In partnership with

D & P Solutions

Project	Beeches, Long Meadow, Goring on Thames RG89EG	
Subject	**Structural Calculations**	
Calc. No. **23-1806-C01**	Rev **B**	Date **21.02.24**

Note to Contractor: **PLEASE READ BEFORE COMMENCING ON SITE**

1. If you require any additional information before starting the works please email us.
2. Whilst carrying out the works, if you uncover any additional structural elements not noted within this calculation package please contact us as this may require a check and revised structural calculations
3. The contractor should carry out their own measured survey and investigations prior to starting works on site and ordering materials to confirm any critical assumptions noted in this document on page 3!
4. Please carefully read all notes on next two pages.
5. These calculations should be submitted for a full plans submission to building control prior to starting the works, a compliance report must be issued to the structural engineer prior to the works commencing on site. If you proceed with the works using a Building Notice, you are assuming the risk for the project and we will not accept responsibility or liability for any delays on site or associated costs or damages in connection with the delay or materials and labour cost associated with the re-design.

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IMPORTANT NOTES

General Notes

1. All works are to be in accordance with the current British Standard and Building Regulations.
2. This document to be read in conjunction with all relevant drawings issued by the Architect and specialist sub-contractors together with the specifications. Any discrepancies to be reported to Engineer.
3. Please note that the lengths of structural elements indicated in these calculations are not for fabrication purposes. The length of elements may differ slightly to allow for bearing, etc. The lengths of elements should always be based on onsite measurements. If the lengths of elements should differ from these calculations by more than 10%, please contact Engineer.
4. All setting out, levels, DPC, insulation, fire protection & waterproofing information is to be obtained from the Architect.
5. The Party Wall Act may apply.
6. Structural elements not shown in this document are out of scope and to be designed by others.
7. Off-the-shelf items to be installed as per manufacturer's details/recommendations.
8. All specified structural elements (i.e. steel beams & columns, timber beams&posts, etc.) are to be installed in a single continuous length unless stated otherwise.
9. No holes, chases, cut-outs, existing or proposed services or the like may be formed in or pass through any beam, column, or load bearing wall.
10. This document is intended to be printed in colour.
11. CALCULATIONS ARE SUBJECT TO BUILDING CONTROL APPROVAL. ANY WORKS CARRIED OUT PRIOR TO APPROVAL OF CALCULATIONS BY BUILDING CONTROL ARE AT OWN RISK. WE WILL NOT ACCEPT LIABILITY FOR ANY REQUIREMENTS, ALTERNATIONS, COSTS OR DELAYS RESULTING FROM THIS.

Construction Notes / Health & Safety Notes

1. We do not provide monitoring on site and the experience, diligence and management of the building contractor's team must be relied on. The Contractor must provide permanent, experienced site managers capable of understanding the requirements of our specifications and design.
2. The Contractor shall ensure that stability of the building and adjacent premises is maintained at all stages of construction. The contractor is to design, install and maintain all necessary temporary works and programme the work accordingly.
3. In addition to the usual risks associated with building works and materials, of which competent builder should be aware, the following site and work specific health and safety risks have been identified: demolition, excavation, drilling and cutting into existing structure or materials should be carried out carefully in case there are any unknows services hidden in the area.
4. The project requires the introduction of heavy structural elements such as steel beams or concrete lintels. Builder is to take into consideration the placement of all structural elements, ensuring that the method of lifting and placement is safely carried out. Responsibility for this element lies with the Contractor. As the existing walls need to be propped in order to introduce some of the lintels, this should also be considered in relationship to the risk assessment of the Contractor. Safe working procedures must be adopted. Responsibility for this element lies with the Contractor. Splice details for long-span beams can often be accommodated if required.
5. The design has been based on the assumption that the construction will be undertaken by a Competent Building Contractor used to undertaking this form of building works, of this type and complexity, and in accordance with Good Building Practice and general accepted standards and methods of construction.

Steelwork Notes

1. All steel beams / columns to be of steel grade min. S355. All plates to be of steel grade min. S275.
2. All bolts to be grade 8.8 unless noted otherwise.
3. All welds to be min 6mm fillet welds unless noted otherwise.
4. Steel elements end bearing to be equal to full width of any spreader or post / min. 100mm end bearing unless noted otherwise.
5. Corus "The Prevention of corrosion on structural steelwork" to be used as a guidance for steelwork finish/paint system.
6. Design of all connections is the responsibility of the steelwork sub-contractor unless noted otherwise.
7. Steel fabricator to submit fabrication drawings for checking before fabrication begins.
8. Padstones and steel beams to avoid clashes with chimney breast. Please contact Engineer if otherwise.
9. All padstones to be C35 grade.
10. As an alternative to padstones, 25mm thick steel spreader plates for padstones less than 440mm long can be used and 45mm thick steel spreader plates for padstones longer or equal than 440mm long can be used. Steel plates plan dimensions to be the same as padstones plan dimensions.
11. Provide clearance to under-side of steelwork at intersecting wall locations where no bearing information is shown to prevent unintended load transfer.
12. Where pair of beams is presented, steel beams to be bolted together with M16 bolts @ spacer tubes @max 600mm centres.
13. Beams and columns to be placed centrally on bearings, ie beams/posts/padstones unless noted otherwise. Beams to be located centrally under walls, unless they are working as lintels on external cavity walls.
14. All steelwork below ground to have a minimum of 50mm concrete encasement unless noted otherwise.
15. All new columns to be tied to walls using wall starter kits or ancon ties.
16. In places where beam is located parallel to padstone, beam must be centralized on the padstone. End bearing length of the beam to be equal to half padstone length. In places where beam is located perpendicular to padstone, end bearing length to be equal to padstone width. See drawings for details.
17. Site welding is not allowed unless noted otherwise.
18. Site modifications to structural steelwork shall not be carried out.

Masonry Notes

1. All proposed bricks to be standard format clay 20N/mm2 bricks unless noted otherwise.
2. All proposed blockwork to be 7.3N blocks unless noted otherwise.
3. Mortar below DPC to be designation M6 (ii), above designation M4 (iii).
4. Existing loadbearing masonry wall to be minimum 100mm thick wall.
5. 100mm wide blocks shall not be laid flat if load bearing.
6. Any disturbed and loose masonry should be removed and rebuilt.
7. Wall ties to be provided in accordance with the provisions in Building Regulation requirements.

Timber Notes

1. All structural timber to be grade C24 unless noted otherwise.
2. All bolts to be grade 8.8 unless noted otherwise.
3. All timbers to be treated with an approved preservative to BS 5268 PT5
4. All cut ends to be retreated before fixing
5. Timber elements end bearing length to be equal to full width of any spreader or post / min. 100mm end bearing unless noted otherwise.
6. All joist hangers are to be galvanised mild steel with minimum thickness of 2.5mm specified and designed by the specialist manufacturer. Timber joints between members are to be created using either traditional joinery techniques or proprietary fixings. Where input is required contact with engineer.
7. Floor and roof constructions, walls require lateral restraints by straps in accordance with the provisions in Building Regulation requirements.
8. Where two or more pieces of timber are specified in one element the timbers are to be fixed together using M12 bolts @500mm CTRS
9. New timber joists spanning more than 2.5m to be restrained by solid noggins in 1/3 of their length.
10. Provide clearance to under-side of timber joists at intersecting wall locations where no bearing information is shown to prevent unintended load transfer.
11. Double joists shall be provided under non-load bearing studwork partitions running parallel with joists spans, under baths and under airing cupboards.
12. Notch at support for timber element can be provided for rafters to a depth not greater than 40mm underside of the element (if required notch depth is greater, contact with engineer). For other timber elements using notch at support is not permitted. If it is required then contact engineer.
13. Timber post adjacent to existing masonry wall need to be resin anchored into the masonry using min M12 anchors @ max 450mm CTRS or angle brackets (if preferred).
14. Timber to timber/steel connections to be specified by others.

Foundation Notes

1. For calculation purposes allowable bearing capacity of 100kN/m2 is assumed. Building control officer or other suitably qualified individual to ensure that formation level bearing stratum is valid.
2. Concrete to be grade C28/35, reinforcement to be high yield (fy = 500 N/mm2) unless noted otherwise.
3. All new foundations to be mass concrete strip footing (minimum width 0.6m, minimum depth 0.6m or minimum depth 1.0m if soil is found to be shrinkage clay, final depth to building control officer) unless noted otherwise.These depths may need to be increased in order to transfer the loading onto satisfactory ground, or where there are trees nearby.
4. Minimum cover to reinforcement to be 50mm unless noted otherwise.
5. Existing foundations are assumed sufficient to carry the existing building.
6. Main contractor to check condition of existing walls and foundations prior to construction.
7. When additional load is added onto existing foundations , the existing foundations to be exposed and inspected by the BCO to checked/approved if adequate prior to commencement of works.
8. If soil is found to be shrinkable clays and trees are located nearby, foundations depth may need to be calculated in accordance with NHBC standard chapter 4.2. Spread foundations may not be suitable to use.
9. Pad footing to be placed centrally under columns/piers unless noted otherwise.
10. Pad footing near existing foundations should be at least equal in depth to existing foundation depth. Local underpinning may be required to prevent undermining if new pad footing proposed formation level is deeper than adjacent existing footing.
11. Footing near existing foundations should be at least equal in depth to existing foundation depth. Local underpinning may be required to prevent undermining if new footing proposed formation level is deeper than adjacent existing footing. New foundations to be excavated in 1.0m long bays; bays being excavated at the same time must not be adjacent to each other.
12. OBTAIN APPROVAL FROM LOCAL AUTHORITY BUILDING CONTROL BEFORE CASTING ANY FOUNDATIONS.

Design Approach

BS 6399 P1/P2/P3	Loading for Building. Code of practice for dead and imposed loads. Code of practice for wind loads. Code of practice for imposed roof loads.
BS 8103 P3	Structural design of low-rise buildings. Code of practice for timber floors and roofs for housing.
BS 5950 P1	Structural use of steelwork in building. Code of practice for design – Rolled and welded sections
BS 8110 P1	Structural use of concrete. Code of practice for design and construction
BS 5628 P1	Code of practice for the use of masonry. Structural use of unreinforced masonry.
BS 5268 P2	Structural use of timber. Code of practice for permissible stress design, materials and workmanship.

SYMBOL KEY & DESIGN ASSUMPTIONS

SYMBOL KEY

- LOAD BEARING MASONRY WALL
- LOAD BEARING STUD / DORMER WALL
- APPROX LINE OF LOAD BEARING STUD / DORMER WALL OVER SHOWN DASHED
- NON-LOADBEARING TIMBER PARTITION WALL SHEATHED IN PLYWOOD / OSB EITHER SIDE. WALL TO BE STRAPPED TO WALLS AND FLOORS.
- PLY / OSB BOARDED JOISTS WITH ADDITIONAL LATERAL RESTRAINT BY STRAPS. SEE PLYBOARDING OF TIMBER JOISTS NOTE ON GENERAL ARRANGEMENT PAGE.
- STEEL BEAM ON PLAN/ COLUMN ON SECTION / ELEVATION
- STEEL UB / UC COLUMN ON PLAN / STEEL BEAM ON SECTION / ELEVATION
- STEEL UB / UC COLUMN OVER SHOWN DASHED
- STEEL SHS COLUMN
- STEEL SHS COLUMN OVER SHOWN DASHED
- TIMBER BEAM ON PLAN / TIMBER POST ON SECTION / ELEVATION
- TIMBER POST / RAKING STRUT
- APPROX BEARING OF TIMBER POST / RAKING STRUT OVER SHOWN DASHED
- LINTEL
- EXISTING BEAM / EXISTING LINTEL
- FLEXIBLE ENDPLATE CONNECTION. SEE DRAWING DETAILS
- EXISTING JOISTS SPAN DIRECTION UNLESS NOTED OTHERWISE
- RAF — NEW RAFTERS SPAN DIRECTION
- RJ — NEW FLAT ROOF JOISTS SPAN DIRECTION
- CJ — NEW CEILING JOISTS SPAN DIRECTION
- FJ — NEW FLOOR JOISTS SPAN DIRECTION
- GFJ — NEW GROUND FLOOR JOISTS SPAN DIRECTION
- PADSTONE SHAPE

DESIGN ASSUMPTIONS

CRITICAL ASSUMPTIONS - THESE MUST BE CONFIRMED BEFORE COMMENCING THE WORK ON SITE AS DESIGN MAY NEED TO CHANGE:

1. Masonry load bearing wall locations (hatched on general arrangement / steel beam bearing positions).

2. Existing floors above ground floor are timber construction.

3. If ground is shrinkable clay and there are trees within 30m of the proposed development, then a tree survey to be forwarded to engineer, as foundations may need to be updated.

4. Existing/Proposed ground floor is ground bearing slab.

CONSERVATIVE ASSUMPTIONS - THESE CAN BE CONFIRMED TO POTENTIALLY OPTIMISE DESIGN BUT ARE NOT CRUCIAL:

1. Existing/Proposed blockwork assumed as dense blocks.

2. Existing floor joists span direction.

2. Wall above beam B6 assumed as masonry wall supporting roof via purlins.

4. Beams B7, B8, B9, B11 assumed as supporting masonry wall and roof via purlins existing floor joists.

5. Wall above existing beam EB1 assumed as masonry wall/

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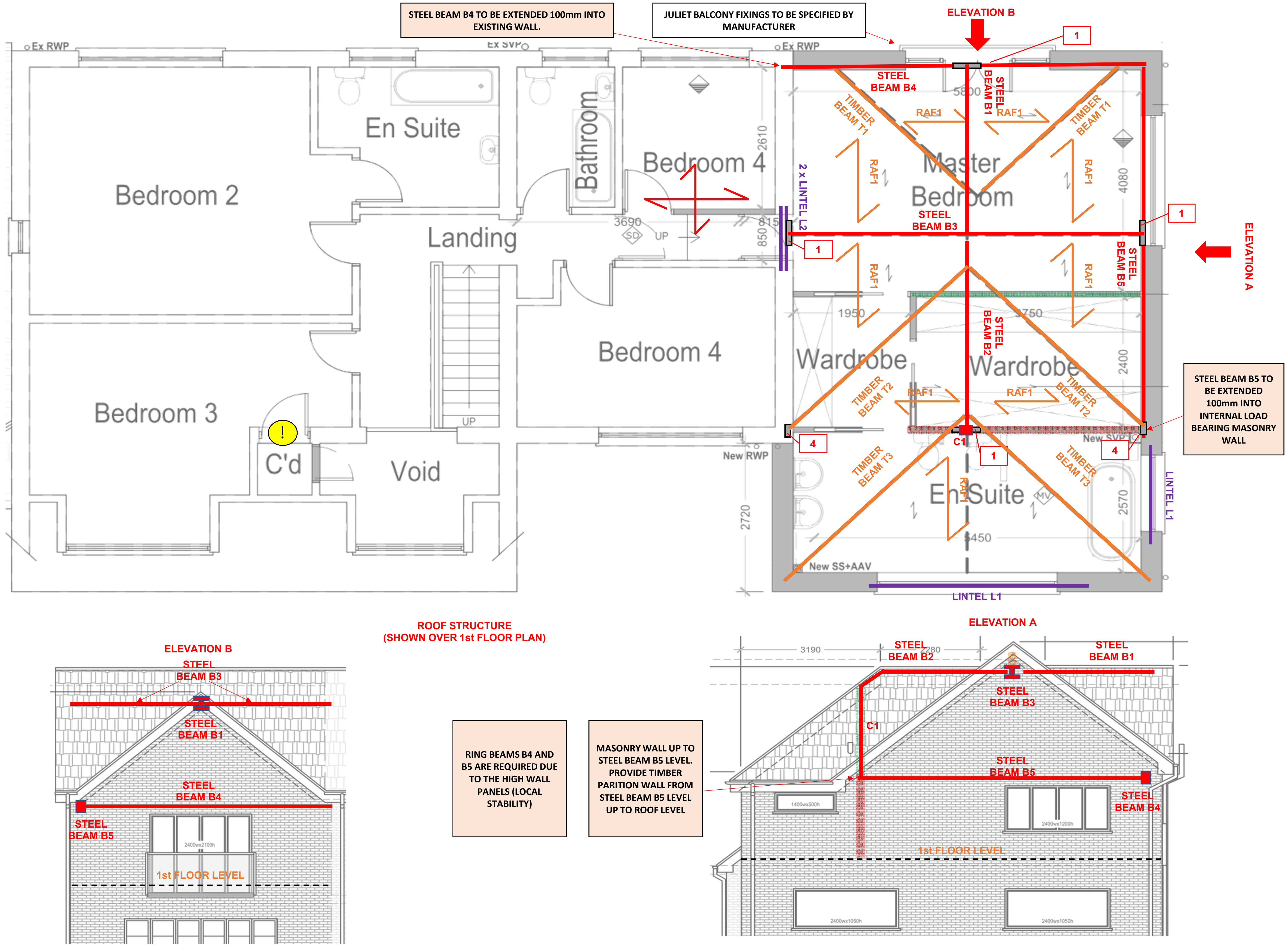
Calculation Number	Rev	Des.	Chkd.	Chkd.	Date
23-1806-C01	B	DL	DK	DK	21.02.24

SYMBOL KEY

! REMOVED WALL IS NON-LOADBEARING (TBC BY CONTRACTOR ON-SITE PRIOR TO REMOVAL)

FOR ELEMENT SPECIFICATIONS REFER TO SUMMARY PAGE



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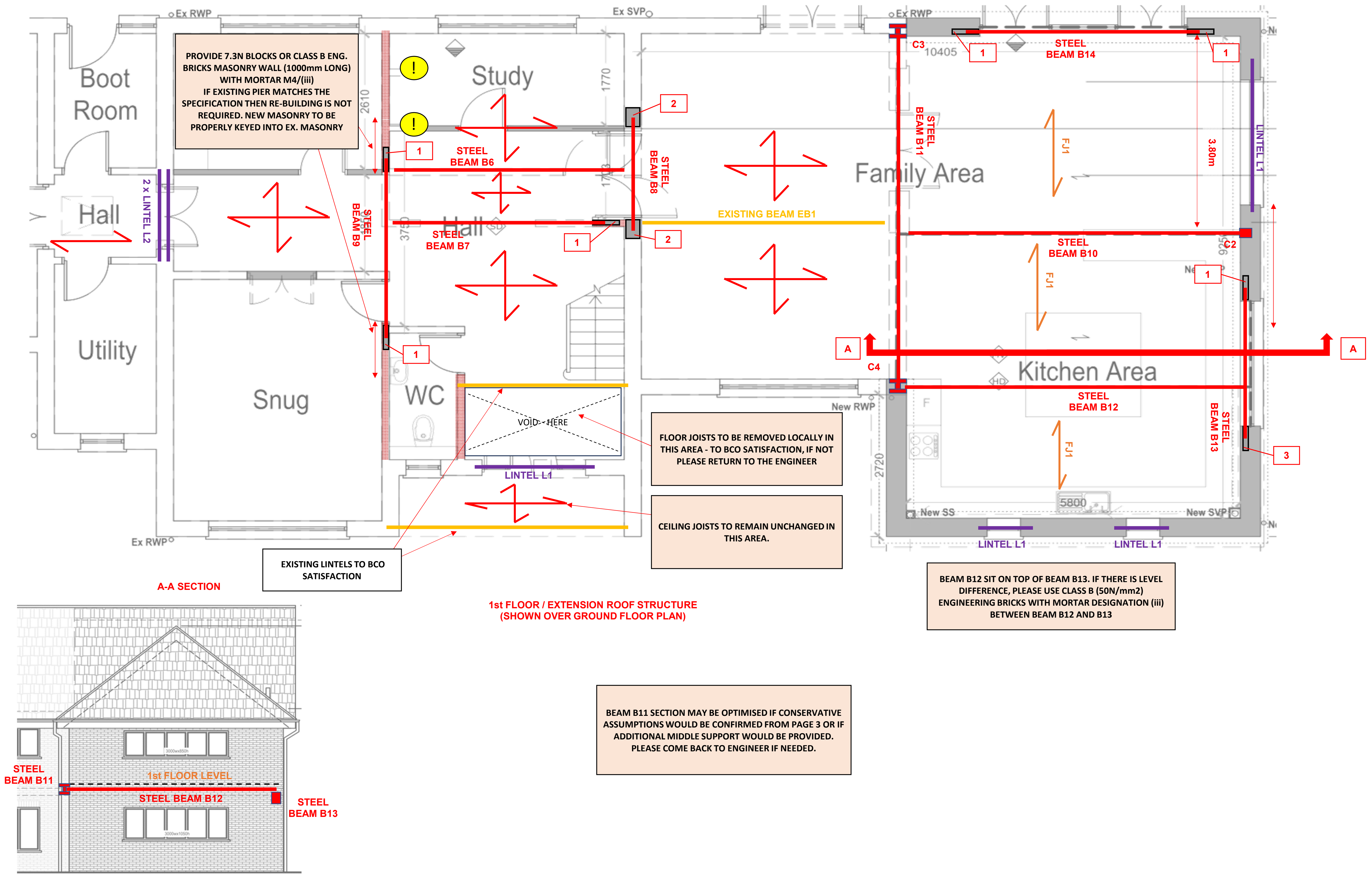

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REGEN project — In partnership with D & P Solutions

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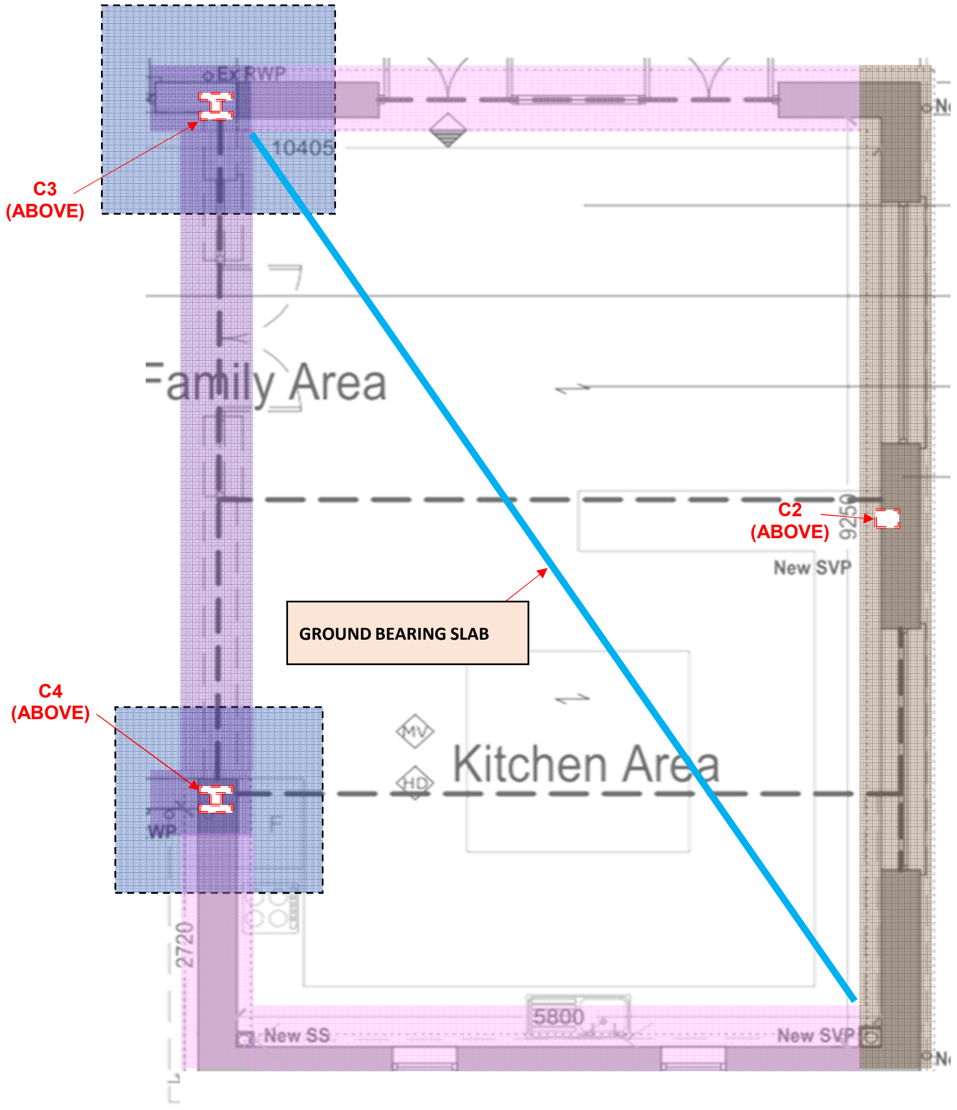

