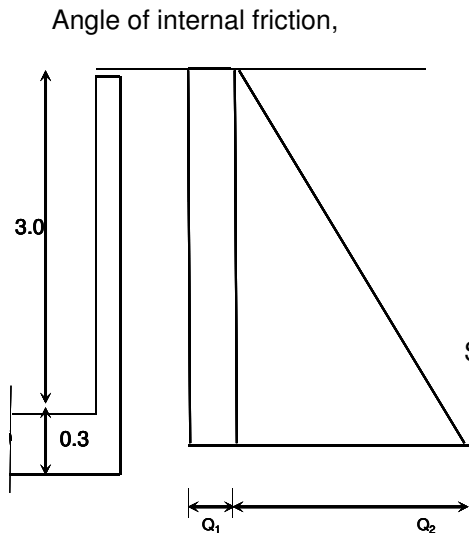


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RETAINING WALL DESIGN



Angle of internal friction, $\phi = 30$

Coefficient of active earth pressure,

$$K_a := \frac{1 - \sin(\phi)}{1 + \sin(\phi)} = 0.33$$

surcharge (q) = 2 kN/m²

Soil density (γ) = 18 kN/m³

Total Height of soil pressure acting = 3.15 m
(Bottom of raft - Raft thk/2)=3.3-0.15

Lateral pressure due to Surcharge $Q_1 = K_a q = 0.33 \times 2 = 0.66$ kN/m² per meter run

Lateral pressure due to soil $Q_2 = K_a \cdot \gamma \cdot h_1 = 0.33 \times 18 \times 3.15 = 18.71$ kN/m² per meter run

Lateral pressure at top $Q_1 = 0.66$ kN/m² per meter run

Lateral pressure at bottom $Q_1 + Q_2 = 19.37$ kN/m² per meter run

Moment due to soil $M_1 = K_a \gamma h_1^3 / 6 = 0.33 \times 18 \times 3.15^3 / 6 = 30.94$ kNm per meter run

Moment due to surcharge $M_2 = K_a q h_1^2 / 2 = 0.33 \times 2 \times 3.15^2 / 2 = 3.3$ kNm per meter run

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MAIN REINFORCEMENT (VERTICAL)

Design for Maximum moment

Characteristic strength of concrete	f_{cu}	=	30	N/mm ²
Characteristic strength of steel	f_y	=	460	N/mm ²
Factored bending moment	$1.4 \times M_1 = M_u$	=	47.90	kNm
Width of wall	b	=	1000	mm
Thickness of wall	D	=	200	mm
Clear cover	c	=	50	mm
Diameter of main reinforcement	d_m	=	20	mm
Diameter of secondary reinforcement	d_s	=	12	mm
Effective depth	d	=	$D - c - d_m - d_s / 2$	
		=	124	mm
	$K = M_u / (b \times d^2 \times f_{cu})$	=	0.104	
	$z = d \times [0.5 + \text{SQRT}(0.25 - K / 0.9)]$	=	107.49	mm
	$0.95 \times d$	=	117.8	mm
	Since $0.95 \times d$ is greater than z , value of z is	=	107.49	
Reinforcement required	$A_{st} = M / (0.95 \times f_y \times z)$	=	1020	mm ²
Min reinf. each face per table 3.25 BS 8110-1 = 0.2%		=	400	mm ²
	Main reinforcement		20 @ 200	mm c/c
	+ Extra reinforcement		0 @ 0	mm c/c
Area of reinforcement provided		=	1570	mm ²
			Hence OK.	
	Horizontal reinforcement		12 @ 200	mm c/c
Area of reinforcement provided		=	565	mm ²

Reinforcement Summary:

Provide vertical reinforcement T20 @ 200 mm c/c.
Provide horizontal reinforcement T12 @ 200 mm c/c.