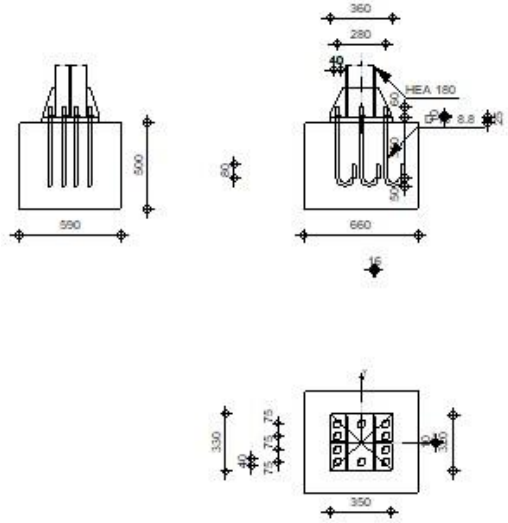
Autodesk Robot Structural Analysis Professional 2020

Fixed column base design

Eurocode 3: NF EN 1993-1-8:2005/NA:2007/AC:2009 + CEB Design Guide: Design of fastenings in concrete

OK

Ratio **0.83**



GENERAL

Connection no.: 14
Connection name: Fixed column base
Structure node: 37
Structure bars: 39

GEOMETRY

COLUMN

Section: HEA 180
Bar no.: 39

L_c =	4.50	[m]	Column length
α =	0.0	[Deg]	Inclination angle
h_c =	171	[mm]	Height of column section
b_{fc} =	180	[mm]	Width of column section
t_{wc} =	6	[mm]	Thickness of the web of column section
t_{fc} =	10	[mm]	Thickness of the flange of column section
r_c =	15	[mm]	Radius of column section fillet
A_c =	45.25	[cm^2]	Cross-sectional area of a column
I_{yc} =	2510.29	[cm^4]	Moment of inertia of the column section

Material: ACIER

f_{yc} =	235.00	[MPa]	Resistance
f_{uc} =	365.00	[MPa]	Yield strength of a material

COLUMN BASE

l_{pd} =	360	[mm]	Length
b_{pd} =	330	[mm]	Width
t_{pd} =	25	[mm]	Thickness

Material: ACIER E24

f_{ypd} =	235.00	[MPa]	Resistance
f_{upd} =	365.00	[MPa]	Yield strength of a material

ANCHORAGE

The shear plane passes through the UNTHREADED portion of the bolt.

Class =	8.8		Anchor class
f_{yb} =	550.00	[MPa]	Yield strength of the anchor material
f_{ub} =	800.00	[MPa]	Tensile strength of the anchor material
d =	18	[mm]	Bolt diameter
A_s =	1.92	[cm^2]	Effective section area of a bolt
A_v =	2.54	[cm^2]	Area of bolt section
n_H =	3		Number of bolt columns
n_V =	4		Number of bolt rows

Horizontal spacing e_{Hi} = 140 [mm]

Vertical spacing e_{Vi} = 75;75 [mm]

Anchor dimensions

L_1 =	60	[mm]
L_2 =	350	[mm]
L_3 =	100	[mm]
L_4 =	80	[mm]

STIFFENER

l_s =	350	[mm]	Length
w_s =	320	[mm]	Width
h_s =	171	[mm]	Height
t_s =	10	[mm]	Thickness
d_1 =	20	[mm]	Cut
d_2 =	20	[mm]	Cut

LOADS

Case: 16: ULS /142/ 1*1.35 + 2*1.35 + 3*1.35 + 4*1.35 + 5*1.35 + 6*1.35 + 7*1.05 + 9*1.05 + 15*1.50

$N_{j,Ed}$ =	-54.82	[kN]	Axial force
$V_{j,Ed,y}$ =	0.00	[kN]	Shear force
$V_{j,Ed,z}$ =	-22.59	[kN]	Shear force
$M_{j,Ed,y}$ =	43.94	[kN*m]	Bending moment
$M_{j,Ed,z}$ =	-0.00	[kN*m]	Bending moment

RESULTS

CONNECTION CAPACITY CHECK

$N_{j,Ed}$ / $N_{j,Rd}$ ≤ 1,0 (6.24)	0.02 < 1.00	verified	(0.02)	
e_y =	802	[mm]	Axial force eccentricity	[6.2.8.3]
$z_{c,y}$ =	90	[mm]	Lever arm $F_{C,Rd,y}$	[6.2.8.1.(2)]
$z_{t,y}$ =	140	[mm]	Lever arm $F_{T,Rd,y}$	[6.2.8.1.(3)]
$M_{j,Rd,y}$ =	55.24	[kN*m]	Connection resistance for bending	[6.2.8.3]

