-0.79	-0.25	-0.16	-0.50	-0.62	0.46	-0.60
2	7	2	3.14	1.88	-0.51	5.22	-1.59	0.02	4.33	-0.12	1.36
3	8	6	0.22	0.92	-0.88	-0.05	0.47	-0.21	0.03	0.61	-0.37
4	2	8	4.65	0.63	0.00	3.61	-1.11	-0.88	4.21	-0.11	0.41
5	1	4	0.29	-0.01	0.09	0.29	-0.01	0.07	0.29	-0.01	0.08
6	4	3	0.29	-0.11	0.07	0.29	-0.11	-0.37	0.29	-0.11	-0.16
7	1	5	-1.82	-0.29	-0.09	-1.82	-0.29	-0.56	-1.82	-0.29	-0.32
8	6	3	-0.01	0.29	-0.09	-0.01	0.29	0.37	-0.01	0.29	0.14
9	7	9	-3.95	-0.01	0.01	-3.95	-0.01	0.00	-3.95	-0.01	0.01
10	9	8	-3.95	0.00	0.00	-3.95	0.00	0.00	-3.95	0.00	0.00
11	4	9	-6.98	0.01	-0.01	-6.98	0.01	0.01	-6.98	0.01	0.00
12	9	2	-6.98	0.01	0.00	-6.98	0.01	0.01	-6.98	0.01	0.01
13	10	5	0.00	0.00	0.00	0.39	-0.66	-0.23	0.00	0.00	0.00
14	6	11	0.20	0.33	-0.11	0.00	0.00	0.00	0.00	0.00	0.00

Forze interne, Carico, : (Q4) Vento QkwL=-0.059, QkwR=-0.332 [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	0.53	0.28	0.26	0.53	0.34	0.56	0.53	0.30	0.35
2	7	2	-0.46	-0.26	0.55	-0.46	-0.04	0.00	-0.46	-0.13	0.14
3	8	6	0.13	-0.02	-0.14	0.13	0.30	0.00	0.13	0.20	-0.08
4	2	8	-0.87	-0.64	-0.01	-0.87	0.58	-0.13	-0.87	-0.12	-0.61
5	1	4	0.70	-0.15	0.61	0.70	-0.15	-0.01	0.70	-0.15	0.32
6	4	3	0.69	-0.15	0.01	0.69	-0.15	-0.60	0.69	-0.15	-0.32
7	1	5	0.07	0.48	-0.61	0.07	0.58	0.24	0.07	0.48	-0.22
8	6	3	0.52	0.16	-0.08	0.52	0.69	0.60	0.52	0.16	0.05
9	7	9	1.16	0.00	0.01	1.16	0.00	0.00	1.16	0.00	0.00
10	9	8	1.17	0.00	0.00	1.17	0.00	-0.01	1.17	0.00	0.00
11	4	9	1.21	0.01	-0.01	1.21	0.01	0.01	1.21	0.01	0.00
12	9	2	1.20	0.00	0.00	1.20	0.00	0.01	1.20	0.00	0.01
13	10	5	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00
14	6	11	0.00	-0.23	0.08	0.00	0.00	0.00	0.00	0.00	0.00

(m punto del momento massimo per il carico permanente, o punto medio dell'elemento)

Forze interne, Carico, : (Q5) Vento QkwL=-0.332, QkwR=-0.059 [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	0.11	-0.29	-0.01	0.11	0.03	-0.14	0.11	-0.19	-0.08
2	7	2	-0.90	-0.58	-0.13	-0.90	0.64	-0.01	-0.90	0.12	-0.61
3	8	6	0.52	-0.35	0.56	0.52	-0.29	0.25	0.52	-0.31	0.34
4	2	8	-0.49	0.04	0.00	-0.49	0.26	0.55	-0.49	0.13	0.14
5	1	4	-0.49	0.16	-0.61	-0.49	0.16	0.01	-0.49	0.16	-0.32
6	4	3	-0.47	0.15	0.00	-0.47	0.15	0.60	-0.47	0.15	0.32
7	1	5	0.51	-0.70	0.61	0.51	-0.17	-0.09	0.51	-0.70	0.05
8	6	3	0.05	-0.57	0.23	0.05	-0.47	-0.60	0.05	-0.57	-0.22
9	7	9	1.18	0.00	-0.01	1.18	0.00	0.00	1.18	0.00	0.00
10	9	8	1.17	0.00	0.00	1.17	0.00	0.01	1.17	0.00	0.00
11	4	9	1.24	-0.01	0.01	1.24	-0.01	-0.01	1.24	-0.01	0.00
12	9	2	1.24	0.00	0.00	1.24	0.00	-0.01	1.24	0.00	-0.01
13	10	5	0.00	0.00	0.00	0.00	0.23	0.08	0.00	0.00	0.00
14	6	11	0.00	-0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00

Forze interne, Carico, : (Qf) di esercizio Qkf = 2.200 [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	-1.53	0.26	-0.31	-1.53	0.26	-0.05	-1.53	0.26	-0.22
2	7	2	-1.95	0.01	-0.05	-1.95	0.01	0.00	-1.95	0.01	-0.02
3	8	6	-1.53	-0.26	-0.05	-1.53	-0.26	-0.31	-1.53	-0.26	-0.22
4	2	8	-1.95	-0.01	0.00	-1.95	-0.01	-0.05	-1.95	-0.01	-0.02
5	1	4	1.18	3.89	-1.58	1.18	-4.91	-3.61	1.18	-0.18	1.86
6	4	3	1.18	4.91	-3.61	1.18	-3.89	-1.58	1.18	0.18	1.86
7	1	5	-1.01	-1.18	1.58	-1.01	-1.18	-0.31	-1.01	-1.18	0.64
8	6	3	-1.01	1.18	-0.31	-1.01	1.18	1.58	-1.01	1.18	0.64
9	7	9	0.49	0.00	0.00	0.49	0.00	0.00	0.49	0.00	0.00
10	9	8	0.49	0.00	0.00	0.49	0.00	0.00	0.49	0.00	0.00
11	4	9	2.03	0.00	0.00	2.03	0.00	0.00	2.03	0.00	0.00
12	9	2	2.03	0.00	0.00	2.03	0.00	0.00	2.03	0.00	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(m punto del momento massimo per il carico permanente, o punto medio dell'elemento)

Forze interne, Carico, : (Qi) Sovraccario (H) Qi = 0.550 [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	-0.24	0.08	-0.29	-0.01	-0.31	-0.40	-0.17	-0.04	-0.28
2	7	2	1.94	0.86	-0.40	2.83	-0.64	0.01	2.45	0.00	0.51
3	8	6	-0.01	0.31	-0.40	-0.24	-0.08	-0.29	-0.17	0.04	-0.28
4	2	8	2.83	0.64	0.01	1.94	-0.86	-0.40	2.45	0.00	0.51
5	1	4	0.17	0.03	-0.08	0.17	0.03	0.04	0.17	0.03	-0.02
6	4	3	0.17	-0.03	0.04	0.17	-0.03	-0.08	0.17	-0.03	-0.02
7	1	5	-0.53	-0.17	0.08	-0.53	-0.17	-0.19	-0.53	-0.17	-0.05
8	6	3	-0.53	0.17	-0.19	-0.53	0.17	0.08	-0.53	0.17	-0.05
9	7	9	-2.27	0.00	0.00	-2.27	0.00	0.00	-2.27	0.00	0.00
10	9	8	-2.27	0.00	0.00	-2.27	0.00	0.00	-2.27	0.00	0.00
11	4	9	-4.01	0.00	0.00	-4.01	0.00	0.00	-4.01	0.00	0.00
12	9	2	-4.01	0.00	0.00	-4.01	0.00	0.00	-4.01	0.00	0.00
13	10	5	0.00	0.00	0.00	0.17	-0.28	-0.10	0.00	0.00	0.00
14	6	11	0.17	0.28	-0.10	0.00	0.00	0.00	0.00	0.00	0.00

(m punto del momento massimo per il carico permanente, o punto medio dell'elemento)

Forze interne, Carico, : (Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1) [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	0.34	0.04	0.19	0.29	0.00	0.21	0.32	0.03	0.20
2	7	2	0.29	0.01	0.21	0.08	-0.12	0.00	0.17	-0.06	0.15
3	8	6	-0.28	0.01	-0.21	-0.33	0.04	-0.18	-0.31	0.03	-0.20
4	2	8	-0.06	-0.12	0.00	-0.27	0.01	-0.21	-0.15	-0.06	-0.15
5	1	4	0.36	-0.10	0.38	0.36	-0.10	-0.01	0.36	-0.10	0.20
6	4	3	0.35	-0.09	0.00	0.35	-0.09	-0.37	0.35	-0.09	-0.20
7	1	5	0.14	0.36	-0.38	0.14	0.36	0.20	0.14	0.36	-0.09
8	6	3	-0.13	0.35	-0.19	-0.13	0.35	0.37	-0.13	0.35	0.09
9	7	9	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00
10	9	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	4	9	-0.01	0.01	-0.01	-0.01	0.01	0.01	-0.01	0.01	0.00
12	9	2	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00
13	10	5	0.00	0.00	0.00	-0.04	-0.02	-0.01	0.00	0.00	0.00
14	6	11	0.04	-0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00

(m punto del momento massimo per il carico permanente, o punto medio dell'elemento)

Forze interne, Carico, : (Aey) AeY Sismica $qv=0.006x(G+0.30xQkf+0.20xQk1)$ [kN/m]

elem.	nodo-1	nodo-2	N1 [kN]	V1 [kN]	M1 [kNm]	N2 [kN]	V2 [kN]	M2 [kNm]	Nm [kN]	VQm [kN]	Mm [kNm]
1	5	7	-0.01	0.00	-0.01	-0.01	0.00	-0.01	-0.01	0.00	0.00
2	7	2	0.02	0.01	-0.01	0.03	-0.01	0.00	0.03	0.00	0.01
3	8	6	-0.01	0.00	-0.01	-0.01	0.00	-0.01	-0.01	0.00	0.00
4	2	8	0.03	0.01	0.00	0.02	-0.01	-0.01	0.03	0.00	0.01
5	1	4	0.01	0.02	-0.01	0.01	-0.02	-0.01	0.01	0.00	0.01
6	4	3	0.01	0.02	-0.01	0.01	-0.02	-0.01	0.01	0.00	0.01
7	1	5	-0.01	-0.01	0.01	-0.01	-0.01	0.00	-0.01	-0.01	0.00
8	6	3	-0.01	0.01	0.00	-0.01	0.01	0.01	-0.01	0.01	0.00
9	7	9	-0.03	0.00	0.00	-0.03	0.00	0.00	-0.03	-0.01	-0.01
10	9	8	-0.03	0.00	0.00	-0.03	0.00	0.00	-0.03	-0.01	-0.01
11	4	9	-0.05	0.00	0.00	-0.05	0.00	0.00	-0.05	0.00	0.00
12	9	2	-0.05	0.00	0.00	-0.05	0.00	0.00	-0.05	0.00	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1.7.3. Sforzi all'estremità dell'elemento**Sforzi all'estremità dell'elemento, Carico: (G) Proprio $Gk1 = 0.862$, $Gk2 = 0.110$, $Gkf=0.55$ [kN/m]**

elem.	nodo-1	nodo-2	F1x [kN]	F1y [kN]	M1 [kNm]	F2x [kN]	F2y [kN]	M2 [kNm]
1	5	7	0.66	0.66	-0.61	-0.66	0.18	0.74
2	7	2	-3.34	-0.17	-0.75	3.34	3.36	-0.01
3	8	6	0.66	0.18	-0.74	-0.66	0.66	0.61
4	2	8	-3.34	3.36	0.01	3.34	-0.17	0.75
5	1	4	-0.66	1.22	-0.62	0.66	1.42	1.01
6	4	3	-0.66	1.42	-1.01	0.66	1.22	0.62
7	1	5	0.66	1.27	0.62	-0.66	-1.27	0.43
8	6	3	0.66	-1.27	-0.43	-0.66	1.27	-0.62
9	7	9	4.00	0.00	0.01	-4.00	0.00	0.00
10	9	8	4.00	0.00	0.00	-4.00	0.00	-0.01
11	4	9	0.00	6.72	0.00	0.00	-6.72	0.00
12	9	2	0.00	6.71	0.00	0.00	-6.71	0.00
13	10	5	0.00	0.00	0.00	0.00	0.60	0.18
14	6	11	0.00	0.60	-0.18	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Q1) Neve $QksL= 1.278$, $QksR= 1.278$ [kN/m]

elem.	nodo-1	nodo-2	F1x [kN]	F1y [kN]	M1 [kNm]	F2x [kN]	F2y [kN]	M2 [kNm]
1	5	7	0.39	0.46	-0.66	-0.39	0.61	0.92
2	7	2	-4.88	-0.61	-0.93	4.88	4.65	-0.01
3	8	6	0.39	0.61	-0.92	-0.39	0.46	0.66
4	2	8	-4.88	4.65	0.01	4.88	-0.61	0.93
5	1	4	-0.39	0.07	-0.18	0.39	-0.07	-0.09
6	4	3	-0.39	-0.07	0.09	0.39	0.07	0.18
7	1	5	0.39	1.22	0.18	-0.39	-1.22	0.43
8	6	3	0.39	-1.22	-0.43	-0.39	1.22	-0.18
9	7	9	5.27	0.00	0.01	-5.27	0.00	0.00
10	9	8	5.27	0.00	0.00	-5.27	0.00	-0.01
11	4	9	0.00	9.31	0.00	0.00	-9.31	0.00
12	9	2	0.00	9.30	0.00	0.00	-9.30	0.00
13	10	5	0.00	0.00	0.00	0.00	0.77	0.23
14	6	11	0.00	0.77	-0.23	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Q2) Neve QksL= 0.639, QksR= 1.278[kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.29	-0.37	-0.21	-0.29	0.91	0.88
2	7	2	-3.66	-0.91	-0.88	3.66	2.93	0.00
3	8	6	0.29	0.01	-0.50	-0.29	1.06	0.79
4	2	8	-3.66	4.05	0.02	3.66	0.00	0.51
5	1	4	-0.29	0.11	-0.37	0.29	-0.11	-0.07
6	4	3	-0.29	0.01	0.07	0.29	-0.01	-0.09
7	1	5	0.29	0.01	0.37	-0.29	-0.01	0.09
8	6	3	0.29	-1.82	-0.56	-0.29	1.82	0.09
9	7	9	3.95	0.00	0.00	-3.95	0.00	0.00
10	9	8	3.95	0.01	0.00	-3.95	-0.01	-0.01
11	4	9	0.01	6.98	0.01	-0.01	-6.98	0.01
12	9	2	0.01	6.98	0.00	-0.01	-6.98	0.01
13	10	5	0.00	0.00	0.00	0.00	0.38	0.11
14	6	11	0.00	0.77	-0.23	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Q3) Neve QksL= 1.278, QksR= 0.639[kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.29	1.06	-0.79	-0.29	0.01	0.50
2	7	2	-3.66	0.00	-0.51	3.66	4.05	-0.02
3	8	6	0.29	0.91	-0.88	-0.29	-0.37	0.21
4	2	8	-3.66	2.93	0.00	3.66	-0.91	0.88
5	1	4	-0.29	-0.01	0.09	0.29	0.01	-0.07
6	4	3	-0.29	-0.11	0.07	0.29	0.11	0.37
7	1	5	0.29	1.82	-0.09	-0.29	-1.82	0.56
8	6	3	0.29	-0.01	-0.09	-0.29	0.01	-0.37
9	7	9	3.95	-0.01	0.01	-3.95	0.01	0.00
10	9	8	3.95	0.00	0.00	-3.95	0.00	0.00
11	4	9	-0.01	6.98	-0.01	0.01	-6.98	-0.01
12	9	2	-0.01	6.98	0.00	0.01	-6.98	-0.01
13	10	5	0.00	0.00	0.00	0.00	0.77	0.23
14	6	11	0.00	0.38	-0.11	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Q4) Vento QkwL=-0.059, QkwR=-0.332[kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	-0.60	-0.03	0.26	0.63	-0.02	-0.56
2	7	2	0.53	0.02	0.55	-0.42	-0.20	0.00
3	8	6	-0.12	0.05	-0.14	-0.04	-0.32	0.00
4	2	8	0.41	-1.00	-0.01	-1.04	-0.05	0.13
5	1	4	-0.70	-0.15	0.61	0.70	0.15	0.01
6	4	3	-0.69	-0.15	0.01	0.69	0.15	0.60
7	1	5	-0.48	-0.07	-0.61	0.58	0.07	-0.24
8	6	3	0.16	0.52	-0.08	-0.69	-0.52	-0.60
9	7	9	-1.16	0.00	0.01	1.16	0.00	0.00
10	9	8	-1.17	0.00	0.00	1.17	0.00	0.01
11	4	9	-0.01	-1.21	-0.01	0.01	1.21	-0.01
12	9	2	0.00	-1.20	0.00	0.00	1.20	-0.01
13	10	5	0.00	0.00	0.00	0.02	-0.04	-0.01
14	6	11	-0.12	-0.20	0.08	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Q5) Vento QkwL=-0.332, QkwR=-0.059[kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.05	-0.31	-0.01	0.11	0.03	0.14
2	7	2	1.07	-0.04	-0.13	-0.44	-1.02	0.01
3	8	6	-0.62	-0.03	0.56	0.59	-0.02	-0.25
4	2	8	0.44	-0.22	0.00	-0.56	0.03	-0.55
5	1	4	0.49	0.16	-0.61	-0.49	-0.16	-0.01
6	4	3	0.47	0.15	0.00	-0.47	-0.15	-0.60
7	1	5	0.70	-0.51	0.61	-0.17	0.51	0.09
8	6	3	-0.57	0.05	0.23	0.47	-0.05	0.60
9	7	9	-1.18	0.00	-0.01	1.18	0.00	0.00
10	9	8	-1.17	0.00	0.00	1.17	0.00	-0.01
11	4	9	0.01	-1.24	0.01	-0.01	1.24	0.01
12	9	2	0.00	-1.24	0.00	0.00	1.24	0.01
13	10	5	0.00	0.00	0.00	0.12	-0.20	-0.08
14	6	11	-0.02	-0.04	0.01	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Qf) di esercizio Qkf = 2.200[kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	1.18	1.01	-0.31	-1.18	-1.01	0.05
2	7	2	1.67	1.01	-0.05	-1.67	-1.01	0.00
3	8	6	1.18	-1.01	-0.05	-1.18	1.01	0.31
4	2	8	1.67	-1.01	0.00	-1.67	1.01	0.05
5	1	4	-1.18	3.89	-1.58	1.18	4.91	3.61
6	4	3	-1.18	4.91	-3.61	1.18	3.89	1.58
7	1	5	1.18	1.01	1.58	-1.18	-1.01	0.31
8	6	3	1.18	-1.01	-0.31	-1.18	1.01	-1.58
9	7	9	-0.49	0.00	0.00	0.49	0.00	0.00
10	9	8	-0.49	0.00	0.00	0.49	0.00	0.00
11	4	9	0.00	-2.03	0.00	0.00	2.03	0.00
12	9	2	0.00	-2.03	0.00	0.00	2.03	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Qi) Sovraccario (H) Qi = 0.550[kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.17	0.20	-0.29	-0.17	0.26	0.40
2	7	2	-2.10	-0.26	-0.40	2.10	2.00	-0.01
3	8	6	0.17	0.26	-0.40	-0.17	0.20	0.29
4	2	8	-2.10	2.00	0.01	2.10	-0.26	0.40
5	1	4	-0.17	0.03	-0.08	0.17	-0.03	-0.04
6	4	3	-0.17	-0.03	0.04	0.17	0.03	0.08
7	1	5	0.17	0.53	0.08	-0.17	-0.53	0.19
8	6	3	0.17	-0.53	-0.19	-0.17	0.53	-0.08
9	7	9	2.27	0.00	0.00	-2.27	0.00	0.00
10	9	8	2.27	0.00	0.00	-2.27	0.00	0.00
11	4	9	0.00	4.01	0.00	0.00	-4.01	0.00
12	9	2	0.00	4.01	0.00	0.00	-4.01	0.00
13	10	5	0.00	0.00	0.00	0.00	0.33	0.10
14	6	11	0.00	0.33	-0.10	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Aex) AeX Sismica $q_h=0.053x(G+0.30xQ_{kf}+0.20xQ_{k1})$ [kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	-0.31	-0.14	0.19	0.25	0.14	-0.21
2	7	2	-0.25	-0.14	0.21	0.01	0.14	0.00
3	8	6	0.24	-0.13	-0.21	-0.31	0.13	0.18
4	2	8	-0.01	-0.13	0.00	-0.24	0.13	0.21
5	1	4	-0.36	-0.10	0.38	0.36	0.10	0.01
6	4	3	-0.35	-0.09	0.00	0.35	0.09	0.37
7	1	5	-0.36	-0.14	-0.38	0.36	0.14	-0.20
8	6	3	0.35	-0.13	-0.19	-0.35	0.13	-0.37
9	7	9	0.01	0.00	0.00	-0.01	0.00	0.00
10	9	8	0.00	0.00	0.00	0.00	0.00	0.00
11	4	9	-0.01	0.01	-0.01	0.01	-0.01	-0.01
12	9	2	0.00	0.01	0.00	0.00	-0.01	0.00
13	10	5	0.00	0.00	0.00	-0.05	0.00	0.01
14	6	11	-0.05	0.00	0.01	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

Sforzi all'estremità dell'elemento, Carico: (Aey) AeY Sismica $q_v=0.006x(G+0.30xQ_{kf}+0.20xQ_{k1})$ [kN/m]

elem.	nodo-1	nodo-2	Flx[kN]	Fly[kN]	M1[kNm]	F2x[kN]	F2y[kN]	M2[kNm]
1	5	7	0.01	0.01	-0.01	-0.01	0.00	0.01
2	7	2	-0.02	0.00	-0.01	0.02	0.03	0.00
3	8	6	0.01	0.00	-0.01	-0.01	0.01	0.01
4	2	8	-0.02	0.03	0.00	0.02	0.00	0.01
5	1	4	-0.01	0.02	-0.01	0.01	0.02	0.01
6	4	3	-0.01	0.02	-0.01	0.01	0.02	0.01
7	1	5	0.01	0.01	0.01	-0.01	-0.01	0.00
8	6	3	0.01	-0.01	0.00	-0.01	0.01	-0.01
9	7	9	0.03	0.00	0.00	-0.03	0.00	0.00
10	9	8	0.03	0.00	0.00	-0.03	0.00	0.00
11	4	9	0.00	0.05	0.00	0.00	-0.05	0.00
12	9	2	0.00	0.05	0.00	0.00	-0.05	0.00
13	10	5	0.00	0.00	0.00	0.00	0.00	0.00
14	6	11	0.00	0.00	0.00	0.00	0.00	0.00

(sforzi alle estremità dell'elemento nel sistema di coordinate globali x-y)

1.7.4. spostamenti verticali dei nodi (in mm)

nodo	Gk	Qk1	Qk2	Qk3	Qk4	Qk5	Qkf	Qki
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	-0.22	-0.30	-0.23	-0.23	0.04	0.04	0.07	-0.19
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	-0.02	-0.02	0.00	-0.02	0.00	0.01	-0.01	-0.01
6	-0.02	-0.02	-0.02	0.00	0.01	0.00	-0.01	-0.01
7	-0.61	-0.85	0.57	-1.84	-1.22	1.48	0.20	-0.91
8	-0.61	-0.85	-1.84	0.57	1.47	-1.22	0.20	-0.16
9	-0.11	-0.16	-0.12	-0.12	0.02	0.02	0.03	-0.10
10	-0.05	0.05	-0.72	0.80	1.13	-1.09	-0.32	0.27
11	-0.05	0.05	0.80	-0.72	-1.08	1.12	-0.32	-0.20

1.7.5. Reazioni agli appoggi (kN)

nodo	reaz.	Gk	Qk1	Qk2	Qk3	Qk4	Qk5	Qkf	Qki
1	Fx	0.00	0.00	0.00	0.00	-1.19	1.19	0.00	0.00
1	Fy	2.49	1.29	0.12	1.82	-0.22	-0.35	4.91	0.56
3	Fx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Fy	2.49	1.29	1.82	0.12	-0.37	-0.20	4.91	0.56
4	Fx	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Fy	9.55	9.17	6.88	6.88	-1.20	-1.24	7.79	3.95

1.8. Reazioni agli appoggi combinazione di carichi(kN)

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

1.8.1. Reazioni nel nodo : 1 (kN)

L.C.	Combinazione di carichi	classe di	durata	kmod	Fx	Fy	Fx/Kmod	Fy/Kmod
1	$\gamma_g.G$	Permanente	0.60	0.000	3.234	0.000	5.390	
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	0.000	5.171	0.000	5.745	
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	0.000	3.413	0.000	3.792	
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	0.000	5.960	0.000	6.623	
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	-1.784	2.899	-1.982	3.222	
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	1.784	2.706	1.982	3.007	
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	0.000	10.593	0.000	13.241	
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	0.000	4.068	0.000	4.520	
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.071	10.121	-1.189	11.246	
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	1.070	10.005	1.189	11.117	
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.071	8.363	-1.189	9.292	
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	1.070	8.247	1.189	9.163	
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.071	10.911	-1.189	12.123	
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	1.070	10.795	1.189	11.994	
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.784	9.406	-1.982	10.451	
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.784	8.176	-1.982	9.084	
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.784	9.959	-1.982	11.066	
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	1.784	9.213	1.982	10.236	
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	1.784	7.982	1.982	8.869	
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	1.784	9.766	1.982	10.851	
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	-1.071	11.748	-1.189	13.053	
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	1.070	11.632	1.189	12.924	
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	-1.071	10.517	-1.189	11.686	
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	1.070	10.401	1.189	11.557	
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	-1.071	12.301	-1.189	13.667	
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	1.070	12.185	1.189	13.538	
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.071	10.374	-1.190	11.526	
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	1.070	10.258	1.189	11.397	
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.071	9.143	-1.189	10.159	
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	1.070	9.027	1.189	10.030	
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-1.071	10.927	-1.189	12.141	
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	1.070	10.811	1.189	12.012	
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	1.380	4.457	1.380	4.457	
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	0.000	4.245	0.000	4.245	
	Valori massimi				1.784	12.301	1.982	13.667
35	$\gamma_g.G+\gamma_q.Q4=0.9G+1.5Q4$, (EQU)	Breve	0.90	-1.784	1.904	-1.982	2.116	
36	$\gamma_g.G+\gamma_q.Q5=0.9G+1.5Q5$, (EQU)	Breve	0.90	1.784	1.711	1.982	1.901	

1.8.2. Reazioni nel nodo : 4 (kN)

L.C.	Combinazione di carichi	classe di	durata	kmod	Fx	Fy	Fx/Kmod	Fy/Kmod
1	vg.G	Permanente	0.60	0.000	12.420	0.000	20.700	
2	vg.G+vg.Q1	Breve	0.90	0.000	26.178	0.000	29.087	
3	vg.G+vg.Q2	Breve	0.90	0.000	22.738	0.000	25.265	
4	vg.G+vg.Q3	Breve	0.90	0.000	22.739	0.000	25.265	
5	vg.G+vg.Q4	Breve	0.90	0.000	10.615	0.000	11.795	
6	vg.G+vg.Q5	Breve	0.90	0.000	10.559	0.000	11.732	
7	vg.G+vg.Qf	Media	0.80	0.000	24.102	0.000	30.128	
8	vg.G+vg.Qi	Breve	0.90	0.000	18.343	0.000	20.381	
9	vg.G+vg.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	0.000	33.272	0.000	36.969	
10	vg.G+vg.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	0.000	33.239	0.000	36.932	
11	vg.G+vg.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	0.000	29.833	0.000	33.147	
12	vg.G+vg.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	0.000	29.799	0.000	33.110	
13	vg.G+vg.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	0.000	29.833	0.000	33.148	
14	vg.G+vg.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	0.000	29.799	0.000	33.110	
15	vg.G+vg.Q4+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	0.000	28.423	0.000	31.581	
16	vg.G+vg.Q4+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	0.000	26.015	0.000	28.906	
17	vg.G+vg.Q4+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	0.000	26.016	0.000	28.906	
18	vg.G+vg.Q5+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	0.000	28.367	0.000	31.519	
19	vg.G+vg.Q5+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	0.000	25.959	0.000	28.843	
20	vg.G+vg.Q5+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	0.000	25.959	0.000	28.844	
21	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q4	Breve	0.90	0.000	32.650	0.000	36.277	
22	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q5	Breve	0.90	0.000	32.616	0.000	36.240	
23	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q4	Breve	0.90	0.000	30.242	0.000	33.602	
24	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q5	Breve	0.90	0.000	30.208	0.000	33.564	
25	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q4	Breve	0.90	0.000	30.242	0.000	33.602	
26	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q5	Breve	0.90	0.000	30.208	0.000	33.565	
27	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	0.000	35.068	0.000	38.964	
28	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	0.000	35.034	0.000	38.927	
29	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	0.000	32.660	0.000	36.289	
30	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	0.000	32.626	0.000	36.251	
31	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	0.000	32.660	0.000	36.289	
32	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	0.000	32.626	0.000	36.252	
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	0.000	13.736	0.000	13.736	
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	0.000	13.813	0.000	13.813	
	Valori massimi				0.000	35.068	0.000	38.964
35	vg.G+vg.Q4=0.9G+1.5Q4, (EQU)	Breve	0.90	0.000	6.794	0.000	7.549	
36	vg.G+vg.Q5=0.9G+1.5Q5, (EQU)	Breve	0.90	0.000	6.737	0.000	7.486	

