

Structural Calculations  
For  
Retaining Wall  
at  
8 Church Road  
Baglan  
Port Talbot  
SA12 8AY

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**STRUCTURAL CALCULATIONS**  
**FOR**  
**BUILDING REGULATIONS APPROVAL**

The structural elements included in these calculations are designed in accordance with the following relevant British Standards and Codes of Practice:

1. B.S. 6399: Pt 1:1996 & Pt 3: 1988 - Loadings for Buildings
2. B.S. 648: 1964 - Schedule of Weights of Building Materials
3. B.S. 8110: Pt: 1: 1985 - Structural Use of Concrete
4. B.S. 5950: Pt: 1: 1990 - Structural Use of Steelwork in Buildings
5. B.S. 5628: Pt 1: 1992 - Structural Use of Unreinforced Masonry

The Building Regulations 2008 (with amendments)

**Notes**

These calculations have been based on the Architects drawings and no liability is accepted for any errors or discrepancies on the information provided.

It is the responsibility of the Client or his representative to ensure that: -

- Building Regulations approval is obtained prior to commencing the work
- The relevant Authorities undertake inspections of the work
- The work is carried out in accordance with the drawings and details

  
Prepared by

Date February 2024.

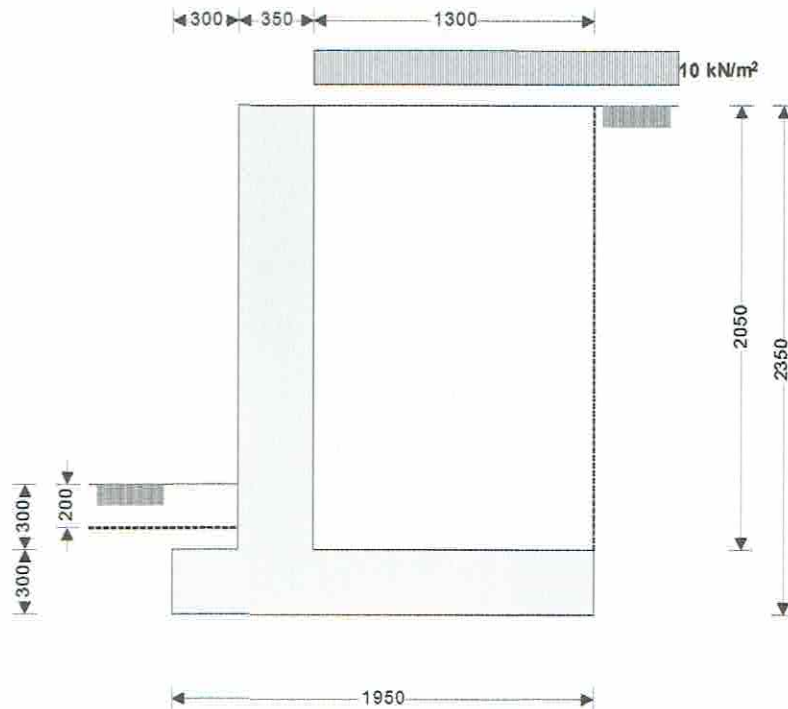


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## RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



### Wall details

Retaining wall type  
Height of retaining wall stem  
Thickness of wall stem  
Length of toe  
Length of heel  
Overall length of base  
Thickness of base  
Depth of downstand  
Position of downstand  
Thickness of downstand  
Height of retaining wall  
Depth of cover in front of wall  
Depth of unplanned excavation  
Height of ground water behind wall  
Height of saturated fill above base  
Density of wall construction  
Density of base construction  
Angle of rear face of wall  
Angle of soil surface behind wall  
Effective height at virtual back of wall

### Unpropped cantilever

$h_{\text{stem}} = 2050 \text{ mm}$   
 $t_{\text{wall}} = 350 \text{ mm}$   
 $l_{\text{toe}} = 300 \text{ mm}$   
 $l_{\text{heel}} = 1300 \text{ mm}$   
 $l_{\text{base}} = l_{\text{toe}} + l_{\text{heel}} + t_{\text{wall}} = 1950 \text{ mm}$   
 $t_{\text{base}} = 300 \text{ mm}$   
 $d_{\text{ds}} = 0 \text{ mm}$   
 $l_{\text{ds}} = 1200 \text{ mm}$   
 $t_{\text{ds}} = 300 \text{ mm}$   
 $h_{\text{wall}} = h_{\text{stem}} + t_{\text{base}} + d_{\text{ds}} = 2350 \text{ mm}$   
 $d_{\text{cover}} = 300 \text{ mm}$   
 $d_{\text{exc}} = 200 \text{ mm}$   
 $h_{\text{water}} = 0 \text{ mm}$   
 $h_{\text{sat}} = \max(h_{\text{water}} - t_{\text{base}} - d_{\text{ds}}, 0 \text{ mm}) = 0 \text{ mm}$   
 $\gamma_{\text{wall}} = 18.0 \text{ kN/m}^3$   
 $\gamma_{\text{base}} = 23.6 \text{ kN/m}^3$   
 $\alpha = 90.0 \text{ deg}$   
 $\beta = 0.0 \text{ deg}$   
 $h_{\text{eff}} = h_{\text{wall}} + l_{\text{heel}} \times \tan(\beta) = 2350 \text{ mm}$

### Retained material details

Mobilisation factor  
 $M = 1.5$



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Moist density of retained material  $\gamma_m = 18.0 \text{ kN/m}^3$

Saturated density of retained material  $\gamma_s = 21.0 \text{ kN/m}^3$

Design shear strength  $\phi' = 24.2 \text{ deg}$

Angle of wall friction  $\delta = 0.0 \text{ deg}$

#### Base material details

Moist density  $\gamma_{mb} = 18.0 \text{ kN/m}^3$

Design shear strength  $\phi'_b = 24.2 \text{ deg}$

Design base friction  $\delta_b = 18.6 \text{ deg}$

Allowable bearing pressure  $P_{\text{bearing}} = 100 \text{ kN/m}^2$

#### Using Coulomb theory

Active pressure coefficient for retained material

$$K_a = \sin(\alpha + \phi')^2 / (\sin(\alpha)^2 \times \sin(\alpha - \delta) \times [1 + \sqrt{(\sin(\phi' + \delta) \times \sin(\phi' - \beta) / (\sin(\alpha - \delta) \times \sin(\alpha + \beta)))^2}] = 0.419$$

