BEAM CALCULATIONS (DOC 2 OF 2)

BY

CALCS-ONLINE.CO.UK

DOCUMENT REFERENCE

15-0295-C02

FOR

Ms Helen Burrows

PROJECT ADDRESS

59B OSENEY CRESCENT, NW5

Calculations By :	**IEA**	**26/05/15**
Revision :	**0**	
Checked By :	**AM**	**26/05/15**
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INTRODUCTION

The following document is associated with the construction work to take place at the above mentioned address and contains design calculations for structural elements, as well as approximate schematic arrangements of those elements.

DEFINITIONS

The "Engineer" is PorthouseDean Limited.
The "Client" is the individual or organisation that has instructed the engineer to carry out structural engineering consultancy work.
The "Architect" is the individual or organisation that has provided the information upon which these calculations are based.
The "Builder" is the contractor who has been engaged to undertake the construction work to which this document relates.

IMPORTANT GUIDANCE ON THE USE OF THIS DOCUMENT (TO BE READ BY ALL PARTIES)

This document is intended to be accompanied by all relevant architects' and engineer's drawings, and all relevant documentation should be considered prior to commencement of the work. Engineer's drawings relating to this document will be explicitly outlined herein. The document is arranged in the following order:

1. Introduction - a general outline of the purpose of the document
2. Important Guidance on the Use of this Document (to be Read by All Parties)
3. Approach / **Methodology** - outlining the analysis and design approach
4. Design Standards - defining the generally adopted design standards i.e. British Standards
5. Load Combinations - combinations of load adopted as outlined in the design standards
6. Materials - technical data relating to the materials specified
7. Loading Details - a breakdown of dead and imposed loads adopted for the design
8. Health and Safety Notes
9. Construction Notes - important notes associated with construction requirements (primarily for builder's use)
10. Structural Layouts - this is where the proposed structural layouts and element sizes are summarised
11. Element Design Calculations - analysis and design calculations for individual elements, analysis summaries for frames
12. Appendices - if required, the numerical data from computer analysis and/or design calculations

The document should be reviewed in its entirety by the builder, architect (if applicable) and client, along with any other relevant documentation, prior to commencement of the work, and any layouts, instructions or recommendations should be followed. Any deviations from the proposals outlined herein are to be approved by the engineer prior to the work being undertaken. Any deviations from the proposals made without the engineer's consent are beyond the scope of this document and the engineer cannot be held liable for any adverse consequences of such deviations.

The calculations carried out in this document have been carried out in good faith based on the proposed and existing dimensions and data provided by the client and/or architect. Where appropriate extracts of the information provided will be included within this document for reference. It is the responsibility of the architect (where applicable) or client to notify the engineer when changes are made to the proposals so that the design can be reviewed and, where necessary, changes made to the design.

Approval of these calculations and drawings by the Local Authority Building Control should be obtained prior to any ordering of material or fabrication. No liability is accepted for any changes that may be required as a result of work having commenced prior to such an approval having been obtained.

Where information about the existing arrangements of buildings, such as floor / roof span orientations or load-bearing wall arrangements, is not available, the engineer will use their judgement to make assumptions. These, generally conservative assumptions will be clearly outlined within the document, and should be confirmed by a suitably qualified individual on site prior to commencement of the work. The engineer is then to be notified of any discrepancies prior to commencement of the work as design changes may be necessary.

Where drawings, construction specifications, method statements or additional design calculations are omitted and are not referenced it is because these have not been requested by the client. These can be made available by the engineer at the client's request.

IF IN DOUBT: ASK!!

APPROACH / METHODOLOGY

All structural members are to be designed to be capable of withstanding all the applied loadings during construction, operation and maintenance of the building without any distress, failure, loss of function, damage or durability problems. They are to support the most onerous combinations of dead, imposed and (where applicable) wind loads tending to produce either maximum ultimate stresses or deflection.

The design calculations are based on the information provided by the client / architect.

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DESIGN STANDARDS

BS 6399	Loadings for Buildings	Part 2	Code of practice for dead and imposed loads.
BS 5950	Structural use of Steelwork in Buildings	Part 1	Code of practice for design: Hot rolled and welded sections
BS 8110	Structural use of Concrete	Part 1	Code of Practice for design and construction.
BS5628	Structural use of Masonry	Part 1	Code of practice for un-reinforced masonry.
BS 5268	Structural use of Timber	Part 2	Code of practice for permissible stress design, materials and workmanship

LOAD COMBINATIONS

Loads are combined in all valid combinations of adverse and beneficial effects to obtain the most onerous load condition. Load Factors are adopted generally in accordance with the recommendations of table 2.1 of BS 8110 part 1: 1997. The load combinations used are summarised in the table below:

Combination	Dead	Imposed	Wind
01 : DL + IL	1.4	1.6	-
02 : DL+IL+WL	1.2	1.2	1.2
03 : DL + WL	0.9	-	1.4

MATERIALS (UNLESS NOTED OTHERWISE)

- All steelwork is of Grade 43A (Grade S275 to EN 10025: 1993).
- All concrete is to be Grade C28/35 to BS8500-1.
- All reinforcement for concrete is to be high yield (fy = 500 N/mm2) to BS4449:2005.
- All timber is to be Grade C24 to BS5268:2-2005
- All strip / pad foundations are to be reinforced concrete construction (concrete / reinforcement specs as noted above)
- All new blockwork is to be dense 7N/mm2. All new bricks to be standard format clay 30N/mm2. All mortar to be designation (iii) to BS5628.