1.8.3. Reazioni nel nodo : 3 (kN)

L.C.	Combinazione di carichi	classe di	durata	kmod	Fx	Fy	Fx/Kmod	Fy/Kmod
1	yg.G	Permanente	0.60	0.000	3.234	0.000	5.390	
2	yg.G+yq.Q1	Breve	0.90	0.000	5.171	0.000	5.745	
3	yg.G+yq.Q2	Breve	0.90	0.000	5.960	0.000	6.623	
4	yg.G+yq.Q3	Breve	0.90	0.000	3.413	0.000	3.792	
5	yg.G+yq.Q4	Breve	0.90	0.000	2.678	0.000	2.976	
6	yg.G+yq.Q5	Breve	0.90	0.000	2.927	0.000	3.252	
7	yg.G+yq.Qf	Media	0.80	0.000	10.593	0.000	13.241	
8	yg.G+yq.Qi	Breve	0.90	0.000	4.068	0.000	4.520	
9	yg.G+yq.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	0.000	9.989	0.000	11.098	
10	yg.G+yq.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	0.000	10.138	0.000	11.264	
11	yg.G+yq.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	0.000	10.778	0.000	11.976	
12	yg.G+yq.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	0.000	10.927	0.000	12.142	
13	yg.G+yq.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	0.000	8.231	0.000	9.145	
14	yg.G+yq.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	0.000	8.380	0.000	9.311	
15	yg.G+yq.Q4+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	0.000	9.185	0.000	10.206	
16	yg.G+yq.Q4+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	0.000	9.738	0.000	10.820	
17	yg.G+yq.Q4+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	0.000	7.955	0.000	8.839	
18	yg.G+yq.Q5+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	0.000	9.434	0.000	10.482	
19	yg.G+yq.Q5+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	0.000	9.987	0.000	11.096	
20	yg.G+yq.Q5+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	0.000	8.203	0.000	9.115	
21	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q4	Breve	0.90	0.000	11.615	0.000	12.906	
22	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q5	Breve	0.90	0.000	11.764	0.000	13.072	
23	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q4	Breve	0.90	0.000	12.168	0.000	13.520	
24	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q5	Breve	0.90	0.000	12.317	0.000	13.686	
25	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q4	Breve	0.90	0.000	10.385	0.000	11.539	
26	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q5	Breve	0.90	0.000	10.534	0.000	11.704	
27	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	0.000	10.241	0.000	11.379	
28	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	0.000	10.390	0.000	11.545	
29	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	0.000	10.794	0.000	11.993	
30	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	0.000	10.943	0.000	12.159	
31	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	0.000	9.011	0.000	10.012	
32	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	0.000	9.160	0.000	10.178	
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	0.000	4.446	0.000	4.446	
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	0.000	4.245	0.000	4.245	
	Valori massimi				0.000	12.317	0.000	13.686
35	yg.G+yq.Q4=0.9G+1.5Q4, (EQU)	Breve	0.90	0.000	1.683	0.000	1.870	
36	yg.G+yq.Q5=0.9G+1.5Q5, (EQU)	Breve	0.90	0.000	1.932	0.000	2.147	

1.9. Stato limite di servizio**1.9.1. Stato limite di servizio** (UNI EN1995-1-1:2009, §2.2.3, §7)**Deformazione a flessione nel nodo 7** (EC5 §7.2)

Carico [kN/m]		u[mm]	Azione	ψ_0	ψ_1	ψ_2	Kdef
(Gk) Proprio	Gk1 = 0.862, Gk2 = 0.110, Gkf=0.550	-0.606	Permanente	1.00	1.00	1.00	0.60
(Qk1) Neve	QksL= 1.278, QksR= 1.278	-0.846	Breve	0.70	0.50	0.20	0.60
(Qk2) Neve	QksL= 0.639, QksR= 1.278	0.574	Breve	0.70	0.50	0.20	0.60
(Qk3) Neve	QksL= 1.278, QksR= 0.639	-1.842	Breve	0.70	0.50	0.20	0.60
(Qk4) Vento	QkwL=-0.059, QkwR=-0.332	-1.219	Breve	0.60	0.20	0.00	0.60
(Qk5) Vento	QkwL=-0.332, QkwR=-0.059	1.477	Breve	0.60	0.20	0.00	0.60
(Qkf) di esercizio	Qkf = 2.200	0.199	Media	0.70	0.50	0.30	0.60

Combinazione di carico	w.inst	w.fin [mm]
1 Gk	0.606	0.969
2 Gk + Qk1	1.451	1.916
3 Gk + Qk2	0.606	0.969
4 Gk + Qk3	2.448	3.032
5 Gk + Qk4	1.825	2.189
6 Gk + Qk5	0.606	0.969
7 Gk + Qkf	0.606	0.969
8 Gk + Qk1 + ψ_0 .Qk4 + ψ_0 .Qkf	2.183	2.648
9 Gk + Qk1 + ψ_0 .Qk5 + ψ_0 .Qkf	1.451	1.916
10 Gk + Qk2 + ψ_0 .Qk4 + ψ_0 .Qkf	1.337	1.701
11 Gk + Qk2 + ψ_0 .Qk5 + ψ_0 .Qkf	0.606	0.969
12 Gk + Qk3 + ψ_0 .Qk4 + ψ_0 .Qkf	3.179	3.764
13 Gk + Qk3 + ψ_0 .Qk5 + ψ_0 .Qkf	2.448	3.032
14 Gk + Qk4 + ψ_0 .Qk1 + ψ_0 .Qkf	2.417	2.882
15 Gk + Qk4 + ψ_0 .Qk2 + ψ_0 .Qkf	1.825	2.189
16 Gk + Qk4 + ψ_0 .Qk3 + ψ_0 .Qkf	3.115	3.699
17 Gk + Qk5 + ψ_0 .Qk1 + ψ_0 .Qkf	1.198	1.663
18 Gk + Qk5 + ψ_0 .Qk2 + ψ_0 .Qkf	0.606	0.969
19 Gk + Qk5 + ψ_0 .Qk3 + ψ_0 .Qkf	1.895	2.480
20 Gk + Qkf + ψ_0 .Qk1 + ψ_0 .Qk4	1.929	2.394
21 Gk + Qkf + ψ_0 .Qk1 + ψ_0 .Qk5	1.198	1.663
22 Gk + Qkf + ψ_0 .Qk2 + ψ_0 .Qk4	1.337	1.701
23 Gk + Qkf + ψ_0 .Qk2 + ψ_0 .Qk5	0.606	0.969
24 Gk + Qkf + ψ_0 .Qk3 + ψ_0 .Qk4	2.627	3.211
25 Gk + Qkf + ψ_0 .Qk3 + ψ_0 .Qk5	1.895	2.480

$w_{fin,g} = w_{inst,g}(1+k_{def})$, $w_{fin,q} = w_{inst,q}(1+\psi_2 \cdot k_{def})$ (EC5 §2.2.3, Eq.2.3, Eq.2.4)

Massimi valori della freccia nel nodo 7

$w_{inst} = 3.179$ mm, $w_{fin} = 3.764$ mm

Verifica secondo UNI EN1995-1-1:2009 §7.2, Tab.7.2**Deformazioni finali nel nodo 7**

$w_{inst} = 3.179$ mm < $L/300 = 8000/300 = 26.667$ mm

$w_{net,fin} = 3.764$ mm < $L/250 = 8000/250 = 32.000$ mm

$w_{fin} = 3.764$ mm < $L/150 = 8000/150 = 53.333$ mm

La verifica è soddisfatta

1.9.2. Stato limite di servizio (UNI EN1995-1-1:2009, §2.2.3, §7)**Deformazione a flessione nel nodo 10** (EC5 §7.2)

Carico [kN/m]		u[mm]	Azione	ψ_0	ψ_1	ψ_2	Kdef		
(Gk) Proprio	Gk1 = 0.862, Gk2 = 0.110, Gkf=0.550	-0.054	Permanente	1.00	1.00	1.00	0.60		
(Qk1) Neve	QksL= 1.278, QksR= 1.278	0.055	Breve	0.70	0.50	0.20	0.60		
(Qk2) Neve	QksL= 0.639, QksR= 1.278	-0.716	Breve	0.70	0.50	0.20	0.60		
(Qk3) Neve	QksL= 1.278, QksR= 0.639	0.798	Breve	0.70	0.50	0.20	0.60		
(Qk4) Vento	QkwL=-0.059, QkwR=-0.332	1.129	Breve	0.60	0.20	0.00	0.60		
(Qk5) Vento	QkwL=-0.332, QkwR=-0.059	-1.086	Breve	0.60	0.20	0.00	0.60		
(Qkf) di esercizio	Qkf = 2.200	-0.322	Media	0.70	0.50	0.30	0.60		

Combinazione di carico	w.inst	w.fin [mm]
1 Gk	0.054	0.086
2 Gk + Qk1	0.054	0.086
3 Gk + Qk2	0.770	0.888
4 Gk + Qk3	0.054	0.086
5 Gk + Qk4	0.054	0.086
6 Gk + Qk5	1.140	1.172
7 Gk + Qkf	0.376	0.466
8 Gk + Qk1 + $\psi_0 \cdot Qk4$ + $\psi_0 \cdot Qkf$	0.279	0.370
9 Gk + Qk1 + $\psi_0 \cdot Qk5$ + $\psi_0 \cdot Qkf$	0.931	1.021
10 Gk + Qk2 + $\psi_0 \cdot Qk4$ + $\psi_0 \cdot Qkf$	0.995	1.172
11 Gk + Qk2 + $\psi_0 \cdot Qk5$ + $\psi_0 \cdot Qkf$	1.647	1.823
12 Gk + Qk3 + $\psi_0 \cdot Qk4$ + $\psi_0 \cdot Qkf$	0.279	0.370
13 Gk + Qk3 + $\psi_0 \cdot Qk5$ + $\psi_0 \cdot Qkf$	0.931	1.021
14 Gk + Qk4 + $\psi_0 \cdot Qk1$ + $\psi_0 \cdot Qkf$	0.279	0.370
15 Gk + Qk4 + $\psi_0 \cdot Qk2$ + $\psi_0 \cdot Qkf$	0.781	0.957
16 Gk + Qk4 + $\psi_0 \cdot Qk3$ + $\psi_0 \cdot Qkf$	0.279	0.370
17 Gk + Qk5 + $\psi_0 \cdot Qk1$ + $\psi_0 \cdot Qkf$	1.365	1.456
18 Gk + Qk5 + $\psi_0 \cdot Qk2$ + $\psi_0 \cdot Qkf$	1.867	2.043
19 Gk + Qk5 + $\psi_0 \cdot Qk3$ + $\psi_0 \cdot Qkf$	1.365	1.456
20 Gk + Qkf + $\psi_0 \cdot Qk1$ + $\psi_0 \cdot Qk4$	0.376	0.466
21 Gk + Qkf + $\psi_0 \cdot Qk1$ + $\psi_0 \cdot Qk5$	1.028	1.118
22 Gk + Qkf + $\psi_0 \cdot Qk2$ + $\psi_0 \cdot Qk4$	0.877	1.053
23 Gk + Qkf + $\psi_0 \cdot Qk2$ + $\psi_0 \cdot Qk5$	1.529	1.705
24 Gk + Qkf + $\psi_0 \cdot Qk3$ + $\psi_0 \cdot Qk4$	0.376	0.466
25 Gk + Qkf + $\psi_0 \cdot Qk3$ + $\psi_0 \cdot Qk5$	1.028	1.118

$w_{fin,g} = w_{inst,g}(1+k_{def})$, $w_{fin,q} = w_{inst,q}(1+\psi_2 \cdot k_{def})$ (EC5 §2.2.3, Eq.2.3, Eq.2.4)

Massimi valori della freccia nel nodo 10

$w_{inst} = 1.867$ mm, $w_{fin} = 2.043$ mm

Verifica secondo UNI EN1995-1-1:2009 §7.2, Tab.7.2

Deformazioni finali nel nodo 10

$w_{inst} = 1.867$ mm < $L/150 = 600/150 = 4.000$ mm

$w_{net,fin} = 2.043$ mm < $L/125 = 600/125 = 4.800$ mm

$w_{fin} = 2.043$ mm < $L/75 = 600/75 = 8.000$ mm

La verifica è soddisfatta

1.9.3. Stato limite di servizio (UNI EN1995-1-1:2009, §2.2.3, §7)**Deformazione a flessione a metà asta 2** (EC5 §7.2)

Carico [kN/m]		u[mm]	Azione	ψ_0	ψ_1	ψ_2	Kdef		
(Gk) Proprio	Gk1 = 0.862, Gk2 = 0.110, Gkf=0.550	1.773	Permanente	1.00	1.00	1.00	0.60		
(Qk1) Neve	QksL= 1.278, QksR= 1.278	2.628	Breve	0.70	0.50	0.20	0.60		
(Qk2) Neve	QksL= 0.639, QksR= 1.278	1.314	Breve	0.70	0.50	0.20	0.60		
(Qk3) Neve	QksL= 1.278, QksR= 0.639	2.628	Breve	0.70	0.50	0.20	0.60		
(Qk4) Vento	QkwL=-0.059, QkwR=-0.332	-0.141	Breve	0.60	0.20	0.00	0.60		
(Qk5) Vento	QkwL=-0.332, QkwR=-0.059	-0.796	Breve	0.60	0.20	0.00	0.60		
(Qkf) di esercizio	Qkf = 2.200	0.000	Media	0.70	0.50	0.30	0.60		

Combinazione di carico	w.inst	w.fin [mm]
1 Gk	1.773	2.837
2 Gk + Qk1	4.401	5.781
3 Gk + Qk2	3.087	4.309
4 Gk + Qk3	4.401	5.781
5 Gk + Qk4	1.773	2.837
6 Gk + Qk5	1.773	2.837
7 Gk + Qkf	1.773	2.837
8 Gk + Qk1 + ψ_0 .Qk4 + ψ_0 .Qkf	4.401	5.781
9 Gk + Qk1 + ψ_0 .Qk5 + ψ_0 .Qkf	4.401	5.781
10 Gk + Qk2 + ψ_0 .Qk4 + ψ_0 .Qkf	3.087	4.309
11 Gk + Qk2 + ψ_0 .Qk5 + ψ_0 .Qkf	3.087	4.309
12 Gk + Qk3 + ψ_0 .Qk4 + ψ_0 .Qkf	4.401	5.781
13 Gk + Qk3 + ψ_0 .Qk5 + ψ_0 .Qkf	4.401	5.781
14 Gk + Qk4 + ψ_0 .Qk1 + ψ_0 .Qkf	3.613	4.992
15 Gk + Qk4 + ψ_0 .Qk2 + ψ_0 .Qkf	2.693	3.915
16 Gk + Qk4 + ψ_0 .Qk3 + ψ_0 .Qkf	3.613	4.992
17 Gk + Qk5 + ψ_0 .Qk1 + ψ_0 .Qkf	3.613	4.992
18 Gk + Qk5 + ψ_0 .Qk2 + ψ_0 .Qkf	2.693	3.915
19 Gk + Qk5 + ψ_0 .Qk3 + ψ_0 .Qkf	3.613	4.992
20 Gk + Qkf + ψ_0 .Qk1 + ψ_0 .Qk4	3.613	4.992
21 Gk + Qkf + ψ_0 .Qk1 + ψ_0 .Qk5	3.613	4.992
22 Gk + Qkf + ψ_0 .Qk2 + ψ_0 .Qk4	2.693	3.915
23 Gk + Qkf + ψ_0 .Qk2 + ψ_0 .Qk5	2.693	3.915
24 Gk + Qkf + ψ_0 .Qk3 + ψ_0 .Qk4	3.613	4.992
25 Gk + Qkf + ψ_0 .Qk3 + ψ_0 .Qk5	3.613	4.992

$w_{fin,g}=w_{inst,g}(1+k_{def})$, $w_{fin,q}=w_{inst,q}(1+\psi_2 \cdot k_{def})$ (EC5 §2.2.3, Eq.2.3, Eq.2.4)

Massimi valori della freccia a metà asta 2

$w_{inst} = 4.401$ mm, $w_{fin} = 5.781$ mm

Verifica secondo UNI EN1995-1-1:2009 §7.2, Tab.7.2

Deformazioni finali a metà asta 2

$w_{inst} = 4.401$ mm < $L/300=3693/300= 12.310$ mm

$w_{net,fin} = 5.781$ mm < $L/250=3693/250= 14.772$ mm

$w_{fin} = 5.781$ mm < $L/150=3693/150= 24.620$ mm

La verifica è soddisfatta

1.10. Frequenze strutturali naturali caratteristiche (peso proprio + carichi permanenti)

Dopo un'analisi dinamica vengono calcolate le frequenze naturali di base della struttura.
Per il calcolo delle frequenze naturali si considera una massa corrispondente

No.	Frequenza[Hz]	Periodo[sec]
1	5.15417	0.19402
2	16.22235	0.06164
3	18.88343	0.05296
4	24.62276	0.04061
5	26.38878	0.03789
6	31.58397	0.03166
7	45.96239	0.02176
8	49.16771	0.02034
9	61.00763	0.01639

1.11. Stato limite ultimo**1.11.1. Stato limite ultimo** (UNI EN1995-1-1:2009, §6)**Puntone, elementi: 1, 3**

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

L.C.	Combinazione di carichi	Classe di durata	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	$\gamma_g.G$	Permanente	0.60	-1.959	0.000	1.058	1.601
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	-2.249	0.000	1.908	2.603
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	-2.631	0.000	2.247	2.540
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	-2.631	0.000	2.247	2.540
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	-1.306	0.000	0.705	1.294
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	-1.306	0.000	0.705	1.295
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	-4.340	0.000	0.871	1.570
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	-1.712	0.000	1.223	1.728
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.035	0.000	1.599	2.795
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.035	0.000	1.599	2.795
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.288	0.000	1.938	2.596
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.417	0.000	1.907	2.733
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.417	0.000	1.915	2.732
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.305	0.000	1.938	2.596
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-3.752	0.000	1.238	2.425
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-3.804	0.000	1.475	2.165
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.020	0.000	1.523	2.381
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-3.752	0.000	1.238	2.426
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.020	0.000	1.523	2.382
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-3.832	0.000	1.475	2.179
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	-4.517	0.000	1.106	2.358
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	-4.517	0.000	1.106	2.359
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	-4.656	0.000	1.356	2.317
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	-4.785	0.000	1.655	2.316
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	-4.785	0.000	1.655	2.316
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	-4.673	0.000	1.364	2.325
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-4.158	0.000	1.756	2.995
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-4.158	0.000	1.756	2.995
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-4.296	0.000	1.993	2.815
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-4.425	0.000	1.962	2.952
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-4.425	0.000	1.970	2.951
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-4.313	0.000	1.993	2.815
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-1.205	0.000	0.374	0.764
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-0.991	0.000	0.371	0.629
	Valori massimi				-4.785	0.000	2.247 2.995

1.11.2. Verifica della sezione Puntone, elementi: 1, 3**Puntone, elementi: 1, 3, combinazione di carico No 25****Compressione parallela alla fibratura, $F_{c0d} = -4.307$ kN** (EC5 §6.1.4)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=12\,600$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² (EC5 Eq.2.14) $F_{c0d} = -4.307$ kN, $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 4.307 / 12600 = 0.34$ N/mm² < 12.00 N/mm² = f_{c0d} (Eq.6.2)

La verifica è soddisfatta

Puntone, elementi: 1, 3, combinazione di carico No 3**Taglio, $F_v = 2.022$ kN** (EC5 §6.1.7)Sezione rettangolare, $b_{ef}=0.67 \times 63 = 42$ mm, $h=200$ mm, $A=8\,400$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{vk}=3.80$ N/mm², $f_{vd}=K_{mod} \cdot f_{vk} / \gamma_M = 0.90 \times 3.80 / 1.50 = 2.28$ N/mm² (EC5 Eq.2.14) $F_v = 2.022$ kN, $\tau_{v0d} = 1.50 F_{v0d} / A_{netto} = 1000 \times 1.50 \times 2.022 / 8400 = 0.36$ N/mm² < 2.28 N/mm² = f_{v0d} (Eq.6.13)

La verifica è soddisfatta

Puntone, elementi: 1, 3, combinazione di carico No 28**Flessione, $M_{yd} = 2.696$ kNm, $M_{zd} = 0.000$ kNm** (EC5 §6.1.6)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{yk}=22.00$ N/mm², $f_{y0d}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{zk}=22.00$ N/mm², $f_{z0d}=K_{mod} \cdot f_{zk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{yd} = M_{yd} / W_{my, netto} = 1E+06 \times 2.696 / 4.200E+005 = 6.42$ N/mm² $\sigma_{zd} = M_{zd} / W_{mz, netto} = 1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm² $\sigma_{yd} / f_{y0d} + K_m \cdot \sigma_{zd} / f_{z0d} = 0.486 + 0.000 = 0.49 < 1$ (EC5 Eq.6.11) $K_m \cdot \sigma_{yd} / f_{y0d} + \sigma_{zd} / f_{z0d} = 0.340 + 0.000 = 0.34 < 1$ (EC5 Eq.6.12)

La verifica è soddisfatta

Puntone, elementi: 1, 3, combinazione di carico No 25**Flessione e compressione assiale combinate, $F_{c0d} = -4.307$ kN, $M_{yd} = 2.084$ kNm, $M_{zd} = 0.000$ kNm** (§6.2.4)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² $f_{yk}=22.00$ N/mm², $f_{y0d}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{zk}=22.00$ N/mm², $f_{z0d}=K_{mod} \cdot f_{zk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 4.307 / 12600 = 0.34$ N/mm² $\sigma_{yd} = M_{yd} / W_{my, netto} = 1E+06 \times 2.084 / 4.200E+005 = 4.96$ N/mm² $\sigma_{zd} = M_{zd} / W_{mz, netto} = 1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm² $(\sigma_{c0d} / f_{c0d})^2 + \sigma_{yd} / f_{y0d} + K_m \cdot \sigma_{zd} / f_{z0d} = 0.001 + 0.376 + 0.000 = 0.38 < 1$ (EC5 Eq.6.19) $(\sigma_{c0d} / f_{c0d})^2 + K_m \cdot \sigma_{yd} / f_{y0d} + \sigma_{zd} / f_{z0d} = 0.001 + 0.263 + 0.000 = 0.26 < 1$ (EC5 Eq.6.20)

La verifica è soddisfatta

Puntone, elementi: 1, 3, combinazione di carico No 28**Flessione e compressione assiale combinate, $F_{c0d} = -3.641$ kN, $M_{yd} = 2.696$ kNm, $M_{zd} = 0.000$ kNm** (§6.2.4)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² $f_{yk}=22.00$ N/mm², $f_{y0d}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{zk}=22.00$ N/mm², $f_{z0d}=K_{mod} \cdot f_{zk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))
 $\sigma_{c0d} = F_{c0d}/A_{netto} = 1000 \times 3.641 / 12600 = 0.29 \text{ N/mm}^2$
 $\sigma_{myd} = M_{yd}/W_{my,netto} = 1E+06 \times 2.696 / 4.200E+005 = 6.42 \text{ N/mm}^2$
 $\sigma_{mzd} = M_{zd}/W_{mz,netto} = 1E+06 \times 0.000 / 1.323E+005 = 0.00 \text{ N/mm}^2$

$$(\sigma_{c0d}/f_{c0d})^2 + \sigma_{myd}/f_{myd} + K_m \cdot \sigma_{mzd}/f_{mzd} = 0.001 + 0.486 + 0.000 = 0.49 < 1 \quad (\text{EC5 Eq.6.19})$$

$$(\sigma_{c0d}/f_{c0d})^2 + K_m \cdot \sigma_{myd}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.001 + 0.340 + 0.000 = 0.34 < 1 \quad (\text{EC5 Eq.6.20})$$

La verifica è soddisfatta

Puntone, elementi: 1, 3, combinazione di carico No 25

Stabilità a pressoflessione, $F_{c0d} = -4.307 \text{ kN}$, $M_{yd} = 2.084 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.2)

Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260E+004 \text{ mm}^2$, $W_y=4.200E+005 \text{ mm}^3$, $W_z=1.323E+005 \text{ mm}^3$
 Coefficiente di correzione $K_{mod}=0.90$, coefficiente del materiale $\gamma_M=1.50$, $E_{005}=6700 \text{ N/mm}^2$
 $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k}/\gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$
 $f_{myk}=22.00 \text{ N/mm}^2$, $f_{myd}=K_{mod} \cdot f_{myk}/\gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$
 $f_{mzk}=22.00 \text{ N/mm}^2$, $f_{mzd}=K_{mod} \cdot f_{mzk}/\gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))
 $\sigma_{c0d} = F_{c0d}/A_{netto} = 1000 \times 4.307 / 12600 = 0.34 \text{ N/mm}^2$
 $\sigma_{myd} = M_{yd}/W_{my,netto} = 1E+06 \times 2.084 / 4.200E+005 = 4.96 \text{ N/mm}^2$
 $\sigma_{mzd} = M_{zd}/W_{mz,netto} = 1E+06 \times 0.000 / 1.323E+005 = 0.00 \text{ N/mm}^2$

Lunghezza libera di inflessione S_k

$$S_{ky} = 1.00 \times 0.972 = 0.972 \text{ m} = 972 \text{ mm} \quad (\text{più sfavorevole})$$

$$S_{kz} = 0.31 \times 0.972 = 0.300 \text{ m} = 300 \text{ mm} \quad (\text{lunghezza efficace/lunghezza totale} = 0.30/0.97 = 0.31)$$

Snellezza

$$i_y = \sqrt{I_y/A} = 0.289 \times 200 = 58 \text{ mm}, \lambda_y = 972/58 = 16.76$$

$$i_z = \sqrt{I_z/A} = 0.289 \times 63 = 18 \text{ mm}, \lambda_z = 300/18 = 16.67$$

Tensioni critiche

$$\sigma_{c,crity} = \pi^2 E_{005} / \lambda_y^2 = 235.41 \text{ N/mm}^2, \lambda_{rel,y} = \sqrt{f_{c0k}/\sigma_{c,crity}} = 0.29 \quad (\text{EC5 Eq.6.21})$$

$$\sigma_{c,critz} = \pi^2 E_{005} / \lambda_z^2 = 237.96 \text{ N/mm}^2, \lambda_{rel,z} = \sqrt{f_{c0k}/\sigma_{c,critz}} = 0.29 \quad (\text{EC5 Eq.6.22})$$

$\beta_c = 0.20$ (legno massiccio)

$$k_y = 0.5 [1 + \beta_c (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2] = 0.50, K_{cy} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) = 1.000 \quad (\text{Eq.6.27 6.25})$$

$$k_z = 0.5 [1 + \beta_c (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2] = 0.50, K_{cz} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) = 1.000 \quad (\text{Eq.6.28 6.26})$$

$$(\sigma_{c0d}/f_{c0d})^2 + \sigma_{myd}/f_{myd} + K_m \cdot \sigma_{mzd}/f_{mzd} = 0.001 + 0.376 + 0.000 = 0.38 < 1$$

$$(\sigma_{c0d}/f_{c0d})^2 + K_m \cdot \sigma_{myd}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.001 + 0.263 + 0.000 = 0.26 < 1$$

$$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd}/f_{myd} + K_m \cdot \sigma_{mzd}/f_{mzd} = 0.028 + 0.376 + 0.000 = 0.40 < 1 \quad (\text{EC5 Eq.6.23})$$

$$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_m \cdot \sigma_{myd}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.028 + 0.263 + 0.000 = 0.29 < 1 \quad (\text{EC5 Eq.6.24})$$

