RAPORT TEKNIK KONSTRUKTIV

OBJEKTI:

NDERTIMI I GODINES SE RE TE ZJARRFIKESES NE BASHKINE HIMARE

Orbori Jaho

Digitally signed by Orbori Jaho
Date: 2026.06.08 15:18:09 +02'00'

Hartoi Raportin: Inxh. Orbori Jaho Lic.K.2670/3

1-Pershkrim mbi vendndodhjen e objektit.

Stacioni I zjarrfikesve do te ndertohet ne territorin e bashkise Himare.

2-Seksionet terthore te elementeve strukturale

Objekti qe do te ndertohet perbehet nga nje konstruskion b/a me sistemin me trare, kolona, “frame-system”:

- Trare b/a C25/30 me dimensione 30x60, 80x30, 40x50,
- Kolona C30/37 me dimensione 60x30, 30x30, 50x50,
- Soleta monolite kati 0 solete 20 cm, pjesa e zjarrfiksve, dhe 15 cm pjesa e zyrave
- Plinta b/a me dimensione 200x200, 180x220
- Rramballka me dimensione 30x80
- Solete monolite 20 cm dhe solete me mbushje te lehtesuar 30 cm
- Kolona HEA 260, Trare IPE 270 etj

3.Ngarkesat llogaritese te implementuara ne analize.

Ne llogaritjen e struktures, kemi marre parrasysh te dhenat e meposhtme:

Kategorite e ngarkesave sipas EC 1991.1.1.2002 Tabela 6.1 eshte si me poshte:

Beton C25/30 me fck=25 N/mm2, fcu=30 N/mm2, y=1.5 ***per strukturat horizontale, trare dhe soleta, shkalla + themelin***

Celik B500 C me fyk=500 N/mm2, E=210000 N/mm2, y=1.15

Shtresa mbrojtese Cnom(themele)=50mm, Cnom(kolona dhe trare)=25 mm, Cnom (soleta dhe shkalle)=15 mm.

- Pesha vetjake e struktures DL

Pesha vetjake e struktures llogaritet automatikisht nga program bazuar ne volumin e elementeve dhe peshen specifike te strukturave b/a 2500 kg/m3

- Ngarkesat e perhershem DL, LL,

  - ***Ngarkesa e shtresave D=2.0 kN/m2 ne sheshin e stacionit(shtrese me helicopter ne solete),***
  - ***Ngarkesa e shtresave D=3.0 kN/m2, ne zonen 1 kat te zyrave,***
  - ***Ngarkesa e shtresave ne tarrace D=4.0 Kn/m2,***
  - ***Ngarkesa e shtresave ne nderkatin e zones se zjarfiksve D=3.0 Kn/m2***
  - ***Ngarkesa e mbuleses D=1.0 kN/m2***
  - ***Ngarkesa Live ne sheshin e stacionit L=10 kN/m2***
  - ***Ngarkesa Live ne zonen 1 kat zyrat L=3.0 kn/m2***
  - ***Ngarkesa Live ne tarracen e objektit 1 kat, L=2.0 Kn/m2***
  - ***Ngarkesa e soletes ne soleten kompozit zona e stacionit te zjarrfiksve L=5.0 kN/m2***
  - ***Shpejtesia e eres V=35 m/s***

Table 6.1 - Categories of use

Category	Specific Use	Example
A	Areas for domestic and residential activities	Rooms in residential buildings and houses; bedrooms and wards in hospitals; bedrooms in hotels and hostels kitchens and toilets.
B	Office areas	
C	Areas where people may congregate (with the exception of areas defined under category A, B, and D[1])	**C1**: Areas with tables, etc. e.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions. **C2**: Areas with fixed seats, e.g. areas in churches, theatres or cinemas, conference rooms, lecture halls, assembly halls, waiting rooms, railway waiting rooms. **C3**: Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms, etc. and access areas in public and administration buildings, hotels, hospitals, railway station forecourts. **C4**: Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages. **C5**: Areas susceptible to large crowds, e.g. in buildings for public events like concert halls, sports halls including stands, terraces and access areas and railway platforms.
D	Shopping areas	**D1**: Areas in general retail shops **D2**: Areas in department stores

Fig.3.1 Tabela e kategorizimit te ngarkesave sipas EC1

Nga tabela e mesiperme ne shohim qe objekti jone I perket kategorise A, e per te nxjerre madhesine e ngarkeses bazohemi tek tabela 6.2 EC.1992.1.1.2002 si

Table 6.2 - Imposed loads on floors, balconies and stairs in buildings

Categories of loaded areas	q_k [kN/m^2]	Q_k [kN]
Category A		
- Floors	1,5 to2,0	2,0 to 3,0
- Stairs	2,0 to4,0	2,0 to 4,0
- Balconies	2,5 to 4,0	2,0 to 3,0
Category B	2,0 to 3,0	1,5 to 4,5
Category C		
- C1	2,0 to 3,0	3,0 to 4,0
- C2	3,0 to 4,0	2,5 to 7,0 (4,0)
- C3	3,0 to 5,0	4,0 to 7,0
- C4	4,5 to 5,0	3,5 to 7,0
- C5	5,0 to 7,5	3,5 to 4,5
category D		
- D1	4,0 to 5,0	3,5 to 7,0 (4,0)
- D2	4,0 to 5,0	3,5 to 7,0

Fig.3.2 Tabela e ngarkesave sipas EC1

Sipas te dhenave te hartave sizmike objekti do te ndertohet ne kategorine ***e truallit "B"***

Tab. 3-1 Tipet e truallit

Tipi i truallit	Përshkrim i profilit stratigrafik	Parametrat		
		$v_{s,30}$(m/s)	N_{SPT} (goditje/30cm)	c_u (kPa)
A	Shkëmb ose formacion tjetër gjeologjik i ngjashëm me shkëmbin, duke përfshirë të shumtën 5 m material më të dobët në sipërfaqe	> 800	–	–
B	Depozitime me rërë shumë të ngjeshur, zhavor ose argjilë shumë të ngurtë, të paktën me disa dhjetra metra trashësi, të karakterizuara nga një rritje graduale e vetive mekanike, me rritjen e thellësisë	360 – 800	> 50	> 250
C	Depozitime të thella me rërë të ngjeshur,ose gjysmë të ngjeshur, zhavorr ose argjilë të ngurtë, me trashësi nga disa dhjetra në disa qindra metra	180 – 360	15 – 50	70 – 250
D	Depozitime dherash të palidhur deri gjysmë të palidhur (me ose pa disa shtresa të buta lidhëse kohezive), ose depozitime dherash që në masën mbizotëruese janë të buta (të dobëta) deri në të forta, të lidhura	< 180	< 15	< 70
E	Një profil dheu që ka një shtresë sipërfaqësore aluvionesh me vlera v_s të tipit C dhe D dhe trashësi që ndryshon nga rreth 5 m deri në 20 m, e vendosur mbi një material të ngurtë mbështetës me v_s > 800 m/sek			
S_1	Depozitime që kanë ose përmbajnë një shtresë prej të paktën 10 m trashësi me argjila/lymra të buta me tregues (indeks) të lartë plasticiteti (PI > 40) dhe nivel të lartë ujërash nëntokësore	< 100 (tregues)	–	10 – 20
S_2	Depozitime dherash të lëngëzueshme, argjilash të ndjeshme (të dobëta) ose çdo profil tjetër dheu që nuk përfshihet në tipat A-E ose S_1			

Fig.3.3 Kategorizimi I truallit sipas EC8

Duke u mbeshtetur ne Harten Sizmike te IGJEUM, PGA eshte ***0.399 g***., koeficenti I rendesise 1.40, Objekti eshte klasifikuar ne kategorine e objekteve IV, dhe koeficent rendesie 1.40, stacioni I zjarrfikseve

Klasa e rëndësisë	Ndërtesat	γ_I
I	Ndërtesa të një rëndësie të vogël për sigurinë publike, p.sh. ndërtesa bujqësore etj.	0.8
II	Ndërtesa të zakonshme, që nuk u përkasin kategorive të tjera	1
III	Ndërtesa, rezistenca sizmike e të cilave është me rëndësi në këndvështrimin e rrjedhojave që shkakton një shembje, p.sh. shkolla, salla mbledhjesh, institucione kulturore etj.	1.2
IV	Ndërtesa, integriteti gjatë tërmetit i të cilave është me rëndësi jetësore për mbrojtjen civile, si p.sh. spitalet, stacionet e zjarrfikëseve, centralet energjetike etj.	1.4

Fig.3.4.Klasat e rendesise se objektit

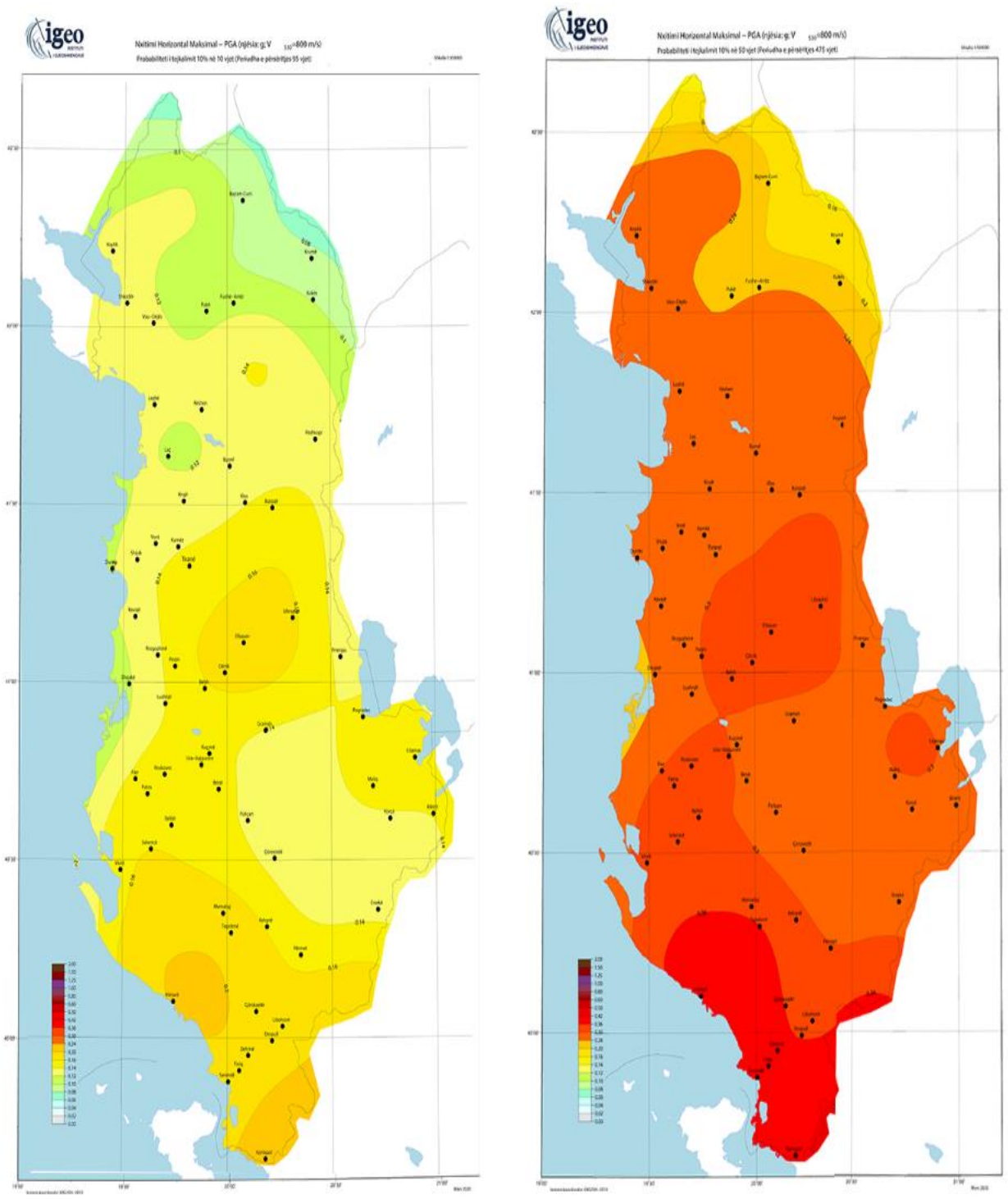


Fig.3.5 Harta e shperndarjes se nxitimit sizmik

.Sipas hartave te mesiperme per objektin tone do te pranojme nje shpejtim te truallit PGA=0.399 m/s2 .Objekti hyn ne rendesine e objekteve te rendesie IV

Te dhenat gjeologjike te sheshit te ndertimit pranuar sipas hartave ne zona te tilla.:

Aftesia mbajtese e bazamentit eshte Sigma=3.2 kg/cm2, Themeli do te jete themel plint me trashesi . Koeficenti winkler 285000 kN/m3.

- **SPEKTRI I REAGIMIT ELASTIK PËR GJENDJEN E FUNDIT KUFITARE**

Për komponentet horizontale të veprimit sizmik, spektri i reagimit elastik *Se*(*T*) përcaktohet nga shprehjet vijuese:

$0 \le T \le T_B$ $\quad S_e = a_g * S * \left[1 + \frac{T}{T_B}(\eta * 2.5 - 1)\right]$ **[3.9]**

$T_B \le T \le T_C$ $\quad S_e = a_g * S * \eta * 2.5$ **[3.10]**

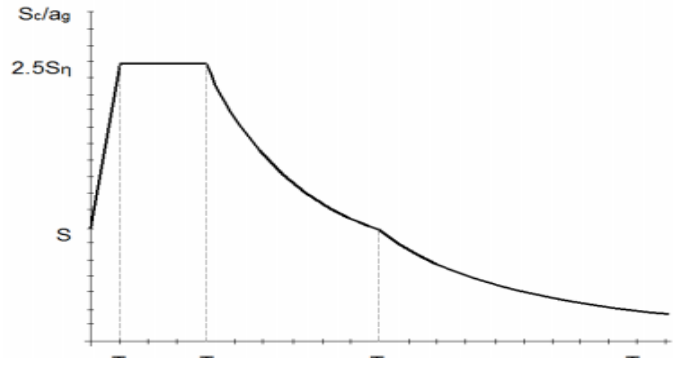
$T_C \le T \le T_D$ $\quad S_e = a_g * S * \eta * 2.5 * \left[\frac{T_C}{T}\right]$ **[3.11]**

$T_D \le T \le 4$ $\quad S_e = a_g * S * \eta * 2.5 * \left[\frac{T_C * T_D}{T^2}\right]$ **[3.12]**

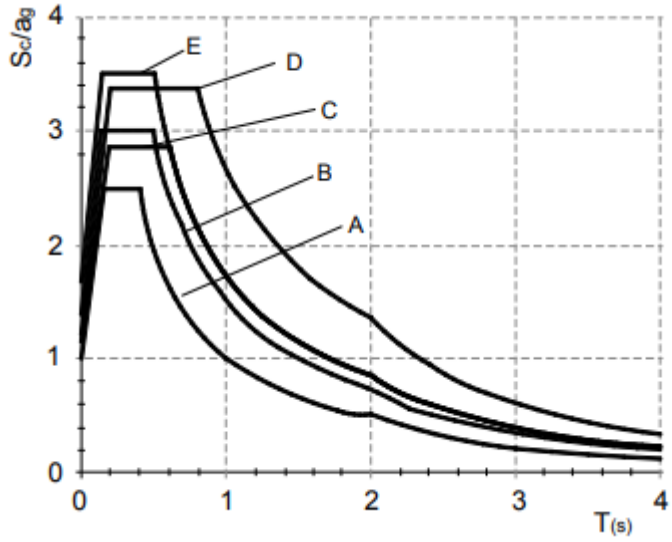
Periodat TB, TC dhe TD dhe faktori i truallit S, përshkruajnë formën e spektrit. Ato varen nga tipi i truallit. Ata gjithashtu varen nga tipi i spektrit të reagimit elastik (tipi “1” i referohet tërmetit me Magnitudë MS>5,5; tipi “2” i referohet tërmetit me Magnitudë MS ≤ 5,5). Për shkak të mungesës të të dhënave të mjaftueshme dhe të besueshme nga një burim sizmik i vetëm, këshillohet të përdoret kurba spektrale “mbështjellëse”, që konsideron vlerat maksimale të dy tipeve të tërmeteve, me magnitudë MS>5,5 dhe MS≤5,5. Ne rastin tone marrim ne studim Tipin 1

Tipi i truallit	S	T_B (s)	T_C (s)	T_D (s)
A	1,0	0,15	0,4	2,0
B	1,2	0,15	0,5	2,0
C	1,15	0,20	0,6	2,0
D	1,35	0,20	0,8	2,0
E	1,4	0,15	0,5	2,0

T është perioda e lëkundjeve e një sistemi linear me një shkallë lirie;
a_g është shpejtimi i projektimit të truallit në formacione shkëmbore ose pothuajse shkëmbore të tipit A ($a_g = \gamma_I a_{gR}$).
S është faktori i truallit i dhënë nga të dhënat gjeoteknike
T_B, T_C, T_D janë disa vlera specifike të periodave
η është faktori i korrigjimit të shuarjes me një vlerë referencë prej h = 1 për 5% shuarje viskoze.



Forma e reagimit te spektrit elastic te reagimit



Vlera e spektrit te reagimit per te gjitha kategorite e truallit me shuarje 5%

TIPI STRUKTUROR	DCM	DCH
Sistem rame,sistem dual, sistem me mure te çiftezuar	$3,0\alpha_u/\alpha_1$	$4,5\ \alpha_u/\alpha_1$
Sistem me mure	3,0	$4,0\ \alpha_u/\alpha_1$
Sistem me fleksibilitet perdredhes (i perkulshem nga perdredhja)	2,0	3,0
Sistem i tipit lavjerres i permbysur	1,5	2,0

- Kombinimi kryesor

$$\sum_{j\geq 1} \gamma_{G,j} G_{k,j} + \gamma_{Q,1} Q_{k,1} + \sum_{i>1} \gamma_{Q,i} \psi_{o,i} Q_{k,i}$$

$G_{k,j}$	Vlera karakteristike e veprimit të përhershëm
$\gamma_{G,j}$	Koefiçienti pjesor i sigurisë (1.35) për veprimet e përhershme
$Q_{k,1}$	Vlera karakteristike e veprimit kryesor të përkohshëm
$\gamma_{Q,1}$	Koefiçienti pjesor i sigurisë për veprimin kryesor të përkohshëm (1.5)
$Q_{k,i}$	Vlera karakteristike e veprimit shoqërues të përkohshëm
$\gamma_{Q,i}$	Koefiçienti pjesor i sigurisë për veprimin shoqërues të përkohshëm (1.5)
$\psi_{o,i}$	Koefiçienti i jobesueshmërisë të veprimit të ngarkesave.

Për përmasimin paraprak të kolonave nisemi nga kriteri i projektimit sipas kapaciteteve "trarë të dobët - kolona të forta". Kushti që duhet të plotësohet është:

$$\sum M_{RC} \geq 1.3 \sum M_{RB}$$

Ku:

$\sum M_{RC}$ është shuma e momenteve rezistuese projektuese e kolonave që bëjnë pjesë në nyje. Vlera minimale e momentit rezistues të kolonës dhe forcës aksiale të saj, e marrë nga projektimi sizmik merret në konsideratë në këtë rast.

$\sum M_{RB}$ është shuma e momenteve rezistuese projektuese e trarëve që bëjnë pjesë në nyje. Kur përdoren lidhjet me fortësi të pjesshme, momenteve rezistuese projektuese të këtyre lidhjeve merren parasysh në llogaritjen e $\Sigma M_{Rb.}$ Kur përdoren lidhjet (nyjet) me fortësi të pjesshme, projektimi i kapacitetit të kolonës duhet të derivohet nga kapaciteti plastik i nyjeve.

- Kombinimi sizmik

$$\sum G_{k,j} + \sum \psi_{2,i} Q_{k,i} + \gamma E_{Ed}$$

Ku:

E_{Ed}	Vlera projektuese e veprimit sizmik
γ	Koefiçienti pjesor i sigurisë për veprimin sizmik. Për godinat e banimit γ=1
$\psi_{2,i}$	Koefiçienti i pjesëmarrjes së ngarkesave të përkohshme. Përcaktohet nga lloji i objektit. Për godinat e banimit =0.3

Në rastin tonë kemi neglizhuar efektin e veprimit sizmik në drejtimin vertikal duke marrë në konsideratë si më poshtë:

a) $E_{Edx} + 0.3E_{Edy}$
b) $0.3E_{Edx} + E_{Edy}$

Ku:

E_{Edx}	përfaqëson efektin për shkak të aplikimit të veprimit sizmik përgjatë aksit x të strukturës
E_{Edy}	përfaqëson efektin për shkak të aplikimit të veprimit sizmik përgjatë aksit y të strukturës

-Detajimi I mureve bazohet ne rregullat e meposhtme:

Capacity design check at beam-column joints: [10]	$1.3\sum M_{Rb} \leq \sum M_{Rc}$ No moment in transverse direction of column		-
Verification for M_x-M_y-N:	Truly biaxial, or uniaxial with (M_z/0.7, N), (M_y/0.7, N)		
Axial load ratio $\nu_d = N_{Ed}/A_c f_{cd}$	≤ 0.55	≤ 0.65	-
Shear design:			
V_{Ed} seismic [11]	$1.3\frac{\sum M_{Rc}^{ends}}{l_{cl}}$ (11)	$1.1\frac{\sum M_{Rc}^{ends}}{l_{cl}}$ (11)	from analysis for design seismic action plus gravity
$V_{Rd,max}$ seismic [12], [13]	As in EC2: $V_{Rd,max} = 0.3(1-f_{ck}(MPa)/250) b_{wo} z f_{cd} \sin 2\delta$, $1 \leq \cot\delta \leq 2.5$		
$V_{Rd,s}$ seismic [12], [13], [14]	As in EC2: $V_{Rd,s} = b_w z \rho_w f_{ywd} \cot\delta + N_{Ed}(h-x)/l_{cl}$ [13], $1 \leq \cot\delta \leq 2.5$		

-Detajimi I kolonave bazohet ne rregullat e meposhtme:

	DCH	DCM	DCL
Cross-section sides, h_c, $b_c \geq$	0.25m; $h_w/10$ if $\theta=P\delta/Vh>0.1$ [1]	-	
“critical region” length [1] $\geq$	1.5h_c, 1.5b_c, 0.6m, $l_c/5$	h_c, b_c, 0.45m, $l_c/6$	h_c, b_c
Longitudinal bars (L):			
ρ_{min}	1%		$0.1N_d/A_cf_{yd}$, 0.2% [0]
ρ_{max}	4%		4% [0]
$d_{bL} \geq$	8mm		
bars per side $\geq$	3		2
Spacing between restrained bars	≤150mm	≤200mm	-
Distance of unrestrained bar from nearest restrained nearest restrained bar	≤150mm		
Transverse bars (w):			
Outside critical regions:			
$d_{bw} \geq$	6mm, $d_{bL}/4$		
spacing $s_w \leq$	20d_{bL}, h_c, b_c, 400mm		12d_{bL}, 0.6h_c, 0.6b_c, 240mm
at lap splices, if d_{bL}>14mm: $s_w \leq$	12d_{bL}, 0.6h_c, 0.6b_c, 240mm		
Within critical regions: [2]			
$d_{bw} \geq$ [3]	6mm, $0.4(f_{yd}/f_{ywd})^{1/2}d_{bL}$	6mm, $d_{bL}/4$	
$s_w \leq$ [3],[4]	6d_{bL}, $b_o/3$, 125mm	8d_{bL}, $b_o/2$, 175mm	-
$\omega_{wd} \geq$ [5]	0.08	-	
$\alpha\omega_{wd} \geq$ [4],[5],[6],[7]	$30\mu_\phi^* \nu_d \varepsilon_{sy,d} b_c/b_o$-0.035	-	
In critical region at column base:			
$\omega_{wd} \geq$	0.12	0.08	-
$\alpha\omega_{wd} \geq$ [4],[5],[6],[8],[9]	$30\mu_\phi \nu_d \varepsilon_{sy,d} b_c/b_o$-0.035		-

-Detajimi I trareve realizohet sipas tabeles se meposhtme :

	DC H	DCM	DCL
"critical region" length	$1.5h_w$	h_w	
Longitudinal bars (L):			
ρ_{min}, tension side	$0.5f_{ctm}/f_{yk}$		$0.26f_{ctm}/f_{yk}$, 0.13%(0)
ρ_{max}, critical regions(1)	$\rho'+0.0018f_{cd}/(\mu_\phi\varepsilon_{sy,d}f_{yd})$(1)		0.04
$A_{s,min}$, top & bottom	$2\Phi14$ ($308mm^2$)	-	
$A_{s,min}$, top-span	$A_{s,top\text{-}supports}/4$	-	
$A_{s,min}$, critical regions bottom	$0.5A_{s,top}$(2)		-
$A_{s,min}$, supports bottom	$A_{s,bottom\text{-}span}/4$(0)		
d_{bL}/h_c - bar crossing interior joint(3)	$\le \frac{6.25(1+0.8\nu_d)}{(1+0.75\frac{\rho'}{\rho_{max}})}\frac{f_{ctm}}{f_{yd}}$	$\le \frac{7.5(1+0.8\nu_d)}{(1+0.5\frac{\rho'}{\rho_{max}})}\frac{f_{ctm}}{f_{yd}}$	-
d_{bL}/h_c - bar anchored at exterior joint(3)	$\le 6.25(1+0.8\nu_d)\frac{f_{ctm}}{f_{yd}}$	$\le 7.5(1+0.8\nu_d)\frac{f_{ctm}}{f_{yd}}$	-
Transverse bars (w):			
(i) outside critical regions			
spacing $s_w\le$	0.75d		
$\rho_w\ge$	$0.08\sqrt{f_{ck}(MPa)}/f_{yk}(MPa)$(0)		
(ii) in critical regions:			
$d_{bw}\ge$	6mm		
spacing $s_w\le$	$6d_{bL}$, $\frac{h_w}{4}$, $24d_{bw}$, 175mm	$8d_{bL}$, $\frac{h_w}{4}$, $24d_{bw}$, 225mm	-
Shear design:			
V_{Ed}, seismic(4)	$1.2\frac{\sum M_{Rb}}{l_{cl}} \pm V_{o,g+\psi_2 q}$(4)	$\frac{\sum M_{Rb}}{l_{cl}} \pm V_{o,g+\psi_2 q}$(4)	from analysis for design seismic action plus gravity
$V_{Rd,max}$ seismic (5)	As in EC2: $V_{Rd,max}=0.3(1-f_{ck}(MPa)/250)b_{wo}zf_{cd}\sin2\delta$ (5), $1\le\cot\delta\le2.5$		
$V_{Rd,s}$, outside critical regions(5)	As in EC2: $V_{Rd,s}=b_w z\rho_w f_{ywd}\cot\delta$ (5), $1\le\cot\delta\le2.5$		
$V_{Rd,s}$, critical regions(5)	$V_{Rd,s}=b_w z\rho_w f_{ywd}$ ($\delta=45^o$)	As in EC2: $V_{Rd,s}=b_w z\rho_w f_{ywd}\cot\delta$, $1\le\cot\delta\le2.5$	
If $\zeta=V_{Emin}/V_{Emax}$(6) <-0.5: inclined bars at angle $\pm\alpha$ to beam axis, with cross-section A_s/direction	If $V_{Emax}/(2+\zeta)f_{ctd}b_w d>1$: $A_s=0.5V_{Emax}/f_{yd}\sin\alpha$ & stirrups for $0.5V_{Emax}$	-	

Shenim.Rregullat e mesiperme I perkasin klasave te ndryshme te duktilitetit, per objektin tone bazohemi tek klasa DCM.