LOADING DETAILS

Roof Dead

Finishes	= 0.40	kN/m2
Battens / Felt / Insulation	= 0.20	kN/m2
Structure	= 0.20	kN/m2
Ceiling	= 0.20	kN/m2
	= 1.00	kN/m2

Roof Imposed

Pitched Roof Snow / Access	= 0.60	kN/m2
Flat Roof Snow / Access	= 0.75	kN/m2

Walls

Brickwork	=	2.10	kN/m2
Blockwork	=	2.10	kN/m2
225mm Thick Solid Brick Wall	=	4.20	kN/m2
Internal Timber Stud Wall	=	0.35	kN/m2
Tile Hung Dormer Face Wall	=	1.00	kN/m2

Floor Dead

Finishes	= 0.20	kN/m2
Insulation	= 0.10	kN/m2
Joists	= 0.10	kN/m2
Ceiling	= 0.20	kN/m2
Stud Walls	= 0.50	kN/m2
	= 1.10	kN/m2

Floor Imposed

Self Contained Dwelling Unit	=	1.50	kN/m2
Storage Space	=	1.00	kN/m2

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HEALTH AND SAFETY INFORMATION

It should be noted that structural work, particularly where this involves the transit and installation of large, heavy structural elements, has the potential to be hazardous. Where possible any specific risks are identified either within these calculations or drawings related to this document.

An overview of the health and safety risks which may result from the undertaking of instructions noted in this document (and related documents), and possible means of mitigating these risks are noted in the table below. If you would like any guidance on the table below please ask the engineer.

No.	Description of Risk	Risk of Occurrence	Possible Consequence(s)	Possible Mitigation Measures
1	Crushing due to falling structural elements	High	Death Serious Injury Damage to Property	a) Reduce weight of elements b) Find alternative method of construction c) Splicing of large / heavy structural elements to reduce handling weights d) Produce method statement for installation e) Use of suitable lifting equipment f) Ensure suitable temporary works in place
2	Collapsing trenches / banks of retained earth	High	Death Serious Injury	a) Stabilise earth using box shutters / raking shores / sheet piles or other during construction b) Restricting persons from working in deep trenches or adjacent to steep banks of un-retained earth
3	Rupture of concrete shuttering	Medium	Serious Injury Damage to Property	a) Ensure concrete pour heights of not more than 0.75m b) Ensure suitable shuttering in place
4	Fire from site welding	High	Death Serious Injury Damage to Property	a) Check for combustible materials in vicinity. Implement suitable precautionary measures e.g. removal or shielding of combustible materials. b) Avoid site welding except where absolutely necessary
5	Fire from shot-firing	Medium	Death Serious Injury Damage to Property	a) Check for combustible materials in vicinity. Implement suitable precautionary measures e.g. removal or shielding of combustible materials. b) Avoid shot-firing except where absolutely necessary
6	General site risks i.e. falls from height, falling objects, hazardous / heavy machinery etc.	High	Death Serious Injury	a) Use PPE i.e. hard-hat, gloves, goggles, hi-viz clothing, earplugs, site boots et al. b) Implement general precautionary measures i.e. installation of necessary barriers, signage, alarms etc. c) Conduct sites-specific health and safety assessments d) Produce method statements

GENERAL CONSTRUCTION NOTES

- Any span dimensions shown in this document are for the purpose of calculations only and are not to be used as a final dimension for the fabrication / machining of structural elements.
- All dimensions are to be checked on site by the builder / contractor / fabricator prior to commencement of fabrication / machining / construction. Any discrepancies between the information outlined herein and the dimensions on site are to be reported to the engineer.
- Temporary works are the sole responsibility of the builder / contractor. Temporary works method statements are to be provided to the engineer by the builder / contractor prior to commencement of the work.
- All parties are assumed to be aware of their responsibilities under the Construction Design and Management (CDM) Regulations 2007. If you are unsure of this please contact the engineer.
- All proprietary (i.e. off-the-shelf) items specified within this document are to be installed in strict accordance with the manufacturer's recommendations. This includes, but is not limited to, restraint straps, lintels, chemical / resin anchors and fixing brackets.
- Where beams are to be seated on posts they are to be positioned centrally on the posts unless noted otherwise.

MASONRY NOTES

- At locations where bearing information is provided on the layout generally this will be in a position where load-bearing masonry (with foundations / support) has been assumed. It should be confirmed by a suitably qualified individual that these walls are load-bearing, and the masonry is to be inspected for suitability prior to commencement of the work.
- In many instances historic buildings, particularly in the south east, will have poor quality masonry and degrading mortar capable of sustaining only a limited amount of compressive force. In such cases the engineer should be notified as the padstone sizes specified may need to be increased in size.
- All padstones specified are to be C35 concrete (as specified in the materials section). Where it is not possible to find "off the shelf" padstone sizes it may be necessary to cast in-situ padstones.
- Where existing masonry is deemed to be of poor quality, or where the mortar has degraded significantly, the brickwork should be either re-pointed or replaced in its entirety as appropriate prior to loading.
- Where steel beams bear directly onto masonry (i.e. no padstones) they are to be bedded onto a dry / level mortar bed.
- Unless noted otherwise all concrete blocks are to be bedded on narrow edge i.e. NOT laid flat.