La verifica è soddisfatta

Puntone, elementi: 1, 3, combinazione di carico No 28

Stabilità a pressoflessione, $F_{c0d} = -3.641 \text{ kN}$, $M_{yd} = 2.696 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.2)

Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260E+004 \text{ mm}^2$, $W_y=4.200E+005 \text{ mm}^3$, $W_z=1.323E+005 \text{ mm}^3$
 Coefficiente di correzione $K_{mod}=0.90$, coefficiente del materiale $\gamma_M=1.50$, $E_{005}=6700 \text{ N/mm}^2$
 $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k}/\gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$
 $f_{myk}=22.00 \text{ N/mm}^2$, $f_{myd}=K_{mod} \cdot f_{myk}/\gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$
 $f_{mzk}=22.00 \text{ N/mm}^2$, $f_{mzd}=K_{mod} \cdot f_{mzk}/\gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))

$$\sigma_{c0d} = F_{c0d}/A_{netto} = 1000 \times 3.641 / 12600 = 0.29 \text{ N/mm}^2$$

$$\sigma_{myd} = M_{yd}/W_{my,netto} = 1E+06 \times 2.696 / 4.200E+005 = 6.42 \text{ N/mm}^2$$

$$\sigma_{mzd} = M_{zd}/W_{mz,netto} = 1E+06 \times 0.000 / 1.323E+005 = 0.00 \text{ N/mm}^2$$

Lunghezza libera di inflessione S_k

$S_{ky} = 1.00 \times 0.972 = 0.972 \text{ m} = 972 \text{ mm}$ (più sfavorevole)

$S_{kz} = 0.31 \times 0.972 = 0.300 \text{ m} = 300 \text{ mm}$ (lunghezza efficace/lunghezza totale = $0.30/0.97 = 0.31$)

Snellezza

$i_y = \sqrt{(I_y/A)} = 0.289 \times 200 = 58 \text{ mm}$, $\lambda_y = 972 / 58 = 16.76$

$i_z = \sqrt{(I_z/A)} = 0.289 \times 63 = 18 \text{ mm}$, $\lambda_z = 300 / 18 = 16.67$

Tensioni critiche

$\sigma_{c,crity} = \pi^2 E_{005} / \lambda_y^2 = 235.41 \text{ N/mm}^2$, $\lambda_{rel,y} = \sqrt{(f_{c0k} / \sigma_{c,crity})} = 0.29$ (EC5 Eq.6.21)

$\sigma_{c,critz} = \pi^2 E_{005} / \lambda_z^2 = 237.96 \text{ N/mm}^2$, $\lambda_{rel,z} = \sqrt{(f_{c0k} / \sigma_{c,critz})} = 0.29$ (EC5 Eq.6.22)

$\beta_c = 0.20$ (legno massiccio)

$k_y = 0.5 [1 + \beta_c (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2] = 0.50$, $K_{cy} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) = 1.000$ (Eq.6.27 6.25)

$k_z = 0.5 [1 + \beta_c (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2] = 0.50$, $K_{cz} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) = 1.000$ (Eq.6.28 6.26)

$(\sigma_{c0d} / f_{c0d})^2 + \sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.001 + 0.486 + 0.000 = 0.49 < 1$

$(\sigma_{c0d} / f_{c0d})^2 + K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.001 + 0.340 + 0.000 = 0.34 < 1$

$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.024 + 0.486 + 0.000 = 0.51 < 1$ (EC5 Eq.6.23)

$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.024 + 0.340 + 0.000 = 0.36 < 1$ (EC5 Eq.6.24)

La verifica è soddisfatta

Puntone, elementi: 1, 3, combinazione di carico No 28

Stabilità laterale, $M_{yd} = 2.696 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.3)

Sezione rettangolare, $b = 63 \text{ mm}$, $h = 200 \text{ mm}$, $A = 1.260 \text{ E} + 004 \text{ mm}^2$, $W_y = 4.200 \text{ E} + 005 \text{ mm}^3$, $W_z = 1.323 \text{ E} + 005 \text{ mm}^3$

Coefficiente di correzione $K_{mod} = 0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M = 1.50$ (DM2008

$f_{c0k} = 20.00 \text{ N/mm}^2$, $f_{c0d} = K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$

$f_{myk} = 22.00 \text{ N/mm}^2$, $f_{myd} = K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

$f_{mzk} = 22.00 \text{ N/mm}^2$, $f_{mzd} = K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

Sezione rettangolare $K_m = 0.70$ (EC5 §6.1.6.(2))

$\sigma_{myd} = M_{yd} / W_{my,netto} = 1 \text{ E} + 06 \times 2.696 / 4.200 \text{ E} + 005 = 6.42 \text{ N/mm}^2$

$\sigma_{mzd} = M_{zd} / W_{mz,netto} = 1 \text{ E} + 06 \times 0.000 / 1.323 \text{ E} + 005 = 0.00 \text{ N/mm}^2$

Lunghezza libera di inflessione S_k

$S_{ky} = 1.00 \times 0.972 = 0.972 \text{ m} = 972 \text{ mm}$ (più sfavorevole)

$S_{kz} = 0.31 \times 0.972 = 0.300 \text{ m} = 300 \text{ mm}$ (lunghezza efficace/lunghezza totale = $0.30/0.97 = 0.31$)

Snellezza

$i_y = \sqrt{(I_y/A)} = 0.289 \times 200 = 58 \text{ mm}$, $\lambda_y = 972 / 58 = 16.76$

$i_z = \sqrt{(I_z/A)} = 0.289 \times 63 = 18 \text{ mm}$, $\lambda_z = 300 / 18 = 16.67$

$\sigma_{m,crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 63^2 \times 6700 / (200 \times 972) = 106.72 \text{ N/mm}^2$ (EC5 Eq.6.32)

$\sigma_{m,crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 200^2 \times 6700 / (63 \times 300) = 11060.32 \text{ N/mm}^2$ (EC5 Eq.6.32)

Tensioni critiche

$\sigma_{m,crity} = 106.72 \text{ N/mm}^2$, $\lambda_{rel,my} = \sqrt{(f_{myk} / \sigma_{m,crity})} = 0.45$ (EC5 Eq.6.30)

$\sigma_{m,critz} = 11060.32 \text{ N/mm}^2$, $\lambda_{rel,mz} = \sqrt{(f_{mzk} / \sigma_{m,critz})} = 0.04$ (EC5 Eq.6.30)

$\lambda_{rel,my} = 0.45$, ($\lambda_{rel} \leq 0.75$), $K_{crity} = 1.00$ (EC5 Eq.6.34)

$\lambda_{rel,mz} = 0.04$, ($\lambda_{rel} \leq 0.75$), $K_{critz} = 1.00$ (EC5 Eq.6.34)

$\sigma_{myd} / (K_{crity} \cdot f_{myd}) + K_m \cdot \sigma_{mzd} / (K_{critz} \cdot f_{mzd}) = 0.486 + 0.000 = 0.49 < 1$ (EC5 Eq.6.33)

$K_m \cdot \sigma_{myd} / (K_{crity} \cdot f_{myd}) + \sigma_{mzd} / (K_{critz} \cdot f_{mzd}) = 0.340 + 0.000 = 0.34 < 1$ (EC5 Eq.6.33)

La verifica è soddisfatta

1.11.3. Stato limite ultimo (UNI EN1995-1-1:2009, §6)**Puntone, elementi: 2, 4**

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

L.C.	Combinazione di carichi	Classe di durata	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod	
1	$\gamma_g.G$	Permanente	0.60	0.000	9.947	3.402	1.997	
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	0.000	17.594	5.585	3.296	
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	0.000	15.329	5.400	3.598	
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	0.000	15.329	5.400	3.598	
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	0.000	6.632	2.268	1.562	
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	0.000	6.632	2.268	1.562	
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	0.000	3.803	2.576	1.460	
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	0.000	11.351	3.696	2.177	
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	15.319	5.600	3.411	
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	15.319	5.600	3.411	
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	13.053	5.415	3.575	
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	12.560	5.158	3.713	
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	12.590	5.158	3.714	
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	13.053	5.415	3.575	
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	12.030	4.605	2.914	
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	10.444	4.475	2.895	
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	9.779	4.047	3.126	
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	12.030	4.605	2.914	
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	9.779	4.047	3.126	
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	10.444	4.475	2.895	
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	11.055	4.611	2.812	
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	11.055	4.611	2.811	
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	9.469	4.482	2.885	
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	8.976	4.225	3.023	
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	9.005	4.225	3.023	
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	9.469	4.482	2.885	
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	16.749	6.033	3.667	
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	16.749	6.033	3.667	
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	15.163	5.903	3.741	
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	14.670	5.646	3.879	
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	14.700	5.646	3.879	
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	15.164	5.903	3.741	
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	0.000	3.601	1.320	0.865	
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	0.000	3.570	1.323	0.772	
	Valori massimi				0.000	17.594	6.033	3.879

1.11.4. Verifica della sezione Puntone, elementi: 2, 4**Puntone, elementi: 2, 4, combinazione di carico No 2****Trazione parallela alla fibratura, $F_{t0d}=15.835$ kN** (EC5 §6.1.2)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=12\,600$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{t0k}=13.00$ N/mm², $f_{t0d}=K_{mod} \cdot f_{t0k} / \gamma_M = 0.90 \times 13.00 / 1.50 = 7.80$ N/mm² (EC5 Eq.2.14) $F_{t0d}=15.835$ kN, $\sigma_{t0d}=F_{t0d}/A_{netto}=1000 \times 15.835 / 12600 = 1.26$ N/mm² < 7.80 N/mm² = f_{t0d} (Eq.6.1)

La verifica è soddisfatta

Puntone, elementi: 2, 4, combinazione di carico No 27**Taglio, $F_v=5.430$ kN** (EC5 §6.1.7)Sezione rettangolare, $b_{ef}=0.67 \times 63 = 42$ mm, $h=200$ mm, $A=8\,400$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{vk}=3.80$ N/mm², $f_{vd}=K_{mod} \cdot f_{vk} / \gamma_M = 0.90 \times 3.80 / 1.50 = 2.28$ N/mm² (EC5 Eq.2.14) $F_v=5.430$ kN, $\tau_{v0d}=1.50 F_{v0d} / A_{netto} = 1000 \times 1.50 \times 5.430 / 8400 = 0.97$ N/mm² < 2.28 N/mm² = f_{v0d} (Eq.6.13)

La verifica è soddisfatta

Puntone, elementi: 2, 4, combinazione di carico No 31**Flessione, $M_{yd}=3.491$ kNm, $M_{zd}=0.000$ kNm** (EC5 §6.1.6)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{yk}=22.00$ N/mm², $f_{y0d}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{zk}=22.00$ N/mm², $f_{z0d}=K_{mod} \cdot f_{zk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{yd}=M_{yd}/W_{my,netto}=1E+06 \times 3.491 / 4.200E+005 = 8.31$ N/mm² $\sigma_{zd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm² $\sigma_{yd}/f_{y0d} + K_m \cdot \sigma_{zd}/f_{z0d} = 0.630 + 0.000 = 0.63 < 1$ (EC5 Eq.6.11) $K_m \cdot \sigma_{yd}/f_{y0d} + \sigma_{zd}/f_{z0d} = 0.441 + 0.000 = 0.44 < 1$ (EC5 Eq.6.12)

La verifica è soddisfatta

Puntone, elementi: 2, 4, combinazione di carico No 31**Stabilità laterale, $M_{yd}=3.491$ kNm, $M_{zd}=0.000$ kNm** (EC5 §6.3.3)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² $f_{yk}=22.00$ N/mm², $f_{y0d}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{zk}=22.00$ N/mm², $f_{z0d}=K_{mod} \cdot f_{zk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{yd}=M_{yd}/W_{my,netto}=1E+06 \times 3.491 / 4.200E+005 = 8.31$ N/mm² $\sigma_{zd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm²Lunghezza libera di inflessione S_k $S_{ky}=1.00 \times 3.693 = 3.693$ m = 3693 mm (più sfavorevole) $S_{kz}=0.08 \times 3.693 = 0.300$ m = 300 mm (lunghezza efficace/lunghezza totale = $0.30/3.69 = 0.08$)Snellezza $i_y = \sqrt{I_y/A} = 0.289 \times 200 = 58$ mm, $\lambda_y = 3693 / 58 = 63.67$ $i_z = \sqrt{I_z/A} = 0.289 \times 63 = 18$ mm, $\lambda_z = 300 / 18 = 16.67$ $\sigma_{m,crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 63^2 \times 6700 / (200 \times 3324) = 31.20$ N/mm² (EC5 Eq.6.32) $\sigma_{m,crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 200^2 \times 6700 / (63 \times 300) = 11060.32$ N/mm² (EC5 Eq.6.32)Tensioni critiche $\sigma_{m,crity} = 31.20$ N/mm², $\lambda_{rel,my} = \sqrt{f_{yk}/\sigma_{m,crity}} = 0.84$ (EC5 Eq.6.30) $\sigma_{m,critz} = 11060.32$ N/mm², $\lambda_{rel,mz} = \sqrt{f_{mzk}/\sigma_{m,critz}} = 0.04$ (EC5 Eq.6.30)

$\lambda_{rel,my}=0.84$, ($0.75 < \lambda_{rel} \leq 1.40$, $K_{crit}=1.56-0.75\lambda_{rel}$), $K_{crity}=0.93$ (EC5 Eq.6.34)
 $\lambda_{rel,mz}=0.04$, ($\lambda_{rel} \leq 0.75$), $K_{critz}=1.00$ (EC5 Eq.6.34)

$\sigma_{myd}/(K_{crity} \cdot f_{myd}) + K_{m, \sigma_{mzd}}/(K_{critz} \cdot f_{mzd}) = 0.677 + 0.000 = 0.68 < 1$ (EC5 Eq.6.33)

$K_{m, \sigma_{myd}}/(K_{crity} \cdot f_{myd}) + \sigma_{mzd}/(K_{critz} \cdot f_{mzd}) = 0.474 + 0.000 = 0.47 < 1$ (EC5 Eq.6.33)

La verifica è soddisfatta

Puntone, elementi: 2, 4, combinazione di carico No 2

Flessione e trazione assiale combinate, $F_{t0d}=15.835kN$, $M_{yd}=2.966kNm$, $M_{zd}=0.000kNm$ (EC5 §6.2.3)

Sezione rettangolare, $b=63mm$, $h=200mm$, $A=1.260E+004mm^2$, $W_y=4.200E+005mm^3$, $W_z=1.323E+005mm^3$

Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008

$f_{t0k}=13.00 N/mm^2$, $f_{t0d}=K_{mod} \cdot f_{t0k}/\gamma_M=0.90 \times 13.00/1.50=7.80N/mm^2$

$f_{myk}=22.00 N/mm^2$, $f_{myd}=K_{mod} \cdot f_{myk}/\gamma_M=0.90 \times 22.00/1.50=13.20N/mm^2$

$f_{mk}=22.00 N/mm^2$, $f_{mzd}=K_{mod} \cdot f_{mk}/\gamma_M=0.90 \times 22.00/1.50=13.20N/mm^2$

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))

$\sigma_{t0d}=F_{t0d}/A_{netto}=1000 \times 15.835/12600= 1.26 N/mm^2$

$\sigma_{myd}=M_{yd}/W_{my,netto}=1E+06 \times 2.966/4.200E+005= 7.06 N/mm^2$

$\sigma_{mzd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000/1.323E+005= 0.00 N/mm^2$

$\sigma_{t0d}/f_{t0d} + \sigma_{myd}/f_{myd} + K_{m, \sigma_{mzd}}/f_{mzd} = 0.161 + 0.535 + 0.000 = 0.70 < 1$ (EC5 Eq.6.17)

$\sigma_{t0d}/f_{t0d} + K_{m, \sigma_{myd}}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.161 + 0.375 + 0.000 = 0.54 < 1$ (EC5 Eq.6.18)

La verifica è soddisfatta

Puntone, elementi: 2, 4, combinazione di carico No 31

Flessione e trazione assiale combinate, $F_{t0d}=13.230kN$, $M_{yd}=3.491kNm$, $M_{zd}=0.000kNm$ (EC5 §6.2.3)

Sezione rettangolare, $b=63mm$, $h=200mm$, $A=1.260E+004mm^2$, $W_y=4.200E+005mm^3$, $W_z=1.323E+005mm^3$

Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008

$f_{t0k}=13.00 N/mm^2$, $f_{t0d}=K_{mod} \cdot f_{t0k}/\gamma_M=0.90 \times 13.00/1.50=7.80N/mm^2$

$f_{myk}=22.00 N/mm^2$, $f_{myd}=K_{mod} \cdot f_{myk}/\gamma_M=0.90 \times 22.00/1.50=13.20N/mm^2$

$f_{mk}=22.00 N/mm^2$, $f_{mzd}=K_{mod} \cdot f_{mk}/\gamma_M=0.90 \times 22.00/1.50=13.20N/mm^2$

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))

$\sigma_{t0d}=F_{t0d}/A_{netto}=1000 \times 13.230/12600= 1.05 N/mm^2$

$\sigma_{myd}=M_{yd}/W_{my,netto}=1E+06 \times 3.491/4.200E+005= 8.31 N/mm^2$

$\sigma_{mzd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000/1.323E+005= 0.00 N/mm^2$

$\sigma_{t0d}/f_{t0d} + \sigma_{myd}/f_{myd} + K_{m, \sigma_{mzd}}/f_{mzd} = 0.135 + 0.630 + 0.000 = 0.76 < 1$ (EC5 Eq.6.17)

$\sigma_{t0d}/f_{t0d} + K_{m, \sigma_{myd}}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.135 + 0.441 + 0.000 = 0.58 < 1$ (EC5 Eq.6.18)

La verifica è soddisfatta

1.11.5. Stato limite ultimo (UNI EN1995-1-1:2009, §6)**Puntone, elementi: 13, 14**

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

L.C.	Combinazione di carichi	Classe di durata	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod	
1	$\gamma_g.G$	Permanente	0.60	0.000	0.673	1.121	0.392	
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	0.000	1.106	1.843	0.645	
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	0.000	1.106	1.843	0.645	
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	0.000	1.106	1.843	0.645	
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	0.000	0.448	0.747	0.261	
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	0.000	0.448	0.747	0.261	
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	0.000	0.504	0.841	0.294	
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	0.000	0.731	1.219	0.426	
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	1.106	1.843	0.645	
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	1.106	1.843	0.645	
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	1.106	1.843	0.645	
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	1.106	1.843	0.645	
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	1.106	1.802	0.630	
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	1.106	1.611	0.563	
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	0.909	1.514	0.530	
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	0.909	1.514	0.530	
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	0.908	1.445	0.506	
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	0.909	1.514	0.530	
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	0.909	1.514	0.530	
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	0.908	1.131	0.396	
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	0.909	1.514	0.530	
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	0.909	1.514	0.530	
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	0.909	1.514	0.530	
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	0.909	1.514	0.530	
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	0.908	1.473	0.515	
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	0.908	1.282	0.448	
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	1.192	1.986	0.695	
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	1.192	1.986	0.695	
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	1.192	1.986	0.695	
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	1.192	1.986	0.695	
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	1.191	1.944	0.680	
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	1.191	1.754	0.613	
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	0.000	0.286	0.449	0.157	
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	0.000	0.261	0.435	0.152	
	Valori massimi				0.000	1.192	1.986	0.695

1.11.6. Verifica della sezione Puntone, elementi: 13, 14**Puntone, elementi: 13, 14 , combinazione di carico No 28****Trazione parallela alla fibratura, $F_{t0d}=1.072$ kN** (EC5 §6.1.2)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=12\,600$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{t0k}=13.00$ N/mm², $f_{t0d}=K_{mod} \cdot f_{t0k} / \gamma_M = 0.90 \times 13.00 / 1.50 = 7.80$ N/mm² (EC5 Eq.2.14) $F_{t0d}=1.072$ kN, $\sigma_{t0d}=F_{t0d}/A_{netto}=1000 \times 1.072 / 12600 = 0.09$ N/mm² < 7.80 N/mm² = f_{t0d} (Eq.6.1)

La verifica è soddisfatta

Puntone, elementi: 13, 14 , combinazione di carico No 30**Taglio, $F_v=1.787$ kN** (EC5 §6.1.7)Sezione rettangolare, $b_{ef}=0.67 \times 63 = 42$ mm, $h=200$ mm, $A=8\,400$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{vk}=3.80$ N/mm², $f_{vd}=K_{mod} \cdot f_{vk} / \gamma_M = 0.90 \times 3.80 / 1.50 = 2.28$ N/mm² (EC5 Eq.2.14) $F_v=1.787$ kN, $\tau_{v0d}=1.50 F_{v0d} / A_{netto} = 1000 \times 1.50 \times 1.787 / 8400 = 0.32$ N/mm² < 2.28 N/mm² = f_{v0d} (Eq.6.13)

La verifica è soddisfatta

Puntone, elementi: 13, 14 , combinazione di carico No 30**Flessione, $M_{yd}=0.625$ kNm, $M_{zd}=0.000$ kNm** (EC5 §6.1.6)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{yk}=22.00$ N/mm², $f_{ykd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{mk}=22.00$ N/mm², $f_{mkd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{yd}=M_{yd}/W_{my,netto}=1E+06 \times 0.625 / 4.200E+005 = 1.49$ N/mm² $\sigma_{zd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm² $\sigma_{yd}/f_{ykd} + K_m \cdot \sigma_{zd}/f_{mkd} = 0.113 + 0.000 = 0.11 < 1$ (EC5 Eq.6.11) $K_m \cdot \sigma_{yd}/f_{ykd} + \sigma_{zd}/f_{mkd} = 0.079 + 0.000 = 0.08 < 1$ (EC5 Eq.6.12)

La verifica è soddisfatta

Puntone, elementi: 13, 14 , combinazione di carico No 30**Stabilità laterale, $M_{yd}=0.625$ kNm, $M_{zd}=0.000$ kNm** (EC5 §6.3.3)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² $f_{yk}=22.00$ N/mm², $f_{ykd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{mk}=22.00$ N/mm², $f_{mkd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{yd}=M_{yd}/W_{my,netto}=1E+06 \times 0.625 / 4.200E+005 = 1.49$ N/mm² $\sigma_{zd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm²Lunghezza libera di inflessione S_k $S_{ky}=1.00 \times 1.399 = 1.399$ m = 1399 mm (più sfavorevole) $S_{kz}=0.21 \times 1.399 = 0.300$ m = 300 mm (lunghezza efficace/lunghezza totale = $0.30/1.40 = 0.21$)Snellezza $i_y = \sqrt{I_y/A} = 0.289 \times 200 = 58$ mm, $\lambda_y = 1399 / 58 = 24.13$ $i_z = \sqrt{I_z/A} = 0.289 \times 63 = 18$ mm, $\lambda_z = 300 / 18 = 16.67$ $\sigma_{m,crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 63^2 \times 6700 / (200 \times 1259) = 82.34$ N/mm² (EC5 Eq.6.32) $\sigma_{m,crit} = 0.78 \cdot b^2 \cdot E_{005} / (h \cdot L_{ef}) = 0.78 \times 200^2 \times 6700 / (63 \times 300) = 11060.32$ N/mm² (EC5 Eq.6.32)Tensioni critiche $\sigma_{m,crity} = 82.34$ N/mm², $\lambda_{rel,my} = \sqrt{f_{yk}/\sigma_{m,crity}} = 0.52$ (EC5 Eq.6.30) $\sigma_{m,critz} = 11060.32$ N/mm², $\lambda_{rel,mz} = \sqrt{f_{mk}/\sigma_{m,critz}} = 0.04$ (EC5 Eq.6.30)

$\lambda_{rel,my}=0.52, (\lambda_{rel}\leq 0.75), K_{cristy}=1.00$ (EC5 Eq.6.34)
 $\lambda_{rel,mz}=0.04, (\lambda_{rel}\leq 0.75), K_{critz}=1.00$ (EC5 Eq.6.34)

$\sigma_{myd}/(K_{cristy}\cdot f_{myd})+K_m\cdot\sigma_{mzd}/(K_{critz}\cdot f_{mzd})=0.113+0.000= 0.11 < 1$ (EC5 Eq.6.33)
 $K_m\cdot\sigma_{myd}/(K_{cristy}\cdot f_{myd})+\sigma_{mzd}/(K_{critz}\cdot f_{mzd})=0.079+0.000= 0.08 < 1$ (EC5 Eq.6.33)
 La verifica è soddisfatta

Puntone, elementi: 13, 14 , combinazione di carico No 28

Flessione e trazione assiale combinate, $F_{t0d}=1.072kN$, $M_{yd}=0.552kNm$, $M_{zd}=0.000kNm$ (EC5 §6.2.3)

Sezione rettangolare, $b=63mm$, $h=200mm$, $A=1.260E+004mm^2$, $W_y=4.200E+005mm^3$, $W_z=1.323E+005mm^3$

Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008

$f_{t0k}=13.00$ N/mm², $f_{t0d}=K_{mod}\cdot f_{t0k}/\gamma_M=0.90\times 13.00/1.50=7.80$ N/mm²

$f_{myk}=22.00$ N/mm², $f_{myd}=K_{mod}\cdot f_{myk}/\gamma_M=0.90\times 22.00/1.50=13.20$ N/mm²

$f_{mzk}=22.00$ N/mm², $f_{mzd}=K_{mod}\cdot f_{mzk}/\gamma_M=0.90\times 22.00/1.50=13.20$ N/mm²

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))

$\sigma_{t0d}=F_{t0d}/A_{netto}=1000\times 1.072/12600= 0.09$ N/mm²

$\sigma_{myd}=M_{yd}/W_{my,netto}=1E+06\times 0.552/4.200E+005= 1.31$ N/mm²

$\sigma_{mzd}=M_{zd}/W_{mz,netto}=1E+06\times 0.000/1.323E+005= 0.00$ N/mm²

$\sigma_{t0d}/f_{t0d}+\sigma_{myd}/f_{myd}+K_m\cdot\sigma_{mzd}/f_{mzd}=0.011+0.100+0.000= 0.11 < 1$ (EC5 Eq.6.17)

$\sigma_{t0d}/f_{t0d}+K_m\cdot\sigma_{myd}/f_{myd}+\sigma_{mzd}/f_{mzd}=0.011+0.070+0.000= 0.08 < 1$ (EC5 Eq.6.18)

La verifica è soddisfatta

1.11.7. Stato limite ultimo (UNI EN1995-1-1:2009, §6)**Catena, elementi: 5, 6**

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

L.C.	Combinazione di carichi	Classe di durata	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod	
1	$\gamma_g.G$	Permanente	0.60	0.000	1.424	3.072	2.190	
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	0.000	1.593	1.933	1.306	
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	0.000	1.438	2.058	1.506	
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	0.000	1.438	2.058	1.506	
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	0.000	2.124	2.305	1.474	
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	0.000	0.949	2.300	1.467	
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	0.000	3.273	11.508	8.414	
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	0.000	1.226	1.999	1.394	
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	3.670	7.814	5.528	
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	2.966	7.811	5.524	
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	3.504	7.785	5.564	
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	2.799	7.936	5.569	
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	3.515	7.939	5.573	
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	2.810	7.785	5.564	
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	3.947	7.951	5.580	
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	3.830	7.904	5.602	
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	3.838	8.039	5.611	
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	2.772	7.946	5.573	
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	2.656	8.034	5.605	
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	0.000	2.663	7.899	5.597	
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	4.065	10.303	7.380	
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	3.361	10.300	7.376	
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	3.949	10.255	7.403	
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	3.244	10.388	7.407	
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	0.000	3.956	10.391	7.411	
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	0.000	3.252	10.252	7.403	
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	3.754	7.799	5.508	
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	3.050	7.796	5.504	
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	3.638	7.751	5.531	
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	2.933	7.884	5.535	
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	3.645	7.887	5.539	
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	0.000	2.941	7.748	5.531	
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	0.000	0.964	1.981	1.387	
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	0.000	0.729	1.930	1.393	
	Valori massimi				0.000	4.065	11.508	8.414

1.11.8. Verifica della sezione Catena, elementi: 5, 6**Catena, elementi: 5, 6, combinazione di carico No 21****Trazione parallela alla fibratura, $F_{t0d}=3.659$ kN** (EC5 §6.1.2)Sezione rettangolare, $b=75$ mm, $h=225$ mm, $A=16\,875$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{t0k}=13.00$ N/mm², $f_{t0d}=K_{mod} \cdot f_{t0k} / \gamma_M = 0.90 \times 13.00 / 1.50 = 7.80$ N/mm² (EC5 Eq.2.14) $F_{t0d}=3.659$ kN, $\sigma_{t0d}=F_{t0d}/A_{netto}=1000 \times 3.659 / 16875 = 0.22$ N/mm² < 7.80 N/mm² = f_{t0d} (Eq.6.1)

