

PERMIT

**22 KINGS ROAD
HAYLING ISLAND
HANTS**

PROPOSED LOFT CONVERSION AND SIDE EXTENSION

STRUCTURAL CALCULATIONS AND DESIGNS

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PROJECT: 22 KINGS ROAD, HAYLING ISLAND

✓ PROPOSED LOFT CONVERSION

✓ STRUCTURAL CALCULATIONS

JOB NO:
1883

DATE:
2.09.10

DESIGN STANDARDS:

Loadings	...	...	In accordance with CP3 Chapter V
Timber	...	...	In accordance with BS5268 (Part 2)
Steelwork	...	...	In accordance with BS449
Masonry	...	...	In accordance with BS5628 (Part 1)
Reinforced Concrete	...	...	In accordance with BS8110

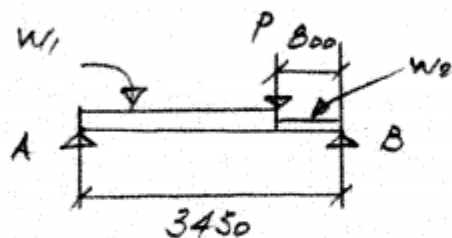
Loadings General

Pitched Roof:-	KN/m^2
Tiles & Felt	= .70
Timber	= .20
Ceiling & Insulation	= .20
Live Load (snow) $42\frac{1}{2}^\circ$ pitch	= .40
	<u>1.50</u>
First Floor Ceilings & Joists	= .30
Suspended Timber Floors:-	
Boards	= .15
Joists	= .15
Ceiling	= Nil
Live Load	= 1.50
	<u>1.80</u>

Take Timber Stud Partitions at 40 KN/m^2

Take Masonry Partitions at 2.35 KN/m^2

Note:
Ceilings
over First
Floor
Independent
of 2nd Floor
Joists

New Second Floor Joists Span 3.45m max

Loading Diagram

$$P = [2.5(1.50) + 70(40)] \cdot 40 = 1.61 \text{ kN}$$

p. roof studs joist spacing

$$W_1 = 2.65(1.80) \cdot 40 = 1.91 \text{ kN}$$

2nd Floor

$$W_2 = 0.80(0.30) \cdot 40 = 1.0 \text{ kN}$$

Void

$$\therefore R_A = \frac{1}{3.45} [1.61(1.80) + 1.91(2.125) + 1.0(0.40)]$$

$$= \frac{1}{3.45} (1.29 + 4.06 + 0.4) = 1.56 \text{ kN}$$

$$\therefore R_B = 3.62 - 1.56 = 2.06 \text{ kN}$$

$$\therefore \text{Zero Shear at } \frac{1.56}{1.91} (2.65) = 2.16 \text{ m from A}$$

$$\therefore M_{\max} = \frac{1.56(2.16)}{2} = 1.69 \text{ kN.m}$$

$$\therefore d_{\text{reqd}} = \sqrt{\frac{1.69(10)^6}{1.1(7.5)(50)}} = 157 \text{ mm}$$

(175 x 50 C24 at 400 ctrs OK)

Deflection,

$$= \left[0.11(1.61) + \frac{5(2.01)}{384} \right] \frac{(10)^3 (3450)^3}{1.1(10800)(50)(175)^3}$$

$$= (0.018 + 0.026) 154.8 = 6.81 \text{ mm}$$

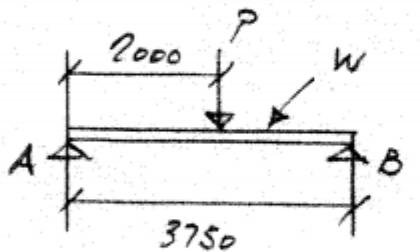
$$\text{Permiss. } \Delta = 1003(3450) = 10.35 \text{ mm}$$

✓
OK

New 2nd Floor
Joists

Adopt- 175 x 50 C24
at 400 ctrs.
12mm above
Existing
Ceiling Boards
& Blocked Up
off Intermed.
Support Wall
(with Noggins
at Mid Span)

Steel Beams Supporting 2nd Floor Joists,
Existing Ceilings & Roof Verge Span 3.75m max (over Rear Bedroom)



