

Vara Consulting Engineers Ltd.

Consulting Civil & Structural Engineers.

Project No: VCE-10124a.

Date: July 2011.

Client: Mr Donald. D. Davies.

**Job Title: 7C Gainsborough Gardens,
London, NW3 1BJ.**

Client Ref: 11/026.

**Structural Design
Calcs. For Proposed
Loft Conversion.**

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1.0 RELEVANT DESIGN REFERENCE DOCUMENTS :-

a. British Standards and Code of Practice's :

- I. Schedule of Weights of Building Materials: BS648
- II. Loadings for Buildings: BS6399: Parts 1,2 & 3
- III. Wind Loads: CP3 Chapter V: Part 2
- IV. Structural Use of Concrete: BS8110: Part 1
- V. Structural Use of Steelwork: BS5950: Part 1
- VI. Foundations: BS8004
- VII. Structural Use of Masonry: BS5628: Part 1
- VIII. Structural Use of Timber: BS5268: Part 1
- IX. Building Regulation 2000: Document A
- X. Lintels: Method of Assessment of Load: BS5977: Part 1

2.0 RELEVANT ARCHITECT'S REFERENCE DRAWINGS:

- (ii) EXISTING 2ND FLOOR & LOFT FLOOR PLANS :
Dwg No. 11/026/EX/002.
- (iii) PROPOSED SECOND FLOOR & LOFT FLOOR PLANS :
Dwg No. 11/026/PL/001.

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3.0 DESIGN STATEMENT AND PREMISE:

- (1) All Chimney stacks below roof eaves level are to be removed and supported within loft space using gallow brackets.
- (2) Existing foundations will be assumed to be constructed of nominal footing for design check for additional loading from loft conversion for minimum allowable ground bearing pressure of 150 kN/m² for overconsolidate ground.
- (3) Existing 'Horse' roof truss Chords are to be removed for loft conversion and if possible existing rafters are to be retained with introduction of floor/roof support integrated beams together with load-bearing Studwork walls for support of the rafters. This will have minimal affect on construction and hence cost.
- (4) For simplicity and ease of construction it is deemed necessary to remove existing ceiling joists instead of strengthening the existing for installation of studwork support beams.
- (5) Trimmers around stairs into loft space will be reqd.
- (6) No structural work is reqd at second floor level as floor space modified using studwork walls only.

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4.0 LOADINGS

1. Pitched Roof (Old)

DL		kn/m ²	
	Slate or Tile	=	0.70
	Felt & Battens	=	0.05
	Purlins & Rafters	=	0.15
	Ceiling Joists	=	0.10
	Lathe & Plaster	=	0.40
			<u>1.40</u>
LL			
	Ceiling	=	0.25
	Roof	=	0.75
			<u>1.00</u>
Total			<u>2.40 kn/m²</u>

2. Pitched Roof (New)

DL		kn/m ²	
	Slate or Tile	=	0.70
	Felt & Battens	=	0.05
	Trussed Rafters	=	0.10
	Ceiling	=	0.15
			<u>1.00</u>
LL			
	Ceiling	=	0.25
	Roof	=	0.75
			<u>1.00</u>
Total			<u>2.00 kn/m²</u>

3. Flat Roof

DL		kn/m ²	
	Felt/Chippings	=	0.25
	Insulation	=	0.05
	Deck	=	0.15
	Joists	=	0.15
	Soffits	=	0.15
			<u>0.75</u>
LL			
	Snow	=	0.75
			<u>0.75</u>
Total			<u>1.50 kn/m²</u>

4. Timber Floor (Old)

DL		kn/m ²	
	Boards	=	0.20
	Joists	=	0.20
	Lathe & Plaster	=	0.40
			<u>0.80</u>
LL			
	Domestic	=	1.50
			<u>1.50</u>
Total			<u>2.30 kn/m²</u>

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5. Timber Floor (New)

DL		kn/m ²	
Boards	=	0.15	
Joists	=	0.20	
Ceiling	=	0.15	
			<u>0.50</u>
LL			
Domestic	=	1.50	
			<u>1.50</u>
Total			<u><u>2.00 kn/m²</u></u>

6. Ceiling Roof
7. Space (not habitable)

DL		kn/m ²	
Joists	=	0.15	
Soffits	=	0.15	
			<u>0.30</u>
LL			
Domestic	=	0.25	
			<u>0.25</u>
Total			<u><u>0.55 kn/m²</u></u>

