PCC Consultants

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# Structural Engineer's Calculations and Report

## 18a Calthorpe St
## London WC1X 0JS

| PCC Document Management | |
|---|---|
| **Job Number:** | 9428 |
| **Date of Issue:** | July 2016 |
| **Author:** | Peter Cole |

| | |
|---|---|
| Project No | 9428 |
| Sheet No | 2 |
| Date | 7/16 |
| Prepared | PJC |

**Synopsis**

I am instructed by Ciaran Tuohy in connection with the proposed alterations to 18a Calthorpe St, London WC1X 0JS. The work involves the removal of or opening-up of loadbearing walls at ground first floor level. I visited the property on 12 April 2016 and undertook measurements of the interior of the property as well as a series of photographs of the internal area.

The calculations are prepared in accordance with the following design codes:

- Manual for the Design of Building Structures to Eurocode 1 and basis of structural design.
- Manual for the design of steelwork building structures to Eurocode 3.
- Manual for the design of timber building structures to Eurocode 5.
- Manual for the design of of plain masonry in building structures to Eurocode 6.
- Tata Interactive Blue Book

**P J Cole BSc CEng FIStructE MICE**
**PCC Consultants Ltd**
**Chartered Structural Engineers**

**Signed:** _____

**On behalf of PCC Consultants Ltd**

**Date:** **19 July 2016**

| | |
|---|---|
| Project No | 9428 |
| Sheet No | 3 |
| Date | 7/16 |
| Prepared | PJC |

**General Notes**

1) The span of the floor joists has been checked by non-intrusive methods and it will be the responsibility of the contractor, when undertaking the proposed alterations, to check that the assumed span is correct and that the ceiling joists and roof structure span in the form indicated and onto the walls that are to remain unaltered.
2) Walls to be removed and that are not to be replaced with a beam (marked with an indication of reference to note 2) and marked with red cross hatching on the plans, should be checked that they do not carry any load from ceiling structure, roof structure or isolated posts. The plasterwork should be stripped from the studwork and locally from the ceiling to clearly show if any structure is supported. If any members are supported by the studwork walls, PCC Consultants are to be informed immediately so that appropriate provision may be made.
3) It is the main contractors responsibility to ensure that any beams or other structural members supplied are of the correct length and suitable allowance shall be made for bearing onto padstones and the like. The contractor shall take responsibility to ensure that the dimensions and levels are correct and permit compliance with all necessary aspects of the building regulations.
4) The main contractor will be responsible for all temporary works and these works should ensure that remaining structure is fully supported without damage or distortion following demolition work. Where necessary due to the scale of the works, a specialist subcontractor should be appointed to design and install temporary works to adequately support the applied loads.
5) Temporary works shall not be removed until supporting beams, columns or other structure are properly installed, fully bolted or welded and pinned-up by dry packing or shimming and that any mortar packing or concrete is sufficiently mature.
6) Refer to Architects drawings & specifications for all waterproofing, DPC, DPM, tanking & insulation details/requirements and any fireproofing requirements.
7) Unless noted otherwise use minimum 7 N/mm2 blockwork set in M4 mortar above dpc level.
8) All structural timber shall be preservative treated and stress graded to BS 5268 and either C16 or C24 timber as noted on the drawings.
9) All fixings i.e. truss clips, framing anchors, etc. shall be galvanised/sheradized.
10) All structural steel work is to be grade S275 to BS EN 10025, unless noted otherwise, fabricated and erected in accordance with BS 5950:2001. All steelwork is to be shot blast cleaned to SA 2.5 and primed with total DFT=75 microns. Steelwork to have all scuffs repaired on site and all built in steelwork to be painted with two coats bituminous paint. Exposed steelwork treated with oil based undercoat and gloss, colour to be agreed. Connections to be designed by fabricator to the loads indicated on the drawings.
11) Bolts to all structural connections to be grade 8.8 unless noted otherwise.
12) Any exposed steelwork shall be hot dip galvanised to BS EN ISO 1461:1999.

