پـــــروژه بیمارستان شریعتی

گزارش

CALCULATION CABLE TRAY SUPPORT-ALT01

1- Loading

This document has been prepared to show for support analysis under dead loads and seismic loads.

Table 1- Load Cases

#	Load Case Type	Name in Model
1	Dead Load	DEAD
2	Live Load	LIVE
3	Earthquake Load (X)	EX
4	Earthquake Load (Y)	EY
5	Earthquake Load (Z)	EZ

Table 2- Load Combinations

#	Load Combination
1	1.4 DEAD
2	1.2 DEAD + 1.6 LIVE
3	1.2 DEAD + 1.0 LIVE + EX + EZ
4	1.2 DEAD + 1.0 LIVE + EX - EZ
5	1.2 DEAD + 1.0 LIVE - EX + EZ
6	1.2 DEAD + 1.0 LIVE - EX - EZ
7	1.2 DEAD + 1.0 LIVE + EY + EZ
8	1.2 DEAD + 1.0 LIVE + EY - EZ
9	1.2 DEAD + 1.0 LIVE - EY + EZ
10	1.2 DEAD + 1.0 LIVE - EY -EZ
11	0.9 DEAD + EX + EZ
12	0.9 DEAD + EX - EZ
13	0.9 DEAD - EX + EZ
14	0.9 DEAD - EX - EZ
15	0.9 DEAD + EY + EZ
16	0.9 DEAD + EY - EZ
17	0.9 DEAD - EY + EZ
18	0.9 DEAD - EY - EZ
19	1.2 DEAD + 1.0 LIVE + 0.3 EX + EY+EZ
20	1.2 DEAD + 1.0 LIVE + 0.3 EX - EY+EZ
21	1.2 DEAD + 1.0 LIVE - 0.3 EX + EY+EZ
22	1.2 DEAD + 1.0 LIVE - 0.3 EX - EY+EZ
23	1.2 DEAD + 1.0 LIVE + EX + 0.3 EY+EZ
24	1.2 DEAD + 1.0 LIVE + EX - 0.3 EY+EZ
25	1.2 DEAD + 1.0 LIVE - EX + 0.3 EY+EZ
26	1.2 DEAD + 1.0 LIVE - EX - 0.3 EY+EZ
27	1.2 DEAD + 1.0 LIVE + 0.3 EX + EY-EZ
28	1.2 DEAD + 1.0 LIVE + 0.3 EX - EY-EZ
29	1.2 DEAD + 1.0 LIVE - 0.3 EX + EY-EZ

30	1.2 DEAD + 1.0 LIVE - 0.3 EX - EY-EZ
31	1.2 DEAD + 1.0 LIVE + EX + 0.3 EY-EZ
32	1.2 DEAD + 1.0 LIVE + EX - 0.3 EY-EZ
33	1.2 DEAD + 1.0 LIVE - EX + 0.3 EY-EZ
34	1.2 DEAD + 1.0 LIVE - EX - 0.3 EY-EZ