5-Analiza Modale e objektit

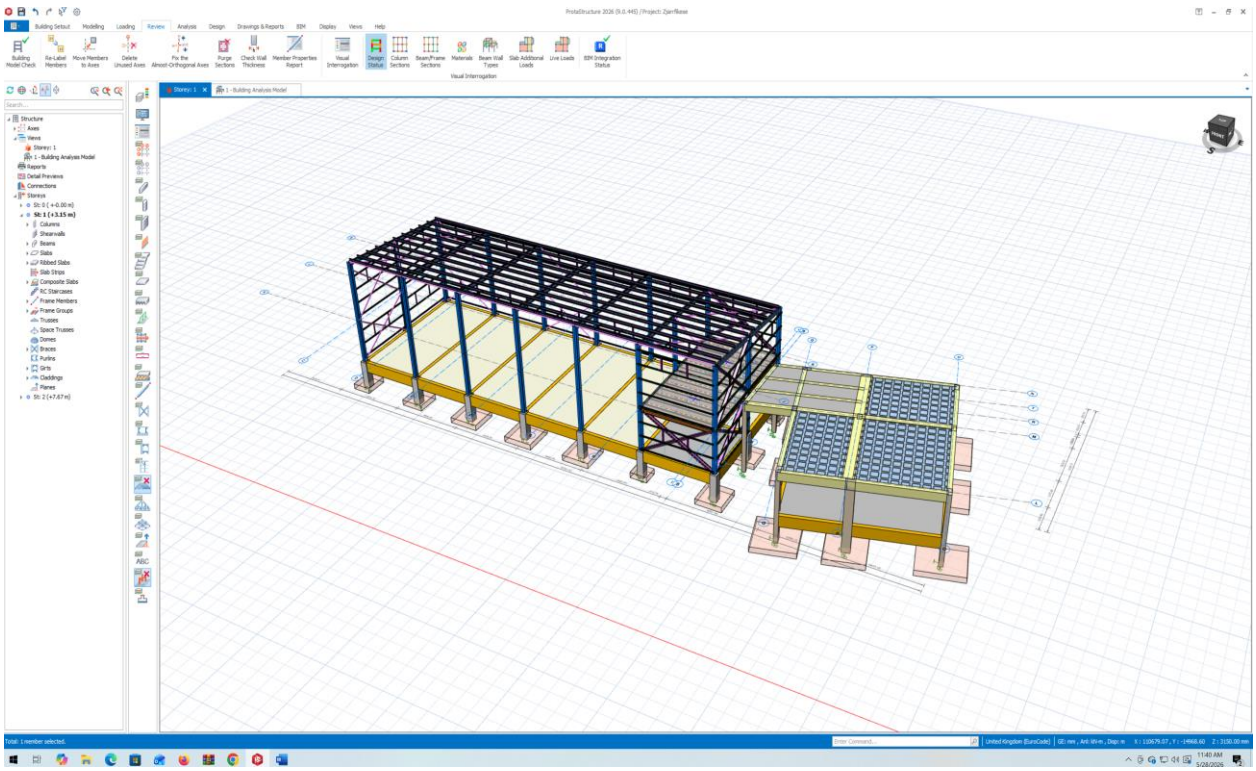


Fig.5.1. Modeli 3D I Struktures

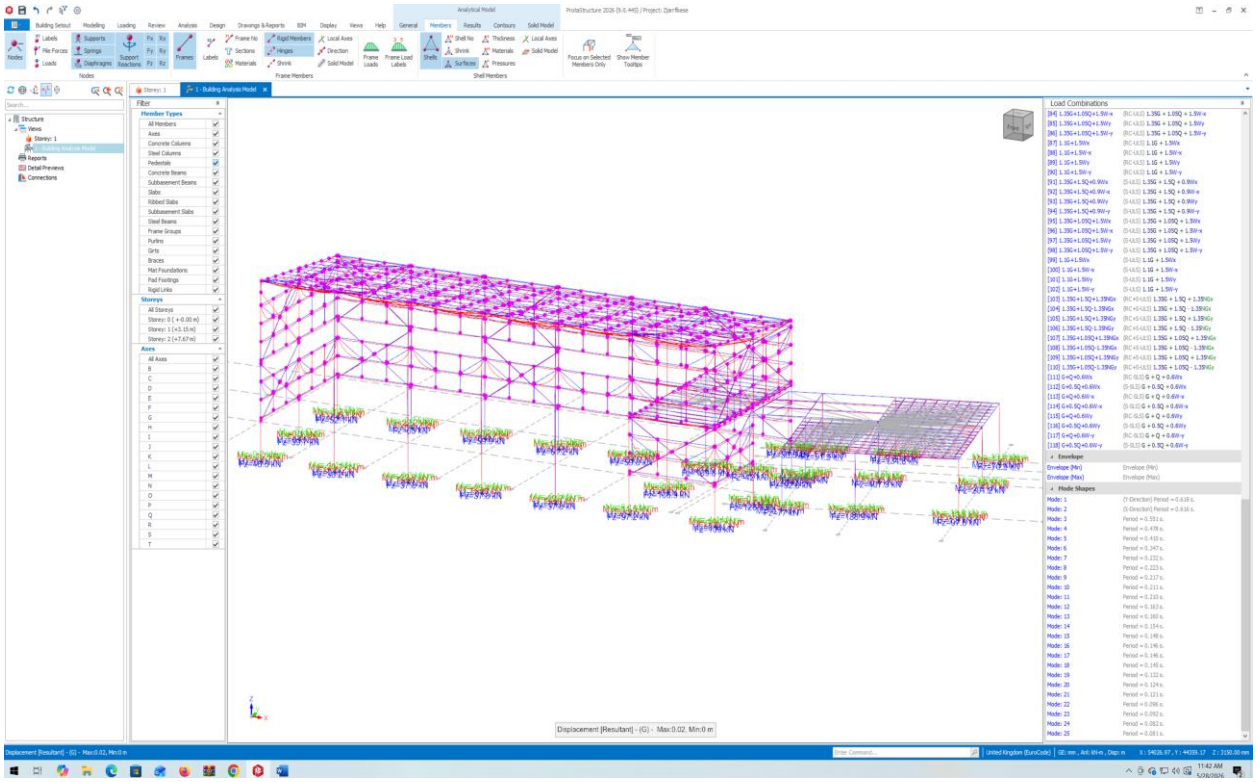


Fig.5.2. Modeli 3D I Struktures MESH

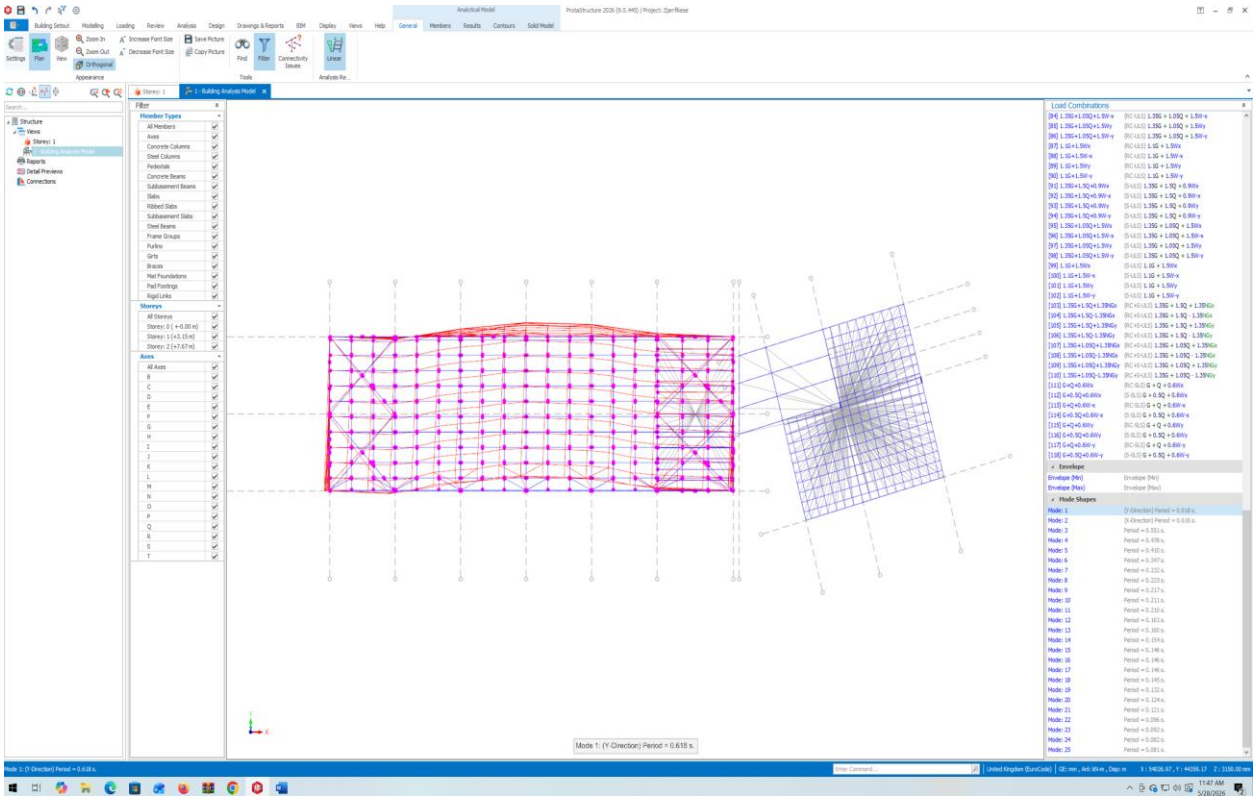


Fig.5.3. Modi, I pare I lekundjeve Levizje translative Y-Y

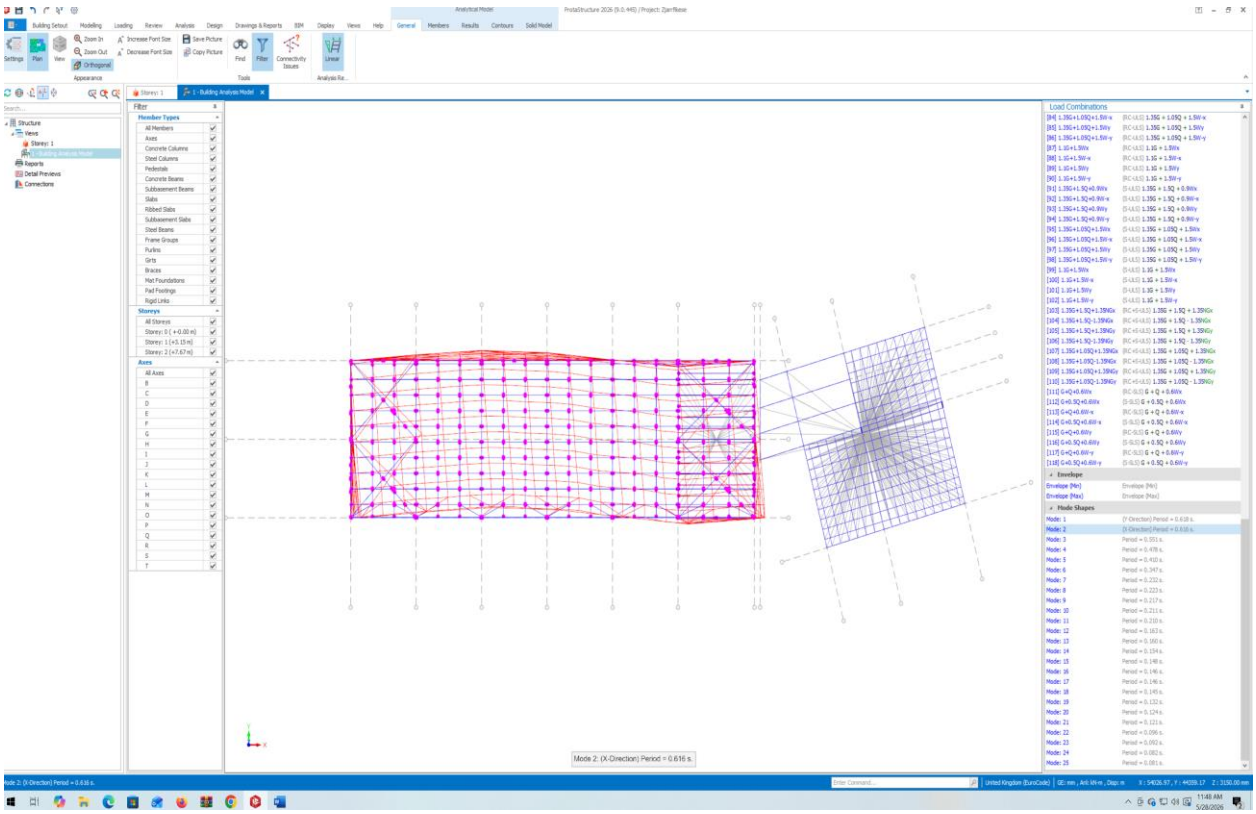


Fig.5.4. Modi, I dyte I lekundjeve Levizje jo e paster translative X-X

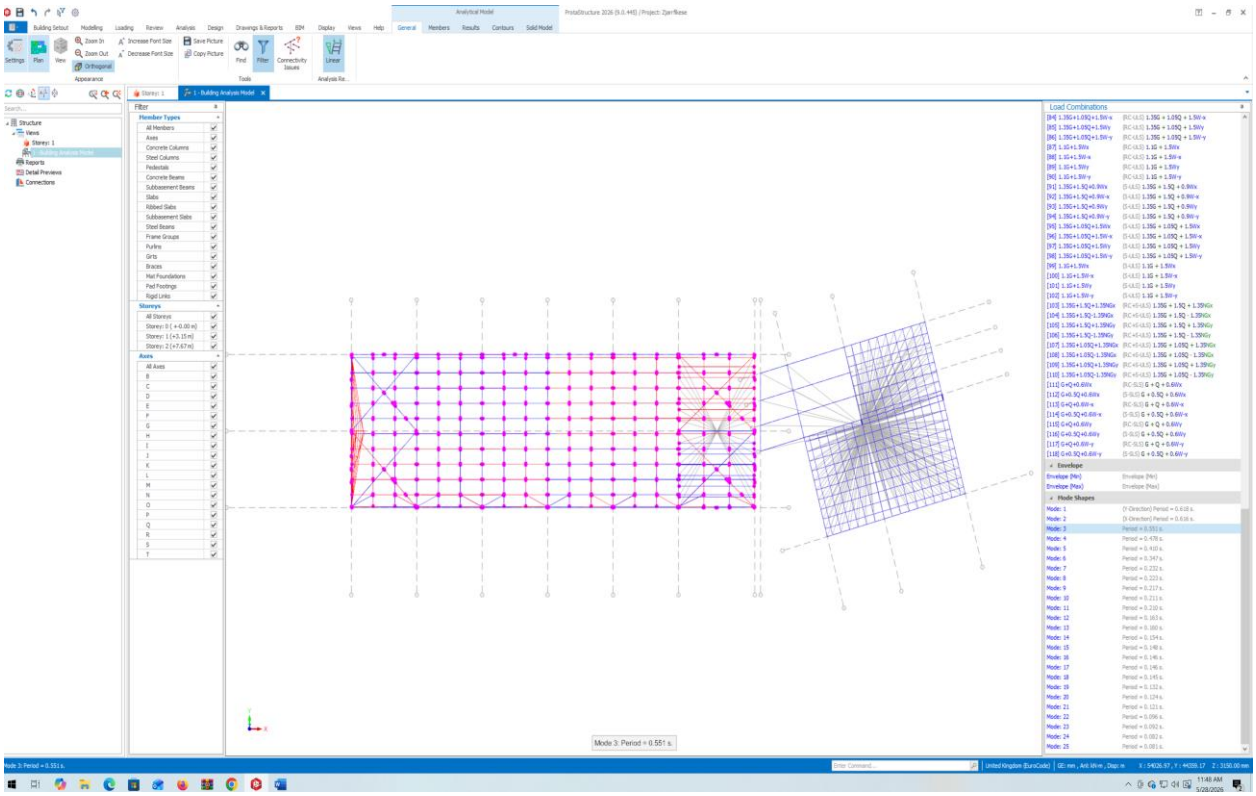


Fig.5.5. Modi, I trete I lekundjeve Levizje e paster translative y-y

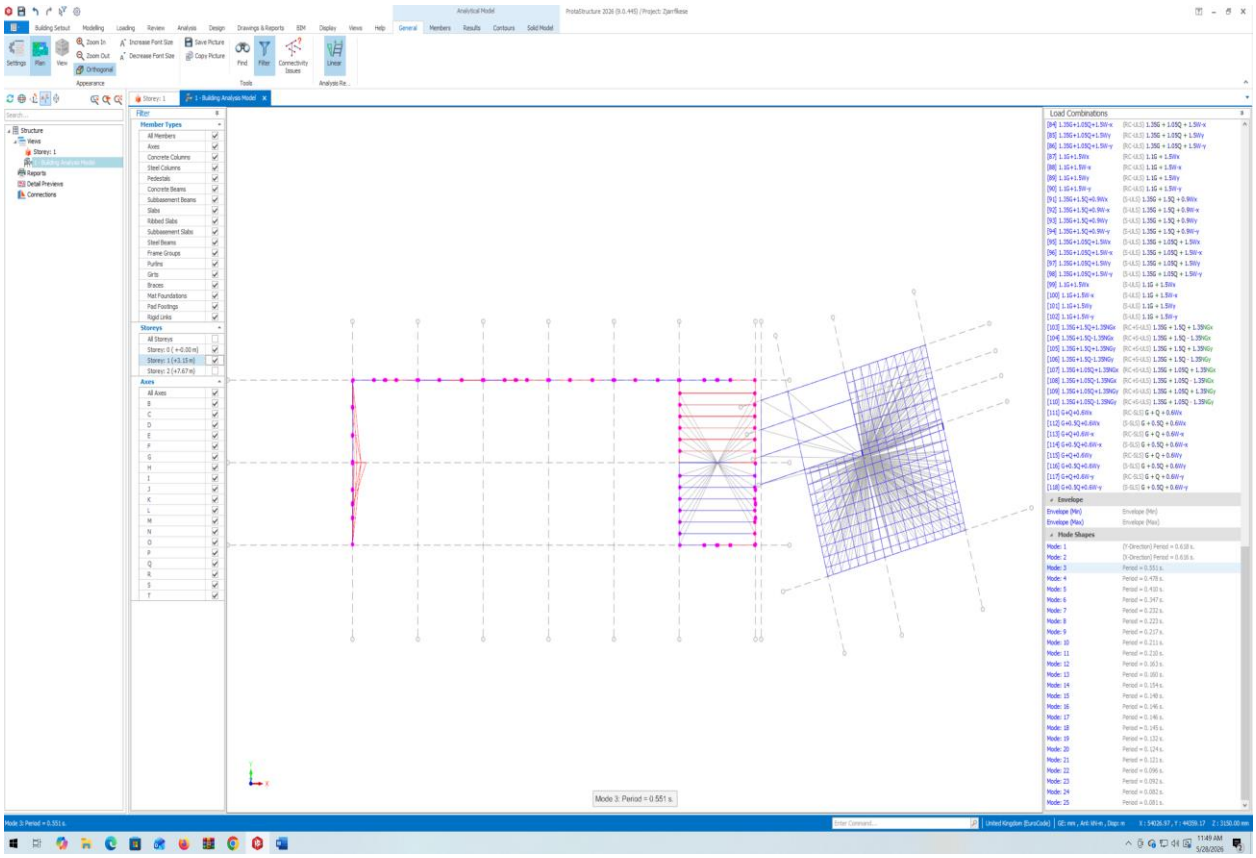


Fig.5.6. Grafiku I perqendrimit te ngurtesise +3.50

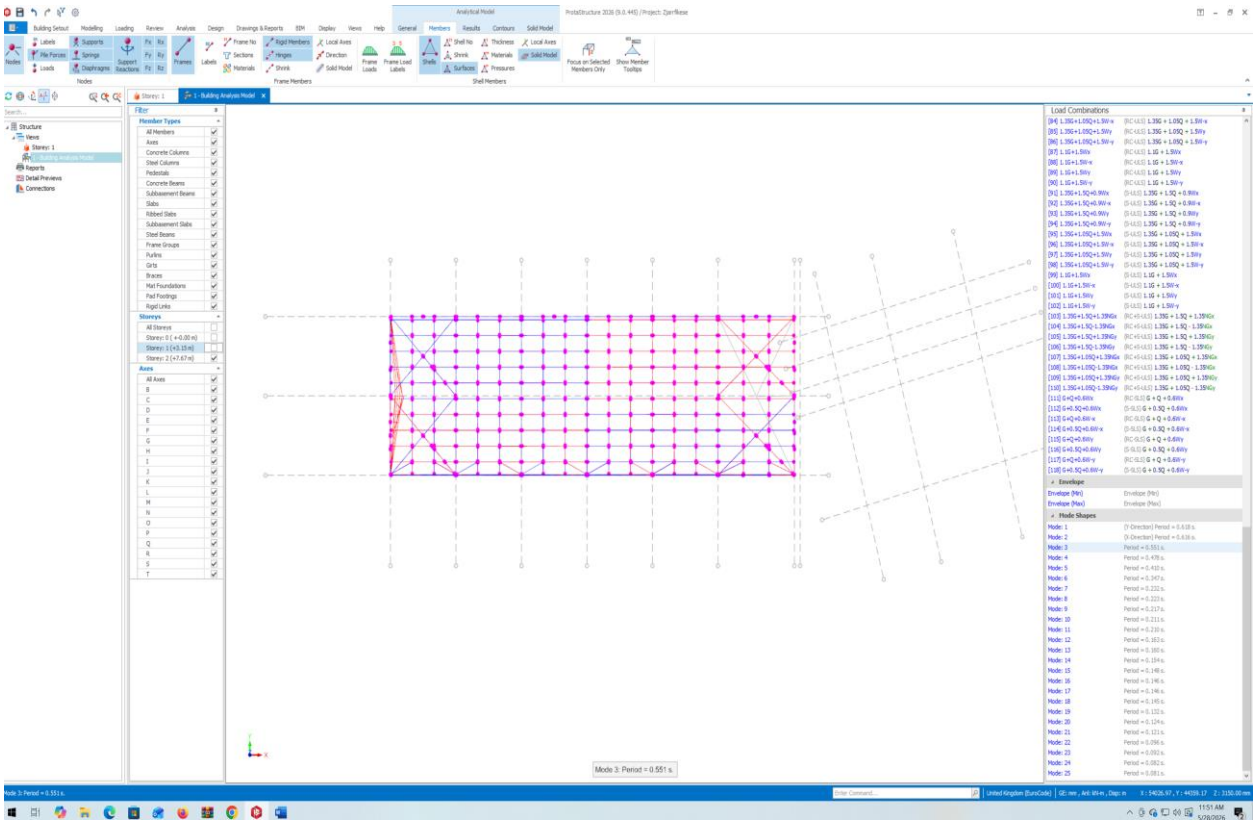


Fig.5.6. Grafiku I perqendrimit te ngurtesise +7.70

- Modi I I I Lekundjeve 0.618 sek
- Modi I II I Lekundjeve 0.616 sek
- Modi I III I Lekundjeve 0.551 sek
- Perioda e perfaert $T=0.085*H^{3/4}=0.085*(8.5)*^{0.75}=0.450$ sek

Tmode=0.618, Temipr *1.2=0.45*1.2=0.55.

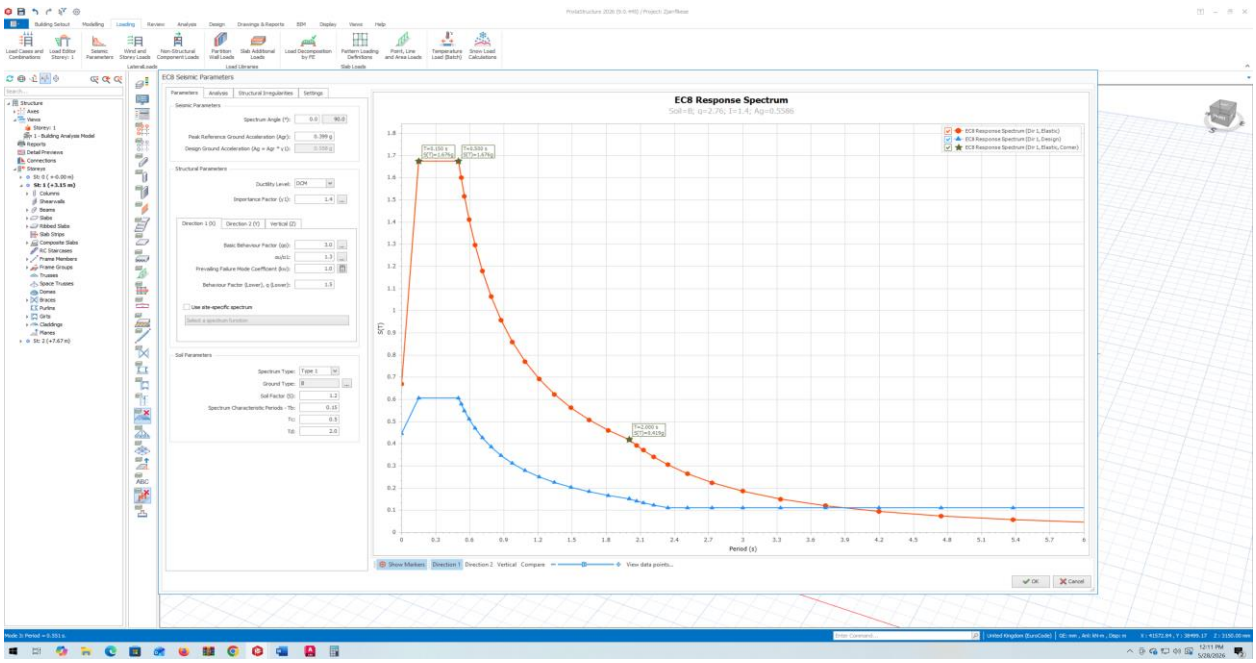


Fig.5.7. Spektri I projektimit dhe te dhenat x-x

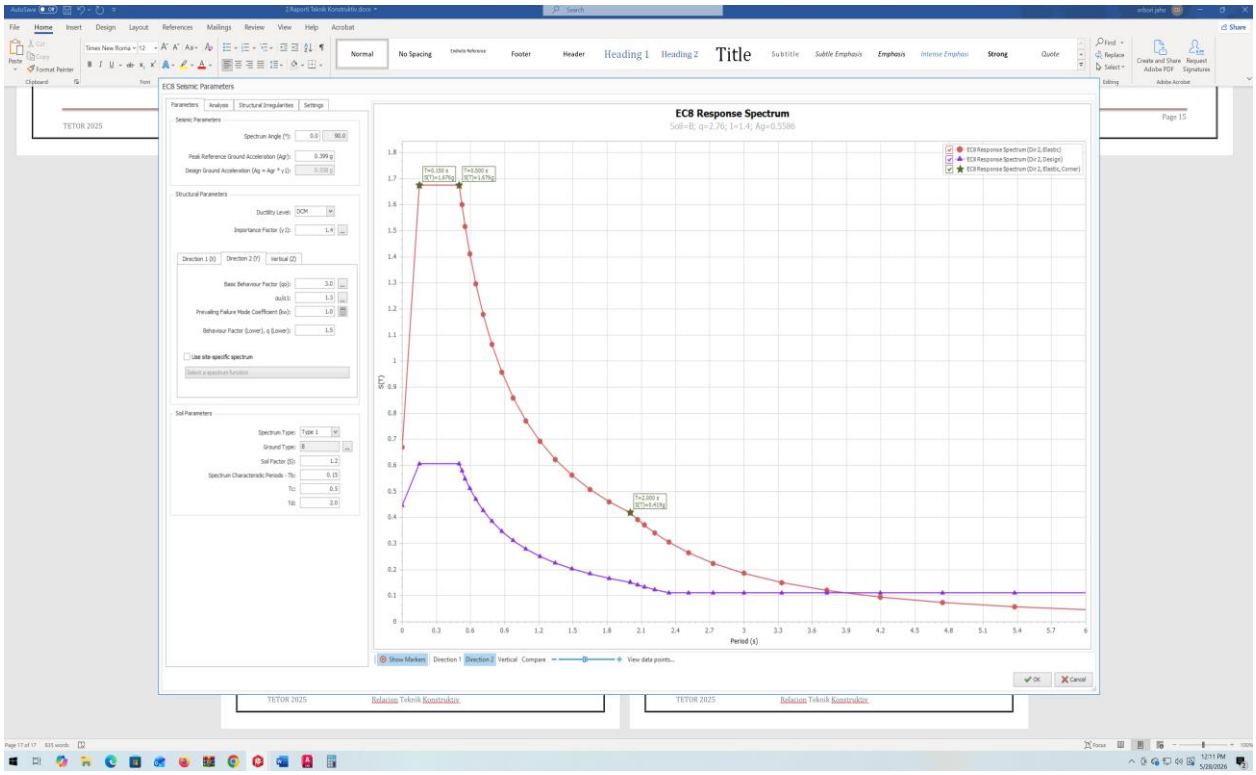


Fig.5.8. Spektri I projektimit dhe te dhenat y-y

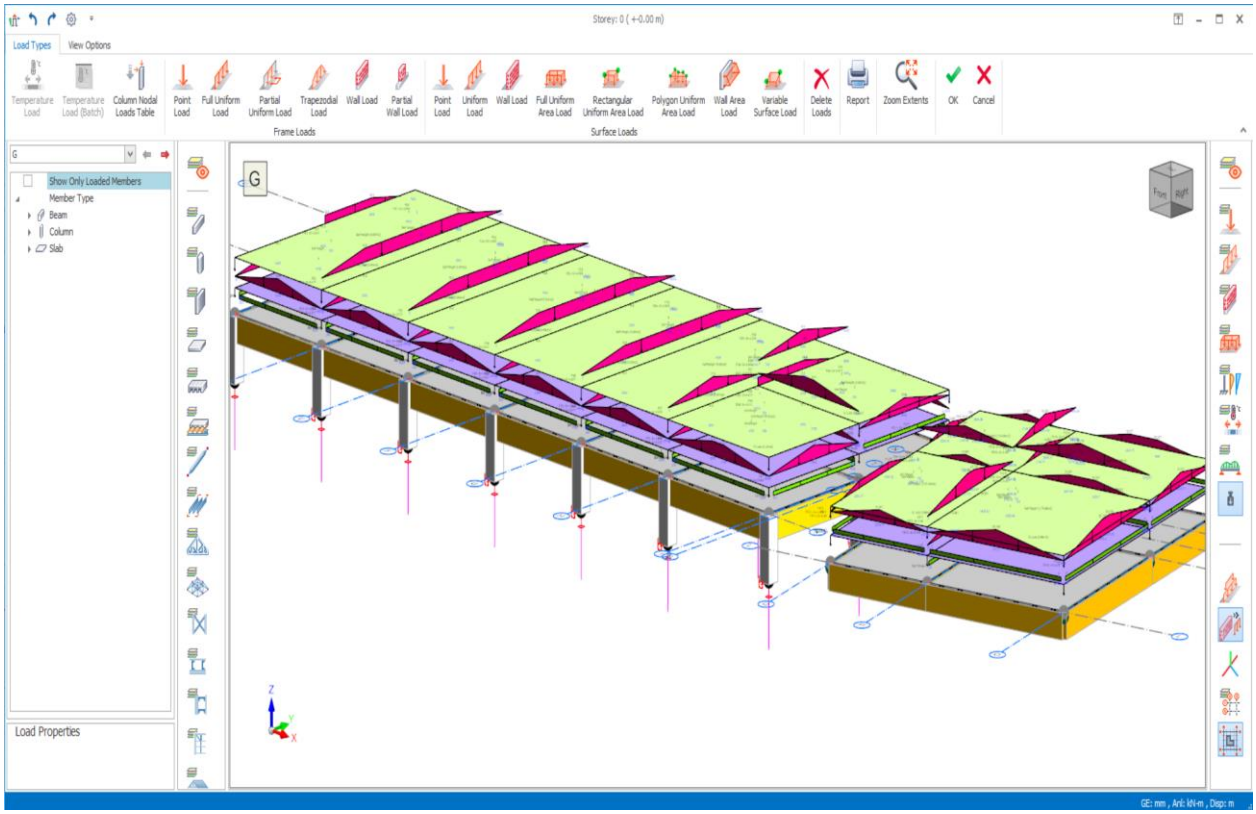


Fig.5.9. Ngarkesa -+0.00

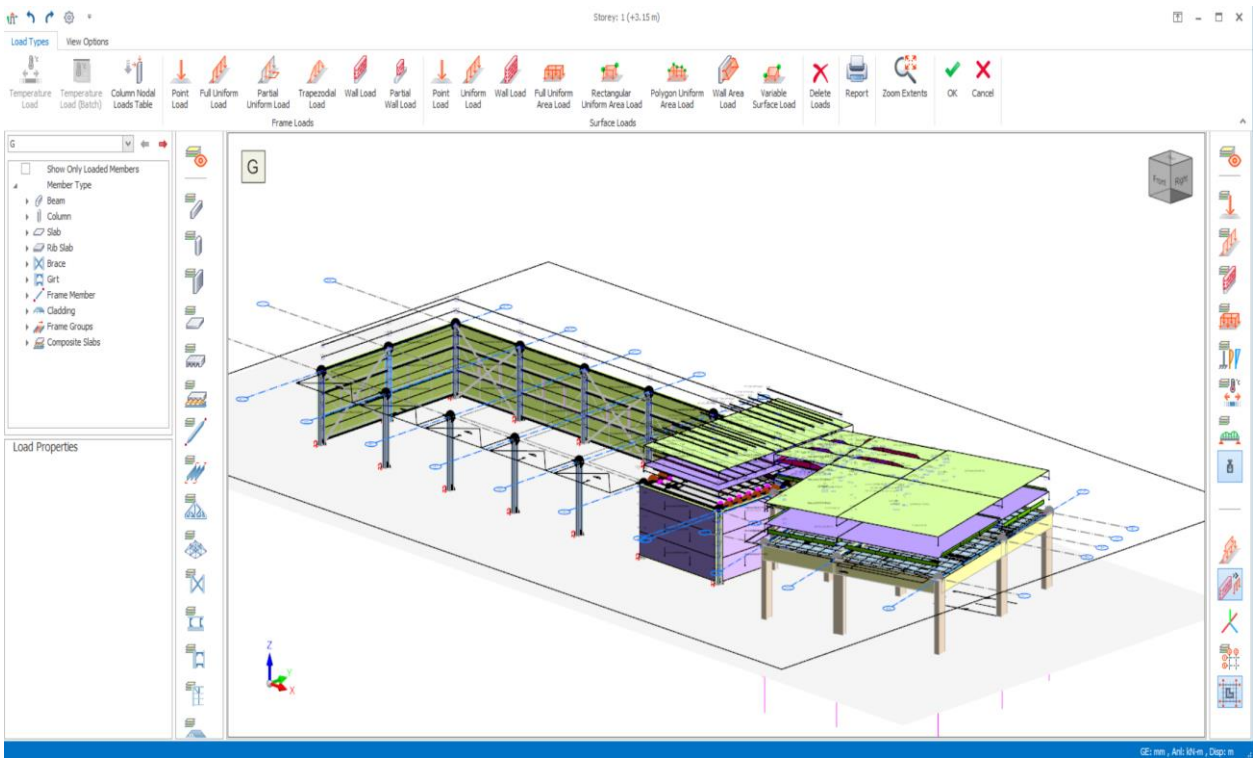


Fig.5.10. Ngarkesa +3.50

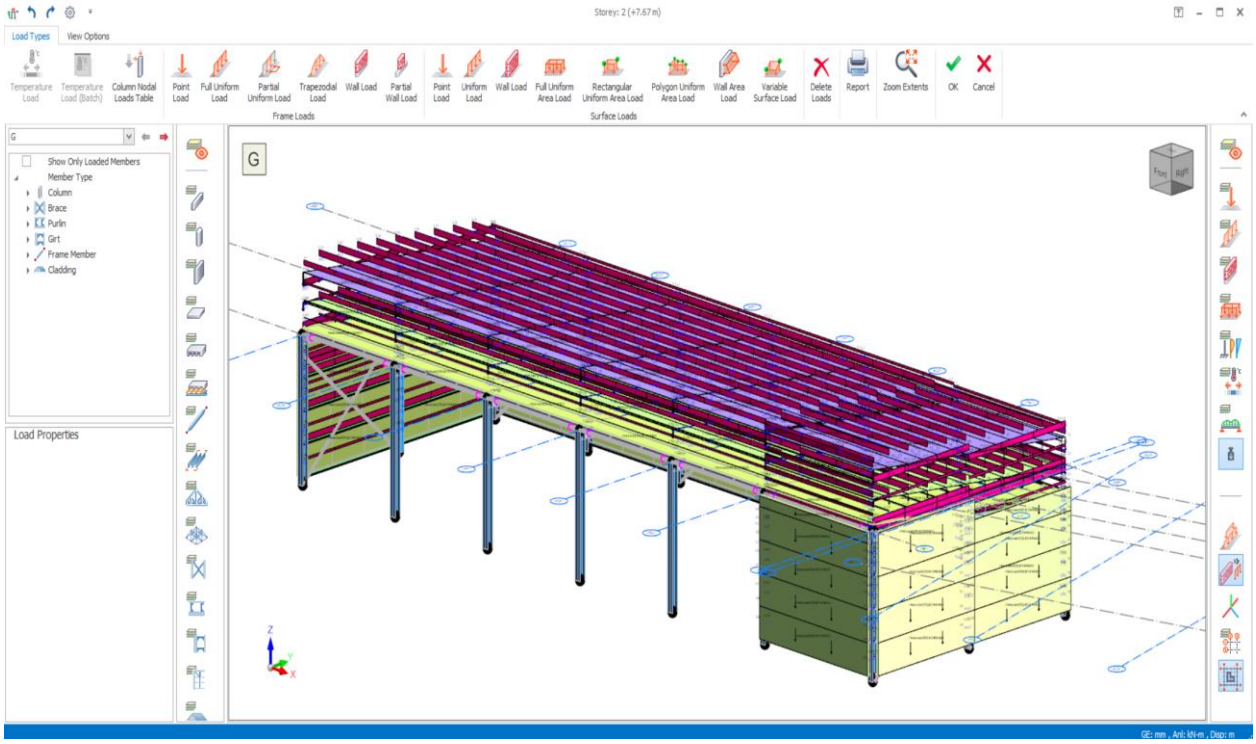


Fig.5.10. Ngarkesa +7.67

Wind Load Summary Report

EN-1991-1-4 [2005] Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions

Inputs

Wind Code	:	EN1991-1-4 (2005)
Basic Wind Speed (m/s)	:	35 m/s
Min. Wind Pressure (kPa)	:	0.77 kN/m2
Primary Wind Angle (°)	:	0 °
Wind direction step angle (CCW from horizontal X-axis)	:	90 °
Horizontal dist. of structure to crest of the hill/ridge/escarpment, X	:	50 m
Downwind slope Length, Ld	:	100 m
Upwind slope length, Lu	:	150 m
Hill Type	:	Cliffs and escarpments
Upwind/Downwind	:	Upwind
Directional factor, Cdir	:	1
Seasonal factor, Cseason	:	1
Terrain Category	:	Category II - Area with low vegetation such as grass and isolated obstacles with separations of at least 20 obstacle heights

Calculations

Wind Velocity

Terrain Category	z_0 (m)	z_{Min} (m)
Category 0 - Sea or coastal area exposed to the open sea	0.03	1
Category I - Flat area with negligible vegetation and without obstacles	0.01	1
Category II - Area with low vegetation such as grass and isolated obstacles with separations of at least 20 obstacle heights	0.05	2
Category III -Area with regular cover of vegetation or buildings or with isolated obstacles with separations of maximum 20 obstacles heights	0.3	5
Category IV - Area In which at Least 15 % of the surface is covered with buildings and their average height exceed 15m	1	10

z_0 = 0.05 m
z_{Min} = 2 m
z_{Max} = 200 m
z = 7.67
$z_{Min} \leq z \leq z_{Max}$
$2 \leq 7.67 \leq 200$

$v_m(z) = c_r(z) \cdot c_0(z) \cdot v_b$ (Eq. 4.3)
where v_m is mean velocity, c_r is the roughness factor, c_0 is the orographic factor.

$c_r = k_r \cdot \ln(z/z_0)$ (Eq. 4.4), $z \geq z_{min}$
where k_r is terrain factor depending on the roughness length (Eq. 4.5), z_0 and z_{min} are factors depending on terrain category.
c_0 =1is defined according to (Annex A.3)

$z_0 = 0.050$
$z_{min} = 2.000$
$k_r = 0.19 * (z_0 / 0.05)^{(0.05)} = 0.190$

Wind Turbulence

$I_v = k_I / (c_0 \cdot \ln(z/z_0))$
where I_v is the turbulence intensity, k_I is the turbulence factor, z_0 is the roughness length.

Peak Velocity Pressure

$q_p = 1/2 \cdot \rho \cdot v_m^2 \cdot (1 + 7 \cdot I_v)$
where q_p is peak velocity pressure, ρ is the air density, ρ = 1.25 kg/m³.

q_p = 1673.90kg/m^2 (For the Whole Building)

Storey	c0	cr	Vm (m/s)	Iv	qp (kg/m²)
1	1.000	0.701	24.531	0.271	1089.808
2	1.000	0.856	29.953	0.222	1432.199

Pressure Values

In order to obtain wind pressures, peak velocity pressures are multiplied by pressure coefficients. Internal and external pressure coefficients are calculated according to Section 7.

	Cp-windward	Cp-leeward	Cp-net	q (kg/m²)
Storey 1				
W0	0.700	0.300	1.000	1089.808
W90	0.740	0.500	1.240	1350.914
W180	0.700	0.300	1.000	1089.808
W270	0.740	0.500	1.240	1350.914
Storey 2				
W0	0.701	0.500	1.201	1720.379
W90	0.769	0.500	1.269	1817.350
W180	0.701	0.500	1.201	1720.379
W270	0.769	0.500	1.269	1817.350

Structural Factor (cscd)

Structural factor is calculated according to Section 6.

cscd = (1 + 2 · kp · Ivze · (B²·R²)^(0.5)) / (1 + 7 · Ivze)
where k_p is the peak factor,
I_{vze} is the turbulence intensity for reference height (z_e)
B² and R² are correction factors for the pressure acting on the structure surface

kp = (2·ln(v·T))^(0.5) + 0.6 / (2·ln(v·T))^(0.5), kp≥3.0
where v is the up-crossing frequency and T is the averaging time for the mean wind velocity.

v = n1·(R² / (B² + R²))^0.5, v≥0.08 Hz
where n_1 is the natural frequency of the structure.

R² = (π² / 2δ)·SL·Rh · Rb
where Rh and R_b are the aerodynamic admittance functions.

Rh = 1 / ηh - (1 - e^(-2·ηh) / (2·ηh²)

Rb = 1 / ηb - (1 - e^(-2·ηb) / (2·ηb²)

ηh = 4.6·h / (Lze) ·fl

ηb = 4.6·b / (Lze) ·fl

fl = n1·Iz / vm

SL = 6.8·fl / ((1 + 10.2·fl)^(5/3))

n1 = 46 / h

Direction	Ivze	Kp	B²	fl	SL	ηh	Rh	ηb	Rb	R²	cscd
W0	0.221	5.484	0.628	10.309	0.029	8.626	0.109	15.767	0.000	0.006	1.151
W90	0.221	5.272	0.491	10.309	0.029	8.626	0.109	50.641	0.000	0.002	1.035
W180	0.221	5.484	0.628	10.309	0.029	8.626	0.109	15.767	0.000	0.006	1.151
W270	0.221	5.272	0.491	10.309	0.029	8.626	0.109	50.641	0.000	0.002	1.035

Results

Wind Values: Wx (0 °)

Storey	Height (m)	Length (m)	Width (m)	Cscd	Pressures (kN/m2)	Loads (kN)
1	3.15	45.03	14.02	1.15	1.1	102.0
2	4.52	29.60	10.00	1.20	1.7	46.6

Wind Values: Wy (90 °)

Storey	Height (m)	Length (m)	Width (m)	Cscd	Pressures (kN/m2)	Loads (kN)
1	3.15	14.02	45.03	1.04	1.4	331.7
2	4.52	10.00	29.60	1.10	1.8	133.3

Wind Values: W-x (180 °)

Storey	Height (m)	Length (m)	Width (m)	Cscd	Pressures (kN/m2)	Loads (kN)
1	3.15	45.03	14.02	1.15	1.1	102.0
2	4.52	29.60	10.00	1.20	1.7	46.6

Wind Values: W-y (270 °)

Storey	Height (m)	Length (m)	Width (m)	Cscd	Pressures (kN/m2)	Loads (kN)
1	3.15	14.02	45.03	1.04	1.4	331.7
2	4.52	10.00	29.60	1.10	1.8	133.3

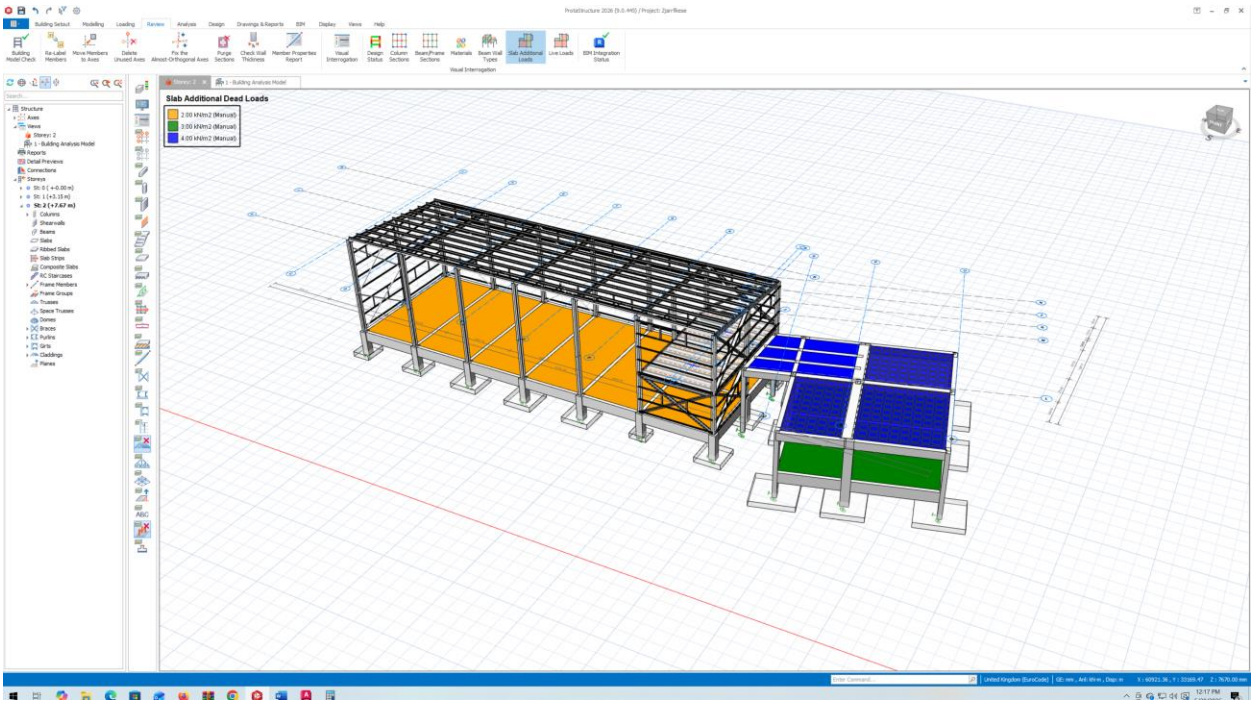


Fig.5.11. Ngarkesa Dead Load

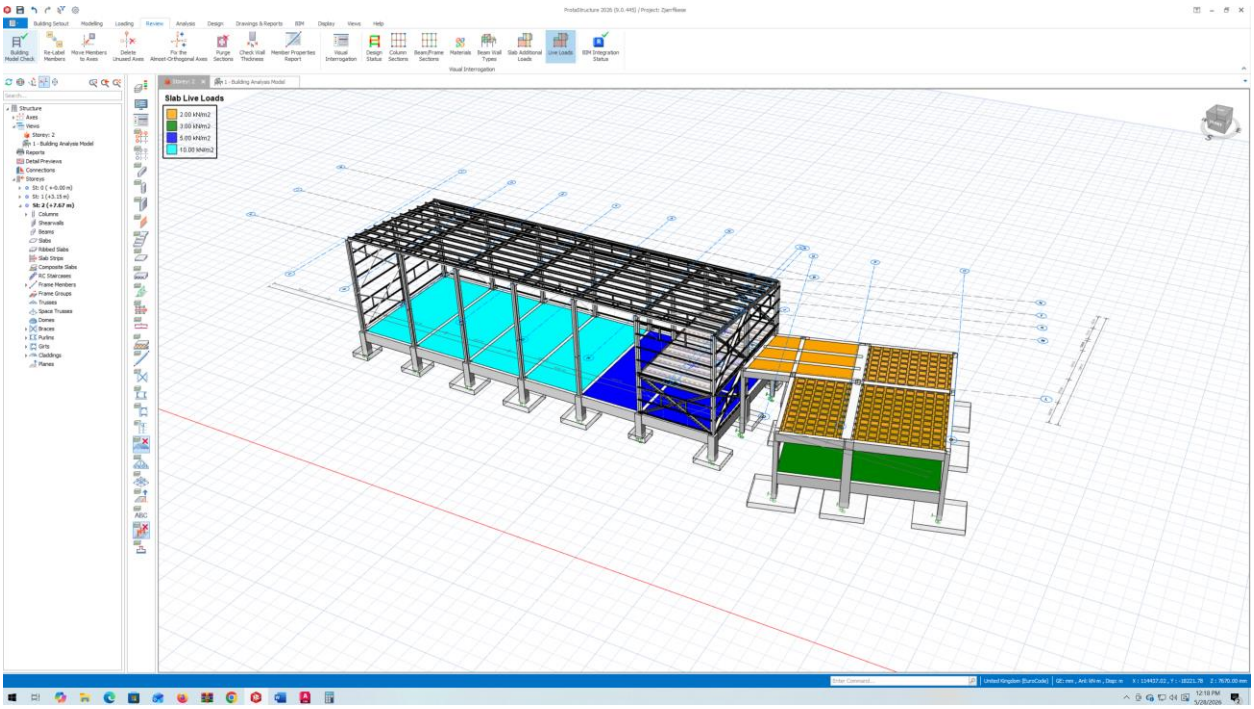


Fig.5.11. Ngarkesa Live Load

Axial Load Comparison Report

TOTAL LOADS (Based On Slabs Loads):

G - Dead Loads:

Storey	Column	Wall	Beam	Slab	Ribbed Slab	Total (kN)
2 (+7.67 m)	56.9	0.0	62.2	334.7	0.0	453.8
1 (+3.15 m)	192.8	0.0	414.7	644.3	793.0	2044.8
0 (+-0.00 m)	212.5	0.0	0.0	0.0	0.0	212.5
Total						**2711.0**

Q - Live Loads:

Storey	Column	Wall	Beam	Slab	Ribbed Slab	Total (kN)
2 (+7.67 m)	0.0	0.0	0.0	398.9	0.0	398.9
1 (+3.15 m)	0.0	0.0	0.0	422.8	200.8	623.6
0 (+-0.00 m)	0.0	0.0	0.0	0.0	0.0	0.0
Total						**1022.5**

TOTAL LOADS (Decomposed to Beams):

G - Dead Loads:

Storey	Column	Wall	Beam	Slab	Ribbed Slab	Total (kN)
2 (+7.67 m)	56.9	0.0	396.9	0.0	0.0	453.8
1 (+3.15 m)	192.8	0.0	1059.1	0.0	793.0	2044.9
0 (+-0.00 m)	212.5	0.0	0.0	0.0	0.0	212.5
Total						**2711.1**

Q - Live Loads:

Storey	Column	Wall	Beam	Slab	Ribbed Slab	Total (kN)
2 (+7.67 m)	0.0	0.0	398.9	0.0	0.0	398.9
1 (+3.15 m)	0.0	0.0	422.6	0.0	200.8	623.5
0 (+-0.00 m)	0.0	0.0	0.0	0.0	0.0	0.0
Total						**1022.4**

BUILDING ANALYSIS COLUMN AND WALL AXIAL LOADS:

Storey	G (kN)	Delta G (kN)	Q (kN)	Delta Q (kN)
2 (+7.67 m)	444.7	444.7	395.0	395.0
1 (+3.15 m)	2475.7	2031.0	1006.3	611.4
0 (+-0.00 m)	238.8	238.8	15.8	15.8
Total		**2714.5**		**1022.1**

Note: The values printed in this table are based on the sum of axial load results of columns and walls.

BUILDING ANALYSIS TOTAL BASE REACTIONS:

	G (kN)	Q (kN)
Total	2714.5	1022.1

Note: The values printed in this table are based on the sum of vertical reactions of all supported nodes.

There are brace members that may be transferring axial loads to base in addition to the columns and walls.
Axial load comparison of analysis results will be based on the base reactions rather than the table above.

Seismic Joint Spacing Report

Eurocode 8 (EN 1998) Design of Structures for Earthquake Resistance (Base Code)

Formulation

$$\delta = \sqrt[2]{(\delta_1)^2 + (\delta_2)^2} \qquad EC - 8\,(4.4.2.7(b))$$

Seismic Joint Design

X Direction

Storey	Elevation (m)	Current Model Storey Displacement, δ_1 m	Second Model Storey Displacement, δ_2 m	Seismic Joint, δ m
St: 2 (+7.67 m)	7.7	0.015	0.000	0.046
St: 1 (+3.15 m)	3.2	0.004	0.000	0.013

X Direction seismic joint must be higher than : **0.0m**

Y Direction

Storey	Elevation (m)	Current Model Storey Displacement, δ_1 m	Second Model Storey Displacement, δ_2 m	Seismic Joint, δ m
St: 2 (+7.67 m)	7.7	0.014	0.000	0.043

St: 1 (+3.15 m)	3.2	0.004	0.000	0.013

Y Direction seismic joint must be higher than : **0.0m**

Pre-analysis Checks

Building Data

Number of Storeys = 2
Number of Effective Storeys = 2
Number of Rigid Basements = 0

Storey	Storey Height (mm)	Level (mm)	Live Load Simultaneous Presence Factor	Live Load Reduction Factor	Structural System Type	FE Shell Model
2	4520.00	7670.00	1.00	0.000	RC	-
1	3150.00	3150.00	0.50	0.000	RC	-

Analysis Parameters

Analysis Type = Mod Superposition Analysis

Storey Degrees of Freedom = X, Y and Torsion
Rigid Zones at Joints = NONE

Shearwall Analytical Model Type = FE Shell Model
Average Shell Size = 1000.00 / 1000.00 mm

Seismic Code = **Eurocode 8**
(EN 1998) Design of Structures for Earthquake Resistance (Base Code)
Concrete Design Code = **Eurocode 2**
(EN 1992) Design of Concrete Structures (Base Code)
Steel Design Code = **Eurocode 3**
(EN 1993) Design of Steel Structures (Base Code)
Wind Load Code = **EN-1991-1-4 [2005]**
Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions

Peak Reference Ground Acceleration, (Agr) = 0.399g
Design Ground Acceleration, (Ag) = 0.5586g
Ductility Level = DCM

Direction: 1

Load Bearing System = A5
AlphaU/Alpha1 = 1.3
Basic Behavior Factor, (q0) = 3
Prevailing Failure Mode Coef. , (kw) = 1
Behavior Factor, (q) = 2.76

Direction: 2

Load Bearing System = A5
AlphaU/Alpha1 = 1.3
Basic Behavior Factor, (q0) = 3
Prevailing Failure Mode Coef. , (kw) = 1
Behavior Factor, (q) = 2.76

Building Usage and Type = Ordinary Buildings
Lateral Load Eccentricity = 5.0 %

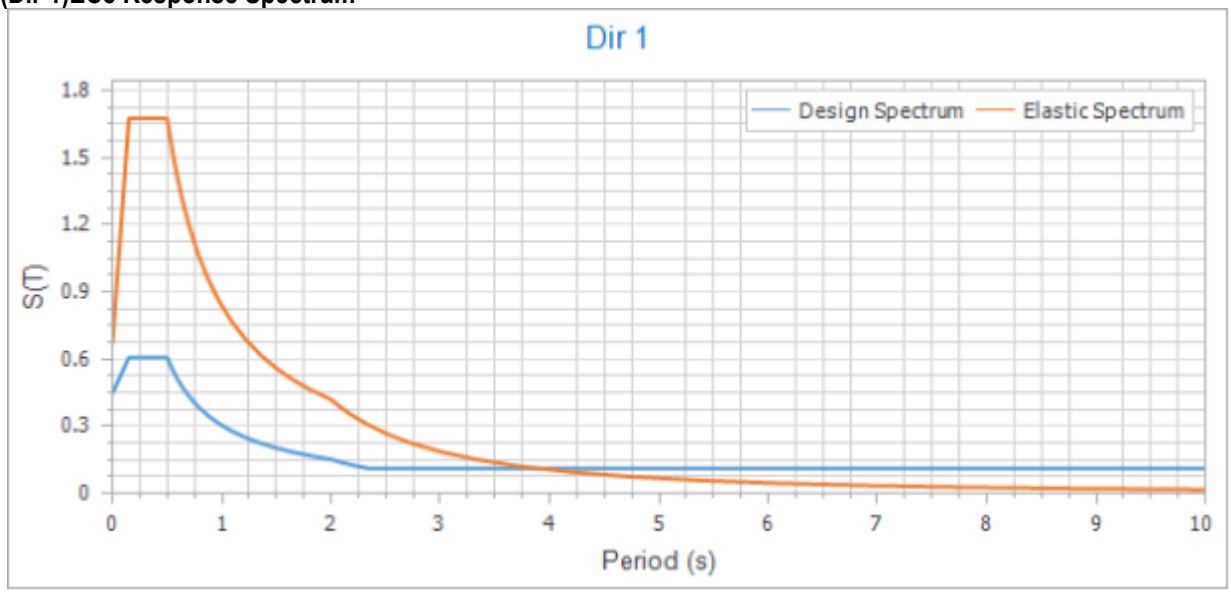
Quasi-permanent Live Load Coef., (Psi2)	= 0.30
Number of Modes to be Used	= 25
Damping Ratio	= 0.05

Seismic Response Spectrum Properties

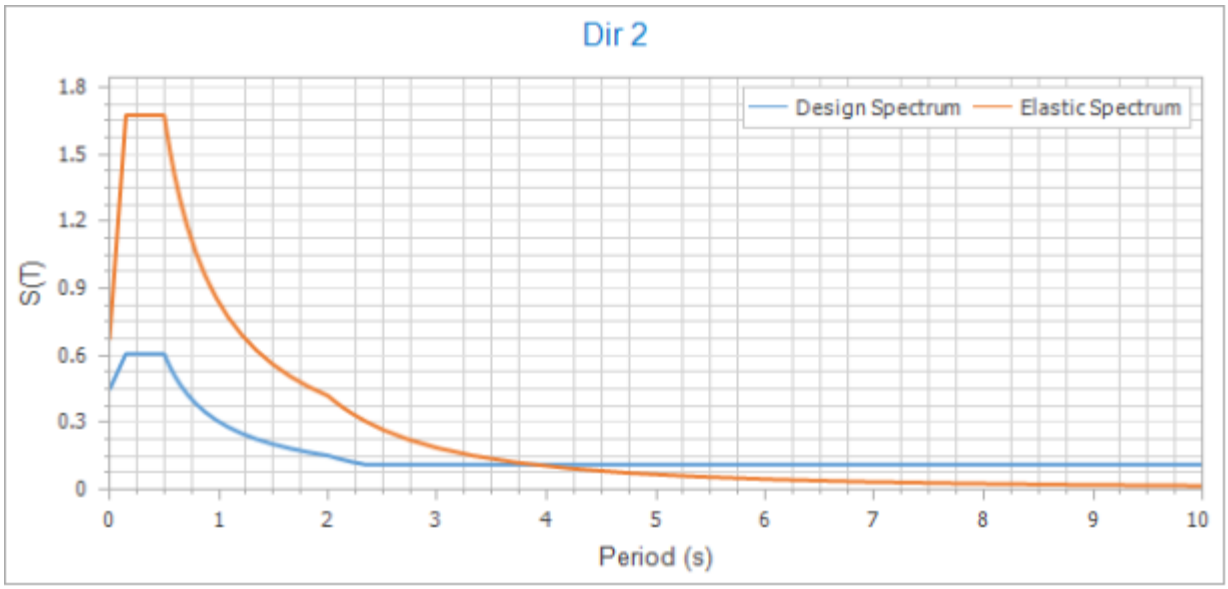
Local Soil Class	=	B
Spectrum Characteristic Periods	Tb =	0.15 s
	Tc =	0.50 s
	Td =	2.00 s
Soil Factor	=	1.20
Building Importance Factor	I =	1.40
Earthquake Direction	Dir-1	0.00 °
	Dir-2	90.00 °

Spectrum Type = 1

(Dir 1)EC8 Response Spectrum



(Dir 2)EC8 Response Spectrum



Dir 1			Dir 2		
Period (s)	Elastic Spectrum	Design Spectrum	Period (s)	Elastic Spectrum	Design Spectrum
0.000	0.6703	0.4469	0.000	0.6703	0.4469
0.150	1.6758	0.6072	0.150	1.6758	0.6072
0.500	1.6758	0.6072	0.500	1.6758	0.6072
0.523	1.6008	0.5800	0.523	1.6008	0.5800
0.553	1.5159	0.5492	0.553	1.5159	0.5492
0.594	1.4112	0.5113	0.594	1.4112	0.5113
0.646	1.2961	0.4696	0.646	1.2961	0.4696
0.711	1.1786	0.4270	0.711	1.1786	0.4270
0.787	1.0645	0.3857	0.787	1.0645	0.3857
0.875	0.9576	0.3470	0.875	0.9576	0.3470
0.975	0.8597	0.3115	0.975	0.8597	0.3115
1.086	0.7716	0.2796	1.086	0.7716	0.2796
1.209	0.6931	0.2511	1.209	0.6931	0.2511
1.344	0.6236	0.2259	1.344	0.6236	0.2259
1.490	0.5623	0.2037	1.490	0.5623	0.2037
1.648	0.5083	0.1842	1.648	0.5083	0.1842
1.818	0.4608	0.1670	1.818	0.4608	0.1670
2.000	0.4190	0.1518	2.000	0.4190	0.1518
2.000	0.4190	0.1518	2.000	0.4190	0.1518
2.064	0.3934	0.1425	2.064	0.3934	0.1425
2.125	0.3711	0.1345	2.125	0.3711	0.1345
2.216	0.3413	0.1236	2.216	0.3413	0.1236
2.343	0.3053	0.1117	2.343	0.3053	0.1117
2.512	0.2656	0.1117	2.512	0.2656	0.1117
2.729	0.2250	0.1117	2.729	0.2250	0.1117
3.000	0.1862	0.1117	3.000	0.1862	0.1117
3.331	0.1510	0.1117	3.331	0.1510	0.1117
3.728	0.1206	0.1117	3.728	0.1206	0.1117
4.197	0.0951	0.1117	4.197	0.0951	0.1117
4.744	0.0745	0.1117	4.744	0.0745	0.1117
5.375	0.0580	0.1117	5.375	0.0580	0.1117
6.096	0.0451	0.1117	6.096	0.0451	0.1117
6.913	0.0351	0.1117	6.913	0.0351	0.1117
7.832	0.0273	0.1117	7.832	0.0273	0.1117
8.859	0.0214	0.1117	8.859	0.0214	0.1117
10.000	0.0168	0.1117	10.000	0.0168	0.1117

Soil Properties

Soil Subgrade Reaction Coefficient = 285000.00 kN/m3
Allowable Soil Pressure = 320.0 kN/m2

Load Combinations

No	Combination	G	Gc	Q	Qc	Qp1	Qp2	Qp3	Qp4	Ex+	Ex-	Ey+
1	1.35G	1.35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	1.35G+1.5Q	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
3	1.35G+1.5Q	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
4	1.35G+1.5Qp1	1.35	.00	.00	.00	1.50	.00	.00	.00	.00	.00	.00
5	1.35G+1.5Qp2	1.35	.00	.00	.00	.00	1.50	.00	.00	.00	.00	.00
6	1.35G+1.5Qp3	1.35	.00	.00	.00	.00	.00	1.50	.00	.00	.00	.00
7	1.35G+1.5Qp4	1.35	.00	.00	.00	.00	.00	.00	1.50	.00	.00	.00
8	1.35G+1.5Qp1	1.35	.00	.00	.00	1.50	.00	.00	.00	.00	.00	.00
9	1.35G+1.5Qp2	1.35	.00	.00	.00	.00	1.50	.00	.00	.00	.00	.00
10	1.35G+1.5Qp3	1.35	.00	.00	.00	.00	.00	1.50	.00	.00	.00	.00
11	1.35G+1.5Qp4	1.35	.00	.00	.00	.00	.00	.00	1.50	.00	.00	.00
12	G+Q	1.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00
13	Q	.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00
14	G+0.5Q	1.00	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00
15	Gc+0.3Qc+Ex++0.3Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	1.00	.00	.00
16	Gc+0.3Qc-Ex+-0.3Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	- 1.00	.00	.00
17	Gc+0.3Qc+Ex-+0.3Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	1.00	0.30
18	Gc+0.3Qc-Ex--0.3Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	- 1.00	- 0.30
19	Gc+0.3Qc+Ex+-0.3Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	1.00	.00	- 0.30
20	Gc+0.3Qc-Ex++0.3Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	- 1.00	.00	0.30
21	Gc+0.3Qc+Ex--0.3Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	1.00	.00
22	Gc+0.3Qc-Ex-+0.3Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	- 1.00	.00
23	Gc+0.3Qc+0.3Ex-+Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	0.30	1.00
24	Gc+0.3Qc-0.3Ex--Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	- 0.30	- 1.00
25	Gc+0.3Qc+0.3Ex++Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	0.30	.00	.00
26	Gc+0.3Qc-0.3Ex+-Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	- 0.30	.00	.00
27	Gc+0.3Qc-0.3Ex++Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	- 0.30	.00	1.00
28	Gc+0.3Qc+0.3Ex+-Ey+	.00	1.00	.00	0.30	.00	.00	.00	.00	0.30	.00	- 1.00
29	Gc+0.3Qc-0.3Ex-+Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	- 0.30	.00
30	Gc+0.3Qc+0.3Ex--Ey-	.00	1.00	.00	0.30	.00	.00	.00	.00	.00	0.30	.00
31	1.15Gc+Ex++0.3Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	1.00	.00	.00
32	1.15Gc-Ex+-0.3Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	- 1.00	.00	.00
33	1.15Gc+Ex-+0.3Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	.00	1.00	0.30
34	1.15Gc-Ex--0.3Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	.00	- 1.00	- 0.30
35	1.15Gc+Ex+-0.3Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	1.00	.00	- 0.30
36	1.15Gc-Ex++0.3Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	- 1.00	.00	0.30
37	1.15Gc+Ex--0.3Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	.00	1.00	.00
38	1.15Gc-Ex-+0.3Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	.00	- 1.00	.00
39	1.15Gc+0.3Ex-+Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	.00	0.30	1.00
40	1.15Gc-0.3Ex--Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	.00	- 0.30	- 1.00
41	1.15Gc+0.3Ex++Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	0.30	.00	.00
42	1.15Gc-0.3Ex+-Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	- 0.30	.00	.00
43	1.15Gc-0.3Ex++Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	- 0.30	.00	1.00
44	1.15Gc+0.3Ex+-Ey+	.00	1.15	.00	.00	.00	.00	.00	.00	0.30	.00	- 1.00
45	1.15Gc-0.3Ex-+Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	.00	- 0.30	.00
46	1.15Gc+0.3Ex--Ey-	.00	1.15	.00	.00	.00	.00	.00	.00	.00	0.30	.00
47	G+0.3Q+Ex++0.3Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	1.00	.00	.00
48	G+0.3Q-Ex+-0.3Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	- 1.00	.00	.00
49	G+0.3Q+Ex-+0.3Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	1.00	0.30
50	G+0.3Q-Ex--0.3Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	- 1.00	- 0.30
51	G+0.3Q+Ex+-0.3Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	1.00	.00	- 0.30
52	G+0.3Q-Ex++0.3Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	- 1.00	.00	0.30
53	G+0.3Q+Ex--0.3Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	1.00	.00
54	G+0.3Q-Ex-+0.3Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	- 1.00	.00

55	G+0.3Q+0.3Ex-+Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	0.30	1.00
56	G+0.3Q-0.3Ex--Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	- 0.30	- 1.00
57	G+0.3Q+0.3Ex++Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	0.30	.00	.00
58	G+0.3Q-0.3Ex+-Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	- 0.30	.00	.00
59	G+0.3Q-0.3Ex++Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	- 0.30	.00	1.00
60	G+0.3Q+0.3Ex+-Ey+	1.00	.00	0.30	.00	.00	.00	.00	.00	0.30	.00	- 1.00
61	G+0.3Q-0.3Ex-+Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	- 0.30	.00
62	G+0.3Q+0.3Ex--Ey-	1.00	.00	0.30	.00	.00	.00	.00	.00	.00	0.30	.00
63	1.15G+Ex++0.3Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	1.00	.00	.00
64	1.15G-Ex+-0.3Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	- 1.00	.00	.00
65	1.15G+Ex-+0.3Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	.00	1.00	0.30
66	1.15G-Ex--0.3Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	.00	- 1.00	- 0.30
67	1.15G+Ex+-0.3Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	1.00	.00	- 0.30
68	1.15G-Ex++0.3Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	- 1.00	.00	0.30
69	1.15G+Ex--0.3Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	.00	1.00	.00
70	1.15G-Ex-+0.3Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	.00	- 1.00	.00
71	1.15G+0.3Ex-+Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	.00	0.30	1.00
72	1.15G-0.3Ex--Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	.00	- 0.30	- 1.00
73	1.15G+0.3Ex++Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	0.30	.00	.00
74	1.15G-0.3Ex+-Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	- 0.30	.00	.00
75	1.15G-0.3Ex++Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	- 0.30	.00	1.00
76	1.15G+0.3Ex+-Ey+	1.15	.00	.00	.00	.00	.00	.00	.00	0.30	.00	- 1.00
77	1.15G-0.3Ex-+Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	.00	- 0.30	.00
78	1.15G+0.3Ex--Ey-	1.15	.00	.00	.00	.00	.00	.00	.00	.00	0.30	.00
79	1.35G+1.5Q+0.9Wx	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
80	1.35G+1.5Q+0.9W-x	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
81	1.35G+1.5Q+0.9Wy	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
82	1.35G+1.5Q+0.9W-y	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
83	1.35G+1.05Q+1.5Wx	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
84	1.35G+1.05Q+1.5W-x	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
85	1.35G+1.05Q+1.5Wy	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
86	1.35G+1.05Q+1.5W-y	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
87	1.1G+1.5Wx	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
88	1.1G+1.5W-x	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
89	1.1G+1.5Wy	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
90	1.1G+1.5W-y	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
91	1.35G+1.5Q+0.9Wx	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
92	1.35G+1.5Q+0.9W-x	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
93	1.35G+1.5Q+0.9Wy	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
94	1.35G+1.5Q+0.9W-y	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
95	1.35G+1.05Q+1.5Wx	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
96	1.35G+1.05Q+1.5W-x	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
97	1.35G+1.05Q+1.5Wy	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
98	1.35G+1.05Q+1.5W-y	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
99	1.1G+1.5Wx	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
100	1.1G+1.5W-x	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
101	1.1G+1.5Wy	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
102	1.1G+1.5W-y	1.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
103	1.35G+1.5Q+1.35NGx	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
104	1.35G+1.5Q-1.35NGx	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
105	1.35G+1.5Q+1.35NGy	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
106	1.35G+1.5Q-1.35NGy	1.35	.00	1.50	.00	.00	.00	.00	.00	.00	.00	.00
107	1.35G+1.05Q+1.35NGx	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
108	1.35G+1.05Q-1.35NGx	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
109	1.35G+1.05Q+1.35NGy	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
110	1.35G+1.05Q-1.35NGy	1.35	.00	1.05	.00	.00	.00	.00	.00	.00	.00	.00
111	G+Q+0.6Wx	1.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00
112	G+0.5Q+0.6Wx	1.00	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00
113	G+Q+0.6W-x	1.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00
114	G+0.5Q+0.6W-x	1.00	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00
115	G+Q+0.6Wy	1.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00
116	G+0.5Q+0.6Wy	1.00	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00

117	G+Q+0.6W-y	1.00	.00	1.00	.00	.00	.00	.00	.00	.00	.00	.00
118	G+0.5Q+0.6W-y	1.00	.00	0.50	.00	.00	.00	.00	.00	.00	.00	.00

No	Combination	Ey-	NGx	NQx	NGy	NQy	Wx	W-x	Wy	W-y
1	1.35G	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	1.35G+1.5Q	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	1.35G+1.5Q	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	1.35G+1.5Qp1	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	1.35G+1.5Qp2	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	1.35G+1.5Qp3	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	1.35G+1.5Qp4	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	1.35G+1.5Qp1	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	1.35G+1.5Qp2	.00	.00	.00	.00	.00	.00	.00	.00	.00
10	1.35G+1.5Qp3	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	1.35G+1.5Qp4	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	G+Q	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	Q	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	G+0.5Q	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	Gc+0.3Qc+Ex++0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
16	Gc+0.3Qc-Ex+-0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
17	Gc+0.3Qc+Ex-+0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	Gc+0.3Qc-Ex--0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	Gc+0.3Qc+Ex+-0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	Gc+0.3Qc-Ex++0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	Gc+0.3Qc+Ex--0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
22	Gc+0.3Qc-Ex-+0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
23	Gc+0.3Qc+0.3Ex-+Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	Gc+0.3Qc-0.3Ex--Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
25	Gc+0.3Qc+0.3Ex++Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00
26	Gc+0.3Qc-0.3Ex+-Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
27	Gc+0.3Qc-0.3Ex++Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	Gc+0.3Qc+0.3Ex+-Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	Gc+0.3Qc-0.3Ex-+Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00
30	Gc+0.3Qc+0.3Ex--Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
31	1.15Gc+Ex++0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
32	1.15Gc-Ex+-0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
33	1.15Gc+Ex-+0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
34	1.15Gc-Ex--0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	1.15Gc+Ex+-0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	1.15Gc-Ex++0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	1.15Gc+Ex--0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
38	1.15Gc-Ex-+0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
39	1.15Gc+0.3Ex-+Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	1.15Gc-0.3Ex--Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	1.15Gc+0.3Ex++Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00
42	1.15Gc-0.3Ex+-Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
43	1.15Gc-0.3Ex++Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	1.15Gc+0.3Ex+-Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	1.15Gc-0.3Ex-+Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00
46	1.15Gc+0.3Ex--Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
47	G+0.3Q+Ex++0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
48	G+0.3Q-Ex+-0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
49	G+0.3Q+Ex-+0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	G+0.3Q-Ex--0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
51	G+0.3Q+Ex+-0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
52	G+0.3Q-Ex++0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
53	G+0.3Q+Ex--0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
54	G+0.3Q-Ex-+0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
55	G+0.3Q+0.3Ex-+Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
56	G+0.3Q-0.3Ex--Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
57	G+0.3Q+0.3Ex++Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00

58	G+0.3Q-0.3Ex+-Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
59	G+0.3Q-0.3Ex++Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
60	G+0.3Q+0.3Ex+-Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
61	G+0.3Q-0.3Ex-+Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00
62	G+0.3Q+0.3Ex--Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
63	1.15G+Ex++0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
64	1.15G-Ex+-0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
65	1.15G+Ex-+0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
66	1.15G-Ex--0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
67	1.15G+Ex+-0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
68	1.15G-Ex++0.3Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
69	1.15G+Ex--0.3Ey-	- 0.30	.00	.00	.00	.00	.00	.00	.00	.00
70	1.15G-Ex-+0.3Ey-	0.30	.00	.00	.00	.00	.00	.00	.00	.00
71	1.15G+0.3Ex-+Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
72	1.15G-0.3Ex--Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
73	1.15G+0.3Ex++Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00
74	1.15G-0.3Ex+-Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
75	1.15G-0.3Ex++Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
76	1.15G+0.3Ex+-Ey+	.00	.00	.00	.00	.00	.00	.00	.00	.00
77	1.15G-0.3Ex-+Ey-	1.00	.00	.00	.00	.00	.00	.00	.00	.00
78	1.15G+0.3Ex--Ey-	- 1.00	.00	.00	.00	.00	.00	.00	.00	.00
79	1.35G+1.5Q+0.9Wx	.00	.00	.00	.00	.00	0.90	.00	.00	.00
80	1.35G+1.5Q+0.9W-x	.00	.00	.00	.00	.00	.00	0.90	.00	.00
81	1.35G+1.5Q+0.9Wy	.00	.00	.00	.00	.00	.00	.00	0.90	.00
82	1.35G+1.5Q+0.9W-y	.00	.00	.00	.00	.00	.00	.00	.00	0.90
83	1.35G+1.05Q+1.5Wx	.00	.00	.00	.00	.00	1.50	.00	.00	.00
84	1.35G+1.05Q+1.5W-x	.00	.00	.00	.00	.00	.00	1.50	.00	.00
85	1.35G+1.05Q+1.5Wy	.00	.00	.00	.00	.00	.00	.00	1.50	.00
86	1.35G+1.05Q+1.5W-y	.00	.00	.00	.00	.00	.00	.00	.00	1.50
87	1.1G+1.5Wx	.00	.00	.00	.00	.00	1.50	.00	.00	.00
88	1.1G+1.5W-x	.00	.00	.00	.00	.00	.00	1.50	.00	.00
89	1.1G+1.5Wy	.00	.00	.00	.00	.00	.00	.00	1.50	.00
90	1.1G+1.5W-y	.00	.00	.00	.00	.00	.00	.00	.00	1.50
91	1.35G+1.5Q+0.9Wx	.00	.00	.00	.00	.00	0.90	.00	.00	.00
92	1.35G+1.5Q+0.9W-x	.00	.00	.00	.00	.00	.00	0.90	.00	.00
93	1.35G+1.5Q+0.9Wy	.00	.00	.00	.00	.00	.00	.00	0.90	.00
94	1.35G+1.5Q+0.9W-y	.00	.00	.00	.00	.00	.00	.00	.00	0.90
95	1.35G+1.05Q+1.5Wx	.00	.00	.00	.00	.00	1.50	.00	.00	.00
96	1.35G+1.05Q+1.5W-x	.00	.00	.00	.00	.00	.00	1.50	.00	.00
97	1.35G+1.05Q+1.5Wy	.00	.00	.00	.00	.00	.00	.00	1.50	.00
98	1.35G+1.05Q+1.5W-y	.00	.00	.00	.00	.00	.00	.00	.00	1.50
99	1.1G+1.5Wx	.00	.00	.00	.00	.00	1.50	.00	.00	.00
100	1.1G+1.5W-x	.00	.00	.00	.00	.00	.00	1.50	.00	.00
101	1.1G+1.5Wy	.00	.00	.00	.00	.00	.00	.00	1.50	.00
102	1.1G+1.5W-y	.00	.00	.00	.00	.00	.00	.00	.00	1.50
103	1.35G+1.5Q+1.35NGx	.00	1.35	.00	.00	.00	.00	.00	.00	.00
104	1.35G+1.5Q-1.35NGx	.00	- 1.35	.00	.00	.00	.00	.00	.00	.00
105	1.35G+1.5Q+1.35NGy	.00	.00	.00	1.35	.00	.00	.00	.00	.00
106	1.35G+1.5Q-1.35NGy	.00	.00	.00	- 1.35	.00	.00	.00	.00	.00
107	1.35G+1.05Q+1.35NGx	.00	1.35	.00	.00	.00	.00	.00	.00	.00
108	1.35G+1.05Q-1.35NGx	.00	- 1.35	.00	.00	.00	.00	.00	.00	.00
109	1.35G+1.05Q+1.35NGy	.00	.00	.00	1.35	.00	.00	.00	.00	.00
110	1.35G+1.05Q-1.35NGy	.00	.00	.00	- 1.35	.00	.00	.00	.00	.00
111	G+Q+0.6Wx	.00	.00	.00	.00	.00	0.60	.00	.00	.00
112	G+0.5Q+0.6Wx	.00	.00	.00	.00	.00	0.60	.00	.00	.00
113	G+Q+0.6W-x	.00	.00	.00	.00	.00	.00	0.60	.00	.00
114	G+0.5Q+0.6W-x	.00	.00	.00	.00	.00	.00	0.60	.00	.00
115	G+Q+0.6Wy	.00	.00	.00	.00	.00	.00	.00	0.60	.00
116	G+0.5Q+0.6Wy	.00	.00	.00	.00	.00	.00	.00	0.60	.00
117	G+Q+0.6W-y	.00	.00	.00	.00	.00	.00	.00	.00	0.60
118	G+0.5Q+0.6W-y	.00	.00	.00	.00	.00	.00	.00	.00	0.60

Bottom Part load case results are combined with the Upper Part results automatically. Therefore, they are not included in the combinations.

Vertical Load Cases

G	= Dead Loads
Gc	= Dead Loads (Cracked)
Q	= Live Loads
Qc	= Live Loads (Cracked)
Qp1	= Pattern Live Loads 1
Qp2	= Pattern Live Loads 2
Qp3	= Pattern Live Loads 3
Qp4	= Pattern Live Loads 4

Lateral Load Cases

Ex+	= Modal Superposition Seismic X (E+) (Cracked)
Ex-	= Modal Superposition Seismic X (E-) (Cracked)
Ey+	= Modal Superposition Seismic Y (E+) (Cracked)
Ey-	= Modal Superposition Seismic Y (E-) (Cracked)
NGx	= Notional Loads (G) x
NQx	= Notional Loads (Q) x
NGy	= Notional Loads (G) y
NQy	= Notional Loads (Q) y
Wx	= Wind Load X
W-x	= Wind Load -X
Wy	= Wind Load Y
W-y	= Wind Load -Y

Gc and **Qc** load cases uses **cracked sections** for being combined with seismic load cases.
G and **Q** load cases usesow **uncracked sections** for being combined with vertical load combinations.

