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GABION RETAINING WALL ANLYSIS & DESIGN

In accordance with EN 1997-1:2004 - Code of Practice for Geotechnical design and the UK National Annex

Tedds calculation version 2.0.03

Design summary

Combination 1

Action	Resistance	Force	FoS	Allowable FoS	Status
Overturning, sliding a	nd bearing at base	level	·	·	·
Overturning (kNm/m)	8869.5	1949.0	4.551	1.000	PASS
Sliding (kN/m)	1188.5	555.6	2.139	1.000	PASS
Bearing (kN/m ²)	300.0	263.7	1.138	1.000	PASS
Eccentricity (mm)	Reaction acts wit	hin the middle third	of base		PASS
Overturning and slidir	ng between course	s 1 and 2			
Overturning (kNm/m)	6468.2	1446.1	4.473	1.000	PASS
Sliding (kN/m)	998.7	455.8	2.191	1.000	PASS
Overturning and slidir	ng between course	s 2 and 3			
Overturning (kNm/m)	4544.9	1037.7	4.380	1.000	PASS
Sliding (kN/m)	788.5	365.8	2.155	1.000	PASS
Overturning and slidir	ng between course	s 3 and 4	- 1		
Overturning (kNm/m)	3046.6	714.1	4.266	1.000	PASS
Sliding (kN/m)	603.1	285.6	2.112	1.000	PASS
Overturning and slidir	ng between course	s 4 and 5			
Overturning (kNm/m)	1920.0	465.4	4.126	1.000	PASS
Sliding (kN/m)	442.6	215.1	2.057	1.000	PASS
Overturning and slidir	ng between course	s 5 and 6	1	1	1
Overturning (kNm/m)	1112.4	281.8	3.947	1.000	PASS
Sliding (kN/m)	307.0	154.5	1.987	1.000	PASS
Overturning and slidir	ng between course	s 6 and 7			
Overturning (kNm/m)	570.6	153.6	3.714	1.000	PASS
Sliding (kN/m)	196.2	103.5	1.896	1.000	PASS
Overturning and slidir	ng between course	s 7 and 8	1	1	1
Overturning (kNm/m)	241.6	71.0	3.404	1.000	PASS
Sliding (kN/m)	110.3	62.2	1.772	1.000	PASS
Overturning and slidir	ng between course	s 8 and 9	- 1		
Overturning (kNm/m)	72.4	24.1	3.007	1.000	PASS
Sliding (kN/m)	49.3	30.5	1.618	1.000	PASS
Overturning and slidir	ng between course	s 9 and 10	1	1	1
Overturning (kNm/m)	10.1	3.2	3.126	1.000	PASS
Sliding (kN/m)	13.4	7.6	1.754	1.000	PASS

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Action	Resistance	Force	FoS	Allowable FoS	Status
Overturning, sliding a	nd bearing at bas	se level	•		
Overturning (kNm/m)	8903.7	1779.0	5.005	1.000	PASS
Sliding (kN/m)	953.5	503.4	1.894	1.000	PASS
Bearing (kN/m ²)	300.0	263.7	1.138	1.000	PASS
Eccentricity (mm)	Reaction acts w	ithin the middle th	nird of base		PASS
Overturning and slidir	ng between cours	ses 1 and 2			•
Overturning (kNm/m)	6495.6	1321.9	4.914	1.000	PASS
Sliding (kN/m)	801.4	413.3	1.939	1.000	PASS
Overturning and slidir	ng between cours	es 2 and 3	I		1
Overturning (kNm/m)	4566.2	950.2	4.805	1.000	PASS
Sliding (kN/m)	632.9	332.1	1.906	1.000	PASS
Overturning and slidir	ng between cours	ses 3 and 4	1	1	1
Overturning (kNm/m)	3062.5	655.3	4.673	1.000	PASS
Sliding (kN/m)	484.3	259.6	1.865	1.000	PASS
Overturning and slidir	ng between cours	ses 4 and 5	I		1
Overturning (kNm/m)	1931.4	428.3	4.510	1.000	PASS
Sliding (kN/m)	355.5	195.9	1.815	1.000	PASS
Overturning and slidir	ng between cours	es 5 and 6	I		1
Overturning (kNm/m)	1120.0	260.3	4.303	1.000	PASS
Sliding (kN/m)	246.7	141.0	1.750	1.000	PASS
Overturning and slidir	ng between cours	es 6 and 7	I		1
Overturning (kNm/m)	575.2	142.6	4.033	1.000	PASS
Sliding (kN/m)	157.8	94.9	1.663	1.000	PASS
Overturning and slidir	ng between cours	es 7 and 8	•		•
Overturning (kNm/m)	243.9	66.4	3.672	1.000	PASS
Sliding (kN/m)	88.8	57.4	1.546	1.000	PASS
Overturning and slidir	ng between cours	es 8 and 9	I		
Overturning (kNm/m)	73.2	22.9	3.193	1.000	PASS
Sliding (kN/m)	39.7	28.6	1.390	1.000	PASS
Overturning and slidir	ng between cours	ses 9 and 10	1	1	1
Overturning (kNm/m)	10.1	3.3	3.038	1.000	PASS
Sliding (kN/m)	10.7	7.7	1.384	1.000	PASS

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Wall geometry

0 7
Width of gabion 1
Height of gabion 1
Width of gabion 2
Height of gabion 2
Step to front face between courses 1 and 2
Width of gabion 3
Height of gabion 3
Step to front face between courses 2 and 3
Width of gabion 4
Height of gabion 4
Step to front face between courses 3 and 4
Width of gabion 5
Height of gabion 5
Step to front face between courses 4 and 5
Width of gabion 6
Height of gabion 6
Step to front face between courses 5 and 6
Width of gabion 7
Height of gabion 7
Step to front face between courses 6 and 7
Width of gabion 8
Height of gabion 8
Step to front face between courses 7 and 8
Width of gabion 9

w ₁ = 10000 mm
h1 = 1000 mm
w2 = 9000 mm
h ₂ = 1000 mm
s ₂ = 0 mm
w ₃ = 8000 mm
h₃ = 1000 mm
s ₃ = 0 mm
w4 = 7000 mm
h4 = 1000 mm
s4 = 0 mm
w5 = 6000 mm
h5 = 1000 mm
s ₅ = 0 mm
w ₆ = 5000 mm
h ₆ = 1000 mm
s ₆ = 0 mm
w7 = 4000 mm
h7 = 1000 mm
s ₇ = 0 mm
w ₈ = 3000 mm
h ₈ = 1000 mm
$s_8 = 0 mm$
w ₉ = 2000 mm

	Project	GABION W	ALL DESIGN	I	Job Ref.			
S	Section				Sheet no./rev.			
C	Calc. by VIC	Date 8/14/2023	Chk'd by	Date	App'd by	Date		
Height of gabion 9		h₀ = 1000 mm						
Step to front face between cour	ses 8 and 9	s ₉ = 0 mm						
Width of gabion 10		w ₁₀ = 1000 mn	n					
Height of gabion 10		h ₁₀ = 1000 mm	n					
Step to front face between cour	ses 9 and 10	s ₁₀ = 0 mm						
Wall inclination		$\epsilon = 0 \deg$						
Gabion properties								
Unit weight of fill		γ _d = 18.0 kN/m	3					
Friction between gabions		δ _{bg.k} = 35.0 de						
Loading		_	-					
Variable surcharge		p _{o,Q} = 10 kN/m	2					
-								
Soil properties								
Slope of retained soil		β = 0.0 deg						
Characteristic effective shearing		φ'r.k = 30.0 deg						
Characteristic saturated density	of retained soil	γsr = 19.0 kN/m						
Coefficient for wall friction		kmembrane = 0.7	5					
Wall friction angle		$\delta_{r.k} = 22.5 \text{ deg}$						
Characteristic base friction ang		$\delta_{bb,k} = 34.0 \text{ deg}$						
Bearing capacity of founding so	11	q = 300 kN/m ²						
Wall geometry								
Horizontal distance to centre of		$x_{g1} = w_1 / 2 = 5$						
Vertical distance to centre of gr	avity gabion 1	$y_{g1} = h_1 / 2 = 500 \text{ mm}$						
Weight of gabion 1		$W_{g1} = \gamma_d \times w_1 \times h_1 = 180.0 \text{ kN/m}$						
Horizontal distance to centre of		$x_{g2} = w_2 / 2 + s_2 = 4500 \text{ mm}$						
Vertical distance to centre of gr	avity gabion 2	$y_{g2} = h_2 / 2 + h_1 = 1500 \text{ mm}$						
Weight of gabion 2		$W_{g2} = \gamma_d \times W_2 >$						
Horizontal distance to centre of		$x_{g3} = w_3 / 2 + s_3$						
Vertical distance to centre of gr	avity gabion 3	$y_{g3} = h_3 / 2 + h_3$						
Weight of gabion 3		$W_{g3} = \gamma_d \times W_3 >$						
Horizontal distance to centre of		$x_{g4} = W_4 / 2 + s_{g4}$						
Vertical distance to centre of gr	avity gabion 4	$y_{g4} = h_4 / 2 + h_4$						
Weight of gabion 4	mavity achies C	$W_{g4} = \gamma_d \times W_4 >$						
Horizontal distance to centre of		$x_{g5} = W_5 / 2 + s$						
Vertical distance to centre of gr	avity yabion 5	$y_{g5} = h_5 / 2 + h$						
Weight of gabion 5	arovity achies 6	$W_{g5} = \gamma_d \times W_5 >$			~			
Horizontal distance to centre of		-		s + s ₆ = 2500 m				
Vertical distance to centre of gr	avity yabion o			14 + h5 = 5500 m /m	111			
Weight of gabion 6	aravity appian 7	$W_{g6} = \gamma_d \times W_6 >$)0 mm			
Horizontal distance to centre of Vertical distance to centre of gr		•		s5 + S6 + S7 = 200 14 + h5 + h6 = 65 0				
	avity gabion /	yg/ — 11/ / ∠ + 11	T TIZ T TI3 T I	$14 \pm 115 \pm 116 = 00$				

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Horizontal distance to centre of gravity	gabion 8	$x_{g8} = w_8 / 2 + s_2$	2 + S3 + S4 + S5	+ S ₆ + S ₇ + S ₈ = 1	500 mm			
Vertical distance to centre of gravity ga	bion 8	$y_{g8} = h_8 / 2 + h_1$	+ h ₂ + h ₃ + h ₄	+ h₅ + h ₆ + h ₇ = 7	′500 mm			
Weight of gabion 8		$W_{g8} = \gamma_d \times W_8 \times$						
Horizontal distance to centre of gravity	gabion 9	$x_{g9} = w_9 / 2 + s_2$	2 + S3 + S4 + S5	+ S ₆ + S ₇ + S ₈ + S ₈	9 = 1000 mm			
Vertical distance to centre of gravity ga	bion 9	$y_{g9} = h_9 / 2 + h_1$	+ h ₂ + h ₃ + h ₄	+ h ₅ + h ₆ + h ₇ + h	n ₈ = 8500 mm	n		
Weight of gabion 9		$W_{g9} = \gamma_d \times W_9 \times$	h ₉ = 36.0 kN/r	n				
Horizontal distance to centre of gravity	gabion 10	$x_{g10} = w_{10} / 2 +$	S2 + S3 + S4 + S	S5 + S6 + S7 + S8 +	S9 + S10 = 50	0 mm		
Vertical distance to centre of gravity ga	bion 10	$y_{g10} = h_{10} / 2 +$	h1 + h2 + h3 + l	n4 + h5 + h6 + h7 +	h ₈ + h ₉ = 95	00 mm		
Weight of gabion 10		$W_{g10} = \gamma_d \times W_{10}$	× h ₁₀ = 18.0 k	N/m				
Weight of entire gabion		$W_g = W_{g1} + W_g$	2 + W _{g3} + W _{g4}	+ W _{g5} + W _{g6} + W _g	7 + W _{g8} + W _g	9 + W _{g10} =		
		990.0 kN/m						
Horiz distance to centre of gravity entire	e gabion	$x_g = ((W_{g1} \times x_{g1})$) + (W _{g2} \times x _{g2})	+ ($W_{g3} \times x_{g3}$) + (V	$V_{g4} imes x_{g4}$) + (V	$W_{g5} \times x_{g5}$) +		
		$(W_{g6} \times x_{g6})$ + (V	$V_{g7} \times x_{g7}$) + (W	$_{g8} imes x_{g8}$) + (W _{g9} $ imes$)	x _{g9}) + (W _{g10} >	< x g10)) / Wg		
		3500 mm						
Vert distance to centre of gravity entire	gabion	$y_g = ((W_{g1} \times y_{g1})$) + (W _{g2} \times y _{g2})	+ ($W_{g3} \times y_{g3}$) + (V	$V_{g4} \times y_{g4}$) + (V	$W_{g5} \times y_{g5}$) +		
		$(W_{g6} \times y_{g6}) + (V$	$V_{g7} \times y_{g7}$) + (W	$_{g8} \times y_{g8}$) + (W _{g9} \times)	y _{g9}) + (W _{g10} >	< y _{g10})) / W _g		
		3500 mm						
Correcting for wall inclination horiz dist		$X_g = x_g \times \cos(\epsilon)$) + $y_g \times sin(\epsilon)$ =	= 3500 mm				
Vertical change in height due to wall in	clination	$H_{f} = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times cos(\epsilon) - (x_{g10} + w_{10}/2) \times sin(\epsilon)) = 0 \text{ mm}$						
Design dimensions								
Effective angle of rear plane of wall		α = 90deg - Ata	an((w1 - (x _{g10} +	(w ₁₀ / 2))) / (y _{g10} -	+ h ₁₀ / 2)) + ε	= 48.0 deg		
Effective face angle		θ = 90deg - ε = 90.0 deg						
Effective height of wall		$H = (y_{g10} + h_{10} / 2) + (w_1 \times sin(\epsilon)) - H_f = 10000 \text{ mm}$						
Height of wall from toe to front edge of	top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times sin(\epsilon)) = 10000 \text{mm}$						
Active pressure using Coulomb theory		$K_{a} = \sin(\alpha + \phi'_{r,k})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r,k}) \times (1 + \sqrt{(\sin(\phi'_{r,k} + \delta_{r,k})} \times \sin(\phi'_{r,k} - \delta_{r,k}))$						
		β) / (sin(α - $\delta_{r,k}$) × sin(α + β)))) ²) = 0.901						
Active thrust due to soil		$P_{a,soil} = 0.5 \times K_{a}$	$a \times \gamma_{sr} \times H^2 = 8$	55.5 kN/m				
Pressure at base								
Horizontal forces								
Retained soil		$F_{\text{soil_h,q}} = P_{a,\text{soil}}$	$\times \cos(90 - \alpha +$	δ _{r.k}) = 368.5 kN/m	n			
Height of soil thrust resolved vertically		$d_{h,soil} = H / 3 - v$	$v_1 \times sin(\varepsilon) = 33$	33 mm				
Surcharge		$F_{\text{surch}_h,q} = p_{o,Q}$	$\times K_a imes H imes$ cos	(90 - α + δ _{r.k}) = 38	3.8 kN/m			
Height of surcharge thrust resolved vertically		$d_{h,surch} = H / 2 - w_1 \times sin(\varepsilon) = 5000 \text{ mm}$						
Vertical forces								
Gabion weight		$F_{gabion_v,q} = W_g$	= 990.0 kN/m					
Retained soil		$F_{soil_v,q} = P_{a,soil}$	$\times \sin(90 - \alpha + \delta)$	ōr.k) = 772.1 kN/m				
Horizontal dist to where soil thrust acts		$b_{v,soil} = w_1 \times cos$	s(ε) - (Η / 3) / ta	an(α) = 7000 mm				
Surcharge				90 - α + δ _{r.k}) = 81 .				
Horizontal dist to where surcharge thru	st acts			$tan(\alpha) = 5500 mr$				
Total horizontal unfactored force		$T_q = F_{soil_h,q} + F$						
Total vertical unfactored force								

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Force normal to base		$N_s = N_q \times \cos(s)$	ϵ) + T _q × sin(ϵ)	= 1843.3 kN/m	1			
Total unfactored overturning force		$M_{o,q} = F_{soil_h,q} \times$						
Total unfactored restoring force					$h_v,q \times b_{v,surch} = 9$	316.5 kNm		
Eccentricity		$e = w_1 / 2 - (M_F)$						
		Υ.	, , , , , , , , , , , , , , , , , , ,		cts within middl	le third of l		
Pressure at toe		$\sigma_{toe} = N_s / w_1 \times$	(1 + (6 × e / w	√1)) = 263.7 kN/	/m²			
Pressure at heel		$\sigma_{\text{heel}} = N_{\text{s}} / w_{1}$						
Factor of safety		$FoS_Q = q / max$						
Allowable factor of safety		$FoSq_allow = 1.0$						
-	Design Fos	S for allowable b		ure exceeds m	nin allowable pr	essure to l		
Design approach 1								
Partial factors on actions - Section	A.3.1 - Com	bination 1						
Permanent unfavourable action		γg = 1.35						
Permanent favourable action		γG,f = 1.00						
Variable unfavourable action		γ Q = 1.50						
Variable favourable action		$\gamma_{Q,f} = 0.00$						
Partial factors for soil parameters -	Section A.3	3.2 - Combinatio	n 1					
Angle of shearing resistance	-	$\gamma_{\Phi'} = 1.00$						
Weight density		$\gamma_{\gamma} = 1.00$						
Design soil properties								
Design effective shearing resistance a	angle	∳'r.d = Atan(tan	(φ'r.k) / γ _{φ'}) = 30).0 deg				
Design saturated density of retained s	-	$\gamma_{s,d} = \gamma_{sr} / \gamma_{\gamma} = 19.0 \text{ kN/m}^3$						
Design wall friction angle		$\delta_{r,d} = \min(\operatorname{atan}(\operatorname{tan}(\delta_{r,k}) / \gamma_{\phi}), \phi'_{r,d} \times k_{\operatorname{membrane}}) = 22.5 \text{ deg}$						
Design base friction angle		$\delta_{bb,d} = Atan(tan(\delta_{bb,k}) / \gamma_{\phi}) = 34.0 \text{ deg}$						
Design friction between gabions		$\delta_{\text{bg.d}} = \text{Atan}(\tan(\delta_{\text{bg.k}}) / \gamma_{\phi}) = 35.0 \text{ deg}$						
Active pressure using Coulomb theory	1	$K_{a} = \sin(\alpha + \phi'_{r,d})^{2} / (\sin(\alpha)^{2} \times \sin(\alpha - \delta_{r,d}) \times (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) \times \sin(\phi'_{r,d})^{2})})$						
		β / (sin(α - $\delta_{r.d}$						
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$						
Horizontal forces			·					
Retained soil		$F_{soil h} = v_G \times P_{soil h}$	$soil \times cos(90 -$	$\alpha + \delta_{rd} = 497$	4 kN/m			
Surcharge		$\begin{aligned} F_{\text{soil}_h} &= \gamma_G \times P_{\text{a},\text{soil}} \times \cos(90 - \alpha + \delta_{r.d}) = \textbf{497.4 kN/m} \\ F_{\text{surch}_h} &= p_{\text{o},\text{Q}} \times \gamma_{\text{Q}} \times K_{\text{a}} \times H \times \cos(90 - \alpha + \delta_{r.d}) = \textbf{58.2 kN/m} \end{aligned}$						
Vertical forces		···· =·· 1 ···		,	,			
Gabion weight		Equation $y f = y c f$	× Wa = <u>99</u> 0 م ا	kN/m				
Retained soil	-							
Surcharge		$F_{\text{surch}_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times \sin(90 - \alpha + \delta_{r.d}) = 0.0 \text{ kN/m}$						
Overturning stability - take moment	s about the			``				
Overturning moment		$M_o = F_{soil_h} \times d_i$	n.soil + Fsurch h ×	dh.surch = 1949	.0 kNm/m			
Restoring moment					$v_{,f} \times b_{v,surch} = 8869$	9.5 kNm/m		
-		-	-	Suici_v	.,. ·· ~v,suicii – 000			
Factor of safety $FoS_M = M_R / M_o = 4.551$ Allowable factor of safety $FoS_{M_allow} = 1.000$								

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PASS - Design FOS for overturning exceeds min allowable FOS for overturning

Sliding stability - ignore any passive	e pressure in front of the structure
Total horizontal force	T = F _{soil_h} + F _{surch_h} = 555.6 kN/m
Total vertical force	$N = F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 1762.1 \text{ kN/m}$
Sliding force	$F_f = T \times cos(\epsilon) - N \times sin(\epsilon) = 555.6 \text{ kN/m}$
Sliding resistance	$F_R = (T \times sin(\epsilon) + N \times cos(\epsilon)) \times tan(\delta_{bb.d}) = 1188.5 \text{ kN/m}$
Factor of safety	FoSs = F _R / F _f = 2.139
Allowable factor of safety	FoS _{S_allow} = 1.000
	PASS - Design FOS for sliding exceeds min allowable FOS for sliding

