

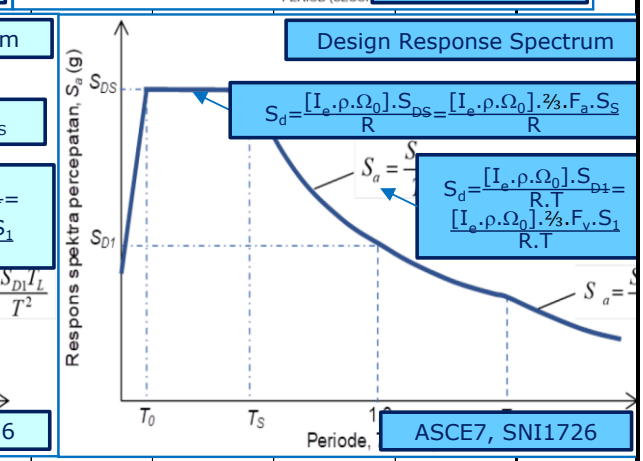
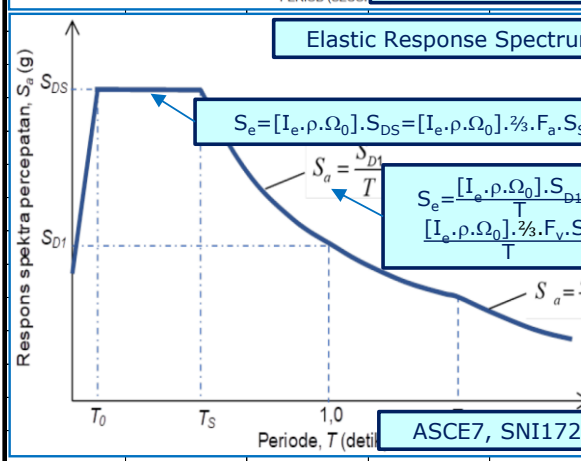
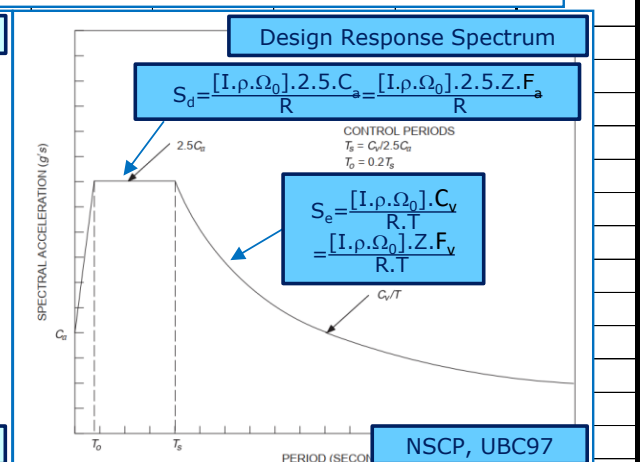
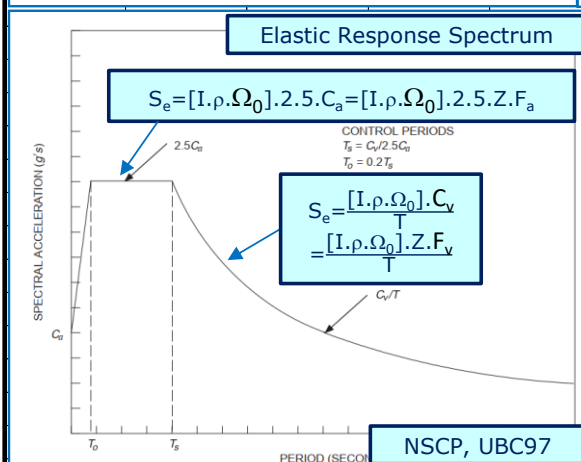
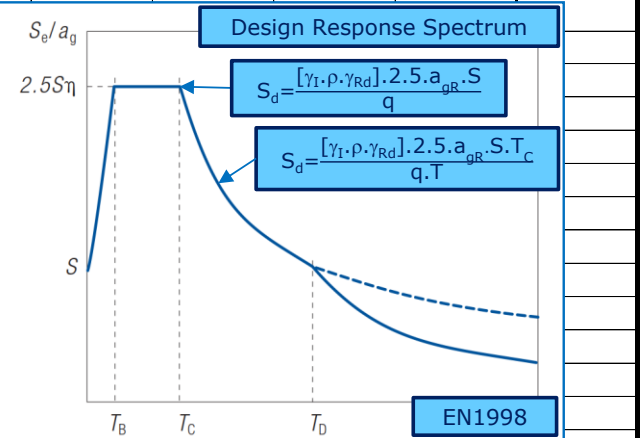
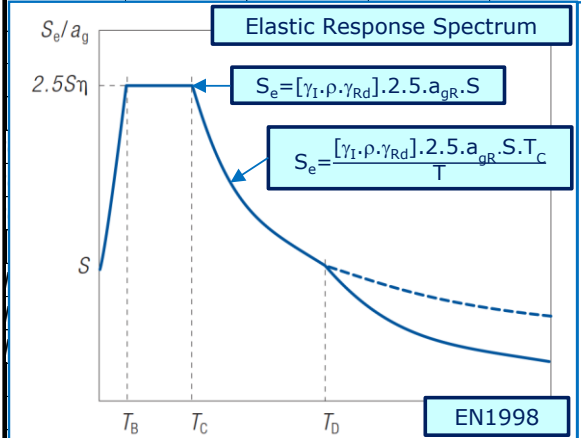
CONSULTING ENGINEERS	Engineering Calculation Sheet Consulting Engineers				Job No.	Sheet No.	Rev.
					jXXX	1	
Member/Location							
Job Title	Structure Design - EQ Load Definition and EQ Effects v				Drg. Ref.		
Structure Design - EQ Load Definition and EQ Effects					Made by	XX	Date
						9/4/2026	Chd.
EQ Response Spectra in Direction X, Y, Z							
Peak Ground Acceleration (Horizontal), PGA(g) Spectral Acceleration (Horizontal) S_s(g), S₁(g)							
Note that PGA(g) , S_s(g) , S₁(g) define the site seismic hazard at the design level.							
Factor for EQ in ULS load combos for superstructure ULS design						1.00	
Factor for EQ in SLS load combos for superstructure deflection design						1.00	
Factor for EQ in ULS load combos for foundation ULS design						1.00	
Factor for EQ in SLS load combos for foundation SLS design						0.70	
Location							
UBC97 Zone 4, World [UBC97-1997]							
Alternate return period, T					475	years	Lubkowski, 20
Ref. PGA, a _{gR} (g) PGA, PGA(g) Zone factor, Z(g) Hazard factor, Z(g)					0.400	g m/s ²	cl.208.4.4.1
Ref. return period, T _R					475	years	
Exponent, k					0.30		Lubkowski, 20
475 Year PGA		0.05g	0.10g	0.20g	0.30g	0.40g	
k		0.45	0.435	0.40	0.35	0.30	
Multiplier for alternate return period, (T/T _R) ^k					1.00		
Alternate return period, T					475	years	Lubkowski, 20
Spectral response acceleration at 0.2s, S _s (g)					0.922	g m/s ²	CE7 cl.6.1
Ref. return period, T _R					475	years	
Exponent, k					0.35		Lubkowski, 20
475 Year S _s		0.20g	0.55g	0.90g	1.20g	1.50g	
k		0.46	0.42	0.39	0.35	0.30	