$$Seismic\ Laods:\ ASCE\ 7-\ Chapter\ 13-\ Sec13.2$$

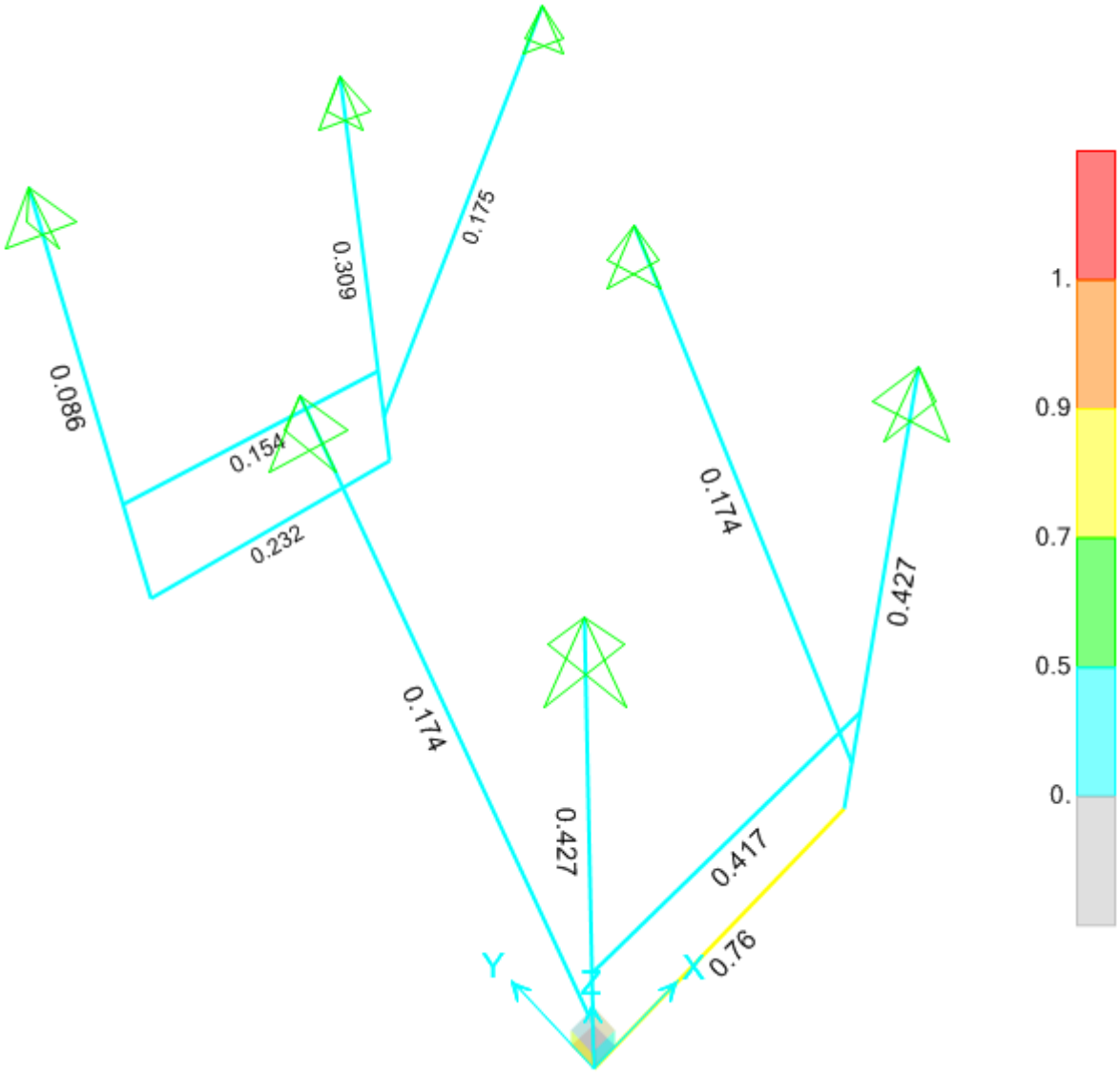
$$0.3S_{DS}I_PW_P \le F_P = \frac{0.4a_PS_{DS}I_PW_P}{R_P}(1+2\left(\frac{Z}{H}\right))$$

Equipment		1	1
Type	Str	Tray	Tray
SPECIFICATION			
Name	Str	T-50	T-50
Width (cm)	-	50	50
DEAD LOAD			
Unit Weight (kg/m)	-	40	25
Frame Spacing (m)		1.5	1.5
Loading Width (cm)	-	50	50
Weight (kg)	10	60	37.5
Distributed Dead Load (kg/cm)	-	1.2	0.75
Point Dead Load (kg)	0	0	0
LIVE LOAD			
Point Live Load (kg)	-	-	-
SEISMIC LOADS			
Z (m)	15.5	15.5	15.5
H (m)	68.8	68.8	68.8
I_p	1.4	1.4	1.4
a_p	2.5	2.5	2.5
S_{DS}	1.1629	1.1629	1.1629
R_p	6	6	6
C_{min}	0.488	0.488	0.488
C_{max}	2.605	2.605	2.605
C_{calc}	0.3936	0.3936	0.3936
$C_x=C_y$	0.488	0.488	0.488
C_z	0.326	0.326	0.326
Space Number of X Brace (Sx)	2	2	2

Space Number of Y Brace (Sy)	4	4	4
$F_x=C_{x/y}W$ (Sx)	9.8	1.2	0.7
$F_y=C_{x/y}W$ (Sy)	19.5	2.3	1.5
$F_z=C_zW$	3.3	0.4	0.2

2- Modeling & Design According to AISI-LRFD96 (SAP2000)

The structure was modeled in SAP2000 V19.2.2.



