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20 GLYNNEATH ROAD
RESOLVEN, NEATH

AT

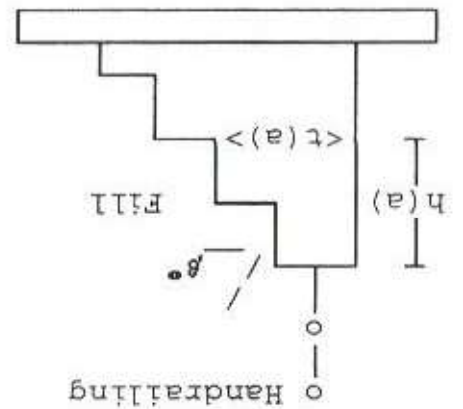
RETAINING WALL

FOR

Structural Calculations
Design Stage 2025

Masonry gravity wall

Designed in accordance with BS5628:Part 1: 1992.
 Location: Wall on grid line A/1-2



Soil details

Weight/unit volume of soil & wall $w_e = 18 \text{ kN/m}^3$
 Internal angle of friction $\phi = 30^\circ$
 Angle of backfill $\beta = 0^\circ$
 Active soil pressure is applicable.
 Sine angle of internal friction $sp = \sin(\text{RAD}(\phi)) = 0.5$
 Active pressure coefficient $ce = (1 - sp) / (1 + sp) = (1 - 0.5) / (1 + 0.5) = 0.3333$

Masonry details

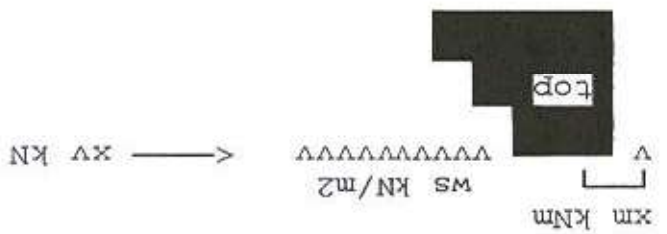
Mortar designation to Table 1 mortar=3
 Masonry type (1=clay 2=calc silicate 3=conc brick 4=block) typ(1)=4
 Concrete Blocks Dimensions

Height $hb = 215 \text{ mm}$
 Least horiz dimension $lhd = 100 \text{ mm}$
 ratio height/least horiz dim $rb = hb/lhd = 215/100 = 2.15$
 Compressive strength of blocks $po = 7.3 \text{ N/mm}^2$
 Characteristic flexural strength for bed failure and leaf greater than

Steps are numbered down from the top.
 $h(a)$ is height at step a (from top)
 $t(a)$ is thickness at step a

250mm thick - Table 3
Partial safety factor material
fb(a)=TABLE 3.71 for po=7.3, mortar=3
=0.1586 N/mm²
gamma_m=3.5

External loading



Applied moment at top of wall
Applied shear at top of wall
Weight/unit area of surcharge
Load factor external loads at top
Load factor surcharge
Load factor earth pressure
Load factor self weight
gamma_ma_e=1.4
gamma_ma_s=1.6
gamma_ma_f=0.9

Wall design

Number of steps proposed in wall steps=4

Step 1 Typical Analysis which is repeated for each step

Proposed height at step
Proposed thickness at step
Moment at height h
surcharge
Ultimate moment at height h
Section modulus at thickness t
h(1)=0.45 m
t(1)=0.325 m
me=ce*we*h(a)³/6=0.3333*18*0.45³/6
=0.09113 kNm
ms=ce*ws*h(a)³/2=0.3333*1.5*0.45³/2
=0.05063 kNm
mu=me*gamma_ma_e+ms*gamma_ma_s+(xm+xv*h(a))
*gamma_mmax
=0.09113*1.4+0.05063*1.6+(0+0
*0.45)*1.6
=0.2086
z=t(a)²/6=0.325²/6=0.0176 m³

Weight/unit area at depth h

$$gd = (ws + we \cdot h(a)) \cdot \gamma_{maf} / 1000$$

$$= (1.5 + 18 \cdot 0.45) \cdot 0.9 / 1000$$

$$= 0.00864 \text{ N/mm}^2$$

$$mr = (fb(1) / (\gamma_{mam} + gd)) \cdot 2 \cdot 1000$$

$$= (0.1586 / 3.5 + 0.00864) \cdot 0.0176 \cdot 1000$$

$$= 0.9497 \text{ kNm}$$

Applied moment less than moment of resistance (0.2086 <= 0.9497)

therefore section is satisfactory.

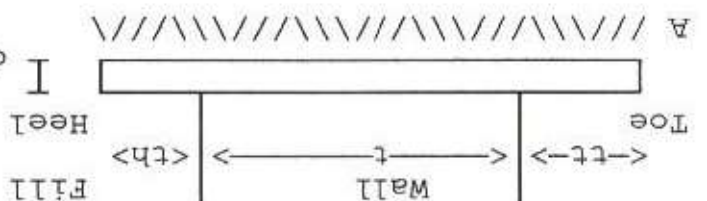
Step 1 width 0.325 m

height 0.45 m

Step height (m)	Step thickness (m)	Ultimate Moments (kNm)	Resistance Applied
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0.45	0.325	0.9497	0.2086
0.9	0.45	2.067	1.345
1.45	0.675	5.327	5.109
2.225	1.125	17.44	17.4

Stability and bearing check



Width of toe

Width of heel

Thickness of wall

Height of wall

Width of base

Depth of base

Overall depth

Weight of fill and wall

Eccentricity from A

$$ef = (t + (t + th) / 2) = 0.25 + (1.125 + 0.25) / 2$$

$$= 55.07 \text{ kN}$$

$$wf = we \cdot (t + th) \cdot h = 18 \cdot (1.125 + 0.25) \cdot 2.225$$

$$od = h + db = 2.225 + 0.3 = 2.525 \text{ m}$$

$$db = 0.30 \text{ m}$$

$$= 1.625$$

$$tb = t + tt + th = 1.125 + 0.25 + 0.25$$

$$h = 2.225 \text{ m}$$

$$t = 1.125 \text{ m}$$

$$th = 0.25 \text{ m}$$

$$tt = 0.25 \text{ m}$$

Weight of base

$$wb=tb*db*24=1.625*0.3*24$$

Earth horizontal force

$$sfe=ce*we*od^2/2=0.3333*18*2.525^2/2$$

Moment due to earth pressure

$$me=sfe*od/3=19.13*2.525/3$$

Surcharge horizontal force

$$sfs=ws*ce*od=1.5*0.3333*2.525$$

Moment due to surcharge

$$ms=sfs*od/2=1.263*2.525/2$$

Wall shear

Horizontal shear force

$$usf=(sfe*gammae)+(sfs*gammaas)$$

Shear stress at bottom of wall

$$uss=usf/(t(steps)*1000)$$

Weight at bottom of step 1

$$uwt=t(a)*we*h(a)*gammaf$$

Weight at bottom of step 2

$$uwt=uwt+(t(a)*we*h(a)*gammaf)$$

Weight at bottom of step 3

$$uwt=uwt+(t(a)*we*h(a)*gammaf)$$

Weight at bottom of step 4

$$uwt=uwt+(t(a)*we*h(a)*gammaf)$$

Weight per. unit area

$$ga=uwt/(t(steps)*1000)$$

Permissible shear stress

$$fv=0.15+0.6*ga=0.15+0.6*0.05808$$

Applied shear less than shear resistance (0.0256 <= 0.1848)
therefore section is satisfactory.

Overturning

Overturning moment about A

$$om = me + ms + (xm + xv * od) = 16.1 + 1.594 + (0 + 0 * 2.525) = 17.69 \text{ kNm}$$

Restoring moment abt A fill/wall

$$rmf = wf * ef = 55.07 * 0.9375 = 51.63 \text{ kNm}$$

$$rmb = wb * tb / 2 = 11.7 * 1.625 / 2 = 9.506 \text{ kNm}$$

$$rms = ws * (t + th) * ef = 1.5 * (1.125 + 0.25) * 0.9375 = 1.934$$

$$rm = rmf + rmb + rms = 51.63 + 9.506 + 1.934 = 63.07$$

Factor of safety

$$fso = rm / om = 63.07 / 17.69 = 3.565$$

Sliding (passive resistance ignored)

Sliding force

$$sf = sfe + sfs + xv = 19.13 + 1.263 + 0 = 20.39$$

Details of bearing stratas
angle of friction
cohesion
Coefficient of friction

$$phi b = 40^\circ$$

$$cu = 0 \text{ kN/m}^2$$

$$cf = TAN(RAD(phi b * 2 / 3)) = TAN(RAD(40 * 2 / 3)) = 0.5022$$

Resisting force

$$rff = wf * cf = 55.07 * 0.5022 = 27.66 \text{ kN}$$

$$rfb = wb * cf + tb * cu / 2 = 11.7 * 0.5022 + 1.625 * 0 / 2 = 5.876 \text{ kN}$$

$$rfs = ws * (t + th) * cf = 1.5 * (1.125 + 0.25) * 0.5022 = 1.036 \text{ kN}$$

surcharge

$$rf = rff + rfb + rfs = 27.66 + 5.876 + 1.036 = 34.57 \text{ kN}$$

total

$$fss = rf / sf = 34.57 / 20.39 = 1.695$$

Factor of safety

Bearing pressure

Weight of surcharge

Moments about centre of base

Section modulus of base

Total weight

Pressure due to weight

Pressure due to moment (+/-)

Maximum pressure

Minimum pressure

Summary of stability check

Factor of safety overturning

Factor of safety sliding

Maximum base pressure

DESIGN SUMMARY

Wall height

Wall design

Step thickness

(m)

Step height

Ultimate Moments (kNm)

Resistance Applied

2.225 m

3.565

1.695

66.33 kN/m²Summary of stability check

Factor of safety overturning

Factor of safety sliding

Maximum base pressure

DESIGN SUMMARY

Wall height

Wall design

Step thickness

(m)

Step height

Ultimate Moments (kNm)

Resistance Applied

0.2086

1.345

5.109

17.4

0.325

0.45

0.675

1.125

0.9497

2.067

5.327

17.44

3.565

1.695

66.33 kN/m²

Factor of safety overturning

Factor of safety sliding

Maximum base pressure

THIS IS AN UPDATE AND NEEDS YOUR OWN L.NAM FILE.