Multiplier for alternate return period, (T/T _R) ^k					1.00		
Spectral response acceleration at 1.0s, S ₁ (g)					0.331	g m/s ²	CE7 cl.6.1
Ref. return period, T _R					475	years	
Exponent, k					0.40		Lubkowski, 20
475 Year S ₁		0.01g	0.02g	0.05g	0.10g	0.20g	
k		0.40	0.40	0.40	0.40	0.40	
Multiplier for alternate return period, (T/T _R) ^k					1.00		
Ref. PGA, a _{gR} (g) PGA, PGA(g) Zone factor, Z(g) Hazard factor, Z(g)					0.400	g m/s ²	cl.208.4.4.
Spectral response acceleration at 0.2s, (T/T _R) ^k .S _s (g)					0.922	g m/s ²	CE7 cl.6.1
Spectral response acceleration at 1.0s, (T/T _R) ^k .S ₁ (g)					0.331	g m/s ²	CE7 cl.6.1
Note spectral response acceleration can be obtained at https://ascehazardtool.org/ .							
Note spectral response acceleration can be obtained at SNI1726-2019 Earthquake Code - Response SNI1726							
Design horizontal PGA, a _g (g) = γ _I .a _{gR} (g)					0.400	g m/s ²	2.1(3) EN1
Design horizontal PGA very low, a _g (g) ≤ 0.04g a _g (g).S ≤ 0.05g					N/A		cl.3.2.1(5) EN1
Design horizontal PGA low, a _g (g) ≤ 0.08g a _g (g).S ≤ 0.10g					N/A		cl.3.2.1(4) EN1
Design horizontal PGA moderate, a _g (g) ≤ 0.30g a _g (g).S ≤ 0.375g					N/A		
Design horizontal PGA high, a _g (g) > 0.30g a _g (g).S > 0.375g					High Seismicity		
Peak Ground Acceleration (Vertical), PGA(g)							
Vertical peak ground acceleration factor, k _v					0.67		208.5.3.2 NSCP cl.7.
Design vertical PGA, a _{vg} (g) = γ _I .k _v .a _{gR} (g)					0.267	g m/s ²	
Inclusion of vertical action ?					0.267g	>	0.250g
					Included		cl.4.3.3.5.2 EN1
Fundamental Building Period, T_{1,X Y Z}							
					X-Dir	Y-Dir	Z-Dir
Fundamental period of building, T _{1,X Y Z}					0.55	2.40	0.15
					s		NOT OK
Note for employing the equivalent lateral static force method, check T _{1,X Y} ≤ 4T _c and 2.0s. cl.4.3.3.2.1 EN1							

