Hudds Design

Structural & Architectural Engineering
DESIGN CONSULTANTS

PLANNING AND BUILDING CONTROL; CALCULATIONS & DRAWINGS

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STRUCTURAL CALCULATIONS
GARAGE
FOR

SANTOKH SINGH
@
2 VERNON CLOSE, EDGERTON, HUDDERSFIELD, HD1 5QE

Design Summary: (See Sheet A1)

Notes:

- All dimensions and Beam Lengths to be confirmed and checked by builder on site prior to works commencing and materials being ordered
- All Beam Heights and Levels to be agreed with client on site.
- All steel to be minimum grade S275 (UNO)
- All Timber / Timber Packing to be minimum grade C24 (UNO)
- Minimum end bearing for steel to be 100mm (UNO)
- Minimum end bearing for timber to be 100mm
- Minimum end bearing for lintels to be 150mm
- All bolted connections to be Min. 4 No. M16 Grade 8.8 Bolts per 10mm end plates fully welded to flanges. Edge distance for bolts to be 30mm to bolting member (UNO)
- All welded connections for steel to be minimum 6mm fillet welds all round connecting member (UNO)
- All Beams to have minimum fire protection of 30 minutes or as required by building regulations
- All new masonry blockwork to be minimum 7.3 N/mm^2 strength
- All returns and loadbearing walls as shown on Architects drawings and mark ups
- All concrete to be minimum grade C30
- All steel to be high yield strength, minimum 500 N/mm^2
- All ground conditions to approval of local authority / building inspector
- All temporary support works to builder/contractor's specification
- All party wall notices and approvals are client/contractor's responsibility.
- Hudds Design has not been appointed as CDM coordinator and is the responsibility of the builder.

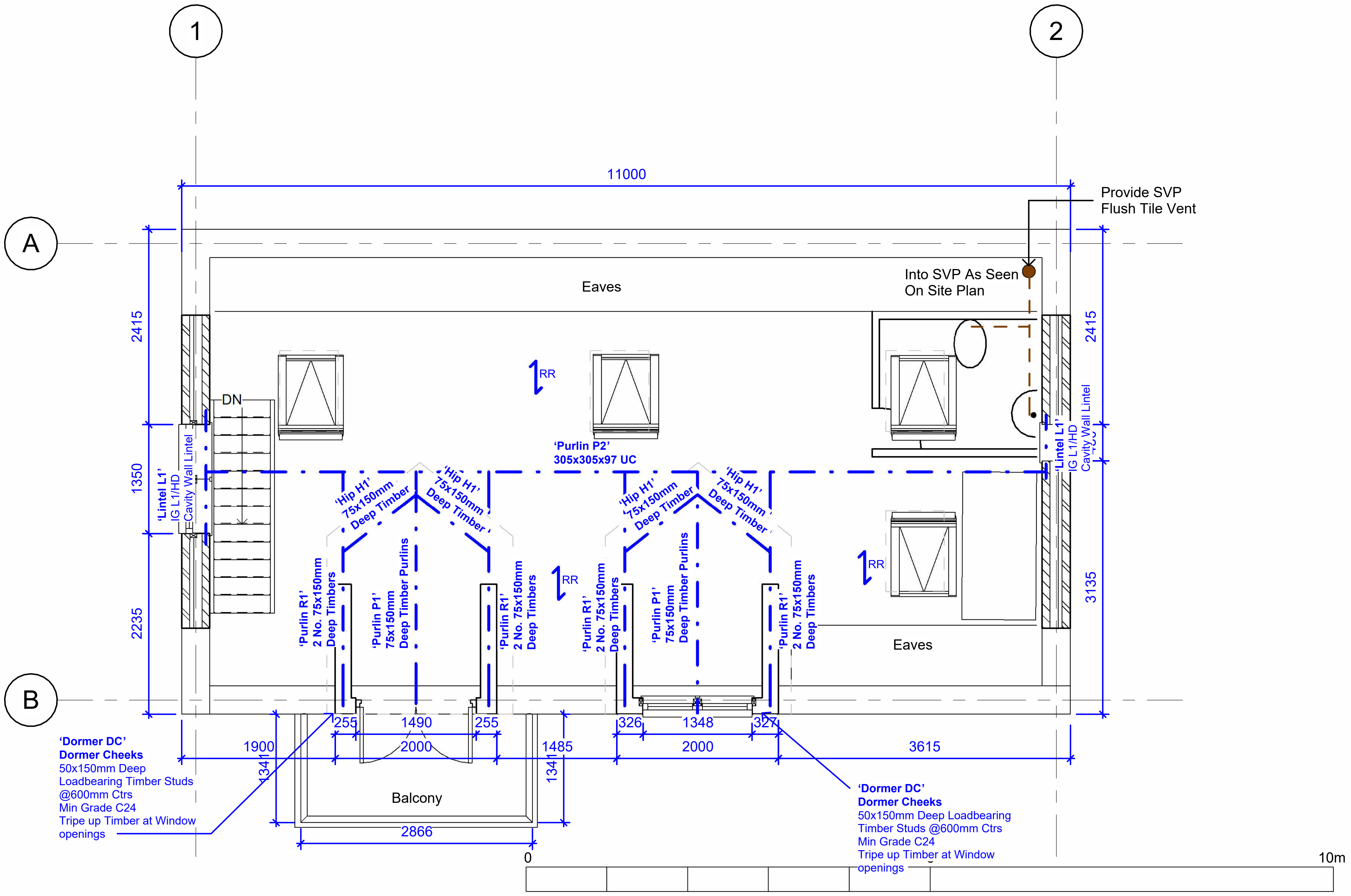
ISSUED FOR BUILDING CONTROL APPROVAL:	**27th January 2026**
HUDDS DESIGN	**Ref: HD-S26-0104G**

SHEET A1
Refer to sketch mark ups for references and Refer to drawings for dimensions

DESIGN SUMMARY

'Rafters RR'	**Roof Rafters** 50x150mm Deep Timber Rafters @400mm Ctrs Min Grade C24 Note: Double Up Rafters all around Roof-lights (UNO)
'Floor FJ'	**Floor Joists** 50x200mm Deep Timber Joists @400mm Ctrs Min Grade C24 Double all joists below stud partitions **OR** Easi Joists WS200 Easi Joist @ 400mm Ctrs, 195mm Depth 122x35 Chords Double all joists below stud partitions
'Purlin P1'	**75x150mm Deep Timber Purlins** **Min Grade C24**
'Purlin R1'	**2 No. 75x150mm Deep Timbers** **Min Grade C24**
'Hip H1'	**75x150mm Deep Timber** **Min Grade C24**
'Purlin P2'	**305x305x97 UC** 300x100x215mm Deep Concrete Padstones
'Beam B1'	**203x102x23 UB** Provide corrosion protection to beam and bolts Bolted to Beam B2 using 4 No. M16 bolts with full length 10mm angle cleats / 10mm end plates fully welded Min 6mm Fillet welds. Min 30mm edge distance for bolts
'Beam B2'	**203x203x46 UC – Cantilever Beam** 440x100x215mm Deep Concrete Padstone Provide corrosion protection to beam and bolts Provide Insulated Farrat bolted connection over inner leaf Bolted to using 4 No. M20 bolts
'Beam B3'	**203x203x46 UC** 440x100x215mm Deep Concrete Padstone
'Dormer DC'	**Dormer Cheeks** 50x150mm Deep Loadbearing Timber Studs @600mm Ctrs Min Grade C24 Tripe up Timber at Window openings
'Lintel L1/L3'	IG L1/HD Cavity Wall Lintel
'Lintel L2/L4'	IG L1/S Cavity Wall Lintel

'Lintel L5/L6'	**Boot Lintel 152x152x37 UC with 10mm plate fully welded to bottom** **Min 6mm fillet welds** 400x100x215mm Deep Concrete Padstones Min 200mm End bearing
'Windpost WP'	**100x100x8 SHS in cavity/inner skin of masonry** with fixings top and bottom Fixed top and Bottom using 10mm cleats fully welded with 2 No. M12 grade 8.8 bolts. Fixings to floor joists, steel beams as required. Provide Ties at 225mm Ctrs to masonry
'Raft Foundation RF'	**USE** 250mm Thick Reinforced Concrete Raft Slab With **2 Layers** A393 Mesh Top **and** Bottom (2 Top & 2 Bottom) Provide edge and internal thickenings as shown 450x450mm RC Beams with 3 No. T16 Bars top and bottom with T10 links at 200mm ctrs. Provide links at 100mm ctrs to all corners 1m away. Add diagonal T16 corner bars (top + bottom) at re-entrant corners and sharp external/internal corners. Full lap throughs for Bars on all corners. Min Well Compacted Hardcore below to siltstone Min 50mm Cover to all reinforcement Min Grade C30 Concrete **Note:** Coal Depth is 17m at 1.2m Max. 10T (12m) Rule satisfied for Strip Footing. Raft provided for additional robustness. **Refer to Geo Tech Report G25226 Rev B, dated 8th Sept 2025.**



1 Proposed Garage First Floor Plan

1 : 50

NOTE-
All Dimensions Are Approximate And TBC On Site By Contractor

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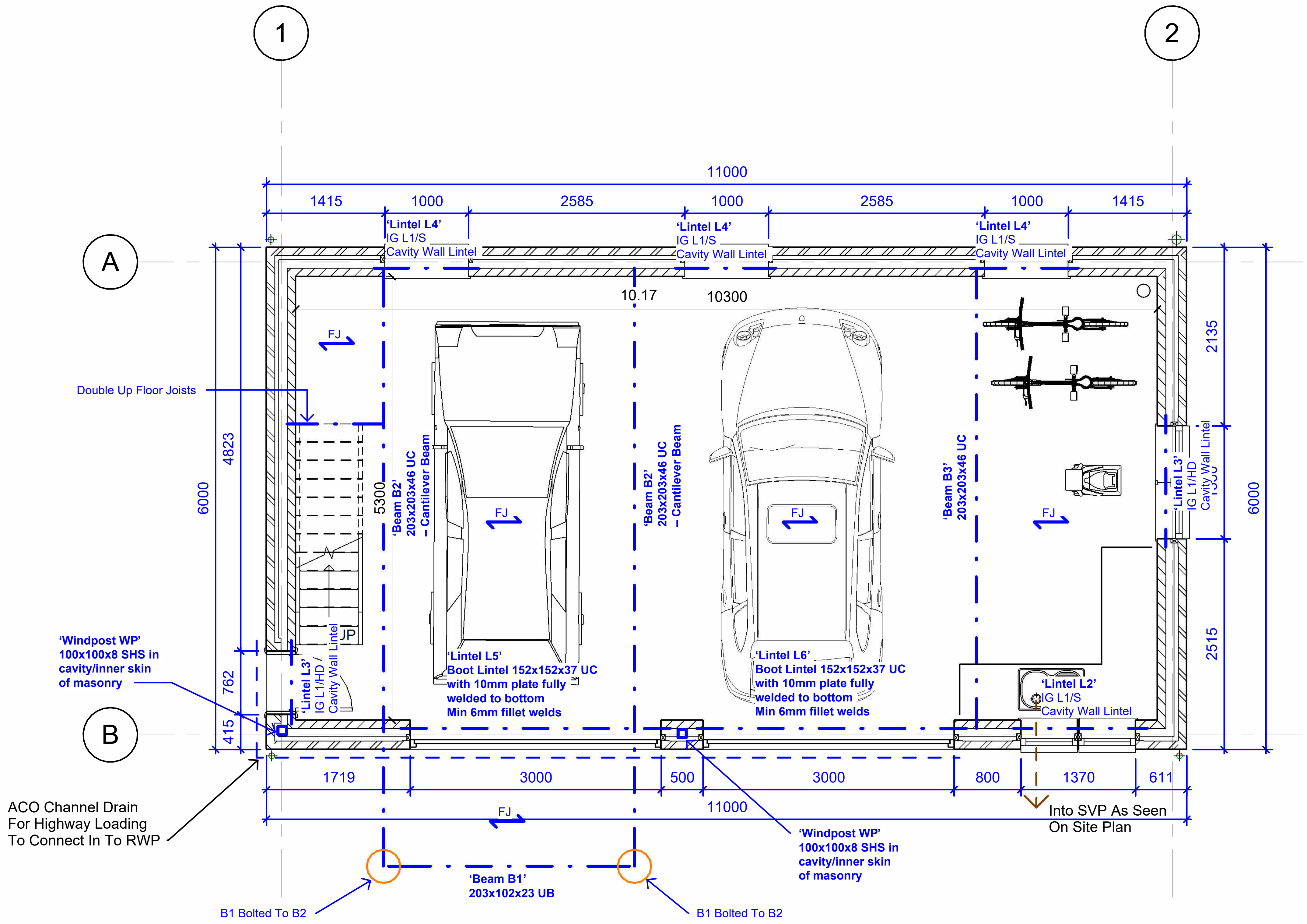
Project Name
2 Vernon Close, Edgerton, Huddersfield, HD1 5QE

Drawing Title:
Proposed Garage First Floor Plan

Drawing Number:	Scale:
HD-S25-0104G-A2	1 : 50@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA

Reason For Issue:
Building Regs



1 Proposed Garage Ground Floor Plan

1 : 50

NOTE-
All Dimensions Are Approximate
And TBC On Site By Contractor

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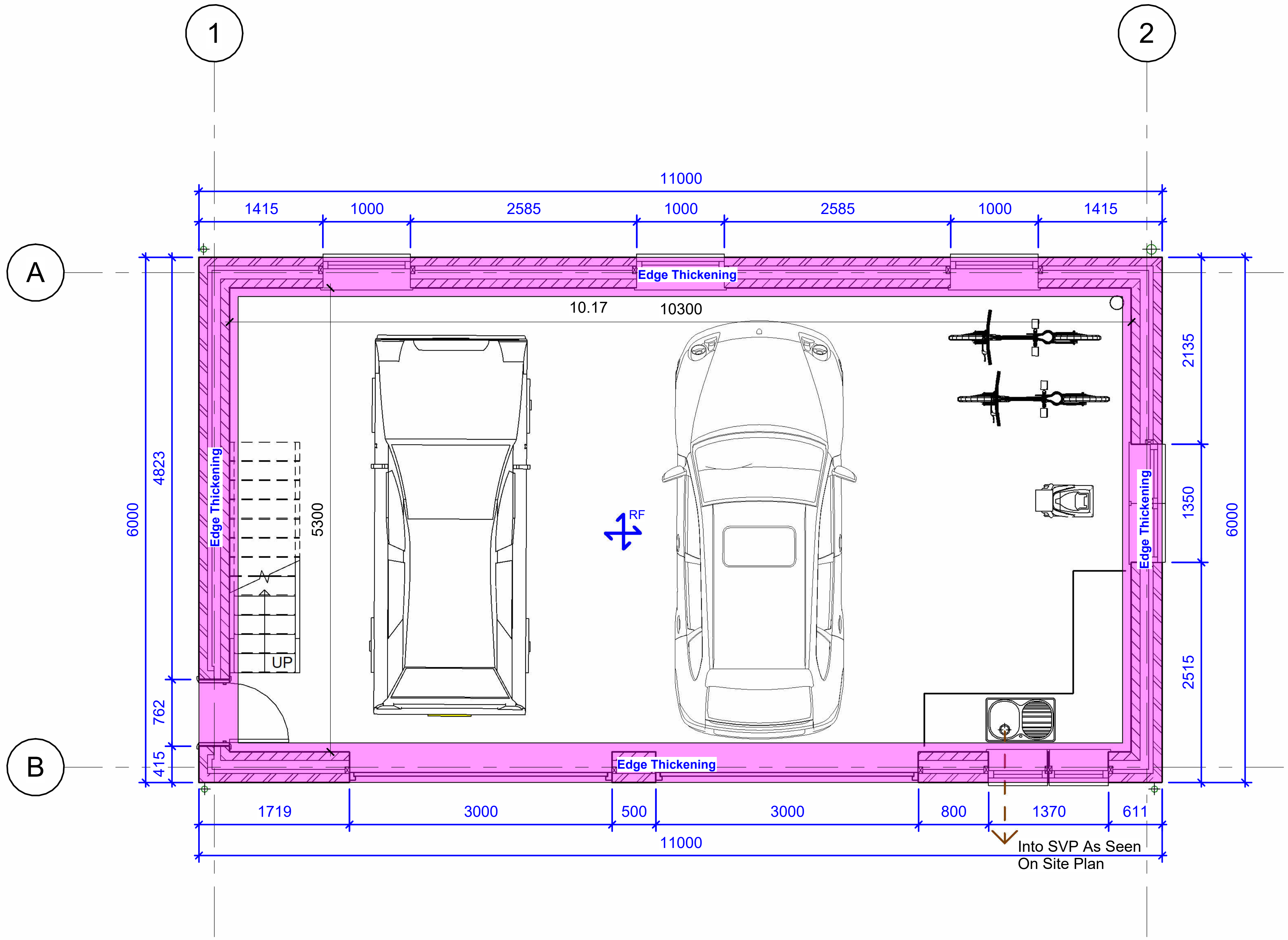
Project Name
2 Vernon Close, Edgerton, Huddersfield, HD1 5QE

Drawing Title:
Proposed Garage Ground Floor Plan

Drawing Number: HD-S25-0104G-A3	Scale: 1 : 50@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA

Reason For Issue:
Building Regs



1 Proposed Foundation Plan

1 : 50

NOTE-
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And TBC On Site By Contractor

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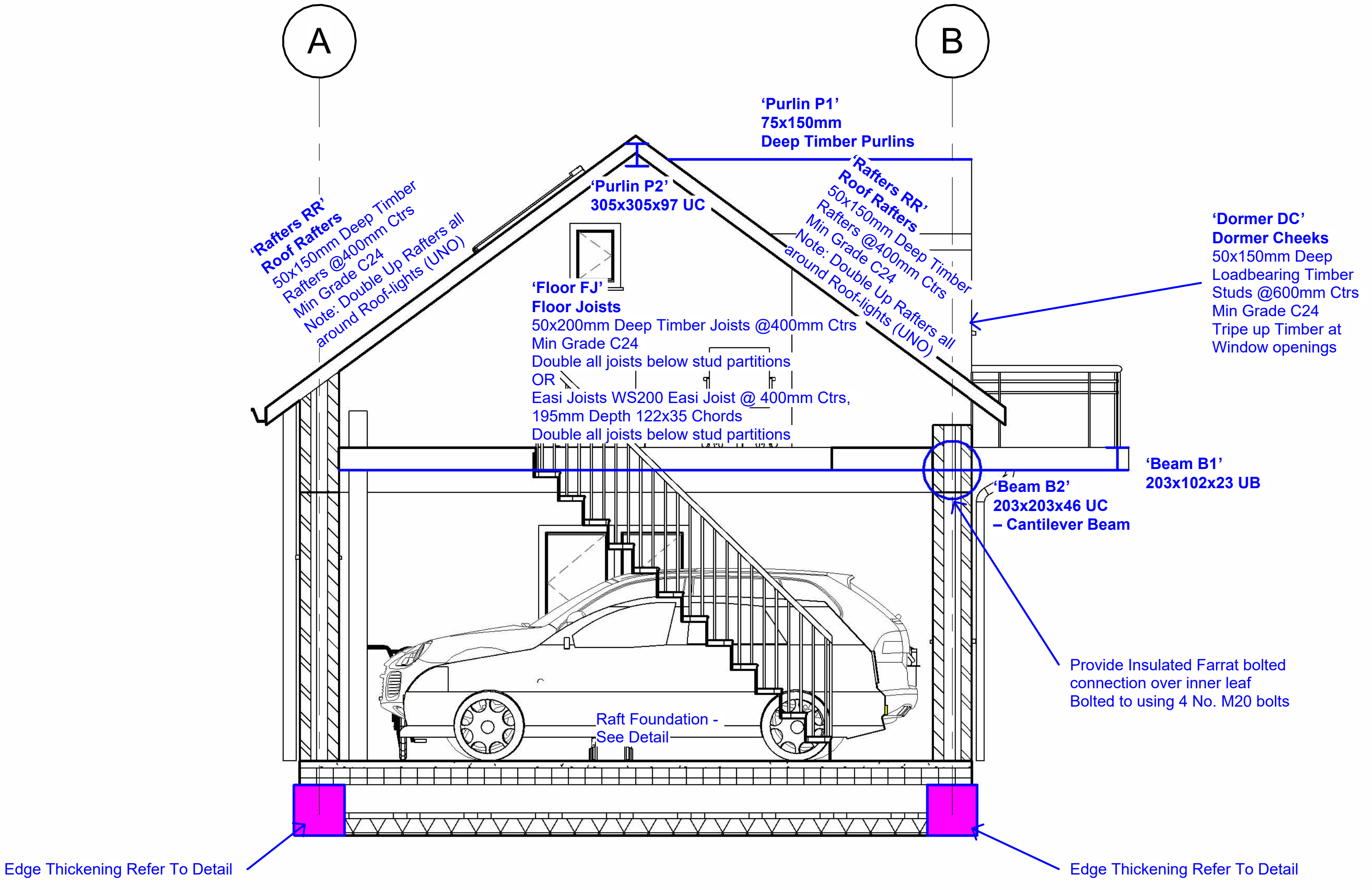
Project Name

2 Vernon Close, Edgerton, Huddersfield, HD1 5QE

Drawing Title:
Proposed Foundation Plan

Drawing Number: HD-S25-0104G-A4	Scale: 1 : 50@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA

Reason For Issue:
Building Regs



1 Proposed Garage Section

1 : 50

NOTE-
All Dimensions Are Approximate
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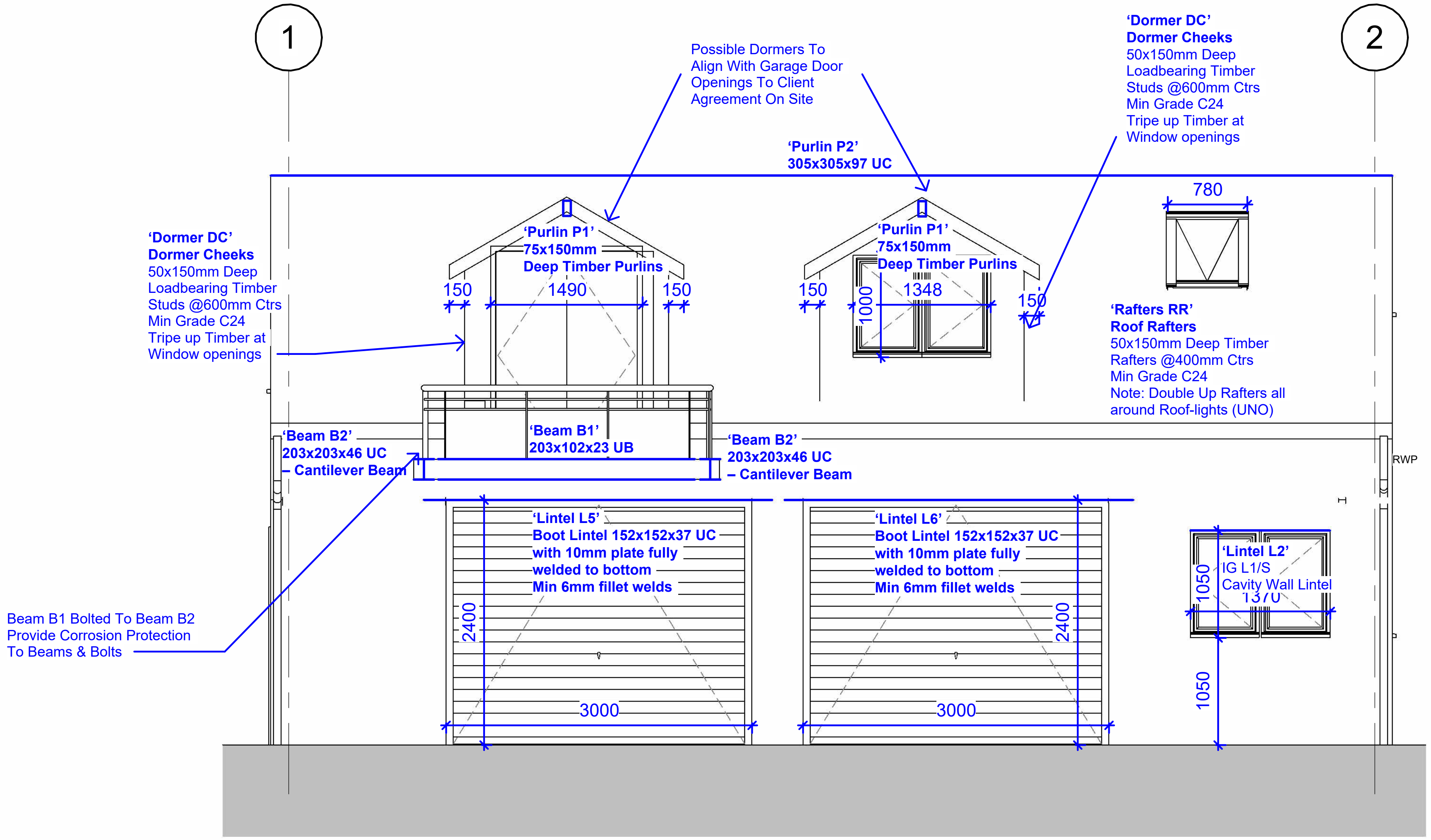
Project Name	
2 Vernon Close, Edgerton, Huddersfield, HD1 5QE	
Drawing Title: Proposed Garage Section	
Drawing Number: HD-S25-0104G-A5	Scale: 1 : 50@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA
Reason For Issue: Building Regs	



1 Proposed South Elevation

1 : 50

NOTE-
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And TBC On Site By Contractor

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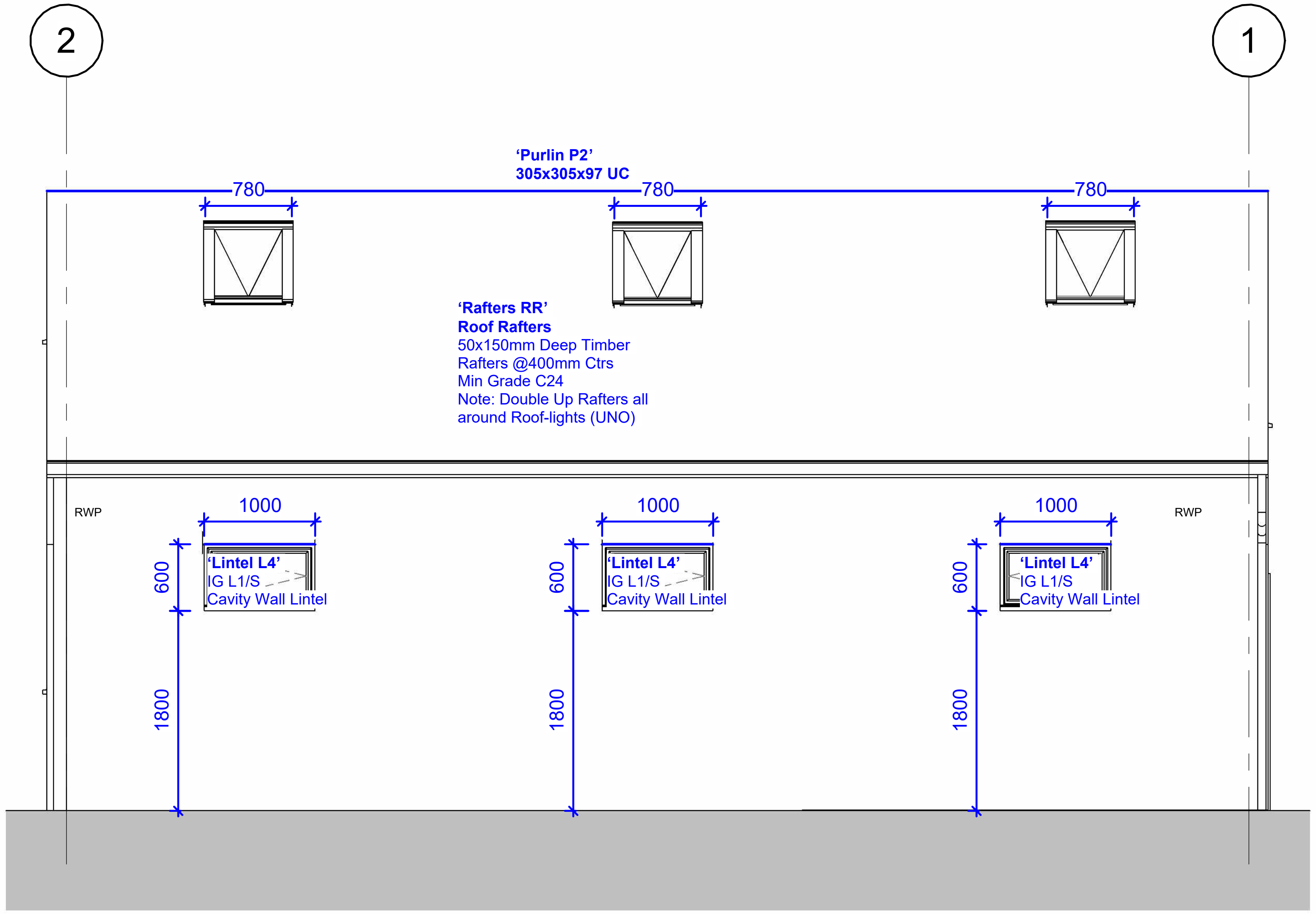
Project Name
2 Vernon Close, Edgerton, Huddersfield, HD1 5QE