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## Unit Loads

| **ROOF CONSTRUCTION** | | Dead kN/m2 | Live kN/m2 |
|---|---|---|---|
| Slates/tiles | | 0.65 | |
| Rafters, purlins, ceiling joists | | 0.15 | |
| Ceiling | | 0.20 | |
| Snow | BS 6399 Part 3 | | 0.60 |
| **TOTAL** | | **1.00** | **0.60** |

| **FLOOR CONSTRUCTION** | | Dead kN/m2 | Live kN/m2 |
|---|---|---|---|
| Allowance for partitions | | 0.50 | |
| Boarding and joists | | 0.35 | |
| Plastered ceiling | | 0.15 | |
| Live Load, Domestic | BS 6399 Part 3 | | 1.50 |
| **TOTAL** | | **1.00** | **1.50** |

### Masonry

- Allow for 4.6 kN/m2 to include for 9 inch masonry and plaster on 2 faces.
- Allow for 4.0 kN/m2 to include for block and brick cavity wall, plastered.
- Allow for 1.0 kN/m2 for studwork partitions.

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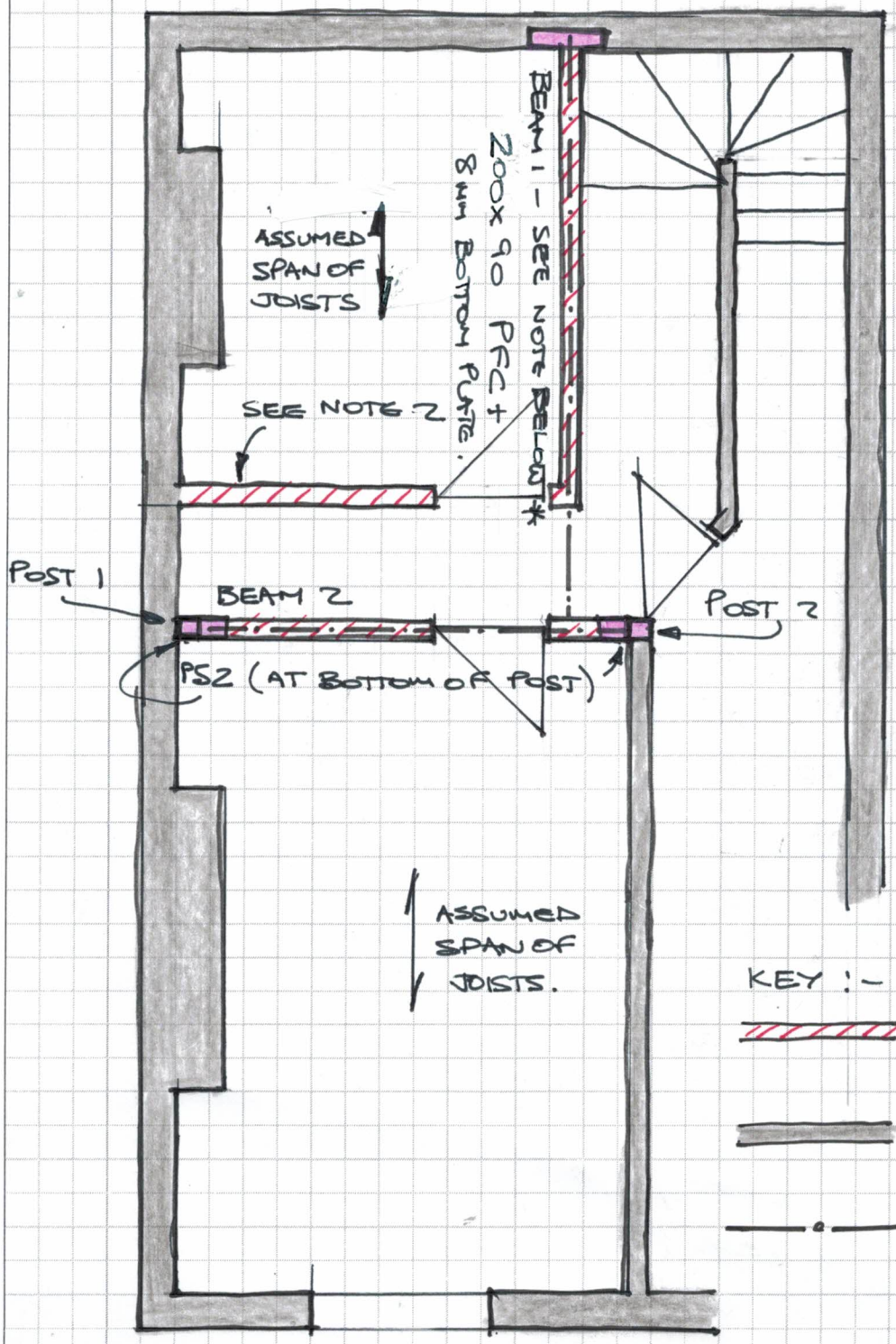
| PROJECT No. | 9428 |
|---|---|
| SHEET No. | 5 |
| DATE | 7/16 |

| PROJECT TITLE | PREPARED | CHECKED |
|---|---|---|
| 18a CALTHORPE ST., WC1X 9JS. | POC | |

# LAYOUT AT GROUND FLOOR LEVEL

PS1 - 450 x 100 x 150 PADSTONE.




NOTE - IT IS ASSUMED THAT WITHIN SEMI-BASEMENT THE WALL ON THE LINE OF BEAM 2 THAT SUPPORTS POSTS 1 & 2 IS 215 THICK. THIS TO BE CHECKED ON SITE

KEY :-

- WALL TO BE REMOVED
- WALLS TO REMAIN.
- BEAM.

* BEAM 1 - FOLLOWS LINE OF UPPER STAIRCASE AND TO BE FABRICATED TO TEMPLATE MADE ON SITE.

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| PROJECT No. | 9428 |
|---|---|
| SHEET No. | 6 |
| DATE | 7/16 |

PROJECT TITLE
18a CALTHORPE STREET WC1X QJS

| PREPARED | CHECKED |
|---|---|
| PJC | |

BEAM 1. SPAN = 4400.

LOADING - 0.6m STAIRCASE @

(1.0, 1.5) x 2 — 2.0 — 3.0

+ SAY 7.0m STUDWORK @ 1.0 — 7.0

9.0 — 3.0

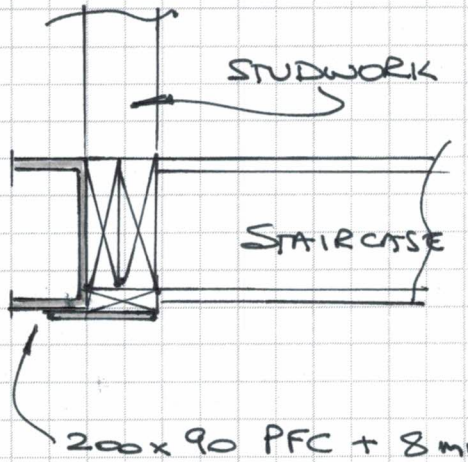
FACTORED = 9 x 1.35 + 3.0 x 1.5

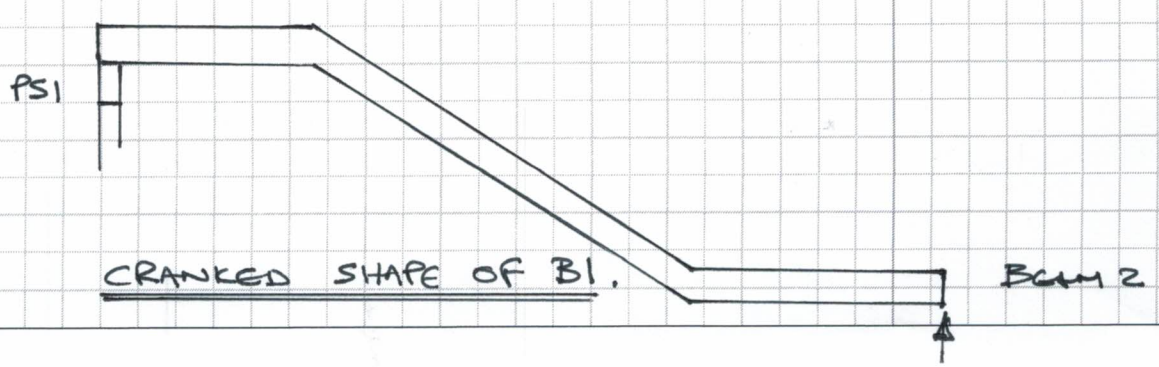
= 16.7 kN/m

M = 16.7 x $4.4^2$ / 8 = 40.4 kN.m

TRY 200 x 90 PFC WITH

BOTTOM PLATE AND/OR CLEATS.