Check overturning and sliding between courses 1 and 2

Wall geometry

Horizontal distance to centre of gravity gabion 2	x _{g2} = w ₂ / 2 = 4500 mm
Vertical distance to centre of gravity gabion 2	y _{g2} = h ₂ / 2 = 500 mm
Weight of gabion 2	$W_{g2} = \gamma_d \times w_2 \times h_2 = 162.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 3	x _{g3} = w ₃ / 2 + s ₃ = 4000 mm
Vertical distance to centre of gravity gabion 3	y _{g3} = h ₃ / 2 + h ₂ = 1500 mm
Weight of gabion 3	$W_{g3} = \gamma_d \times w_3 \times h_3 = $ 144.0 kN/m
Horizontal distance to centre of gravity gabion 4	x _{g4} = w ₄ / 2 + s ₃ + s ₄ = 3500 mm
Vertical distance to centre of gravity gabion 4	$y_{g4} = h_4 / 2 + h_2 + h_3 = 2500 \text{ mm}$
Weight of gabion 4	$W_{g4} = \gamma_d \times w_4 \times h_4 = \textbf{126.0 kN/m}$
Horizontal distance to centre of gravity gabion 5	$x_{g5} = w_5 / 2 + s_3 + s_4 + s_5 = 3000 \text{ mm}$
Vertical distance to centre of gravity gabion 5	$y_{g5} = h_5 / 2 + h_2 + h_3 + h_4 = 3500 \text{ mm}$
Weight of gabion 5	$W_{g5} = \gamma_d \times w_5 \times h_5 = 108.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 6	$x_{g6} = w_6 / 2 + s_3 + s_4 + s_5 + s_6 = 2500 \text{ mm}$
Vertical distance to centre of gravity gabion 6	$y_{g6} = h_6 / 2 + h_2 + h_3 + h_4 + h_5 = 4500 \text{ mm}$
Weight of gabion 6	$W_{g6} = \gamma_d \times w_6 \times h_6 = 90.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 7	$x_{g7} = w_7 / 2 + s_3 + s_4 + s_5 + s_6 + s_7 = 2000 \text{ mm}$
Vertical distance to centre of gravity gabion 7	y _{g7} = h ₇ / 2 + h ₂ + h ₃ + h ₄ + h ₅ + h ₆ = 5500 mm
Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 8	$x_{g8} = w_8 / 2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 = 1500 \text{ mm}$
Vertical distance to centre of gravity gabion 8	$y_{g8} = h_8 / 2 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 = 6500 \text{ mm}$
Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = $ 54.0 kN/m
Horizontal distance to centre of gravity gabion 9	$x_{g9} = w_9 / 2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 = 1000 \text{ mm}$
Vertical distance to centre of gravity gabion 9	y _{g9} = h ₉ / 2 + h ₂ + h ₃ + h ₄ + h ₅ + h ₆ + h ₇ + h ₈ = 7500 mm
Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = 36.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
Vertical distance to centre of gravity gabion 10	$y_{g10} = h_{10} / 2 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 + h_9 = 8500 \text{ mm}$
Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = 18.0 \text{ kN/m}$
Weight of entire gabion	$W_{g} = W_{g2} + W_{g3} + W_{g4} + W_{g5} + W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = 810.0$
	kN/m
Horiz distance to centre of gravity entire gabion	$x_{g} = ((W_{g2} \times x_{g2}) + (W_{g3} \times x_{g3}) + (W_{g4} \times x_{g4}) + (W_{g5} \times x_{g5}) + (W_{g6} \times x_{g6}) +$
	$(W_{g7} \times x_{g7}) + (W_{g8} \times x_{g8}) + (W_{g9} \times x_{g9}) + (W_{g10} \times x_{g10})) / W_g = 3167 \text{ mm}$

Project	t	GABION W	ALL DESIGN		Job Ref.	
Section	1				Sheet no./rev	
C		1	I			8
Calc. by	у	Date	Chk'd by	Date	App'd by	Date
	VIC	8/14/2023				
Vert distance to centre of gravity entire gab	bion) + (W _{g4} \times y _{g4}) + V _{g9} \times y _{g9}) + (W _{g1}		
Correcting for wall inclination horiz dist		$X_g = X_g \times \cos(\varepsilon)$			iu ∧ ygiu <i>)) i</i> vvg –	. 310 7 mm
Vertical change in height due to wall inclina	ation			$/2) \times \cos(\varepsilon) - (x_0)$	-10 + W10/2) × sir	n(s)) - 0 mn
		1 II — y gið 1 1110/2		72) × 003(8) (Xį	giù i wiù/ <i>2 j</i> × 311	
Design dimensions		. Oodaa At		· (w. (2))) / (w	(2)) .	10 1 dog
Effective angle of rear plane of wall Effective face angle				+ (w ₁₀ / 2))) / (y _g	10 + 110 / 2)) + E	: = 40.4 deg
Ŭ		$\theta = 90 \text{deg} - \varepsilon =$	C C	-(.)) 0000		
Effective height of wall	achier			$n(\varepsilon)) - H_f = 9000$		000
Height of wall from toe to front edge of top	yabion			$x_{g10} - (x_{g10} - (w_{10} / w_{10}))$		
Active pressure using Coulomb theory				$\propto \sin(\alpha - \delta_{r.d}) \times (2)$	$1 + \gamma(SIN(\phi'r.d + \phi))$	br.d) × SIN(φ'r
A struct through the state of the		β) / (sin(α - $\delta_{r.d}$				
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$.a × γs.d × H² =	684.9 KN/M		
Horizontal forces						
Retained soil		-	-	$\alpha + \delta_{r.d}$) = 403.4		
Surcharge		$F_{surch_h} = p_{o,Q} \times$	γ $_{Q} \times K_{a} \times H \times$	cos(90 - α + δ _r	_{.d}) = 52.4 kN/m	
Vertical forces						
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	× Wg = 810.0	kN/m		
Retained soil		$F_{soil_v,f} = \gamma_{G,f} \times F$	P _{a,soil} × sin(90	- α + δ _{r.d}) = 616	.3 kN/m	
Surcharge		$F_{surch_v,f} = p_{o,Q}$	$\times \gamma_{Q,f} imes K_a imes H$	$\times \sin(90 - \alpha + \delta)$	d) = 0.0 kN/m	
Overturning stability - take moments abo	out the t	oe				
Overturning moment		$M_o = F_{\text{soil}_h} \times d_i$	h,soil + Fsurch_h :	$\times d_{h,surch} = 1446$.1 kNm/m	
Restoring moment		$M_R = F_{gabion_v,f}$	× Xg + F _{soil_v,f}	× b _{v,soil} + F _{surch_v}	$h_{f} \times b_{v,surch} = 646$	8.2 kNm/m
Factor of safety		$FoS_M = M_R / M_R$	_o = 4.473			
Allowable factor of safety		$FoS_{M_allow} = 1.0$	000			
	PASS -	Design FOS fo	r overturning	exceeds min a	allowable FOS	for overtur
Sliding stability - ignore any passive pre	essure in	n front of the st	ructure			
Total horizontal force		$T = F_{soil_h} + F_{su}$				
Total vertical force		•		n_v,f = 1426.3 kN	l/m	
Sliding force		$F_f = T \times cos(\epsilon)$				
Sliding resistance		,		$\times \tan(\delta_{\text{bg.d}}) = 9$	98.7 kN/m	
Factor of safety		$FoS_S = F_R / F_f$				
Allowable factor of safety		$FoSs_allow = 1.0$				
		_	gn FOS for sl	iding exceeds	min allowable	FOS for sli
Check overturning and sliding between	courses	2 and 3				
Wall geometry						
Horizontal distance to centre of gravity gab		$x_{g3} = w_3 / 2 = 4$				
Vertical distance to centre of gravity gabion	n 3	$y_{g3} = h_3 / 2 = 50$				
Weight of gabion 3		$W_{g3} = \gamma_d \times W_3 \times V_3$		N/m		
Horizontal distance to centre of gravity gab		$x_{g4} = w_4 / 2 + s$				
Vertical distance to centre of gravity gabion	า 4	$y_{g4} = h_4 / 2 + h_3$	3 = 1500 mm			

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Weight of gabion 4	$W_{g4} = \gamma_d \times w_4 \times h_4 = 126.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 5	x _{g5} = w ₅ / 2 + s ₄ + s ₅ = 3000 mm
Vertical distance to centre of gravity gabion 5	y _{g5} = h ₅ / 2 + h ₃ + h ₄ = 2500 mm
Weight of gabion 5	$W_{g5} = \gamma_d \times w_5 \times h_5 = 108.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 6	x _{g6} = w ₆ / 2 + s ₄ + s ₅ + s ₆ = 2500 mm
Vertical distance to centre of gravity gabion 6	y _{g6} = h ₆ / 2 + h ₃ + h ₄ + h ₅ = 3500 mm
Weight of gabion 6	$W_{g6} = \gamma_d \times w_6 \times h_6 = 90.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 7	x _{g7} = w ₇ / 2 + s ₄ + s ₅ + s ₆ + s ₇ = 2000 mm
Vertical distance to centre of gravity gabion 7	y _{g7} = h ₇ / 2 + h ₃ + h ₄ + h ₅ + h ₆ = 4500 mm
Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 8	$x_{g8} = w_8 / 2 + s_4 + s_5 + s_6 + s_7 + s_8 = 1500 \text{ mm}$
Vertical distance to centre of gravity gabion 8	$y_{g8} = h_8 / 2 + h_3 + h_4 + h_5 + h_6 + h_7 = 5500 \text{ mm}$
Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = $ 54.0 kN/m
Horizontal distance to centre of gravity gabion 9	$x_{g9} = w_9 / 2 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 = 1000 \text{ mm}$
Vertical distance to centre of gravity gabion 9	$y_{g9} = h_9 / 2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 = 6500 \text{ mm}$
Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = 36.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
Vertical distance to centre of gravity gabion 10	$y_{g10} = h_{10} / 2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 + h_9 = 7500 \text{ mm}$
Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = $ 18.0 kN/m
Weight of entire gabion	$W_{g} = W_{g3} + W_{g4} + W_{g5} + W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = \textbf{648.0 kN/m}$
Horiz distance to centre of gravity entire gabion	$x_{g} = ((W_{g3} \times x_{g3}) + (W_{g4} \times x_{g4}) + (W_{g5} \times x_{g5}) + (W_{g6} \times x_{g6}) + (W_{g7} \times x_{g7}) +$
	$(W_{g8} \times x_{g8}) + (W_{g9} \times x_{g9}) + (W_{g10} \times x_{g10})) / W_g = 2833 \text{ mm}$
Vert distance to centre of gravity entire gabion	$y_g = ((W_{g3} \times y_{g3}) + (W_{g4} \times y_{g4}) + (W_{g5} \times y_{g5}) + (W_{g6} \times y_{g6}) + (W_{g7} \times y_{g7}) +$
	$(W_{g8} \times y_{g8})$ + $(W_{g9} \times y_{g9})$ + $(W_{g10} \times y_{g10})) / W_g$ = 2833 mm
Correcting for wall inclination horiz dist	$X_g = x_g \times cos(\varepsilon) + y_g \times sin(\varepsilon) = 2833 \text{ mm}$
Vertical change in height due to wall inclination	$H_{f} = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times cos(\epsilon) - (x_{g10} + w_{10}/2) \times sin(\epsilon)) = 0 \text{ mm}$
Design dimensions	
Effective angle of rear plane of wall	α = 90deg - Atan((w ₃ - (x _{g10} + (w ₁₀ / 2))) / (y _{g10} + h ₁₀ / 2)) + ϵ = 48.8 deg
Effective face angle	θ = 90deg - ε = 90.0 deg
Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_3 \times sin(\epsilon)) - H_f = 8000 \text{ mm}$
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times \cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times \sin(\epsilon)) = 8000 \text{mm}$
Active pressure using Coulomb theory	$K_{a} = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times (1 + \sqrt{(\sin(\phi'_{r.d} + \delta_{r.d})} \times \sin(\phi'_{r.d} - \delta_{r.d})))$
	$\beta) / (\sin(\alpha - \delta_{r.d}) \times \sin(\alpha + \beta))))^2) = 0.877$
Active thrust due to soil	$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = 533.3 \text{ kN/m}$
Horizontal forces	
Retained soil	$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r,d}) = 319.2 \text{ kN/m}$
Surcharge	$F_{\text{surch}_h} = p_{0,Q} \times \gamma_Q \times K_a \times H \times \cos(90 - \alpha + \delta_{r,d}) = \textbf{46.7 kN/m}$
-	
Vertical forces	
Gabion weight	$F_{gabion_v,f} = \gamma_{G,f} \times W_g = 648.0 \text{ kN/m}$
Retained soil	$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r,d}) = 478.0 \text{ kN/m}$
Surcharge	$F_{surch_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = 0.0 \text{ kN/m}$

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Sliding stability ignore any page	PASS - Design FOS for overturning exceeds min allowable FOS for overturning ive pressure in front of the structure
Allowable factor of safety	FoS _{M_allow} = 1.000
Factor of safety	$FoS_M = M_R / M_o = 4.380$
Restoring moment	$M_{R} = F_{gabion_v,f} \times X_{g} + F_{soil_v,f} \times b_{v,soil} + F_{surch_v,f} \times b_{v,surch} = \textbf{4544.9 kNm/m}$
Overturning moment	$M_{o} = F_{soil_h} \times d_{h,soil} + F_{surch_h} \times d_{h,surch} = 1037.7 \text{ kNm/m}$

Total horizontal force	T = F _{soil_h} + F _{surch_h} = 365.8 kN/m
Total vertical force	$N = F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 1126.0 \text{ kN/m}$
Sliding force	$F_f = T \times cos(\epsilon) - N \times sin(\epsilon) = 365.8 \text{ kN/m}$
Sliding resistance	$F_{R} = (T \times sin(\epsilon) + N \times cos(\epsilon)) \times tan(\delta_{bg.d}) = 788.5 \text{ kN/m}$
Factor of safety	$FoS_{S} = F_{R} / F_{f} = 2.155$
Allowable factor of safety	FoSs_allow = 1.000
	PASS - Design FOS for sliding exceeds min allowable FOS for sliding

Check overturning and sliding between courses 3 and 4

Wall geometry

Than geometry	
Horizontal distance to centre of gravity gabion 4	x _{g4} = w ₄ / 2 = 3500 mm
Vertical distance to centre of gravity gabion 4	y _{g4} = h ₄ / 2 = 500 mm
Weight of gabion 4	$W_{g4} = \gamma_d \times w_4 \times h_4 = 126.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 5	x _{g5} = w ₅ / 2 + s ₅ = 3000 mm
Vertical distance to centre of gravity gabion 5	y _{g5} = h ₅ / 2 + h ₄ = 1500 mm
Weight of gabion 5	$W_{g5} = \gamma_d \times w_5 \times h_5 = \textbf{108.0 kN/m}$
Horizontal distance to centre of gravity gabion 6	x _{g6} = w ₆ / 2 + s ₅ + s ₆ = 2500 mm
Vertical distance to centre of gravity gabion 6	y _{g6} = h ₆ / 2 + h ₄ + h ₅ = 2500 mm
Weight of gabion 6	$W_{g6} = \gamma_d \times w_6 \times h_6 = \textbf{90.0 kN/m}$
Horizontal distance to centre of gravity gabion 7	$x_{g7} = w_7 / 2 + s_5 + s_6 + s_7 = 2000 \text{ mm}$
Vertical distance to centre of gravity gabion 7	y _{g7} = h ₇ / 2 + h ₄ + h ₅ + h ₆ = 3500 mm
Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 8	$x_{g8} = w_8 / 2 + s_5 + s_6 + s_7 + s_8 = 1500 \text{ mm}$
Vertical distance to centre of gravity gabion 8	$y_{g8} = h_8 / 2 + h_4 + h_5 + h_6 + h_7 = 4500 \text{ mm}$
Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = \textbf{54.0 kN/m}$
Horizontal distance to centre of gravity gabion 9	$x_{g9} = w_9 / 2 + s_5 + s_6 + s_7 + s_8 + s_9 = 1000 \text{ mm}$
Vertical distance to centre of gravity gabion 9	y _{g9} = h ₉ / 2 + h ₄ + h ₅ + h ₆ + h ₇ + h ₈ = 5500 mm
Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = 36.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
Vertical distance to centre of gravity gabion 10	y _{g10} = h ₁₀ / 2 + h ₄ + h ₅ + h ₆ + h ₇ + h ₈ + h ₉ = 6500 mm
Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = \textbf{18.0 kN/m}$
Weight of entire gabion	$W_g = W_{g4} + W_{g5} + W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = $ 504.0 kN/m
Horiz distance to centre of gravity entire gabion	$x_{g} = ((W_{g4} \times x_{g4}) + (W_{g5} \times x_{g5}) + (W_{g6} \times x_{g6}) + (W_{g7} \times x_{g7}) + (W_{g8} \times x_{g8}) +$
	$(W_{g9} \times x_{g9}) + (W_{g10} \times x_{g10})) / W_g = 2500 \text{ mm}$

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Vert distance to centre of gravity entire	gabion			;) + (W _{g6} × y _{g6}) · W _g = 2500 mm	+ (W _{g7} × y _{g7}) + ($W_{g8} imes y_{g8}$) +
Correcting for wall inclination horiz dist		$X_g = x_g \times \cos(\epsilon)$		-		
Vertical change in height due to wall inc	lination					n(ε)) = 0 mm
Design dimensions				, ,, ,	- ,	
Effective angle of rear plane of wall		$\alpha = 90 \text{deg} - \text{At}$	an((w4 - (x ₀₁₀	+ (w10 / 2))) / (v	_{g10} + h ₁₀ / 2)) + a	s = 49.4 dea
Effective face angle		$\theta = 90 \text{deg} - \varepsilon =$. (gio : 1110, _,, : .	
Effective height of wall		-	-	n(ε)) - H _f = 700	0 mm	
Height of wall from toe to front edge of t	on dabion				′2)) × sin(ε)) = 7	'000 mm
Active pressure using Coulomb theory					2)) × sin(ε)) = · 1 + √(sin(φ'r.d +	
		β / (sin(α - $\delta_{r.d}$				
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$				
Horizontal forces						
Retained soil		Fact to The YO Y P.		$\alpha + \delta_{r.d}$ = 244.	7 kN/m	
Surcharge		-	-		r.d) = 40.9 kN/m	
-		Γ surch_h = $P_{0,Q}$ ×	άγα × r\a × Π ×	$\cos(90 - \alpha + \delta)$	r.d = 40.9 Kin/III	
Vertical forces		_				
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	-			
Retained soil		-	-	- α + δ _{r.d}) = 357		
Surcharge		$F_{surch_v,f} = p_{o,Q}$	$\times \gamma_{Q,f} \times K_a \times H$	$\times \sin(90 - \alpha + \delta)$	δr.d) = 0.0 kN/m	
Overturning stability - take moments	about the	toe				
Overturning moment		$M_o = F_{soil_h} \times d$	h,soil + Fsurch_h	\times dh,surch = 714.	1 kNm/m	
Restoring moment		$M_{R} = F_{gabion_v, f}$	$ imes X_g$ + F _{soil_v,f}	× b _{v,soil} + F _{surch_}	$v_{v,f} \times b_{v,surch} = 304$	46.6 kNm/m
Factor of safety		$FoS_M = M_R / M$	_o = 4.266			
Allowable factor of safety		$FoS_{M_{allow}} = 1.0$				
	PASS	- Design FOS fo	r overturning	exceeds min	allowable FOS	for overtur
Sliding stability - ignore any passive	pressure					
Total horizontal force		$T = F_{soil_h} + F_{su}$				
Total vertical force		-		h_v,f = 861.3 kN/	/m	
Sliding force		$F_f = T \times cos(\epsilon)$				
Sliding resistance				$) \times \tan(\delta_{\text{bg.d}}) = 6$	603.1 kN/m	
Factor of safety		$FoSs = F_R / F_f$				
Allowable factor of safety		$FoSs_{allow} = 1.0$		lding over	min ellesset	
			gn FUS for sl	iaing exceeds	min allowable	rus for sli
Check overturning and sliding betwe Wall geometry	en course	es 4 and 5				
Horizontal distance to centre of gravity	nabion 5	$x_{g5} = w_5 / 2 = 3$	000 mm			
Vertical distance to centre of gravity gat		$y_{g5} = w_5 / 2 = 3$ $y_{g5} = h_5 / 2 = 5$				
Weight of gabion 5		$W_{g5} = \gamma_d \times W_5 >$		N/m		
Horizontal distance to centre of gravity	abion 6	$x_{g6} = w_6 / 2 + s$				
HONZONIAL DISTANCE TO CENTE OF OTAVIV O						