CONSULTING ENGINEERS		Engineering Calculation Sheet Consulting Engineers			Job No.	Sheet No.	Rev.
					jXXX	2	
					Member/Location		
Job Title	Structure Design - EQ Load Definition and EQ Effects v				Drg. Ref.		
Structure Design - EQ Load Definition and EQ Effects					Made by	XX	Date 9/4/2026 Chd.
Importance Factor Redundancy Factor Overstrength Factor							
Note that the importance factor, redundancy factor, and overstrength factor, linearly multiply the horizontal peak ground acceleration, PGA(g) and spectral accelerations $S_s(g)$, $S_1(g)$.							
Importance factor, γ_I I_e Probability factor, k_p					1.00	1726 cl.208.4.2 NSCP	
Imp. class Risk cat. Occupancy cat. Imp. level						SNI1726 cl.103.1 NSCP	
Cat. IV [Ordinary Buildings] [1.00] [T=475 Years]							
Redundancy factor for horizontal spectra, ρ					1.00	12.3.4 ASCE7 cl.7.3.1	
Structure w/o. Vertical Irregularity [cl.1630.1.1] [1.00]							
Overstrength factor for horizontal spectra, γ_{Rd} Ω_0					1.00	5 cl.208.4.10.1 NSCP	
10 No Overstrength ULS Effects (Dissipative Element Mechanism) [1.00]							
NSCP cl.3.2 AS1170.4 cl.1627 UBC97 cl.6.2.2.2 IS1893-1							
Behaviour Factor, q Response Modification Factor, R							
10							
The behaviour factor, q or response modification factor, R linearly divides the elastic spectral response to produce the design (inelastic) spectral response.							
					X-Dir	Y-Dir	Z-Dir
Behaviour factor, $q = q_0 \cdot k_w$ Response mod. factor, R					5.50	5.50	1.00
1.2 SNI1726 Shear Wall [T.16-N-2 RC Wall] [R=5.50] [Cd=0.7R]						5.50	1.00
Moment Frame [T.16-N-3 Intermediate Moment Frame] [R=5.50] [Cd=0.7R]						5.50	1.00
12					X-Dir	Y-Dir	Z-Dir
Prevailing failure mode for walls, k_w					1.00	1.00	
N/A						1.00	1.00
N/A						1.00	1.00
1.2 SNI1726							
12							
1 NSCP cl.3.2 AS1170.4 cl.1627 UBC97 cl.3.28 IS1893-1							
1.2 SNI1726							
1.2 SNI1726							
998							
998							
998							
2(c) AS1170.4 cl.1631.2 UBC97 cl.6.2.3.2 IS1893-1							
998							
998							
998							

Earthquake Spectra

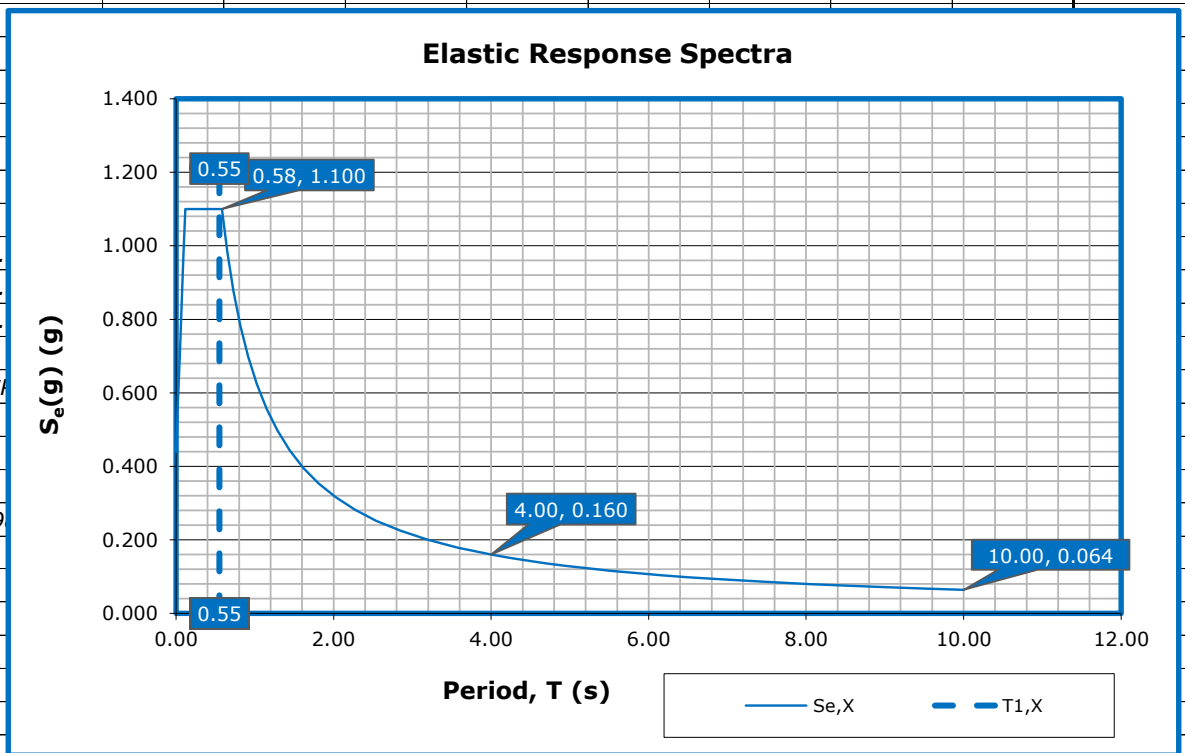
Note that the earthquake spectra define the **spectral accelerations** for all structural periods.

Earthquake spectrum	UBC97 World [1997]	▼ 726 cl.208.5.3.2 NSC
A fundamental expectation of ASCE7-16 SNI1726-2019, is that the S_S and S_1 correspond to MCE_R . The spectra themselves, will change these MCE levels, to DLE levels, by multiplying 2/3, as per cl.11.4.5, cl.11.9.3 ASCE7		
Ground type Site class Soil ty	Soil Type D [Stiff Soil, 15<N<50, vs>180m/s, TS<0.70s]	▼ 726 cl.208.4.3.1 NSC
Soil response parameter, S F_{PGA}		N/A cl.3.2.2.2 EN1
Short-period seismic coefficient, F_a		1.10 3.4.4.4 NSCP cl.6.4 A
Long-period seismic coefficient, F_v		1.60 3.4.4.4 NSCP cl.6.4 A
		X Y-Dir Z-Dir
Constant accn. region LL, T_B T_0		0.12 0.12 s 3.5.3.2 NSC
Constant accn. region UL, T_C Short-period transition, T_S		0.58 0.58 s 3.5.3.2 NSC
Constant disp. region LL, T_D Long-period transition, T_L		4.00 4.00 s 3.5.3.2 NSC

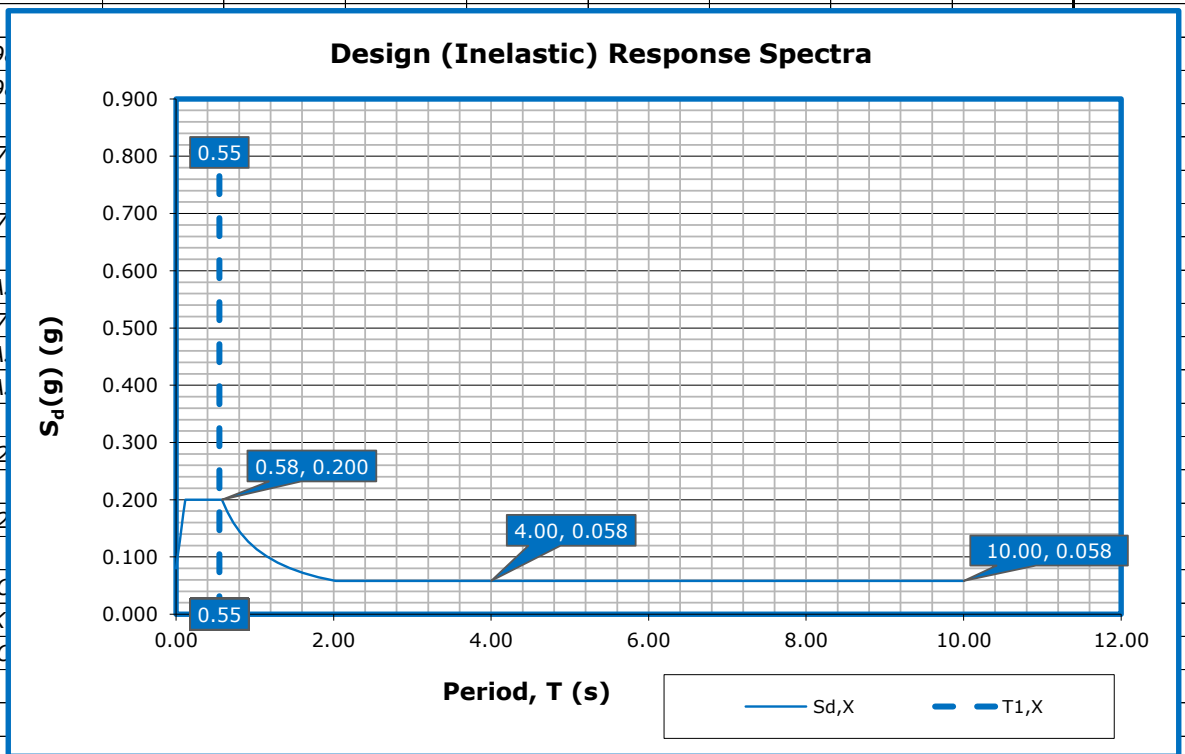


CONSULTING ENGINEERS		Engineering Calculation Sheet Consulting Engineers			Job No.	Sheet No.	Rev.
					jXXX	4	
Member/Location							
Job Title					Drg. Ref.		
Structure Design - EQ Load Definition and EQ Effects v					Made by XX Date 9/4/2026 Chd.		
Structure Design - EQ Load Definition and EQ Effects							
Displacement Compatibility Factor, C_d (Displacements and Non-Seismic Participating Columns)							
The displacement compatibility factor, C _d linearly multiplies the design (inelastic) spectra to determine the structural displacements and action effects within non-seismic-participating columns . Herewith, this figure does not affect the presentation of the spectra and resulting forces.							
Spectra							
16.					X-Dir	Y-Dir	Z-Dir
Displacement compatibility factor, C _d					3.85	3.85	26 cl.208.6.4.2, cl.8.998
998 Shear Wall [T.16-N-2 RC Wall] [R=5.50] [Cd=0.7R]							3.85 26 cl.208.6.4.2, cl.8.
S1170.4 Moment Frame [T.16-N-3 Intermediate Moment Frame] [R=5.50] [Cd=0.7R]							3.85 26 cl.208.6.4.2, cl.8.
S1170.4 cl.1629.4.3 UBC97 cl.6.2.3.2 IS1893-1					X-Dir	Y-Dir	Z-Dir
Displacement drift criteria, [\Delta\delta_{X Y} /h_s]_{limit}					1:50	1:50	1726 cl.208.6.5.1 NS
P cl.6.4 AS1170.4 cl.1631.2 UBC97 cl.6.2.3.2 IS1893-1							