Drawing Title:
Proposed South Elevation

Drawing Number: HD-S25-0104G-A6	Scale: 1 : 50@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA

Reason For Issue:
Building Regs



1 **Proposed North Elevation**

1 : 50

NOTE-
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And TBC On Site By Contractor

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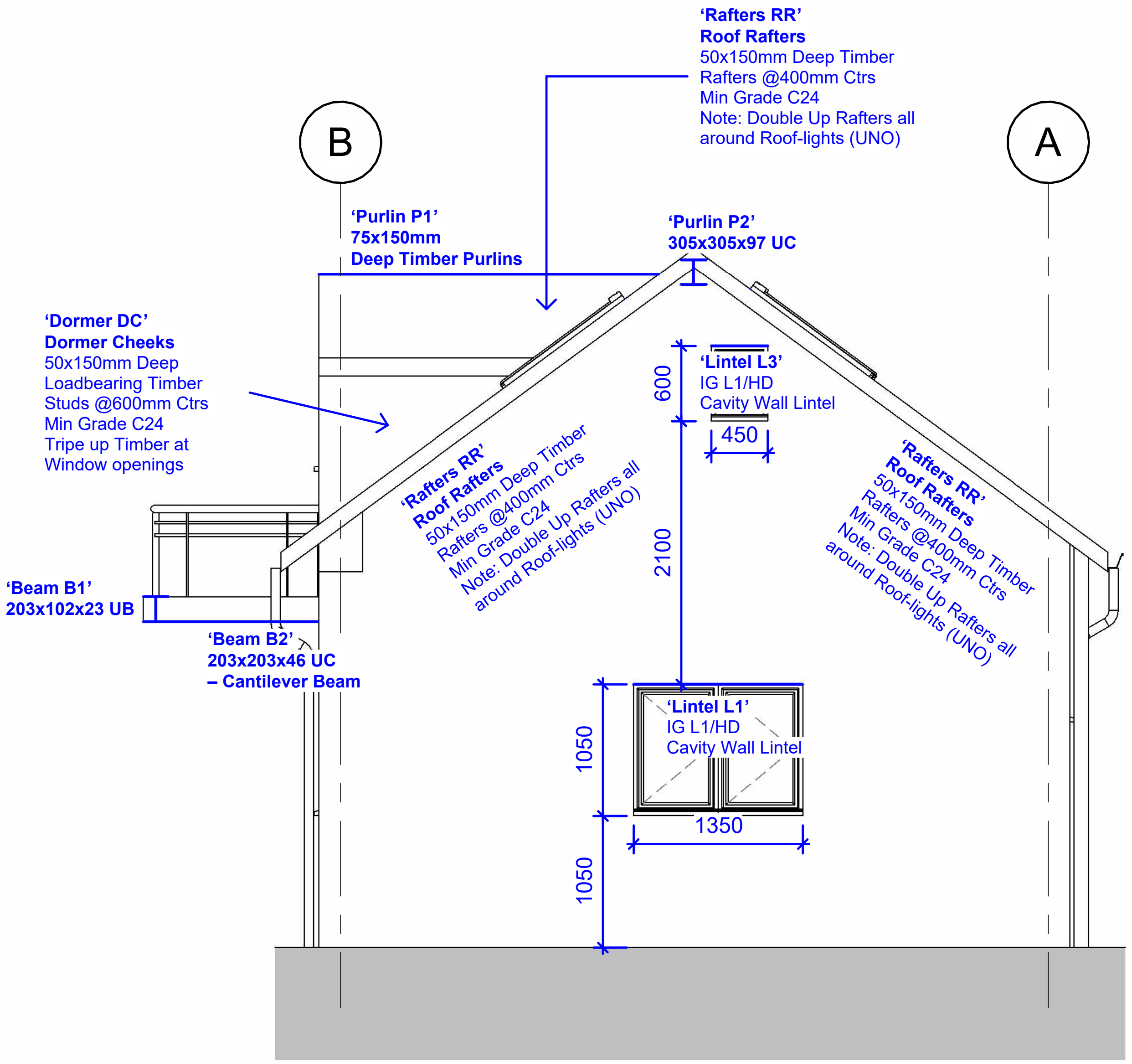
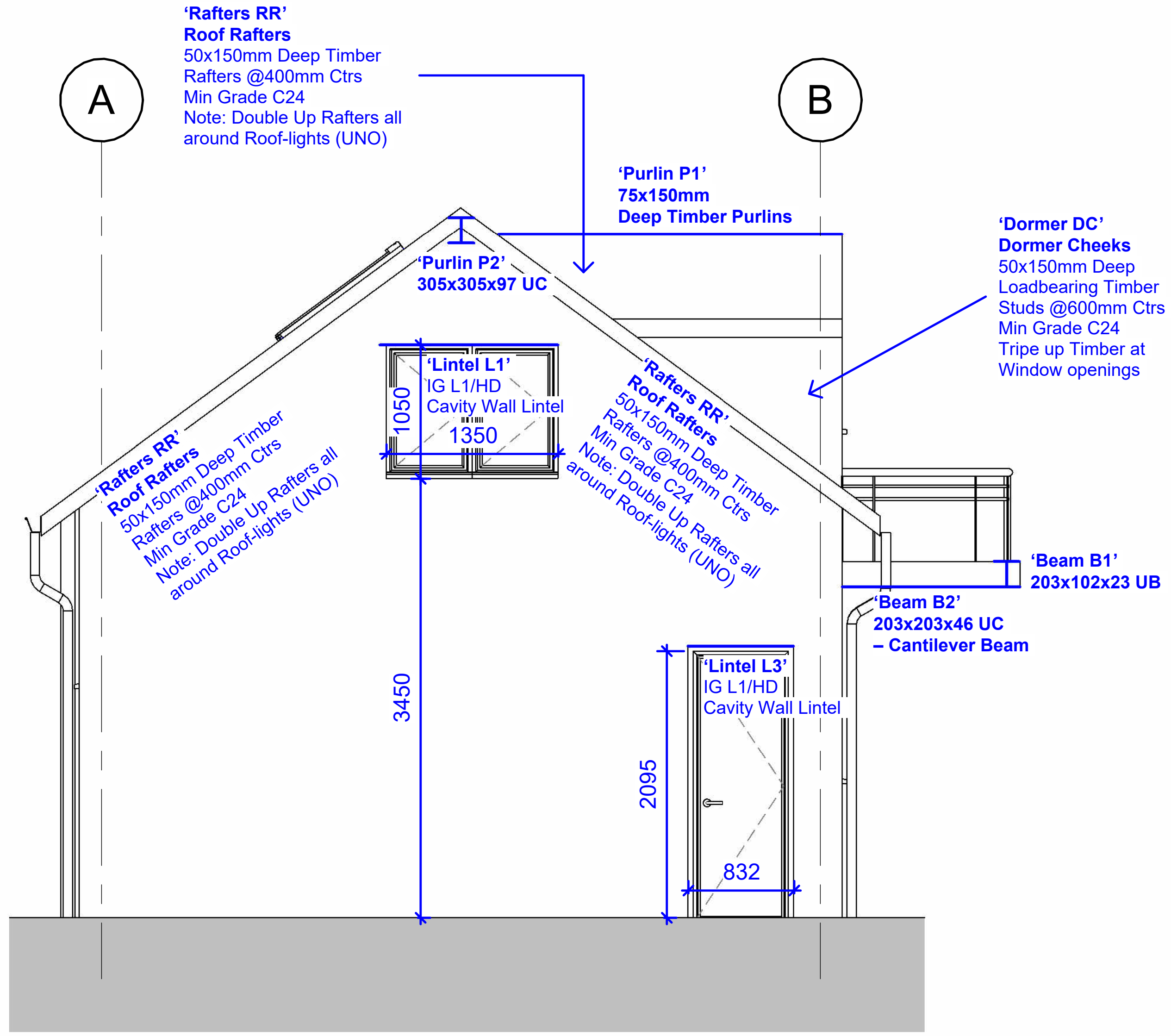
Project Name 2 Vernon Close, Edgerton, Huddersfield, HD1 5QE	
Drawing Title: Proposed North Elevation	
Drawing Number: HD-S25-0104G-A7	Scale: 1 : 50@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA
Reason For Issue: Building Regs	



1 **Proposed East Elevation**
1 : 50



2 **Proposed West Elevation**
1 : 50

NOTE-
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And TBC On Site By Contractor

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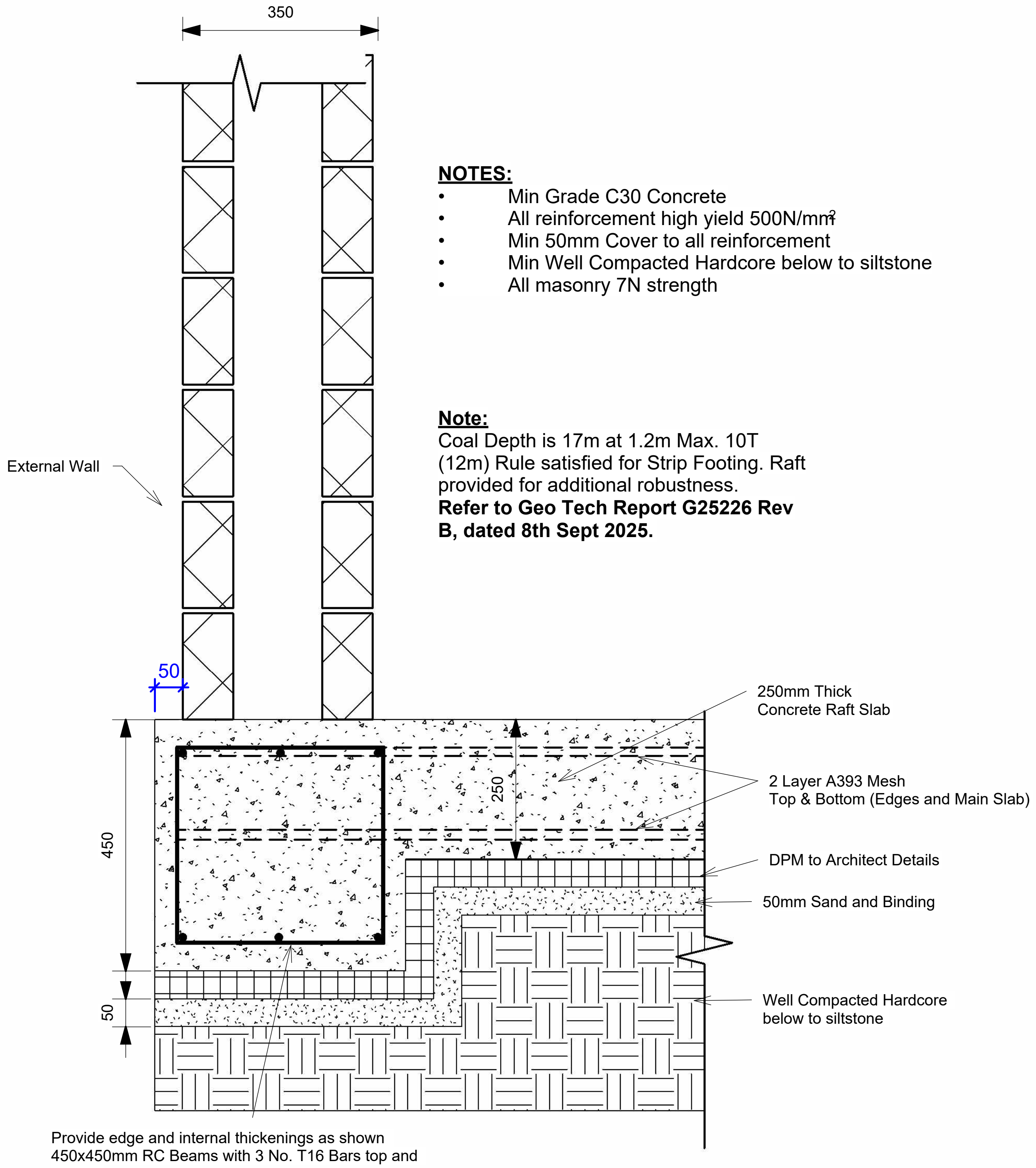
Project Name 2 Vernon Close, Edgerton, Huddersfield, HD1 5QE	
Drawing Title: Proposed Side Elevations	
Drawing Number: HD-S25-0104G-A8	Scale: 1 : 50@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA
Reason For Issue: Building Regs	



NOTES:

- Min Grade C30 Concrete
- All reinforcement high yield 500N/mm²
- Min 50mm Cover to all reinforcement
- Min Well Compacted Hardcore below to siltstone
- All masonry 7N strength

Note:
Coal Depth is 17m at 1.2m Max. 10T (12m) Rule satisfied for Strip Footing. Raft provided for additional robustness.
Refer to Geo Tech Report G25226 Rev B, dated 8th Sept 2025.