Materials:

Concrete Grades

		F_{ck} (N/mm2)	F_{cd} (N/mm2)	F_{ctd} (N/mm2)	E (N/mm2)
Columns	C25/30	25.00	14.17	1.17	31000.0
Walls	C25/30	25.00	14.17	1.17	31000.0
Beams	C25/30	25.00	14.17	1.17	31000.0
Slabs	C25/30	25.00	14.17	1.17	31000.0
Ribbed Slabs	C25/30	25.00	14.17	1.17	31000.0
Foundations	C25/30	25.00	14.17	1.17	31000.0

Rebar Grades

		F_{yk} (N/mm2)	F_{yd} (N/mm2)	E (N/mm2)
Columns	Grade 500 (Type 2)	500.00	434.78	200000.0
Walls	Grade 500 (Type 2)	500.00	434.78	200000.0
- Web Longitudinal	Grade 500 (Type 2)	500.00	434.78	200000.0
- Web Horizontal	Grade 500 (Type 2)	500.00	434.78	200000.0
Beams	Grade 500 (Type 2)	500.00	434.78	200000.0
Slabs	Grade 500 (Type 2)	500.00	434.78	200000.0
Ribbed Slabs	Grade 500 (Type 2)	500.00	434.78	200000.0
Foundations	Grade 500 (Type 2)	500.00	434.78	200000.0
Links	Grade 500 (Type 2)	500.00	434.78	200000.0

Steel Grades

Label	F_y (N/mm2)	F_u (N/mm2)
S235	235.00	360.00
S275	275.00	430.00

S355	355.00	510.00
S550	550.00	680.00
E360	360.00	360.00

Filler Block Unit Weight: 4.50 kN/m3

Member Section Properties

Area : Gross Section Area
A_s : Section Shear Area
I_{11} : Moment of Inertia About Member Local Axis-1
I_{22} : Moment of Inertia About Member Local Axis-2

RC Column and Shearwall Section Properties

Section	b1xb2 (mm)	Area (m^2)	A_s (m^2)	I_{11} (m^4)	I_{22} (m^4)
600x300-C	600x300	0.180	0.150	0.001350	0.005400
300x300-C	300x300	0.090	0.075	0.000675	0.000675
500x500-C	500x500	0.250	0.208	0.005208	0.005208

RC Beam Section Properties

Section	b1xb2 (mm)	Area (m^2)	A_s (m^2)	I_{11} (m^4)	I_{22} (m^4)
300x600-B	300x600	0.180	0.150	0.005400	0.001350
300x500-B	300x500	0.150	0.125	0.003125	0.001125
400x500-B	400x500	0.200	0.167	0.004167	0.002667
250x800-B	250x800	0.200	0.167	0.010667	0.001042
800x300-B	800x300	0.240	0.200	0.001800	0.012800

Steel Column Section Properties

Section	b1xb2 (mm)	Area (m^2)	A_s (m^2)	I_{11} (m^4)	I_{22} (m^4)
HE240A	240x230	0.008	0.006	0.000078	0.000028
HE260A	260x250	0.009	0.007	0.000105	0.000037
HE260A	260x250	0.009	0.007	0.000105	0.000037
HE260A	260x250	0.009	0.007	0.000105	0.000037
HE260A	260x250	0.009	0.007	0.000105	0.000037
HE260A	260x250	0.009	0.007	0.000105	0.000037

Steel Beam Section Properties

Section	b1xb2 (mm)	Area (m^2)	A_s (m^2)	I_{11} (m^4)	I_{22} (m^4)
IPE240	120x240	0.004	0.002	0.000039	0.000003
IPE270	135x270	0.005	0.003	0.000058	0.000004
IPE270	135x270	0.005	0.003	0.000058	0.000004
IPE270	135x270	0.005	0.003	0.000058	0.000004
IPE200	100x200	0.003	0.002	0.000019	0.000001

Steel Purlin and Girt Section Properties

Section	b1xb2 (mm)	Area (m^2)	A_s (m^2)	I_{11} (m^4)	I_{22} (m^4)
S200-45x75x20x2	75x200	0.001	0.000	0.000005	4.533E-07

Steel Brace Section Properties

Section	b1xb2 (mm)	Area (m^2)	A_s (m^2)	I_{11} (m^4)	I_{22} (m^4)
L80X8	80x80	0.001	0.001	7.224E-07	7.224E-07

TUBO-D76.1X3.2	D=76.1	0.001	0.000	4.878E-07	4.878E-07
L80X8	80x80	0.001	0.001	7.224E-07	7.224E-07
TUBO-D88.9X3.2	D=88.9	0.001	0.001	7.921E-07	7.921E-07
IPE240	120x240	0.004	0.002	0.000039	0.000003
TUBO-D101.6X3.6	D=101.6	0.001	0.001	0.000001	0.000001
TUBO-D101.6X3.6	D=101.6	0.001	0.001	0.000001	0.000001
IPE270	135x270	0.005	0.003	0.000058	0.000004
TUBO-D101.6X3.6	D=101.6	0.001	0.001	0.000001	0.000001
TUBO-D76.1X3.2	D=76.1	0.001	0.000	4.878E-07	4.878E-07
TUBO-D88.9X3.2	D=88.9	0.001	0.001	7.921E-07	7.921E-07

Calculation of the Column and Wall Inertia Center

Coordinates of Center of Rigidity (x-R and y-R) is based on the coordinates of lower left column on the plan.

Storey	Σ EI_{xx} Column / Wall ($kN/m^2\ m^4$)	Σ EI_{xx} Total ($kN/m^2\ m^4$)	Σ EI_{yy} Column / Wall ($kN/m^2\ m^4$)	Σ EI_{yy} Total ($kN/m^2\ m^4$)	Σ x EI_{xx} Total ($m\ kN/m^2\ m^4$)	Σ y EI_{yy} Total ($m\ kN/m^2\ m^4$)	x_{cs} (m)	y_{cs} (m)
Storey: 2	3.468E+05	0.000000	3.468E+05	1.407E+05	0.000000	1.407E+05	15.573	6.896
Storey: 1	1.502E+06	0.000000	1.502E+06	9.595E+05	0.000000	9.595E+05	33.202	7.552

Post-Analysis Checks

INTERSTOREY STIFFNESS IRREGULARITY CHECK (Soft Storey):

(EN 1998-1 - Cl. 4.2.3.3(3))

h_i : Storey Height

Δ : Relative Storey Drift ($\delta_{column,top} - \delta_{column,bottom}$)

Upper Storey Ratio : $(\Delta_i / h_i) / (\Delta_{i+1} / h_{i+1})$

EARTHQUAKE DIRECTION: 1 (Angle From X 0.000 Deg)

Load Case: Ex+

Storey	h_i (m)	Δ_{min} (m)	Δ_{max} (m)	Δ_{ave} (m)	Δ_{ave} / h	Upper Storey Ratio
Storey: 2	4.520	2C13 / 0.000	2C16 / 0.033	0.017	0.003678	---
Storey: 1	3.150	1C16 / 0.001	1C17 / 0.014	0.007	0.002350	0.640 ≤ 1.300 ✓

Load Case: Ex-

Storey	h_i (m)	Δ_{min} (m)	Δ_{max} (m)	Δ_{ave} (m)	Δ_{ave} / h	Upper Storey Ratio
Storey: 2	4.520	2C5 / 0.000	2C16 / 0.035	0.018	0.003924	---
Storey: 1	3.150	1C13 / 0.001	1C7 / 0.012	0.006	0.001931	0.493 ≤ 1.300 ✓

Load Case: Ex-

Dir 1: Stiffness Irregularity does not exist. ✓

EARTHQUAKE DIRECTION: 2 (Angle From X 90.000 Deg)

Load Case: Ey+

Storey	h_i (m)	Δ_{min} (m)	Δ_{max} (m)	Δ_{ave} (m)	Δ_{ave} / h	Upper Storey Ratio
Storey: 2	4.520	2C17 / 0.001	2C10 / 0.029	0.015	0.003326	---
Storey: 1	3.150	1C7 / 0.001	1C4 / 0.018	0.010	0.003021	0.909 ≤ 1.300 ✓

Load Case: Ey-

Storey	h_i (m)	Δ_{min} (m)	Δ_{max} (m)	Δ_{ave} (m)	Δ_{ave} / h	Upper Storey Ratio
Storey: 2	4.520	2C14 / 0.001	2C10 / 0.029	0.015	0.003301	---
Storey: 1	3.150	1C8 / 0.001	1C4 / 0.018	0.009	0.002986	0.905 ≤ 1.300 ✓

Load Case: Ey-

Dir 2: Stiffness Irregularity does not exist. ✓

INTERSTOREY STRENGTH IRREGULARITY CHECK (Weak Storey)

(EN 1998-1 - Cl. 4.2.3.3(4))

Earthquake Direction: 1 (Angle From X 0.00 Deg)

Storey No	A-Column (m2)	A-Wall (m2)	A-Total (m2)	A-Part.Wall (m2)	η_C
Storey: 2	0.147	0.000	0.147	0.000	1.000 ≥ 0.80
Storey: 1	1.948	0.000	1.948	0.000	13.286 ≥ 0.80

Earthquake Direction: 2 (Angle From X 90.00 Deg)

Storey No	A-Column (m2)	A-Wall (m2)	A-Total (m2)	A-Part.Wall (m2)	η_C
Storey: 2	0.147	0.000	0.147	0.000	1.000 ≥ 0.80
Storey: 1	1.948	0.000	1.948	0.000	13.286 ≥ 0.80

Interstorey Strength Irregularity (Weak Storey) does NOT exist in the building.

RELATIVE STOREY DRIFT CHECK:

(EN 1998-1 - Cl. 4.3.4 and 4.4.3.2(1)a)
h : Storey Height
d_e : Absolute Storey Displacement (reduced by q)
d_s : Absolute Storey Displacement ($d_s = d_e * q$)
d_r : Relative Storey Drift ($d_{s(i)} - d_{s(i-1)}$)
v : EC8 Reduction Factor

EARTHQUAKE DIRECTION: 1 (Angle From X 0.000 Deg)

Load Case: Ex+

Storey	h (m)	d_e (max) (m)	d_e (min) (m)	d_e (ave) (m)	d_s (m)	d_r (m)	d_r* v / h
Storey: 2	4.520	2C16 / 0.047	2C13 / 0.003	0.025	0.049	0.033	0.003 ≤ 0.005 ✓
Storey: 1	3.150	1C17 / 0.016	1C16 / 0.002	0.009	0.018	0.015	0.002 ≤ 0.005 ✓

Load Case: Ex-

Storey	h (m)	d_e (max) (m)	d_e (min) (m)	d_e (ave) (m)	d_s (m)	d_r (m)	d_r* v / h
Storey: 2	4.520	2C16 / 0.038	2C5 / 0.002	0.020	0.040	0.035	0.003 ≤ 0.005 ✓
Storey: 1	3.150	1C7 / 0.013	1C13 / 0.002	0.007	0.014	0.012	0.002 ≤ 0.005 ✓

Dir 1... Relative Storey Drifts satisfies the Limits. ✓

EARTHQUAKE DIRECTION: 2 (Angle From X 90.000 Deg)

Load Case: Ey+

Storey	h (m)	d_e (max) (m)	d_e (min) (m)	d_e (ave) (m)	d_s (m)	d_r (m)	d_r* v / h
Storey: 2	4.520	2C10 / 0.046	2C17 / 0.003	0.024	0.048	0.030	0.003 ≤ 0.005 √
Storey: 1	3.150	1C4 / 0.020	1C7 / 0.002	0.011	0.022	0.019	0.002 ≤ 0.005 √

Load Case: Ey-

Storey	h (m)	d_e (max) (m)	d_e (min) (m)	d_e (ave) (m)	d_s (m)	d_r (m)	d_r* v / h
Storey: 2	4.520	2C10 / 0.046	2C14 / 0.003	0.024	0.048	0.029	0.003 ≤ 0.005 √
Storey: 1	3.150	1C4 / 0.020	1C8 / 0.001	0.011	0.021	0.019	0.002 ≤ 0.005 √

Dir 2... Relative Storey Drifts satisfies the Limits. √

TORSION FLEXIBILITY CHECK:

(EN 1998-1 - Cl. 4.2.3.2)

δ_{Min} : Minimum Absolute Storey Displacement
δ_{Max} : Maximum Absolute Storey Displacement
Δ : Relative Storey Drift ($\delta_{column,top} - \delta_{column,bottom}$)
η_b : $\Delta_{Max} / \Delta_{ave}$

EARTHQUAKE DIRECTION: 1 (Angle From X 0.00 Deg)

Load Case: **Ex+** (Modal Superposition Seismic X (E+))

Storey	δ_{Min} (m)	δ_{Max} (m)	Δ_{Min} (m)	Δ_{Max} (m)	Δ_{ave} (m)	η_b	Status
Storey: 2	2C13 / 0.003	2C16 / 0.047	0.000	0.033	0.017	1.975 > 1.20	Exists
Storey: 1	1C16 / 0.002	1C17 / 0.016	0.001	0.014	0.007	1.922 > 1.20	Exists

Load Case: **Ex-** (Modal Superposition Seismic X (E-))

Storey	δ_{Min} (m)	δ_{Max} (m)	Δ_{Min} (m)	Δ_{Max} (m)	Δ_{ave} (m)	η_b	Status
Storey: 2	2C5 / 0.002	2C16 / 0.038	0.000	0.035	0.018	1.981 > 1.20	Exists
Storey: 1	1C13 / 0.002	1C7 / 0.013	0.001	0.012	0.006	1.901 > 1.20	Exists

Warning: Dir 1... Building is Torsionally Flexible.

Max. Torsion Irregularity Coefficient = 1.981 > 1.2

EARTHQUAKE DIRECTION: 2 (Angle From X 90.00 Deg)

Load Case: **Ey+** (Modal Superposition Seismic Y (E+))

Storey	δ_{Min} (m)	δ_{Max} (m)	Δ_{Min} (m)	Δ_{Max} (m)	Δ_{ave} (m)	η_b	Status
Storey: 2	2C17 / 0.003	2C10 / 0.046	0.001	0.029	0.015	1.954 > 1.20	Exists
Storey: 1	1C7 / 0.002	1C4 / 0.020	0.001	0.018	0.010	1.878 > 1.20	Exists

Load Case: **Ey-** (Modal Superposition Seismic Y (E-))

Storey	δ_{Min} (m)	δ_{Max} (m)	Δ_{Min} (m)	Δ_{Max} (m)	Δ_{ave} (m)	η_b	Status
Storey: 2	2C14 / 0.003	2C10 / 0.046	0.001	0.029	0.015	1.957 > 1.20	Exists
Storey: 1	1C8 / 0.001	1C4 / 0.020	0.001	0.018	0.009	1.876 > 1.20	Exists

Warning: Dir 2... Building is Torsionally Flexible.

Max. Torsion Irregularity Coefficient = 1.957 > 1.2

EFFECTIVE MASS PARTICIPATION RATIO CHECK:

(EN 1998-1 - Cl. 4.3.3.3.1(3))

Mode	Dir	Ex+		Ex-		Ey+		Ey-	
1	X	2.127		2.127		2.127		2.127	
	Y	7.655		7.655		7.655		7.655	
	Rot	13.435		13.435		13.435		13.435	
2	X	9.275		9.275		9.275		9.275	
	Y	9.265		9.265		9.265		9.265	
	Rot	38.778		38.778		38.778		38.778	
3	X	9.946		9.946		9.946		9.946	
	Y	9.265		9.265		9.265		9.265	
	Rot	44.291		44.291		44.291		44.291	
4	X	11.071		11.071		11.071		11.071	
	Y	9.267		9.267		9.267		9.267	
	Rot	56.587		56.587		56.587		56.587	
5	X	11.072		11.072		11.072		11.072	
	Y	9.689		9.689		9.689		9.689	
	Rot	56.635		56.635		56.635		56.635	
6	X	11.900		11.900		11.900		11.900	
	Y	9.689		9.689		9.689		9.689	
	Rot	56.964		56.964		56.964		56.964	
7	X	63.846		63.846		63.846		63.846	
	Y	10.505		10.505		10.505		10.505	
	Rot	57.179		57.179		57.179		57.179	
8	X	65.195		65.195		65.195		65.195	
	Y	33.192		33.192		33.192		33.192	
	Rot	61.225		61.225		61.225		61.225	
9	X	66.289		66.289		66.289		66.289	
	Y	33.888		33.888		33.888		33.888	
	Rot	61.492		61.492		61.492		61.492	
10	X	66.731		66.731		66.731		66.731	
	Y	85.832		85.832		85.832		85.832	
	Rot	61.765		61.765		61.765		61.765	
11	X	68.498		68.498		68.498		68.498	
	Y	91.375	> 90 ✓	91.375	> 90 ✓	91.375	> 90 ✓	91.375	> 90 ✓
	Rot	62.097		62.097		62.097		62.097	
12	X	70.394		70.394		70.394		70.394	
	Y	92.907	> 90 ✓	92.907	> 90 ✓	92.907	> 90 ✓	92.907	> 90 ✓
	Rot	69.106		69.106		69.106		69.106	
13	X	70.394		70.394		70.394		70.394	
	Y	92.915	> 90 ✓	92.915	> 90 ✓	92.915	> 90 ✓	92.915	> 90 ✓
	Rot	69.106		69.106		69.106		69.106	
14	X	70.431		70.431		70.431		70.431	
	Y	92.915	> 90 ✓	92.915	> 90 ✓	92.915	> 90 ✓	92.915	> 90 ✓
	Rot	69.166		69.166		69.166		69.166	
15	X	90.264	> 90 ✓	90.264	> 90 ✓	90.264	> 90 ✓	90.264	> 90 ✓
	Y	92.997	> 90 ✓	92.997	> 90 ✓	92.997	> 90 ✓	92.997	> 90 ✓
	Rot	74.688		74.688		74.688		74.688	

16	X	93.850	> 90 ✓	93.850	> 90 ✓	93.850	> 90 ✓	93.850	> 90 ✓
	Y	93.056	> 90 ✓	93.056	> 90 ✓	93.056	> 90 ✓	93.056	> 90 ✓
	Rot	77.709		77.709		77.709		77.709	
17	X	93.850	> 90 ✓	93.850	> 90 ✓	93.850	> 90 ✓	93.850	> 90 ✓
	Y	93.058	> 90 ✓	93.058	> 90 ✓	93.058	> 90 ✓	93.058	> 90 ✓
	Rot	77.727		77.727		77.727		77.727	
18	X	93.981	> 90 ✓	93.981	> 90 ✓	93.981	> 90 ✓	93.981	> 90 ✓
	Y	93.058	> 90 ✓	93.058	> 90 ✓	93.058	> 90 ✓	93.058	> 90 ✓
	Rot	77.727		77.727		77.727		77.727	
19	X	94.607	> 90 ✓	94.607	> 90 ✓	94.607	> 90 ✓	94.607	> 90 ✓
	Y	93.073	> 90 ✓	93.073	> 90 ✓	93.073	> 90 ✓	93.073	> 90 ✓
	Rot	80.743		80.743		80.743		80.743	
20	X	95.182	> 90 ✓	95.182	> 90 ✓	95.182	> 90 ✓	95.182	> 90 ✓
	Y	93.401	> 90 ✓	93.401	> 90 ✓	93.401	> 90 ✓	93.401	> 90 ✓
	Rot	82.302		82.302		82.302		82.302	
21	X	95.777	> 90 ✓	95.777	> 90 ✓	95.777	> 90 ✓	95.777	> 90 ✓
	Y	93.401	> 90 ✓	93.401	> 90 ✓	93.401	> 90 ✓	93.401	> 90 ✓
	Rot	82.310		82.310		82.310		82.310	
22	X	95.790	> 90 ✓	95.790	> 90 ✓	95.790	> 90 ✓	95.790	> 90 ✓
	Y	93.469	> 90 ✓	93.469	> 90 ✓	93.469	> 90 ✓	93.469	> 90 ✓
	Rot	84.587		84.587		84.587		84.587	
23	X	96.036	> 90 ✓	96.036	> 90 ✓	96.036	> 90 ✓	96.036	> 90 ✓
	Y	94.373	> 90 ✓	94.373	> 90 ✓	94.373	> 90 ✓	94.373	> 90 ✓
	Rot	90.488		90.488		90.488		90.488	
24	X	96.461	> 90 ✓	96.461	> 90 ✓	96.461	> 90 ✓	96.461	> 90 ✓
	Y	94.592	> 90 ✓	94.592	> 90 ✓	94.592	> 90 ✓	94.592	> 90 ✓
	Rot	99.999		99.999		99.999		99.999	
25	X	96.461	> 90 ✓	96.461	> 90 ✓	96.461	> 90 ✓	96.461	> 90 ✓
	Y	94.592	> 90 ✓	94.592	> 90 ✓	94.592	> 90 ✓	94.592	> 90 ✓
	Rot	100.000		100.000		100.000		100.000	

Effective Mass Ratio satisfies the code requirements. ✓

SECOND ORDER EFFECTS REQUIREMENT CHECK:

h_i : Storey Height
Δ_{ave} : Average Relative Storey Drift ($\delta_{column,top} - \delta_{column,bottom}$)
W_i : Storey Seismic Weight (W = G + nQ)
ΣW_{i-n} : Total Seismic Weight
V_i : Storey Base Shear

EARTHQUAKE DIRECTION: 1 (Angle From X 0.000 Deg)

Load Case: **Ex+** (Modal Superposition Seismic X (E+))

Storey	**h (m)**	**Δ_{ave} (m)**	**W_i (kN)**	**ΣW_{i-n} (kN)**	**V_i (kN)**	**$\Theta_i = (W_i * \Delta_i) / (V_i * h_i)$**
Storey: 2	4.520	0.017	573.4	573.4	134.9	0.0156 ≤ 0.10 ✓
Storey: 1	3.150	0.007	2138.3	2651.9	737.7	0.0084 ≤ 0.10 ✓

Load Case: **Ex-** (Modal Superposition Seismic X (E-))

Storey	**h (m)**	**Δ_{ave} (m)**	**W_i (kN)**	**ΣW_{i-n} (kN)**	**V_i (kN)**	**$\Theta_i = (W_i * \Delta_i) / (V_i * h_i)$**
Storey: 2	4.520	0.018	573.4	573.4	134.9	0.0167 ≤ 0.10 ✓
Storey: 1	3.150	0.006	2138.3	2651.9	737.7	0.0069 ≤ 0.10 ✓

Dir 1: Second Order Effects are considered using code based slenderness methods. ✓

EARTHQUAKE DIRECTION: 2 (Angle From X 90.000 Deg)

Load Case: **Ey+** (Modal Superposition Seismic Y (E+))

Storey	h (m)	Δ_{ave} (m)	W_i (kN)	ΣW_{i-n} (kN)	V_i (kN)	$\Theta_i = (W_i * \Delta_i) / (V_i * h_i)$
Storey: 2	4.520	0.015	573.4	573.4	172.3	0.0111 ≤ 0.10 ✓
Storey: 1	3.150	0.010	2138.3	2651.9	938.8	0.0085 ≤ 0.10 ✓

Load Case: **Ey-** (Modal Superposition Seismic Y (E-))

Storey	h (m)	Δ_{ave} (m)	W_i (kN)	ΣW_{i-n} (kN)	V_i (kN)	$\Theta_i = (W_i * \Delta_i) / (V_i * h_i)$
Storey: 2	4.520	0.015	573.4	573.4	172.3	0.0110 ≤ 0.10 ✓
Storey: 1	3.150	0.009	2138.3	2651.9	938.8	0.0084 ≤ 0.10 ✓

Dir 2: Second Order Effects are considered using code based slenderness methods. ✓

MEMBER EFFECTIVE SECTION STIFFNESS FACTORS

Member Type	Elasticity Module	Axial Area		Bending Stiffness	Shear Area	Torsional Stiffness
Walls (Shell)	1.000	1.000	In-Plane Out-Of-Plane	1.000 0.500	0.500 0.500	0.500
Walls (Frame)	1.000	1.000	Major Dir Minor Dir	0.500 0.500	0.500 0.500	0.500
Basement Walls	1.000	1.000	In-Plane Out-Of-Plane	0.500 0.500	0.500 0.500	0.500
Slabs	1.000	1.000	In-Plane Out-Of-Plane	0.500 0.500	0.500 0.500	0.500
Columns	1.000	1.000		0.500	0.500	0.100
Beams	1.000	1.000		0.500	0.500	0.100
Coupling Beams	1.000	1.000		0.500	0.500	0.100

STOREY MASSES:

h : Storey Height
m, mr^2 : Storey Mass and Mass Moment of Inertia
G, Q : Sum of Dead and Live Loads in Storey
Qs : Sum of Snow Loads in Storey
W : Storey Seismic Weight (W = G + nQ)
Slab Stiffness : In-Plane / Out-of-Plane Reduction Factors

Storey	h (m)	m (t)	mr^2 (t.m2)	G (kN)	Q (kN)	Qs (kN)	W (kN)	Storey Diaphragm	Storey FE Mesh	Slab Stiffness
2	4.520	57.343	0.000	453.8	398.9	0.0	573.4	Rigid	None	
1	3.150	213.832	5005.866	2044.8	623.6	0.0	2138.3	Rigid	None	
Total				2498.5	1022.5		2711.8			

STOREY CENTER OF GRAVITY TABLE

B_x, B_y : Plan Width of Storeys
X_g, Y_g : Story Center of Gravity Coordinates
e_x, e_y : Eccentricities (Percent of Plan Width)

Storey	B_x (m)	X_g (m)	e_x (%)	B_y (m)	Y_g (m)	e_y (%)
2	29.600	15.232	5.00	10.000	7.448	5.00
1	45.032	33.944	5.00	14.023	7.200	5.00

EARTHQUAKE DYNAMIC INERTIA FORCES:

EARTHQUAKE DIRECTION: 1 (Angle From X 0.00 Deg)

q(1) = 2.76... Earthquake forces are calculated using this response reduction factor value.
Any reduction to this factor due to irregularities has been reflected to design forces.

Earthquake Load Case: Ex+

Storey	Fx (kN)	Fy (kN)	Fz (kN)	Mz (kN.m)	β_{tE} Fx (kN)	β_{tE} Fy (kN)	β_{tE} Fz (kN)	β_{tE} Mz (kN.m)
2	134.9	29.6	0.0	0.0	134.9	29.6	0.0	0.0
1	602.8	-89.3	0.0	818.4	602.8	-89.3	0.0	818.4
Total	737.7	-59.7	0.0	818.4	737.7	-59.7	0.0	818.4

Earthquake Load Case: Ex-

Storey	Fx (kN)	Fy (kN)	Fz (kN)	Mz (kN.m)	β_{tE} Fx (kN)	β_{tE} Fy (kN)	β_{tE} Fz (kN)	β_{tE} Mz (kN.m)
2	134.9	29.6	0.0	0.0	134.9	29.6	0.0	0.0
1	602.8	-89.3	0.0	1227.6	602.8	-89.3	0.0	1227.6
Total	737.7	-59.7	0.0	1227.6	737.7	-59.7	0.0	1227.6

EARTHQUAKE DIRECTION: 2 (Angle From X 90.00 Deg)

q(2) = 2.76... Earthquake forces are calculated using this response reduction factor value.
Any reduction to this factor due to irregularities has been reflected to design forces.

Earthquake Load Case: Ey+

Storey	Fx (kN)	Fy (kN)	Fz (kN)	Mz (kN.m)	β_{tE} Fx (kN)	β_{tE} Fy (kN)	β_{tE} Fz (kN)	β_{tE} Mz (kN.m)
2	-35.7	172.3	0.0	0.0	-35.7	172.3	0.0	0.0
1	-83.2	766.5	0.0	-1487.9	-83.2	766.5	0.0	-1487.9
Total	-119.0	938.8	0.0	-1487.9	-119.0	938.8	0.0	-1487.9

Earthquake Load Case: Ey-

Storey	Fx (kN)	Fy (kN)	Fz (kN)	Mz (kN.m)	β_{tE} Fx (kN)	β_{tE} Fy (kN)	β_{tE} Fz (kN)	β_{tE} Mz (kN.m)
2	-35.7	172.3	0.0	0.0	-35.7	172.3	0.0	0.0
1	-83.2	766.5	0.0	-2655.1	-83.2	766.5	0.0	-2655.1
Total	-119.0	938.8	0.0	-2655.1	-119.0	938.8	0.0	-2655.1

SEISMIC OVERTURNING CHECK:

h_i : Total Building Height measured from foundation level
F_1, F_2 : Earthquake forces
M_{a1}, M_{a2} : Overturning Moments
M_{p1}, M_{p2} : Resisting Moments at storey level
d_1, d_2 : Moment arm of resisting forces to overturning
X_g, Y_g : Story Center of Gravity Coordinates
W : Storey Seismic Weight (W = G + nQ)

Earthquake effects are calculated using the following behaviour factors: q(1) = 2.76 q(2) = 2.76

OVERTURNING EFFECTS:

Storey	h (m)	F_1 (kN)	M_{a1} (kN.m)	F_2 (kN)	M_{a2} (kN.m)
Storey: 2	7.670	138.1	1059.2	176.0	1349.7
Storey: 1	3.150	609.4	1919.6	771.0	2428.7
Total			2978.8		3778.4

RESISTING EFFECTS (Negative Earthquake Direction):

Storey	W (kN)	d_1 (m)	M_{p1} (kN.m)	d_2 (m)	M_{p2} (kN.m)
Storey: 2	573.4	15.232	8734.4	7.448	4270.9
Storey: 1	2138.3	33.944	72584.0	7.200	15395.1
Foundation	4714.1		101702.2		32483.0
Total			183020.6		52149.0

RESISTING EFFECTS (Positive Earthquake Direction):

Storey	W (kN)	d_1 (m)	M_{p1} (kN.m)	d_2 (m)	M_{p2} (kN.m)
Storey: 2	573.4	29.800	17088.4	6.575	3770.3
Storey: 1	2138.3	11.088	23708.9	6.823	14590.5
Foundation	4714.1		110581.6		33622.0
Total			151378.9		51982.8

Overturning Check: Dir 1 ... M_{p1} / M_{a1} = 151378.9 / 2978.8 = 50.8187 ≥ 2 Adequate ✓

Overturning Check: Dir 2 ... M_{p2} / M_{a2} = 51982.8 / 3778.4 = 13.7578 ≥ 2 Adequate ✓

Direction: 1

α_u / α_1 = 1.3

Plan Irregularity Exist. $q = q_0 (1 + \alpha_u / \alpha_1) / 2$ = 3.45

Frame system, dual system, coupled wall SystemTotal Hw = 28.00 mTotal Lw = 7.00 m Kw = 1.00

Elevation Irregularity Exist. $q = 0.8\ q\ k_w$ = 2.76

Direction: 2

α_u / α_1 = 1.3

Plan Irregularity Exist. $q = q_0 (1 + \alpha_u / \alpha_1) / 2$ = 3.45

Frame system, dual system, coupled wall SystemTotal Hw = 28.00 mTotal Lw = 7.00 m Kw = 1.00

Elevation Irregularity Exist. $q = 0.8\ q\ k_w$ = 2.76

Joint Shear Checks

Eurocode 8 (EN 1998) Design of Structures for Earthquake Resistance (Base Code)
Eurocode 2 (EN 1992) Design of Concrete Structures (Base Code)

Load Combinations

15 Gc+0.3Qc+Ex++0.3Ey-
16 Gc+0.3Qc-Ex+-0.3Ey-
17 Gc+0.3Qc+Ex-+0.3Ey+
18 Gc+0.3Qc-Ex--0.3Ey+
19 Gc+0.3Qc+Ex+-0.3Ey+
20 Gc+0.3Qc-Ex++0.3Ey+
21 Gc+0.3Qc+Ex--0.3Ey-
22 Gc+0.3Qc-Ex-+0.3Ey-
23 Gc+0.3Qc+0.3Ex-+Ey+
24 Gc+0.3Qc-0.3Ex--Ey+
25 Gc+0.3Qc+0.3Ex++Ey-
26 Gc+0.3Qc-0.3Ex+-Ey-
27 Gc+0.3Qc-0.3Ex++Ey+

28 Gc+0.3Qc+0.3Ex+-Ey+
29 Gc+0.3Qc-0.3Ex-+Ey-
30 Gc+0.3Qc+0.3Ex--Ey-
31 1.15Gc+Ex++0.3Ey-
32 1.15Gc-Ex+-0.3Ey-
33 1.15Gc+Ex-+0.3Ey+
34 1.15Gc-Ex--0.3Ey+
35 1.15Gc+Ex+-0.3Ey+
36 1.15Gc-Ex++0.3Ey+
37 1.15Gc+Ex--0.3Ey-
38 1.15Gc-Ex-+0.3Ey-
39 1.15Gc+0.3Ex-+Ey+
40 1.15Gc-0.3Ex--Ey+
41 1.15Gc+0.3Ex++Ey-
42 1.15Gc-0.3Ex+-Ey-
43 1.15Gc-0.3Ex++Ey+
44 1.15Gc+0.3Ex+-Ey+
45 1.15Gc-0.3Ex-+Ey-
46 1.15Gc+0.3Ex--Ey-
47 G+0.3Q+Ex++0.3Ey-
48 G+0.3Q-Ex+-0.3Ey-
49 G+0.3Q+Ex-+0.3Ey+
50 G+0.3Q-Ex--0.3Ey+
51 G+0.3Q+Ex+-0.3Ey+
52 G+0.3Q-Ex++0.3Ey+
53 G+0.3Q+Ex--0.3Ey-
54 G+0.3Q-Ex-+0.3Ey-
55 G+0.3Q+0.3Ex-+Ey+
56 G+0.3Q-0.3Ex--Ey+
57 G+0.3Q+0.3Ex++Ey-
58 G+0.3Q-0.3Ex+-Ey-
59 G+0.3Q-0.3Ex++Ey+
60 G+0.3Q+0.3Ex+-Ey+
61 G+0.3Q-0.3Ex-+Ey-
62 G+0.3Q+0.3Ex--Ey-
63 1.15G+Ex++0.3Ey-
64 1.15G-Ex+-0.3Ey-
65 1.15G+Ex-+0.3Ey+
66 1.15G-Ex--0.3Ey+
67 1.15G+Ex+-0.3Ey+
68 1.15G-Ex++0.3Ey+
69 1.15G+Ex--0.3Ey-
70 1.15G-Ex-+0.3Ey-
71 1.15G+0.3Ex-+Ey+
72 1.15G-0.3Ex--Ey+
73 1.15G+0.3Ex++Ey-
74 1.15G-0.3Ex+-Ey-
75 1.15G-0.3Ex++Ey+
76 1.15G+0.3Ex+-Ey+
77 1.15G-0.3Ex-+Ey-
78 1.15G+0.3Ex--Ey-

Legend and Formulations

V_{jhd}	:	Horizontal shear force acting on the concrete core of the joints
V_C	:	The shear force in the column above the joint, from the analysis in the seismic design situation
v_d	:	The shear force in the column above the joint, from the analysis in the seismic design situation
b_w	:	Thickness of confined parts of a wall section, or width of the web of a beam
b_j	:	The effective joint width
A_{s1}	:	The area of the beam top reinforcement
A_{s2}	:	The area of the beam top reinforcement

V_{jhd}	:	$\gamma_{Rd} F_{yd}(A_{s1} + A_{s2}) - V_c$		EC 8 (5.22)
v_d	:	$N_{ed} / (f_{cd}\, b\, h)$		EC 8 (5.5.3.3) (3)
η	:	$0.6\,(1 - f_{ck}/250)$	f_{ck} is given in MPa	EC 8 (5.5.3.3)
$V_{jhd,max}$	:	$\eta\, f_{cd}\,(1 - v_d / \eta)^{1/2}\, b_j\, h_c$	(Confined)	EC 8 (5.33)
$V_{jhd,max}$	:	$80\%\,(\eta\, f_{cd}(1 - v_d / \eta)^{1/2}\, b_j\, h_c)$	(Unconfined)	EC 8 (5.5.3.3) (2) b