Passive pressure coefficient for base material

$$K_p = \sin(90 - \phi'_b)^2 / (\sin(90 - \delta_b) \times [1 - \sqrt{(\sin(\phi'_b + \delta_b) \times \sin(\phi'_b) / (\sin(90 + \delta_b)))^2}] = 4.187$$

#### At-rest pressure

At-rest pressure for retained material  $K_0 = 1 - \sin(\phi') = 0.590$

#### Loading details

Surcharge load on plan Surcharge = 10.0 kN/m<sup>2</sup>

Applied vertical dead load on wall  $W_{\text{dead}} = 0.0 \text{ kN/m}$

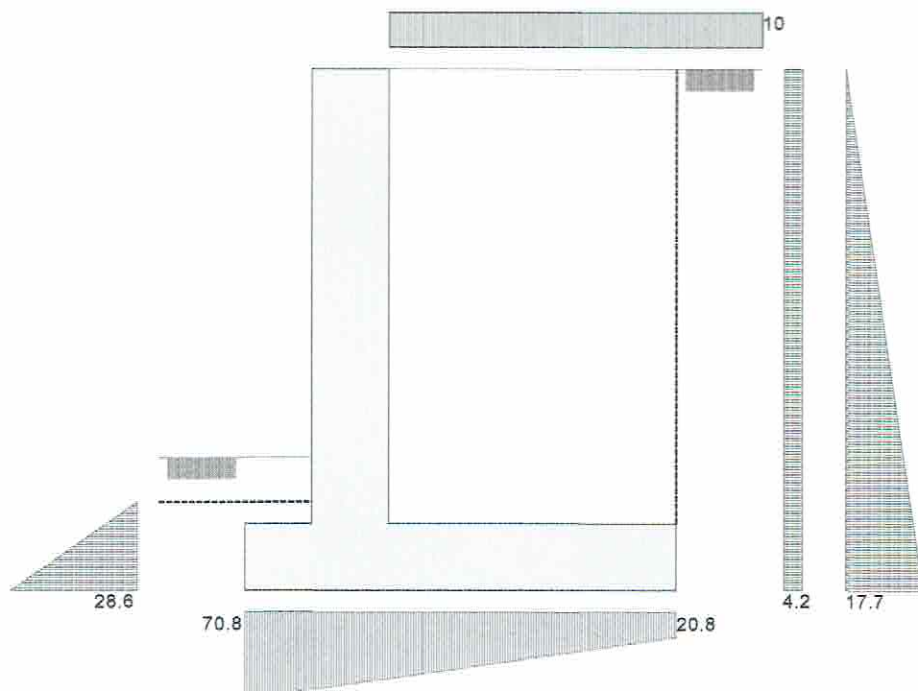
Applied vertical live load on wall  $W_{\text{live}} = 0.0 \text{ kN/m}$

Position of applied vertical load on wall  $l_{\text{load}} = 0 \text{ mm}$

Applied horizontal dead load on wall  $F_{\text{dead}} = 0.0 \text{ kN/m}$

Applied horizontal live load on wall  $F_{\text{live}} = 0.0 \text{ kN/m}$

Height of applied horizontal load on wall  $h_{\text{load}} = 0 \text{ mm}$



Loads shown in kN/m, pressures shown in kN/m<sup>2</sup>

|                                                                                                                                                                        |           |                      |            |              |                         |               |
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#### Vertical forces on wall

Wall stem

$$W_{wall} = h_{stem} \times t_{wall} \times \gamma_{wall} = 12.9 \text{ kN/m}$$

Wall base

$$W_{base} = l_{base} \times t_{base} \times \gamma_{base} = 13.8 \text{ kN/m}$$

Surcharge

$$W_{sur} = \text{Surcharge} \times l_{heel} = 13 \text{ kN/m}$$

Moist backfill to top of wall

$$W_{m_w} = l_{heel} \times (h_{stem} - h_{sat}) \times \gamma_m = 48 \text{ kN/m}$$

Soil in front of wall

$$W_p = l_{toe} \times d_{cover} \times \gamma_{mb} = 1.6 \text{ kN/m}$$

Total vertical load

$$W_{total} = W_{wall} + W_{base} + W_{sur} + W_{m_w} + W_p = 89.3 \text{ kN/m}$$

#### Horizontal forces on wall

Surcharge

$$F_{sur} = K_a \times \text{Surcharge} \times h_{eff} = 9.8 \text{ kN/m}$$

Moist backfill above water table

$$F_{m_a} = 0.5 \times K_a \times \gamma_m \times (h_{eff} - h_{water})^2 = 20.8 \text{ kN/m}$$

Total horizontal load

$$F_{total} = F_{sur} + F_{m_a} = 30.6 \text{ kN/m}$$

#### Calculate stability against sliding

Passive resistance of soil in front of wall

$$F_p = 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb} = 5.7 \text{ kN/m}$$

Resistance to sliding

$$F_{res} = F_p + (W_{total} - W_{sur} - W_p) \times \tan(\delta_b) = 30.8 \text{ kN/m}$$

**PASS - Resistance force is greater than sliding force**

#### Overtuning moments

Surcharge

$$M_{sur} = F_{sur} \times (h_{eff} - 2 \times d_{ds}) / 2 = 11.6 \text{ kNm/m}$$

Moist backfill above water table

$$M_{m_a} = F_{m_a} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3 = 16.3 \text{ kNm/m}$$

Total overturning moment

$$M_{ot} = M_{sur} + M_{m_a} = 27.9 \text{ kNm/m}$$

#### Restoring moments

Wall stem

$$M_{wall} = W_{wall} \times (l_{toe} + t_{wall} / 2) = 6.1 \text{ kNm/m}$$

Wall base

$$M_{base} = W_{base} \times l_{base} / 2 = 13.5 \text{ kNm/m}$$

Moist backfill

$$M_{m_r} = (W_{m_w} \times (l_{base} - l_{heel} / 2) + W_{m_s} \times (l_{base} - l_{heel} / 3)) = 62.4 \text{ kNm/m}$$

Total restoring moment

$$M_{rest} = M_{wall} + M_{base} + M_{m_r} = 82 \text{ kNm/m}$$

#### Check stability against overturning

Total overturning moment

$$M_{ot} = 27.9 \text{ kNm/m}$$

Total restoring moment

$$M_{rest} = 82.0 \text{ kNm/m}$$

**PASS - Restoring moment is greater than overturning moment**

#### Check bearing pressure

Surcharge

$$M_{sur_r} = W_{sur} \times (l_{base} - l_{heel} / 2) = 16.9 \text{ kNm/m}$$

Soil in front of wall

$$M_{p_r} = W_p \times l_{toe} / 2 = 0.2 \text{ kNm/m}$$

Total moment for bearing

$$M_{total} = M_{rest} - M_{ot} + M_{sur_r} + M_{p_r} = 71.2 \text{ kNm/m}$$

Total vertical reaction

$$R = W_{total} = 89.3 \text{ kN/m}$$

Distance to reaction

$$x_{bar} = M_{total} / R = 798 \text{ mm}$$

Eccentricity of reaction

$$e = \text{abs}((l_{base} / 2) - x_{bar}) = 177 \text{ mm}$$

**Reaction acts within middle third of base**

Bearing pressure at toe

$$p_{toe} = (R / l_{base}) + (6 \times R \times e / l_{base}^2) = 70.8 \text{ kN/m}^2$$

Bearing pressure at heel

$$p_{heel} = (R / l_{base}) - (6 \times R \times e / l_{base}^2) = 20.8 \text{ kN/m}^2$$

**PASS - Maximum bearing pressure is less than allowable bearing pressure**

|                                                                                                                                                                        |           |            |                      |              |                         |               |
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## RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

### Ultimate limit state load factors

|                                 |                      |
|---------------------------------|----------------------|
| Dead load factor                | $\gamma_{f_d} = 1.4$ |
| Live load factor                | $\gamma_{f_l} = 1.6$ |
| Earth and water pressure factor | $\gamma_{f_e} = 1.4$ |

### Factored vertical forces on wall

|                               |                                                                                                            |
|-------------------------------|------------------------------------------------------------------------------------------------------------|
| Wall stem                     | $W_{wall_f} = \gamma_{f_d} \times h_{stem} \times t_{wall} \times \gamma_{wall} = 18.1 \text{ kN/m}$       |
| Wall base                     | $W_{base_f} = \gamma_{f_d} \times l_{base} \times t_{base} \times \gamma_{base} = 19.3 \text{ kN/m}$       |
| Surcharge                     | $W_{sur_f} = \gamma_{f_l} \times \text{Surcharge} \times l_{heel} = 20.8 \text{ kN/m}$                     |
| Moist backfill to top of wall | $W_{m_w_f} = \gamma_{f_d} \times l_{heel} \times (h_{stem} - h_{sat}) \times \gamma_m = 67.2 \text{ kN/m}$ |
| Soil in front of wall         | $W_{p_f} = \gamma_{f_d} \times l_{toe} \times d_{cover} \times \gamma_{mb} = 2.3 \text{ kN/m}$             |
| Total vertical load           | $W_{total_f} = W_{wall_f} + W_{base_f} + W_{sur_f} + W_{m_w_f} + W_{p_f} = 127.6 \text{ kN/m}$             |

### Factored horizontal at-rest forces on wall

|                                             |                                                                                                                                                             |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Surcharge                                   | $F_{sur_f} = \gamma_{f_l} \times K_0 \times \text{Surcharge} \times h_{eff} = 22.2 \text{ kN/m}$                                                            |
| Moist backfill above water table            | $F_{m_a_f} = \gamma_{f_e} \times 0.5 \times K_0 \times \gamma_m \times (h_{eff} - h_{water})^2 = 41.1 \text{ kN/m}$                                         |
| Total horizontal load                       | $F_{total_f} = F_{sur_f} + F_{m_a_f} = 63.2 \text{ kN/m}$                                                                                                   |
| Passive resistance of soil in front of wall | $F_{p_f} = \gamma_{f_e} \times 0.5 \times K_p \times \cos(\delta_b) \times (d_{cover} + t_{base} + d_{ds} - d_{exc})^2 \times \gamma_{mb} = 8 \text{ kN/m}$ |

### Factored overturning moments

|                                  |                                                                                                          |
|----------------------------------|----------------------------------------------------------------------------------------------------------|
| Surcharge                        | $M_{sur_f} = F_{sur_f} \times (h_{eff} - 2 \times d_{ds}) / 2 = 26.1 \text{ kNm/m}$                      |
| Moist backfill above water table | $M_{m_a_f} = F_{m_a_f} \times (h_{eff} + 2 \times h_{water} - 3 \times d_{ds}) / 3 = 32.2 \text{ kNm/m}$ |
| Total overturning moment         | $M_{ot_f} = M_{sur_f} + M_{m_a_f} = 58.2 \text{ kNm/m}$                                                  |

### Restoring moments

|                        |                                                                                                                              |
|------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Wall stem              | $M_{wall_f} = W_{wall_f} \times (l_{toe} + t_{wall} / 2) = 8.6 \text{ kNm/m}$                                                |
| Wall base              | $M_{base_f} = W_{base_f} \times l_{base} / 2 = 18.8 \text{ kNm/m}$                                                           |
| Surcharge              | $M_{sur_f} = W_{sur_f} \times (l_{base} - l_{heel} / 2) = 27 \text{ kNm/m}$                                                  |
| Moist backfill         | $M_{m_r_f} = (W_{m_w_f} \times (l_{base} - l_{heel} / 2) + W_{m_s_f} \times (l_{base} - l_{heel} / 3)) = 87.3 \text{ kNm/m}$ |
| Soil in front of wall  | $M_{p_r_f} = W_{p_f} \times l_{toe} / 2 = 0.3 \text{ kNm/m}$                                                                 |
| Total restoring moment | $M_{rest_f} = M_{wall_f} + M_{base_f} + M_{sur_f} + M_{m_r_f} + M_{p_r_f} = 142.1 \text{ kNm/m}$                             |

### Factored bearing pressure

|                          |                                                                       |
|--------------------------|-----------------------------------------------------------------------|
| Total moment for bearing | $M_{total_f} = M_{rest_f} - M_{ot_f} = 83.9 \text{ kNm/m}$            |
| Total vertical reaction  | $R_f = W_{total_f} = 127.6 \text{ kN/m}$                              |
| Distance to reaction     | $\bar{x}_{bar_f} = M_{total_f} / R_f = 657 \text{ mm}$                |
| Eccentricity of reaction | $e_f = \text{abs}((l_{base} / 2) - \bar{x}_{bar_f}) = 318 \text{ mm}$ |

