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Structural Analysis Report

24 Ormes Road, Skewen, Neath

September 2020

24 Ormes Road, Skewen, Neath
September 2020

Site name: 24 Ormes Road, Skewen, Neath

Client name: Ms. Jill Howells

Type of report: Structural Analysis Report

Prepared by: Iwan Griffiths BEng (Hons) ICE IStructE

Signed



Date: 30th September 2020

Revision History:

Rev.	Date	Comments
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1	12/10/2020	Used 85kN/m ² as ground bearing capacity as given in the geotechnical report as opposed to typical ground type bearing capacity of 200kN/m ²
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1. Introduction

1.1. Brief

Following a request from the client, Ms. Jill Howells, a structural analysis of the newly constructed gabion retaining wall at 24 Ormes Road, Skewen, Neath was carried out.

The client proposes to develop the site by building a new house. The client has arranged excavation into an earth bank on the site, to increase the area of level for the development.

A ground investigation report was commissioned by the client, and a retaining wall was recommended in the report. The client has arranged for the construction of a gabion retaining wall, and this report presents the analysis of the gabion wall to ascertain its structural stability.

A site visit was undertaken to make a visual inspection and take measurements. Those measurements and a ground investigation report carried out by Quantum Geotech (APPENDIX 1) provide the basis of the calculations carried out as part of the analysis.

From the ground investigation report it is taken that the bearing ground for the gabion wall is dense clayey slightly sandy gravel. Most of the retained material consists of firm slightly gravelly and sandy clay. The ground bearing capacity of 85kN/mm² given on page 14 of the geotechnical report has been used in the calculations.

The characteristic parameters which are suggested for retaining wall design on page 15 of the report are:

Effective angle of shearing resistance = 32 degrees.

Cohesion intercept in terms of effective stress = 0kN/m³

Effective weight density = 19kN/m³

The surface of the retained ground slopes upward away from the gabion at 10 degrees.

The main length of the gabion, which is the narrowest section, and therefore the section considered for this report in order to provide an analysis of the worst case consists of three gabion baskets 1m high and 1m deep per metre run of gabion wall. Each layer of gabion baskets is recessed by 150mm above the gabion basket beneath it. (See sketch in Calculations section).

The contractor who constructed the gabion structure has informed that there is a 1m deep shelf of poured concrete behind the lowest gabion basket, and there is a backfill of MOT Type 3 sub-base behind the upper two gabion baskets, from the rear face of the gabions in line with the rear face of the concrete shelf. A geotechnical membrane has been placed

between the retained ground and the sub-base.

The material density for the gabion basket stone fill has been assumed to be 15.5 kN/m³. In order to provide a conservative analysis, this density value has been used for the entire gabion structure, which includes the sub-base section behind the upper two baskets and the concrete shelf behind the lower gabion basket, as 15.5 kN/m³ is a similar density that would typically be considered for MOT Type 3 – sub-base and lower than concrete.

2. CALCULATIONS

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GABION RETAINING WALL ANALYSIS & DESIGN

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

Tedds calculation version 2.0.02

Design summary

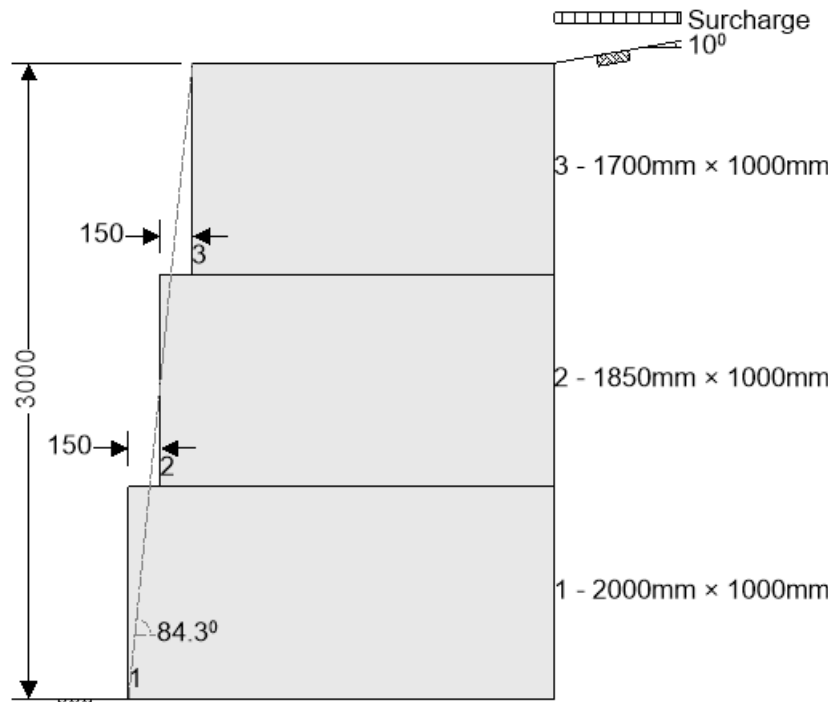
Combination 1

Action	Resistance	Force	FoS	Allowable FoS	Status
Overturning, sliding and bearing at base level					
Overturning (kNm/m)	113.9	34.9	3.266	1.000	PASS
Sliding (kN/m)	60.5	34.2	1.769	1.000	PASS
Bearing (kN/m ²)	85.0	61.1	1.390	1.000	PASS
Eccentricity (mm)	Reaction acts within the middle third of base				PASS
Overturning and sliding between courses 1 and 2					
Overturning (kNm/m)	61.8	10.6	5.822	1.000	PASS
Sliding (kN/m)	37.4	15.5	2.414	1.000	PASS
Overturning and sliding between courses 2 and 3					
Overturning (kNm/m)	24.4	1.4	17.051	1.000	PASS
Sliding (kN/m)	17.2	4.1	4.212	1.000	PASS

Combination 2

Action	Resistance	Force	FoS	Allowable FoS	Status
Overturning, sliding and bearing at base level					
Overturning (kNm/m)	114.7	33.8	3.393	1.000	PASS
Sliding (kN/m)	48.6	33.1	1.471	1.000	PASS
Bearing (kN/m ²)	85.0	61.1	1.390	1.000	PASS
Eccentricity (mm)	Reaction acts within the middle third of base				PASS
Overturning and sliding between courses 1 and 2					
Overturning (kNm/m)	62.1	10.3	6.014	1.000	PASS
Sliding (kN/m)	30.0	15.0	1.998	1.000	PASS
Overturning and sliding between courses 2 and 3					
Overturning (kNm/m)	24.5	1.4	17.373	1.000	PASS
Sliding (kN/m)	13.8	4.0	3.454	1.000	PASS

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Wall geometry

Width of gabion 1	$w_1 = 2000$ mm
Height of gabion 1	$h_1 = 1000$ mm
Width of gabion 2	$w_2 = 1850$ mm
Height of gabion 2	$h_2 = 1000$ mm
Step to front face between courses 1 and 2	$s_2 = 150$ mm
Width of gabion 3	$w_3 = 1700$ mm
Height of gabion 3	$h_3 = 1000$ mm
Step to front face between courses 2 and 3	$s_3 = 150$ mm
Wall inclination	$\varepsilon = 0$ deg

Gabion properties

Unit weight of fill	$\gamma_d = 15.5$ kN/m ³
Friction between gabions	$\delta_{bg,k} = 32.0$ deg

Loading

Variable surcharge	$p_{o,Q} = 1$ kN/m ²
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Soil properties

Slope of retained soil	$\beta = 10.0$ deg
Characteristic effective shearing resistance angle	$\phi'_{r,k} = 32.0$ deg
Characteristic saturated density of retained soil	$\gamma_{sr} = 19.0$ kN/m ³
Coefficient for wall friction	$k_{membrane} = 0.75$
Wall friction angle	$\delta_{r,k} = 24.0$ deg
Characteristic base friction angle	$\delta_{bb,k} = 32.0$ deg
Bearing capacity of founding soil	$q = 85$ kN/m ²

Wall geometry

Horizontal distance to centre of gravity gabion 1	$x_{g1} = w_1 / 2 = 1000$ mm
Vertical distance to centre of gravity gabion 1	$y_{g1} = h_1 / 2 = 500$ mm

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Weight of gabion 1	$W_{g1} = \gamma_d * w_1 * h_1 = \mathbf{31.0}$ kN/m
Horizontal distance to centre of gravity gabion 2	$x_{g2} = w_2 / 2 + s_2 = \mathbf{1075}$ mm
Vertical distance to centre of gravity gabion 2	$y_{g2} = h_2 / 2 + h_1 = \mathbf{1500}$ mm
Weight of gabion 2	$W_{g2} = \gamma_d * w_2 * h_2 = \mathbf{28.7}$ kN/m
Horizontal distance to centre of gravity gabion 3	$x_{g3} = w_3 / 2 + s_2 + s_3 = \mathbf{1150}$ mm
Vertical distance to centre of gravity gabion 3	$y_{g3} = h_3 / 2 + h_1 + h_2 = \mathbf{2500}$ mm
Weight of gabion 3	$W_{g3} = \gamma_d * w_3 * h_3 = \mathbf{26.4}$ kN/m
Weight of entire gabion	$W_g = W_{g1} + W_{g2} + W_{g3} = \mathbf{86.0}$ kN/m
Horiz distance to centre of gravity entire gabion	$x_g = ((W_{g1} * x_{g1}) + (W_{g2} * x_{g2}) + (W_{g3} * x_{g3})) / W_g = \mathbf{1071}$ mm
Vert distance to centre of gravity entire gabion	$y_g = ((W_{g1} * y_{g1}) + (W_{g2} * y_{g2}) + (W_{g3} * y_{g3})) / W_g = \mathbf{1446}$ mm
Correcting for wall inclination horiz dist	$x_g = x_g * \cos(\epsilon) + y_g * \sin(\epsilon) = \mathbf{1071}$ mm
Vertical change in height due to wall inclination	$H_f = y_{g3} + h_3/2 - ((y_{g3} + h_3/2) * \cos(\epsilon) - (x_{g3} + w_3/2) * \sin(\epsilon)) = \mathbf{0}$ mm

Design dimensions

Effective angle of rear plane of wall	$\alpha = 90 \text{ deg} + \epsilon = \mathbf{90.0}$ deg
Effective face angle	$\theta = \text{Atan}((y_{g3} + (h_3 / 2)) / ((x_{g3} - (w_3 / 2)))) - \epsilon = \mathbf{84.3}$ deg
Effective height of wall	$H = (y_{g3} + h_3 / 2) + (w_1 * \sin(\epsilon)) - H_f = \mathbf{3000}$ mm
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g3} + h_3 / 2) * \cos(\epsilon) - (x_{g3} - (w_3 / 2)) * \sin(\epsilon)) = \mathbf{3000}$ mm
Active pressure using Coulomb theory	$K_a = \sin(\alpha + \phi'_{r,k})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r,k}) * (1 + \sqrt{(\sin(\phi'_{r,k} + \delta_{r,k}) * \sin(\phi'_{r,k} - \beta) / (\sin(\alpha - \delta_{r,k}) * \sin(\alpha + \beta))))^2) = \mathbf{0.312}$
Active thrust due to soil	$P_{a,soil} = 0.5 * K_a * \gamma_{sr} * H^2 = \mathbf{26.7}$ kN/m

Pressure at base

Horizontal forces

Retained soil	$F_{soil_h,q} = P_{a,soil} * \cos(90 - \alpha + \delta_{r,k}) = \mathbf{24.4}$ kN/m
Height of soil thrust resolved vertically	$d_{h,soil} = H / 3 - w_1 * \sin(\epsilon) = \mathbf{1000}$ mm
Surcharge	$F_{surch_h,q} = p_{o,Q} * K_a * H * \cos(90 - \alpha + \delta_{r,k}) = \mathbf{0.9}$ kN/m
Height of surcharge thrust resolved vertically	$d_{h,surch} = H / 2 - w_1 * \sin(\epsilon) = \mathbf{1500}$ mm

Vertical forces

Gabion weight	$F_{gabion_v,q} = W_g = \mathbf{86.0}$ kN/m
Retained soil	$F_{soil_v,q} = P_{a,soil} * \sin(90 - \alpha + \delta_{r,k}) = \mathbf{10.9}$ kN/m
Horizontal dist to where soil thrust acts	$b_{v,soil} = w_1 * \cos(\epsilon) - (H / 3) / \tan(\alpha) = \mathbf{2000}$ mm
Surcharge	$F_{surch_v,q} = p_{o,Q} * K_a * H * \sin(90 - \alpha + \delta_{r,k}) = \mathbf{0.4}$ kN/m
Horizontal dist to where surcharge thrust acts	$b_{v,surch} = w_1 * \cos(\epsilon) - (H / 2) / \tan(\alpha) = \mathbf{2000}$ mm
Total horizontal unfactored force	$T_q = F_{soil_h,q} + F_{surch_h,q} = \mathbf{25.3}$ kN/m
Total vertical unfactored force	$N_q = F_{gabion_v,q} + F_{soil_v,q} + F_{surch_v,q} = \mathbf{97.3}$ kN/m
Force normal to base	$N_s = N_q * \cos(\epsilon) + T_q * \sin(\epsilon) = \mathbf{97.3}$ kN/m
Total unfactored overturning force	$M_{o,q} = F_{soil_h,q} * d_{h,soil} + F_{surch_h,q} * d_{h,surch} = \mathbf{25.7}$ kNm/m
Total unfactored restoring force	$M_{R,q} = F_{gabion_v,q} * x_g + F_{soil_v,q} * b_{v,soil} + F_{surch_v,q} * b_{v,surch} = \mathbf{114.6}$ kNm/m
Eccentricity	$e = w_1 / 2 - (M_{R,q} - M_{o,q}) / N_s = \mathbf{86}$ mm

Reaction acts within middle third of base

Pressure at toe	$\sigma_{toe} = N_s / w_1 * (1 + (6 * e / w_1)) = \mathbf{61.1}$ kN/m ²
Pressure at heel	$\sigma_{heel} = N_s / w_1 * (1 - (6 * e / w_1)) = \mathbf{36.1}$ kN/m ²
Factor of safety	$FoS_Q = q / \max(\sigma_{toe}, \sigma_{heel}) = \mathbf{1.390}$
Allowable factor of safety	$FoS_{Q_allow} = \mathbf{1.000}$

PASS - Design FoS for allowable bearing pressure exceeds min allowable pressure to base

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Design approach 1

Partial factors on actions - Section A.3.1 - Combination 1

Permanent unfavourable action	$\gamma_G = 1.35$
Permanent favourable action	$\gamma_{G,f} = 1.00$
Variable unfavourable action	$\gamma_Q = 1.50$
Variable favourable action	$\gamma_{Q,f} = 0.00$

Partial factors for soil parameters - Section A.3.2 - Combination 1

Angle of shearing resistance	$\gamma_{\phi'} = 1.00$
Weight density	$\gamma_\gamma = 1.00$

Design soil properties

Design effective shearing resistance angle	$\phi'_{r,d} = \text{Atan}(\tan(\phi'_{r,k}) / \gamma_{\phi'}) = 32.0 \text{ deg}$
Design saturated density of retained soil	$\gamma_{s,d} = \gamma_{sr} / \gamma_\gamma = 19.0 \text{ kN/m}^3$
Design wall friction angle	$\delta_{r,d} = \min(\text{atan}(\tan(\delta_{r,k}) / \gamma_{\phi'}), \phi'_{r,d} * k_{\text{membrane}}) = 24.0 \text{ deg}$
Design base friction angle	$\delta_{bb,d} = \text{Atan}(\tan(\delta_{bb,k}) / \gamma_{\phi'}) = 32.0 \text{ deg}$
Design friction between gabions	$\delta_{bg,d} = \text{Atan}(\tan(\delta_{bg,k}) / \gamma_{\phi'}) = 32.0 \text{ deg}$
Active pressure using Coulomb theory	$K_a = \sin(\alpha + \phi'_{r,d})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r,d}) * (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) * \sin(\phi'_{r,d} - \beta) / (\sin(\alpha - \delta_{r,d}) * \sin(\alpha + \beta))))^2) = 0.312$
Active thrust due to soil	$P_{a,\text{soil}} = 0.5 * K_a * \gamma_{s,d} * H^2 = 26.7 \text{ kN/m}$

Horizontal forces

Retained soil	$F_{\text{soil}_h} = \gamma_G * P_{a,\text{soil}} * \cos(90 - \alpha + \delta_{r,d}) = 32.9 \text{ kN/m}$
Surcharge	$F_{\text{surch}_h} = p_{o,Q} * \gamma_Q * K_a * H * \cos(90 - \alpha + \delta_{r,d}) = 1.3 \text{ kN/m}$

Vertical forces

Gabion weight	$F_{\text{gabion}_v,f} = \gamma_{G,f} * W_g = 86.0 \text{ kN/m}$
Retained soil	$F_{\text{soil}_v,f} = \gamma_{G,f} * P_{a,\text{soil}} * \sin(90 - \alpha + \delta_{r,d}) = 10.9 \text{ kN/m}$
Surcharge	$F_{\text{surch}_v,f} = p_{o,Q} * \gamma_{Q,f} * K_a * H * \sin(90 - \alpha + \delta_{r,d}) = 0.0 \text{ kN/m}$

Overturning stability - take moments about the toe

Overturning moment	$M_o = F_{\text{soil}_h} * d_{h,\text{soil}} + F_{\text{surch}_h} * d_{h,\text{surch}} = 34.9 \text{ kNm/m}$
Restoring moment	$M_R = F_{\text{gabion}_v,f} * X_g + F_{\text{soil}_v,f} * b_{v,\text{soil}} + F_{\text{surch}_v,f} * b_{v,\text{surch}} = 113.9 \text{ kNm/m}$
Factor of safety	$FoS_M = M_R / M_o = 3.266$
Allowable factor of safety	$FoS_{M,\text{allow}} = 1.000$

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

Sliding stability - ignore any passive pressure in front of the structure

Total horizontal force	$T = F_{\text{soil}_h} + F_{\text{surch}_h} = 34.2 \text{ kN/m}$
Total vertical force	$N = F_{\text{gabion}_v,f} + F_{\text{soil}_v,f} + F_{\text{surch}_v,f} = 96.9 \text{ kN/m}$
Sliding force	$F_f = T * \cos(\epsilon) - N * \sin(\epsilon) = 34.2 \text{ kN/m}$
Sliding resistance	$F_R = (T * \sin(\epsilon) + N * \cos(\epsilon)) * \tan(\delta_{bb,d}) = 60.5 \text{ kN/m}$
Factor of safety	$FoS_S = F_R / F_f = 1.769$
Allowable factor of safety	$FoS_{S,\text{allow}} = 1.000$

