Worked example – T-shaped gravity wall

Dr Andrew Bond

Director, Geocentrix Ltd

Chairman TC250/SC7

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DESIGN SITUATION

Design situation for gravity wall example

Earth pressure theory

Use Rankine's equation for K_a:

$$K_{a,\beta} = \left(\frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\varphi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\varphi}} \right) \cos\beta$$

Horizontal and vertical component of K_a are:

$$K_{a,h} = K_{a,\beta} \times \cos\beta$$

$$K_{a,v} = K_{a,\beta} \times \sin\beta \left(= K_{a,h} \times \tan\beta \right)$$

Some numbers to save you time...

Self-weight of wall stem

$$W_{stem,k} = \gamma_{c,k} \times t_s \times H$$

$$= 25 \times 0.7 \times 6 = 105 \, kN/m$$

Self-weight of wall base

$$W_{base,k} = \gamma_{c,k} \times t_b \times B$$

$$= 25 \times 0.8 \times 3.9 = 78 \, kN/m$$

Self-weight of backfill

$$W_{fill,k} = \gamma_k \times b_{heel} \times \left(\frac{H + h_f}{2} \right)$$

$$= 19 \times 2.25 \times \left(\frac{6 + 6.82}{2} \right) = 274 \, kN/m$$

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Bearing capacity coefficients

φ	N_q	φ	N_q
20	6.4	30	18.4
21	7.1	31	20.6
22	7.8	32	23.2
23	8.7	33	26.1
24	9.6	34	29.4
25	10.7	35	33.3
26	11.9	36	37.8
27	13.2	37	42.9
28	14.7	38	48.9
29	16.4	39	56.0

Worksheet − T-shaped gravity wall

Calculate:

1. Earth pressure coefficient K_a
2. Moments about wall toe, the determine eccentricity of loading
3. Bearing resistance under eccentric, inclined loads
4. Sliding resistance
5. Toppling resistance

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SOLUTION

Solutions DA1/DA2* – T-shaped gravity wall

Verification	DA1		DA2*	Traditional
	DA1-1	DA1-2		
Sliding	66%	85%	99%	$F_s = 1.52$
Bearing	125%	230%	93%	$F_b = 2.03$
Eccentricity	0.92 m	0.64 m	0.42 m	Same as DA2*
Effective width	2.05 m	2.63 m	3.06 m	
Toppling	31%	31%	31%	$F_O = 4.35$

Summary of key points

DA2* requires a wall base of width B $\geq$ 3.9 m
Equivalent to traditional F_s = 1.5 and F_b = 2.0

DA1 requires a wall base of width B $\geq$ 5.1 m
Equivalent to traditional F_s = 1.86 and F_b = 3.93

Main difference between DAs 1 and 2* is bearing resistance
   Calculated load eccentricity is very different
   Effective width is much smaller in DA1

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