Loading Diagram

$$P = 1.60 \text{ (avg. ht stud partition)} (1.80) (.40) \frac{1}{2} = 1.58 \text{ KN}$$

$$W = \left[1.61 \text{ (stud/roof)} \frac{(1.9)}{2.7} \left(\frac{1}{.40} \right) + (1.8 + .30) 1.9 \left(\frac{.95}{2.7} \right) \right]$$

$$+ (.30 + .30 + 1.50) \frac{1.10}{2} + .30 \left] 3.75 \right.$$

$$= (2.83 + 1.40 + 1.15 + .30) 3.75 = 21.30 \text{ KN}$$

$$\therefore M_{\max} = \frac{1.58(3.75)}{4} + \frac{21.30(3.75)}{8}$$

$$= .54 + 9.98 = 10.52 \text{ KN.m}$$

For a 152 x 152 x 23 UC as a beam,

$$\frac{L}{r_y} = \frac{3750}{36.8} = 102 \quad \frac{D}{T} = 22.3$$

$$\therefore p_{bc} = 130 \text{ N/mm}^2$$

$$f_{bc} = \frac{10.52(10)^6}{165.7(10)^3} = 64 \text{ N/mm}^2$$

Deflection :-

$$\Delta_{\text{total}} = \frac{5}{384} \frac{21.30(10)^6(3750)^3}{2.1(10)^5 \cdot 1263(10)^4}$$

$$= 5.66 \text{ mm}$$

$$\text{Permiss } \Delta_{L.L.} = \frac{3750}{360} = 10.42 \text{ mm} \quad \left. \begin{array}{l} \text{OK} \end{array} \right\}$$

Length of Bearing - 100mm

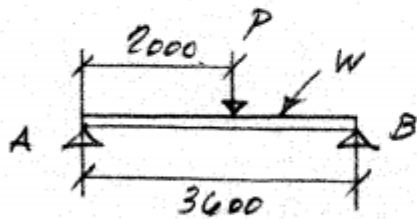
Concrete Padstones :-

- (i) On Intermediate Walls - 250L x 100W x 100 Deep
- (ii) On End (Gable) Walls - 225L x 100W x 100 Deep

Steel Beams Supporting 2nd Floor Rear

Adopt - 152 x 152 x 23 UC's Profile Welded or Fish Plated on Intermediate Supporting Walls

Steel Beams Over Front Bedroom
Carrying 2nd Floor Joists, Existing Ceilings
& Roof Span 3.60 m max



Loading Diagram

$$P = 1.60(2.4)(.40)\frac{1}{2} = .77 \text{ KN}$$

avg. ht

$$W = \left[1.61 \left(\frac{2.5}{3.4} \right) \frac{1}{.40} + (1.8 + .30) 2.4 \left(\frac{1.2}{3.4} \right) \right]$$

stud/roof floor c.j's

$$+ (.30 + .30 + 1.50) \frac{1.10}{2} + .30 \Big] 3.60$$

e.j's joist roof 2 Sw

$$= (2.96 + 1.78 + 1.15 + .30) 3.6 = 22.28 \text{ KN}$$

$$\therefore M_{\max} = \frac{.77(3.6)}{4} + \frac{22.28(3.6)}{8}$$

$$= .69 + 10.03 = 10.72 \text{ KN.m}$$

Similar to Beam on Page 3

$\therefore$ Adopt —

Steel Beams
Supporting 2nd
Floor Front

152 x 152 x 23
UC's
Profile
Welded & or
Fish Plated
on Intermed.
Supporting
Walls

Length of Bearing
& Concrete Padstones

} As Page 3

Check Existing Beam Over Lounge* to Carry New Load From Second Floor Span 3.25m

* Advised
Exg. Beam
178 x 102 x 19
U.B.

Beam Loading :-

kN/m

Pitched Roof & Studs,

$$p.2 \rightarrow \left[\frac{1.61}{1.40} \left(\frac{.8}{3.45} + \frac{.8}{2.70} \right) + (1.8 + 1.3) \left(\frac{1.9}{2.7} + \frac{2.1}{3.45} \right) + (.30 + .30) \left(\frac{.4}{2.7} + \frac{.4}{3.45} \right) \right]$$

roof & studs 2nd Floor & c.j.'s
void joists & c.j.'s

$$= 2.13 + 2.76 + .16 = 5.05$$

$$\text{2nd Floor Partition } \frac{7.42(.40)}{2} \frac{1}{3.25} = .46$$

$$\text{Masonry Partition Over 2.10 (2.35)} = 4.93$$

$$\text{SW Beam} = .20$$

$$\underline{10.64}$$

$$\frac{L}{r_y} \text{ for } 178 \times 102 \times 19 \text{ UB Built into walls}$$

$$\text{Both Ends} = \frac{.70(3250)}{23.9} = 95 \quad \frac{D}{T} = 22.5$$

$$\therefore p_{bc} = 137 \text{ N/mm}^2$$

$$M_{\max} \text{ for Exg. Beam} = \frac{10.64(3.25)^2}{8} = 14.05 \text{ kN.m}$$

$$\therefore f_{bc} = \frac{14.05(10)^6}{153(10)^3} = 92 \text{ N/mm}^2 < 137 \text{ N/mm}^2$$

