



# BUILDING REGULATIONS SUBMISSION

PROJECT ADDRESS:  
LYNE HOUSE, WORTHING, BN14 9QY

PROJECT DESCRIPTION:  
Access road design – ring beam and associated foundations

Date: March 25  
Project Number: 25-084  
Revision Number: BR1

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## Introduction

### 1.1 Design Check

|                                         |                                                                                   |                |                |
|-----------------------------------------|-----------------------------------------------------------------------------------|----------------|----------------|
| Project: Lyne House, Worthing, Bn14 9qy |                                                                                   |                |                |
| Project No: 25-084                      |                                                                                   |                |                |
|                                         |                                                                                   |                |                |
| Issue                                   | Date                                                                              | Description    |                |
| BR1                                     | March 25                                                                          | First Issue    |                |
|                                         |                                                                                   |                |                |
| Engineering Check List                  | Date Complete                                                                     |                |                |
| NO                                      | Date                                                                              |                |                |
|                                         |                                                                                   |                |                |
|                                         | Prepared By                                                                       | Checked By     | Approved By    |
| Name                                    | Robert Collett                                                                    | Charlie Bowles | Charlie Bowles |
| Signature                               |  |                |                |

## 1.2 Building regulations submission

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |       |          |                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|----------|----------------|
| Project: Lyne House, Worthing, Bn14 9qy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |       |          |                |
| Project No:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 25-084 | Date: | March 25 | Engineer: RCC  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |       |          | Checked By: CB |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |       |          | Sheet No: G2   |
| 1) Local Authority: Adur and Worthing Council                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |       |          |                |
| 2) Parts of structure: Refer to section 1.3 for description of works                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |       |          |                |
| 3) Design assumptions made in calculations: No major design assumptions of note other than noted on drawings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |       |          |                |
| a) Based on drawings: Creating Spaces Root Bridge Drawing: LR.ROOT.02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |       |          |                |
| b) Existing brickwork strength assumed as $f_k = 2.8 \text{ N/mm}^2$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |       |          |                |
| c) Safe ground bearing pressure (to be confirmed on site by the Building Control Officer) taken as 150kPa                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |       |          |                |
| d) Permanent & Variable loads (refer to standard loading table on calculations)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |       |          |                |
| 4) Codes of Practice<br>The building design for this scheme has been undertaken to the follow codes of practice. Where applicable, the Eurocodes were read in correspondence with the appropriate national annexe.<br><br>General<br>Eurocode 0 (BS EN 1990 2002): Basis of Structural Design<br>Eurocode 1 (BS EN 1991-1-1 2002): Actions, Densities & Self Weight<br><br>Concrete<br>Eurocode 2 (BS EN 1991-1-2004 – General Rules<br><br>Steelwork<br>Eurocode 3 (BS EN 1993-1-1 2005) Steel - General Rules and Rules for Buildings<br>Eurocode 3 (BS EN 1993-1-8 2005) Steel - Design of Joints<br><br>Timber<br>Eurocode 5 (BS EN 1995-1-1 2004) Timber - Common Rules and Rules for Building<br><br>Masonry<br>Eurocode 6 (BS EN 1996-1-1 2005) Masonry, Reinforced and Unreinforced General Rules<br>Eurocode 6 (BS EN 1996-2 2006) Masonry, Materials & Execution |        |       |          |                |
| For Building Control Approval Only (Details contained in this submission are not to be used for construction)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |       |          |                |

### 1.3 Philosophy & design overview

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |               |                |              |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------|----------------|--------------|--|
| Project: Lyne House, Worthing, Bn14 9qy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |               |                |              |  |
| Project No: 25-084                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Date: March 25 | Engineer: RCC | Checked By: CB | Sheet No: G3 |  |
| <p>Introduction</p> <p>QED have been appointed to design check the access road “Root Bridge” solution presented on Creating Spaces drawing LR.ROOT.02. This consists of a road formed of metal gratings supported by SHS sections, screw piles and a ring beam formed by steels encased in concrete. The access road should allow provision for an 18T fire tender and not load the existing retaining wall.</p> <p>The attached calculations check the ring beam and foundation design. Piles were found to be unsuitable with proposed size and bearing pressure and a solution based on unreinforced pad foundations has been presented instead.</p> |                |               |                |              |  |
| <p>Ground Conditions</p> <p>Assumed as presented on drawing LR.ROOT.02</p> <p>I.E. Chalk – assumed bearing capacity 150kPa</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |               |                |              |  |
| <p>Foundations</p> <p>New foundations formed from unreinforced concrete pads bearing directly onto chalk</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |               |                |              |  |
| <p>Stability</p> <p>Stability is achieved by the system of screw piles and concrete pad foundations transferring horizontal loads to the ground via shear.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |               |                |              |  |
| <p>Loadings</p> <p>All proposed loads are in line with Eurocodes.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |               |                |              |  |
| <p>Fire Protection</p> <p>To architects’ details</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |               |                |              |  |
| <p>Building Consequence Class</p> <p>N/A</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |               |                |              |  |