La verifica è soddisfatta

Catena, elementi: 5, 6, combinazione di carico No 7**Taglio, $F_v=9.207$ kN** (EC5 §6.1.7)Sezione rettangolare, $b_{ef}=0.67 \times 75 = 50$ mm, $h=225$ mm, $A=11\,250$ mm²Coefficiente di correzione $K_{mod}=0.80$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{vk}=3.80$ N/mm², $f_{vd}=K_{mod} \cdot f_{vk} / \gamma_M = 0.80 \times 3.80 / 1.50 = 2.03$ N/mm² (EC5 Eq.2.14) $F_v=9.207$ kN, $\tau_{v0d}=1.50 F_{v0d} / A_{netto} = 1000 \times 1.50 \times 9.207 / 11250 = 1.23$ N/mm² < 2.03 N/mm² = f_{v0d} (Eq.6.13)

La verifica è soddisfatta

Catena, elementi: 5, 6, combinazione di carico No 7**Flessione, $M_{yd}=6.731$ kNm, $M_{zd}=0.000$ kNm** (EC5 §6.1.6)Sezione rettangolare, $b=75$ mm, $h=225$ mm, $A=1.688E+004$ mm², $W_y=6.328E+005$ mm³, $W_z=2.109E+005$ mm³Coefficiente di correzione $K_{mod}=0.80$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{myk}=22.00$ N/mm², $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.80 \times 22.00 / 1.50 = 11.73$ N/mm² $f_{mzk}=22.00$ N/mm², $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.80 \times 22.00 / 1.50 = 11.73$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{myd}=M_{yd}/W_{my,netto}=1E+06 \times 6.731 / 6.328E+005 = 10.64$ N/mm² $\sigma_{mzd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000 / 2.109E+005 = 0.00$ N/mm² $\sigma_{myd}/f_{myd} + K_m \cdot \sigma_{mzd}/f_{mzd} = 0.907 + 0.000 = 0.91 < 1$ (EC5 Eq.6.11) $K_m \cdot \sigma_{myd}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.635 + 0.000 = 0.63 < 1$ (EC5 Eq.6.12)

La verifica è soddisfatta

Catena, elementi: 5, 6, combinazione di carico No 21**Flessione e trazione assiale combinate, $F_{t0d}=3.659$ kN, $M_{yd}=6.642$ kNm, $M_{zd}=0.000$ kNm** (EC5 §6.2.3)Sezione rettangolare, $b=75$ mm, $h=225$ mm, $A=1.688E+004$ mm², $W_y=6.328E+005$ mm³, $W_z=2.109E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{t0k}=13.00$ N/mm², $f_{t0d}=K_{mod} \cdot f_{t0k} / \gamma_M = 0.90 \times 13.00 / 1.50 = 7.80$ N/mm² $f_{myk}=22.00$ N/mm², $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{mzk}=22.00$ N/mm², $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{t0d}=F_{t0d}/A_{netto}=1000 \times 3.659 / 16875 = 0.22$ N/mm² $\sigma_{myd}=M_{yd}/W_{my,netto}=1E+06 \times 6.642 / 6.328E+005 = 10.50$ N/mm² $\sigma_{mzd}=M_{zd}/W_{mz,netto}=1E+06 \times 0.000 / 2.109E+005 = 0.00$ N/mm² $\sigma_{t0d}/f_{t0d} + \sigma_{myd}/f_{myd} + K_m \cdot \sigma_{mzd}/f_{mzd} = 0.028 + 0.795 + 0.000 = 0.82 < 1$ (EC5 Eq.6.17) $\sigma_{t0d}/f_{t0d} + K_m \cdot \sigma_{myd}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.028 + 0.557 + 0.000 = 0.58 < 1$ (EC5 Eq.6.18)

La verifica è soddisfatta

Catena, elementi: 5, 6, combinazione di carico No 7**Flessione e trazione assiale combinate, $F_{t0d}=2.619$ kN, $M_{yd}=6.731$ kNm, $M_{zd}=0.000$ kNm** (EC5 §6.2.3)Sezione rettangolare, $b=75$ mm, $h=225$ mm, $A=1.688E+004$ mm², $W_y=6.328E+005$ mm³, $W_z=2.109E+005$ mm³Coefficiente di correzione $K_{mod}=0.80$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{t0k}=13.00$ N/mm², $f_{t0d}=K_{mod} \cdot f_{t0k} / \gamma_M = 0.80 \times 13.00 / 1.50 = 6.93$ N/mm² $f_{myk}=22.00$ N/mm², $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.80 \times 22.00 / 1.50 = 11.73$ N/mm² $f_{mzk}=22.00$ N/mm², $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.80 \times 22.00 / 1.50 = 11.73$ N/mm²

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))
 $\sigma_{t0d}=F_{t0d}/A_{netto}=1000 \times 2.619/16875= 0.16 \text{ N/mm}^2$
 $\sigma_{myd}=M_{yd}/W_{my, netto}=1E+06 \times 6.731/6.328E+005=10.64 \text{ N/mm}^2$
 $\sigma_{mzd}=M_{zd}/W_{mz, netto}=1E+06 \times 0.000/2.109E+005= 0.00 \text{ N/mm}^2$

$\sigma_{t0d}/f_{t0d}+\sigma_{myd}/f_{myd}+K_m.\sigma_{mzd}/f_{mzd}=0.022+0.907+0.000= 0.93 < 1$ (EC5 Eq.6.17)

$\sigma_{t0d}/f_{t0d}+K_m.\sigma_{myd}/f_{myd}+\sigma_{mzd}/f_{mzd}=0.022+0.635+0.000= 0.66 < 1$ (EC5 Eq.6.18)

La verifica è soddisfatta

1.11.9. Stato limite ultimo (UNI EN1995-1-1:2009, §6)**Elementi:** 7, 8

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

L.C.	Combinazione di carichi	Classe di durata	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	$\gamma_g.G$	Permanente	0.60	-2.743	0.000	1.424	1.340
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	-3.865	0.000	1.593	1.347
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	-4.868	0.000	1.438	1.556
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	-4.868	0.000	1.437	1.556
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	-1.828	0.000	2.105	1.898
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	-1.828	0.000	2.122	1.911
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	-3.960	0.000	3.273	3.961
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	-2.705	0.000	1.226	1.026
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-5.048	0.000	2.966	3.041
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-5.048	0.000	2.966	3.041
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-6.052	0.000	2.810	3.345
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-5.998	0.000	3.503	3.956
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-5.983	0.000	3.493	3.948
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-6.052	0.000	2.810	3.345
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.438	0.000	3.928	3.953
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.269	0.000	3.819	3.632
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-5.140	0.000	3.812	4.166
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.438	0.000	3.945	3.966
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-5.140	0.000	3.829	4.179
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-4.295	0.000	3.836	3.646
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	-4.945	0.000	4.054	4.340
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	-4.945	0.000	4.064	4.347
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	-5.125	0.000	3.945	4.019
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	-5.647	0.000	3.948	4.560
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	-5.647	0.000	3.938	4.552
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	-5.140	0.000	3.955	4.027
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-5.314	0.000	3.050	3.081
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-5.314	0.000	3.050	3.081
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-6.016	0.000	2.941	3.294
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-5.963	0.000	3.637	3.905
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-5.947	0.000	3.627	3.897
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-6.016	0.000	2.941	3.294
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-1.300	0.000	0.960	1.000
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-1.217	0.000	0.729	0.757
	Valori massimi				-6.052	0.000	4.064
							4.560

1.11.10. Verifica della sezione Elementi: 7, 8**Elementi: 7, 8 , combinazione di carico No 11****Compressione parallela alla fibratura, $F_{c0d} = -5.446$ kN** (EC5 §6.1.4)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=12\,600$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² (EC5 Eq.2.14) $F_{c0d} = -5.446$ kN, $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 5.446 / 12600 = 0.43$ N/mm² < 12.00 N/mm² = f_{c0d} (Eq.6.2)

La verifica è soddisfatta

Elementi: 7, 8 , combinazione di carico No 22**Taglio, $F_v = 3.658$ kN** (EC5 §6.1.7)Sezione rettangolare, $b_{ef}=0.67 \times 63 = 42$ mm, $h=200$ mm, $A=8\,400$ mm²Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{vk}=3.80$ N/mm², $f_{vd}=K_{mod} \cdot f_{vk} / \gamma_M = 0.90 \times 3.80 / 1.50 = 2.28$ N/mm² (EC5 Eq.2.14) $F_v = 3.658$ kN, $\tau_{v0d} = 1.50 F_{v0d} / A_{netto} = 1000 \times 1.50 \times 3.658 / 8400 = 0.65$ N/mm² < 2.28 N/mm² = f_{v0d} (Eq.6.13)

La verifica è soddisfatta

Elementi: 7, 8 , combinazione di carico No 24**Flessione, $M_{yd} = 4.104$ kNm, $M_{zd} = 0.000$ kNm** (EC5 §6.1.6)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{myk}=22.00$ N/mm², $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{mzk}=22.00$ N/mm², $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{myd} = M_{yd} / W_{my,netto} = 1E+06 \times 4.104 / 4.200E+005 = 9.77$ N/mm² $\sigma_{mzd} = M_{zd} / W_{mz,netto} = 1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm² $\sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.740 + 0.000 = 0.74 < 1$ (EC5 Eq.6.11) $K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.518 + 0.000 = 0.52 < 1$ (EC5 Eq.6.12)

La verifica è soddisfatta

Elementi: 7, 8 , combinazione di carico No 11**Flessione e compressione assiale combinate, $F_{c0d} = -5.446$ kN, $M_{yd} = 3.011$ kNm, $M_{zd} = 0.000$ kNm** (§6.2.4)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² $f_{myk}=22.00$ N/mm², $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{mzk}=22.00$ N/mm², $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 5.446 / 12600 = 0.43$ N/mm² $\sigma_{myd} = M_{yd} / W_{my,netto} = 1E+06 \times 3.011 / 4.200E+005 = 7.17$ N/mm² $\sigma_{mzd} = M_{zd} / W_{mz,netto} = 1E+06 \times 0.000 / 1.323E+005 = 0.00$ N/mm² $(\sigma_{c0d} / f_{c0d})^2 + \sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.001 + 0.543 + 0.000 = 0.54 < 1$ (EC5 Eq.6.19) $(\sigma_{c0d} / f_{c0d})^2 + K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.001 + 0.380 + 0.000 = 0.38 < 1$ (EC5 Eq.6.20)

La verifica è soddisfatta

Elementi: 7, 8 , combinazione di carico No 24**Flessione e compressione assiale combinate, $F_{c0d} = -2.721$ kN, $M_{yd} = 4.104$ kNm, $M_{zd} = 0.000$ kNm** (§6.2.4)Sezione rettangolare, $b=63$ mm, $h=200$ mm, $A=1.260E+004$ mm², $W_y=4.200E+005$ mm³, $W_z=1.323E+005$ mm³Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00$ N/mm², $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00$ N/mm² $f_{myk}=22.00$ N/mm², $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm² $f_{mzk}=22.00$ N/mm², $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20$ N/mm²

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))
 $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 2.721 / 12600 = 0.22 \text{ N/mm}^2$
 $\sigma_{myd} = M_{yd} / W_{my}, \text{netto} = 1 \times 10^6 \times 4.104 / 4.200 \times 10^5 = 9.77 \text{ N/mm}^2$
 $\sigma_{mzd} = M_{zd} / W_{mz}, \text{netto} = 1 \times 10^6 \times 0.000 / 1.323 \times 10^5 = 0.00 \text{ N/mm}^2$

$$(\sigma_{c0d} / f_{c0d})^2 + \sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.000 + 0.740 + 0.000 = 0.74 < 1 \quad (\text{EC5 Eq.6.19})$$

$$(\sigma_{c0d} / f_{c0d})^2 + K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.000 + 0.518 + 0.000 = 0.52 < 1 \quad (\text{EC5 Eq.6.20})$$

La verifica è soddisfatta

Elementi: 7, 8, combinazione di carico No 11

Stabilità a pressoflessione, $F_{c0d} = -5.446 \text{ kN}$, $M_{yd} = 3.011 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.2)

Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \times 10^4 \text{ mm}^2$, $W_y=4.200 \times 10^5 \text{ mm}^3$, $W_z=1.323 \times 10^5 \text{ mm}^3$
 Coefficiente di correzione $K_{mod}=0.90$, coefficiente del materiale $\gamma_M=1.50$, $E_{005}=6700 \text{ N/mm}^2$
 $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$
 $f_{myk}=22.00 \text{ N/mm}^2$, $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$
 $f_{mzk}=22.00 \text{ N/mm}^2$, $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))
 $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 5.446 / 12600 = 0.43 \text{ N/mm}^2$
 $\sigma_{myd} = M_{yd} / W_{my}, \text{netto} = 1 \times 10^6 \times 3.011 / 4.200 \times 10^5 = 7.17 \text{ N/mm}^2$
 $\sigma_{mzd} = M_{zd} / W_{mz}, \text{netto} = 1 \times 10^6 \times 0.000 / 1.323 \times 10^5 = 0.00 \text{ N/mm}^2$

Lunghezza libera di inflessione S_k

$$S_{ky} = 1.00 \times 1.600 = 1.600 \text{ m} = 1600 \text{ mm} \quad (\text{più sfavorevole})$$

$$S_{kz} = 1.00 \times 1.600 = 1.600 \text{ m} = 1600 \text{ mm} \quad (\text{più sfavorevole})$$

Snellezza

$$i_y = \sqrt{I_y / A} = 0.289 \times 200 = 58 \text{ mm}, \lambda_y = 1600 / 58 = 27.59$$

$$i_z = \sqrt{I_z / A} = 0.289 \times 63 = 18 \text{ mm}, \lambda_z = 1600 / 18 = 88.89$$

Tensioni critiche

$$\sigma_{c, \text{crit}y} = \pi^2 E_{005} / \lambda_y^2 = 86.87 \text{ N/mm}^2, \lambda_{\text{rel}, y} = \sqrt{f_{c0k} / \sigma_{c, \text{crit}y}} = 0.48 \quad (\text{EC5 Eq.6.21})$$

$$\sigma_{c, \text{crit}z} = \pi^2 E_{005} / \lambda_z^2 = 8.37 \text{ N/mm}^2, \lambda_{\text{rel}, z} = \sqrt{f_{c0k} / \sigma_{c, \text{crit}z}} = 1.55 \quad (\text{EC5 Eq.6.22})$$

$$\beta_c = 0.20 \quad (\text{legno massiccio})$$

$$k_y = 0.5 [1 + \beta_c (\lambda_{\text{rel}y} - 0.3) + \lambda_{\text{rel}y}^2] = 0.63, K_{cy} = 1 / (k_y + \sqrt{k_y^2 - \lambda_{\text{rel}y}^2}) = 0.956 \quad (\text{Eq.6.27 6.25})$$

$$k_z = 0.5 [1 + \beta_c (\lambda_{\text{rel}z} - 0.3) + \lambda_{\text{rel}z}^2] = 1.82, K_{cz} = 1 / (k_z + \sqrt{k_z^2 - \lambda_{\text{rel}z}^2}) = 0.360 \quad (\text{Eq.6.28 6.26})$$

$$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.038 + 0.543 + 0.000 = 0.58 < 1 \quad (\text{EC5 Eq.6.23})$$

$$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.100 + 0.380 + 0.000 = 0.48 < 1 \quad (\text{EC5 Eq.6.24})$$

La verifica è soddisfatta

Elementi: 7, 8, combinazione di carico No 24

Stabilità a pressoflessione, $F_{c0d} = -2.721 \text{ kN}$, $M_{yd} = 4.104 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.2)

Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \times 10^4 \text{ mm}^2$, $W_y=4.200 \times 10^5 \text{ mm}^3$, $W_z=1.323 \times 10^5 \text{ mm}^3$
 Coefficiente di correzione $K_{mod}=0.90$, coefficiente del materiale $\gamma_M=1.50$, $E_{005}=6700 \text{ N/mm}^2$
 $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$
 $f_{myk}=22.00 \text{ N/mm}^2$, $f_{myd}=K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$
 $f_{mzk}=22.00 \text{ N/mm}^2$, $f_{mzd}=K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2))
 $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 2.721 / 12600 = 0.22 \text{ N/mm}^2$
 $\sigma_{myd} = M_{yd} / W_{my}, \text{netto} = 1 \times 10^6 \times 4.104 / 4.200 \times 10^5 = 9.77 \text{ N/mm}^2$
 $\sigma_{mzd} = M_{zd} / W_{mz}, \text{netto} = 1 \times 10^6 \times 0.000 / 1.323 \times 10^5 = 0.00 \text{ N/mm}^2$

Lunghezza libera di inflessione S_k

$$S_{ky} = 1.00 \times 1.600 = 1.600 \text{ m} = 1600 \text{ mm} \quad (\text{più sfavorevole})$$

$$S_{kz} = 1.00 \times 1.600 = 1.600 \text{ m} = 1600 \text{ mm} \quad (\text{più sfavorevole})$$

Snellezza

$$i_y = \sqrt{I_y/A} = 0.289 \times 200 = 58 \text{ mm}, \lambda_y = 1600/58 = 27.59$$

$$i_z = \sqrt{I_z/A} = 0.289 \times 63 = 18 \text{ mm}, \lambda_z = 1600/18 = 88.89$$

Tensioni critiche

$$\sigma_{c,crity} = \pi^2 E_{005} / \lambda_y^2 = 86.87 \text{ N/mm}^2, \lambda_{rel,y} = \sqrt{f_{c0k} / \sigma_{c,crity}} = 0.48 \text{ (EC5 Eq. 6.21)}$$

$$\sigma_{c,critz} = \pi^2 E_{005} / \lambda_z^2 = 8.37 \text{ N/mm}^2, \lambda_{rel,z} = \sqrt{f_{c0k} / \sigma_{c,critz}} = 1.55 \text{ (EC5 Eq. 6.22)}$$

$$\beta_c = 0.20 \text{ (legno massiccio)}$$

$$k_y = 0.5 [1 + \beta_c (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2] = 0.63, K_{cy} = 1 / (k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}) = 0.956 \text{ (Eq. 6.27 6.25)}$$

$$k_z = 0.5 [1 + \beta_c (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2] = 1.82, K_{cz} = 1 / (k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}) = 0.360 \text{ (Eq. 6.28 6.26)}$$

$$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd} / f_{myd} + K_{m} \cdot \sigma_{mzd} / f_{mzd} = 0.019 + 0.740 + 0.000 = 0.76 < 1 \text{ (EC5 Eq. 6.23)}$$

$$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_{m} \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.050 + 0.518 + 0.000 = 0.57 < 1 \text{ (EC5 Eq. 6.24)}$$

La verifica è soddisfatta

1.11.11. Stato limite ultimo (UNI EN1995-1-1:2009, §6)**Elementi:** 9, 10

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

L.C.	Combinazione di carichi	Classe di durata	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	$\gamma_g.G$	Permanente	0.60	-8.660	0.000	0.382	0.292
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	-14.550	0.000	0.260	0.188
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	-12.356	0.000	0.254	0.195
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	-12.356	0.000	0.263	0.195
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	-5.774	0.000	0.255	0.200
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	-5.774	0.000	0.249	0.200
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	-5.577	0.000	0.286	0.220
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	-9.552	0.000	0.257	0.192
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-13.979	0.000	0.260	0.192
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-13.979	0.000	0.256	0.192
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-11.784	0.000	0.254	0.195
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-11.785	0.000	0.250	0.198
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-11.785	0.000	0.263	0.198
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-11.784	0.000	0.259	0.195
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-11.346	0.000	0.258	0.195
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-9.810	0.000	0.254	0.195
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-9.810	0.000	0.261	0.200
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-11.346	0.000	0.252	0.195
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-9.810	0.000	0.248	0.200
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-9.810	0.000	0.255	0.195
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	-11.101	0.000	0.258	0.194
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	-11.101	0.000	0.254	0.194
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	-9.565	0.000	0.254	0.195
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	-9.566	0.000	0.250	0.198
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	-9.566	0.000	0.260	0.198
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	-9.565	0.000	0.257	0.195
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-15.124	0.000	0.260	0.191
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-15.124	0.000	0.257	0.191
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-13.588	0.000	0.256	0.192
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-13.589	0.000	0.253	0.195
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-13.589	0.000	0.263	0.195
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-13.588	0.000	0.259	0.192
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.274	0.000	0.119	0.090
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-3.290	0.000	0.127	0.097
	Valori massimi				-15.124	0.000	0.382 0.292

1.11.12. Verifica della sezione Elementi: 9, 10**Elementi: 9, 10 , combinazione di carico No 28****Compressione parallela alla fibratura, $F_{c0d} = -13.612 \text{ kN}$ (EC5 §6.1.4)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=12\,600 \text{ mm}^2$ Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$ (EC5 Eq.2.14) $F_{c0d} = -13.612 \text{ kN}$, $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 13.612 / 12600 = 1.08 \text{ N/mm}^2 < 12.00 \text{ N/mm}^2 = f_{c0d}$ (Eq.6.2)

La verifica è soddisfatta

Tensione di taglio trascurabile, verifica a taglio non necessaria (EC5 §6.1.7)**Elementi: 9, 10 , combinazione di carico No 1****Flessione, $M_{yd}=0.175 \text{ kNm}$, $M_{zd}=0.000 \text{ kNm}$ (EC5 §6.1.6)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \text{ E}+004 \text{ mm}^2$, $W_y=4.200 \text{ E}+005 \text{ mm}^3$, $W_z=1.323 \text{ E}+005 \text{ mm}^3$ Coefficiente di correzione $K_{mod}=0.60$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{yk}=22.00 \text{ N/mm}^2$, $f_{myd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.60 \times 22.00 / 1.50 = 8.80 \text{ N/mm}^2$ $f_{mk}=22.00 \text{ N/mm}^2$, $f_{mzd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.60 \times 22.00 / 1.50 = 8.80 \text{ N/mm}^2$ Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{myd} = M_{yd} / W_{my,netto} = 1 \text{ E}+06 \times 0.175 / 4.200 \text{ E}+005 = 0.42 \text{ N/mm}^2$ $\sigma_{mzd} = M_{zd} / W_{mz,netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$ $\sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.047 + 0.000 = 0.05 < 1$ (EC5 Eq.6.11) $K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.033 + 0.000 = 0.03 < 1$ (EC5 Eq.6.12)

La verifica è soddisfatta

Elementi: 9, 10 , combinazione di carico No 28**Flessione e compressione assiale combinate, $F_{c0d} = -13.612 \text{ kN}$, $M_{yd}=0.172 \text{ kNm}$, $M_{zd}=0.000 \text{ kNm}$ (§6.2.4)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \text{ E}+004 \text{ mm}^2$, $W_y=4.200 \text{ E}+005 \text{ mm}^3$, $W_z=1.323 \text{ E}+005 \text{ mm}^3$ Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$ $f_{yk}=22.00 \text{ N/mm}^2$, $f_{myd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ $f_{mk}=22.00 \text{ N/mm}^2$, $f_{mzd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 13.612 / 12600 = 1.08 \text{ N/mm}^2$ $\sigma_{myd} = M_{yd} / W_{my,netto} = 1 \text{ E}+06 \times 0.172 / 4.200 \text{ E}+005 = 0.41 \text{ N/mm}^2$ $\sigma_{mzd} = M_{zd} / W_{mz,netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$ $(\sigma_{c0d} / f_{c0d})^2 + \sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.008 + 0.031 + 0.000 = 0.04 < 1$ (EC5 Eq.6.19) $(\sigma_{c0d} / f_{c0d})^2 + K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.008 + 0.022 + 0.000 = 0.03 < 1$ (EC5 Eq.6.20)

La verifica è soddisfatta

Elementi: 9, 10 , combinazione di carico No 1**Flessione e compressione assiale combinate, $F_{c0d} = -5.196 \text{ kN}$, $M_{yd}=0.175 \text{ kNm}$, $M_{zd}=0.000 \text{ kNm}$ (§6.2.4)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \text{ E}+004 \text{ mm}^2$, $W_y=4.200 \text{ E}+005 \text{ mm}^3$, $W_z=1.323 \text{ E}+005 \text{ mm}^3$ Coefficiente di correzione $K_{mod}=0.60$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.60 \times 20.00 / 1.50 = 8.00 \text{ N/mm}^2$ $f_{yk}=22.00 \text{ N/mm}^2$, $f_{myd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.60 \times 22.00 / 1.50 = 8.80 \text{ N/mm}^2$ $f_{mk}=22.00 \text{ N/mm}^2$, $f_{mzd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.60 \times 22.00 / 1.50 = 8.80 \text{ N/mm}^2$ Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 5.196 / 12600 = 0.41 \text{ N/mm}^2$ $\sigma_{myd} = M_{yd} / W_{my,netto} = 1 \text{ E}+06 \times 0.175 / 4.200 \text{ E}+005 = 0.42 \text{ N/mm}^2$ $\sigma_{mzd} = M_{zd} / W_{mz,netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$

$$(\sigma_{c0d}/f_{c0d})^2 + \sigma_{myd}/f_{myd} + K_m \cdot \sigma_{mzd}/f_{mzd} = 0.003 + 0.047 + 0.000 = 0.05 < 1 \quad (\text{EC5 Eq.6.19})$$

$$(\sigma_{c0d}/f_{c0d})^2 + K_m \cdot \sigma_{myd}/f_{myd} + \sigma_{mzd}/f_{mzd} = 0.003 + 0.033 + 0.000 = 0.04 < 1 \quad (\text{EC5 Eq.6.20})$$

La verifica è soddisfatta

Elementi: 9, 10 , combinazione di carico No 28

Stabilità a pressoflessione, $F_{c0d} = -13.612 \text{ kN}$, $M_{yd} = 0.172 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.2)

Sezione rettangolare, $b = 63 \text{ mm}$, $h = 200 \text{ mm}$, $A = 1.260 \text{ E}+004 \text{ mm}^2$, $W_y = 4.200 \text{ E}+005 \text{ mm}^3$, $W_z = 1.323 \text{ E}+005 \text{ mm}^3$

Coefficiente di correzione $K_{mod} = 0.90$, coefficiente del materiale $\gamma_M = 1.50$, $E_{005} = 6700 \text{ N/mm}^2$

$$f_{c0k} = 20.00 \text{ N/mm}^2, \quad f_{c0d} = K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$$

$$f_{myk} = 22.00 \text{ N/mm}^2, \quad f_{myd} = K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$$

$$f_{mzk} = 22.00 \text{ N/mm}^2, \quad f_{mzd} = K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$$

Sezione rettangolare $K_m = 0.70$ (EC5 §6.1.6.(2))

$$\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 13.612 / 12600 = 1.08 \text{ N/mm}^2$$

$$\sigma_{myd} = M_{yd} / W_{my}, \text{netto} = 1 \text{ E}+06 \times 0.172 / 4.200 \text{ E}+005 = 0.41 \text{ N/mm}^2$$

$$\sigma_{mzd} = M_{zd} / W_{mz}, \text{netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$$

Lunghezza libera di inflessione S_k

$$S_{ky} = 1.00 \times 3.167 = 3.167 \text{ m} = 3167 \text{ mm} \text{ (più sfavorevole)}$$

$$S_{kz} = 0.09 \times 3.167 = 0.300 \text{ m} = 300 \text{ mm} \text{ (lunghezza efficace/lunghezza totale} = 0.30/3.17 = 0.09)$$

Snellezza

$$i_y = \sqrt{(I_y/A)} = 0.289 \times 200 = 58 \text{ mm}, \quad \lambda_y = 3167 / 58 = 54.60$$

$$i_z = \sqrt{(I_z/A)} = 0.289 \times 63 = 18 \text{ mm}, \quad \lambda_z = 300 / 18 = 16.67$$

Tensioni critiche

$$\sigma_{c,crity} = \pi^2 E_{005} / \lambda_y^2 = 22.18 \text{ N/mm}^2, \quad \lambda_{rel,y} = \sqrt{(f_{c0k} / \sigma_{c,crity})} = 0.95 \quad (\text{EC5 Eq.6.21})$$

$$\sigma_{c,critz} = \pi^2 E_{005} / \lambda_z^2 = 237.96 \text{ N/mm}^2, \quad \lambda_{rel,z} = \sqrt{(f_{c0k} / \sigma_{c,critz})} = 0.29 \quad (\text{EC5 Eq.6.22})$$