**Reaction acts within middle third of base**

|                                 |                                                                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Bearing pressure at toe         | $p_{toe_f} = (R_f / l_{base}) + (6 \times R_f \times e_f / l_{base}^2) = 129.5 \text{ kN/m}^2$                              |
| Bearing pressure at heel        | $p_{heel_f} = (R_f / l_{base}) - (6 \times R_f \times e_f / l_{base}^2) = 1.5 \text{ kN/m}^2$                               |
| Rate of change of base reaction | $\text{rate} = (p_{toe_f} - p_{heel_f}) / l_{base} = 65.64 \text{ kN/m}^2/\text{m}$                                         |
| Bearing pressure at stem / toe  | $p_{stem\_toe_f} = \max(p_{toe_f} - (\text{rate} \times l_{toe}), 0 \text{ kN/m}^2) = 109.8 \text{ kN/m}^2$                 |
| Bearing pressure at mid stem    | $p_{stem\_mid_f} = \max(p_{toe_f} - (\text{rate} \times (l_{toe} + t_{wall} / 2)), 0 \text{ kN/m}^2) = 98.3 \text{ kN/m}^2$ |
| Bearing pressure at stem / heel | $p_{stem\_heel_f} = \max(p_{toe_f} - (\text{rate} \times (l_{toe} + t_{wall})), 0 \text{ kN/m}^2) = 86.8 \text{ kN/m}^2$    |

### Design of reinforced concrete retaining wall toe (BS 8002:1994)

#### Material properties

|                                     |                              |
|-------------------------------------|------------------------------|
| Characteristic strength of concrete | $f_{cu} = 35 \text{ N/mm}^2$ |
|-------------------------------------|------------------------------|

|                                                                                                                                                                        |           |                      |            |              |                         |               |
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Characteristic strength of reinforcement

$$f_y = 500 \text{ N/mm}^2$$

#### Base details

Minimum area of reinforcement

$$k = 0.13 \%$$

Cover to reinforcement in toe

$$c_{toe} = 35 \text{ mm}$$

#### Calculate shear for toe design

Shear from bearing pressure

$$V_{toe\_bear} = (p_{toe\_f} + p_{stem\_toe\_f}) \times l_{toe} / 2 = 35.9 \text{ kN/m}$$

Shear from weight of base

$$V_{toe\_wt\_base} = \gamma_{fd} \times \gamma_{base} \times l_{toe} \times t_{base} = 3 \text{ kN/m}$$

Shear from weight of soil

$$V_{toe\_wt\_soil} = W_{p\_f} - (\gamma_{fd} \times \gamma_m \times l_{toe} \times d_{exc}) = 0.8 \text{ kN/m}$$

Total shear for toe design

$$V_{toe} = V_{toe\_bear} - V_{toe\_wt\_base} - V_{toe\_wt\_soil} = 32.2 \text{ kN/m}$$

#### Calculate moment for toe design

Moment from bearing pressure

$$M_{toe\_bear} = (2 \times p_{toe\_f} + p_{stem\_mid\_f}) \times (l_{toe} + t_{wall} / 2)^2 / 6 = 13.4 \text{ kNm/m}$$

Moment from weight of base

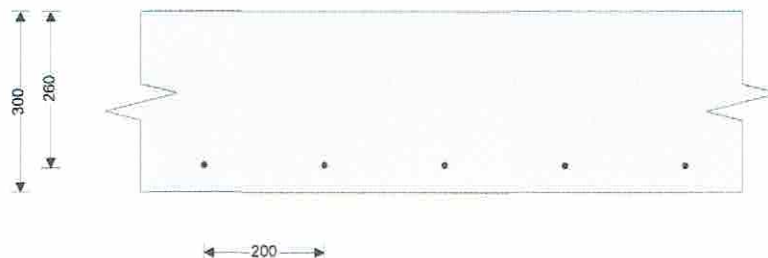
$$M_{toe\_wt\_base} = (\gamma_{fd} \times \gamma_{base} \times t_{base} \times (l_{toe} + t_{wall} / 2)^2 / 2) = 1.1 \text{ kNm/m}$$

Moment from weight of soil

$$M_{toe\_wt\_soil} = (W_{p\_f} - (\gamma_{fd} \times \gamma_m \times l_{toe} \times d_{exc})) \times (l_{toe} + t_{wall}) / 2 = 0.2 \text{ kNm/m}$$

Total moment for toe design

$$M_{toe} = M_{toe\_bear} - M_{toe\_wt\_base} - M_{toe\_wt\_soil} = 12.1 \text{ kNm/m}$$



#### Check toe in bending

Width of toe

$$b = 1000 \text{ mm/m}$$

Depth of reinforcement

$$d_{toe} = t_{base} - c_{toe} - (\phi_{toe} / 2) = 260.0 \text{ mm}$$

Constant

$$K_{toe} = M_{toe} / (b \times d_{toe}^2 \times f_{cu}) = 0.005$$

**Compression reinforcement is not required**

Lever arm

$$z_{toe} = \min(0.5 + \sqrt{(0.25 - (\min(K_{toe}, 0.225) / 0.9))}, 0.95) \times d_{toe}$$

$$z_{toe} = 247 \text{ mm}$$

Area of tension reinforcement required

$$A_{s\_toe\_des} = M_{toe} / (0.87 \times f_y \times z_{toe}) = 112 \text{ mm}^2/\text{m}$$

Minimum area of tension reinforcement

$$A_{s\_toe\_min} = k \times b \times t_{base} = 390 \text{ mm}^2/\text{m}$$

Area of tension reinforcement required

$$A_{s\_toe\_req} = \text{Max}(A_{s\_toe\_des}, A_{s\_toe\_min}) = 390 \text{ mm}^2/\text{m}$$

Reinforcement provided

**A393 mesh**

Area of reinforcement provided

$$A_{s\_toe\_prov} = 393 \text{ mm}^2/\text{m}$$

**PASS - Reinforcement provided at the retaining wall toe is adequate**

#### Check shear resistance at toe

Design shear stress

$$v_{toe} = V_{toe} / (b \times d_{toe}) = 0.124 \text{ N/mm}^2$$

Allowable shear stress

$$v_{adm} = \min(0.8 \times \sqrt{f_{cu} / 1 \text{ N/mm}^2}, 5) \times 1 \text{ N/mm}^2 = 4.733 \text{ N/mm}^2$$

**PASS - Design shear stress is less than maximum shear stress**

From BS8110:Part 1:1997 – Table 3.8

Design concrete shear stress

$$v_{c\_toe} = 0.419 \text{ N/mm}^2$$

**$v_{toe} < v_{c\_toe}$  - No shear reinforcement required**

|                                                                                                                                                        |                 |  |                          |            |                         |                              |
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### Design of reinforced concrete retaining wall heel (BS 8002:1994)