FOUNDATION LEVEL STRUCTURE
(SHOWN OVER GROUND FLOOR PLAN)

SYMBOL KEY

- PROPOSED STRIP FOUNDATION (F1)
- PROPOSED STRIP FOUNDATION (F2)
- PROPOSED PAD FOUNDATION BENEATCH STEEL COLUMNS
- EXISTING STRIP FOUNDATION - SEE SUMMARY TABLE FOR DETAILS

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SUMMARY PAGE

STEEL ELEMENTS

B1 = 152 x 152 x 23 UKC
B2 = 152 x 152 x 30 UKC (BEAM NEEDS TO BE CRANKED TO FOLLOW ROOF SHAPE; CRANKED LOCATION TO BE FULLY-BUTT WELDED BY SUITABLY QUALIFIED STEEL FABRICATOR)
B3 = 203 x 203 x 60 UKC
B4 = 200x100x12.5 RHS
B5 = 250x150x8.0 RHS
B6 = 152 x 152 x 37 UKC
B7 = 152 x 152 x 30 UKC
B8 = 152 x 152 x 30 UKC (BEAM WITH PLATE, SEE DETAILS BELOW)
B9 = 152 x 152 x 37 UKC
B10 = 203 x 203 x 46 UKC
B11 = 305 x 305 x 118 UKC (BEAM WITH PLATE, SEE DETAILS BELOW)
B12 = 203 x 203 x 60 UKC
B13 = 200x100x8.0 RHS (BEAM WITH PLATE, SEE DETAILS BELOW)
B14 = 200x100x5.0 RHS (BEAM WITH PLATE, SEE DETAILS BELOW)

C1 = 100x100x5.0 SHS (B4/B5 RING BEAMS LEVEL TO ROOF LEVEL) (SATISFACTORY BY INSPECTION)
C2 = 100x100x5.0 SHS (GROUND FLOOR TO 1st FLOOR LEVEL) (SATISFACTORY BY INSPECTION)
C3 = 152 x 152 x 37 UKC (GROUND FLOOR TO 1st FLOOR LEVEL)
C4 = 152 x 152 x 37 UKC (GROUND FLOOR TO 1st FLOOR LEVEL)

STEELWORK GRADE: S355

BEAMS WITH PLATE:
- FOR BEAMS PLACED AT INNER LEAF AND ACTING AS LINTEL: PROVIDE 15mm THICK AND WALL WIDTH WIDE PLATE 6mm FILLET WELDED TO BOTTOM FLANGE OF BEAM.
- FOR BEAMS PLACED CENTRALLY UNDER 215mm THICK WALL / CAVITY WALL / CHIMNEY: PROVIDE 10mm THICK AND WALL WIDTH / CHIMNEY WIDTH PLATE 6mm FILLET WELDED TO TOP FLANGE OF BEAM.

TIMBER ELEMENTS

RAF1 - RAFTER = 200 x 50 C24 @ 400mm CTRS
FJ1 - FLOOR JOIST = 200 x 50 C24 @ 400mm CTRS

T1 (VALLEY RAFTER) = 2No 300x50 C24
T2 (VALLEY RAFTER) = 3No 300x50 C24
T3 (HIP RAFTER) = 3No 300x50 C24

STEEL / TIMBER BEAMS BEARING DETAILS

PADSTONE DIMENSIONS ARE SPECIFIED AS:
YYY (LENGTH) x YYY (WIDTH) x YYY (HEIGHT).
ALL DIMENSIONS IN mm.

1 - 440x100x215 CONCRETE PADSTONE
2 - 400x(WALL WIDTH)x215 CONCRETE PADSTONE
3 - 600x100x250 CONCRETE PADSTONE
4 - 215x100x65 CONCRETE PADSTONE

IN PLACES WHERE BEAM IS LOCATED PARALLEL TO PADSTONE, BEAM MUST BE CENTRALIZED ON THE PADSTONE. END BEARING LENGTH OF BEAM TO BE EQUAL TO HALF PADSTONE LENGTH. IN PLACES WHERE BEAM IS LOCATED PERPENDICULAR TO PADSTONE, END BEARING LENGTH TO BE EQUAL TO PADSTONE WIDTH. (SEE DRAWINGS PAGE FOR DETAILS)

LINTELS

L1 = CATNIC CG CAVITY WALL LINTEL (SATISFACTORY BY INSPECTION)
L2 = 140x100 R6 HI-SPEC NAYLOR LINTEL OR SIMILAR (SATISFACTORY BY INSPECTION)

MASONRY ELEMENTS

ALL PROPOSED BLOCKWORK (INNER SKIN OF CAVITY WALL AND WALL ABOVE BEAM B12) TO BE CONSTRUCTED USING LIGHTWEIGHT BLOCKS (MAXIMUM DENSITY: 1000 kg/m3).

FOUNDATIONS

ALLOWABLE BEARING CAPACITY OF 100kN/m2 ASSUMED.

PAD FOUNDATION TO BE PLACED CENTRALLY UNDER COLUMN/PIER UNLESS NOTED OTHERWISE.

DEPTH OF FOUNDATIONS TO BE MEASURED FROM TOP OF PADSTONE FOR COLUMNS AND FROM GROUND FLOOR LEVEL FOR PIERS.

SEVERAL FOUNDATION OPTIONS ARE SHOWN FOR EACH ELEMENT. THE MOST SUITABLE OPTION TO BE CHOSEN ON THE SITE.

EXISTING FOUNDATION TO BE EXPOSED AND IF EXISTING FOUNDATIONS MATCH THE SPECIFICATION - THEN THE RE-USE OF THESE FOUNDATIONS IS TO BE AGREED ON SITE WITH BUILDING CONTROL INSPECTOR.

UNDER C2:
- STRIP FOUNDATION: MIN DEPTH: 0.90m / MIN WIDTH: 0.60m / CONCRETE PADSTONE UNDER COLUMN: 440x100x215mm

UNDER C3:
- PAD FOUNDATION: 1.40mx1.40mx0.50m WITH A393 MESH (TOP AND 2 BOTTOM)

UNDER C4:
- PAD FOUNDATION: 1.60mx1.60mx0.60m WITH A393 MESH (TOP AND 2 BOTTOM)

PROPOSED STRIP FOUNDATION (F1):
600mm WIDE, MIN 225mm CONCRETE THICKNESS, MIN 900mm DEPTH (SATISFACTORY BY INSPECTION)

PROPOSED STRIP FOUNDATION (F2):
600mm WIDE, MIN 225mm CONCRETE THICKNESS, MIN 600mm DEPTH (SATISFACTORY BY INSPECTION)

FINAL DEPTH TO BE AGREED WITH BUILDING CONTROL OFFICER ON SITE.

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DRAWINGS / CONNECTION DETAILS

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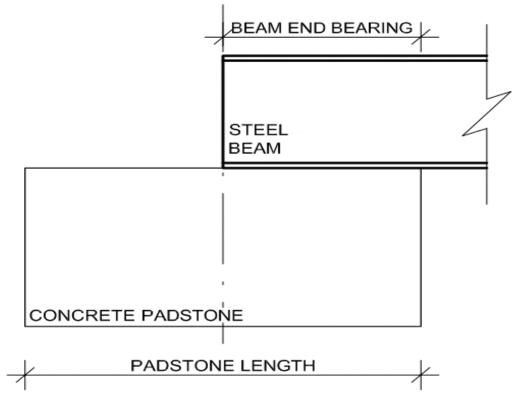
2. ALL DETAILS AND DIMENSIONS ARE TO BE CHECKED/ADJUSTED TO SITE CONDITIONS BY THE CONTRACTOR/FABRICATOR PRIOR TO COMMENCEMENT OF CONSTRUCTION/FABRICATION. DO NOT SCALE THIS DRAWING.
3. STEEL FABRICATOR TO SUBMIT FABRICATION DRAWINGS FOR CHECKING BEFORE FABRICATION BEGINS.
4. ALL DIMENSIONS IN mm U.N.O.
5. ALL STEEL BEAMS / COLUMNS TO BE OF STEEL GRADE MIN. S355. ALL PLATES TO BE OF STEEL GRADE MIN. S275.
6. PLEASE NOTE THOSE ARE TYPICAL DETAILS, SEVERAL OPTIONS MAY BE SHOWN FOR EACH ELEMENT. THE MOST SUITABLE OPTION TO BE CHOSEN ON THE SITE

PADSTONE DETAILS

IN PLACES WHERE BEAM IS LOCATED PARALLEL TO PADSTONE, BEAM MUST BE CENTRALIZED ON THE PADSTONE. END BEARING LENGTH OF THE BEAM TO BE EQUAL TO HALF PADSTONE LENGTH. IN PLACES WHERE BEAM IS LOCATED PERPENDICULAR TO PADSTONE, END BEARING LENGTH TO BE EQUAL TO PADSTONE WIDTH. SEE SKETCHES.

BEAM PARALLEL TO PADSTONE

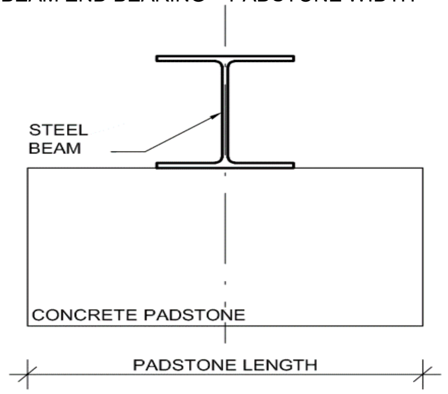
BEAM END BEARING = HALF PADSTONE LENGTH



BEAM PERPENDICULAR TO PADSTONE

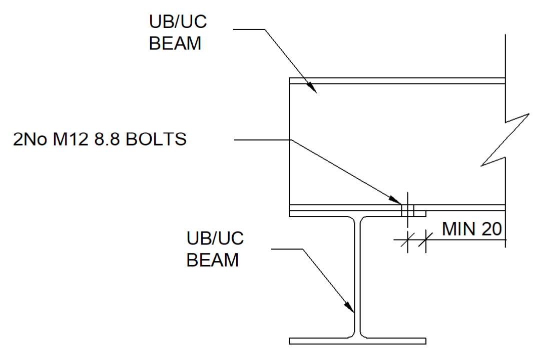
BEAM END BEARING = PADSTONE WIDTH

NOTE: SECTION INDICATIVE ONLY



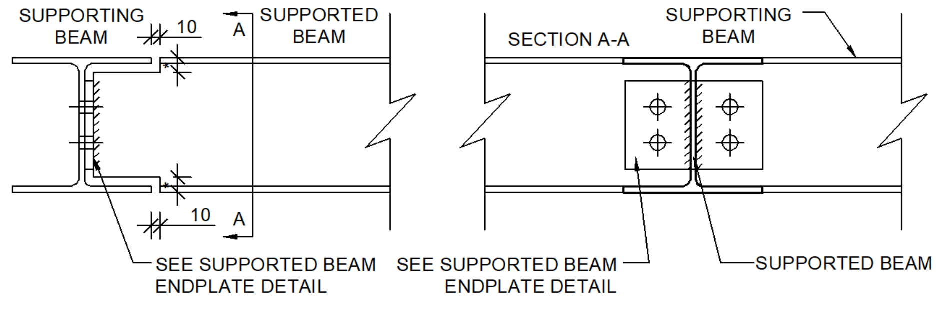
BEAM TO BEAM CONNECTIONS

TYPICAL BEAM ON TOP OF UB/UC DETAIL



SUITABLE FOR: B6 TO B8/B9, B7 TO B8, B10/B12 TO B11

TYPICAL BEAM TO BEAM CONNECTION DETAIL



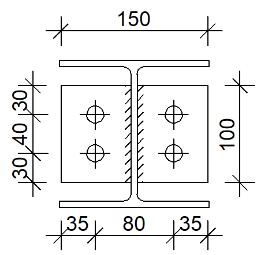
*NOTCH TO BE AS MINIMUM AS POSSIBLE REQUIRED

SUITABLE FOR: B1/B2 TO B3, B6 TO B8/B9, B7 TO B8, B10/B12 TO B11

152 UC SUPPORTED BEAM ENDPLATE DETAIL

4No M12 8.8 BOLTS

10mm THICK ENDPLATE (GRADE S275) WELDED TO 152 UC WITH 6mm FWFP

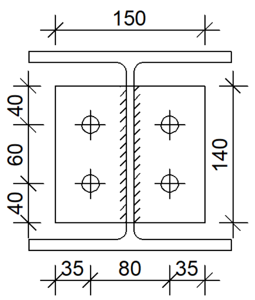


B1, B2, B6, B7

203 UC SUPPORTED BEAM ENDPLATE DETAIL

4No M16 8.8 BOLTS

10mm THICK ENDPLATE (GRADE S275) WELDED TO 203 UC WITH 6mm FWFP



B10, B12

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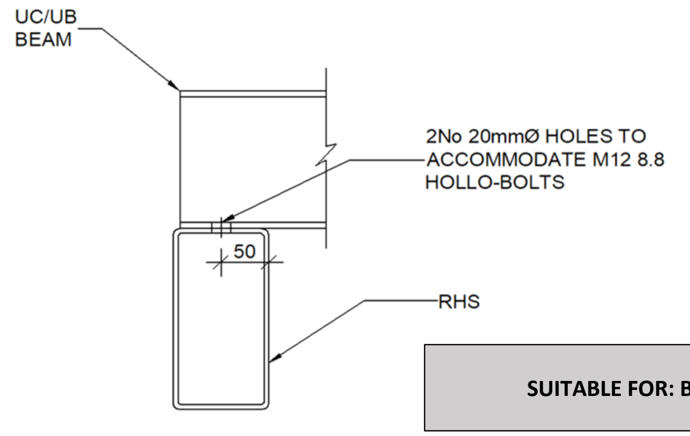
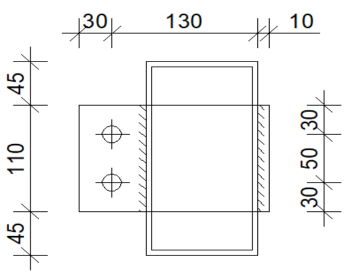
3. STEEL FABRICATOR TO SUBMIT FABRICATION DRAWINGS FOR CHECKING BEFORE FABRICATION BEGINS.
4. ALL DIMENSIONS IN mm U.N.O.
5. ALL STEEL BEAMS / COLUMNS TO BE OF STEEL GRADE MIN. S355. ALL PLATES TO BE OF STEEL GRADE MIN. S275.
6. PLEASE NOTE THOSE ARE TYPICAL DETAILS, SEVERAL OPTIONS MAY BE SHOWN FOR EACH ELEMENT. THE MOST SUITABLE OPTION TO BE CHOSEN ON THE SITE

TYPICAL BEAM ON TOP OF RHS DETAIL



SUITABLE FOR: B12 TO B13

200 RHS ENDPLATE DETAIL

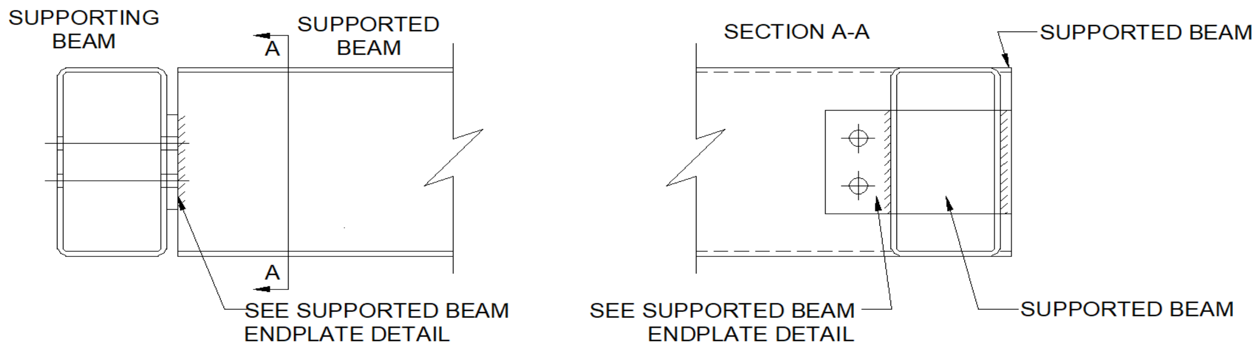


2No M12 8.8 HOLLO-BOLTS

10mm THICK ENDPLATE (GRADE S275) WELDED TO 200 RHS WITH 6mm FWFP

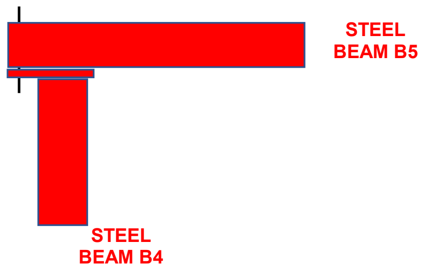
B4

TYPICAL BEAM TO BEAM CONNECTION DETAIL



SUITABLE FOR: B4 TO B5

TOP VIEW: B4 TO B5



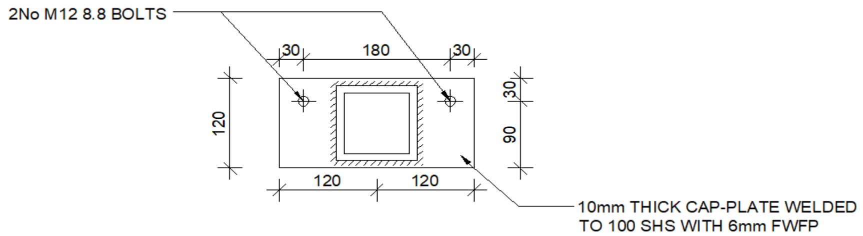
REGEN project — In partnership with D & P Solutions	Project: Beeches, Long Meadow, Goring on Thames RG89EG					
	Subject: Structural Calculations					
	Calculation Number	Rev	Des.	Chkd.	Chkd.	Date
	23-1806-C01	B	DL	DK	DK	21.02.24

DRAWINGS / CONNECTION DETAILS

1. PLEASE READ WITH CONJUCTION WITH PAGE 2 AND GENERAL ARRANGEMENT
2. ALL DETAILS AND DIMENSIONS ARE TO BE CHECKED/ADJUSTED TO SITE CONDITIONS BY THE CONTRACTOR/FABRICATOR PRIOR TO COMMENCEMENT OF CONSTRUCTION/FABRICATION. DO NOT SCALE THIS DRAWING.
3. STEEL FABRICATOR TO SUBMIT FABRICATION DRAWINGS FOR CHECKING BEFORE FABRICATION BEGINS.
4. ALL DIMENSIONS IN mm U.N.O.
5. ALL STEEL BEAMS / COLUMNS TO BE OF STEEL GRADE MIN. S355. ALL PLATES TO BE OF STEEL GRADE MIN. S275.
6. PLEASE NOTE THOSE ARE TYPICAL DETAILS, SEVERAL OPTIONS MAY BE SHOWN FOR EACH ELEMENT. THE MOST SUITABLE OPTION TO BE CHOSEN ON THE SITE

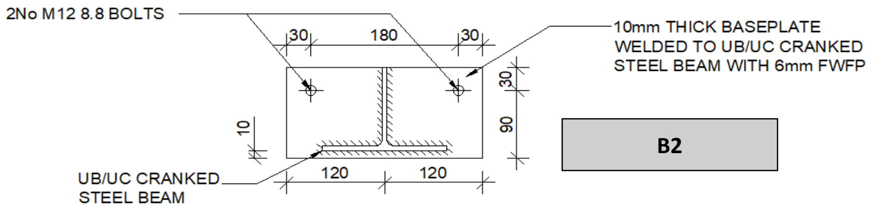
SHS COLUMNS CONNECTIONS

TYPICAL 100 SHS CAP PLATE DETAIL (SUPPORTING CRANKED STEEL BEAM)



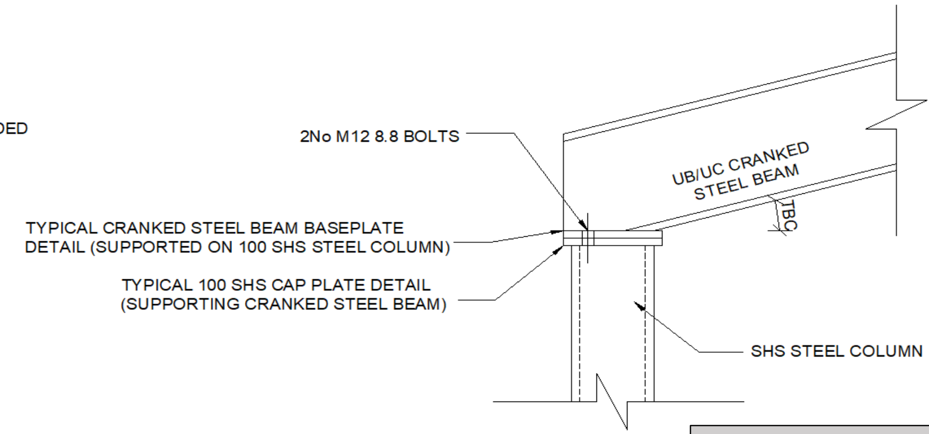
C1

TYPICAL CRANKED STEEL BEAM BASEPLATE DETAIL (SUPPORTED ON 100 SHS STEEL COLUMN)



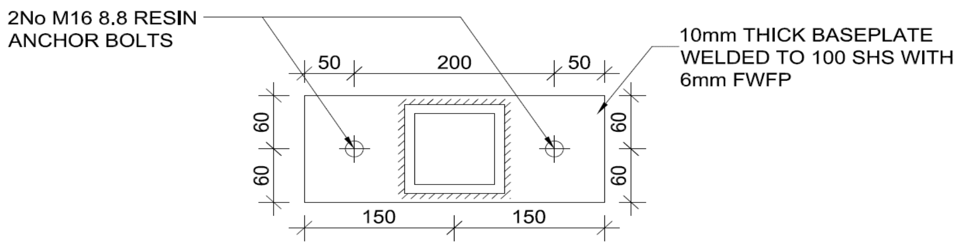
B2

ELEVATION: TYPICAL CRANKED STEEL BEAM SUPPORTED ON 100 SHS STEEL COLUMN



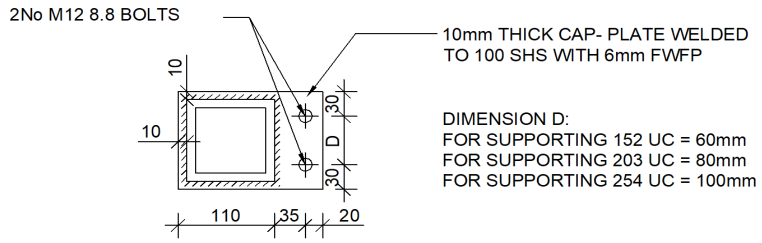
SUITABLE FOR: B2 TO C1

BASEPLATE DETAIL FOR 100 SHS COLUMN (COLUMN SUPPORTED ON MASONRY WALL WITH 100mm WIDE PADSTONE)



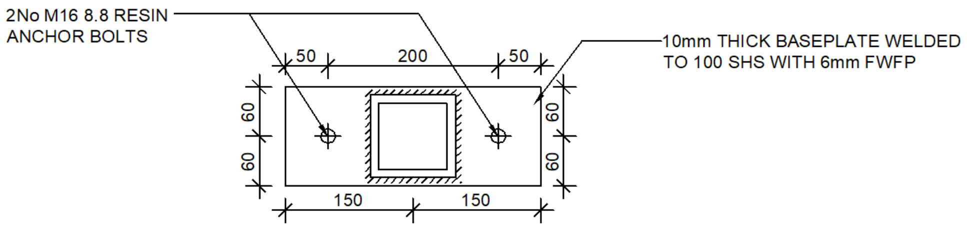
SUITABLE FOR: C1

100 SHS CAP PLATE DETAIL (SUPPORTING UC BEAM)



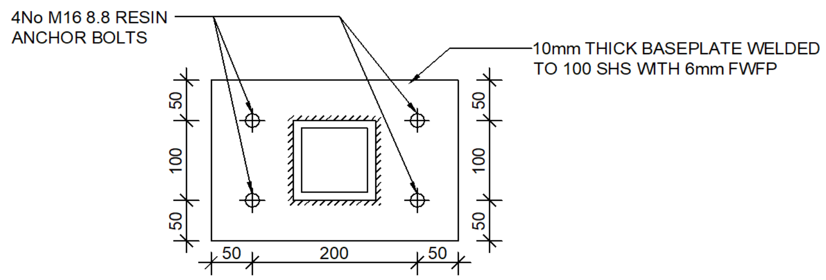
SUITABLE FOR: C2

BASEPLATE DETAIL FOR 100 SHS COLUMN (COLUMN SUPPORTED ON STRIP FOUNDATIONS WITH 100mm WIDE PADSTONE)



SUITABLE FOR: C2

BASEPLATE DETAIL FOR 100 SHS COLUMN (COLUMN SUPPORTED ON STRIP FOUNDATIONS WITH PADSTONE WIDER THAN 100mm OR TO PAD FOUNDATION)



SUITABLE FOR: C2

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	23-1806-C01	B	DL	DK	DK	21.02.24

DRAWINGS / CONNECTION DETAILS

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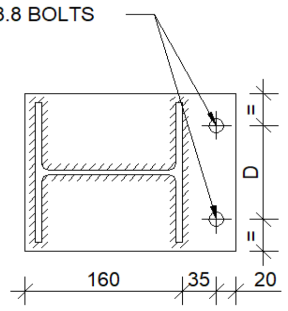
4. ALL DIMENSIONS IN mm U.N.O.
5. ALL STEEL BEAMS / COLUMNS TO BE OF STEEL GRADE MIN. S355. ALL PLATES TO BE OF STEEL GRADE MIN. S275.
6. PLEASE NOTE THOSE ARE TYPICAL DETAILS, SEVERAL OPTIONS MAY BE SHOWN FOR EACH ELEMENT. THE MOST SUITABLE OPTION TO BE CHOSEN ON THE SITE

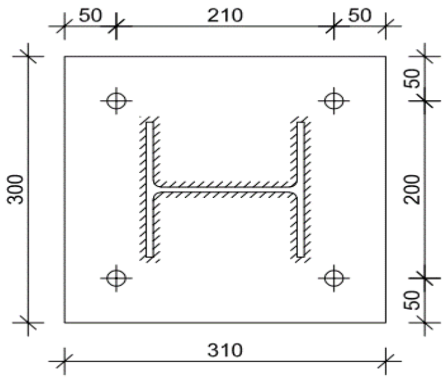
UB / UC COLUMNS CONNECTIONS

152 UC CAP PLATE DETAIL (SUPPORTING UC BEAM)



SUITABLE FOR: C3, C4

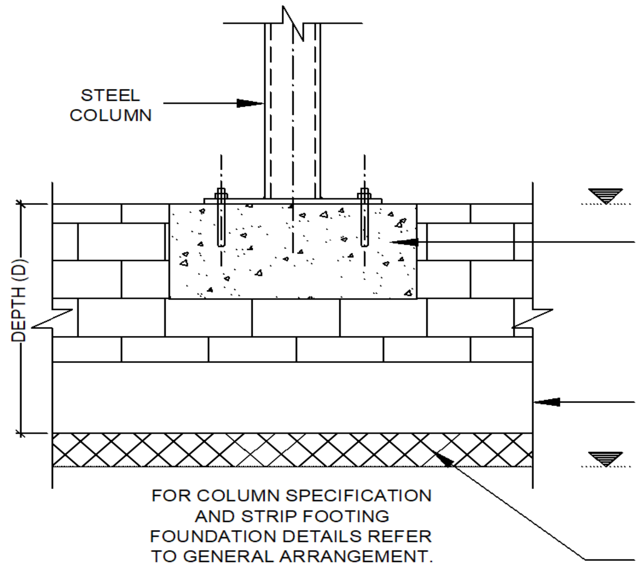
152 UC COLUMN BASEPLATE DETAIL (COLUMN SUPPORTED ON PAD FOUNDATION)



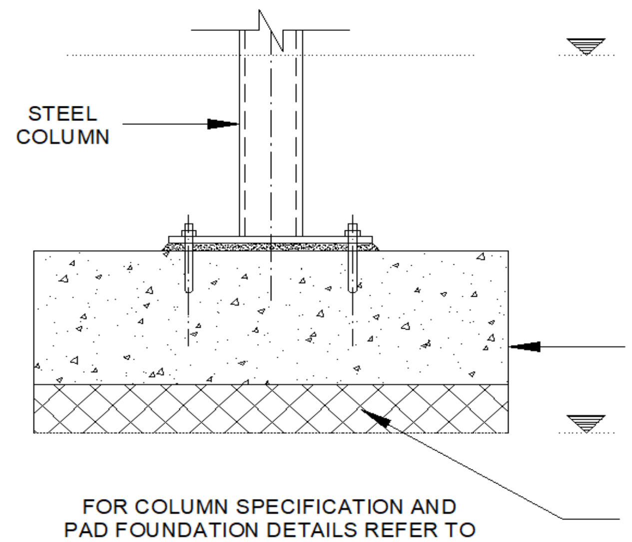
SUITABLE FOR: C3, C4

FOUNDATIONS

COLUMN SUPPORTED ON STRIP FOOTING FOUNDATION



COLUMN SUPPORTED ON NEW PAD FOUNDATION



LOAD SUMMARY

Beam & Block Floor

Finishes	0.20 kN/m2
75mm Screed	1.80 kN/m2
Insulation	0.10 kN/m2
150mm B&B Floor	1.80 kN/m2
Total Dead load	**3.90 kN/m2**
Imposed load	**1.50 kN/m2**

Balcony

Finishes & Boarding	1.00 kN/m2
Insulation	0.10 kN/m2
Joists	0.10 kN/m2
Ceiling / Plasterboard	0.20 kN/m2
Total Dead load	**1.40 kN/m2**
Imposed load	**1.50 kN/m2**

Timber Floor

Finishes & Boarding	0.20 kN/m2
Insulation	0.10 kN/m2
Joists	0.10 kN/m2
Ceiling / Plasterboard	0.20 kN/m2
Partition Walls	0.50 kN/m2
Total Dead load	**1.10 kN/m2**
Imposed load	**1.50 kN/m2**

Ceiling

Finishes	0.05 kN/m2
Insulation	0.10 kN/m2
Joists	0.10 kN/m2
Ceiling / Plasterboard	0.20 kN/m2
Total Dead load	**0.45 kN/m2**
Imposed load	**0.25 kN/m2**

Pitched Roof

Finishes / Tiles	0.50 kN/m2
Battens / Felt / Insulation	0.10 kN/m2
Structure	0.20 kN/m2
Ceiling / Plasterboard	0.20 kN/m2
Total Dead load	**1.00 kN/m2**
Imposed load	**0.75 kN/m2**

Flat Roof

Finishes	0.50 kN/m2
Felt / Insulation	0.10 kN/m2
Joists	0.20 kN/m2
Ceiling / Plasterboard	0.20 kN/m2
Total Dead load	**1.00 kN/m2**
Imposed load	**0.75 kN/m2**

WALLS

Solid 215mm Masonry Wall / Cavity Wall	**4.20 kN/m2**
100mm Blockwork / Brickwork Wall	**2.10 kN/m2**
New Cavity Wall	**3.20 kN/m2**
100mm Lightweight Wall	**1.10 kN/m2**
Dormer Wall / External Timber Wall	**1.00 kN/m2**
Timber Partition Wall	**0.35 kN/m2**

OTHERS

Bi-folds Doors	**0.50 kN/m2**
Glazing	**0.50 kN/m2**
Chimney	**2.10 kN/m2**
PV Panels	**0.30 kN/m2**
Balustrade	**0.50 kN/m2**

Site altitude Δs = 44 m
Snow zone = A

WIND LOAD W1 - DESIGN DUE TO BS 6399 **(FOR B4, C3)**

Building and topography data

Location =	Oxford	
Basic wind speed Vb =	19.7	m/s
Terrain category =	Country	
Reference height of building Hr =	8.50	m
Site altitude Δs =	44	m
Altitude factor Sa =	1.04	
Distance from the location to the sea =	80	km

Site wind speed

Wind direction =	64°± 45°	
Direction factor Sd =	0.75	
Seasonal factor Ss =	1.00	
Probability factor Sp =	1.00	
Site wind speed Vs =	15.39	m/s

Dynamic pressure - windward wall

Effective height He =	8.50	m
Terrain and building factor Sb =	1.59	
Effective wind speed Ve =	24.53	m/s
Dynamic pressure qs =	0.369	kN/m^2

Pressure coefficient

External pressure coefficient cpe =	0.85	(Conservative approach)
Internal pressure coefficient cpi =	-0.30	(Conservative approach)

Size effect factor

Size effect factor Ca =	1.00	(Conservative approach)

Net pressure = **0.424 kN/m^2**

WIND LOAD W2 - DESIGN DUE TO BS 6399 **(FOR B5)**

Building and topography data

Location =	Oxford	
Basic wind speed Vb =	19.7	m/s
Terrain category =	Country	
Reference height of building Hr =	8.50	m
Site altitude Δs =	44	m
Altitude factor Sa =	1.04	
Distance from the location to the sea =	80	km

Site wind speed

Wind direction =	154°± 45°	
Direction factor Sd =	0.90	
Seasonal factor Ss =	1.00	
Probability factor Sp =	1.00	
Site wind speed Vs =	18.52	m/s

Dynamic pressure - windward wall

Effective height He =	8.50	m
Terrain and building factor Sb =	1.59	
Effective wind speed Ve =	29.53	m/s
Dynamic pressure qs =	0.535	kN/m^2

Pressure coefficient

External pressure coefficient cpe =	0.85	(Conservative approach)
Internal pressure coefficient cpi =	-0.30	(Conservative approach)

Size effect factor

Size effect factor Ca =	1.00	(Conservative approach)

Net pressure = **0.615 kN/m^2**

ALLOWABLE JOISTS SPAN DUE TO TRADA (U.N.O.)

Rafters
For Dead Load more than 0.75kN/m2 but not more than 1.00 kN/m2 ; For Imposed Load 0.75 kN/m2

Section (RAF):	**200 x 50 C24 @400mm c/c 30.0-45.0 deg**	Span	4.50 m	<=	Allowable Span	4.77 m	**OK**

MAXIMUM ALLOWABLE CLEAR SPAN FOR RAFTERS CALCULATED BY ENGINEER. IF REQUIRED, CALCULATIONS CAN BE FORWARDED.

Floor Joists
For floors supporting non loadbearing lightweight partitions
For Dead Load more than 0.50kN/m2 but not more than 1.25 kN/m2 ; For Imposed Load 1.5 kN/m2

Section (FJ):	**200 x 50 C24 @400mm c/c**	Span	3.80 m	<=	Allowable Span	3.83 m	**OK**

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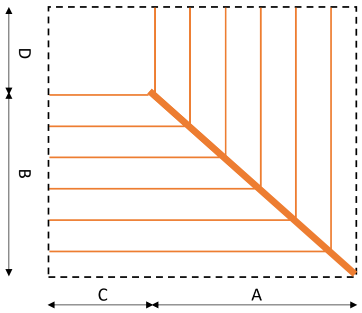
TIMBER BEAM T1 (VALLEY RAFTER)

1st dimension in plan (A) = 2.30 m
2nd dimension in plan (B) = 2.30 m
Height = 2.55 m

Total Beam Span L = 4.13 m
Slope = 38.1 °

1st additional loading - length in plan (C) = 0.75 m
2nd additional loading - length in plan (D) = 0.00 m



Load	Load Positioned from (m)	to (m)	Element Span/Height				
Roof (sloping)	0.00	1.38	6.66 m	/	2.00	=	3.33 m
Roof (sloping)	1.38	2.76	3.99 m	/	2.00	=	2.00 m
Roof (sloping)	2.76	4.13	1.33 m	/	2.00	=	0.67 m

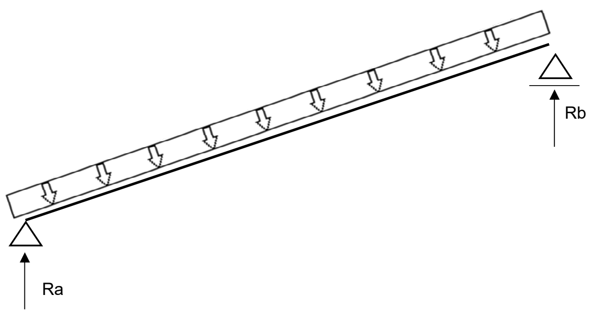
UDL LOADING

UDL Dead Loading

Beam Self Weight					0.11 kN/m	x	1.00	=	0.11 kN/m
Roof (sloping)	1.00 kN/m2	x	3.33 m	=	3.33 kN/m	x	1.00	=	3.33 kN/m
Roof (sloping)	1.00 kN/m2	x	2.00 m	=	2.00 kN/m	x	1.00	=	2.00 kN/m
Roof (sloping)	1.00 kN/m2	x	0.67 m	=	0.67 kN/m	x	1.00	=	0.67 kN/m
					6.10 kN/m				**6.10 kN/m**

UDL Imposed Loading

Roof (sloping)	0.75 kN/m2	x	3.33 m	=	2.50 kN/m	x	1.00	=	2.50 kN/m
Roof (sloping)	0.75 kN/m2	x	2.00 m	=	1.50 kN/m	x	1.00	=	1.50 kN/m
Roof (sloping)	0.75 kN/m2	x	0.67 m	=	0.50 kN/m	x	1.00	=	0.50 kN/m
					4.49 kN/m				**4.49 kN/m**



Ra = 9.59 kN
unf. DL = 5.57 kN
unf. IL = 4.01 kN

Rb = 5.31 kN
unf. DL = 3.13 kN
unf. IL = 2.18 kN

FORCES IN BEAM

Moment = 6.11 kNm
Shear Force = 7.54 kN
Axial Force = 5.91 kN

DEFLECTION CRITERIA

0.003L

DURATION OF LOADING

Medium-term (K3 = 1.25)

USAGE OF (VALLEY RAFTER) (T1)

Compression perpendicular to grain	25.99 %
Compression parallel to grain	3.30 %
Shear parallel to grain	59.77 %
Bending parallel to grain	46.33 %
Axial compression and bending	50.08 %
Deflection	60.15 %

TIMBER BEAM T1 (VALLEY RAFTER) = 2No 300x50mm C24

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
T1 (LHS):	T1	14.22	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	88	1.62	440	100	0	0.32	Satisfactory
T1 (RHS):	T1	7.87	Beam Connection										

Beam Support Summary:

T1 (LHS): Provide MIN 440x100x215 Concrete Padstone
T1 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

TIMBER BEAM T1 (VALLEY RAFTER) - DESIGN DUE TO BS 5268

Properties of 2No 300x50mm

Depth h =	295 mm	Timber grade:	C24	
Overall breadth of member b =	88 mm	Service Class:	1	
Length of bearing lb_l =	100 mm	Load Duration:	Medium-term	
Length of bearing lb_r =	100 mm	Loadsharing system:	No	
Area of beam A =	25960 mm^2	Depth to Breadth Ratio:	6	
Min modulus of elasticity Emin =	7.20 GPa			
Modified min modulus of elasticity E =	8.21 GPa	K2 =	1.00	(Service class 1)
Modulus of rigidity G =	0.51 Gpa	K3 =	1.25	(Medium-term)
Moment of inertia Iy =	18826 cm^4	K4 =	1.00	(Conservative approach)
Section modulus Zy =	1276 cm^3	K5 =	0.86	(Beam with notch)
Root radius ry =	8.52 cm	K7 =	1.00	(72mm < h ≤ 300mm)
Moment of inertia Iz =	1675 cm^4	K8 =	1.10	(2No element)
Root radius rz =	2.54 cm	K9 =	1.14	(2No softwoods element)
Notch n =	40.00 mm	K12 =	0.74	(Table 22 — Modification factor, K12)

Forces in beam

Moment	=	6.11 kNm
Shear Force	=	7.54 kN
Axial Force	=	5.91 kN

Slenderness ratio

Ley =	4.13 m	
Lez =	0.76 m	
Slenderness ratio λy =	48.53	
Slenderness ratio λz =	30.01	
Limit of slenderness ratio =	250.00	OK

Lateral support

Ends held in position and compression edge held in line, as by direct connection of sheathing, deck or joists, together with adequate bridging or blocking spaced at intervals not exceeding six times the depth.

Permissible depth-to-breadth ratio =	6.000	
Actual depth-to-breadth ratio =	3.352	OK

Compression perpendicular to grain

Permissible bearing stress σc_adm =	3.300 N/mm^2	
Applied bearing stress σc_a =	0.857 N/mm^2	OK

Compression parallel to grain

Permissible bearing stress σc_adm =	8.004 N/mm^2	
Applied bearing stress σc_a =	0.264 N/mm^2	OK

Shear parallel to grain

Permissible shear stress τadm =	0.844 N/mm^2	
Applied shear stress τa =	0.504 N/mm^2	OK

Bending parallel to grain

Permissible bending stress σm_adm =	10.332 N/mm^2	
Applied bending stress σm_a =	4.787 N/mm^2	OK

Axial compression and bending

Euler critical stress σe =	30.168 N/mm^2	
Euler coefficient =	0.990	
Compression and bending ratio =	0.50 ≤ 1.00	OK

Deflection

Total dead and imposed load =	11.72 kN	
Shear area for beam Ay =	21633 mm	
Beam effective span leff =	4.23 m	
Shear deflection δv=	0.550 mm	
Bending deflection δb=	6.908 mm	
Total deflection δa=	7.458 mm	
Limiting deflection =	12.399 mm (0.003L)	OK

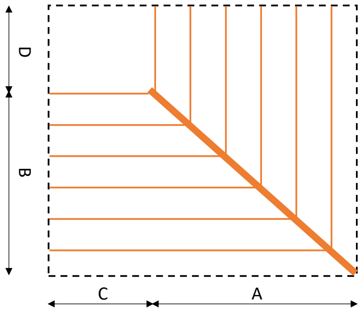
TIMBER BEAM T1 (VALLEY RAFTER) = 2No 300x50mm C24

TIMBER BEAM T2 (VALLEY RAFTER)

1st dimension in plan (A) = 2.90 m
2nd dimension in plan (B) = 2.90 m
Height = 3.00 m

1st additional loading - length in plan (C) = 0.75 m
2nd additional loading - length in plan (D) = 0.00 m

Total Beam Span L = 5.08 m
Slope = 36.2 °



Load	Load Positioned from (m)	to (m)	Element Span/Height				
Roof (sloping)	0.00	1.69	7.85 m	/	2.00	=	3.93 m
Roof (sloping)	1.69	3.39	4.71 m	/	2.00	=	2.36 m
Roof (sloping)	3.39	5.08	1.57 m	/	2.00	=	0.79 m

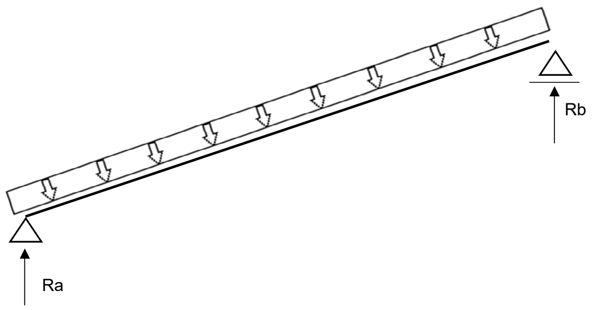
UDL LOADING

UDL Dead Loading

Beam Self Weight					0.16 kN/m	x	1.00	=	0.16 kN/m
Roof (sloping)	1.00 kN/m2	x	3.93 m	=	3.93 kN/m	x	1.00	=	3.93 kN/m
Roof (sloping)	1.00 kN/m2	x	2.36 m	=	2.36 kN/m	x	1.00	=	2.36 kN/m
Roof (sloping)	1.00 kN/m2	x	0.79 m	=	0.79 kN/m	x	1.00	=	0.79 kN/m
					7.23 kN/m				**7.23 kN/m**

UDL Imposed Loading

Roof (sloping)	0.75 kN/m2	x	3.93 m	=	2.95 kN/m	x	1.00	=	2.95 kN/m
Roof (sloping)	0.75 kN/m2	x	2.36 m	=	1.77 kN/m	x	1.00	=	1.77 kN/m
Roof (sloping)	0.75 kN/m2	x	0.79 m	=	0.59 kN/m	x	1.00	=	0.59 kN/m
					5.30 kN/m				**5.30 kN/m**



Ra = 13.99 kN
unf. DL = 8.18 kN
unf. IL = 5.82 kN

Rb = 7.79 kN
unf. DL = 4.63 kN
unf. IL = 3.16 kN

FORCES IN BEAM

Moment = 11.25 kNm
Shear Force = 11.30 kN
Axial Force = 8.26 kN

DEFLECTION CRITERIA
0.003L

DURATION OF LOADING
Medium-term (K3 = 1.25)

USAGE OF (VALLEY RAFTER) (T2)

Compression perpendicular to grain	25.94 %
Compression parallel to grain	3.41 %
Shear parallel to grain	59.65 %
Bending parallel to grain	56.88 %
Axial compression and bending	60.99 %
Deflection	83.40 %

TIMBER BEAM T2 (VALLEY RAFTER) = 3No 300x50mm C24

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
T2 (LHS):	T2	20.76	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	132	1.57	215	100	0	0.97	Satisfactory
T2 (RHS):	T2	11.53	Beam Connection										

Beam Support Summary:
T2 (LHS): Provide MIN 215x100x65 Concrete Padstone
T2 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

TIMBER BEAM T2 (VALLEY RAFTER) - DESIGN DUE TO BS 5268

Properties of 3No 300x50mm

Depth h =	295	mm	Timber grade:	C24	
Overall breadth of member b =	132	mm	Service Class:	1	
Length of bearing lb_l =	100	mm	Load Duration:	Medium-term	
Length of bearing lb_r =	100	mm	Loadsharing system:	No	
Area of beam A =	38940	mm^2	Depth to Breadth Ratio:	6	
Min modulus of elasticity Emin =	7.20	GPa			
Modified min modulus of elasticity E =	8.71	GPa	K2 =	1.00	(Service class 1)
Modulus of rigidity G =	0.54	Gpa	K3 =	1.25	(Medium-term)
Moment of inertia Iy =	28240	cm^4	K4 =	1.00	(Conservative approach)
Section modulus Zy =	1915	cm^3	K5 =	0.86	(Beam with notch)
Root radius ry =	8.52	cm	K7 =	1.00	(72mm < h ≤ 300mm)
Moment of inertia Iz =	5654	cm^4	K8 =	1.10	(3No element)
Root radius rz =	3.81	cm	K9 =	1.21	(3No softwoods element)
Notch n =	40.00	mm	K12 =	0.66	(Table 22 — Modification factor, K12)

Forces in beam

Moment	=	11.25	kNm
Shear Force	=	11.30	kN
Axial Force	=	8.26	kN

Slenderness ratio

Ley =	5.08	m	
Lez =	0.74	m	
Slenderness ratio λy =	59.67		
Slenderness ratio λz =	19.51		
Limit of slenderness ratio =	250.00		OK

Lateral support

Ends held in position and compression edge held in line, as by direct connection of sheathing, deck or joists, together with adequate bridging or blocking spaced at intervals not exceeding six times the depth.

Permissible depth-to-breadth ratio =	6.000	
Actual depth-to-breadth ratio =	2.235	OK

Compression perpendicular to grain

Permissible bearing stress σc_adm =	3.300	N/mm^2	
Applied bearing stress σc_a =	0.856	N/mm^2	OK

Compression parallel to grain

Permissible bearing stress σc_adm =	7.218	N/mm^2	
Applied bearing stress σc_a =	0.245	N/mm^2	OK

Shear parallel to grain

Permissible shear stress τadm =	0.844	N/mm^2	
Applied shear stress τa =	0.503	N/mm^2	OK

Bending parallel to grain

Permissible bending stress σm_adm =	10.332	N/mm^2	
Applied bending stress σm_a =	5.876	N/mm^2	OK

Axial compression and bending

Euler critical stress σe =	19.959	N/mm^2	
Euler coefficient =	0.988		
Compression and bending ratio =	0.61	≤ 1.00	OK

Deflection

Total dead and imposed load =	17.58	kN	
Shear area for beam Ay =	32450	mm	
Beam effective span leff =	5.18	m	
Shear deflection δv=	0.637	mm	
Bending deflection δb=	12.076	mm	
Total deflection δa=	12.713	mm	
Limiting deflection =	15.244	mm (0.003L)	OK

TIMBER BEAM T2 (VALLEY RAFTER) = 3No 300x50mm C24

REGEN project

In partnership with

D & P Solutions

Project	Beeches, Long Meadow, Goring on Thames RG89EG
Subject	Structural Calculations

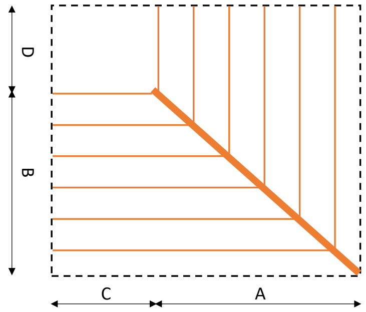
Calculation Number	Rev	Des.	Chkd.	Chkd.	Date
23-1806-C01	B	DL	DK	DK	21.02.24

TIMBER BEAM T3 (HIP RAFTER)

1st dimension in plan (A) = 2.90 m
2nd dimension in plan (B) = 2.90 m
Height = 3.00 m

Total Beam Span L = 5.08 m
Slope = 36.2 °

1st additional loading - length in plan (C) = 0.00 m
2nd additional loading - length in plan (D) = 0.00 m



Load	Load Positioned from (m)	to (m)	Element Span/Height				
Roof (sloping)	0.00	1.69	1.39 m	/	2.00	=	0.70 m
Roof (sloping)	1.69	3.39	4.17 m	/	2.00	=	2.09 m
Roof (sloping)	3.39	5.08	6.95 m	/	2.00	=	3.48 m

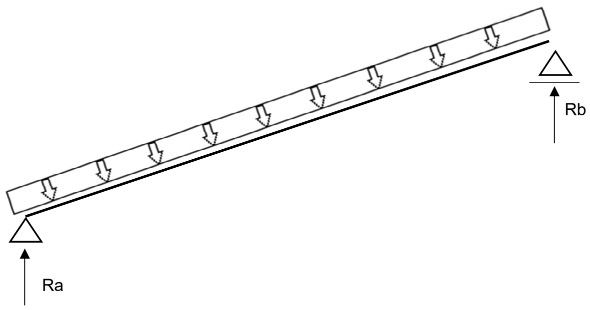
UDL LOADING

UDL Dead Loading

Beam Self Weight					0.16 kN/m	x	1.00	=	0.16 kN/m
Roof (sloping)	1.00 kN/m2	x	0.70 m	=	0.70 kN/m	x	1.00	=	0.70 kN/m
Roof (sloping)	1.00 kN/m2	x	2.09 m	=	2.09 kN/m	x	1.00	=	2.09 kN/m
Roof (sloping)	1.00 kN/m2	x	3.48 m	=	3.48 kN/m	x	1.00	=	3.48 kN/m
					6.42 kN/m				**6.42 kN/m**

UDL Imposed Loading

Roof (sloping)	0.75 kN/m2	x	0.70 m	=	0.52 kN/m	x	1.00	=	0.52 kN/m
Roof (sloping)	0.75 kN/m2	x	2.09 m	=	1.56 kN/m	x	1.00	=	1.56 kN/m
Roof (sloping)	0.75 kN/m2	x	3.48 m	=	2.61 kN/m	x	1.00	=	2.61 kN/m
					4.69 kN/m				**4.69 kN/m**



Ra = 6.94 kN
unf. DL = 4.15 kN
unf. IL = 2.80 kN

Rb = 12.44 kN
unf. DL = 7.29 kN
unf. IL = 5.15 kN

FORCES IN BEAM

Moment = 10.04 kNm
Shear Force = 10.04 kN
Axial Force = 7.34 kN

DEFLECTION CRITERIA

0.003L

DURATION OF LOADING

Medium-term (K3 = 1.25)

USAGE OF (HIP RAFTER) (T3)

Compression perpendicular to grain	23.05 %
Compression parallel to grain	3.03 %
Shear parallel to grain	53.03 %
Bending parallel to grain	50.75 %
Axial compression and bending	54.33 %
Deflection	74.11 %

TIMBER BEAM T3 (HIP RAFTER) = 3No 300x50mm C24

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
T3 (LHS):	T3	10.28	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	132	0.78	-	-	-	-	Satisfactory
T3 (RHS):	T3	18.45	Beam Connection										

Beam Support Summary:

T3 (LHS): Provide Minimum 100mm End Bearing Length
T3 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

TIMBER BEAM T3 (HIP RAFTER) - DESIGN DUE TO BS 5268

Properties of 3No 300x50mm

Depth h =	295	mm	Timber grade:	C24	
Overall breadth of member b =	132	mm	Service Class:	1	
Length of bearing lb_l =	100	mm	Load Duration:	Medium-term	
Length of bearing lb_r =	100	mm	Loadsharing system:	No	
Area of beam A =	38940	mm^2	Depth to Breadth Ratio:	6	
Min modulus of elasticity Emin =	7.20	GPa			
Modified min modulus of elasticity E =	8.71	GPa	K2 =	1.00	(Service class 1)
Modulus of rigidity G =	0.54	Gpa	K3 =	1.25	(Medium-term)
Moment of inertia Iy =	28240	cm^4	K4 =	1.00	(Conservative approach)
Section modulus Zy =	1915	cm^3	K5 =	0.86	(Beam with notch)
Root radius ry =	8.52	cm	K7 =	1.00	(72mm < h ≤ 300mm)
Moment of inertia Iz =	5654	cm^4	K8 =	1.10	(3No element)
Root radius rz =	3.81	cm	K9 =	1.21	(3No softwoods element)
Notch n =	40.00	mm	K12 =	0.66	(Table 22 — Modification factor, K12)

Forces in beam

Moment	=	10.04	kNm
Shear Force	=	10.04	kN
Axial Force	=	7.34	kN

Slenderness ratio

Ley =	5.08	m	
Lez =	0.74	m	
Slenderness ratio λy =	59.67		
Slenderness ratio λz =	19.51		
Limit of slenderness ratio =	250.00		OK

Lateral support

Ends held in position and compression edge held in line, as by direct connection of sheathing, deck or joists, together with adequate bridging or blocking spaced at intervals not exceeding six times the depth.

Permissible depth-to-breadth ratio =	6.000	
Actual depth-to-breadth ratio =	2.235	OK

Compression perpendicular to grain

Permissible bearing stress σc_adm =	3.300	N/mm^2	
Applied bearing stress σc_a =	0.761	N/mm^2	OK

Compression parallel to grain

Permissible bearing stress σc_adm =	7.218	N/mm^2	
Applied bearing stress σc_a =	0.218	N/mm^2	OK

Shear parallel to grain

Permissible shear stress τadm =	0.844	N/mm^2	
Applied shear stress τa =	0.447	N/mm^2	OK

Bending parallel to grain

Permissible bending stress σm_adm =	10.332	N/mm^2	
Applied bending stress σm_a =	5.243	N/mm^2	OK

Axial compression and bending

Euler critical stress σe =	19.959	N/mm^2	
Euler coefficient =	0.989		
Compression and bending ratio =	0.54	≤ 1.00	OK

Deflection

Total dead and imposed load =	15.64	kN	
Shear area for beam Ay =	32450	mm	
Beam effective span leff =	5.18	m	
Shear deflection δv=	0.568	mm	
Bending deflection δb=	10.729	mm	
Total deflection δa=	11.297	mm	
Limiting deflection =	15.244	mm (0.003L)	OK

TIMBER BEAM T3 (HIP RAFTER) = 3No 300x50mm C24

LINTEL L1. **(Calculated For Loading Purposes Only)**

Clear Span L = 2.00 m
Total Span = 2.30 m
Effective Span = 2.15 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
215mm/Cavity Wall	0.00	2.00	2.80 m	/	1.00	=	2.80 m
Roof (sloping)	0.00	2.00	5.40 m	/	2.00	=	2.70 m
-	0.00	2.00	0.00 m	/	1.00	=	0.00 m
-	0.00	2.00	0.00 m	/	1.00	=	0.00 m
-	0.00	2.00	0.00 m	/	1.00	=	0.00 m
-	0.00	2.00	0.00 m				
-	0.00	2.00	0.00 m				

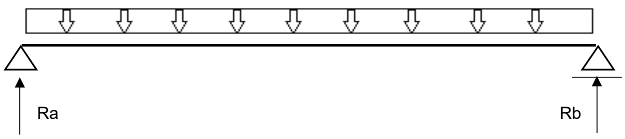
UDL LOADING
UDL Dead Loading

215mm/Cavity Wall	4.20 kN/m2	x	2.80 m	=	11.76 kN/m
Roof (sloping)	1.00 kN/m2	x	2.70 m	=	2.70 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m
					14.46 kN/m

UDL Imposed Loading

215mm/Cavity Wall	0.00 kN/m2	x	2.80 m	=	0.00 kN/m
Roof (sloping)	0.75 kN/m2	x	2.70 m	=	2.03 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m
					2.03 kN/m

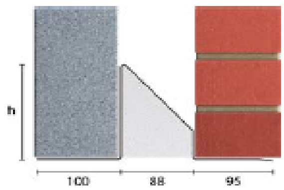
Ra = 16.49 kN
unf. DL = 14.46 kN
unf. IL = 2.03 kN



Rb = 16.49 kN
unf. DL = 14.46 kN
unf. IL = 2.03 kN

Standard Duty

Standard lengths are available in 150mm increments up to 3000mm, 300mm at lengths from 3000mm to 3600mm.



CG90/100

Standard lengths (mm)	750-1500	1650-1800	1950-2100	2250-2400	2550-2700	2850-3600
SWL 1:1/3:1 (kN)	15	18	20	22	26	26
Weight (kg/m)	6.1	7.6	8.3	8.9	10.2	13.0
Nominal height 'h' (mm)	140	140	160	180	220	220

BEAM EB1

Beam Span L = 4.30 m

(Calculated For Loading Purposes Only)

Load	Load Positioned from (m)	to (m)	Element Span/Height				
100mm Thick Wall	0.00	4.30	2.50 m	/	1.00	=	2.50 m
-	0.00	4.30	0.00 m	/	1.00	=	0.00 m
-	0.00	4.30	0.00 m	/	1.00	=	0.00 m
-	0.00	4.30	0.00 m	/	1.00	=	0.00 m
-	0.00	4.30	0.00 m	/	1.00	=	0.00 m
-	0.00	4.30	0.00 m				
-	0.00	4.30	0.00 m				

UDL LOADING

UDL Dead Loading

100mm Thick Wall	2.10 kN/m2	x	2.50 m	=	5.25 kN/m	x	1.40	=	7.35 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					5.25 kN/m				**7.35 kN/m**

UDL Imposed Loading

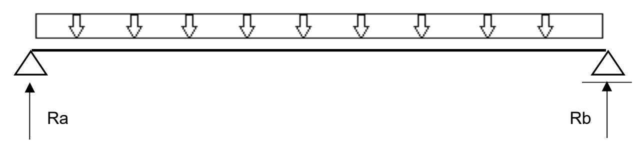
100mm Thick Wall	0.00 kN/m2	x	2.50 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					0.00 kN/m				**0.00 kN/m**

Point Load P1 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 15.80 kN
unf. DL = 11.29 kN
unf. IL = 0.00 kN



Rb = 15.80 kN
unf. DL = 11.29 kN
unf. IL = 0.00 kN

BEAM B1
Beam Span L = 3.05 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
Roof (sloping)	0.00	2.30	2.00 m	/	2.00	=	1.00 m
-	0.00	3.05	0.00 m	/	1.00	=	0.00 m
-	0.00	3.05	0.00 m	/	1.00	=	0.00 m
-	0.00	3.05	0.00 m	/	1.00	=	0.00 m
-	0.00	3.05	0.00 m	/	1.00	=	0.00 m
-	0.00	3.05	0.00 m				
-	0.00	3.05	0.00 m				

UDL LOADING
UDL Dead Loading

Beam Self Weight					0.23 kN/m	x	1.40	=	0.32 kN/m
Roof (sloping)	1.00 kN/m2	x	1.00 m	=	1.00 kN/m	x	1.40	=	1.40 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					1.23 kN/m				**1.72 kN/m**

UDL Imposed Loading

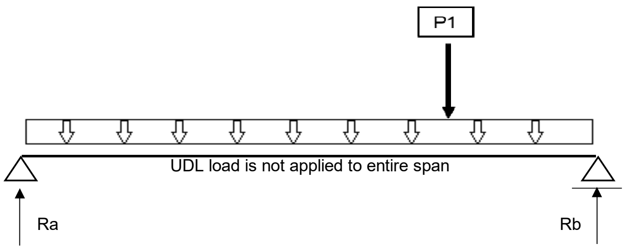
Roof (sloping)	0.75 kN/m2	x	1.00 m	=	0.75 kN/m	x	1.60	=	1.20 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					0.75 kN/m				**1.20 kN/m**

Point Load P1 @ 2.30 m
From Beam = 2.00 x T1(MIN) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 6.26 kN x 1.40 = 8.76 kN
IL = 4.36 kN x 1.60 = 6.97 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 8.08 kN
unf. DL = 3.32 kN
unf. IL = 2.15 kN



Rb = 14.61 kN
unf. DL = 5.94 kN
unf. IL = 3.94 kN

FORCES IN BEAM

Moment = 10.85 kNm
Shear Force = 14.61 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/250 (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B1

Shear capacity 7.76 %
Moment capacity 18.64 %
Buckling resistance moment 27.79 %
Vertical deflection 20.05 %

STEEL BEAM B1 = 152 x 152 x 23 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B1 (LHS):	B1	8.08	3.6N Blocks	3.5	1.25xfk/3.5 1.25	20	152.2	2.66	440	100	0	0.18	Satisfactory
B1 (RHS):	B1	14.61	Beam Connection										

Beam Support Summary:
B1 (LHS): Provide MIN 440x100x215 Concrete Padstone
B1 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.0 + 2 x D

STEEL BEAM B1 - DESIGN DUE TO BS 5950-1

Properties of 152 x 152 x 23 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	3.05 m
Half of flange b =	76.10 mm	Web depth d =	123.60 mm
Flange thickness T =	6.8 mm	Web thickness t =	5.8 mm
Area of cross-section A =	29.2 cm^2	Overall depth D =	152.4 mm
Rad of gyration (minor axis) r =	3.70 cm	Overall breadth B =	152.2 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	1250 cm^4
Elastic modulus Zx =	164 cm^3	Plastic modulus Sx =	182 cm^3
		Root radius r =	7.60 mm

Forces in beam

Moment	=	10.85 kNm
Shear Force	=	14.61 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.0 + 2 x D

Classification of cross-section

Parameter ε =	0.880	
Web d/t =	21.31	
Web (d/t)/ε =	24.21 ≤ 80	Class 1 plastic
Flanges b/t =	11.19	
Flanges (b/t)/ε =	12.72 ≤ 15	Class 3 semi-compact

Section is class 3 semi-compact

Shear capacity

Shear area Av =	883.92 mm (Av = tD, UC section)	
Web (d/t)/ε =	24.21 ≤ 70 (Web does not need to be checked for shear buckling)	
Shear capacity Pv =	188.27 kN	
Design shear force =	14.61 kN	OK

Moment capacity

Design bending moment M=	10.85 kNm	
Moment capacity low shear Mc =	58.22 kNm (Mc = py*Z)	OK

Effective length for lateral-torsional buckling

Total Beam Span =	3050 mm
Effective length Le =	3660 mm
Slenderness ratio λ =	98.91

Equivalent slenderness

Buckling parameter u =	0.842
Torsional index x =	20.6
Slenderness factor v =	0.826
Ratio βw =	0.901 (Z/S)
Equivalent slenderness λLT =	65.27
Limiting slenderness λL0 =	30.20

λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght

Bending strenght ρb = 238.09 N/mm^2 (With Table 16)

Buckling resistance moment

Equivalent uniform moment factor mLT =	1.00 (Conservative approach)	
Buckling resistance moment Mb =	39.05 kNm	
Design bending moment	10.85 kNm	OK

Vertical dead & imposed load deflection

Limiting deflection =	12.200 mm (L/250)	
Maximum deflection =	2.445 mm	OK

Vertical imposed load deflection

Limiting deflection =	8.472 mm (L/360)	
Maximum deflection =	0.974 mm	OK

STEEL BEAM B1 = 152 x 152 x 23 UKC

BEAM B2

Beam Span L = 3.70 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
Roof (sloping)	0.75	3.05	2.50 m	/	2.00	=	1.25 m
-	0.00	3.70	0.00 m	/	1.00	=	0.00 m
-	0.00	3.70	0.00 m	/	1.00	=	0.00 m
-	0.00	3.70	0.00 m	/	1.00	=	0.00 m
-	0.00	3.70	0.00 m	/	1.00	=	0.00 m
-	0.00	3.70	0.00 m				
-	0.00	3.70	0.00 m				

UDL LOADING

UDL Dead Loading

Beam Self Weight					0.30 kN/m	x	1.40	=	0.42 kN/m
Roof (sloping)	1.00 kN/m2	x	1.25 m	=	1.25 kN/m	x	1.40	=	1.75 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					1.55 kN/m				**2.17 kN/m**

UDL Imposed Loading

Roof (sloping)	0.75 kN/m2	x	1.25 m	=	0.94 kN/m	x	1.60	=	1.50 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					0.94 kN/m				**1.50 kN/m**

Point Load P1 @ 0.75 m

From Beam = 2.00 x T2(MIN) + 1.00 x (MAX) + 1.00 x (MAX)

DL = 9.26 kN x 1.40 = 12.96 kN

IL = 6.32 kN x 1.60 = 10.11 kN

Point Load P2 @ 3.05 m

From Beam = 2.00 x T3(MAX)

DL = 14.57 kN x 1.40 = 20.40 kN

IL = 10.31 kN x 1.60 = 16.49 kN

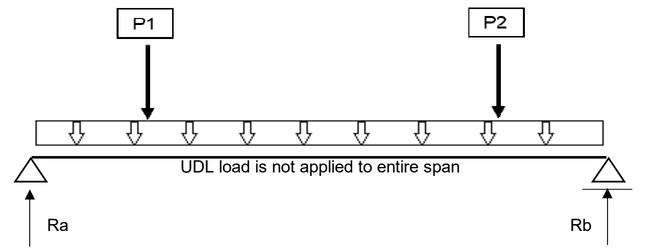
Point Load P3 @ 0.00 m

From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)

DL = 0.00 kN x 1.40 = 0.00 kN

IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 29.29 kN
unf. DL = 11.89 kN
unf. IL = 7.90 kN



Rb = 39.70 kN
unf. DL = 15.92 kN
unf. IL = 10.88 kN

FORCES IN BEAM

Moment = 26.59 kNm
Shear Force = 39.70 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/250 (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B2

Shear capacity	18.20 %
Moment capacity	30.21 %
Buckling resistance moment	46.06 %
Vertical deflection	52.62 %

STEEL BEAM B2 = 152 x 152 x 30 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B2 (LHS):	B2	29.29	Beam Connection										
B2 (RHS):	B2	39.70	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	152.9	2.60	440	100	0	0.90	Satisfactory

Beam Support Summary:

B2 (LHS): Provide Steel Beam/Column/Timber Post Connection

B2 (RHS): Provide MIN 440x100x215 Concrete Padstone (UNDER COLUMN C1)

Refer To G.A. for more details.