$\beta_c = 0.20$ (legno massiccio)

$$k_y = 0.5 [1 + \beta_c (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2] = 1.02, \quad K_{cy} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) = 0.726 \quad (\text{Eq.6.27 6.25})$$

$$k_z = 0.5 [1 + \beta_c (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2] = 0.50, \quad K_{cz} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) = 1.000 \quad (\text{Eq.6.28 6.26})$$

$$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd} / f_{myd} + K_m \cdot \sigma_{mzd} / f_{mzd} = 0.124 + 0.031 + 0.000 = 0.15 < 1 \quad (\text{EC5 Eq.6.23})$$

$$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_m \cdot \sigma_{myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.090 + 0.022 + 0.000 = 0.11 < 1 \quad (\text{EC5 Eq.6.24})$$

La verifica è soddisfatta

Elementi: 9, 10 , combinazione di carico No 1

Stabilità a pressoflessione, $F_{c0d} = -5.196 \text{ kN}$, $M_{yd} = 0.175 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.2)

Sezione rettangolare, $b = 63 \text{ mm}$, $h = 200 \text{ mm}$, $A = 1.260 \text{ E}+004 \text{ mm}^2$, $W_y = 4.200 \text{ E}+005 \text{ mm}^3$, $W_z = 1.323 \text{ E}+005 \text{ mm}^3$

Coefficiente di correzione $K_{mod} = 0.60$, coefficiente del materiale $\gamma_M = 1.50$, $E_{005} = 6700 \text{ N/mm}^2$

$$f_{c0k} = 20.00 \text{ N/mm}^2, \quad f_{c0d} = K_{mod} \cdot f_{c0k} / \gamma_M = 0.60 \times 20.00 / 1.50 = 8.00 \text{ N/mm}^2$$

$$f_{myk} = 22.00 \text{ N/mm}^2, \quad f_{myd} = K_{mod} \cdot f_{myk} / \gamma_M = 0.60 \times 22.00 / 1.50 = 8.80 \text{ N/mm}^2$$

$$f_{mzk} = 22.00 \text{ N/mm}^2, \quad f_{mzd} = K_{mod} \cdot f_{mzk} / \gamma_M = 0.60 \times 22.00 / 1.50 = 8.80 \text{ N/mm}^2$$

Sezione rettangolare $K_m = 0.70$ (EC5 §6.1.6.(2))

$$\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 5.196 / 12600 = 0.41 \text{ N/mm}^2$$

$$\sigma_{myd} = M_{yd} / W_{my}, \text{netto} = 1 \text{ E}+06 \times 0.175 / 4.200 \text{ E}+005 = 0.42 \text{ N/mm}^2$$

$$\sigma_{mzd} = M_{zd} / W_{mz}, \text{netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$$

Lunghezza libera di inflessione S_k

$$S_{ky} = 1.00 \times 3.167 = 3.167 \text{ m} = 3167 \text{ mm} \text{ (più sfavorevole)}$$

$$S_{kz} = 0.09 \times 3.167 = 0.300 \text{ m} = 300 \text{ mm} \text{ (lunghezza efficace/lunghezza totale} = 0.30/3.17 = 0.09)$$

Snellezza

$$i_y = \sqrt{(I_y/A)} = 0.289 \times 200 = 58 \text{ mm}, \quad \lambda_y = 3167 / 58 = 54.60$$

$$i_z = \sqrt{(I_z/A)} = 0.289 \times 63 = 18 \text{ mm}, \quad \lambda_z = 300 / 18 = 16.67$$

Tensioni critiche

$$\sigma_{c,crity} = \pi^2 E 005 / \lambda_y^2 = 22.18 \text{ N/mm}^2, \lambda_{rel,y} = \sqrt{f_{c0k} / \sigma_{c,crity}} = 0.95 \text{ (EC5 Eq.6.21)}$$

$$\sigma_{c,critz} = \pi^2 E 005 / \lambda_z^2 = 237.96 \text{ N/mm}^2, \lambda_{rel,z} = \sqrt{f_{c0k} / \sigma_{c,critz}} = 0.29 \text{ (EC5 Eq.6.22)}$$

$\beta_c = 0.20$ (legno massiccio)

$$k_y = 0.5 [1 + \beta_c (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2] = 1.02, K_{cy} = 1 / (k_y + \sqrt{k_y^2 - \lambda_{rel,y}^2}) = 0.726 \text{ (Eq.6.27 6.25)}$$

$$k_z = 0.5 [1 + \beta_c (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2] = 0.50, K_{cz} = 1 / (k_z + \sqrt{k_z^2 - \lambda_{rel,z}^2}) = 1.000 \text{ (Eq.6.28 6.26)}$$

$$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd} / f_{myd} + K_{m, \sigma mzd} / f_{mzd} = 0.071 + 0.047 + 0.000 = 0.12 < 1 \text{ (EC5 Eq.6.23)}$$

$$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_{m, \sigma myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.052 + 0.033 + 0.000 = 0.08 < 1 \text{ (EC5 Eq.6.24)}$$

La verifica è soddisfatta

1.11.13. Stato limite ultimo (UNI EN1995-1-1:2009, §6)**Elementi: 11, 12**

Carico [kN/m]	Azione	γ_g	γ_q	ψ_0	
(Gk) Proprio Gk1 = 0.862, Gk2 = 0.110, Gkf=0.55	Permanente		1.30	0.00	1.00
(Qk1) Neve QksL= 1.278, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk2) Neve QksL= 0.639, QksR= 1.278	Breve		0.00	1.50	0.70
(Qk3) Neve QksL= 1.278, QksR= 0.639	Breve		0.00	1.50	0.70
(Qk4) Vento QkwL=-0.059, QkwR=-0.332	Breve		0.00	1.50	0.60
(Qk5) Vento QkwL=-0.332, QkwR=-0.059	Breve		0.00	1.50	0.60
(Qkf) di esercizio Qkf = 2.200	Media		0.00	1.50	0.70
(Qki) Sovraccario (H) Qi = 0.550	Breve		0.00	1.50	0.00
(Aex) AeX Sismica qh=0.053x(G+0.30xQkf+0.20xQk1)	Accidental				
(Aey) AeY Sismica qv=0.006x(G+0.30xQkf+0.20xQk1)	Accidental				

L.C.	Combinazione di carichi	Classe di durata	kmod	-N/Kmod	+N/Kmod	V/Kmod	M/Kmod
1	$\gamma_g.G$	Permanente	0.60	-14.556	0.000	0.000	0.000
2	$\gamma_g.G+\gamma_q.Q1$	Breve	0.90	-25.221	0.000	0.000	0.000
3	$\gamma_g.G+\gamma_q.Q2$	Breve	0.90	-21.342	0.000	0.011	0.023
4	$\gamma_g.G+\gamma_q.Q3$	Breve	0.90	-21.342	0.000	0.011	0.023
5	$\gamma_g.G+\gamma_q.Q4$	Breve	0.90	-7.695	0.000	0.018	0.023
6	$\gamma_g.G+\gamma_q.Q5$	Breve	0.90	-9.704	0.000	0.000	0.000
7	$\gamma_g.G+\gamma_q.Qf$	Media	0.80	-7.111	0.000	0.000	0.000
8	$\gamma_g.G+\gamma_q.Qi$	Breve	0.90	-16.384	0.000	0.000	0.000
9	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-21.648	0.000	0.011	0.014
10	$\gamma_g.G+\gamma_q.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-22.854	0.000	0.000	0.000
11	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-18.974	0.000	0.011	0.023
12	$\gamma_g.G+\gamma_q.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-17.737	0.000	0.022	0.033
13	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Qf$	Breve	0.90	-17.769	0.000	0.022	0.033
14	$\gamma_g.G+\gamma_q.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Qf$	Breve	0.90	-18.974	0.000	0.011	0.023
15	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-16.189	0.000	0.018	0.023
16	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-13.473	0.000	0.011	0.015
17	$\gamma_g.G+\gamma_q.Q4+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-13.474	0.000	0.026	0.033
18	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Qf$	Breve	0.90	-18.198	0.000	0.000	0.000
19	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Qf$	Breve	0.90	-15.482	0.000	0.007	0.016
20	$\gamma_g.G+\gamma_q.Q5+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Qf$	Breve	0.90	-15.483	0.000	0.007	0.016
21	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4$	Breve	0.90	-15.978	0.000	0.011	0.014
22	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5$	Breve	0.90	-17.183	0.000	0.000	0.000
23	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4$	Breve	0.90	-14.468	0.000	0.007	0.016
24	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5$	Breve	0.90	-13.231	0.000	0.019	0.026
25	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4$	Breve	0.90	-13.263	0.000	0.019	0.026
26	$\gamma_g.G+\gamma_q.Qf+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5$	Breve	0.90	-14.468	0.000	0.007	0.016
27	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-23.673	0.000	0.011	0.014
28	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q1+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-24.878	0.000	0.000	0.000
29	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-22.163	0.000	0.007	0.016
30	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q2+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-20.926	0.000	0.019	0.026
31	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q4+\gamma_q.\psi_0.Q$	Breve	0.90	-20.958	0.000	0.019	0.026
32	$\gamma_g.G+\gamma_q.Qi+\gamma_q.\psi_0.Q3+\gamma_q.\psi_0.Q5+\gamma_q.\psi_0.Q$	Breve	0.90	-22.163	0.000	0.007	0.016
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-5.320	0.000	0.004	0.006
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-5.348	0.000	0.000	0.000
	Valori massimi				-25.221	0.000	0.026 0.033

1.11.14. Verifica della sezione Elementi: 11, 12**Elementi: 11, 12 , combinazione di carico No 2****Compressione parallela alla fibratura, $F_{c0d} = -22.699 \text{ kN}$ (EC5 §6.1.4)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=12\,600 \text{ mm}^2$ Coefficiente di correzione $K_{mod}=0.90$ (Tab.3.1), coefficiente del materiale $\gamma_M=1.50$ (Tab. 2.3) $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$ (EC5 Eq.2.14) $F_{c0d} = -22.699 \text{ kN}$, $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 22.699 / 12600 = 1.80 \text{ N/mm}^2 < 12.00 \text{ N/mm}^2 = f_{c0d}$ (Eq.6.2)

La verifica è soddisfatta

Tensione di taglio trascurabile, verifica a taglio non necessaria (EC5 §6.1.7)**Elementi: 11, 12 , combinazione di carico No 17****Flessione, $M_{yd}=0.030 \text{ kNm}$, $M_{zd}=0.000 \text{ kNm}$ (EC5 §6.1.6)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \text{ E}+004 \text{ mm}^2$, $W_y=4.200 \text{ E}+005 \text{ mm}^3$, $W_z=1.323 \text{ E}+005 \text{ mm}^3$ Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{yk}=22.00 \text{ N/mm}^2$, $f_{ykd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ $f_{mk}=22.00 \text{ N/mm}^2$, $f_{mkd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{yd} = M_{yd} / W_{my,netto} = 1 \text{ E}+06 \times 0.030 / 4.200 \text{ E}+005 = 0.07 \text{ N/mm}^2$ $\sigma_{zd} = M_{zd} / W_{mz,netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$ $\sigma_{yd} / f_{ykd} + K_m \cdot \sigma_{zd} / f_{mkd} = 0.005 + 0.000 = 0.01 < 1$ (EC5 Eq.6.11) $K_m \cdot \sigma_{yd} / f_{ykd} + \sigma_{zd} / f_{mkd} = 0.004 + 0.000 = 0.00 < 1$ (EC5 Eq.6.12)

La verifica è soddisfatta

Elementi: 11, 12 , combinazione di carico No 17**Flessione e compressione assiale combinate, $F_{c0d} = -12.126 \text{ kN}$, $M_{yd}=0.030 \text{ kNm}$, $M_{zd}=0.000 \text{ kNm}$ (§6.2.4)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \text{ E}+004 \text{ mm}^2$, $W_y=4.200 \text{ E}+005 \text{ mm}^3$, $W_z=1.323 \text{ E}+005 \text{ mm}^3$ Coefficiente di correzione $K_{mod}=0.90$ (DM2008 T.4.4.IV), coefficiente del materiale $\gamma_M=1.50$ (DM2008) $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$ $f_{yk}=22.00 \text{ N/mm}^2$, $f_{ykd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ $f_{mk}=22.00 \text{ N/mm}^2$, $f_{mkd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 12.126 / 12600 = 0.96 \text{ N/mm}^2$ $\sigma_{yd} = M_{yd} / W_{my,netto} = 1 \text{ E}+06 \times 0.030 / 4.200 \text{ E}+005 = 0.07 \text{ N/mm}^2$ $\sigma_{zd} = M_{zd} / W_{mz,netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$ $(\sigma_{c0d} / f_{c0d})^2 + \sigma_{yd} / f_{ykd} + K_m \cdot \sigma_{zd} / f_{mkd} = 0.006 + 0.005 + 0.000 = 0.01 < 1$ (EC5 Eq.6.19) $(\sigma_{c0d} / f_{c0d})^2 + K_m \cdot \sigma_{yd} / f_{ykd} + \sigma_{zd} / f_{mkd} = 0.006 + 0.004 + 0.000 = 0.01 < 1$ (EC5 Eq.6.20)

La verifica è soddisfatta

Elementi: 11, 12 , combinazione di carico No 2**Stabilità a pressoflessione, $F_{c0d} = -22.699 \text{ kN}$, $M_{yd}=0.000 \text{ kNm}$, $M_{zd}=0.000 \text{ kNm}$ (EC5 §6.3.2)**Sezione rettangolare, $b=63 \text{ mm}$, $h=200 \text{ mm}$, $A=1.260 \text{ E}+004 \text{ mm}^2$, $W_y=4.200 \text{ E}+005 \text{ mm}^3$, $W_z=1.323 \text{ E}+005 \text{ mm}^3$ Coefficiente di correzione $K_{mod}=0.90$, coefficiente del materiale $\gamma_M=1.50$, $E_{005}=6700 \text{ N/mm}^2$ $f_{c0k}=20.00 \text{ N/mm}^2$, $f_{c0d}=K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$ $f_{yk}=22.00 \text{ N/mm}^2$, $f_{ykd}=K_{mod} \cdot f_{yk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ $f_{mk}=22.00 \text{ N/mm}^2$, $f_{mkd}=K_{mod} \cdot f_{mk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$ Sezione rettangolare $K_m=0.70$ (EC5 §6.1.6.(2)) $\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 22.699 / 12600 = 1.80 \text{ N/mm}^2$ $\sigma_{yd} = M_{yd} / W_{my,netto} = 1 \text{ E}+06 \times 0.000 / 4.200 \text{ E}+005 = 0.00 \text{ N/mm}^2$ $\sigma_{zd} = M_{zd} / W_{mz,netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$

Lunghezza libera di inflessione S_k

$S_{ky} = 1.00 \times 2.100 = 2.100 \text{ m} = 2100 \text{ mm}$ (più sfavorevole)

$S_{kz} = 1.00 \times 2.100 = 2.100 \text{ m} = 2100 \text{ mm}$ (più sfavorevole)

Snellezza

$i_y = \sqrt{(I_y/A)} = 0.289 \times 200 = 58 \text{ mm}$, $\lambda_y = 2100 / 58 = 36.21$

$i_z = \sqrt{(I_z/A)} = 0.289 \times 63 = 18 \text{ mm}$, $\lambda_z = 2100 / 18 = 116.67$

Tensioni critiche

$\sigma_{c,crity} = \pi^2 E_{005} / \lambda_y^2 = 50.43 \text{ N/mm}^2$, $\lambda_{rel,y} = \sqrt{(f_{c0k} / \sigma_{c,crity})} = 0.63$ (EC5 Eq.6.21)

$\sigma_{c,critz} = \pi^2 E_{005} / \lambda_z^2 = 4.86 \text{ N/mm}^2$, $\lambda_{rel,z} = \sqrt{(f_{c0k} / \sigma_{c,critz})} = 2.03$ (EC5 Eq.6.22)

$\beta_c = 0.20$ (legno massiccio)

$k_y = 0.5 [1 + \beta_c (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2] = 0.73$, $K_{cy} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) = 0.907$ (Eq.6.27 6.25)

$k_z = 0.5 [1 + \beta_c (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2] = 2.73$, $K_{cz} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) = 0.219$ (Eq.6.28 6.26)

$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd} / f_{myd} + K_{m, \sigma mzd} / f_{mzd} = 0.166 + 0.000 + 0.000 = 0.17 < 1$ (EC5 Eq.6.23)

$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_{m, \sigma myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.686 + 0.000 + 0.000 = 0.69 < 1$ (EC5 Eq.6.24)

La verifica è soddisfatta

Elementi: 11, 12 , combinazione di carico No 17

Stabilità a pressoflessione, $F_{c0d} = -12.126 \text{ kN}$, $M_{yd} = 0.030 \text{ kNm}$, $M_{zd} = 0.000 \text{ kNm}$ (EC5 §6.3.2)

Sezione rettangolare, $b = 63 \text{ mm}$, $h = 200 \text{ mm}$, $A = 1.260 \text{ E}+004 \text{ mm}^2$, $W_y = 4.200 \text{ E}+005 \text{ mm}^3$, $W_z = 1.323 \text{ E}+005 \text{ mm}^3$

Coefficiente di correzione $K_{mod} = 0.90$, coefficiente del materiale $\gamma_M = 1.50$, $E_{005} = 6700 \text{ N/mm}^2$

$f_{c0k} = 20.00 \text{ N/mm}^2$, $f_{c0d} = K_{mod} \cdot f_{c0k} / \gamma_M = 0.90 \times 20.00 / 1.50 = 12.00 \text{ N/mm}^2$

$f_{myk} = 22.00 \text{ N/mm}^2$, $f_{myd} = K_{mod} \cdot f_{myk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

$f_{mzk} = 22.00 \text{ N/mm}^2$, $f_{mzd} = K_{mod} \cdot f_{mzk} / \gamma_M = 0.90 \times 22.00 / 1.50 = 13.20 \text{ N/mm}^2$

Sezione rettangolare $K_m = 0.70$ (EC5 §6.1.6.(2))

$\sigma_{c0d} = F_{c0d} / A_{netto} = 1000 \times 12.126 / 12600 = 0.96 \text{ N/mm}^2$

$\sigma_{myd} = M_{yd} / W_{my,netto} = 1 \text{ E}+06 \times 0.030 / 4.200 \text{ E}+005 = 0.07 \text{ N/mm}^2$

$\sigma_{mzd} = M_{zd} / W_{mz,netto} = 1 \text{ E}+06 \times 0.000 / 1.323 \text{ E}+005 = 0.00 \text{ N/mm}^2$

Lunghezza libera di inflessione S_k

$S_{ky} = 1.00 \times 2.100 = 2.100 \text{ m} = 2100 \text{ mm}$ (più sfavorevole)

$S_{kz} = 1.00 \times 2.100 = 2.100 \text{ m} = 2100 \text{ mm}$ (più sfavorevole)

Snellezza

$i_y = \sqrt{(I_y/A)} = 0.289 \times 200 = 58 \text{ mm}$, $\lambda_y = 2100 / 58 = 36.21$

$i_z = \sqrt{(I_z/A)} = 0.289 \times 63 = 18 \text{ mm}$, $\lambda_z = 2100 / 18 = 116.67$

Tensioni critiche

$\sigma_{c,crity} = \pi^2 E_{005} / \lambda_y^2 = 50.43 \text{ N/mm}^2$, $\lambda_{rel,y} = \sqrt{(f_{c0k} / \sigma_{c,crity})} = 0.63$ (EC5 Eq.6.21)

$\sigma_{c,critz} = \pi^2 E_{005} / \lambda_z^2 = 4.86 \text{ N/mm}^2$, $\lambda_{rel,z} = \sqrt{(f_{c0k} / \sigma_{c,critz})} = 2.03$ (EC5 Eq.6.22)

$\beta_c = 0.20$ (legno massiccio)

$k_y = 0.5 [1 + \beta_c (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2] = 0.73$, $K_{cy} = 1 / (k_y + \sqrt{(k_y^2 - \lambda_{rel,y}^2)}) = 0.907$ (Eq.6.27 6.25)

$k_z = 0.5 [1 + \beta_c (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2] = 2.73$, $K_{cz} = 1 / (k_z + \sqrt{(k_z^2 - \lambda_{rel,z}^2)}) = 0.219$ (Eq.6.28 6.26)

$\sigma_{c0d} / (K_{cy} \cdot f_{c0d}) + \sigma_{myd} / f_{myd} + K_{m, \sigma mzd} / f_{mzd} = 0.088 + 0.005 + 0.000 = 0.09 < 1$ (EC5 Eq.6.23)

$\sigma_{c0d} / (K_{cz} \cdot f_{c0d}) + K_{m, \sigma myd} / f_{myd} + \sigma_{mzd} / f_{mzd} = 0.366 + 0.004 + 0.000 = 0.37 < 1$ (EC5 Eq.6.24)

La verifica è soddisfatta

1.12. Progetto delle unioni

1.12.1. Resistenza di giunzioni (UNI EN1995-1-1:2009, §8)

Viti del giunto e piastre del giunto

Viti selezionati 5.0/45 (d=5.0mm, L=45mm, Lef=20mm). Piastre del giunto t=2.0mm.

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$. Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Proprietà della sezione

Spessore del legname d=63.0 mm, spessore della piastra in acciaio t=2.0mm

Proprietà dei viti (EC5 §8.7.1)

Diametro dei viti d=5.0 mm, lunghezza dei viti l=45 mm, l_{ef}=20 mm,

diametro rondella ≥15.0mm spessore ≥1.5mm, senza preforatura.

Distanza tra i viti (EC5 Table 8.2)

come maggiormente sfavorevole viene scelta $a_1=14d=14 \times 5.0=70$ mm, $a_2=5d=25$ mm

Momento caratteristico di snervamento (EC5 §8.3.1.1)

$M_{yk}=0.30 f_{ud} \cdot d^2 = 0.30 \times 400 \times 4.5^2 = 5991$ Nmm ($f_u=400\text{N/mm}^2$, $\text{def}=0.9d$) (EN1995-1-1 Eq.8.14)

Valori caratteristici della resistenza a rifollamento (EC5 §8.3.1.1)

$f_{hk}=0.082 \rho_k / d^{0.3} = 17.20\text{N/mm}^2$, ($\rho_k=340\text{kg/m}^3$, d=5.0mm) (EN1995-1-1 Eq.8.15)

Azione permanente

Resistenza caratteristica a taglio dei viti -Unione a doppia sezione resistente (EC5 §8.2.3)

t₂=19.7mm (spessore del legname), Spessore della piastra in acciaio t=2.0mm

Attenzione, La profondità di penetrazione dei viti dev'essere ≥4d=20 mm

$R_d = \text{il minore tra i valori (UNI EN1995-1-1:2009 Eq.8.11(f), 8.11(h))}$

$$1.00 f_{hk} \cdot t_2 \cdot d = 1.691 \text{ kN}$$

$$1.00 f_{hk} \cdot t_2 \cdot d (\sqrt{[2 + 4 M_{yk} / (f_{hk} \cdot d \cdot t_2^2)]} - 1) = 1.098 \text{ kN}$$

$$2.30 \sqrt{M_{yk} \cdot f_{hk} \cdot d} = 1.651 \text{ kN}$$

Resistenza caratteristica dei viti $R_d = 2 K_{mod} \cdot F_{vrk} / \gamma_M = 2 \times 0.60 \times 1.098 / 1.50 = 0.879 \text{ kN}$

Azione di lunga durata

Resistenza caratteristica a taglio dei viti -Unione a doppia sezione resistente (EC5 §8.2.3)

t₂=19.7mm (spessore del legname), Spessore della piastra in acciaio t=2.0mm

Attenzione, La profondità di penetrazione dei viti dev'essere ≥4d=20 mm

$R_d = \text{il minore tra i valori (UNI EN1995-1-1:2009 Eq.8.11(f), 8.11(h))}$

$$1.00 f_{hk} \cdot t_2 \cdot d = 1.691 \text{ kN}$$

$$1.00 f_{hk} \cdot t_2 \cdot d (\sqrt{[2 + 4 M_{yk} / (f_{hk} \cdot d \cdot t_2^2)]} - 1) = 1.098 \text{ kN}$$

$$2.30 \sqrt{M_{yk} \cdot f_{hk} \cdot d} = 1.651 \text{ kN}$$

Resistenza caratteristica dei viti $R_d = 2 K_{mod} \cdot F_{vrk} / \gamma_M = 2 \times 0.80 \times 1.098 / 1.50 = 1.172 \text{ kN}$

Azione di breve durata

Resistenza caratteristica a taglio dei viti -Unione a doppia sezione resistente (EC5 §8.2.3)

t₂=19.7mm (spessore del legname), Spessore della piastra in acciaio t=2.0mm

Attenzione, La profondità di penetrazione dei viti dev'essere ≥4d=20 mm

$R_d = \text{il minore tra i valori (UNI EN1995-1-1:2009 Eq.8.11(f), 8.11(h))}$

$$1.00 f_{hk} \cdot t_2 \cdot d = 1.691 \text{ kN}$$

$$1.00 f_{hk} \cdot t_2 \cdot d (\sqrt{[2 + 4 M_{yk} / (f_{hk} \cdot d \cdot t_2^2)]} - 1) = 1.098 \text{ kN}$$

$$2.30 \sqrt{M_{yk} \cdot f_{hk} \cdot d} = 1.651 \text{ kN}$$

Resistenza caratteristica dei viti $R_d = 2 K_{mod} \cdot F_{vrk} / \gamma_M = 2 \times 0.90 \times 1.098 / 1.50 = 1.318 \text{ kN}$

Azione Accidentale

Resistenza caratteristica dei viti $R_d = 2 K_{mod} \cdot F_{vrk} / \gamma_M = 2 \times 1.00 \times 1.098 / 1.00 = 2.197 \text{ kN}$

Ipotesi per la progettazione di unioni con viti

La progettazione dell'unione è basata sull'analisi plastica. Gli sforzi sui viti raggiungono tutti lo stesso valore limite. La resistenza della piastra metallica è basata sulla sezione resistente plastica. Lo sforzo resistente a compressione è ridotto a $0.50 \times F_d$

1.12.2. Stato limite ultimo

Progettazione di unione con viti al nodo : 2 (UNI EN1995-1-1:2009, §8.7)

Unione con due (2) piastre metalliche.