## Calculations

1.5

Provisionally allow for Finished Drive Level of 43.78 (505mm below datum) but ensure tree roots are at least 235mm below this target, adjust on site to suite.

43.78

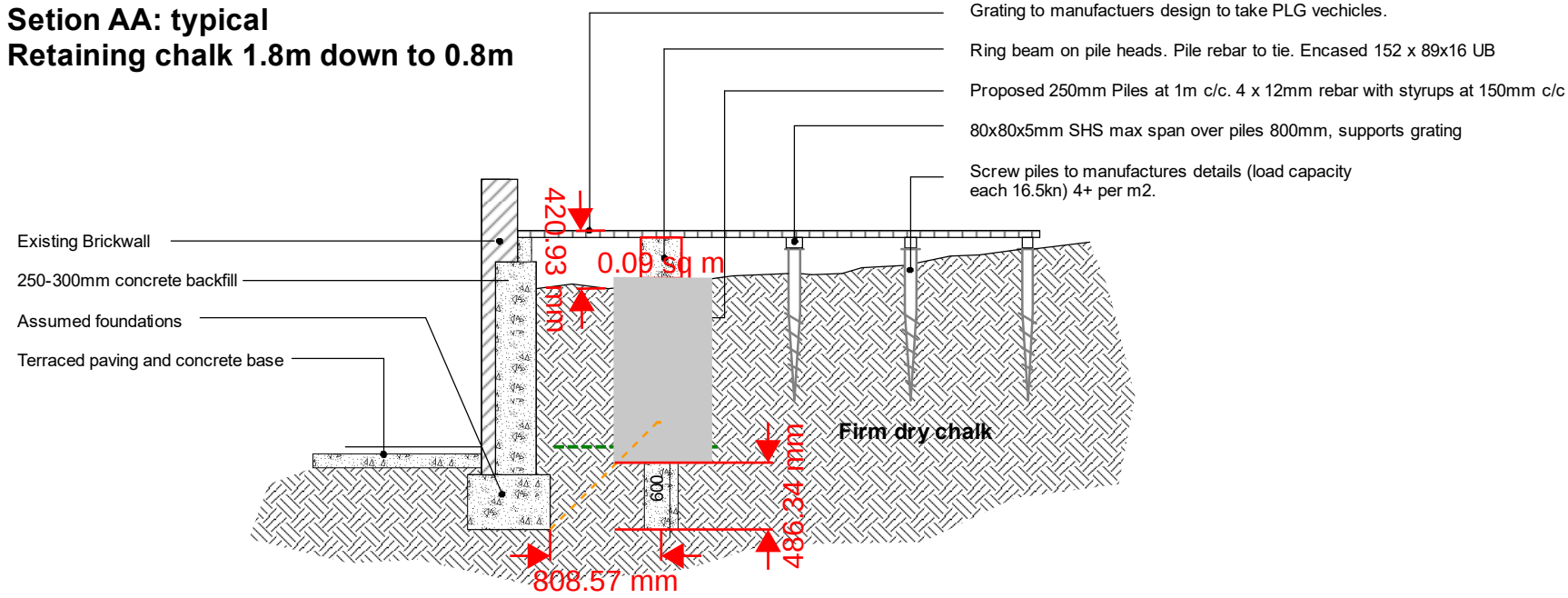
42.82

42.34

41.86

GRATE SETOUT  
63.23m2

Setion AA: typical  
Retaining chalk 1.8m down to 0.8m



EXISTING WALL IS RETAINING 1.8m

EXISTING WALL IS RETAINING 1.4m

EXISTING WALL IS RETAINING 1.m

Setion AA

250mm concrete piles, drilled with auger. Compact the base  
When near the retaining wall piles need to extend below the ground level of swimming pool, by at least 600mm but deeper is possible .

Ring beam fitted above piles formed with a 152x89 UB, end bearing onto piles and encased with concrete ensuring at least 50mm cover to all sides / faces. Pile re-bar to tie into ring beam. Ring beam to be 300mm wide x 280mm deep.