Beam bearing design details:

Restraint Condition Coef. Support A: 1.0 + 2 x D

Restraint Condition Coef. Support B: 1.0 + 2 x D

STEEL BEAM B2 - DESIGN DUE TO BS 5950-1

Properties of 152 x 152 x 30 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	3.70 m
Half of flange b =	76.45 mm	Web depth d =	123.60 mm
Flange thickness T =	9.4 mm	Web thickness t =	6.5 mm
Area of cross-section A =	38.3 cm^2	Overall depth D =	157.6 mm
Rad of gyration (minor axis) r =	3.83 cm	Overall breadth B =	152.9 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	1750 cm^4
Elastic modulus Zx =	222 cm^3	Plastic modulus Sx =	248 cm^3
		Root radius r =	7.60 mm

Forces in beam

Moment	=	26.59 kNm
Shear Force	=	39.70 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.0 + 2 x D
Restraint Condition Coef. Support B:	1.0 + 2 x D

Classification of cross-section

Parameter ε =	0.880	
Web d/t =	19.02	
Web (d/t)/ε =	21.60 ≤ 80	Class 1 plastic
Flanges b/t =	8.13	
Flanges (b/t)/ε =	9.24 ≤ 10	Class 2 compact

Section is class 2 compact

Shear capacity

Shear area Av =	1024.40 mm (Av = tD, UC section)	
Web (d/t)/ε =	21.60 ≤ 70 (Web does not need to be checked for shear buckling)	
Shear capacity Pv =	218.20 kN	
Design shear force =	39.70 kN	OK

Moment capacity

Design bending moment M=	26.59 kNm	
Moment capacity low shear Mc =	88.04 kNm	OK

Effective length for lateral-torsional buckling

Total Beam Span =	3700 mm
Effective length Le =	4015 mm
Slenderness ratio λ =	104.84

Equivalent slenderness

Buckling parameter u =	0.847
Torsional index x =	16.1
Slenderness factor v =	0.752
Ratio βw =	1.000
Equivalent slenderness λLT =	66.81
Limiting slenderness λL0 =	30.20

λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght

Bending strenght ρb = 232.84 N/mm^2 (With Table 16)

Buckling resistance moment

Equivalent uniform moment factor mLT =	1.00 (Conservative approach)	
Buckling resistance moment Mb =	57.74 kNm	
Design bending moment	26.59 kNm	OK

Vertical dead & imposed load deflection

Limiting deflection =	14.800 mm (L/250)	
Maximum deflection =	7.787 mm	OK

Vertical imposed load deflection

Limiting deflection =	10.278 mm (L/360)	
Maximum deflection =	3.136 mm	OK

STEEL BEAM B2 = 152 x 152 x 30 UKC

Project	Beeches, Long Meadow, Goring on Thames RG89EG					
Subject	Structural Calculations					
Calculation Number	Rev	Des.	Chkd.	Chkd.	Date	
23-1806-C01	B	DL	DK	DK	21.02.24	

REGEN project
In partnership with
D & P Solutions

BEAM B3
Beam Span L = 5.80 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
Roof (sloping)	0.00	5.80	5.60 m	/	2.00	=	2.80 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m				
-	0.00	5.80	0.00 m				

UDL LOADING
UDL Dead Loading

Beam Self Weight					0.60 kN/m	x	1.40	=	0.84 kN/m
Roof (sloping)	1.00 kN/m2	x	2.80 m	=	2.80 kN/m	x	1.40	=	3.92 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					3.40 kN/m				**4.76 kN/m**

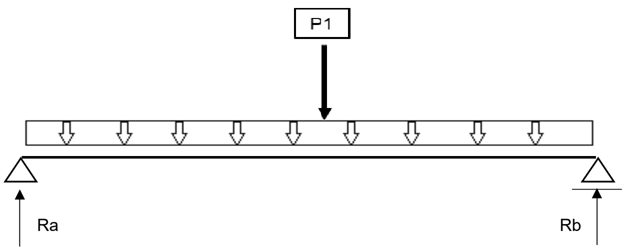
UDL Imposed Loading

Roof (sloping)	0.75 kN/m2	x	2.80 m	=	2.10 kN/m	x	1.60	=	3.36 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					2.10 kN/m				**3.36 kN/m**

Point Load P1 @ 3.10 m
From Beam = 1.00 x B1(RHS) + 1.00 x B2(LHS) + 1.00 x (MAX)
DL = 17.83 kN x 1.40 = 24.96 kN
IL = 11.83 kN x 1.60 = 18.93 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN



Ra = 43.98 kN
unf. DL = 18.16 kN
unf. IL = 11.60 kN

Rb = 47.01 kN
unf. DL = 19.39 kN
unf. IL = 12.41 kN

FORCES IN BEAM

Moment = 95.04 kNm
Shear Force = 47.01 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/250 (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B3

Shear capacity	11.21 %
Moment capacity	40.81 %
Buckling resistance moment	72.26 %
Vertical deflection	69.11 %

STEEL BEAM B3 = 203 x 203 x 60 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B3 (LHS):	B3	43.98	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	205.8	2.14	440	100	0	1.00	Satisfactory
B3 (RHS):	B3	47.01	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	205.8	2.28	440	100	0	1.07	Satisfactory

Beam Support Summary:
B3 (LHS): Provide MIN 440x100x215 Concrete Padstone
B3 (RHS): Provide MIN 440x100x215 Concrete Padstone
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B3 - DESIGN DUE TO BS 5950-1

Properties of 203 x 203 x 60 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	5.80 m
Half of flange b =	102.90 mm	Web depth d =	160.80 mm
Flange thickness T =	14.2 mm	Web thickness t =	9.4 mm
Area of cross-section A =	76.4 cm^2	Overall depth D =	209.6 mm
Rad of gyration (minor axis) r =	5.20 cm	Overall breadth B =	205.8 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	6120 cm^4
Elastic modulus Zx =	584 cm^3	Plastic modulus Sx =	656 cm^3
		Root radius r =	10.20 mm

Forces in beam

Moment	=	95.04 kNm
Shear Force	=	47.01 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε =	0.880	
Web d/t =	17.11	
Web (d/t)/ε =	19.44 ≤ 80	Class 1 plastic
Flanges b/t =	7.25	
Flanges (b/t)/ε =	8.23 ≤ 9	Class 1 plastic

Section is class 1 plastic

Shear capacity

Shear area Av =	1970.24 mm (Av = tD, UC section)	
Web (d/t)/ε =	19.44 ≤ 70 (Web does not need to be checked for shear buckling)	
Shear capacity Pv =	419.66 kN	
Design shear force =	47.01 kN	OK

Moment capacity

Design bending moment M=	95.04 kNm	
Moment capacity low shear Mc =	232.88 kNm	OK

Effective length for lateral-torsional buckling

Total Beam Span =	5800 mm
Effective length Le =	7379 mm
Slenderness ratio λ =	141.91

Equivalent slenderness

Buckling parameter u =	0.846
Torsional index x =	14.1
Slenderness factor v =	0.637
Ratio βw =	1.000
Equivalent slenderness λLT =	76.50
Limiting slenderness λL0 =	30.20

λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght

Bending strenght ρb = 200.49 N/mm^2 (With Table 16)

Buckling resistance moment

Equivalent uniform moment factor mLT =	1.00 (Conservative approach)	
Buckling resistance moment Mb =	131.52 kNm	
Design bending moment	95.04 kNm	OK

Vertical dead & imposed load deflection

Limiting deflection =	23.200 mm (L/250)	
Maximum deflection =	16.032 mm	OK

Vertical imposed load deflection

Limiting deflection =	16.111 mm (L/360)	
Maximum deflection =	6.285 mm	OK

STEEL BEAM B3 = 203 x 203 x 60 UKC

BEAM B4

Horizontal loads

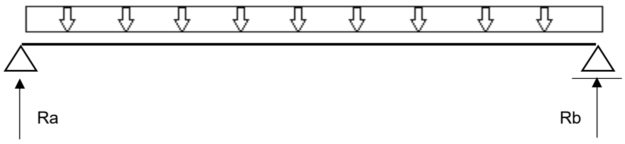
Beam Span L = 5.80 m
Wall Height H = 2.15 m

	Load Positioned		Element				
Load	from (m)	to (m)	Span/Height				
Wind load (W1)	0.00	5.80	2.30 m	/	1.00	=	2.30 m

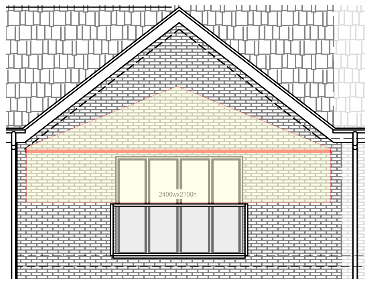
UDL LOADING
UDL Imposed Loading

Wind load (W1) 0.42 kN/m2 x 2.30 m = 0.98 kN/m x 1.40 = 1.37 kN/m

Ra = 3.96 kN
unf. DL = 0.00 kN
unf. IL = 2.83 kN



Rb = 3.96 kN
unf. DL = 0.00 kN
unf. IL = 2.83 kN



FORCES IN BEAM

Moment = 5.75 kNm
Shear Force = 3.96 kN
Axial Force = 0.00 kN

STEEL BEAM B4 - DESIGN DUE TO BS 5950-1

Properties of 200x100x12.5 RHS Section

Design strength of steel py =	355.00 N/mm^2	Web depth d =	162.50 mm
Flange dimension (RHS section) b =	62.50 mm	Web thickness t =	12.5 mm
Flange thickness T =	12.5 mm	Overall depth D =	200.00 mm
Area of cross-section A =	67.1 cm^2	Overall breadth B =	100.00 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Iy =	1000 cm^4
Elastic modulus Zy =	201 cm^3	Plastic modulus Sy =	245 cm^3
		Root radius r =	0.00 mm

Classification of cross-section

Parameter ε = 0.88

Webs b/t = 5.00
Webs (b/t)/ε = 5.68 ≤ 64 Class 1 plastic

Flanges d/t = 13.00
Flanges (d/t)/ε = 14.77 ≤ min(28; 80-b/t/ε) Class 1 plastic

Section is class 1 plastic

Shear capacity

Shear area Av = 2236.67 mm (Av = AB/(D+B), RHS section)
Webs (b/t)/ε = 5.68 ≤ 70 (Web does not need to be checked for shear buckling)
Shear capacity Pv = 476.41 kN
Design shear force = 3.96 kN OK

Moment capacity

Design bending moment M= 5.75 kNm
Moment capacity low shear Mc = 85.63 kNm OK

Biaxial bending

Biaxial bending usage factor = 0.07 + 0.02 = 0.09 ≤ 1.00 OK

Horizontal deflection

Limiting deflection (due to beam length) = 16.111 mm (L/360)
Limiting deflection (due to wall height) = 7.167 mm (H/300)
Maximum deflection = 7.015 mm OK

USAGE OF STEEL BEAM B4

Shear capacity 0.84 %
Moment capacity 6.72 %
Biaxial bending 9.03 %
Horizontal deflection 97.89 %

STEEL BEAM B4 (200x100x12.5 RHS) IS DESIGNED CORRECTLY

REGEN project In partnership with D & P Solutions	Project: Beeches, Long Meadow, Goring on Thames RG89EG					
	Subject: Structural Calculations					
	Calculation Number	Rev	Des.	Chkd.	Chkd.	Date
	23-1806-C01	B	DL	DK	DK	21.02.24

BEAM B5

Horizontal loads

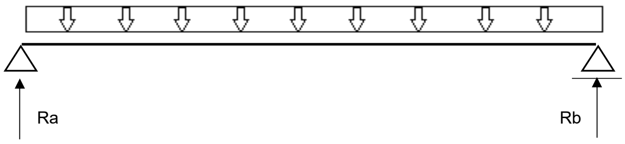
Beam Span L = 6.60 m
Wall Height H = 2.15 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
Wind load (W2)	0.00	6.60	1.85 m	/	1.00	=	1.85 m

UDL LOADING
UDL Imposed Loading

Wind load (W2)	0.61 kN/m2	x	1.85 m	=	1.14 kN/m	x	1.40	=	1.59 kN/m

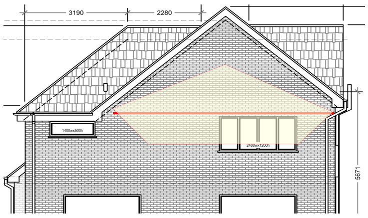
Ra = 5.25 kN
unf. DL = 0.00 kN
unf. IL = 3.75 kN



Rb = 5.25 kN
unf. DL = 0.00 kN
unf. IL = 3.75 kN

FORCES IN BEAM

Moment = 8.67 kNm
Shear Force = 5.25 kN
Axial Force = 0.00 kN



STEEL BEAM B5 - DESIGN DUE TO BS 5950-1

Properties of 250x150x8.0 RHS Section

Design strength of steel py =	355.00 N/mm^2	Web depth d =	226.00 mm
Flange dimension (RHS section) b =	126.00 mm	Web thickness t =	8.0 mm
Flange thickness T =	8.0 mm	Overall depth D =	250.00 mm
Area of cross-section A =	60.8 cm^2	Overall breadth B =	150.00 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Iy =	2300 cm^4
Elastic modulus Zy =	306 cm^3	Plastic modulus Sy =	350 cm^3
		Root radius r =	0.00 mm

Classification of cross-section
Parameter ε = 0.88

Webs b/t = 15.75
Webs (b/t)/ε = 17.89 ≤ 64 Class 1 plastic

Flanges d/t = 28.25
Flanges (d/t)/ε = 32.10 ≤ 40 Class 3 semi-compact

Section is class 3 semi-compact

Shear capacity
Shear area Av = 2280.00 mm (Av = AB/(D+B), RHS section)
Webs (b/t)/ε = 17.89 ≤ 70 (Web does not need to be checked for shear buckling)
Shear capacity Pv = 485.64 kN
Design shear force = 5.25 kN OK

Moment capacity
Design bending moment M= 8.67 kNm
Moment capacity low shear Mc = 108.63 kNm (Mc = py*Z) OK

Biaxial bending
Biaxial bending usage factor = 0.08 + 0.02 = 0.10 ≤ 1.00 OK

Horizontal deflection
Limiting deflection (due to beam length) = 18.333 mm (L/360)
Limiting deflection (due to wall height) = 7.167 mm (H/300)
Maximum deflection = 5.959 mm OK

USAGE OF STEEL BEAM B5

Shear capacity 1.09 %
Moment capacity 7.99 %
Biaxial bending 10.07 %
Horizontal deflection 83.15 %

STEEL BEAM B5 (250x150x8.0 RHS) IS DESIGNED CORRECTLY

BEAM B6
Beam Span L = 4.10 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
100mm Thick Wall	0.00	4.10	2.50 m	/	1.00	=	2.50 m
Timber floor (1st)	0.00	4.10	3.55 m	/	2.00	=	1.78 m
Ceiling	0.00	4.10	3.55 m	/	2.00	=	1.78 m
Roof (sloping)	0.00	4.10	3.55 m	/	2.00	=	1.78 m
-	0.00	4.10	0.00 m	/	1.00	=	0.00 m
-	0.00	4.10	0.00 m				
-	0.00	4.10	0.00 m				

UDL LOADING
UDL Dead Loading

Beam Self Weight					0.37 kN/m	x	1.40	=	0.52 kN/m
100mm Thick Wall	2.10 kN/m2	x	2.50 m	=	5.25 kN/m	x	1.40	=	7.35 kN/m
Timber floor (1st)	1.10 kN/m2	x	1.78 m	=	1.95 kN/m	x	1.40	=	2.73 kN/m
Ceiling	0.45 kN/m2	x	1.78 m	=	0.80 kN/m	x	1.40	=	1.12 kN/m
Roof (sloping)	1.00 kN/m2	x	1.78 m	=	1.78 kN/m	x	1.40	=	2.49 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					10.15 kN/m				**14.20 kN/m**

UDL Imposed Loading

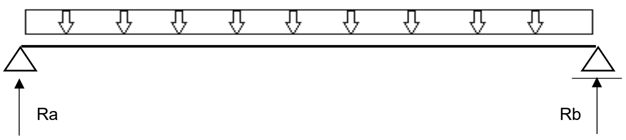
100mm Thick Wall	0.00 kN/m2	x	2.50 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Timber floor (1st)	1.50 kN/m2	x	1.78 m	=	2.66 kN/m	x	1.60	=	4.26 kN/m
Ceiling	0.25 kN/m2	x	1.78 m	=	0.44 kN/m	x	1.60	=	0.71 kN/m
Roof (sloping)	0.75 kN/m2	x	1.78 m	=	1.33 kN/m	x	1.60	=	2.13 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					4.44 kN/m				**7.10 kN/m**

Point Load P1 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 43.67 kN
unf. DL = 20.80 kN
unf. IL = 9.10 kN



Rb = 43.67 kN
unf. DL = 20.80 kN
unf. IL = 9.10 kN

FORCES IN BEAM

Moment = 44.77 kNm
Shear Force = 43.67 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/300; Brittle finishes (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B6

Shear capacity	15.85 %
Moment capacity	40.82 %
Buckling resistance moment	68.24 %
Vertical deflection	86.84 %

STEEL BEAM B6 = 152 x 152 x 37 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B6 (LHS):	B6	43.67	Beam Connection										
B6 (RHS):	B6	43.67	Beam Connection										

Beam Support Summary:
B6 (LHS): Provide Steel Beam/Column/Timber Post Connection
B6 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B6 - DESIGN DUE TO BS 5950-1

Properties of 152 x 152 x 37 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	4.10 m
Half of flange b =	77.20 mm	Web depth d =	123.60 mm
Flange thickness T =	11.5 mm	Web thickness t =	8.0 mm
Area of cross-section A =	47.1 cm^2	Overall depth D =	161.8 mm
Rad of gyration (minor axis) r =	3.87 cm	Overall breadth B =	154.4 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	2210 cm^4
Elastic modulus Zx =	273 cm^3	Plastic modulus Sx =	309 cm^3
		Root radius r =	7.60 mm

Forces in beam

Moment	=	44.77 kNm
Shear Force	=	43.67 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε =	0.880	
Web d/t =	15.45	
Web (d/t)/ε =	17.55 ≤ 80	Class 1 plastic
Flanges b/t =	6.71	
Flanges (b/t)/ε =	7.63 ≤ 9	Class 1 plastic

Section is class 1 plastic

Shear capacity

Shear area Av =	1294.40 mm (Av = tD, UC section)	
Web (d/t)/ε =	17.55 ≤ 70 (Web does not need to be checked for shear buckling)	
Shear capacity Pv =	275.71 kN	
Design shear force =	43.67 kN	OK

Moment capacity

Design bending moment M=	44.77 kNm	
Moment capacity low shear Mc =	109.70 kNm	OK

Effective length for lateral-torsional buckling

Total Beam Span =	4100 mm
Effective length Le =	5244 mm
Slenderness ratio λ =	135.49

Equivalent slenderness

Buckling parameter u =	0.848
Torsional index x =	13.3
Slenderness factor v =	0.634
Ratio βw =	1.000
Equivalent slenderness λLT =	72.85
Limiting slenderness λL0 =	30.20

λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght

Bending strenght ρb = 212.32 N/mm^2 (With Table 16)

Buckling resistance moment

Equivalent uniform moment factor mLT =	1.00 (Conservative approach)	
Buckling resistance moment Mb =	65.61 kNm	
Design bending moment	44.77 kNm	OK

Vertical dead & imposed load deflection

Limiting deflection =	13.667 mm (L/300; Brittle finishes)	
Maximum deflection =	11.868 mm	OK

Vertical imposed load deflection

Limiting deflection =	11.389 mm (L/360)	
Maximum deflection =	3.611 mm	OK

STEEL BEAM B6 = 152 x 152 x 37 UKC

BEAM B6. **(Calculated For Loading Purposes Only)**

Beam Span L = 4.10 m

	Load Positioned		Element				
Load	from (m)	to (m)	Span/Height				
100mm Thick Wall	0.00	4.10	2.50 m	/	1.00	=	2.50 m
-	0.00	4.10	0.00 m	/	1.00	=	0.00 m
-	0.00	4.10	0.00 m	/	1.00	=	0.00 m
-	0.00	4.10	0.00 m	/	1.00	=	0.00 m
-	0.00	4.10	0.00 m	/	1.00	=	0.00 m
-	0.00	4.10	0.00 m				
-	0.00	4.10	0.00 m				

UDL LOADING

UDL Dead Loading

Beam Self Weight					0.37 kN/m	x	1.40	=	0.52 kN/m
100mm Thick Wall	2.10 kN/m2	x	2.50 m	=	5.25 kN/m	x	1.40	=	7.35 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					5.62 kN/m				**7.87 kN/m**

UDL Imposed Loading

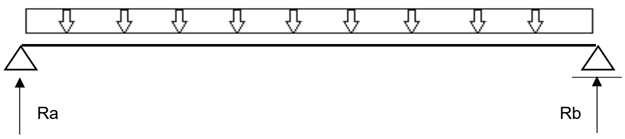
100mm Thick Wall	0.00 kN/m2	x	2.50 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					0.00 kN/m				**0.00 kN/m**

Point Load P1 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 16.13 kN
unf. DL = 11.52 kN
unf. IL = 0.00 kN



Rb = 16.13 kN
unf. DL = 11.52 kN
unf. IL = 0.00 kN

BEAM B7
Beam Span L = 3.72 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
100mm Thick Wall	0.00	3.72	1.50 m	/	1.00	=	1.50 m
Timber floor (1st)	0.00	3.72	3.90 m	/	2.00	=	1.95 m
Ceiling	0.00	3.72	3.90 m	/	2.00	=	1.95 m
Roof (sloping)	0.00	3.72	3.90 m	/	2.00	=	1.95 m
-	0.00	3.72	0.00 m	/	1.00	=	0.00 m
-	0.00	3.72	0.00 m				
-	0.00	3.72	0.00 m				

UDL LOADING
UDL Dead Loading

Beam Self Weight					0.30 kN/m	x	1.40	=	0.42 kN/m
100mm Thick Wall	2.10 kN/m2	x	1.50 m	=	3.15 kN/m	x	1.40	=	4.41 kN/m
Timber floor (1st)	1.10 kN/m2	x	1.95 m	=	2.15 kN/m	x	1.40	=	3.00 kN/m
Ceiling	0.45 kN/m2	x	1.95 m	=	0.88 kN/m	x	1.40	=	1.23 kN/m
Roof (sloping)	1.00 kN/m2	x	1.95 m	=	1.95 kN/m	x	1.40	=	2.73 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					8.42 kN/m				**11.79 kN/m**

UDL Imposed Loading

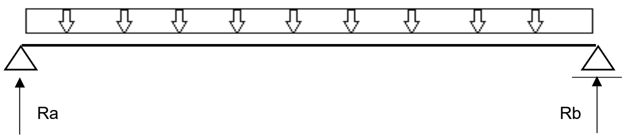
100mm Thick Wall	0.00 kN/m2	x	1.50 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Timber floor (1st)	1.50 kN/m2	x	1.95 m	=	2.93 kN/m	x	1.60	=	4.68 kN/m
Ceiling	0.25 kN/m2	x	1.95 m	=	0.49 kN/m	x	1.60	=	0.78 kN/m
Roof (sloping)	0.75 kN/m2	x	1.95 m	=	1.46 kN/m	x	1.60	=	2.34 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					4.88 kN/m				**7.80 kN/m**

Point Load P1 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 36.44 kN
unf. DL = 15.67 kN
unf. IL = 9.07 kN



Rb = 36.44 kN
unf. DL = 15.67 kN
unf. IL = 9.07 kN

FORCES IN BEAM

Moment = 33.89 kNm
Shear Force = 36.44 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/300; Brittle finishes (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B7

Shear capacity	16.71 %
Moment capacity	38.50 %
Buckling resistance moment	66.35 %
Vertical deflection	74.69 %

STEEL BEAM B7 = 152 x 152 x 30 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B7 (LHS):	B7	36.44	Beam Connection										
B7 (RHS):	B7	36.44	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	152.9	2.38	440	100	0	0.83	Satisfactory

Beam Support Summary:
B7 (LHS): Provide Steel Beam/Column/Timber Post Connection
B7 (RHS): Provide MIN 440x100x215 Concrete Padstone
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B7 - DESIGN DUE TO BS 5950-1

Properties of 152 x 152 x 30 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	3.72 m
Half of flange b =	76.45 mm	Web depth d =	123.60 mm
Flange thickness T =	9.4 mm	Web thickness t =	6.5 mm
Area of cross-section A =	38.3 cm^2	Overall depth D =	157.6 mm
Rad of gyration (minor axis) r =	3.83 cm	Overall breadth B =	152.9 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	1750 cm^4
Elastic modulus Zx =	222 cm^3	Plastic modulus Sx =	248 cm^3
		Root radius r =	7.60 mm

Forces in beam

Moment	=	33.89 kNm
Shear Force	=	36.44 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε =	0.880	
Web d/t =	19.02	
Web (d/t)/ε =	21.60 ≤ 80	Class 1 plastic
Flanges b/t =	8.13	
Flanges (b/t)/ε =	9.24 ≤ 10	Class 2 compact

Section is class 2 compact

Shear capacity

Shear area Av =	1024.40 mm (Av = tD, UC section)	
Web (d/t)/ε =	21.60 ≤ 70 (Web does not need to be checked for shear buckling)	
Shear capacity Pv =	218.20 kN	
Design shear force =	36.44 kN	OK

Moment capacity

Design bending moment M=	33.89 kNm	
Moment capacity low shear Mc =	88.04 kNm	OK

Effective length for lateral-torsional buckling

Total Beam Span =	3720 mm
Effective length Le =	4779 mm
Slenderness ratio λ =	124.78

Equivalent slenderness

Buckling parameter u =	0.847
Torsional index x =	16.1
Slenderness factor v =	0.707
Ratio βw =	1.000
Equivalent slenderness λLT =	74.72
Limiting slenderness λL0 =	30.20

λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght

Bending strenght ρb = 205.96 N/mm^2 (With Table 16)

Buckling resistance moment

Equivalent uniform moment factor mLT =	1.00 (Conservative approach)	
Buckling resistance moment Mb =	51.08 kNm	
Design bending moment	33.89 kNm	OK

Vertical dead & imposed load deflection

Limiting deflection =	12.400 mm (L/300; Brittle finishes)	
Maximum deflection =	9.261 mm	OK

Vertical imposed load deflection

Limiting deflection =	10.333 mm (L/360)	
Maximum deflection =	3.395 mm	OK

STEEL BEAM B7 = 152 x 152 x 30 UKC

BEAM B8
Beam Span L = 2.15 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
215mm/Cavity Wall	0.00	2.15	5.25 m	/	1.00	=	5.25 m
Timber floor (1st)	0.00	2.15	8.30 m	/	2.00	=	4.15 m
Ceiling	0.00	2.15	8.30 m	/	2.00	=	4.15 m
Roof (sloping)	0.00	2.15	8.30 m	/	2.00	=	4.15 m
-	0.00	2.15	0.00 m	/	1.00	=	0.00 m
-	0.00	2.15	0.00 m				
-	0.00	2.15	0.00 m				

UDL LOADING
UDL Dead Loading

Beam Self Weight					0.30 kN/m	x	1.40	=	0.42 kN/m
215mm/Cavity Wall	4.20 kN/m2	x	5.25 m	=	22.05 kN/m	x	1.40	=	30.87 kN/m
Timber floor (1st)	1.10 kN/m2	x	4.15 m	=	4.57 kN/m	x	1.40	=	6.39 kN/m
Ceiling	0.45 kN/m2	x	4.15 m	=	1.87 kN/m	x	1.40	=	2.61 kN/m
Roof (sloping)	1.00 kN/m2	x	4.15 m	=	4.15 kN/m	x	1.40	=	5.81 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					32.93 kN/m				**46.11 kN/m**

UDL Imposed Loading

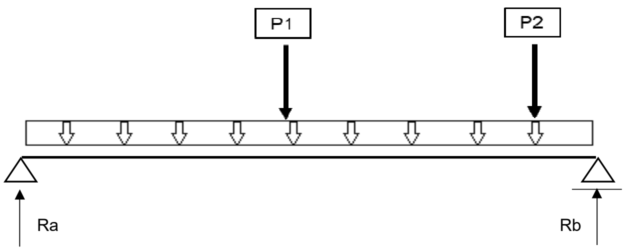
215mm/Cavity Wall	0.00 kN/m2	x	5.25 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Timber floor (1st)	1.50 kN/m2	x	4.15 m	=	6.23 kN/m	x	1.60	=	9.96 kN/m
Ceiling	0.25 kN/m2	x	4.15 m	=	1.04 kN/m	x	1.60	=	1.66 kN/m
Roof (sloping)	0.75 kN/m2	x	4.15 m	=	3.11 kN/m	x	1.60	=	4.98 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					10.38 kN/m				**16.60 kN/m**

Point Load P1 @ 1.00 m
From Beam = 1.00 x B6.(RHS) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 11.52 kN x 1.40 = 16.13 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 1.95 m
From Beam = 1.00 x EB1(MAX)
DL = 11.29 kN x 1.40 = 15.80 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 77.51 kN
unf. DL = 42.61 kN
unf. IL = 11.15 kN



Rb = 89.24 kN
unf. DL = 51.00 kN
unf. IL = 11.15 kN

FORCES IN BEAM

Moment = 45.88 kNm
Shear Force = 89.24 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/300; Brittle finishes (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B8

Shear capacity	40.91 %
Moment capacity	52.11 %
Buckling resistance moment	65.94 %
Vertical deflection	58.70 %

STEEL BEAM B8 = 152 x 152 x 30 UKC S355 *BEAM WITH PLATE, SEE DETAILS ON SUMMARY PAGE*

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B8 (LHS):	B8	77.51	3.6N Blocks	3.5	1.25xfk/3.5 1.25	200	152.9	2.53	400	200	0	0.97	Satisfactory
B8 (RHS):	B8	89.24	3.6N Blocks	3.5	1.25xfk/3.5 1.25	200	152.9	2.92	400	200	0	1.12	Satisfactory

Beam Support Summary:
B8 (LHS): Provide MIN 400x(Wall Width)x215 Concrete Padstone
B8 (RHS): Provide MIN 400x(Wall Width)x215 Concrete Padstone
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B8 - DESIGN DUE TO BS 5950-1

Properties of 152 x 152 x 30 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	2.15 m
Half of flange b =	76.45 mm	Web depth d =	123.60 mm
Flange thickness T =	9.4 mm	Web thickness t =	6.5 mm
Area of cross-section A =	38.3 cm^2	Overall depth D =	157.6 mm
Rad of gyration (minor axis) r =	3.83 cm	Overall breadth B =	152.9 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	1750 cm^4
Elastic modulus Zx =	222 cm^3	Plastic modulus Sx =	248 cm^3
		Root radius r =	7.60 mm

Forces in beam

Moment	=	45.88 kNm
Shear Force	=	89.24 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε = 0.880

Web d/t = 19.02
Web (d/t)/ε = 21.60 ≤ 80 Class 1 plastic

Flanges b/t = 8.13
Flanges (b/t)/ε = 9.24 ≤ 10 Class 2 compact

Section is class 2 compact

Shear capacity
Shear area Av = 1024.40 mm (Av = tD, UC section)
Web (d/t)/ε = 21.60 ≤ 70 (Web does not need to be checked for shear buckling)
Shear capacity Pv = 218.20 kN
Design shear force = 89.24 kN **OK**

Moment capacity
Design bending moment M= 45.88 kNm
Moment capacity low shear Mc = 88.04 kNm **OK**

Effective length for lateral-torsional buckling
Total Beam Span = 2150 mm
Effective length Le = 2895 mm
Slenderness ratio λ = 75.59

Equivalent slenderness
Buckling parameter u = 0.847
Torsional index x = 16.1
Slenderness factor v = 0.830
Ratio βw = 1.000
Equivalent slenderness λLT = 53.17
Limiting slenderness λL0 = 30.20
λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght
Bending strenght ρb = 280.58 N/mm^2 (With Table 16)

Buckling resistance moment
Equivalent uniform moment factor mLT = 1.00 (Conservative approach)
Buckling resistance moment Mb = 69.58 kNm
Design bending moment 45.88 kNm **OK**

Vertical dead & imposed load deflection
Limiting deflection = 7.167 mm (L/300; Brittle finishes)
Maximum deflection = 4.207 mm **OK**

Vertical imposed load deflection
Limiting deflection = 5.972 mm (L/360)
Maximum deflection = 0.806 mm **OK**

STEEL BEAM B8 = 152 x 152 x 30 UKC

BEAM B9

Beam Span L = 3.29 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
100mm Thick Wall	0.00	3.29	1.75 m	/	1.00	=	1.75 m
Timber floor (1st)	0.00	3.29	7.70 m	/	2.00	=	3.85 m
Ceiling	0.00	3.29	7.70 m	/	2.00	=	3.85 m
Roof (sloping)	0.00	3.29	7.70 m	/	2.00	=	3.85 m
-	0.00	3.29	0.00 m	/	1.00	=	0.00 m
-	0.00	3.29	0.00 m				
-	0.00	3.29	0.00 m				

UDL LOADING

UDL Dead Loading

Beam Self Weight					0.37 kN/m	x	1.40	=	0.52 kN/m
100mm Thick Wall	2.10 kN/m2	x	1.75 m	=	3.68 kN/m	x	1.40	=	5.15 kN/m
Timber floor (1st)	1.10 kN/m2	x	3.85 m	=	4.24 kN/m	x	1.40	=	5.93 kN/m
Ceiling	0.45 kN/m2	x	3.85 m	=	1.73 kN/m	x	1.40	=	2.43 kN/m
Roof (sloping)	1.00 kN/m2	x	3.85 m	=	3.85 kN/m	x	1.40	=	5.39 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					13.86 kN/m				**19.41 kN/m**

UDL Imposed Loading

100mm Thick Wall	0.00 kN/m2	x	1.75 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Timber floor (1st)	1.50 kN/m2	x	3.85 m	=	5.78 kN/m	x	1.60	=	9.24 kN/m
Ceiling	0.25 kN/m2	x	3.85 m	=	0.96 kN/m	x	1.60	=	1.54 kN/m
Roof (sloping)	0.75 kN/m2	x	3.85 m	=	2.89 kN/m	x	1.60	=	4.62 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					9.63 kN/m				**15.40 kN/m**

Point Load P1 @ 0.17 m

From Beam = 1.00 x B6.(MAX) + 1.00 x (MAX) + 1.00 x (MAX)

DL = 11.52 kN x 1.40 = 16.13 kN

IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 0.00 m

From Beam = 1.00 x (MAX)

DL = 0.00 kN x 1.40 = 0.00 kN

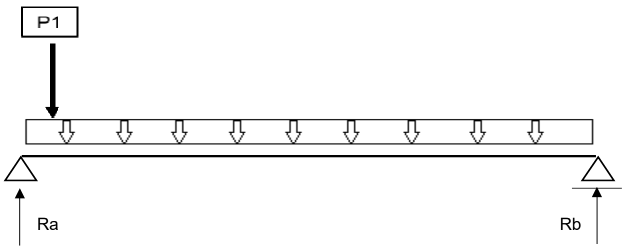
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m

From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)

DL = 0.00 kN x 1.40 = 0.00 kN

IL = 0.00 kN x 1.60 = 0.00 kN



Ra = 72.55 kN
unf. DL = 33.73 kN
unf. IL = 15.83 kN

Rb = 58.09 kN
unf. DL = 23.40 kN
unf. IL = 15.83 kN

FORCES IN BEAM

Moment	=	48.47 kNm
Shear Force	=	72.55 kN
Axial Force	=	0.00 kN

DEFLECTION CRITERIA

L/300; Brittle finishes (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B9

Shear capacity	26.32 %
Moment capacity	44.19 %
Buckling resistance moment	65.11 %
Vertical deflection	74.93 %

STEEL BEAM B9 = 152 x 152 x 37 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B9 (LHS):	B9	72.55	7.3N Blocks	6.4	1.25xfk/3.5 2.29	100	154.4	4.70	440	100	0	1.65	Satisfactory
B9 (RHS):	B9	58.09	7.3N Blocks	6.4	1.25xfk/3.5 2.29	100	154.4	3.76	440	100	0	1.32	Satisfactory

Beam Support Summary:

B9 (LHS): Provide MIN 440x100x215 Concrete Padstone
B9 (RHS): Provide MIN 440x100x215 Concrete Padstone
Refer To G.A. for more details.

Beam bearing design details:

Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B9 - DESIGN DUE TO BS 5950-1

Properties of 152 x 152 x 37 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	3.29 m
Half of flange b =	77.20 mm	Web depth d =	123.60 mm
Flange thickness T =	11.5 mm	Web thickness t =	8.0 mm
Area of cross-section A =	47.1 cm^2	Overall depth D =	161.8 mm
Rad of gyration (minor axis) r =	3.87 cm	Overall breadth B =	154.4 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	2210 cm^4
Elastic modulus Zx =	273 cm^3	Plastic modulus Sx =	309 cm^3
		Root radius r =	7.60 mm

Forces in beam

Moment	=	48.47 kNm
Shear Force	=	72.55 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε = 0.880

Web d/t = 15.45
Web (d/t)/ε = 17.55 ≤ 80 — Class 1 plastic

Flanges b/t = 6.71
Flanges (b/t)/ε = 7.63 ≤ 9 — Class 1 plastic

Section is class 1 plastic

Shear capacity
Shear area Av = 1294.40 mm (Av = tD, UC section)
Web (d/t)/ε = 17.55 ≤ 70 (Web does not need to be checked for shear buckling)
Shear capacity Pv = 275.71 kN
Design shear force = 72.55 kN — **OK**

Moment capacity
Design bending moment M= 48.47 kNm
Moment capacity low shear Mc = 109.70 kNm — **OK**

Effective length for lateral-torsional buckling
Total Beam Span = 3290 mm
Effective length Le = 4272 mm
Slenderness ratio λ = 110.38

Equivalent slenderness
Buckling parameter u = 0.848
Torsional index x = 13.3
Slenderness factor v = 0.689
Ratio βw = 1.000
Equivalent slenderness λLT = 64.47
Limiting slenderness λL0 = 30.20
λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght
Bending strenght ρb = 240.92 N/mm^2 (With Table 16)

Buckling resistance moment
Equivalent uniform moment factor mLT = 1.00 (Conservative approach)
Buckling resistance moment Mb = 74.44 kNm
Design bending moment 48.47 kNm — **OK**

Vertical dead & imposed load deflection
Limiting deflection = 10.967 mm (L/300; Brittle finishes)
Maximum deflection = 8.217 mm — **OK**

Vertical imposed load deflection
Limiting deflection = 9.139 mm (L/360)
Maximum deflection = 3.247 mm — **OK**

STEEL BEAM B9 = 152 x 152 x 37 UKC

REGEN project

In partnership with

D & P Solutions

Project					
Beeches, Long Meadow, Goring on Thames RG89EG					
Subject					
Structural Calculations					
Calculation Number	Rev	Des.	Chkd.	Chkd.	Date
23-1806-C01	B	DL	DK	DK	21.02.24

BEAM B10

Beam Span L = 5.80 m

	Load Positioned		Element				
Load	from (m)	to (m)	Span/Height				
Timber floor (1st)	0.00	5.80	6.60 m	/	2.00	=	3.30 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m				
-	0.00	5.80	0.00 m				

UDL LOADING

UDL Dead Loading

Beam Self Weight					0.46 kN/m	x	1.40	=	0.65 kN/m
Timber floor (1st)	1.10 kN/m2	x	3.30 m	=	3.63 kN/m	x	1.40	=	5.08 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					4.09 kN/m				**5.73 kN/m**

UDL Imposed Loading

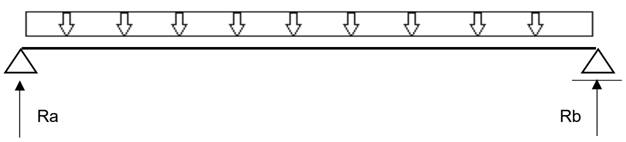
Timber floor (1st)	1.50 kN/m2	x	3.30 m	=	4.95 kN/m	x	1.60	=	7.92 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					4.95 kN/m				**7.92 kN/m**

Point Load P1 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 39.58 kN
unf. DL = 11.86 kN
unf. IL = 14.36 kN



Rb = 39.58 kN
unf. DL = 11.86 kN
unf. IL = 14.36 kN

FORCES IN BEAM

Moment = 57.39 kNm
Shear Force = 39.58 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/250 (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B10

Shear capacity	12.71 %
Moment capacity	35.93 %
Buckling resistance moment	59.40 %
Vertical deflection	61.42 %

STEEL BEAM B10 = 203 x 203 x 46 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B10 (LHS):	B10	39.58	Beam Connection										
B10 (RHS):	B10	39.58	Beam Connection										

Beam Support Summary:
B10 (LHS): Provide Steel Beam/Column/Timber Post Connection
B10 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.0 + 2 x D
Restraint Condition Coef. Support B: 1.0 + 2 x D

STEEL BEAM B10 - DESIGN DUE TO BS 5950-1

Properties of 203 x 203 x 46 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	5.80 m
Half of flange b =	101.80 mm	Web depth d =	160.80 mm
Flange thickness T =	11.0 mm	Web thickness t =	7.2 mm
Area of cross-section A =	58.7 cm^2	Overall depth D =	203.2 mm
Rad of gyration (minor axis) r =	5.13 cm	Overall breadth B =	203.6 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	4570 cm^4
Elastic modulus Zx =	450 cm^3	Plastic modulus Sx =	497 cm^3
		Root radius r =	10.20 mm

Forces in beam

Moment	=	57.39 kNm
Shear Force	=	39.58 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A: 1.0 + 2 x D
Restraint Condition Coef. Support B: 1.0 + 2 x D

Classification of cross-section

Parameter ε = 0.880

Web d/t = 22.33
Web (d/t)/ε = 25.37 ≤ 80 Class 1 plastic

Flanges b/t = 9.25
Flanges (b/t)/ε = 10.51 ≤ 15 Class 3 semi-compact

Section is class 3 semi-compact

Shear capacity
Shear area Av = 1463.04 mm (Av = tD, UC section)
Web (d/t)/ε = 25.37 ≤ 70 (Web does not need to be checked for shear buckling)
Shear capacity Pv = 311.63 kN
Design shear force = 39.58 kN **OK**

Moment capacity
Design bending moment M= 57.39 kNm
Moment capacity low shear Mc = 159.75 kNm (Mc = py*Z) **OK**

Effective length for lateral-torsional buckling
Total Beam Span = 5800 mm
Effective length Le = 6206 mm
Slenderness ratio λ = 120.98

Equivalent slenderness
Buckling parameter u = 0.847
Torsional index x = 17.7
Slenderness factor v = 0.740
Ratio βw = 0.905 (Z/S)
Equivalent slenderness λLT = 72.15
Limiting slenderness λL0 = 30.20
λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght
Bending strenght ρb = 214.69 N/mm^2 (With Table 16)

Buckling resistance moment
Equivalent uniform moment factor mLT = 1.00 (Conservative approach)
Buckling resistance moment Mb = 96.61 kNm
Design bending moment 57.39 kNm **OK**

Vertical dead & imposed load deflection
Limiting deflection = 23.200 mm (L/250)
Maximum deflection = 14.248 mm **OK**

Vertical imposed load deflection
Limiting deflection = 16.111 mm (L/360)
Maximum deflection = 7.801 mm **OK**

STEEL BEAM B10 = 203 x 203 x 46 UKC

BEAM B11

Beam Span L = 6.60 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
215mm/Cavity Wall	0.00	6.60	4.05 m	/	1.00	=	4.05 m
Timber floor (1st)	0.00	6.60	4.30 m	/	2.00	=	2.15 m
Ceiling	0.00	6.60	4.30 m	/	2.00	=	2.15 m
Roof (sloping)	0.00	6.60	4.30 m	/	2.00	=	2.15 m
-	0.00	6.60	0.00 m	/	1.00	=	0.00 m
B3	0.00	6.60	6.60 m				(LHS)
-	0.00	6.60	0.00 m				

UDL LOADING

UDL Dead Loading

Beam Self Weight					1.18 kN/m	x	1.40	=	1.65 kN/m
215mm/Cavity Wall	4.20 kN/m2	x	4.05 m	=	17.01 kN/m	x	1.40	=	23.81 kN/m
Timber floor (1st)	1.10 kN/m2	x	2.15 m	=	2.37 kN/m	x	1.40	=	3.31 kN/m
Ceiling	0.45 kN/m2	x	2.15 m	=	0.97 kN/m	x	1.40	=	1.35 kN/m
Roof (sloping)	1.00 kN/m2	x	2.15 m	=	2.15 kN/m	x	1.40	=	3.01 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
B3	18.16 kN	/	6.60 m	=	2.75 kN/m	x	1.40	=	3.85 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					26.42 kN/m				**36.99 kN/m**

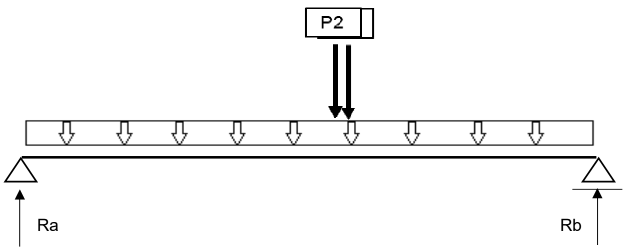
UDL Imposed Loading

215mm/Cavity Wall	0.00 kN/m2	x	4.05 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Timber floor (1st)	1.50 kN/m2	x	2.15 m	=	3.23 kN/m	x	1.60	=	5.16 kN/m
Ceiling	0.25 kN/m2	x	2.15 m	=	0.54 kN/m	x	1.60	=	0.86 kN/m
Roof (sloping)	0.75 kN/m2	x	2.15 m	=	1.61 kN/m	x	1.60	=	2.58 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
B3	11.60 kN	/	6.60 m	=	1.76 kN/m	x	1.60	=	2.81 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					7.13 kN/m				**11.41 kN/m**