Verifica dell'unione dell'elemento 2, con gli elementi 4 e 12, al nodo 2

Caratteristiche della ferramenta:

Due (2) piastre metalliche 2.0 mm delle dimensioni

BxH=355mmx350mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

9 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forza al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=Fa/n+Ma/W_p$

n: numero di viti, a: sezione del viti

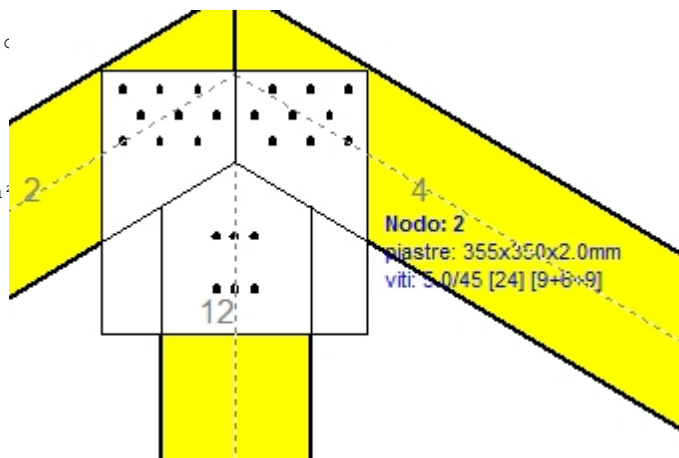
$A=n \cdot x \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

W_p : modulo di resistenza del collegamento

$n=9$, ($k_{ef}=1.0$, $n_{eff}=n$), $A=177\text{mm}^2$, $r=90\text{mm}$, $W_p=15320\text{mm}^3$

σ e σ_d tens. normale e di esercizio piastra N/mm^2



Sforzi nel nodo 2 ,dagli elementi 4, 12, al centro della unioni F(forza) M(momento)

Verifica resistenza della unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	F _n (kN)	R _d (kN)
1	vg.G	Permanente	0.60	3.078	-0.089	0.450 <	0.879
2	vg.G+vg.Q1	Breve	0.90	8.134	-0.231	1.185 <	1.318
3	vg.G+vg.Q2	Breve	0.90	6.585	-0.172	0.945 <	1.318
4	vg.G+vg.Q3	Breve	0.90	7.167	-0.220	1.058 <	1.318
5	vg.G+vg.Q4	Breve	0.90	2.750	-0.087	0.408 <	1.318
6	vg.G+vg.Q5	Breve	0.90	3.078	-0.089	0.450 <	1.318
7	vg.G+vg.Qf	Media	0.80	1.694	-0.061	0.253 <	1.172
8	vg.G+vg.Qi	Breve	0.90	5.254	-0.150	0.766 <	1.318
9	vg.G+vg.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	6.943	-0.210	1.021 <	1.318
10	vg.G+vg.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	7.139	-0.211	1.046 <	1.318
11	vg.G+vg.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	5.382	-0.151	0.781 <	1.318
12	vg.G+vg.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	5.581	-0.152	0.806 <	1.318
13	vg.G+vg.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	5.994	-0.198	0.895 <	1.318
14	vg.G+vg.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	6.186	-0.200	0.920 <	1.318
15	vg.G+vg.Q4+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	5.299	-0.166	0.784 <	1.318
16	vg.G+vg.Q4+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	4.201	-0.125	0.616 <	1.318
17	vg.G+vg.Q4+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	4.641	-0.158	0.696 <	1.318
18	vg.G+vg.Q5+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	5.624	-0.169	0.826 <	1.318
19	vg.G+vg.Q5+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	4.530	-0.127	0.657 <	1.318
20	vg.G+vg.Q5+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	4.959	-0.161	0.737 <	1.318
21	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q4	Breve	0.90	5.008	-0.159	0.742 <	1.318
22	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q5	Breve	0.90	5.202	-0.160	0.766 <	1.318
23	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q4	Breve	0.90	3.909	-0.117	0.573 <	1.318
24	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q5	Breve	0.90	4.105	-0.119	0.598 <	1.318
25	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q4	Breve	0.90	4.356	-0.151	0.653 <	1.318
26	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q5	Breve	0.90	4.544	-0.152	0.678 <	1.318
27	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	7.602	-0.228	1.117 <	1.318
28	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	7.798	-0.230	1.142 <	1.318
29	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	6.508	-0.187	0.949 <	1.318
30	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	6.707	-0.188	0.974 <	1.318
31	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	6.933	-0.220	1.029 <	1.318
32	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	7.128	-0.222	1.053 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	2.812	-0.086	0.414 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	2.776	-0.083	0.407 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	σ	σ_d (N/mm ²)
1	yg.G	Permanente	0.60	3.078	-0.089	8 <	131
2	yg.G+yq.Q1	Breve	0.90	8.134	-0.231	21 <	196
3	yg.G+yq.Q2	Breve	0.90	6.585	-0.172	16 <	196
4	yg.G+yq.Q3	Breve	0.90	7.167	-0.220	18 <	196
5	yg.G+yq.Q4	Breve	0.90	2.750	-0.087	7 <	196
6	yg.G+yq.Q5	Breve	0.90	3.078	-0.089	8 <	196
7	yg.G+yq.Qf	Media	0.80	1.694	-0.061	5 <	175
8	yg.G+yq.Qi	Breve	0.90	5.254	-0.150	13 <	196
9	yg.G+yq.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	6.943	-0.210	18 <	196
10	yg.G+yq.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	7.139	-0.211	18 <	196
11	yg.G+yq.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	5.382	-0.151	14 <	196
12	yg.G+yq.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	5.581	-0.152	14 <	196
13	yg.G+yq.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	5.994	-0.198	16 <	196
14	yg.G+yq.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	6.186	-0.200	16 <	196
15	yg.G+yq.Q4+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	5.299	-0.166	14 <	196
16	yg.G+yq.Q4+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	4.201	-0.125	11 <	196
17	yg.G+yq.Q4+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	4.641	-0.158	12 <	196
18	yg.G+yq.Q5+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	5.624	-0.169	14 <	196
19	yg.G+yq.Q5+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	4.530	-0.127	11 <	196
20	yg.G+yq.Q5+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	4.959	-0.161	13 <	196
21	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q4	Breve	0.90	5.008	-0.159	13 <	196
22	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q5	Breve	0.90	5.202	-0.160	13 <	196
23	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q4	Breve	0.90	3.909	-0.117	10 <	196
24	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q5	Breve	0.90	4.105	-0.119	10 <	196
25	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q4	Breve	0.90	4.356	-0.151	12 <	196
26	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q5	Breve	0.90	4.544	-0.152	12 <	196
27	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	7.602	-0.228	19 <	196
28	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	7.798	-0.230	20 <	196
29	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	6.508	-0.187	16 <	196
30	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	6.707	-0.188	17 <	196
31	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	6.933	-0.220	18 <	196
32	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	7.128	-0.222	18 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	2.812	-0.086	7 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	2.776	-0.083	7 <	240

Verifica dell'unione dell'elemento 12, con gli elementi 2 e 4, al nodo 2

Caratteristiche della ferramenta:

Due(2) piastre metalliche 2.0 mm delle dimensioni

BxH=355mmx350mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

6 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forza al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=F_a/n+M_a/W_p$

n: numero di viti, a: sezione del viti

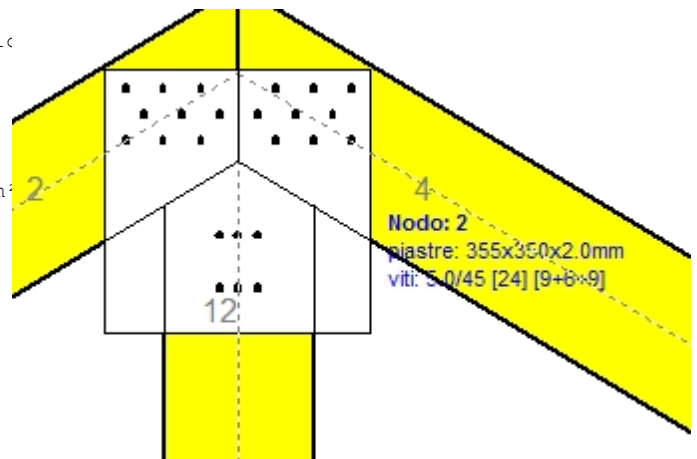
$A=n \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

Wp: modulo di resistenza del collegamento

n= 6, ($k_{ef}=1.0$, $n_{eff}=n$), $A=118\text{mm}^2$, $r=31\text{mm}$, $W_p=612\text{mm}^3$

σ e σ_d tens. normale e di esercizio piastra N/mm²



Sforzi nel nodo 2 ,dall'elemento 12, al centro della unioni F(forza) M(momento)
Verifica resistenza della unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	Fn (kN)	Rd (kN)
1	yg.G	Permanente	0.60	-4.364	0.000	0.364 <	0.879
2	yg.G+yq.Q1	Breve	0.90	-11.342	0.000	0.945 <	1.318
3	yg.G+yq.Q2	Breve	0.90	-9.597	0.010	0.813 <	1.318
4	yg.G+yq.Q3	Breve	0.90	-9.598	-0.010	0.813 <	1.318
5	yg.G+yq.Q4	Breve	0.90	-3.460	-0.008	0.298 <	1.318
6	yg.G+yq.Q5	Breve	0.90	-4.364	0.000	0.364 <	1.318
7	yg.G+yq.Qf	Media	0.80	-2.842	0.000	0.237 <	1.172
8	yg.G+yq.Qi	Breve	0.90	-7.368	0.000	0.614 <	1.318
9	yg.G+yq.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-9.735	-0.005	0.817 <	1.318
10	yg.G+yq.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-10.277	0.000	0.856 <	1.318
11	yg.G+yq.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-8.532	0.010	0.724 <	1.318
12	yg.G+yq.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-7.976	0.015	0.684 <	1.318
13	yg.G+yq.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-7.990	-0.015	0.685 <	1.318
14	yg.G+yq.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-8.532	-0.010	0.724 <	1.318
15	yg.G+yq.Q4+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	-7.280	-0.008	0.617 <	1.318
16	yg.G+yq.Q4+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	-6.059	-0.001	0.506 <	1.318
17	yg.G+yq.Q4+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	-6.059	-0.015	0.524 <	1.318
18	yg.G+yq.Q5+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	-8.183	0.000	0.682 <	1.318
19	yg.G+yq.Q5+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	-6.962	0.007	0.589 <	1.318
20	yg.G+yq.Q5+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	-6.962	-0.007	0.590 <	1.318
21	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q4	Breve	0.90	-7.185	-0.005	0.605 <	1.318
22	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q5	Breve	0.90	-7.727	0.000	0.644 <	1.318
23	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q4	Breve	0.90	-6.505	0.007	0.551 <	1.318
24	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q5	Breve	0.90	-5.949	0.012	0.511 <	1.318
25	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q4	Breve	0.90	-5.964	-0.012	0.512 <	1.318
26	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q5	Breve	0.90	-6.506	-0.007	0.551 <	1.318
27	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-10.646	-0.005	0.893 <	1.318
28	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-11.187	0.000	0.932 <	1.318
29	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-9.966	0.007	0.840 <	1.318
30	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-9.410	0.012	0.800 <	1.318
31	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-9.424	-0.012	0.801 <	1.318
32	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-9.966	-0.007	0.840 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.988	-0.002	0.335 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.008	0.000	0.334 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	σ	σ_d (N/mm ²)
1	yg.G	Permanente	0.60	-4.364	0.000	4 <	131
2	yg.G+yq.Q1	Breve	0.90	-11.342	0.000	11 <	196
3	yg.G+yq.Q2	Breve	0.90	-9.597	0.010	9 <	196
4	yg.G+yq.Q3	Breve	0.90	-9.598	-0.010	9 <	196
5	yg.G+yq.Q4	Breve	0.90	-3.460	-0.008	3 <	196
6	yg.G+yq.Q5	Breve	0.90	-4.364	0.000	4 <	196
7	yg.G+yq.Qf	Media	0.80	-2.842	0.000	3 <	175
8	yg.G+yq.Qi	Breve	0.90	-7.368	0.000	7 <	196
9	yg.G+yq.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-9.735	-0.005	9 <	196
10	yg.G+yq.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-10.277	0.000	10 <	196
11	yg.G+yq.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-8.532	0.010	8 <	196
12	yg.G+yq.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-7.976	0.015	8 <	196
13	yg.G+yq.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-7.990	-0.015	8 <	196
14	yg.G+yq.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-8.532	-0.010	8 <	196
15	yg.G+yq.Q4+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	-7.280	-0.008	7 <	196
16	yg.G+yq.Q4+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	-6.059	-0.001	6 <	196
17	yg.G+yq.Q4+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	-6.059	-0.015	6 <	196
18	yg.G+yq.Q5+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	-8.183	0.000	8 <	196
19	yg.G+yq.Q5+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	-6.962	0.007	7 <	196
20	yg.G+yq.Q5+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	-6.962	-0.007	7 <	196
21	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q4	Breve	0.90	-7.185	-0.005	7 <	196
22	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q5	Breve	0.90	-7.727	0.000	7 <	196
23	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q4	Breve	0.90	-6.505	0.007	6 <	196
24	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q5	Breve	0.90	-5.949	0.012	6 <	196
25	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q4	Breve	0.90	-5.964	-0.012	6 <	196
26	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q5	Breve	0.90	-6.506	-0.007	6 <	196
27	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-10.646	-0.005	10 <	196
28	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-11.187	0.000	11 <	196
29	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-9.966	0.007	9 <	196
30	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-9.410	0.012	9 <	196
31	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-9.424	-0.012	9 <	196
32	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-9.966	-0.007	9 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.988	-0.002	4 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.008	0.000	4 <	240

1.12.3. Stato limite ultimo

Progettazione di unioni con viti nei nodi : 7, 8 (UNI EN1995-1-1:2009, §8.7)

Unione con due (2) piastre metalliche.

Verifica dell'unione dell'elemento 9, con gli elementi 1 e 2, al nodo 7

Caratteristiche della ferramenta:

Due (2) piastre metalliche 2.0 mm delle dimensioni

BxH=325mmx75mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

4 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forza al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=F_a/n+M_a/W_p$

n: numero di viti, a: sezione del viti

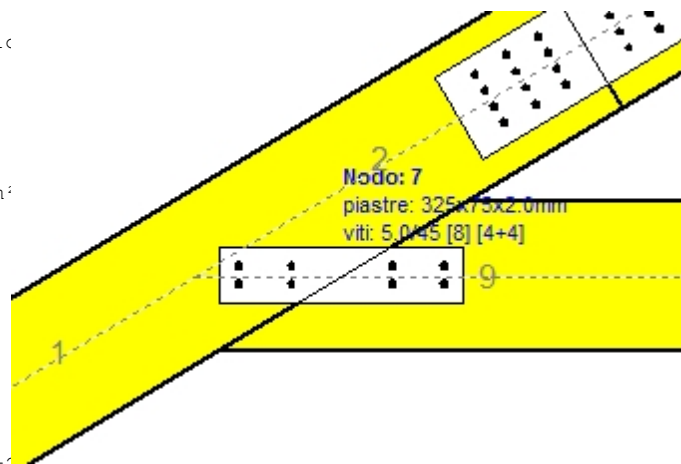
$A=n \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

W_p : modulo di resistenza del collegamento

$n=4$, ($k_{ef}=1.0$, $n_{eff}=n$), $A=79\text{mm}^2$, $r=27\text{mm}$, $W_p=2917\text{mm}^3$

σ e σ_d tens. normale e di esercizio piastra N/mm^2



Sforzi nel nodo 7 ,dall'elemento 9, al centro della unioni F(forza) M(momento)

Verifica resistenza della unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	F _n (kN)	R _d (kN)
1	yg.G	Permanente	0.60	-2.598	0.004	0.338 <	0.879
2	yg.G+yg.Q1	Breve	0.90	-6.548	0.011	0.852 <	1.318
3	yg.G+yg.Q2	Breve	0.90	-5.560	0.004	0.707 <	1.318
4	yg.G+yg.Q3	Breve	0.90	-5.560	0.014	0.741 <	1.318
5	yg.G+yg.Q4	Breve	0.90	-2.598	0.004	0.338 <	1.318
6	yg.G+yg.Q5	Breve	0.90	-1.711	-0.002	0.221 <	1.318
7	yg.G+yg.Qf	Media	0.80	-2.231	0.004	0.291 <	1.172
8	yg.G+yg.Qi	Breve	0.90	-4.298	0.007	0.559 <	1.318
9	yg.G+yg.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-6.291	0.010	0.819 <	1.318
10	yg.G+yg.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-5.758	0.006	0.740 <	1.318
11	yg.G+yg.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-5.303	0.003	0.673 <	1.318
12	yg.G+yg.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-4.771	0.000	0.598 <	1.318
13	yg.G+yg.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-5.303	0.014	0.708 <	1.318
14	yg.G+yg.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-4.771	0.010	0.629 <	1.318
15	yg.G+yg.Q4+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-5.106	0.008	0.665 <	1.318
16	yg.G+yg.Q4+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-4.414	0.004	0.563 <	1.318
17	yg.G+yg.Q4+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-4.415	0.011	0.587 <	1.318
18	yg.G+yg.Q5+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-4.219	0.002	0.534 <	1.318
19	yg.G+yg.Q5+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-3.527	-0.003	0.450 <	1.318
20	yg.G+yg.Q5+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-3.528	0.005	0.456 <	1.318
21	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q4	Breve	0.90	-4.996	0.008	0.651 <	1.318
22	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q5	Breve	0.90	-4.463	0.004	0.572 <	1.318
23	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q4	Breve	0.90	-4.304	0.003	0.549 <	1.318
24	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q5	Breve	0.90	-3.772	0.000	0.473 <	1.318
25	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q4	Breve	0.90	-4.305	0.011	0.573 <	1.318
26	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q5	Breve	0.90	-3.772	0.007	0.494 <	1.318
27	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-6.806	0.011	0.886 <	1.318
28	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-6.274	0.007	0.807 <	1.318
29	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-6.115	0.006	0.784 <	1.318
30	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-5.582	0.002	0.706 <	1.318
31	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-6.115	0.014	0.808 <	1.318
32	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-5.583	0.010	0.729 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-2.455	0.006	0.325 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-2.467	0.004	0.321 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	σ	σ_d (N/mm ²)
1	yg.G	Permanente	0.60	-2.598	0.004	13 <	131
2	yg.G+yq.Q1	Breve	0.90	-6.548	0.011	32 <	196
3	yg.G+yq.Q2	Breve	0.90	-5.560	0.004	26 <	196
4	yg.G+yq.Q3	Breve	0.90	-5.560	0.014	28 <	196
5	yg.G+yq.Q4	Breve	0.90	-2.598	0.004	13 <	196
6	yg.G+yq.Q5	Breve	0.90	-1.711	-0.002	8 <	196
7	yg.G+yq.Qf	Media	0.80	-2.231	0.004	11 <	175
8	yg.G+yq.Qi	Breve	0.90	-4.298	0.007	21 <	196
9	yg.G+yq.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-6.291	0.010	30 <	196
10	yg.G+yq.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-5.758	0.006	27 <	196
11	yg.G+yq.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-5.303	0.003	24 <	196
12	yg.G+yq.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-4.771	0.000	21 <	196
13	yg.G+yq.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-5.303	0.014	27 <	196
14	yg.G+yq.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-4.771	0.010	24 <	196
15	yg.G+yq.Q4+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	-5.106	0.008	25 <	196
16	yg.G+yq.Q4+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	-4.414	0.004	20 <	196
17	yg.G+yq.Q4+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	-4.415	0.011	22 <	196
18	yg.G+yq.Q5+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	-4.219	0.002	19 <	196
19	yg.G+yq.Q5+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	-3.527	-0.003	16 <	196
20	yg.G+yq.Q5+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	-3.528	0.005	17 <	196
21	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q4	Breve	0.90	-4.996	0.008	24 <	196
22	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q5	Breve	0.90	-4.463	0.004	21 <	196
23	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q4	Breve	0.90	-4.304	0.003	20 <	196
24	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q5	Breve	0.90	-3.772	0.000	17 <	196
25	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q4	Breve	0.90	-4.305	0.011	22 <	196
26	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q5	Breve	0.90	-3.772	0.007	18 <	196
27	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-6.806	0.011	33 <	196
28	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-6.274	0.007	30 <	196
29	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-6.115	0.006	29 <	196
30	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-5.582	0.002	25 <	196
31	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-6.115	0.014	30 <	196
32	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-5.583	0.010	27 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-2.455	0.006	12 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-2.467	0.004	12 <	240

1.12.4. Stato limite ultimo

Progettazione di unioni con viti nei nodi : 5, 6 (UNI EN1995-1-1:2009, §8.7)

Unione con due (2) piastre metalliche.

Verifica dell'unione tra gli elementi 7 e 1, al nodo 5

Caratteristiche della ferramenta:

Due(2) piastre metalliche 2.0 mm delle dimensioni

BxH=235mmx140mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

9 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forza al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=Fa/n+Ma/W_p$

n: numero di viti, a: sezione del viti

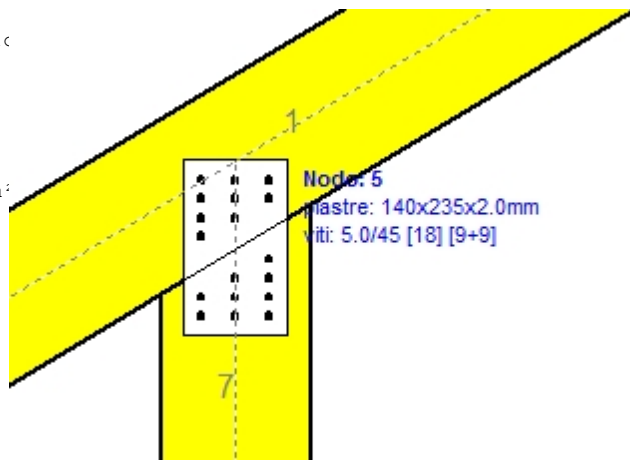
$A=n \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

W_p : modulo di resistenza del collegamento

$n=9$, ($k_{ef}=1.0$, $n_{eff}=n$), $A=177\text{mm}^2$, $r=37\text{mm}$, $W_p=954\text{mm}^3$

σ e σ_d tens. normale e di esercizio piastra N/mm^2



Sforzi nel nodo 5 ,dall'elemento 7, al centro della unioni F(forza) M(momento)

Verifica resistenza della unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	F _n (kN)	R _d (kN)
1	yg.G	Permanente	0.60	-0.927	0.265	0.317 <	0.879
2	yg.G+yg.Q1	Breve	0.90	-1.881	0.579	0.681 <	1.318
3	yg.G+yg.Q2	Breve	0.90	-1.049	0.326	0.389 <	1.318
4	yg.G+yg.Q3	Breve	0.90	-2.284	0.676	0.791 <	1.318
5	yg.G+yg.Q4	Breve	0.90	-0.927	0.265	0.317 <	1.318
6	yg.G+yg.Q5	Breve	0.90	-0.711	0.329	0.377 <	1.318
7	yg.G+yg.Qf	Media	0.80	-2.055	0.461	0.582 <	1.172
8	yg.G+yg.Qi	Breve	0.90	-1.336	0.400	0.474 <	1.318
9	yg.G+yg.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.485	0.617	0.752 <	1.318
10	yg.G+yg.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-2.635	0.717	0.867 <	1.318
11	yg.G+yg.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-1.855	0.463	0.575 <	1.318
12	yg.G+yg.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-1.754	0.501	0.611 <	1.318
13	yg.G+yg.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.873	0.714	0.862 <	1.318
14	yg.G+yg.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-3.002	0.813	0.977 <	1.318
15	yg.G+yg.Q4+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-2.355	0.622	0.758 <	1.318
16	yg.G+yg.Q4+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-1.811	0.445	0.553 <	1.318
17	yg.G+yg.Q4+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-2.605	0.690	0.834 <	1.318
18	yg.G+yg.Q5+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-2.124	0.686	0.817 <	1.318
19	yg.G+yg.Q5+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-1.648	0.508	0.614 <	1.318
20	yg.G+yg.Q5+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-2.345	0.753	0.894 <	1.318
21	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q4	Breve	0.90	-2.690	0.681	0.837 <	1.318
22	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q5	Breve	0.90	-2.553	0.719	0.873 <	1.318
23	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q4	Breve	0.90	-2.157	0.504	0.633 <	1.318
24	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q5	Breve	0.90	-2.053	0.542	0.669 <	1.318
25	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q4	Breve	0.90	-2.932	0.749	0.914 <	1.318
26	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q5	Breve	0.90	-2.779	0.787	0.950 <	1.318
27	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.609	0.658	0.799 <	1.318
28	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-2.757	0.758	0.914 <	1.318
29	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.196	0.580	0.710 <	1.318
30	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-2.070	0.618	0.746 <	1.318
31	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.880	0.726	0.877 <	1.318
32	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-3.013	0.825	0.991 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-0.911	0.193	0.241 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-1.064	0.287	0.348 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	k _{mod}	F _a (kN)	M _a (kNm)	σ	σ _d (N/mm ²)
1	yg.G	Permanente	0.60	-0.927	0.265	20 <	131
2	yg.G+yq.Q1	Breve	0.90	-1.881	0.579	44 <	196
3	yg.G+yq.Q2	Breve	0.90	-1.049	0.326	25 <	196
4	yg.G+yq.Q3	Breve	0.90	-2.284	0.676	51 <	196
5	yg.G+yq.Q4	Breve	0.90	-0.927	0.265	20 <	196
6	yg.G+yq.Q5	Breve	0.90	-0.711	0.329	24 <	196
7	yg.G+yq.Qf	Media	0.80	-2.055	0.461	36 <	175
8	yg.G+yq.Qi	Breve	0.90	-1.336	0.400	30 <	196
9	yg.G+yq.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-2.485	0.617	48 <	196
10	yg.G+yq.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-2.635	0.717	55 <	196
11	yg.G+yq.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-1.855	0.463	36 <	196
12	yg.G+yq.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-1.754	0.501	38 <	196
13	yg.G+yq.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-2.873	0.714	55 <	196
14	yg.G+yq.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-3.002	0.813	62 <	196
15	yg.G+yq.Q4+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	-2.355	0.622	48 <	196
16	yg.G+yq.Q4+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	-1.811	0.445	35 <	196
17	yg.G+yq.Q4+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	-2.605	0.690	53 <	196
18	yg.G+yq.Q5+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	-2.124	0.686	52 <	196
19	yg.G+yq.Q5+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	-1.648	0.508	38 <	196
20	yg.G+yq.Q5+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	-2.345	0.753	57 <	196
21	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q4	Breve	0.90	-2.690	0.681	53 <	196
22	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q5	Breve	0.90	-2.553	0.719	55 <	196
23	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q4	Breve	0.90	-2.157	0.504	39 <	196
24	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q5	Breve	0.90	-2.053	0.542	42 <	196
25	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q4	Breve	0.90	-2.932	0.749	58 <	196
26	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q5	Breve	0.90	-2.779	0.787	60 <	196
27	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-2.609	0.658	51 <	196
28	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-2.757	0.758	58 <	196
29	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-2.196	0.580	45 <	196
30	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-2.070	0.618	47 <	196
31	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-2.880	0.726	56 <	196
32	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-3.013	0.825	63 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-0.911	0.193	15 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-1.064	0.287	22 <	240

1.12.5. Stato limite ultimo

Progettazione di unioni con viti nei nodi : 1, 3 (UNI EN1995-1-1:2009, §8.7)

Unione con due (2) piastre metalliche.

Verifica dell'unione tra gli elementi 7 e 5, al nodo 1

Caratteristiche della ferramenta:

Due(2) piastre metalliche 2.0 mm delle dimensioni

BxH=255mmx150mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

20 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forza al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=Fa/n+Ma/W_p$

n: numero di viti, a: sezione del viti

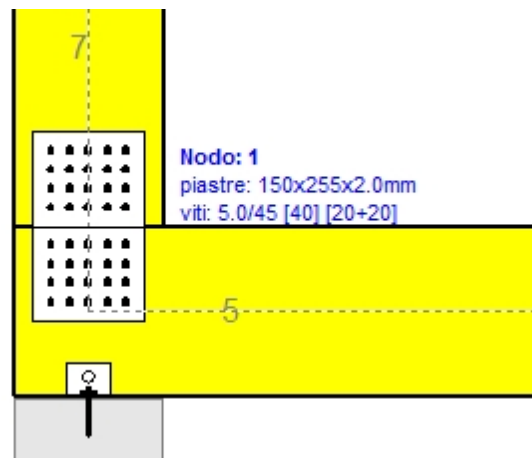
$A=n \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

W_p : modulo di resistenza del collegamento

$n=20$, ($k_{ef}=1.0$, $n_{eff}=n$), $A=393\text{mm}^2$, $r=45\text{mm}$, $W_p=10019\text{mm}^3$

σ e σ_d tens. normale e di esercizio piastra N/mm^2



Sforzi nel nodo 1 ,dall'elemento 7, al centro della unioni F(forza) M(momento)

Verifica resistenza della unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	F _n (kN)	R _d (kN)
1	yg.G	Permanente	0.60	-0.927	0.386	0.225 <	0.879
2	yg.G+yg.Q1	Breve	0.90	-1.881	0.514	0.312 <	1.318
3	yg.G+yg.Q2	Breve	0.90	-1.049	0.653	0.370 <	1.318
4	yg.G+yg.Q3	Breve	0.90	-2.284	0.310	0.212 <	1.318
5	yg.G+yg.Q4	Breve	0.90	-0.927	0.386	0.225 <	1.318
6	yg.G+yg.Q5	Breve	0.90	-1.052	0.824	0.460 <	1.318
7	yg.G+yg.Qf	Media	0.80	-2.055	1.535	0.860 <	1.172
8	yg.G+yg.Qi	Breve	0.90	-1.336	0.441	0.262 <	1.318
9	yg.G+yg.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.503	1.053	0.612 <	1.318
10	yg.G+yg.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-2.635	1.318	0.756 <	1.318
11	yg.G+yg.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-1.855	1.458	0.814 <	1.318
12	yg.G+yg.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-1.942	1.721	0.956 <	1.318
13	yg.G+yg.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.888	0.849	0.511 <	1.318
14	yg.G+yg.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-3.002	1.115	0.655 <	1.318
15	yg.G+yg.Q4+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-2.355	1.280	0.730 <	1.318
16	yg.G+yg.Q4+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-1.811	1.378	0.771 <	1.318
17	yg.G+yg.Q4+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-2.605	1.138	0.659 <	1.318
18	yg.G+yg.Q5+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-2.401	1.718	0.966 <	1.318
19	yg.G+yg.Q5+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-1.982	1.816	1.007 <	1.318
20	yg.G+yg.Q5+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-2.591	1.576	0.895 <	1.318
21	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q4	Breve	0.90	-2.690	1.625	0.921 <	1.318
22	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q5	Breve	0.90	-2.708	1.888	1.062 <	1.318
23	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q4	Breve	0.90	-2.157	1.723	0.961 <	1.318
24	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q5	Breve	0.90	-2.238	1.985	1.103 <	1.318
25	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q4	Breve	0.90	-2.932	1.482	0.850 <	1.318
26	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q5	Breve	0.90	-2.919	1.745	0.991 <	1.318
27	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.627	1.070	0.623 <	1.318
28	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-2.757	1.335	0.768 <	1.318
29	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.196	1.433	0.808 <	1.318
30	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-2.238	1.696	0.950 <	1.318
31	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-2.896	0.927	0.552 <	1.318
32	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-3.013	1.193	0.697 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-0.911	0.362	0.211 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-1.064	0.547	0.313 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	σ	σ_d (N/mm ²)
1	yg.G	Permanente	0.60	-0.927	0.386	25 <	131
2	yg.G+yq.Q1	Breve	0.90	-1.881	0.514	35 <	196
3	yg.G+yq.Q2	Breve	0.90	-1.049	0.653	41 <	196
4	yg.G+yq.Q3	Breve	0.90	-2.284	0.310	23 <	196
5	yg.G+yq.Q4	Breve	0.90	-0.927	0.386	25 <	196
6	yg.G+yq.Q5	Breve	0.90	-1.052	0.824	51 <	196
7	yg.G+yq.Qf	Media	0.80	-2.055	1.535	96 <	175
8	yg.G+yq.Qi	Breve	0.90	-1.336	0.441	29 <	196
9	yg.G+yq.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-2.503	1.053	68 <	196
10	yg.G+yq.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-2.635	1.318	84 <	196
11	yg.G+yq.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-1.855	1.458	91 <	196
12	yg.G+yq.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-1.942	1.721	106 <	196
13	yg.G+yq.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-2.888	0.849	57 <	196
14	yg.G+yq.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-3.002	1.115	73 <	196
15	yg.G+yq.Q4+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	-2.355	1.280	81 <	196
16	yg.G+yq.Q4+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	-1.811	1.378	86 <	196
17	yg.G+yq.Q4+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	-2.605	1.138	73 <	196
18	yg.G+yq.Q5+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	-2.401	1.718	107 <	196
19	yg.G+yq.Q5+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	-1.982	1.816	112 <	196
20	yg.G+yq.Q5+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	-2.591	1.576	99 <	196
21	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q4	Breve	0.90	-2.690	1.625	102 <	196
22	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q5	Breve	0.90	-2.708	1.888	118 <	196
23	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q4	Breve	0.90	-2.157	1.723	107 <	196
24	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q5	Breve	0.90	-2.238	1.985	123 <	196
25	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q4	Breve	0.90	-2.932	1.482	94 <	196
26	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q5	Breve	0.90	-2.919	1.745	110 <	196
27	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-2.627	1.070	69 <	196
28	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-2.757	1.335	85 <	196
29	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-2.196	1.433	90 <	196
30	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-2.238	1.696	105 <	196
31	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	-2.896	0.927	61 <	196
32	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	-3.013	1.193	77 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-0.911	0.362	24 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-1.064	0.547	35 <	240

1.12.6. Stato limite ultimo**Progettazione di unione con viti al nodo : 4** (UNI EN1995-1-1:2009, §8.7)

Unione con due (2) piastre metalliche.

