	39 Brumell Drive, NE61 3RB	

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 17.5°	0.72	Imposed load	0.25
Dead on plan 28°	0.77		
Dead on plan 35°	0.81		
Imposed 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) Beams supporting front wall over Canopy

Inner Leaf			
Pitched roof dead load 4.3x0.72	3.096	X1.4	4.335
Pitched roof live load 4.3x1.0	4.300	X1.6	6.880
Ceiling dead load 3.7x0.22	0.814	X1.4	1.140
Ceiling live load 3.7x0.25	0.925	X1.6	1.480
Masonry [2.65x4.0 – 2.4x1.2]/4.0 x 1.8	3.474	X1.4	4.864
	12.609		18.699

Outer Leaf			
Pitched roof dead load 0.7x0.81	0.567	X1.4	0.794
Pitched roof live load 0.7x1.0	0.700	X1.6	1.120
Ceiling dead load 0.7x0.22	0.154	X1.4	0.216
Ceiling live load 0.7x0.25	0.175	X1.6	0.280
Masonry [2.65x4.0 – 2.4x1.2]/4.0 x 2.2	4.246	X1.4	5.945
	5.842		8.355

M $19.0 \times 4.0^2 \times 0.125 = 38.0$KNm

Deflection limit = 4000/360 = 11.1mm

Ixx required $[(1/205 \times 11) \times (5 \times 13.0 \times 4.0^4/384)] \times 10^5 = 1922 cm^4$

Try two number 203x133x30kg UB's, one to each leaf $I = 2896 cm^4$

b/2t = 6.97 d/s = 26.9:- Plastic section

Effective length 4.0 x 0.85 = 3.40m

λ 340/3.17 = 108

x = 21.5

$\lambda / x = 5.0$

N = 0.5

From table 14 v = 0.82

U = 0.881

N = 0.94

Alt = 0.94x0.881x0.82x108 = 73.4

Pb = 179N/mm²

MB = 179x314 x 10^{-3} = 56.2KNm

Bearing on walls

Max reaction 19.0 + 8.75 x4.0x0.5 = 55.50KN

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

Bearing length required 55.50x10^3/1.25x100 = 444mm

Try a 600mm long bearing

Check at 0.4h down wall 0.4h = 1.0m

General stress in wall 3.6x1.8x1.4x10^3/100x10^3 = 0.091N/mm²

Dispersal length = 647x 30 Tan + 600 = 929mm

Dispersed stress 55.5x10^3/929x100 = 0.597N/mm²

Combined stress 0.091+0.597 = 0.688N/mm²

Hef/tef 2500/135 = 18.5

ß = 0.70

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

2) Beams supporting rear wall of extension

Inner Leaf			
Pitched roof dead load 4.3x0.72	3.096	X1.4	4.335
Pitched roof live load 4.3x1.0	4.300	X1.6	6.880
Ceiling dead load 3.7x0.22	0.814	X1.4	1.140
Ceiling live load 3.7x0.25	0.925	X1.6	1.480
Masonry [2.65x4.0 – 2x0.6x1.05]/4.0 x 1.8	4.203	X1.4	5.885
	13.338		19.720

Outer Leaf			
Pitched roof dead load 0.9x0.77	0.693	X1.4	0.971
Pitched roof live load 0.9x1.0	0.900	X1.6	1.440
Ceiling dead load 0.9x0.22	0.198	X1.4	0.278
Ceiling live load 0.9x0.25	0.225	X1.6	0.360
Masonry [2.65x4.0 – 2x0.6x1.05]/4.0 x 2.2	5.137	X1.4	7.192
	7.153		10.241

These beams are to be above the existing extension beams and are cantilevered

Inner beam

Ri x 2.85 = 20.25x4.0x2.0 Ri = 56.85KN

Rg = 20.25x4.0 – 56.85 = 24.15KN

M@ Gable 19.25/8 (2.85²-2x1.15² = -13.20KNm

M@ support 19.25x1.15²/2 -12.73KNm

M max 19.25x2.85²/128 (36x0.404⁴-28x0.404²+9) = 15.40KNm

Adopt 203x133x30kg UB's as for front beams

Outer beam

Ri x 2.85 = 10.5x4.0x2.0 Ri = 29.50KNKN

Rg = 10.5x4.0 – 29.5 = 12.5KN

Bearing on walls

Existing gable

Reaction 24.15+12.5 = 36.65KN

Allowable bearing stress in brick = 5.0x1.25/3.5 = 1.78 N/mm²

Bearing length required $36.65x10^3/1.78x100$ = 206mm

Try 450mm long bearing

Check at 0.4h down wall 0.4h = 1.08m

General stress in wall $1.4x[0.74x1.4+1.5x1.6] + 4.5x1.8x1.4x10^3/100x10^3 = 0.162N/mm^2$

