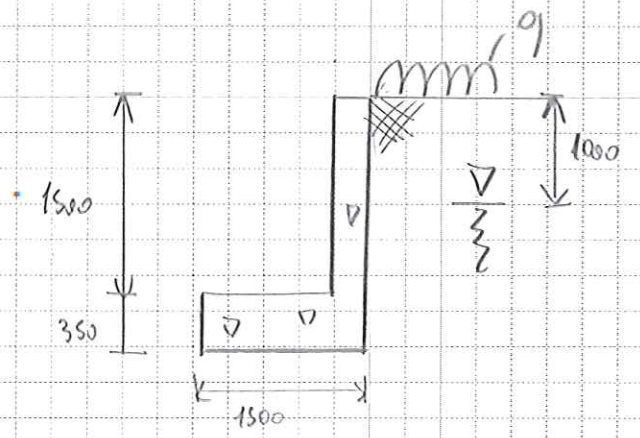
Lyons | O'Neill
Structural Engineers

Job 15168 - 18 GROVE TERRACE Date SEPT '16 Page

Title BASEMENT WALL By FDS Chkd IS

GEOMETRY

$q = 1.5\ kN/m^2$



ALLOW FOR WATER TABLE @ 1m FROM TOP OF WALL

THIS IS CONSERVATIVE, COMPARED TO SITE INVESTIGATION RESULTS.

REAR GARDEN WALLS WILL NOT SURCHARGE THE NEW WALLS. REFER TO SECTION C-C WITHIN APPENDIX B.

ALLOWABLE BEARING PRESSURE FROM SITE INVESTIGATION = $125 kN/m^2$

FROM TEDDS, FOS = 4.4

RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.01

Retaining wall details

Stem type	Cantilever
Stem height	h_{stem} = **1500** mm
Stem thickness	t_{stem} = **250** mm
Angle to rear face of stem	α = **90** deg
Stem density	γ_{stem} = **25** kN/m^3
Toe length	l_{toe} = **1250** mm
Base thickness	t_{base} = **350** mm
Base density	γ_{base} = **25** kN/m^3
Height of retained soil	h_{ret} = **1500** mm
Angle of soil surface	β = **0** deg
Depth of cover	d_{cover} = **0** mm
Height of water	h_{water} = **500** mm
Water density	γ_w = **9.8** kN/m^3

Retained soil properties

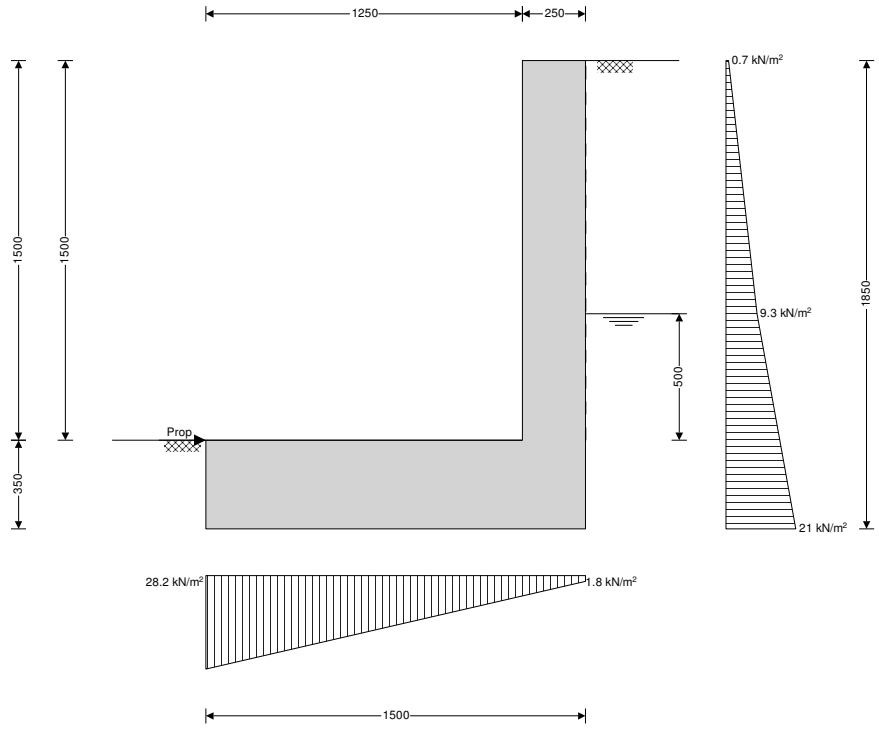
Soil type	Firm clay
Moist density	γ_{mr} = **18** kN/m^3
Saturated density	γ_{sr} = **18** kN/m^3
Characteristic effective shear resistance angle	$\phi'_{r.k}$ = **18** deg
Characteristic wall friction angle	$\delta_{r.k}$ = **9** deg

Base soil properties

Soil type	Organic clay
Soil density	γ_b = **18** kN/m^3
Characteristic effective shear resistance angle	$\phi'_{b.k}$ = **18** deg
Characteristic wall friction angle	$\delta_{b.k}$ = **9** deg
Characteristic base friction angle	$\delta_{bb.k}$ = **12** deg
Presumed bearing capacity	$P_{bearing}$ = **125** kN/m^2