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	$X_{g2} = W_2 / 2 = 925 \text{ mm}$
Vertical distance to centre of gravity gabion 2	$Y_{g2} = h_2 / 2 = 500 \text{ mm}$

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Weight of gabion 2	$W_{g2} = \gamma_d * w_2 * h_2 = \mathbf{28.7 \text{ kN/m}}$
Horizontal distance to centre of gravity gabion 3	$x_{g3} = w_3 / 2 + s_3 = \mathbf{1000 \text{ mm}}$
Vertical distance to centre of gravity gabion 3	$y_{g3} = h_3 / 2 + h_2 = \mathbf{1500 \text{ mm}}$
Weight of gabion 3	$W_{g3} = \gamma_d * w_3 * h_3 = \mathbf{26.4 \text{ kN/m}}$
Weight of entire gabion	$W_g = W_{g2} + W_{g3} = \mathbf{55.0 \text{ kN/m}}$
Horiz distance to centre of gravity entire gabion	$x_g = ((W_{g2} * x_{g2}) + (W_{g3} * x_{g3})) / W_g = \mathbf{961 \text{ mm}}$
Vert distance to centre of gravity entire gabion	$y_g = ((W_{g2} * y_{g2}) + (W_{g3} * y_{g3})) / W_g = \mathbf{979 \text{ mm}}$
Correcting for wall inclination horiz dist	$X_g = x_g * \cos(\epsilon) + y_g * \sin(\epsilon) = \mathbf{961 \text{ mm}}$
Vertical change in height due to wall inclination	$H_f = y_{g3} + h_3/2 - ((y_{g3} + h_3/2) * \cos(\epsilon) - (x_{g3} + w_3/2) * \sin(\epsilon)) = \mathbf{0 \text{ mm}}$

Design dimensions

Effective angle of rear plane of wall	$\alpha = 90 \text{ deg} + \epsilon = \mathbf{90.0 \text{ deg}}$
Effective face angle	$\theta = \text{Atan}((y_{g3} + (h_3 / 2)) / ((x_{g3} - (w_3 / 2)))) - \epsilon = \mathbf{85.7 \text{ deg}}$
Effective height of wall	$H = (y_{g3} + h_3 / 2) + (w_2 * \sin(\epsilon)) - H_f = \mathbf{2000 \text{ mm}}$
Height of wall from toe to front edge of top gabion	$H_{incl} = ((y_{g3} + h_3 / 2) * \cos(\epsilon) - (x_{g3} - (w_3 / 2)) * \sin(\epsilon)) = \mathbf{2000 \text{ mm}}$
Active pressure using Coulomb theory	$K_a = \sin(\alpha + \phi'_{r,d})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r,d}) * (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) * \sin(\phi'_{r,d} - \beta) / (\sin(\alpha - \delta_{r,d}) * \sin(\alpha + \beta))))^2) = \mathbf{0.312}$
Active thrust due to soil	$P_{a,soil} = 0.5 * K_a * \gamma_{s,d} * H^2 = \mathbf{11.9 \text{ kN/m}}$

Horizontal forces

Retained soil	$F_{soil,h} = \gamma_G * P_{a,soil} * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{14.6 \text{ kN/m}}$
Surcharge	$F_{surch,h} = p_{o,Q} * \gamma_Q * K_a * H * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{0.9 \text{ kN/m}}$

Vertical forces

Gabion weight	$F_{gabion,v,f} = \gamma_{G,f} * W_g = \mathbf{55.0 \text{ kN/m}}$
Retained soil	$F_{soil,v,f} = \gamma_{G,f} * P_{a,soil} * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{4.8 \text{ kN/m}}$
Surcharge	$F_{surch,v,f} = p_{o,Q} * \gamma_{Q,f} * K_a * H * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{0.0 \text{ kN/m}}$

Overtuning stability - take moments about the toe

Overtuning moment	$M_o = F_{soil,h} * d_{h,soil} + F_{surch,h} * d_{h,surch} = \mathbf{10.6 \text{ kNm/m}}$
Restoring moment	$M_R = F_{gabion,v,f} * X_g + F_{soil,v,f} * b_{v,soil} + F_{surch,v,f} * b_{v,surch} = \mathbf{61.8 \text{ kNm/m}}$
Factor of safety	$FoSM = M_R / M_o = \mathbf{5.822}$
Allowable factor of safety	$FoSM_{allow} = \mathbf{1.000}$

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

Sliding stability - ignore any passive pressure in front of the structure

Total horizontal force	$T = F_{soil,h} + F_{surch,h} = \mathbf{15.5 \text{ kN/m}}$
Total vertical force	$N = F_{gabion,v,f} + F_{soil,v,f} + F_{surch,v,f} = \mathbf{59.9 \text{ kN/m}}$
Sliding force	$F_f = T * \cos(\epsilon) - N * \sin(\epsilon) = \mathbf{15.5 \text{ kN/m}}$
Sliding resistance	$F_R = (T * \sin(\epsilon) + N * \cos(\epsilon)) * \tan(\delta_{bg,d}) = \mathbf{37.4 \text{ kN/m}}$
Factor of safety	$FoSS = F_R / F_f = \mathbf{2.414}$
Allowable factor of safety	$FoSS_{allow} = \mathbf{1.000}$

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

Check overturning and sliding between courses 2 and 3

Wall geometry

Horizontal distance to centre of gravity gabion 3	$x_{g3} = w_3 / 2 = \mathbf{850 \text{ mm}}$
Vertical distance to centre of gravity gabion 3	$y_{g3} = h_3 / 2 = \mathbf{500 \text{ mm}}$
Weight of gabion 3	$W_{g3} = \gamma_d * w_3 * h_3 = \mathbf{26.4 \text{ kN/m}}$
Weight of entire gabion	$W_g = W_{g3} = \mathbf{26.4 \text{ kN/m}}$

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Horiz distance to centre of gravity entire gabion $X_g = ((W_{g3} * X_{g3})) / W_g = \mathbf{850 \text{ mm}}$
 Vert distance to centre of gravity entire gabion $y_g = ((W_{g3} * y_{g3})) / W_g = \mathbf{500 \text{ mm}}$
 Correcting for wall inclination horiz dist $X_g = X_g * \cos(\epsilon) + y_g * \sin(\epsilon) = \mathbf{850 \text{ mm}}$
 Vertical change in height due to wall inclination $H_f = y_{g3} + h_3/2 - ((y_{g3} + h_3/2) * \cos(\epsilon) - (X_{g3} + w_3/2) * \sin(\epsilon)) = \mathbf{0 \text{ mm}}$

Design dimensions

Effective angle of rear plane of wall $\alpha = 90 \text{ deg} + \epsilon = \mathbf{90.0 \text{ deg}}$
 Effective face angle $\theta = 90 \text{ deg} - \epsilon = \mathbf{90.0 \text{ deg}}$
 Effective height of wall $H = (y_{g3} + h_3 / 2) + (w_3 * \sin(\epsilon)) - H_f = \mathbf{1000 \text{ mm}}$
 Height of wall from toe to front edge of top gabion $H_{incl} = ((y_{g3} + h_3 / 2) * \cos(\epsilon) - (X_{g3} - (w_3 / 2)) * \sin(\epsilon)) = \mathbf{1000 \text{ mm}}$
 Active pressure using Coulomb theory $K_a = \sin(\alpha + \phi'_{r,d})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r,d}) * (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) * \sin(\phi'_{r,d} - \beta) / (\sin(\alpha - \delta_{r,d}) * \sin(\alpha + \beta))))^2) = \mathbf{0.312}$
 Active thrust due to soil $P_{a,soil} = 0.5 * K_a * \gamma_{s,d} * H^2 = \mathbf{3.0 \text{ kN/m}}$

Horizontal forces

Retained soil $F_{soil,h} = \gamma_G * P_{a,soil} * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{3.7 \text{ kN/m}}$
 Surcharge $F_{surch,h} = p_{o,Q} * \gamma_Q * K_a * H * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{0.4 \text{ kN/m}}$

Vertical forces

Gabion weight $F_{gabion,v,f} = \gamma_{G,f} * W_g = \mathbf{26.4 \text{ kN/m}}$
 Retained soil $F_{soil,v,f} = \gamma_{G,f} * P_{a,soil} * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{1.2 \text{ kN/m}}$
 Surcharge $F_{surch,v,f} = p_{o,Q} * \gamma_{Q,f} * K_a * H * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{0.0 \text{ kN/m}}$

Overtuning stability - take moments about the toe

Overtuning moment $M_o = F_{soil,h} * d_{h,soil} + F_{surch,h} * d_{h,surch} = \mathbf{1.4 \text{ kNm/m}}$
 Restoring moment $M_R = F_{gabion,v,f} * X_g + F_{soil,v,f} * b_{v,soil} + F_{surch,v,f} * b_{v,surch} = \mathbf{24.4 \text{ kNm/m}}$
 Factor of safety $FoSM = M_R / M_o = \mathbf{17.051}$
 Allowable factor of safety $FoSM_{allow} = \mathbf{1.000}$

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

Sliding stability - ignore any passive pressure in front of the structure

Total horizontal force $T = F_{soil,h} + F_{surch,h} = \mathbf{4.1 \text{ kN/m}}$
 Total vertical force $N = F_{gabion,v,f} + F_{soil,v,f} + F_{surch,v,f} = \mathbf{27.6 \text{ kN/m}}$
 Sliding force $F_f = T * \cos(\epsilon) - N * \sin(\epsilon) = \mathbf{4.1 \text{ kN/m}}$
 Sliding resistance $F_R = (T * \sin(\epsilon) + N * \cos(\epsilon)) * \tan(\delta_{bg,d}) = \mathbf{17.2 \text{ kN/m}}$
 Factor of safety $FoS_S = F_R / F_f = \mathbf{4.212}$
 Allowable factor of safety $FoS_S_{allow} = \mathbf{1.000}$

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

Design approach 1

Partial factors on actions - Section A.3.1 - Combination 2

Permanent unfavourable action $\gamma_G = \mathbf{1.00}$
 Permanent favourable action $\gamma_{G,f} = \mathbf{1.00}$
 Variable unfavourable action $\gamma_Q = \mathbf{1.30}$
 Variable favourable action $\gamma_{Q,f} = \mathbf{0.00}$

Partial factors for soil parameters - Section A.3.2 - Combination 2

Angle of shearing resistance $\gamma_{\phi'} = \mathbf{1.25}$
 Weight density $\gamma_{\gamma} = \mathbf{1.00}$

Design soil properties

Design effective shearing resistance angle $\phi'_{r,d} = \text{Atan}(\tan(\phi'_{r,k}) / \gamma_{\phi'}) = \mathbf{26.6 \text{ deg}}$

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Design saturated density of retained soil

$$\gamma_{s,d} = \gamma_{sr} / \gamma_r = \mathbf{19.0 \text{ kN/m}^3}$$

Design wall friction angle

$$\delta_{r,d} = \min(\text{atan}(\tan(\delta_{r,k}) / \gamma_\psi), \phi'_{r,d} * k_{\text{membrane}}) = \mathbf{19.6 \text{ deg}}$$

Design base friction angle

$$\delta_{bb,d} = \text{Atan}(\tan(\delta_{bb,k}) / \gamma_\psi) = \mathbf{26.6 \text{ deg}}$$

Design friction between gabions

$$\delta_{bg,d} = \text{Atan}(\tan(\delta_{bg,k}) / \gamma_\psi) = \mathbf{26.6 \text{ deg}}$$

Wall geometry

Horizontal distance to centre of gravity gabion 1

$$x_{g1} = w_1 / 2 = \mathbf{1000 \text{ mm}}$$

Vertical distance to centre of gravity gabion 1

$$y_{g1} = h_1 / 2 = \mathbf{500 \text{ mm}}$$

Weight of gabion 1

$$W_{g1} = \gamma_d * w_1 * h_1 = \mathbf{31.0 \text{ kN/m}}$$

Horizontal distance to centre of gravity gabion 2

$$x_{g2} = w_2 / 2 + s_2 = \mathbf{1075 \text{ mm}}$$

Vertical distance to centre of gravity gabion 2

$$y_{g2} = h_2 / 2 + h_1 = \mathbf{1500 \text{ mm}}$$

Weight of gabion 2

$$W_{g2} = \gamma_d * w_2 * h_2 = \mathbf{28.7 \text{ kN/m}}$$

Horizontal distance to centre of gravity gabion 3

$$x_{g3} = w_3 / 2 + s_2 + s_3 = \mathbf{1150 \text{ mm}}$$

Vertical distance to centre of gravity gabion 3

$$y_{g3} = h_3 / 2 + h_1 + h_2 = \mathbf{2500 \text{ mm}}$$

Weight of gabion 3

$$W_{g3} = \gamma_d * w_3 * h_3 = \mathbf{26.4 \text{ kN/m}}$$

Weight of entire gabion

$$W_g = W_{g1} + W_{g2} + W_{g3} = \mathbf{86.0 \text{ kN/m}}$$

Horiz distance to centre of gravity entire gabion

$$x_g = ((W_{g1} * x_{g1}) + (W_{g2} * x_{g2}) + (W_{g3} * x_{g3})) / W_g = \mathbf{1071 \text{ mm}}$$

Vert distance to centre of gravity entire gabion

$$y_g = ((W_{g1} * y_{g1}) + (W_{g2} * y_{g2}) + (W_{g3} * y_{g3})) / W_g = \mathbf{1446 \text{ mm}}$$

Correcting for wall inclination horiz dist

$$X_g = x_g * \cos(\epsilon) + y_g * \sin(\epsilon) = \mathbf{1071 \text{ mm}}$$

Vertical change in height due to wall inclination

$$H_r = y_{g3} + h_3/2 - ((y_{g3} + h_3/2) * \cos(\epsilon) - (x_{g3} + w_3/2) * \sin(\epsilon)) = \mathbf{0 \text{ mm}}$$

Design dimensions

Effective angle of rear plane of wall

$$\alpha = 90 \text{ deg} + \epsilon = \mathbf{90.0 \text{ deg}}$$

Effective face angle

$$\theta = \text{Atan}((y_{g3} + (h_3 / 2)) / ((x_{g3} - (w_3 / 2)))) - \epsilon = \mathbf{84.3 \text{ deg}}$$

Effective height of wall

$$H = (y_{g3} + h_3 / 2) + (w_1 * \sin(\epsilon)) - H_r = \mathbf{3000 \text{ mm}}$$

Height of wall from toe to front edge of top gabion

$$H_{\text{incl}} = ((y_{g3} + h_3 / 2) * \cos(\epsilon) - (x_{g3} - (w_3 / 2)) * \sin(\epsilon)) = \mathbf{3000 \text{ mm}}$$

Active pressure using Coulomb theory

$$K_a = \sin(\alpha + \phi'_{r,d})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r,d}) * (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) * \sin(\phi'_{r,d} - \beta) / (\sin(\alpha - \delta_{r,d}) * \sin(\alpha + \beta))}))^2) = \mathbf{0.393}$$

Active thrust due to soil

$$P_{a,\text{soil}} = 0.5 * K_a * \gamma_{s,d} * H^2 = \mathbf{33.6 \text{ kN/m}}$$

Horizontal forces

Retained soil

$$F_{\text{soil}_h} = \gamma_G * P_{a,\text{soil}} * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{31.6 \text{ kN/m}}$$

Surcharge

$$F_{\text{surch}_h} = p_{o,Q} * \gamma_Q * K_a * H * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{1.4 \text{ kN/m}}$$

Vertical forces

Gabion weight

$$F_{\text{gabion}_v,f} = \gamma_{G,f} * W_g = \mathbf{86.0 \text{ kN/m}}$$

Retained soil

$$F_{\text{soil}_v,f} = \gamma_{G,f} * P_{a,\text{soil}} * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{11.3 \text{ kN/m}}$$

Surcharge

$$F_{\text{surch}_v,f} = p_{o,Q} * \gamma_{Q,f} * K_a * H * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{0.0 \text{ kN/m}}$$

Overturning stability - take moments about the toe

Overturning moment

$$M_o = F_{\text{soil}_h} * d_{h,\text{soil}} + F_{\text{surch}_h} * d_{h,\text{surch}} = \mathbf{33.8 \text{ kNm/m}}$$

Restoring moment

$$M_R = F_{\text{gabion}_v,f} * X_g + F_{\text{soil}_v,f} * b_{v,\text{soil}} + F_{\text{surch}_v,f} * b_{v,\text{surch}} = \mathbf{114.7 \text{ kNm/m}}$$

Factor of safety

$$FoS_M = M_R / M_o = \mathbf{3.393}$$

Allowable factor of safety

$$FoS_{M_allow} = \mathbf{1.000}$$

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

Sliding stability - ignore any passive pressure in front of the structure

Total horizontal force

$$T = F_{\text{soil}_h} + F_{\text{surch}_h} = \mathbf{33.1 \text{ kN/m}}$$

Total vertical force

$$N = F_{\text{gabion}_v,f} + F_{\text{soil}_v,f} + F_{\text{surch}_v,f} = \mathbf{97.3 \text{ kN/m}}$$

Sliding force

$$F_f = T * \cos(\epsilon) - N * \sin(\epsilon) = \mathbf{33.1 \text{ kN/m}}$$

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Sliding resistance $F_R = (T * \sin(\epsilon) + N * \cos(\epsilon)) * \tan(\delta_{bb,d}) = \mathbf{48.6 \text{ kN/m}}$

Factor of safety $FoS_S = F_R / F_t = \mathbf{1.471}$

Allowable factor of safety $FoS_{S,allow} = \mathbf{1.000}$

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 $x_{g2} = W_2 / 2 = \mathbf{925 \text{ mm}}$

Vertical distance to centre of gravity gabion 2 $y_{g2} = h_2 / 2 = \mathbf{500 \text{ mm}}$

Weight of gabion 2 $W_{g2} = \gamma_d * W_2 * h_2 = \mathbf{28.7 \text{ kN/m}}$

Horizontal distance to centre of gravity gabion 3 $x_{g3} = W_3 / 2 + S_3 = \mathbf{1000 \text{ mm}}$

Vertical distance to centre of gravity gabion 3 $y_{g3} = h_3 / 2 + h_2 = \mathbf{1500 \text{ mm}}$

Weight of gabion 3 $W_{g3} = \gamma_d * W_3 * h_3 = \mathbf{26.4 \text{ kN/m}}$

Weight of entire gabion $W_g = W_{g2} + W_{g3} = \mathbf{55.0 \text{ kN/m}}$

Horiz distance to centre of gravity entire gabion $x_g = ((W_{g2} * x_{g2}) + (W_{g3} * x_{g3})) / W_g = \mathbf{961 \text{ mm}}$

Vert distance to centre of gravity entire gabion $y_g = ((W_{g2} * y_{g2}) + (W_{g3} * y_{g3})) / W_g = \mathbf{979 \text{ mm}}$

Correcting for wall inclination horiz dist $x_g = x_g * \cos(\epsilon) + y_g * \sin(\epsilon) = \mathbf{961 \text{ mm}}$

Vertical change in height due to wall inclination $H_t = y_{g3} + h_3/2 - ((y_{g3} + h_3/2) * \cos(\epsilon) - (x_{g3} + w_3/2) * \sin(\epsilon)) = \mathbf{0 \text{ mm}}$

Design dimensions

Effective angle of rear plane of wall $\alpha = 90 \text{ deg} + \epsilon = \mathbf{90.0 \text{ deg}}$

Effective face angle $\theta = \text{Atan}((y_{g3} + (h_3 / 2)) / ((x_{g3} - (w_3 / 2)))) - \epsilon = \mathbf{85.7 \text{ deg}}$

Effective height of wall $H = (y_{g3} + h_3 / 2) + (w_2 * \sin(\epsilon)) - H_t = \mathbf{2000 \text{ mm}}$

Height of wall from toe to front edge of top gabion $H_{incl} = ((y_{g3} + h_3 / 2) * \cos(\epsilon) - (x_{g3} - (w_3 / 2)) * \sin(\epsilon)) = \mathbf{2000 \text{ mm}}$

Active pressure using Coulomb theory $K_a = \sin(\alpha + \phi'_{r,d})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r,d}) * (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) * \sin(\phi'_{r,d} - \beta) / (\sin(\alpha - \delta_{r,d}) * \sin(\alpha + \beta))}))^2 = \mathbf{0.393}$

Active thrust due to soil $P_{a,soil} = 0.5 * K_a * \gamma_{s,d} * H^2 = \mathbf{14.9 \text{ kN/m}}$

Horizontal forces

Retained soil $F_{soil,h} = \gamma_G * P_{a,soil} * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{14.1 \text{ kN/m}}$

Surcharge $F_{surch,h} = p_{o,Q} * \gamma_Q * K_a * H * \cos(90 - \alpha + \delta_{r,d}) = \mathbf{1.0 \text{ kN/m}}$

Vertical forces

Gabion weight $F_{gabion,v,f} = \gamma_{G,f} * W_g = \mathbf{55.0 \text{ kN/m}}$

Retained soil $F_{soil,v,f} = \gamma_{G,f} * P_{a,soil} * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{5.0 \text{ kN/m}}$

Surcharge $F_{surch,v,f} = p_{o,Q} * \gamma_{Q,f} * K_a * H * \sin(90 - \alpha + \delta_{r,d}) = \mathbf{0.0 \text{ kN/m}}$

Overturning stability - take moments about the toe

Overturning moment $M_o = F_{soil,h} * d_{h,soil} + F_{surch,h} * d_{h,surch} = \mathbf{10.3 \text{ kNm/m}}$

Restoring moment $M_R = F_{gabion,v,f} * X_g + F_{soil,v,f} * b_{v,soil} + F_{surch,v,f} * b_{v,surch} = \mathbf{62.1 \text{ kNm/m}}$

Factor of safety $FoS_M = M_R / M_o = \mathbf{6.014}$

Allowable factor of safety $FoS_{M,allow} = \mathbf{1.000}$

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

Sliding stability - ignore any passive pressure in front of the structure

Total horizontal force $T = F_{soil,h} + F_{surch,h} = \mathbf{15.0 \text{ kN/m}}$

Total vertical force $N = F_{gabion,v,f} + F_{soil,v,f} + F_{surch,v,f} = \mathbf{60.0 \text{ kN/m}}$

Sliding force $F_t = T * \cos(\epsilon) - N * \sin(\epsilon) = \mathbf{15.0 \text{ kN/m}}$

Sliding resistance $F_R = (T * \sin(\epsilon) + N * \cos(\epsilon)) * \tan(\delta_{bg,d}) = \mathbf{30.0 \text{ kN/m}}$

Factor of safety $FoS_S = F_R / F_t = \mathbf{1.998}$

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Allowable factor of safety

$$FoS_{allow} = 1.000$$

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

Check overturning and sliding between courses 2 and 3

Wall geometry

Horizontal distance to centre of gravity gabion 3

$$X_{g3} = w_3 / 2 = 850 \text{ mm}$$

Vertical distance to centre of gravity gabion 3

$$y_{g3} = h_3 / 2 = 500 \text{ mm}$$

Weight of gabion 3

$$W_{g3} = \gamma_d * w_3 * h_3 = 26.4 \text{ kN/m}$$

Weight of entire gabion

$$W_g = W_{g3} = 26.4 \text{ kN/m}$$

Horiz distance to centre of gravity entire gabion

$$X_g = ((W_{g3} * X_{g3})) / W_g = 850 \text{ mm}$$

Vert distance to centre of gravity entire gabion

$$y_g = ((W_{g3} * y_{g3})) / W_g = 500 \text{ mm}$$

Correcting for wall inclination horiz dist

$$X_g = X_g * \cos(\epsilon) + y_g * \sin(\epsilon) = 850 \text{ mm}$$

Vertical change in height due to wall inclination

$$H_r = y_{g3} + h_3/2 - ((y_{g3} + h_3/2) * \cos(\epsilon) - (X_{g3} + w_3/2) * \sin(\epsilon)) = 0 \text{ mm}$$

Design dimensions

Effective angle of rear plane of wall

$$\alpha = 90 \text{ deg} + \epsilon = 90.0 \text{ deg}$$

Effective face angle

$$\theta = 90 \text{ deg} - \epsilon = 90.0 \text{ deg}$$

Effective height of wall

$$H = (y_{g3} + h_3 / 2) + (w_3 * \sin(\epsilon)) - H_r = 1000 \text{ mm}$$

Height of wall from toe to front edge of top gabion

$$H_{incl} = ((y_{g3} + h_3 / 2) * \cos(\epsilon) - (X_{g3} - (w_3 / 2)) * \sin(\epsilon)) = 1000 \text{ mm}$$

Active pressure using Coulomb theory

$$K_a = \sin(\alpha + \phi'_{r,d})^2 / (\sin(\alpha)^2 * \sin(\alpha - \delta_{r,d}) * (1 + \sqrt{(\sin(\phi'_{r,d} + \delta_{r,d}) * \sin(\phi'_{r,d} - \beta) / (\sin(\alpha - \delta_{r,d}) * \sin(\alpha + \beta))))^2) = 0.393$$

Active thrust due to soil

$$P_{a,soil} = 0.5 * K_a * \gamma_{s,d} * H^2 = 3.7 \text{ kN/m}$$

Horizontal forces

Retained soil

$$F_{soil,h} = \gamma_G * P_{a,soil} * \cos(90 - \alpha + \delta_{r,d}) = 3.5 \text{ kN/m}$$

Surcharge

$$F_{surch,h} = p_{o,Q} * \gamma_Q * K_a * H * \cos(90 - \alpha + \delta_{r,d}) = 0.5 \text{ kN/m}$$

Vertical forces

Gabion weight

$$F_{gabion,v,f} = \gamma_{G,f} * W_g = 26.4 \text{ kN/m}$$

Retained soil

$$F_{soil,v,f} = \gamma_{G,f} * P_{a,soil} * \sin(90 - \alpha + \delta_{r,d}) = 1.3 \text{ kN/m}$$

Surcharge

$$F_{surch,v,f} = p_{o,Q} * \gamma_{Q,f} * K_a * H * \sin(90 - \alpha + \delta_{r,d}) = 0.0 \text{ kN/m}$$

Overturning stability - take moments about the toe

Overturning moment

$$M_o = F_{soil,h} * d_{h,soil} + F_{surch,h} * d_{h,surch} = 1.4 \text{ kNm/m}$$

Restoring moment

$$M_R = F_{gabion,v,f} * X_g + F_{soil,v,f} * b_{v,soil} + F_{surch,v,f} * b_{v,surch} = 24.5 \text{ kNm/m}$$

Factor of safety

$$FoS_M = M_R / M_o = 17.373$$

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 front of the structure

Total horizontal force

$$T = F_{soil,h} + F_{surch,h} = 4.0 \text{ kN/m}$$

Total vertical force

$$N = F_{gabion,v,f} + F_{soil,v,f} + F_{surch,v,f} = 27.6 \text{ kN/m}$$

Sliding force

$$F_r = T * \cos(\epsilon) - N * \sin(\epsilon) = 4.0 \text{ kN/m}$$

Sliding resistance

$$F_R = (T * \sin(\epsilon) + N * \cos(\epsilon)) * \tan(\delta_{bg,d}) = 13.8 \text{ kN/m}$$

Factor of safety

$$FoS_S = F_R / F_r = 3.454$$

Allowable factor of safety

$$FoS_{S,allow} = 1.000$$

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

3. CONCLUSIONS

The calculations show that the gabion structure is stable.

24 Ormes Road, Skewen, Neath
September 2020

APPENDIX 1

24 ORMES ROAD, SKEWEN, NEATH

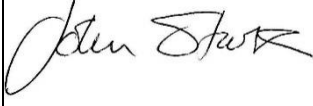
Ground Investigation Report

Report No. Q0177/GIR

February 2020

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<i>Disclaimer: Quantum Geotechnic Limited has prepared this report in accordance with the instructions of the above-named Client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.</i> Quantum Geotechnic Ltd, Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ ☎ 01554 744880 ✉ enquiries@quantumgeotech.co.uk				

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0.0 FOREWORD

The following Conditions and Notes on Site Investigation Procedures should be read in conjunction with this report.

General

Recommendations made and opinions expressed in the report are based on the strata observed in the excavations / recovered samples, together with the results of site and laboratory testing. No responsibility can be held for conditions which have not been revealed by the exploratory holes or which occur between exploratory holes. Whilst the report may suggest the likely configuration of strata, both between exploratory holes and below the maximum depth of investigation, this is only indicative and liability cannot be accepted for its accuracy.

Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction below or close to the site.

Investigation Procedures

Intrusive techniques for ground investigation have been employed throughout the project. All intrusive operations, geotechnical / environmental sampling, logging of soils / rocks and in-situ testing complies with the recommendations of the British Code of Practice BS 5930: 2015 'Site Investigations', British Code of Practice BS 10175: 2011 +A1:2013 'Investigation of Potentially Contaminated Sites' and BS 1377: 1990, 'Methods of Test for Soils for Engineering Purposes'.

Routine Sampling

Representative bulk, disturbed and environmental samples of the different strata were taken. All samples are returned from site to Quantum Geotechnic Ltd.'s laboratory partners for controlled storage within 24 hours of sampling to await test scheduling / requirements.

In-Situ Testing, Surveying & Instrumentation

In-situ testing comprised windowless sample boreholes with standard penetration tests, supplemented by dynamic probing.

Groundwater

Where possible, the depth of entry of any influx of groundwater is recorded during the course of excavation or boring operations. The rate of inflow into the excavation or borehole is monitored during the course of the excavation or during boring procedures. Upon encountering any water strikes, work is temporarily halted and the water levels monitored for a standard twenty-minute period recording the change in water level at the end of the twenty minutes.

Groundwater conditions observed in the excavations are those appertaining to the period of investigation. It should be noted, that groundwater levels are subject to diurnal, seasonal and climatic variations as well as affects caused by drainage conditions or other causes.

Retention of Samples

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material is discarded. Further to notifying the Client / Engineer with one week's notice, all soil and / or rock samples not tested will be discarded 28 days after submission of the approved final report.

1.0 INTRODUCTION

1.1 General

Upon the instructions of our Client, Ms. Jill Howells, Quantum Geotechnic Ltd (QG) was commissioned to undertake a ground investigation at 24 Ormes Road, Skewen, Neath.

1.2 Purpose of Ground Investigation

The purpose of the ground investigation was to allow a site-specific geotechnical assessment of the ground conditions, to aid with the design of the new dwelling following demolition of the existing structure on site and to identify any potential geotechnical and stability issues that may be present that may affect the proposed works.

1.3 Scope of Work

The general scope of work undertaken in the preparation of this assessment was as follows:

- Conduct an intrusive ground investigation with the aim of identifying the underlying ground conditions, targeting the issues that could potentially impact the reconstruction of the new property
- Carry out laboratory testing to gain geotechnical data.
- Provide an interpretative ground investigation report presenting an analysis of the ground conditions and offering recommendations on site suitability for the proposed development with regards to geotechnical parameters and overall stability.

The investigation works scoped by QG comprised of six windowless sample boreholes drilled to allow a ground model to be developed. The details of the work undertaken is described in Section 3.

General notes on the techniques employed by Quantum Geotechnic Ltd are described in the Foreword together with the limitations inherent in carrying out ground investigation work.

2.0 SITE SETTING

2.1 Site Description

The site is located at the eastern end of Ormes Road, Skewen. The postcode of the site is SA10 6SY.

The site is currently occupied by a bungalow on its western half with an outbuilding to the eastern side. A gabion retaining wall supports the higher ground to the north of the property.

The National Grid Reference of the centre of the site is SS 722 976. The approximate elevation of the site is c.70m.AOD. The site location is indicated on the aerial image capture presented below.



Figure 1: Site Location on Aerial Image ©Google Maps 2020 [Not to Scale]

2.2 Published Geology

The Six Inch to One Mile (1:10,560 scale) British Geological Survey map SS79NW shows the detailed geology of the site. An extract from the map is presented over page.



Figure 2: BGS SS79NW Extract (Not to Scale) British Geological Survey © NERC

This edition map indicates the site to have no superficial/soil cover, although Glacial Till (boulder clay) is mapped close to the south of the site boundary. The underlying solid strata is shown to be from the Hughes Beds of the Upper Coal Measures. The conjectural outcrop of the Swansea Two Feet coal seam is shown approximately 30m south of the site. The strata are shown dipping in a generally northern direction at angles of around 10°.

The current British Geological Survey on-line mapping resource 'Geology of Britain viewer' <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> shows a similar setting to the large scale map, with the Hughes Beds being described as mudstones, siltstones and sandstones.

The map also details historical mining features with two adits to the east of the site; the closest being some 150m distant.

2.3 Mining History

Given the location of the site and proximity of potential historical mining features, a Coal Authority Mining Report has been obtained for the site. This is presented in Appendix V.

In summary the Report states:

Past Underground Mining: The property is in a surface area that could be affected by underground mining in 1 seam of coal at 230m to 240m depth, and last worked in 1910. Any movement in the ground due to coal mining activity associated with these workings should have stopped by now.

Present underground coal mining: The property is not within a surface area that could be affected by present underground mining.

Mine Entries: There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.

Opencast coal mining: The property is not within the boundary of an opencast site from which coal has been removed by opencast methods. The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

Coal mining subsidence: The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994. There is no current Stop Notice delaying the start of remedial works or repairs to the property. The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine Gas:

The Coal Authority has no record of a mine gas emission requiring action.

Hazards related to coal mining: The property has not been subject to remedial works, by or on behalf of the Coal Authority, under its Emergency Surface Hazard Call Out procedures.

3.0 FIELDWORK

The fieldwork was carried out between the 14th and 15th January 2020 under the direction of Quantum's Project Engineer.

The windowless sample boreholes were positioned in order to provide detailed information on the ground for the new build and to be able to draw a cross section through the site for development and assessment of the ground model.

The fieldworks comprised of six boreholes advanced by percussive windowless sampling methods. On refusal of the windowless sampling, the boreholes were extended by continuous dynamic probing, to refusal. A summary of the investigation hole depths is tabulated below. Groundwater monitoring standpipes were installed in two boreholes' one above the gabion wall; and one at house level.

In addition, two infiltration permeability tests were carried out in the boreholes WS05 and WS06 to inform the drainage strategy for the site.

Table 1: Summary of Investigation holes.

Borehole	Location)	Depth (m.bgl)	Observations
WS01	Above Gabion	2.5m	WS to 2.0m; DP extended to 2.5m.
WS02	Above Gabion	2.1m	WS to 2.0m; DP extended to 2.1m. Standpipe installed.
WS03	Road/Front	3.5m	WS to 3.0m; DP extended to 3.5m.
WS04	Road/Front	3.5m	WS to 3.0m; DP extended to 3.5m.
WS05	Adj. Bungalow	1.6m	WS to 1.4m; DP extended to 1.6m.
WS06	Adj. Bungalow	1.8m	WS to 1.5m; DP extended to 1.8m. Standpipe installed.

All site operations, sampling and logging, including in-situ testing were undertaken in accordance with the relevant British Standards, namely: BS5930:2015 *Code of practice for ground investigation*; BS EN 1997-2:2007 *Eurocode 7. Geotechnical design. Ground investigation and testing*; BS1377-9:1999 *Method of test for soils for civil engineering purposes. In-situ testing*; BS EN ISO 14688-1:2018 *Geotechnical investigation and testing. Identification and classification of soil. Identification and description*; and BS EN ISO 14688-2:2018 *Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification* and BS EN ISO 22476-2:2005+A1:2011 *Geotechnical investigation and testing. Field testing. Dynamic probing*.

The relative positions of the holes are shown on the site plan included in Appendix I. The engineering logs of the investigation holes are presented in Appendix II. The permeability test results are presented in Appendix III.

4.0 LABORATORY TESTING

4.1 General

The laboratory testing was scheduled by Quantum and comprised of geotechnical testing on selected soil samples obtained from the investigation to inform interpretation of the ground.

4.2 Geotechnical Laboratory Testing

All the geotechnical soil testing was carried out in accordance with the procedure stipulated in the various sections of BS 1377:1999 Parts 1 – 9 Methods of test for soils for civil engineering purposes. Table 2 details the tests undertaken.

Table 2: Summary of Scheduled Geotechnical Tests.

Type of Test	No. of Tests
Natural Moisture Content	9
Atterberg Limits.	9
PSD - Wet Sieve	9
PSD - Sedimentation	9
pH & Sulphate	6

A full set of geotechnical laboratory test certificates are provided within Appendix IV.

5.0 GROUND CONDITIONS

5.1 Summary of Strata Encountered

A detailed description of the strata encountered during the investigation is given in the Engineering Geologist's logs presented in Appendix II. Table 3 summarises the strata encountered in the investigation holes.

Table 3: Summary of strata encountered

Borehole	Depth (m.bgl)		Description
	From	To	
WS01 <i>Above Gabion</i>	GL	0.45	Made Ground: Silty slightly Sandy GRAVEL
	0.45	>2.0	Firm slightly gravelly & sandy CLAY <i>Slow groundwater ingress at 1.9m depth</i>
WS02 <i>Above Gabion</i>	GL	0.35	Made Ground: Sandy GRAVEL (Hardcore)
	0.35	0.7	Made Ground: Slightly sandy & gravelly CLAY
	0.7	1.8	Firm slightly gravelly & sandy CLAY
	1.8	>2.0	Medium dense clayey slightly sandy GRAVEL <i>Medium groundwater ingress at 1.7m depth</i>
WS03 <i>In Road</i>	GL	1.3	Made Ground: Slightly clayey, silty & sandy GRAVEL
	1.3	1.6	Soft organic SILT/CLAY
	1.6	2.3	Soft slightly gravelly & sandy CLAY
	2.3	>3.0	Soft to firm slightly sandy gravelly CLAY <i>No groundwater</i>
WS04 <i>In Road</i>	GL	1.5	Made Ground: Slightly clayey, silty & sandy GRAVEL
	1.5	2.2	Soft slightly sandy slightly organic SILT/CLAY
	2.2	>3.0	Soft to firm slightly sandy gravelly CLAY <i>No groundwater</i>
WS05 <i>Adj. House</i>	GL	0.35	Made Ground: clayey slightly sandy GRAVEL
	0.35	>1.4	Dense clayey slightly sandy GRAVEL <i>Slow groundwater ingress at 1.2m depth</i>
WS06 <i>Adj. House</i>	GL	0.3	Made Ground: clayey slightly sandy GRAVEL
	0.3	>1.5	Dense clayey slightly sandy GRAVEL <i>Slow groundwater ingress at 1.3m depth</i>

A schematic cross section has been constructed through the site and is presented in Appendix I.

In summary, this ground model shows beneath a mantle of mixed made ground over firm variably sandy and gravelly Clay at the upper level, north of the gabion wall (WS01/WS02).

The boreholes drilled adjacent to the house (WS05/WS06), at around existing house formation level, reveal a dense clayey and sandy Gravel.

The two boreholes drilled to the south on Ormes Road (WS03/WS04) revealed up to 1.5m of mixed poorly compacted Made Ground resting on a slightly organic soft Clay; perhaps the original ground level. This gave way to soft, becoming soft to firm, sandy gravelly Clay.

All the window sample boreholes terminated in firm/stiff or dense strata at their bases. The follow on dynamic probes all showed a rapidly increasing relative density, reaching refusal within 0.5m of the window sample borehole base. This is interpreted as the on-set of weathered bedrock.

The succession of strata in each trial hole beneath the re-worked stratum, where present, revealed a weathered profile of the underlying bedrock.

5.2 Groundwater Conditions

Groundwater strikes were recorded in four of the six window sample boreholes drilled.

The depths of water strikes were as follows:

Table 4: Summary of Groundwater Strikes

Borehole	Depth of GW Strike (m.bgl)
WS01	1.9
WS02	1.7
WS03	None
WS04	None
WS05	1.2
WS06	1.3

Simple standpipes were installed in WS02 and WS06 to measure the equilibrium groundwater level.

It should be noted that groundwater levels are subject to diurnal, seasonal and climatic conditions or may vary due to other causes.

5.3 Visual & Olfactory Evidence of Soil Contamination

There was no visual and / or olfactory evidence of any soil contamination during the investigation works.

5.4 Visual & Olfactory Evidence of Groundwater & Surface Water Contamination

There was no evidence of any groundwater contamination during the investigation works.

6.0 GEOTECHNICAL ENGINEERING APPRAISAL

6.1 General

The purpose of this Ground Investigation, and subsequent reporting, was to determine and assess the existing shallow ground conditions on site in preparation for the construction of new storage tanks.

The main aims of the geotechnical investigation are to provide an assessment of the ground conditions to inform design of the proposed works and determine chemical conditions in respect of below ground structures, confirm ground water levels within the working area and highlight any potential contamination issues revealed within the ground.

6.2 Engineering Properties of Strata

The engineering descriptions of the strata are presented on the exploratory hole logs in Appendix II.

A summary of the geotechnical testing classification testing results are summarised in the table below.

Table 5: Summary of Geotechnical Test Results

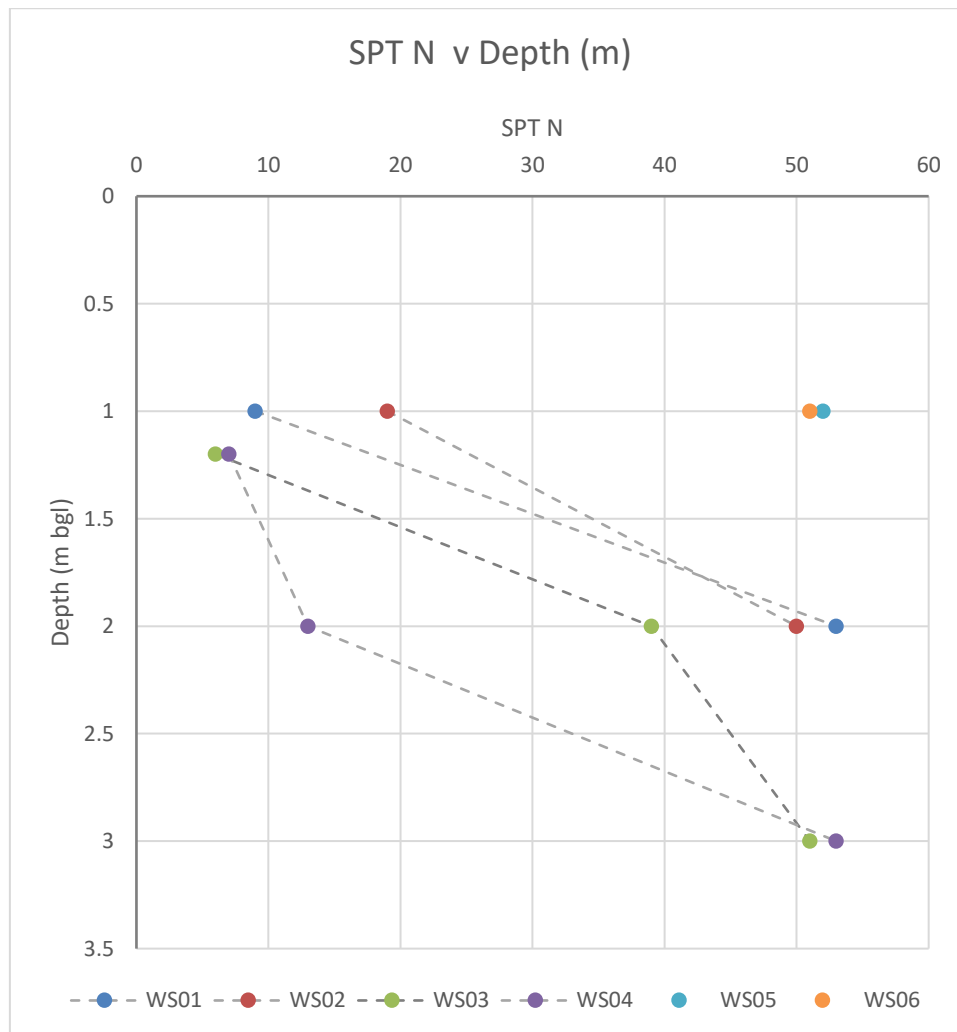
Hole	Depth (m)	Classification Tests							Particle Size Gradings				
		w	LL	PL	PI	<425 μ m	PI _{mod}	Plasticity	Cobbles	Gravel	Sand	Silt	Clay
		%	%	%	%	%	%		%	%	%	%	%
WS01	1.0	20	46	22	24	65	16	CI	0	25	19	21	35
WS02	0.7	27											
WS02	1.0	31	65	21	44	100	44	CH	0	0	1	4	95
WS02	1.3	20	52	23	29	72	21	CH	0	22	9	14	55
	2.0	10											
WS03	1.4	39											
	1.8	20											
	2.5	19	53	18	35	50	18	CH	0	32	26	14	28
WS04	0.5	12											
	1.8	25	46	19	27	87	23	CI					
	2.5	17	40	16	24	31	7	CI	0	53	23	6	18
WS05	0.5	25	51	20	31	48	15	CH	0	48	11	11	30
WS06	0.5	15	45	17	28	20	6	CI	0	72	11	4	13

Classification tests showed variable characteristics: A cohesive dominant soil was proved in WS01 & WS02 above the gabion wall, with a more mixed soil in WS05/WS06 at house level and in the ground to the south. The Modified Plasticity Index, allowing for the proportion of coarser material, ranged between 6% and 44%.

At this modified Plasticity Index these shallow soils are predominantly of *Medium* shrink/swell potential (in accordance with NHBC Standards), with one higher value in WS02 of 44%. The classification of CI and CH type soils is more akin to a completely weathered bedrock than typical clay soils in this area.

The results of the Particle Size Distribution curves (PSD) analysis undertaken confirm the range in soil types present.

The consistency and relative density of the soil profile was measured by undertaking Standard Penetration Tests in the window sample boreholes. A summary of the results is presented graphically below.



From these results, the overall average SPT N is 33, with a 25th percentile value of 12. Taking the mean value of all tests in natural soils where full penetration was achieved; the average N value is 36. Adopting the 25th percentile value as indicative of a characteristic value, the N_{char} is 17.

6.3 Foundations

Foundations for the new building on site should be set in the natural clayey slightly sandy Gravel proved at a depth of 0.35m in WS05. Foundations should be constructed at a level consistent with Building Regulations requirements and the maximum modified Plasticity Index recorded of 44%.

On the basis of the SPT testing undertaken, given the presence of relatively shallow groundwater, we would recommend an allowable bearing capacity of 85kN/m² at a depth below 0.5m in this stratum.

We would recommend that the new house foundations are set on a raft foundation to limit any differential settlements.

The existing bungalow showed evidence of differential settlement at the front (south) of the building,

suggesting a variation in founding strata across the footprint of the property. We would therefore recommend that any new foundations are set within uniform strata across the foundation. This may require excavation and replacement of unsuitable soils on the southern elevation, or possibly deepening or stepping of the foundation to suit.

6.4 Site Stability

The area of Ormes Road has an anecdotal history of generic instability.

The geological map extract presented in Section 2.2 does not detail any areas of made ground or landslip.

The BGS *GeoIndex* on-line resource shows recorded landslides along with areas of *made ground*, *landscaped ground* and *worked ground*. An extract from this is presented below for the Skewen area.

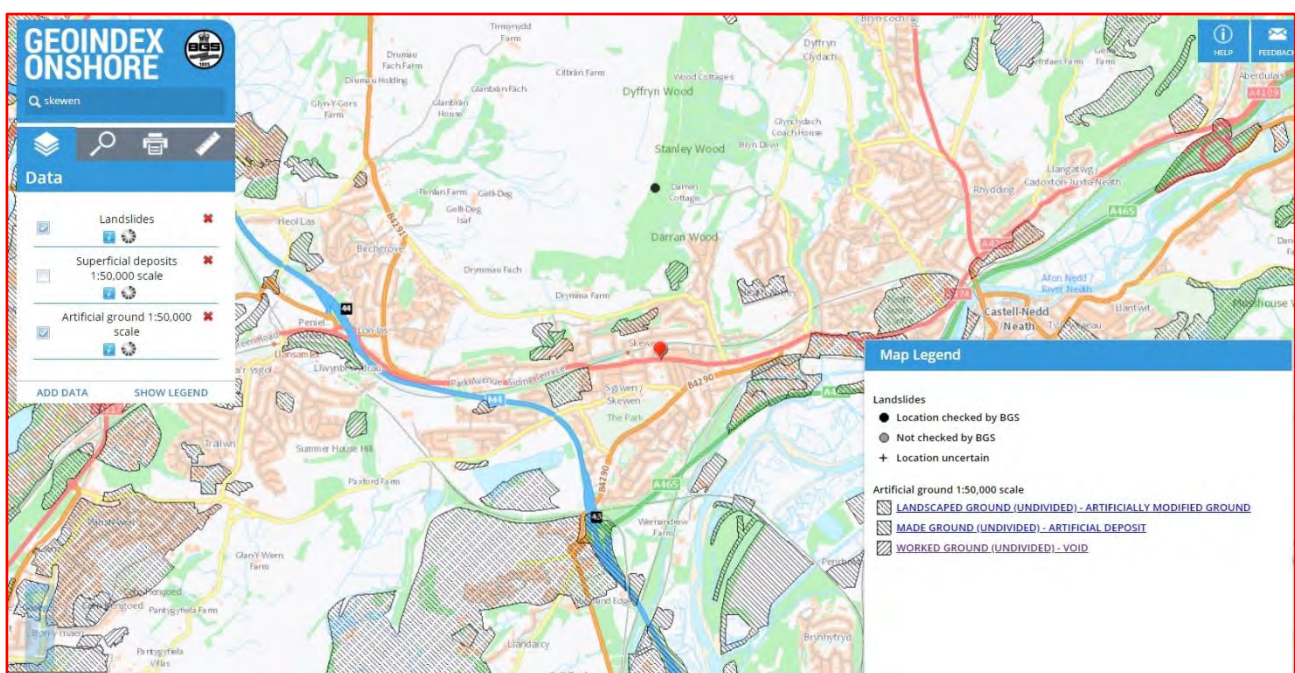


Figure 3: BGS GeoIndex Extract (British Geological Survey © NERC)

The only recorded landslip is to the north of the site. An area of *Made Ground* is mapped to the east of the site, interpreted to be associated with former coal mining activity.

The Institute of Geological Sciences South Wales Coalfield Landslip Survey (1980) mapped all landslides in the South Wales Coalfield area. No feature is noted in the Skewen area.

From the investigation work undertaken for this development site, undisturbed ground has been proved over the whole site, with the boreholes proving the on-set of bedrock at their bases.

Given the findings of the investigation and ground model concluded (Figure 2 Appendix I), the new development will be entirely within virgin ground, with the foundation footprint (and zone of influence of load) being within competent strata.

The investigation boreholes put down on the higher ground above the gabion wall forming part of the northern boundary of the site, indicate that this is founded on dense/firm ground. The material retained by the wall is essentially a firm, becoming firmer/denser with depth, variably sandy and gravelly Clay.

A properly designed retaining structure will be required immediately north of the new building. Typical characteristic parameters that could be used in the design of this, based on the ground investigation, are:

$$\phi' = 32^\circ$$

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

$$\gamma' = 19 \text{ kN/m}^3$$

Any drainage entering the site from the northern side as part of any temporary or permanent works must be trained in to formal drainage and not allowed to percolate to ground.

6.5 Earthworks

Site Preparation

Prior to commencing any earth / groundworks for any proposed works, any live services on and in the vicinity of the site, should be accurately located, protected and diverted, if required. Any ledges of hard rock, roots of trees or former services at the base of the proposed development area shall be excavated and replaced with general fill which shall be suitably compacted.

All topsoil shall be stripped. Where required for further use, stockpiled in an area provided by the contractor and agreed by the Engineer.

Any exposed formations should be protected from the effects of the weather, site traffic or water in order to prevent deterioration of this surface. It is recommended that any exposed formation be protected with a minimum thickness of 200mm of suitable granular material or a thin layer of building concrete, which should be placed immediately after excavation and exposure.

Cutting and Filling

Cutting and filling is not envisaged to be required for this development.

Excavation Plant

On the basis of the observations made during the investigation, it is considered that excavations within the natural soils will be possible with conventional excavation plant.

The excavatability of the strata below the depths of investigation cannot be commented on.

Control of Groundwater

Groundwater was encountered at 1.2m.bgl in WS05 adjacent to the existing house. Conventional foundation excavations should therefore not encounter significant groundwater inflows.

If deeper excavations that approach 1.2m, for whatever purpose, do encounter groundwater, then some instability may be encountered owing to the granular dominant nature of the soils encountered on this level of the site.

Sump pumping should be adequate for dewatering any excavations where groundwater seepage is encountered or where surface water ingress occurs. Care must be taken in any control of groundwater that a loss of fines from any formation is inhibited.

Any pumping out of groundwater from excavations should be properly trained to existing drains, assuming the appropriate permissions have been obtained.

Stability of Excavations

From observations made on site, it would be prudent to allow for temporary support or shoring of excavations which should be mandatory if manned entry is required. Given the presence of groundwater, temporary support of the excavations should be allowed for.

6.6 Concrete Classification

The Aggressive Chemical Environment for Concrete (ACEC) classification for the site has been assessed according to the guidelines within BRE Special Digest (2005). For classification purposes, based on the BRE guidance, the groundwater must be classed as 'mobile' unless proven to be 'static' over a 24hr period.

The pH values of the soil samples taken from across the site ranged between 6.1 and 6.8 whilst the levels of water-soluble sulphate (SO_4) content of the tested soil samples varied between 0.03g/l and 0.06g/l.

Based on the there being little re-worked soils on the development footprint site a *greenfield* situation is assumed with a mobile water table. The Design Sulphate (DS) class for the site is assessed as DS-1 with an ACEC classification as AC-1.

6.7 Infiltration Testing

Two borehole soakaway tests were undertaken as part of the ground investigation work in the two boreholes drilled adjacent and on the level of the existing bungalow. The test results are presented in Appendix III.

The tests did not result in a sufficient drop in water level to allow calculation of the infiltration rate by conventional methods. The infiltration rate was therefore calculated using the procedure within BS5930 for borehole permeability testing by the general approach. The permeability infiltration rates calculated were:

WS05: 8.8×10^{-8} m/sec

WS06: 1.1×10^{-8} m/sec

These indicate very poor drainage characteristics that would not lend themselves to soakaway drainage.

Given the history of the wider site area as discussed in Section 6.4. We would not recommend that soakaway drainage to the ground was utilised.

7 REFERENCES

British Geological Survey (BGS)

- British Geological Survey Sheet SS79NW 1:10,560 scale.
- BGS Geology of Britain Viewer/GeoIndex (www.bgs.ac.uk).
- IGS Special Surveys Division (1980), South Wales Landslip Survey, Report No. EG80/4.