Point Load P1 @ 3.80 m
From Beam = 1.00 x B10(MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 11.86 kN x 1.40 = 16.61 kN
IL = 14.36 kN x 1.60 = 22.97 kN

Point Load P2 @ 3.65 m
From Beam = 1.00 x EB1(MAX)
DL = 11.29 kN x 1.40 = 15.80 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN



Ra = 183.59 kN
unf. DL = 97.27 kN
unf. IL = 29.63 kN

Rb = 191.26 kN
unf. DL = 100.27 kN
unf. IL = 31.80 kN

FORCES IN BEAM

Moment = 347.51 kNm
Shear Force = 191.26 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/300; Brittle finishes (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B11

Shear capacity 24.49 %
Moment capacity 51.40 %
Buckling resistance moment 80.59 %
Vertical deflection 84.02 %

STEEL BEAM B11 = 305 x 305 x 118 UKC S355 *BEAM WITH PLATE, SEE DETAILS ON SUMMARY PAGE*

BEARING CHECK

The beam weighs over 500kg

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B11 (LHS):	B11	183.59	Beam Connection										
B11 (RHS):	B11	191.26	Beam Connection										

Beam Support Summary:
B11 (LHS): Provide Steel Beam/Column/Timber Post Connection
B11 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B11 - DESIGN DUE TO BS 5950-1

Properties of 305 x 305 x 118 UKC Section

Design strength of steel py =	345.00 N/mm^2	Total beam span L =	6.60 m
Half of flange b =	153.70 mm	Web depth d =	246.70 mm
Flange thickness T =	18.7 mm	Web thickness t =	12.0 mm
Area of cross-section A =	150 cm^2	Overall depth D =	314.5 mm
Rad of gyration (minor axis) r =	7.77 cm	Overall breadth B =	307.4 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	27700 cm^4
Elastic modulus Zx =	1760 cm^3	Plastic modulus Sx =	1960 cm^3
		Root radius r =	15.20 mm

Forces in beam

Moment	=	347.51 kNm
Shear Force	=	191.26 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε = 0.893

Web d/t = 20.56
Web (d/t)/ε = 23.03 ≤ 80 Class 1 plastic

Flanges b/t = 8.22
Flanges (b/t)/ε = 9.21 ≤ 10 Class 2 compact

Section is class 2 compact

Shear capacity
Shear area Av = 3774.00 mm (Av = tD, UC section)
Web (d/t)/ε = 23.03 ≤ 70 (Web does not need to be checked for shear buckling)
Shear capacity Pv = 781.22 kN
Design shear force = 191.26 kN **OK**

Moment capacity
Design bending moment M= 347.51 kNm
Moment capacity low shear Mc = 676.20 kNm **OK**

Effective length for lateral-torsional buckling
Total Beam Span = 6600 mm
Effective length Le = 8549 mm
Slenderness ratio λ = 110.03

Equivalent slenderness
Buckling parameter u = 0.852
Torsional index x = 16.1
Slenderness factor v = 0.740
Ratio βw = 1.000
Equivalent slenderness λLT = 69.37
Limiting slenderness λL0 = 30.63
λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght
Bending strenght ρb = 220.02 N/mm^2 (With Table 16)

Buckling resistance moment
Equivalent uniform moment factor mLT = 1.00 (Conservative approach)
Buckling resistance moment Mb = 431.25 kNm
Design bending moment 347.51 kNm **OK**

Vertical dead & imposed load deflection
Limiting deflection = 22.000 mm (L/300; Brittle finishes)
Maximum deflection = 18.483 mm **OK**

Vertical imposed load deflection
Limiting deflection = 18.333 mm (L/360)
Maximum deflection = 4.576 mm **OK**

STEEL BEAM B11 = 305 x 305 x 118 UKC

BEAM B12

Beam Span L = 5.80 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
Timber floor (1st)	0.00	5.80	5.45 m	/	2.00	=	2.73 m
Lightweight Leaf	0.00	5.80	2.20 m	/	1.00	=	2.20 m
Timber Partition	0.00	5.80	2.20 m	/	1.00	=	2.20 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m	/	1.00	=	0.00 m
-	0.00	5.80	0.00 m				
-	0.00	5.80	0.00 m				

UDL LOADING

UDL Dead Loading

Beam Self Weight					0.60 kN/m	x	1.40	=	0.84 kN/m
Timber floor (1st)	1.10 kN/m2	x	2.73 m	=	3.00 kN/m	x	1.40	=	4.20 kN/m
Lightweight Leaf	1.10 kN/m2	x	2.20 m	=	2.42 kN/m	x	1.40	=	3.39 kN/m
Timber Partition	0.35 kN/m2	x	2.20 m	=	0.77 kN/m	x	1.40	=	1.08 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					6.79 kN/m				**9.50 kN/m**

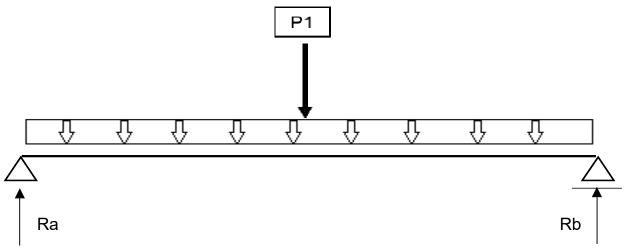
UDL Imposed Loading

Timber floor (1st)	1.50 kN/m2	x	2.73 m	=	4.09 kN/m	x	1.60	=	6.54 kN/m
Lightweight Leaf	0.00 kN/m2	x	2.20 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Timber Partition	0.00 kN/m2	x	2.20 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					4.09 kN/m				**6.54 kN/m**

Point Load P1 @ 2.90 m
From Beam = 1.00 x B2(RHS) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 15.92 kN x 1.40 = 22.29 kN
IL = 10.88 kN x 1.60 = 17.41 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN



Ra =	66.37 kN	Rb =	66.37 kN
unf. DL =	27.64 kN	unf. DL =	27.64 kN
unf. IL =	17.30 kN	unf. IL =	17.30 kN

FORCES IN BEAM

Moment = 125.03 kNm
Shear Force = 66.37 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/250 (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B12

Shear capacity 15.82 %
Moment capacity 53.69 %
Buckling resistance moment 89.86 %
Vertical deflection 92.79 %

STEEL BEAM B12 = 203 x 203 x 60 UKC S355

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B12 (LHS):	B12	66.37	Beam Connection										
B12 (RHS):	B12	66.37	Beam Connection										

Beam Support Summary:
B12 (LHS): Provide Steel Beam/Column/Timber Post Connection
B12 (RHS): Provide Steel Beam/Column/Timber Post Connection
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.0 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B12 - DESIGN DUE TO BS 5950-1

Properties of 203 x 203 x 60 UKC Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	5.80 m
Half of flange b =	102.90 mm	Web depth d =	160.80 mm
Flange thickness T =	14.2 mm	Web thickness t =	9.4 mm
Area of cross-section A =	76.4 cm^2	Overall depth D =	209.6 mm
Rad of gyration (minor axis) r =	5.20 cm	Overall breadth B =	205.8 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	6120 cm^4
Elastic modulus Zx =	584 cm^3	Plastic modulus Sx =	656 cm^3
		Root radius r =	10.20 mm

Forces in beam

Moment	=	125.03 kNm
Shear Force	=	66.37 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.0 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε =	0.880	
Web d/t =	17.11	
Web (d/t)/ε =	19.44 ≤ 80	Class 1 plastic
Flanges b/t =	7.25	
Flanges (b/t)/ε =	8.23 ≤ 9	Class 1 plastic

Section is class 1 plastic

Shear capacity

Shear area Av =	1970.24 mm (Av = tD, UC section)	
Web (d/t)/ε =	19.44 ≤ 70 (Web does not need to be checked for shear buckling)	
Shear capacity Pv =	419.66 kN	
Design shear force =	66.37 kN	OK

Moment capacity

Design bending moment M=	125.03 kNm	
Moment capacity low shear Mc =	232.88 kNm	OK

Effective length for lateral-torsional buckling

Total Beam Span =	5800 mm
Effective length Le =	6799 mm
Slenderness ratio λ =	130.75

Equivalent slenderness

Buckling parameter u =	0.846
Torsional index x =	14.1
Slenderness factor v =	0.659
Ratio βw =	1.000
Equivalent slenderness λLT =	72.91
Limiting slenderness λL0 =	30.20

λLT > λL0 (Allowance should be made for lateral-torsional buckling)

Bending strenght

Bending strenght ρb = 212.12 N/mm^2 (With Table 16)

Buckling resistance moment

Equivalent uniform moment factor mLT =	1.00 (Conservative approach)	
Buckling resistance moment Mb =	139.15 kNm	
Design bending moment	125.03 kNm	OK

Vertical dead & imposed load deflection

Limiting deflection =	23.200 mm (L/250)	
Maximum deflection =	21.526 mm	OK

Vertical imposed load deflection

Limiting deflection =	16.111 mm (L/360)	
Maximum deflection =	8.354 mm	OK

STEEL BEAM B12 = 203 x 203 x 60 UKC

BEAM B13
Beam Span L = 2.92 m

Load	Load Positioned from (m)	to (m)	Element Span/Height				
New Cavity Wall	0.00	2.92	2.80 m	/	1.00	=	2.80 m
Roof (sloping)	0.00	2.92	5.40 m	/	2.00	=	2.70 m
-	0.00	2.92	0.00 m	/	1.00	=	0.00 m
-	0.00	2.92	0.00 m	/	1.00	=	0.00 m
-	0.00	2.92	0.00 m	/	1.00	=	0.00 m
-	0.00	2.92	0.00 m				
-	0.00	2.92	0.00 m				

UDL LOADING
UDL Dead Loading

Beam Self Weight					0.35 kN/m	x	1.40	=	0.49 kN/m
New Cavity Wall	3.20 kN/m2	x	2.80 m	=	8.96 kN/m	x	1.40	=	12.54 kN/m
Roof (sloping)	1.00 kN/m2	x	2.70 m	=	2.70 kN/m	x	1.40	=	3.78 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					12.01 kN/m				**16.82 kN/m**

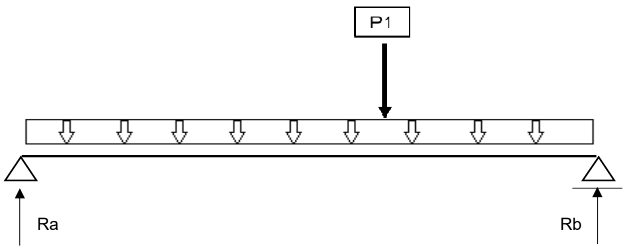
UDL Imposed Loading

New Cavity Wall	0.00 kN/m2	x	2.80 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Roof (sloping)	0.75 kN/m2	x	2.70 m	=	2.03 kN/m	x	1.60	=	3.24 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					2.03 kN/m				**3.24 kN/m**

Point Load P1 @ 1.87 m
From Beam = 1.00 x B12(MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 27.64 kN x 1.40 = 38.70 kN
IL = 17.30 kN x 1.60 = 27.67 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN



Ra = 53.15 kN
unf. DL = 27.48 kN
unf. IL = 9.18 kN

Rb = 71.79 kN
unf. DL = 35.24 kN
unf. IL = 14.03 kN

FORCES IN BEAM

Moment = 62.89 kNm
Shear Force = 71.79 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/250 (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B13

Shear capacity 11.29 %
Moment capacity 66.21 %

Vertical deflection 63.99 %

STEEL BEAM B13 = 200x100x8.0 RHS S355

BEAM WITH PLATE, SEE DETAILS ON SUMMARY PAGE

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B13 (LHS):	B13	53.15	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	100	5.31	440	100	0	1.21	Satisfactory
B13 (RHS):	B13	71.79	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	100	7.18	600	100	0	1.20	Satisfactory

Beam Support Summary:
B13 (LHS): Provide MIN 440x100x215 Concrete Padstone
B13 (RHS): Provide MIN 600x100x250 Concrete Padstone
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B13 - DESIGN DUE TO BS 5950-1

Properties of 200x100x8.0 RHS Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	2.92 m
Flange dimension (RHS section) b =	76.00 mm	Web depth d =	176.00 mm
Flange thickness T =	8.0 mm	Web thickness t =	8.0 mm
Area of cross-section A =	44.8 cm^2	Overall depth D =	200.00 mm
Rad of gyration (minor axis) r =	4.06 cm	Overall breadth B =	100.00 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	2230 cm^4
Elastic modulus Zx =	223 cm^3	Plastic modulus Sx =	282 cm^3

Forces in beam

Moment	=	62.89 kNm
Shear Force	=	71.79 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε = 0.880

Webs d/t = 22.00
Webs (d/t)/ε = 25.00 ≤ 64 Class 1 plastic

Flanges b/t = 9.50
Flanges (b/t)/ε = 10.79 ≤ min(28; 80-d/t/ε) Class 1 plastic

Section is class 1 plastic

Shear capacity
Shear area Av = 2986.67 mm (Av = AD/(D+B), RHS section)
Webs (d/t)/ε = 25.00 ≤ 70 (Web does not need to be checked for shear buckling)
Shear capacity Pv = 636.16 kN
Design shear force = 71.79 kN **OK**

Moment capacity
Design bending moment M= 62.89 kNm
Moment capacity low shear Mc = 95.00 kNm **OK**

Effective length for lateral-torsional buckling
Total Beam Span = 2920 mm
Effective length Le = 3904 mm
Slenderness ratio λ = 96.16

Limiting slenderness ratio
Limiting slenderness ratio 263.38 (Table 15) **λ is less than limiting slenderness ratio, no allowance need be made for lateral-torsional buckling**

Vertical dead & imposed load deflection
Limiting deflection = 11.680 mm (L/250)
Maximum deflection = 7.474 mm **OK**

Vertical imposed load deflection
Limiting deflection = 8.111 mm (L/360)
Maximum deflection = 2.183 mm **OK**

STEEL BEAM B13 (200x100x8.0 RHS) IS DESIGNED CORRECTLY

BEAM B14

Beam Span L = 4.04 m

Load	Load Positioned from (m)	to (m)	Element Span/Height					
New Cavity Wall	0.00	4.04	3.50 m	/	1.00	=	3.50 m	Avg. Due to window opening
Bi-fold Doors	0.00	4.04	2.10 m	/	1.00	=	2.10 m	
-	0.00	4.04	0.00 m	/	1.00	=	0.00 m	
-	0.00	4.04	0.00 m	/	1.00	=	0.00 m	
-	0.00	4.04	0.00 m	/	1.00	=	0.00 m	
B1	0.00	4.04	5.90 m					(LHS)
-	0.00	4.04	0.00 m					

UDL LOADING

UDL Dead Loading

Beam Self Weight					0.23 kN/m	x	1.40	=	0.32 kN/m
New Cavity Wall	3.20 kN/m2	x	3.50 m	=	11.20 kN/m	x	1.40	=	15.68 kN/m
Bi-fold Doors	0.50 kN/m2	x	2.10 m	=	1.05 kN/m	x	1.40	=	1.47 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
B1	3.32 kN	/	5.90 m	=	0.56 kN/m	x	1.40	=	0.79 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.40	=	0.00 kN/m
					13.04 kN/m				**18.25 kN/m**

UDL Imposed Loading

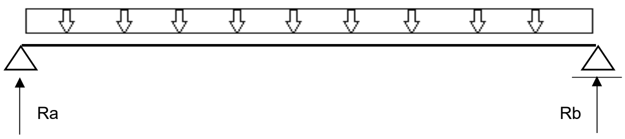
New Cavity Wall	0.00 kN/m2	x	3.50 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
Bi-fold Doors	0.00 kN/m2	x	2.10 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
B1	2.15 kN	/	5.90 m	=	0.36 kN/m	x	1.60	=	0.58 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.60	=	0.00 kN/m
					0.36 kN/m				**0.58 kN/m**

Point Load P1 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P2 @ 0.00 m
From Beam = 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Point Load P3 @ 0.00 m
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.40 = 0.00 kN
IL = 0.00 kN x 1.60 = 0.00 kN

Ra = 38.05 kN
unf. DL = 26.34 kN
unf. IL = 0.73 kN



Rb = 38.05 kN
unf. DL = 26.34 kN
unf. IL = 0.73 kN

FORCES IN BEAM

Moment = 38.43 kNm
Shear Force = 38.05 kN
Axial Force = 0.00 kN

DEFLECTION CRITERIA

L/250 (all loads)
L/360 (imposed loads only)

USAGE OF STEEL BEAM B14

Shear capacity 9.34 %
Moment capacity 60.55 %

Vertical deflection 93.75 %

STEEL BEAM B14 = 200x100x5.0 RHS S355

BEAM WITH PLATE, SEE DETAILS ON SUMMARY PAGE

BEARING CHECK

Beam No	Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
B14 (LHS):	B14	38.05	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	100	3.81	440	100	0	0.86	Satisfactory
B14 (RHS):	B14	38.05	3.6N Blocks	3.5	1.25xfk/3.5 1.25	100	100	3.81	440	100	0	0.86	Satisfactory

Beam Support Summary:
B14 (LHS): Provide MIN 440x100x215 Concrete Padstone
B14 (RHS): Provide MIN 440x100x215 Concrete Padstone
Refer To G.A. for more details.

Beam bearing design details:
Restraint Condition Coef. Support A: 1.2 + 2 x D
Restraint Condition Coef. Support B: 1.2 + 2 x D

STEEL BEAM B14 - DESIGN DUE TO BS 5950-1

Properties of 200x100x5.0 RHS Section

Design strength of steel py =	355.00 N/mm^2	Total beam span L =	4.04 m
Flange dimension (RHS section) b =	85.00 mm	Web depth d =	185.00 mm
Flange thickness T =	5.0 mm	Web thickness t =	5.0 mm
Area of cross-section A =	28.7 cm^2	Overall depth D =	200.00 mm
Rad of gyration (minor axis) r =	4.19 cm	Overall breadth B =	100.00 mm
Modulus of elasticity E =	205.00 GPa	Moment of inertia Ix =	1500 cm^4
Elastic modulus Zx =	149 cm^3	Plastic modulus Sx =	185 cm^3

Forces in beam

Moment	=	38.43 kNm
Shear Force	=	38.05 kN
Axial Force	=	0.00 kN

Beam bearing design details

Restraint Condition Coef. Support A:	1.2 + 2 x D
Restraint Condition Coef. Support B:	1.2 + 2 x D

Classification of cross-section

Parameter ε =	0.880		
Webs d/t =	37.00		
Webs (d/t)/ε =	42.04	≤ 64	Class 1 plastic
Flanges b/t =	17.00		
Flanges (b/t)/ε =	19.32	≤ min(28; 80-d/t/ε)	Class 1 plastic

Section is class 1 plastic

Shear capacity

Shear area Av =	1913.33 mm (Av = AD/(D+B), RHS section)	
Webs (d/t)/ε =	42.04 ≤ 70 (Web does not need to be checked for shear buckling)	
Shear capacity Pv =	407.54 kN	
Design shear force =	38.05 kN	OK

Moment capacity

Design bending moment M=	38.43 kNm	
Moment capacity low shear Mc =	63.47 kNm	OK

Effective length for lateral-torsional buckling

Total Beam Span =	4040 mm
Effective length Le =	5248 mm
Slenderness ratio λ =	125.25

Limiting slenderness ratio

Limiting slenderness ratio 263.38 (Table 15) **λ is less than limiting slenderness ratio, no allowance need be made for lateral-torsional buckling**

Vertical dead & imposed load deflection

Limiting deflection =	16.160 mm (L/250)	
Maximum deflection =	15.149 mm	OK

Vertical imposed load deflection

Limiting deflection =	11.222 mm (L/360)	
Maximum deflection =	0.411 mm	OK

STEEL BEAM B14 (200x100x5.0 RHS) IS DESIGNED CORRECTLY

LOADS ACTING ON THE FOOTING (BELOW COLUMN C2)

Load	Load Positioned from (m)	to (m)	Element Span/Height						Load Dispersion Length
New Cavity Wall	0.00	1.80	7.80 m	/	1.00	=	7.80 m		2*D
Roof (sloping)	0.00	1.80	5.40 m	/	2.00	=	2.70 m		2*D
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m		
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m		
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m		
B13	0.00	0.90	2.10 m					1 x B13 (LHS)	D
L1.	0.00	0.90	1.40 m					1 x L1. (MAX)	D

UDL LOADING
UDL Dead Loading

New Cavity Wall	3.20 kN/m2	x	7.80 m	=	24.96 kN/m	x	1.00	=	24.96 kN/m
Roof (sloping)	1.00 kN/m2	x	2.70 m	=	2.70 kN/m	x	1.00	=	2.70 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
B13	27.48 kN	/	2.10 m	=	13.08 kN/m	x	1.00	=	13.08 kN/m
L1.	14.46 kN	/	1.40 m	=	10.33 kN/m	x	1.00	=	10.33 kN/m
					51.07 kN/m				**51.07 kN/m**

UDL Imposed Loading

New Cavity Wall	0.00 kN/m2	x	7.80 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
Roof (sloping)	0.75 kN/m2	x	2.70 m	=	2.03 kN/m	x	1.00	=	2.03 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
B13	9.18 kN	/	2.10 m	=	4.37 kN/m	x	1.00	=	4.37 kN/m
L1.	2.03 kN	/	1.40 m	=	1.45 kN/m	x	1.00	=	1.45 kN/m
					7.84 kN/m				**7.84 kN/m**

Point Load P1

From Beam	=	1.00 x B10(MAX) + 1.00 x (MAX) + 1.00 x (MAX)				
DL	=	11.86 kN	x	1.00	=	11.86 kN
IL	=	14.36 kN	x	1.00	=	14.36 kN

Point Load P2

From Beam	=	1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)				
DL	=	0.00 kN	x	1.00	=	0.00 kN
IL	=	0.00 kN	x	1.00	=	0.00 kN

DESIGN FORCES

STRIP FOOTING OPTION

Vertical Force N = 105.96 kN 1*B10 (MAX)+UDL*Load Dispersion Length

Allowable Bearing Capacity of Soil = 100.00 kN/m2

LOCATION: COLUMN C2
STRIP FOOTING OPTION

Plan Area Required	N/Allowable Bearing Capacity of Soil	=	1.06 m2
Minimum Footing Width	W	=	0.60 m
Minimum Footing Depth	D	=	0.90 m
Plan Area Provided	W*(2*D)	=	1.08 m2

Plan Area Required **<** **Plan Area Provided** Satisfactory (0.98)

BEARING CHECK BELOW COLUMN C2 PADSTONE @ GROUND FLOOR LEVEL

Total Vertical Load From	kN	Type of Support	Charact. Compr. Strength fk, N/mm2	Local Strength γb*fk/γm N/mm2	Bearing Length mm	Bearing Width mm	Stress Below Bearing N/mm2	Padstone Length mm	Padstone Width mm	Ecc mm	Stress Below Padstone N/mm2	Summary
				1.25xfk/3.5								
C2	39.58	3.6N Blocks	3.5	1.25	-	-	-	440	100	0	0.90	Satisfactory

COLUMN C2 Padstone Summary:
Provide MIN 440x100x215 Concrete Padstone

STRIP FOOTINGS ARE SATISFACTORY IF BELOW CRITERIA ARE FULFILLED:
- DEPTH MEASURED FROM GROUND FLOOR LEVEL TO UNDERSIDE OF FOOTING LEVEL IS NOT LESS THAN 0.90m
- FOOTING WIDTH IS NOT LESS THAN 0.60m; FOOTING THICKNESS IS NOT LESS THAN 0.225m FOR NEW STRIP FOOTING

COLUMN C3 — **DESIGN DUE TO BS 5950-1:2000**

Column Height, L = 3.00 m

SECTION 152 x 152 x 37 UKC S355 E = 205.00 kN/mm2

D = 161.8mm ; B = 154.4mm ; rx = 6.85cm ; ry = 3.87cm ; Ag = 47.1cm2 ; Ix = 2210cm4 ; Iy = 706cm4 ; Zx = 273cm3 ; Zy = 91.5cm3 ; u = 0.848 ; x = 13.3

Major Axis x-x:	Lex =	1.5 * L =	4.50 m	Slenderness:	λx =	Lex / rx =	65.69	OK
Minor Axix y-y:	Ley =	1.5 * L =	4.50 m	Slenderness:	λy =	Ley / ry =	116.28	OK

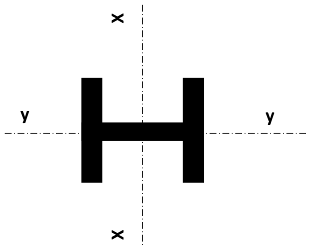
Slenderness factor: v = 1/ [1 + 0.05 (λy /x)^2]^0.25 = 0.67

Equiv. Slenderness: λLT = u v λy √βw = 66.54

VERTICAL LOAD

From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN
IL = 0.00 kN
Eccentricity = B/2 = 77.20 mm

From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN
IL = 0.00 kN
Eccentricity = D/2 = 80.90 mm



From Beam = 1.00 x B11(LHS) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 97.27 kN
IL = 29.63 kN
Eccentricity = D/2 = -80.90 mm

From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN
IL = 0.00 kN
Eccentricity = B/2 = -77.20 mm

HORIZONTAL LOAD

Wind Load	=	0.42 kN/m2
Area	=	4.50 m2
Total Horizontal Load	=	1.91 kN
Construction	=	Simply Supported
Wind Load Applied in	=	Major Axis (x-x)

DESIGN LOADING AND MOMENT **BS 5950 2.4.1.2**

Load Combination 1 1.4 DL + 1.6 IL			Load Combination 2 1.4 DL + 1.4 WL			Load Combination 3 1.2 DL + 1.2 IL + 1.2 WL		
Axial Force	=	183.59 kN	Axial Force	=	136.18 kN	Axial Force	=	152.28 kN
Shear Force	=	0.00 kN	Shear Force	=	1.34 kN	Shear Force	=	1.15 kN
Moment x-x	=	14.85 kNm	Moment x-x	=	12.35 kNm	Moment x-x	=	13.47 kNm
Moment y-y	=	0.00 kNm	Moment y-y	=	0.00 kNm	Moment y-y	=	0.00 kNm

Factored Forces			**Unfactored Forces**		
Max. Axial Force, Fc	=	183.59 kN	Max. Axial Force DL	=	97.27 kN
Max. Shear Force	=	1.34 kN	Max. Axial Force IL	=	29.63 kN
Max. Major Moment x-x, Mx	=	14.85 kNm	Max. Shear Force	=	0.95 kN
Max. Minor Moment y-y, My	=	0.00 kNm	Max Moment x-x	=	11.22 kNm
			Max Moment y-y	=	0.00 kNm

ALLOWABLE STRESSES

Design Strength of Steel	py	=	355.00 N/mm2	
Compressive Strength	pcy	=	112.00 N/mm2	(table 24, curve c)
Bending Strength	pb	=	239.00 N/mm2	(table 16 for I-sections, pb = py for SHS sections)

ACTUAL

Compression Resistance	Pcy = Ag * pcy	=	527.52 kN	
Moment Capacity (Major Axis)	Mc,x = py * Zx	=	96.92 kNm	
Moment Capacity (Minor Axis)	Mc,y = py * Zy	=	32.48 kNm	
Buckling Resistance Moment	Mb= pb * Zx	=	65.25 kNm	(For SHS Sections Mb = Mc,x)

SUMMARY

[1] Fc / Pcy	=	0.35	OK
[2] mLT * Mx / Mb ; mLT = 1.0	=	0.23	OK
[3] my * My / Mc,y ; my = 1.0	=	0.00	OK

[1] + [2] + [3] = 0.58 < 1.00 OK

DEFLECTIONS

Allowable Deflection	L/300	=	10.00 mm	
Moment from vertical loads: x-x	M	=	10.27 kNm	
Vertical loads max deflection: x-x	M*L^2 / 16EI	=	1.27 mm	
Moment from vertical loads: y-y	M	=	0.00 kNm	
Vertical loads max deflection: y-y	M*L^2 / 16EI	=	0.00 mm	
Wind load Horizontal force: x-x	H	=	1.91 kN	
Wind loads maximum deflection	H * L^3 / 48EI	=	0.24 mm	
Max Deflection		=	1.51 mm	OK

STEEL COLUMN C3 = 152 x 152 x 37 UKC (S355)

LOADS ACTING ON THE FOOTING (BELOW COLUMN C3)

Load	Load Positioned from (m)	to (m)	Element Span/Height					Load Dispersion Length
215mm/Cavity Wall	0.00	5.00	5.20 m	/	1.00	=	5.20 m	2*D
Roof (sloping)	0.00	5.00	4.00 m	/	2.00	=	2.00 m	2*D
Timber floor (1st)	0.00	2.50	3.80 m	/	2.00	=	1.90 m	D
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m	
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m	
-	0.00	1.00	0.00 m					
-	0.00	1.00	0.00 m					

UDL LOADING
UDL Dead Loading

215mm/Cavity Wall	4.20 kN/m2	x	5.20 m	=	21.84 kN/m	x	1.00	=	21.84 kN/m
Roof (sloping)	1.00 kN/m2	x	2.00 m	=	2.00 kN/m	x	1.00	=	2.00 kN/m
Timber floor (1st)	1.10 kN/m2	x	1.90 m	=	2.09 kN/m	x	1.00	=	2.09 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
					25.93 kN/m				**25.93 kN/m**

UDL Imposed Loading

215mm/Cavity Wall	0.00 kN/m2	x	5.20 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
Roof (sloping)	0.75 kN/m2	x	2.00 m	=	1.50 kN/m	x	1.00	=	1.50 kN/m
Timber floor (1st)	1.50 kN/m2	x	1.90 m	=	2.85 kN/m	x	1.00	=	2.85 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
					4.35 kN/m				**4.35 kN/m**

Point Load P1

From Beam	=	1.00 x B11(LHS) + 1.00 x (MAX) + 1.00 x (MAX)				
DL	=	97.27 kN	x	1.00	=	97.27 kN
IL	=	29.63 kN	x	1.00	=	29.63 kN

Point Load P2

From Beam	=	1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)				
DL	=	0.00 kN	x	1.00	=	0.00 kN
IL	=	0.00 kN	x	1.00	=	0.00 kN

DESIGN FORCES

PAD FOUNDATION OPTION

Vertical Force	Pz	=	165.84 kN	1*B11 (LHS)+UDL*Load Dispersion Length
Horizontal Force in x direction	Fx	=	0.00 kN	
Horizontal Force in y direction	Fy	=	0.00 kN	
Major axis moment x-x	Mxx	=	0.00 kNm	
Major axis moment y-y	Myy	=	0.00 kNm	
Eccentricity x-x	ex	=	0.00 mm	
Eccentricity y-y	ey	=	0.00 mm	

Allowable Bearing Capacity of Soil = 100.00 kN/m2

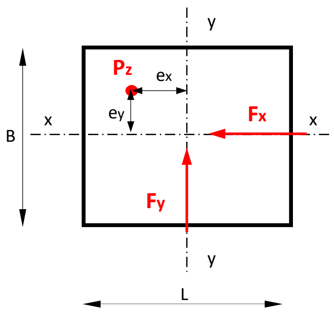
LOCATION: COLUMN C3
STRIP FOOTING OPTION

- STRIP FOOTING IS NOT RECOMMENDED FOR STRUCTURAL REASONS

PAD FOUNDATION OPTION

FOUNDATION DIMENSIONS

Length of Pad Footing	L	=	1.40 m		
Width of Pad Footing	B	=	1.40 m		
Depth of Pad Footing	H	=	0.50 m		
Pad Foundation Selfweight	Sf	=	12.00 kN/m2		
Area of Pad Foundation	A=L*B	=	1.96 m2		
Bearing Pressure	(Pz+Sf)/A	=	96.61 kN/m2	Satisfactory	



CHECK STABILITY AGAINST OVERTURNING IN X-DIRECTION

Total Overturning Moment	Mox=Myy+Fx*H	=	0.00 kNm		
Total Restoring Moment	Mrx=Pz*(L/2-ex)+Sf*A*L/2	=	132.55 kNm		
Overturning Safety Factor	FOS=Mrx/Mox	=	Correct		

CHECK STABILITY AGAINST OVERTURNING IN Y-DIRECTION

Total Overturning Moment	Moy=Mxx+Fy*H	=	0.00 kNm		
Total Restoring Moment	Mry=Pz*(B/2-ey)+Sf*A*B/2	=	132.55 kNm		
Overturning Safety Factor	FOS=Mry/Moy	=	Correct		

PAD FOUNDATION BASE REACTIONS AND BASE PRESSURES IN X-DIRECTION

Total Pad Base Reaction	T=Pz+Sf*A	=	189.36 kN		
Total Pad Base Moment	Mbx=Myy+Pz*ex+Fx*H	=	0.00 kNm		
Maximum Base Pressure	qxmax=T/A+6*Mbx/(B*L*L)	=	96.61 kN/m2	Satisfactory	(0.97)
Minimum Base Pressure	qxmin=T/A-6*Mbx/(B*L*L)	=	96.61 kN/m2	Satisfactory	(0.97)

PAD FOUNDATION BASE REACTIONS AND BASE PRESSURES IN Y-DIRECTION

Total Pad Base Reaction	T=Pz+Sf*A	=	189.36 kN		
Total Pad Base Moment	Mby=Mxx+Pz*ey+Fy*H	=	0.00 kNm		
Maximum Base Pressure	qymax=T/A+6*Mby/(L*B*B)	=	96.61 kN/m2	Satisfactory	(0.97)
Minimum Base Pressure	qymin=T/A-6*Mby/(L*B*B)	=	96.61 kN/m2	Satisfactory	(0.97)

CHECK PAD BASE REACTION ECCENTRICITY AND BEARING PRESSURE IN X-DIRECTION

Half of base	l=L/2	=	0.70 m		
Middle Third of Base	tx=L/6	=	0.23 m		
Eccentricity of Base Reaction	ebx=Mbx/T	=	0.00 m	Within Middle Third of Base	
Bearing Pressure	Qx=qxmax	**=**	**96.61 kN/m2**	Satisfactory	(0.97)

CHECK PAD BASE REACTION ECCENTRICITY AND BEARING PRESSURE IN Y-DIRECTION

Half of base	b=B/2	=	0.70 m		
Middle Third of Base	ty=B/6	=	0.23 m		
Eccentricity of Base Reaction	eby=Mby/T	=	0.00 m	Within Middle Third of Base	
Bearing Pressure	Qy=qymax	**=**	**96.61 kN/m2**	Satisfactory	(0.97)

PROVIDE 1.40m x 1.40m PAD FOOTING WITH 0.50m PAD THICKNESS
AND 3No A393 MESH (1 TOP & 2 BOTTOM)

REGEN project In partnership with D & P Solutions	Project	Beeches, Long Meadow, Goring on Thames RG89EG	
	Subject	Structural Calculations	

Calculation Number	Rev	Des.	Chkd.	Chkd.	Date
23-1806-C01	B	DL	DK	DK	21.02.24

COLUMN C4 **DESIGN DUE TO BS 5950-1:2000**

Column Height, L = 3.00 m

SECTION 152 x 152 x 37 UKC S355 E = 205.00 kN/mm2

D = 161.8mm ; B = 154.4mm ; rx = 6.85cm ; ry = 3.87cm ; Ag = 47.1cm2 ; Ix = 2210cm4 ; Iy = 706cm4 ; Zx = 273cm3 ; Zy = 91.5cm3 ; u = 0.848 ; x = 13.3

Major Axis x-x:	Lex =	1.5 * L =	4.50 m	Slenderness:	λx =	Lex / rx =	65.69	OK
Minor Axix y-y:	Ley =	1.5 * L =	4.50 m	Slenderness:	λy =	Ley / ry =	116.28	OK

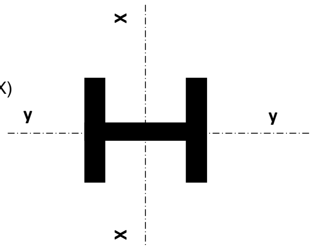
Slenderness factor: v = 1/ [1 + 0.05 (λy /x)^2]^0.25 = 0.67

Equiv. Slenderness: λLT = u v λy √βw = 66.54

VERTICAL LOAD

From Beam = 1.00 x B12(LHS) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 27.64 kN
IL = 17.30 kN
Eccentricity = B/2 = 77.20 mm

From Beam = 1.00 x B11(RHS) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 100.27 kN
IL = 31.80 kN
Eccentricity = D/2 = 80.90 mm



From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN
IL = 0.00 kN
Eccentricity = D/2 = -80.90 mm

From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN
IL = 0.00 kN
Eccentricity = B/2 = -77.20 mm

HORIZONTAL LOAD

Wind Load	=	0.00 kN/m2
Area	=	0.00 m2
Total Horizontal Load	=	0.00 kN
Construction	=	Simply Supported
Wind Load Applied in	=	Major Axis (x-x)

DESIGN LOADING AND MOMENT **BS 5950 2.4.1.2**

Load Combination 1 1.4 DL + 1.6 IL			Load Combination 2 1.4 DL + 1.4 WL			Load Combination 3 1.2 DL + 1.2 IL + 1.2 WL		
Axial Force	=	257.63 kN	Axial Force	=	179.08 kN	Axial Force	=	212.41 kN
Shear Force	=	0.00 kN	Shear Force	=	0.00 kN	Shear Force	=	0.00 kN
Moment x-x	=	15.47 kNm	Moment x-x	=	11.36 kNm	Moment x-x	=	12.82 kNm
Moment y-y	=	5.12 kNm	Moment y-y	=	2.99 kNm	Moment y-y	=	4.16 kNm

Factored Forces			**Unfactored Forces**		
Max. Axial Force, Fc	=	257.63 kN	Max. Axial Force DL	=	127.91 kN
Max. Shear Force	=	0.00 kN	Max. Axial Force IL	=	49.10 kN
Max. Major Moment x-x, Mx	=	15.47 kNm	Max. Shear Force	=	0.00 kN
Max. Minor Moment y-y, My	=	5.12 kNm	Max Moment x-x	=	10.68 kNm
			Max Moment y-y	=	3.47 kNm

ALLOWABLE STRESSES

Design Strength of Steel	py	=	355.00 N/mm2	
Compressive Strength	pcy	=	112.00 N/mm2	(table 24, curve c)
Bending Strength	pb	=	239.00 N/mm2	(table 16 for I-sections, pb = py for SHS sections)

ACTUAL

Compression Resistance	Pcy = Ag * pcy	=	527.52 kN	
Moment Capacity (Major Axis)	Mc,x = py * Zx	=	96.92 kNm	
Moment Capacity (Minor Axis)	Mc,y = py * Zy	=	32.48 kNm	
Buckling Resistance Moment	Mb= pb * Zx	=	65.25 kNm	(For SHS Sections Mb = Mc,x)

SUMMARY

[1] Fc / Pcy	=	0.49	OK
[2] mLT * Mx / Mb ; mLT = 1.0	=	0.24	OK
[3] my * My / Mc,y ; my = 1.0	=	0.16	OK

[1] + [2] + [3] = 0.88 < 1.00 OK

DEFLECTIONS

Allowable Deflection	L/300	=	10.00 mm
Moment from vertical loads: x-x	M	=	10.68 kNm
Vertical loads max deflection: x-x	M*L^2 / 16EI	=	1.33 mm
Moment from vertical loads: y-y	M	=	3.47 kNm
Vertical loads max deflection: y-y	M*L^2 / 16EI	=	1.35 mm
Wind load Horizontal force	H	=	0.00 kN
Wind loads maximum deflection	H * L^3 / 48EI	=	0.00 mm
Max Deflection		=	1.35 mm

OK **STEEL COLUMN C4 = 152 x 152 x 37 UKC (S355)**

LOADS ACTING ON THE FOOTING (BELOW COLUMN C4)

Load	Load Positioned from (m)	to (m)	Element Span/Height					Load Dispersion Length
215mm/Cavity Wall	0.00	0.60	4.80 m	/	1.00	=	4.80 m	D
-	0.00	0.60	0.00 m	/	1.00	=	0.00 m	D
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m	
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m	
-	0.00	1.00	0.00 m	/	1.00	=	0.00 m	
-	0.00	1.00	0.00 m					
-	0.00	1.00	0.00 m					

UDL LOADING
UDL Dead Loading

215mm/Cavity Wall	4.20 kN/m2	x	4.80 m	=	20.16 kN/m	x	1.00	=	20.16 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
					20.16 kN/m				**20.16 kN/m**

UDL Imposed Loading

215mm/Cavity Wall	0.00 kN/m2	x	4.80 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
-	0.00 kN	/	0.00 m	=	0.00 kN/m	x	1.00	=	0.00 kN/m
					0.00 kN/m				**0.00 kN/m**

Point Load P1
From Beam = 1.00 x B11(RHS) + 1.00 x B12(LHS) + 1.00 x (MAX)
DL = 127.91 kN x 1.00 = 127.91 kN
IL = 49.10 kN x 1.00 = 49.10 kN

Point Load P2
From Beam = 1.00 x (MAX) + 1.00 x (MAX) + 1.00 x (MAX)
DL = 0.00 kN x 1.00 = 0.00 kN
IL = 0.00 kN x 1.00 = 0.00 kN

DESIGN FORCES

PAD FOUNDATION OPTION

Vertical Force	Pz	=	193.14 kN	1*B11 (RHS) +1*B12 (LHS)+UDL*Load Dispersion Length
Horizontal Force in x direction	Fx	=	0.00 kN	
Horizontal Force in y direction	Fy	=	0.00 kN	
Major axis moment x-x	Mxx	=	0.00 kNm	
Major axis moment y-y	Myy	=	0.00 kNm	
Eccentricity x-x	ex	=	0.00 mm	
Eccentricity y-y	ey	=	0.00 mm	

Allowable Bearing Capacity of Soil = 100.00 kN/m2

REGEN project In partnership with D & P Solutions	Project: Beeches, Long Meadow, Goring on Thames RG89EG				
	Subject: Structural Calculations				
	Calculation Number 23-1806-C01	Rev B	Des. DL	Chkd. DK	Chkd. DK	Date 21.02.24

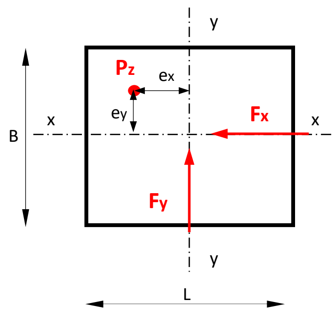
LOCATION: COLUMN C4
STRIP FOOTING OPTION

- STRIP FOOTING IS NOT RECOMMENDED FOR STRUCTURAL REASONS

PAD FOUNDATION OPTION

FOUNDATION DIMENSIONS

Length of Pad Footing	L	=	1.60 m		
Width of Pad Footing	B	=	1.60 m		
Depth of Pad Footing	H	=	0.60 m		
Pad Foundation Selfweight	Sf	=	14.40 kN/m2		
Area of Pad Foundation	A=L*B	=	2.56 m2		
Bearing Pressure	(Pz+Sf)/A	=	89.84 kN/m2	Satisfactory	



CHECK STABILITY AGAINST OVERTURNING IN X-DIRECTION

Total Overturning Moment	Mox=Myy+Fx*H	=	0.00 kNm
Total Restoring Moment	Mrx=Pz*(L/2-ex)+Sf*A*L/2	=	184.00 kNm
Overturning Safety Factor	FOS=Mrx/Mox	=	Correct

CHECK STABILITY AGAINST OVERTURNING IN Y-DIRECTION

Total Overturning Moment	Moy=Mxx+Fy*H	=	0.00 kNm
Total Restoring Moment	Mry=Pz*(B/2-ey)+Sf*A*B/2	=	184.00 kNm
Overturning Safety Factor	FOS=Mry/Moy	=	Correct

PAD FOUNDATION BASE REACTIONS AND BASE PRESSURES IN X-DIRECTION

Total Pad Base Reaction	T=Pz+Sf*A	=	230.00 kN		
Total Pad Base Moment	Mbx=Myy+Pz*ex+Fx*H	=	0.00 kNm		
Maximum Base Pressure	qxmax=T/A+6*Mbx/(B*L*L)	=	89.84 kN/m2	Satisfactory	(0.90)
Minimum Base Pressure	qxmin=T/A-6*Mbx/(B*L*L)	=	89.84 kN/m2	Satisfactory	(0.90)

PAD FOUNDATION BASE REACTIONS AND BASE PRESSURES IN Y-DIRECTION

Total Pad Base Reaction	T=Pz+Sf*A	=	230.00 kN		
Total Pad Base Moment	Mby=Mxx+Pz*ey+Fy*H	=	0.00 kNm		
Maximum Base Pressure	qymax=T/A+6*Mby/(L*B*B)	=	89.84 kN/m2	Satisfactory	(0.90)
Minimum Base Pressure	qymin=T/A-6*Mby/(L*B*B)	=	89.84 kN/m2	Satisfactory	(0.90)

CHECK PAD BASE REACTION ECCENTRICITY AND BEARING PRESSURE IN X-DIRECTION

Half of base	l=L/2	=	0.80 m		
Middle Third of Base	tx=L/6	=	0.27 m		
Eccentricity of Base Reaction	ebx=Mbx/T	=	0.00 m	Within Middle Third of Base	
Bearing Pressure	Qx=qxmax	**=**	**89.84 kN/m2**	Satisfactory	(0.90)

CHECK PAD BASE REACTION ECCENTRICITY AND BEARING PRESSURE IN Y-DIRECTION

Half of base	b=B/2	=	0.80 m		
Middle Third of Base	ty=B/6	=	0.27 m		
Eccentricity of Base Reaction	eby=Mby/T	=	0.00 m	Within Middle Third of Base	
Bearing Pressure	Qy=qymax	**=**	**89.84 kN/m2**	Satisfactory	(0.90)

PROVIDE 1.60m x 1.60m PAD FOOTING WITH 0.60m PAD THICKNESS
AND 3No A393 MESH (1 TOP & 2 BOTTOM)