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| PROJECT No. | 9428 |
|---|---|
| SHEET No. | 7 |
| DATE | 7/16 |

PROJECT TITLE: 18a CALTHORPE ST., WC1X 0JS

PREPARED: POL. CHECKED:

BEAM 2. SPAN = 3.3m.

APPLIED LOAD =

2 FLOORS, $\frac{4.2+5.0}{2} \times (1.0, 1.5)$ 9.20 13.8

ROOF ASSUME "BUTTERFLY"

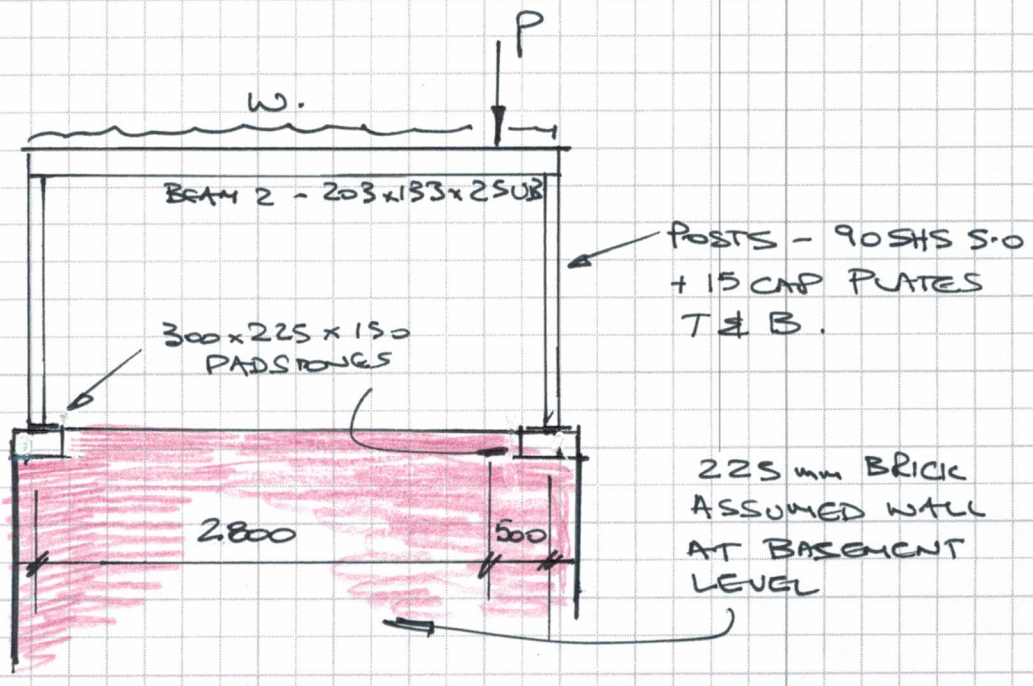
$\frac{4.2+5.0}{2} \times 1.0, 0.6$ 4.6 2.8

13.8 16.6

REACTION, BEAM 1

$2.2 \times (9.0, 3.0)$ = 19.8 6.6

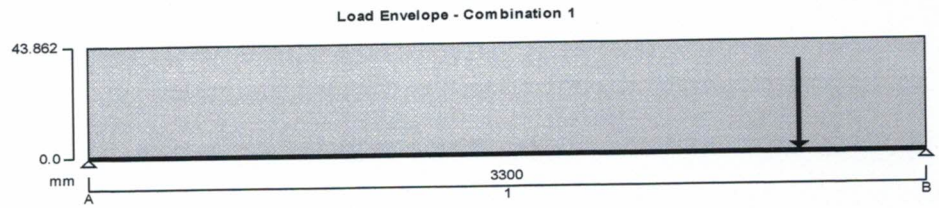
CHECK OUT BEAM USING TEDDS.

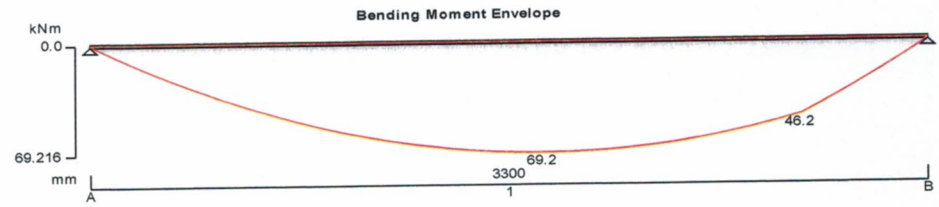


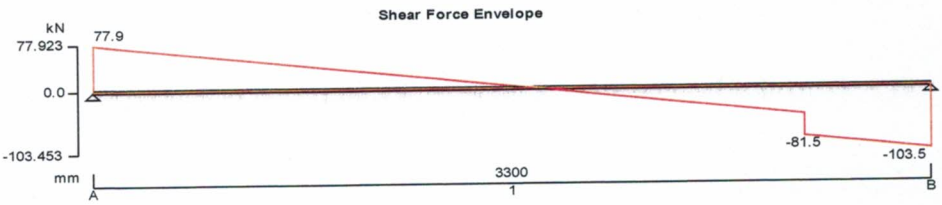
## STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

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

TEDDS calculation version 3.0.13




### Support conditions

| | |
|---|---|
| Support A | Vertically restrained<br>Rotationally free |
| Support B | Vertically restrained<br>Rotationally free |

### Applied loading

Beam loads

- Permanent self weight of beam × 1
- Permanent full UDL 13.8 kN/m
- Variable full UDL 16.6 kN/m
- Permanent point load 19.8 kN at 2800 mm
- Variable point load 6.6 kN at 2800 mm

### Load combinations

Load combination 1

| | |
|---|---|
| Support A | Permanent × 1.35<br>Variable × 1.50 |
| Span 1 | Permanent × 1.35<br>Variable × 1.50 |
| Support B | Permanent × 1.35 |

Variable × 1.50

**Analysis results**

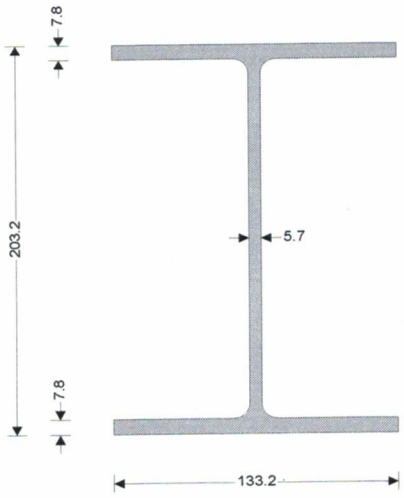
| | | |
|---|---|---|
| Maximum moment | $M_{max}$ = **69.2** kNm | $M_{min}$ = **0** kNm |
| Maximum shear | $V_{max}$ = **77.9** kN | $V_{min}$ = **-103.5** kN |
| Deflection | $\delta_{max}$ = **5.7** mm | $\delta_{min}$ = **0** mm |
| Maximum reaction at support A | $R_{A\_max}$ = **77.9** kN | $R_{A\_min}$ = **77.9** kN |
| Unfactored permanent load reaction at support A | $R_{A\_Permanent}$ = **26.2** kN | |
| Unfactored variable load reaction at support A | $R_{A\_Variable}$ = **28.4** kN | |
| Maximum reaction at support B | $R_{B\_max}$ = **103.5** kN | $R_{B\_min}$ = **103.5** kN |
| Unfactored permanent load reaction at support B | $R_{B\_Permanent}$ = **40** kN | |
| Unfactored variable load reaction at support B | $R_{B\_Variable}$ = **33** kN | |

**Section details**

| | |
|---|---|
| Section type | **UB 203x133x25 (BS4-1)** |
| Steel grade | **S275** |

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

| | |
|---|---|
| Nominal thickness of element | $t = \max(t_f, t_w)$ = **7.8** mm |
| Nominal yield strength | $f_y$ = **275** N/mm$^2$ |
| Nominal ultimate tensile strength | $f_u$ = **410** N/mm$^2$ |
| Modulus of elasticity | E = **210000** N/mm$^2$ |




**Partial factors - Section 6.1**

| | |
|---|---|
| Resistance of cross-sections | $\gamma_{M0}$ = **1.00** |
| Resistance of members to instability | $\gamma_{M1}$ = **1.00** |
| Resistance of tensile members to fracture | $\gamma_{M2}$ = **1.10** |

**Lateral restraint**

Span 1 has full lateral restraint

**Effective length factors**

| | |
|---|---|
| Effective length factor in major axis | $K_y$ = **1.000** |
| Effective length factor in minor axis | $K_z$ = **1.000** |
| Effective length factor for torsion | $K_{LT.A}$ = **1.000** |
| | $K_{LT.B}$ = **1.000** |

**Classification of cross sections - Section 5.5**

$\varepsilon = \sqrt{[235\ N/mm^2 / f_y]} = \mathbf{0.92}$

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

Width of section: $c = d = \mathbf{172.4}$ mm

$c / t_w = 32.7 \times \varepsilon <= 72 \times \varepsilon$ Class 1

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

Width of section: $c = (b - t_w - 2 \times r) / 2 = \mathbf{56.1}$ mm

$c / t_f = 7.8 \times \varepsilon <= 9 \times \varepsilon$ Class 1

***Section is class 1***

**Check shear - Section 6.2.6**

Height of web: $h_w = h - 2 \times t_f = \mathbf{187.6}$ mm

Shear area factor: $\eta = \mathbf{1.000}$

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

***Shear buckling resistance can be ignored***

Design shear force: $V_{Ed} = \max(\text{abs}(V_{max}), \text{abs}(V_{min})) = \mathbf{103.5}$ kN

Shear area - cl 6.2.6(3): $A_v = \max(A - 2 \times b \times t_f + (t_w + 2 \times r) \times t_f, \eta \times h_w \times t_w) = \mathbf{1282}\ mm^2$

Design shear resistance - cl 6.2.6(2): $V_{c,Rd} = V_{pl,Rd} = A_v \times (f_y / \sqrt{[3]}) / \gamma_{M0} = \mathbf{203.5}$ kN

***PASS - Design shear resistance exceeds design shear force***

**Combined bending and shear - Section 6.2.8**

Reduction factor - cl.6.2.8(3): $\rho_v = [(2 \times V_{Ed} / V_{pl,Rd}) - 1]^2 = \mathbf{0}$

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

Design bending moment: $M_{Ed} = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min})) = \mathbf{69.2}$ kNm

Design bending resistance moment - eq 6.13: $M_{c,Rd} = M_{pl,Rd} = [(W_{pl,y} - t_w \times h^2 / 4) + (t_w \times h^2 / 4) \times (1 - \rho_v)] \times f_y / \gamma_{M0} =$ **70.9** kNm

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

**Check vertical deflection - Section 7.2.1**

Consider deflection due to variable loads

Limiting deflection: $\delta_{lim} = L_{s1} / 360 = \mathbf{9.2}$ mm

Maximum deflection span 1: $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min})) = \mathbf{5.66}$ mm

***PASS - Maximum deflection does not exceed deflection limit***

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| PROJECT No. | 9428 |
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| SHEET No. | 11 |
| DATE | 7/16 |

PROJECT TITLE: 18a CALTHORPE ST., WC1X 0JS.

PREPARED: PJC | CHECKED:

## PADSTONES.

PS1 - REACTION = 19.8 6.6

= 36.6 kN.

ASSUME WALLS, 20 N/mm² BRICK IN M2 MORTAR

$f_k$ = 5.01 N/mm².

TRY PADSTONE 450 x 150 (DEEP) x 100 WIDE.

CAPACITY = $\frac{450 \times 100 \times 5.01 \times 10^{-3}}{2.5}$ = 90.1 kN.

USE 450 x 100 x 150 (DEEP) PADSTONE.

## POST 1 & 2.

ASSUME CAP & BASE PLATE - NO SIGNIFICANT MOMENT OR ECCENTRICITY.

DESIGN FOR $R_B$ = 40.0 33.0

USE 90 SHS 5.0, CAPACITY = 268 kN

BASED ON $l_e$ = 3.0 OKAY

FACTORED APPLIED LOAD = 103.5 kN (< 268 kN)

USE 15 mm CAP & BASE PLATES.

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| PROJECT No. | 9428 |
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| SHEET No. | 12 |
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| PROJECT TITLE | PREPARED | CHECKED |
|---|---|---|
| 18a CALTHORPE ST., WC1X 0JS. | PJC | |

ASSUME 225 WALL IN BASEMENT

TRY 225 x 225 x 150 DEEP

PADSTONE.

$$\text{CAPACITY} = \frac{225 \times 225 \times 5.01}{2.5} \times 10^{-3}$$

$$= 101 \text{ kN}.$$

USE 300 x 225 PADSTONE.