Coal Authority

- Mining Report No. 51002233175001, January 2020

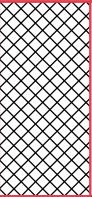
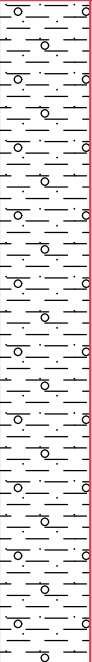
Specialist Publications

- BS 5930:2015 '*Code of Practice for Site Investigations*'
- BS 1377:1990 '*Methods of test for soils for civil engineering purposes*'.
- BS EN ISO 14688-1:2018 *Geotechnical investigation and testing. Identification and classification of soil. Identification and description.*
- BS EN ISO 14688-2:2018 *Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification.*
- BS EN 1997-2:2007 *Eurocode 7. Geotechnical design. Ground investigation and testing*;
- *BS EN ISO 22476-2:2005+A1:2011 Geotechnical investigation and testing. Field testing. Dynamic probing.*
- Health and Safety Executive Guidance Note EH40/90
- BRE (2005) Special Digest 1:2005, 3rd Edition, *Concrete in aggressive ground.*
- BS 6031: 2009 *Code of Practice for Earthworks.*
- CIRIA Report 113 (1986) *Control of Groundwater for Temporary Works*
- Workmanship for excavation shall comply with BS 8000: 1989 Part 1, Sections 3.1, 3.2 and 3.3.
- Bentley and Carter (1991) *Correlations of Soil Properties.*

APPENDIX I – SITE PLANS

APPENDIX II – EXPLORATORY HOLE LOGS

Contract : 24 Ormes Road, Skewen										Window Sample No.	
Client : Jill Howells										WS01	
Dates : 14/1/20 - 14/1/20					Job Number : Q0177			Ground Level :			
Location : Above Gabion baskets					Engineer :			Coordinates:			

	Samples		Sample Run		Tests		STRATA					Water
	Depth	Type No.	Diam. (mm)	Recovery (%)	Depth	SPT & Hand Vane Results	Depth (Thickness)	DESCRIPTION	Legend	Depth (Thickness)		
1	0.20	D 1					(0.45)	MADE GROUND: Black silty slightly sandy GRAVEL. Gravel is angular to sub angular fine to coarse sandstone siltstone and tile, fine to medium coal and ash.		(0.45)		
			87	55			0.45	Firm mottled brownish orange grey slightly gravelly slightly sandy CLAY. Gravel is angular to sub angular fine to coarse siltstone.		0.45		
	1.00 - 2.00	B 2			1.00	SPT (C) 9 (1-0-1-2-3-3)	(1.55)	with pockets of slightly sandy slightly gravelly Silt.		(1.55)		
2					2.00	SPT (C) 53 (7-9-12-13-14-14)	2.00	Sampling terminated on refusal of sampler and CPT. Continued with Dynamic probe.		2.00		

Equipment / plant used: Dart terrier rig

Remarks: Available STATS checked and area CAT and genny scanned prior to excavation. On completion hole backfilled with bentonite pellets with arisings to surface as existing layer.

Slow water ingress at 1.9mbgl

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator: DS&ST	Logged By: A Jones	Sheet No. 1 Of 1	m Per Page 3.5	All measurements in metres unless otherwise stated	
	Library File: C:\USERS\ARWELJONES\QUANTUM\DESKTOP\QUANTUM 4.GLB. Form Name: WINDOW SAMPLE PREC2 WITH SPT. Version 1.10.100, 10/05/16 Output By: ArwelJones						

Contract : 24 Ormes Road, Skewen

Client : Jill Howells

Borehole No.

WS01

Dates : 14/1/20 - 14/1/20

Job Number : Q0177

Ground Level :

Location : Above Gabion baskets

Engineer :

Coordinates:

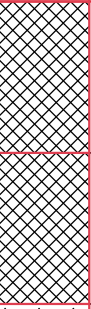
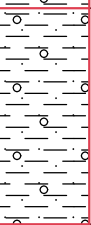


Contract : 24 Ormes Road, Skewen Client : Jill Howells											Dynamic Probe WS01	
Dates : 14/1/20 - 14/1/20 Location : Above Gabion baskets					Job Number : Q0177 Engineer :					Ground Level : Coordinates:		

Depth (m)	Reading (Blows / 100mm)					BLOW COUNT (N100 VALUES)										Torque (Nm)	Remarks
	1	2	3	4	5	5	10	15	20	25	30	35	40	45			
0.5																	
1.0																	
1.5																	
2.0	7																
		9															
			13														
				31													
2.5					50												
3.0																	
3.5																	
4.0																	
4.5																	
5.0																	
5.5																	
6.0																	
6.5																	
7.0																	
7.5																	
8.0																	
8.5																	
9.0																	
9.5																	

Equipment: Dart terrier rig Test carried out in accordance with BS 1377 (1990):Part 9, Sect.3.2					Comments: Continued from window sample refusal.										
---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator: DS&ST	Logged By: A Jones	Sheet No. 1 Of 1	m Per Page 10	All measurements in metres unless otherwise stated	

Contract : 24 Ormes Road, Skewen Client : Jill Howells										Window Sample No. WS02	
Dates : 14/1/20 - 14/1/20 Location : Above Gabion baskets					Job Number : Q0177 Engineer :			Ground Level : Coordinates:			
Samples		Sample Run		Tests		STRATA					
Depth	Type No.	Diam. (mm)	Recovery (%)	Depth	SPT & Hand Vane Results	Depth (Thickness)	DESCRIPTION	Legend	Depth (Thickness)	Water	
1	0.30	D 1			SPT (C) 19 (3-3-4-5-5-5)	(0.35)	MADE GROUND: Grey slightly silty slightly sandy GRAVEL. Gravel is angular fine to coarse Limestone.		(0.35)		
						(0.35)	MADE GROUND: Soft to firm mottled brownish orange grey slightly gravelly slightly sandy re-worked CLAY. Gravel is angular to sub angular fine to coarse siltstone, siltstone and rare brick fragments with pockets of slightly sandy slightly gravelly Silt.		(0.35)		
	0.70	D 2	87	100		(0.70)	Firm mottled brownish orange grey slightly gravelly slightly sandy CLAY. Gravel is angular to sub angular fine to coarse siltstone and sandstone.		(0.60)		
	1.00 - 1.30	B 3				(1.30)	Pale brown slightly sandy gravelly CLAY. Gravel is angular to sub-angular fine to coarse siltstone and sandstone.		(0.50)		
	1.30 - 1.80	B 4	77	100		(1.80)	Pale brown clayey slightly sandy GRAVEL. Gravel is angular to sub angular fine to coarse siltstone and sandstone.		(0.20)		
2	2.00	D 5			SPT (C) 50/75mm (16-22-50---)	2.00	Sampling terminated on refusal of sampler and CPT. Continued with Dynamic probe.		2.00		

DRAFT

1
↓
↓

Equipment / plant used: Dart terrier rig
Remarks: Available STATS checked and area CAT and genny scanned prior to excavation. On completion hole installed with water monitoring standpipe.
 Medium water ingress at 1.7mbgl

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator:	Logged By:	Sheet No.	m Per Page	All measurements in metres unless otherwise stated	
		DS&ST	A Jones	1 Of 1	3.5		

Contract : 24 Ormes Road, Skewen

Client : Jill Howells

Borehole No.

WS02

Dates : 14/1/20 - 14/1/20

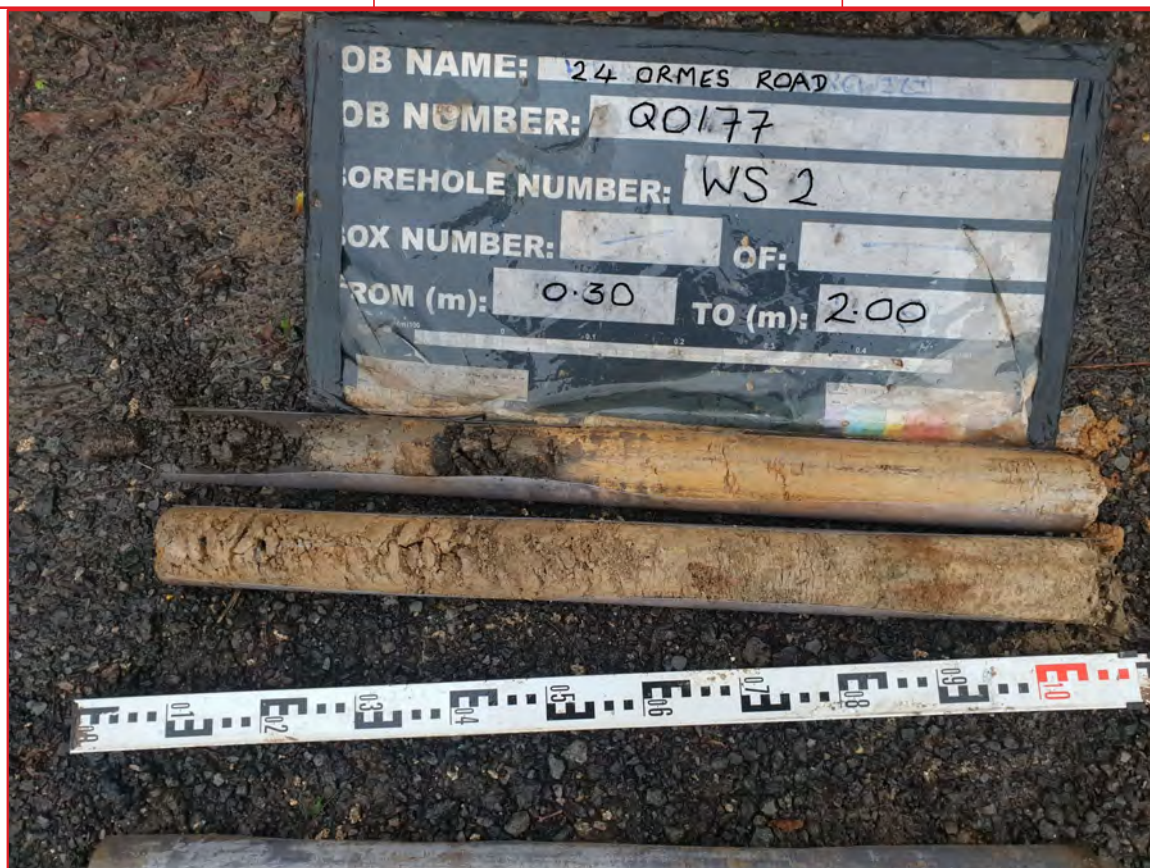
Job Number : Q0177

Ground Level :

Location : Above Gabion baskets

Engineer :

Coordinates:



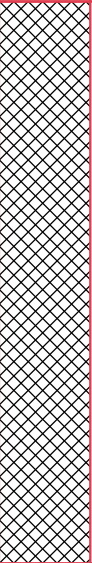
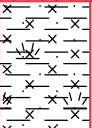
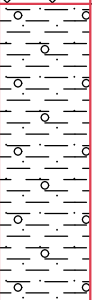
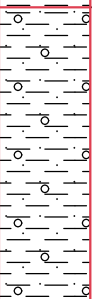
Contract : 24 Ormes Road, Skewen											Dynamic Probe WS02	
Client : Jill Howells												
Dates : 14/1/20 - 14/1/20					Job Number : Q0177					Ground Level :		
Location : Above Gabion baskets					Engineer :					Coordinates:		

Depth (m)	Reading (Blows / 100mm)					BLOW COUNT (N100 VALUES)										Torque (Nm)	Remarks
	1	2	3	4	5	5	10	15	20	25	30	35	40	45			
0.5																	
1.0																	
1.5																	
2.0	50																
2.5																	
3.0																	
3.5																	
4.0																	
4.5																	
5.0																	
5.5																	
6.0																	
6.5																	
7.0																	
7.5																	
8.0																	
8.5																	
9.0																	
9.5																	

Equipment: Dart terrier rig					Comments: Continued from window sample refusal.				
Test carried out in accordance with BS 1377 (1990):Part 9, Sect.3.2									

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		DS&ST	A Jones	1 Of 1	10		

Contract : 24 Ormes Road, Skewen										Window Sample No.	
Client : Jill Howells										WS03	
Dates : 14/1/20 - 14/1/20					Job Number : Q0177			Ground Level :			
Location : Road Level					Engineer :			Coordinates:			

	Samples		Sample Run		Tests		STRATA					Water
	Depth	Type No.	Diam. (mm)	Recovery (%)	Depth	SPT & Hand Vane Results	Depth (Thickness)	DESCRIPTION	Legend	Depth (Thickness)		
1	0.50 - 1.00	B 1			1.20	SPT (C) 6 (2-2-1-2-1-2)	(1.30)	MADE GROUND: Brown grey slightly clayey slightly silty slightly sandy GRAVEL with low cobble content of brick concrete and sandstone. Gravel is angular to sub angular fine to coarse sandstone, siltstone, brick and concrete.		(1.30)		
	1.40 - 1.60	D 2	87	95			1.30 (0.30)	Soft grey slightly sandy slightly organic SILT / CLAY.		1.30 (0.30)		
	1.80 - 2.00	D 3					1.60 (0.70)	Soft mottled brownish orange grey slightly gravelly slightly sandy CLAY. Gravel is angular to sub angular fine to coarse siltstone and sandstone.		1.60 (0.70)		
2	2.50 - 3.00	B 4	77	100	2.00	SPT (C) 39 (4-5-8-8-11-12)	2.30 (0.70)	Soft to firm pale brown slightly sandy gravelly CLAY. Gravel is angular to sub-angular fine to coarse siltstone and sandstone.		2.30 (0.70)		
3					3.00	SPT (C) 51 (4-8-10-13-14-14)	3.00	Sampling terminated on refusal of sampler and CPT. Continued with Dynamic probe.		3.00		

Equipment / plant used: Dart terrier rig

Remarks: Available STATS checked and area CAT and genny scanned prior to excavation. On completion hole backfilled with bentonite pellets with arisings to surface as existing layer.

Water entering pit from surface, standing water level on completion = 2.2mbgl

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator:	Logged By:	Sheet No.	m Per Page	All measurements in metres unless otherwise stated	
		DS&ST	A Jones	1 Of 1	3.5		

Library File: C:\USERS\ARWELJONES\QUANTUM\DESKTOP\QUANTUM 4.GLB. Form Name: WINDOW SAMPLE PREC2 WITH SPT. Version 1.10.100, 10/05/16 Output By: ArwelJones

Contract : 24 Ormes Road, Skewen

Client : Jill Howells

Borehole No.

WS03

Dates : 14/1/20 - 14/1/20

Job Number : Q0177

Ground Level :

Location : Road Level

Engineer :

Coordinates:



Plas Newydd, Llanedi,
Pontarddulais, Swansea, SA4 0FQ
Tel: 01554 744880
Fax:
email: enquiries@quantumgeotech.co.uk

Operator:
DS&ST

Logged By:
A Jones

Sheet No.
1 Of 1

**m Per
Page**
2

All measurements in
metres unless
otherwise stated

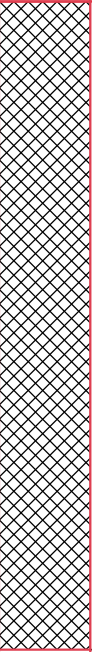
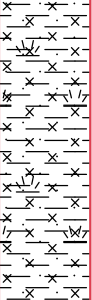
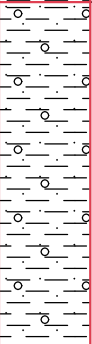


Contract : 24 Ormes Road, Skewen Client : Jill Howells											Dynamic Probe WS03	
Dates : 14/1/20 - 14/1/20 Location : Road Level					Job Number : Q0177 Engineer :					Ground Level : Coordinates:		

Depth (m)	Reading (Blows / 100mm)					BLOW COUNT (N100 VALUES)										Torque (Nm)	Remarks
	1	2	3	4	5	5	10	15	20	25	30	35	40	45			
0.5																	
1.0																	
1.5																	
2.0																	
2.5																	
3.0	13																
		18															
			19														
				25													
3.5					50												
4.0																	
4.5																	
5.0																	
5.5																	
6.0																	
6.5																	
7.0																	
7.5																	
8.0																	
8.5																	
9.0																	
9.5																	

Equipment: Dart terrier rig					Comments: Continued from window sample refusal.				
Test carried out in accordance with BS 1377 (1990):Part 9, Sect.3.2									

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator: DS&ST	Logged By: A Jones	Sheet No. 1 Of 1	m Per Page 10	All measurements in metres unless otherwise stated	
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Contract : 24 Ormes Road, Skewen Client : Jill Howells										Window Sample No. WS04	
Dates : 14/1/20 - 14/1/20 Location : Road Level					Job Number : Q0177 Engineer :			Ground Level : Coordinates:			
Samples		Sample Run		Tests		STRATA					
Depth	Type No.	Diam. (mm)	Recovery (%)	Depth	SPT & Hand Vane Results	Depth (Thickness)	DESCRIPTION	Legend	Depth (Thickness)	Water	
1	B 1			1.20	SPT (C) 7 (1-0-1-2-2-2)	1.50	MADE GROUND: Brown grey slightly clayey slightly silty slightly sandy GRAVEL with low cobble content of brick concrete and sandstone. Gravel is angular to sub angular fine to coarse sandstone, siltstone, brick and concrete.		1.50		
2	D 2			2.00	SPT (C) 13 (3-5-2-3-4-4)	2.20	Soft grey slightly sandy slightly organic SILT / CLAY.		2.20		
3	B 3			3.00	SPT (C) 53 (7-9-14-14-12-13)	3.00	Soft to firm pale brown slightly sandy gravelly CLAY. Gravel is angular to sub-angular fine to coarse siltstone and sandstone.		3.00		
							Sampling terminated on refusal of sampler and CPT. Continued with Dynamic probe.				

Equipment / plant used: Dart terrier rig
Remarks: Available STATS checked and area CAT and genny scanned prior to excavation. On completion hole backfilled with bentonite pellets with arisings to surface as existing layer.
 Water entering pit from surface, standing water level on completion = 2.5mbgl

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator:	Logged By:	Sheet No.	m Per Page	All measurements in metres unless otherwise stated	
		DS&ST	A Jones	1 Of 1	3.5		

Contract : 24 Ormes Road, Skewen

Client : Jill Howells

Borehole No.

WS04

Dates : 14/1/20 - 14/1/20

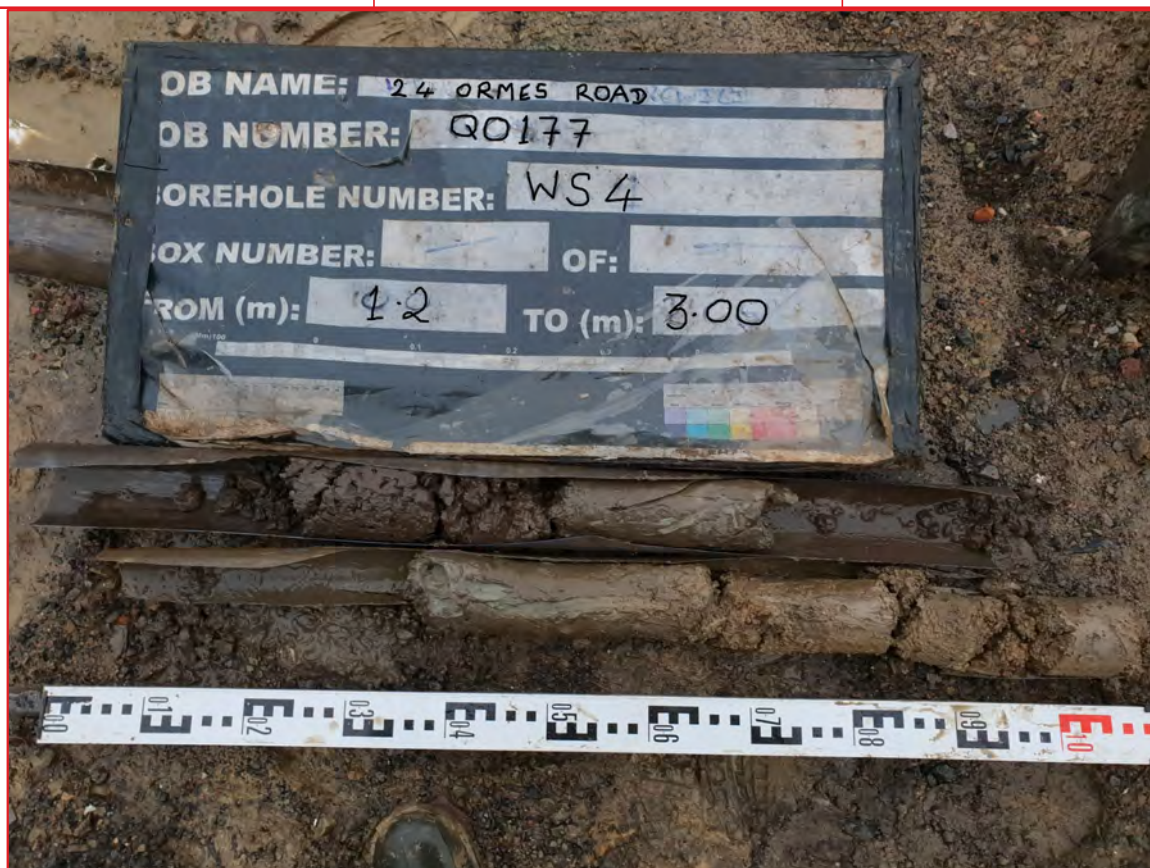
Job Number : Q0177

Ground Level :

Location : Road Level

Engineer :

Coordinates:



Plas Newydd, Llanedi,
Pontarddulais, Swansea, SA4 0FQ
Tel: 01554 744880
Fax:
email: enquiries@quantumgeotech.co.uk

Operator:
DS&ST

Logged By:
A Jones

Sheet No.
1 Of 1

**m Per
Page**
2

All measurements in
metres unless
otherwise stated

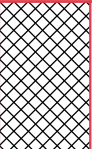
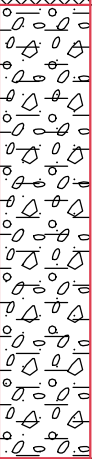


Contract : 24 Ormes Road, Skewen											Dynamic Probe WS04	
Client : Jill Howells												
Dates : 14/1/20 - 14/1/20					Job Number : Q0177					Ground Level :		
Location : Road Level					Engineer :					Coordinates:		

Depth (m)	Reading (Blows / 100mm)					BLOW COUNT (N100 VALUES)										Torque (Nm)	Remarks
	1	2	3	4	5	5	10	15	20	25	30	35	40	45			
0.5																	
1.0																	
1.5																	
2.0																	
2.5																	
3.0	16																
		19															
			25														
				32													
3.5					50												
4.0																	
4.5																	
5.0																	
5.5																	
6.0																	
6.5																	
7.0																	
7.5																	
8.0																	
8.5																	
9.0																	
9.5																	

Equipment: Dart terrier rig					Comments: Continued from window sample refusal.				
Test carried out in accordance with BS 1377 (1990):Part 9, Sect.3.2									

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator:	Logged By:	Sheet No.	m Per Page	All measurements in metres unless otherwise stated	
		DS&ST	A Jones	1 Of 1	10		

Contract : 24 Ormes Road, Skewen Client : Jill Howells										Window Sample No. WS05	
Dates : 15/1/20 - 15/1/20 Location : Below Gabion baskets					Job Number : Q0177 Engineer :			Ground Level : Coordinates:			
Samples		Sample Run		Tests		STRATA					
Depth	Type No.	Diam. (mm)	Recovery (%)	Depth	SPT & Hand Vane Results	Depth (Thickness)	DESCRIPTION	Legend	Depth (Thickness)	Water	
0.50 - 1.00	B 1			1.00	SPT (C) 52/225mm (10-15-15-17-20-)	(0.35)	MADE GROUND (Re-worked): Pale brown clayey slightly sandy GRAVEL with low cobble content of sandstone and rare brick. Gravel is angular to sub angular fine to coarse siltstone and sandstone.		(0.35)		
						0.35	Pale brown clayey slightly sandy GRAVEL. Gravel is angular to sub angular fine to coarse siltstone and sandstone.		0.35		
						(1.05)		(1.05)			
		87	0			1.40	Sampling terminated on refusal of sampler and CPT. Continued with Dynamic probe.		1.40		

DRAFT

Equipment / plant used: Orange wheeled rig

Remarks: Available STATS checked and area CAT and genny scanned prior to excavation. On completion hole backfilled with bentonite pellets with arisings to surface as existing layer.

Slow water ingress at 1.2mbgl

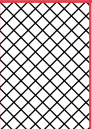
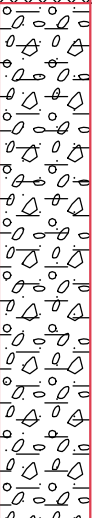
	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator:	Logged By:	Sheet No.	m Per Page	All measurements in metres unless otherwise stated	
		DS&ST	A Jones	1 Of 1	3.5		

Contract : 24 Ormes Road, Skewen Client : Jill Howells											Dynamic Probe WS05	
Dates : 15/1/20 - 15/1/20 Location : Below Gabion baskets					Job Number : Q0177 Engineer :					Ground Level : Coordinates:		

Depth (m)	Reading (Blows / 100mm)					BLOW COUNT (N100 VALUES)										Torque (Nm)	Remarks
	1	2	3	4	5	5	10	15	20	25	30	35	40	45			
0.5																	
1.0																	
1.5	31																
		50															
2.0																	
2.5																	
3.0																	
3.5																	
4.0																	
4.5																	
5.0																	
5.5																	
6.0																	
6.5																	
7.0																	
7.5																	
8.0																	
8.5																	
9.0																	
9.5																	

Equipment: Orange wheeled rig					Comments: Continued from window sample refusal.				
Test carried out in accordance with BS 1377 (1990):Part 9, Sect.3.2									

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator: DS&ST	Logged By: A Jones	Sheet No. 1 Of 1	m Per Page 10	All measurements in metres unless otherwise stated	

Contract : 24 Ormes Road, Skewen Client : Jill Howells										Window Sample No. WS06	
Dates : 15/1/20 - 15/1/20 Location : Below Gabion baskets					Job Number : Q0177 Engineer :			Ground Level : Coordinates:			
Samples		Sample Run		Tests		STRATA					
Depth	Type No.	Diam. (mm)	Recovery (%)	Depth	SPT & Hand Vane Results	Depth (Thickness)	DESCRIPTION	Legend	Depth (Thickness)	Water	
0.50 - 1.00	B 1	87	0	1.00	SPT (C) 51 (7-9-10-12-13-16)	(0.30)	MADE GROUND (Re-worked): Pale brown clayey slightly sandy GRAVEL with low cobble content of sandstone and rare brick. Gravel is angular to sub angular fine to coarse siltstone and sandstone.		(0.30)		
						0.30	Pale brown clayey slightly sandy GRAVEL. Gravel is angular to sub angular fine to coarse siltstone and sandstone.		0.30		
						(1.20)		(1.20)			
						1.50	Sampling terminated on refusal of sampler and CPT. Continued with Dynamic probe.		1.50		

DRAFT

Equipment / plant used: Orange wheeled rig
Remarks: Available STATS checked and area CAT and genny scanned prior to excavation. On completion hole installed with water monitoring standpipe.
 Slow water ingress at 1.3mbgl

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator:	Logged By:	Sheet No.	m Per Page	All measurements in metres unless otherwise stated	
		DS&ST	A Jones	1 Of 1	3.5		

Contract : 24 Ormes Road, Skewen											Dynamic Probe WS06	
Client : Jill Howells												
Dates : 15/1/20 - 15/1/20					Job Number : Q0177					Ground Level :		
Location : Below Gabion baskets					Engineer :					Coordinates:		

Depth (m)	Reading (Blows / 100mm)					BLOW COUNT (N100 VALUES)										Torque (Nm)	Remarks
	1	2	3	4	5	5	10	15	20	25	30	35	40	45			
0.5																	
1.0																	
1.5	11	27															
2.0			50														
2.5																	
3.0																	
3.5																	
4.0																	
4.5																	
5.0																	
5.5																	
6.0																	
6.5																	
7.0																	
7.5																	
8.0																	
8.5																	
9.0																	
9.5																	

Equipment: Orange wheeled rig					Comments: Continued from window sample refusal.				
Test carried out in accordance with BS 1377 (1990):Part 9, Sect.3.2									

	Plas Newydd, Llanedi, Pontarddulais, Swansea, SA4 0FQ Tel: 01554 744880 Fax: email: enquiries@quantumgeotech.co.uk	Operator:	Logged By:	Sheet No.	m Per Page	All measurements in metres unless otherwise stated	
		DS&ST	A Jones	1 Of 1	10		

APPENDIX III – INFILTRATION TEST RESULTS

Test Location : WS6
Test No : 1
Date : 15/01/2020

Diagram illustrating the components of a borehole soakaway:

- GL**: Ground Level
- WL**: Water Level
- Depth to water**: Vertical distance from the ground level to the water level.
- Borehole depth**: Total vertical depth of the borehole.
- Effective depth**: Vertical depth of the water column, divided into:
 - 75% Effective Depth (top portion)
 - 25% Effective Depth (bottom portion)

Effective depth (Head of Water) = 0.70 m

$$\begin{aligned} \mathbf{v}_{p75-25} &= 0.00 \text{ m}^3 \\ \mathbf{a}_{p50} &= 0.14 \text{ m}^2 \\ \mathbf{t}_{p75-25} &= 0 \text{ min} \end{aligned}$$

Soil Infiltration rate, f = m/sec
Unable to determine

Sheet 1 of 2

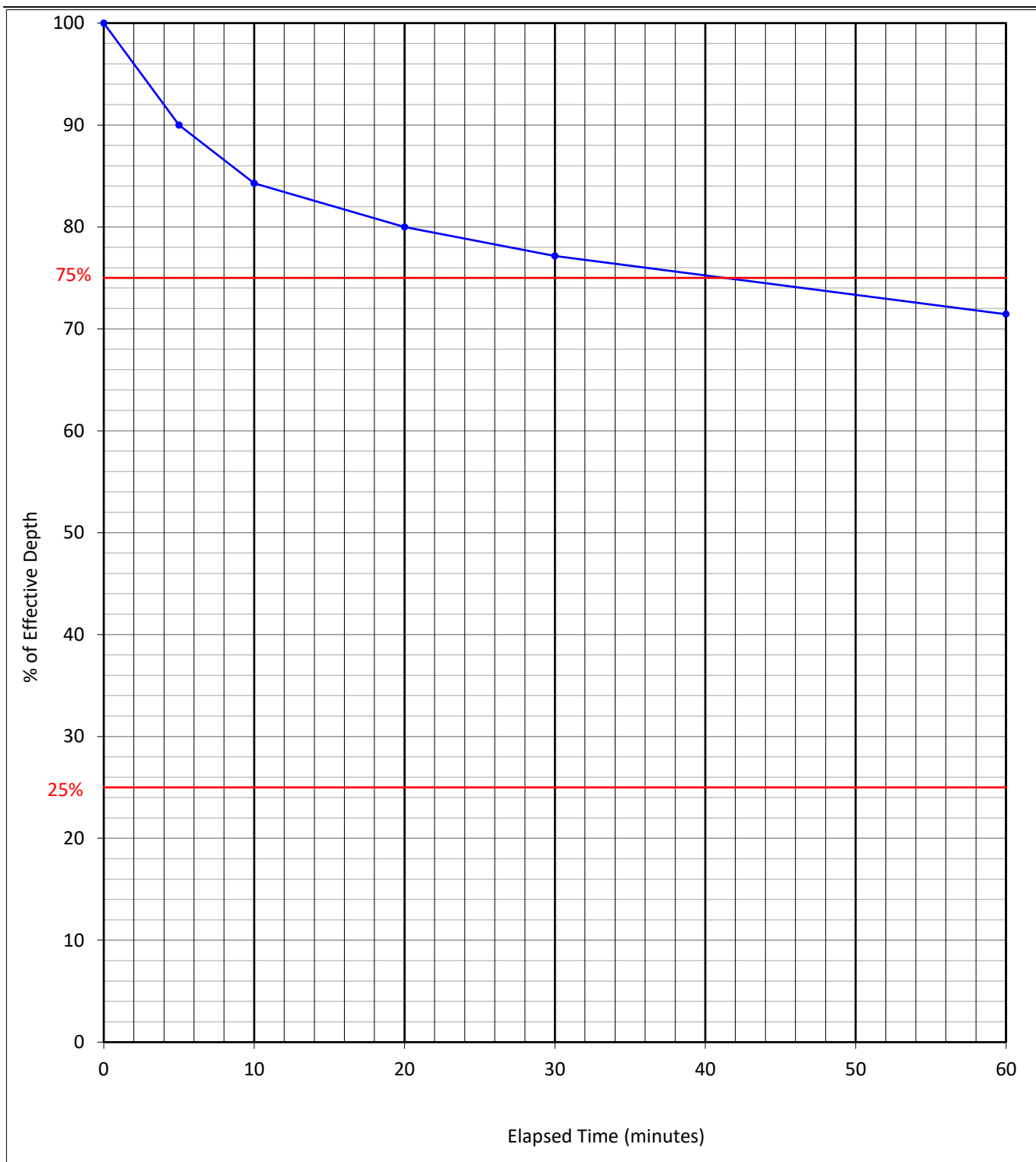
Remarks:



IN-SITU TESTING - Soakaway Test

Project: 24 Ormes Road
Project No: Q0177
Client: Jill Howells

Test Location : WS6
Test No : 1
Date : 15/01/2020



t_{p75} =	minutes
t_{p25} =	minutes

Sheet 2 of 2

Remarks:

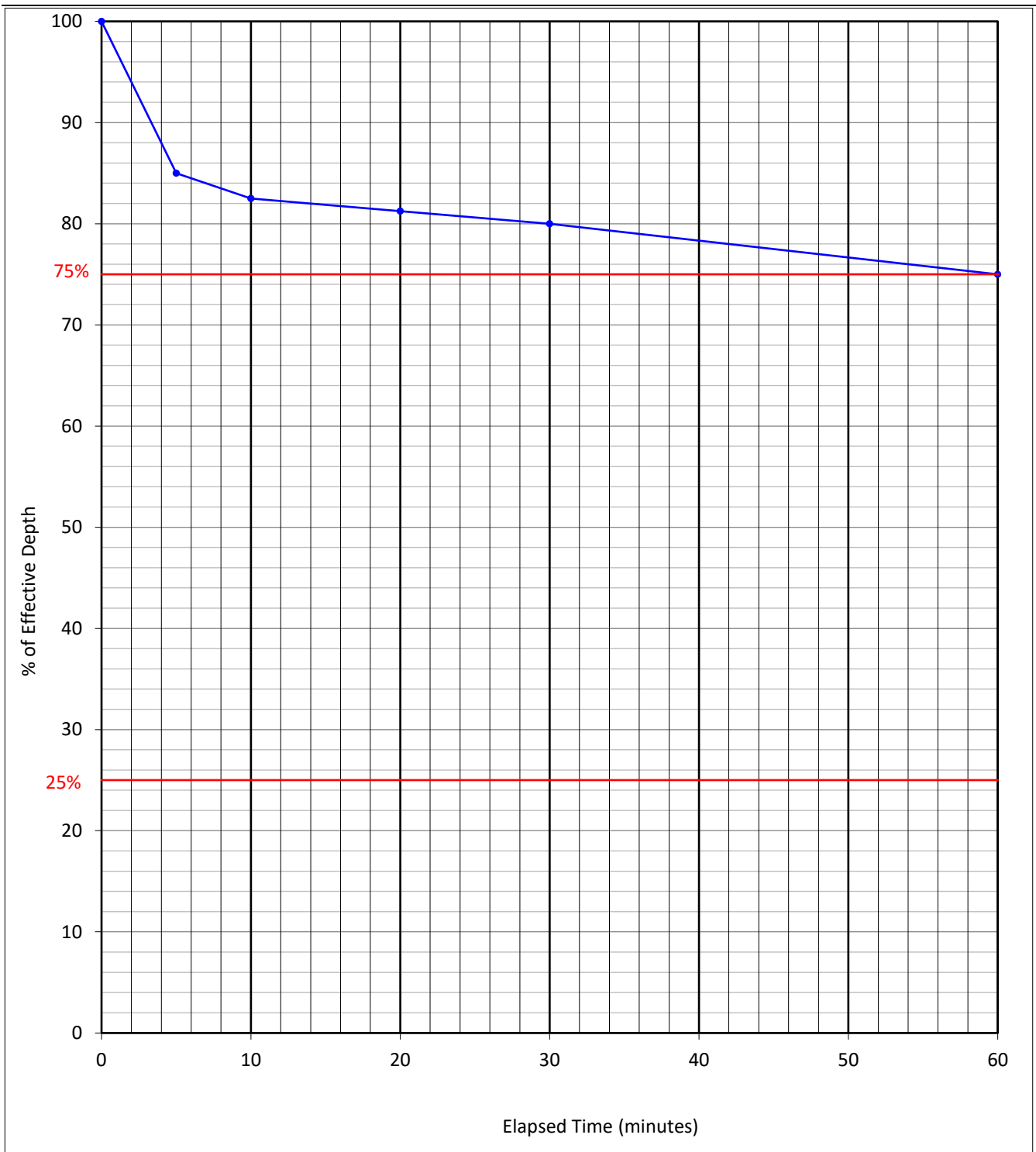




IN-SITU TESTING - Soakaway Test

Project: 24 Ormes Road
Project No: Q0177
Client: Jill Howells

Test Location : WS5
Test No : 1
Date : 15/01/2020



t_{p75} =	minutes
t_{p25} =	minutes

Sheet 2 of 2

Remarks:



APPENDIX IV – GEOTECHNICAL LABORATORY TEST RESULTS



Contract Number: 47604

Client Ref: **Q0177**

Report Date: **14-02-2020**

Client PO:

Client **Quantum Geotechnic Ltd**
Ty Berwig
Bynea
Llanelli.
Carmarthenshire.
SA14 9ST

Contract Title: **24 Ormes Road, Skewen**
For the attention of: **John Stark**

Date Received: **03-02-2020**

Date Completed: **14-02-2020**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	13
4 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.3 & 5.3 - * UKAS	8
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	7
Water Soluble Sulphate 2:1 extract BS 1377:1990 - Part 3 : 5.3 - @ Non Accredited Test	5
pH value of soil BS 1377:1990 - Part 3 : 9.5 - @ Non Accredited Test	5
PSD: Sedimentation by pipette carried out with Wet Sieve (Wet Sieve must also be selected) BS 1377:1990 - Part 2 : 9.4 - * UKAS	7
Disposal of samples for job	1

Notes: Observations and Interpretations are outside the UKAS Accreditation
* - denotes test included in laboratory scope of accreditation
- denotes test carried out by approved contractor
@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:

Emma Sharp (Office Manager) - Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager)
Sean Penn (Administrative/Accounts Assistant) - Shaun Jones (Laboratory manager) - Wayne Honey (Administrative/Quality Assistant)

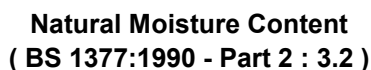
Natural Moisture Content
(BS 1377:1990 - Part 2 : 3.2)

DESCRIPTIONS

Contract Number	47604	
Site Name	24 Ormes Road, Skewen	
Date Tested	10/02/2020	

[illegible]

Operators	Checked	14/02/2020	Wayne Honey (Administrative/Quality Assistant)
Daniel Bassett	Approved	14/02/2020	Paul Evans (Quality/Technical Manager)



Contract Number

47604

Site Name

24 Ormes Road, Skewen

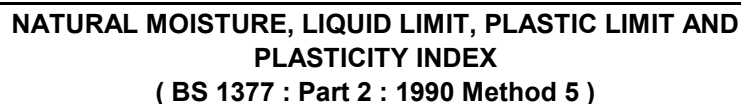
Date Tested

10/02/2020

Operators	Checked	14/02/2020	Wayne Honey (Administrative/Quality Assistant)
Daniel Bassett	Approved	14/02/2020	Paul Evans (Quality/Technical Manager)



2788



Contract Number

47604

Site Name

24 Ormes Road, Skewen

Date Tested

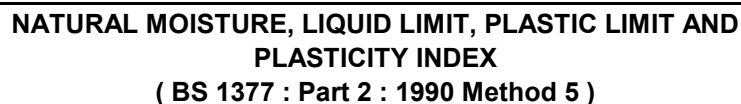
14/02/2020

DESCRIPTIONS

[illegible]

Operators	Checked	14/02/2020	Wayne Honey (Administrative/Quality Assistant)
** Please Select Operator **	Approved	14/02/2020	Paul Evans (Quality/Technical Manager)



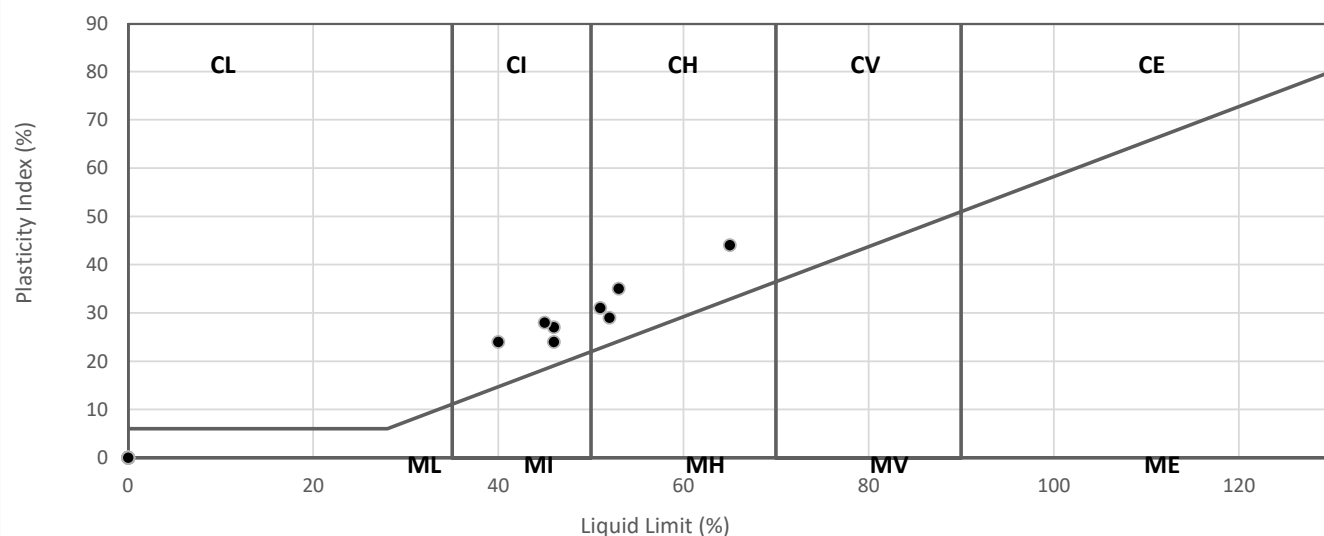


Contract Number	47604	
Project Location	24 Ormes Road, Skewen	
Date Tested	14/02/2020	

[illegible]

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION



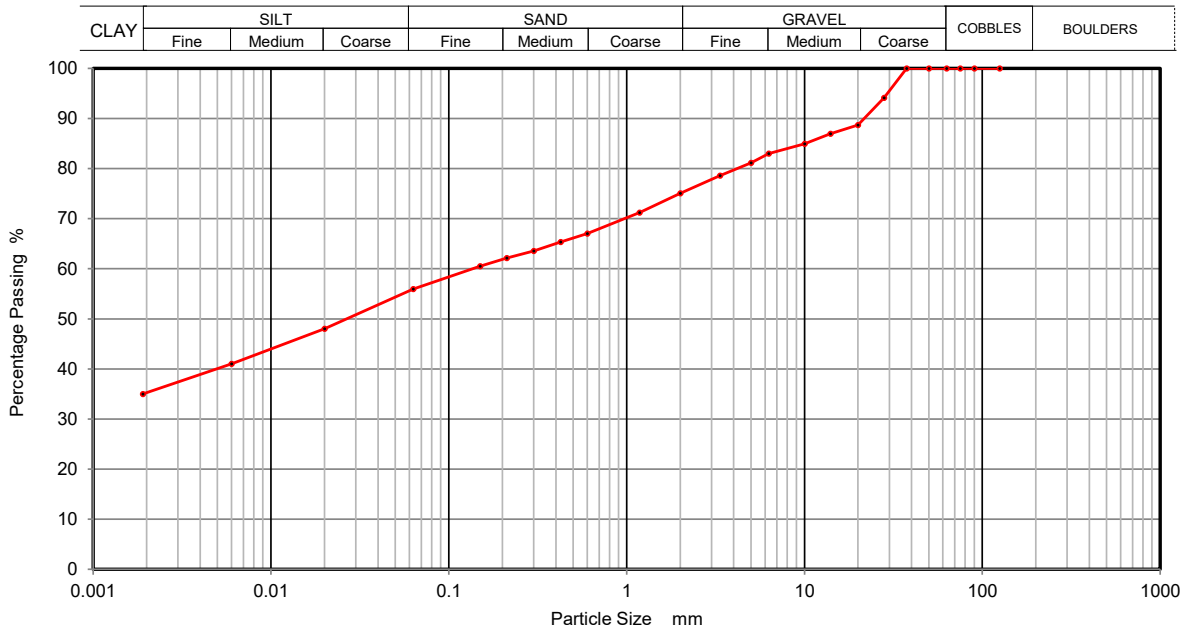
Operators	Checked	14/02/2020	Wayne Honey (Administrative/Quality Assistant)
** Please Select Operator **	Approved	14/02/2020	Paul Evans (Quality/Technical Manager)



PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Contract Number	47604
Borehole/Pit No.	WS01
Sample No.	2
Depth Top	1.00
Depth Base	2.00
Sample Type	B

Site Name	24 Ormes Road, Skewen
Soil Description	Brown fine to coarse sandy silty fine to coarse gravelly CLAY
Date Tested	11/02/2020



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	48
90	100	0.0060	41
75	100	0.0020	35
63	100		
50	100		
37.5	100		
28	94		
20	89		
14	87		
10	85		
6.3	83		
5	81		
3.35	79		
2	75		
1.18	71		
0.6	67		
0.425	65		
0.3	64		
0.212	62		
0.15	61		
0.063	56		

Sample Proportions	% dry mass
Cobbles	0
Gravel	25
Sand	19
Silt	21
Clay	35

Remarks
 Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	13/02/2020	Wayne Honey	<i>W. Honey</i>
RO/MH	Approved	14/02/2020	Paul Evans	<i>P. Evans</i>

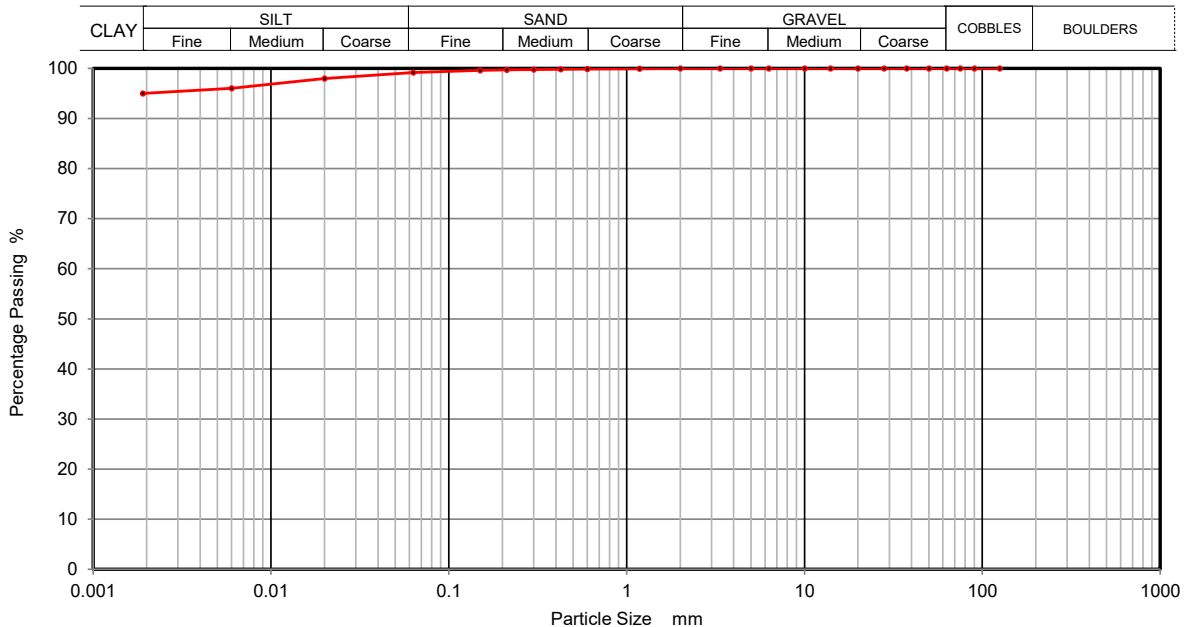




PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Contract Number	47604
Borehole/Pit No.	WS02
Sample No.	3
Depth Top	1.00
Depth Base	1.30
Sample Type	B

Site Name	24 Ormes Road, Skewen
Soil Description	Brownish grey slightly sandy slightly silty CLAY
Date Tested	11/02/2020



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	98
90	100	0.0060	96
75	100	0.0020	95
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	100		
0.212	100		
0.15	100		
0.063	99		

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	1
Silt	4
Clay	95

Remarks
 Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	13/02/2020	Wayne Honey	<i>W. Honey</i>
RO/MH	Approved	14/02/2020	Paul Evans	<i>P. Evans</i>





PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Contract Number **47604**

Borehole/Pit No. **WS02**

Site Name **24 Ormes Road, Skewen**

Sample No. **4**

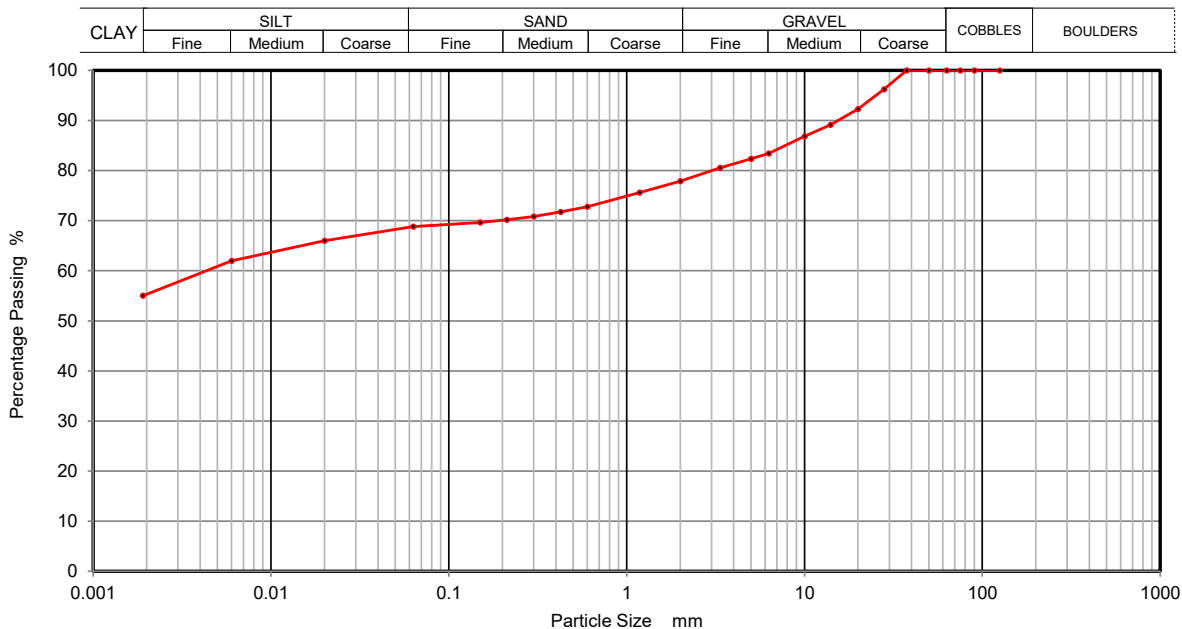
Soil Description **Grey slightly fine to coarse sandy silty fine to coarse gravelly CLAY**

Depth Top **1.30**

Depth Base **1.80**

Date Tested **11/02/2020**

Sample Type **B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	66
90	100	0.0060	62
75	100	0.0020	55
63	100		
50	100		
37.5	100		
28	96		
20	92		
14	89		
10	87		
6.3	83		
5	82		
3.35	81		
2	78		
1.18	76		
0.6	73		
0.425	72		
0.3	71		
0.212	70		
0.15	70		
0.063	69		

Sample Proportions	% dry mass
Cobbles	0
Gravel	22
Sand	9
Silt	14
Clay	55

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	13/02/2020	Wayne Honey	<i>W. Honey</i>
RO/MH	Approved	14/02/2020	Paul Evans	<i>P. Evans</i>



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PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Contract Number **47604**

Borehole/Pit No. **WS03**

Site Name **24 Ormes Road, Skewen**

Sample No. **4**

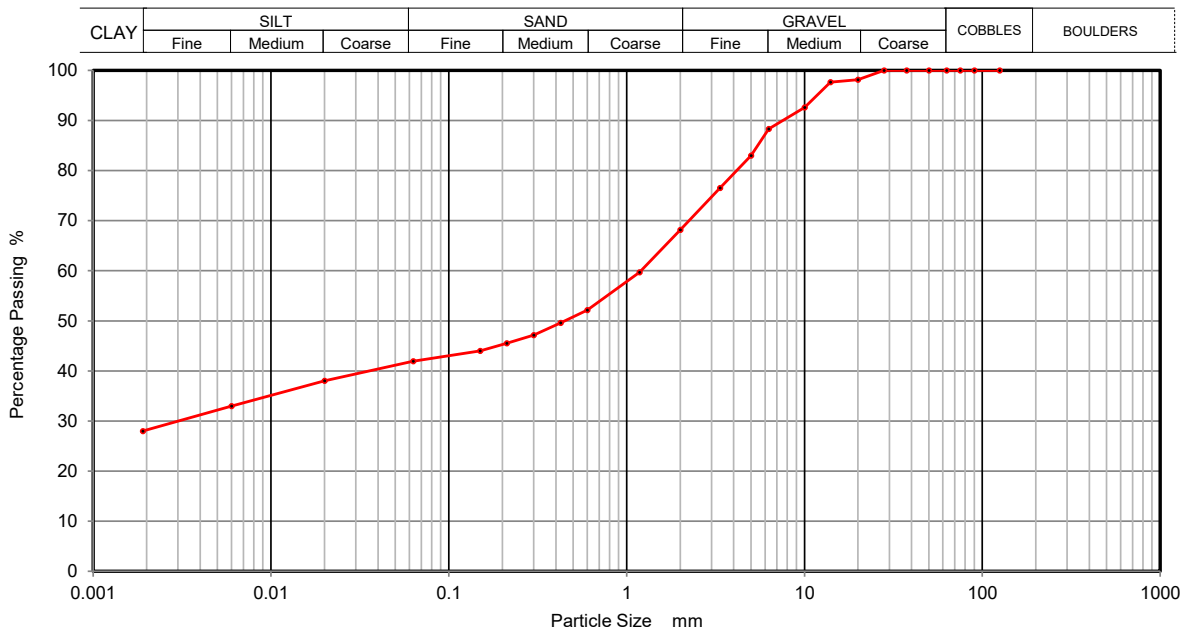
Soil Description **Grey silty fine to coarse sandy clayey fine to coarse GRAVEL**