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STEELWORK NOTES

- Where possible beams installed in pairs should be bolted together through the centre of the webs using M12 bolts @ 500mm centres with spacer tubes in between.
- All steel beams which are to support a wall above are to be positioned centrally to that wall. Where this is a single beam supporting a cavity wall the beam is to be installed central to the cavity, and, if necessary, an 8mm thick mild steel plate is to be welded centrally to the top flange to suit the cavity wall width above.
- All beams are to be seated centrally on padstones and posts unless noted otherwise.
- Unless noted otherwise in the design or layout information beams are to bear over the full width of any spreader or post.
- In some instances where single beams support external walls (acting as window lintels) a 10mm mild steel shelf plate will be required to be continuously fillet welded to the under-side of the beam to support the outer leaf of masonry. This requirement is to be confirmed by the architect prior to commencement of the work. The plate is to extend for the full length of the beam (including the bearings) and is to be grouted into the outer leaf masonry bed joints at the bearings.
- Where cranked beams are specified these should be full-strength butt-welded at the cranked joint by a suitably qualified steel fabricator unless noted otherwise. Any welded joints should be tested in accordance with the relevant British or European standards.
- For steelwork levels refer to the architect's drawings.
- All steel fabricator's drawings and specifications are to be forwarded to the engineer for approval prior to commencement of fabrication.
- Where possible beams are to be bolted to the centreline of the supporting masonry wall / column /padstone using 2 No. proprietary M12 chemical anchors, and the padstone strapped down to the adjacent masonry using 2 No. mild steel restraint straps. DO NOT BOLT AWAY FROM THE CENTRE LINE OF THE MASONRY / PADSTONE. Where the centre line of the masonry / padstone is not accessible the beam itself is to be strapped.
- Where columns / posts are to be set into or flush up against a masonry wall they are to be fixed by either welding / shot-firing frame cramps to the web / flange @ 450mm vertical centres (to be coursed into the masonry bed joints), or bolted to the face of the wall by welding flat mild steel brackets to the flanges of the column @450mm vertical centres and bolting through using M12 chemical anchors.
- Provide 15mm gap to under-side of steelwork at interesecting wall locations where no bearing information is shown so as to prevent unintended load transfer to non load-bearing walls.

TIMBER NOTES

- Where two or more pieces of timber are specified together (as constituent parts of the same member) the timbers are to be bolted together along the vertical centreline using M12 bolts @ 500mm centres.
- All timbers are to have an end bearing length of not less than 100mm, or the full width of any supporting post.
- Where members are to be notched at the supports to a depth greater than 1/3 of the depth of the member the engineer is to be notified.
- Joints between members are to be created using either traditional joinery techniques or proprietary fixings. Where input is required contact the engineer.

FOUNDATION NOTES

- Foundation designs calculations will, unless noted otherwise, be based on as assumed bearing capacity of 100kN/m^2. For the design to be valid it should be ensured that the formation level bearing stratum is inspected for suitability on site by an LABC officer or other suitably qualified individual prior to commencement of the work. If the formation level stratum is found not to achieve the required bearing capacity stated herein the engineer is to be notified immediately as a design review will be required.
- Unless this is a document specifically intended to calculate required spread footing depths for shrinkable clays with near-by vegetation the foundation depths will not be specified within this document. Any reference to "depths" of footings or pads will likely refer to the thickness of the concrete required.
- General minimum depths for strip footings / spread foundations are not less than 450mm for bearing strata other than clay, and not less than 900mm for footings in shrinkable clay with no nearby vegetation. For foundations in shrinkable clays the proximity of nearby vegetation should be carefully considered and the guidance of the engineer and/or LABC officer should be sought as spread foundations may not be suitable or the footing depth may need to be calculated.
- Where the thickness of concrete specified in spread foundations is not sufficient to reach a suitable bearing stratum the excavation can be filled using either well compacted crushed hardcore or lean-mix concrete up to foundation formation level.
- Where openings are to be created in existing walls which may reduce the effective area of the foundations, or where the load is to be focused on a particular area of existing foundations, it is advised that the foundations are inspected for suitability by an LABC officer or other suitably qualified individual prior to commencement of the work.