8. RC Ground Floor Slab

DL		kn/m ²	
Slab = 24.0 kn ² 0.15	=	3.60	
Finishes = screed & insulation	=	1.30	
			<u>4.90</u>
LL			
Domestic	=	1.50	
			<u>1.50</u>
Total			<u><u>6.40 kn/m²</u></u>

9. Wind

WL
 Outskirts London V=38.0m/s
 $S_1 = S_3 = 1.0$ Ground roughness (3) Class B H = 9.0m
 $S_2 = 0.72$
 $V_s = 0.72 \times 38.0 = 27.4\text{m/s}$
 $q = 0.613 \times 10^{-3} \times 27.4^2$
 $q = 0.461 \text{ kn/m}^2$

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10. Walls

DL		kn/m ²
Cavity Wall		
	100mm Brickwork	= 2.10
	100mm Blockwork	= 1.50
	Plaster	= 0.23
		<u>3.83 kn/m²</u>
	102 brick	= 2.10
	Plaster	= 0.23
	Total	<u>2.33 kn/m²</u>
	102 brick	= 2.10
	2 x Plaster	= 0.46
	Total	<u>2.56 kn/m²</u>
	215 brick	= 4.52
	Plaster	= 0.23
	Total	<u>4.75 kn/m²</u>
	215 brick	= 4.52
	2 x Plaster	= 0.46
	Total	<u>4.98 kn/m²</u>
	215 block	= 3.23
	Render	= 0.40
	Plaster	= 0.23
	Total	<u>3.86 kn/m²</u>
	100 light-wt blk	= 0.70
	2 x Plaster	= 0.46
	Total	<u>1.16 kn/m²</u>
	140 light-wt blk	= 1.00
	2 x Plaster	= 0.46
	Total	<u>1.46 kn/m²</u>
Stud Partition		
	Studs / Insulation	= 0.20
	Plaster	= 0.30
	Total	<u>0.50 kn/m²</u>
Cavity Wall		
	100 Brickwork	= 2.10
	140 Blockwork	= 2.10
	Plaster	= 0.23
	Total	<u>4.43 kn/m²</u>
Tile Hung Wall		
	Tiles	= 0.65
	Ply	= 0.15
	Studs / Insulation /Plaster	= 0.40
	Total	<u>1.20 kn/m²</u>

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S.O STEELWORK SUPPORT BEAMS:

(1) BEAM B1:

Roof rafter and left floor support beam.

$$L = 7.70m$$

LOADING (VF):

NOTE:

loading over full length from dormers will be considered to act - Conservative Approach to allow for snow loading etc.

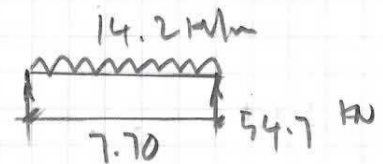
	on slope	kN/m
EXTL ROOF	$= 2.40 kN/m^2 \times 0.5, 0.20$	$= 7.44$
NEW LFT FLOOR	$= 2.0 kN/m^2 \times 0.5, 1.50$	$= 1.50$
SWT BEAM	$= \text{say}$	$= 0.50$
		<u>$9.44 kN/m$</u>

$$= W (kN/m) \sim 1.5 \times 9.44 kN/m$$

$$= 14.2 kN/m$$

$$M_x = \frac{14.2 \times 7.7^2}{8}$$

$$= 105.2 kNm$$



TRY 203, 71 UC (5275)

$$\therefore M_b (7.70) = 142.0 kNm (> M_x) \text{ O.K.}$$

$$\delta_{v, (0.13) VF} = 5 \times 9.44 \times 7700^4 / 384 \times 2.10^8 \times 7620 \times 10^4$$

$$= 28.4mm (\sim 4271)$$

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		Calculations by	KW

5.0 (1) BEAM B1 - CONTD.

$$\begin{aligned}
 \therefore F_{>> (D1 \text{ only})} &= \frac{2.0 \times 0.45}{4.4} = 20.4 \\
 &= 12.9 \text{ m} \left(\sim \frac{1}{596} \right) 0.4
 \end{aligned}$$

PROVIDE 203, 203, 71 UL (S215) BEAM

OR ALTERNATIVELY USING FLITCH BEAMS:

For design analysis and output refer to attached
Calc Sheet nos. 13 - 15 resp.

USE 2 NO. 300 x 100 mm GRADE D40 TIMBER WITH
3 NO. 250 x 20 mm STEEL PLATES (S215) BOLTED TOGETHER
@ MID-HIT @ 400mm CENTRES WITH M16 (8.8) BOLTS,
PROV. OF 2 NO. BOLTS @ SUPPORTS.

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5.0 (2) BEAM B2

Left floor and roof support beam via C-B Studwork walls.

$$L = 7.70m.$$

LOADING (D+L) U.F.

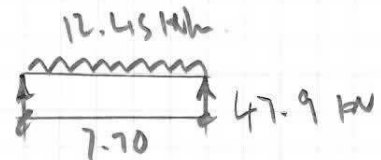
Roof	$= 2.40 kN/m^2 \times 0.5 \times 3.2$	$= 3.84$
Studwork wall	$= 0.5 kN/m^2 \times 1.5$	$= 0.75$
Floor	$= 2.0 kN/m^2 \times 0.5 \times 3.2$	$= 3.20$
Sw	$= \text{any}$	$= 0.50$
		<u>$8.30 kN/m$</u>

$$\therefore W_{tot} = 1.5 \times 8.30$$

$$= 12.45 kN/m.$$

$$M_x = 12.45 \times 7.70^2 / 8$$

$$= 92.3 kNm.$$



Try 203, 606

$$\sigma_{xx} (A_{eff}) U.F. = 5 \times 8.3 \times 7700^4 / 384 \times 2 \times 10^5 \times 6130 \times 10^4$$

$$= 3110m \quad (\sim 248)$$

$$\sigma_{xx} (Flange) = 0.45 \times 3110$$

$$= 139m \quad (\sim 1552) \quad O.K.$$

Use 203, 203, 606 (SL15) Beams

NOTE: Alternatively, Provide Fluted Beam as per Beam B1 above as adapted by inspection to Scripps deflection system.

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6.0 PADSTONES AND WALL BEARINGS:

For Beams B1 & B2 as Considered per Concrete Calc.

$V_{max} B1 = 54.7 \text{ kN}$ - Bearing onto Solid brick wall.

For design refer to attached calc sheet Nos. 16 & 17 nsp.

Provide Nom. 300 LG x 150mm x 215mm GRADE C20

CONC. PADSTONE - ELSE PROVIDE 300 LG x 200mm x 15mm
(5215) STEEL SHIM PLTS.

7.0 LOAD-BEARING INT. STUDWORK WALL ~ As support roof.

$W_{ROOF} = 2.40 \text{ kN/m}^2 \times 0.5 \times 3.2$

$\sim 3.84 \text{ kN/m}$

For design refer to attached calc sheet Nos. 18 & 19 nsp.

Provide 100 x 50 GRC C16 TIMBER STUD WALL CONCR.

@ 400mm HORIZ CENTRES.

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8.0 FLOOR JOISTS

$L_{max} = 3.10m$

$$W_{max} = 1.0 kN/m^2 \times 0.4 \\ = 0.4 kN/m = 0.8 kN/m o/a$$

For design refer to attached Calc sheet Nos. 20 & 21 resp.

Provide No. 175, 75 GR C16 Joists @ 400mm Centres.

9.0 ROOF JOISTS

$$W_{ROOF CASE} = 2.40 kN/m^2 \times 0.33 - \text{Rise to Calc sheet} \\ = 0.84 kN/m \quad \text{Nos 22-24 resp for design.}$$

Check adequacy of exty roof rafters - 125, 50 mm GR C16 @ 350mm Centres.

Hence Exty 125, 50 GR C16 Rafters are deemed just adequate with additional intermediate rafters at 175mm o/a Centres.

10.0 CHIMNEY SUPPORTS

Consider Gallow brackets for Cant within loft space at eaves level - all Chimneys to be removed up to roof level 1st above Second Fl.

$$\text{Chimney Load } W = 1.5 \times 21.0 kN/m^3 \times 0.455 \times 6.1 \\ = 83.6 kN/m$$

Try Gallow brackets at 500mm Centres.

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10.0 CHIMNEY SUPPORT BRACKETS - CONTD.

$$\therefore W / \text{BRACKET} = 83.6 \text{ kNm} > 0.5 \\ = 41.8 \text{ kN}$$

$$\begin{array}{r} 41.8 \\ 41.8 \overline{) 59.1} \end{array}$$

$$\therefore F_c = 41.8 / \cos 45^\circ = 59.1 \text{ kN} (< 165.0 \text{ kN}).$$

THUS PROVIDE KNEE BRACES 70.70 x 6 RISA GAWWAY BRACKETS AS DETAILS FULLY WELDED

PROVIDE FININGS

$$F_f = 41.8 / \cos 45^\circ \\ = 6.96 \text{ kN} (< 12.8 \text{ kN})$$

PROVIDE GNS MIN / BRACKET M12 GIVE FININGS FULLY THREADED RODS MORTAR INJECTION SYSTEM FIG V.

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11.0 Check Adequacy Of Existing Footings.

For additional load due to loft conversion.

For assumed nominal Gable wall construction for 500mm thick solid brickwork wall.

Consider loading on Gable walls:

$$\begin{array}{rcl}
 \text{Roof} & = & 2.40 \text{ kN/m}^2 \times 0.5 \times 6.24 = 7.49 \\
 \text{2nd fl. conv, FF \& SFL} & = & 3 \text{ N}^{\circ} \times 2.01 \text{ kN/m}^2 \times 0.5 \times 6.24 = 18.72 \\
 \text{WALL} & = & 21.01 \text{ kN/m}^2 \times 0.3 \times 10.0 = 63.0 \\
 \text{SFL FOOTING} & = & 21.0 \text{ kN/m}^2 \times 0.6 \times 0.3 = 4.32 \\
 & & \hline
 & & 93.2 \text{ kN/m}
 \end{array}$$

$$\therefore \text{Actual GBP} = 93.2 / 0.6$$

$$= 155.3 \text{ kN/m}^2 \quad (\sim 150 \text{ kN/m}^2)$$

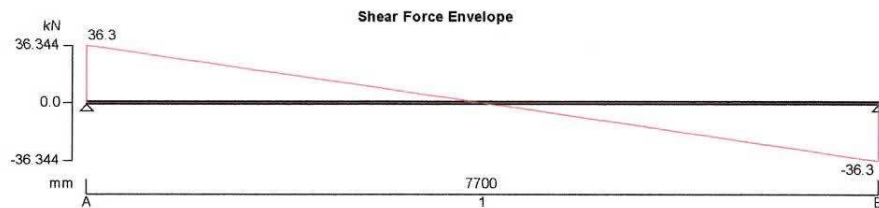
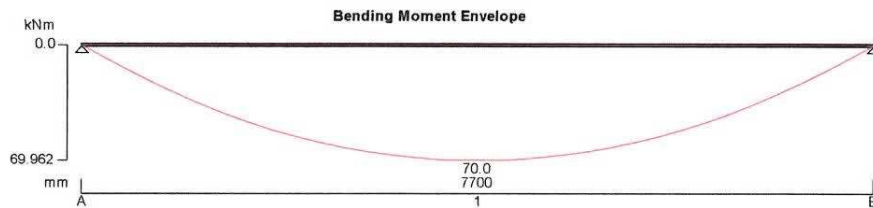
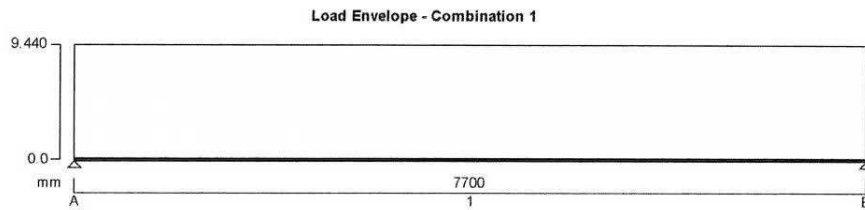
Say 0.1

HENCE, EXISTG FOOTINGS ARE DEEMED ADEQUATE.

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7c Gainsborough Road				VCE-10124a	
Calcs for				Start page no./Revision	
Alternate Option - Edge Flitch Beam B1.				13	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
mv	13/07/2011				

FLITCH BEAM ANALYSIS & DESIGN TO BS5268-2:2002

TEDDS calculation version 1.5.04



Applied loading

Beam loads

DI full UDL 9.440 kN/m

Load combinations

Load combination 1

Support A

Dead $\times$ 1.00
Imposed $\times$ 1.00

Span 1

DI $\times$ 1.00
Dead $\times$ 1.00
Imposed $\times$ 1.00

Support B

DI $\times$ 1.00
Dead $\times$ 1.00
Imposed $\times$ 1.00
DI $\times$ 1.00

Analysis results

Design moment

M = 69.962 kNm

Design shear

F = 36.344 kN