	"Pinecroft", Fieldhouse Lane, Hepscott	

Loadings

Pitched Roof	KN/m²	Ceiling	KN/m²
Roof covering	0.55	Joists	0.06
Battens and felt	0.04	Insulation	0.02
Rafters	0.10	Plaster	0.14
Dead load on slope	0.69	Dead load	0.22
Dead load on plan, truss roof	0.81	Imposed load	0.25
Dead load on plan, dormer roof	0.72		
Dead load on plan, GF extension	0.71		
Imposed load on plan	1.00		
Floor	**KN/m²**	**Walling**	**KN/m²**
Boarding	0.18	Brick outer	2.20
Joists	0.15	Brick and plaster	2.40
Insulation	0.02	Block and plaster	1.80
Plaster	0.14	Stud walls	0.36
Partition allowance	0.25		
Dead load	0.74		
Imposed load	1.50		

1) Lintel over openings in extension rear wall to Kitchen/Family area.

Inner leaf	KN/m		KN/m
Pitched roof/ceiling dead load 2.40x0.94	2.256	X 1.4	3.159
Pitched roof live load 2.40 x 1.0	2.400	X 1.6	3.840
Masonry 0.30x1.80	0.540	X1.4	0.756
	5.196		7.755

Outer leaf	KN/m		KN/m
Masonry 0.30x2.20	0.660	X1.4	0.924

M $9.25 \times 4.5^2 \times 0.125 = 23.42$KNm

Deflection limit = 4500/360 = 12.5mm

Limit to 6mm for door operation

Ixx required $[(1/205 \times 6) \times (5 \times 6.5 \times 4.5^4/384)] \times 10^5 = 2822cm^4$

Try two number 180x90PFC's back to back $I = 3634cm^4$

b/2t = 7.20 d/s = 20.2:- Plastic section

Effective length 0.18x2 + 4.50 x 1.2 = 5.84m

λ 584/4.28 = 137

x = 12.8

$\lambda / x = 10.7$

N = 0.5

From table 14 v = 0.62

U = 0.949

N = 0.94

Alt = 0.94x0.949x0.62x137 = 76

Pb = 170 N/mm²

MB = 170x2x232 x 10^{-3} = 78.8KNm

Bearing on walls

Inner leaf

Max reaction 8.25 x4.5x0.5 = 18.6KN

Allowable bearing stress in block = 3.5x1.25/3.5 = 1.25 N/mm²

Bearing length required 18.6x10^3/1.25x100 = 149mm

Try a 225mm long bearing

Check at 0.4h down wall 0.4h = 0.96m

General stress in wall 8.25 + 0.96x1.8x1.4x10^3/100x10^3 = 0.107N/mm²

Dispersal length = 770x 30 Tan + 225 = 617mm

Dispersed stress 18.6x10^3/617x100 = 0.302N/mm²

Combined stress 0.107+0.302 = 0.409N/mm²

Hef/tef 2400/135 = 18.0

ß = 0.70

Allowable stress 3.5x0.70/3.5 = 0.70N/mm²

Bottom plate

Load on outer leaf = 1.25KN/m

M 1.25x0.15 = 0.19KNm

T required √6x0.19x10^3/275 = 2.04mm

Adopt a 4mm thick plate

2) Beam to support head of dormer adjacent gable end at First Floor

	KN/m		KN/m
Trussed rafter roof dead load 2.40x0.81	1.944	X 1.4	2.722
Trussed rafter roof live load 2.40x1.00	2.400	X 1.6	3.840
Level ceiling dead load 2.00x0.22	0.440	X1.4	0.616
Level ceiling live load 2.00x0.25	0.500	X1.6	0.800
Sloping roof and ceiling dead load 1.70x0.95	1.663	X1.4	2.329
Timbered roof imposed load 1.70x1.00	1.700	X1.6	2.720
Retained masonry 0.45x2.40	1.080	X1.4	1.512
	9.727		14.539

M 15.0x2.4²x0.125 = 10.8KNm

Deflection limit = 2400/360 = 6.6mm

Ixx required [(1/205x6) x (5 x 10.25 x 2.4⁴/384]) x 10^5 = 369cm⁴

Try a 178x102x19kg UB I = 1356cm⁴

b/2t = 6.41 d/s = 30.6:- Plastic section

Effective length 0.178x2 + 2.40 x 1.2 = 3.31m

λ 331/2.37 = 140

x = 22.6

λ / x = 6.2

N = 0.5

From table 14 v = 0.77

U = 0.888

N = 0.94

Alt = 0.94x0.888x0.77x140 = 90

Pb = 144 N/mm²

MB = 144x171 x 10^{-3} = 24.6KNm

Bearing on walls

Inner leaf

Max reaction 15.0 x2.4x0.5 = 18.0KN

Allowable bearing stress in block = 3.5x1.25/3.5 = 1.25 N/mm²

Bearing length required 18.0x10^3/1.25x100 = 144mm

Try a 225mm long bearing

Check at 0.4h down wall 0.4h = 0.96m

General stress in wall 15 + 0.96x1.8x1.4x10^3/100x10^3 = 0.175N/mm²

Dispersal length = 682x 30 Tan + 225 = 572mm

Dispersed stress 18.0x10^3/572x100 = 0.315N/mm²

Combined stress 0.175+0.315 = 0.490N/mm²

Hef/tef 2400/135 = 18.0

ß = 0.70

Allowable stress 3.5x0.70/3.5 = 0.70N/mm²

3) Short trimmers to lantern light over Family room

Rafter loads	KN/m		KN/m
Pitched roof/ceiling dead load 0.91x0.60	0.546	X 1.4	
Pitched roof live load 0.98x0.60	0.588	X 1.6	
	1.134		

