COPP WILSON PETTITT MOORE

Consulting Civil & Structural Engineers

First Floor, Unit 7, Brook Business Centre
Cowley Mill Road, Uxbridge, Middlesex UB8 2FX

Tel: 01895 231000
Fax: 01895 230044

STRUCTURAL CALCULATIONS

Project: 4 OVAL ROAD, LONDON, NW1 Sheet No.: 01

Job No: 16022 Date: SEP '16

THESE CALCULATIONS HAVE BEEN PREPARED IN ACCORDANCE WITH (where appropriate) THE FOLLOWING CURRENT DOCUMENTS.

BS 6399: Design Loading for Buildings.
BS 5628: Code of Practice for use of Masonry.
BS 5268: Structural use of Timber.
BS 449: The use of Structural Steel in Building.
BS 5950: Structural use of Steelwork in Buildings.
BS 8110: Structural use of Concrete.
BS 5977: Lintels.
CP 2004: Foundations.
The Building Regulations.

LOADINGS: (Dead loads)

Plain tiles, battens & rafters	0.90 kN/m²
Interlocking tiles, battens & rafters	0.70 "
Real slate, battens & rafters	0.50 "
Imitation slate, battens & rafters	0.40 "
3 layer felt & chippings	0.30 "
20mm asphalt	0.45 "
Roof or floor boarding	0.10 "
Ceiling joists plus lath & plaster	0.40 "
Ceiling joists & plasterboard	0.20 "
Floor joists, board, lath & plaster	0.50 "
Floor joists, boards & plasterboard	0.30 "
215mm brick wall, 1 render & 1 plaster	4.80 "
250mm cavity wall, brick / block, render & plaster	2.70 "
103mm brick wall , 2 render & 2 plaster	3.00 "
100mm lightweight block wall plus 2 render & 2 plaster	1.60 "

Reinforced & dense concrete	24.00 kN/m³
Brickwork	20.00 "
Lightweight blockwork	6.00 "
Steel	76.93 "
Softwood	5.40 "

LOADINGS: (Imposed loads)

Ceiling	0.25 kN/m²
Floors (self contained dwelling)	1.50 "
Snow	1.50 kN/m³

Loadings are modified where appropriate, to take account of roof slopes, snow drifting and other variables.

COPP WILSON PETTITT MOORE
First Floor, Unit 7, Brook Business Centre
Cowley Mill Road, Uxbridge, Middlesex UB8 2FX
Consulting Civil & Structural Engineers
Tel: 01895 231000
Fax: 01895 230044

Sheet: 02
Date: SEP '16
Job no: 16022

PROJECT: 4 OVAL ROAD, LONDON

EXISTING BEAM AT UPPER GROUND FLOOR (PARALLEL TO STAIRS)

SPAN = 3.2m

LOADING

STUD WALL 0.5 kN/m2 x 9.68m = 4.84 kN/m
STAIRS (0.5+1.5) kN/m2 x 1.0 m x 2 no. = 4.0 "
S/W 0.3 kN/m = 0.30 "
TOTAL = 9.14 kN/m

$R_A = R_B$ = 14.62 kN

$M = 9.14 \text{ kN/m} \times 3.2^2/8 = 11.69$ kNm

CHECK EXISTING 7" x 4" RSJ.

$I_x = 39.2 \times 25.4^4 = 1631.6 \text{ cm}^4$

$r_y = 0.85 \times 25.4 = 21.59$ mm

$Z_x = 11.2 \times 25.4^3 = 183.5 \times 10^3 \text{ mm}^3$

$T = 0.39 \times 25.4 = 9.91$ mm

D = 178 mm

$D/T = 178/9.91 = 17.96$ $\quad L_E/r_y = 3200/21.59 = 148.2$

FROM TABLE 3a BS 4449-2 $p_{bc} = 115 \text{ N/mm}^2$

$f_b = M/Z = 11.69 \times 10^6 / 183.5 \times 10^3 = 63.7 \text{ N/mm}^2 < 115 \text{ N/mm}^2$ o.k.