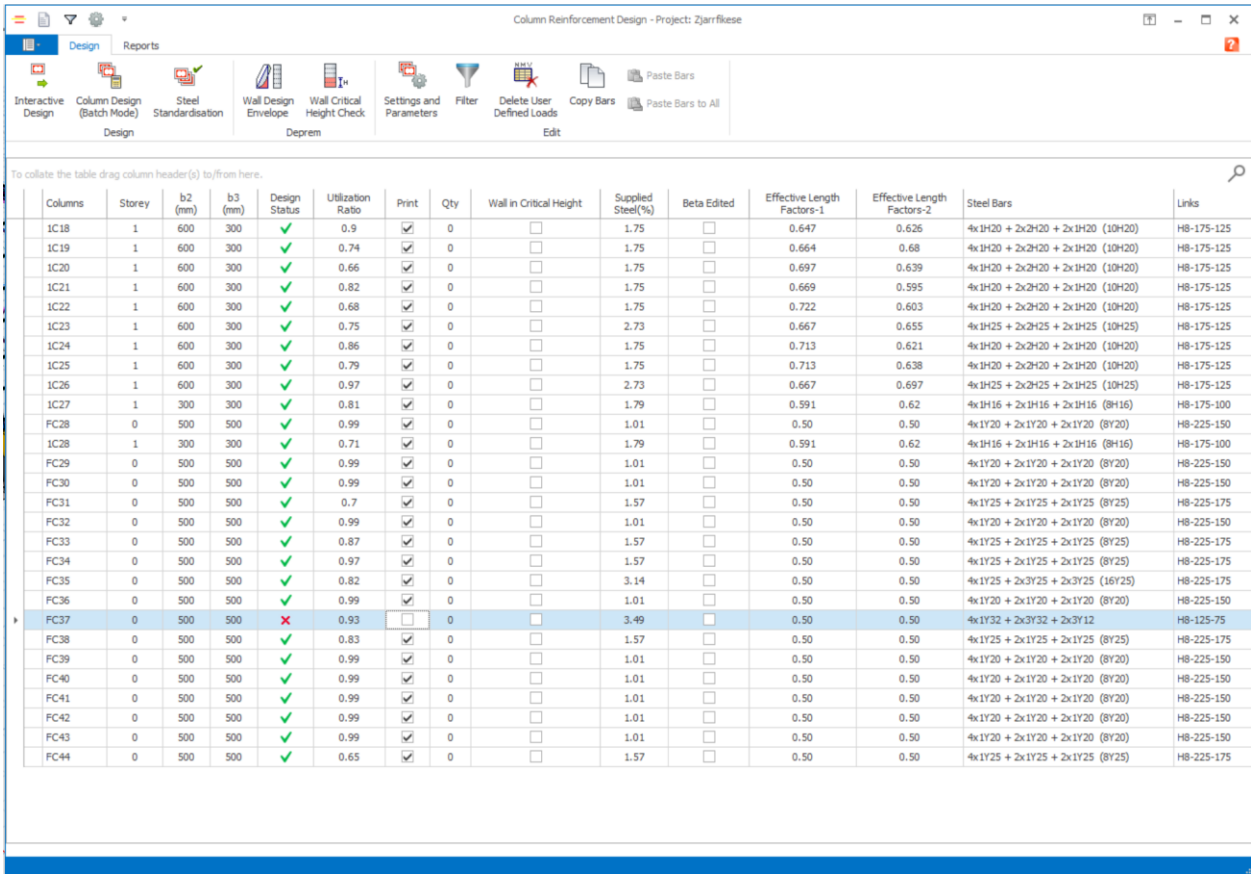
X Direction Checks

Storey	Column	b_j (mm)	h (mm)	V_c / V_u (kN)	Confined	Beam	bw (mm)	$A_{s,Top}$ (mm^2)	$As_{s,Bot}$ (mm^2)	Vc (kN)	η	v_d	V_{jhd} (kN)	$V_{jhd,limit}$ (kN)	Status
St: 1	1C18	300.0	600.0	129.1	No	1B1 (I)	300.0	603.19	603.19	129.1	0.54	0.02	198.8	1082.2	√
St: 1	1C19	300.0	600.0	139.1	No	1B2 (I)	300.0	942.48	603.19	139.1	0.54	0.04	373.1	1063.8	√
St: 1	1C20	300.0	600.0	93.6	No	1B2 (J)	300.0	603.19	603.19	93.6	0.54	0.00	234.2	1096.8	√
St: 1	1C21	300.0	600.0	150.4	No	1B9 (I)	400.0	804.25	603.19	150.4	0.54	0.07	286.7	1027.8	√
St: 1	1C22	300.0	600.0	128.4	Yes	1B10 (I)	400.0	1472.62	942.48	128.4	0.54	0.16	671.9	1151.0	√
St: 1	1C23	300.0	600.0	135.1	No	1B10 (J)	400.0	804.25	942.48	135.1	0.54	0.07	377.2	1025.7	√
St: 1	1C24	300.0	600.0	131.5	No	1B6 (I)	300.0	603.19	603.19	131.5	0.54	0.01	196.3	1093.4	√
St: 1	1C25	300.0	600.0	113.3	No	1B5 (J)	300.0	603.19	603.19	113.3	0.54	0.02	214.5	1077.3	√
St: 1	1C26	300.0	600.0	179.8	No	1B5 (I)	300.0	1472.62	603.19	179.8	0.54	0.06	620.6	1035.9	√
St: 1	1C27	300.0	300.0	23.2	No	1B14 (I)	300.0	603.19	452.39	23.2	0.54	0.02	304.6	541.5	√
St: 1	1C28	300.0	300.0	23.1	No	1B13 (I)	400.0	603.19	603.19	23.1	0.54	0.01	304.7	544.7	√

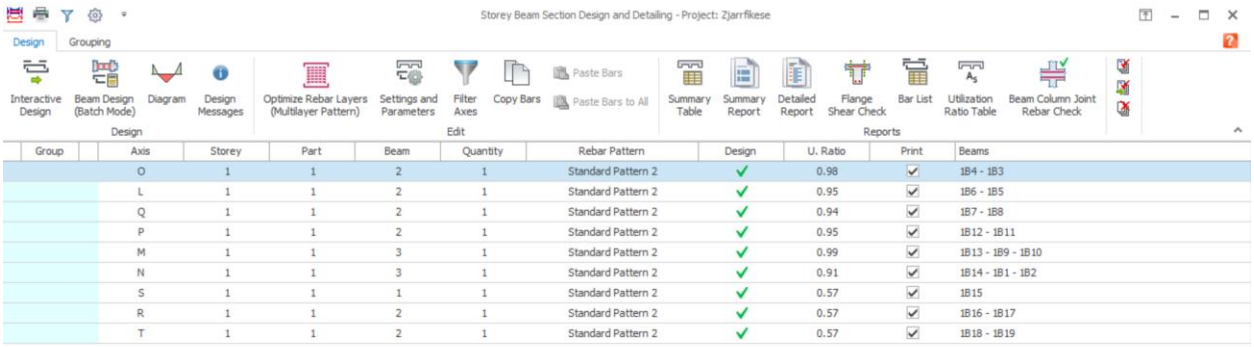
Y Direction Checks

Storey	Column	b_j (mm)	h (mm)	V_c / V_u (kN)	Confined	Beam	bw (mm)	$A_{s,Top}$ (mm^2)	$As_{s,Bot}$ (mm^2)	Vc (kN)	η	v_d	V_{jhd} (kN)	$V_{jhd,limit}$ (kN)	Status
St: 1	1C18	600.0	300.0	59.0	No	1B8 (J)	300.0	603.19	603.19	59.0	0.54	0.02	268.8	1082.2	√
St: 1	1C19	600.0	300.0	44.5	No	1B11 (J)	800.0	1206.37	1206.37	44.5	0.54	0.04	611.2	1063.8	√
St: 1	1C20	600.0	300.0	47.4	No	1B3 (J)	300.0	942.48	603.19	47.4	0.54	0.00	464.8	1096.8	√
St: 1	1C21	600.0	300.0	43.1	No	1B8 (I)	300.0	1472.62	603.19	43.1	0.54	0.07	757.2	1027.8	√
St: 1	1C22	600.0	300.0	58.3	Yes	1B11 (I)	800.0	2945.24	1319.47	58.3	0.54	0.16	1542.4	1851.0	√
St: 1	1C23	600.0	300.0	66.5	No	1B3 (I)	300.0	942.48	603.19	66.5	0.54	0.07	445.7	1025.7	√
St: 1	1C24	600.0	300.0	63.0	No	1B7 (I)	300.0	942.48	603.19	63.0	0.54	0.01	449.2	1093.4	√
St: 1	1C25	600.0	300.0	64.7	No	1B4 (I)	300.0	942.48	603.19	64.7	0.54	0.02	447.5	1077.3	√
St: 1	1C26	600.0	300.0	69.3	No	1B12 (I)	800.0	1884.96	1884.96	69.3	0.54	0.06	955.2	1035.9	√
St: 1	1C27	300.0	300.0	31.2	No	1B15 (J)	300.0	603.19	603.19	31.2	0.54	0.02	296.6	541.5	√

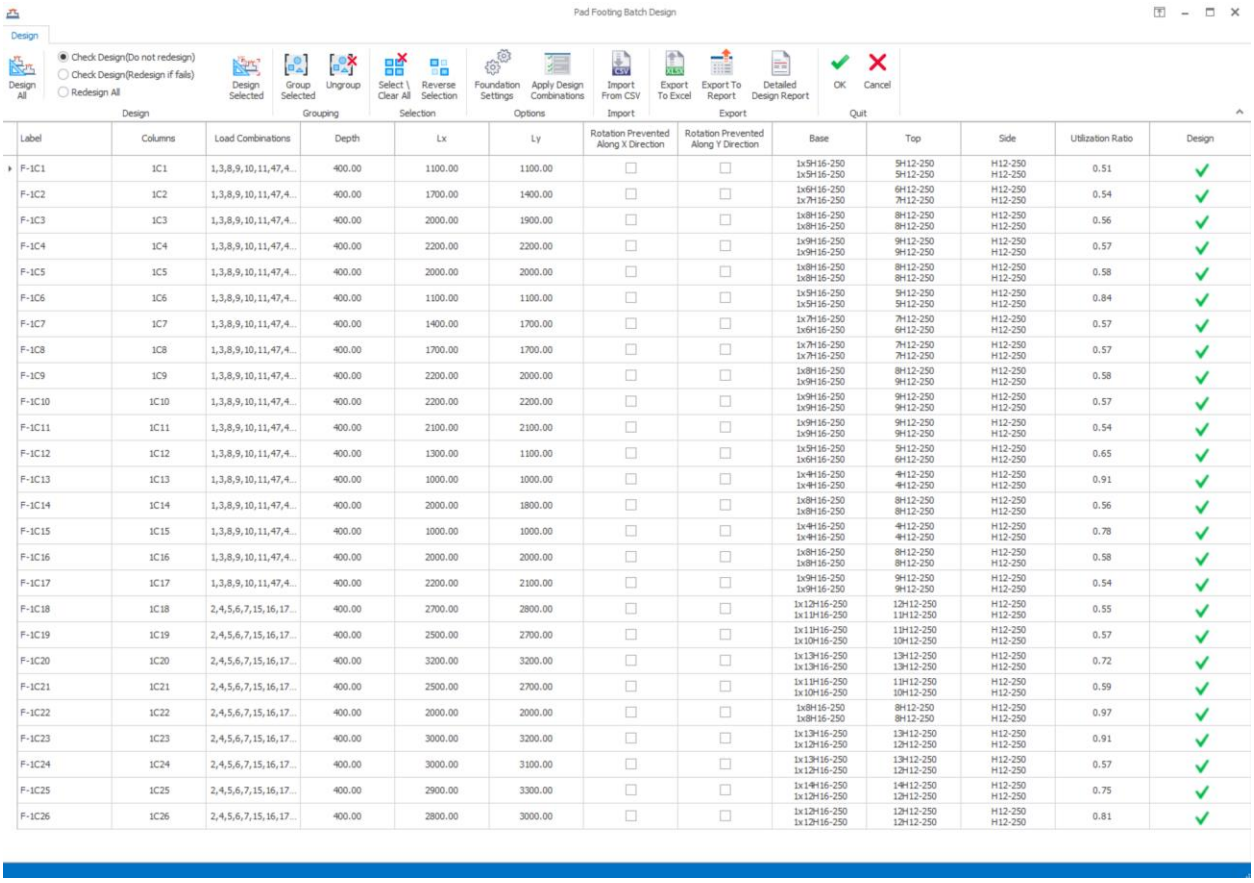
St: 1	1C28	300.0	300.0	31.0	No	1B15 (I)	300.0	603.19	603.19	31.0	0.54	0.01	296.8	544.7	√



Columns	Storey	b2 (mm)	b3 (mm)	Design Status	Utilization Ratio	Print	Qty	Wall in Critical Height	Supplied Steel(%)	Beta Edited	Effective Length Factors-1	Effective Length Factors-2	Steel Bars	Links
1C18	1	600	300	✓	0.9	☑	0	☐	1.75	☐	0.647	0.626	4x1H20 + 2x2H20 + 2x1H20 (10H20)	H8-175-125
1C19	1	600	300	✓	0.74	☑	0	☐	1.75	☐	0.664	0.68	4x1H20 + 2x2H20 + 2x1H20 (10H20)	H8-175-125
1C20	1	600	300	✓	0.66	☑	0	☐	1.75	☐	0.697	0.639	4x1H20 + 2x2H20 + 2x1H20 (10H20)	H8-175-125
1C21	1	600	300	✓	0.82	☑	0	☐	1.75	☐	0.669	0.595	4x1H20 + 2x2H20 + 2x1H20 (10H20)	H8-175-125
1C22	1	600	300	✓	0.68	☑	0	☐	1.75	☐	0.722	0.603	4x1H20 + 2x2H20 + 2x1H20 (10H20)	H8-175-125
1C23	1	600	300	✓	0.75	☑	0	☐	2.73	☐	0.667	0.655	4x1H25 + 2x2H25 + 2x1H25 (10H25)	H8-175-125
1C24	1	600	300	✓	0.86	☑	0	☐	1.75	☐	0.713	0.621	4x1H20 + 2x2H20 + 2x1H20 (10H20)	H8-175-125
1C25	1	600	300	✓	0.79	☑	0	☐	1.75	☐	0.713	0.638	4x1H20 + 2x2H20 + 2x1H20 (10H20)	H8-175-125
1C26	1	600	300	✓	0.97	☑	0	☐	2.73	☐	0.667	0.697	4x1H25 + 2x2H25 + 2x1H25 (10H25)	H8-175-125
1C27	1	300	300	✓	0.81	☑	0	☐	1.79	☐	0.591	0.62	4x1H16 + 2x1H16 + 2x1H16 (8H16)	H8-175-100
FC28	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
1C28	1	300	300	✓	0.71	☑	0	☐	1.79	☐	0.591	0.62	4x1H16 + 2x1H16 + 2x1H16 (8H16)	H8-175-100
FC29	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC30	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC31	0	500	500	✓	0.7	☑	0	☐	1.57	☐	0.50	0.50	4x1Y25 + 2x1Y25 + 2x1Y25 (8Y25)	H8-225-175
FC32	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC33	0	500	500	✓	0.87	☑	0	☐	1.57	☐	0.50	0.50	4x1Y25 + 2x1Y25 + 2x1Y25 (8Y25)	H8-225-175
FC34	0	500	500	✓	0.97	☑	0	☐	1.57	☐	0.50	0.50	4x1Y25 + 2x1Y25 + 2x1Y25 (8Y25)	H8-225-175
FC35	0	500	500	✓	0.82	☑	0	☐	3.14	☐	0.50	0.50	4x1Y25 + 2x3Y25 + 2x3Y25 (16Y25)	H8-225-175
FC36	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC37	0	500	500	✗	0.93	☐	0	☐	3.49	☐	0.50	0.50	4x1Y32 + 2x3Y32 + 2x3Y12	H8-125-75
FC38	0	500	500	✓	0.83	☑	0	☐	1.57	☐	0.50	0.50	4x1Y25 + 2x1Y25 + 2x1Y25 (8Y25)	H8-225-175
FC39	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC40	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC41	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC42	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC43	0	500	500	✓	0.99	☑	0	☐	1.01	☐	0.50	0.50	4x1Y20 + 2x1Y20 + 2x1Y20 (8Y20)	H8-225-150
FC44	0	500	500	✓	0.65	☑	0	☐	1.57	☐	0.50	0.50	4x1Y25 + 2x1Y25 + 2x1Y25 (8Y25)	H8-225-175



Group	Axis	Storey	Part	Beam	Quantity	Rebar Pattern	Design	U. Ratio	Print	Beams
	O	1	1	2	1	Standard Pattern 2	✓	0.98	☑	1B4 - 1B3
	L	1	1	2	1	Standard Pattern 2	✓	0.95	☑	1B6 - 1B5
	Q	1	1	2	1	Standard Pattern 2	✓	0.94	☑	1B7 - 1B8
	P	1	1	2	1	Standard Pattern 2	✓	0.95	☑	1B12 - 1B11
	M	1	1	3	1	Standard Pattern 2	✓	0.99	☑	1B13 - 1B9 - 1B10
	N	1	1	3	1	Standard Pattern 2	✓	0.91	☑	1B14 - 1B1 - 1B2
	S	1	1	1	1	Standard Pattern 2	✓	0.57	☑	1B15
	R	1	1	2	1	Standard Pattern 2	✓	0.57	☑	1B16 - 1B17
	T	1	1	2	1	Standard Pattern 2	✓	0.57	☑	1B18 - 1B19



Label	Columns	Load Combinations	Depth	Lx	Ly	Rotation Prevented Along X Direction	Rotation Prevented Along Y Direction	Base	Top	Side	Utilization Ratio	Design
F-1C1	1C1	1,3,8,9,10,11,47,4...	400.00	1100.00	1100.00	☐	☐	1x5H16-250 1x5H16-250	5H12-250 5H12-250	H12-250 H12-250	0.51	✓
F-1C2	1C2	1,3,8,9,10,11,47,4...	400.00	1700.00	1400.00	☐	☐	1x6H16-250 1x7H16-250	6H12-250 7H12-250	H12-250 H12-250	0.54	✓
F-1C3	1C3	1,3,8,9,10,11,47,4...	400.00	2000.00	1900.00	☐	☐	1x8H16-250 1x8H16-250	8H12-250 8H12-250	H12-250 H12-250	0.56	✓
F-1C4	1C4	1,3,8,9,10,11,47,4...	400.00	2200.00	2200.00	☐	☐	1x9H16-250 1x9H16-250	9H12-250 9H12-250	H12-250 H12-250	0.57	✓
F-1C5	1C5	1,3,8,9,10,11,47,4...	400.00	2000.00	2000.00	☐	☐	1x8H16-250 1x8H16-250	8H12-250 8H12-250	H12-250 H12-250	0.58	✓
F-1C6	1C6	1,3,8,9,10,11,47,4...	400.00	1100.00	1100.00	☐	☐	1x5H16-250 1x5H16-250	5H12-250 5H12-250	H12-250 H12-250	0.84	✓
F-1C7	1C7	1,3,8,9,10,11,47,4...	400.00	1400.00	1700.00	☐	☐	1x7H16-250 1x6H16-250	7H12-250 6H12-250	H12-250 H12-250	0.57	✓
F-1C8	1C8	1,3,8,9,10,11,47,4...	400.00	1700.00	1700.00	☐	☐	1x7H16-250 1x7H16-250	7H12-250 7H12-250	H12-250 H12-250	0.57	✓
F-1C9	1C9	1,3,8,9,10,11,47,4...	400.00	2200.00	2000.00	☐	☐	1x8H16-250 1x9H16-250	8H12-250 9H12-250	H12-250 H12-250	0.58	✓
F-1C10	1C10	1,3,8,9,10,11,47,4...	400.00	2200.00	2200.00	☐	☐	1x9H16-250 1x9H16-250	9H12-250 9H12-250	H12-250 H12-250	0.57	✓
F-1C11	1C11	1,3,8,9,10,11,47,4...	400.00	2100.00	2100.00	☐	☐	1x9H16-250 1x9H16-250	9H12-250 9H12-250	H12-250 H12-250	0.54	✓
F-1C12	1C12	1,3,8,9,10,11,47,4...	400.00	1300.00	1100.00	☐	☐	1x5H16-250 1x6H16-250	5H12-250 6H12-250	H12-250 H12-250	0.65	✓
F-1C13	1C13	1,3,8,9,10,11,47,4...	400.00	1000.00	1000.00	☐	☐	1x4H16-250 1x4H16-250	4H12-250 4H12-250	H12-250 H12-250	0.91	✓
F-1C14	1C14	1,3,8,9,10,11,47,4...	400.00	2000.00	1800.00	☐	☐	1x8H16-250 1x8H16-250	8H12-250 8H12-250	H12-250 H12-250	0.56	✓
F-1C15	1C15	1,3,8,9,10,11,47,4...	400.00	1000.00	1000.00	☐	☐	1x4H16-250 1x4H16-250	4H12-250 4H12-250	H12-250 H12-250	0.78	✓
F-1C16	1C16	1,3,8,9,10,11,47,4...	400.00	2000.00	2000.00	☐	☐	1x8H16-250 1x8H16-250	8H12-250 8H12-250	H12-250 H12-250	0.58	✓
F-1C17	1C17	1,3,8,9,10,11,47,4...	400.00	2200.00	2100.00	☐	☐	1x9H16-250 1x9H16-250	9H12-250 9H12-250	H12-250 H12-250	0.54	✓
F-1C18	1C18	2,4,5,6,7,15,16,17...	400.00	2700.00	2800.00	☐	☐	1x12H16-250 1x11H16-250	12H12-250 11H12-250	H12-250 H12-250	0.55	✓
F-1C19	1C19	2,4,5,6,7,15,16,17...	400.00	2500.00	2700.00	☐	☐	1x11H16-250 1x10H16-250	11H12-250 10H12-250	H12-250 H12-250	0.57	✓
F-1C20	1C20	2,4,5,6,7,15,16,17...	400.00	3200.00	3200.00	☐	☐	1x13H16-250 1x13H16-250	13H12-250 13H12-250	H12-250 H12-250	0.72	✓
F-1C21	1C21	2,4,5,6,7,15,16,17...	400.00	2500.00	2700.00	☐	☐	1x11H16-250 1x10H16-250	11H12-250 10H12-250	H12-250 H12-250	0.59	✓
F-1C22	1C22	2,4,5,6,7,15,16,17...	400.00	2000.00	2000.00	☐	☐	1x8H16-250 1x8H16-250	8H12-250 8H12-250	H12-250 H12-250	0.97	✓
F-1C23	1C23	2,4,5,6,7,15,16,17...	400.00	3000.00	3200.00	☐	☐	1x13H16-250 1x12H16-250	13H12-250 12H12-250	H12-250 H12-250	0.91	✓
F-1C24	1C24	2,4,5,6,7,15,16,17...	400.00	3000.00	3100.00	☐	☐	1x13H16-250 1x12H16-250	13H12-250 12H12-250	H12-250 H12-250	0.57	✓
F-1C25	1C25	2,4,5,6,7,15,16,17...	400.00	2900.00	3300.00	☐	☐	1x14H16-250 1x12H16-250	14H12-250 12H12-250	H12-250 H12-250	0.75	✓
F-1C26	1C26	2,4,5,6,7,15,16,17...	400.00	2800.00	3000.00	☐	☐	1x12H16-250 1x12H16-250	12H12-250 12H12-250	H12-250 H12-250	0.81	✓

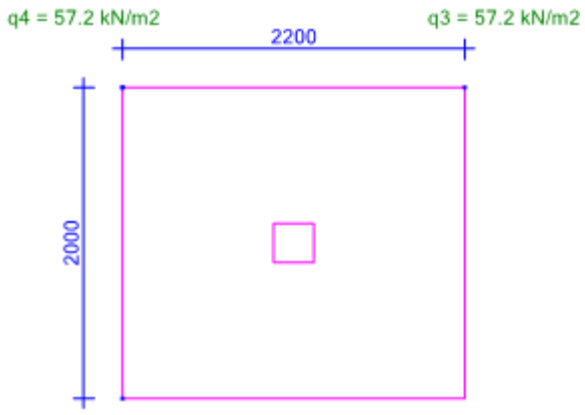
Pad Footing Report

Eurocode 2 (EN 1992) Design of Concrete Structures (Base Code)

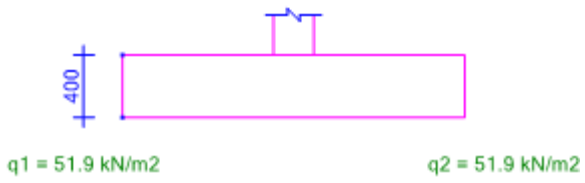
F-1C9 Design Summary

Utilization Ratio **0.584**

Footing Materials



Top View



Front View

Concrete Material	C25/30
Rebar Material	Grade 500 (Type 2)

Geometric Properties

L_X	2200.00 mm
L_Y	2000.00 mm
Height	400.00 mm
Taper Height	0.00 mm
Concrete Cover	40.00 mm
Soil Fill Height	1600.00 mm
Column	1C9 - HE260A

Corner Stresses

Lower-Left Corner	51.9 kN/m2
Lower-Right Corner	51.9 kN/m2
Upper-Right Corner	57.2 kN/m2
Upper-Left Corner	57.2 kN/m2

Loading Info

Combinations	N	Vx	Vy	Mx	My
Comb #1 - 1C9	34.1 kN	0.0 kN	7.0 kN	0.3 kN.m	-16.8 kN.m
Comb #3 - 1C9	69.5 kN	-0.1 kN	16.5 kN	0.7 kN.m	-39.3 kN.m
Comb #47 - 1C9	27.9 kN	1.9 kN	0.1 kN	14.2 kN.m	-47.6 kN.m
Comb #48 - 1C9	36.8 kN	-2.0 kN	14.1 kN	-13.5 kN.m	13.8 kN.m
Comb #49 - 1C9	27.8 kN	2.1 kN	0.0 kN	15.4 kN.m	-48.1 kN.m
Comb #50 - 1C9	36.9 kN	-2.2 kN	14.2 kN	-14.8 kN.m	14.3 kN.m
Comb #51 - 1C9	31.1 kN	1.5 kN	5.2 kN	11.9 kN.m	-25.1 kN.m
Comb #52 - 1C9	33.6 kN	-1.6 kN	9.0 kN	-11.3 kN.m	-8.7 kN.m
Comb #53 - 1C9	31.0 kN	1.8 kN	5.1 kN	13.2 kN.m	-25.6 kN.m
Comb #54 - 1C9	33.7 kN	-1.9 kN	9.1 kN	-12.5 kN.m	-8.3 kN.m

Comb #55 - 1C9	26.1 kN	1.1 kN	-2.8 kN	8.0 kN.m	-60.7 kN.m
Comb #56 - 1C9	38.6 kN	-1.2 kN	17.0 kN	-7.3 kN.m	26.9 kN.m
Comb #57 - 1C9	26.2 kN	1.2 kN	-2.7 kN	8.1 kN.m	-60.0 kN.m
Comb #58 - 1C9	38.5 kN	-1.2 kN	16.9 kN	-7.4 kN.m	26.2 kN.m
Comb #59 - 1C9	27.8 kN	0.0 kN	-0.1 kN	0.0 kN.m	-48.9 kN.m
Comb #60 - 1C9	36.9 kN	-0.1 kN	14.3 kN	0.7 kN.m	15.1 kN.m
Comb #61 - 1C9	28.0 kN	0.0 kN	0.0 kN	0.1 kN.m	-48.2 kN.m
Comb #62 - 1C9	36.7 kN	-0.1 kN	14.2 kN	0.6 kN.m	14.4 kN.m
Comb #63 - 1C9	24.6 kN	1.9 kN	-1.0 kN	14.1 kN.m	-45.0 kN.m
Comb #64 - 1C9	33.5 kN	-2.0 kN	13.0 kN	-13.5 kN.m	16.4 kN.m
Comb #65 - 1C9	24.5 kN	2.1 kN	-1.1 kN	15.4 kN.m	-45.5 kN.m
Comb #66 - 1C9	33.6 kN	-2.2 kN	13.1 kN	-14.8 kN.m	16.9 kN.m
Comb #67 - 1C9	27.8 kN	1.5 kN	4.1 kN	11.9 kN.m	-22.5 kN.m
Comb #68 - 1C9	30.3 kN	-1.6 kN	7.9 kN	-11.3 kN.m	-6.1 kN.m
Comb #69 - 1C9	27.7 kN	1.8 kN	4.0 kN	13.2 kN.m	-22.9 kN.m
Comb #70 - 1C9	30.4 kN	-1.8 kN	8.0 kN	-12.6 kN.m	-5.7 kN.m
Comb #71 - 1C9	22.8 kN	1.1 kN	-3.9 kN	7.9 kN.m	-58.1 kN.m
Comb #72 - 1C9	35.3 kN	-1.2 kN	15.9 kN	-7.4 kN.m	29.5 kN.m
Comb #73 - 1C9	22.9 kN	1.2 kN	-3.8 kN	8.1 kN.m	-57.4 kN.m
Comb #74 - 1C9	35.2 kN	-1.2 kN	15.8 kN	-7.5 kN.m	28.8 kN.m
Comb #75 - 1C9	24.5 kN	0.0 kN	-1.2 kN	-0.1 kN.m	-46.3 kN.m
Comb #76 - 1C9	33.6 kN	-0.1 kN	13.2 kN	0.7 kN.m	17.7 kN.m
Comb #77 - 1C9	24.7 kN	0.0 kN	-1.1 kN	0.0 kN.m	-45.6 kN.m
Comb #78 - 1C9	33.4 kN	-0.1 kN	13.1 kN	0.5 kN.m	17.0 kN.m
Comb #91 - 1C9	69.4 kN	-0.5 kN	16.2 kN	3.7 kN.m	-38.1 kN.m
Comb #92 - 1C9	69.6 kN	0.3 kN	16.7 kN	-2.2 kN.m	-40.4 kN.m
Comb #93 - 1C9	66.3 kN	-0.2 kN	11.1 kN	1.5 kN.m	-15.0 kN.m
Comb #94 - 1C9	72.7 kN	0.0 kN	21.8 kN	0.0 kN.m	-63.5 kN.m
Comb #95 - 1C9	58.7 kN	-0.8 kN	13.2 kN	5.5 kN.m	-30.6 kN.m
Comb #96 - 1C9	59.1 kN	0.6 kN	14.0 kN	-4.2 kN.m	-34.4 kN.m
Comb #97 - 1C9	53.6 kN	-0.3 kN	4.7 kN	1.9 kN.m	7.9 kN.m
Comb #98 - 1C9	64.1 kN	0.1 kN	22.6 kN	-0.7 kN.m	-72.9 kN.m
Comb #99 - 1C9	27.6 kN	-0.8 kN	5.3 kN	5.1 kN.m	-11.8 kN.m
Comb #100 - 1C9	28.0 kN	0.7 kN	6.1 kN	-4.6 kN.m	-15.6 kN.m
Comb #101 - 1C9	22.5 kN	-0.3 kN	-3.2 kN	1.6 kN.m	26.7 kN.m
Comb #102 - 1C9	33.0 kN	0.2 kN	14.7 kN	-1.0 kN.m	-54.1 kN.m
Comb #103 - 1C9	69.5 kN	-0.1 kN	16.5 kN	0.9 kN.m	-39.2 kN.m
Comb #104 - 1C9	69.5 kN	-0.1 kN	16.5 kN	0.6 kN.m	-39.3 kN.m
Comb #105 - 1C9	69.4 kN	-0.1 kN	16.4 kN	0.7 kN.m	-38.8 kN.m
Comb #106 - 1C9	69.6 kN	-0.1 kN	16.6 kN	0.8 kN.m	-39.7 kN.m
Comb #107 - 1C9	58.9 kN	-0.1 kN	13.6 kN	0.8 kN.m	-32.4 kN.m
Comb #108 - 1C9	58.9 kN	-0.1 kN	13.7 kN	0.5 kN.m	-32.6 kN.m
Comb #109 - 1C9	58.8 kN	-0.1 kN	13.5 kN	0.6 kN.m	-32.1 kN.m
Comb #110 - 1C9	58.9 kN	-0.1 kN	13.7 kN	0.6 kN.m	-33.0 kN.m

Soil Stress Check

N	:	**Axial Load Of Combination**
$\sum N$	:	Total Axial Load
TW	:	Total Weight of Footing
h	:	Footing Depth
h_{taper}	:	Taper Height
Ecc_1	:	Column Eccentricity in X Direction
Ecc_2	:	Column Eccentricity in Y Direction
$\sum M_x$	:	Total Moment in X Direction
$\sum M_y$	:	Total Moment in Y Direction

Total footing, soil and pedestal weight is calculated.

Member	Volume (m3)	Unit Weight (kN/m3)	Weight (kN)

Pad Footing	:	1.760	25	44
Soil	:	7.040	18	126.72
Total	:			170.72

$\Sigma N = N + TW$

$\Sigma M_x = M_x + V_x (h - h_{taper}) + Ecc_1 N$

$\Sigma M_y = M_y + V_y (h - h_{taper}) + Ecc_2 N$

Rotation is prevented for direction X. Hence, moment is not included.

Corner stresses,

$\sigma_1 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$

$\sigma_2 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$

$\sigma_3 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$

$\sigma_4 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$

Comb	ΣN (kN)	ΣMx (kN.m)	ΣMy (kN.m)	σ1 (kN/m2)	σ2 (kN/m2)	σ3 (kN/m2)	σ4 (kN/m2)
Comb #1 - 1C9	204.8	0.0	0.4	46.3	46.3	46.8	46.8
Comb #3 - 1C9	240.2	0.0	0.8	54.1	54.1	55.1	55.1
Comb #47 - 1C9	198.6	0.0	13.4	36.0	36.0	54.3	54.3
Comb #48 - 1C9	207.5	0.0	-12.7	55.8	55.8	38.5	38.5
Comb #49 - 1C9	198.5	0.0	14.6	35.2	35.2	55.0	55.0
Comb #50 - 1C9	207.6	0.0	-13.9	56.6	56.6	37.7	37.7
Comb #51 - 1C9	201.8	0.0	11.3	38.1	38.1	53.6	53.6
Comb #52 - 1C9	204.3	0.0	-10.6	53.7	53.7	39.2	39.2
Comb #53 - 1C9	201.7	0.0	12.5	37.3	37.3	54.4	54.4
Comb #54 - 1C9	204.4	0.0	-11.8	54.5	54.5	38.4	38.4
Comb #55 - 1C9	196.8	0.0	7.5	39.6	39.6	49.9	49.9
Comb #56 - 1C9	209.3	0.0	-6.8	52.2	52.2	42.9	42.9
Comb #57 - 1C9	196.9	0.0	7.6	39.6	39.6	50.0	50.0
Comb #58 - 1C9	209.2	0.0	-6.9	52.3	52.3	42.8	42.8
Comb #59 - 1C9	198.5	0.0	0.0	45.1	45.1	45.1	45.1
Comb #60 - 1C9	207.6	0.0	0.7	46.7	46.7	47.7	47.7
Comb #61 - 1C9	198.7	0.0	0.1	45.1	45.1	45.2	45.2
Comb #62 - 1C9	207.4	0.0	0.6	46.7	46.7	47.6	47.6
Comb #63 - 1C9	195.3	0.0	13.4	35.3	35.3	53.5	53.5
Comb #64 - 1C9	204.2	0.0	-12.8	55.1	55.1	37.7	37.7
Comb #65 - 1C9	195.2	0.0	14.5	34.5	34.5	54.3	54.3
Comb #66 - 1C9	204.3	0.0	-13.9	55.9	55.9	36.9	36.9
Comb #67 - 1C9	198.5	0.0	11.3	37.4	37.4	52.8	52.8
Comb #68 - 1C9	201.0	0.0	-10.7	53.0	53.0	38.4	38.4
Comb #69 - 1C9	198.4	0.0	12.4	36.6	36.6	53.6	53.6
Comb #70 - 1C9	201.1	0.0	-11.8	53.8	53.8	37.6	37.6
Comb #71 - 1C9	193.5	0.0	7.5	38.9	38.9	49.1	49.1
Comb #72 - 1C9	206.0	0.0	-6.9	51.5	51.5	42.1	42.1
Comb #73 - 1C9	193.6	0.0	7.6	38.8	38.8	49.2	49.2
Comb #74 - 1C9	205.9	0.0	-7.0	51.6	51.6	42.0	42.0
Comb #75 - 1C9	195.2	0.0	-0.1	44.4	44.4	44.3	44.3
Comb #76 - 1C9	204.3	0.0	0.7	46.0	46.0	46.9	46.9
Comb #77 - 1C9	195.4	0.0	0.0	44.4	44.4	44.4	44.4
Comb #78 - 1C9	204.1	0.0	0.6	46.0	46.0	46.8	46.8
Comb #91 - 1C9	240.1	0.0	3.9	51.9	51.9	57.2	57.2
Comb #92 - 1C9	240.4	0.0	-2.3	56.2	56.2	53.0	53.0
Comb #93 - 1C9	237.1	0.0	1.6	52.8	52.8	55.0	55.0
Comb #94 - 1C9	243.4	0.0	-0.1	55.4	55.4	55.3	55.3

Comb #95 - 1C9	229.4	0.0	5.8	48.2	48.2	56.1	56.1
Comb #96 - 1C9	229.8	0.0	-4.5	55.3	55.3	49.2	49.2
Comb #97 - 1C9	224.3	0.0	2.1	49.6	49.6	52.4	52.4
Comb #98 - 1C9	234.9	0.0	-0.7	53.9	53.9	52.9	52.9
Comb #99 - 1C9	198.3	0.0	5.5	41.3	41.3	48.8	48.8
Comb #100 - 1C9	198.7	0.0	-4.9	48.5	48.5	41.8	41.8
Comb #101 - 1C9	193.2	0.0	1.7	42.8	42.8	45.1	45.1
Comb #102 - 1C9	203.8	0.0	-1.1	47.1	47.1	45.6	45.6
Comb #103 - 1C9	240.2	0.0	1.0	53.9	53.9	55.2	55.2
Comb #104 - 1C9	240.2	0.0	0.6	54.2	54.2	55.0	55.0
Comb #105 - 1C9	240.2	0.0	0.8	54.1	54.1	55.1	55.1
Comb #106 - 1C9	240.3	0.0	0.8	54.1	54.1	55.1	55.1
Comb #107 - 1C9	229.6	0.0	0.8	51.6	51.6	52.7	52.7
Comb #108 - 1C9	229.6	0.0	0.5	51.9	51.9	52.5	52.5
Comb #109 - 1C9	229.5	0.0	0.6	51.7	51.7	52.6	52.6
Comb #110 - 1C9	229.7	0.0	0.7	51.7	51.7	52.6	52.6

Demand/Capacity couple which leads to the maximum utilization ratio is shown below.