Loading details

Variable surcharge load	$Surcharge_Q$ = **1.5** kN/m^2



General arrangement

Calculate retaining wall geometry

Base length	$l_{base} = l_{toe} + t_{stem} =$ **1500** mm
Saturated soil height	$h_{sat} = h_{water} + d_{cover} =$ **500** mm
Moist soil height	$h_{moist} = h_{ret} - h_{water} =$ **1000** mm
Length of surcharge load	$l_{sur} = l_{heel} =$ **0** mm
- Distance to vertical component	$x_{sur\_v} = l_{base} - l_{heel} / 2 =$ **1500** mm
Effective height of wall	$h_{eff} = h_{base} + d_{cover} + h_{ret} =$ **1850** mm
- Distance to horizontal component	$x_{sur\_h} = h_{eff} / 2 =$ **925** mm
Area of wall stem	$A_{stem} = h_{stem} \times t_{stem} =$ **0.375** m²
- Distance to vertical component	$x_{stem} = l_{toe} + t_{stem} / 2 =$ **1375** mm
Area of wall base	$A_{base} = l_{base} \times t_{base} =$ **0.525** m²
- Distance to vertical component	$x_{base} = l_{base} / 2 =$ **750** mm

Using Coulomb theory

Active pressure coefficient	$K_A = \sin(\alpha + \phi'_{r.k})^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta_{r.k}) \times [1 + \sqrt{[\sin(\phi'_{r.k} + \delta_{r.k}) \times \sin(\phi'_{r.k} - \beta) / (\sin(\alpha - \delta_{r.k}) \times \sin(\alpha + \beta))]}]^2) =$ **0.483**
Passive pressure coefficient	$K_P = \sin(90 - \phi'_{b.k})^2 / (\sin(90 + \delta_{b.k}) \times [1 - \sqrt{[\sin(\phi'_{b.k} + \delta_{b.k}) \times \sin(\phi'_{b.k}) / (\sin(90 + \delta_{b.k}))]}]^2) =$ **2.359**

Bearing pressure check

Vertical forces on wall

Wall stem	$F_{stem} = A_{stem} \times \gamma_{stem} =$ **9.4** kN/m
Wall base	$F_{base} = A_{base} \times \gamma_{base} =$ **13.1** kN/m

Total	$F_{total\_v} = F_{stem} + F_{base} + F_{water\_v} =$ **22.5** kN/m

Horizontal forces on wall

Surcharge load	$F_{sur\_h} = K_A \times \cos(\delta_{r.d}) \times Surcharge_Q \times h_{eff} =$ **1.3** kN/m
Saturated retained soil	$F_{sat\_h} = K_A \times \cos(\delta_{r.d}) \times (\gamma_{sr}' - \gamma_w') \times (h_{sat} + h_{base})^2 / 2 =$ **1.4** kN/m
Water	$F_{water\_h} = \gamma_w' \times (h_{water} + d_{cover} + h_{base})^2 / 2 =$ **3.5** kN/m
Moist retained soil	$F_{moist\_h} = K_A \times \cos(\delta_{r.d}) \times \gamma_{mr}' \times ((h_{eff} - h_{sat} - h_{base})^2 / 2 + (h_{eff} - h_{sat} - h_{base}) \times (h_{sat} + h_{base})) =$ **11.6** kN/m
Base soil	$F_{pass\_h} = -K_P \times \cos(\delta_{b.d}) \times \gamma_b' \times (d_{cover} + h_{base})^2 / 2 =$ **-2.6** kN/m
Total	$F_{total\_h} = F_{sat\_h} + F_{moist\_h} + F_{pass\_h} + F_{water\_h} + F_{sur\_h} =$ **15.3** kN/m

Moments on wall

Wall stem	$M_{stem} = F_{stem} \times x_{stem} =$ **12.9** kNm/m
Wall base	$M_{base} = F_{base} \times x_{base} =$ **9.8** kNm/m
Surcharge load	$M_{sur} = -F_{sur\_h} \times x_{sur\_h} =$ **-1.2** kNm/m
Saturated retained soil	$M_{sat} = -F_{sat\_h} \times x_{sat\_h} =$ **-0.4** kNm/m
Water	$M_{water} = -F_{water\_h} \times x_{water\_h} =$ **-1** kNm/m
Moist retained soil	$M_{moist} = -F_{moist\_h} \times x_{moist\_h} =$ **-8.2** kNm/m
Total	$M_{total} = M_{stem} + M_{base} + M_{sat} + M_{moist} + M_{water} + M_{sur} =$ **11.9** kNm/m

Check bearing pressure

Propping force	$F_{prop\_base} = F_{total\_h} =$ **15.3** kN/m
Distance to reaction	$\bar{x} = M_{total} / F_{total\_v} =$ **530** mm
Eccentricity of reaction	$e = \bar{x} - l_{base} / 2 =$ **-220** mm
Loaded length of base	$l_{load} = l_{base} =$ **1500** mm
Bearing pressure at toe	$q_{toe} = F_{total\_v} / l_{base} \times (1 - 6 \times e / l_{base}) =$ **28.2** kN/m^2
Bearing pressure at heel	$q_{heel} = F_{total\_v} / l_{base} \times (1 + 6 \times e / l_{base}) =$ **1.8** kN/m^2
Factor of safety	$FoS_{bp} = P_{bearing} / \max(q_{toe}, q_{heel}) =$ **4.431**

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure