



Job Number

25030303

DATE

14/04/2026

ENGINEERING COMPUTATIONS



SLEEPER WALLS V5.10

Barrasons Engineers

Wall: (Sleeper Wall Pier 1.6mH) 1600mm high, 5.0kPa surcharge (Drained)
Loads: Surcharge = 5.00kPa, Drained, Additional overturning applied
Steel Upright: 150UC23.4 (G300) (Galv.)
 $M^* = 29.10\text{kNm} < \phi M = 50.69\text{kNm}$, $V^* = 25.11\text{kN} < \phi V_{vm} = 160.22\text{kN}$ OK (0.57,0.16)
 $\delta(dI) = ht/1041$ (1.5mm), $\delta(dI + \psi I.II) = ht/364$ (4.4mm) OK
Timber Upright: Not Applicable

Footing: $M^*o = 59.23\text{kNm} < \phi Mr = 63.00\text{kNm}$ OK (0.94)
Sleepers: Concrete sleepers - refer Concrete Member Design or manufacturer's specifications
 $wdl = 1.85\text{kN/m}$, $wll = 0.34\text{kN/m}$, $w^* = 2.82\text{kN/m}$, $M^* = 1.14\text{kNm}$

Geometry

Warning - Pier depth/diameter ratio = 4.9

Wall assumed fully drained

Geometry Retaining height must be a multiple of the sleeper vertical dimension (1600mm)
Retaining height (ht) = 1600 mm
Post centres (cts) = 1800 mm
Upright = S (T)imber,(S)teel,(B)oth
Concrete sleepers = Y (Y)es,(N)o Concrete sleeper width = 200 mm (Vert. dimension)
Risk class = B (A),(B),(C) - Moderate damage and loss of services - Table 1.1
Backfill type = U Class(1), Class(2), (U)ncontrolled, (I)n-situ - Table 5.1(A)

Soil parameters (behind wall)

Internal friction (ϕ) = 37 ° ($0^\circ \leq \phi \leq 45^\circ$)
Incline of soil at top (β) = 3 ° ($0^\circ \leq \beta \leq 45^\circ$) 1 in 19.1
Soil weight (γ_s) = 18.0 kN/m³
Cohesion (c) = 0 kPa

Footing - Cohesive

Total footing depth (d) = 2200 mm (From surface)
Ignore top (ig) = 200 mm
Footing diameter (dia) = 450 mm
Soil cohesion (cf) = 40 kPa (0 for cohesionless)

Design $cf^* = cf \cdot \Phi_{uc} (=0.7) = 28.0$ kPa insitu material

Sleepers Minor axis bending

Sleeper depth (dSD) = N/A mm (Horz. dimension)
Sleeper width (dSW) = 200 mm (Vert. dimension)
Max number of layers = 8 (1600mm high)

Live Load duration = Permanent

Long term LL factor (ψ_l) = 1.00 AS 1170.0 Table 4.1
Duration factor (k_1) = 0.57

Design loads - Appendix J & Section 4 - AS4678

Min. surcharge = 5.0 kPa - Table 4.1
Water height (hw) = 0.0 mm (Drained)
Surcharge (s) = 5.0 kPa

Dead only factor = 1.35 (1.35)
Earth factor = 1.25 (1.25)
Live load factor = 1.50 (1.50 - 0.0 for stabilising effect)
Stabilising factor = 0.80 AS4678 - Appendix J2

Additional upright overturning

Thrust (V_a) = 0.00 kN/upright
Overturning (M_a) = 9.16 kNm/upright
Load factor = 1.50
Long term LL factor (ψ_{lo}) = 0.40
 $V_a^* = 0.00$ kN/upright
 $M_a^* = 13.74$ kNm/upright
(Thrust/moment applied at the top of the wall)

Material design factors - Section 5

$\Phi_{uc} = 0.50$ $c^* = c \cdot \Phi_{uc} = 0.0$ kPa CI 5.2.1
 $\Phi_{uo} = 0.75$ $\phi^* = 29.5^\circ$ CI 5.2.2 $\phi^* = 0.514$ rad

Design factor (Φ_n) = 1.00 Table 5.2
 $K_a = 0.342$ (Rankine) Depth of tension zone = 0 mm
 $K_p = 2.917$ (Rankine) Acting soil height (h_a) = 1600 mm



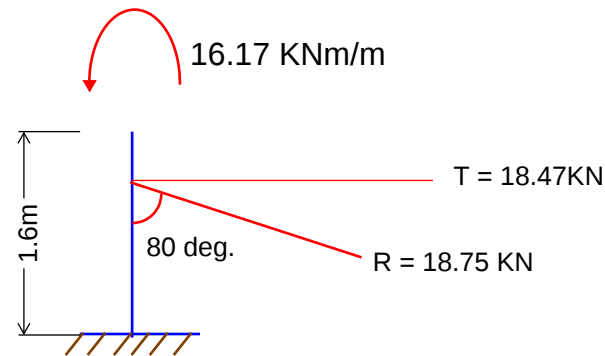
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Design moment in upright (about top of footing, per m of wall)

	Pressure kPa	Thrust kN/m	Thrust* kN/m	Lever arm mm	Mw kNm/m	Mw* kNm/m	Comments
Soil = $K_a \gamma s^* h_a$ =	9.85	7.88	9.85	533	4.20	5.25	(At wall base)
Surcharge = $K_a s$ =	1.71	2.74	4.10	800	2.19	3.28	Max. pressure at base
Additional =		0.00	0.00	1600	5.09	7.63	Uniform pressure dist.
Total =		10.61	13.95		11.48	16.17	
Total thrust (Vw) =	10.61 kN/m				Total moment (Mw) =	11.48 kNm/m	
Total ult. thrust (Vw*) =	13.95 kN/m				Total ult. moment (Mw*) =	16.17 kNm/m	
Total ult. thrust (Vw*/ Φ_n) =	13.95 kNm/m				Total ult. moment (Mw*/ Φ_n) =	16.17 kNm/m	
					Ultimate factor =	1.41	

Sleeper design - AS1720.1 Section 3 (Not Applicable)



$$T = 129.10 \text{ kN-m} / 1.6\text{m} = 18.47\text{KN}$$

$$R = 18.47 \text{ KN} / \cos 10 \text{ deg} = 18.75 \text{ KN}$$

Anchor Spacing 1.8m
Design Moment = $16.17 \text{ kNm/m} \times 1.8\text{m}$
= 29.10 kNm

Steel upright design - AS4100 Section 5

$V^* = Vw^* \cdot \text{cts} / \Phi_n =$	25.11 kN					
$M^* = Mw^* \cdot \text{cts} / \Phi_n =$	29.10 kNm					
Description = 150UC23.4 (G300)			Capacity factor (ϕ) =	0.9	Table 3.4	
Flange yield (fyf) = 320 MPa			Warping constant (Iw) =	21.1	$\times 10^9 \text{ mm}^6$	
Area (Ag) = 2980 mm ²			Torsional constant (J) =	50.2	$\times 10^3 \text{ mm}^4$	
Stiffness (Ix) = $12.6 \times 10^6 \text{ mm}^4$			Effective section mod. (Zex) =	176	$\times 10^3 \text{ mm}^3$	
Shear modulus (G) = 80000 MPa - Cl 1.4			Effective section mod. (Zey) =	73.5	$\times 10^3 \text{ mm}^3$	
			Modulus of elasticity (Es) =	200000	MPa - Cl 1.4	
Msx = 56.3 kNm - Cl 5.2		$\phi Msx =$	50.7 kNm	OK (0.57)		
$\phi Vv = \phi Vu =$	160.2 kN					
$\phi Vvm =$	160.2 kN	$\phi Vvm = \phi Vv$		OK (0.16)		
Deflection horizontal at top $\delta(dI) =$	1.5 mm			ht / 1041		
$\delta(LL) =$	1.0 mm			ht / 1600		
$\delta(II) \text{ (other)} =$	4.7 mm			ht / 344		
Total $\delta(II) =$	5.7 mm			ht / 283		
Total deflection horizontal $\delta(dI + \psi I, II) =$	4.4 mm			ht / 364		



Timber upright design - AS1720.1 Section 3 (Not Applicable)

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Footing design [ASD] - Cohesive

Shear included in footing

Footing geometry

Total footing depth (d) =	2200 mm
Ignore depth (ig) =	200 mm
Design depth (D=d-ig) =	2000 mm
Rotation depth (rD=D/2) =	1000 mm
Footing diameter (dia) =	450 mm

Upright reactions

V* =	25.11 kN
M* =	29.10 kNm

Overturning moment

$$M^*o = M^* + V^* \cdot (ig + rD) = 59.23 \text{ kNm}$$

Soil parameters (footing)

Clay cohesion (cf*) =	28.0 kPa
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$$\phi Mr = 1.25 \cdot cf^* \cdot dia \cdot D^2 = 63.0 \text{ kNm} \quad \text{OK (0.94)}$$

Horizontal bearing

$$\text{Ultimate bearing } BP^* = 6 \cdot M^*o / (dia \cdot D^2) = 197.4 \text{ kPa (Horizontal)}$$