

Sample of Excel Spreadsheet Analysis and Design of Cantilever Retaining Walls

Note:
Assume the Bearing Capacity of the Foundation, $q_{all} = 3000$ psf

AN20

Name:	PROJECT TITLE:	SHEET No:	
ID:	DESCRIPTION: Retaining Wall	DATE:	
	LOCATION:	DATE:	

DESIGN OF CANTILEVER RETAINING WALL PER ACI318-05

SECTION A-A & B-B

b) Geometry input

B =	7.00 m	22.97 ft
b ₁ =	1.50 m	4.92 ft
D _r =	2.50 m	8.20 ft
t ₁ =	1.50 m	4.92 ft
h _a =	11.10 m	36.42 ft
a =	0.00 m	0.00 ft
t ₁ =	1.00 m	3.28 ft
t ₂ =	0.50 m	1.64 ft
b ₂ =	4.50 m	14.76 ft
h =	12.60 m	41.34 ft
H =	12.60 m	41.34 ft

1) Design Inputs

a) Material

Concrete grade	$f_c = 35$ Mpa	5076.32 psi
Steel grade	$f_y = 420$ Mpa	60915.85 psi
Material factor	$\phi = 0.9$	
Concrete density	$\gamma_c = 24$ kN/m ³	152.88 lb/ft ³
Soil density	$\gamma_o = 18$ kN/m ³	114.66 lb/ft ³
Angle of repose for soil	$\theta = 30$ degree	30 degree
Coefficient of active earth pressure $k_a = \frac{1 - \sin(\theta)}{1 + \sin(\theta)}$	$k_a = 0.33$ radian	0.33 radian
Coefficient of passive earth pressure $k_p = \frac{1 - \sin(\theta)}{1 + \sin(\theta)}$	$k_p = 0.33$ radian	0.33 radian

Safe Bearing Capacity $f_{b,all} = 500$ kPa 10442.736 lb/ft²

Coeff of friction for Sliding $m = 0.5$ 0.5

c) Loading

Surcharge pressure $q = 12$ kN/m² 250.62521 lb/ft²

Design Summary

F.S against Overturning = 1.51 > 1.5 Safe !!

F.S against Sliding = 0.33 < 1.5 Not Safe!! Hence Provide shear Key

Max. bearing pressure = 372.63 kPa < 500 kPa Hence Safe

Wall Main reinforcement = 16 @ 25c/c

Heel Top Main reinforcement = 20 @ 75c/c

Toe bottom main reinforcement = 16 @ 50c/c

Phase - I

Page 1
Design Input

Page 2
Design Output
(External Stability)
REQUIRED

Page 3
Design Output
(Internal Stability)
NOT REQUIRED
IN THIS PROJECT

AN20

SECTION A-A & B-B

h = 12.60 m 41.34 ft
H = 12.60 m 41.34 ft

1) Design Inputs

a) Material

Concrete grade	$f_c = 35$ Mpa	5076.32 psi
Steel grade	$f_y = 420$ Mpa	60915.85 psi
Material factor	$\phi = 0.9$	
Concrete density	$\gamma_c = 24$ kN/m ³	152.88 lb/ft ³
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Safe Bearing Capacity $f_{b,all} = 500$ kPa 10442.736 lb/ft²

Coeff of friction for Sliding $m = 0.5$ 0.5

c) Loading

Surcharge pressure $q = 12$ kN/m² 250.62521 lb/ft²

Design Summary

F.S against Overturning = 2.81 > 1.5 Safe !!

F.S against Sliding = 1.33 < 1.5 Not Safe!! Hence Provide shear Key

Max. bearing pressure = 372.63 kPa < 500 kPa Hence Safe

Wall Main reinforcement = 16 @ 25c/c

Heel Top Main reinforcement = 20 @ 75c/c

Toe bottom main reinforcement = 16 @ 50c/c

2) Design Output

2.1) Stability Calculation

a) Check for Overturning

Item	Load (kN)	Dist. (m)	Moment (kNm)
W ₁	217.2	4.25	922.8
W ₂	252	3.5	882
W ₃	133.2	2.25	299.7
W ₄	66.6	1.833	122.1
W ₅	54	4.25	228.5
Total	1405 kN		5631.0 kNm

Calculation of Overturning Moment about "O"

Item	Load (kN)	Dist. (m)	Moment (kNm)
W ₁	217.2	4.25	922.8
W ₂	252	3.5	882
W ₃	133.2	2.25	299.7
W ₄	66.6	1.833	122.1
W ₅	54	4.25	228.5
Total	1405 kN		5631.0 kNm

Stability of Restoring Moment about "O"

Item	Load (kN)	Dist. (m)	Moment (kNm)
W ₁	217.2	4.25	922.8
W ₂	252	3.5	882
W ₃	133.2	2.25	299.7
W ₄	66.6	1.833	122.1
W ₅	54	4.25	228.5
Total	1405 kN		5631.0 kNm

Total Overturning Moment $M_o = 2310$ kNm

Total Restoring Moment $M_r = 5631$ kNm

Factor of Safety = $M_r/M_o = 5631 / 2310 = 2.44 > 1.5$ Safe !!

b) Check for Sliding

Total Horizontal force $H = 5267$ kN

Restoring force = $m \times W = 0.5 \times 1404.9 = 702.5$ kN

Factor Safety = $W/H = 1404.9 / 702.5 = 2.00 > 1.5$ Not Safe!!

Hence Provide shear Key

c) Check for Bearing Pressure

C/g of Load	$x = (M_o/M_r) \times B = 2.501$
eccentricity	$e = B/2 - x = 0.999$
Resultant	$P(A) + 6e(B) = 372.63$ kPa < 500 kPa
Resultant	$P(A)(1 - 6e/B) = 28.76$ kPa > 0

Hence Safe

2.2) Structural Design

Design