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	GABION WALL DESIGN					
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Weight of gabion 6	$W_{g6} = \gamma_d \times w_6 \times h_6 = 90.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 7	$x_{q7} = w_7 / 2 + s_6 + s_7 = 2000 mm$
Vertical distance to centre of gravity gabion 7	$y_{g7} = h_7 / 2 + h_5 + h_6 = 2500 \text{ mm}$
Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 8	$x_{g8} = w_8 / 2 + s_6 + s_7 + s_8 = 1500 \text{ mm}$
Vertical distance to centre of gravity gabion 8	$y_{g8} = h_8 / 2 + h_5 + h_6 + h_7 = 3500 \text{ mm}$
Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = $ 54.0 kN/m
Horizontal distance to centre of gravity gabion 9	$x_{g9} = w_9 / 2 + s_6 + s_7 + s_8 + s_9 = 1000 \text{ mm}$
Vertical distance to centre of gravity gabion 9	y ₉₉ = h ₉ / 2 + h ₅ + h ₆ + h ₇ + h ₈ = 4500 mm
Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = 36.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_6 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
Vertical distance to centre of gravity gabion 10	$y_{g10} = h_{10} / 2 + h_5 + h_6 + h_7 + h_8 + h_9 = 5500 \text{ mm}$
Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = $ 18.0 kN/m
Weight of entire gabion	$W_g = W_{g5} + W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = 378.0 \text{ kN/m}$
Horiz distance to centre of gravity entire gabion	$x_{g} = ((W_{g5} \times x_{g5}) + (W_{g6} \times x_{g6}) + (W_{g7} \times x_{g7}) + (W_{g8} \times x_{g8}) + (W_{g9} \times x_{g9}) +$
	$(W_{g10} \times x_{g10})) / W_g = 2167 \text{ mm}$
Vert distance to centre of gravity entire gabion	$y_{g} = ((W_{g5} \times y_{g5}) + (W_{g6} \times y_{g6}) + (W_{g7} \times y_{g7}) + (W_{g8} \times y_{g8}) + (W_{g9} \times y_{g9}) +$
	$(W_{g10} \times y_{g10})) / W_g = 2167 \text{ mm}$
Correcting for wall inclination horiz dist	$X_g = x_g \times cos(\epsilon) + y_g \times sin(\epsilon) = 2167 \text{ mm}$
Vertical change in height due to wall inclination	$H_{f} = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times cos(\epsilon) - (x_{g10} + w_{10}/2) \times sin(\epsilon)) = 0 \text{ mm}$
Design dimensions	
Effective angle of rear plane of wall	α = 90deg - Atan((w ₅ - (x _{g10} + (w ₁₀ / 2))) / (y _{g10} + h ₁₀ / 2)) + ϵ = 50.2 deg
Effective face angle	$\theta = 90 \text{deg} - \epsilon = 90.0 \text{ deg}$
Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_5 \times sin(\epsilon)) - H_f = 6000 \text{ mm}$
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times sin(\epsilon)) = 6000 \text{mm}$
Active pressure using Coulomb theory	$K_{a} = \sin(\alpha + \phi'_{r.d})^{2} / (\sin(\alpha)^{2} \times \sin(\alpha - \delta_{r.d}) \times (1 + \sqrt{(\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d} - \delta_{r.d})}) \times (1 + \sqrt{(\sin(\alpha)^{2} + \delta_{r.d})^{2} + \delta_{r.d}}) \times (1 + \sqrt{(\sin(\alpha)^{2} + \delta_{r.d})^{2} + \delta_{r.d})^{2} + \delta_{r.d})} \times (1 + \sqrt{(\sin(\alpha)^{2} + \delta_{r.d})^{2} + \delta_{r.d})^{2} + \delta_{r.d})} \times (1 + \sqrt{(\sin(\alpha)^{2} + \delta_{r.d})^{2} + \delta_{r.d})^{2$
	β) / (sin(α - $\delta_{r.d}$) × sin(α + β)))) ²) = 0.839
Active thrust due to soil	$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = \textbf{287.0 kN/m}$
Horizontal forces	
Retained soil	$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r,d}) = 180.0 \text{ kN/m}$
Surcharge	$F_{\text{surch}_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = \textbf{35.1 kN/m}$
Vertical forces	
Gabion weight	$F_{gabion_v,f} = \gamma_{G,f} \times W_g = \textbf{378.0 kN/m}$
Retained soil	$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r.d}) = 254.1 \text{ kN/m}$
Surcharge	$F_{surch_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = 0.0 \text{ kN/m}$
Overturning stability - take moments about the	toe
Overturning moment	$M_{o} = F_{soil_h} \times d_{h,soil} + F_{surch_h} \times d_{h,surch} = \textbf{465.4 kNm/m}$
Restoring moment	$M_{R} = F_{gabion_v,f} \times X_{g} + F_{soil_v,f} \times b_{v,soil} + F_{surch_v,f} \times b_{v,surch} = \textbf{1920.0} \ kNm/m$
Factor of safety	$FoS_M = M_R / M_o = 4.126$
Allowable factor of safety	FoS _{M_allow} = 1.000
PASS -	- Design FOS for overturning exceeds min allowable FOS for overturning

	Project				Job Ref.	
	GABION WALL DESIGN					
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Total horizontal force	T = F _{soil h} + F _{surch h} = 215.1 kN/m
Total vertical force	$N = F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 632.1 \text{ kN/m}$
Sliding force	$F_f = T \times cos(\varepsilon) - N \times sin(\varepsilon) = 215.1 \text{ kN/m}$
Sliding resistance	$F_R = (T \times sin(\varepsilon) + N \times cos(\varepsilon)) \times tan(\delta_{bg,d}) = 442.6 \text{ kN/m}$
Factor of safety	$FoSs = F_R / F_f = 2.057$
Allowable factor of safety	FoSs_allow = 1.000
	PASS - Design FOS for sliding exceeds min allowable FOS for slid
Check overturning and sliding between courses	s 5 and 6
Wall geometry	
Horizontal distance to centre of gravity gabion 6	x _{g6} = w ₆ / 2 = 2500 mm
Vertical distance to centre of gravity gabion 6	y _{g6} = h ₆ / 2 = 500 mm
Weight of gabion 6	$W_{g6} = \gamma_d \times w_6 \times h_6 = 90.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 7	x _{g7} = w ₇ / 2 + s ₇ = 2000 mm
Vertical distance to centre of gravity gabion 7	y _{g7} = h ₇ / 2 + h ₆ = 1500 mm
Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 8	x _{g8} = w ₈ / 2 + s ₇ + s ₈ = 1500 mm
Vertical distance to centre of gravity gabion 8	y _{g8} = h ₈ / 2 + h ₆ + h ₇ = 2500 mm
Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = 54.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 9	x _{g9} = w ₉ / 2 + s ₇ + s ₈ + s ₉ = 1000 mm
Vertical distance to centre of gravity gabion 9	y _{g9} = h ₉ / 2 + h ₆ + h ₇ + h ₈ = 3500 mm
Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = 36.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
Vertical distance to centre of gravity gabion 10	y _{g10} = h ₁₀ / 2 + h ₆ + h ₇ + h ₈ + h ₉ = 4500 mm
Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = $ 18.0 kN/m
Weight of entire gabion	$W_g = W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = 270.0 \text{ kN/m}$
Horiz distance to centre of gravity entire gabion	
Vert distance to centre of gravity entire gabion	$y_g = ((W_{g6} \times y_{g6}) + (W_{g7} \times y_{g7}) + (W_{g8} \times y_{g8}) + (W_{g9} \times y_{g9}) + (W_{g10} \times y_{g10}))$ W _g = 1833 mm
Correcting for wall inclination horiz dist	$X_g = x_g \times cos(\varepsilon) + y_g \times sin(\varepsilon) = 1833 \text{ mm}$
Vertical change in height due to wall inclination	$H_{f} = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times cos(\epsilon) - (x_{g10} + w_{10}/2) \times sin(\epsilon)) = 0 \text{ mm}$
Design dimensions	
Effective angle of rear plane of wall	$\alpha = 90 \text{deg} - \text{Atan}((w_6 - (x_{g10} + (w_{10} / 2))) / (y_{g10} + h_{10} / 2)) + \epsilon = 51.3 \text{ deg}$
Effective face angle	θ = 90deg - ε = 90.0 deg
Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_6 \times sin(\epsilon)) - H_f = 5000 \text{ mm}$
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times \cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times \sin(\epsilon)) = 5000 \text{mm}$
Active pressure using Coulomb theory	$K_{a} = \sin(\alpha + \phi'_{r.d})^{2} / (\sin(\alpha)^{2} \times \sin(\alpha - \delta_{r.d}) \times (1 + \sqrt{(\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.c})^{2} + \delta_{r.d})})$
	$\beta / (\sin(\alpha - \delta_{r,d}) \times \sin(\alpha + \beta)))^2) = 0.809$
Active thrust due to soil	$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = 192.2 \text{ kN/m}$

	Project				Job Ref.		
	Co-ti-r	GABION V	ALL DESIGN		Objection (
S	Section				Sheet no./rev.	14	
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	VIC	8/14/2023					
Horizontal forces							
Retained soil		E	" × coc/00	α + δ _{r.d}) = 125.2	kN/m		
Surcharge		•		$(1 + \delta_{r.d}) = 123.2$ $\cos(90 - \alpha + \delta_{r.d})$			
Vertical forces							
Gabion weight		Eachion $y t = y c t$	× Wg = 270.0 k	N/m			
Retained soil			-	α + δ _{r.d}) = 168.4	. kN/m		
Surcharge		-	-	< sin(90 - α + δ _{r.d}			
0		•	∧ yu,i∧ na∧ ii x	、 υπτου - α τ υ <u>ι</u> .ο	$y = \mathbf{v} \cdot \mathbf{v} \cdot \mathbf{v} \cdot \mathbf{v} + \mathbf{v} \cdot \mathbf{v}$		
Overturning stability - take mo	ments about the		_		N I (
Overturning moment		_	. –	d _{h,surch} = 281.8 k		 .	
Restoring moment				$b_{v,soil} + F_{surch_v,f}$	× b _{v,surch} = 111	2.4 kNm/m	
Factor of safety		$FoS_M = M_R / N_R$					
Allowable factor of safety		$FoS_{M_{allow}} = 1.0$					
	PASS	Design FOS fo	r overturning	exceeds min all	iowable FOS f	or overtur	
Sliding stability - ignore any p	assive pressure i	n front of the s	ructure				
Total horizontal force		T = F _{soil_h} + F _{surch_h} = 154.5 kN/m					
Total vertical force		$N = F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 438.4 \text{ kN/m}$					
Sliding force		$F_f = T \times cos(\epsilon) - N \times sin(\epsilon) = 154.5 \text{ kN/m}$					
Sliding resistance		$F_{R} = (T \times sin(\epsilon) + N \times cos(\epsilon)) \times tan(\delta_{bg.d}) = 307.0 \text{ kN/m}$					
Factor of safety		$FoSs = F_R / F_f$	= 1.987				
Allowable factor of safety		$FoS_{S_{allow}} = 1.0$					
		PASS - Desi	gn FOS for sli	ding exceeds m	in allowable l	FOS for sli	
Check overturning and sliding	between course	<u>s 6 and 7</u>					
Wall geometry							
Horizontal distance to centre of	gravity gabion 7	x ₉₇ = w ₇ / 2 = 2000 mm					
Horizontal distance to centre of gravity gabion 7		$y_{g7} = h_7 / 2 = 500 \text{ mm}$					
Vertical distance to centre of gra	vity gabion 7	y _{g7} = h ₇ / 2 = 5	00 mm				
Vertical distance to centre of gra Weight of gabion 7	vity gabion 7		00 mm < h⁊ = 72.0 kN/r	n			
•			< h7 = 72.0 kN/r	n			
Weight of gabion 7	gravity gabion 8	$W_{g7} = \gamma_d \times W_7$	< h7 = 72.0 kN/r s ₈ = 1500 mm	n			
Weight of gabion 7 Horizontal distance to centre of g	gravity gabion 8	$W_{g7} = \gamma_d \times W_7 \times X_{g8} = W_8 / 2 + s$ $y_{g8} = h_8 / 2 + h_8$	< h7 = 72.0 kN/r s ₈ = 1500 mm				
Weight of gabion 7 Horizontal distance to centre of g Vertical distance to centre of gra	gravity gabion 8 vity gabion 8	$W_{g7} = \gamma_d \times W_7 \times X_{g8} = W_8 / 2 + s$ $y_{g8} = h_8 / 2 + h$ $W_{g8} = \gamma_d \times W_8 \times 3$	< h7 = 72.0 kN/r 6 ₈ = 1500 mm 7 = 1500 mm	n			
Weight of gabion 7 Horizontal distance to centre of g Vertical distance to centre of gra Weight of gabion 8	gravity gabion 8 vity gabion 8 gravity gabion 9	$W_{g7} = \gamma_{d} \times W_{7} \times X_{g8} = W_{8} / 2 + s$ $y_{g8} = h_{8} / 2 + h$ $W_{g8} = \gamma_{d} \times W_{8} \times X_{g9} = W_{9} / 2 + s$	< h7 = 72.0 kN/r 88 = 1500 mm 7 = 1500 mm < h8 = 54.0 kN/r	n nm			
Weight of gabion 7 Horizontal distance to centre of g Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of g	gravity gabion 8 vity gabion 8 gravity gabion 9	$W_{g7} = \gamma_d \times W_7 \approx x_{g8} = W_8 / 2 + s_8$ $y_{g8} = h_8 / 2 + h_8$ $W_{g8} = \gamma_d \times W_8 \approx x_{g9} = W_9 / 2 + s_8$ $y_{g9} = h_9 / 2 + h_8$	< h7 = 72.0 kN/r 88 = 1500 mm 7 = 1500 mm < h8 = 54.0 kN/r 88 + S9 = 1000 n	n nm nm			
Weight of gabion 7 Horizontal distance to centre of g Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra	gravity gabion 8 vity gabion 8 gravity gabion 9 vity gabion 9	$W_{g7} = \gamma_{d} \times W_{7} \times X_{g8} = W_{8} / 2 + s$ $y_{g8} = h_{8} / 2 + h$ $W_{g8} = \gamma_{d} \times W_{8} \times X_{g9} = W_{9} / 2 + s$ $y_{g9} = h_{9} / 2 + h$ $W_{g9} = \gamma_{d} \times W_{9} \times y_{9} \times y_{9}$	< h7 = 72.0 kN/r	n nm nm			
Weight of gabion 7 Horizontal distance to centre of ga Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Vertical distance to centre of gra	gravity gabion 8 vity gabion 8 gravity gabion 9 vity gabion 9 gravity gabion 10	$W_{g7} = \gamma_d \times W_7 \approx x_{g8} = W_8 / 2 + s_8$ $y_{g8} = h_8 / 2 + h_8$ $W_{g8} = \gamma_d \times W_8 \approx x_{g9} = W_9 / 2 + s_8$ $y_{g9} = h_9 / 2 + h_8$ $W_{g9} = \gamma_d \times W_9 \approx x_{g10} = W_{10} / 2 + h_8$	< h7 = 72.0 kN/r s8 = 1500 mm 7 = 1500 mm < h8 = 54.0 kN/r s8 + s9 = 1000 m 7 + h8 = 2500 m < h9 = 36.0 kN/r	n nm n 5 00 mm			
Weight of gabion 7 Horizontal distance to centre of g Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Weight of gabion 9 Horizontal distance to centre of gra	gravity gabion 8 vity gabion 8 gravity gabion 9 vity gabion 9 gravity gabion 10	$W_{g7} = \gamma_d \times W_7 \approx x_{g8} = w_8 / 2 + s_8$ $y_{g8} = h_8 / 2 + h_8$ $W_{g8} = \gamma_d \times w_8 \approx x_{g9} = w_9 / 2 + s_8$ $y_{g9} = h_9 / 2 + h_8$ $W_{g9} = \gamma_d \times w_9 \approx x_{g10} = w_{10} / 2 + s_8$ $y_{g10} = h_{10} / 2 + s_8$	 h7 = 72.0 kN/r s = 1500 mm 7 = 1500 mm < h8 = 54.0 kN/r s + s9 = 1000 m 7 + h8 = 2500 m < h9 = 36.0 kN/r • S8 + S9 + S10 =	n nm nm 500 mm 3500 mm			
Weight of gabion 7 Horizontal distance to centre of g Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Weight of gabion 9 Horizontal distance to centre of gra	gravity gabion 8 vity gabion 8 gravity gabion 9 vity gabion 9 gravity gabion 10	$W_{g7} = \gamma_d \times W_7 \times W_7 \times W_{g8} = W_8 / 2 + s$ $y_{g8} = h_8 / 2 + h$ $W_{g8} = \gamma_d \times W_8 \times W_{g9} = W_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times W_9 \times W_{g10} = W_{10} / 2 + h$ $W_{g10} = h_{10} / 2 + h$ $W_{g10} = \gamma_d \times W_{10}$		n nm n 500 mm 3500 mm			
Weight of gabion 7 Horizontal distance to centre of ga Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Weight of gabion 9 Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 10	gravity gabion 8 vity gabion 8 gravity gabion 9 vity gabion 9 gravity gabion 10 vity gabion 10	$W_{g7} = \gamma_d \times W_7 \approx x_{g8} = W_8 / 2 + s_8$ $y_{g8} = h_8 / 2 + h_8$ $W_{g8} = \gamma_d \times W_8 \approx x_{g9} = W_9 / 2 + s_8$ $y_{g9} = h_9 / 2 + h_8$ $W_{g9} = \gamma_d \times W_9 \approx x_{g10} = w_{10} / 2 + h_8$ $W_{g10} = w_{10} / 2 + h_8$ $W_{g10} = h_{10} / 2 + h_8$ $W_{g10} = \gamma_d \times W_{10}$ $W_{g10} = \gamma_d \times W_{10}$ $W_{g10} = W_{g7} + W_{g10}$		n nm n 500 mm 3500 mm	′Wg10 × xg10)) /	Wg = 1500	
Weight of gabion 7 Horizontal distance to centre of ga Vertical distance to centre of ga Weight of gabion 8 Horizontal distance to centre of ga Vertical distance to centre of ga Weight of gabion 9 Horizontal distance to centre of ga Vertical distance to centre of ga Weight of gabion 10 Weight of entire gabion	gravity gabion 8 vity gabion 8 gravity gabion 9 vity gabion 9 gravity gabion 10 vity gabion 10 vity gabion 10	$W_{g7} = \gamma_d \times W_7 \times W_7 \times W_{g8} = W_8 / 2 + s$ $y_{g8} = h_8 / 2 + h$ $W_{g8} = \gamma_d \times W_8 \times W_{g9} = W_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times W_9 \times W_{g10} = W_{10} / 2 + s$ $y_{g10} = h_{10} / 2 + s$ $W_{g10} = h_{10} / 2 + s$ $W_{g10} = \gamma_d \times W_{10} \times W_{g10} = W_{g10} \times W_{10}$ $W_g = W_{g7} + W$ $x_g = ((W_{g7} \times x_g))$		n nm n 500 mm 3500 mm V/m = 180.0 kN/m			
Weight of gabion 7 Horizontal distance to centre of ga Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 9 Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravit	gravity gabion 8 vity gabion 8 gravity gabion 9 vity gabion 9 gravity gabion 10 vity gabion 10 y entire gabion entire gabion	$W_{g7} = \gamma_d \times W_7 \approx x_{g8} = W_8 / 2 + s_7 \approx y_{g8} = h_8 / 2 + h_7 \approx x_{g9} = h_8 / 2 + h_7 \approx x_{g9} = m_9 / 2 + h_7 \approx y_{g9} = h_9 / 2 + h_7 \approx y_{g10} = h_{10} / 2 + h_7 \approx h_$		n nm n 500 mm 3500 mm V/m = 180.0 kN/m + $(W_{g9} \times x_{g9}) + ($ + $(W_{g9} \times y_{g9}) + ($			

	oject	GABION W	ALL DESIGN	I	Job Ref.			
Sec	tion				Sheet no./rev			
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Cal	c. by	Date	Chk'd by	Date	App'd by	Date		
	VIC	8/14/2023	<u> </u>					
Design dimensions								
Effective angle of rear plane of wall		α = 90deg - At	an((w7 - (x _{g10}	+ (w ₁₀ / 2))) / (y	y _{g10} + h ₁₀ / 2)) + ε	= 53.1 deg		
Effective face angle		θ = 90deg - ϵ =	= 90.0 deg					
Effective height of wall		$H = (y_{g10} + h_{10})$	/ 2) + (w ₇ × si	n(ε)) - H _f = 400)0 mm			
Height of wall from toe to front edge of the	op gabion	$H_{incl} = ((y_{g10} + I$	$n_{10} / 2) \times \cos(3)$	ε) - (x g10 - (w 10	(2) \times sin(ε)) = 4	000 mm		
Active pressure using Coulomb theory		$K_a = sin(\alpha + \phi'_a)$	$(d)^2 / (\sin(\alpha)^2)$	$\times \sin(\alpha - \delta_{r.d}) \times$	$(1 + \sqrt{\sin(\phi'_{r.d} + \delta)})$	δr.d) × sin(φ'r		
		β) / (sin(α - $\delta_{r.d}$	$) \times sin(\alpha + \beta))$)) ²) = 0.766				
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$	$a \times \gamma_{s.d} \times H^2 =$	116.4 kN/m				
Horizontal forces								
Retained soil		$F_{soil_h} = \gamma_G \times P_a$	_{a,soil} × cos(90 -	$\alpha + \delta_{r.d}$) = 80.	1 kN/m			
Surcharge		$F_{surch_h} = p_{o,Q} \times$	της × K _a × Η ×	cos(90 - α + δ	δr.d) = 23.4 kN/m			
Vertical forces								
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	$\times W_{g} = 180.0$	kN/m				
Retained soil		$F_{soil_v,f} = \gamma_{G,f} \times I$	⊃ _{a,soil} × sin(90	- α + δ _{r.d}) = 10	0.2 kN/m			
Surcharge		$F_{\text{surch}_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times \sin(90 - \alpha + \delta_{r.d}) = 0.0 \text{ kN/m}$						
Overturning stability - take moments	about the	toe						
Overturning moment		$M_o = F_{soil_h} \times d_i$	h,soil + F _{surch_h} :	$\times d_{h,surch} = 153$.6 kNm/m			
Restoring moment		$M_{R} = F_{gabion_v,f} \times X_{g} + F_{soil_v,f} \times b_{v,soil} + F_{surch_v,f} \times b_{v,surch} = \textbf{570.6 kNm/m}$						
Factor of safety		$FoS_M = M_R / M_o = 3.714$						
Allowable factor of safety		FoS _{M_allow} = 1.000 - Design FOS for overturning exceeds min allowable FOS for overturn						
		-	-	exceeds min	allowable FOS	tor overtur		
Sliding stability - ignore any passive	pressure i			(N1/m				
Total horizontal force		$T = F_{soil_h} + F_{surch_h} = 103.5 \text{ kN/m}$						
Total vertical force		$\begin{split} N &= F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 280.2 \ kN/m \\ F_{f} &= T \times \cos(\varepsilon) - N \times \sin(\varepsilon) = 103.5 \ kN/m \end{split}$						
Sliding force Sliding resistance								
Factor of safety		$F_{R} = (T \times sin(\varepsilon) + N \times cos(\varepsilon)) \times tan(\delta_{bg.d}) = 196.2 \text{ kN/m}$						
Allowable factor of safety		FoS _S = F _R / F _f = 1.896 FoS _{S_allow} = 1.000						
Anowable racior of salety		PASS - Design FOS for sliding exceeds min allowable FOS for sliding						
Check overturning and sliding between	en courses	s 7 and 8						
Wall geometry								
Horizontal distance to centre of gravity g	abion 8	x _{g8} = w ₈ / 2 = 1500 mm						
Vertical distance to centre of gravity gat	ion 8	y _{g8} = h ₈ / 2 = 500 mm						
Weight of gabion 8		$W_{g8} = \gamma_d \times w_8 \times h_8 = $ 54.0 kN/m						
Horizontal distance to centre of gravity g	abion 9	$x_{g9} = w_9 / 2 + s$	9 = 1000 mm					
Vertical distance to centre of gravity gab	oion 9	y _{g9} = h ₉ / 2 + h	8 = 1500 mm					
Weight of gabion 9		$W_{g9} = \gamma_d \times W_9 >$	∝ h ₉ = 36.0 kN	/m				
Horizontal distance to centre of gravity g	abion 10	$x_{g10} = w_{10} / 2 +$	S9 + S10 = 50	0 mm				
Vertical distance to centre of gravity gab	ion 10							
Weight of gabion 10		$y_{g10} = h_{10} / 2 + h_8 + h_9 = 2500 \text{ mm}$ $W_{g10} = \gamma_d \times w_{10} \times h_{10} = 18.0 \text{ kN/m}$						