#### Material properties

Characteristic strength of concrete

$$f_{cu} = 35 \text{ N/mm}^2$$

Characteristic strength of reinforcement

$$f_y = 500 \text{ N/mm}^2$$

#### Base details

Minimum area of reinforcement

$$k = 0.13 \%$$

Cover to reinforcement in heel

$$C_{heel} = 35 \text{ mm}$$

#### Calculate shear for heel design

Shear from bearing pressure

$$V_{heel\_bear} = (p_{heel\_f} + p_{stem\_heel\_f}) \times l_{heel} / 2 = 57.4 \text{ kN/m}$$

Shear from weight of base

$$V_{heel\_wt\_base} = \gamma_{fd} \times \gamma_{base} \times l_{heel} \times t_{base} = 12.9 \text{ kN/m}$$

Shear from weight of moist backfill

$$V_{heel\_wt\_m} = w_{m\_w\_f} = 67.2 \text{ kN/m}$$

Shear from surcharge

$$V_{heel\_sur} = w_{sur\_f} = 20.8 \text{ kN/m}$$

Total shear for heel design

$$V_{heel} = -V_{heel\_bear} + V_{heel\_wt\_base} + V_{heel\_wt\_m} + V_{heel\_sur} = 43.5 \text{ kN/m}$$

#### Calculate moment for heel design

Moment from bearing pressure

$$M_{heel\_bear} = (2 \times p_{heel\_f} + p_{stem\_mid\_f}) \times (l_{heel} + t_{wall} / 2)^2 / 6 = 36.7 \text{ kNm/m}$$

Moment from weight of base

$$M_{heel\_wt\_base} = (\gamma_{fd} \times \gamma_{base} \times t_{base} \times (l_{heel} + t_{wall} / 2)^2 / 2) = 10.8 \text{ kNm/m}$$

Moment from weight of moist backfill

$$M_{heel\_wt\_m} = w_{m\_w\_f} \times (l_{heel} + t_{wall}) / 2 = 55.4 \text{ kNm/m}$$

Moment from surcharge

$$M_{heel\_sur} = w_{sur\_f} \times (l_{heel} + t_{wall}) / 2 = 17.2 \text{ kNm/m}$$

Total moment for heel design

$$M_{heel} = -M_{heel\_bear} + M_{heel\_wt\_base} + M_{heel\_wt\_m} + M_{heel\_sur} = 46.7 \text{ kNm/m}$$



#### Check heel in bending

Width of heel

$$b = 1000 \text{ mm/m}$$

Depth of reinforcement

$$d_{heel} = t_{base} - C_{heel} - (\phi_{heel} / 2) = 261.0 \text{ mm}$$

Constant

$$K_{heel} = M_{heel} / (b \times d_{heel}^2 \times f_{cu}) = 0.020$$

**Compression reinforcement is not required**

Lever arm

$$z_{heel} = \min(0.5 + \sqrt{(0.25 - (\min(K_{heel}, 0.225) / 0.9))}, 0.95) \times d_{heel}$$

$$z_{heel} = 248 \text{ mm}$$

Area of tension reinforcement required

$$A_{s\_heel\_des} = M_{heel} / (0.87 \times f_y \times z_{heel}) = 433 \text{ mm}^2/\text{m}$$

Minimum area of tension reinforcement

$$A_{s\_heel\_min} = k \times b \times t_{base} = 390 \text{ mm}^2/\text{m}$$

Area of tension reinforcement required

$$A_{s\_heel\_req} = \text{Max}(A_{s\_heel\_des}, A_{s\_heel\_min}) = 433 \text{ mm}^2/\text{m}$$

Reinforcement provided

**B503 mesh**

Area of reinforcement provided

$$A_{s\_heel\_prov} = 503 \text{ mm}^2/\text{m}$$

**PASS - Reinforcement provided at the retaining wall heel is adequate**

#### Check shear resistance at heel

Design shear stress

$$v_{heel} = V_{heel} / (b \times d_{heel}) = 0.167 \text{ N/mm}^2$$

Allowable shear stress

$$v_{adm} = \min(0.8 \times \sqrt{f_{cu} / 1 \text{ N/mm}^2}, 5) \times 1 \text{ N/mm}^2 = 4.733 \text{ N/mm}^2$$

**PASS - Design shear stress is less than maximum shear stress**

|                                                                                                                                                        |                                 |                          |            |              |                              |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------|------------|--------------|------------------------------|---------------|
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|                                                                                                                                                        | Calcs for<br>Retaining Wall     |                          |            |              | Start page no./Revision<br>7 |               |
|                                                                                                                                                        | Calcs by<br>GAB                 | Calcs date<br>11/02/2024 | Checked by | Checked date | Approved by                  | Approved date |

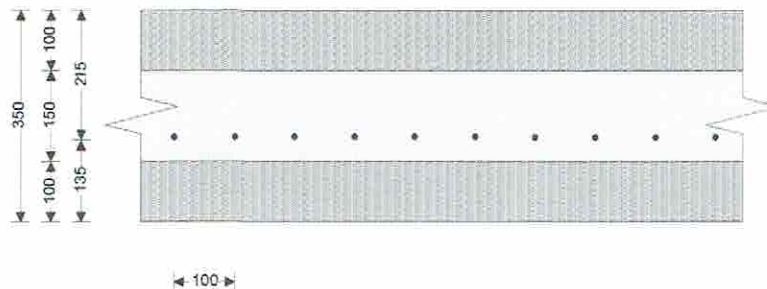
From BS8110:Part 1:1997 – Table 3.8

Design concrete shear stress

$$V_{c\_heel} = 0.454 \text{ N/mm}^2$$

$V_{heel} < V_{c\_heel}$  - No shear reinforcement required

#### Design of cavity reinforced masonry retaining wall stem - BS5628-2:2000



#### Wall details

Thickness of outer leaf of wall

$$t_{outer} = 100 \text{ mm}$$

Thickness of inner leaf of wall

$$t_{inner} = 100 \text{ mm}$$

Thickness of reinforced cavity

$$t_{cavity} = t_{wall} - t_{outer} - t_{inner} = 150 \text{ mm}$$

Depth of stem reinforcement

$$d_{stem} = 215 \text{ mm}$$

#### Masonry details

Masonry type

Aggregate concrete blocks no voids

Compressive strength of units

$$p_{unit} = 7.3 \text{ N/mm}^2$$

Mortar designation

(ii)