✓ OK

Deflection :-

$$\text{Load Excluding Partitions} = 5.05(3.25) = 16.41 \text{ kN}$$

$$\therefore \Delta = \frac{5}{384} \frac{(16.41)(10)^3(3250)^3}{2.1(10)^5 \cdot 1360(10)^4}$$

$$= 2.57 \text{ mm}$$

$$\text{Permiss. } \underline{\Delta_{2L}} = \frac{3250}{360} = 9.03 \text{ mm} \quad \left. \vphantom{\frac{3250}{360}} \right\} \checkmark \text{ OK}$$

Existing
178 x 102 x 19
UB Satisfactory
to carry
Load From
2nd Floor.

Design First Floor Beam Over Lounge to
Carry First Floor Partition & Load From
UC Carrying 2nd Floor & Roof Span = 2.90m

Beam Loading :-

$$\text{Steel at 2nd Floor} \left(\frac{2.6}{4.6} \left[\frac{6.3}{2} \left(\frac{22.28}{3.6} \right) + \frac{1.77(2.0)}{(3.6)} \right] \right) = 11.26 \text{ KN}$$

UDL Stud partition

$$\text{First Floor} \frac{4.00}{2} (2.00) 2.90 = 11.60$$

$$\text{Masonry Partition} (2.10)(2.35) \frac{3.50}{3.65} (2.60) = 12.31$$

$$\text{SW & Casing} 2.90(1.30) = 1.67$$

$$\underline{\underline{36.04}}$$

$$\therefore M_{\max} = \frac{36.04(2.90)}{8} = 13.07 \text{ KN.m}$$

For a 178 x 102 x 19 UB

$$\frac{L}{r_y} = \frac{2900}{23.9} = 85 \quad \frac{D}{T} = 22.5$$

$$\therefore p_{bc} = 145 \text{ N/mm}^2$$

$$f_{bc} = \frac{13.07(10)^6}{153(10)^3} = 86 \text{ N/mm}^2 \quad \left. \vphantom{\frac{13.07(10)^6}{153(10)^3}} \right\} \text{OK}$$

Deflection :-

Load Excluding Partition Over & F. Floor

$$\text{Dead Load} = 11.26 + \frac{4}{2} (1.50) 2.90 = 19.96 \text{ KN}$$

$$\therefore \Delta = \frac{5}{384} \frac{19.96(10)^3 (2900)^3}{2.1(10)^5 1360(10)^4}$$

$$= 2.22 \text{ mm}$$

$$\text{Permiss. } \underline{\underline{\Delta_{LL}}} = \frac{2900}{360} = 8.06 \text{ mm} \quad \left. \vphantom{\frac{2900}{360}} \right\} \text{OK}$$

Length of Bearing 100 mm
 Concrete
 Padstones -

Beam over
 Lounge,
 Carrying First
 Floor Partition

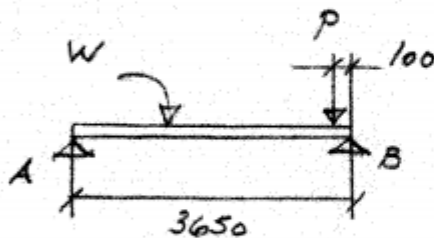
Adopt 178 x 102 x 19
 UB

225 L x 100 W
 x 100 Deep

Check First Floor Joists Over Front of Lounge
to Carry Partition over onto Steel Beam on Page 6

} 175x50
Joists at
400 ctrs
Advised

Span Reduced to 3.65m



Loading Diagram

$$P = \left(\underbrace{11.26 + 12.31}_{\text{from page 6}} \right) \cdot \frac{40}{2.60} = 3.62 \text{ KN}$$

$$W = 3.55(2.00) \cdot 40 = 2.84 \text{ KN}$$

F. Floor

$$\therefore R_A = \frac{1}{3.65} \left[3.62(1.0) + 2.84 \left(\frac{3.65}{2} \right) \right]$$

$$= \frac{1}{3.65} (1.56 + 5.18) = 1.51 \text{ KN}$$

$$\therefore R_B = 6.46 - 1.51 = 4.95 \text{ KN}$$

Zero Shear at $\frac{1.51}{1.80} = 1.89 \text{ m}$ from A

$$\therefore M_{\text{max}} = \frac{1.51(1.89)}{2} = 1.42 \text{ KN.m}$$

$$\therefore d_{\text{reqd}} = \sqrt{\frac{1.42(10)^6}{1.1(5.3)(50)}} = 171 \text{ mm}$$