Proje	ect	GABION W	ALL DESIGN		Job Ref.			
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Weight of entire gabion		$W_g = W_{g8} + W_g$	9 + W _{g10} = 10	B.0 kN/m				
Horiz distance to centre of gravity entire g	abion	$x_g = ((W_{g8} \times x_{g8}))$	$(W_{g9} \times x_{g9})$ + ($W_{g9} \times x_{g9}$) + ($W_{g10} \times x_{g10}$)) / W _g = 1167 m	nm		
Vert distance to centre of gravity entire ga	abion	$y_g = ((W_{g8} \times y_{g8}))$	$(W_{g9} \times y_{g9})$ + ($W_{g9} \times y_{g9}$) + ($W_{g10} \times y_{g10}$)) / W _g = 1167 m	nm		
Correcting for wall inclination horiz dist		$X_g = x_g \times \cos(\epsilon$) + $y_g \times sin(\epsilon)$	= 1167 mm				
Vertical change in height due to wall inclin	nation	$H_f = y_{g10} + h_{10}/2$	2 - ((y _{g10} + h ₁₀	$/2) \times \cos(\varepsilon)$ - (x	(g10 + w 10/2) × sir	n(ε)) = 0 mn		
Design dimensions								
Effective angle of rear plane of wall		α = 90deg - At	an((w8 - (x _{g10} -	+ (w₁₀ / 2))) / (y	_{g10} + h ₁₀ / 2)) + ε	= 56.3 deg		
Effective face angle		θ = 90deg - ϵ =	90.0 deg					
Effective height of wall		$H = (y_{g10} + h_{10})$	$(2) + (w_8 \times sir$	n(ε)) - H _f = 300	0 mm			
Height of wall from toe to front edge of top	o gabion	$H_{incl} = ((y_{g10} + h))$	n ₁₀ / 2) × cos(a	:) - (x g10 - (w 10 /	(2)) $\times \sin(\varepsilon)$) = 3	000 mm		
Active pressure using Coulomb theory		$K_a = sin(\alpha + \phi'_r)$	$_{ m d})^2$ / (sin($lpha$) 2 ×	$\sin(\alpha - \delta_{r.d}) \times ($	[1 + √(sin(φ'r.d + δ	δr.d) × sin(φ'r		
		β) / (sin(α - δ _{r.d}	$(\alpha + \beta))$)) ²) = 0.697				
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$	$a \times \gamma_{s.d} \times H^2 =$	59.6 kN/m				
Horizontal forces								
Retained soil		$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r.d}) = 44.8 \text{ kN/m}$						
Surcharge		$F_{\text{surch}_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = 17.5 \text{ kN/m}$						
Vertical forces								
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f} \times W_g = 108.0 \text{ kN/m}$						
Retained soil		$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r.d}) = 49.5 \text{ kN/m}$						
Surcharge		$F_{\text{surch}_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = 0.0 \text{ kN/m}$						
Overturning stability - take moments al	bout the	toe						
Overturning moment		$M_{o} = F_{soil_h} \times d_{h,soil} + F_{surch_h} \times d_{h,surch} = \textbf{71.0 kNm/m}$						
Restoring moment		$M_{R} = F_{gabion_v,f} \times X_{g} + F_{soil_v,f} \times b_{v,soil} + F_{surch_v,f} \times b_{v,surch} = \textbf{241.6 kNm/m}$						
Factor of safety		$FoS_M = M_R / M_o = 3.404$						
Allowable factor of safety	D 400	FoS _{M_allow} = 1.000 - Design FOS for overturning exceeds min allowable FOS for overturn						
Sliding stability - ignoro any nassive r		-	-	exceeas min	allowable FUS	ior overtui		
Sliding stability - ignore any passive protocol Total horizontal force	cooure ll	T = F_{soil_h} + F_{surch_h} = 62.2 kN/m						
Total vertical force					/m			
Sliding force		$\begin{split} N &= F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 157.5 \ kN/m \\ F_{f} &= T \times \cos(\varepsilon) - N \times \sin(\varepsilon) = 62.2 \ kN/m \end{split}$						
Sliding resistance					1 0.3 kN/m			
Factor of safety		$F_{R} = (T \times sin(\epsilon) + N \times cos(\epsilon)) \times tan(\delta_{bg,d}) = 110.3 \text{ kN/m}$ $FoS_{S} = F_{R} / F_{f} = 1.772$						
Allowable factor of safety		$FoSs_{allow} = 1.0$						
				iding exceeds	min allowable	FOS for sli		
Check overturning and sliding betweer	n courses	s 8 and 9						
Wall geometry								
Horizontal distance to centre of gravity ga	bion 9	x _{g9} = w ₉ / 2 = 1000 mm						
Vertical distance to centre of gravity gabic	on 9	y _{g9} = h ₉ / 2 = 500 mm						
Weight of gabion 9		$W_{g9} = \gamma_d \times w_9 \times h_9 = 36.0 \text{ kN/m}$						
weight of gabion 9		$x_{g10} = w_{10} / 2 + s_{10} = 500 \text{ mm}$						

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Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = $ 18.0 kN/m
Weight of entire gabion	$W_g = W_{g9} + W_{g10} = $ 54.0 kN/m
Horiz distance to centre of gravity entire gabion	$x_g = ((W_{g9} \times x_{g9}) + (W_{g10} \times x_{g10})) / W_g = 833 \text{ mm}$
Vert distance to centre of gravity entire gabion	$y_g = ((W_{g9} \times y_{g9}) + (W_{g10} \times y_{g10})) / W_g = 833 \text{ mm}$
Correcting for wall inclination horiz dist	$X_g = x_g \times cos(\varepsilon) + y_g \times sin(\varepsilon) = 833 mm$
Vertical change in height due to wall inclination	$H_{f} = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times cos(\epsilon) - (x_{g10} + w_{10}/2) \times sin(\epsilon)) = 0 \text{ mm}$
Design dimensions	
Effective angle of rear plane of wall	α = 90deg - Atan((w ₉ - (x _{g10} + (w ₁₀ / 2))) / (y _{g10} + h ₁₀ / 2)) + ϵ = 63.4 deg
Effective face angle	θ = 90deg - ε = 90.0 deg
Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_9 \times sin(\epsilon)) - H_f = 2000 mm$
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times sin(\epsilon)) = 2000$ mm
Active pressure using Coulomb theory	$K_{a} = \sin(\alpha + \phi'_{r,d})^{2} / (\sin(\alpha)^{2} \times \sin(\alpha - \delta_{r,d}) \times (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) \times \sin(\phi'_{r,d} - \delta_{r,d})})$
	$\beta) / (\sin(\alpha - \delta_{r,d}) \times \sin(\alpha + \beta))))^2) = 0.572$
Active thrust due to soil	$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = \textbf{21.7 kN/m}$
Horizontal forces	
Retained soil	$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r.d}) = 19.2 \text{ kN/m}$
Surcharge	$F_{surch_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = 11.2 \text{ kN/m}$
Vertical forces	
Gabion weight	$F_{gabion_v,f} = \gamma_{G,f} \times W_g = \textbf{54.0 kN/m}$
Retained soil	$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r,d}) = 16.4 \text{ kN/m}$
Surcharge	$F_{\text{surch}_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = \textbf{0.0 kN/m}$
Overturning stability - take moments about the	toe
Overturning moment	$M_{o} = F_{soil_{h}} \times d_{h,soil} + F_{surch_{h}} \times d_{h,surch} = 24.1 \text{ kNm/m}$
Restoring moment	$M_{R} = F_{gabion_v,f} \times X_{g} + F_{soil_v,f} \times b_{v,soil} + F_{surch_v,f} \times b_{v,surch} = \textbf{72.4 kNm/m}$
Factor of safety	$FoS_M = M_R / M_o = 3.007$
Allowable factor of safety	FoS _{M_allow} = 1.000
PASS -	Design FOS for overturning exceeds min allowable FOS for overturning
Sliding stability - ignore any passive pressure in	n front of the structure
Total horizontal force	$T = F_{soil_h} + F_{surch_h} = 30.5 \text{ kN/m}$
Total vertical force	$N = F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 70.4 \text{ kN/m}$
Sliding force	$F_f = T \times cos(\epsilon) - N \times sin(\epsilon) = 30.5 \text{ kN/m}$
Sliding resistance	$F_{R} = (T \times sin(\epsilon) + N \times cos(\epsilon)) \times tan(\delta_{bg.d}) = 49.3 \text{ kN/m}$
Factor of safety	FoSs = F _R / F _f = 1.618
Allowable factor of safety	FoS _{S_allow} = 1.000
	PASS - Design FOS for sliding exceeds min allowable FOS for sliding
Check overturning and sliding between courses	s 9 and 10
Wall geometry	

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Weight of gabion 10		$W_{g10} = \gamma_d \times W_{10}$	0 × h ₁₀ = 18.0	kN/m				
Weight of entire gabion		$W_{g} = W_{g10} = 13$	8.0 kN/m					
Horiz distance to centre of grav	vity entire gabion	$x_g = ((W_{g10} \times x))$	_{g10})) / W _g = 50)0 mm				
Vert distance to centre of gravi	ty entire gabion	$y_g = ((W_{g10} \times y$	_{g10})) / W _g = 50)0 mm				
Correcting for wall inclination h	oriz dist	$X_g = x_g \times \cos(a)$	x) + y _g × sin(ε)	= 500 mm				
Vertical change in height due te	o wall inclination	$H_f = y_{g10} + h_{10}/$	2 - ((y _{g10} + h ₁₀	o/2) × cos(ε) - (>	κ_{g10} + $w_{10}/2$) × sir	n(ε)) = 0 m		
Design dimensions								
Effective angle of rear plane of	wall	α = 90 deg + ϵ	= 90.0 deg					
Effective face angle		θ = 90deg - ϵ =	= 90.0 deg					
Effective height of wall		$H = (y_{g10} + h_{10} / 2) + (w_{10} \times sin(\epsilon)) - H_f = 1000 \text{ mm}$						
Height of wall from toe to front	edge of top gabion							
Active pressure using Coulomb	o theory	$K_{a} = sin(\alpha + \phi'_{r,d})^2 / (sin(\alpha)^2 \times sin(\alpha - \delta_{r,d}) \times (1 + \sqrt{(sin(\phi'_{r,d} + \delta_{r,d})} \times sin(\phi'_{r,d}))$						
		β) / (sin(α - $\delta_{r.d}$) × sin(α + β)))) ²) = 0.296						
Active thrust due to soil		$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = \textbf{2.8 kN/m}$						
Horizontal forces								
Retained soil		$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r,d}) = 3.5 \text{ kN/m}$						
Surcharge		$F_{surch_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = \textbf{4.1 kN/m}$						
Vertical forces								
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f} \times W_g = 18.0 \text{ kN/m}$						
Retained soil		$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r.d}) = 1.1 \text{ kN/m}$						
Surcharge		$F_{surch_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = \textbf{0.0 kN/m}$						
Overturning stability - take m	noments about the	toe						
Overturning moment		$M_o = F_{soil_h} \times d$	h,soil + F _{surch_h}	\times d _{h,surch} = 3.2 k	<nm m<="" td=""><td></td></nm>			
Restoring moment		$M_{R} = F_{\text{gabion}_v, f}$	$\times X_g + F_{soil_v,f}$	$\times b_{v,soil}$ + F _{surch} _	$v,f \times b_{v,surch} = 10.$	1 kNm/m		
Factor of safety		$FoS_M = M_R / M_o = 3.126$						
Allowable factor of safety		FoS _{M_allow} = 1.000						
	PASS -	Design FOS fo	r overturning	g exceeds min	allowable FOS	for overtu		
Sliding stability - ignore any	passive pressure i							
Total horizontal force		$T = F_{soil_h} + F_{surch_h} = 7.6 \text{ kN/m}$						
Total vertical force		-		ch_v,f = 19.1 kN/r	n			
Sliding force		$F_f = T \times cos(\epsilon) - N \times sin(\epsilon) = 7.6 \text{ kN/m}$						
Sliding resistance				$) \times \tan(\delta_{\text{bg.d}}) = 1$	13.4 kN/m			
Factor of safety		$FoS_S = F_R / F_f$	= 1.754					
Allowable factor of safety		FoSs_allow = 1.0						

PASS - Design FOS for sliding exceeds min allowable FOS for sliding

Design approach 1

Partial factors on actions - Section A.3.1 - Comb	pination 2
Permanent unfavourable action	γg = 1.00
Permanent favourable action	γG,f = 1.00
Variable unfavourable action	γ Q = 1.30

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Variable favourable action		$\gamma_{Q,f} = 0.00$						
Partial factors for soil parameters - Se	ection A.3		n 2					
Angle of shearing resistance		$\gamma_{\phi'} = 1.25$						
Weight density		$\gamma_{\gamma} = 1.00$						
Design soil properties								
Design effective shearing resistance and	gle	φ'r.d = Atan(tan	$(\phi'_{r.k}) / \gamma_{\phi'}) = 24$	4.8 deg				
Design saturated density of retained soil		$\gamma_{s.d} = \gamma_{sr} / \gamma_{\gamma} = 1$	1 9.0 kN/m ³					
Design wall friction angle		$\delta_{r.d} = min(atan$	(tan(δ _{r.k}) / γ _{φ'}),	ϕ' r.d × kmembrane	e) = 18.3 deg			
Design base friction angle		$\delta_{bb.d} = Atan(tar)$	n(δ _{bb.k}) / γ _{φ'}) = 2	28.4 deg				
Design friction between gabions		δ _{bg.d} = Atan(tai						
Wall geometry								
Horizontal distance to centre of gravity g	abion 1	$x_{g1} = w_1 / 2 = 5$	6000 mm					
Vertical distance to centre of gravity gab	ion 1	$y_{g1} = h_1 / 2 = 5$	00 mm					
Weight of gabion 1		$W_{g1} = \gamma_d \times W_1 >$	< h₁ = 180.0 kl	N/m				
Horizontal distance to centre of gravity g	abion 2	x _{g2} = w ₂ / 2 + s ₂ = 4500 mm						
Vertical distance to centre of gravity gab	ion 2	y _{g2} = h ₂ / 2 + h ₁ = 1500 mm						
Weight of gabion 2		$W_{g2} = \gamma_d \times w_2 \times h_2 = \textbf{162.0 kN/m}$						
Horizontal distance to centre of gravity g	abion 3	$x_{g3} = w_3 / 2 + s_3$	s ₂ + s ₃ = 4000	mm				
Vertical distance to centre of gravity gab	ion 3	y _{g3} = h ₃ / 2 + h ₁ + h ₂ = 2500 mm						
Weight of gabion 3		$W_{g3} = \gamma_d \times W_3 >$	< h ₃ = 144.0 kl	N/m				
Horizontal distance to centre of gravity g		$x_{g4} = w_4 / 2 + s_4$						
Vertical distance to centre of gravity gab	ion 4	$y_{g4} = h_4 / 2 + h_1 + h_2 + h_3 = 3500 \text{ mm}$						
Weight of gabion 4		$W_{g4} = \gamma_d \times w_4 \times h_4 = \textbf{126.0 kN/m}$						
Horizontal distance to centre of gravity g		$x_{g5} = w_5 / 2 + s_2 + s_3 + s_4 + s_5 = 3000 \text{ mm}$						
Vertical distance to centre of gravity gab	ion 5	$y_{g5} = h_5 / 2 + h_1 + h_2 + h_3 + h_4 = 4500 \text{ mm}$						
Weight of gabion 5		$W_{g5} = \gamma_d \times w_5 \times h_5 = \textbf{108.0 kN/m}$						
Horizontal distance to centre of gravity g		$x_{g6} = w_6 / 2 + s_2 + s_3 + s_4 + s_5 + s_6 = 2500 \text{ mm}$						
Vertical distance to centre of gravity gab	ion 6	$y_{g6} = h_6 / 2 + h_1 + h_2 + h_3 + h_4 + h_5 = 5500 \text{ mm}$						
Weight of gabion 6		$W_{g6} = \gamma_d \times W_6 >$						
Horizontal distance to centre of gravity g		x _{g7} = w ₇ / 2 + s ₂ + s ₃ + s ₄ + s ₅ + s ₆ + s ₇ = 2000 mm						
Vertical distance to centre of gravity gab	ion 7	$y_{g7} = h_7 / 2 + h_1 + h_2 + h_3 + h_4 + h_5 + h_6 = 6500 \text{ mm}$						
Weight of gabion 7		$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$						
Horizontal distance to centre of gravity g		$x_{g8} = w_8 / 2 + s_2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 = 1500 \text{ mm}$						
Vertical distance to centre of gravity gab	ion 8	$y_{g8} = h_8 / 2 + h_8$			n7 = 7500 mm			
Weight of gabion 8		$W_{g8} = \gamma_d \times W_8 >$						
Horizontal distance to centre of gravity g		$x_{g9} = w_9 / 2 + s_2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 = 1000 \text{ mm}$						
Vertical distance to centre of gravity gab	ion 9				h ₇ + h ₈ = 8500 mm			
Weight of gabion 9		$W_{g9} = \gamma_d \times W_9 >$						
Horizontal distance to centre of gravity g					$s_8 + s_9 + s_{10} = 500$			
Vertical distance to centre of gravity gab	ion 10				h ₇ + h ₈ + h ₉ = 950	0 mm		
Weight of gabion 10		$W_{g10} = \gamma_d \times W_{10}$	$h \times h_{10} = 18.0$	kN/m				