DEFLECTION $= \dfrac{5 \times 9.14 \times 10^3 \times 3.2 \times 3200^3}{384 \times 205000 \times 1631.6 \times 10^4} = 3.73\text{mm} < 3200/360 = 8.89\text{mm}$ o.k.

EXISTING BEAM IS SATISFACTORY UNDER CURRENT CONDITIONS

FOR PROPOSED SPAN (3.8m) PROVIDE 2 NO. 125 x 65 PFC IS (ONE TO EACH SIDE OF WEB OF EXISTING BEAM).

$R_A = R_B = (9.14 + 0.3) \text{ kN/m} \times 3.8/2 = 17.94$ kN (ULS = 25.1kN)

$M = 9.44 \text{ kN/m} \times 3.8^2/8 = 17.04$ kNm (ULS = 23.9kNm)

CHECK MOMENT CAPACITY OF NEW PFC ONLY $M_b = 34.7$ kNm > 23.9 o.k.

COPP WILSON PETTITT MOORE
First Floor, Unit 7, Brook Business Centre
Cowley Mill Road, Uxbridge, Middlesex UB8 2FX
Consulting Civil & Structural Engineers
Tel: 01895 231000
Fax: 01895 230044

Sheet: 03
Date: SEP '16
Job no: 16022

PROJECT: 4 OVAL ROAD, LONDON

DEFLECTION = $\frac{5 \times 9.44 \times 10^3 \times 3.8 \times 3800^3}{384 \times 205000 \times (966 + 1631.6) \times 10^4}$ = 4.81 mm < 3800/360 = 10.56mm O.K.

PROVIDE 2 NO. 125 x 65 PFC'S TO EXISTING BEAM, BOLTED TOGETHER USING M16 GRADE 8.8 BOLTS AT 400 CRS

AT BEARING ON WALL

R = 25.1 kN

L.D.S. = 0.94 N/mm²

WIDTH = 100mm L = $25.1 \times 10^3 / 0.94 \times 100$ = 267mm

CHECK BEARING ON WALL. ALLOW FOR NEW 300 x 100 x 15mm THK. M.S. SPREADER PLATE

COPP WILSON PETTITT MOORE
First Floor, Unit 7, Brook Business Centre
Cowley Mill Road, Uxbridge, Middlesex UB8 2FX
Consulting Civil & Structural Engineers
Tel: 01895 231000
Fax: 01895 230044

Sheet: 04
Date: SEP '16
Job no: 16022

PROJECT: 4 OVAL ROAD, LONDON

EXISTING BEAM OVER GROUND FLOOR OPENING

SPAN = 5.0m

LOADING

FIRST / SECOND FLOORS: (0.5 + 1.5) kN/m² x 7.8/2 x 2 = 15.6 kN/m
STUD WALLS 0.5 kN/m² x 6.61m = 3.31 "
S/W 0.5 kN/m = 0.5 "
TOTAL = 19.41 kN/m

RA = RB = 48.5 kN

M = 19.41 x 5²/8 = 60.65 kNm

CHECK EXISTING 9" x 4" RSJ.

$I_x = 81.1 \times 25.4^4 = 3375 \times 10^4 mm^4$

$I_y = 4.15 \times 25.4^4 = 172.7 \times 10^4 mm^4$

$r_y = 0.82 \times 25.4 = 20.83 mm$

$Z_x = 18 \times 25.4^3 = 294.9 \times 10^3 mm^3$

D = 229 mm T = 0.46 x 25.4 = 11.68

D/T = 229/11.68 = 19.6

$L_e/r_y = 5000/20.83 = 240.$

FROM TABLE 3a BS 449-2 P_{bc} = 72 N/mm²

$f_b = M/Z = 60.65 \times 10^6 / 294.9 \times 10^3 = 205.6$ N/mm² > 72 N/mm²
∴ OVERSTRESSED.

DEFLECTION = $\frac{5 \times 19.41 \times 10^3 \times 5 \times 5000^3}{384 \times 205000 \times 3375 \times 10^4} = 22.83 mm$

ALLOWABLE = 5000/360 = 13.89mm ∴ 22.83 > 13.89mm
UNSATISFACTORY.

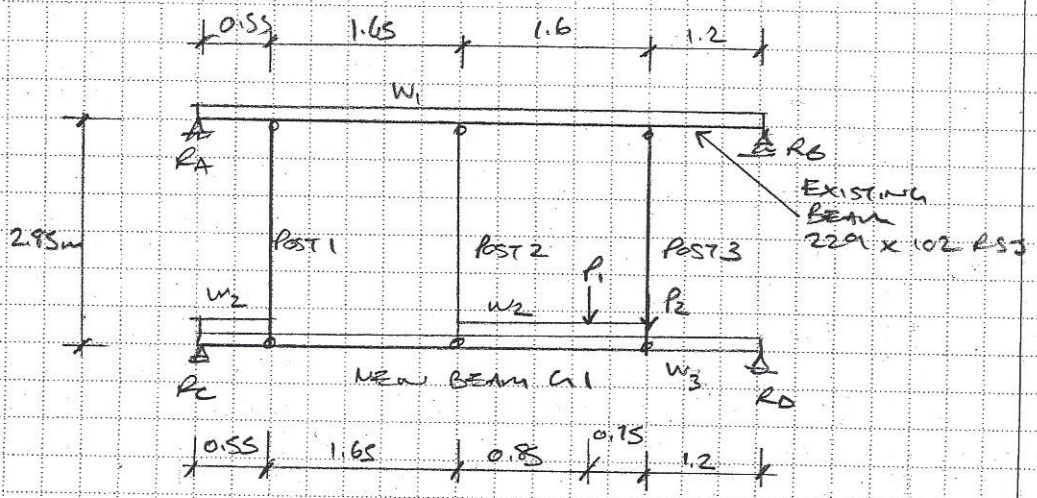
PROVIDE NEW STEEL POSTS ALONG SPAN, SEE NEXT SHEETS.

COPP WILSON PETTITT MOORE
First Floor, Unit 7, Brook Business Centre
Cowley Mill Road, Uxbridge, Middlesex UB8 2FX
Consulting Civil & Structural Engineers
Tel: 01895 231000
Fax: 01895 230044

Sheet: 05
Date: SEP '16
Job no: 16022

PROJECT: 4 OVAL ROAD, LONDON

EXISTING BEAM OVER GROUND FLOOR & NEW BEAM G1 UNDER GROUND FLOOR



LOADING (UNFACTORED)

W_1 = 19.41 kN/m (SEE PREVIOUS SHEET) = 19.41 kN/m
W_2 = STUD WALL 0.5 kN/m2 x 2.65 = 1.33 kN/m
W_3 = GROUND FLOOR (0.5+1.5) kN/m2 x 7.9/2 + 1.2 = 9.10 kN/m
P_1 = FROM EXISTING BEAM: 17.94 kN = 17.94 kN
P_2 = STUD WALL 0.5 kN/m2 x 3.2 x 1.25m = 2.0 kN

R_A = 9.58 kN R_B = 18.24 kN

R_C = 70.59 kN R_D = 66.8 kN

EXISTING BEAM

M_{MAX} = 14.7 kNm V = 20.8 kN

$f_b = M/Z = 14.7 \times 10^6 / 294.9 \times 10^3 = 49.8$ N/mm2 < 72 N/mm2 o.k.

DEFLECTION = 5.2mm < 5000/360 = 13.89 mm o.k.

$\tau = 20.8 \times 10^3 / 229 \times 7.62 = 11.91$ N/mm2 < 110 N/mm2 o.k.

EXISTING BEAM ADEQUATE

POSTS 1 – 3

F_C = 28 kN x 1.5 = 42 kN L_E = 2.85m

M_x = 42 x 0.1 = 4.2 kNm

COPP WILSON PETTITT MOORE
First Floor, Unit 7, Brook Business Centre
Cowley Mill Road, Uxbridge, Middlesex UB8 2FX
Consulting Civil & Structural Engineers
Tel: 01895 231000
Fax: 01895 230044

Sheet: 06
Date: SEP '16
Job no: 16022

PROJECT: 4 OVAL ROAD, LONDON

TRY 100 x 100 x 8 THK. SHS (S275)

P_c = 607.3 kN M_{cx} = 26.37 kNm

$f_c/P_c + M_x/M_{cx}$ = 0.23 < 1.0 O.K.

PROVIDE 100 x 100 x 8 THK. SHS

BEAM G1

R = 70.59 kN x 1.5 = 105.9 kN (= V)

M = 97.4 kNm x 1.5 = 146.1 kNm

CHECK 254 x 254 UC 73 WITH 430 x 12mm THK. BOTTOM FLANGE PLATE & 200 x 12 TOP FLANGE PLATE.

I_x = 23 999.89 x 10^4 mm^4

Le = 5.0m M_b = 223.6 kNm (IGNORING PLATES) > 146.1 kNm O.K.

P_v = 361 kN > 105.9 kN O.K.

DEFLECTION = 5.05mm < 5000/360 = 13.88mm O.K.

PROVIDE 254 x 254 UC 73 WITH 430 x 12mm THK. BOTTOM FLANGE PLATE & 200 x 12 TOP FLANGE PLATE.

SPREADER BEAMS TO BEAM G1 BEARINGS

LOCAL DESIGN STRENGTH OF EXISTING BRICK. = $1.5 f_k/\gamma_m$

f_k = 25 N/mm² γ_m = 3.5 L.D.S. = 1.5 x 25/3.5 = 10.7 N/mm²

ASSUME b = 100mm R = 105.9 kN

L = $105.9 \times 10^3 / 10.7 \times 100$ = 989.7 mm

PROVIDE 1.1m LONG SPREADER BEAM.

$M = \left(105.9/1.1\right)\left(\frac{1.1 - 0.254}{2}\right)^2 \times \frac{1}{2}$ = 8.61 kNm

Le = 1.1m

PROVIDE 203 x 102 UB 23 (L = 1.1m) M_b = 61.6 kNm P_v = 181 kN

4 Oval Road, London
Beam G1 splice connection

16/09/2016

by T. K. Sharma
January 2005, updated 2/06

BEAM SPLICE CONNECTION DESIGN (BS 5950)

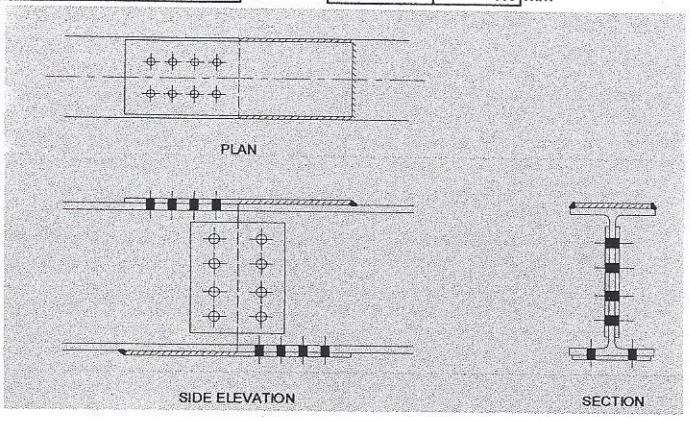
Note: 1) Design assumes that flange cover plates resist the design bending moment & 2) web cover plates resist the design shear force together with the torsional moment.

	Ultimate	
Applied moment, *M*	146.1	kNm
Vertical shear force, *F*	105.9	kN

Beam size:	254 x 254 UC 73	
Beam Depth, D	254.1	mm
Beam width, B	254.6	mm

Flange thk.	14.2	mm
Web thk.	8.6	mm

Note: All bolts grade 8.8



Drawing diagrammatic only.

FLANGE SPLICE

Shear Force in flange *M / D = F*	**575.0**	kN

Table 1: Shear capacity of 1 no.bolt

Bolt size	Tensile area (N/mm²)	Single Shear P_S 375 N/mm² (kN)	number of bolts req.
M16	157	58.9	9.8
M20	245	91.9	6.3
M24	353	132.4	4.3
M30	561	210.4	2.7

Enter bolt no. & properties: **Note: for one side of joint only**

number of bolts	Bolt dia. (mm)	Tensile area (N/mm²)	Single Shear (kN)	Total capacity (kN)	> F
8	20	245	91.9	**735.2**	**O.K.**

Check Bearing Capacity of Beam Flange

Flange thk. (mm)	14.2	mm

$P_{bs} = 460 d_b t_p$

P_{bs} (kN)	Total capacity (kN)	> F
130.64	**1045.12**	**O.K.**

Check tension capacity of flange cover plate

Enter plate width & thickness:

Plate width (mm)	250	mm
Plate thk. (mm)	12	mm

Yield strength, P_y	275	N/mm²

Gross x-section area (mm²)	Net area, α_n (N/mm²)	Tension Capacity, $P_t = 1.2\alpha_n P_y$ (kN)	> F_{plate}	
3000	2472	**815.76**	**549.0**	**O.K.**

Equivalent fillet weld strength (grade S275 steel & p_w = 220 N/mm²)

Select:

Flange plate length from joint		-	mm

Note: for one side of joint only

Leg length, s (mm)	Throat size, a = 0.7s (mm)	Longitudinal capacity, P_w (kN/mm)	Effective weld length (mm)	Total capacity of weld (kN)	> F
-	#VALUE!	#VALUE!	#VALUE!	**#VALUE!**	**#VALUE!**

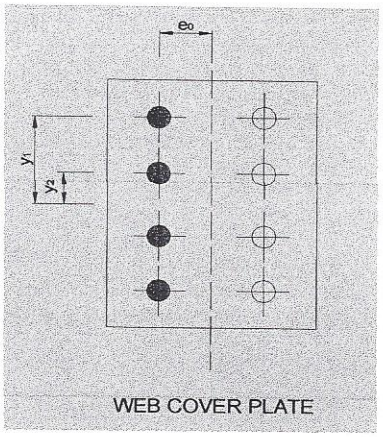
Provide:
950 x 250 x 12mm thk. top flange plate & 950 x 430 x 12mm thk. bottom flange plate, 8 no. M20 grade 8.8 bolts to each side of joint, top & bottom.

WEB SPLICE (2 no. web cover plates)

Check bolts in web splice

Vertical shear, F	105.9	kN
Eccentricity, e_0	50	mm
Torsional moment, m_t	5295	kNmm

Note: e_0 = Half of distance between centres of bolt groups either side of joint



Drawing diagrammatic only.

Note: for one side of joint only

number of bolts	Bolt dia. (mm)	Single Shear, P (kN)	Double Shear, 2P (kN)
4	20	91.9	183.8

Maximum resultant force F_R occurs on outermost bolts $F_R = \sqrt{F_{vs}^2 + F_{tm}^2}$

where, F_{vs} is the force due to vertical shear & F_{tm} is the force due to torsional moment. $F_{tm} = \frac{m_t y_1}{2\sum y_n^2}$

F_{vs} = F / n (kN)	Distance of furthest bolt, y_1 (mm)	$\Sigma\, y_n^2$	F_{tm} (kN)	F_R (kN)	< 2P
26.475	50	2500	52.95	59.2	O.K.

Check web cover plates for shear

Web plate thk. (mm)	Depth of plate (mm)	Net area, A_{net} (mm²)	Shear capacity of one plate, P_v (kN)	> F/2 (kN)
12	200	1344	199.584	52.95

O.K.

$P_V = 0.6 p_y A_{v(net)}$

$A_{V(net)} = 0.9 A_{net}$

Provide:
200 x 200 x 12mm thk. Web plate both sides, with 2 no. M20 grade 8.8 bolts each side of joint.