Point load from cut rafter 1.134x1.2x0.5 = 0.69KN

M = 0.69x1.25x0.25 = 0.22KNm

Zxx required 0.22x10^3/5.3x1.25x1.034 = 32.20x10^3mm³

Try a 45x145 C16 timber Z = 157x10^3mm³

Equivalent UDL 0.22x8/1.25² = 1.13KN/m

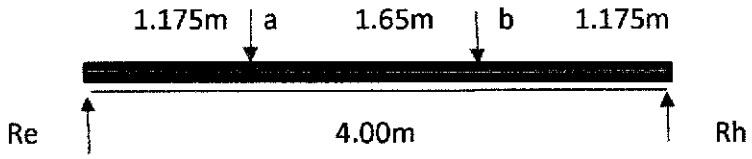
Deflection 5x1.12x1250⁴/384x5800x11.4x10^6 + 12x1.12x1250²/5x5800x45x145 = 0.65mm

Limit 1250x0.003 = 3.75mm

4) Long trimmers to sides of Velux light

UDL along trimmer = 1.134KN/m

Point loads 0.69x0.5 = 0.35KN



Reactions = 1.134x2 + 0.35 = 2.62KN

M@ a 2.62x1.175 – 1.134x1.175x0.5875 = 2.30KNm

M@ centre 2.62x2 – 1.134x2x1 + 0.35x0.825 = 2.70KNm

Zxx required 2.70x10^3/5.3x1.25x1.034 = 395x10^3mm³

Try 2 number 45x220 C16 timbers Z = 726x10^3mm³

Equivalent UDL 2.70x8/4.0² = 1.35KN/m

Deflection 5x1.35x4000⁴/384x5800x1.14x79.8x10^6 + 12x1.35x4000²/5x5800x1.14x220x90 = 9.0mm

Limit 4000x0.003 = 12mm

Summary

1) **Lintel over combination frames in rear wall of extension** - 2 number 180x90mm PFC's back to back, tie together with M16 Grade 8.8 bolts at 600mm centres along the length of the Channels in the mid depth of the webs, length = clear span + 450mm to give

225mm bearing each end onto 100mm thick 3.5N block inner leaf. Provide a continuous 4mm thick steel bottom plate with a width equal to the full wall thickness less 10mm. weld plate to underside of bottom flange of outer PFC with continuous 3mm fillet welds to both toes. Provide appropriate corrosion protection following fabrication by hot-dip galvanising or powder coating;

2) **Beam to support head of dormer adjacent gable end at First Floor** – 178x102x19kg UB, length = clear span + 325mm. Provide 225x100x100mm PCC padstones to each end bearing, 100mm bearing on gable and 225mm on parallel wall;
3) **Short trimmer to top and bottom of Velux** – 45x145mm C16 timber with steel joist hanger support to main timbers;
4) **Long trimmer to sides of Velux** – pairs of 45x220mm C16 timbers to each side of Velux opening, bolt together at short trimmer junction with M16 bolts in mid depth of timbers;

Notes for Client commissioning the work

It is your responsibly to ensure the main contractor is competent and fully experienced in this form of work. Take guidance from previous Clients and the various trade organisations who can provide background information. The formation of large openings in the existing structure comes with certain risks which require a competent contractor to control. Ensure the contractor is provided with all the relevant information to ensure the work meets the design.

Notes for Main Contractor

Ensure the provisions of the Party Wall Act are implemented for work involving any party wall.

H&S guidance for Principal Designer and Contractor

These works should not pose any risks beyond the capabilities and understanding of a competent contractor. Ensure all the design information has been provided by the Client and that you are fully conversant with the requirements therein.

Ensure appropriate risk assessments have been undertaken relative to the scale and complexity of the work. Prepare a program for the works to ensure all the required equipment is in place prior to each stage of the structural work;

Ensure appropriately trained and experienced operatives are employed to perform the works who are fully conversant with major structural works and support systems;

Ensure the correctly sized steelwork is ordered and installed, packed and supported.

Working at height – provide suitable and safe scaffolding, erected and inspected daily by a suitably qualified scaffold erector;

Cutting equipment – wear appropriate PPE and employ adequate dust suppression, ensure operatives are appropriately trained in the use of the equipment;

Falling masonry and objects – wear appropriate PPE and ensure all loose masonry is made safe at all times;

Propping of walls – ensure an adequate number of props are installed on suitable supports. Place suitable steel needles through the walls to spread the loads onto the props;

Manual lifting – ensure all operatives are trained in manual handling and are aware of the risks involved. Provide appropriate mechanical lifting equipment to safely position the loads, the use of Genie lifts is strongly recommended for lifting beams and steelwork. With careful planning and the use of appropriate mechanical aids, heavy steels can be installed with safety and relative ease;

Hot work – ensure appropriate PPE is worn and that appropriate permissions are obtained. The operatives must be suitably trained , and no other operatives should be in the area whilst hot work is in progress;

Existing structures – where these sustain additional/revised loadings the MC must ascertain their structural adequacy to support all loadings: