IKT CONSULTING
STRUCTURAL ENGINEERS LIMITED

Client: Mr Client

Project: Park Lane, Colston Bassett

Report: Structural Calculations

Job No.: IKT0000

Date: 1 April 2024

Document History

REVISION	DATE	DESCRIPTION	PREPARED BY	CHECKED BY
	01 April 2024	Structural Calculations	S. Engineer	An Engineer

1 INTRODUCTION

The following calculations have been produced for the proposed structural alteration referred to as No. Park Lane, Colston Bassett.

The existing property appears to be a typical solid wall construction, with a traditional cut timber roof formed with rafters and purlins.

Scope of Design /work

IKT Consulting Limited design was limited to 1No. loose steel beam and masonry required to support the wall, floor and roof loadings.

1.1 General Notes

The engineer has carried out the design in accordance with the information provided to him during the initial site visit.

However, unless and until the structural fabric of the building is fully exposed, these should be treated as assumptions and not certainties. They should be confirmed or disproven by the contractor on-site. If the contractor's site discoveries indicate that these assumptions are incorrect, they should immediately inform the engineer and await the engineer's advice on how to proceed.

Sketches are intended to demonstrate certain features of the design and are not intended as working drawings. Details, where shown, are intended to identify the main structural features. It is assumed that the work will be carried out by experienced and competent personnel; therefore, exhaustive detailing is not required.

The fabricator/supplier will normally bear responsibility for the structural members until they are off-loaded onto the site. From that point, they become the responsibility of the contractor. The delivery should be checked to ensure compliance with the specification, as well as correct quantities and dimensions. Any discrepancies must be immediately brought to the attention of the supplier.

The contractor/builder appointed to carry out the construction work must carefully assess our proposed layouts, proposed structural specifications, and the existing site before undertaking any construction work. If the contractor is unsure about the length or size of any design structural element, they must contact the structural engineer for clarification before proceeding with the construction work.

The contractor must demonstrate a full understanding of the project before starting deconstruction/construction work. If there is any uncertainty about any part of the design, the contractor must contact us before undertaking the work.

If required, the client or contractor must obtain local authority approval by submitting the proposed design and layout for approval before starting any construction work.

The contractor must provide the client with details of the construction process and risks involved (e.g., damage to existing decoration, existing features, and fixtures) before carrying out the construction work.

Fire protection must be in accordance with relevant Building Regulations and the architect's details. New steel beams should be fire-protected using British Gypsum Gyproc Fireline Pink plasterboard or 2 layers of plasterboard and skim, achieving a minimum of 30 minutes to 1 hour of fire protection.

All dimensions must be confirmed by the contractor on-site before commencing construction.

All internal steelworks must be shot blasted to SA2.5 Standard and painted with 2 coats of zinc phosphate, minimum 120 microns, or Red Oxide Primer, except as noted on the drawings.

All steel beam ends embedded in the external wall must be painted with 2 coats of bituminous paint.

All external steelworks should be galvanized to suit exposure conditions.

All temporary works are to be designed and detailed by the contractor.

These calculations and designs are copyright and must not be reproduced, defaced, or passed to any other person or persons for any purpose other than as originally intended."

1.2 Amendments to the design

Before placing an order or commencing work on-site, the contractor should ensure that the design brief is correct and that they have sufficient information to perform the works safely. IKT Consulting Ltd cannot be held responsible for any incorrect or incomplete design brief.

1.3 Codes of Practice

This project was generally designed using the following standards:

The Building Regs. – Approved Document A (2010)

BS EN 1990 - Basis of structural design

BS EN 1991 - Actions on structures

BS EN 1993 - Design of steel structures

BS EN 1996 – Design of Masonry Structures

1.4 Calculation Method

Tekla TEDDS v3.0.14 design software will be used to assist with these calculations (printouts are included) to Eurocodes / British Standards.

1.5 Structural Consideration

All ground floor internal walls are assumed to be solid brickwork walls and are to be confirmed on site.

The condition and adequacy of existing structures to support additional loads should be confirmed onsite before commencing construction works.

1.6 Design Notes

1. This design/sketch should be reviewed in conjunction with all specifications and all relevant architects, engineers, services, and specialist drawings.
2. All dimensions must be confirmed by the contractor on-site prior to construction.
3. The steelwork should be grade S355, execution class 2, and CE marked unless otherwise specified. To minimise deflections of the existing structure, new beams must be securely pinned to the existing construction with slate or dry-pack mortar, and all mortar must be allowed to cure before removing supports.
4. All work must be conducted in accordance with the current Building Regulations Part A, British Standards, and good building practices.
5. Beams and lintels should have a minimum bearing length of 100mm when perpendicular to the wall, and 150mm when parallel to the wall, unless stated otherwise.
6. Due to significant structural works, minor post-construction deflection of brittle finishes may be expected in the existing building. All load-bearing inner skin walls should be a minimum of 100mm thick medium density (3.6N) concrete blockwork wall, unless stated otherwise.
7. All steels that support timber work should have the flanges pre-drilled at 500mm centres to accommodate timber plates.
8. All proprietary lintels are to lintel specialist's design and to be installed to the manufacturer's specification unless noted otherwise.
9. Drawings are not drawn to scale.

2 DESIGN SUMMARY - Member Sizes

2.1 Member Sizes

Beam (B1): 1No. 203 x 102 UB 23, Grade S355; Span dimension to be confirmed by builder on site.

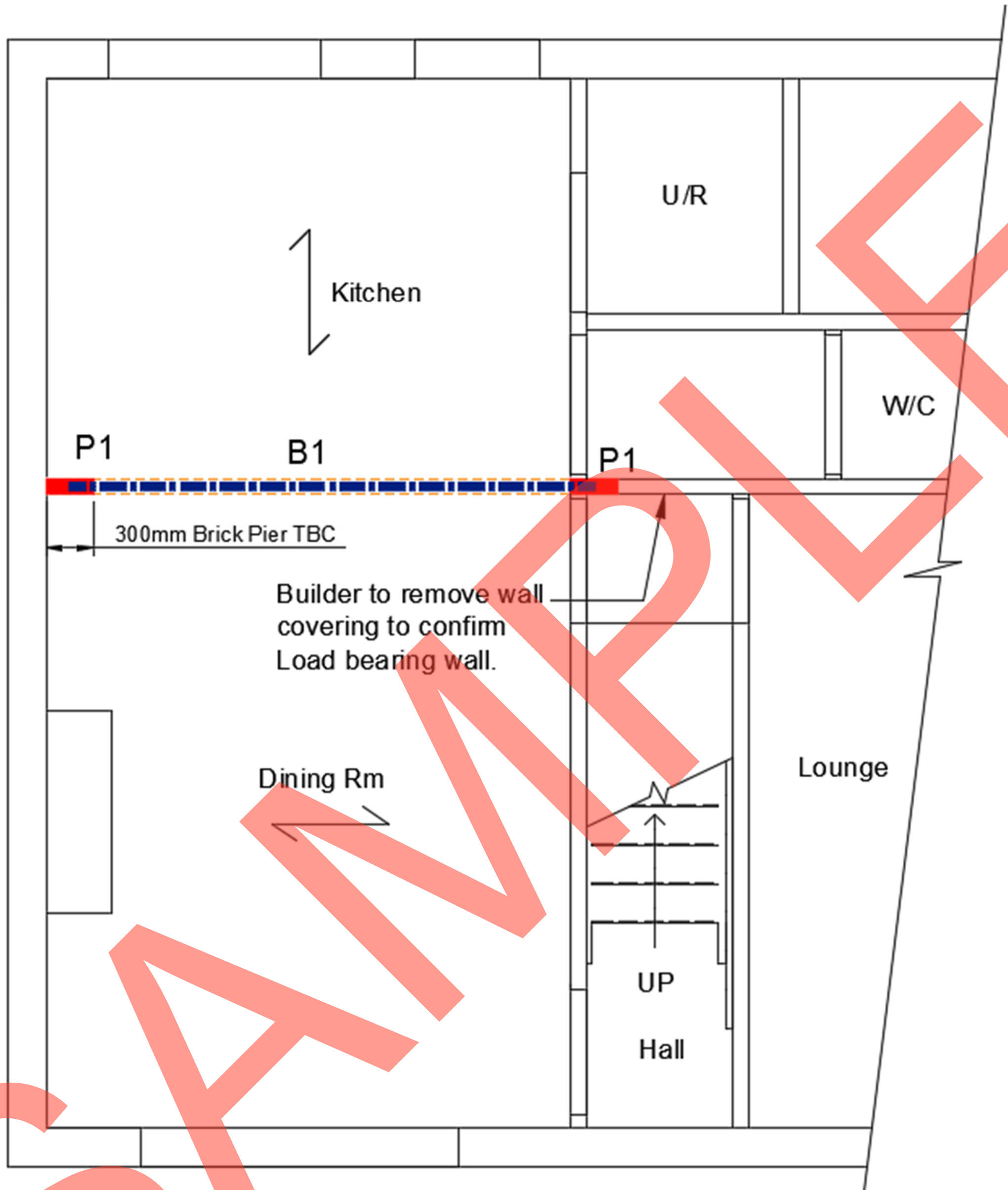
2.2 Padstones

PS 1: 1No. 300 (L) x 100 (W) x 140 (H), C35 Mass Concrete padstones

Our initial site visit was limited to a visual inspection. The contractor/builder appointed to carry out the construction work must carefully assess our proposed layouts and structural specifications against the existing site. They should do this by removing the building covering and plasterboards to expose the structure before ordering materials or commencing work on-site. If there is any uncertainty about any part of the design, the contractor must contact IKT Consulting before ordering materials and allow a sufficient timescale of no less than 48 hours to resolve any discrepancy.

3 KEY PLAN

ALL TOP OF STEEL BEAM TO BE CONFIRMED ON SITE



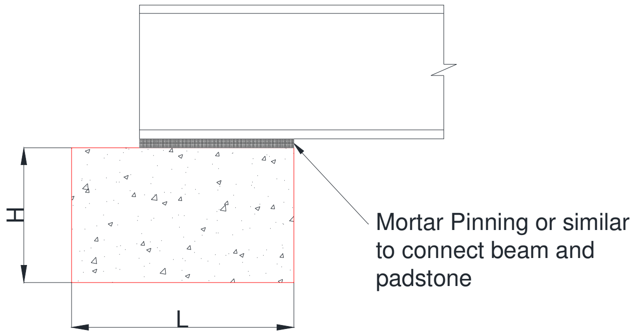
NOTE:
Do not scale from this drawing.
Existing structures must be adequately propped during beam installation.

All site works shall be in accordance with the health & safety Act & associated regulations issued by the Health & Safety Executive & the Construction Regulations.

Materials in excess of 20kg must be 2 man lift or machine lift

All dimensions are to be confirmed by the contractor on site prior to placing an order or commencing work on site.

Indicates floor span @ first floor



Minimum bearing length of 200mm when parallel to the wall unless noted otherwise.

Detail 1 - Typical Padstone

4 CALCULATIONS

4.1 Loading Schedule

Cut Roof (Clay) Roof Pitch 40 degrees

				Service		Factored
Dead	Tiles	0.70				
	Felt/Battens	0.05				
	Insulation	0.05				
	Rafters	0.15				
	Ceiling	0.20				
		1.15	/Cos Pitch	= 1.50	x 1.35	= 2.1
Imposed						
	Imposed	0.60	Use 0.6[(60-pitch)/30			
	Attic Storage	0.00				
		0.60		= 0.60	x 1.5	= 1.0
				2.1kN/m²		3.1kN/m²

Timber Floor 0

				Service		Factored
Dead	Finishes	0.00				
	Boarding	0.20				
	Joists	0.15				
	Ceiling	0.20				
	Services	0.05				
		0.60		= 0.60	x 1.35	= 0.8
Imposed						
	Imposed	1.50				
	Partitions	0.50				
		2.00		= 2.00	x 1.5	= 3.2
				2.6kN/m²		4.0kN/m²

100mm Bwk Wall

			Service		Factored
Dead	Plaster	0.20			
	Block	2.25			
	Plaster	0.20			
		2.65	= 2.65	x 1.35	= 3.7
Imposed					
	N/A	N/A			
		0.00	= 0.00	x 1.5	= 0.0
			2.7kN/m²		3.7kN/m²

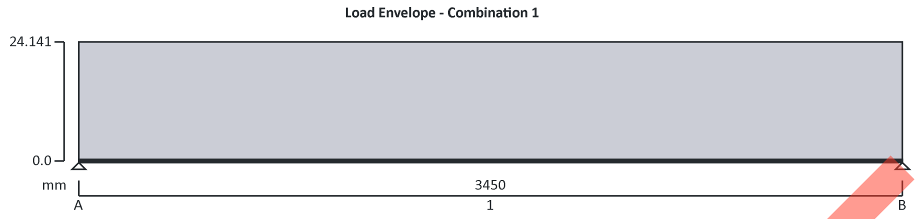
4.2 Beam - B1

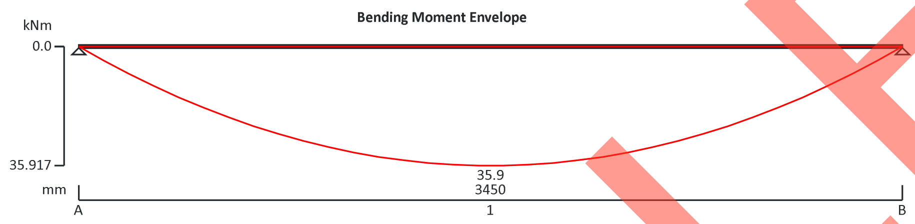
	Bearing – RHS (mm)	Opening (mm)	Bearing – LHS (mm)	Total Span (mm)
	200	3050	200	3450
	LOADS FROM	WIDTH SUPPORTED (m)	LIVE LOADS (kN/m)	DEAD LOADS (kN/m)
	Roof	3	1.8	4.50
	1st Floor	1.5	3.0	0.9
	Internal Wall	2.5		6.6

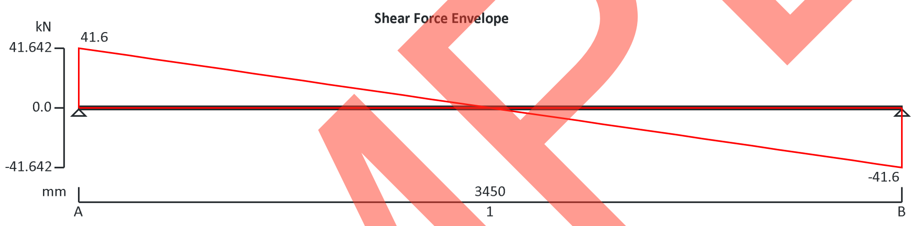
STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

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

TEDDS calculation version 3.0.14







Support conditions

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

Applied loading

Beam loads	Wall - Permanent full UDL 6.6 kN/m
	1st Fl - Variable full UDL 3 kN/m
	1st FL - Permanent full UDL 1 kN/m
	Roof - Variable full UDL 2 kN/m
	Roof - Permanent full UDL 4.5 kN/m
	Permanent self weight of beam × 1

Load combinations

Load combination 1	Support A	Permanent × 1.35
		Variable × 1.50
		Permanent × 1.35
		Variable × 1.50
	Support B	Permanent × 1.35
		Variable × 1.50

Analysis results

Maximum moment;	M_{max} = **35.9** kNm;	M_{min} = **0** kNm
Maximum shear;	V_{max} = **41.6** kN;	V_{min} = **-41.6** kN

Deflection;	δ_{max} = **7.2** mm;	δ_{min} = **0** mm
Maximum reaction at support A;	R_{A_max} = **41.6** kN;	R_{A_min} = **41.6** kN
Unfactored permanent load reaction at support A;	$R_{A\_Permanent}$ = **21.3** kN	
Unfactored variable load reaction at support A;	$R_{A\_Variable}$ = **8.6** kN	
Maximum reaction at support B;	R_{B_max} = **41.6** kN;	R_{B_min} = **41.6** kN
Unfactored permanent load reaction at support B;	$R_{B\_Permanent}$ = **21.3** kN	
Unfactored variable load reaction at support B;	$R_{B\_Variable}$ = **8.6** kN	

Section details

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

Steel grade; **S355**

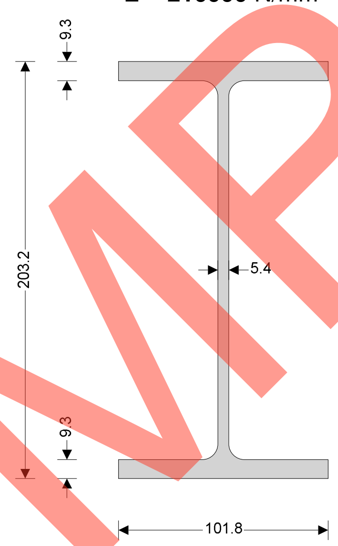
EN 10025-2:2004 - Hot rolled products of structural steels

Nominal thickness of element; $t = \max(t_f, t_w)$ = **9.3** mm

Nominal yield strength; f_y = **355** N/mm^2

Nominal ultimate tensile strength; f_u = **470** N/mm^2

Modulus of elasticity; E = **210000** N/mm^2



Partial factors - Section 6.1

Resistance of cross-sections; γ_{M0} = **1.00**

Resistance of members to instability; γ_{M1} = **1.00**

Resistance of tensile members to fracture; γ_{M2} = **1.10**

Lateral restraint

Span 1 has lateral restraint at supports only

Effective length factors

Effective length factor in major axis; K_y = **1.000**

Effective length factor in minor axis; K_z = **1.000**

Effective length factor for torsion; $K_{LT.A}$ = **1.000**; + 2 × h

$K_{LT.B}$ = **1.000**;

Classification of cross sections - Section 5.5

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

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

Width of section; c = d = **169.4** mm

	$c / t_w = 38.6 \times \varepsilon <= 72 \times \varepsilon$; Class 1

Outstand flanges - Table 5.2 (sheet 2 of 3)

Width of section;	$c = (b - t_w - 2 \times r) / 2 =$ **40.6** mm
	$c / t_f = 5.4 \times \varepsilon <= 9 \times \varepsilon$; Class 1

Section is class 1

Check shear - Section 6.2.6

Height of web;	$h_w = h - 2 \times t_f =$ **184.6** mm
Shear area factor;	$\eta =$ **1.000**
	$h_w / t_w < 72 \times \varepsilon / \eta$

Shear buckling resistance can be ignored

Design shear force;	$V_{Ed} = \max(\mathrm{abs}(V_{max}), \mathrm{abs}(V_{min})) =$ **41.6** kN
Shear area - cl 6.2.6(3);	$A_v = \max(A - 2 \times b \times t_f + (t_w + 2 \times r) \times t_f, \eta \times h_w \times t_w) =$ **1238** mm^2
Design shear resistance - cl 6.2.6(2);	$V_{c,Rd} = V_{pl,Rd} = A_v \times (f_y / \sqrt{[3]}) / \gamma_{M0} =$ **253.7** kN

PASS - Design shear resistance exceeds design shear force

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

Design bending moment;	$M_{Ed} = \max(\mathrm{abs}(M_{s1\_max}), \mathrm{abs}(M_{s1\_min})) =$ **35.9** kNm
Design bending resistance moment - eq 6.13;	$M_{c,Rd} = M_{pl,Rd} = W_{pl.y} \times f_y / \gamma_{M0} =$ **83.1** kNm

Slenderness ratio for lateral torsional buckling

Correction factor - Table 6.6;	$k_c =$ **0.94**
	$C_1 = 1 / k_c^2 =$ **1.132**
Curvature factor;	$g = \sqrt{[1 - (I_z / I_y)]} =$ **0.96**
Poissons ratio;	$\nu =$ **0.3**
Shear modulus;	$G = E / [2 \times (1 + \nu)] =$ **80769** N/mm^2
Unrestrained length;	$L = (1.0 \times L_{s1} + 2 \times h + 1.0 \times L_{s1}) / 2 =$ **3653** mm
Elastic critical buckling moment;	$M_{cr} = C_1 \times \pi^2 \times E \times I_z / (L^2 \times g) \times \sqrt{[I_w / I_z + L^2 \times G \times I_t / (\pi^2 \times E \times I_z)]} =$ **53.4** kNm
Slenderness ratio for lateral torsional buckling;	$\bar{\lambda}_{LT} = \sqrt{(W_{pl.y} \times f_y / M_{cr})} =$ **1.248**
Limiting slenderness ratio;	$\bar{\lambda}_{LT,0} =$ **0.4**

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

Design resistance for buckling - Section 6.3.2.1

Buckling curve - Table 6.5;	b
Imperfection factor - Table 6.3;	$\alpha_{LT} =$ **0.34**
Correction factor for rolled sections;	$\beta =$ **0.75**
LTB reduction determination factor;	$\phi_{LT} = 0.5 \times [1 + \alpha_{LT} \times (\bar{\lambda}_{LT} - \bar{\lambda}_{LT,0}) + \beta \times \bar{\lambda}_{LT}^2] =$ **1.228**
LTB reduction factor - eq 6.57;	$\chi_{LT} = \min(1 / [\phi_{LT} + \sqrt{(\phi_{LT}^2 - \beta \times \bar{\lambda}_{LT}^2)}], 1, 1 / \bar{\lambda}_{LT}^2) =$ **0.552**
Modification factor;	$f = \min(1 - 0.5 \times (1 - k_c) \times [1 - 2 \times (\bar{\lambda}_{LT} - 0.8)^2], 1) =$ **0.982**
Modified LTB reduction factor - eq 6.58;	$\chi_{LT,mod} = \min(\chi_{LT} / f, 1) =$ **0.562**
Design buckling resistance moment - eq 6.55;	$M_{b,Rd} = \chi_{LT,mod} \times W_{pl.y} \times f_y / \gamma_{M1} =$ **46.7** kNm

PASS - Design buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 7.2.1

Consider deflection due to permanent and variable loads

Limiting deflection;	$\delta_{lim} = L_{s1} / 360 =$ **9.6** mm
Maximum deflection span 1;	$\delta = \max(\mathrm{abs}(\delta_{max}), \mathrm{abs}(\delta_{min})) =$ **7.231** mm

PASS - Maximum deflection does not exceed deflection limit

4.2.1 TYPICAL PADSTONE – PS1

Brickwork in M4, fk = 3.5N/mm^2

Padstone on the internal wall				
Consider Bearings-assume wall in (fk)		=	3.5	N/mm^2
Max. Load		=	45	kN
			Bearing Type 2	
γ_m		=	3.5	
Wall Thickness		=	100	mm
Required Bearing length		=	300	mm

Provide 1No. 300x 100 x 140mm dp, C35 Mass concrete Padstone.