Design Ground Displacement							
P cl.6.4 AS1170.4 cl.1631.2 UBC97 cl.6.2.3.2 IS1893-1							
Design ground displacement, d_{g,X Y} = 0.025.a_g(g).S.T_C.T_D					N/A		mm 2.2.4 EN1
Non-Structural Component (NSC) Seismic Effects							
Weight of NSC, W_a W_p							80 kN
Height of NSC from foundation, z							25.0 m
Building height from foundation, h							25.0 m
					X-Dir	Y-Dir	Z-Dir
Inelastic (design) force of NSC, F_a = W_a.S_a(g)					N/A	N/A	kN 5.2(2) EN
$S_a(g) = \frac{a_g(g) \cdot S \cdot \gamma_a}{q_a} \cdot \left[\frac{3 \cdot (1+z/h)}{1 + (1 - T_{a,X Y}/T_{1,X Y})^2} - 0.5 \right]$					N/A	N/A	g m/s^2 5.2(3) EN
Fundamental period of NSC, T_{a,X Y}					0.50	0.50	s
Importance factor of NSC, \gamma_a							1.00 cl.4.3.5.3 EN1
Behaviour factor of NSC, q_a							2.00 cl.4.3.5.4 EN1
Inelastic (design) force of NSC, F_p = W_p.S_a(g)					87	87	11 kN 13.3.1 ASC
$S_a(g) = 0.4a_p \cdot S_{DS} \cdot [1 + 2 \cdot (z/h)] \cdot \Omega_0 \cdot I_p / R_p$ $S_{DS} = 2/3 \cdot F_a \cdot S_S 0.3S_{DS} \cdot I_p \leq S_a(g) \leq 1.6S_{DS} \cdot I_p$					1.082	1.082	0.135 g m/s^2 13.3.1 ASC
Amplification factor of NSC, a_p							2.50 T.13.5-1, T.13.6-1
Importance factor of NSC, I_p							1.00 cl.13.1.3 ASC
Overstrength factor of NSC, \Omega_0							2.00 T.13.5-1, T.13.6-1
Response mod. factor of NSC, R_p							2.50 T.13.5-1, T.13.6-1
Inelastic (design) force of NSC, F_p = W_p.S_a(g)					117	117	kN SCP cl.16
$0.7C_a \cdot I_p \leq S_a(g) = \frac{a_p \cdot C_a \cdot I_p}{R_p} \cdot [1 + 3 \cdot z/h] \leq 4C_a \cdot I_p$					1.467	1.467	g m/s^2 SCP cl.16
Component amplification factor of NSC, a_p							2.50 T.208-13 NSCP T.16
Importance factor of NSC, I_p							1.00 T.208-1 NSCP T.16
Response mod. factor of NSC, R_p							3.00 T.208-13 NSCP T.16
$\frac{D_1 T_L}{T^2}$							

CONSULTING ENGINEERS	Engineering Calculation Sheet Consulting Engineers	Job No.	Sheet No.	Rev.
		jXXX	5	
Member/Location				
Job Title	Structure Design - EQ Load Definition and EQ Effects v	Drg. Ref.		
Structure Design - EQ Load Definition and EQ Effects		Made by XX	Date 9/4/2026	Chd.