$M_{j,Ed,y} / M_{j,Rd,y} \le 1,0$ (6.23)			0.80 < 1.00	verified	(0.80)
e_z =	0	[mm]	Axial force eccentricity		[6.2.8.3]
$z_{c,z}$ =	83	[mm]	Lever arm $F_{C,Rd,z}$		[6.2.8.1.(2)]
$z_{t,z}$ =	113	[mm]	Lever arm $F_{T,Rd,z}$		[6.2.8.1.(3)]
$M_{j,Rd,z}$ =	0.00	[kN*m]	Connection resistance for bending		[6.2.8.3]
$M_{j,Ed,z} / M_{j,Rd,z} \le 1,0$ (6.23)			0.04 < 1.00	verified	(0.04)
$M_{j,Ed,y} / M_{j,Rd,y} + M_{j,Ed,z} / M_{j,Rd,z} \le 1,0$			0.83 < 1.00	verified	(0.83)

SHEAR

SHEAR CHECK

$V_{j,Rd,y} = n_b * \min(F_{1,vb,Rd,y}, F_{2,vb,Rd}, F_{v,Rd,cp}, F_{v,Rd,c,y}) + F_{f,Rd}$

$V_{j,Rd,y}$ =	206.31	[kN]	Connection resistance for shear		CEB [9.3.1]
$V_{j,Ed,y} / V_{j,Rd,y} \le 1,0$			0.00 < 1.00	verified	(0.00)

$V_{j,Rd,z} = n_b * \min(F_{1,vb,Rd,z}, F_{2,vb,Rd}, F_{v,Rd,cp}, F_{v,Rd,c,z}) + F_{f,Rd}$

$V_{j,Rd,z}$ =	206.31	[kN]	Connection resistance for shear		CEB [9.3.1]
$V_{j,Ed,z} / V_{j,Rd,z} \le 1,0$			0.11 < 1.00	verified	(0.11)
$V_{j,Ed,y} / V_{j,Rd,y} + V_{j,Ed,z} / V_{j,Rd,z} \le 1,0$			0.11 < 1.00	verified	(0.11)

STIFFENER CHECK

Stiffener parallel to the web (along the extension of the column web)

M_1 =	9.24	[kN*m]	Bending moment acting on a stiffener	
Q_1 =	169.61	[kN]	Shear force acting on a stiffener	
z_s =	29	[mm]	Location of the neutral axis (from the plate base)	
I_s =	1819.98	[cm^4]	Moment of inertia of a stiffener	
σ_d =	2.20	[MPa]	Normal stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]
σ_g =	84.65	[MPa]	Normal stress in upper fibers	EN 1993-1-1:[6.2.1.(5)]
τ =	99.19	[MPa]	Tangent stress in a stiffener	EN 1993-1-1:[6.2.1.(5)]
σ_z =	171.81	[MPa]	Equivalent stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]

max (σ_g, τ / (0.58), σ_z) / (f_{yp}/γ_{M0}) ≤ 1.0 (6.1)	0.73 < 1.00	verified	(0.73)

Stiffener perpendicular to the web (along the extension of the column flanges)

M_1 =	1.73	[kN*m]	Bending moment acting on a stiffener	
Q_1 =	46.07	[kN]	Shear force acting on a stiffener	
z_s =	39	[mm]	Location of the neutral axis (from the plate base)	
I_s =	1630.18	[cm^4]	Moment of inertia of a stiffener	
σ_d =	1.54	[MPa]	Normal stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]
σ_g =	16.59	[MPa]	Normal stress in upper fibers	EN 1993-1-1:[6.2.1.(5)]
τ =	26.94	[MPa]	Tangent stress in a stiffener	EN 1993-1-1:[6.2.1.(5)]
σ_z =	46.69	[MPa]	Equivalent stress on the contact surface between stiffener and plate	EN 1993-1-1:[6.2.1.(5)]

max (σ_g, τ / (0.58), σ_z) / (f_{yp}/γ_{M0}) ≤ 1.0 (6.1)	0.20 < 1.00	verified	(0.20)