Verifica dell'unione dell'elemento 11, con gli elementi 5 e 6, al nodo 4

Caratteristiche della ferramenta:

Due(2) piastre metalliche 2.0 mm delle dimensioni

BxH=100mmx245mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

6 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$ Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forza al centro dell'unione

Ma= momento al centro dell'unione

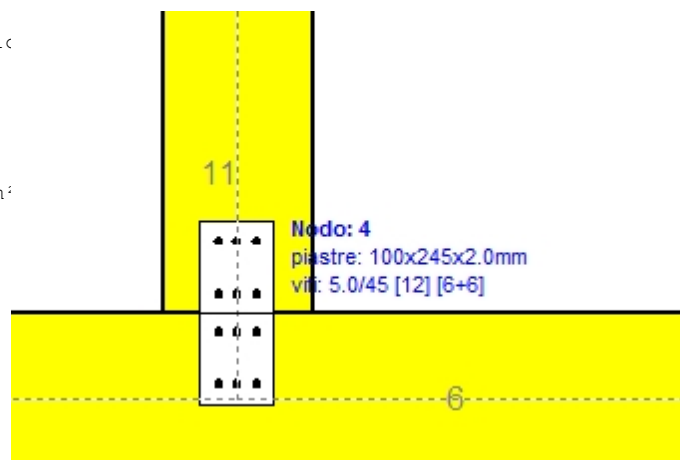
Sforzo max viti d'angolo $F_n=Fa/n+Ma/W_p$

n: numero di viti, a: sezione del viti

 $A=n \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

Wp: modulo di resistenza del collegamento

n= 6, ($k_{ef}=1.0$, $n_{eff}=n$), $A=118\text{mm}^2$, $r=31\text{mm}$, $W_p=612\text{mm}^3$ σ e σ_d tens. normale e di esercizio piastra N/mm^2 **Sforzi nel nodo 4 ,dall'elemento 11, al centro della unione F(forza) M(momento)****Verifica resistenza della unione**

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	F _n (kN)	R _d (kN)
1	vg.G	Permanente	0.60	-4.367	0.000	0.364 <	0.879
2	vg.G+vg.Q1	Breve	0.90	-11.350	0.000	0.946 <	1.318
3	vg.G+vg.Q2	Breve	0.90	-9.604	0.005	0.807 <	1.318
4	vg.G+vg.Q3	Breve	0.90	-9.604	-0.005	0.807 <	1.318
5	vg.G+vg.Q4	Breve	0.90	-3.463	-0.010	0.302 <	1.318
6	vg.G+vg.Q5	Breve	0.90	-4.367	0.000	0.364 <	1.318
7	vg.G+vg.Qf	Media	0.80	-2.844	0.000	0.237 <	1.172
8	vg.G+vg.Qi	Breve	0.90	-7.373	0.000	0.614 <	1.318
9	vg.G+vg.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-9.742	-0.006	0.820 <	1.318
10	vg.G+vg.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-10.284	0.000	0.857 <	1.318
11	vg.G+vg.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-8.538	0.005	0.719 <	1.318
12	vg.G+vg.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-7.982	0.012	0.680 <	1.318
13	vg.G+vg.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-7.996	-0.012	0.681 <	1.318
14	vg.G+vg.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-8.538	-0.005	0.719 <	1.318
15	vg.G+vg.Q4+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	-7.285	-0.010	0.620 <	1.318
16	vg.G+vg.Q4+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	-6.063	-0.006	0.514 <	1.318
17	vg.G+vg.Q4+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	-6.063	-0.014	0.524 <	1.318
18	vg.G+vg.Q5+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	-8.189	0.000	0.682 <	1.318
19	vg.G+vg.Q5+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	-6.967	0.004	0.586 <	1.318
20	vg.G+vg.Q5+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	-6.967	-0.004	0.586 <	1.318
21	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q4	Breve	0.90	-7.190	-0.006	0.607 <	1.318
22	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q5	Breve	0.90	-7.733	0.000	0.644 <	1.318
23	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q4	Breve	0.90	-6.510	0.004	0.547 <	1.318
24	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q5	Breve	0.90	-5.954	0.010	0.509 <	1.318
25	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q4	Breve	0.90	-5.968	-0.010	0.510 <	1.318
26	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q5	Breve	0.90	-6.511	-0.004	0.547 <	1.318
27	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-10.653	-0.006	0.896 <	1.318
28	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-11.195	0.000	0.933 <	1.318
29	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-9.973	0.004	0.836 <	1.318
30	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-9.417	0.010	0.798 <	1.318
31	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-9.431	-0.010	0.799 <	1.318
32	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-9.973	-0.004	0.836 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.990	-0.004	0.338 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.011	0.000	0.334 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	σ	σ_d (N/mm ²)
1	yg.G	Permanente	0.60	-4.367	0.000	15 <	131
2	yg.G+yg.Q1	Breve	0.90	-11.350	0.000	38 <	196
3	yg.G+yg.Q2	Breve	0.90	-9.604	0.005	33 <	196
4	yg.G+yg.Q3	Breve	0.90	-9.604	-0.005	33 <	196
5	yg.G+yg.Q4	Breve	0.90	-3.463	-0.010	13 <	196
6	yg.G+yg.Q5	Breve	0.90	-4.367	0.000	15 <	196
7	yg.G+yg.Qf	Media	0.80	-2.844	0.000	9 <	175
8	yg.G+yg.Qi	Breve	0.90	-7.373	0.000	25 <	196
9	yg.G+yg.Q1+yg. ψ o.Q4+yg. ψ o.Qf	Breve	0.90	-9.742	-0.006	33 <	196
10	yg.G+yg.Q1+yg. ψ o.Q5+yg. ψ o.Qf	Breve	0.90	-10.284	0.000	34 <	196
11	yg.G+yg.Q2+yg. ψ o.Q4+yg. ψ o.Qf	Breve	0.90	-8.538	0.005	29 <	196
12	yg.G+yg.Q2+yg. ψ o.Q5+yg. ψ o.Qf	Breve	0.90	-7.982	0.012	28 <	196
13	yg.G+yg.Q3+yg. ψ o.Q4+yg. ψ o.Qf	Breve	0.90	-7.996	-0.012	28 <	196
14	yg.G+yg.Q3+yg. ψ o.Q5+yg. ψ o.Qf	Breve	0.90	-8.538	-0.005	29 <	196
15	yg.G+yg.Q4+yg. ψ o.Q1+yg. ψ o.Qf	Breve	0.90	-7.285	-0.010	26 <	196
16	yg.G+yg.Q4+yg. ψ o.Q2+yg. ψ o.Qf	Breve	0.90	-6.063	-0.006	21 <	196
17	yg.G+yg.Q4+yg. ψ o.Q3+yg. ψ o.Qf	Breve	0.90	-6.063	-0.014	22 <	196
18	yg.G+yg.Q5+yg. ψ o.Q1+yg. ψ o.Qf	Breve	0.90	-8.189	0.000	27 <	196
19	yg.G+yg.Q5+yg. ψ o.Q2+yg. ψ o.Qf	Breve	0.90	-6.967	0.004	24 <	196
20	yg.G+yg.Q5+yg. ψ o.Q3+yg. ψ o.Qf	Breve	0.90	-6.967	-0.004	24 <	196
21	yg.G+yg.Qf+yg. ψ o.Q1+yg. ψ o.Q4	Breve	0.90	-7.190	-0.006	25 <	196
22	yg.G+yg.Qf+yg. ψ o.Q1+yg. ψ o.Q5	Breve	0.90	-7.733	0.000	26 <	196
23	yg.G+yg.Qf+yg. ψ o.Q2+yg. ψ o.Q4	Breve	0.90	-6.510	0.004	22 <	196
24	yg.G+yg.Qf+yg. ψ o.Q2+yg. ψ o.Q5	Breve	0.90	-5.954	0.010	21 <	196
25	yg.G+yg.Qf+yg. ψ o.Q3+yg. ψ o.Q4	Breve	0.90	-5.968	-0.010	21 <	196
26	yg.G+yg.Qf+yg. ψ o.Q3+yg. ψ o.Q5	Breve	0.90	-6.511	-0.004	22 <	196
27	yg.G+yg.Qi+yg. ψ o.Q1+yg. ψ o.Q4+yg. ψ o.Qf	Breve	0.90	-10.653	-0.006	36 <	196
28	yg.G+yg.Qi+yg. ψ o.Q1+yg. ψ o.Q5+yg. ψ o.Qf	Breve	0.90	-11.195	0.000	37 <	196
29	yg.G+yg.Qi+yg. ψ o.Q2+yg. ψ o.Q4+yg. ψ o.Qf	Breve	0.90	-9.973	0.004	34 <	196
30	yg.G+yg.Qi+yg. ψ o.Q2+yg. ψ o.Q5+yg. ψ o.Qf	Breve	0.90	-9.417	0.010	33 <	196
31	yg.G+yg.Qi+yg. ψ o.Q3+yg. ψ o.Q4+yg. ψ o.Qf	Breve	0.90	-9.431	-0.010	33 <	196
32	yg.G+yg.Qi+yg. ψ o.Q3+yg. ψ o.Q5+yg. ψ o.Qf	Breve	0.90	-9.973	-0.004	34 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.990	-0.004	14 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.011	0.000	13 <	240

1.12.7. Stato limite ultimo

Progettazione di unione con viti al nodo : 9 (UNI EN1995-1-1:2009, §8.7)

Unione con due (2) piastre metalliche.

Verifica dell'unione dell'elemento 12, con gli elementi 9 e 10, al nodo 9

Caratteristiche della ferramenta:

Due(2) piastre metalliche 2.0 mm delle dimensioni

BxH=155mmx105mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

6 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forza al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=F_a/n+M_a/W_p$

n: numero di viti, a: sezione del viti

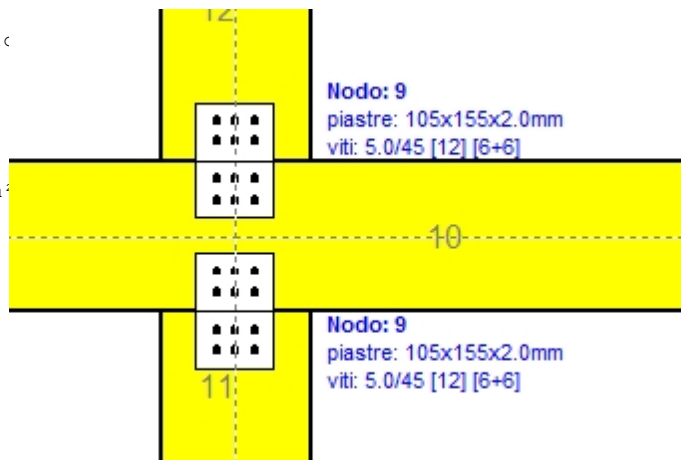
$A=n \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

W_p : modulo di resistenza del collegamento

$n=6$, ($k_{ef}=1.0$, $n_{eff}=n$), $A=118\text{mm}^2$, $r=31\text{mm}$, $W_p=0.12/\text{mm}^3$

σ e σ_d tens. normale e di esercizio piastra N/mm^2

**Sforzi nel nodo 9 ,dall'elemento 12, al centro della unioni F(forza) M(momento)****Verifica resistenza della unione**

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	F _n (kN)	R _d (kN)
1	vg.G	Permanente	0.60	-4.364	0.000	0.364 <	0.879
2	vg.G+vg.Q1	Breve	0.90	-11.342	0.000	0.945 <	1.318
3	vg.G+vg.Q2	Breve	0.90	-9.597	-0.002	0.803 <	1.318
4	vg.G+vg.Q3	Breve	0.90	-9.598	0.002	0.803 <	1.318
5	vg.G+vg.Q4	Breve	0.90	-3.460	0.003	0.293 <	1.318
6	vg.G+vg.Q5	Breve	0.90	-4.364	0.000	0.364 <	1.318
7	vg.G+vg.Qf	Media	0.80	-2.842	0.000	0.237 <	1.172
8	vg.G+vg.Qi	Breve	0.90	-7.368	0.000	0.614 <	1.318
9	vg.G+vg.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-9.735	0.002	0.814 <	1.318
10	vg.G+vg.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-10.277	0.000	0.856 <	1.318
11	vg.G+vg.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-8.532	-0.002	0.714 <	1.318
12	vg.G+vg.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-7.976	-0.004	0.670 <	1.318
13	vg.G+vg.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-7.990	0.004	0.671 <	1.318
14	vg.G+vg.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-8.532	0.002	0.714 <	1.318
15	vg.G+vg.Q4+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	-7.280	0.003	0.611 <	1.318
16	vg.G+vg.Q4+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	-6.059	0.002	0.507 <	1.318
17	vg.G+vg.Q4+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	-6.059	0.005	0.511 <	1.318
18	vg.G+vg.Q5+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	-8.183	0.000	0.682 <	1.318
19	vg.G+vg.Q5+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	-6.962	-0.002	0.582 <	1.318
20	vg.G+vg.Q5+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	-6.962	0.002	0.582 <	1.318
21	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q4	Breve	0.90	-7.185	0.002	0.601 <	1.318
22	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q5	Breve	0.90	-7.727	0.000	0.644 <	1.318
23	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q4	Breve	0.90	-6.505	-0.002	0.544 <	1.318
24	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q5	Breve	0.90	-5.949	-0.003	0.500 <	1.318
25	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q4	Breve	0.90	-5.964	0.003	0.502 <	1.318
26	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q5	Breve	0.90	-6.506	0.002	0.544 <	1.318
27	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-10.646	0.002	0.890 <	1.318
28	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-11.187	0.000	0.932 <	1.318
29	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-9.966	-0.002	0.833 <	1.318
30	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-9.410	-0.003	0.789 <	1.318
31	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	-9.424	0.003	0.790 <	1.318
32	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	-9.966	0.002	0.833 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.988	0.001	0.334 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.008	0.000	0.334 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	σ	σ_d (N/mm ²)
1	yg.G	Permanente	0.60	-4.364	0.000	14 <	131
2	yg.G+yg.Q1	Breve	0.90	-11.342	0.000	36 <	196
3	yg.G+yg.Q2	Breve	0.90	-9.597	-0.002	31 <	196
4	yg.G+yg.Q3	Breve	0.90	-9.598	0.002	31 <	196
5	yg.G+yg.Q4	Breve	0.90	-3.460	0.003	11 <	196
6	yg.G+yg.Q5	Breve	0.90	-4.364	0.000	14 <	196
7	yg.G+yg.Qf	Media	0.80	-2.842	0.000	9 <	175
8	yg.G+yg.Qi	Breve	0.90	-7.368	0.000	23 <	196
9	yg.G+yg.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-9.735	0.002	31 <	196
10	yg.G+yg.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-10.277	0.000	33 <	196
11	yg.G+yg.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-8.532	-0.002	27 <	196
12	yg.G+yg.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-7.976	-0.004	26 <	196
13	yg.G+yg.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-7.990	0.004	26 <	196
14	yg.G+yg.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-8.532	0.002	27 <	196
15	yg.G+yg.Q4+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-7.280	0.003	24 <	196
16	yg.G+yg.Q4+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-6.059	0.002	19 <	196
17	yg.G+yg.Q4+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-6.059	0.005	20 <	196
18	yg.G+yg.Q5+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-8.183	0.000	26 <	196
19	yg.G+yg.Q5+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-6.962	-0.002	22 <	196
20	yg.G+yg.Q5+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-6.962	0.002	22 <	196
21	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q4	Breve	0.90	-7.185	0.002	23 <	196
22	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q5	Breve	0.90	-7.727	0.000	25 <	196
23	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q4	Breve	0.90	-6.505	-0.002	21 <	196
24	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q5	Breve	0.90	-5.949	-0.003	19 <	196
25	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q4	Breve	0.90	-5.964	0.003	19 <	196
26	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q5	Breve	0.90	-6.506	0.002	21 <	196
27	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-10.646	0.002	34 <	196
28	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-11.187	0.000	36 <	196
29	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-9.966	-0.002	32 <	196
30	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-9.410	-0.003	30 <	196
31	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-9.424	0.003	30 <	196
32	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-9.966	0.002	32 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.988	0.001	13 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.008	0.000	13 <	240

Verifica dell'unione dell'elemento 11, con gli elementi 9 e 10, al nodo 9

Caratteristiche della ferramenta:

Due(2) piastre metalliche 2.0 mm delle dimensioni

BxH=155mmx105mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

6 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forzo al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=F_a/n+M_a/W_p$

n: numero di viti, a: sezione del viti

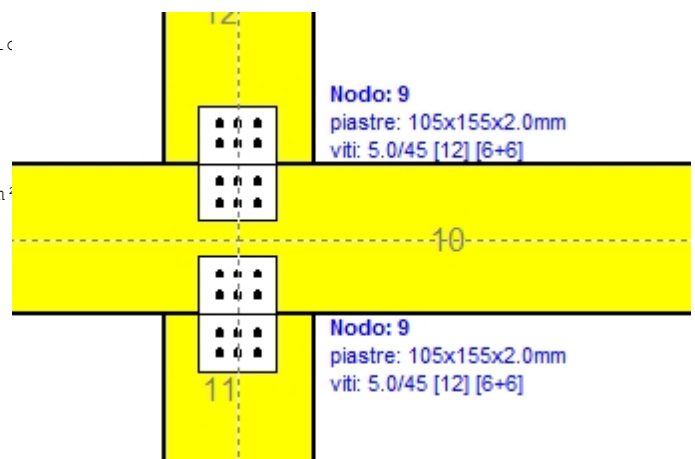
$A=n \cdot x \cdot a$: area totale viti

r :distanza viti d'angolo dal centro unione

Wp: modulo di resistenza del collegamento

$n=6$, ($k_{ef}=1.0$, $n_{eff}=n$), $A=118\text{mm}^2$, $r=31\text{mm}$, $W_p=0.12/\text{mm}^3$

σ e σ_d tens. normale e di esercizio piastra N/mm²



Sforzi nel nodo 9 ,dall'elemento 11, al centro della unioni F(forza) M(momento)
Verifica resistenza della unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	Fn (kN)	Rd (kN)
1	yg.G	Permanente	0.60	-4.367	0.000	0.364 <	0.879
2	yg.G+yq.Q1	Breve	0.90	-11.350	0.000	0.946 <	1.318
3	yg.G+yq.Q2	Breve	0.90	-9.604	0.004	0.806 <	1.318
4	yg.G+yq.Q3	Breve	0.90	-9.604	-0.004	0.806 <	1.318
5	yg.G+yq.Q4	Breve	0.90	-3.463	-0.007	0.297 <	1.318
6	yg.G+yq.Q5	Breve	0.90	-4.367	0.000	0.364 <	1.318
7	yg.G+yq.Qf	Media	0.80	-2.844	0.000	0.237 <	1.172
8	yg.G+yq.Qi	Breve	0.90	-7.373	0.000	0.614 <	1.318
9	yg.G+yq.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-9.742	-0.004	0.817 <	1.318
10	yg.G+yq.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-10.284	0.000	0.857 <	1.318
11	yg.G+yq.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-8.538	0.004	0.717 <	1.318
12	yg.G+yq.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-7.982	0.008	0.676 <	1.318
13	yg.G+yq.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-7.996	-0.008	0.677 <	1.318
14	yg.G+yq.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-8.538	-0.004	0.717 <	1.318
15	yg.G+yq.Q4+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	-7.285	-0.007	0.616 <	1.318
16	yg.G+yq.Q4+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	-6.063	-0.004	0.510 <	1.318
17	yg.G+yq.Q4+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	-6.063	-0.010	0.518 <	1.318
18	yg.G+yq.Q5+yq.ψo.Q1+yq.ψo.Qf	Breve	0.90	-8.189	0.000	0.682 <	1.318
19	yg.G+yq.Q5+yq.ψo.Q2+yq.ψo.Qf	Breve	0.90	-6.967	0.003	0.585 <	1.318
20	yg.G+yq.Q5+yq.ψo.Q3+yq.ψo.Qf	Breve	0.90	-6.967	-0.003	0.585 <	1.318
21	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q4	Breve	0.90	-7.190	-0.004	0.604 <	1.318
22	yg.G+yq.Qf+yq.ψo.Q1+yq.ψo.Q5	Breve	0.90	-7.733	0.000	0.644 <	1.318
23	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q4	Breve	0.90	-6.510	0.003	0.546 <	1.318
24	yg.G+yq.Qf+yq.ψo.Q2+yq.ψo.Q5	Breve	0.90	-5.954	0.007	0.505 <	1.318
25	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q4	Breve	0.90	-5.968	-0.007	0.507 <	1.318
26	yg.G+yq.Qf+yq.ψo.Q3+yq.ψo.Q5	Breve	0.90	-6.511	-0.003	0.547 <	1.318
27	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-10.653	-0.004	0.893 <	1.318
28	yg.G+yq.Qi+yq.ψo.Q1+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-11.195	0.000	0.933 <	1.318
29	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-9.973	0.003	0.835 <	1.318
30	yg.G+yq.Qi+yq.ψo.Q2+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-9.417	0.007	0.794 <	1.318
31	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q4+yq.ψo.Qf	Breve	0.90	-9.431	-0.007	0.795 <	1.318
32	yg.G+yq.Qi+yq.ψo.Q3+yq.ψo.Q5+yq.ψo.Qf	Breve	0.90	-9.973	-0.003	0.835 <	1.318
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.990	-0.003	0.336 <	2.197
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.011	0.000	0.334 <	2.197

Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	k _{mod}	F _a (kN)	M _a (kNm)	σ	σ _d (N/mm ²)
1	yg.G	Permanente	0.60	-4.367	0.000	14 <	131
2	yg.G+yg.Q1	Breve	0.90	-11.350	0.000	36 <	196
3	yg.G+yg.Q2	Breve	0.90	-9.604	0.004	31 <	196
4	yg.G+yg.Q3	Breve	0.90	-9.604	-0.004	31 <	196
5	yg.G+yg.Q4	Breve	0.90	-3.463	-0.007	12 <	196
6	yg.G+yg.Q5	Breve	0.90	-4.367	0.000	14 <	196
7	yg.G+yg.Qf	Media	0.80	-2.844	0.000	9 <	175
8	yg.G+yg.Qi	Breve	0.90	-7.373	0.000	23 <	196
9	yg.G+yg.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-9.742	-0.004	31 <	196
10	yg.G+yg.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-10.284	0.000	33 <	196
11	yg.G+yg.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-8.538	0.004	28 <	196
12	yg.G+yg.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-7.982	0.008	26 <	196
13	yg.G+yg.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-7.996	-0.008	26 <	196
14	yg.G+yg.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-8.538	-0.004	28 <	196
15	yg.G+yg.Q4+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-7.285	-0.007	24 <	196
16	yg.G+yg.Q4+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-6.063	-0.004	20 <	196
17	yg.G+yg.Q4+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-6.063	-0.010	20 <	196
18	yg.G+yg.Q5+yg.ψo.Q1+yg.ψo.Qf	Breve	0.90	-8.189	0.000	26 <	196
19	yg.G+yg.Q5+yg.ψo.Q2+yg.ψo.Qf	Breve	0.90	-6.967	0.003	22 <	196
20	yg.G+yg.Q5+yg.ψo.Q3+yg.ψo.Qf	Breve	0.90	-6.967	-0.003	22 <	196
21	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q4	Breve	0.90	-7.190	-0.004	23 <	196
22	yg.G+yg.Qf+yg.ψo.Q1+yg.ψo.Q5	Breve	0.90	-7.733	0.000	25 <	196
23	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q4	Breve	0.90	-6.510	0.003	21 <	196
24	yg.G+yg.Qf+yg.ψo.Q2+yg.ψo.Q5	Breve	0.90	-5.954	0.007	20 <	196
25	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q4	Breve	0.90	-5.968	-0.007	20 <	196
26	yg.G+yg.Qf+yg.ψo.Q3+yg.ψo.Q5	Breve	0.90	-6.511	-0.003	21 <	196
27	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-10.653	-0.004	34 <	196
28	yg.G+yg.Qi+yg.ψo.Q1+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-11.195	0.000	36 <	196
29	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-9.973	0.003	32 <	196
30	yg.G+yg.Qi+yg.ψo.Q2+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-9.417	0.007	31 <	196
31	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q4+yg.ψo.Qf	Breve	0.90	-9.431	-0.007	31 <	196
32	yg.G+yg.Qi+yg.ψo.Q3+yg.ψo.Q5+yg.ψo.Qf	Breve	0.90	-9.973	-0.003	32 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	-3.990	-0.003	13 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	-4.011	0.000	13 <	240

1.12.8. Stato limite ultimo

Progettazione di unioni con viti degli elementi : 2, 4 (UNI EN1995-1-1:2009, §8.7)

Unione con due (2) piastre metalliche.

Verifica dell'unione dell'elemento 2

Caratteristiche della ferramenta:

Due(2) piastre metalliche 2.0 mm delle dimensioni

BxH=385mmx125mm, e di spessore 2.0mm

Viti 5.0/45 (d=5.0mm, L=45mm, Lef=20mm),

12 viti su ogni elemento collegato

Distanza tra i viti a1=70 mm, a2=25 mm

Res. snervamento piastre in acciaio $f_y=240\text{N/mm}^2$

Superficie netta piastra $A_{net}=(0.75) \cdot b \cdot t$

Fa= forzo al centro dell'unione

Ma= momento al centro dell'unione

Sforzo max viti d'angolo $F_n=F_a/n+M_a/W_p$

n: numero di viti, a: sezione del viti

A=nxa: area totale viti

r :distanza viti d'angolo dal centro unione

Wp: modulo di resistenza del collegamento

n=12, (kef=1.0, neff=n), A=236mm², r=57mm, Wp =15749mm³

σ e σ_d tens. normale e di esercizio piastra N/mm²

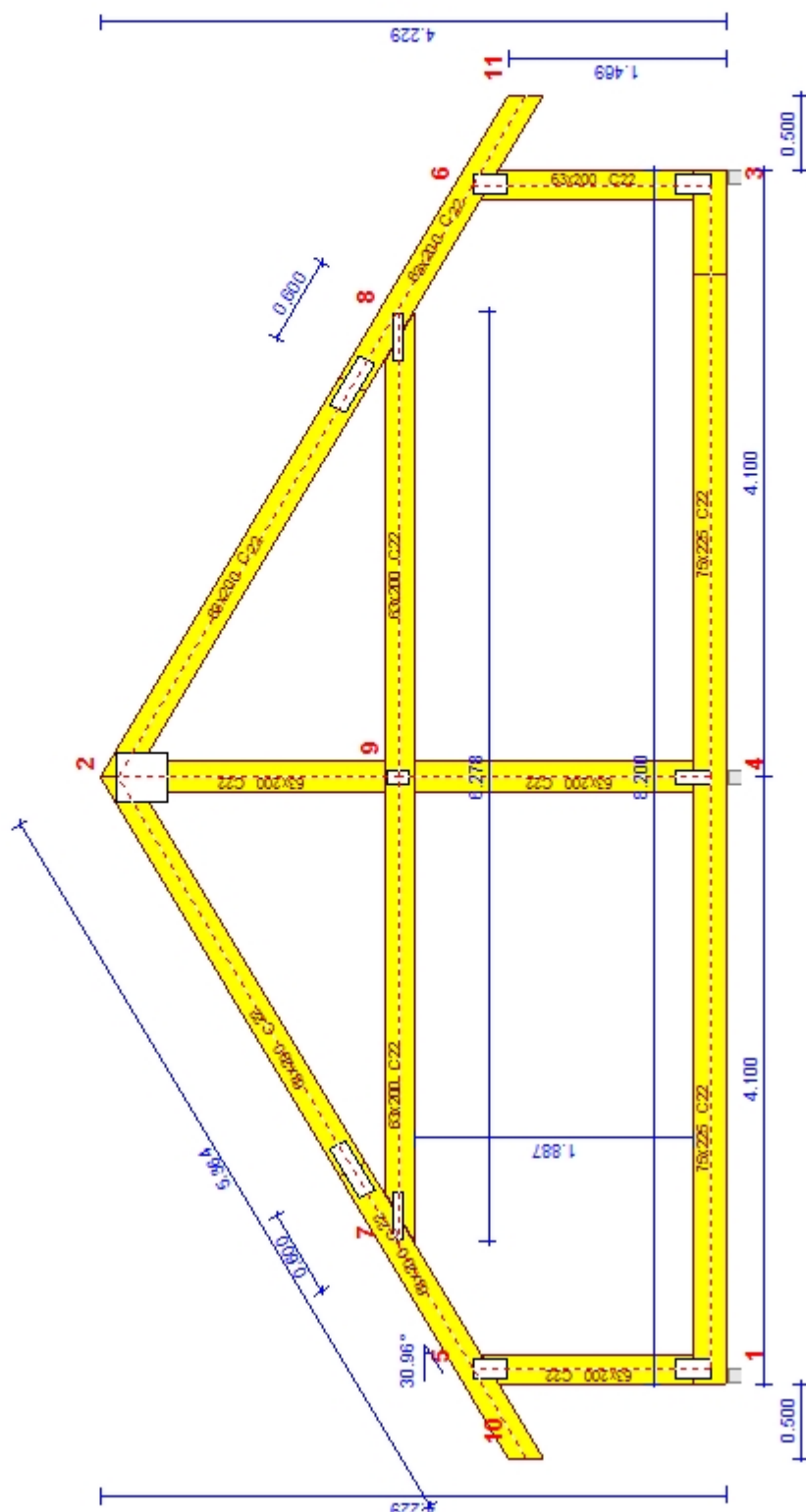
Forze alla giunzione dell'elemento 2 , al centro della unioni F(forza) M(momento)**Verifica resistenza della unione**

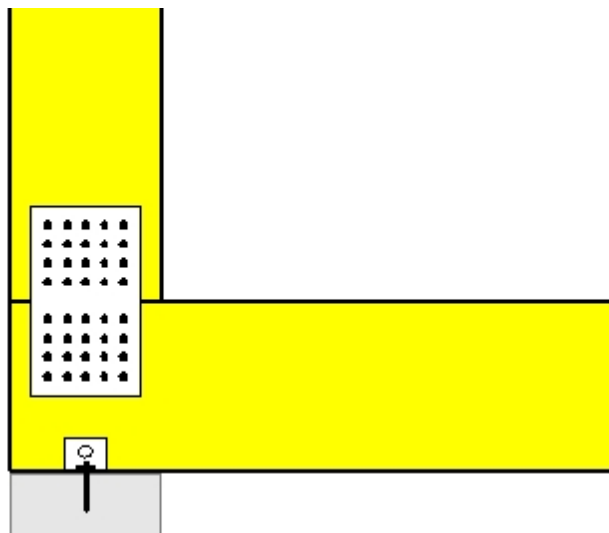
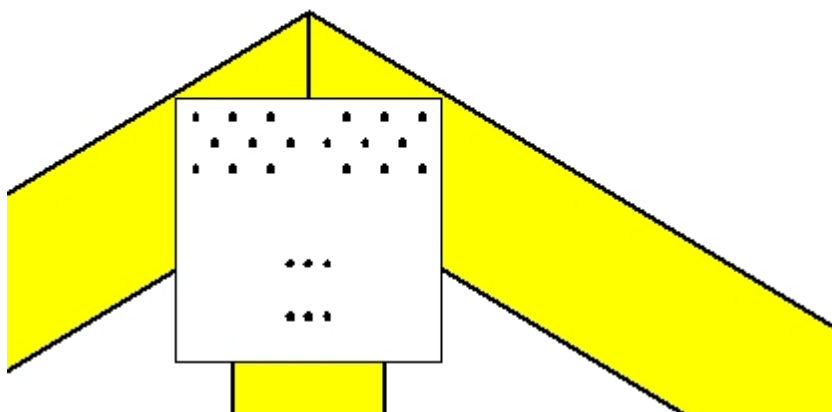
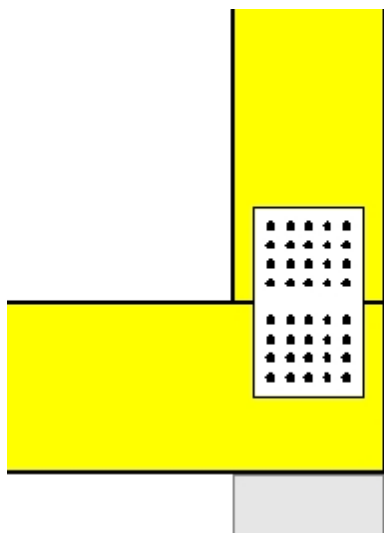
L.C.	Combinazione di carichi	Classe di	durata	kmod	F _n (kN)	F _v (kN)	M _a (kNm)	F _n	R _d (kN)
1	vg.G	Permanente	0.60	2.092	0.732	0.041	0.279	<0.879	
2	vg.G+vg.Q1	Breve	0.90	5.718	1.802	0.113	0.744	<1.318	
3	vg.G+vg.Q2	Breve	0.90	4.925	1.351	-0.186	0.575	<1.318	
4	vg.G+vg.Q3	Breve	0.90	4.699	1.719	0.376	0.985	<1.318	
5	vg.G+vg.Q4	Breve	0.90	1.745	0.566	0.347	0.617	<1.318	
6	vg.G+vg.Q5	Breve	0.90	2.092	0.732	0.041	0.279	<1.318	
7	vg.G+vg.Qf	Media	0.80	0.630	0.742	0.011	0.137	<1.172	
8	vg.G+vg.Qi	Breve	0.90	3.653	1.193	0.072	0.479	<1.318	
9	vg.G+vg.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	4.486	1.709	0.275	0.843	<1.318	
10	vg.G+vg.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	4.694	1.809	0.092	0.640	<1.318	
11	vg.G+vg.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	3.692	1.258	-0.024	0.369	<1.318	
12	vg.G+vg.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	3.901	1.357	-0.207	0.521	<1.318	
13	vg.G+vg.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	3.466	1.626	0.539	1.087	<1.318	
14	vg.G+vg.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	3.675	1.726	0.355	0.883	<1.318	
15	vg.G+vg.Q4+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	3.259	1.322	0.376	0.839	<1.318	
16	vg.G+vg.Q4+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	2.703	1.006	0.167	0.507	<1.318	
17	vg.G+vg.Q4+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	2.545	1.263	0.561	1.010	<1.318	
18	vg.G+vg.Q5+vg.ψo.Q1+vg.ψo.Qf	Breve	0.90	3.607	1.488	0.070	0.500	<1.318	
19	vg.G+vg.Q5+vg.ψo.Q2+vg.ψo.Qf	Breve	0.90	3.051	1.172	-0.139	0.376	<1.318	
20	vg.G+vg.Q5+vg.ψo.Q3+vg.ψo.Qf	Breve	0.90	2.893	1.430	0.255	0.671	<1.318	
21	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q4	Breve	0.90	2.959	1.391	0.245	0.660	<1.318	
22	vg.G+vg.Qf+vg.ψo.Q1+vg.ψo.Q5	Breve	0.90	3.168	1.491	0.061	0.456	<1.318	
23	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q4	Breve	0.90	2.404	1.075	0.036	0.327	<1.318	
24	vg.G+vg.Qf+vg.ψo.Q2+vg.ψo.Q5	Breve	0.90	2.612	1.175	-0.148	0.353	<1.318	
25	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q4	Breve	0.90	2.245	1.333	0.429	0.832	<1.318	
26	vg.G+vg.Qf+vg.ψo.Q3+vg.ψo.Q5	Breve	0.90	2.454	1.433	0.246	0.628	<1.318	
27	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	4.959	1.849	0.285	0.903	<1.318	
28	vg.G+vg.Qi+vg.ψo.Q1+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	5.167	1.949	0.101	0.700	<1.318	
29	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	4.403	1.533	0.075	0.572	<1.318	
30	vg.G+vg.Qi+vg.ψo.Q2+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	4.612	1.633	-0.108	0.446	<1.318	
31	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q4+vg.ψo.Qf	Breve	0.90	4.245	1.791	0.469	1.074	<1.318	
32	vg.G+vg.Qi+vg.ψo.Q3+vg.ψo.Q5+vg.ψo.Qf	Breve	0.90	4.454	1.890	0.285	0.870	<1.318	
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	1.929	0.702	0.137	0.383	<2.197	
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	1.812	0.712	0.035	0.248	<2.197	

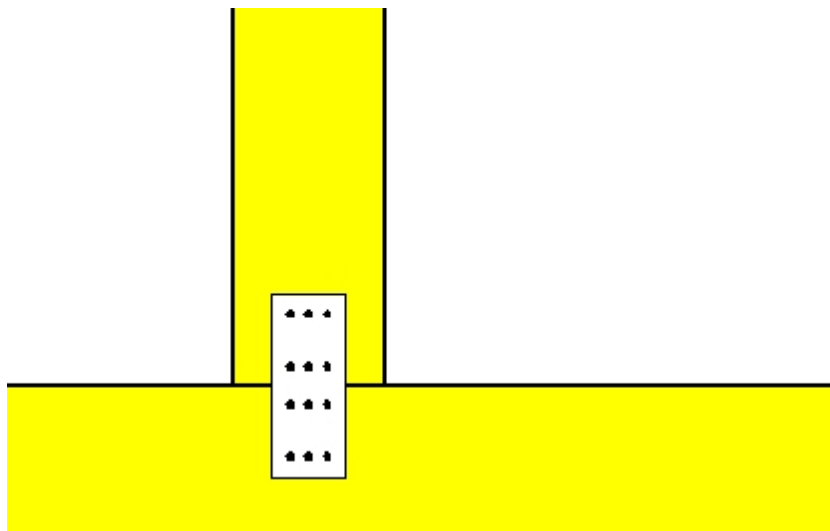
Verifica la resistenza della piastra di unione

L.C.	Combinazione di carichi	Classe di durata	kmod	Fa (kN)	Ma (kNm)	σ	σ_d (N/mm ²)
1	yg.G	Permanente	0.60	2.217	0.076	25 <	131
2	yg.G+yq.Q1	Breve	0.90	5.996	0.198	66 <	196
3	yg.G+yq.Q2	Breve	0.90	5.107	-0.122	48 <	196
4	yg.G+yq.Q3	Breve	0.90	5.003	0.458	105 <	196
5	yg.G+yq.Q4	Breve	0.90	1.834	0.374	74 <	196
6	yg.G+yq.Q5	Breve	0.90	2.217	0.076	25 <	196
7	yg.G+yq.Qf	Media	0.80	0.973	0.047	13 <	175
8	yg.G+yq.Qi	Breve	0.90	3.843	0.129	42 <	196
9	yg.G+yq.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	4.800	0.357	86 <	196
10	yg.G+yq.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	5.031	0.178	57 <	196
11	yg.G+yq.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	3.901	0.036	27 <	196
12	yg.G+yq.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	4.130	-0.143	46 <	196
13	yg.G+yq.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	3.829	0.616	126 <	196
14	yg.G+yq.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	4.060	0.437	96 <	196
15	yg.G+yq.Q4+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	3.517	0.439	94 <	196
16	yg.G+yq.Q4+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	2.884	0.215	52 <	196
17	yg.G+yq.Q4+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	2.842	0.621	121 <	196
18	yg.G+yq.Q5+yq. ψ o.Q1+yq. ψ o.Qf	Breve	0.90	3.901	0.141	45 <	196
19	yg.G+yq.Q5+yq. ψ o.Q2+yq. ψ o.Qf	Breve	0.90	3.268	-0.083	32 <	196
20	yg.G+yq.Q5+yq. ψ o.Q3+yq. ψ o.Qf	Breve	0.90	3.227	0.323	72 <	196
21	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q4	Breve	0.90	3.270	0.311	71 <	196
22	yg.G+yq.Qf+yq. ψ o.Q1+yq. ψ o.Q5	Breve	0.90	3.501	0.132	41 <	196
23	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q4	Breve	0.90	2.633	0.087	29 <	196
24	yg.G+yq.Qf+yq. ψ o.Q2+yq. ψ o.Q5	Breve	0.90	2.864	-0.092	31 <	196
25	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q4	Breve	0.90	2.611	0.493	98 <	196
26	yg.G+yq.Qf+yq. ψ o.Q3+yq. ψ o.Q5	Breve	0.90	2.842	0.314	69 <	196
27	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	5.292	0.373	92 <	196
28	yg.G+yq.Qi+yq. ψ o.Q1+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	5.523	0.194	63 <	196
29	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	4.663	0.148	50 <	196
30	yg.G+yq.Qi+yq. ψ o.Q2+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	4.892	-0.031	31 <	196
31	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q4+yq. ψ o.Qf	Breve	0.90	4.607	0.554	119 <	196
32	yg.G+yq.Qi+yq. ψ o.Q3+yq. ψ o.Q5+yq. ψ o.Qf	Breve	0.90	4.838	0.375	90 <	196
33	G+0.3xQf+0.2xQ1 + AedX	Accidental	1.00	2.053	0.171	40 <	240
34	G+0.3xQf+0.2xQ1 + AedY	Accidental	1.00	1.947	0.069	22 <	240

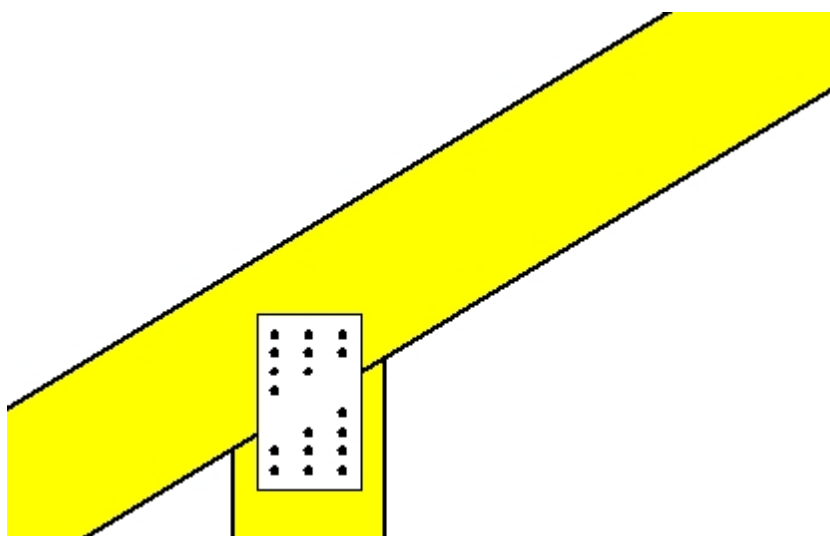
Scala 1:50



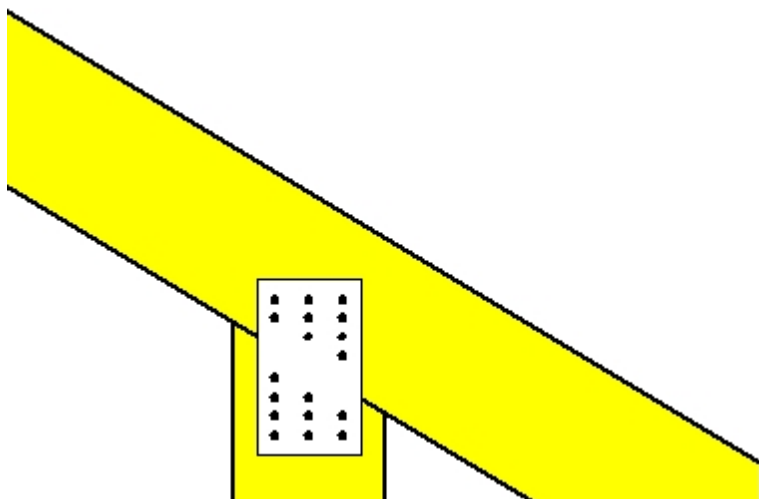
**Unione chiodata al nodo 1**(nodo a $x=0.000$ m, $y=0.000$ m)**piastre:** 150x255x2.0mm**viti:** 5.0/45 [40] [20+20]**Unione chiodata al nodo 2**(nodo a $x=4.000$ m, $y=3.883$ m)**piastre:** 355x350x2.0mm**viti:** 5.0/45 [24] [9+6+9]**Unione chiodata al nodo 3**(nodo a $x=8.000$ m, $y=0.000$ m)**piastre:** 150x255x2.0mm**viti:** 5.0/45 [40] [20+20]

**Unione chiodata al nodo 4**

(nodo a x=4.000 m, y=0.112 m)

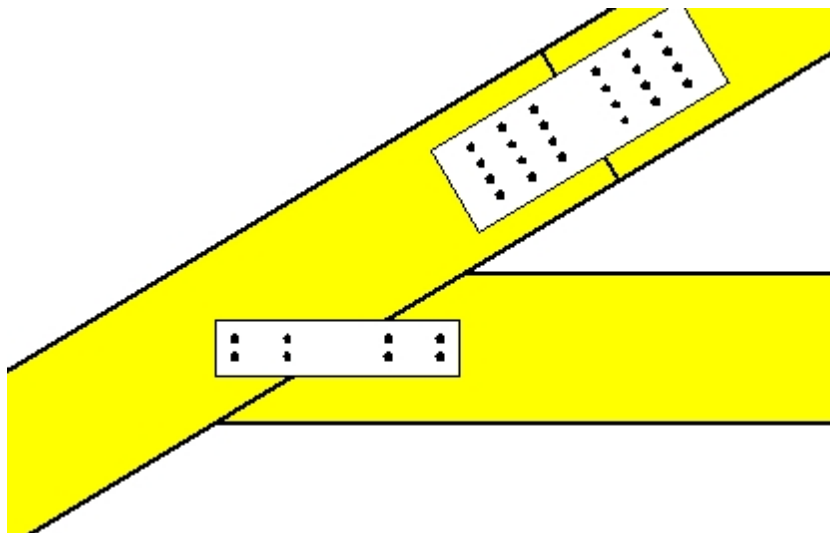
piastre: 100x245x2.0mm**viti: 5.0/45 [12] [6+6]****Unione chiodata al nodo 5**

(nodo a x=0.000 m, y=1.600 m)

piastre: 140x235x2.0mm**viti: 5.0/45 [18] [9+9]****Unione chiodata al nodo 6**

(nodo a x=8.000 m, y=1.600 m)

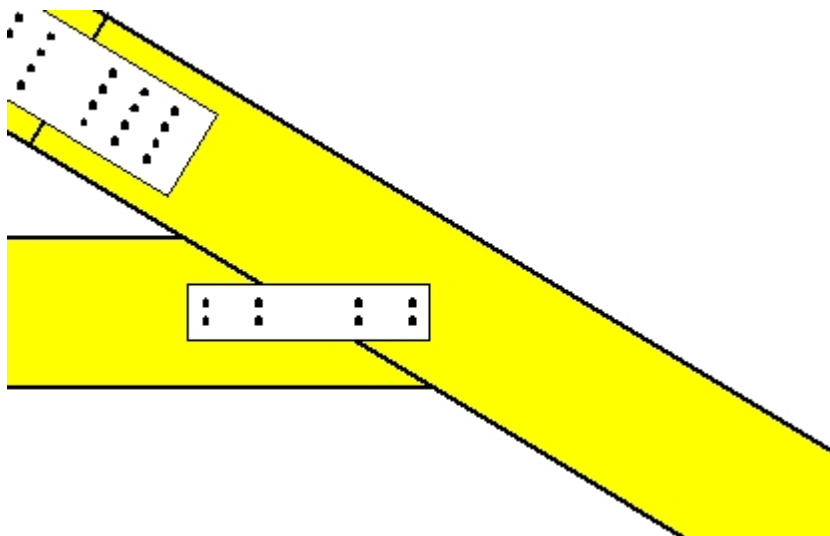
piastre: 140x235x2.0mm**viti: 5.0/45 [18] [9+9]**

**Unione chiodata al nodo 7**

(nodo a $x=0.639$ m, $y=2.100$ m)

piastre: 325x75x2.0mm

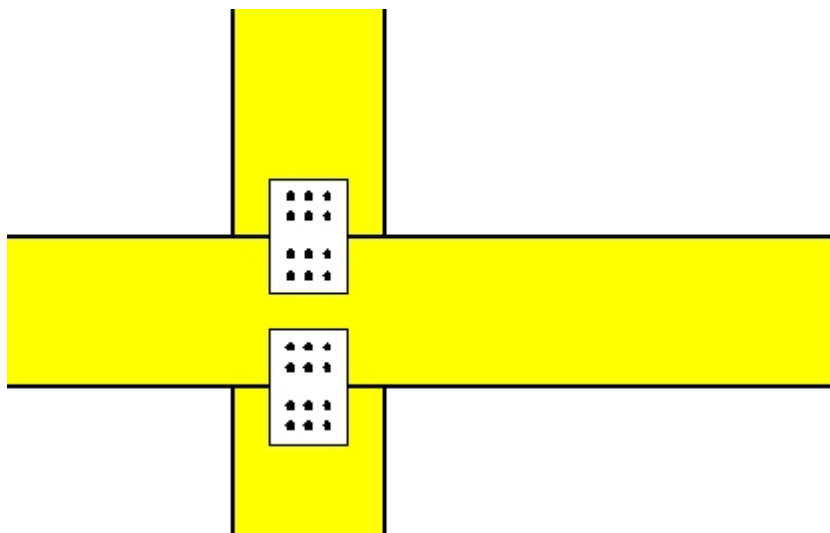
viti: 5.0/45 [8] [4+4]

**Unione chiodata al nodo 8**

(nodo a $x=6.972$ m, $y=2.100$ m)

piastre: 325x75x2.0mm

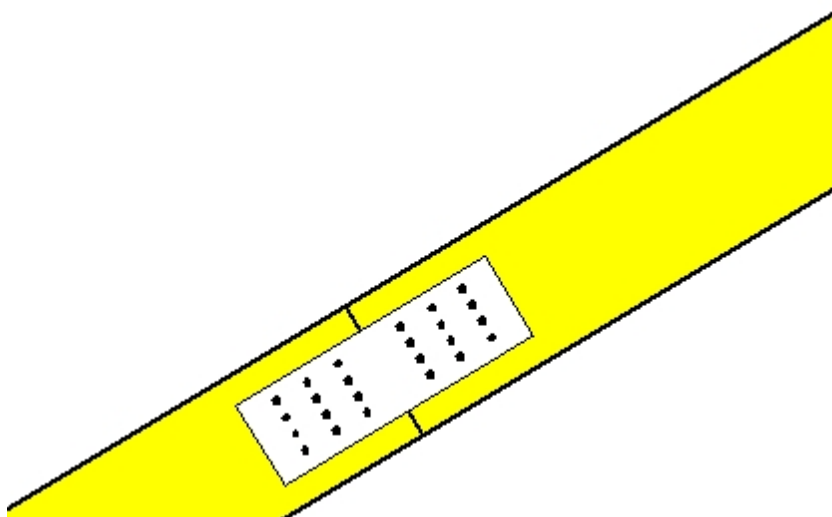
viti: 5.0/45 [8] [4+4]

**Unione chiodata al nodo 9**

(nodo a $x=4.000$ m, $y=2.100$ m)

piastre: 105x155x2.0mm

viti: 5.0/45 [12] [6+6]

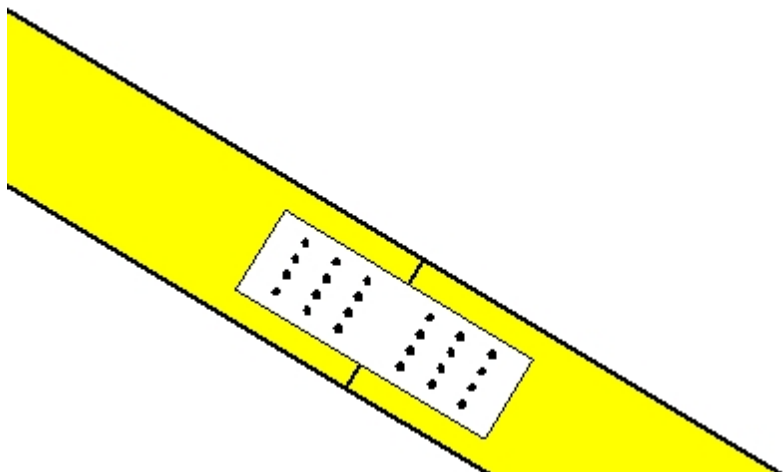


Giunto nell'elemento

(a x=1.348 m, y=2.409 m)

piastre: 385x125x2.0mm

viti: 5.0/45 [24] [12+12]

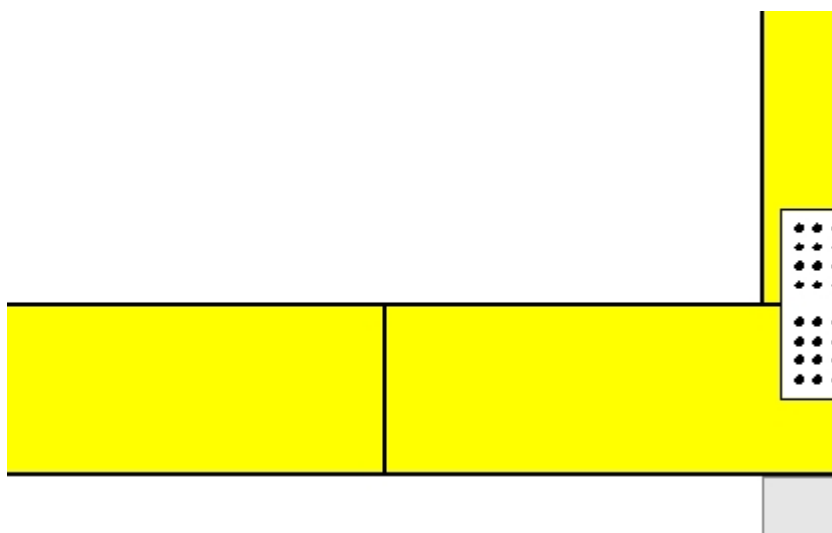


Giunto nell'elemento

(a x=6.652 m, y=2.409 m)

piastre: 385x125x2.0mm

viti: 5.0/45 [24] [12+12]



Giunto nell'elemento

(a x=7.400 m, y=0.000 m)