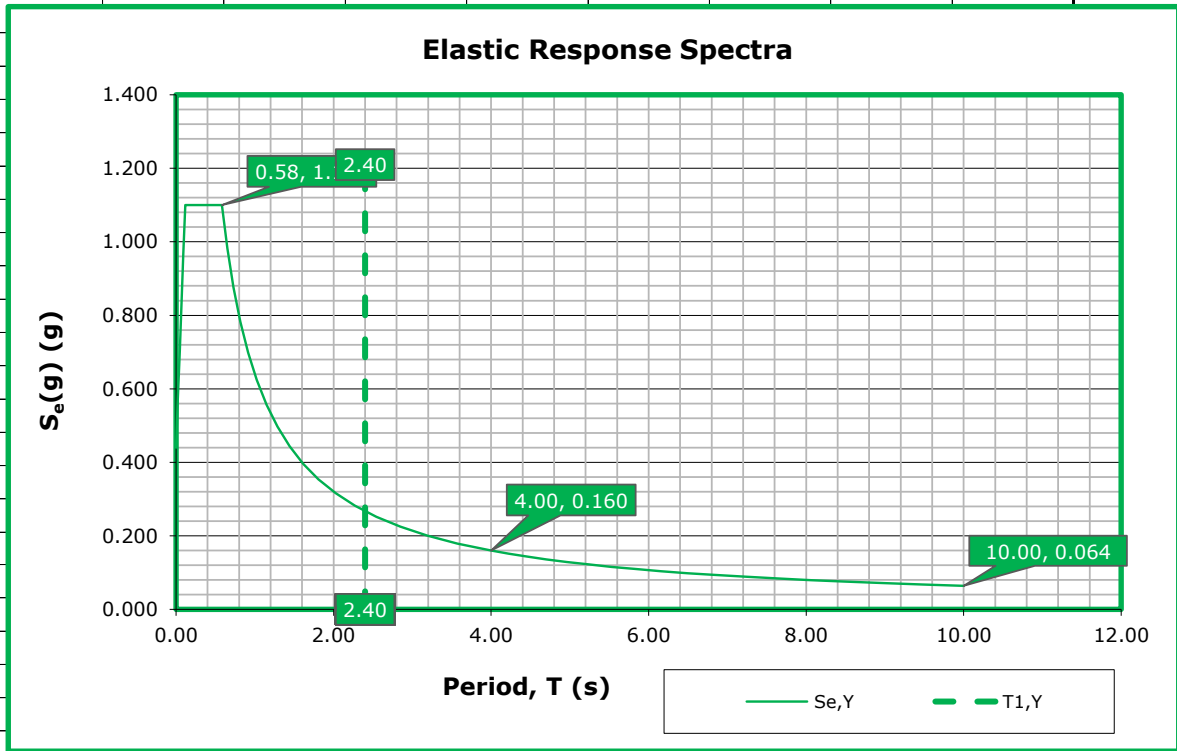


Elastic spectral acceleration, $S_e(g)(T_1)$	1.100 g m/s ²	X-Dir
Elastic base shear force, $F_{be}(W) = W \cdot S_e(g)(T_1) \cdot \lambda$	1.100 W kN	V1998 cl.
1998 Eff. mass participation factor, λ	1.00 [RSPEC]	1.00 cl.4.3.3.2.2 EN

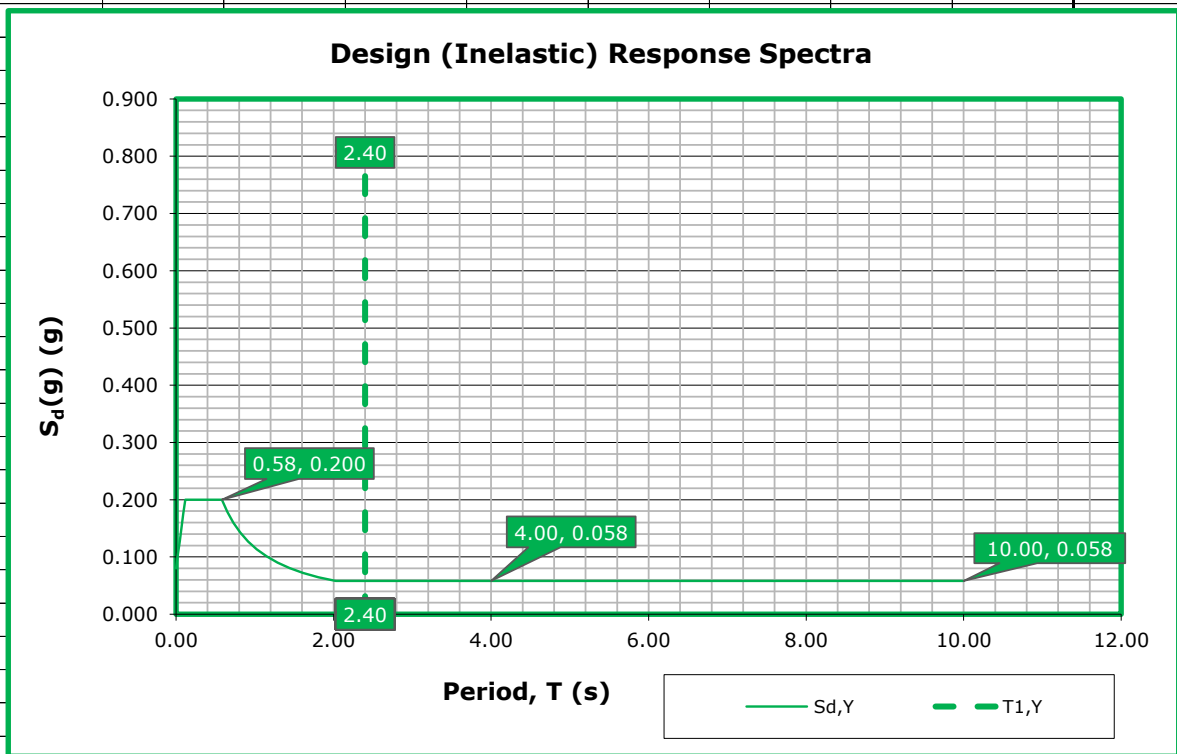


Inelastic (design) spectral acceleration, $S_d(g)(T_1)$	0.200 g m/s ²	
<i>Note spectra level {low inelastic 0.050g - 0.070g, high inelastic 0.150g - 0.200g, high elastic 0.250g - 0.300g}</i>		
Inelastic base shear force, $F_{bd}(W) = W \cdot S_d(g)(T_1) \cdot \lambda$	0.200 W kN	V1998 cl.
Eff. mass participation factor, λ	1.00 [RSPEC]	1.00 cl.4.3.3.2.2 EN

CONSULTING ENGINEERS	Engineering Calculation Sheet Consulting Engineers	Job No.	Sheet No.	Rev.
		jXXX	6	
Member/Location				
Job Title	Structure Design - EQ Load Definition and EQ Effects v	Drg. Ref.		
Structure Design - EQ Load Definition and EQ Effects		Made by XX	Date 9/4/2026	Chd.

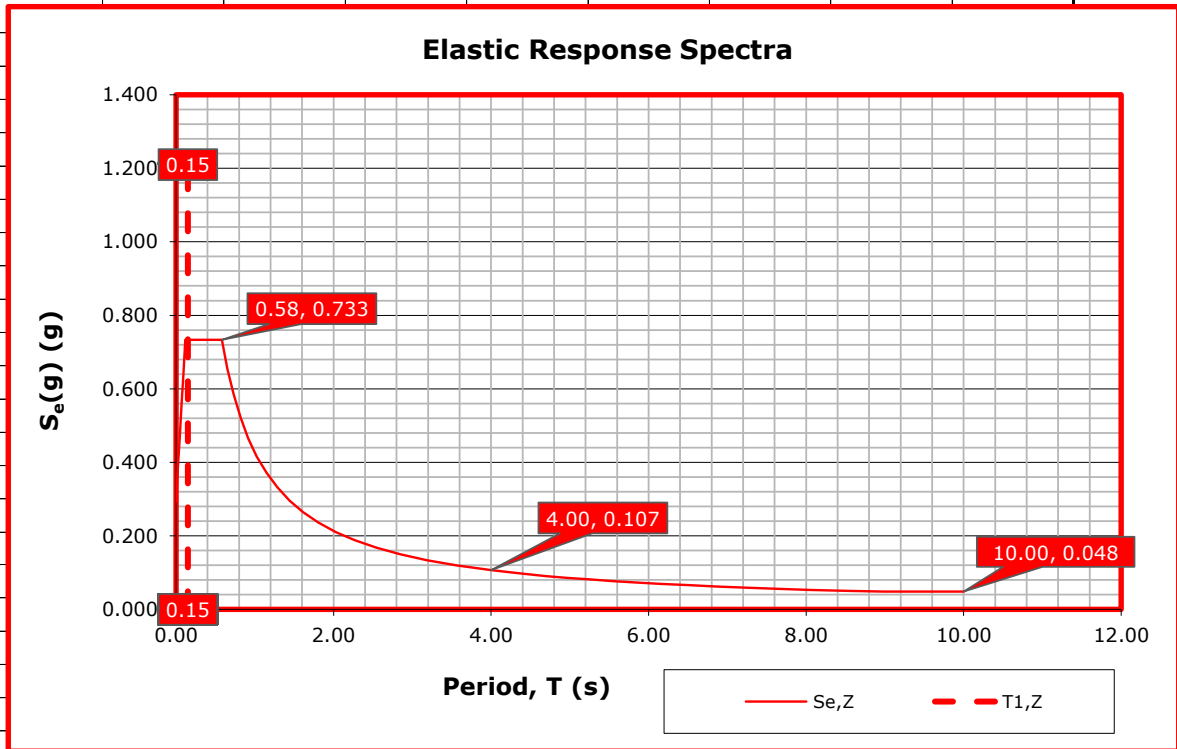


Elastic spectral acceleration, $S_e(g)(T_1)$	0.267 g m/s ²	Y-Dir
Elastic base shear force, $F_{be}(W) = W \cdot S_e(g)(T_1) \cdot \lambda$	0.267 W kN	V1998 cl.
998 Eff. mass participation factor, λ	1.00 [RSPEC]	1.00 cl.4.3.3.2.2 EN