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Weight of entire gabion		W _g = W _{g1} + W _g 990.0 kN/m	$_{12} + W_{g3} + W_{g}$	4 + W _{g5} + W _{g6} +	- W _{g7} + W _{g8} + W _g	_{g9} + W _{g10} =		
Horiz distance to centre of gravity	entire gabion	$x_g = ((W_{g1} \times x_g))$	$_{1})$ + (W _{g2} × X _{g2}	$(W_{g3} \times x_{g3})$	+ $(W_{g4} \times x_{g4})$ + ($W_{g5} \times X_{g5}$) +		
		(W _{g6} × x _{g6}) + (\ 3500 mm	$N_{g7} \times X_{g7}$) + (\	$V_{g8} \times X_{g8}$) + (W_{g8}	$_{g9} \times x_{g9}$) + (W _{g10} :	× x _{g10})) / W _g		
Vert distance to centre of gravity e	ntire gabion	$y_g = ((W_{g1} \times y_g))$	1) + ($W_{g2} \times y_{g2}$	$(W_{g3} \times y_{g3}) + (W_{g3} \times y_{g3})$	+ ($W_{g4} \times y_{g4}$) + ($W_{g5} \times y_{g5}$) +		
		(W _{g6} × y _{g6}) + (∖ 3500 mm	N _{g7} × y _{g7}) + (\	$V_{g8} \times y_{g8}$) + (W_{g8}	$_{g9} \times y_{g9}$) + (W _{g10} :	× y _{g10})) / W _g		
Correcting for wall inclination horiz	z dist	$X_g = x_g \times \cos(\epsilon)$) + $y_g \times sin(\epsilon)$	= 3500 mm				
Vertical change in height due to w	all inclination	$H_f = y_{g10} + h_{10}/2$	2 - ((y _{g10} + h ₁₀)/2) × cos(ε) - ()	κ _{g10} + w₁₀/2) × sir	n(ε)) = 0 mm		
Design dimensions								
Effective angle of rear plane of wa	II	α = 90deg - At	an((w1 - (xa10	+ (w ₁₀ / 2))) / (v	/ _{g10} + h ₁₀ / 2)) + ε	: = 48.0 dea		
Effective face angle		$\alpha = 90 \text{deg} - \text{Atan}((w_1 - (x_{g10} + (w_{10} / 2))) / (y_{g10} + h_{10} / 2)) + \epsilon = 48.0 \text{ deg}$ $\theta = 90 \text{deg} - \epsilon = 90.0 \text{ deg}$						
Effective height of wall		$H = (y_{g10} + h_{10})$	-	n(ε)) - H _f = 100	00 mm			
Height of wall from toe to front edg	e of top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times \cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times \sin(\epsilon)) = 10000 \text{mm}$						
Active pressure using Coulomb th		$K_{a} = \sin(\alpha + \phi'_{r.d})^{2} / (\sin(\alpha)^{2} \times \sin(\alpha - \delta_{r.d}) \times (1 + \sqrt{(\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d})^{2} + \delta_{r.d})}$						
		β) / (sin($\alpha - \delta_{r,d}$) × sin($\alpha + \beta$)))) ²) = 0.941						
Active thrust due to soil		$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = \textbf{894.3 kN/m}$						
Horizontal forces								
Retained soil		$F_{soil_h} = \gamma_G \times P_a$	_{a,soil} × cos(90 ·	α + δ _{r.d}) = 442	.8 kN/m			
Surcharge		$F_{surch_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = \textbf{60.6 kN/m}$						
Vertical forces								
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f} \times W_g = 990.0 \text{ kN/m}$						
Retained soil		$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r.d}) = 777.0 \text{ kN/m}$						
Surcharge		$F_{\text{surch}_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = \textbf{0.0 kN/m}$						
Overturning stability - take mon	nents about the	toe						
Overturning moment		$M_o = F_{soil_h} \times d$	h,soil + Fsurch_h	$\times d_{h,surch} = 1779$	9.0 kNm/m			
Restoring moment		$M_{R} = F_{\text{gabion}_v, f}$	$\times X_g + F_{soil_v,f}$	$\times b_{v,soil} + F_{surch_{-}}$	$v_{v,f} \times b_{v,surch} = 890$)3.7 kNm/m		
Factor of safety		$FoS_M = M_R / M_o = 5.005$						
Allowable factor of safety		FoS _{M_allow} = 1.000						
	PASS -	Design FOS fo	r overturning	exceeds min	allowable FOS	for overtur		
Sliding stability - ignore any pas	ssive pressure in	n front of the st	ructure					
Total horizontal force		T = F _{soil_h} + F _{surch_h} = 503.4 kN/m						
Total vertical force		$N = F_{gabion_v,f} + $			N/m			
Sliding force		$F_f = T \times \cos(\varepsilon)$						
Sliding resistance		$F_R = (T \times sin(\varepsilon))$		$) \times tan(\delta_{bb.d}) = 9$	953.5 kN/m			
Factor of safety		$FoS_S = F_R / F_f$						
Allowable factor of safety		$FoSs_{allow} = 1.0$		liding avaaada	min allowable	EOS for all		
		rass - Desi	JII FUS TOP S	iung exceeds	min allowable	rus for sli		

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		GABION W	ALL DESIGN			
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Check overturning and sliding between course	<u>s 1 and 2</u>
Wall geometry	
Horizontal distance to centre of gravity gabion 2	x _{g2} = w ₂ / 2 = 4500 mm
Vertical distance to centre of gravity gabion 2	y _{g2} = h ₂ / 2 = 500 mm
Weight of gabion 2	$W_{g2} = \gamma_d \times w_2 \times h_2 = $ 162.0 kN/m
Horizontal distance to centre of gravity gabion 3	x _{g3} = w ₃ / 2 + s ₃ = 4000 mm
Vertical distance to centre of gravity gabion 3	y ₉₃ = h ₃ / 2 + h ₂ = 1500 mm
Weight of gabion 3	$W_{g3} = \gamma_d \times w_3 \times h_3 = $ 144.0 kN/m
Horizontal distance to centre of gravity gabion 4	x _{g4} = w ₄ / 2 + s ₃ + s ₄ = 3500 mm
Vertical distance to centre of gravity gabion 4	y _{g4} = h ₄ / 2 + h ₂ + h ₃ = 2500 mm
Weight of gabion 4	$W_{g4} = \gamma_d \times w_4 \times h_4 = $ 126.0 kN/m
Horizontal distance to centre of gravity gabion 5	x ₉₅ = w ₅ / 2 + s ₃ + s ₄ + s ₅ = 3000 mm
Vertical distance to centre of gravity gabion 5	y ₉₅ = h ₅ / 2 + h ₂ + h ₃ + h ₄ = 3500 mm
Weight of gabion 5	$W_{g5} = \gamma_d \times w_5 \times h_5 = $ 108.0 kN/m
Horizontal distance to centre of gravity gabion 6	x ₉₆ = w ₆ / 2 + s ₃ + s ₄ + s ₅ + s ₆ = 2500 mm
Vertical distance to centre of gravity gabion 6	$y_{g6} = h_6 / 2 + h_2 + h_3 + h_4 + h_5 = 4500 \text{ mm}$
Weight of gabion 6	$W_{g6} = \gamma_d \times w_6 \times h_6 = \textbf{90.0 kN/m}$
Horizontal distance to centre of gravity gabion 7	x ₉₇ = w ₇ / 2 + s ₃ + s ₄ + s ₅ + s ₆ + s ₇ = 2000 mm
Vertical distance to centre of gravity gabion 7	$y_{g7} = h_7 / 2 + h_2 + h_3 + h_4 + h_5 + h_6 = 5500 \text{ mm}$
Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 8	$x_{g8} = w_8 / 2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 = 1500 \text{ mm}$
Vertical distance to centre of gravity gabion 8	$y_{g8} = h_8 / 2 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 = 6500 \text{ mm}$
Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = $ 54.0 kN/m
Horizontal distance to centre of gravity gabion 9	$x_{g9} = w_9 / 2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 = 1000 \text{ mm}$
Vertical distance to centre of gravity gabion 9	$y_{g9} = h_9 / 2 + h_2 + h_3 + h_4 + h_5 + h_6 + h_7 + h_8 = 7500 \text{ mm}$
Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = 36.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
Vertical distance to centre of gravity gabion 10	y _{g10} = h ₁₀ / 2 + h ₂ + h ₃ + h ₄ + h ₅ + h ₆ + h ₇ + h ₈ + h ₉ = 8500 mm
Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = $ 18.0 kN/m
Weight of entire gabion	$W_g = W_{g2} + W_{g3} + W_{g4} + W_{g5} + W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = 810.0$ kN/m
Horiz distance to centre of gravity entire gabion	$x_{g} = ((W_{g2} \times x_{g2}) + (W_{g3} \times x_{g3}) + (W_{g4} \times x_{g4}) + (W_{g5} \times x_{g5}) + (W_{g6} \times x_{g6}) +$
Fionz distance to centre of gravity entire gabion	$(W_{g7} \times x_{g7}) + (W_{g8} \times x_{g8}) + (W_{g9} \times x_{g9}) + (W_{g10} \times x_{g10}) / W_g = 3167 \text{ mm}$
Vert distance to centre of gravity entire gabion	$y_{g} = ((W_{g2} \times y_{g2}) + (W_{g3} \times y_{g3}) + (W_{g4} \times y_{g4}) + (W_{g5} \times y_{g5}) + (W_{g6} \times y_{g6}) + (W_{g6} \times y_{g6$
ven distance to centre of gravity entire gabion	
Correction for well inclination basis dist	$(W_{g7} \times y_{g7}) + (W_{g8} \times y_{g8}) + (W_{g9} \times y_{g9}) + (W_{g10} \times y_{g10})) / W_g = 3167 \text{ mm}$
Correcting for wall inclination horiz dist	$X_{g} = x_{g} \times \cos(\varepsilon) + y_{g} \times \sin(\varepsilon) = 3167 \text{ mm}$
Vertical change in height due to wall inclination	$H_{f} = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times \cos(\epsilon) - (x_{g10} + w_{10}/2) \times \sin(\epsilon)) = 0 \text{ mm}$
Design dimensions	
Effective angle of rear plane of wall	$\alpha = 90 \text{deg} - \text{Atan}((w_2 - (x_{g10} + (w_{10} / 2))) / (y_{g10} + h_{10} / 2)) + \epsilon = 48.4 \text{ deg}$
Effective face angle	θ = 90deg - ε = 90.0 deg
Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_2 \times sin(\epsilon)) - H_f = 9000 \text{ mm}$

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Height of wall from toe to front edge of t	top gabion	$H_{incl} = ((V_{a10} + l))$	$n_{10} / 2) \times \cos(\varepsilon)$	- (x _{g10} - (w ₁₀ / 2))	× sin(ε)) = 90	00 mm
Active pressure using Coulomb theory	1 0			$in(\alpha - \delta_{r.d}) \times (1 +$		
			$(\alpha + \beta)))^2$			-, - (1
Active thrust due to soil		.,	$a \times \gamma_{s.d} \times H^2 = 71$			
Horizontal forces						
Retained soil		F _{soil h} = γ _G × P _a	$_{\rm soil} imes \cos(90 - lpha)$	+ δ _{r.d}) = 358.8 kN	√m	
Surcharge		-	-	os(90 - α + δ _{r.d}) =		
Vertical forces		·····		,		
Gabion weight		Eachion $y = y + z$	< Wg = 810.0 kN	l/m		
Retained soil			-	α + δ _{r.d}) = 620.6 k	N/m	
Surcharge		-		sin(90 - α + δ _{r.d})		
-		•	×γų,i∧ na× i i ×	$\sin(30 - \alpha + \text{or.d})$	- U.U KIN/III	
Overturning stability - take moments	about the t		_			
Overturning moment				h,surch = 1321.9 k		
Restoring moment				$D_{v,soil} + F_{surch_v,f} \times$	bv,surch = 6495	.6 kNm/m
Factor of safety		$FoS_M = M_R / M_C$				
Allowable factor of safety	PASS-	$FoS_{M_{allow}} = 1.0$		xceeds min allo	wahla EAS fr	or overturn
						overtain
Sliding stability - ignore any passive Total horizontal force	pressure ii		rch_h = 413.3 kN/	/m		
Total vertical force				_{,f} = 1430.6 kN/m		
Sliding force		-	- N × sin(ε) = 41			
Sliding resistance				$tan(\delta_{bg.d}) = 801.4$	1 kN/m	
Factor of safety		$FoS_S = F_R / F_f =$				
			- 1.555			
•			00			
Allowable factor of safety		FoSs_allow = 1.0		ing exceeds mir	n allowable F	OS for slid
Allowable factor of safety	en courses	FoSs_allow = 1.0 <i>PASS - Desig</i>		ing exceeds mir	n allowable F	OS for slid
Allowable factor of safety <u>Check overturning and sliding between</u>	<u>en courses</u>	FoSs_allow = 1.0 <i>PASS - Desig</i>		ing exceeds mir	n allowable F	OS for slid
Allowable factor of safety <u>Check overturning and sliding betwe</u> Wall geometry		FoSs_allow = 1.0 <i>PASS - Desig</i> 5 2 and 3	n FOS for slid	ing exceeds mir	n allowable F	OS for slia
Allowable factor of safety <u>Check overturning and sliding betwe</u> Wall geometry Horizontal distance to centre of gravity g	gabion 3	FoSs_allow = 1.0 <i>PASS - Desig</i> <u>5 2 and 3</u> $x_{g3} = w_3 / 2 = 4$	n FOS for slid. 000 mm	ing exceeds mir	n allowable F	OS for slia
Allowable factor of safety Check overturning and sliding betwe Wall geometry Horizontal distance to centre of gravity gate Vertical distance to centre of gravity gate	gabion 3	FoSs_allow = 1.0 <i>PASS - Desig</i> $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 56$	yn FOS for slid 000 mm 00 mm		n allowable F	OS for slia
Allowable factor of safety <u>Check overturning and sliding betwe</u> Wall geometry Horizontal distance to centre of gravity g	gabion 3 bion 3	FoSs_allow = 1.0 <i>PASS - Desig</i> $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 56$	yn FOS for slid 000 mm 00 mm h ₃ = 144.0 kN/r		n allowable F	OS for slia
Allowable factor of safety <u>Check overturning and sliding betwee</u> Wall geometry Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 3	gabion 3 bion 3 gabion 4	FoSs_allow = 1.0 PASS - Designs $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 56$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + 5$	n FOS for slid 000 mm 00 mm h₃ = 144.0 kN/r ₄ = 3500 mm		n allowable F	OS for slid
Allowable factor of safety Check overturning and sliding betwee Wall geometry Horizontal distance to centre of gravity gate Vertical distance to centre of gravity gate Weight of gabion 3 Horizontal distance to centre of gravity gate	gabion 3 bion 3 gabion 4	FoSs_allow = 1.0 PASS - Designs $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 50$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + s$ $y_{g4} = h_4 / 2 + h_3$	n FOS for slid 000 mm 00 mm h₃ = 144.0 kN/r ₄ = 3500 mm	n	n allowable F	OS for slia
Allowable factor of safety Check overturning and sliding betwee Wall geometry Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 3 Horizontal distance to centre of gravity gat	gabion 3 bion 3 gabion 4 bion 4	FoSs_allow = 1.0 PASS - Designs $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 56$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + s_3$ $y_{g4} = h_4 / 2 + h_3$ $W_{g4} = \gamma_d \times w_4 \times x_{g4}$	n FOS for slid 000 mm 00 mm h ₃ = 144.0 kN/r 4 = 3500 mm 5 = 1500 mm	n	n allowable F	OS for slid
Allowable factor of safety Check overturning and sliding betwee Wall geometry Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 3 Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 4	gabion 3 bion 3 gabion 4 bion 4 gabion 5	FoSs_allow = 1.0 PASS - Designs $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 56$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + s_5$ $y_{g4} = h_4 / 2 + h_3$ $W_{g4} = \gamma_d \times w_4 \times x_{g5} = w_5 / 2 + s_5$	n FOS for slid 000 mm h ₃ = 144.0 kN/r = 3500 mm = 1500 mm h ₄ = 126.0 kN/r	n m m	n allowable F	OS for slia
Allowable factor of safety Check overturning and sliding betwee Wall geometry Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 3 Horizontal distance to centre of gravity gat Weight of gabion 4 Horizontal distance to centre of gravity gat	gabion 3 bion 3 gabion 4 bion 4 gabion 5	FoSs_allow = 1.0 PASS - Designs $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 50$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + s_5$ $y_{g4} = h_4 / 2 + h_5$ $W_{g4} = \gamma_d \times w_4 \times x_{g5} = w_5 / 2 + s_5$ $y_{g5} = h_5 / 2 + h_5$	n FOS for slid 000 mm 00 mm h ₃ = 144.0 kN/r 4 = 3500 mm b ₄ = 126.0 kN/r 4 + s ₅ = 3000 m	n m m	n allowable F	OS for slia
Allowable factor of safety Check overturning and sliding betwee Wall geometry Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 3 Horizontal distance to centre of gravity gat Weight of gabion 4 Horizontal distance to centre of gravity gat	gabion 3 bion 3 gabion 4 bion 4 gabion 5 bion 5	FoSs_allow = 1.0 PASS - Designs $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 56$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + s_5$ $y_{g4} = h_4 / 2 + h_3$ $W_{g4} = \gamma_d \times w_4 \times x_{g5} = w_5 / 2 + s_5$ $y_{g5} = h_5 / 2 + h_3$ $W_{g5} = \gamma_d \times w_5 \times x_{g5}$	$\begin{array}{l} \textbf{pr FOS for slid}\\ \textbf{000 mm}\\ \textbf{b}_3 = \textbf{144.0 kN/r}\\ \textbf{a} = \textbf{3500 mm}\\ \textbf{b}_4 = \textbf{1500 mm}\\ \textbf{b}_4 = \textbf{126.0 kN/r}\\ \textbf{a} + \textbf{s}_5 = \textbf{3000 mm}\\ \textbf{s} + \textbf{b}_4 = \textbf{2500 mm} \end{array}$	n m m n	n allowable F	OS for slid
Allowable factor of safety Check overturning and sliding between Wall geometry Horizontal distance to centre of gravity gate Vertical distance to centre of gravity gate Weight of gabion 3 Horizontal distance to centre of gravity gate Vertical distance to centre of gravity gate Weight of gabion 4 Horizontal distance to centre of gravity gate Weight of gabion 5	gabion 3 bion 3 gabion 4 bion 4 gabion 5 bion 5 gabion 6	FoSs_allow = 1.0 PASS - Designs s 2 and 3 $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 56$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + s_5$ $y_{g4} = h_4 / 2 + h_3$ $W_{g4} = \gamma_d \times w_4 \times x_{g5} = w_5 / 2 + s_5$ $y_{g5} = h_5 / 2 + h_3$ $W_{g5} = \gamma_d \times w_5 \times x_{g6} = w_6 / 2 + s_5$	$\begin{array}{l} \text{000 mm} \\ \text{000 mm} \\ \text{00 mm} \\ \text{h}_3 = 144.0 \text{ kN/r} \\ \text{4} = 3500 \text{ mm} \\ \text{5} = 1500 \text{ mm} \\ \text{h}_4 = 126.0 \text{ kN/r} \\ \text{4} + \text{S}_5 = 3000 \text{ mm} \\ \text{6} + \text{h}_4 = 2500 \text{ mm} \\ \text{h}_5 = 108.0 \text{ kN/r} \end{array}$	n m m n n D0 mm	n allowable F	OS for slia
Allowable factor of safety Check overturning and sliding betwee Wall geometry Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 3 Horizontal distance to centre of gravity gat Weight of gabion 4 Horizontal distance to centre of gravity gat Weight of gabion 5 Horizontal distance to centre of gravity gat	gabion 3 bion 3 gabion 4 bion 4 gabion 5 bion 5 gabion 6	FoSs_allow = 1.0 PASS - Design $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 50$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + h_3$ $y_{g4} = h_4 / 2 + h_3$ $W_{g4} = \gamma_d \times w_4 \times x_{g5} = w_5 / 2 + h_3$ $W_{g5} = \gamma_d \times w_5 \times x_{g6} = w_6 / 2 + h_3$	$\begin{array}{l} \text{000 mm} \\ \text{000 mm} \\ \text{h}_3 = 144.0 \text{ kN/r} \\ \text{a} = 3500 \text{ mm} \\ \text{h}_4 = 3500 \text{ mm} \\ \text{h}_4 = 126.0 \text{ kN/r} \\ \text{a} + \text{s}_5 = 3000 \text{ m} \\ \text{a} + \text{h}_4 = 2500 \text{ m} \\ \text{h}_5 = 108.0 \text{ kN/r} \\ \text{a} + \text{s}_5 + \text{s}_6 = 250 \end{array}$	n m m n 00 mm 00 mm	n allowable F	OS for slid
Allowable factor of safety Check overturning and sliding betwee Wall geometry Horizontal distance to centre of gravity gat Vertical distance to centre of gravity gat Weight of gabion 3 Horizontal distance to centre of gravity gat Weight of gabion 4 Horizontal distance to centre of gravity gat Weight of gabion 5 Horizontal distance to centre of gravity gat Weight of gabion 5 Horizontal distance to centre of gravity gat	gabion 3 bion 3 gabion 4 bion 4 gabion 5 bion 5 gabion 6 bion 6	FoSs_allow = 1.0 PASS - Design $x_{g3} = w_3 / 2 = 4$ $y_{g3} = h_3 / 2 = 50$ $W_{g3} = \gamma_d \times w_3 \times x_{g4} = w_4 / 2 + h_3$ $y_{g4} = h_4 / 2 + h_3$ $W_{g4} = \gamma_d \times w_4 \times x_{g5} = w_5 / 2 + h_3$ $W_{g5} = \gamma_d \times w_5 \times x_{g6} = w_6 / 2 + h_3$	$\begin{array}{l} \text{000 mm} \\ \text{000 mm} \\ \text{h}_3 = 144.0 \text{ kN/r} \\ \text{h}_3 = 144.0 \text{ kN/r} \\ \text{h}_3 = 1500 \text{ mm} \\ \text{h}_4 = 3500 \text{ mm} \\ \text{h}_4 = 126.0 \text{ kN/r} \\ \text{h}_5 = 108.0 \text{ kN/r} \\ \text{h}_5 = 108.0 \text{ kN/r} \\ \text{h}_5 = 108.0 \text{ kN/r} \\ \text{h}_5 = 5500 \text{ mm} \\ \text{h}_6 = 90.0 \text{ kN/r} \end{array}$	n m m n 00 mm 00 mm	n allowable F	OS for slid

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		GABION V	VALL DESIGI	N		
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	Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
	Horizontal distance to centre of gravity gabion 8	$x_{g8} = w_8 / 2 + s_4 + s_5 + s_6 + s_7 + s_8 = 1500 \text{ mm}$
	Vertical distance to centre of gravity gabion 8	y _{g8} = h ₈ / 2 + h ₃ + h ₄ + h ₅ + h ₆ + h ₇ = 5500 mm
,	Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = $ 54.0 kN/m
	Horizontal distance to centre of gravity gabion 9	$x_{g9} = w_9 / 2 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 = 1000 \text{ mm}$
	Vertical distance to centre of gravity gabion 9	y _{g9} = h ₉ / 2 + h ₃ + h ₄ + h ₅ + h ₆ + h ₇ + h ₈ = 6500 mm
,	Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = \textbf{36.0 kN/m}$
	Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
	Vertical distance to centre of gravity gabion 10	y _{g10} = h ₁₀ / 2 + h ₃ + h ₄ + h ₅ + h ₆ + h ₇ + h ₈ + h ₉ = 7500 mm
	Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = \textbf{18.0 kN/m}$
	Weight of entire gabion	$W_g = W_{g3} + W_{g4} + W_{g5} + W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = \textbf{648.0} \text{ kN/m}$
	Horiz distance to centre of gravity entire gabion	$x_{g} = ((W_{g3} \times x_{g3}) + (W_{g4} \times x_{g4}) + (W_{g5} \times x_{g5}) + (W_{g6} \times x_{g6}) + (W_{g7} \times x_{g7}) +$
		$(W_{g8} \times x_{g8}) + (W_{g9} \times x_{g9}) + (W_{g10} \times x_{g10})) / W_g = 2833 \text{ mm}$
,	Vert distance to centre of gravity entire gabion	$y_{g} = ((W_{g3} \times y_{g3}) + (W_{g4} \times y_{g4}) + (W_{g5} \times y_{g5}) + (W_{g6} \times y_{g6}) + (W_{g7} \times y_{g7}) +$
		$(W_{g8} \times y_{g8}) + (W_{g9} \times y_{g9}) + (W_{g10} \times y_{g10})) / W_g = 2833 \text{ mm}$
	Correcting for wall inclination horiz dist	$X_g = x_g \times \cos(\varepsilon) + y_g \times \sin(\varepsilon) = 2833 \text{ mm}$
	Vertical change in height due to wall inclination	$H_f = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times \cos(\epsilon) - (x_{g10} + w_{10}/2) \times \sin(\epsilon)) = 0 \text{ mm}$
	Design dimensions	
	Effective angle of rear plane of wall	$\alpha = 90 \text{deg} - \text{Atan}((w_3 - (x_{g10} + (w_{10} / 2))) / (y_{g10} + h_{10} / 2)) + \varepsilon = 48.8 \text{ deg}$
	Effective face angle	$\theta = 90 \text{deg} - \varepsilon = 90.0 \text{ deg}$
	Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_3 \times sin(\epsilon)) - H_f = 8000 \text{ mm}$
	Height of wall from toe to front edge of top gabion	$H_{\text{incl}} = ((y_{g10} + h_{10} / 2) \times \cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times \sin(\epsilon)) = 8000 \text{ mm}$
	Active pressure using Coulomb theory	$K_{a} = \sin(\alpha + \phi'_{r,d})^{2} / (\sin(\alpha)^{2} \times \sin(\alpha - \delta_{r,d}) \times (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) \times \sin(\phi'_{r,d} - \phi'_{r,d})}))^{2} = 0.020$
		$\beta) / (\sin(\alpha - \delta_{r,d}) \times \sin(\alpha + \beta)))^2) = 0.920$
	Active thrust due to soil	$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = 559.1 \text{ kN/m}$
	Horizontal forces	
	Retained soil	$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r.d}) = 283.6 \text{ kN/m}$
	Surcharge	$F_{surch_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = 48.5 \text{ kN/m}$
	Vertical forces	
	Gabion weight	$F_{gabion_v,f} = \gamma_{G,f} \times W_g = 648.0 \text{ kN/m}$
	Retained soil	$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r.d}) = 481.8 \text{ kN/m}$
	Surcharge	$F_{surch_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = 0.0 \text{ kN/m}$
	Overturning stability - take moments about the	toe
	Overturning moment	$M_o = F_{soil_h} \times d_{h,soil} + F_{surch_h} \times d_{h,surch} = 950.2 \text{ kNm/m}$
	Restoring moment	$M_{R} = F_{gabion_v,f} \times X_g + F_{soil_v,f} \times b_{v,soil} + F_{surch_v,f} \times b_{v,surch} = 4566.2 kNm/m$
	Factor of safety	$FoS_{M} = M_{R} / M_{o} = 4.805$
	Allowable factor of safety	FoS _{M_allow} = 1.000
	-	Design FOS for overturning exceeds min allowable FOS for overturning
	Sliding stability - ignore any passive pressure in	
	Total horizontal force	$T = F_{soil_h} + F_{surch_h} = 332.1 \text{ kN/m}$
	Total vertical force	$N = F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 1129.8 \text{ kN/m}$

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Sliding force		$F_f = T \times cos(\varepsilon)$	$- N \times sin(\varepsilon) =$	332.1 kN/m		
Sliding resistance) × tan($\delta_{bg,d}$) = 6	32.9 kN/m	
Factor of safety		$FoS_s = F_R / F_f$				
Allowable factor of safety		$FoSs_{allow} = 1.0$				
				liding exceeds	min allowable	FOS for sl
Check overturning and sliding betw	veen course	es 3 and 4				
Wall geometry						
Horizontal distance to centre of gravity	/ gabion 4	$x_{g4} = w_4 / 2 = 3$	500 mm			
Vertical distance to centre of gravity g	abion 4	$y_{g4} = h_4 / 2 = 5$				
Weight of gabion 4		$W_{g4} = \gamma_d \times W_4 >$	k h ₄ = 126.0 k	N/m		
Horizontal distance to centre of gravity	/ gabion 5	$x_{g5} = w_5 / 2 + s$				
Vertical distance to centre of gravity g	-	y _{g5} = h ₅ / 2 + h				
Weight of gabion 5		$W_{g5} = \gamma_d \times W_5 >$		N/m		
Horizontal distance to centre of gravity	/ gabion 6	$x_{g6} = w_6 / 2 + s$				
Vertical distance to centre of gravity g	-	$y_{g6} = h_6 / 2 + h_6$				
Weight of gabion 6		$W_{g6} = \gamma_d \times W_6 >$				
Horizontal distance to centre of gravity	/ dabion 7	$x_{g7} = w_7 / 2 + s$				
Vertical distance to centre of gravity g	-	$y_{g7} = h_7 / 2 + h_7$				
Weight of gabion 7		$W_{g7} = \gamma_d \times W_7 >$				
Horizontal distance to centre of gravity	/ aabion 8	$x_{g8} = w_8 / 2 + s$				
Vertical distance to centre of gravity g	-	$y_{g8} = h_8 / 2 + h_8$				
Weight of gabion 8		$W_{g8} = \gamma_d \times W_8 >$				
Horizontal distance to centre of gravity	/ gabion 9	•		s ₈ + s ₉ = 1000 m	m	
Vertical distance to centre of gravity g	0	0		n7 + h8 = 5500 m		
Weight of gabion 9		$W_{g9} = \gamma_d \times W_9 >$				
Horizontal distance to centre of gravity	aabion 10			$S_8 + S_9 + S_{10} = $	500 mm	
Vertical distance to centre of gravity g	0	-		$h_7 + h_8 + h_9 = 6$		
Weight of gabion 10		$W_{g10} = \gamma_d \times W_{10}$				
Weight of entire gabion		-		7 + W _{g8} + W _{g9} +	W _{g10} = 504.0 k	N/m
Horiz distance to centre of gravity enti	re gabion			$(W_{g6} \times X_{g6}) + (W_{g6} \times X_{g6}) + (W_{$	-	
	le gabien			W _g = 2500 mm	(•••9/ × ×9/) • (rigo x xgo) .
Vert distance to centre of gravity entire	apion		• • • •	$(W_{g} = 2000 \text{ mm})$ 5) + ($W_{g6} \times y_{g6}$) +	· (\\\	W
	gabion			W _g = 2500 mm	(VVg/ × yg/) · (vvg8 ~ yg8) i
Correcting for well inclination berindia	+		• • • • •	•		
Correcting for wall inclination horiz dis		$X_g = x_g \times \cos(\varepsilon)$			····· /0)	
Vertical change in height due to wall in	iclination	$n_{\rm f} = y_{\rm g10} + n_{10}/$	∠ - ((y _{g10} + h ₁₀	$(x_{g}) \times \cos(\varepsilon) - (x_{g})$	₁₀ + W ₁₀ /2) × SI	$u(\varepsilon)) = 0 mr$
Design dimensions						
Effective angle of rear plane of wall				+ (w ₁₀ / 2))) / (y _g	10 + h10 / 2)) + a	s = 49.4 deg
Effective face angle		θ = 90deg - ϵ =	-			
Effective height of wall		$H = (y_{g10} + h_{10})$	/ 2) + (w ₄ × si	n(ε)) - H _f = 7000	mm	
	f top gabion				2)) × sin(ε)) = 7	

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Active pressure using Coulomb theory		$K_a = sin(\alpha + \phi)$	$(a)^2 / (\sin(\alpha)^2)$	$\times \sin(\alpha - \delta_{r.d}) \times ($	[1 + √(sin(φ'r.d + δ	$\delta_{r.d}$) × sin(ϕ'_r
		β) / (sin(α - δr.c				
Active thrust due to soil		$P_{a,soil} = 0.5 \times k$	$L_a \times \gamma_{s.d} \times H^2 =$	= 420.9 kN/m		
Horizontal forces						
Retained soil		$F_{soil_h} = \gamma_G \times P_a$	$_{\rm a,soil} \times \cos(90)$	- α + δ _{r.d}) = 217 .	. 2 kN/m	
Surcharge		$F_{surch_h} = p_{o,Q}$	$\times \gamma_{Q} \times K_{a} \times H$:	$\times \cos(90 - \alpha + \delta)$	_{r.d}) = 42.5 kN/m	
Vertical forces						
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	× Wa = 504.0	kN/m		
Retained soil			-	- α + δ _{r.d}) = 36 ().5 kN/m	
Surcharge		•		$1 \times \sin(90 - \alpha + \delta)$		
Overturning stability - take moments	about the	•	1-11-1	- (·,	
Overturning moment			h soil + Faurah h	\times d _{h,surch} = 655.3	3 kNm/m	
Restoring moment					$v_{,f} \times b_{v,surch} = 306$	32 5 kNm/m
Factor of safety		$FoS_{M} = M_{R} / M$				
Allowable factor of safety		$FoS_{M_allow} = 1.0$				
	PASS	- Design FOS fo		n exceeds min	allowable FOS	for overtur
Cliding stability igners any passive		-		, execcue min		
Sliding stability - ignore any passive Total horizontal force	pressure	$T = F_{soil_h} + F_{su}$		kN/m		
Total vertical force				ch_v,f = 864.5 kN/	/m	
Sliding force		$F_f = T \times cos(\epsilon)$				
Sliding resistance				$\lambda = 233.0 \text{ km/m}$ $\lambda = 4$	184 3 kN/m	
Factor of safety		$FoS_s = F_R / F_f$		$\gamma \times \tan(\operatorname{obg.d}) = \neg$	104.3 KN/III	
Allowable factor of safety		$FoSs_allow = 1.0$				
				liding exceeds	min allowable	FOS for sli
Check overturning and sliding betwee	en course	es 4 and 5				
Wall geometry						
Horizontal distance to centre of gravity	gabion 5	$x_{g5} = w_5 / 2 = 3$	000 mm			
Vertical distance to centre of gravity gal	oion 5	y _{g5} = h ₅ / 2 = 5	00 mm			
Weight of gabion 5		$W_{g5} = \gamma_d \times W_5 >$	< h ₅ = 108.0 k	N/m		
Horizontal distance to centre of gravity	gabion 6	$x_{g6} = w_6 / 2 + s_6$	₆ = 2500 mm			
Theme of gravity	oion 6	$y_{g6} = h_6 / 2 + h_6$	₅ = 1500 mm			
Vertical distance to centre of gravity gal		$W_{g6} = \gamma_d \times W_6 >$	k h6 = 90.0 kN	l/m		
· · ·						
Vertical distance to centre of gravity gal	gabion 7	$x_{g7} = w_7 / 2 + s_7$	6 + S7 = 2000	mm		
Vertical distance to centre of gravity gal Weight of gabion 6	-	x _{g7} = w ₇ / 2 + s y _{g7} = h ₇ / 2 + h				
Vertical distance to centre of gravity gal Weight of gabion 6 Horizontal distance to centre of gravity	-	-	5 + h ₆ = 2500	mm		
Vertical distance to centre of gravity gal Weight of gabion 6 Horizontal distance to centre of gravity Vertical distance to centre of gravity gal Weight of gabion 7 Horizontal distance to centre of gravity	pion 7 gabion 8	$y_{g7} = h_7 / 2 + h_7$	₅ + h6 = 2500 < h7 = 72.0 kN	mm I/m		
Vertical distance to centre of gravity gal Weight of gabion 6 Horizontal distance to centre of gravity Vertical distance to centre of gravity gal Weight of gabion 7	pion 7 gabion 8	$y_{g7} = h_7 / 2 + h$ $W_{g7} = \gamma_d \times W_7 >$	5 + h6 = 2500 < h7 = 72.0 kN 56 + S7 + S8 = 1	mm I/m 1 500 mm		
Vertical distance to centre of gravity gal Weight of gabion 6 Horizontal distance to centre of gravity Vertical distance to centre of gravity gal Weight of gabion 7 Horizontal distance to centre of gravity	pion 7 gabion 8	$y_{g7} = h_7 / 2 + h$ $W_{g7} = \gamma_d \times W_7 >$ $x_{g8} = w_8 / 2 + s$	5 + h ₆ = 2500 4 h ₇ = 72.0 kN 5 + S ₇ + S ₈ = 5 5 + h ₆ + h ₇ = 3	mm I/m 1500 mm 3500 mm		
Vertical distance to centre of gravity gal Weight of gabion 6 Horizontal distance to centre of gravity Vertical distance to centre of gravity gal Weight of gabion 7 Horizontal distance to centre of gravity gal Weight of gabion 8 Horizontal distance to centre of gravity	pion 7 gabion 8 pion 8 gabion 9	$y_{g7} = h_7 / 2 + h$ $W_{g7} = \gamma_d \times w_7 \times x_{g8} = w_8 / 2 + s$ $y_{g8} = h_8 / 2 + h$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$	$5 + h_6 = 2500$ $4 h_7 = 72.0 kM$ $4 h_6 + S_7 + S_8 = 7$ $5 + h_6 + h_7 = 3$ $4 h_8 = 54.0 kM$ $4 h_8 = 54.0 kM$	mm I/m 1500 mm 3500 mm I/m S9 = 1000 mm		
Vertical distance to centre of gravity gal Weight of gabion 6 Horizontal distance to centre of gravity Vertical distance to centre of gravity gal Weight of gabion 7 Horizontal distance to centre of gravity gal Vertical distance to centre of gravity gal	pion 7 gabion 8 pion 8 gabion 9	$y_{g7} = h_7 / 2 + h$ $W_{g7} = \gamma_d \times w_7 \times$ $x_{g8} = w_8 / 2 + s$ $y_{g8} = h_8 / 2 + h$ $W_{g8} = \gamma_d \times w_8 \times$	$5 + h_6 = 2500$ $4 h_7 = 72.0 kM$ $4 h_6 + S_7 + S_8 = 7$ $5 + h_6 + h_7 = 3$ $4 h_8 = 54.0 kM$ $4 h_8 = 54.0 kM$	mm I/m 1500 mm 3500 mm I/m S9 = 1000 mm		

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Horizontal distance to centre of gravity ga	abion 10	$x_{g10} = w_{10} / 2 +$	S6 + S7 + S8 +	S9 + S10 = 500	mm		
Vertical distance to centre of gravity gabi	on 10	$y_{g10} = h_{10} / 2 +$	h5 + h6 + h7 +	h ₈ + h ₉ = 5500	mm		
Weight of gabion 10		$W_{g10} = \gamma_d \times W_{10}$	× h ₁₀ = 18.0	κN/m			
Weight of entire gabion		$W_g = W_{g5} + W_g$	₉₆ + W _{g7} + W _{g8}	8 + W _{g9} + W _{g10} :	= 378.0 kN/m		
Horiz distance to centre of gravity entire	gabion	$x_g = ((W_{g5} \times x_{g5}))$	5) + ($W_{g6} \times X_{g6}$) + ($W_{g7} \times x_{g7}$)	+ ($W_{g8} \times x_{g8}$) + ($W_{g9} \times x_{g9}$)	
		(W _{g10} × x _{g10})) /	Wg = 2167 mi	m			
Vert distance to centre of gravity entire ga	abion	$y_g = ((W_{g5} \times y_{g5}))$	$_{5}$) + (W _{g6} × y _{g6}) + ($W_{g7} \times y_{g7}$)	+ ($W_{g8} \times y_{g8}$) + ($W_{g9} \times y_{g9}$)	
		$(W_{g10} \times y_{g10})) /$	W _g = 2167 mi	m			
Correcting for wall inclination horiz dist		$X_g = x_g \times \cos(\epsilon)$) + $y_g \times sin(\epsilon)$	= 2167 mm			
Vertical change in height due to wall incli	nation	$H_f = y_{g10} + h_{10}/2$	2 - ((y _{g10} + h ₁₀	$/2) \times \cos(\varepsilon)$ - (x	k _{g10} + w₁₀/2) × sii	n(ε)) = 0 m	
Design dimensions							
Effective angle of rear plane of wall		α = 90deg - At	an((w5 - (x _{g10} -	+ (w ₁₀ / 2))) / (y	g10 + h10 / 2)) + ε	s = 50.2 de	
Effective face angle		θ = 90deg - ϵ =	= 90.0 deg				
Effective height of wall		$H = (y_{g10} + h_{10})$	/ 2) + (w ₅ × sir	n(ε)) - H _f = 600	0 mm		
Height of wall from toe to front edge of to	p gabion				(2)) $\times \sin(\varepsilon)$) = 6	000mm	
Active pressure using Coulomb theory		$K_{a} = \sin(\alpha + \phi'_{r,d})^{2} / (\sin(\alpha)^{2} \times \sin(\alpha - \delta_{r,d}) \times (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) \times \sin(\phi'_{r,d})}))$					
		β) / (sin(α - δ _{r.d}				·/ (1	
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$	$a \times \gamma_{s.d} \times H^2 =$	302.3 kN/m			
Horizontal forces							
Retained soil		$F_{soil_h} = \gamma_G \times P_a$	$_{\rm u,soil} imes \cos(90$ -	α + $\delta_{r.d}$) = 159.	. 5 kN/m		
Surcharge		$F_{surch_h} = p_{o,Q} \times$	$\gamma_Q \times K_a \times H \times H$	$\cos(90 - \alpha + \delta)$	r.d) = 36.4 kN/m		
Vertical forces							
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	× W _g = 378.0	kN/m			
Retained soil		$F_{\text{soil}_v,f} = \gamma_{G,f} \times I$	$P_{a,soil} \times sin(90)$	- α + δ _{r.d}) = 256	6.7 kN/m		
Surcharge		$F_{surch_v,f} = p_{o,Q}$	$\times \gamma_{Q,f} \times K_{a} \times H$	$\times \sin(90 - \alpha + \alpha)$	δ _{r.d}) = 0.0 kN/m		
Overturning stability - take moments a	bout the	toe					
Overturning moment		$M_o = F_{soil_h} \times d_i$	h,soil + Fsurch_h >	\times dh,surch = 428.	3 kNm/m		
Restoring moment		$M_{R} = F_{gabion_v, f}$	$\times X_g + F_{soil_v,f}$	$\times b_{v,soil} + F_{surch_}$	$v, f \times b_{v, surch} = 193$	31.4 kNm/r	
Factor of safety		$FoS_M = M_R / M_R$	₀ = 4.510				
Allowable factor of safety		FoS _{M_allow} = 1.0					
	PASS -	Design FOS fo	r overturning	exceeds min	allowable FOS	for overtu	
Sliding stability - ignore any passive p	ressure i						
Total horizontal force		$T = F_{soil_h} + F_{su}$,		
Total vertical force		$N = F_{gabion_v,f} +$			/m		
Sliding force		$F_f = T \times \cos(\varepsilon)$					
Sliding resistance		$F_R = (T \times sin(\epsilon))$		$\times \tan(\delta_{\text{bg.d}}) = 3$	355.5 kN/m		
Factor of safety		$FoS_S = F_R / F_f$					
Allowable factor of safety		$FoS_{S_{allow}} = 1.0$				500 5	
		PASS - Desig	gn ⊢OS for sl	iaing exceeds	min allowable	FUS for s	

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Wall geometry	
Horizontal distance to centre of gravity gabion 6	x _{g6} = w ₆ / 2 = 2500 mm
Vertical distance to centre of gravity gabion 6	y _{g6} = h ₆ / 2 = 500 mm
Weight of gabion 6	$W_{g6} = \gamma_d \times w_6 \times h_6 = 90.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 7	x _{g7} = w ₇ / 2 + s ₇ = 2000 mm
Vertical distance to centre of gravity gabion 7	y _{g7} = h ₇ / 2 + h ₆ = 1500 mm
Weight of gabion 7	$W_{g7} = \gamma_d \times w_7 \times h_7 = 72.0 \text{ kN/m}$
Horizontal distance to centre of gravity gabion 8	x _{g8} = w ₈ / 2 + s ₇ + s ₈ = 1500 mm
Vertical distance to centre of gravity gabion 8	$y_{g8} = h_8 / 2 + h_6 + h_7 = 2500 \text{ mm}$
Weight of gabion 8	$W_{g8} = \gamma_d \times w_8 \times h_8 = \textbf{54.0 kN/m}$
Horizontal distance to centre of gravity gabion 9	x _{g9} = w ₉ / 2 + s ₇ + s ₈ + s ₉ = 1000 mm
Vertical distance to centre of gravity gabion 9	$y_{g9} = h_9 / 2 + h_6 + h_7 + h_8 = 3500 \text{ mm}$
Weight of gabion 9	$W_{g9} = \gamma_d \times w_9 \times h_9 = \textbf{36.0 kN/m}$
Horizontal distance to centre of gravity gabion 10	$x_{g10} = w_{10} / 2 + s_7 + s_8 + s_9 + s_{10} = 500 \text{ mm}$
Vertical distance to centre of gravity gabion 10	$y_{g10} = h_{10} / 2 + h_6 + h_7 + h_8 + h_9 = 4500 \text{ mm}$
Weight of gabion 10	$W_{g10} = \gamma_d \times w_{10} \times h_{10} = \textbf{18.0 kN/m}$
Weight of entire gabion	$W_g = W_{g6} + W_{g7} + W_{g8} + W_{g9} + W_{g10} = 270.0 \text{ kN/m}$
Horiz distance to centre of gravity entire gabion	
Vert distance to centre of gravity entire gabion	$\begin{split} y_g &= ((W_{g6} \times y_{g6}) + (W_{g7} \times y_{g7}) + (W_{g8} \times y_{g8}) + (W_{g9} \times y_{g9}) + (W_{g10} \times y_{g10})) \\ W_g &= \textbf{1833} \text{ mm} \end{split}$
Correcting for wall inclination horiz dist	$X_g = x_g \times cos(\epsilon) + y_g \times sin(\epsilon) = 1833 \text{ mm}$
Vertical change in height due to wall inclination	$H_{f} = y_{g10} + h_{10}/2 - ((y_{g10} + h_{10}/2) \times cos(\epsilon) - (x_{g10} + w_{10}/2) \times sin(\epsilon)) = 0 \text{ mm}$
Design dimensions	
Effective angle of rear plane of wall	α = 90deg - Atan((w ₆ - (x _{g10} + (w ₁₀ / 2))) / (y _{g10} + h ₁₀ / 2)) + ϵ = 51.3 deg
Effective face angle	θ = 90deg - ε = 90.0 deg
Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_6 \times sin(\epsilon)) - H_f = 5000 \text{ mm}$
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times sin(\epsilon)) = 5000 \text{mm}$
Active pressure using Coulomb theory	$K_{a} = \sin(\alpha + \phi'_{r.d})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.d}) \times (1 + \sqrt{(\sin(\phi'_{r.d} + \delta_{r.d}) \times \sin(\phi'_{r.d})}))$
	$β$) / (sin(α - $δ_{r.d}$) × sin(α + $β$)))) ²) = 0.856
Active thrust due to soil	$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = \textbf{203.3 kN/m}$
Horizontal forces	
Retained soil	$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r.d}) = 110.7 \text{ kN/m}$
Surcharge	$F_{surch_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = 30.3 \text{ kN/m}$
Vertical forces	
Gabion weight	$F_{gabion_v,f} = \gamma_{G,f} \times W_g = 270.0 \text{ kN/m}$
Retained soil	$F_{\text{soil},v,f} = \gamma_{\text{G},f} \times P_{\text{a},\text{soil}} \times \sin(90 - \alpha + \delta_{\text{r.d}}) = 170.5 \text{ kN/m}$
Surcharge	$F_{\text{surch}_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times \sin(90 - \alpha + \delta_{r,d}) = 0.0 \text{ kN/m}$

	Project	GABION W	ALL DESIGN		Job Ref.	
S	Section				Sheet no./rev	28
	Calc. by VIC	Date 8/14/2023	Chk'd by	Date	App'd by	Date
Overturning stability - take mom	ents about the	toe				
Overturning moment			h soil + Fsurch h	× dh,surch = 260.	3 kNm/m	
Restoring moment		_			$v_{v,f} \times b_{v,surch} = 112$	20 0 kNm/m
Factor of safety		$FoS_M = M_R / M$				
Allowable factor of safety		$FoS_{M allow} = 1.0$				
	PASS -	Design FOS fo		exceeds min	allowable FOS	for overtur
Sliding stability - ignore any pass		-	-			
Total horizontal force	sive pressure i	$T = F_{\text{soil } h} + F_{\text{suil } h}$		/M/m		
Total vertical force				h_v,f = 440.5 kN/	(m	
Sliding force		$F_f = T \times \cos(\varepsilon)$				
Sliding resistance) × tan($\delta_{bg.d}$) = 2	246 7 kN/m	
Factor of safety		$F_R = (T \times SIII(\epsilon))$ FoSs = F _R / F _f		$\gamma \wedge \operatorname{ran}(\operatorname{Obg.d}) = \mathbf{Z}$		
Allowable factor of safety		FOSs = FR / Ff FoSs_allow = 1.0				
Anomabic racior or salety				iding exceeds	min allowable	FOS for sli
Check overturning and sliding be	otween course		-	•		
		<u>5 5 unu /</u>				
Wall geometry			000			
Horizontal distance to centre of gra		$x_{g7} = W_7 / 2 = 2$				
Vertical distance to centre of gravity	/ gabion /	$y_{g7} = h_7 / 2 = 5$		line		
Weight of gabion 7	vitu nahian 0	$W_{g7} = \gamma_d \times W_7 >$		/m		
Horizontal distance to centre of gra		$x_{g8} = w_8 / 2 + s$				
Vertical distance to centre of gravity	/ gabion 8	$y_{g8} = h_8 / 2 + h$		100		
Weight of gabion 8	vity appian 0	$W_{g8} = \gamma_d \times W_8 >$				
Horizontal distance to centre of gra	vity gabion 9	$x_{g9} = w_9 / 2 + s$				
Vortional distance to contro at area in	appion 0	V h. / O h	h <u>^</u>			
Vertical distance to centre of gravity	/ gabion 9	$y_{g9} = h_9 / 2 + h$				
Weight of gabion 9	-	$W_{g9} = \gamma_d \times W_9 >$	< h ₉ = 36.0 kN	/m		
Weight of gabion 9 Horizontal distance to centre of gra	vity gabion 10	$W_{g9} = \gamma_d \times W_9 >$ $x_{g10} = W_{10} / 2 +$	< h ₉ = 36.0 kN s ₈ + s ₉ + s ₁₀ :	/m = 500 mm		
Weight of gabion 9 Horizontal distance to centre of gra Vertical distance to centre of gravity	vity gabion 10	$W_{g9} = \gamma_d \times W_9 >$ $x_{g10} = W_{10} / 2 +$ $y_{g10} = h_{10} / 2 +$	 h9 = 36.0 kN S8 + S9 + S10 = h7 + h8 + h9 =	/m = 500 mm : 3500 mm		
Weight of gabion 9 Horizontal distance to centre of gra Vertical distance to centre of gravity Weight of gabion 10	vity gabion 10	$W_{g9} = \gamma_d \times W_9 >$ $x_{g10} = W_{10} / 2 +$ $y_{g10} = h_{10} / 2 +$ $W_{g10} = \gamma_d \times W_{10}$	$h_9 = 36.0 \text{ kN}$ $s_8 + s_9 + s_{10} + s_{1$	/m = 500 mm : 3500 mm kN/m		
Weight of gabion 9 Horizontal distance to centre of gra Vertical distance to centre of gravity Weight of gabion 10 Weight of entire gabion	vity gabion 10 y gabion 10	$W_{g9} = \gamma_d \times W_9 >$ $x_{g10} = W_{10} / 2 +$ $y_{g10} = h_{10} / 2 +$ $W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_g$	$h_9 = 36.0 \text{ kN}$ $s_8 + s_9 + s_{10} =$ $h_7 + h_8 + h_9 =$ $s_0 \times h_{10} = 18.0$ $s_8 + W_{g9} + W_{g9}$	/m = 500 mm : 3500 mm kN/m 10 = 180.0 kN/m		/ W/ 1500
Weight of gabion 9 Horizontal distance to centre of gravity Vertical distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity e	vity gabion 10 y gabion 10 entire gabion	$W_{g9} = \gamma_d \times W_9 > x_{g10} = W_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_{g10}$ $x_g = ((W_{g7} \times x_{g10}) + W_{g10} + W_{g10})$		/m = 500 mm : 3500 mm kN/m 10 = 180.0 kN/m 1) + (W _{g9} × x _{g9}) ·	+ (W _{g10} × x _{g10})) /	-
Weight of gabion 9 Horizontal distance to centre of gravity Vertical distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en	vity gabion 10 y gabion 10 entire gabion ntire gabion	$W_{g9} = \gamma_d \times W_9 > x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_{g10} = \gamma_d \times W_{10}$ $W_{g} = W_{g7} + W_{g}$ $x_{g} = ((W_{g7} \times x_{g}) + W_{g7} \times y_{g})$		/m = 500 mm : 3500 mm kN/m 10 = 180.0 kN/m s) + (W _{g9} × x _{g9}) - s) + (W _{g9} × y _{g9}) -		-
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz	vity gabion 10 y gabion 10 entire gabion ntire gabion dist	$W_{g9} = \gamma_d \times W_9 > x_{g10} = W_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_g$ $x_g = ((W_{g7} \times x_g) + W_{g7} + W$		/m = 500 mm : 3500 mm kN/m 10 = 180.0 kN/m 1) + (W _{g9} × X _{g9}) - 1) + (W _{g9} × Y _{g9}) - = 1500 mm	+ (W _{g10} × x _{g10})) / + (W _{g10} × y _{g10})) /	W _g = 1500
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to wa	vity gabion 10 y gabion 10 entire gabion ntire gabion dist	$W_{g9} = \gamma_d \times W_9 > x_{g10} = W_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_g$ $x_g = ((W_{g7} \times x_g) + W_{g7} + W$		/m = 500 mm : 3500 mm kN/m 10 = 180.0 kN/m 1) + (W _{g9} × X _{g9}) - 1) + (W _{g9} × Y _{g9}) - = 1500 mm	+ (W _{g10} × x _{g10})) /	W _g = 1500
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to war Design dimensions	vity gabion 10 y gabion 10 entire gabion ntire gabion dist Il inclination	$W_{g9} = \gamma_d \times W_9 > x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_g$ $x_g = ((W_{g7} \times x_g) + W_{g7} + W$	$x h_9 = 36.0 \text{ kN}$ $x_8 + y_9 + x_{10} = x_{10}$ $h_7 + h_8 + h_9 = x_{10}$ $h_7 + h_8 + h_9 = x_{10}$ $h_7 + h_8 + h_9 = x_{10}$ $h_9 + W_{9} + W_{9}$ $h_9 + W_{9} + W_{9}$ $h_7 + (W_{98} \times y_{98}$ $h_7 + (W_{98} \times y_{98}$ $h_7 + y_9 \times \sin(\epsilon)$ $h_7 + y_9 \times \sin(\epsilon)$ $h_7 + h_1 + h_1$	/m = 500 mm : 3500 mm kN/m $x_{10} = 180.0 kN/mx_{3} + (W_{g9} \times x_{g9}) + (W_{g9} \times y_{g9}) + (X_{g9} \times y_{g9}) + (X$	+ (W _{g10} × x _{g10})) / + (W _{g10} × y _{g10})) / _{'g10} + w ₁₀ /2) × sir	$W_{g} = 1500$ $m(\epsilon)) = 0 mm$
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to wa	vity gabion 10 y gabion 10 entire gabion ntire gabion dist Il inclination	$W_{g9} = \gamma_d \times W_9 > x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_g$ $x_g = ((W_{g7} \times x_g) + W_{g7} \times y_g)$ $X_g = x_g \times \cos(\alpha + H_f) = y_{g10} + h_{10} / \alpha$ $\alpha = 90 \text{deg - At}$		/m = 500 mm : 3500 mm kN/m $x_{10} = 180.0 kN/mx_{3} + (W_{g9} \times x_{g9}) + (W_{g9} \times y_{g9}) + (X_{g9} \times y_{g9}) + (X$	+ (W _{g10} × x _{g10})) / + (W _{g10} × y _{g10})) /	$W_{g} = 1500$ $m(\epsilon)) = 0 mm$
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to war Design dimensions	vity gabion 10 y gabion 10 entire gabion ntire gabion dist Il inclination	$W_{g9} = \gamma_d \times W_9 > x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_g$ $x_g = ((W_{g7} \times x_g) + W_{g7} + W$		/m = 500 mm : 3500 mm kN/m $x_{10} = 180.0 kN/mx_{3} + (W_{g9} \times x_{g9}) + (W_{g9} \times y_{g9}) + (X_{g9} \times y_{g9}) + (X$	+ (W _{g10} × x _{g10})) / + (W _{g10} × y _{g10})) / _{'g10} + w ₁₀ /2) × sir	$W_{g} = 1500$ $m(\epsilon)) = 0 mm$
Weight of gabion 9 Horizontal distance to centre of gravity Vertical distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to was Design dimensions Effective angle of rear plane of wall	vity gabion 10 y gabion 10 entire gabion ntire gabion dist Il inclination	$W_{g9} = \gamma_d \times W_9 >$ $x_{g10} = W_{10} / 2 +$ $y_{g10} = h_{10} / 2 +$ $W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_{g}$ $x_g = ((W_{g7} \times x_g) + W_{g10} +$	$x h_9 = 36.0 \text{ kN}$ $x_8 + y_9 + x_{10} = x_{10}$ $h_7 + h_8 + h_9 = x_{10}$ $h_7 + h_8 + h_9 = x_{10}$ $h_7 + h_8 + h_9 = x_{10}$ $h_8 + W_{g9} + W_{g7}$ $h_9 + W_{g9} + W_{g7}$ $h_7 + (W_{g8} \times y_{g8}$ $h_8 + (W_{g10} + W_{g10})$ $h_8 + (W_{g10} + h_{10})$	/m = 500 mm : 3500 mm kN/m $x_{10} = 180.0 kN/mx_{3} + (W_{g9} \times x_{g9}) + (W_{g9} \times y_{g9}) + (X_{g9} \times y_{g9}) + (X$	+ (W _{g10} × x _{g10})) / + (W _{g10} × y _{g10})) / : _{g10} + w ₁₀ /2) × sir _{g10} + h ₁₀ / 2)) + a	$W_{g} = 1500$ $m(\epsilon)) = 0 mm$
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to wan Design dimensions Effective angle of rear plane of wall Effective face angle	vity gabion 10 y gabion 10 entire gabion ntire gabion dist Il inclination	$W_{g9} = \gamma_d \times W_9 > x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g7} + W_g$ $x_g = ((W_{g7} \times x_g) + W_{g7} + W$		/m = 500 mm x 3500 mm kN/m $x_{10} = 180.0 kN/mx_{10} = 180.0 kN/mx_{10} = 180.0 kN/mx_{10} = 180.0 kN/mx_{10} + (W_{g9} \times x_{g9}) - x_{g9}) - x_{g9}= 1500 mmx_{2} \times \cos(\varepsilon) - (x_{10} + (w_{10} / 2))) / (y_{10} + (w_{10} / 2))) / (y_{10} + (w_{10} / 2))) / (y_{10} + (w_{10} / 2))) - H_{f} = 4000$	+ (W _{g10} × x _{g10})) / + (W _{g10} × y _{g10})) / : _{g10} + w ₁₀ /2) × sir _{g10} + h ₁₀ / 2)) + a	$W_g = 1500$ $m(\varepsilon)) = 0 mm$ c = 53.1 deg
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to wan Design dimensions Effective angle of rear plane of wall Effective face angle Effective height of wall	vity gabion 10 y gabion 10 entire gabion tire gabion dist Il inclination	$W_{g9} = \gamma_d \times w_9 > x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + y_{g10} = \gamma_d \times w_{10}$ $W_{g10} = \gamma_d \times w_{10}$ $W_{g} = W_{g7} + W_{g}$ $x_{g} = ((W_{g7} \times x_{g}) + y_{g10} + (W_{g7} \times y_{g10}) + y_{g10} + y_{g10$		/m = 500 mm : 3500 mm kN/m $x_{10} = 180.0 kN/mx_{10} = 180.0 kN/mx_{10} = 180.0 kN/mx_{10} + (W_{g9} \times x_{g9}) + (W_{g9} \times y_{g9}) + (W_{g9} \times y_{$	+ (W _{g10} × x _{g10})) / + (W _{g10} × y _{g10})) / : _{g10} + w ₁₀ /2) × sir _{g10} + h ₁₀ / 2)) + ε 0 mm	$W_g = 1500$ $h(\epsilon)) = 0 mm$ $\epsilon = 53.1 deg$ 000mm
Weight of gabion 9 Horizontal distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en Vert distance to centre of gravity en Correcting for wall inclination horiz Vertical change in height due to wan Design dimensions Effective angle of rear plane of wall Effective face angle Effective height of wall Height of wall from toe to front edge	vity gabion 10 y gabion 10 entire gabion tire gabion dist Il inclination	$W_{g9} = \gamma_d \times w_9 > x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + y_{g10} = \gamma_d \times w_{10}$ $W_{g10} = \gamma_d \times w_{10}$ $W_{g} = W_{g7} + W_{g}$ $x_{g} = ((W_{g7} \times x_{g}) + y_{g10} + (W_{g7} \times y_{g10}) + y_{g10} + y_{g10$		/m = 500 mm kN/m = 180.0 kN/m = 180.0 kN/m = 180.0 kN/m = 180.0 kN/m = 1500 mm = 1500	+ $(W_{g10} \times x_{g10})) /$ + $(W_{g10} \times y_{g10})) /$ $G_{g10} + W_{10}/2) \times sin$ $G_{g10} + h_{10} / 2)) + a$ D mm $G_{2}(2)) \times sin(able) = 4$	$W_g = 1500$ $h(\epsilon)) = 0 mm$ $\epsilon = 53.1 deg$ 000mm