Demand	Capacity	Status
Maximum Soil Stress: 57.2 kN/m2	Allowable Maximum Soil Stress: 400.0 kN/m2	√

Eccentricity Check

Comb	Direction	Moment (kN.m)	Axial Load (kN)	Eccentricity (M/N)	Limit (L/6)	Status
Comb #1 - 1C9	X	0.0	204.8	0.00 mm	366.67 mm	✓
	Y	0.4	204.8	1.74 mm	333.33 mm	✓
Comb #65 - 1C9	X	0.0	195.2	0.00 mm	366.67 mm	✓
	Y	14.5	195.2	74.35 mm	333.33 mm	✓

Punching Check

V_{pd}	:	**Punching Demand (At Critical Control Perimeter)**
V_{pc}	:	Punching Capacity (At Critical Control Perimeter)
$C_{Rd,c}$	:	Parameter based on selected National Annex, (Suggested value : 0.12)
k	:	Factor for punching resistance calculation
ρ	:	Flexural Reinforcement Ratio
f_{ck}	:	Concrete Characteristic Compressive Strength
v_{min}	:	Minimum punching resistance (expression 6.3N)
d	:	Effective Depth
a	:	Distance from the column periphery to the control perimeter
a_c	:	Critical Control Distance for Punching
$V_{ed,red}$	:	Concentric punching demand due to applied shear force minus net upwards force due to soil pressure
u	:	Control Perimeter
$k_{punching}$	:	Coefficient dependent on the ratio between column dimensions
W	:	Shear distribution coefficient

Punching check will be conducted for control perimeters up to 2d distance from the column periphery. EN 1992-1-1:2004 (6.4.4) (2)

$V_{pc} = C_{Rd,c}k(100\rho f_{ck})^{1/3} * 2d/a \leq v_{min} * 2d/a$ (6.50)

$C_{Rd,c} = 0.18 / \gamma_c$; $k = 1 + (200/d)^{(1/2)} \leq 2.0$

k = 1 + (200/d)^(1/2) ≤ 2.0 =

$\rho = (\rho_x * \rho_y)^{(1/2)} * \rho_f \leq 0.02$

$\rho = 0.0024$

$d_x = h + h_{taper} - \phi_x/2$; $d_y = h + h_{taper} - \phi_x - \phi_y/2$

$d = (d_x + d_y) / 2 = 344$ mm

$V_{pd} = V_{ed} * A_{sect}$

$V_{ed} = V_{ed,red}/(u_p d) * [1 + k_{punching} * (M_d * u) / (V_{ed,red} * W)]$ (6.51)

$V_{ed,red} = V_{ed} - \Delta V_{ed} = \Sigma N - \sigma_s * A_{cp}$

Comb	ΣN (kN)	Vpd (kN)	Vpc (kN)	a_c (m)	D/C
Comb #1 - 1C9	204.8	171.7	896.3	0.344	0.19
Comb #3 - 1C9	240.2	202.0	896.3	0.344	0.23
Comb #47 - 1C9	198.6	187.3	896.3	0.344	0.21
Comb #48 - 1C9	207.5	193.6	896.3	0.344	0.22
Comb #49 - 1C9	198.5	189.0	896.3	0.344	0.21
Comb #50 - 1C9	207.6	195.5	896.3	0.344	0.22
Comb #51 - 1C9	201.8	186.7	896.3	0.344	0.21
Comb #52 - 1C9	204.3	187.7	896.3	0.344	0.21
Comb #53 - 1C9	201.7	188.4	896.3	0.344	0.21
Comb #54 - 1C9	204.4	189.5	896.3	0.344	0.21
Comb #55 - 1C9	196.8	176.4	896.3	0.344	0.20
Comb #56 - 1C9	209.3	185.8	896.3	0.344	0.21
Comb #57 - 1C9	196.9	176.7	896.3	0.344	0.20
Comb #58 - 1C9	209.2	185.8	896.3	0.344	0.21
Comb #59 - 1C9	198.5	166.0	896.3	0.344	0.19
Comb #60 - 1C9	207.6	174.7	896.3	0.344	0.19
Comb #61 - 1C9	198.7	166.2	896.3	0.344	0.19
Comb #62 - 1C9	207.4	174.4	896.3	0.344	0.19
Comb #63 - 1C9	195.3	184.4	896.3	0.344	0.21
Comb #64 - 1C9	204.2	190.9	896.3	0.344	0.21
Comb #65 - 1C9	195.2	186.2	896.3	0.344	0.21
Comb #66 - 1C9	204.3	192.8	896.3	0.344	0.22
Comb #67 - 1C9	198.5	183.8	896.3	0.344	0.21
Comb #68 - 1C9	201.0	185.0	896.3	0.344	0.21
Comb #69 - 1C9	198.4	185.6	896.3	0.344	0.21
Comb #70 - 1C9	201.1	186.9	896.3	0.344	0.21
Comb #71 - 1C9	193.5	173.6	896.3	0.344	0.19
Comb #72 - 1C9	206.0	183.1	896.3	0.344	0.20
Comb #73 - 1C9	193.6	173.9	896.3	0.344	0.19
Comb #74 - 1C9	205.9	183.1	896.3	0.344	0.20
Comb #75 - 1C9	195.2	163.3	896.3	0.344	0.18
Comb #76 - 1C9	204.3	171.8	896.3	0.344	0.19
Comb #77 - 1C9	195.4	163.3	896.3	0.344	0.18
Comb #78 - 1C9	204.1	171.5	896.3	0.344	0.19
Comb #91 - 1C9	240.1	206.8	896.3	0.344	0.23
Comb #92 - 1C9	240.4	204.5	896.3	0.344	0.23
Comb #93 - 1C9	237.1	200.7	896.3	0.344	0.22
Comb #94 - 1C9	243.4	203.5	896.3	0.344	0.23
Comb #95 - 1C9	229.4	200.9	896.3	0.344	0.22
Comb #96 - 1C9	229.8	199.2	896.3	0.344	0.22
Comb #97 - 1C9	224.3	190.8	896.3	0.344	0.21
Comb #98 - 1C9	234.9	197.5	896.3	0.344	0.22
Comb #99 - 1C9	198.3	174.4	896.3	0.344	0.19
Comb #100 - 1C9	198.7	173.8	896.3	0.344	0.19
Comb #101 - 1C9	193.2	164.2	896.3	0.344	0.18
Comb #102 - 1C9	203.8	172.1	896.3	0.344	0.19
Comb #103 - 1C9	240.2	202.3	896.3	0.344	0.23
Comb #104 - 1C9	240.2	201.7	896.3	0.344	0.23

Comb #105 - 1C9	240.2	202.0	896.3	0.344	0.23
Comb #106 - 1C9	240.3	202.1	896.3	0.344	0.23
Comb #107 - 1C9	229.6	193.2	896.3	0.344	0.22
Comb #108 - 1C9	229.6	192.7	896.3	0.344	0.21
Comb #109 - 1C9	229.5	192.9	896.3	0.344	0.22
Comb #110 - 1C9	229.7	193.0	896.3	0.344	0.22

Comparison at	**Demand / Capacity**	**Critical Control Distance for Punching**
Effective Perimeter	206.8 kN / 896.3 kN	0.344 m

Shear Check

V_{dx-d}	**:**	**Shear Force On Location d Away From Column Face, X-Direction**
V_{dy-d}	:	Shear Force On Location d Away From Column Face, Y-Direction
V_{c-x}	:	Shear capacity of concrete section, X-Direction
V_{c-y}	:	Shear capacity of concrete section, Y-Direction
d_{v2}	:	Distance from Location d Away From Column Face to Footing Edge
σ_{cf}	:	Soil stress on column face
σ_c	:	Soil stress at nearest corner
σ_{max}	:	Max. corner stress

Shear capacity is calculated according to Eurocode,

$V_c = [C_{rd,c} * k(100\ \rho_l * f_{ck})^{1/3}] * b_w * d \leq V_{min} * b_w * d$

$V_{min} = 0.035 * k^{3/2} * f_{ck}^{1/2}$

$C_{rd,c} = 0.18 / \gamma_c = 0.12$

$k = 1 + (200 / d)^{1/2} \leq 2.0$

$b_{w-x} = L_y$; $b_{w-y} = L_x$

$V_{c-x} = 286.14$ kN

$V_{c-y} = 305.01$ kN

$V_{dx-d} = \sigma_{cf}\ d_{vx2}\ L_y + ((\sigma_{max} - \sigma_{cf})\ d_{vx2}\ L_y / 2)$

$V_{dy-d} = \sigma_{cf}\ d_{vy2}\ L_x + ((\sigma_{max} - \sigma_{cf})\ d_{vy2}\ L_x / 2)$

At "d" Distance Away From Column Face,

	X-Direction			Y-Direction		
Comb	**Demand (kN)**	**Capacity (kN)**	**Status (kN)**	**Demand (kN)**	**Capacity (kN)**	**Status (kN)**
Comb #1 - 1C9	9.9	286.1	✓	9.4	305.0	✓
Comb #3 - 1C9	20.2	286.1	✓	19.2	305.0	✓
Comb #47 - 1C9	19.1	286.1	✓	15.4	305.0	✓
Comb #48 - 1C9	21.1	286.1	✓	17.4	305.0	✓
Comb #49 - 1C9	20.1	286.1	✓	16.1	305.0	✓
Comb #50 - 1C9	22.0	286.1	✓	18.1	305.0	✓
Comb #51 - 1C9	18.3	286.1	✓	15.1	305.0	✓
Comb #52 - 1C9	18.4	286.1	✓	15.3	305.0	✓
Comb #53 - 1C9	19.2	286.1	✓	15.7	305.0	✓

Comb #54 - 1C9	19.4	286.1	✓	16.0	305.0	✓
Comb #55 - 1C9	13.7	286.1	✓	11.5	305.0	✓
Comb #56 - 1C9	16.6	286.1	✓	14.4	305.0	✓
Comb #57 - 1C9	13.8	286.1	✓	11.6	305.0	✓
Comb #58 - 1C9	16.6	286.1	✓	14.5	305.0	✓
Comb #59 - 1C9	7.8	286.1	✓	7.5	305.0	✓
Comb #60 - 1C9	11.0	286.1	✓	10.4	305.0	✓
Comb #61 - 1C9	7.9	286.1	✓	7.6	305.0	✓
Comb #62 - 1C9	10.8	286.1	✓	10.3	305.0	✓
Comb #63 - 1C9	18.2	286.1	✓	14.5	305.0	✓
Comb #64 - 1C9	20.2	286.1	✓	16.6	305.0	✓
Comb #65 - 1C9	19.1	286.1	✓	15.2	305.0	✓
Comb #66 - 1C9	21.2	286.1	✓	17.3	305.0	✓
Comb #67 - 1C9	17.3	286.1	✓	14.2	305.0	✓
Comb #68 - 1C9	17.5	286.1	✓	14.5	305.0	✓
Comb #69 - 1C9	18.3	286.1	✓	14.8	305.0	✓
Comb #70 - 1C9	18.5	286.1	✓	15.2	305.0	✓
Comb #71 - 1C9	12.7	286.1	✓	10.6	305.0	✓
Comb #72 - 1C9	15.7	286.1	✓	13.6	305.0	✓
Comb #73 - 1C9	12.8	286.1	✓	10.7	305.0	✓
Comb #74 - 1C9	15.8	286.1	✓	13.6	305.0	✓
Comb #75 - 1C9	7.0	286.1	✓	6.7	305.0	✓
Comb #76 - 1C9	10.0	286.1	✓	9.5	305.0	✓
Comb #77 - 1C9	6.9	286.1	✓	6.7	305.0	✓
Comb #78 - 1C9	9.9	286.1	✓	9.4	305.0	✓
Comb #91 - 1C9	22.8	286.1	✓	21.0	305.0	✓
Comb #92 - 1C9	21.5	286.1	✓	20.1	305.0	✓
Comb #93 - 1C9	20.0	286.1	✓	18.8	305.0	✓
Comb #94 - 1C9	20.5	286.1	✓	19.6	305.0	✓
Comb #95 - 1C9	21.4	286.1	✓	19.2	305.0	✓
Comb #96 - 1C9	20.4	286.1	✓	18.6	305.0	✓
Comb #97 - 1C9	16.8	286.1	✓	15.7	305.0	✓
Comb #98 - 1C9	18.7	286.1	✓	17.7	305.0	✓
Comb #99 - 1C9	12.3	286.1	✓	10.6	305.0	✓
Comb #100 - 1C9	12.0	286.1	✓	10.4	305.0	✓
Comb #101 - 1C9	7.8	286.1	✓	7.1	305.0	✓
Comb #102 - 1C9	10.2	286.1	✓	9.6	305.0	✓
Comb #103 - 1C9	20.3	286.1	✓	19.3	305.0	✓
Comb #104 - 1C9	20.0	286.1	✓	19.1	305.0	✓
Comb #105 - 1C9	20.2	286.1	✓	19.2	305.0	✓
Comb #106 - 1C9	20.2	286.1	✓	19.2	305.0	✓

Comb #107 - 1C9	17.2	286.1	✓	16.4	305.0	✓
Comb #108 - 1C9	16.9	286.1	✓	16.2	305.0	✓
Comb #109 - 1C9	17.1	286.1	✓	16.2	305.0	✓
Comb #110 - 1C9	17.1	286.1	✓	16.3	305.0	✓

Comparison at	**Demand / Capacity**	**Status**
Effective Perimeter in X-Direction	22.8 kN / 286.1 kN	√
Effective Perimeter in Y-Direction	21.0 kN / 305.0 kN	√

Bending Reinforcement Check

Comb	**Md_x (kN.m)**	**Required As_x (mm2)**	**Md_y (kN.m)**	**Required As_y (mm2)**
Comb #1 - 1C9	7.5	938.98	6.7	985.93
Comb #3 - 1C9	15.4	938.98	13.6	985.93
Comb #47 - 1C9	14.6	938.98	10.8	985.93
Comb #48 - 1C9	16.0	938.98	12.2	985.93
Comb #49 - 1C9	15.3	938.98	11.2	985.93
Comb #50 - 1C9	16.8	938.98	12.7	985.93
Comb #51 - 1C9	13.9	938.98	10.6	985.93
Comb #52 - 1C9	14.0	938.98	10.8	985.93
Comb #53 - 1C9	14.6	938.98	11.0	985.93
Comb #54 - 1C9	14.8	938.98	11.2	985.93
Comb #55 - 1C9	10.4	938.98	8.1	985.93
Comb #56 - 1C9	12.6	938.98	10.2	985.93
Comb #57 - 1C9	10.5	938.98	8.1	985.93
Comb #58 - 1C9	12.7	938.98	10.2	985.93
Comb #59 - 1C9	6.0	938.98	5.3	985.93
Comb #60 - 1C9	8.4	938.98	7.4	985.93
Comb #61 - 1C9	6.0	938.98	5.4	985.93
Comb #62 - 1C9	8.3	938.98	7.3	985.93
Comb #63 - 1C9	13.8	938.98	10.1	985.93
Comb #64 - 1C9	15.3	938.98	11.6	985.93
Comb #65 - 1C9	14.6	938.98	10.6	985.93
Comb #66 - 1C9	16.1	938.98	12.1	985.93
Comb #67 - 1C9	13.2	938.98	9.9	985.93
Comb #68 - 1C9	13.3	938.98	10.1	985.93
Comb #69 - 1C9	13.9	938.98	10.4	985.93
Comb #70 - 1C9	14.1	938.98	10.6	985.93
Comb #71 - 1C9	9.7	938.98	7.4	985.93
Comb #72 - 1C9	12.0	938.98	9.6	985.93
Comb #73 - 1C9	9.8	938.98	7.5	985.93
Comb #74 - 1C9	12.0	938.98	9.6	985.93
Comb #75 - 1C9	5.3	938.98	4.7	985.93
Comb #76 - 1C9	7.6	938.98	6.7	985.93
Comb #77 - 1C9	5.3	938.98	4.7	985.93
Comb #78 - 1C9	7.5	938.98	6.6	985.93
Comb #91 - 1C9	17.3	938.98	14.9	985.93
Comb #92 - 1C9	16.4	938.98	14.3	985.93
Comb #93 - 1C9	15.2	938.98	13.4	985.93
Comb #94 - 1C9	15.6	938.98	13.9	985.93
Comb #95 - 1C9	16.3	938.98	13.6	985.93
Comb #96 - 1C9	15.5	938.98	13.1	985.93
Comb #97 - 1C9	12.8	938.98	11.1	985.93
Comb #98 - 1C9	14.2	938.98	12.6	985.93
Comb #99 - 1C9	9.4	938.98	7.5	985.93
Comb #100 - 1C9	9.1	938.98	7.3	985.93
Comb #101 - 1C9	5.9	938.98	5.0	985.93
Comb #102 - 1C9	7.8	938.98	6.8	985.93
Comb #103 - 1C9	15.5	938.98	13.7	985.93

Comb #104 - 1C9	15.3	938.98	13.6	985.93
Comb #105 - 1C9	15.3	938.98	13.6	985.93
Comb #106 - 1C9	15.4	938.98	13.6	985.93
Comb #107 - 1C9	13.1	938.98	11.6	985.93
Comb #108 - 1C9	12.9	938.98	11.5	985.93
Comb #109 - 1C9	13.0	938.98	11.5	985.93
Comb #110 - 1C9	13.0	938.98	11.6	985.93

Required reinforcement is less than the minimum reinforcement in X direction -> Minimum reinforcement is set as required reinforcement.

Required reinforcement is less than the minimum reinforcement in Y direction -> Minimum reinforcement is set as required reinforcement.

Comparison of	**Design Moment**	**Selected Rebar**	**Required / Provided**	**Status**
Reinforcement Area in X-Direction	17.3 kN.m	8ϕ16 / 250.0 mm	938.98 / 1608.50 mm2	√
Reinforcement Area in Y-Direction	14.9 kN.m	9ϕ16 / 250.0 mm	985.93 / 1809.56 mm2	√

Steel Column Design

Check Selected | Check All | Filter | Edit Selected Rows | Mark all for print | Remove all print marks | Design Report | Print Table View | OK

Drag a column header here to group by that column

Member Label	Storey	Print	Section	Material	Section Class	Slenderness Ratio (kL/r)	Utilization Ratio	Design Status	Governing Check
1C1	1	☑	HE260A	E360	Class1	48 ≤ 200	0.88 < 1.00	Pass √	(Torsion)
1C2	1	☑	HE260A	E360	Class1	48 ≤ 200	0.87 < 1.00	Pass √	(Torsion)
1C3	1	☑	HE260A	E360	Class1	48 ≤ 200	0.86 < 1.00	Pass √	(Torsion)
1C4	1	☑	HE260A	E360	Class1	48 ≤ 200	0.87 < 1.00	Pass √	(Torsion)
1C5	1	☑	HE260A	S550	Class1	48 ≤ 200	0.77 < 1.00	Pass √	(Torsion)
1C6	1	☑	HE260A	S275	Class1	48 ≤ 200	0.93 < 1.00	Pass √	(Torsion)
1C7	1	☑	HE260A	S275	Class1	48 ≤ 200	0.55 < 1.00	Pass √	(Torsion)
1C8	1	☑	HE260A	S275	Class1	48 ≤ 200	0.33 < 1.00	Pass √	(Combined)
1C9	1	☑	HE260A	S275	Class1	48 ≤ 200	0.34 < 1.00	Pass √	(Combined)
1C10	1	☑	HE260A	S275	Class1	48 ≤ 200	0.37 < 1.00	Pass √	(Combined)
1C11	1	☑	HE260A	S275	Class1	48 ≤ 200	0.34 < 1.00	Pass √	(Combined)
1C12	1	☑	HE260A	S275	Class1	48 ≤ 200	0.53 < 1.00	Pass √	(Torsion)
1C13	1	☑	HE260A	S275	Class1	48 ≤ 200	0.47 < 1.00	Pass √	(Torsion)
1C14	1	☑	HE260A	S275	Class1	48 ≤ 200	0.47 < 1.00	Pass √	(Torsion)
1C15	1	☑	HE260A	S275	Class1	48 ≤ 200	0.24 < 1.00	Pass √	(Combined)
1C16	1	☑	HE260A	E360	Class1	48 ≤ 200	0.77 < 1.00	Pass √	(Torsion)
1C17	1	☑	HE260A	S355	Class1	48 ≤ 200	0.88 < 1.00	Pass √	(Torsion)
2C3	2	☑	HE260A	S275	Class1	54 ≤ 200	0.45 < 1.00	Pass √	(Combined)
2C6	2	☑	HE260A	S275	Class1	54 ≤ 200	0.49 < 1.00	Pass √	(Combined)
2C4	2	☑	HE260A	S275	Class1	54 ≤ 200	0.46 < 1.00	Pass √	(Combined)
2C7	2	☑	HE260A	S275	Class1	70 ≤ 200	0.36 < 1.00	Pass √	(Combined)
2C1	2	☑	HE260A	S275	Class1	54 ≤ 200	0.42 < 1.00	Pass √	(Torsion)
2C9	2	☑	HE260A	S275	Class1	70 ≤ 200	0.48 < 1.00	Pass √	(Combined)
2C2	2	☑	HE260A	S275	Class1	54 ≤ 200	0.47 < 1.00	Pass √	(Torsion)
2C10	2	☑	HE260A	S275	Class1	70 ≤ 200	0.49 < 1.00	Pass √	(Combined)
2C5	2	☑	HE260A	S275	Class1	54 ≤ 200	0.66 < 1.00	Pass √	(Torsion)
2C14	2	☑	HE260A	S275	Class1	60 ≤ 200	0.87 < 1.00	Pass √	(Torsion)
2C8	2	☑	HE260A	S275	Class1	70 ≤ 200	0.41 < 1.00	Pass √	(Combined)
2C15	2	☑	HE240A	S235	Class1	65 ≤ 200	0.45 < 1.00	Pass √	(Torsion)
2C11	2	☑	HE260A	S275	Class1	70 ≤ 200	0.47 < 1.00	Pass √	(Combined)
2C12	2	☑	HE260A	S275	Class1	70 ≤ 200	0.76 < 1.00	Pass √	(Combined)
2C13	2	☑	HE260A	S275	Class1	54 ≤ 200	0.39 < 1.00	Pass √	(Torsion)
2C17	2	☑	HE260A	S275	Class1	60 ≤ 200	0.33 < 1.00	Pass √	(Torsion)
2C16	2	☑	HE260A	S275	Class1	70 ≤ 200	0.54 < 1.00	Pass √	(Combined)

Total number of members: 34

Steel Frame Member Design

Check Selected | Check All | Filter | Edit Selected Rows | Mark all for print | Remove all print marks | Design Report | Print Table View | OK

Type ▲

Member Label	Storey	Print	Section	Material	Section Class	Slenderness Ratio (kL/r)	Deflection (mm)	Utilization Ratio	Design Status	Governing Check
Type: Beam										
2F1	2	☑	IPE270	S275	Class1	89 ≤ 200	23.2 < 27.9 (L/360.0)	**0.83 < 1.00**	Pass ✓	(Deflection)
2F2	2	☑	IPE270	S355	Class1	89 ≤ 200	24.7 < 27.9 (L/360.0)	**0.88 < 1.00**	Pass ✓	(Deflection)
2F3	2	☑	IPE270	S275	Class1	89 ≤ 200	24.8 < 27.9 (L/360.0)	**0.94 < 1.00**	Pass ✓	(Combined)
2F4	2	☑	IPE270	S355	Class1	89 ≤ 200	24.3 < 27.9 (L/360.0)	**0.88 < 1.00**	Pass ✓	(Combined)
2F5	2	☑	IPE270	S275	Class1	45 ≤ 200	20.2 < 27.9 (L/360.0)	**0.94 < 1.00**	Pass ✓	(Combined)
2F6	2	☑	IPE270	S275	Class1	45 ≤ 200	11.3 < 27.9 (L/360.0)	**0.72 < 1.00**	Pass ✓	(Combined)
2F7	2	☑	IPE270	S275	Class1	45 ≤ 200	11.2 < 27.9 (L/360.0)	**0.69 < 1.00**	Pass ✓	(Combined)
Type: Horizontal Brace										
2F8	2	☑	TUBO-D88.9X3.2	S275	Class1	158 ≤ 200	-	**0.23 < 1.00**	Pass ✓	(Axial Compression)
2F9	2	☑	TUBO-D88.9X3.2	S275	Class1	158 ≤ 200	-	**0.36 < 1.00**	Pass ✓	(Axial Compression)
2F10	2	☑	TUBO-D88.9X3.2	S275	Class1	158 ≤ 200	-	**0.31 < 1.00**	Pass ✓	(Axial Compression)
2F11	2	☑	TUBO-D88.9X3.2	S275	Class1	158 ≤ 200	-	**0.32 < 1.00**	Pass ✓	(Axial Compression)
2F12	2	☑	TUBO-D88.9X3.2	S275	Class1	158 ≤ 200	-	**0.28 < 1.00**	Pass ✓	(Axial Compression)
2F13	2	☑	TUBO-D88.9X3.2	S275	Class1	185 ≤ 200	-	**0.30 < 1.00**	Pass ✓	(Axial Compression)
2F14	2	☑	TUBO-D76.1X3.2	S235	Class1	186 ≤ 200	-	**0.13 < 1.00**	Pass ✓	(Axial Compression)
2F15	2	☑	TUBO-D76.1X3.2	S235	Class1	186 ≤ 200	-	**0.46 < 1.00**	Pass ✓	(Axial Compression)
2F16	2	☑	TUBO-D76.1X3.2	S235	Class1	186 ≤ 200	-	**0.20 < 1.00**	Pass ✓	(Axial Compression)
2F17	2	☑	TUBO-D76.1X3.2	S235	Class1	186 ≤ 200	-	**0.27 < 1.00**	Pass ✓	(Axial Compression)
2F18	2	☑	TUBO-D76.1X3.2	S235	Class1	186 ≤ 200	-	**0.54 < 1.00**	Pass ✓	(Axial Compression)
2F19	2	☑	TUBO-D76.1X3.2	S235	Class1	217 > 200	-	**0.12 < 1.00**	Pass ✓	(Axial Compression)
Type: Primary Composite Beam										
1F1	1	☑	IPE270	S235	Class1	45 ≤ 200	4.7 < 13.9 (L/360.0)	**0.96 < 1.00**	Pass ✓	(Bending (Major))
1F2	1	☑	IPE270	S235	Class1	45 ≤ 200	4.5 < 13.9 (L/360.0)	**0.95 < 1.00**	Pass ✓	(Bending (Major))
1F3	1	☑	IPE270	S235	Class1	185 ≤ 200	0.2 < 15.6 (L/360.0)	**0.43 < 1.00**	Pass ✓	(Bending (Major))
1F4	1	☑	IPE270	S235	Class1	50 ≤ 200	4.4 < 13.9 (L/360.0)	**0.98 < 1.00**	Pass ✓	(Bending (Major))
1F5	1	☑	IPE270	S235	Class1	45 ≤ 200	4.6 < 13.9 (L/360.0)	**0.96 < 1.00**	Pass ✓	(Bending (Major))
1F6	1	☑	IPE200	S235	Class1	251 > 200	0.1 < 15.6 (L/360.0)	**0.07 < 1.00**	Pass ✓	(Bending (Major))
1F7	1	☑	IPE200	S235	Class1	251 > 200	0.4 < 15.6 (L/360.0)	**0.30 < 1.00**	Pass ✓	(Bending (Major))

Composite Beam Design

Check Selected | Check All | Mark all for print | Remove all print marks | Summary Report | OK

Parent Slab ▲ | Type ▲

Member Label	Frame Group Label	Storey	Section / h (mm)	Composite Degree Analysis / Target (%)	Stud Layout Type	Stud Layout	Total Studs	Camber (mm)	Print	Design Status
Parent Slab: 1S1										
Type: Secondary										
1F12	1U1	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F13	1U1	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F14	1U1	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F15	1U1	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F22	1U1	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F23	1U1	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
Parent Slab: 1S2										
Type: Secondary										
1F8	1U2	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F9	1U2	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F10	1U2	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F11	1U2	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F20	1U2	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓
1F21	1U2	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	☑	Pass ✓

Composite Beam Design

Eurocode 3 (EN 1993) Design of Steel Structures (Base Code)
Eurocode 4 (EN 1994) Design of Composite Steel and Concrete Structures

Member Label	Frame Group Label	Type	Storey	Section / h (mm)	Composite Degree Analysis / Target (%)	Stud Layout Type	Stud Layout	Total Studs	Camber (mm)	Design Status
1F12	1U1	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F13	1U1	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F14	1U1	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F15	1U1	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F22	1U1	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F23	1U1	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F8	1U2	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F9	1U2	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F10	1U2	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F11	1U2	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F20	1U2	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓
1F21	1U2	Secondary	1	IPE240 / 150.0	50 / 50	Uniform	1 x [10]	10	-	Pass ✓

1. Notation

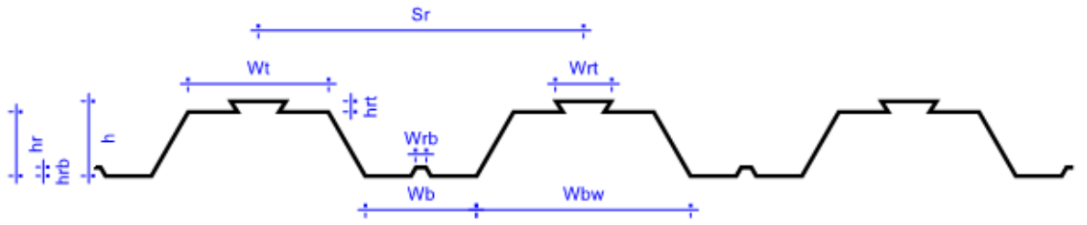
L_{Left} / L_{Right}	Distance to Adjacent Beam
$b_{eff,Left}$ / $b_{eff,Right}$	Effective Width
$h_{p,}$ / $h_{p,}$	Rib Height
$b_{o,}$ / $b_{o,}$	Average Width of Concrete Rib
$h_{c,}$ / $h_{c,}$	Thickness of Concrete above the top of the Ribs of the Sheeting
$S_{r,Left}$ / $S_{r,Right}$	Center to Center Distance of the Rib
$\eta_{Analysis}$	Composite Degree Used During Analysis
η_{Target}	Target Composite Degree
F_u	Ultimate Strength of Stud
h_{sc}	Stud Nominal Height
d_s	Diameter of Stud
s_{hdp}	Depth of Head of Stud
s_{hd}	Diameter of Head of Stud

n_r	Number of Stud Per Trough

2. Stud And Mesh Properties

	Nelson 22/150	Label	
F_u	235.00	f_y	500.00
h_{sc}	150.0	f_{yd}	434.78
d_s	22.0	d_l	8.0
s_{hd}	35.0	s_l	200.0
s_{hdp}	10.0	d_t	8.0
		s_t	200.0

3. Profiled Steel Sheeting



Default Sheeting	NH-32	Thickness	2.0	h_p	76.2
W_t	98.4	W_b	54.0	W_{rt}	0.0
h_{rt}	8.0	W_{rb}	0.0	S_r	223.5
h_{rb}	8.0				

4. Frame : 1F12 Pass ✓

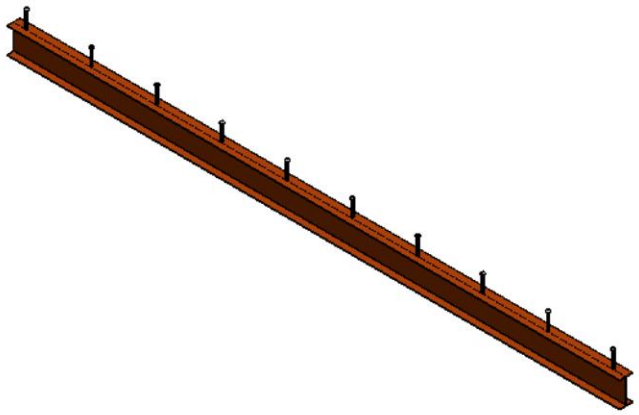
4.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F12	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U1	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

4.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S1	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

4.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.5	Pass ✓
3	Shear Check Major	Construction	0.05	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.15	Pass ✓
10	Resistance To Bending	Composite	0.53	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.23	Pass ✓

13	Serviceability Check	Composite	0.17	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

5. Frame : 1F13 Pass ✓

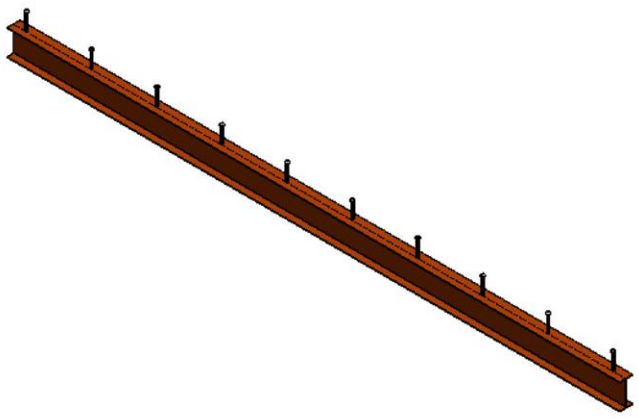
5.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F13	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U1	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

5.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S1	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

5.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.34	Pass ✓
3	Shear Check Major	Construction	0.04	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.23	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

6. Frame : 1F14 Pass ✓

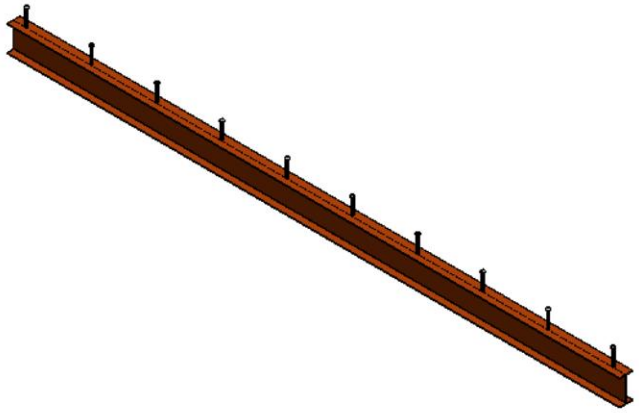
6.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F14	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U1	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

6.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S1	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

6.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.34	Pass ✓
3	Shear Check Major	Construction	0.04	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.23	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

7. Frame : 1F15 Pass ✓

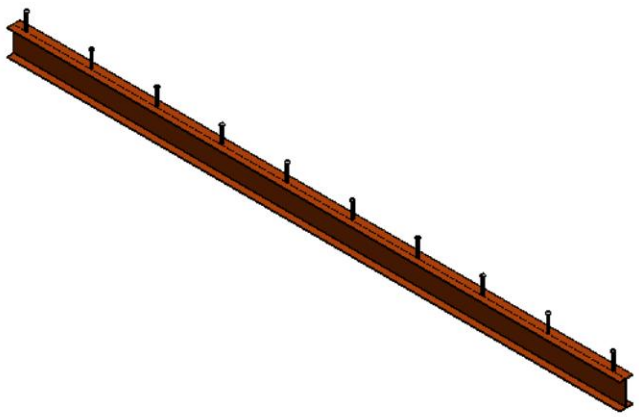
7.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F15	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U1	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

7.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S1	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

7.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.34	Pass ✓
3	Shear Check Major	Construction	0.04	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.23	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

8. Frame : 1F22 Pass ✓

8.1 Steel SectionProperties

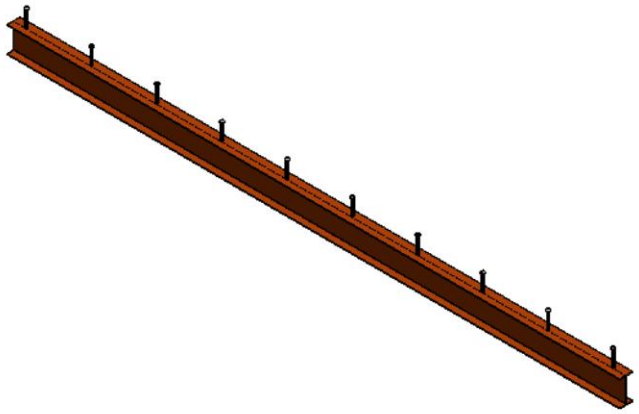
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F22	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U1	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

8.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S1	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5

$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

8.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.34	Pass ✓
3	Shear Check Major	Construction	0.04	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.23	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

9. Frame : 1F23 Pass ✓

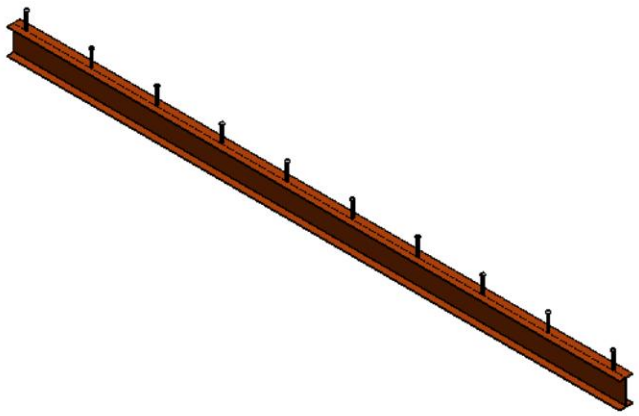
9.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F23	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U1	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