SYMBOL KEY FOR ELEMENT LAYOUTS

P# = CONCRETE PADSTONE SPEC. ### = END BEARING LENGTH SPECIFICATION IN mm = RESTRAINT STRAP

B# = STEEL BEAM SPECIFICATION COL# = STEEL POST SPECIFICATION = LOAD-BEARING MASONRY

T# = TIMBER BEAM SPECIFICATION TP# = TIMBER POST SPECIFICATION = LOAD-BEARING TIMBER STUD WALL

MP# = MASONRY PIER SPECIFICATION F1 = SPREAD FOUNDATION SPECIFICATION = ASSUMED JOIST / RAFTER SPAN DIRECTION

= PROPOSED JOIST / RAFTER SPAN DIRECTION

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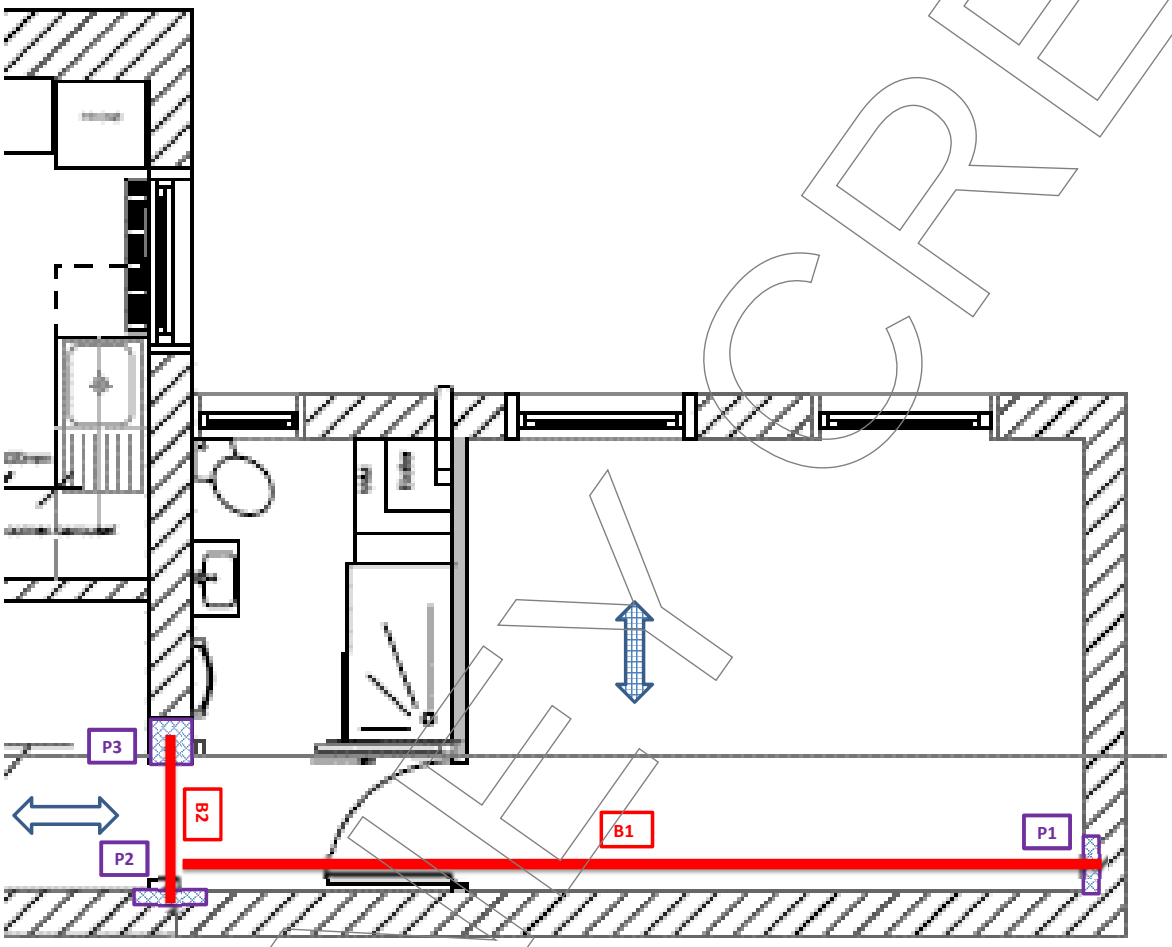
1st FLOOR CEILING LEVEL STRUCTURAL DETAILS (SHOWN OVER FIRST FLOOR PLAN)

FOR RELATED CONSTRUCTION NOTES REFER TO PAGES 2 to 5



STEEL ELEMENTS

B1 = 152x152x37 UC
B2 = 152x152x23 UC

SHELF PLATES MAY BE REQUIRED. FOR SHELF PLATE DETAILS REFER TO PG 5.

TIMBER ELEMENTS

TERRACE JOISTS = 150x50 C24 @400mm c/c

SOLID TIMBER BLOCKING AT 1/3 SPANS TO BE PROVIDED BETWEEN NEW FLOOR JOISTS.

DETAILED DRAWINGS RELATED TO THIS LAYOUT

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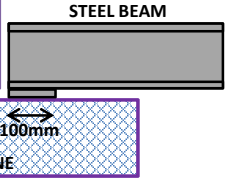
PADSTONES

P1 = 440x100x215 PADSTONE
P2 = 500x100x215 PADSTONE
P3 = 300x(WALL WIDTH)x215 PADSTONE WITH SHIM

FOR PADSTONES WITH SHIMS SEE TYPICAL END BEARING DETAIL WITH SHIM

100x100x10mm THICK M.S. SHIMS SEATED CENTRALLY ON PADSTONE TO RECEIVE BEAM END, THUS ENSURING EVEN DISTRIBUTION OF PRESSURE.



TYPICAL END BEARING DETAIL WITH SHIM

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BEAM REFERENCE = TERRACE JOISTS

Arrangement Details

Beam Span 3.10 m

Load	Beam Loaded from (m)	Beam Loaded to (m)	Element span / height (m)				
1st Floor	0.00	3.10	0.00	/	2	=	0.00 m
2nd Floor	0.00	3.10	0.00	/	2	=	0.00 m
Wall	0.00	3.10	0.00	/	1	=	0.00 m
Balcony	0.00	3.10	0.40	/	1	=	0.40 m

UDL

Dead Loading

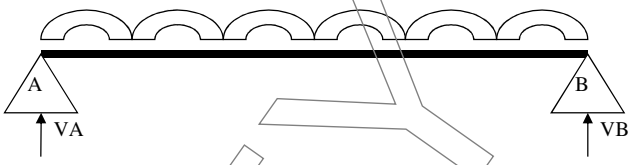
1st Floor	1.10 kN/m2	x	0.00 m	=	0.00 kN/m
2nd Floor	1.10 kN/m2	x	0.00 m	=	0.00 kN/m
Wall	2.10 kN/m2	x	0.00 m	=	0.00 kN/m
Balcony	1.10 kN/m2	x	0.40 m	=	0.44 kN/m

Imposed Loading

1st Floor	1.50 kN/m2	x	0.00 m	=	0.00 kN/m
2nd Floor	1.50 kN/m2	x	0.00 m	=	0.00 kN/m
Balcony	1.50 kN/m2	x	0.40 m	=	0.60 kN/m
			W	=	**1.04 kN/m**

End Reactions

W = 1.04 kN/m



VA = 1.61 kN
unf. DL = 0.68 kN
unf. LL = 0.93 kN

VB = 1.61 kN
unf. DL = 0.68 kN
unf. LL = 0.93 kN

Forces in Beam

Moment	=	**W x L x L / 8**	=	**1.25 kNm**
Shear Force	=	**W x L / 2**	=	**1.61 kN**
Unf. Imposed Load	=	**I x L**	=	**1.86 kN**