Provide edge and internal thickenings as shown
450x450mm RC Beams with 3 No. T16 Bars top and bottom
with T10 links at 200mm ctrs.
Provide links at 100mm ctrs to all corners 1m away.
Add diagonal T16 corner bars (top + bottom) at re-entrant corners and sharp external/internal corners. Full lap throughs for Bars on all corners.

Raft Foundation Detail

1 : 10

NOTE-
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Project Name
2 Vernon Close, Edgerton, Huddersfield, HD1 5QE

Drawing Title:
Proposed Raft Foundation Detail

Drawing Number: HD-S25-0104G-A9	Scale: 1 : 10@A3
Date: 30/01/26	Revision: Approver
Drawn By: AM	Checked by: JA

Reason For Issue:
Building Regs

STRUCTURAL CALCULATIONS

Address: **2 Vernon Close, Edgerton, Huddersfield, HD1 5QE**

Calculations for:

New Build GARAGE with raft foundation Design

DESIGN LOADINGS

External Walls

Inner Skin → 0.1m x 20 kN/m^3 = 2.0 kN/m^2 – (**Block**)

External Skin → 0.1m x 24 kN/m^3 = 2.4 kN/m^2 – (**Stone**)

Roof – (Tiles)

Dead Loads	= 1.1 kN/m^2 – (1.3 to Allow for Ceiling Joists Loads)
Imposed Loads	= 0.6 kN/m^2
Total	**= 1.9 kN/m^2**

First/Second Floor – (Timber)

Dead Loads	= 1.0 kN/m^2
Imposed Loads	= 1.5 kN/m^2
Total	**= 2.1 kN/m^2**

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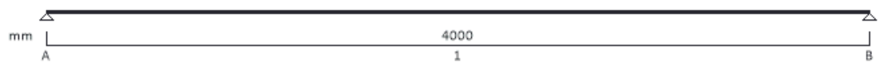
Hudds Design Structural Engineering Consultants Hudds Design 103-105 Bradford Rd Huddersfield HD1 6DZ	Project 2 Vernon Close, Edgerton, Huddersfield, HD1 5QE				Job no. HD-S26-0104G	
	Calcs for Floor Joists FJ				Start page no./Revision FJ- 1	
	Calcs by AM	Calcs date 29/01/2026	Checked by JA	Checked date 29/01/2026	Approved by	Approved date

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

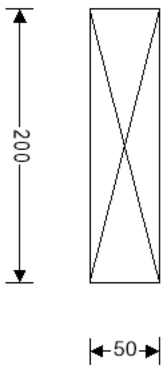
Joist details

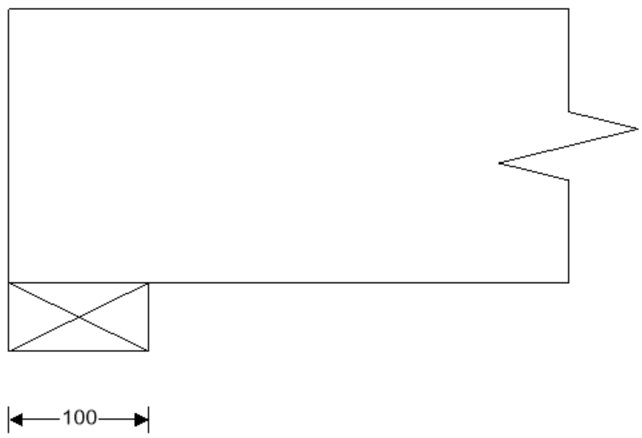
Joist breadth b = **50** mm
Joist depth h = **200** mm
Joist spacing s = **400** mm
Service class of timber **1**
Timber strength class **C24**



Span details

Number of spans N_{span} = **1**
Length of bearing L_b = **100** mm
Clear length of span L_{s1} = **4000** mm





Section properties

Second moment of area I = **33333333** mm^4
Section modulus Z = **333333** mm^3

Loading details

Joist self weight F_{swt} = **0.03** kN/m
Dead load F_{d_udl} = **0.60** kN/m^2
Imposed UDL(Long term) F_{i_udl} = **1.50** kN/m^2
Imposed point load (Medium) F_{i_pt} = **1.40** kN

Consider long term loads

Design bending moment M = **1.749** kNm
Design shear force V = **1.749** kN
Design support reaction R = **1.749** kN
Design deflection δ = **8.406** mm

Check bending stress

Permissible bending stress σ_{m_adm} = **8.626** N/mm^2
Applied bending stress σ_{m_max} = **5.246** N/mm^2

PASS - Applied bending stress within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **0.781** N/mm^2
Applied shear stress τ_{max} = **0.262** N/mm^2

PASS - Applied shear stress within permissible limits

Check bearing stress

Permissible bearing stress σ_{c_adm} = **2.640** N/mm^2 | Applied bearing stress σ_{c_max} = **0.350** N/mm^2

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **12.000** mm | Actual deflection δ = **8.406** mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Design bending moment M = **1.949** kNm | Design shear force V = **1.949** kN

Design support reaction R = **1.949** kN | Design deflection δ = **8.072** mm

Check bending stress

Permissible bending stress σ_{m_adm} = **10.783** N/mm^2 | Applied bending stress σ_{m_max} = **5.846** N/mm^2

PASS - Applied bending stress within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **0.976** N/mm^2 | Applied shear stress τ_{max} = **0.292** N/mm^2

PASS - Applied shear stress within permissible limits

Check bearing stress

Permissible bearing stress σ_{c_adm} = **3.300** N/mm^2 | Applied bearing stress σ_{c_max} = **0.390** N/mm^2

PASS - Applied bearing stress within permissible limits

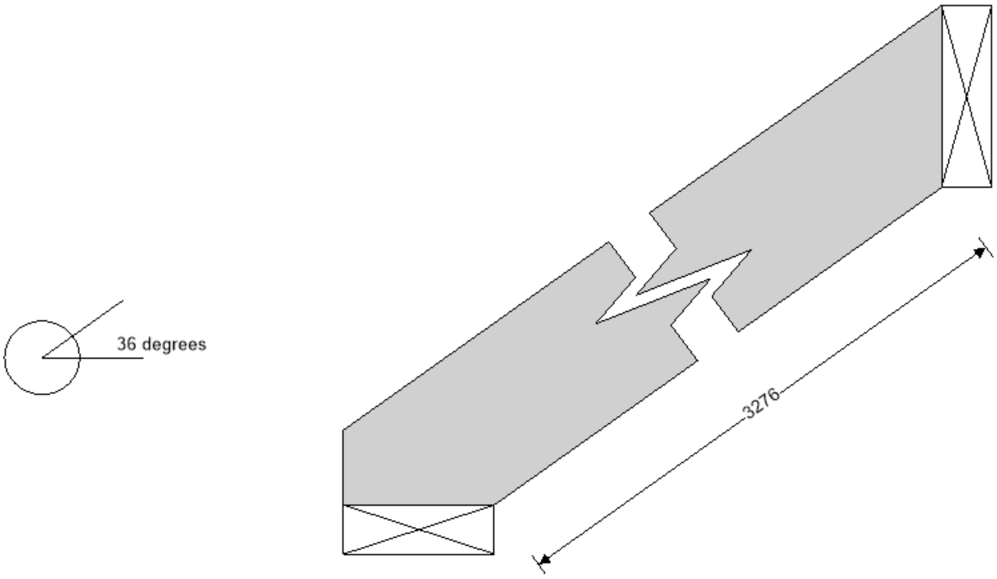
Check deflection

Permissible deflection δ_{adm} = **12.000** mm | Actual deflection δ = **8.072** mm

PASS - Actual deflection within permissible limits

TIMBER RAFTER DESIGN (BS5268-2:2002)

TEDDS calculation version 1.0.03



Rafter details

Breadth of timber sections	b = **50** mm	Depth of timber sections	h = **150** mm
Rafter spacing	s = **400** mm	Rafter span	**Single span**
Clear length of span on slope	L_{cl} = **3276** mm	Rafter slope	α = **36.0** deg
Timber strength class	**C24**		

Section properties

Cross sectional area of rafter	A = **7500** mm^2	Section modulus	Z = **187500** mm^3
Radius of gyration	r = **43** mm	Second moment of area	I = **14062500** mm^4

Loading details

Rafter self weight	F_j = **0.03** kN/m	Dead load on slope	F_d = **1.00** kN/m^2
Imposed snow load on plan	F_u = **0.60** kN/m^2	Imposed point load	F_p = **0.90** kN

Modification factors

Section depth factor	K_7 = **1.08**	Load sharing factor	K_8 = **1.10**

Consider long term load condition

Load duration factor	K_3 = **1.00**	Total UDL perp. to rafter	F = **0.344** kN/m
Notional bearing length	L_b = **4** mm	Effective span	L_{eff} = **3280** mm

Check bending stress

Permissible bending stress	σ_{m_adm} = **8.904** N/mm^2	Applied bending stress	σ_{m_max} = **2.470** N/mm^2

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain

Permissible comp. stress	σ_{c_adm} = **4.813** N/mm^2	Applied compressive stress	σ_{c_max} = **0.268** N/mm^2

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain

Combined loading check **0.338 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **0.781** N/mm² Applied shear stress τ_{max} = **0.113** N/mm²

PASS - Applied shear stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **9.840** mm Total deflection δ_{max} = **3.527** mm

PASS - Total deflection within permissible limits

Consider medium term load condition

Load duration factor K_3 = **1.25** Total UDL perp. to rafter F = **0.502** kN/m

Notional bearing length L_b = **6** mm Effective span L_{eff} = **3282** mm

Check bending stress

Permissible bending stress σ_{m_adm} = **11.130** N/mm² Applied bending stress σ_{m_max} = **3.601** N/mm²

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain

Permissible comp. stress σ_{c_adm} = **5.520** N/mm² Applied compressive stress σ_{c_max} = **0.390** N/mm²

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain

Combined loading check **0.402 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **0.976** N/mm² Applied shear stress τ_{max} = **0.165** N/mm²

PASS - Applied shear stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **9.845** mm Total deflection δ_{max} = **5.148** mm

PASS - Total deflection within permissible limits

Consider short term load condition

Load duration factor K_3 = **1.50** Total UDL perp. to rafter F = **0.344** kN/m

Notional bearing length L_b = **7** mm Effective span L_{eff} = **3283** mm

Check bending stress

Permissible bending stress σ_{m_adm} = **13.355** N/mm² Applied bending stress σ_{m_max} = **5.661** N/mm²

PASS - Applied bending stress within permissible limits

Check compressive stress parallel to grain

Permissible comp. stress σ_{c_adm} = **6.071** N/mm² Applied compressive stress σ_{c_max} = **0.339** N/mm²

PASS - Applied compressive stress within permissible limits

Check combined bending and compressive stress parallel to grain

Combined loading check **0.488 < 1**

PASS - Combined compressive and bending stresses are within permissible limits

Check shear stress

Permissible shear stress τ_{adm} = **1.172** N/mm² Applied shear stress τ_{max} = **0.259** N/mm²

PASS - Applied shear stress within permissible limits

Check deflection

Permissible deflection δ_{adm} = **9.848** mm Total deflection δ_{max} = **7.213** mm

PASS - Total deflection within permissible limits

Purlin P1

Max Clear Span **= 2600mm**

Dead Load

Roof DL	=	1.0m x 1.1 kN/m^2	= 1.1 kN/m
		TOTAL DL	**= 1.1 kN/m**

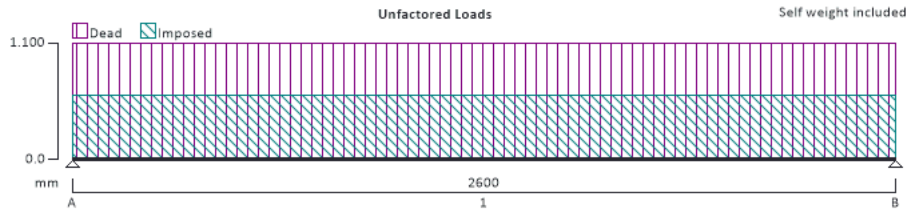
Live Load

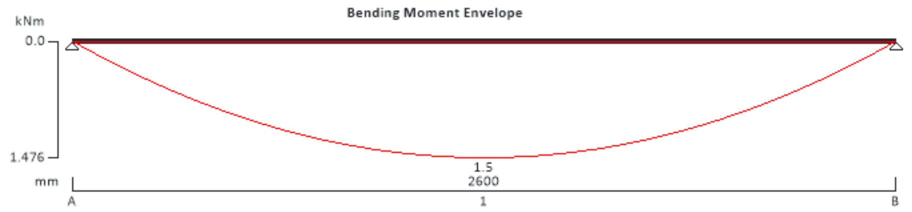
Roof LL	=	1.0m x 0.6 kN/m^2	= 0.6 kN/m
		TOTAL LL	**= 0.6 kN/m**

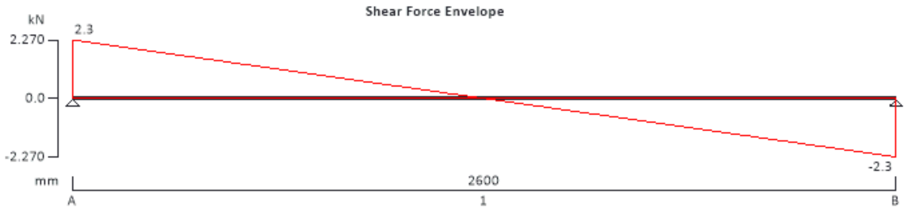
USE
75x150mm Deep Timber – Min Grade C24
(SEE CALC P1T)
Use Same for Hips

TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.7.03







Applied loading

Beam loads

Dead self weight of beam × 1

Dead full UDL 1.100 kN/m

Imposed full UDL 0.600 kN/m

Load combinations

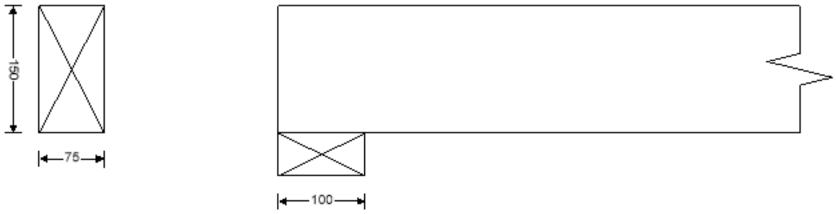
Load combination 1	Support A	Dead × 1.00
		Imposed × 1.00
	Span 1	Dead × 1.00
		Imposed × 1.00
	Support B	Dead × 1.00
		Imposed × 1.00

Analysis results

Design moment	M = **1.476** kNm	Design shear	F = **2.270** kN
Total load on beam	W_{tot} = **4.540** kN		
Reactions at support A	R_{A_max} = **2.270** kN	R_{A_min} = **2.270** kN	
Unfactored dead load reaction at support A	R_{A_Dead} = **1.490** kN		
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **0.780** kN		
Reactions at support B	R_{B_max} = **2.270** kN	R_{B_min} = **2.270** kN	

Unfactored dead load reaction at support B R_{B_Dead} = **1.490** kN

Unfactored imposed load reaction at support B $R_{B\_Imposed}$ = **0.780** kN



Timber section details

Breadth of section	b = **75** mm	Depth of section	h = **150** mm
Number of sections	N = **1**	Breadth of beam	b_b = **75** mm
Timber strength class	**C24**		

Member details

Service class of timber	**1**	Load duration	**Medium term**
Length of span	L_{s1} = **2600** mm		
Length of bearing	L_b = **100** mm		

Lateral support - cl.2.10.8

Permiss.depth-to-breadth ratio **4.00** Actual depth-to-breadth ratio **2.00**

PASS - Lateral support is adequate

Check bearing stress

Permissible bearing stress σ_{c_adm} = **3.000** N/mm^2 Applied bearing stress σ_{c_a} = **0.303** N/mm^2

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permissible bending stress σ_{m_adm} = **10.118** N/mm^2 Applied bending stress σ_{m_a} = **5.247** N/mm^2

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress τ_{adm} = **0.888** N/mm^2 Applied shear stress τ_a = **0.303** N/mm^2

PASS - Applied shear stress is less than permissible shear stress

Deflection

Permissible deflection δ_{adm} = **7.800** mm Total deflection δ_a = **7.192** mm

PASS - Total deflection is less than permissible deflection

Purlin P2

Max Clear Span = 10300mm

Dead Load
Roof DL = 3.2m x 1.1 kN/m^2 = 3.5 kN/m
TOTAL DL = 3.5 kN/m

Live Load
Roof LL = 3.2m x 0.6 kN/m^2 = 1.9 kN/m
TOTAL LL = 1.9 kN/m

USE 305x305x97 UC
(SEE CALC P2)

Padstones

R = 48 kN

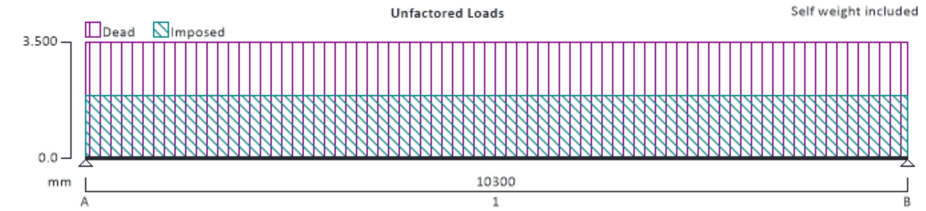
USE 300 x 100 x 215mm DEEP CONCRETE PADSTONES

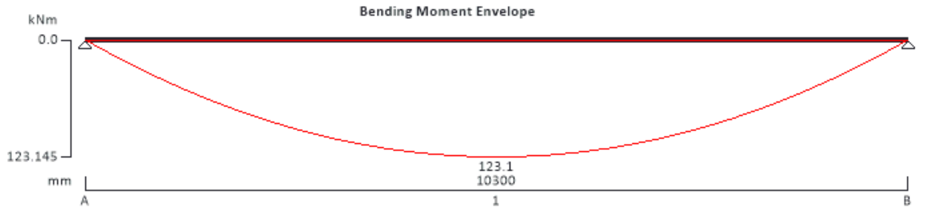
Stress Check = 48 x 1000 / 300 x 100 = 1.6 N/mm^2 < 2.4 N/mm^2
Satisfactory

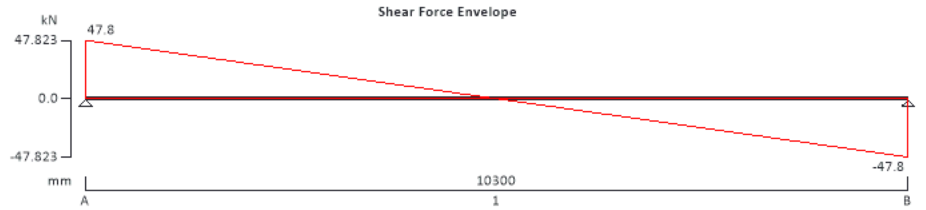
STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.07







Support conditions

Support A	Vertically restrained	
	Rotationally free	
Support B	Vertically restrained	
	Rotationally free	

Applied loading

Beam loads	Dead self weight of beam × 1	
	Dead full UDL 3.5 kN/m	
	Imposed full UDL 1.9 kN/m	

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
		Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **123.1** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **47.8** kN	V_{min} = **-47.8** kN
Deflection	δ_{max} = **6** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **47.8** kN	R_{A_min} = **47.8** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **23** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **9.8** kN	
Maximum reaction at support B	R_{B_max} = **47.8** kN	R_{B_min} = **47.8** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **23** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **9.8** kN	

Section details

Section type **UC 305x305x97 (British Steel Section Range 2022 (BS4-1))** Steel grade **S275**

Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **1.00** Section classification **Compact**

Shear capacity - Section 4.2.3

Design shear force F_v = **47.8** kN Design shear resistance P_v = **503** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **123.1** kNm Moment capacity low shear M_c = **443.1** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **212.9** kNm M_b / m_{LT} = **230.2** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection δ_{lim} = **28.611** mm Maximum deflection δ = **6.036** mm

PASS - Maximum deflection does not exceed deflection limit

Purlin R1

Max Clear Span = 3250mm

Dead Load

Timber DL	=	1.2m x 1.0 kN/m^2	= 1.2 kN/m VDL
Roof DL	=	0.5m x 1.1 kN/m^2	= 0.55 kN/m
		TOTAL DL	**= 0.55 kN/m**

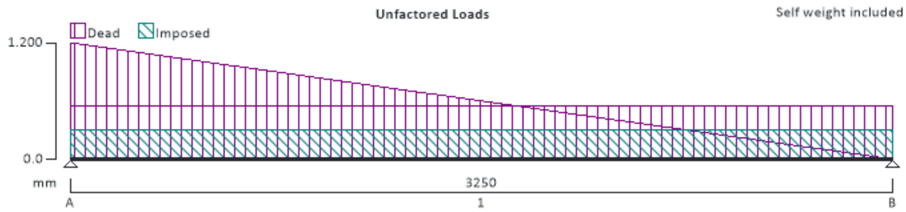
Live Load

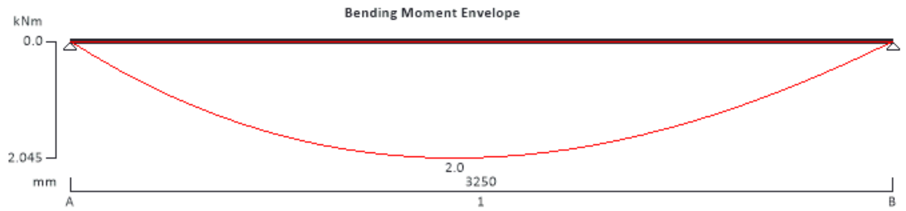
Roof LL	=	0.5m x 0.6 kN/m^2	= 0.3 kN/m
		TOTAL LL	**= 0.3 kN/m**

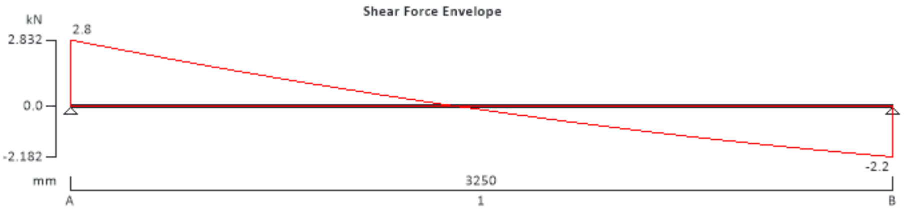
USE
2 No. 75x150mm Deep Timber – Min Grade C24
(SEE CALC R1T)

TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.7.03







Applied loading

Beam loads

Dead self weight of beam × 1
Dead partial VDL 1.200 kN/m at 0 mm to 0.000 kN/m at 3250 mm
Dead full UDL 0.550 kN/m
Imposed full UDL 0.300 kN/m

Load combinations

Load combination 1	Support A	Dead × 1.00
		Imposed × 1.00
	Span 1	Dead × 1.00
		Imposed × 1.00
	Support B	Dead × 1.00
		Imposed × 1.00

Analysis results

Design moment	M = **2.045** kNm	Design shear	F = **2.832** kN
Total load on beam	W_{tot} = **5.014** kN		
Reactions at support A	R_{A_max} = **2.832** kN	R_{A_min} = **2.832** kN	

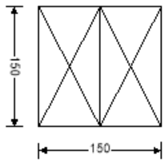
Unfactored dead load reaction at support A R_{A_Dead} = **2.344** kN
Unfactored imposed load reaction at support A $R_{A\_Imposed}$ = **0.487** kN

Hudds Design Structural Engineering Consultants Hudds Design 103 - 105 Bradford Rd Huddersfield HD1 6DZ	Project 2 Vernon Close, Edgerton, Huddersfield, HD1 5QE				Job no. HD-S26-0128G	
	Calcs for Purlin R1 - Timber				Start page no./Revision R1T- 3	
	Calcs by AM	Calcs date 29/01/2026	Checked by JA	Checked date 29/01/2026	Approved by	Approved date

Reactions at support B R_{B_max} = **2.182** kN R_{B_min} = **2.182** kN

Unfactored dead load reaction at support B R_{B_Dead} = **1.694** kN

Unfactored imposed load reaction at support B $R_{B\_Imposed}$ = **0.488** kN



Timber section details

Breadth of section	b = **75** mm	Depth of section	h = **150** mm
Number of sections	N = **2**	Breadth of beam	b_b = **150** mm
Timber strength class	**C24**		

Member details

Service class of timber	**1**	Load duration	**Medium term**
Length of span	L_{s1} = **3250** mm		
Length of bearing	L_b = **100** mm		

Lateral support - cl.2.10.8

Permiss.depth-to-breadth ratio **4.00** Actual depth-to-breadth ratio **1.00**

PASS - Lateral support is adequate

Check bearing stress

Permissible bearing stress σ_{c_adm} = **3.000** N/mm^2 Applied bearing stress σ_{c_a} = **0.189** N/mm^2

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permissible bending stress σ_{m_adm} = **10.118** N/mm^2 Applied bending stress σ_{m_a} = **3.636** N/mm^2

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress τ_{adm} = **0.888** N/mm^2 Applied shear stress τ_a = **0.189** N/mm^2

PASS - Applied shear stress is less than permissible shear stress

Deflection

Permissible deflection δ_{adm} = **9.750** mm Total deflection δ_a = **7.623** mm

PASS - Total deflection is less than permissible deflection

Beam B1 - 2 No. Beams

Max Clear Span = 2800mm

Dead Load

Balustrade DL	=	1.0m x 1.0 kN/m^2	= 1.0 kN/m
Floor DL	=	0.8m x 1.5 kN/m^2	= 1.2 kN/m
		TOTAL DL	**= 2.2 kN/m**

Live Load

Floor LL	=	0.8m x 1.5 kN/m^2	= 1.2 kN/m
		TOTAL LL	**= 1.2 kN/m**

USE 203x102x23 UB
(SEE CALC B1)
Beams to be bolted to B2
Galvanized Beams/Bolts – Corrosion Protection

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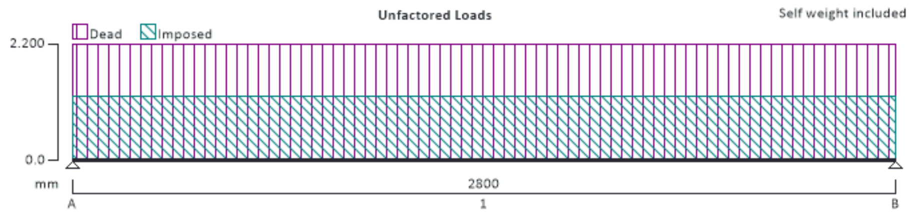
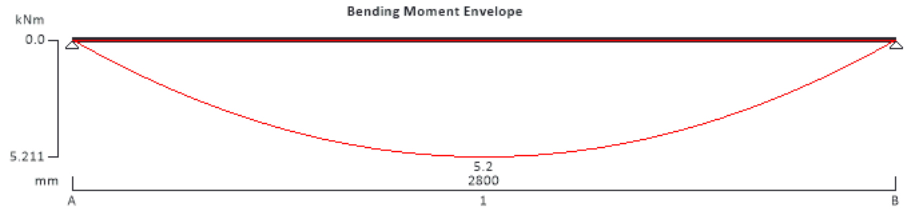
www.huddsdesign.com

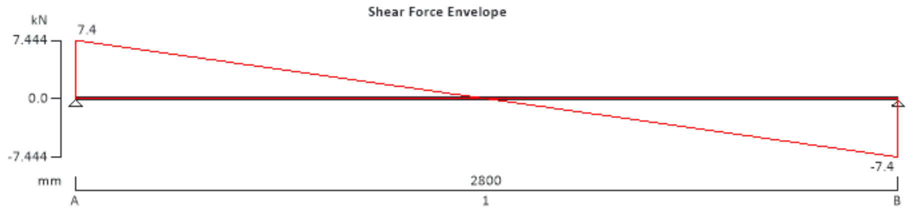
STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.07







Support conditions

Support A	Vertically restrained Rotationally free
Support B	Vertically restrained Rotationally free

Applied loading

Beam loads	Dead self weight of beam × 1 Dead full UDL 2.2 kN/m Imposed full UDL 1.2 kN/m

Load combinations

Load combination 1	Support A	Dead × 1.40 Imposed × 1.60
		Dead × 1.40 Imposed × 1.60
	Support B	Dead × 1.40 Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **5.2** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **7.4** kN	V_{min} = **-7.4** kN
Deflection	δ_{max} = **0.2** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **7.4** kN	R_{A_min} = **7.4** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **3.4** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **1.7** kN	
Maximum reaction at support B	R_{B_max} = **7.4** kN	R_{B_min} = **7.4** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **3.4** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **1.7** kN	

Section details

Section type **UB 203x102x23 (British Steel Section Range 2022 (BS4-1))** Steel grade **S275**

Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **1.00** Section classification **Plastic**

Shear capacity - Section 4.2.3

Design shear force F_v = **7.4** kN Design shear resistance P_v = **181.1** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **5.2** kNm Moment capacity low shear M_c = **64.4** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **27.9** kNm M_b / m_{LT} = **30.2** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection δ_{lim} = **7.778** mm Maximum deflection δ = **0.223** mm

PASS - Maximum deflection does not exceed deflection limit

Beam B2 / B3

Max Clear Span = 5300mm

Dead Load

Floor DL	=	3.4m x 1.0 kN/m^2	= 3.4 kN/m
		TOTAL DL	**= 3.4 kN/m**

Live Load

Floor LL	=	3.4m x 1.5 kN/m^2	= 5.1 kN/m
		TOTAL LL	**= 5.1 kN/m**

USE 203x203x46 UC
(SEE CALC B2)
Galvanized Beams/Bolts – Corrosion Protection for B2 external segement
Provide Farrat Insulated Connection over inner leaf using 4 No. M20 bolts

Padstones

Reaction Maximum = 36 kN

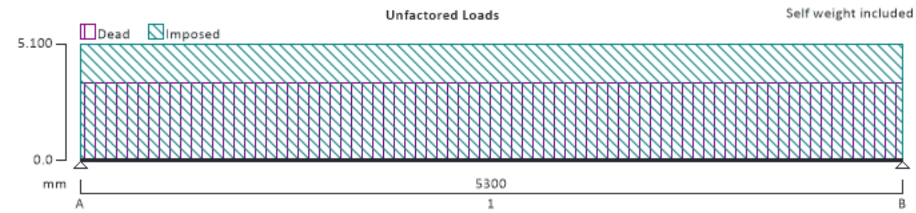
USE 400 x 100 x 215mm DEEP CONCRETE PADSTONES

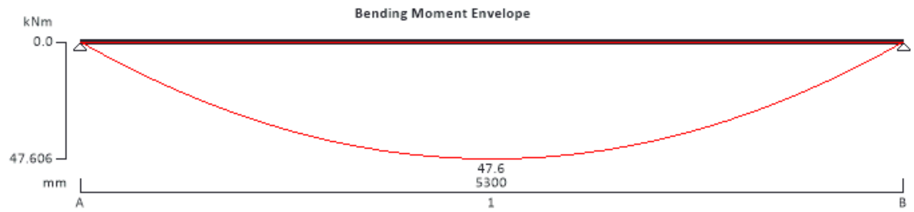
Stress Check = 36 x 1000 / 400 x 100 = 0.9 N/mm^2 < 2.4 N/mm^2
Satisfactory

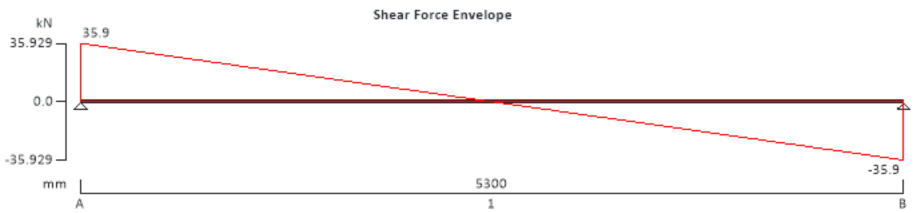
STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.07







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads	Dead self weight of beam × 1
	Dead full UDL 3.4 kN/m
	Imposed full UDL 5.1 kN/m

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60
		Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

Maximum moment	M_{max} = **47.6** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **35.9** kN	V_{min} = **-35.9** kN
Deflection	δ_{max} = **5.6** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **35.9** kN	R_{A_min} = **35.9** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **10.2** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **13.5** kN	
Maximum reaction at support B	R_{B_max} = **35.9** kN	R_{B_min} = **35.9** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **10.2** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **13.5** kN	

Section details

Section type **UC 203x203x46 (British Steel Section Range 2022 (BS4-1))** Steel grade **S275**

Classification of cross sections - Section 3.5

Tensile strain coefficient ε = **1.00** Section classification **Compact**

Shear capacity - Section 4.2.3

Design shear force F_v = **35.9** kN Design shear resistance P_v = **241.4** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment M = **47.6** kNm Moment capacity low shear M_c = **138** kNm

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment M_b = **83** kNm M_b / m_{LT} = **89.8** kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads

Limiting deflection δ_{lim} = **14.722** mm Maximum deflection δ = **5.551** mm

PASS - Maximum deflection does not exceed deflection limit

Raft Slab - RF
Max Clear Span = 11m

Grid Line 1/2 - Worst Case Loading

Dead Load

Wall DL	=	5.5m x 4.4 kN/m^2	= 24.2 kN/m
Floor DL	=	2.0m x 1.0 kN/m^2	= 2.0 kN/m
Roof DL	=	5.0m x 1.3 kN/m^2	= 6.5 kN/m
		TOTAL DL	**= 33.0 kN/m**

Live Load

Floor LL	=	2.0m x 1.5 kN/m^2	= 3.0 kN/m
Roof LL	=	5.0m x 0.6 kN/m^2	= 3.0 kN/m
		TOTAL LL	**= 6.0 kN/m**

Grid Line A/B

Dead Load

Wall DL	=	3.5m x 4.4 kN/m^2	= 15.4 kN/m
Floor DL	=	2.7m x 1.0 kN/m^2	= 2.7 kN/m
Roof DL	=	1.6m x 1.3 kN/m^2	= 2.1 kN/m
		TOTAL DL	**= 20.2 kN/m**

Live Load

Floor LL	=	2.7m x 1.5 kN/m^2	= 4.1 kN/m
Roof LL	=	1.6m x 0.6 kN/m^2	= 1.0 kN/m
		TOTAL LL	**= 5.1 kN/m**

Dead Loads = 1.8 kN/m^2 (Additional Self-Weight Included in TEDDS Calc)

Imposed Loads = 2.5 kN/m^2

'Raft Foundation RF' – See calc RF)
USE 250mm Thick Reinforced Concrete Raft Slab
With **2 Layers** A393 Mesh Top **and** Bottom (2 Top & 2 Bottom)

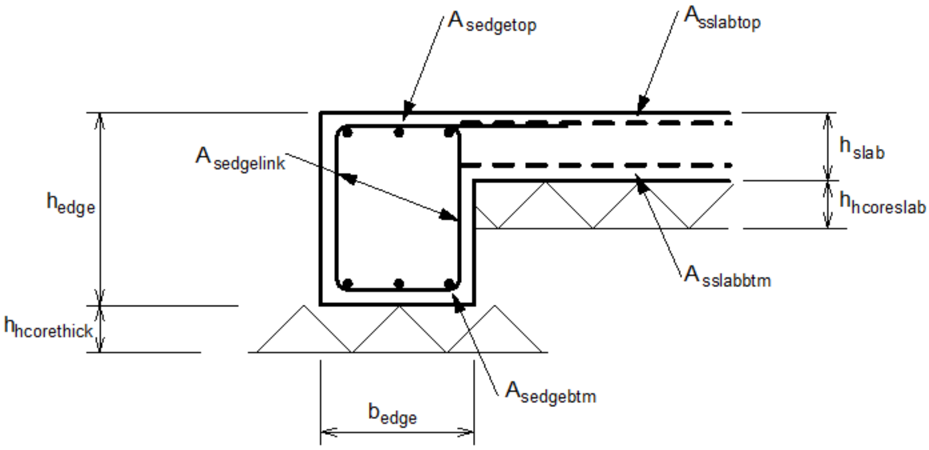
Provide edge and internal thickenings as shown
450x450mm RC Beams with 3 No. T16 Bars top and bottom
with T10 links at 200mm ctrs.
Provide links at 100mm ctrs to all corners 1m away.
Add diagonal T16 corner bars (top + bottom) at re-entrant corners and sharp external/internal corners. Full lap throughs for Bars on all corners.

Min Well Compacted Hardcore below to siltstone
Min 50mm Cover to all reinforcement
Min Grade C30 Concrete

Note: Coal Depth is 17m at 1.2m Max. 10T (12m) Rule satisfied for Strip Footing. Raft provided for additional robustness.
Refer to Geo Tech Report G25226 Rev B, dated 8th Sept 2025.

RAFT FOUNDATION DESIGN (BS8110 : PART 1 : 1997)

Tedds calculation version 1.0.13



Soil and raft definition

Soil definition

Allowable bearing pressure q_{allow} = **50.0** kN/m^2

Number of types of soil forming sub-soil **One type only**

Soil density **Firm**

Depth of hardcore beneath slab $h_{coreslab}$ = **150** mm (Dispersal allowed for bearing pressure check)

Depth of hardcore beneath thickenings $h_{corethick}$ = **150** mm (Dispersal allowed for bearing pressure check)

Density of hardcore γ_{hcore} = **20.0** kN/m^3

Basic assumed diameter of local depression $\phi_{depbasic}$ = **1500**mm

Diameter under slab modified for hardcore $\phi_{depslab} = \phi_{depbasic} - h_{coreslab}$ = **1350** mm

Diameter under thickenings modified for hardcore $\phi_{depthick} = \phi_{depbasic} - h_{corethick}$ = **1350** mm

Raft slab definition

Max dimension/max dimension between joints l_{max} = **11.000** m

Slab thickness h_{slab} = **250** mm

Concrete strength f_{cu} = **25** N/mm^2

Poissons ratio of concrete ν = **0.2**

Slab mesh reinforcement strength f_{yslab} = **500** N/mm^2

Partial safety factor for steel reinforcement γ_s = **1.15**

From C&CA document 'Concrete ground floors' Table 5

Minimum mesh required in top for shrinkage **A142**

Actual mesh provided in top **2 x A393 ($A_{sslabtop}$ = 786 mm^2/m)**

Mesh provided in bottom **2 x A393 ($A_{sslabbtm}$ = 786 mm^2/m)**

Top mesh bar diameter $\phi_{slabtop}$ = **10** mm

Bottom mesh bar diameter $\phi_{slabbtm}$ = **10** mm

Cover to top reinforcement c_{top} = **50** mm

Cover to bottom reinforcement c_{btm} = **50** mm

Average effective depth of top reinforcement $d_{tslabav} = h_{slab} - c_{top} - \phi_{slabtop}$ = **190** mm

Average effective depth of bottom reinforcement $d_{bslabav} = h_{slab} - c_{btm} - \phi_{slabbtm}$ = **190** mm

Overall average effective depth $d_{slabav} = (d_{tslabav} + d_{bslabav})/2$ = **190** mm

Minimum effective depth of top reinforcement $d_{tslabmin} = d_{tslabav} - \phi_{slabtop}/2 =$ **185** mm

Minimum effective depth of bottom reinforcement $d_{bslabmin} = d_{bslabav} - \phi_{slabbtm}/2 =$ **185** mm

Edge beam definition

Overall depth $h_{edge} =$ **450** mm

Width $b_{edge} =$ **450** mm

Strength of main bar reinforcement $f_y =$ **500** N/mm^2

Strength of link reinforcement $f_{ys} =$ **500** N/mm^2

Reinforcement provided in top **3 H16 bars ($A_{sedgetop}$ = 603 mm^2)**

Reinforcement provided in bottom **3 H16 bars ($A_{sedgebtm}$ = 603 mm^2)**

Link reinforcement provided **2 H10 legs at 200 ctrs (A_{sv}/s_v = 0.785 mm)**

Bottom cover to links $c_{beam} =$ **50** mm

Effective depth of top reinforcement $d_{edgetop} = h_{edge} - c_{top} - \phi_{slabtop} - \phi_{edgelink} - \phi_{edgetop}/2 =$ **372** mm

Effective depth of bottom reinforcement $d_{edgebtm} = h_{edge} - c_{beam} - \phi_{edgelink} - \phi_{edgebtm}/2 =$ **382** mm

Internal slab design checks

Basic loading

Slab self weight $w_{slab} = 24$ kN/m$^3 \times h_{slab} =$ **6.0** kN/m^2

Hardcore $w_{hcoreslab} = \gamma_{hcore} \times h_{hcoreslab} =$ **3.0** kN/m^2

Applied loading

Uniformly distributed dead load $w_{Dudl} =$ **1.8** kN/m^2

Uniformly distributed live load $w_{Ludl} =$ **2.5** kN/m^2

Internal slab bearing pressure check

Total uniform load at formation level $w_{udl} = w_{slab} + w_{hcoreslab} + w_{Dudl} + w_{Ludl} =$ **13.3** kN/m^2

PASS - $w_{udl} <= q_{allow}$ - Applied bearing pressure is less than allowable

Internal slab bending and shear check

Applied bending moments

Span of slab $l_{slab} = \phi_{depslab} + d_{tslabav} =$ **1540** mm

Ultimate self weight udl $w_{swult} = 1.4 \times w_{slab} =$ **8.4** kN/m^2

Self weight moment at centre $M_{csw} = w_{swult} \times l_{slab}^2 \times (1 + \nu) / 64 =$ **0.4** kNm/m

Self weight moment at edge $M_{esw} = w_{swult} \times l_{slab}^2 / 32 =$ **0.6** kNm/m

Self weight shear force at edge $V_{sw} = w_{swult} \times l_{slab} / 4 =$ **3.2** kN/m

Moments due to applied uniformly distributed loads

Ultimate applied udl $w_{udlult} = 1.4 \times w_{Dudl} + 1.6 \times w_{Ludl} =$ **6.5** kN/m^2

Moment at centre $M_{cudl} = w_{udlult} \times l_{slab}^2 \times (1 + \nu) / 64 =$ **0.3** kNm/m

Moment at edge $M_{eudl} = w_{udlult} \times l_{slab}^2 / 32 =$ **0.5** kNm/m

Shear force at edge $V_{udl} = w_{udlult} \times l_{slab} / 4 =$ **2.5** kN/m

Resultant moments and shears

Total moment at edge $M_{\Sigma e} =$ **1.1** kNm/m

Total moment at centre $M_{\Sigma c} =$ **0.7** kNm/m

Total shear force $V_{\Sigma} =$ **5.7** kN/m

Reinforcement required in top

K factor $K_{slabtop} = M_{\Sigma e}/(f_{cu} \times d_{tslabav}^2) =$ **0.001**

Lever arm $z_{slabtop} = d_{tslabav} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{slabtop}/0.9)}) =$ **180.5** mm

Area of steel required for bending $A_{sslabtopbend} = M_{\Sigma e}/((1.0/\gamma_s) \times f_{yslab} \times z_{slabtop}) =$ **14** mm^2/m

Minimum area of steel required $A_{sslabmin} = 0.0013 \times h_{slab} =$ **325** mm^2/m

Area of steel required $A_{sslabtopreq} = \max(A_{sslabtopbend}, A_{sslabmin})$ = **325** mm²/m

PASS - $A_{sslabtopreq} <= A_{sslabtop}$ - Area of reinforcement provided in top to span local depressions is adequate

Reinforcement required in bottom

K factor $K_{slabbtm} = M_{\Sigma c}/(f_{cu} \times d_{bslabav}^2)$ = **0.001**

Lever arm $z_{slabbtm} = d_{bslabav} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{slabbtm}/0.9)})$ = **180.5** mm

Area of steel required for bending $A_{sslabbtmbend} = M_{\Sigma c}/((1.0/\gamma_s) \times f_{yslab} \times z_{slabbtm})$ = **8** mm²/m

Area of steel required $A_{sslabbtmreq} = \max(A_{sslabbtmbend}, A_{sslabmin})$ = **325** mm²/m

PASS - $A_{sslabbtmreq} <= A_{sslabbtm}$ - Area of reinforcement provided in bottom to span local depressions is adequate

Shear check

Applied shear stress $v = V_{\Sigma}/d_{tslabmin}$ = **0.031** N/mm²

Tension steel ratio $\rho = 100 \times A_{sslabtop}/d_{tslabmin}$ = **0.425**

From BS8110-1:1997 - Table 3.8

Design concrete shear strength v_c = **0.576** N/mm²

PASS - $v <= v_c$ - Shear capacity of the slab is adequate

Internal slab deflection check

Basic allowable span to depth ratio $Ratio_{basic}$ = **26.0**

Moment factor $M_{factor} = M_{\Sigma c}/d_{bslabav}^2$ = **0.018** N/mm²

Steel service stress $f_s = 2/3 \times f_{yslab} \times A_{sslabbtmbend}/A_{sslabbtm}$ = **3.585** N/mm²

Modification factor $MF_{slab} = \min(2.0, 0.55 + [(477\text{N/mm}^2 - f_s)/(120 \times (0.9\text{N/mm}^2 + M_{factor}))])$

MF_{slab} = **2.000**

Modified allowable span to depth ratio $Ratio_{allow} = Ratio_{basic} \times MF_{slab}$ = **52.000**

Actual span to depth ratio $Ratio_{actual} = l_{slab}/ d_{bslabav}$ = **8.105**

PASS - $Ratio_{actual} <= Ratio_{allow}$ - Slab span to depth ratio is adequate

Edge beam design checks

Basic loading

Hardcore $w_{hcorethick} = \gamma_{hcore} \times h_{hcorethick}$ = **3.0** kN/m²

Edge beam self weight $w_{edge} = 24\text{ kN/m}^3 \times h_{edge} \times b_{edge}$ = **4.9** kN/m

Edge load number 1

Load type **Longitudinal line load**

Dead load w_{Dedge1} = **33.0** kN/m

Live load w_{Ledge1} = **6.0** kN/m

Ultimate load $w_{ultedge1} = 1.4 \times w_{Dedge1} + 1.6 \times w_{Ledge1}$ = **55.8** kN/m

Longitudinal line load width b_{edge1} = **350** mm

Centroid of load from outside face of raft x_{edge1} = **200** mm

Edge beam bearing pressure check

Effective bearing width of edge beam $b_{bearing} = b_{edge}$ = **450** mm

Total uniform load at formation level $w_{udledge} = w_{Dudl}+w_{Ludl}+w_{edge}/b_{bearing}+w_{hcorethick}$ = **18.1** kN/m²

Centroid of longitudinal and equivalent line loads from outside face of raft

Load x distance for edge load 1 $Moment_1 = w_{ultedge1} \times x_{edge1}$ = **11.2** kN

Sum of ultimate longitud'l and equivalent line loads ΣUDL = **55.8** kN/m

Sum of load x distances $\Sigma Moment$ = **11.2** kN

Centroid of loads $x_{bar} = \Sigma Moment/\Sigma UDL$ = **200** mm

Initially assume no moment transferred into slab due to load/reaction eccentricity

Sum of unfactored longitud'l and eff'tive line loads $\Sigma UDLsls$ = **39.0** kN/m

Allowable bearing width $b_{allow} = 2 \times x_{bar} + 2 \times h_{hcoreslab} \times \tan(30) =$ **573** mm

Bearing pressure due to line/point loads $q_{linepoint} = \Sigma UDLsls / b_{allow} =$ **68.0** kN/m²

Total applied bearing pressure $q_{edge} = q_{linepoint} + w_{udledge} =$ **86.1** kN/m²

$q_{edge} > q_{allow}$ - The slab is required to resist a moment due to eccentricity

Now assume moment due to load/reaction eccentricity is resisted by slab

Bearing width required $b_{req} = \Sigma UDLsls/(q_{allow} - w_{udledge}) =$ **1223** mm

Effective bearing width at u/s of slab $b_{reqeff} = b_{req} - 2 \times h_{hcoreslab} \times \tan(30) =$ **1049** mm

Load/reaction eccentricity $e = b_{reqeff}/2 - x_{bar} =$ **325** mm

Ultimate moment to be resisted by slab $M_{ecc} = \Sigma UDL \times e =$ **18.1** kNm/m

From slab bending check

Moment due to depression under slab (hogging) $M_{\Sigma e} =$ **1.1** kNm/m

Total moment to be resisted by slab top steel $M_{slabtop} = M_{ecc} + M_{\Sigma e} =$ **19.2** kNm/m

K factor $K_{slab} = M_{slabtop}/(f_{cu} \times d_{tslabmin}^2) =$ **0.022**

Lever arm $z_{slab} = d_{tslabmin} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{slab}/0.9)}) =$ **176** mm

Area of steel required $A_{sslabreq} = M_{slabtop}/((1.0/\gamma_s) \times f_y \times z_{slab}) =$ **252** mm²/m

PASS - $A_{sslabreq} <= A_{sslabtop}$ - Area of reinforcement provided to transfer moment into slab is adequate

The allowable bearing pressure under the edge beam will not be exceeded

Library item - B pressure with moment transfer

Edge beam bending check

Divider for moments due to udl's $\beta_{udl} =$ **10.0**

Applied bending moments

Span of edge beam $l_{edge} = \phi_{depthick} + d_{edgetop} =$ **1722** mm

Ultimate self weight udl $w_{edgeult} = 1.4 \times w_{edge} =$ **6.8** kN/m

Ultimate slab udl (approx) $w_{edgeslab} = \max(0 \text{ kN/m}, 1.4 \times w_{slab} \times ((\phi_{depthick}/2 \times 3/4) - b_{edge})) =$ **0.5** kN/m

Self weight and slab bending moment $M_{edgesw} = (w_{edgeult} + w_{edgeslab}) \times l_{edge}^2/\beta_{udl} =$ **2.2** kNm

Self weight shear force $V_{edgesw} = (w_{edgeult} + w_{edgeslab}) \times l_{edge}/2 =$ **6.3** kN

Moments due to applied uniformly distributed loads

Ultimate udl (approx) $w_{edgeudl} = w_{udlult} \times \phi_{depthick}/2 \times 3/4 =$ **3.3** kN/m

Bending moment $M_{edgeudl} = w_{edgeudl} \times l_{edge}^2/\beta_{udl} =$ **1.0** kNm

Shear force $V_{edgeudl} = w_{edgeudl} \times l_{edge}/2 =$ **2.8** kN

Moment and shear due to load number 1

Bending moment $M_{edge1} = w_{ultedge1} \times l_{edge}^2/\beta_{udl} =$ **16.5** kNm

Shear force $V_{edge1} = w_{ultedge1} \times l_{edge}/2 =$ **48.0** kN

Resultant moments and shears

Total moment (hogging and sagging) $M_{\Sigma edge} =$ **19.7** kNm

Maximum shear force $V_{\Sigma edge} =$ **57.2** kN

Reinforcement required in top

Width of section in compression zone $b_{edgetop} = b_{edge} =$ **450** mm

Average web width $b_w = b_{edge} =$ **450** mm

K factor $K_{edgetop} = M_{\Sigma edge}/(f_{cu} \times b_{edgetop} \times d_{edgetop}^2) =$ **0.013**

Lever arm $z_{edgetop} = d_{edgetop} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{edgetop}/0.9)}) =$ **353** mm

Area of steel required for bending $A_{sedgetopbend} = M_{\Sigma edge}/((1.0/\gamma_s) \times f_y \times z_{edgetop}) =$ **128** mm²

Minimum area of steel required $A_{sedgetopmin} = 0.0013 \times 1.0 \times b_w \times h_{edge} =$ **263** mm²

Area of steel required $A_{sedgetopreq} = \max(A_{sedgetopbend}, A_{sedgetopmin}) =$ **263** mm²

PASS - $A_{sedgetopreq} <= A_{sedgetop}$ - Area of reinforcement provided in top of edge beams is adequate

Reinforcement required in bottom

Width of section in compression zone $b_{edgebtm} = b_{edge} + 0.1 \times l_{edge} = \mathbf{622}$ mm

K factor $K_{edgebtm} = M_{\Sigma edge}/(f_{cu} \times b_{edgebtm} \times d_{edgebtm}^2) = \mathbf{0.009}$

Lever arm $z_{edgebtm} = d_{edgebtm} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{edgebtm}/0.9)}) = \mathbf{363}$ mm

Area of steel required for bending $A_{sedgebtmbend} = M_{\Sigma edge}/((1.0/\gamma_s) \times f_y \times z_{edgebtm}) = \mathbf{125}$ mm^2

Minimum area of steel required $A_{sedgebtmmin} = 0.0013 \times 1.0 \times b_w \times h_{edge} = \mathbf{263}$ mm^2

Area of steel required $A_{sedgebtmreq} = \max(A_{sedgebtmbend}, A_{sedgebtmmin}) = \mathbf{263}$ mm^2

PASS - $A_{sedgebtmreq}$ <= $A_{sedgebtm}$ - Area of reinforcement provided in bottom of edge beams is adequate

Edge beam shear check

Applied shear stress $v_{edge} = V_{\Sigma edge}/(b_w \times d_{edgetop}) = \mathbf{0.341}$ N/mm^2

Tension steel ratio $\rho_{edge} = 100 \times A_{sedgetop}/(b_w \times d_{edgetop}) = \mathbf{0.360}$

From BS8110-1:1997 - Table 3.8

Design concrete shear strength $v_{cedge} = \mathbf{0.458}$ N/mm^2

v_{edge} <= v_{cedge} + 0.4N/mm^2 - Therefore minimum links required

Link area to spacing ratio required $A_{sv\_upon\_s_{vreqedge}} = 0.4\text{N/mm}^2 \times b_w/((1.0/\gamma_s) \times f_{ys}) = \mathbf{0.414}$ mm

Link area to spacing ratio provided $A_{sv\_upon\_s_{vprovedge}} = N_{edgelink} \times \pi \times \phi_{edgelink}^2/(4 \times s_{vedge}) = \mathbf{0.785}$ mm

PASS - $A_{sv\_upon\_s_{vreqedge}}$ <= $A_{sv\_upon\_s_{vprovedge}}$ - Shear reinforcement provided in edge beams is adequate

Corner design checks

Basic loading

Corner bearing pressure check

Total uniform load at formation level $w_{udlcorner} = w_{Dudl} + w_{Ludl} + W_{edge}/b_{bearing} + w_{hcorethick} = \mathbf{18.1}$ kN/m^2

PASS - $w_{udlcorner}$ <= q_{allow} - Applied bearing pressure is less than allowable

Corner beam bending check

Cantilever span of edge beam $l_{corner} = \phi_{depthick}/\sqrt{(2)} + d_{edgetop}/2 = \mathbf{1141}$ mm

Moment and shear due to self weight

Ultimate self weight udl $w_{edgeult} = 1.4 \times w_{edge} = \mathbf{6.8}$ kN/m

Average ultimate slab udl (approx) $w_{cornerslab} = \max(0\text{ kN/m}, 1.4 \times w_{slab} \times (\phi_{depthick}/(\sqrt{(2)} \times 2) - b_{edge})) = \mathbf{0.2}$ kN/m

Self weight and slab bending moment $M_{cornersw} = (w_{edgeult} + w_{cornerslab}) \times l_{corner}^2/2 = \mathbf{4.6}$ kNm

Self weight and slab shear force $V_{cornersw} = (w_{edgeult} + w_{cornerslab}) \times l_{corner} = \mathbf{8.0}$ kN