9.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S1	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	800.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	400.0 / 350.0
$\eta_{Analysis}$	**0%**	η_{Target}	**50%**	n_r	1

9.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓

2	Bending Check Major	Construction	0.54	Pass ✓
3	Shear Check Major	Construction	0.06	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.16	Pass ✓
10	Resistance To Bending	Composite	0.57	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.23	Pass ✓
13	Serviceability Check	Composite	0.19	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

10. Frame : 1F8 Pass ✓

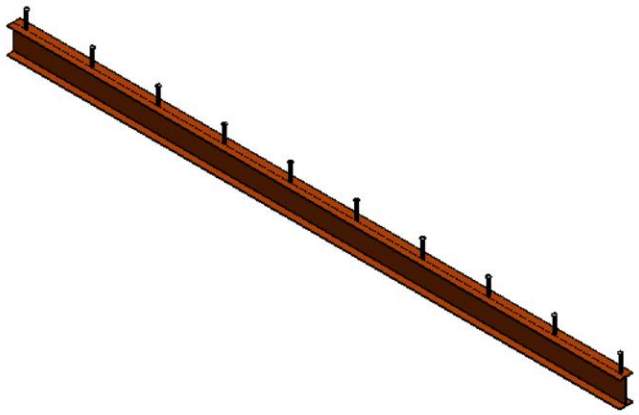
10.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F8	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U2	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

10.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S2	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

10.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[603.6]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.46	Pass ✓
3	Shear Check Major	Construction	0.05	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.15	Pass ✓
10	Resistance To Bending	Composite	0.53	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.97	Pass ✓
13	Serviceability Check	Composite	0.17	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

11. Frame : 1F9 Pass ✓

11.1 Steel SectionProperties

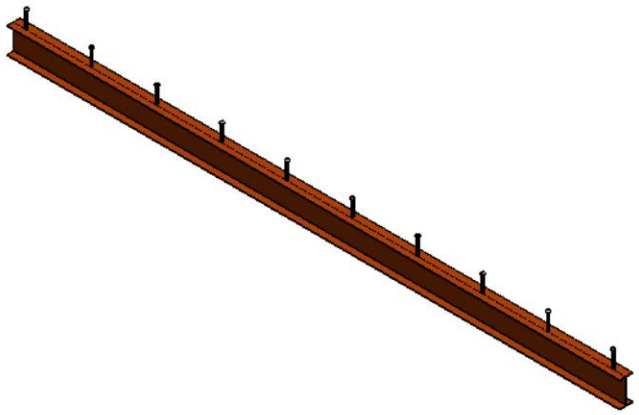
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value

Secondary Composite Beam	1F9	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U2	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

11.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S2	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

11.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.32	Pass ✓
3	Shear Check Major	Construction	0.03	Pass ✓

4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.97	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

12. Frame : 1F10 Pass ✓

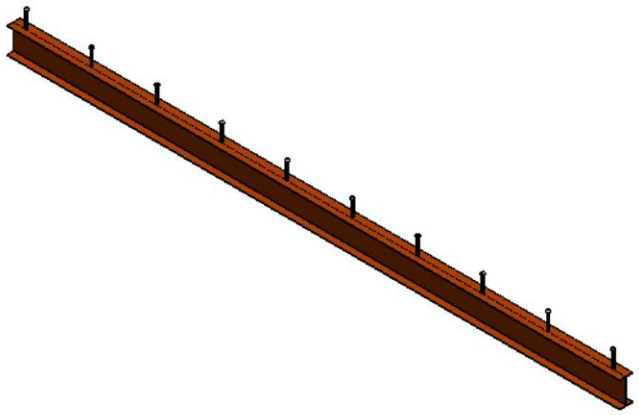
12.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F10	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U2	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

12.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S2	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

12.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.32	Pass ✓
3	Shear Check Major	Construction	0.03	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.97	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

13. Frame : 1F11 Pass ✓

13.1 Steel SectionProperties

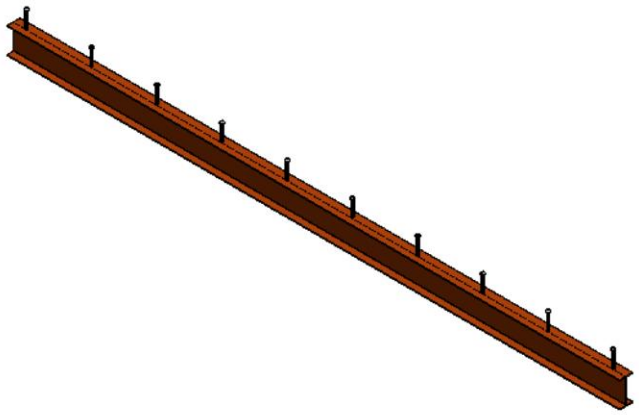
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F11	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)

Parent Member	1U2	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

13.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S2	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

13.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.32	Pass ✓
3	Shear Check Major	Construction	0.03	Pass ✓
4	Camber	Construction	0.01	Pass ✓

5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.97	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

14. Frame : 1F20 Pass ✓

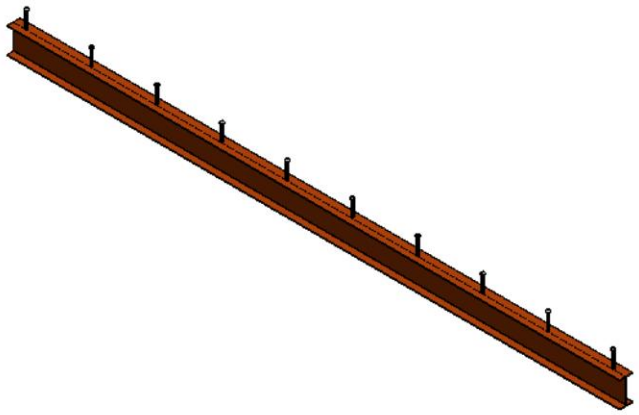
14.1 Steel SectionProperties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F20	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	1U2	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

14.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S2	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	700.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	350.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

14.3 Design Summary



Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[596.1]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.32	Pass ✓
3	Shear Check Major	Construction	0.03	Pass ✓
4	Camber	Construction	0.01	Pass ✓
5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.1	Pass ✓
10	Resistance To Bending	Composite	0.36	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.97	Pass ✓
13	Serviceability Check	Composite	0.12	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

15. Frame : 1F21 Pass ✓

15.1 Steel SectionProperties

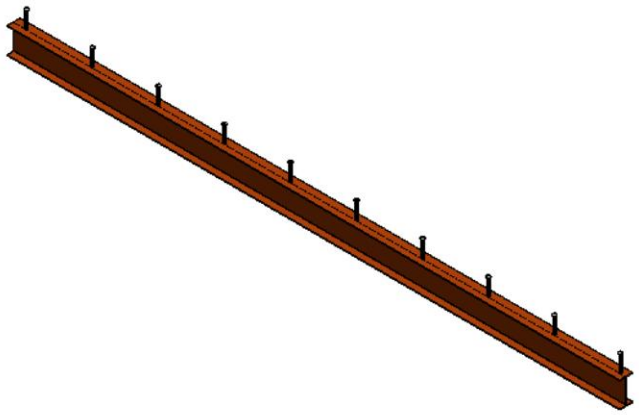
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Secondary Composite Beam	1F21	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)

Parent Member	1U2	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5600.00 mm	A_a	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h_a	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

15.2 Composite Properties

Storey	1	Section	IPE240	Type	Secondary
Parent Slab	1S2	Slab Thickness	150.0	f_{ck}	25.00
E_{cm}	31000.00	$h_{p,}$ / $h_{p,}$	76.2 / 76.2	$S_{r,Left}$ / $S_{r,Right}$	223.5 / 223.5
$h_{c,}$ / $h_{c,}$	73.8 / 73.8	L_{Left} / L_{Right}	800.0 / 700.0	$b_{eff,Left}$ / $b_{eff,Right}$	400.0 / 350.0
$\eta_{Analysis}$	0%	η_{Target}	50%	n_r	1

15.3 Design Summary

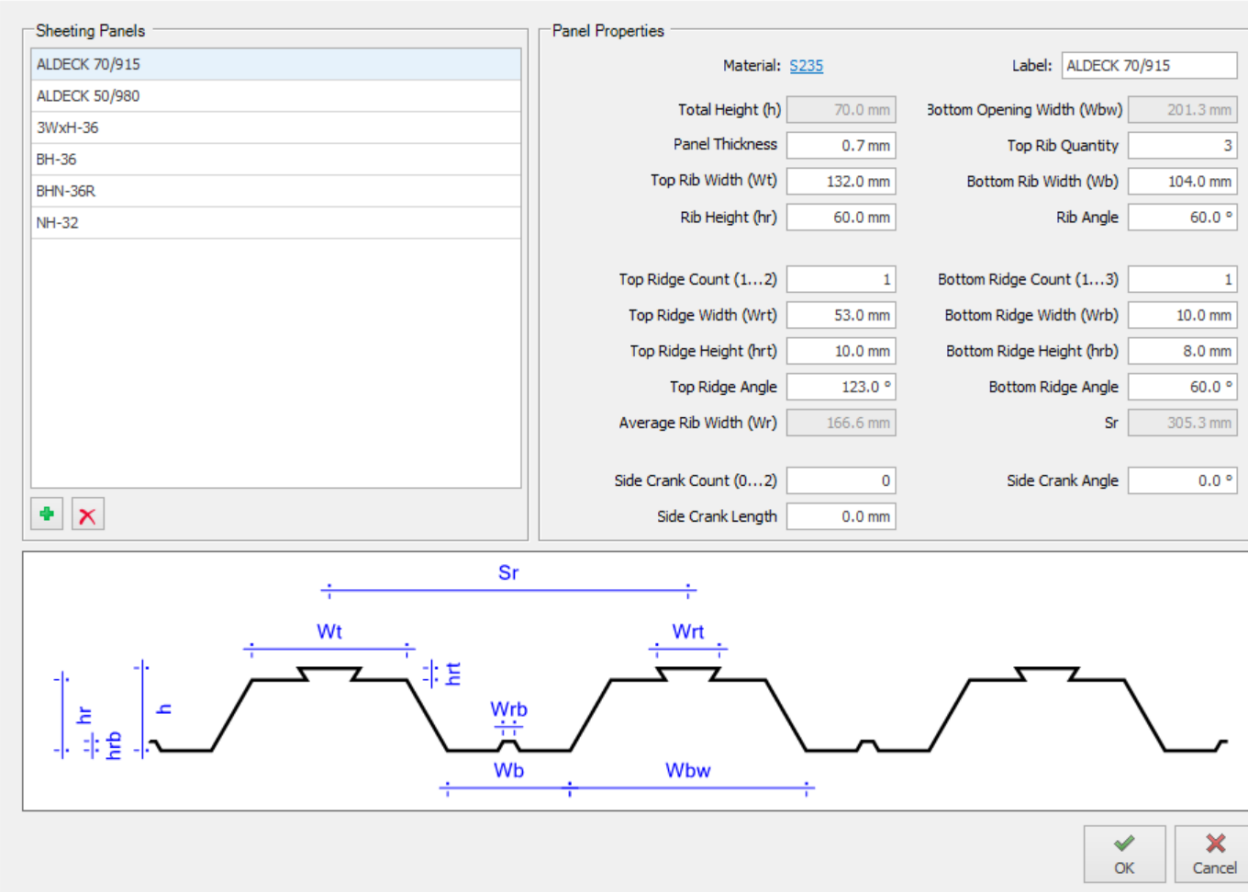


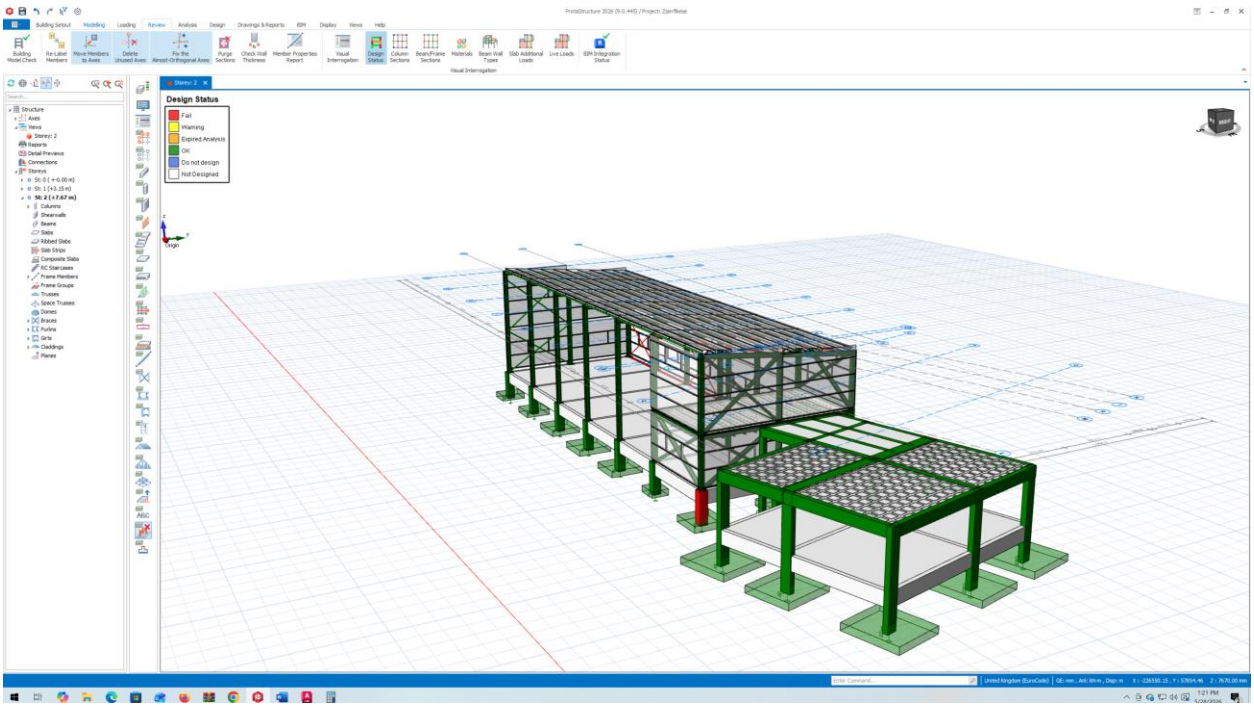
Default Sheeting	NH-32	Stud	Nelson 22/150	Total Studs	10
Stud Layout Type	Uniform	Stud Layout	1 x [10]	Spacing	[603.6]
Camber	-				

No	Check Type	Check Stage	Utilization Ratio	Design Status
1	Section Classification	Construction	-	Pass ✓
2	Bending Check Major	Construction	0.5	Pass ✓
3	Shear Check Major	Construction	0.05	Pass ✓
4	Camber	Construction	0.01	Pass ✓

5	Analysis / Design Composite Degree	Composite	50 / 50	Pass ✓
6	Design Resistance of Shear Connectors	Composite	-	Pass ✓
7	Degree of Shear Connection	Composite	-	Pass ✓
8	Shear Buckling	Composite	0.0	Pass ✓
9	Vertical Shear	Composite	0.16	Pass ✓
10	Resistance To Bending	Composite	0.57	Pass ✓
11	Stud Distribution	Composite	-	Pass ✓
12	Longitudinal Shear Resistance	Composite	0.97	Pass ✓
13	Serviceability Check	Composite	0.19	Pass ✓
14	Detailing Checks	Composite	-	Pass ✓

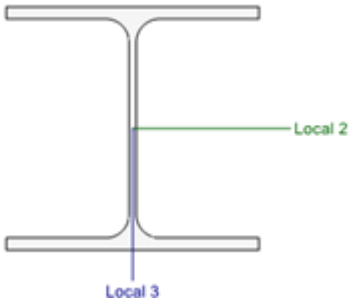
Sheeting Library





Steel Column Design

Eurocode 3 (EN 1993) Design of Steel Structures (Base Code)



General Properties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Column	1C1	b	135.0 mm	r_y	112.3 mm	End Releases J	-
Parent Member	-	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	3150.00 mm	A_g	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	E360	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	360.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	360.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		

h	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	-

Design Forces

Internal Forces	Notation	Value	Critical Position	L_x	L_y	L_b
Axial Compression	N_{Ed}	105.3 kN	(0.00 - 3,150.00) mm	3150.00 mm	3150.00 mm	3150.00 mm
Axial Tension	N_{Ed}	-8.2 kN	(0.00 - 3,150.00) mm	3150.00 mm	3150.00 mm	3150.00 mm
Combined	M_{Ed}	-9.0 kN.m	(0.00 - 3,150.00) mm	3150.00 mm	3150.00 mm	3150.00 mm
Combined	M_{Ed}	-4.3 kN.m	(0.00 - 3,150.00) mm	3150.00 mm	3150.00 mm	3150.00 mm
Shear (Major)	V_{Ed}	-14.1 kN	(0.00 - 3,150.00) mm	3150.00 mm	3150.00 mm	3150.00 mm
Shear (Minor)	V_{Ed}	5.9 kN	(0.00 - 3,150.00) mm	3150.00 mm	3150.00 mm	3150.00 mm
Torsion	T_{Ed}	20.1 kN.m	(0.00 - 3,150.00) mm	3150.00 mm	3150.00 mm	3150.00 mm

Section Classification

Definition	Parameter	Clause
	$\varepsilon = \sqrt{(235 / F_y)} = 0.808$	
Internal Compression Parts		
	$R_1 = 15.0$ mm	
	$c_w = h - 2\,t_f - 2\,R_1 = 177.0$ mm	
Width to Thickness Ratio	$c_w / t_w = 23.600$	
Plastic Stress Ratio	$\alpha = Min (\| 1 / c_w (h / 2 - 0.5 (N_{Ed} / (t_w F_y)) - (t_f - R_1)) \| , 1) = 0.661$	
Web Compactness Limit	$396\,\varepsilon / (13\,\alpha - 1)$ $(\alpha > 0.5) = 42.136$	
	$c_w / t_w < 396\,\varepsilon / (13\,\alpha - 1)$ $(\alpha > 0.5)$	
	$23.600 < 42.136$	
Web Class	Class1	
Outstand Flanges		
	$R_1 = 15.0$ mm	
Top Flange Width	$t_{fw} = 135.0$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
	$c_f = Max (t_{fw} , b_{fw}) / 2 - R_1 - t_w / 2 = 102.3$ mm	
Width to Thickness Ratio	$c_f / t_f = 8.180$	
Plastic Stress Ratio	$\alpha = Min (\| 1 / c_w (h / 2 - 0.5 (N_{Ed} / (t_w F_y)) - (t_f - R_1)) \| , 1) = 0.661$	
Flange Compactness Limit	$9\,\varepsilon / \alpha$ $(\sigma_{Tip} \geq 0) = 11.001$	
	$c_f / t_f < 9\,\varepsilon / \alpha$ $(\sigma_{Tip} \geq 0)$	
	$8.180 < 11.001$	
Flange Class	Class1	
Section Class	**Class1**	

Seismic Checks

Definition	Parameter	Clause
Utilization Ratio Checks		
Axial		
Axial Compression	N_{Ed} = 105.3 kN	
Design Resistance of Cross Section for Uniform Compression	$N_{pl,Rd} = A_g F_y / \gamma_{M0}$ = 3125.5 kN	Eqn. 6.10
Axial Utilization Ratio	$N_{Ed} / N_{pl,Rd}$ = 0.034 < 0.150 ✓	Eqn. 6.3
Shear		
Shear (Major)	$V_{Ed,Z}$ = -8.3 kN	
Shear (Minor)	$V_{Ed,Y}$ = 5.7 kN	
Top Flange Width	t_{fw} = 135.0 mm	
Bottom Flange Width	b_{fw} = 135.0 mm	
Top Flange Thickness	t_{ft} = 10.2 mm	
Bot Flange Thickness	b_{ft} = 10.2 mm	
	R_1 = 15.0 mm	
Major Shear Area	$A_{wZ} = A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2$ = 0.003 m^2	
Top Flange Width	t_{fw} = 135.0 mm	
Bottom Flange Width	b_{fw} = 135.0 mm	
Top Flange Thickness	t_{ft} = 10.2 mm	
Bot Flange Thickness	b_{ft} = 10.2 mm	
	R_1 = 15.0 mm	
Minor Shear Area	$A_{wY} = A_g - (A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2)$ = 0.006 m^2	
Major Plastic Shear Resistance	$V_{pl,Rd\_Z} = A_{wZ} F_y / (\sqrt{3} \gamma_{M0})$ = 597.7 kN	Eqn. 6.18
Plastic Shear Resistance	$V_{pl,Rd\_Y} = A_{wY} F_y / (\sqrt{3} \gamma_{M0})$ = 1206.8 kN	Eqn. 6.18
Shear Utilization Ratio	Max ($V_{Ed,Z} / V_{pl,Rd\_Z}$, $V_{Ed,Y} / V_{pl,Rd\_Y}$) = 0.014 < 0.500 ✓	Eqn. 6.7

Check for Combined Forces

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wy (Comb Id: 93)	
Axial Compression	N_{Ed} = 105.3 kN	
Bending (Major)	M_{Ed} = -9.0 kN.m	
Bending (Minor)	M_{Ed} = -4.3 kN.m	
Axial Compression Ratio	$N_{Ed} / N_{c,Rd}$ = 0.034	
Moment Major Ratio	M_{Ed} / Min ($M_{nY,Rd}$, Major Bending Capacity) = 0.029	
Moment Minor Ratio	M_{Ed} / Min ($M_{nZ,Rd}$, Minor Bending Capacity) = 0.028	
Utilization Ratio	Axial Compression Ratio + Moment Major Ratio + Moment Minor Ratio = 0.090 < 1.000 ✓	6.2.1 (7)

Axial Compression Check

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wy (Comb Id: 93)	
Axial Compression	N_{Ed} = 105.3 kN	
Effective Area	$A_{eff} = A_g$ = 0.009 m^2	
Design Resistance of Cross Section for Uniform Compression	$N_{c,Rd} = A_{eff} F_y / \gamma_{M0}$ = 3125.5 kN	Eqn. 6.10
Y-Y Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2 E I_y / L_x^2$ = 21431.16 kN	
Non-Dimensional Slenderness	$\lambda_y = \sqrt{}(A_g F_y / N_{cr})$ = 0.382	Eqn. 6.49
Imperfection Factor	α_y = 0.340 (Condition : h / b > 1.2 and $t_f \leq$ 40.0 mm)	
Buckling Curve	b	
Reduction Factor For Buckling Of The Section	χ_y = 1.000	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdY} = \chi_y A_{eff} F_y / \gamma_{M1}$ = 3125.5 kN	Eqn. 6.10
Z-Z Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2 E I_z / L_y^2$ = 7522.44 kN	
Non-Dimensional Slenderness	$\lambda_z = \sqrt{}(A_g F_y / N_{cr})$ = 0.645	Eqn. 6.49
Imperfection Factor	α_z = 0.490 (Condition : h / b > 1.2 and $t_f \leq$ 40.0 mm)	
Buckling Curve	c	
Reduction Factor For Buckling Of The Section	χ_z = 1.000	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdZ} = \chi_z A_{eff} F_y / \gamma_{M1}$ = 3125.5 kN	Eqn. 6.10
Capacity	Min ($N_{b,RdY}$, $N_{b,RdZ}$, $N_{c,Rd}$) = 3125.5 kN	
Utilization Ratio	N_{Ed} / Capacity = 0.034 < 1.000 ✓	

Axial Tension Check

Definition	Parameter	Clause
Critical Load Combination	1.15G+Ex++0.3Ey- (Comb Id: 63)	
Axial Tension	N_{Ed} = -8.2 kN	
Design Resistance Of The Cross-Section For Tension Yielding	$N_{pl,Rd} = A_g F_y / \gamma_{M0}$ = 3125.5 kN	Eqn. 6.6
Design Resistance Of The Cross-Section For Rupture	$N_{u,Rd} = 0.9 A_g F_u / \gamma_{M2}$ = 2250.4 kN	Eqn. 6.7
Utilization Ratio	N_{Ed} / Min ($N_{pl,Rd}$, $N_{u,Rd}$) = 0.004 < 1.000 ✓	

Bending Check Major

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wy (Comb Id: 93)	
Bending (Major)	M_{Ed} = -9.0 kN.m	
Link Design Resistance For Bending	$M_{c,Rd} = W_{pl,y} F_y / \gamma_{M0}$ = 331.2 kN.m	Eqn. 6.13
Warping Constant	$I_w = (h - t_f)^2 I_z / 4$ = 517245312500.000	SN003b-EN-EU Eqn. 4
Elastic Critical Moment	$M_{cr} = C_1 \pi^2 E I_z / L_b^2 \sqrt{}(C_w / I_z + L_b^2 G I_t / (\pi^2 E I_z)$ = 1010.1 kN.m	SN003b-EN-EU Eqn. 3

Effective Section Modulus	$W_{eff} = W_{pl,y} = 9.200E-04\ m^3$	
Appropriate Non-dimensional Slenderness Ratio	$\lambda_{LT} = \sqrt{}(W_{eff} F_y / M_{cr}) = 0.573$	Eqn. 6.56
Imperfection Factor	$\alpha_{LT} = 0.210$	Table 6.3
Plateau Length Of The Lateral Torsional Buckling Curves For Rolled and Welded Sections	$\lambda_{LT0} = 0.400$	
Correction Factor For The Lateral Torsional Buckling Curves	$\beta = 0.750$	
Value To Determine The Reduction Factor Chi	$\varphi_{LT} = 0.5 (1 + \alpha_{LT} (\lambda_{LT} - \lambda_{LT0}) + \beta \lambda_{LT}^2 = 0.641$	Eqn. 6.57
Bending Stress Reduction Factor to Account For Lateral Buckling	$\chi_{LT} = Min (1 / (\varphi_{LT} + \sqrt{}(\varphi_{LT}^2 - \beta \lambda_{LT}^2)) , 1) = 0.955$	Eqn. 6.57
Design Buckling Resistance Moment	$M_{b,Rd} = \chi_{LT} W_{pl,z} F_y / \gamma_{M1} = 316.2$ kN.m	Eqn. 6.55
Capacity	$Min (M_{c,Rd} , M_{b,Rd}) = 316.2$ kN.m	
Utilization Ratio	$M_{Ed} / M_{b,Rd} = 0.029 < 1.000$ ✓	

Bending Check Minor

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wy (Comb Id: 93)	
Bending (Minor)	$M_{Ed} = -4.3$ kN.m	
Design Resistance For Bending	$M_{c,Rd} = W_{pl,y} F_y / \gamma_{M0} = 154.8$ kN.m	Eqn. 6.13
Warping Constant	$I_w = (h - t_f)^2 I_z / 4 = 517245312500.000$	SN003b-EN-EU Eqn. 4
Elastic Critical Moment	$M_{cr} = C_1 \pi^2 E I_z / L_b^2 \sqrt{}(I_w / I_z + L_b^2 G I_t / (\pi^2 E I_z) = 1010.1$ kN.m	SN003b-EN-EU Eqn. 3
Effective Section Modulus	$W_{eff} = W_{pl,z} = 4.300E-04\ m^3$	
Appropriate Non-dimensional Slenderness Ratio	$\lambda_{LT} = \sqrt{}(W_{eff} F_y / M_{cr}) = 0.391$	Eqn. 6.56
Imperfection Factor	$\alpha_{LT} = 0.210$	Table 6.3
Plateau Length Of The Lateral Torsional Buckling Curves For Rolled and Welded Sections	$\lambda_{LT0} = 0.400$	
Correction Factor For The Lateral Torsional Buckling Curves	$\beta = 0.750$	
Value To Determine The Reduction Factor Chi	$\varphi_{LT} = 0.5 (1 + \alpha_{LT} (\lambda_{LT} - \lambda_{LT0}) + \beta \lambda_{LT}^2 = 0.557$	Eqn. 6.57
Bending Stress Reduction Factor to Account For Lateral Buckling	$\chi_{LT} = Min (1 / (\varphi_{LT} + \sqrt{}(\varphi_{LT}^2 - \beta \lambda_{LT}^2)) , 1) = 1.000$	Eqn. 6.57
Design Buckling Resistance Moment	$M_{b,Rd} = \chi_{LT} W_{pl,z} F_y / \gamma_{M1} = 331.2$ kN.m	Eqn. 6.55
Capacity	$Min (M_{c,Rd} , M_{b,Rd}) = 154.8$ kN.m	
Utilization Ratio	$M_{Ed} / M_{c,Rd} = 0.028 < 1.000$ ✓	

Shear Check Major

Definition	Parameter	Clause
Critical Load Combination	G+0.3Q-0.3Ex+-Ey- (Comb Id: 58)	
Shear (Major)	$V_{Ed} = -14.1$ kN	
Top Flange Width	$t_{fw} = 135.0$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
Top Flange Thickness	$t_{ft} = 10.2$ mm	
Bot Flange Thickness	$b_{ft} = 10.2$ mm	
	$R_1 = 15.0$ mm	

Shear Area	$A_v = A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2 =$ 0.003 m^2	Chp. 6.2.6 (3)
Design Plastic Shear Resistance		
Design Plastic Shear Resistance	$V_{pl,Rd} = A_v (F_y / \sqrt{3}) / \gamma_{M0} =$ 587.3 kN	Eqn. 6.18
Shear Buckling Capacity		
Top Flange Thickness	$t_{ft} =$ 10.2 mm	
Bot Flange Thickness	$b_{ft} =$ 10.2 mm	
Bottom Flange Width	$b_{fw} =$ 135.0 mm	
Height Thickness Ratio	$h_w / t_w = (h - t_{ft} - b_{ft}) / t_w =$ 30.000	
	$\varepsilon = \sqrt{(235 / F_y)} =$ 0.808	
	$\eta =$ 1.200 ($F_y \leq$ 460 N/mm^2)	EN1993-1-5 Chp. 5.1.2
Shear Buckling Limit	72 ε / η = 48.477	Eqn 6.22
	30.000 < 48.477	Eqn 6.22
	$h_w / t_w <$ 72 ε / η (Shear Buckling Resistance Check is not required)	
Utilization Ratio	$V_{Ed} / V_{pl,Rd} =$ 0.024 < 1.000 ✓	

Shear Check Minor

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9W-y (Comb Id: 94)	
Shear (Minor)	$V_{Ed} =$ 5.9 kN	
Top Flange Width	$t_{fw} =$ 135.0 mm	
Bottom Flange Width	$b_{fw} =$ 135.0 mm	
Top Flange Thickness	$t_{ft} =$ 10.2 mm	
Bot Flange Thickness	$b_{ft} =$ 10.2 mm	
	$R_1 =$ 15.0 mm	
Shear Area	$A_v = A_g - (A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2) =$ 0.006 m^2	Chp. 6.2.6 (3)
Design Plastic Shear Resistance		
Design Plastic Shear Resistance	$V_{pl,Rd} = A_v (F_y / \sqrt{3}) / \gamma_{M0} =$ 1129.08 kN	Eqn. 6.18
Shear Buckling Capacity		
Top Flange Thickness	$t_{ft} =$ 10.2 mm	
Bot Flange Thickness	$b_{ft} =$ 10.2 mm	
Bottom Flange Width	$b_{fw} =$ 135.0 mm	
Height Thickness Ratio	$h_w / t_w = \text{Max} ((t_{ft} / 2 - t_w) / t_{ft} , (b_{fw} / 2 - t_w) / b_{ft} =$ 9.800	
	$\varepsilon = \sqrt{(235 / F_y)} =$ 0.808	
	$\eta =$ 1.200 ($F_y \leq$ 460 N/mm2)	EN1993-1-5 Chp. 5.1.2
Shear Buckling Limit	72 ε / η = 48.477	Eqn. 6.22
	9.800 ≥ 48.477	Eqn. 6.22
	$h_w / t_w \geq$ 72 ε / η (Shear Buckling Resistance Check is not required	
Utilization Ratio		

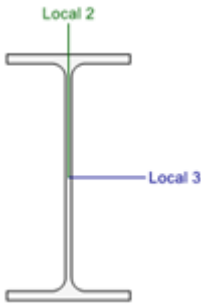
Utilization Ratio	$V_{Ed} / V_{pl,Rd} = 0.005 < 1.000$ ✓

Torsion Check

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.05Q+1.5Wy (Comb Id: 97)	
Torsion	$T_{Des} = 20.1$ kN.m	
Bot Flange Thickness	$t_{bf} = 10.2$ mm	
Top Flange Thickness	$t_{tf} = 10.2$ mm	
Torsion	$M_{f,Ed} = T_{Des} / (h - (t_{bf} + t_{tf}) 0.5) L_b / 4 = 66.7$ kN.m	
Top Flange Width	$w_{tf} = 135.0$ mm	
Bottom Flange Width	$w_{tf} = 135.0$ mm	
Nominal Torsional Strength	$M_{f,Rd} = Min (t_{tf} w_{tf}^2 / 4 , t_{bf} w_{bf}^2 / 4) F_y / \gamma_{M0} = 76.1$ kN.m	
Utilization Ratio	$M_{f,Ed} / M_{f,Rd} = 0.877 < 1.000$ ✓	Eqn. 6.23

Steel Frame Design

Eurocode 3 (EN 1993) Design of Steel Structures (Base Code)



General Properties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Frame Member	2F1	b	135.0 mm	r_y	112.3 mm	End Releases J	Fixed
Parent Member	-	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	10049.88 mm	A_g	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	Fixed		

Design Forces

Internal Forces	Notation	Value	Critical Position	L_x	L_y	L_b
Axial Compression	N_{Ed}	30.3 kN	(0.00 - 10,049.88) mm	10049.88 mm	1200.00 mm	1200.00 mm
Axial Tension	N_{Ed}	-27.9 kN	(0.00 - 10,049.88) mm	10049.88 mm	1200.00 mm	1200.00 mm
Combined	M_{Ed}	-47.4 kN.m	(0.00 - 10,049.88) mm	10049.88 mm	1200.00 mm	1200.00 mm
Combined	M_{Ed}	-11.6 kN.m	(0.00 - 10,049.88) mm	10049.88 mm	1200.00 mm	1200.00 mm
Shear (Major)	V_{Ed}	65.7 kN	(0.00 - 10,049.88) mm	10049.88 mm	1200.00 mm	1200.00 mm
Shear (Minor)	V_{Ed}	33.1 kN	(0.00 - 10,049.88) mm	10049.88 mm	1200.00 mm	1200.00 mm
Torsion	T_{Ed}	-1.2 kN.m	(0.00 - 10,049.88) mm	10049.88 mm	1200.00 mm	1200.00 mm

Section Classification

Definition	Parameter	Clause
	$\varepsilon = \sqrt{(235 / F_y)} = 0.924$	
Internal Compression Parts		
	$R_1 = 15.0$ mm	
	$c_w = h - 2 t_f - 2 R_1 = 219.6$ mm	
Width to Thickness Ratio	$c_w / t_w = 33.273$	
Plastic Stress Ratio	$\alpha = \text{Min}(\lvert 1 / c_w (h / 2 - 0.5 (N_{Ed} / (t_w F_y)) - (t_f - R_1)) \rvert , 1) = 0.611$	
Web Compactness Limit	$396 \varepsilon / (13 \alpha - 1) \quad (\alpha > 0.5) = 52.748$	
	$c_w / t_w < 396 \varepsilon / (13 \alpha - 1) \quad (\alpha > 0.5)$	
	$33.273 < 52.748$	
Web Class	Class1	
Outstand Flanges		
	$R_1 = 15.0$ mm	
Top Flange Width	$t_{fw} = 135.0$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
	$c_f = \text{Max}(t_{fw} , b_{fw}) / 2 - R_1 - t_w / 2 = 49.2$ mm	
Width to Thickness Ratio	$c_f / t_f = 4.824$	
Plastic Stress Ratio	$\alpha = \text{Min}(\lvert 1 / c_w (h / 2 - 0.5 (N_{Ed} / (t_w F_y)) - (t_f - R_1)) \rvert , 1) = 0.611$	
Flange Compactness Limit	$9 \varepsilon / \alpha \quad (\sigma_{Tip} \geq 0) = 13.622$	
	$c_f / t_f < 9 \varepsilon / \alpha \quad (\sigma_{Tip} \geq 0)$	
	$4.824 < 13.622$	
Flange Class	Class1	
Section Class	**Class1**	