WELDS BETWEEN THE COLUMN AND THE BASE PLATE

$\sigma_\perp$ =	25.64	[MPa]	Normal stress in a weld		[4.5.3.(7)]
$\tau_\perp$ =	25.64	[MPa]	Perpendicular tangent stress		[4.5.3.(7)]
τ_{yII} =	0.00	[MPa]	Tangent stress parallel to $V_{j,Ed,y}$		[4.5.3.(7)]
τ_{zII} =	-4.27	[MPa]	Tangent stress parallel to $V_{j,Ed,z}$		[4.5.3.(7)]
β_W =	0.85		Resistance-dependent coefficient		[4.5.3.(7)]
$\sigma_\perp$ / (0.9*f_u/γ_{M2})) ≤ 1.0 (4.1)			0.10 < 1.00	verified	(0.10)
$\sqrt{(\sigma_\perp^2 + 3.0 (\tau_{yII}^2 + \tau_\perp^2))}$ / ($f_u/(\beta_W*\gamma_{M2})$) ≤ 1.0 (4.1)			0.15 < 1.00	verified	(0.15)
$\sqrt{(\sigma_\perp^2 + 3.0 (\tau_{zII}^2 + \tau_\perp^2))}$ / ($f_u/(\beta_W*\gamma_{M2})$) ≤ 1.0 (4.1)			0.13 < 1.00	verified	(0.13)

VERTICAL WELDS OF STIFFENERS

Stiffener parallel to the web (along the extension of the column web)

$\sigma_\perp$ =	83.82	[MPa]	Normal stress in a weld		[4.5.3.(7)]
$\tau_\perp$ =	83.82	[MPa]	Perpendicular tangent stress		[4.5.3.(7)]
τ_{II} =	61.99	[MPa]	Parallel tangent stress		[4.5.3.(7)]
σ_z =	199.08	[MPa]	Total equivalent stress		[4.5.3.(7)]
β_w =	0.85		Resistance-dependent coefficient		[4.5.3.(7)]
max ($\sigma_\perp$, τ_{II} * √3, σ_z) / (f_u/(β_w*γ_{M2})) ≤ 1.0 (4.1)	0.58 < 1.00			verified	(0.58)

Stiffener perpendicular to the web (along the extension of the column flanges)

$\sigma_\perp$ =	15.67	[MPa]	Normal stress in a weld		[4.5.3.(7)]
$\tau_\perp$ =	15.67	[MPa]	Perpendicular tangent stress		[4.5.3.(7)]
τ_{II} =	16.84	[MPa]	Parallel tangent stress		[4.5.3.(7)]
σ_z =	42.81	[MPa]	Total equivalent stress		[4.5.3.(7)]
β_w =	0.85		Resistance-dependent coefficient		[4.5.3.(7)]
max ($\sigma_\perp$, τ_{II} * √3, σ_z) / (f_u/(β_w*γ_{M2})) ≤ 1.0 (4.1)	0.12 < 1.00			verified	(0.12)

TRANSVERSAL WELDS OF STIFFENERS

Stiffener parallel to the web (along the extension of the column web)

$\sigma_\perp$ =	83.75	[MPa]	Normal stress in a weld		[4.5.3.(7)]
$\tau_\perp$ =	83.75	[MPa]	Perpendicular tangent stress		[4.5.3.(7)]
τ_{II} =	80.85	[MPa]	Parallel tangent stress		[4.5.3.(7)]
σ_z =	218.33	[MPa]	Total equivalent stress		[4.5.3.(7)]
β_w =	0.85		Resistance-dependent coefficient		[4.5.3.(7)]
max ($\sigma_\perp$, τ_{II} * √3, σ_z) / (f_u/(β_w*γ_{M2})) ≤ 1.0 (4.1)	0.64 < 1.00			verified	(0.64)

Stiffener perpendicular to the web (along the extension of the column flanges)

$\sigma_\perp$ =	29.09	[MPa]	Normal stress in a weld		[4.5.3.(7)]
$\tau_\perp$ =	29.09	[MPa]	Perpendicular tangent stress		[4.5.3.(7)]
τ_{II} =	17.18	[MPa]	Parallel tangent stress		[4.5.3.(7)]
σ_z =	65.35	[MPa]	Total equivalent stress		[4.5.3.(7)]
β_w =	0.85		Resistance-dependent coefficient		[4.5.3.(7)]
max ($\sigma_\perp$, τ_{II} * √3, σ_z) / (f_u/(β_w*γ_{M2})) ≤ 1.0 (4.1)	0.19 < 1.00			verified	(0.19)

Connection conforms to the code	Ratio	0.83