Category of manufacturing control of units

Category I

Partial safety factor for material strength

$$\gamma_{mm} = 2.0$$

#### Characteristic compressive strength of masonry

Least horizontal dimension of masonry units

$$b_{unit} = 100.0 \text{ mm}$$

Height of masonry units

$$h_{unit} = 215.0 \text{ mm}$$

Ratio of height to least horizontal dimension

$$\text{ratio} = h_{unit} / b_{unit} = 2.2$$

From BS5628:2 Table 3d, mortar ii

Characteristic compressive strength

$$f_k = 6.4 \text{ N/mm}^2$$

#### Factored horizontal at-rest forces on stem

Surcharge

$$F_{s\_sur\_f} = \gamma_{f\_l} \times K_0 \times \text{Surcharge} \times (h_{eff} - t_{base} - d_{ds}) = 19.4 \text{ kN/m}$$

Moist backfill above water table

$$F_{s\_m\_a\_f} = 0.5 \times \gamma_{f\_e} \times K_0 \times \gamma_m \times (h_{eff} - t_{base} - d_{ds} - h_{sat})^2 = 31.2 \text{ kN/m}$$

#### Calculate shear for stem design

Shear at base of stem

$$V_{stem} = F_{s\_sur\_f} + F_{s\_m\_a\_f} = 50.6 \text{ kN/m}$$

#### Calculate moment for stem design

Surcharge

$$M_{s\_sur} = F_{s\_sur\_f} \times (h_{stem} + t_{base}) / 2 = 22.7 \text{ kNm/m}$$

Moist backfill above water table

$$M_{s\_m\_a} = F_{s\_m\_a\_f} \times (2 \times h_{sat} + h_{eff} - d_{ds} + t_{base}) / 3 = 26 \text{ kNm/m}$$

Total moment for stem design

$$M_{stem} = M_{s\_sur} + M_{s\_m\_a} = 48.8 \text{ kNm/m}$$

#### Check maximum design moment for wall stem

Width of wall

$$b = 1000 \text{ mm/m}$$

Maximum design moment

$$M_{d\_stem} = 0.4 \times f_k \times b \times d_{stem}^2 / \gamma_{mm} = 59.2 \text{ kNm/m}$$

**PASS - Applied moment is less than maximum design moment**

|                                                                                                                                                                        |                      |            |            |                         |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------|------------|-------------------------|---------------|
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|                                                                                                                                                                        | Retaining Wall       |            |            | 8                       |               |
|                                                                                                                                                                        | Calcs by             | Calcs date | Checked by | Checked date            | Approved by   |
|                                                                                                                                                                        | GAB                  | 11/02/2024 |            |                         | Approved date |

### Check wall stem in bending

Moment of resistance factor

$$Q = M_{\text{stem}} / d_{\text{stem}}^2 = 1.055 \text{ N/mm}^2$$

$$Q = 2 \times c \times (1 - c) \times f_k / \gamma_{\text{mm}}$$

Lever arm factor

$$c = 0.792$$

Lever arm

$$z_{\text{stem}} = \min(0.95, c) \times d_{\text{stem}} = 170.2 \text{ mm}$$

Area of tension reinforcement required

$$A_{s\_stem\_des} = M_{\text{stem}} \times \gamma_{\text{ms}} / (f_y \times z_{\text{stem}}) = 659 \text{ mm}^2/\text{m}$$

Minimum area of tension reinforcement

$$A_{s\_stem\_min} = k \times b \times t_{\text{wall}} = 455 \text{ mm}^2/\text{m}$$

Area of tension reinforcement required

$$A_{s\_stem\_req} = \text{Max}(A_{s\_stem\_des}, A_{s\_stem\_min}) = 659 \text{ mm}^2/\text{m}$$

Reinforcement provided

**B785 mesh**

Area of reinforcement provided

$$A_{s\_stem\_prov} = \pi \times \phi_{\text{stem}}^2 / (4 \times s_{\text{stem}}) = 785 \text{ mm}^2/\text{m}$$

**PASS - Reinforcement provided at the retaining wall stem is adequate**

### Check shear resistance at wall stem

Design shear stress

$$v_{\text{stem}} = V_{\text{stem}} / (b \times d_{\text{stem}}) = 0.235 \text{ N/mm}^2$$

Basic characteristic shear strength of masonry

$$f_{v\text{bas}} = \min[0.35 + (17.5 \times A_{s\_stem\_prov} / (b \times d_{\text{stem}})), 0.7] \times 1 \text{ N/mm}^2$$

$$f_{v\text{bas}} = 0.414 \text{ N/mm}^2$$

Shear span

$$a = M_{\text{stem}} / V_{\text{stem}} = 964.0 \text{ mm}$$

Characteristic shear strength of masonry

$$f_v = \text{Min}(f_{v\text{bas}} \times \max(2.5 - 0.25 \times (a / d_{\text{stem}}), 1), 1.75 \text{ N/mm}^2)$$

$$f_v = 0.571 \text{ N/mm}^2$$

Allowable shear stress

$$V_{\text{adm}} = f_v / \gamma_{\text{mv}} = 0.285 \text{ N/mm}^2$$

**PASS - Design shear stress is less than maximum shear stress**

### Check limiting dimensions

Limiting span/effective depth ratio

$$\text{ratio}_{\text{max}} = 18.00$$

Actual span/effective depth ratio

$$\text{ratio}_{\text{act}} = (h_{\text{stem}} + d_{\text{stem}} / 2) / d_{\text{stem}} = 10.03$$

**PASS - Span to depth ratio is acceptable**

### Axial load check

Factored axial load on wall

$$N_{\text{wall}} = ([t_{\text{wall}} \times h_{\text{stem}} \times \gamma_{\text{wall}} + W_{\text{dead}}] \times \gamma_{\text{f\_d}}) + (W_{\text{live}} \times \gamma_{\text{f\_l}}) = 18.1 \text{ kN/m}$$

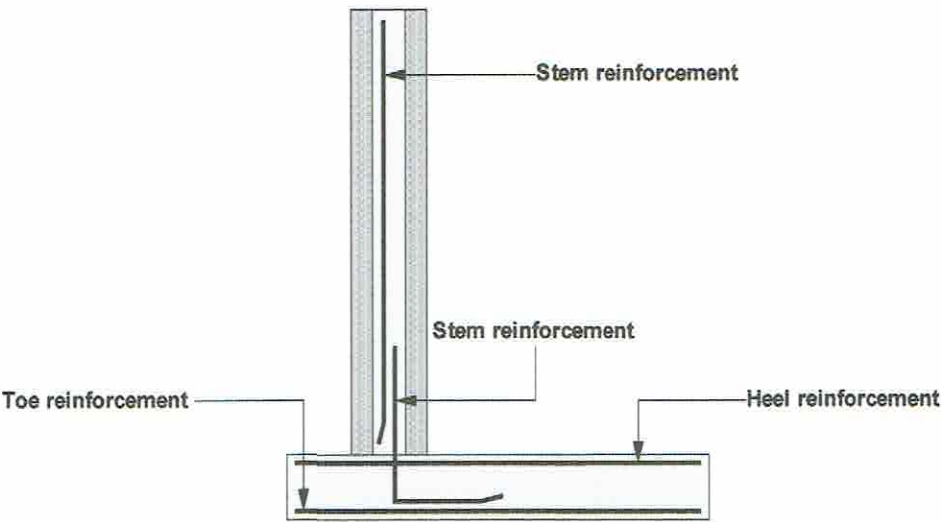
Limiting axial load

$$N_{\text{limit}} = 0.1 \times f_k \times t_{\text{wall}} = 224.0 \text{ kN/m}$$

**Applied axial load may be ignored - calculations valid**

|                                                                                                                                                        |                      |            |            |              |                         |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------|------------|--------------|-------------------------|---------------|
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|                                                                                                                                                        | 8 Church Road Baglan |            |            |              | Start page no./Revision |               |
|                                                                                                                                                        | Retaining Wall       |            |            |              | 9                       |               |
|                                                                                                                                                        | Calcs by             | Calcs date | Checked by | Checked date | Approved by             | Approved date |
|                                                                                                                                                        | GAB                  | 11/02/2024 |            |              |                         |               |

Indicative retaining wall reinforcement diagram



Toe mesh - A393 - (393 mm<sup>2</sup>/m)  
 Heel mesh - B503 - (503 mm<sup>2</sup>/m)  
 Stem mesh - B785 - (785 mm<sup>2</sup>/m)

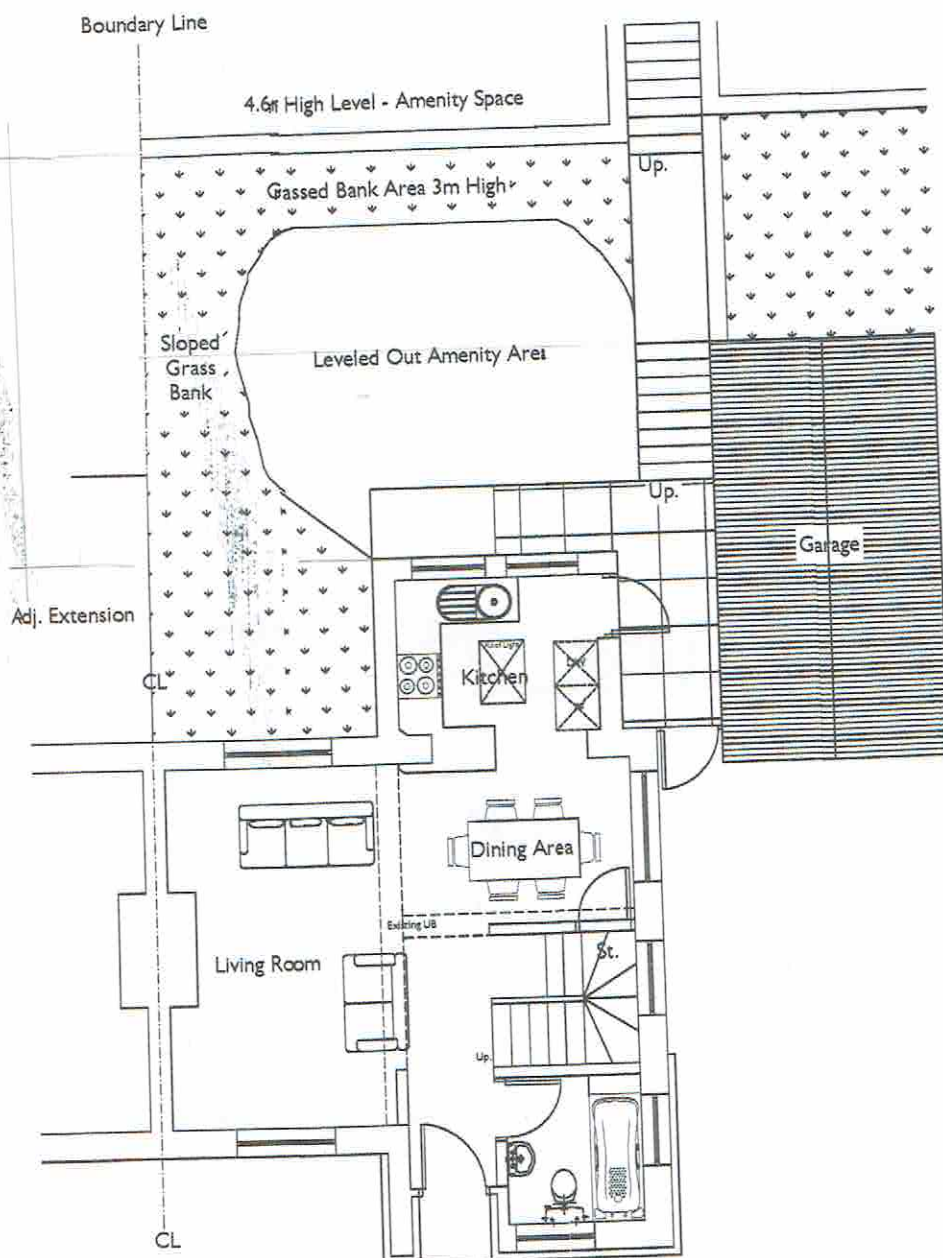
1/200.



10.8 x 1.07 = 11.26 m.



**Side Elevation 1:100**



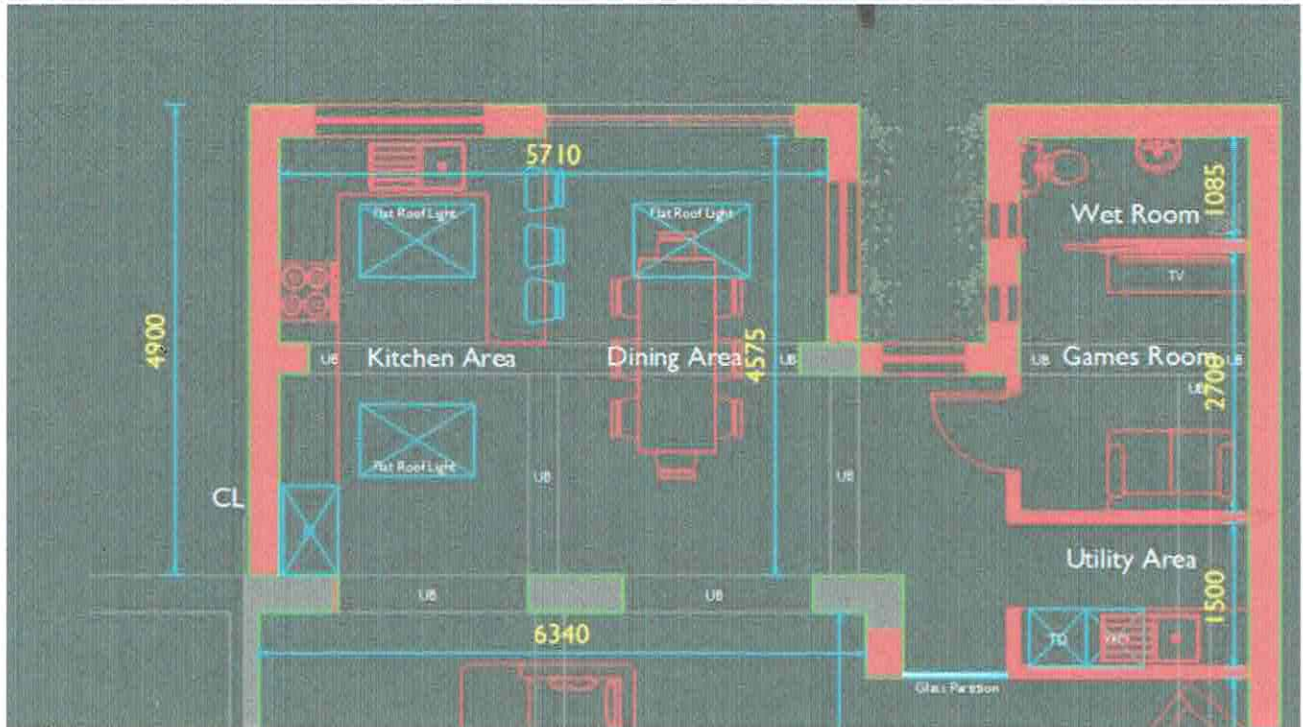
### Ground Floor Plan 1:50

NEW FORT ALBION.

From: George Brown georgeabrown59@gmail.com @  
Subject: Photo from georgeabrown59  
Date: 29 January 2024 at 19:10  
To: georgeabrown59@gmail.com

GB

Sent from my Huawei phone



# 8, CHURCH ROAD, BAGLAN, PORT TALBOT

## Notes

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## Revision:

A

## Description:

Design revised for Planning officers

## External Finishes

Walls - White Rough  
Composite Cladding  
To An Approved Colour

Roof - Existing Roof Tiles  
Membrane To Proposed

Windows - Anthracite  
RWG - Black PVC

## Drawing Status:

PLANNING



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ARCHITECTURE

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## Client:

Neil Edwards & Katherine  
Florance

## Project Title:

Proposal of a Side  
Extension at 8, Church  
Baglan, Port Talbot

## Drawing Title:

Proposed Floor Plan  
Elevations

## Scale:

1:50, 1:100 @ A1

## Drawn:

AH

## Job No:

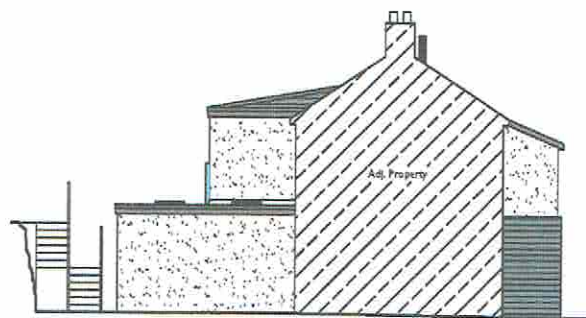
1085

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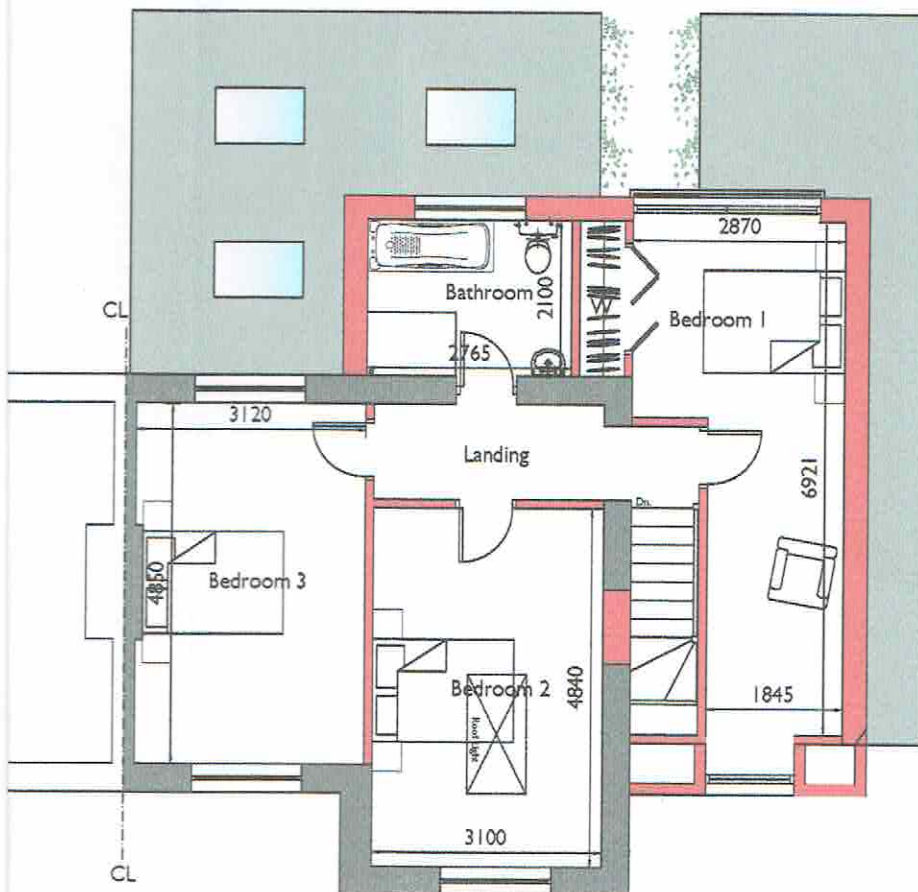
03



Rear Elevation 1:100



Side Elevation 1:100



First Floor Plan 1:50