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DESIGN OF TERRACE JOISTS

Forces in Beam

Moment	=	**1.25 kNm**
Shear Force	=	**1.61 kN**
Axial Force	=	**0.00 kN**
Unf Imposed Load	=	**1.86 kN**
Timber Grade	=	C24
Modulus of Elasticity (mean)	=	10800 N/mm²
Modulus of Elasticity (min)	=	7200 N/mm²
Effective Length about x-x	=	3100 mm
Effective Length about y-y	=	400 mm
End Bearing Length	=	100 mm
Bottom Notch Depth	=	0 mm
Part of Load Sharing System?	=	yes
Extend 75mm beyond bearing?	=	no

Modification Factors	
Class Factor K2 =	1.00
Load Duration Factor K3 =	1.00
Bearing Stress Factor K4 =	1.10
Shear at Notched End K5 =	1.00
Total Depth Factor K7 =	1.08
Loadshare Factor K8 =	1.10
Trimmer Joists/Lintels K9 =	1.00

TRY BEAM SECTION :-

		Overall Section								
Number	**Size**	**Depth mm**	**Breadth mm**	**Ixx cm4**	**Iyy cm4**	**Zxx cm3**	**Zyy cm3**	**rxx cm**	**ryy cm**	**Area cm2**
1No	150x50	150	50	1406	156	188	63	4.33	1.44	75

SLENDERNESS

Slenderness Ratio about xx axis	=	71.59	
Slenderness Ratio about yy axis	=	27.71	Satisfactory

BENDING STRESS

Grade Bending Stress, σ	=	7.50 N/mm²	
Allowable Bearing Stress	=	(K2 x K3 x K7 x K8) x σ	
	=	8.90 N/mm²	
Applied Bending Stress	=	6.66 N/mm²	
Usage Factor	=	0.75	Satisfactory

SHEAR STRESS

Grade Shear Stress, σ	=	0.71 N/mm²	
Allowable Bearing Stress	=	(K2 x K3 x K5 x K8) x σ	
	=	0.78 N/mm²	
Applied Shear Stress	=	0.32 N/mm²	
Usage Factor	=	0.41	Satisfactory

BEARING STRESS

Grade Bearing Stress, σ	=	2.40 N/mm²	
Allowable Bearing Stress	=	(K2 x K3 x K4 x K8) x σ	
	=	2.90 N/mm²	
Applied Bearing Stress	=	0.32 N/mm²	
Usage Factor	=	0.11	Satisfactory

DEFLECTION

Trimmer Joist or Lintel made up of 2 or more pieces?	=	No	
Modulus of Elasticity Modified	=	10800 N/mm²	
Limiting Deflection	=	9.30 mm	
IL Deflection	=	4.75 mm	
DL Deflection	=	3.48 mm	
Total IL+DL Deflection	=	8.23 mm	
Modulus Rigidity, G	=	675 N/mm²	
Shear Area	=	6250 mm²	
Shear Deflection	=	0.30 mm	
Total Deflection (inl. Shear)	=	8.53 mm	Satisfactory

BEAM SUMMARY - PROVIDE 1No 150x50 C24 TIMBER @400 mm c/c

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BEAM REFERENCE = B1

Arrangement Details

Beam Span 5.85 m

Load	Beam Loaded from (m)	Beam Loaded to (m)	Element span / height (m)				
1st Floor	0.00	5.85	0.00	/	2	=	0.00 m
2nd Floor	0.00	5.85	0.00	/	2	=	0.00 m
Wall	1.90	3.20	1.20	/	1	=	1.20 m
Balcony	0.00	5.85	3.10	/	2	=	1.55 m

UDL

Dead Loading

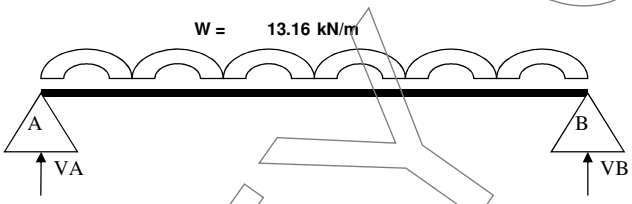
1st Floor	1.10 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.4	=	0.00 kN/m
2nd Floor	1.10 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.4	=	0.00 kN/m
Wall	4.20 kN/m2	x	1.20 m	=	5.04 kN/m	x	1.4	=	7.06 kN/m
Balcony	1.10 kN/m2	x	1.55 m	=	1.71 kN/m	x	1.4	=	2.39 kN/m

Imposed Loading

1st Floor	1.50 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.6	=	0.00 kN/m
2nd Floor	1.50 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.6	=	0.00 kN/m
Balcony	1.50 kN/m2	x	1.55 m	=	2.33 kN/m	x	1.6	=	3.72 kN/m
							W	=	**13.16 kN/m**

End Reactions

W = 13.16 kN/m



VA = 23.04 kN
unf. DL = 8.68 kN
unf. LL = 6.80 kN

VB = 21.86 kN
unf. DL = 7.84 kN
unf. LL = 6.80 kN

Forces in Beam

Moment	=	**W x L x L / 8**	=	**37.85 kNm**
Shear Force	=	**W x L / 2**	=	**23.04 kN**
Unf. Dead Load	=	**D x L**	=	**16.53 kN**
Unf. Imposed Load	=	**I x L**	=	**13.60 kN**

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Doc Reference	15-0295-C02		Client	Ms Helen Burrows		
Project	59B OSENEY CRESCENT, NW5					
Document Title	STRUCTURAL CALCULATIONS					
Revision	**Rev by**	**Date**	**Checked by**	**Date**	**Appr By**	**Date**
0	IEA	26/05/15	AM	26/05/15	SED	26/5/15