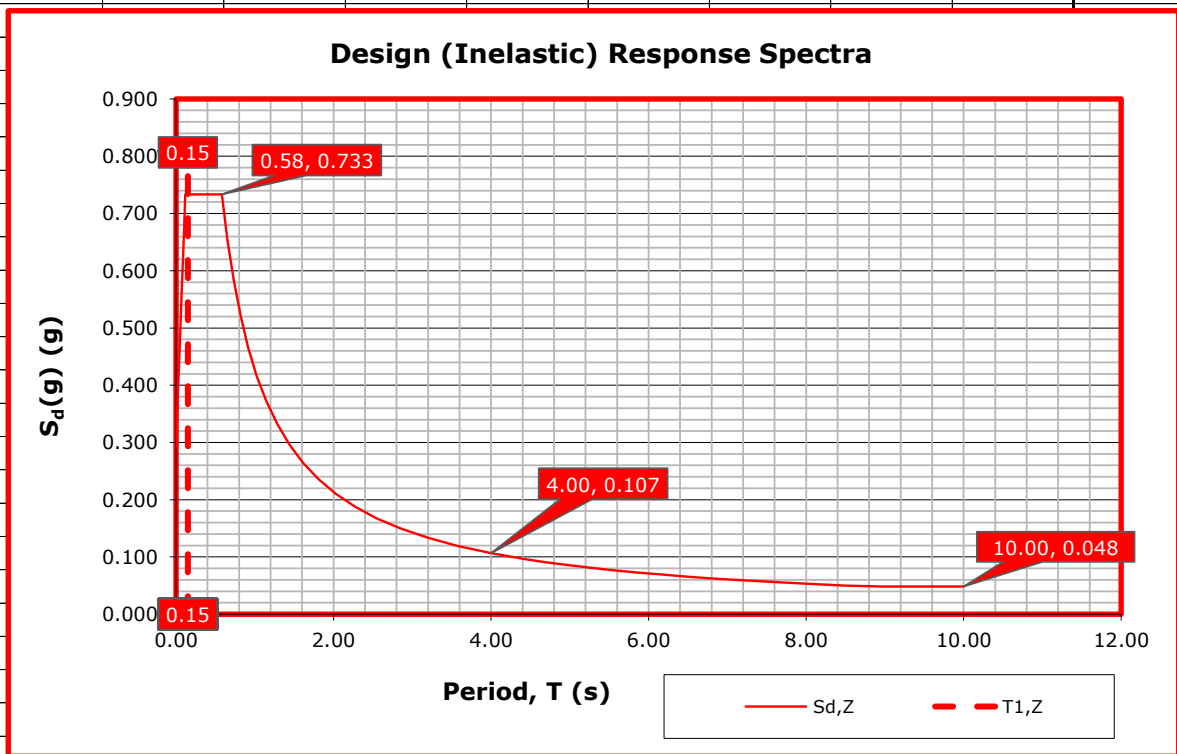


Inelastic (design) spectral acceleration, $S_d(g)(T_1)$	0.058 g m/s ²	0.058 g m/s ²
<i>Note spectra level {low inelastic 0.050g - 0.070g, high inelastic 0.150g - 0.200g, high elastic 0.250g - 0.300g}</i>		
Inelastic base shear force, $F_{bd}(W) = W \cdot S_d(g)(T_1) \cdot \lambda$	0.058 W kN	V1998 cl.
998 Eff. mass participation factor, λ	1.00 [RSPEC]	1.00 cl.4.3.3.2.2 EN

CONSULTING ENGINEERS	Engineering Calculation Sheet Consulting Engineers	Job No.	Sheet No.	Rev.
		jXXX	7	
		Member/Location		
Job Title	Structure Design - EQ Load Definition and EQ Effects v	Drg. Ref.		
Structure Design - EQ Load Definition and EQ Effects		Made by XX	Date 9/4/2026	Chd.



Elastic spectral acceleration, $S_e(g)(T_1)$	0.733 g m/s ²	Z-Dir
Elastic base shear force, $F_{be}(W) = W \cdot S_e(g)(T_1) \cdot \lambda$	0.733 W kN	1998 cl.1
998 Eff. mass participation factor, λ	1.00 [RSPEC]	1.00 2.4.2.2 ASCE7 cl.16



Inelastic (design) spectral acceleration, $S_d(g)(T_1)$	0.733 g m/s ²	
<i>Note spectra level {low inelastic 0.050g - 0.070g, high inelastic 0.150g - 0.200g, high elastic 0.250g - 0.300g}</i>		
Inelastic base shear force, $F_{bd}(W) = W \cdot S_d(g)(T_1) \cdot \lambda$	0.733 W kN	1998 cl.1
998 Eff. mass participation factor, λ	1.00 [RSPEC]	1.00 2.4.2.2 ASCE7 cl.16