(175x50 Joists OK)

Deflection,

$$= \left[.001(3.62) + \frac{5(2.84)}{384} \right] \frac{(10)^3 (3600)^3}{1.1(8800)(50)(175)^3}$$

$$= (.004 + .037) 216 = 8.85 \text{ mm}$$

$$\text{Permiss. } \Delta = .003(3600) = 10.80 \text{ mm}$$

} OK

Existing
First Floor
Joists
Satisfactory
to Carry
New Loading

Steel Beam Over First Floor Landing
Carrying 2nd Floor Joists Span 2.30 m.

Beam Loading :-

2nd Floor Joists	$\frac{1.56(2)}{1.40}$	KN/m	= 7.80
SW			= 1.20
			<u>8.00</u>

$$\therefore M = \frac{8.00(2.30)^2}{8} = 5.29 \text{ KN.m}$$

For a 127 x 76 x 13 UB,

$$\frac{L}{r_y} = \frac{2300}{18.3} = 126 \quad \frac{D}{T} = 16.7$$

$$\therefore p_{bc} = 124 \text{ N/mm}^2$$

$$f_{bc} = \frac{5.29(10)^6}{75.1(10)^3} = 71 \text{ N/mm}^2 \quad \left. \vphantom{\frac{5.29(10)^6}{75.1(10)^3}} \right\} \checkmark \text{ OK}$$

Deflection :-

$$\Delta_{total} = \frac{5}{384} \frac{(8.00)(2.30)(10)^3(2300)}{2.1(10)^5} = 2.91 \text{ mm}$$

$$\text{Permiss. } \Delta_{LL} = \frac{2300}{360} = 6.39 \text{ mm} \quad \left. \vphantom{\frac{2300}{360}} \right\} \checkmark \text{ OK}$$

$\therefore$ Adopt 127 x 76 x 13 U.B.

Length of Bearing 100 mm
 Concrete Padstones 225L x 100W
 x 100 Deep
 or Use
 Engineering
 Brick

Beam over
 1st Floor
 Landing

Side Extension to Dwelling① First Floor Joists Span 2.60m

$$\text{Loading} = 2.60(2.00)(.40) = \underline{2.08 \text{ KN}}$$

$$\therefore M = \frac{2.08(2.60)}{8} = \underline{.676 \text{ KN.m}}$$

$$\therefore drqd = \sqrt{\frac{.676(10)^6}{1.1(5.3)(50)}} = \underline{118 \text{ mm}}$$

(150 x 50 C16 at 400 ctrs)
OK

$$\text{Deflection} = \frac{5}{384} \frac{2.08(10)^3(2600)^3}{1.1(8800)(50)(150)^3}$$

$$= \underline{3.50 \text{ mm}}$$

$$\text{Permiss. } \Delta = .003(2600) = \underline{7.80 \text{ mm}}$$

} OK Adopt

First Floor
Joists to
Extension
150 x 50 C16
at 400 ctrs.
with Noggins
at Mid Span

② Rafters to Roof Extension

Span Parallel to Roof = 2.50m
(From Bolted Collar to Studs)

$$\text{Loading} = 1.70(1.50)(.40) = \underline{1.02 \text{ KN}}$$

$$\therefore M_{\text{max}} = \frac{1.02(2.50)}{8} = \underline{.32 \text{ KN.m}}$$

$$\therefore drqd = \sqrt{\frac{.32(10)^6}{1.1(5.3)(50)}} = \underline{82 \text{ mm}}$$

(100 x 50 C16 OK)

$$\text{Deflection} = \frac{5}{384} \frac{(1.02)(10)^3(2500)^3}{1.1(8800)(50)(100)^3}$$

$$= \underline{5.15 \text{ mm}}$$

$$\text{Permiss. } \Delta = .003(2500) = \underline{7.50 \text{ mm}}$$

} OK

Existing
Rafters to
Extension
(100 x 50 C16
at 400 ctrs.)
Satisfactory