	Project				Job Ref.	
	Section	GABION W	ALL DESIGN		Shoot no /r	
S manager	Section				Sheet no./rev.	29
C	Calc. by	Date	Chk'd by	Date	App'd by	Date
	VIC	8/14/2023				
Horizontal forces			(00	a) 70 7		
Retained soil		-	-	$\alpha + \delta_{r.d}$ = 70.7		
Surcharge		$F_{surch_h} = p_{o,Q} \times$	$\langle \gamma_{Q} \times K_{a} \times H \times H \rangle$	cos(90 - α + δ _r	_{.d}) = 24.2 kN/m	
Vertical forces						
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	× Wg = 180.0 k	kN/m		
Retained soil		$F_{soil_v,f} = \gamma_{G,f} \times I$	$P_{a,soil} imes sin(90 \cdot$	- α + δ _{r.d}) = 101	.7 kN/m	
Surcharge		$F_{\text{surch}_v,f} = p_{o,Q}$	$\times \ \gamma_{Q,f} \times K_a \times H$	$\times \sin(90 - \alpha + \delta)$	d) = 0.0 kN/m	
Overturning stability - take mo	ments about the	toe				
Overturning moment			_{h,soil} + F _{surch_h} ×	< d _{h,surch} = 142.6	i kNm/m	
Restoring moment		$M_R = F_{gabion v.f}$	× Xg + F _{soil v,f} >	< b _{v,soil} + F _{surch v}	$b_{v,surch} = 575$.2 kNm/m
Factor of safety		$FoS_M = M_R / M$	0 _ /			
Allowable factor of safety		FoSM_allow = 1.0	000			
	PASS -	Design FOS fo	r overturning	exceeds min a	allowable FOS a	for overtur
Sliding stability - ignore any p	assive pressure i	n front of the st	ructure			
Total horizontal force		$T = F_{soil h} + F_{su}$		l/m		
Total vertical force				n_v,f = 281.7 kN/i	m	
Sliding force		$F_f = T \times cos(\epsilon)$				
Sliding resistance				× tan($\delta_{bg.d}$) = 1	57.8 kN/m	
Factor of safety		FoSs = Fr / Ff				
Allowable factor of safety		$FoS_{s allow} = 1.0$				
				iding exceeds	min allowable	FOS for sli
Check overturning and sliding	l between course	s 7 and 8				
Wall geometry						
Horizontal distance to centre of	gravity gabion 8	x _{g8} = w ₈ / 2 = 1	500 mm			
		x _{g8} = w ₈ / 2 = 1 y _{g8} = h ₈ / 2 = 5				
Horizontal distance to centre of		5	00 mm	ím		
Horizontal distance to centre of Vertical distance to centre of gra	avity gabion 8	$y_{g8} = h_8 / 2 = 5$	00 mm < h8 = 54.0 kN/	′m		
Horizontal distance to centre of Vertical distance to centre of gra Weight of gabion 8	avity gabion 8 gravity gabion 9	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 > 0$	00 mm < h ₈ = 54.0 kN/ ₀ ₉ = 1000 mm	'n		
Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of a	avity gabion 8 gravity gabion 9	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times W_8 \times x_{g9} = W_9 / 2 + s$	00 mm < h ₈ = 54.0 kN/ ₅ ₉ = 1000 mm ₈ = 1500 mm			
Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra	avity gabion 8 gravity gabion 9 avity gabion 9	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 >$ $x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$	00 mm < h ₈ = 54.0 kN/ 6 ₉ = 1000 mm 8 = 1500 mm < h ₉ = 36.0 kN/	′m		
Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 9	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times w_9 \times w_9$	00 mm < h ₈ = 54.0 kN/ s ₉ = 1000 mm s ₈ = 1500 mm < h ₉ = 36.0 kN/ · s ₉ + s ₁₀ = 500	/m) mm		
Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 9 Horizontal distance to centre of g	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + h$	00 mm < h ₈ = 54.0 kN/ s ₉ = 1000 mm 8 = 1500 mm < h ₉ = 36.0 kN/ • S ₉ + S ₁₀ = 500 h ₈ + h ₉ = 2500	ím) mm) mm		
Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 9 Horizontal distance to centre of gra	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + y$	00 mm (h ₈ = 54.0 kN/ (h ₉ = 1000 mm (h ₉ = 36.0 kN/ (h ₉ = 36.0 kN/ (h ₉ + h ₉ = 2500 (h ₈ + h ₉ = 18.0 k	′m) mm) mm <n m<="" td=""><td></td><td></td></n>		
Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 9 Horizontal distance to centre of gra Vertical distance to centre of gra	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10 avity gabion 10	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + s$ $y_{g10} = h_{10} / 2 + s$ $W_{g10} = \gamma_d \times w_{10} \times w_{10} \times w_{10}$ $W_{g10} = \gamma_d \times w_{10} \times w_{10}$	00 mm $h_8 = 54.0 \text{ kN/}$ $h_9 = 1000 \text{ mm}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 36.0 \text{ kN/}$ $h_9 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 18.0 \text{ kg}$ $h_9 + W_{g10} = 108$	/m) mm) mm :N/m 3.0 kN/m) / Wg = 1167 m	m
Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 9 Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 10 Weight of entire gabion	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10 avity gabion 10 ty entire gabion	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + h$ $W_{g10} = h_{10} / 2 + k$ $W_{g10} = \gamma_d \times w_{10}$ $W_g = W_{g8} + w_{g10}$ $x_g = ((W_{g8} \times x_{g10}))$	00 mm $h_8 = 54.0 \text{ kN/}$ $h_9 = 1000 \text{ mm}$ $h_8 = 1500 \text{ mm}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 36.0 \text{ kN/}$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 18.0 \text{ km}$ $h_9 + W_{g10} = 108$ $h_8 + (W_{g9} \times x_{g9})$	′m) mm) mm (N/m 3.0 kN/m) + (W _{g10} × x _{g10}))) / Wg = 1167 m)) / Wg = 1167 m	
Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 8 Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 9 Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10 avity gabion 10 ty entire gabion	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + h$ $y_{g10} = h_{10} / 2 + y_{g10} = h_{10} / 2 + h$ $W_{g10} = \gamma_d \times w_{10}$ $W_g = W_{g8} + W_g$ $x_g = ((W_{g8} \times x_{g9}) + y_{g10}) = ((W_{g8} \times x_{g9}) + y_{g10})$	00 mm $h_8 = 54.0 \text{ kN/}$ $h_9 = 1000 \text{ mm}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 108$ $h_9 + W_{g10} = 108$ $h_8 + (W_{g9} \times X_{g9})$ $h_8 + (W_{g9} \times Y_{g9})$	/m) mm) mm KN/m 3.0 kN/m) + (W _{g10} × X _{g10})) + (W _{g10} × Y _{g10})		
Horizontal distance to centre of a Vertical distance to centre of gra Weight of gabion 8 Horizontal distance to centre of gra Weight of gabion 9 Horizontal distance to centre of gra Vertical distance to centre of gra Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravit	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10 avity gabion 10 ty entire gabion v entire gabion riz dist	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + y_{g10} = h_{10} / 2 + y_{g10} = \gamma_d \times w_{10}$ $W_g = W_{g8} + W_{g}$ $x_g = ((W_{g8} \times x_{g4}) + y_{g10} = ((W_{g8} \times x_{g4}) + y_{g10} + y_{g10} + y_{g10}) + y_{g10} + y_{g10}$	00 mm $h_8 = 54.0 \text{ kN/}$ $h_9 = 1000 \text{ mm}$ $h_8 = 1500 \text{ mm}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 36.0 \text{ kN/}$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 108$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_9 + h_9 = 2500$ $h_8 + h_9 = 2500$	/m) mm) mm xN/m 3.0 kN/m) + (W _{g10} × x _{g10})) + (W _{g10} × y _{g10}) = 1167 mm		m
Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 8 Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 9 Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity Correcting for wall inclination ho	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10 avity gabion 10 ty entire gabion v entire gabion riz dist	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + y_{g10} = h_{10} / 2 + y_{g10} = h_{10} / 2 + y_{g10} = \gamma_d \times w_{10}$ $W_g = W_{g8} + W_{g}$ $x_g = ((W_{g8} \times x_{g4}) + y_{g10} = ((W_{g8} \times x_{g4}) + y_{g10} + y_{g10} + y_{g10}) + y_{g10} + y_{g10}$	00 mm $h_8 = 54.0 \text{ kN/}$ $h_9 = 1000 \text{ mm}$ $h_8 = 1500 \text{ mm}$ $h_9 = 36.0 \text{ kN/}$ $h_9 = 36.0 \text{ kN/}$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 108$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_8 + h_9 = 2500$ $h_9 + h_9 = 2500$ $h_8 + h_9 = 2500$	/m) mm) mm xN/m 3.0 kN/m) + (W _{g10} × x _{g10})) + (W _{g10} × y _{g10}) = 1167 mm) / W _g = 1167 m	m
Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 8 Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 9 Horizontal distance to centre of a Vertical distance to centre of a Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity Vert distance to centre of gravity Correcting for wall inclination ho Vertical change in height due to	avity gabion 8 gravity gabion 9 avity gabion 9 gravity gabion 10 avity gabion 10 ty entire gabion riz dist wall inclination	$y_{g8} = h_8 / 2 = 5$ $W_{g8} = \gamma_d \times w_8 \times x_{g9} = w_9 / 2 + s$ $y_{g9} = h_9 / 2 + h$ $W_{g9} = \gamma_d \times w_9 \times x_{g10} = w_{10} / 2 + h$ $W_{g10} = h_{10} / 2 + k$ $W_{g10} = \gamma_d \times w_{10}$ $W_g = W_{g8} + W_{g10}$ $x_g = ((W_{g8} \times y_{g10} \times y_$	00 mm $h_8 = 54.0 \text{ kN/}$ $h_9 = 1000 \text{ mm}$ $h_8 = 1500 \text{ mm}$ $h_9 = 36.0 \text{ kN/}$ $h_8 + h_9 = 2500$ $h_8 + h_9 + h_9 = 2500$ $h_8 + h_9 + h_9 = 2500$ $h_8 + h_9 + h_9 =$	/m) mm) mm (N/m 3.0 kN/m) + (W _{g10} × x _{g10})) + (W _{g10} × y _{g10}) = 1167 mm /2) × cos(ε) - (x _g) / W _g = 1167 m	m ι(ε)) = 0 mm

	Project	GABION W	ALL DESIGN		Job Ref.	
S	Section				Sheet no./rev	30
C	Calc. by	Date	Chk'd by	Date	App'd by	Date
	VIC	8/14/2023				
Effective beight of wall			(2) + (wa v ain	(c)) _ H, _ 2000	mm	I
Effective height of wall	of top appior			(ϵ)) - H _f = 3000		000mm
Height of wall from toe to front edge				$-(X_{g10} - (W_{10} / 2))$		
Active pressure using Coulomb theo	ry		, , , , ,	$\sin(\alpha - \delta_{r.d}) \times (1)$	+ $\gamma(\sin(\phi_{r,d} + \phi))$	or.d) × SIN(φ'r
		β) / (sin(α - $\delta_{r.d}$				
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$	a × γs.d × H² = €	94.1 KIN/M		
Horizontal forces						
Retained soil		$F_{\text{soil_h}} = \gamma_{\text{G}} \times P_{\text{a}}$	$_{\rm soil} imes \cos(90 - c)$	α + δr.d) = 39.4 Ι	kN/m	
Surcharge		$F_{surch_h} = p_{o,Q} \times$	$\gamma_Q \times K_a \times H \times e$	cos(90 - α + δr.d) = 18.0 kN/m	
Vertical forces						
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	× Wg = 108.0 k	N/m		
Retained soil			-	α + δ _{r.d}) = 50.5	kN/m	
Surcharge			-	< sin(90 - α + δ _r		
Overturning stability - take momen	nts about the					
Overturning moment				d _{h,surch} = 66.4 k	Nm/m	
Restoring moment				b _v ,soil + F _{surch_v,f}		9 kNm/m
Factor of safety		$FoS_{\rm M} = M_{\rm R} / M_{\rm H}$		UV,SOII T I SUICH_V,	\wedge DV,surch = 243	••• KIN(1)/11
Allowable factor of safety		$FOS_{M} = IVI_{R} / IVI_{R}$ $FOS_{M_{allow}} = 1.0$				
Anomabic racior or sarcly	PASS -	Design FOS for		exceeds min a	llowable FOS	for overtur
Sliding stability - ignore any passi	ve pressure i	n front of the st	ructure			
Total horizontal force		$T = F_{soil_h} + F_{su}$	rch_h = 57.4 kN/	/m		
Total vertical force		$N = F_{gabion_v,f} +$	F _{soil_v,f} + F _{surch_}	_ _{v,f} = 158.5 kN/n	n	
Sliding force		$F_f = T \times cos(\epsilon)$	- N × sin(ε) = 5	7.4 kN/m		
Sliding resistance		$F_R = (T \times sin(\epsilon))$	+ N × cos(ε))	× tan(δ₅ _{bg.d}) = 88	8 .8 kN/m	
Factor of safety		$FoS_S = F_R / F_f$	= 1.546			
Allowable factor of safety		FoSs_allow = 1.0	00			
		PASS - Desig	n FOS for slid	ding exceeds n	nin allowable	FOS for sli
Check overturning and sliding bet	ween courses	s 8 and 9				
Wall geometry						
	ity gabion 9	$x_{g9} = w_9 / 2 = 1$	000 mm			
Horizontal distance to centre of grave	, 0					
Horizontal distance to centre of gravity Vertical distance to centre of gravity		y _g 9 = h ₉ / 2 = 5	00 mm			
-		$y_{g9} = h_9 / 2 = 50$ $W_{g9} = \gamma_d \times w_9 \times w_9$		n		
Vertical distance to centre of gravity	gabion 9		h ₉ = 36.0 kN/r	n		
Vertical distance to centre of gravity Weight of gabion 9	gabion 9 ity gabion 10	$W_{g9} = \gamma_d \times W_9 \times$	h ₉ = 36.0 kN/r s ₁₀ = 500 mm	n		
Vertical distance to centre of gravity Weight of gabion 9 Horizontal distance to centre of gravi	gabion 9 ity gabion 10	$W_{g9} = \gamma_d \times W_9 \times X_{g10} = W_{10} / 2 + $	h ₉ = 36.0 kN/r s ₁₀ = 500 mm h ₉ = 1500 mm			
Vertical distance to centre of gravity Weight of gabion 9 Horizontal distance to centre of gravity Vertical distance to centre of gravity	gabion 9 ity gabion 10	$W_{g9} = \gamma_d \times W_9 \times X_{g10} = W_{10} / 2 + y_{g10} = h_{10} / 2 +$	$h_9 = 36.0 \text{ kN/r}$ $s_{10} = 500 \text{ mm}$ $h_9 = 1500 \text{ mm}$ $\times h_{10} = 18.0 \text{ kl}$	N/m		
Vertical distance to centre of gravity Weight of gabion 9 Horizontal distance to centre of gravity Vertical distance to centre of gravity Weight of gabion 10	gabion 9 ity gabion 10 gabion 10	$W_{g9} = \gamma_{d} \times W_{9} \times X_{g10} = W_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_{d} \times W_{10}$ $W_{g} = W_{g9} + W_{g}$	$h_9 = 36.0 \text{ kN/r}$ $s_{10} = 500 \text{ mm}$ $h_9 = 1500 \text{ mm}$ $\times h_{10} = 18.0 \text{ kI}$ $_{10} = 54.0 \text{ kN/m}$	N/m	ım	
Vertical distance to centre of gravity Weight of gabion 9 Horizontal distance to centre of gravity Vertical distance to centre of gravity Weight of gabion 10 Weight of entire gabion	gabion 9 ity gabion 10 gabion 10 itire gabion	$W_{g9} = \gamma_d \times W_9 \times x_{g10} = W_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g9} + W_{g}$ $x_g = ((W_{g9} \times x_{g9}) + W_{g9} \times x_{g9})$	$h_{9} = 36.0 \text{ kN/r}$ $s_{10} = 500 \text{ mm}$ $h_{9} = 1500 \text{ mm}$ $\times h_{10} = 18.0 \text{ kl}$ $h_{10} = 54.0 \text{ kN/m}$ $s_{10} + (W_{g10} \times x_{g10})$	N/m		
Vertical distance to centre of gravity Weight of gabion 9 Horizontal distance to centre of gravity Vertical distance to centre of gravity Weight of gabion 10 Weight of entire gabion Horiz distance to centre of gravity en	gabion 9 ity gabion 10 gabion 10 itire gabion ire gabion	$W_{g9} = \gamma_d \times W_9 \times x_{g10} = W_{10} / 2 + y_{g10} = h_{10} / 2 + W_{g10} = \gamma_d \times W_{10}$ $W_g = W_{g9} + W_{g}$ $x_g = ((W_{g9} \times x_{g9}) + W_{g9} \times x_{g9})$	$h_9 = 36.0 \text{ kN/r}$ $s_{10} = 500 \text{ mm}$ $h_9 = 1500 \text{ mm}$ $\times h_{10} = 18.0 \text{ kI}$ $h_{10} = 54.0 \text{ kN/m}$ $h_{10} = (W_{g10} \times x_{g10})$ $h_{10} = (W_{g10} \times y_{g10})$	N/m o)) / Wg = 833 m o)) / Wg = 833 m		

	Project	GABION W	ALL DESIGN	J	Job Ref.			
S	ection				Sheet no./rev	•		
C		-	1			31		
C C	alc. by VIC	Date 8/14/2023	Chk'd by	Date	App'd by	Date		
	vio	0/14/2020						
Design dimensions								
Effective angle of rear plane of wall		-		+ (w ₁₀ / 2))) / (y	/ _{g10} + h ₁₀ / 2)) + ε	= 63.4 deg		
Effective face angle		θ = 90deg - ϵ =	-					
Effective height of wall		$H = (y_{g10} + h_{10})$						
Height of wall from toe to front edge of	top gabion				(2) × sin(ε)) = 2			
Active pressure using Coulomb theory		$K_a = sin(\alpha + \phi')$	$(d)^2 / (\sin(\alpha)^2)$	× sin(α - $\delta_{r.d}$) ×	(1 + √(sin(φ'r.d + δ	$\delta_{r.d}$) × sin($\phi'_{r.d}$		
		β) / (sin(α - δ _{r.d}	$) \times \sin(\alpha + \beta)$))) ²) = 0.630				
Active thrust due to soil		$P_{a,soil} = 0.5 \times K$	$a \times \gamma_{s.d} \times H^2 =$	23.9 kN/m				
Horizontal forces								
Retained soil		$F_{soil_h} = \gamma_G \times P_a$	$_{\rm a,soil} imes \cos(90 \cdot$	- α + δ _{r.d}) = 17.0) kN/m			
Surcharge		$F_{surch_h} = p_{o,Q} \times$	$\gamma_{Q} \times K_{a} \times H >$	< cos(90 - α + δ	6 _{r.d}) = 11.6 kN/m			
Vertical forces								
Gabion weight		$F_{gabion_v,f} = \gamma_{G,f}$	× Wg = 54.0 k	κN/m				
Retained soil			-	- α + δ _{r.d}) = 16	.9 kN/m			
Surcharge		$F_{\text{surch_v,f}} = p_{0,Q} \times \gamma_{Q,f} \times K_a \times H \times \sin(90 - \alpha + \delta_{r.d}) = 0.0 \text{ kN/m}$						
Overturning stability - take moments	s about the	toe						
Overturning moment		$M_o = F_{soil_h} \times d$	h,soil + F _{surch_h}	\times d _{h,surch} = 22.9	kNm/m			
Restoring moment					$_v,f \times b_{v,surch} = 73.2$	2 kNm/m		
Factor of safety		$FoS_M = M_R / M$	-					
Allowable factor of safety		$FoS_{M_{allow}} = 1.0$	000					
	PASS -	Design FOS fo	r overturning	g exceeds min	allowable FOS	for overturr		
Sliding stability - ignore any passive	e pressure i	n front of the st	ructure					
Total horizontal force		$T = F_{soil_h} + F_{su}$						
Total vertical force		-		ch_v,f = 70.9 kN/r	m			
Sliding force		$F_f = T \times cos(\epsilon)$						
Sliding resistance				$) \times \tan(\delta_{\text{bg.d}}) = 3$	39.7 kN/m			
Factor of safety		$FoS_S = F_R / F_f$						
Allowable factor of safety		$FoSs_{allow} = 1.0$		liding over all	min allowable	EOS for all		
			yıı rus tor si	naing exceeds	s min allowable	rus tor siid		
Check overturning and sliding betw	een courses	s 9 and 10						
Wall geometry	aphier 10	×	500					
Horizontal distance to centre of gravity	-	$x_{g10} = w_{10} / 2 =$						
Vertical distance to centre of gravity ga		$y_{g10} = h_{10} / 2 =$		kNI/m				
Weight of gabion 10		$W_{g10} = \gamma_d \times W_{10}$		KIN/III				
Weight of entire gabion	a achier	$W_g = W_{g10} = 18$		0				
Horiz distance to centre of gravity entir	-	$\mathbf{x}_{g} = ((\mathbf{W}_{g10} \times \mathbf{x}_{g10} \times x$						
Vert distance to centre of gravity entire	-	$y_g = ((W_{g10} \times y_f))$						
Correcting for wall inclination horiz dist		$X_g = x_g \times \cos(\epsilon)$			x _{g10} + w ₁₀ /2) × sir	()) •		
Vertical change in height due to wall in	alipation		.,	(1) (2)	(1, 1, 1, 1, 1, 1, 1, 1, 2)			

	Project				Job Ref.		
S Presentario C	GABION WALL DESIGN						
	Section					Sheet no./rev.	
						32	
	Calc. by	Date	Chk'd by	Date	App'd by	Date	
	VIC	8/14/2023					

Design dimensions	
Effective angle of rear plane of wall	α = 90 deg + ε = 90.0 deg
Effective face angle	θ = 90deg - ε = 90.0 deg
Effective height of wall	$H = (y_{g10} + h_{10} / 2) + (w_{10} \times sin(\epsilon)) - H_f = 1000 \text{ mm}$
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g10} + h_{10} / 2) \times cos(\epsilon) - (x_{g10} - (w_{10} / 2)) \times sin(\epsilon)) = 1000 \text{mm}$
Active pressure using Coulomb theory	$K_{a} = sin(\alpha + \phi'_{r.d})^2 / (sin(\alpha)^2 \times sin(\alpha - \delta_{r.d}) \times (1 + \sqrt{(sin(\phi'_{r.d} + \delta_{r.d})} \times sin(\phi'_{r.d} - \delta_{r.d})) \times (1 + \sqrt{(sin(\phi'_{r.d} + \delta_{r.d})} \times sin(\phi'_{r.d} - \delta_{r.d})))$
	β) / (sin(α - $\delta_{r.d}$) × sin(α + β)))) ²) = 0.362
Active thrust due to soil	$P_{a,soil} = 0.5 \times K_a \times \gamma_{s.d} \times H^2 = \textbf{3.4 kN}/m$
Horizontal forces	
Retained soil	$F_{soil_h} = \gamma_G \times P_{a,soil} \times cos(90 - \alpha + \delta_{r.d}) = 3.3 \text{ kN/m}$
Surcharge	$F_{\text{surch}_h} = p_{o,Q} \times \gamma_Q \times K_a \times H \times cos(90 - \alpha + \delta_{r.d}) = \textbf{4.5 kN/m}$
Vertical forces	
Gabion weight	$F_{gabion_V,f} = \gamma_{G,f} \times W_g = 18.0 \text{ kN/m}$
Retained soil	$F_{soil_v,f} = \gamma_{G,f} \times P_{a,soil} \times sin(90 - \alpha + \delta_{r.d}) = 1.1 \text{ kN/m}$
Surcharge	$F_{surch_v,f} = p_{o,Q} \times \gamma_{Q,f} \times K_a \times H \times sin(90 - \alpha + \delta_{r.d}) = \textbf{0.0 kN/m}$
Overturning stability - take moments about the	toe
Overturning moment	$M_o = F_{soil_h} \times d_{h,soil} + F_{surch_h} \times d_{h,surch} = 3.3 \text{ kNm/m}$
Restoring moment	$M_{R} = F_{gabion_v,f} \times X_{g} + F_{soil_v,f} \times b_{v,soil} + F_{surch_v,f} \times b_{v,surch} = 10.1 \text{ kNm/m}$
Factor of safety	$FoS_{M} = M_{R} / M_{o} = 3.038$
Allowable factor of safety	FoS _{M_allow} = 1.000
PASS -	Design FOS for overturning exceeds min allowable FOS for overturning
Sliding stability - ignore any passive pressure i	in front of the structure
Total horizontal force	$T = F_{soil_h} + F_{surch_h} = 7.7 \text{ kN/m}$
Total vertical force	$N = F_{gabion_v,f} + F_{soil_v,f} + F_{surch_v,f} = 19.1 \text{ kN/m}$
Sliding force	$F_f = T \times cos(\epsilon) - N \times sin(\epsilon) = 7.7 \text{ kN/m}$
Sliding resistance	$F_R = (T \times sin(\varepsilon) + N \times cos(\varepsilon)) \times tan(\delta_{bg,d}) = 10.7 \text{ kN/m}$

	PASS - Design FOS for sliding exceeds min allowable FOS for sliding	
Allowable factor of safety	FoSs_allow = 1.000	
Factor of safety	$FoSs = F_R / F_f = 1.384$	
Sliding resistance	$F_{R} = (T \times sin(\epsilon) + N \times cos(\epsilon)) \times tan(\delta_{bg.d}) = 10.7 \text{ kN/m}$	