Seismic Checks

Definition	Parameter	Clause

Utilization Ratio Checks		
Axial		
Axial Compression	N_{Ed} = 20.6 kN	
Design Resistance of Cross Section for Uniform Compression	$N_{pl,Rd} = A_g F_y / \gamma_{M0}$ = 1263.5 kN	Eqn. 6.10
Axial Utilization Ratio	$N_{Ed} / N_{pl,Rd}$ = 0.016 < 0.150 ✓	Eqn. 6.3
Shear		
Shear (Major)	$V_{Ed,Z}$ = 65.7 kN	
Shear (Minor)	$V_{Ed,Y}$ = 3.0 kN	
Top Flange Width	t_{fw} = 135.0 mm	
Bottom Flange Width	b_{fw} = 135.0 mm	
Top Flange Thickness	t_{ft} = 10.2 mm	
Bot Flange Thickness	b_{ft} = 10.2 mm	
	R_1 = 15.0 mm	
Major Shear Area	$A_{wZ} = A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2$ = 0.002 m^2	
Top Flange Width	t_{fw} = 135.0 mm	
Bottom Flange Width	b_{fw} = 135.0 mm	
Top Flange Thickness	t_{ft} = 10.2 mm	
Bot Flange Thickness	b_{ft} = 10.2 mm	
	R_1 = 15.0 mm	
Minor Shear Area	$A_{wY} = A_g - (A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2)$ = 0.002 m^2	
Major Plastic Shear Resistance	$V_{pl,Rd\_Z} = A_{wZ} F_y / (\sqrt{3} \gamma_{M0})$ = 351.5 kN	Eqn. 6.18
Plastic Shear Resistance	$V_{pl,Rd\_Y} = A_{wY} F_y / (\sqrt{3} \gamma_{M0})$ = 378.0 kN	Eqn. 6.18
Shear Utilization Ratio	Max ($V_{Ed,Z} / V_{pl,Rd\_Z}$, $V_{Ed,Y} / V_{pl,Rd\_Y}$) = 0.187 < 0.500 ✓	Eqn. 6.4

Check for Combined Forces

Definition	Parameter	Clause
Critical Load Combination	G+0.3Q-0.3Ex--Ey+ (Comb Id: 56)	
Axial Compression	N_{Ed} = 27.9 kN	
Bending (Major)	M_{Ed} = -47.4 kN.m	
Bending (Minor)	M_{Ed} = -11.6 kN.m	
Axial Compression Ratio	$N_{Ed} / N_{c,Rd}$ = 0.022	
Moment Major Ratio	M_{Ed} / Min ($M_{nY,Rd}$, Major Bending Capacity) = 0.356	
Moment Minor Ratio	M_{Ed} / Min ($M_{nZ,Rd}$, Minor Bending Capacity) = 0.434	
Utilization Ratio	Axial Compression Ratio + Moment Major Ratio + Moment Minor Ratio = 0.813 < 1.000 ✓	6.2.1 (7)

Axial Compression Check

Definition	Parameter	Clause
Critical Load Combination	G+0.3Q-Ex--0.3Ey+ (Comb Id: 50)	
Axial Compression	N_{Ed} = 30.3 kN	

Effective Area	$A_{eff} = A_g = 0.005\ m^2$	
Design Resistance of Cross Section for Uniform Compression	$N_{c,Rd} = A_{eff}\ F_y / \gamma_{M0} = 1263.5\ kN$	Eqn. 6.10
Y-Y Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2\ E\ I_y / L_x^2 = 1166.56\ kN$	
Non-Dimensional Slenderness	$\lambda_y = \sqrt{}\ (\ A_g\ F_y / N_{cr}\ ) = 1.041$	Eqn. 6.49
Imperfection Factor	$\alpha_y = 0.210$ (Condition : h / b > 1.2 and $t_f \leq 40.0$ mm)	
Buckling Curve	a	
Reduction Factor For Buckling Of The Section	$\chi_y = 1.000$	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdY} = \chi_y\ A_{eff}\ F_y / \gamma_{M1} = 1263.5\ kN$	Eqn. 6.10
Z-Z Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2\ E\ I_z / L_y^2 = 5935.23\ kN$	
Non-Dimensional Slenderness	$\lambda_z = \sqrt{}\ (\ A_g\ F_y / N_{cr}\ ) = 0.461$	Eqn. 6.49
Imperfection Factor	$\alpha_z = 0.340$ (Condition : h / b > 1.2 and $t_f \leq 40.0$ mm)	
Buckling Curve	b	
Reduction Factor For Buckling Of The Section	$\chi_z = 1.000$	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdZ} = \chi_z\ A_{eff}\ F_y / \gamma_{M1} = 1263.5\ kN$	Eqn. 6.10
Capacity	Min ($N_{b,RdY}$, $N_{b,RdZ}$, $N_{c,Rd}$) = 1263.5 kN	
Utilization Ratio	N_{Ed} / Capacity = 0.024 < 1.000 ✓	

Axial Tension Check

Definition	Parameter	Clause
Critical Load Combination	1.15G+Ex-+0.3Ey+ (Comb Id: 65)	
Axial Tension	$N_{Ed} = -27.9\ kN$	
Design Resistance Of The Cross-Section For Tension Yielding	$N_{pl,Rd} = A_g\ F_y / \gamma_{M0} = 1263.5\ kN$	Eqn. 6.6
Design Resistance Of The Cross-Section For Rupture	$N_{u,Rd} = 0.9\ A_g\ F_u / \gamma_{M2} = 1422.5\ kN$	Eqn. 6.7
Utilization Ratio	N_{Ed} / Min ($N_{pl,Rd}$, $N_{u,Rd}$) = 0.022 < 1.000 ✓	

Bending Check Major

Definition	Parameter	Clause
Critical Load Combination	G+0.3Q-0.3Ex--Ey+ (Comb Id: 56)	
Bending (Major)	$M_{Ed} = -47.4\ kN.m$	
Link Design Resistance For Bending	$M_{c,Rd} = W_{pl,y}\ F_y / \gamma_{M0} = 133.1\ kN.m$	Eqn. 6.13
Warping Constant	$I_w = (\ h - t_f\ )^2\ I_z / 4 = 70870842000.000$	SN003b-EN-EU Eqn. 4
Elastic Critical Moment	$M_{cr} = C_1\ \pi^2\ E\ I_z / L_b^2\ \sqrt{}\ (\ C_w / I_z + L_b^2\ G\ I_t / (\ \pi^2\ E\ I_z\ ) = 807.0\ kN.m$	SN003b-EN-EU Eqn. 3
Effective Section Modulus	$W_{eff} = W_{pl,y} = 4.840E\text{-}04\ m^3$	
Appropriate Non-dimensional Slenderness Ratio	$\lambda_{LT} = \sqrt{}\ (\ W_{eff}\ F_y / M_{cr}\ ) = 0.406$	Eqn. 6.56
Imperfection Factor	$\alpha_{LT} = 0.210$	Table 6.3

Plateau Length Of The Lateral Torsional Buckling Curves For Rolled and Welded Sections	$\lambda_{LT0} = 0.400$	
Correction Factor For The Lateral Torsional Buckling Curves	$\beta = 0.750$	
Value To Determine The Reduction Factor Chi	$\varphi_{LT} = 0.5 (1 + \alpha_{LT} (\lambda_{LT} - \lambda_{LT0}) + \beta \lambda_{LT}^2 = 0.562$	Eqn. 6.57
Bending Stress Reduction Factor to Account For Lateral Buckling	$\chi_{LT} = Min (1 / (\varphi_{LT} + \sqrt{} (\varphi_{LT}^2 - \beta \lambda_{LT}^2)) , 1) = 0.999$	Eqn. 6.57
Design Buckling Resistance Moment	$M_{b,Rd} = \chi_{LT} W_{pl,z} F_y / \gamma_{M1} = 132.9$ kN.m	Eqn. 6.55
Capacity	$Min (M_{c,Rd} , M_{b,Rd}) = 132.9$ kN.m	
Utilization Ratio	$M_{Ed} / M_{b,Rd} = 0.356 < 1.000$ ✓	

Bending Check Minor

Definition	Parameter	Clause
Critical Load Combination	G+0.3Q-0.3Ex--Ey+ (Comb Id: 56)	
Bending (Minor)	$M_{Ed} = -11.6$ kN.m	
Design Resistance For Bending	$M_{c,Rd} = W_{pl,y} F_y / \gamma_{M0} = 26.7$ kN.m	Eqn. 6.13
Warping Constant	$I_w = (h - t_f)^2 I_z / 4 = 70870842000.000$	SN003b-EN-EU Eqn. 4
Elastic Critical Moment	$M_{cr} = C_1 \pi^2 E I_z / L_b^2 \sqrt{} (I_w / I_z + L_b^2 G I_t / (\pi^2 E I_z) = 807.0$ kN.m	SN003b-EN-EU Eqn. 3
Effective Section Modulus	$W_{eff} = W_{pl,z} = 9.700E-05$ m^3	
Appropriate Non-dimensional Slenderness Ratio	$\lambda_{LT} = \sqrt{} (W_{eff} F_y / M_{cr}) = 0.182$	Eqn. 6.56
Imperfection Factor	$\alpha_{LT} = 0.210$	Table 6.3
Plateau Length Of The Lateral Torsional Buckling Curves For Rolled and Welded Sections	$\lambda_{LT0} = 0.400$	
Correction Factor For The Lateral Torsional Buckling Curves	$\beta = 0.750$	
Value To Determine The Reduction Factor Chi	$\varphi_{LT} = 0.5 (1 + \alpha_{LT} (\lambda_{LT} - \lambda_{LT0}) + \beta \lambda_{LT}^2 = 0.489$	Eqn. 6.57
Bending Stress Reduction Factor to Account For Lateral Buckling	$\chi_{LT} = Min (1 / (\varphi_{LT} + \sqrt{} (\varphi_{LT}^2 - \beta \lambda_{LT}^2)) , 1) = 1.000$	Eqn. 6.57
Design Buckling Resistance Moment	$M_{b,Rd} = \chi_{LT} W_{pl,z} F_y / \gamma_{M1} = 133.1$ kN.m	Eqn. 6.55
Capacity	$Min (M_{c,Rd} , M_{b,Rd}) = 26.7$ kN.m	
Utilization Ratio	$M_{Ed} / M_{c,Rd} = 0.434 < 1.000$ ✓	

Shear Check Major

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wx (Comb Id: 91)	
Shear (Major)	$V_{Ed} = 65.7$ kN	
Top Flange Width	$t_{fw} = 135.0$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
Top Flange Thickness	$t_{ft} = 10.2$ mm	
Bot Flange Thickness	$b_{ft} = 10.2$ mm	
	$R_1 = 15.0$ mm	
Shear Area	$A_v = A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2 = 0.002$ m^2	Chp. 6.2.6 (3)
Design Plastic Shear Resistance		

Design Plastic Shear Resistance	$V_{pl,Rd} = A_v (F_y / \sqrt{3}) / \gamma_{M0} = 351.3$ kN	Eqn. 6.18
Shear Buckling Capacity		
Top Flange Thickness	$t_{ft} = 10.2$ mm	
Bot Flange Thickness	$b_{ft} = 10.2$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
Height Thickness Ratio	$h_w / t_w = (h - t_{ft} - b_{ft}) / t_w = 37.818$	
	$\varepsilon = \sqrt{(235 / F_y)} = 0.924$	
	$\eta = 1.200$ ($F_y \leq 460$ N/mm^2)	EN1993-1-5 Chp. 5.1.2
Shear Buckling Limit	$72 \varepsilon / \eta = 55.465$	Eqn 6.22
	$37.818 < 55.465$	Eqn 6.22
	$h_w / t_w < 72 \varepsilon / \eta$ (Shear Buckling Resistance Check is not required)	
Utilization Ratio	$V_{Ed} / V_{pl,Rd} = 0.187 < 1.000$ ✓	

Shear Check Minor

Definition	Parameter	Clause
Critical Load Combination	G+0.3Q+0.3Ex++Ey- (Comb Id: 57)	
Shear (Minor)	$V_{Ed} = 33.1$ kN	
Top Flange Width	$t_{fw} = 135.0$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
Top Flange Thickness	$t_{ft} = 10.2$ mm	
Bot Flange Thickness	$b_{ft} = 10.2$ mm	
	$R_1 = 15.0$ mm	
Shear Area	$A_v = A_g - (A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2) = 0.002$ m^2	Chp. 6.2.6 (3)
Design Plastic Shear Resistance		
Design Plastic Shear Resistance	$V_{pl,Rd} = A_v (F_y / \sqrt{3}) / \gamma_{M0} = 368.84$ kN	Eqn. 6.18
Shear Buckling Capacity		
Top Flange Thickness	$t_{ft} = 10.2$ mm	
Bot Flange Thickness	$b_{ft} = 10.2$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
Height Thickness Ratio	$h_w / t_w = \text{Max} ((t_{ft} / 2 - t_w) / t_{ft} , (b_{fw} / 2 - t_w) / b_{ft} = 5.971$	
	$\varepsilon = \sqrt{(235 / F_y)} = 0.924$	
	$\eta = 1.200$ ($F_y \leq 460$ N/mm2)	EN1993-1-5 Chp. 5.1.2
Shear Buckling Limit	$72 \varepsilon / \eta = 55.465$	Eqn. 6.22
	$5.971 \geq 55.465$	Eqn. 6.22
	$h_w / t_w \geq 72 \varepsilon / \eta$ (Shear Buckling Resistance Check is not required	
Utilization Ratio		
Utilization Ratio	$V_{Ed} / V_{pl,Rd} = 0.090 < 1.000$ ✓	

Torsion Check

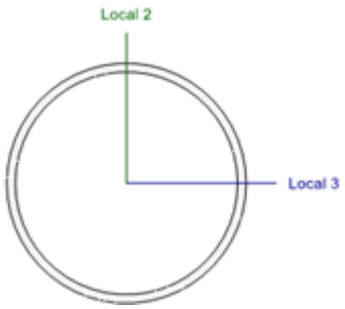
Definition	Parameter	Clause
Critical Load Combination	G+0.3Q-0.3Ex+-Ey- (Comb Id: 58)	
Torsion	T_{Des} = -1.2 kN.m	
Bot Flange Thickness	t_{bf} = 10.2 mm	
Top Flange Thickness	t_{tf} = 10.2 mm	
Torsion	$M_{f,Ed} = T_{Des} / (h - (t_{bf} + t_{tf}) 0.5) L_b / 4$ = 1.3 kN.m	
Top Flange Width	w_{tf} = 135.0 mm	
Bottom Flange Width	w_{tf} = 135.0 mm	
Nominal Torsional Strength	$M_{f,Rd} = Min (t_{tf} w_{tf}^2 / 4 , t_{bf} w_{bf}^2 / 4) F_y / \gamma_{M0}$ = 12.8 kN.m	
Utilization Ratio	$M_{f,Ed} / M_{f,Rd}$ = 0.104 < 1.000 ✓	Eqn. 6.23

Deflection Check

Definition	Parameter	Clause
Deflection Span	L_{span} = 10049.88 mm	
Category	Roof Beam	
Combination (G+0.5Q)		
Deflection	δ_v = 23.111 mm	
Deflection Limit	$\delta_{v,Limit} = L / 360$ = 27.9 mm	
Deflection Check	23.111 < 27.9 (L/360) ✓	
Combination (G+0.5Q+0.6Wx)		
Deflection	δ_v = 23.049 mm	
Deflection Limit	$\delta_{v,Limit} = L / 360$ = 27.9 mm	
Deflection Check	23.049 < 27.9 (L/360) ✓	
Combination (G+0.5Q+0.6W-x)		
Deflection	δ_v = 23.175 mm	
Deflection Limit	$\delta_{v,Limit} = L / 360$ = 27.9 mm	
Deflection Check	23.175 < 27.9 (L/360) ✓	
Combination (G+0.5Q+0.6Wy)		
Deflection	δ_v = 22.991 mm	
Deflection Limit	$\delta_{v,Limit} = L / 360$ = 27.9 mm	
Deflection Check	22.991 < 27.9 (L/360) ✓	
Combination (G+0.5Q+0.6W-y)		
Deflection	δ_v = 23.235 mm	
Deflection Limit	$\delta_{v,Limit} = L / 360$ = 27.9 mm	
Deflection Check	23.235 < 27.9 (L/360) ✓	

Steel Frame Design

Eurocode 3 (EN 1993) Design of Steel Structures (Base Code)



General Properties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Horizontal Brace	2F8	b	135.0 mm	r_y	112.3 mm	End Releases J	(M22,M33)
Parent Member	-	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	4800.00 mm	A_g	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S275	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	275.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	430.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	(M22,M33)		

Design Forces

Internal Forces	Notation	Value	Critical Position	L_x	L_y	L_b
Axial Compression	N_{Ed}	14.1 kN	(0.00 - 4,800.00) mm	4800.00 mm	4800.00 mm	4800.00 mm
Axial Tension	N_{Ed}	-14.8 kN	(0.00 - 4,800.00) mm	4800.00 mm	4800.00 mm	4800.00 mm
Shear (Major)	V_{Ed}	0.2 kN	(0.00 - 4,800.00) mm	4800.00 mm	4800.00 mm	4800.00 mm
Shear (Minor)	V_{Ed}	0.0 kN	(0.00 - 4,800.00) mm	4800.00 mm	4800.00 mm	4800.00 mm

Section Classification

Definition	Parameter	Clause
	$\varepsilon = \sqrt{(235 / F_y)} = 0.924$	
Internal Compression Parts		
	$R_1 = 15.0$ mm	
	$c_w = h - 2\,t_f - 2\,R_1 = 88.9$ mm	

Width to Thickness Ratio	$c_w / t_w = 27.781$
Web Compactness Limit	$50 \varepsilon^2 = 42.727$
	$c_w / t_w < 50 \varepsilon^2$
	$27.781 < 42.727$
Web Class	Class1
Outstand Flanges	
	$R_1 = 15.0$ mm
Top Flange Width	$t_{fw} = 135.0$ mm
Bottom Flange Width	$b_{fw} = 135.0$ mm
	$c_f = Max (t_{fw} , b_{fw}) / 2 - R_1 - t_w / 2 = 88.9$ mm
Width to Thickness Ratio	$c_f / t_f = 27.781$
Flange Compactness Limit	$50 \varepsilon^2 = 42.727$
	$c_f / t_f < 50 \varepsilon^2$
	$27.781 < 42.727$
Flange Class	Class1
Section Class	**Class1**

Axial Compression Check

Definition	Parameter	Clause
Critical Load Combination	1.15G-Ex--0.3Ey+ (Comb Id: 66)	
Axial Compression	$N_{Ed} = 14.1$ kN	
Effective Area	$A_{eff} = A_g = 0.001$ m^2	
Design Resistance of Cross Section for Uniform Compression	$N_{c,Rd} = A_{eff} F_y / \gamma_{M0} = 236.9$ kN	Eqn. 6.10
Y-Y Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2 E I_y / L_x^2 = 69.96$ kN	
Non-Dimensional Slenderness	$\lambda_y = \sqrt{} (A_g F_y / N_{cr}) = 1.840$	Eqn. 6.49
Imperfection Factor	$\alpha_y = 0.210$ (Condition : h / b > 1.2 and $t_f \leq 40.0$ mm)	
Buckling Curve	a	
Value To Determine The Reduction Factor Chi	$\varphi_y = 0.5 (1 + \alpha_y (\lambda_y - 0.2) + \lambda_y^2 = 2.366$	Eqn. 6.49
Reduction Factor For Buckling Of The Section	$\chi_y = Min (1 / (\varphi_y + \sqrt{} (\varphi_y^2 - \lambda_y^2)) 1) = 0.260$	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdY} = \chi_y A_{eff} F_y / \gamma_{M1} = 61.5$ kN	Eqn. 6.47
Z-Z Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2 E I_z / L_y^2 = 69.96$ kN	
Non-Dimensional Slenderness	$\lambda_z = \sqrt{} (A_g F_y / N_{cr}) = 1.840$	Eqn. 6.49
Imperfection Factor	$\alpha_z = 0.210$ (Condition : h / b > 1.2 and $t_f \leq 40.0$ mm)	
Buckling Curve	a	
Value To Determine The Reduction Factor Chi	$\varphi_z = 0.5 (1 + \alpha_z (\lambda_z - 0.2) + \lambda_z^2 = 2.366$	Eqn. 6.49
Reduction Factor For Buckling Of The Section	$\chi_z = Min (1 / (\varphi_z + \sqrt{} (\varphi_z^2 - \lambda_z^2)) 1) = 0.260$	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdZ} = \chi_z A_{eff} F_y / \gamma_{M1} = 61.5$ kN	Eqn. 6.47

Capacity	Min ($N_{b,RdY}$, $N_{b,RdZ}$, $N_{c,Rd}$) = 61.5 kN
Utilization Ratio	N_{Ed} / Capacity = 0.229 < 1.000 ✓

Axial Tension Check

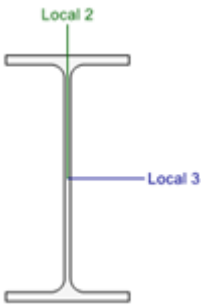
Definition	Parameter	Clause
Critical Load Combination	G+0.3Q+Ex-+0.3Ey+ (Comb Id: 49)	
Axial Tension	N_{Ed} = -14.8 kN	
Design Resistance Of The Cross-Section For Tension Yielding	$N_{pl,Rd} = A_g F_y / \gamma_{M0}$ = 236.9 kN	Eqn. 6.6
Design Resistance Of The Cross-Section For Rupture	$N_{u,Rd} = 0.9 A_g F_u / \gamma_{M2}$ = 266.7 kN	Eqn. 6.7
Utilization Ratio	N_{Ed} / Min ($N_{pl,Rd}$, $N_{u,Rd}$) = 0.062 < 1.000 ✓	

Shear Check Major

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wx (Comb Id: 91)	
Shear (Major)	V_{Ed} = 0.2 kN	
Top Flange Width	t_{fw} = 135.0 mm	
Bottom Flange Width	b_{fw} = 135.0 mm	
Top Flange Thickness	t_{ft} = 10.2 mm	
Bot Flange Thickness	b_{ft} = 10.2 mm	
	R_1 = 15.0 mm	
Shear Area	$A_v = A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2$ = 0.001 m^2	Chp. 6.2.6 (3)
Design Plastic Shear Resistance		
Design Plastic Shear Resistance	$V_{pl,Rd} = A_v (F_y / \sqrt{3}) / \gamma_{M0}$ = 87.1 kN	Eqn. 6.18
Shear Buckling Capacity		
Top Flange Thickness	t_{ft} = 10.2 mm	
Bot Flange Thickness	b_{ft} = 10.2 mm	
Bottom Flange Width	b_{fw} = 135.0 mm	
Height Thickness Ratio	$h_w / t_w = (h - t_{ft} - b_{ft}) / t_w$ = 27.781	
	$\varepsilon = \sqrt{(235 / F_y)}$ = 0.924	
	η = 1.200 ($F_y \leq 460$ N/mm^2)	EN1993-1-5 Chp. 5.1.2
Shear Buckling Limit	72 ε / η = 55.465	Eqn 6.22
	27.781 < 55.465	Eqn 6.22
	hw / t_w< 72 ε / η (Shear Buckling Resistance Check is not required)	
Utilization Ratio	V_{Ed} / $V_{pl,Rd}$ = 0.003 < 1.000 ✓	

Steel Frame Design

Eurocode 3 (EN 1993) Design of Steel Structures (Base Code)



General Properties

Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
Primary Composite Beam	1F2	b	135.0 mm	r_y	112.3 mm	End Releases J	Fixed
Parent Member	-	t_w	6.6 mm	r_z	30.3 mm	C_1	1.000
Section	IPE270	t_f	10.2 mm	I_y	0.000058 m^4	γ_{M0}	1.000
L	5000.00 mm	A_g	0.005 m^2	I_z	0.000004 m^4	γ_{M1}	1.000
Material	S235	A_{s3}	0.003 m^2	I_t	1.204E-07 m^4	γ_{M2}	1.250
F_y	235.00 N/mm^2	A_{s2}	0.002 m^2	K_x	1.000		
F_u	360.00 N/mm^2	$W_{el,y}$	4.289E-04 m^3	K_y	1.000		
E	206182.00 N/mm^2	$W_{el,z}$	6.222E-05 m^3	Support I	None		
G	79434.00 N/mm^2	$W_{pl,y}$	4.840E-04 m^3	Support J	None		
h	270.0 mm	$W_{pl,z}$	9.700E-05 m^3	End Releases I	Fixed		

Design Forces

Internal Forces	Notation	Value	Critical Position	L_x	L_y	L_b
Axial Compression	N_{Ed}	0.0 kN	(0.00 - 5,000.00) mm	5000.00 mm	800.00 mm	800.00 mm
Bending (Major)	M_{Ed}	-108.1 kN.m	(0.00 - 5,000.00) mm	5000.00 mm	800.00 mm	800.00 mm
Bending (Minor)	M_{Ed}	0.0 kN.m	(0.00 - 5,000.00) mm	5000.00 mm	800.00 mm	800.00 mm
Shear (Major)	V_{Ed}	-113.8 kN	(0.00 - 5,000.00) mm	5000.00 mm	800.00 mm	800.00 mm
Shear (Minor)	V_{Ed}	0.0 kN	(0.00 - 5,000.00) mm	5000.00 mm	800.00 mm	800.00 mm
Torsion	T_{Ed}	0.0 kN.m	(0.00 - 5,000.00) mm	5000.00 mm	800.00 mm	800.00 mm

Section Classification

Definition	Parameter	Clause
	$\varepsilon = \sqrt{(235 / F_y)} = 1.000$	

Internal Compression Parts	
	R_1 = 15.0 mm
	$c_w = h - 2\,t_f - 2\,R_1$ = 219.6 mm
Width to Thickness Ratio	c_w / t_w = 33.273
Plastic Stress Ratio	$\alpha = Min (\| 1 / c_w (h / 2 - 0.5 (N_{Ed} / (t_w F_y)) - (t_f - R_1)) \| , 1)$ = 0.637
Web Compactness Limit	$396\,\varepsilon / (13\,\alpha - 1)$ (α > 0.5) = 54.426
	$c_w / t_w < 396\,\varepsilon / (13\,\alpha - 1)$ (α > 0.5)
	33.273 < 54.426
Web Class	Class1
Outstand Flanges	
	R_1 = 15.0 mm
Top Flange Width	t_{fw} = 135.0 mm
Bottom Flange Width	b_{fw} = 135.0 mm
	$c_f = Max (t_{fw} , b_{fw}) / 2 - R_1 - t_w / 2$ = 49.2 mm
Width to Thickness Ratio	c_f / t_f = 4.824
Plastic Stress Ratio	$\alpha = Min (\| 1 / c_w (h / 2 - 0.5 (N_{Ed} / (t_w F_y)) - (t_f - R_1)) \| , 1)$ = 0.637
Flange Compactness Limit	$9\,\varepsilon / \alpha$ ($\sigma_{Tip} \geq 0$) = 14.137
	$c_f / t_f < 9\,\varepsilon / \alpha$ ($\sigma_{Tip} \geq 0$)
	4.824 < 14.137
Flange Class	Class1
Section Class	**Class1**

Axial Compression Check

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.05Q-1.35NGy (Comb Id: 110)	
Axial Compression	N_{Ed} = 0.0 kN	
Effective Area	$A_{eff} = A_g$ = 0.005 m^2	
Design Resistance of Cross Section for Uniform Compression	$N_{c,Rd} = A_{eff} F_y / \gamma_{M0}$ = 1079.7 kN	Eqn. 6.10
Y-Y Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2 E I_y / L_x^2$ = 4712.91 kN	
Non-Dimensional Slenderness	$\lambda_y = \sqrt{} (A_g F_y / N_{cr})$ = 0.479	Eqn. 6.49
Imperfection Factor	α_y = 0.210 (Condition : h / b > 1.2 and $t_f \leq$ 40.0 mm)	
Buckling Curve	a	
Reduction Factor For Buckling Of The Section	χ_y = 1.000	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdY} = \chi_y A_{eff} F_y / \gamma_{M1}$ = 1079.7 kN	Eqn. 6.10
Z-Z Axis		
Elastic Critical Force For The Relevant Buckling Mode Based On The Gross Cross-Sectional Properties	$N_{cr} = \pi^2 E I_z / L_y^2$ = 13354.26 kN	
Non-Dimensional Slenderness	$\lambda_z = \sqrt{} (A_g F_y / N_{cr})$ = 0.284	Eqn. 6.49
Imperfection Factor	α_z = 0.340 (Condition : h / b > 1.2 and $t_f \leq$ 40.0 mm)	

Buckling Curve	b	
Reduction Factor For Buckling Of The Section	$\chi_z = 1.000$	Eqn. 6.49
Design Buckling Resistance Of The Compression Member	$N_{b,RdZ} = \chi_z A_{eff} F_y / \gamma_{M1} = 1079.7$ kN	Eqn. 6.10
Capacity	Min ($N_{b,RdY}$, $N_{b,RdZ}$, $N_{c,Rd}$) = 1079.7 kN	
Utilization Ratio	N_{Ed} / Capacity = 0.000 < 1.000 ✓	

Bending Check Major

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wy (Comb Id: 93)	
Bending (Major)	M_{Ed} = -108.1 kN.m	
Link Design Resistance For Bending	$M_{c,Rd} = W_{pl,y} F_y / \gamma_{M0} = 113.7$ kN.m	Eqn. 6.13
Warping Constant	$I_w = (h - t_f)^2 I_z / 4 = 70870842000.000$	SN003b-EN-EU Eqn. 4
Elastic Critical Moment	$M_{cr} = C_1 \pi^2 E I_z / L_b^2 \sqrt{ (C_w / I_z + L_b^2 G I_t / (\pi^2 E I_z) } = 1771.1$ kN.m	SN003b-EN-EU Eqn. 3
Effective Section Modulus	$W_{eff} = W_{pl,y} = 4.840E-04$ m^3	
Appropriate Non-dimensional Slenderness Ratio	$\lambda_{LT} = \sqrt{ (W_{eff} F_y / M_{cr}) } = 0.253$	Eqn. 6.56
Imperfection Factor	$\alpha_{LT} = 0.210$	Table 6.3
Plateau Length Of The Lateral Torsional Buckling Curves For Rolled and Welded Sections	$\lambda_{LT0} = 0.400$	
Correction Factor For The Lateral Torsional Buckling Curves	$\beta = 0.750$	
Value To Determine The Reduction Factor Chi	$\varphi_{LT} = 0.5 (1 + \alpha_{LT} (\lambda_{LT} - \lambda_{LT0}) + \beta \lambda_{LT}^2 = 0.509$	Eqn. 6.57
Bending Stress Reduction Factor to Account For Lateral Buckling	$\chi_{LT} = Min (1 / (\varphi_{LT} + \sqrt{ (\varphi_{LT}^2 - \beta \lambda_{LT}^2) }) , 1) = 1.000$	Eqn. 6.57
Design Buckling Resistance Moment	$M_{b,Rd} = \chi_{LT} W_{pl,z} F_y / \gamma_{M1} = 113.7$ kN.m	Eqn. 6.55
Capacity	Min ($M_{c,Rd}$, $M_{b,Rd}$) = 113.7 kN.m	
Utilization Ratio	M_{Ed} / $M_{b,Rd}$ = 0.951 < 1.000 ✓	

In cases where bending control is insufficient, reducing the buckling length of the element as well as increasing the section may be a solution. For this purpose, stability elements or braces can be placed around the element.

Bending Check Minor

Definition	Parameter	Clause
Critical Load Combination	1.15G-0.3Ex+-Ey- (Comb Id: 74)	
Bending (Minor)	M_{Ed} = 0.0 kN.m	
Design Resistance For Bending	$M_{c,Rd} = W_{pl,y} F_y / \gamma_{M0} = 22.8$ kN.m	Eqn. 6.13
Warping Constant	$I_w = (h - t_f)^2 I_z / 4 = 70870842000.000$	SN003b-EN-EU Eqn. 4
Elastic Critical Moment	$M_{cr} = C_1 \pi^2 E I_z / L_b^2 \sqrt{ (I_w / I_z + L_b^2 G I_t / (\pi^2 E I_z) } = 1771.1$ kN.m	SN003b-EN-EU Eqn. 3
Effective Section Modulus	$W_{eff} = W_{pl,z} = 9.700E-05$ m^3	
Appropriate Non-dimensional Slenderness Ratio	$\lambda_{LT} = \sqrt{ (W_{eff} F_y / M_{cr}) } = 0.113$	Eqn. 6.56
Imperfection Factor	$\alpha_{LT} = 0.210$	Table 6.3
Plateau Length Of The Lateral Torsional Buckling Curves For Rolled and Welded Sections	$\lambda_{LT0} = 0.400$	

Correction Factor For The Lateral Torsional Buckling Curves	$\beta = 0.750$	
Value To Determine The Reduction Factor Chi	$\varphi_{LT} = 0.5 (1 + \alpha_{LT} (\lambda_{LT} - \lambda_{LT0}) + \beta \lambda_{LT}^2 = 0.475$	Eqn. 6.57
Bending Stress Reduction Factor to Account For Lateral Buckling	$\chi_{LT} = Min (1 / (\varphi_{LT} + \sqrt{} (\varphi_{LT}^2 - \beta \lambda_{LT}^2)) , 1) = 1.000$	Eqn. 6.57
Design Buckling Resistance Moment	$M_{b,Rd} = \chi_{LT} W_{pl,z} F_y / \gamma_{M1} = 113.7$ kN.m	Eqn. 6.55
Capacity	$Min (M_{c,Rd} , M_{b,Rd}) = 22.8$ kN.m	
Utilization Ratio	$M_{Ed} / M_{c,Rd} = 0.000 < 1.000$ ✓	

Shear Check Major

Definition	Parameter	Clause
Critical Load Combination	1.35G+1.5Q+0.9Wy (Comb Id: 93)	
Shear (Major)	$V_{Ed} = -113.8$ kN	
Top Flange Width	$t_{fw} = 135.0$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
Top Flange Thickness	$t_{ft} = 10.2$ mm	
Bot Flange Thickness	$b_{ft} = 10.2$ mm	
	$R_1 = 15.0$ mm	
Shear Area	$A_v = A_g - (t_{fw} t_{ft} + b_{fw} b_{ft}) + (t_w + 2 R_1) (t_{ft} + b_{ft}) / 2 = 0.002$ m^2	Chp. 6.2.6 (3)
Design Plastic Shear Resistance		
Design Plastic Shear Resistance	$V_{pl,Rd} = A_v (F_y / \sqrt{} 3) / \gamma_{M0} = 300.4$ kN	Eqn. 6.18
Shear Buckling Capacity		
Top Flange Thickness	$t_{ft} = 10.2$ mm	
Bot Flange Thickness	$b_{ft} = 10.2$ mm	
Bottom Flange Width	$b_{fw} = 135.0$ mm	
Height Thickness Ratio	$h_w / t_w = (h - t_{ft} - b_{ft}) / t_w = 37.818$	
	$\varepsilon = \sqrt{} (235 / F_y) = 1.000$	
	$\eta = 1.200$ ($F_y \le 460$ N/mm^2)	EN1993-1-5 Chp. 5.1.2
Shear Buckling Limit	$72 \varepsilon / \eta = 60.000$	Eqn 6.22
	$37.818 < 60.000$	Eqn 6.22
	$h_w / tw < 72 \varepsilon / \eta$ (Shear Buckling Resistance Check is not required)	
Utilization Ratio	$V_{Ed} / V_{pl,Rd} = 0.379 < 1.000$ ✓	

Torsion Check

Definition	Parameter	Clause
Critical Load Combination	1.15G+Ex-+0.3Ey+ (Comb Id: 65)	
Torsion	$T_{Des} = 0.0$ kN.m	
Bot Flange Thickness	$t_{bf} = 10.2$ mm	
Top Flange Thickness	$t_{tf} = 10.2$ mm	
Torsion	$M_{f,Ed} = T_{Des} / (h - (t_{bf} + t_{tf}) 0.5) L_b / 4 = 0.0$ kN.m	
Top Flange Width	$w_{tf} = 135.0$ mm	

Bottom Flange Width	w_{tf} = 135.0 mm	
Nominal Torsional Strength	$M_{f,Rd}$ = Min (t_{tf} w_{tf}^2 / 4 , t_{bf} w_{bf}^2 / 4) F_y / γ_{M0} = 10.9 kN.m	
Utilization Ratio	$M_{f,Ed}$ / $M_{f,Rd}$ = 0.000 < 1.000 √	Eqn. 6.23

Deflection Check

Definition	Parameter	Clause
Deflection Span	L_{span} = 5000.00 mm	
Category	Floor Beam	
Combination (G+0.5Q)		
Deflection	δ_v = 4.314 mm	
Deflection Limit	$\delta_{v,Limit}$ = L / 360 = 13.9 mm	
Deflection Check	4.314 < 13.9 (L/360) √	
Combination (G+0.5Q+0.6Wx)		
Deflection	δ_v = 4.143 mm	
Deflection Limit	$\delta_{v,Limit}$ = L / 360 = 13.9 mm	
Deflection Check	4.143 < 13.9 (L/360) √	
Combination (G+0.5Q+0.6W-x)		
Deflection	δ_v = 4.485 mm	
Deflection Limit	$\delta_{v,Limit}$ = L / 360 = 13.9 mm	
Deflection Check	4.485 < 13.9 (L/360) √	
Combination (G+0.5Q+0.6Wy)		
Deflection	δ_v = 4.341 mm	
Deflection Limit	$\delta_{v,Limit}$ = L / 360 = 13.9 mm	
Deflection Check	4.341 < 13.9 (L/360) √	
Combination (G+0.5Q+0.6W-y)		
Deflection	δ_v = 4.288 mm	
Deflection Limit	$\delta_{v,Limit}$ = L / 360 = 13.9 mm	
Deflection Check	4.288 < 13.9 (L/360) √	

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Renaldo Karaj

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