The ring beam is to support the Road grates and block paving above. Provide a minimum 25mm clearance above existing ground / tree roots. Allow:

- 25mm air gap
- 80mm SHS
- 50mm metal grate
- 20mm bedding stone
- 60mm suds block paving

235mm Total

Radix ground screws offering 16.5kN loads on each sciew pile. Supports frame, grates and block paving above. Set piles so they are 80mm below the ring beam.

PILE & RING BEAM SET OUT



NORTH

This drawing is subject to copyright laws and must not be used or copied with Creating Spaces Consent. Do not scale to other than for planning purposes

SITE: Land Adjacent to Lyne House, Worthing, BN14 9QY

SCALE: 1:50 on A1 Paper

DRAWING: Root Bridge

Drawing Ref:  
LR.ROOT.02

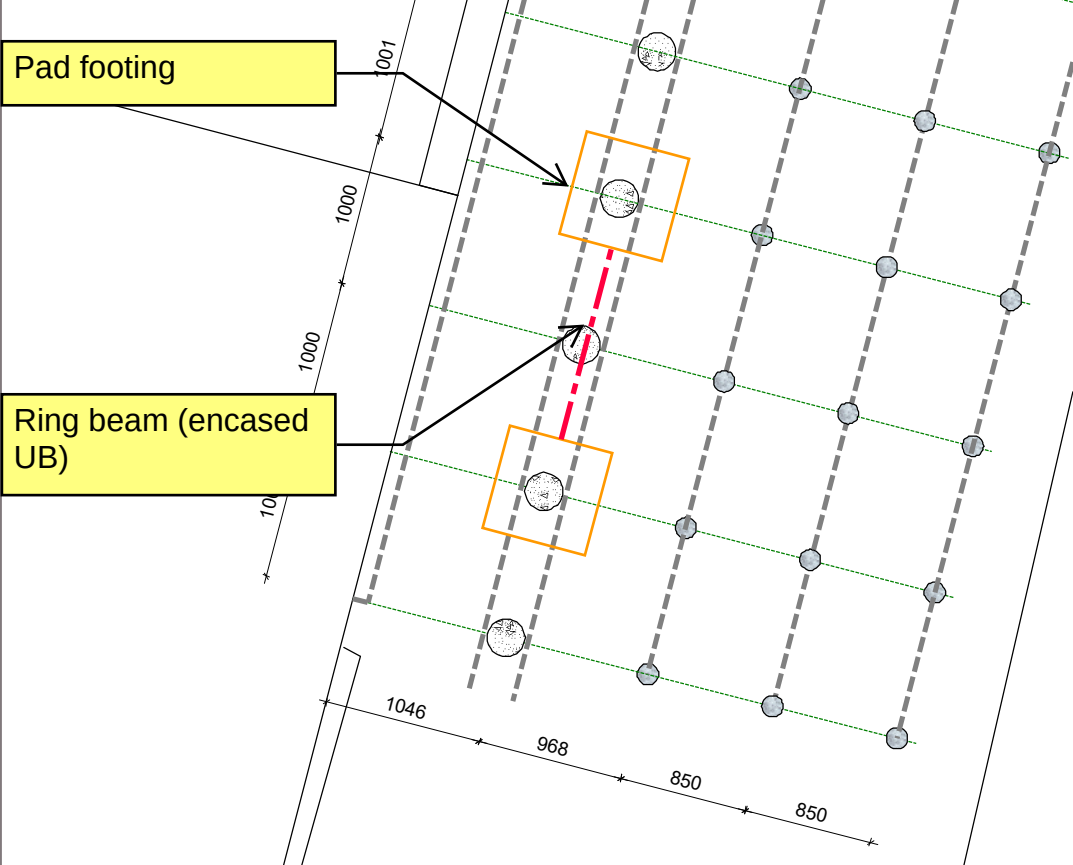
CONSTRUCTION

Drawn by: AM  
March 2025

Revision:

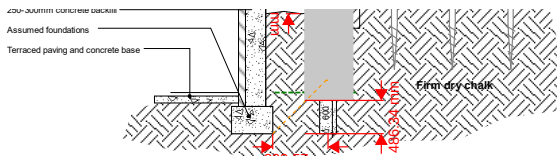
SHS added and grate change  
Pile c/c changed



| Project: Lyne House, Worthing  |                                                                                                                                                                                                                                                                                                                                         |               | Part of Structure: Road - Piles and Ring Beam |           |        |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------------------------|-----------|--------|
| Project No: 25-084             | Date: 13/03/2025                                                                                                                                                                                                                                                                                                                        | Engineer: RCC | Checked By:                                   | Sheet No: |        |
| Ref                            | Calculation                                                                                                                                                                                                                                                                                                                             |               |                                               |           | Output |
| BREGS<br>Part B,<br>Table 13.1 | <p><u>Design of Pad Footings to Road Ring Beam</u></p> <p>LIVE LOADS:<br/>Allow for a standard fire tender of 18 Tonnes with 2 axles<br/>Wheel load = 4.5T = 45kN</p> <p>Allow for 1 wheel to load 1 pad foundation (design vehicle 8.24m long)</p>  |               |                                               |           |        |
|                                | <p>DEAD LOADS:</p> <p>Ring beam: Concrete Encased UB152x89x16</p> <p>Beam = 0.16 kN/m</p> <p>Encasement 0.3 x 0.28 x 24 = 2.02 kN/m</p> <p>Metal grating:</p> <p>Allow 1.0kN/m<sup>2</sup></p> <p>Loaded width say @1m = 1kN/m</p> <p>So 3.2 kN/m</p>                                                                                   |               |                                               |           |        |

OTHER FINISHES NOT ALLOWED FOR IN THIS CALC!

| Project: Lyne House, Worthing |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                | Part of Structure: Loads on Road |                        |             |                 |                |                 |                        |             |                            |      |      |     |        |   |                            |      |      |      |        |   |                  |      |      |      |        |   |  |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------|------------------------|-------------|-----------------|----------------|-----------------|------------------------|-------------|----------------------------|------|------|-----|--------|---|----------------------------|------|------|------|--------|---|------------------|------|------|------|--------|---|--|
| Project No: 25-084            | Date: 13/03/2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Engineer: RCC  | Checked By:                      | Sheet No:              |             |                 |                |                 |                        |             |                            |      |      |     |        |   |                            |      |      |      |        |   |                  |      |      |      |        |   |  |
| Ref                           | Calculation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |                                  |                        | Output      |                 |                |                 |                        |             |                            |      |      |     |        |   |                            |      |      |      |        |   |                  |      |      |      |        |   |  |
|                               | <div><div>DORSET &amp; WILTSHIRE<br/>FIRE AND RESCUE</div></div> <div><div>Latest Incidents</div><div> 6th March, 2025 - 3.24pm: We were called to reports of a commercial pr</div></div> <div><div>Home / Business fire safety / Building regulations / Vehicle dimensions</div><div>Vehicle dimensions</div><div>Any site design should include a safe access route for fire appliances to manoeuvre within the site (including turning circles). This includes ensuring that any route can accommodate the weight and dimensions of fire appliances, based on the larger measurement of either the DWFRS information below or the specifications in section five of the <a href="#">Approved Document Part B (Fire Safety)</a> :</div><table><thead><tr><th>Vehicle</th><th>Height (metres)</th><th>Width (metres)</th><th>Length (metres)</th><th>Weight (gross veh) kgs</th><th>No of axles</th></tr></thead><tbody><tr><td>32m aerial ladder platform</td><td>3.34</td><td>2.55</td><td>9.4</td><td>26,000</td><td>3</td></tr><tr><td>42m aerial ladder platform</td><td>3.56</td><td>2.55</td><td>10.4</td><td>26,000</td><td>3</td></tr><tr><td>DWFRS spec P1/P7</td><td>3.15</td><td>2.55</td><td>8.24</td><td>18,000</td><td>2</td></tr></tbody></table></div> |                |                                  |                        | Vehicle     | Height (metres) | Width (metres) | Length (metres) | Weight (gross veh) kgs | No of axles | 32m aerial ladder platform | 3.34 | 2.55 | 9.4 | 26,000 | 3 | 42m aerial ladder platform | 3.56 | 2.55 | 10.4 | 26,000 | 3 | DWFRS spec P1/P7 | 3.15 | 2.55 | 8.24 | 18,000 | 2 |  |
| Vehicle                       | Height (metres)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Width (metres) | Length (metres)                  | Weight (gross veh) kgs | No of axles |                 |                |                 |                        |             |                            |      |      |     |        |   |                            |      |      |      |        |   |                  |      |      |      |        |   |  |
| 32m aerial ladder platform    | 3.34                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.55           | 9.4                              | 26,000                 | 3           |                 |                |                 |                        |             |                            |      |      |     |        |   |                            |      |      |      |        |   |                  |      |      |      |        |   |  |
| 42m aerial ladder platform    | 3.56                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.55           | 10.4                             | 26,000                 | 3           |                 |                |                 |                        |             |                            |      |      |     |        |   |                            |      |      |      |        |   |                  |      |      |      |        |   |  |
| DWFRS spec P1/P7              | 3.15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.55           | 8.24                             | 18,000                 | 2           |                 |                |                 |                        |             |                            |      |      |     |        |   |                            |      |      |      |        |   |                  |      |      |      |        |   |  |

| Project: Lyne House, Worthing |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               | Part of Structure: Road - Piles and Ring Beam |           |                                                                              |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------------------------|-----------|------------------------------------------------------------------------------|
| Project No: 25-084            | Date: 13/03/2025                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Engineer: RCC | Checked By:                                   | Sheet No: |                                                                              |
| Ref                           | Calculation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                                               |           | Output                                                                       |
|                               | <p><u>Design of Pad Footings to Road Ring Beam</u><br/>Try at 2m centres</p> <p>ANALYSIS:<br/>Vertical loads per pad foundation = <math>6.4 + 45 = 51.4 \text{ kN (SLS)}</math><br/>+ PAVING FINISHES? + Self weight of foundations..</p> <p>Try 650mm x 650mm pads at 2m c/c<br/>Assume safe bearing pressure @ 150kPa for chalk substrate AND a 2.4m deep pad.</p> <p>Pad capacity = 63.4 kN -<br/>Assume Pad weight equal to chalk weight removed save where higher than chalk surface. Allow for 0.5m depth higher than chalk.<br/>Therefore real pad capacity for superstructure = <math>73.5\text{kN} - 0.5 \times 23 \times 0.7^2 = 58.5\text{kN} &gt; 51.4\text{kN OK}</math></p> |               |                                               |           |                                                                              |
|                               | <p><u>Pad Footings to Road Ring Beam</u><br/>Try at 3m centres</p> <p>ANALYSIS:<br/>Vertical loads per pad foundation = <math>9.6 + 45 = 54.4\text{kN (SLS)}</math> + FINISHES? + Self weight of foundations..</p> <p>Try 700mm x 700mm pads at 3m c/c<br/>Assume safe bearing pressure @ 150kPa for chalk substrate AND a 2.4m deep pad.</p> <p>Pad capacity = <math>73.5 - 5.6 = 67.9\text{kN} &gt; \text{Vertical load , OK}</math><br/>(Assume Pad weight equal to chalk weight removed save where higher than chalk surface. Allow for 0.5m depth higher than chalk.)</p>                                                                                                            |               |                                               |           | <p><u>Pads @ 2m c/c</u></p> <p>Provide 650x650mm concrete pads<br/>(88%)</p> |
|                               | <p><u>Pad Founding depth</u><br/>To avoid loading the existing retaining wall foundation, found pads not higher than 450mm above wall foundation</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                                               |           | <p><u>Pads @ 3m c/c</u></p> <p>Provide 700x700mm concrete pads<br/>(92%)</p> |

**Project:** Lyne House, Worthing

**Part of Structure:** Road - Piles and Ring Beam

**Project No:** 25-084

**Date:** 13/03/2025

**Engineer:** RCC

**Checked By:**

**Sheet No:**

**Ref**

**Calculation**

**Output**

### Design of Ring Beam

650mm Pads at 2m centres

#### ANALYSIS:

Clear span of beam = 1300mm

Allow 100mm bearing each end

Pads @ 2m c/c

Provide

UB152x89x16

700mm Pads at 3m centres

#### ANALYSIS:

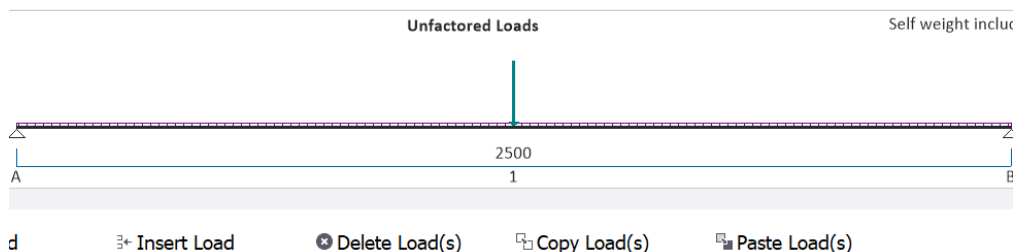
Clear span of beam = 2300mm

Allow 100mm bearing each end

Pads @ 3m c/c

Provide 2No.

UB152x89x16



|   | Description            | Load       | Type      | Load 1    | Pos 1   | Load 2 |  |
|---|------------------------|------------|-----------|-----------|---------|--------|--|
| 1 |                        | SelfWeight | Permanent | 1 factor  |         |        |  |
| 2 | Concrete Encasement    | Full UDL   | Permanent | 3.02 kN/m |         |        |  |
| 3 | Fire Tender Wheel Load | Point Load | Variable  | 45 kN     | 1250 mm |        |  |

700mm Pads at 2.5m centres

#### ANALYSIS:

Clear span of beam = 1800mm

Allow 100mm bearing each end

Pads @ 2.5m c/c

Provide

UB152x89x16

(92% LTB governs)

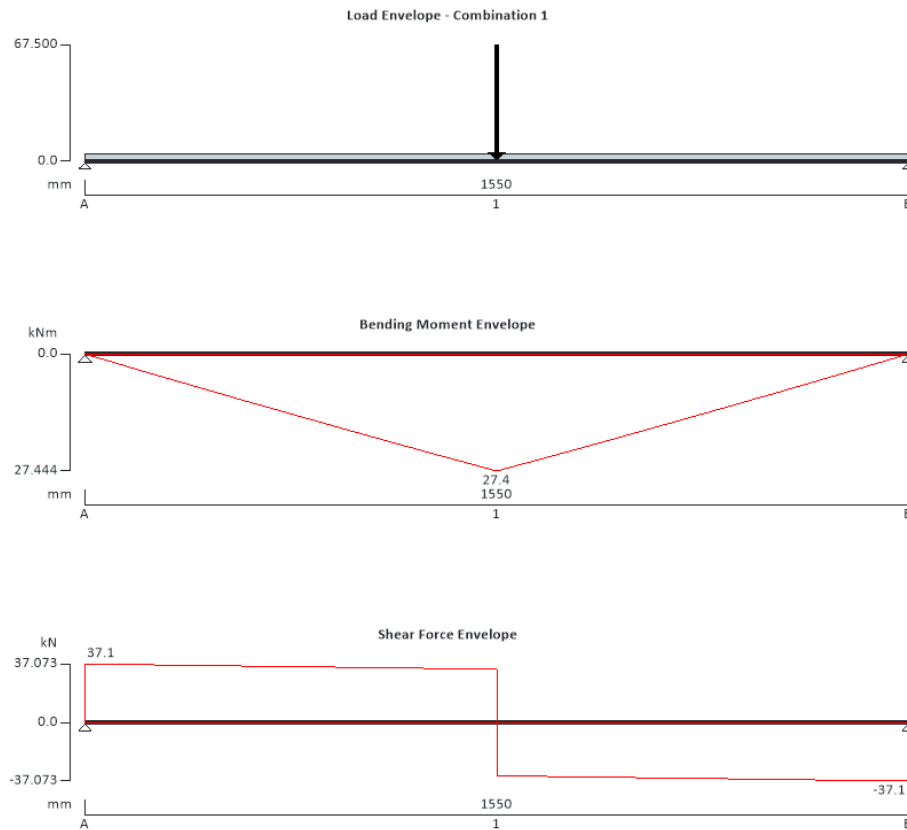
#### Conclusion

Provide 1No. encased  
UB152x89x16  
with 650mm x 650mm pad  
foundations at  
2m centres

## STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009 and the UK national annex

TEDDS calculation version 3.0.14



### Support conditions

Support A

Vertically restrained

Rotationally free

Support B

Vertically restrained

Rotationally free

### Applied loading

Beam loads

Permanent self weight of beam  $\times 1$

Concrete Encasement - Permanent full UDL 3.02 kN/m

Variable point load 45 kN at 775 mm

### Load combinations

Load combination 1

Support A

Permanent  $\times 1.35$

Variable  $\times 1.50$

Permanent  $\times 1.35$

Variable  $\times 1.50$

Support B

Permanent  $\times 1.35$

Variable  $\times 1.50$

### Analysis results

Maximum moment

 $M_{max} = 27.4 \text{ kNm}$ 
 $M_{min} = 0 \text{ kNm}$ 

Maximum shear

 $V_{max} = 37.1 \text{ kN}$ 
 $V_{min} = -37.1 \text{ kN}$ 

Deflection

 $\delta_{max} = 2 \text{ mm}$ 
 $\delta_{min} = 0 \text{ mm}$ 

Maximum reaction at support A

 $R_{A_{max}} = 37.1 \text{ kN}$ 
 $R_{A_{min}} = 37.1 \text{ kN}$ 

Unfactored permanent load reaction at support A

 $R_{A_{Permanent}} = 2.5 \text{ kN}$ 

Unfactored variable load reaction at support A

 $R_{A_{Variable}} = 22.5 \text{ kN}$ 

Maximum reaction at support B

 $R_{B_{max}} = 37.1 \text{ kN}$ 
 $R_{B_{min}} = 37.1 \text{ kN}$ 

Unfactored permanent load reaction at support B

 $R_{B_{Permanent}} = 2.5 \text{ kN}$ 

Unfactored variable load reaction at support B

 $R_{B_{Variable}} = 22.5 \text{ kN}$ 

### Section details

Section type

**UKB 152x89x16 (Tata Steel Advance)**

Steel grade

**S355**
**EN 10025-2:2004 - Hot rolled products of structural steels**

Nominal thickness of element

 $t = \max(t_f, t_w) = 7.7 \text{ mm}$ 

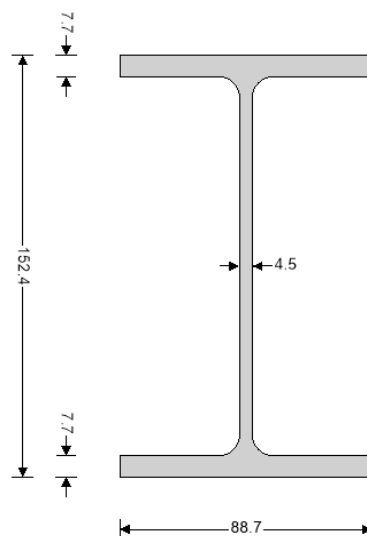
Nominal yield strength

 $f_y = 355 \text{ N/mm}^2$ 

Nominal ultimate tensile strength

 $f_u = 470 \text{ N/mm}^2$ 

Modulus of elasticity

 $E = 210000 \text{ N/mm}^2$ 


### Partial factors - Section 6.1

Resistance of cross-sections

 $\gamma_{M0} = 1.00$ 

Resistance of members to instability

 $\gamma_{M1} = 1.00$ 

Resistance of tensile members to fracture

 $\gamma_{M2} = 1.10$ 

### Lateral restraint

Span 1 has lateral restraint at supports only

### Effective length factors

Effective length factor in major axis

 $K_y = 1.000$ 

Effective length factor in minor axis

 $K_z = 1.000$ 

Effective length factor for torsion

 $K_{LT,A} = 1.000$ 
 $K_{LT,B} = 1.000$

|                                                                                                                                                                 |               |                          |            |              |                         |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------|------------|--------------|-------------------------|---------------|
|  <p>Tekla Tedds<br/>QED<br/>7 Hove Manor Parade<br/>Hove Street<br/>BN3 2DF</p> | Project       |                          |            |              | Job no.                 |               |
|                                                                                                                                                                 | Calcs for     |                          |            |              | Start page no./Revision |               |
|                                                                                                                                                                 |               |                          |            |              | 3                       |               |
|                                                                                                                                                                 | Calcs by<br>R | Calcs date<br>24/03/2025 | Checked by | Checked date | Approved by             | Approved date |

### Classification of cross sections - Section 5.5

$$\varepsilon = \sqrt{[235 \text{ N/mm}^2 / f_y]} = \mathbf{0.81}$$

### Internal compression parts subject to bending - Table 5.2 (sheet 1 of 3)

Width of section

$$c = d = \mathbf{121.8 \text{ mm}}$$

$$c / t_w = 33.3 \times \varepsilon \leq 72 \times \varepsilon \quad \text{Class 1}$$

### Outstand flanges - Table 5.2 (sheet 2 of 3)

Width of section

$$c = (b - t_w - 2 \times r) / 2 = \mathbf{34.5 \text{ mm}}$$

$$c / t_f = 5.5 \times \varepsilon \leq 9 \times \varepsilon \quad \text{Class 1}$$

*Section is class 1*

### Check shear - Section 6.2.6

Height of web

$$h_w = h - 2 \times t_f = \mathbf{137 \text{ mm}}$$

Shear area factor

$$\eta = \mathbf{1.000}$$

$$h_w / t_w < 72 \times \varepsilon / \eta$$

*Shear buckling resistance can be ignored*

Design shear force

$$V_{Ed} = \max(\text{abs}(V_{\max}), \text{abs}(V_{\min})) = \mathbf{37.1 \text{ kN}}$$

Shear area - cl 6.2.6(3)

$$A_v = \max(A - 2 \times b \times t_f + (t_w + 2 \times r) \times t_f, \eta \times h_w \times t_w) = \mathbf{818 \text{ mm}^2}$$

Design shear resistance - cl 6.2.6(2)

$$V_{c,Rd} = V_{pl,Rd} = A_v \times (f_y / \sqrt{3}) / \gamma_{M0} = \mathbf{167.6 \text{ kN}}$$

*PASS - Design shear resistance exceeds design shear force*

### Check bending moment major (y-y) axis - Section 6.2.5

Design bending moment

$$M_{Ed} = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min})) = \mathbf{27.4 \text{ kNm}}$$

Design bending resistance moment - eq 6.13

$$M_{c,Rd} = M_{pl,Rd} = W_{pl,y} \times f_y / \gamma_{M0} = \mathbf{43.8 \text{ kNm}}$$

### Slenderness ratio for lateral torsional buckling

Correction factor - Table 6.6

$$k_c = \mathbf{0.86}$$

$$C_1 = 1 / k_c^2 = \mathbf{1.352}$$

Curvature factor

$$g = \sqrt{[1 - (I_z / I_y)]} = \mathbf{0.945}$$

Poissons ratio

$$\nu = \mathbf{0.3}$$

Shear modulus

$$G = E / [2 \times (1 + \nu)] = \mathbf{80769 \text{ N/mm}^2}$$

Unrestrained length

$$L = 1.0 \times L_{s1} = \mathbf{1550 \text{ mm}}$$

Elastic critical buckling moment

$$M_{cr} = C_1 \times \pi^2 \times E \times I_z / (L^2 \times g) \times \sqrt{[I_w / I_z + L^2 \times G \times I_t / (\pi^2 \times E \times I_z)]} = \mathbf{104.8 \text{ kNm}}$$

Slenderness ratio for lateral torsional buckling

$$\bar{\lambda}_{LT} = \sqrt{(W_{pl,y} \times f_y / M_{cr})} = \mathbf{0.646}$$

Limiting slenderness ratio

$$\bar{\lambda}_{LT,0} = \mathbf{0.4}$$

*$\bar{\lambda}_{LT} > \bar{\lambda}_{LT,0}$  - Lateral torsional buckling cannot be ignored*

### Design resistance for buckling - Section 6.3.2.1

Buckling curve - Table 6.5

$$b$$

Imperfection factor - Table 6.3

$$\alpha_{LT} = \mathbf{0.34}$$

Correction factor for rolled sections

$$\beta = \mathbf{0.75}$$

LTB reduction determination factor

$$\phi_{LT} = 0.5 \times [1 + \alpha_{LT} \times (\bar{\lambda}_{LT} - \bar{\lambda}_{LT,0}) + \beta \times \bar{\lambda}_{LT}^2] = \mathbf{0.698}$$

LTB reduction factor - eq 6.57

$$\chi_{LT} = \min(1 / [\phi_{LT} + \sqrt{(\phi_{LT}^2 - \beta \times \bar{\lambda}_{LT}^2)}], 1, 1 / \bar{\lambda}_{LT}^2) = \mathbf{0.896}$$

Modification factor

$$f = \min(1 - 0.5 \times (1 - k_c) \times [1 - 2 \times (\bar{\lambda}_{LT} - 0.8)^2], 1) = \mathbf{0.933}$$

Modified LTB reduction factor - eq 6.58

$$\chi_{LT,mod} = \min(\chi_{LT} / f, 1) = \mathbf{0.960}$$

Design buckling resistance moment - eq 6.55

$$M_{b,Rd} = \chi_{LT,mod} \times W_{pl,y} \times f_y / \gamma_{M1} = \mathbf{42 \text{ kNm}}$$

*PASS - Design buckling resistance moment exceeds design bending moment*

|                                                                                                                                         |               |                          |            |              |                         |               |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------|------------|--------------|-------------------------|---------------|
| <br>QED<br>7 Hove Manor Parade<br>Hove Street<br>BN3 2DF | Project       |                          |            |              | Job no.                 |               |
|                                                                                                                                         | Calcs for     |                          |            |              | Start page no./Revision |               |
|                                                                                                                                         | Calcs by<br>R | Calcs date<br>24/03/2025 | Checked by | Checked date | Approved by             | Approved date |

**Check vertical deflection - Section 7.2.1**

Consider deflection due to variable loads

Limiting deflection

$$\delta_{lim} = L_{s1} / 360 = \mathbf{4.3 \text{ mm}}$$

Maximum deflection span 1

$$\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min})) = \mathbf{1.993 \text{ mm}}$$

*PASS - Maximum deflection does not exceed deflection limit*