Stress Ration, According to AISI-LRFD96

3- Manual Design of Support According to AISI-2010

Design Basis:

Design basis is based on Load and Resistance Factor Design (LRFD) principles. The design shall be performed in accordance with following Equation:

$R_u \leq \Phi R_n$

- R_u=Required strength
- Φ=Resistance factor
- R_n=Nominal strength
- ΦR_n=Design strength

Abbreviations for Nominal Strength and Ultimate Applied Load:

- P_u: Applied factored compression
- P_n: Nominal axial compression strength
- T_u: Applied factored tension
- T_n: Nominal axial tensile strength
- V_u: Applied factored shear
- V_n: Nominal shear strength
- T_{Qu}: Applied factored torsion
- T_{Qn}: Nominal torsional strength
- M_u: Flexural applied factored moments
- M_n: Nominal flexural strength

Header	Description	Unit	
Section Specification	Member ID	-	**Beam**
	Section Name	-	
	Width	cm	3.50
	Height	cm	3.50
	Thickness	cm	0.15
	Hole Diameter Web 1	cm	1.05
	Hole Diameter Web 2	cm	3.50
	Iz	cm^4	3.53
	Iy	cm^4	3.04
	F_y	kg/cm^2	2350.00
	F_u	kg/cm^2	3750.00
	E	kg/cm^2	2000000.00

(T) TENSION	Yielding in Cross Section	A_g	cm^2	1.77
		Φ_t	-	0.90
		$T_n=A_gF_y$	kg	4159.50
		Φ_tT_n	kg	3743.55
	Rupture in Net Section (Away from Connection)	A_n	cm^2	1.61
		Φ_t	-	0.75
		$T_n=A_nF_u$	kg	6046.88
		Φ_tT_n	kg	4535.16
	Total	Φ_tT_n	kg	3743.55
		T_u	kg	0.00
		$R=T_u/\Phi_tT_n$	<=1	0.00
(M) BENDING	Z-Axis-22	S_{eZ}	cm^3	2.02
		Φ_b	-	0.90
		$M_{nz}=S_{eZ}F_y$	kg.cm	4747.00
		Φ_bM_{nz}	kg.cm	4272.30
		M_{uz}	kg.cm	986.00
		$R=M_{uz}/\Phi_bM_{nz}$	<=1	0.23
	Y-Axis-33	S_{eY}	cm^3	1.60
		Φ_b	-	0.90
		$M_{ny}=S_{eY}F_y$	kg.cm	3760.00
		Φ_bM_{ny}	kg.cm	3384.00
		M_{uy}	kg.cm	1644.00
		$R=M_{uy}/\Phi_bM_{ny}$	<=1	0.49
(V) SHEAR	Z-Axis	A_v	cm^2	0.53
		Φ_v	-	0.95
		h/t	-	23.33
		F_v	kg/cm^2	1410.00
		$V_{nz}=A_vF_v$	kg	740.25
		Φ_vV_{nz}	kg	703.24
		V_{uz}	kg	10.00
		$R=V_{uz}/\Phi_vV_{nz}$	<=1	0.01
	Y-Axis	A_v	cm^2	1.05

		Φ_v	-	0.95
		h/t	-	23.33
		F_v	kg/cm²	1410.00
		$V_{ny}=A_vF_v$	kg	1480.50
		Φ_vV_{ny}	kg	1406.48
		V_{uy}	kg	2.00
		$R=V_{uy}/\Phi_vV_{ny}$	<=1	0.00
(C) COMPRESSION	Spec.	A_g	cm²	1.77
		Φ_c	-	0.85
	Elastic Flexural Stress	L	cm	70.00
		rz	cm	1.41
		ry	cm	1.31
		K	-	1.00
		$\lambda=KL/r_{min}$	-	53.41
		$F_{eF}=\pi^2E/\lambda^2$	kg/cm²	6911.84
	Torsional Buckling	A	cm²	1.77
		L_t	cm	70.00
		r_0	cm	1.93
		C_w	cm⁶	4.69
		G	kg/cm²	769231.00
		K_t	-	1.00
		J	cm⁴	0.020
		ν	-	0.30
		$\lambda=KL/r$	-	36.33
		F_{eT}	kg/cm²	13003.73
	Flexural-Torsional Buckling	$F_{FT}=F_{eF}.F_{eT}/(F_{eF}+F_{eT})$	kg/cm²	4513.04
	Total	$F_e=\min\{F_{eF},F_{eT},F_{FT}\}$	kg/cm²	4513.04
		$\lambda_c=(F_y/F_e)^{0.5}$	-	0.72
		F_n	kg/cm²	1284.49
		$P_n=A_gF_n$	kg	2207.00

		$\Phi_c P_n$	kg	1876.00
		P_u	kg	0.00
		$R=P_u/\Phi_c P_n$	<=1	0.00
INTERACTION	V + M	$R=((M_{uy}/\Phi_b M_{ny})^2+(V_{uz}/\Phi_v V_{nz})^2)^{0.5}$	<=1	0.49
	T + M	$R=(M_{uy}/\Phi_b M_{ny})+(Muz/\Phi bMnz)+(T_u/\Phi_t T_n)$	<=1	0.72
	C + M	$R=(M_{uy}/\Phi_b M_{ny})+(Muz/\Phi bMnz)+(P_u/\Phi_c P_n)$	<=1	0.72
	V + M	$R=((M_{uz}/\Phi_b M_{nz})^2+(V_{uy}/\Phi_v V_{ny})^2)^{0.5}$	<=1	0.23

Design Connections:

Use: *M*10 *FAZ II Anchor*

$$\emptyset_t T_n = 0.55 \times 9.3KN$$
$$= 5.1KN$$
$$\emptyset_v V_n = 0.75 \times 16KN = 12KN$$

Tu . Vu

Anchor Design								
Joint No	**Load Combination**	**F1 (kN)**	**F2 (kN)**	**F3 (kN)**	**$T=T_u/\Phi_t T_n$**	**$V=V_u/\Phi_v V_n$**	**T+V**	**Req. Anchor No.**
1	Env	0.0	0.0	2.4	0.5	0.0	0.5	0.4
1	Env	0.0	0.0	-1.4	0.0	0.0	0.0	0.0
3	Env	0.0	0.0	2.4	0.5	0.0	0.5	0.4
3	Env	0.0	0.0	-1.4	0.0	0.0	0.0	0.0
5	Env	0.0	0.0	0.7	0.1	0.0	0.1	0.1
5	Env	0.0	0.0	0.3	0.1	0.0	0.1	0.1
6	Env	0.0	0.0	2.5	0.5	0.0	0.5	0.4
6	Env	0.0	0.0	-1.4	0.0	0.0	0.0	0.0
7	Env	0.0	1.1	1.7	0.3	0.1	0.4	0.4
7	Env	0.0	-1.1	-1.7	0.0	0.1	0.1	0.1
9	Env	0.0	1.1	1.7	0.3	0.1	0.4	0.4
9	Env	0.0	-1.1	-1.7	0.0	0.1	0.1	0.1
18	Env	1.1	0.0	1.7	0.3	0.1	0.4	0.4
18	Env	-1.1	0.0	-1.7	0.0	0.1	0.1	0.1

Joint No.	Member Type	Anchor Type	Calculated Anchor No.	Rounded Anchor No.
1	COL	FAZ II M10	0.4	2
3	COL	FAZ II M10	0.4	2
5	COL	FAZ II M10	0.1	2
6	COL	FAZ II M10	0.4	2
7	BR-Y	FAZ II M10	0.4	1
9	BR-Y	FAZ II M10	0.4	1
18	BR-X	FAZ II M10	0.4	1

Connection Point (Profile to Profile) Loads (Worst Case)		
TP-SL		
Slipping Load	1	KN
Bolt Type	M10	-
Bolt No.	2	-
Slipping Load on Single Surface Lock	0.5	KN
Recommended Slip Resistance	6	KN
Safety Factor	12.000	OK
MF2		
Load on Single Corner Fitting	1	KN
Recommended Resistance	10	KN
Safety Factor	10	OK
Bolt Strength (Profile to Profile) Loads (Worst Case)		
Shear Load	1	KN
Bolt Type	M10	-
Bolt No.	2	-
Shear Load on Single Bolt	0.5	KN
Recommended Load	12.81	KN
Safety Factor	25.620	OK
Tension Load on Single Bolt	0.5	KN
Recommended Load	17.59	KN
Safety Factor	35.180	OK
Connection Point (Profile to Mount) Loads (Worst Case)		
Surface Lock Strength		

Slipping Load	4.5	KN
Bolt Type	M10	-
Bolt No.	2	-
Slipping Load on Single Surface Lock	2.25	KN
Recommended Slip Resistance	7	KN
Safety Factor	3.111	OK
TB-SB 35*35*1.5		
Tension Load on Base Connection Fitting	2.5	KN
Recommended Resistance	6	KN
Safety Factor	2.4	OK
Bolt Strength (Profile to Mount) Loads (Worst Case)		
Shear Load	0.2	KN
Bolt Type	M10	-
Bolt No.	2	-
Shear Load on Single Bolt	2.25	KN
Recommended Load	12.81	KN
Safety Factor	64	OK