Moment and shear due to udls

Maximum ultimate udl $w_{cornerudl} = ((1.4 \times w_{Dudl}) + (1.6 \times w_{Ludl})) \times \phi_{depthick}/\sqrt{(2)} = \mathbf{6.2}$ kN/m

Bending moment $M_{cornerudl} = w_{cornerudl} \times l_{corner}^2/6 = \mathbf{1.3}$ kNm

Shear force $V_{cornerudl} = w_{cornerudl} \times l_{corner}/2 = \mathbf{3.5}$ kN

Resultant moments and shears

Total design moment $M_{\Sigma corner} = M_{cornersw} + M_{cornerudl} = \mathbf{5.9}$ kNm

Total design shear force $V_{\Sigma corner} = V_{cornersw} + V_{cornerudl} = \mathbf{11.6}$ kN

Reinforcement required in top of edge beam

K factor $K_{corner} = M_{\Sigma corner}/(f_{cu} \times b_{edgetop} \times d_{edgetop}^2) = \mathbf{0.004}$

Lever arm $z_{corner} = d_{edgetop} \times \min(0.95, 0.5 + \sqrt{(0.25 - K_{corner}/0.9)}) = \mathbf{353}$ mm

Area of steel required for bending $A_{scornerbend} = M_{\Sigma corner}/((1.0/\gamma_s) \times f_y \times z_{corner}) = \mathbf{39}$ mm^2

Minimum area of steel required $A_{scornermin} = A_{sedgetopmin} = \mathbf{263}$ mm^2

Area of steel required $A_{scorner} = \max(A_{scornerbend}, A_{scornermin}) = \mathbf{263}$ mm^2

PASS - $A_{scorner}$ <= $A_{sedgetop}$ - Area of reinforcement provided in top of edge beams at corners is adequate

Corner beam shear check

Average web width — $b_w = b_{edge} = \mathbf{450}$ mm

Applied shear stress — $v_{corner} = V_{\Sigma corner}/(b_w \times d_{edgetop}) = \mathbf{0.069}$ N/mm^2

Tension steel ratio — $\rho_{corner} = 100 \times A_{sedgetop}/(b_w \times d_{edgetop}) = \mathbf{0.360}$

From BS8110-1:1997 - Table 3.8

Design concrete shear strength — $v_{ccorner} = \mathbf{0.450}$ N/mm^2

v_{corner} <= $v_{ccorner}$ + 0.4N/mm^2 - Therefore minimum links required

Link area to spacing ratio required — $A_{sv}\_upon\_s_{vreqcorner} = 0.4\text{N/mm}^2 \times b_w/((1.0/\gamma_s) \times f_{ys}) = \mathbf{0.414}$ mm

Link area to spacing ratio provided — $A_{sv}\_upon\_s_{vprovedge} = N_{edgelink} \times \pi \times \phi_{edgelink}^2/(4 \times s_{vedge}) = \mathbf{0.785}$ mm

PASS - $A_{sv}\_upon\_s_{vreqcorner}$ <= $A_{sv}\_upon\_s_{vprovedge}$ - Shear reinforcement provided in edge beams at corners is adequate

Corner beam deflection check

Basic allowable span to depth ratio — $Ratio_{basiccorner} = \mathbf{7.0}$

Moment factor — $M_{factorcorner} = M_{\Sigma corner}/(b_{edgetop} \times d_{edgetop}^2) = \mathbf{0.095}$ N/mm^2

Steel service stress — $f_{scorner} = 2/3 \times f_y \times A_{scornerbend}/A_{sedgetop} = \mathbf{21.308}$ N/mm^2

Modification factor — $MF_{corner}=\min(2.0,0.55+[(477\text{N/mm}^2-f_{scorner})/(120\times(0.9\text{N/mm}^2+M_{factorcorner}))])$

$MF_{corner} = \mathbf{2.000}$

Modified allowable span to depth ratio — $Ratio_{allowcorner} = Ratio_{basiccorner} \times MF_{corner} = \mathbf{14.000}$

Actual span to depth ratio — $Ratio_{actualcorner} = l_{corner}/ d_{edgetop} = \mathbf{3.066}$

PASS - $Ratio_{actualcorner}$ <= $Ratio_{allowcorner}$ - Edge beam span to depth ratio is adequate

Lintel L1

Max Clear Span = 1350mm / 450mm

Dead Load

Wall H	=	1.0m x 4.4 kN/m^2	= 4.4 kN/m
Roof DL	=	5.0m x 1.3 kN/m^2	= 6.5 kN/m
		TOTAL DL	**= 10.9 kN/m**

Live Load

Roof LL	=	5.0m x 0.6 kN/m^2	= 3.0 kN/m
		TOTAL LL	**= 3.0 kN/m**

TOTAL UDL = 13.9 kN/m
Load W = 19 kN / 6.3 kN

USE IG/HD Cavity Wall Lintel
Use same for L3

Le = 1.35m **SWL = 30 kN > 19 kN**
Satisfactory

Le = 0.45m **SWL = 30 kN > 7 kN**
Satisfactory

eng@huddsdesign.com
www.huddsdesign.com

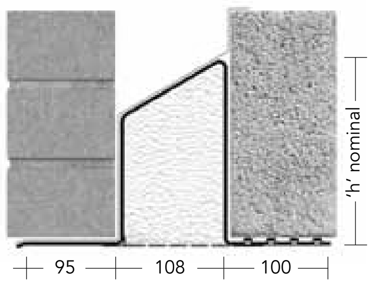
HEAVY DUTY LOAD

L1/HD

Blockwork built tight against inner face of the lintel. Place mortar bed on top of blockwork before floor units are laid to provide even distribution of load. Lintels may be propped to facilitate speed of construction. See Lintel Installation on page 12.

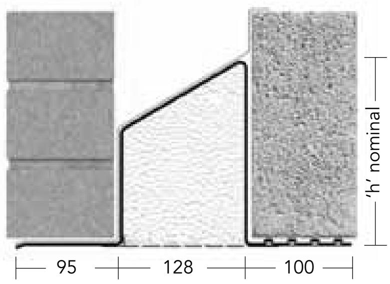
L1/HD 110	**For cavity widths 110-125mm**				
Manufactured length 150mm increments	**600-1500**	**1650-2100**	**2250-3000**	**3150-3600**	**3750-4050**
Height 'h'	125	145	195	195	195
Thickness	2.9	2.9	2.9	3.2	3.2
Total UDL kN 3:1	30	30	35	32	30
Total UDL kN 19:1	20	22	30	28	26

110-125mm cavity



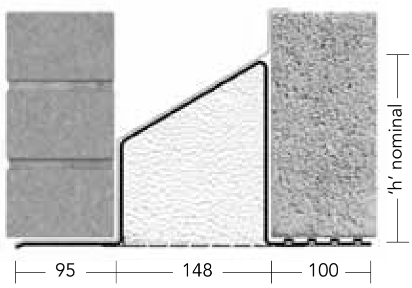
L1/HD 130	**For cavity widths 130-145mm**				
Manufactured length 150mm increments	**600-1500**	**1650-2100**	**2250-3000**	**3150-3600**	**3750-4050**
Height 'h'	115	155	190	190	212
Thickness	2.9	2.9	3.2	3.2	3.2
Total UDL kN 3:1	30	30	35	30	30
Total UDL kN 19:1	20	22	30	25	26

130-145mm cavity

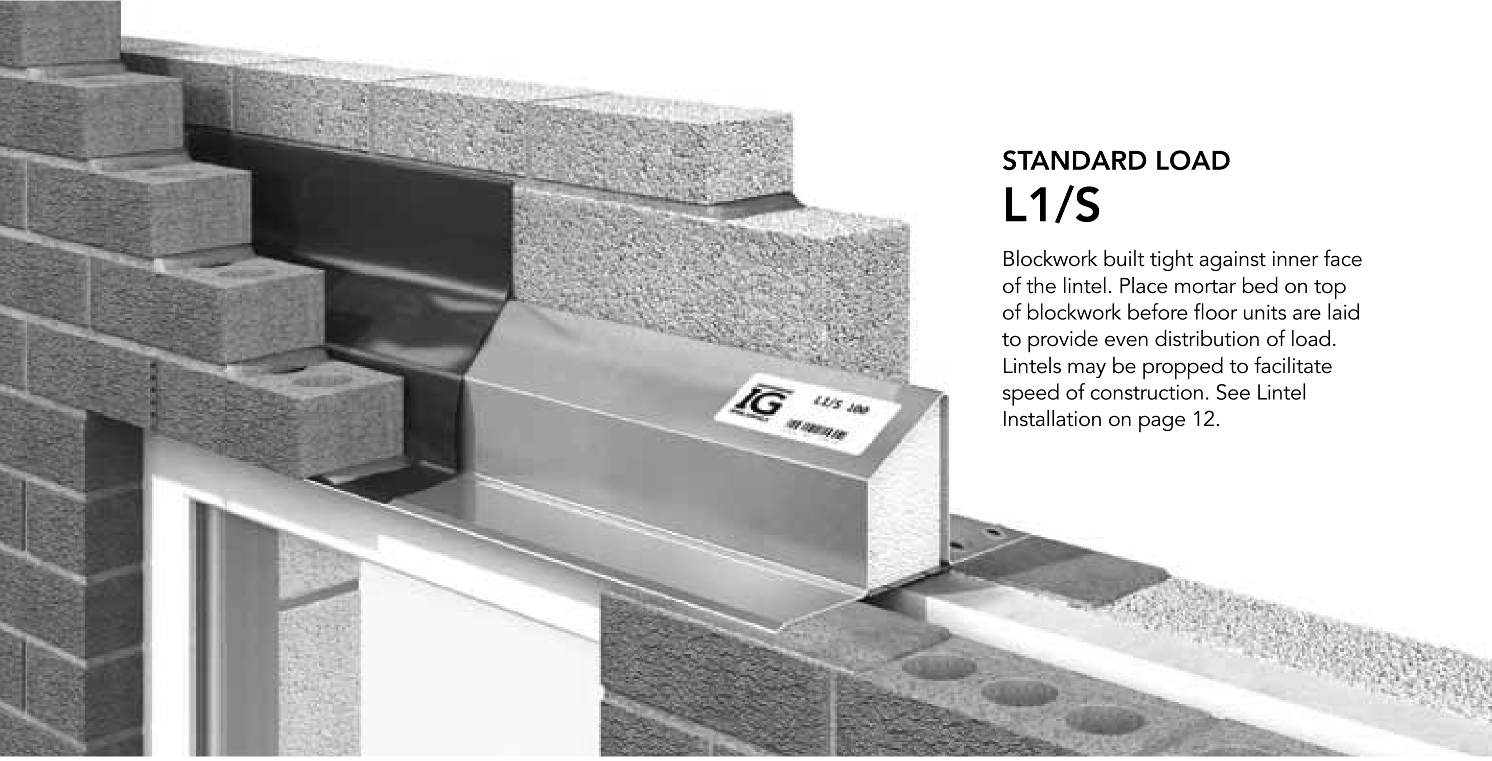


L1/HD 150	**For cavity widths 150-165mm**				
Manufactured length 150mm increments	**600-1500**	**1650-2100**	**2250-3000**	**3150-3600**	**3750-4050**
Height 'h'	125	160	180	180	200
Thickness	2.9	2.9	3.2	3.2	3.2
Total UDL kN 3:1	30	30	35	30	30
Total UDL kN 19:1	20	22	30	25	26

150-165mm cavity



HEAVIER LOADINGS
Tables for heavier loads overleaf.

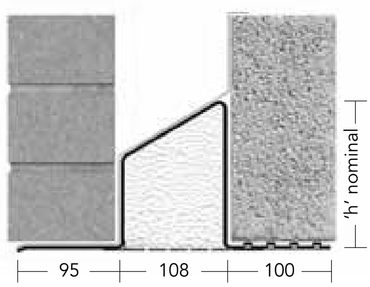


STANDARD LOAD
L1/S

Blockwork built tight against inner face of the lintel. Place mortar bed on top of blockwork before floor units are laid to provide even distribution of load. Lintels may be propped to facilitate speed of construction. See Lintel Installation on page 12.

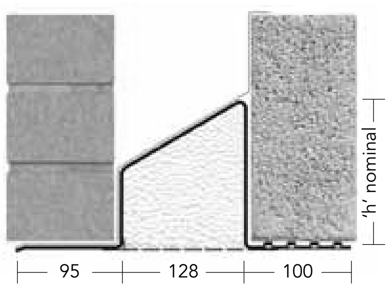
L1/S 110	For cavity widths **110-125mm**					
Manufactured length 150mm increments	600-1500	1650-1800	1950-2100	2250-3000	3150-4050	4200-4800
Height 'h'	95	121	145	195	195	195
Thickness	2.0	2.0	2.6	2.9	3.2	3.4
Total UDL kN 3:1	16	22	24	27	26	25
Total UDL kN 19:1	13	18	18	22	19	20

110-125mm cavity



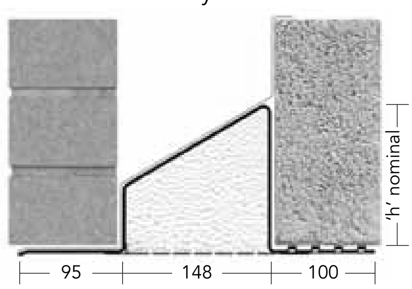
L1/S 130	For cavity widths **130-145mm**					
Manufactured length 150mm increments	600-1500	1650-1800	1950-2100	2250-3000	3150-4050	4200-4800
Height 'h'	103	128	190	190	190	190
Thickness	2.0	2.0	2.5	2.9	3.2	3.4
Total UDL kN 3:1	16	22	24	27	26	25
Total UDL kN 19:1	13	18	18	22	19	20

130-145mm cavity



L1/S 150	For cavity widths **150-165mm**					
Manufactured length 150mm increments	600-1500	1650-1800	1950-2100	2250-3000	3150-4050	4200-4800
Height 'h'	100	125	180	180	180	180
Thickness	2.0	2.0	2.6	2.9	3.2	3.4
Total UDL kN 3:1	16	22	24	27	26	25
Total UDL kN 19:1	13	18	18	22	19	20

150-165mm cavity



HEAVIER LOADINGS
Tables for heavier loads overleaf.