DESIGN OF BEAM B1

Forces in Beam

Moment	=	**37.85**	**kNm**
Shear Force	=	**23.04**	**kN**
Unf. Dead Load	=	**16.53**	**kN**
Unf. Imposed Load	=	**13.60**	**kN**
Steel Grade	=	275	N/mm^2 (275or355)
Modulus of Elasticity	=	205	kN/mm^2
Poissons Ratio	=	0.3	

TRY BEAM SECTION :-

			Thickness		2nd Mom Area		Rad of Gyration		Plastic Modulus		
Serial Size	**Depth mm**	**Breadth mm**	**Web mm**	**Flange mm**	**x cm^4**	**y cm^4**	***x* cm**	**y cm**	**x cm^3**		**y cm^3**
152x152x37	161.8	154.4	8.1	11.5	2213.0	706.0	6.8	3.9	309.0		140.0

u	x	H	J	A
-	-	dm^6	cm^4	cm^2
0.8	13.3	0.0	19.3	47.3

BENDING

Moment Capacity = **85.0 kNm** Satisfactory

BUCKLING

Select Restraint Condition		=	1	
Restraint Condition Coefficient			1.20	
Effective Length	Le	=	702	cm
Slenderness	λ	=	181.4	
	λ/x	=	13.6	
Slenderness Factor	v	=	0.558	(Table 14)
Correction Factor	m or n	=	1.00	(Table 13)
Slenderness	λLT	=	90	
Bending Stength	pb	=	157	
Buckling Resistance		=	**48.5**	**kNm** Satisfactory

Restraint Condition		
1	Torsionally unrestrained, comp flange unrestrained, Both flanges free to rotate	1.20
2	Torsionally unrestrained, comp flange unrestrained, comp flange free to rotate	1.00
3	Torsionally restrained, comp flange restrained, compression flange free to rotate	1.00
4	Torsionally restrained, comp flange restrained, Both flanges partially free to rotate	0.85
5	Torsionally restrained, comp flange restrained, Both flanges not free to rotate	0.70

SHEAR

Shear Capacity = **216.2 kN** Satisfactory

DEFLECTION

Loading Type (1-4)	=	3	
Finish (1-2)	=	1	
Total Defl. = (span / 250)	=	23.4	
Cantilever = (span / 180)	=	32.5	
Brittle Finish = (span / 360)	=	16.3	
General = (span / 200)	=	29.3	
Limiting IL Deflection	=	16.3	mm
Actual IL Deflection	=	**7.82**	**mm** Satisfactory
Limiting Total Deflection	=	23.4	mm
Actual Total Deflection	=	**17.31**	**mm** Satisfactory

Loading Types	
1	Cantilever with udl
2	Cantilever with point Load
3	SS beam with udl
4	SS beam with central point load

Finish	
1	Brittle Finish
2	General

BEAM SUMMARY - PROVIDE 1No 152x152x37 UC

END BEARING - MASONRY CHECK	**LHS**			**RHS**	
Select Masonry Type	Bolted Connection to		=	3.5N Blockwork	
Local Strength (1.25 x fk / 3.5)	Web of Steel Beam B2		=	1.25	N/mm2
Vertical Load from:		B1	=	21.86	kN
Vertical Load from:		No	=	0.00	kN
Total Combined Load			=	21.86	kN
Total Eccentricity			=	0	mm
End Bearing Length			=	100	mm
End Bearing Width			=	154	mm
Stress Below Bearing			=	1.42	N/mm2 **Padstone Required**

Characteristic compressive strength of masonry, fk (mortar designation 3)	
Standard Brick =	4.40 N/mm2
3.5N Block =	3.50 N/mm2
7.0N Block =	6.40 N/mm2
10.0N Block =	8.20 N/mm2

PADSTONE

Padstone Length	=	440	mm
Padstone Width	=	100	mm
Eccentricity, e	=	0	mm
Stress Under Spreader	=	0.50	N/mm2 **Padstone Satisfactory**

BEARING SUMMARY

LHS - PROVIDE BOLTED CONNECTION TO WEB OF STEEL BEAM B2

RHS - PROVIDE 440mm x100mm Concrete Padstone - 215mm deep

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Project	59B OSENEY CRESCENT, NW5					
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0	IEA	26/05/15	AM	26/05/15	SED	26/5/15

BEAM REFERENCE = B2

Arrangement Details

Beam Span 1.05 m

Load	Beam Loaded from (m)	Beam Loaded to (m)	Element span / height (m)				
1st Floor	0.00	1.05	0.00	/	2	=	0.00 m
Stairs	0.00	1.05	4.00	/	2	=	2.00 m
Wall	0.00	1.05	4.60	/	1	=	4.60 m
Roof	0.00	1.05	5.50	/	2	=	2.75 m

UDL

Dead Loading

1st Floor	1.10 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.4	=	0.00 kN/m
Stairs	1.10 kN/m2	x	2.00 m	=	2.20 kN/m	x	1.4	=	3.08 kN/m
Wall	4.20 kN/m2	x	4.60 m	=	19.32 kN/m	x	1.4	=	27.05 kN/m
Roof	1.00 kN/m2	x	2.75 m	=	2.75 kN/m	x	1.4	=	3.85 kN/m

Imposed Loading

1st Floor	1.50 kN/m2	x	0.00 m	=	0.00 kN/m	x	1.6	=	0.00 kN/m
Stairs	1.50 kN/m2	x	2.00 m	=	3.00 kN/m	x	1.6	=	4.80 kN/m
Roof	0.60 kN/m2	x	2.75 m	=	1.65 kN/m	x	1.6	=	2.64 kN/m
							W	=	**41.42 kN/m**

Point Load 1 @ 0.85 m

From Beam Ref = B1

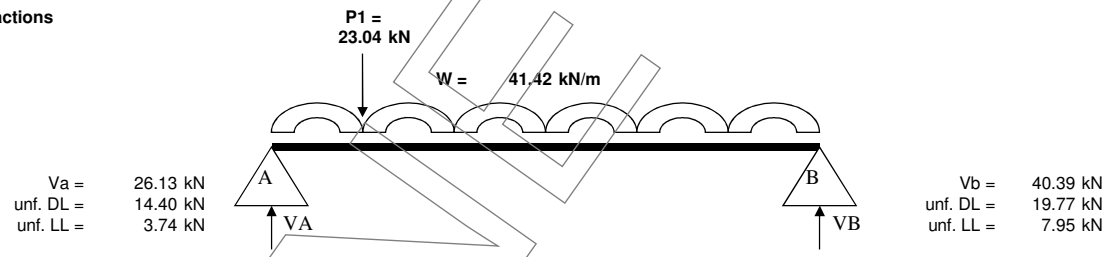
Dead Load	8.68 kN	x	1.4	=	12.16 kN
Imposed Load	6.80 kN	x	1.6	=	10.88 kN
			P1		**23.04 kN**

Point Load 2 @ 0.00 m

From Beam Ref =

Dead Load	0.00 kN	x	1.4	=	0.00 kN
Imposed Load	0.00 kN	x	1.6	=	0.00 kN
			P2		**0.00 kN**

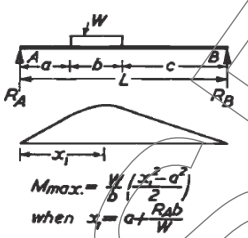
End Reactions



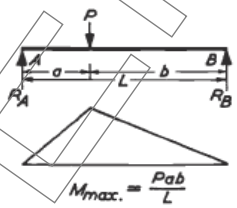
Va = 26.13 kN
unf. DL = 14.40 kN
unf. LL = 3.74 kN

Vb = 40.39 kN
unf. DL = 19.77 kN
unf. LL = 7.95 kN

UDL Bending Moment Diagram



PL Bending Moment Diagram



	Max Moment
1st Floor	0.00 kNm
Stairs	1.09 kNm
Wall	3.73 kNm
Roof	0.89 kNm
Point Load 1	3.73 kNm
Point Load 2	0.00 kNm
Total	9.44 kNm

Bending moment diagrams taken from Steel Designers manual 6th Edition

Forces in Beam

Moment	=	**9.44 kNm**
Shear Force	=	**40.39 kN**
Unf. Dead Load (UDL)	=	**25.48 kN**
Unf. Dead Load (PL)	=	**8.68 kN**
Unf. Imposed Load (UDL)	=	**4.88 kN**
Unf. Imposed Load (PL)	=	**6.80 kN**

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Revision	Rev by	Date	Checked by	Date	Appr By	Date
0	IEA	26/05/15	AM	26/05/15	SED	26/5/15

DESIGN OF BEAM B2

Forces in Beam

Moment	=	**9.44**	**kNm**
Shear Force	=	**40.39**	**kN**
Unf. Dead Load	=	**34.17**	**kN**
Unf. Imposed Load	=	**11.68**	**kN**
Steel Grade	=	275	N/mm^2 (275or355)
Modulus of Elasticity	=	205	kN/mm^c
Poissons Ratio	=	0.3	

TRY BEAM SECTION :-

			Thickness		2nd Mom Area		Rad of Gyration		Plastic Modulus		
Serial Size	Depth mm	Breadth mm	Web mm	Flange mm	x cm^4	y cm^4	x cm	y cm	x cm^3		y cm^3
152x152x23	152.4	152.4	6.1	6.8	1258.0	402.0	6.5	3.7	184.0		80.5

u -	x -	H dm^6	J cm^4	A cm^2
0.8	20.5	0.0	4.8	29.7

BENDING

Moment Capacity	=	**50.6 kNm**	Satisfactory

BUCKLING

Select Restraint Condition		=	1	
Restraint Condition Coefficient			1.20	
Effective Length	Le	=	126 cm	
Slenderness	λ	=	34.2	
	λ/x	=	1.7	
Slenderness Factor	v	=	0.968	(Table 14)
Correction Factor	m or n	=	1.00	(Table 13)
Slenderness	λLT	=	30	
Bending Stength	pb	=	262	
Buckling Resistance		=	**48.2 kNm**	Satisfactory

Restraint Condition		
1	Torsionally unrestrained, comp flange unrestrained, Both flanges free to rotate	1.20
2	Torsionally unrestrained, comp flange unrestrained, comp flange free to rotate	1.00
3	Torsionally restrained, comp flange restrained, compression flange free to rotate	1.00
4	Torsionally restrained, comp flange restrained, Both flanges partially free to rotate	0.85
5	Torsionally restrained, comp flange restrained, Both flanges not free to rotate	0.70

SHEAR

Shear Capacity	=	**153.4 kN**	Satisfactory

DEFLECTION

Loading Type (1-5)	=	5	
Finish (1-2)	=	1	
Total Defl. = (span / 250)	=	4.2	
Cantilever = (span / 180)	=	5.8	
Brittle Finish = (span / 360)	=	2.9	
General = (span / 200)	=	5.3	
Limiting IL Deflection	=	2.9	mm
Actual IL Deflection	=	**0.09 mm**	Satisfactory
Limiting Total Deflection	=	4.2	mm
Actual Total Deflection	=	**0.32 mm**	Satisfactory

Loading Types	
1	Cantilever with udl
2	Cantilever with point Load
3	SS beam with udl
4	SS beam with central point load
5	SS beam with UDL & central PL

Finish	
1	Brittle Finish
2	General

BEAM SUMMARY - PROVIDE 1No 152x152x23 UC

END BEARING - MASONRY CHECK		LHS			RHS	
Select Masonry Type	=	3.5N Blockwork		=	3.5N Blockwork	
Local Strength (1.25 x fk / 3.5)	=	1.25 N/mm2		=	1.25 N/mm2	
Vertical Load from: B2	=	26.13 kN	B2	=	40.39 kN	
Vertical Load from: No	=	0.00 kN	No	=	0.00 kN	
Total Combined Load	=	26.13 kN		=	40.39 kN	
Total Eccentricity	=	0 mm		=	0 mm	
End Bearing Length	=	100 mm		=	100 mm	
End Bearing Width	=	152 mm		=	152 mm	
Stress Below Bearing	=	1.71 N/mm2	Padstone Required	=	2.65 N/mm2	Padstone Required

Characteristic compressive strength of masonry, fk (mortar designation 3)	
Standard Brick =	4.40 N/mm2
3.5N Block =	3.50 N/mm2
7.0N Block =	6.40 N/mm2
10.0N Block =	8.20 N/mm2

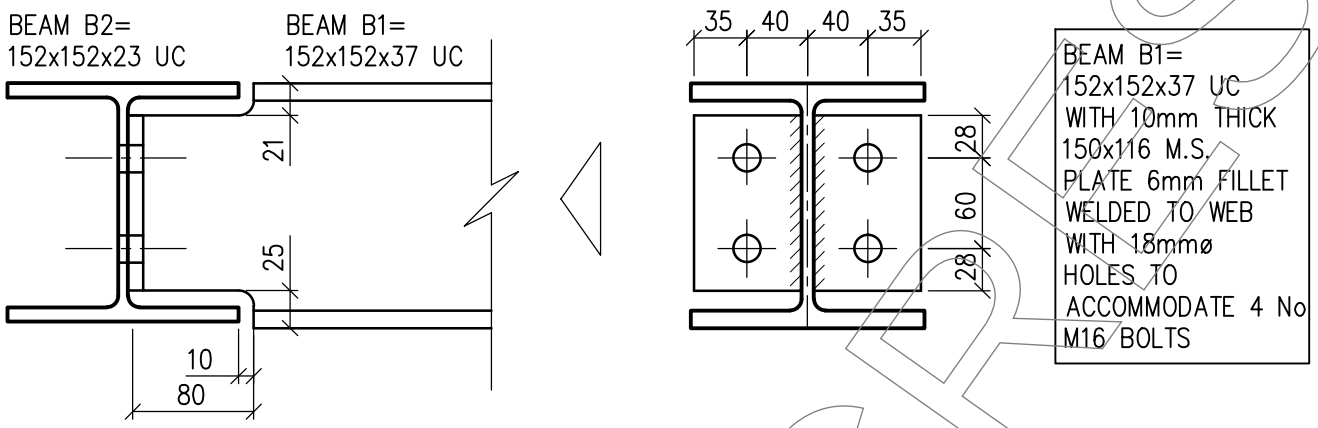
PADSTONE						
Padstone Length	=	300 mm		=	500 mm	
Padstone Width	=	200 mm		=	100 mm	
Eccentricity, e	=	0 mm		=	0 mm	
Stress Under Spreader	=	0.44 N/mm2	Padstone Satisfactory	=	0.81 N/mm2	Padstone Satisfactory

BEARING SUMMARY

LHS - PROVIDE 300mm x200mm Concrete Padstone - 215mm deep. Use MS Shims to Centralise Beam End Bearing on Padstone

RHS - PROVIDE 500mm x100mm Concrete Padstone - 215mm deep

FOR GENERAL ARRANGEMENT REFER TO DOCUMENT 15-0295-C02



STEELWORK NOTES.

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ALL DETAILS AND DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR/FABRICATOR PRIOR TO COMMENCEMENT OF CONSTRUCTION/FABRICATION. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER.
3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
4. ALL STEELWORK FABRICATORS DRAWINGS, DETAILS AND CALCULATIONS ARE TO BE FORWARDED TO THE ENGINEER FOR COMMENTS/ APPROVAL PRIOR TO COMMENCMENT OF FABRICATION. ALSO DRAWINGS AND DETAILS ARE TO BE FORWARDED TO THE ARCHITECT FOR DIMENSIONAL CLEARING.
5. STRUCTURAL STEELWORK SHALL BE S275 IN ACCORDANCE WITH BS5950 UNLESS NOTED OTHERWISE.
6. ALL BOLTS SHALL BE GRADE 8.8 BLACK BOLTS UNLESS NOTED OTHERWISE.
7. FOR STEELWORK LEVELS REFER TO ARCHITECTS DRAWINGS.

DOCUMENT NUMBER	SCALE	REV
15-0295-D01	1:5	0

REV	DATE	REVISION DETAILS	DRAWN	CHKD	APPRD
0	26/05/15	PRELIMINARY	JSP	IEA	SED

CLIENT REFERENCE: —

CLIENT: Ms Helen Burrows

PROJECT: 59B OSENEY CRESCENT, NW5

DRAWING TITLE: B1 TO B2 STEELWORK CONNECTION DETAIL

A4

Halter Inn Workshops, Holcombe Brook, Bury, Lancs BL0 9SA
Tel: 0161 408 0599 | E-mail: info@calcs-online.co.uk

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