Depth Top **2.50**

Depth Base **3.00**

Date Tested **11/02/2020**

Sample Type **B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	38
90	100	0.0060	33
75	100	0.0020	28
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	98		
10	93		
6.3	88		
5	83		
3.35	77		
2	68		
1.18	60		
0.6	52		
0.425	50		
0.3	47		
0.212	46		
0.15	44		
0.063	42		

Sample Proportions	% dry mass
Cobbles	0
Gravel	32
Sand	26
Silt	14
Clay	28

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	13/02/2020	Wayne Honey	W. Honey
RO/MH	Approved	14/02/2020	Paul Evans	P. Evans



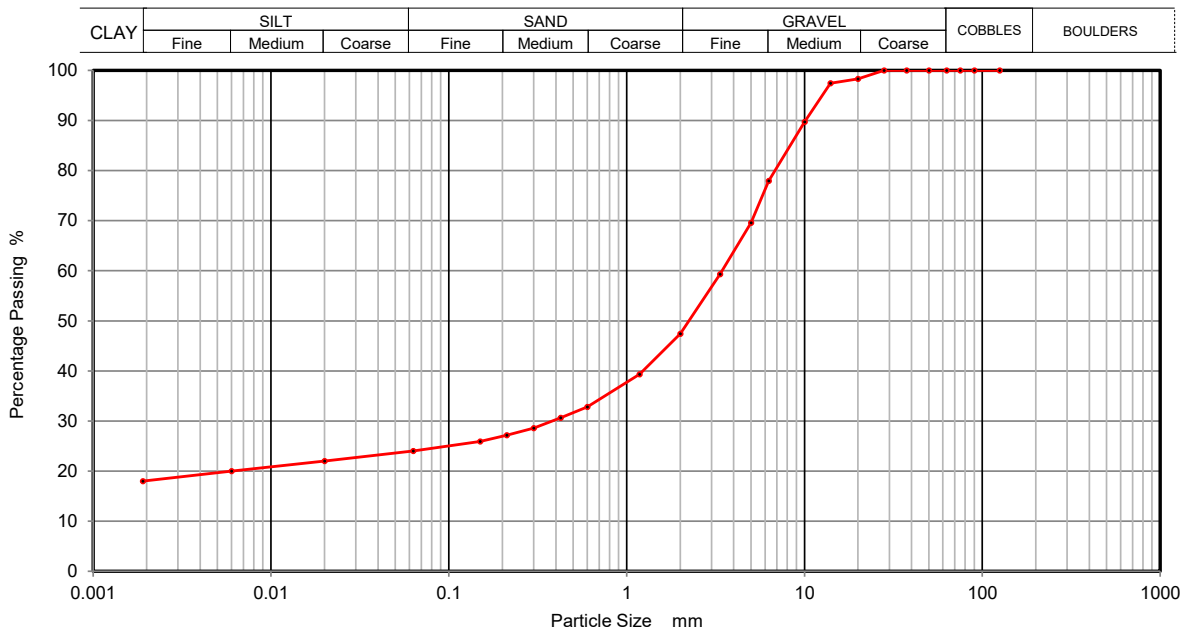
2788



PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Contract Number	47604
Borehole/Pit No.	WS04
Sample No.	3
Depth Top	2.50
Depth Base	3.00
Sample Type	B

Site Name	24 Ormes Road, Skewen
Soil Description	Grey slightly silty clayey fine to coarse sandy fine to coarse GRAVEL
Date Tested	11/02/2020



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	22
90	100	0.0060	20
75	100	0.0020	18
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	97		
10	90		
6.3	78		
5	70		
3.35	59		
2	47		
1.18	39		
0.6	33		
0.425	31		
0.3	29		
0.212	27		
0.15	26		
0.063	24		

Sample Proportions	% dry mass
Cobbles	0
Gravel	53
Sand	23
Silt	6
Clay	18

Remarks
 Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	13/02/2020	Wayne Honey	<i>W. Honey</i>
RO/MH	Approved	14/02/2020	Paul Evans	<i>P. Evans</i>





PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Contract Number **47604**

Borehole/Pit No. **WS05**

Site Name **24 Ormes Road, Skewen**

Sample No. **1**

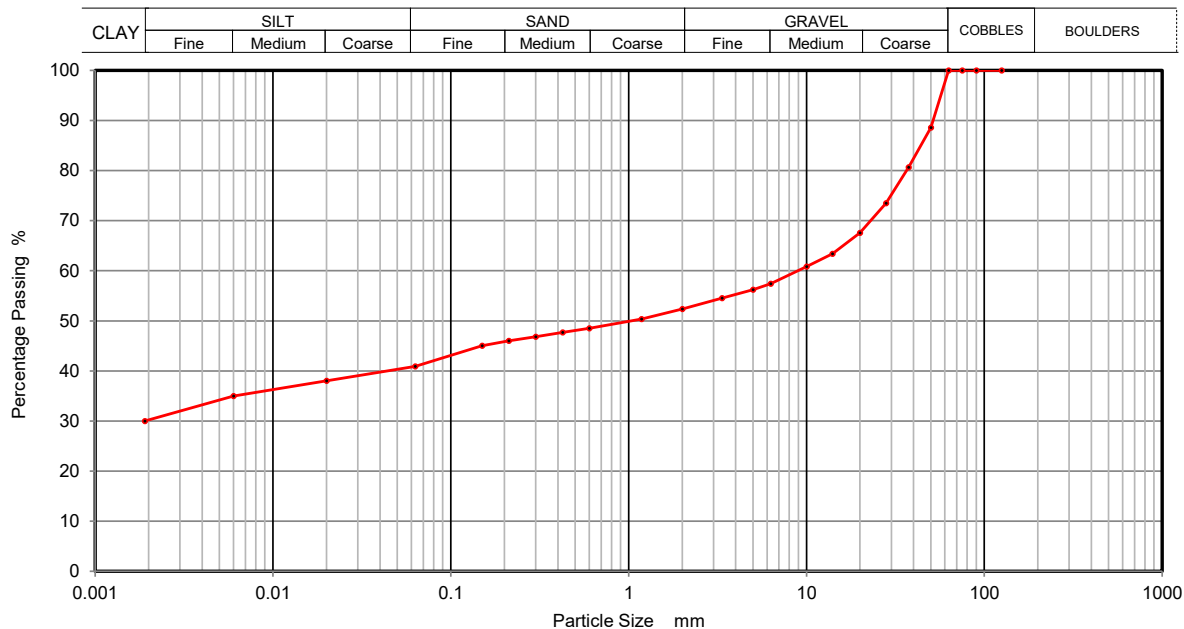
Soil Description **Brown fine to coarse sandy silty clayey fine to coarse GRAVEL**

Depth Top **0.50**

Depth Base **1.00**

Date Tested **11/02/2020**

Sample Type **B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	38
90	100	0.0060	35
75	100	0.0020	30
63	100		
50	89		
37.5	81		
28	73		
20	68		
14	63		
10	61		
6.3	57		
5	56		
3.35	55		
2	52		
1.18	50		
0.6	48		
0.425	48		
0.3	47		
0.212	46		
0.15	45		
0.063	41		

Sample Proportions	% dry mass
Cobbles	0
Gravel	48
Sand	11
Silt	11
Clay	30

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	13/02/2020	Wayne Honey	W. Honey
RO/MH	Approved	14/02/2020	Paul Evans	P. Evans



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PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Contract Number **47604**

Borehole/Pit No. **WS06**

Site Name **24 Ormes Road, Skewen**

Sample No. **1**

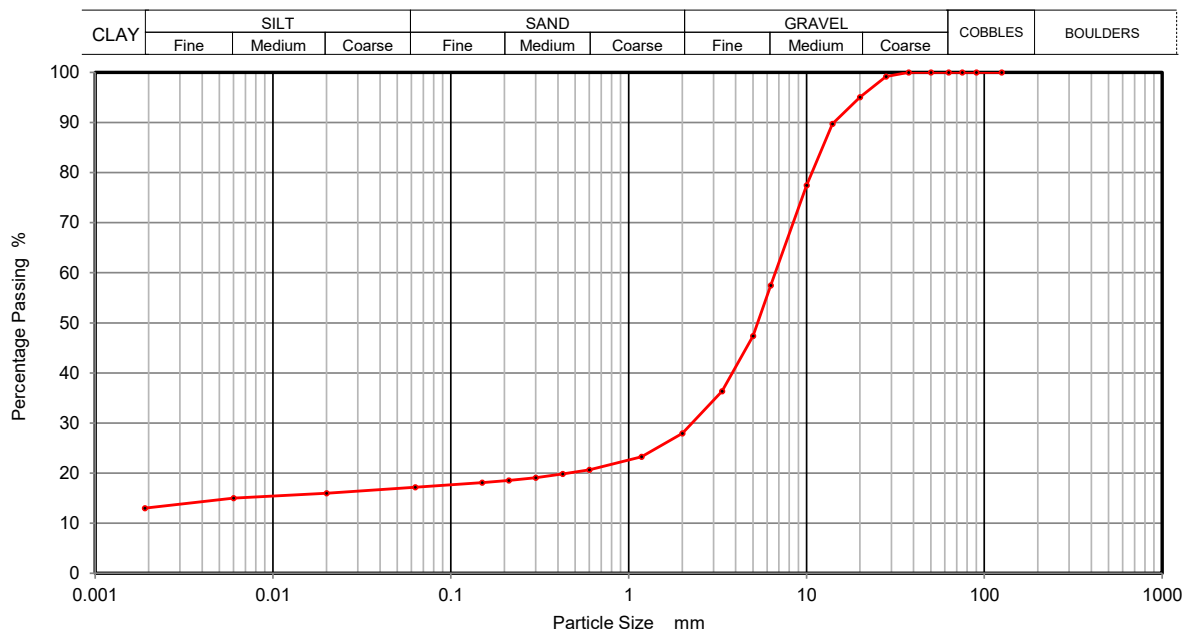
Soil Description **Grey slightly silty fine to coarse sandy clayey fine to coarse GRAVEL**

Depth Top **0.50**

Depth Base **1.00**

Date Tested **11/02/2020**

Sample Type **B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	16
90	100	0.0060	15
75	100	0.0020	13
63	100		
50	100		
37.5	100		
28	99		
20	95		
14	90		
10	77		
6.3	57		
5	47		
3.35	36		
2	28		
1.18	23		
0.6	21		
0.425	20		
0.3	19		
0.212	19		
0.15	18		
0.063	17		

Sample Proportions	% dry mass
Cobbles	0
Gravel	72
Sand	11
Silt	4
Clay	13

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	13/02/2020	Wayne Honey	<i>W. Honey</i>
RO/MH	Approved	14/02/2020	Paul Evans	<i>P. Evans</i>



APPENDIX V – COAL AUTHORITY MINING REPORT



The Coal
Authority

CON29M

coal mining report

24 ORMES ROAD, SKEWEN, NEATH PORT TALBOT, SA10 6SY



Known or potential coal mining risks

Past underground coal mining	Page 3
Future underground coal mining	Page 3



Further action

No further reports from the Coal Authority are required. Further information on any next steps can be found in our Professional opinion.

For more information on our reports please visit
www.groundstability.com



Professional opinion

According to the official mining information records held by the Coal Authority at the time of this search, evidence of, or the potential for, coal mining related features have been identified. It is unlikely that these features will impact on the stability of the enquiry boundary.

Your reference: **Q0177**
Our reference: **51002233175001**
Date: **6 January 2020**

Client name:
Quantum Geotechnical

If you require any further assistance please
contact our experts on:
0345 762 6848
groundstability@coal.gov.uk

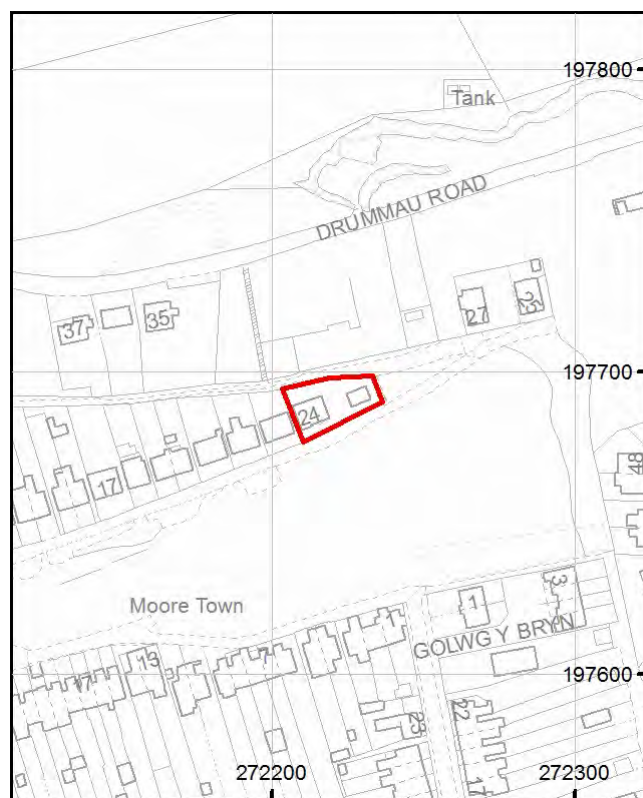


The Law
Society

Enquiry boundary

Key

Approximate position of enquiry boundary shown



We can confirm that the location is
on the coalfield



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This report is prepared in accordance with the latest Law Society's Guidance Notes 2018, the User Guide 2018 and the Coal Authority's Terms and Conditions applicable at the time the report was produced.



Accessibility

If you would like this information in an alternative format, please contact our communications team on 0345 762 6848 or email communications@coal.gov.uk.



What if this information changes?

If this report is for a residential property, insurance is included to cover any loss in property value caused by any changes in the information contained in this report. Please see the attached certificate of insurance for the terms and conditions of this insurance. The insurance does not cover non-residential property or further action reports.

Your reference: **Q0177**
Our reference: **51002233175001**
Date: **6 January 2020**

Client name:
Quantum Geotechnical

If you require any further assistance please
contact our experts on:
0345 762 6848
groundstability@coal.gov.uk

Detailed findings

Information provided by the Coal Authority in this report is compiled in response to the Law Society's CON29M Coal Mining enquiries. The said enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London WC2A 1PL.

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1 Past underground coal mining

The property is in a surface area that could be affected by underground mining in 1 seam of coal at 230m to 240m depth, and last worked in 1910.

Any movement in the ground due to coal mining activity associated with these workings should have stopped by now.

2 Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3 Future underground coal mining

The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods.

The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area likely to be affected from any planned future underground coal mining.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4 Mine entries

There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.

5 Coal mining geology

The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.

6 Past opencast coal mining

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

7 Present opencast coal mining

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

8 Future opencast coal mining

There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

9 Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

10 Mine gas

The Coal Authority has no record of a mine gas emission requiring action.

11 Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Coal Authority, under its Emergency Surface Hazard Call Out procedures.

Statutory cover



Coal mining subsidence

In the unlikely event of any coal mining related subsidence damage, the Coal Authority or the mine operator has a duty to take remedial action in respect of subsidence caused by the withdrawal of support from land or property in connection with lawful coal mining operations.

When the works are the responsibility of the Coal Authority, our dedicated public safety and subsidence team will manage the claim. The house or land owner ("the owner") is covered for these works under the terms of the Coal Mining Subsidence Act 1991 (as amended by the Coal Industry Act 1994). Please note, this Act does not apply where coal was worked or gotten by virtue of the grant of a gale in the Forest of Dean, or any other part of the Hundred of St. Briavels in the county of Gloucester.

If you believe your land or property is suffering from coal mining subsidence damage and you need more information on what to do next, please use the following link to our website which sets out what your rights are and what you need to consider before making a claim.

www.gov.uk/government/publications/coal-mining-subsidence-damage-notice-form



Coal mining hazards

Our public safety and subsidence team provide a 24 hour a day, 7 days a week hazard reporting service, to help protect the public from hazards caused by past coal workings, such as a mine shaft or shallow working collapse. To report any hazards please call **01623 646 333**. Further information can be found on our website: www.gov.uk/coalauthority.



On behalf of the insurer

Coal Mining Report Insurance Policy Schedule

Policy number: 27337482

The insurer: Liberty Legal Indemnities – underwritten by Liberty Mutual Insurance Europe SE

Binding Authority contract number: RNMFP1903841

Property: 24 ORMES ROAD, SKEWEN, NEATH PORT TALBOT, SA10 6SY

Report reference number: 51002233175001

Limit of cover: £50,000.00

Dated: 6 January 2020

This policy and schedule shall be read together and any word or expression to which a specific meaning has been attached in either shall bear such meaning wherever it may appear.

Where a Coal Mining Report has been obtained in connection with a sale of the property, cover is provided for the benefit of a purchaser and their lender; in the case of a re-mortgage or where the existing owner chooses to obtain a Coal Mining Report, cover is provided for the benefit of the owner and their lender.

The policy offers protection against loss sustained by the owner of the property if any new problems or adverse entries are revealed in a subsequent Coal Mining Report which were not revealed by the original report to which the policy was attached.

The insured shall at all times comply with the requirements of the Conditions of this Policy.

Coal Mining Report Terms and Conditions can be viewed online at this link:

<https://www.groundstability.com/insurance/terms/20190404/terms.html>

Glossary



Key terms

adit - horizontal or sloped entrance to a mine

coal mining subsidence - ground movement caused by the removal of coal by underground mining

Coal Mining Subsidence Act 1991 - the Act setting out the duties of the Coal Authority to repair damage caused by coal mining subsidence

coal mining subsidence damage - damage to land, buildings or structures caused by the removal of coal by underground mining

coal seams - bed of coal of varying thickness

future opencast coal mining - a licence granted, or licence application received, by the Coal Authority to excavate coal from the surface

future underground coal mining - a licence granted, or licence application received, by the Coal Authority to excavate coal underground. Although it is unlikely, remaining coal reserves could create a possibility for future mining, which would be licensed by the Coal Authority

mine entries - collective name for shafts and adits

payments to owners of former copyhold land - historically, copyhold land gave rights to coal to the copyholder. Legislation was set up to allow others to work this coal, but they had to issue a notice and pay compensation if a copyholder came forward

shaft - vertical entry into a mine

site investigation - investigations of coal mining risks carried out with the Coal Authority's permission

stop notice - a delay to repairs because further coal mining subsidence damage may occur and it would be unwise to carry out permanent repairs

subsidence claim - a formal notice of subsidence damage to the Coal Authority since it was established on 31 October 1994

withdrawal of support - a historic notice informing landowners that the coal beneath their property was going to be worked

working facilities orders - a court order which gave permission, restricted or prevented coal mine workings