Dispersal length = 777x 30 Tan + 450 = 845mm

Dispersed stress $36.65x10^3/845x100 = 0.434N/mm^2$

Combined stress 0.162+0.434 = 0.596N/mm²

Hef/tef 2700/135 = 20

ß = 0.62

Allowable stress 5.0x0.62/3.5 = 0.88N/mm²

Existing internal wall

Provide additional pier adjacent existing internal wall

Reaction from Beams 56.85+29.5 = 86.35KN

Allowable bearing stress in brick = 6.0x1.25/3.5 = 2.28 N/mm²

Bearing length required $86.35x10^3/2.28x100$ = 379mm

Try 450mm long bearing

General stress in pier $86.35 + 3.0x0.105x0.665x24x10^3/665x105 = 1.31N/mm^2$

Hef/tef 2700/440 = 6.2

ß = 1.0

Allowable stress in 20N bricks 6.6x1.0/3.5 = 1.88N/mm²

Foundation to additional pier

Total load on foundation = 86.35/1.45 + 0.665x0.105x24x3 = 65KN

Assume firm clay with a SBC of 100KN/m²

Width required = 0.65m

Adopt a 0.9x0.9x0.45m mass found

3) Cantilevered floor joists

Load/m on joists at 600mm centres 0.74+1.50x0.6 = 1.35KN/m

Ri x 2.85 = 1.35x4.0x2.0 Ri = 3.79KN

Rg = 1.35x4.0 – 3.79 = 1.61KN

M@ Gable $1.35/8 (2.85^2-2x1.15^2$ = -0.93KNm

M@ support $1.35x1.15^2/2$ = -0.78KNm

M max $1.35x2.85^2/128$ $(36x0.404^4-28x0.404^2+9)$ = 1.09KNm

Zxx required $1.09x10^3/5.3x1.1x1.034$ = $181x10^3mm^3$

Try 45x195 C16 timbers Z = $285x10^3mm^3$

Deflection $5x1.35x2850^4/48x8800x27x10^6x\{2x0.177^4+(6x0.404^3-5)x0.177^2 - (6x0.404^2-3)x0.177^2\}$ + $12x1.35x2850^2/5x8800x195x45$ = 8.39mm

Limit 28500x0.003 = 8.55m

Summary

1) **Beams supporting front wall over Canopy-** 2 number 203x133x30kg UB's, length = clear span + 250mm (approx. 4.15m). Tie together with 16mm bolts in the mid depth of the webs at 700mm centres along the beams, provide 150mm diameter steel tube spacers welded captive to one beam. Hole bottom flanges for 2 number M16 rag bolts at each bearing. At outer end provide a 150mm bearing on a 600x150x150mm deep PCC padstone on the new pier. At inner end provide a 600x100x150mm deep on outer leaf of existing main gable cavity wall. Secure beams to padstones with M16 studding resin anchored into padstones. Provide a 1.50x0.90x0.45m deep mass concrete base to corner pier on firm clay, base placed centrally under pier;
2) **Beams to rear wall over Utility –** 2 number 203x133x30kg UB's, these beams are placed within the floor zone to be above the existing beams and touch the outer face of the existing main house gable cavity wall, thus not placing additional load on the existing beams below the existing floor. Length = clear span + 100mm (approx. 4.0m). Tie together with 16mm bolts in the mid depth of the webs at 700mm centres along the beams, provide 150mm diameter steel tube spacers welded captive to one beam. At outer end provide a 100mm bearing on a 600x100x150mm deep PCC padstone on the existing garage wall. At inner end provide a 600x100x150mm deep on a new 660x105mm brick pier in 20N solid concrete engineering bricks securely tied against the existing masonry internal wall. Provide a 0.90x0.90x0.45m deep mass concrete base to new pier on firm clay, base placed centrally under pier;
3) **Cantilevered floor joists –** 45x195mm C16 timbers at max 600mm centres, to be built into new gable wall and bear on/span over existing internal masonry wall to reach outer face of existing main house cavity wall. The existing internal wall and foundation shall be checked for adequacy to sustain the additional load by the MC:

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: