27 Blackthorn Drive, Blyth

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
Deal load on plan, main roof	0.79	Imposed load	0.25
Dead load on plan, extension	0.72		
Imposed on plan	1.00		
Floor	**KN/m²**	**Walling**	**KN/m²**
Boarding	0.18	Brick outer	2.20
Joists	0.15	Block and plaster	1.80
Insulation	0.02	Stud walls	0.36
Plaster	0.14		
Partition allowance	0.25		
Dead load	0.74		
Imposed load	1.50		

1) **Beams to opening in existing rear wall**

Inner Leaf	KN/m		KN/m
Pitched roof dead load 4.40x0.79	3.476	X 1.4	4.867
Pitched roof live load 4.40 x 1.00	4.400	X 1.6	7.040
Ceiling dead load 3.90x0.22	0.858	X1.4	1.202
Ceiling live load 3.90x0.25	0.975	X1.6	1.560
Floor dead load 1.60x0.74	1.184	X1.4	1.658
Floor live load 1.60x1.50	2.400	X1.6	3.840
Masonry [2.8x8.1 – 1.8x1.2+1.2x1.2+1.2x0.9]/8.1 x 1.8	4.000	X1.4	5.600
	17.293		25.767

Outer Leaf	KN/m		KN/m
Pitched roof dead load 1.60x0.72	1.152	X 1.4	1.613
Pitched roof live load 1.60 x 1.00	1.600	X 1.6	2.560
Ceiling dead load 1.60x0.22	0.352	X1.4	0.493
Ceiling live load 1.50x0.25	0.375	X1.6	0.600
Masonry [2.8x8.1 – 1.8x1.2+1.2x1.2+1.2x0.9]/8.1 x 2.2	4.890	X1.4	6.846
	8.369		12.112

Inner beam

M $26.25 \times 7.05^2 \times 0.125$ = 163.10KNm

Deflection limit = 7050/360 = 19.5mm

Ixx required $[(1/205 \times 19) \times (5 \times 17.80 \times 7.05^4/384)] \times 10^5 = 14700cm^4$

Try two 300x100 PFC's back to back I = $16458cm^4$

b/2t = 6.06 d/s = 26.3:- Plastic section

Effective length 7.050x0.85 = 6.0m

λ 600/4.49 = 134

x = 17

$\lambda / x = 7.9$

$N = 0.5$

From table 14 $v = 0.70$

$U = 0.944$

$N = 0.94$

$Alt = 0.94x0.944x0.70x134 = 83.25$

$Pb = 156\ N/mm^2$

$MB = 156x2x641 \times 10^{-3} = 199KNm$

Splice detail if required at mid span

Maximum force in splice $163.1/0.30 = 544KN$

With Grade 8.8 bolts, resistance/bolt $353x375x10^{-3} = 132KN$

Adopt 6 number bolts/side, resistance = 792KN

Bearing on connected parts limit $0.5x50x15x462 = 173KN$/bolt

Allowable bearing per bolt $24x15x462 = 166KN$/bolt

Plate area required $544x10^3/275 = 1979mm^2$

Try a 200x20 cover plate $200 - 50 x20 = 3000mm^2$

Outer beam

$M\ 12.25x7.05^2x0.125 = 76.1KNm$

Deflection limit = 7050/360 = 19.5mm

Ixx required $[(1/205x19) x (5 x 8.9 x 7.05^4/384]) x 10^5 = 7350cm^4$

Try a 300x100 PFC $I = 8229cm^4$

b/2t = 6.06 d/s = 26.3:- Plastic section

Effective length 7.050x0.85 = 6.0m

λ 600/3.13 = 192

x = 17

$\lambda / x = 11.25$

N = 0.5

From table 14 v = 0.60

U = 0.944

N = 0.94

$Alt = 0.94x0.944x0.60x192 = 102.25$

$Pb = 121\ N/mm^2$

$MB = 121x641 \times 10^{-3} = 77.6KNm$

Bearing on new piers

Reaction $[26.25+12.25]x7.05x0.5 = 135.80KN$

Allowable stress in 20N solid concrete bricks $6.4x1.25/3.5 = 2.28N/mm^2$

Bearing length required $135.8x10^3/330x2.28 = 181mm$

General stress in pier $135.8 + 3.0x0.330x0.60x24x1.4]x10^3/330x600 = 0.87N/mm^2$

Hef/tef 2400/330 = 8.0

ß = 1.0

Allowable stress $6.4x01.0/3.5 = 1.80N/mm^2$

Foundation to pier

Load to base $135.8/1.45 + 3x0.33x0.60x24 = 108KN$

Assume firm clay with a SBC of $100KN/m^2$

Area required = $1.08m^2$

Adopt a 1.2x1.2x0.60m deep mass base on firm clay

2) Combined lintel over bi-fold doors

Outer Leaf	KN/m		KN/m
Masonry 0.30x2.2	0.660	X1.4	0.924

Inner Leaf	KN/m		KN/m
Pitched roof dead load 2.2x0.72	1.584	X 1.4	2.218
Pitched roof live load 2.2 x 1.00	2.200	X 1.6	3.520
Ceiling dead load 1.60x0.22	0.352	X1.4	0.493
Ceiling live load 1.60x0.25	0.400	X1.6	0.640
Masonry 0.45x1.8	0.810	X1.4	1.134
Door suspension allowance	0.500	X1.4	0.700
	5.846		8.705

M $10.0 \times 5.7^2 \times 0.125 = 40.62$KNm

Deflection limit = 5700/360 = 15.8mm

Limit to 6mm for door operation

Ixx required $[(1/205 \times 6) \times (5 \times 7.25 \times 5.7^4/384]) \times 10^5 = 8101 cm^4$

Try 2 number 260x90 PFC's back to back $I = 9456 cm^4$

b/2t = 6.43 d/s = 26.0:- Plastic section

Effective length 0.26x2 + 5.7 x 1.2 = 7.47m

λ 747/4.08 = 183

x = 17.2

$\lambda / x = 10.6$

N = 0.5

From table 14 v = 0.62

U = 0.942

N = 0.94

Alt = 0.94x0.942x0.62x183 = 100.5

Pb = 124 N/mm²

MB = $124 \times 2 \times 425 \times 10^{-3} = 105$KNm

Bearing on walls

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

Reaction 9.5 x5.7x0.5 = 27.1KN

Bearing length required $27.1 \times 10^3/1.25 \times 100 = 217$mm

Try a 300mm long bearing

Check at 0.4h down wall 0.4h = 0.96m

General stress in wall $8.75 + [0.96 \times 1.8 \times 1.4] \times 10^3/100 \times 10^3 = 0.112 N/mm^2$

Dispersal length = 700x 30 Tan + 300 = 656mm

Dispersed stress $27.1 \times 10^3/656 \times 100 = 0.414 N/mm^2$

Combined stress 0.112+0.414 = 0.526N/mm²

Hef/tef 2400/135 = 18

ß = 0.77

Allowable stress 3.5x0.77/3.5 = 0.77N/mm²

Plate to bottom flange

M in plate 1.25x0.15 = 0.19KNm

T required $\sqrt{0.19 \times 6 \times 10^3/275} = 1.7$mm

Adopt a 4mm thick plate

1) **Long span beams to opening in existing rear wall – Inner Beam** - 2 number 300x100 PFC's back to back, located centrally under inner leaf, length = clear span +450mm, tie together with M16 Grade 8.8 bolts at mid depth of web spaced at 700mm centres; **Outer Beam –** single 300x100 PFC under outer leaf, length = clear span + 450mm. Tie to inner beam with M16 bolts spaced at 700mm centres with 150mm diameter steel tube spacers welded captive to one beam. These PFC's may be spliced at mid span as Detail 1 and 2. At both ends provide 600x440mm solid piers in solid 20N concrete engineering bricks laid in 1:3 mortar, all off a 1.2x1.2x0.6m mass concrete base on firm clay foundation to be placed centrally under piers. Provide 440x225x100mm PCC padstones to head of piers.
2) **Combined lintel over bi-fold doors –** 2 number 260x90 PFC's back to back, tie together with M16 Grade 8.8 bolts at mid depth of web spaced at 700mm centres to inner leaf, length = clear span + 600mm to give 300mm direct bearing at each end. To underside of bottom flange provide a continuous 4mm thick steel plate with a width equal to the full wall – 10mm. Weld the plate to both toes of the outer PFC with continuous 3mm fillet welds. Provide suitable corrosion protection by hot-dip galvanising or powder coating post fabrication:

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 for the works associated with these calculations

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;

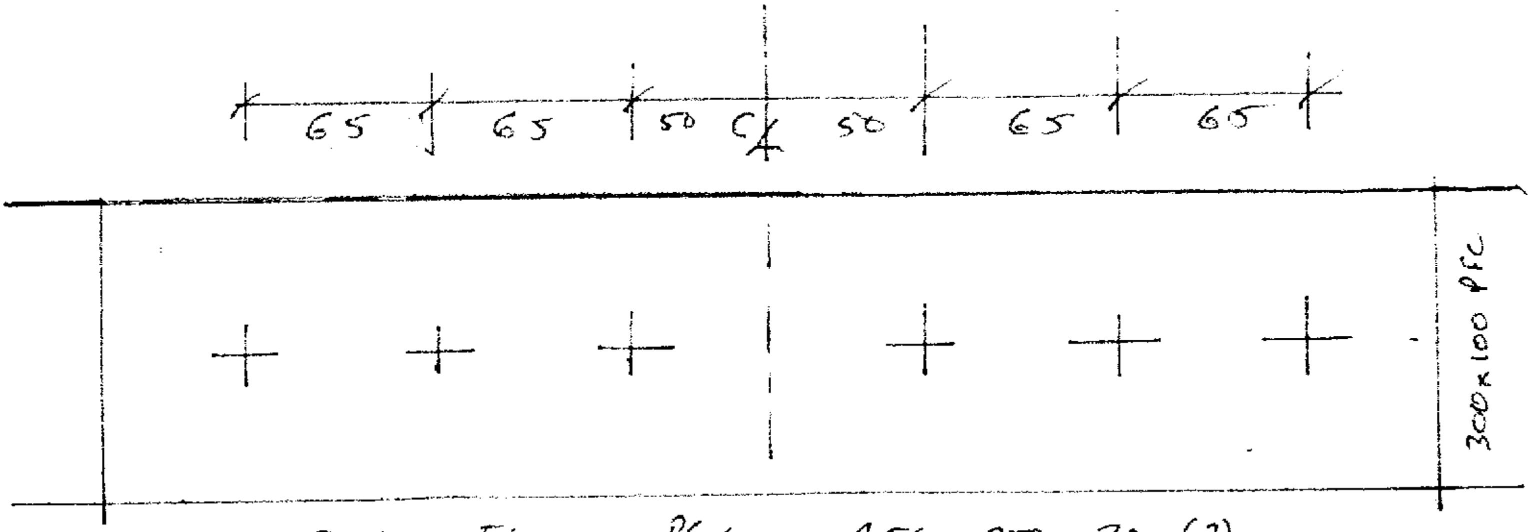
Falling masonry and objects – wear appropriate PPE and ensure all loose masonry is made safe at all times;

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;

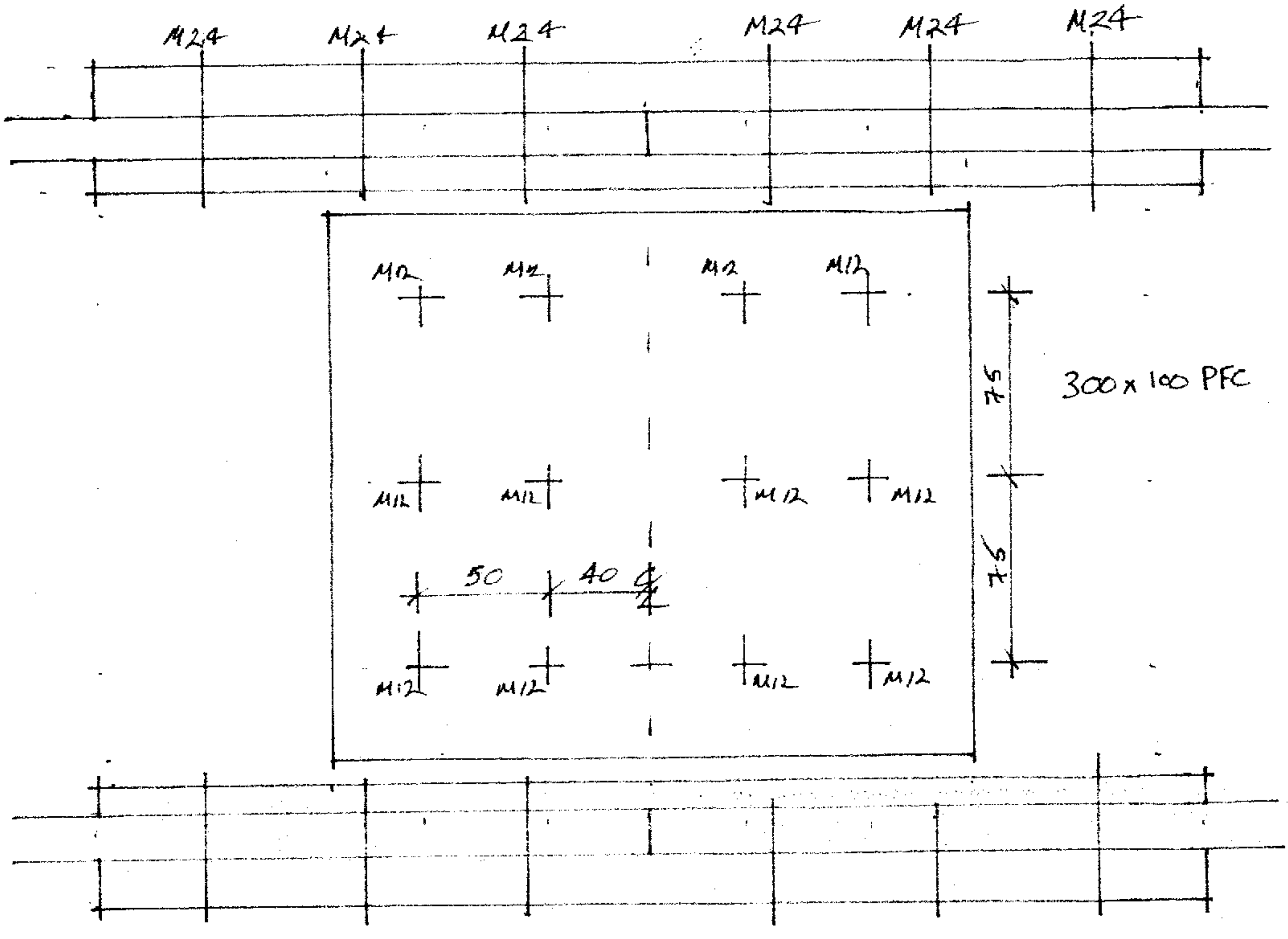
Manual lifting – ensure all operatives are trained in manual handling and are aware of the risks involved. Provide appropriate mechanical lifting equipment to safely position the loads, the use of Genie lifts is strongly recommended for lifting beams and steelwork. With careful planning and the use of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

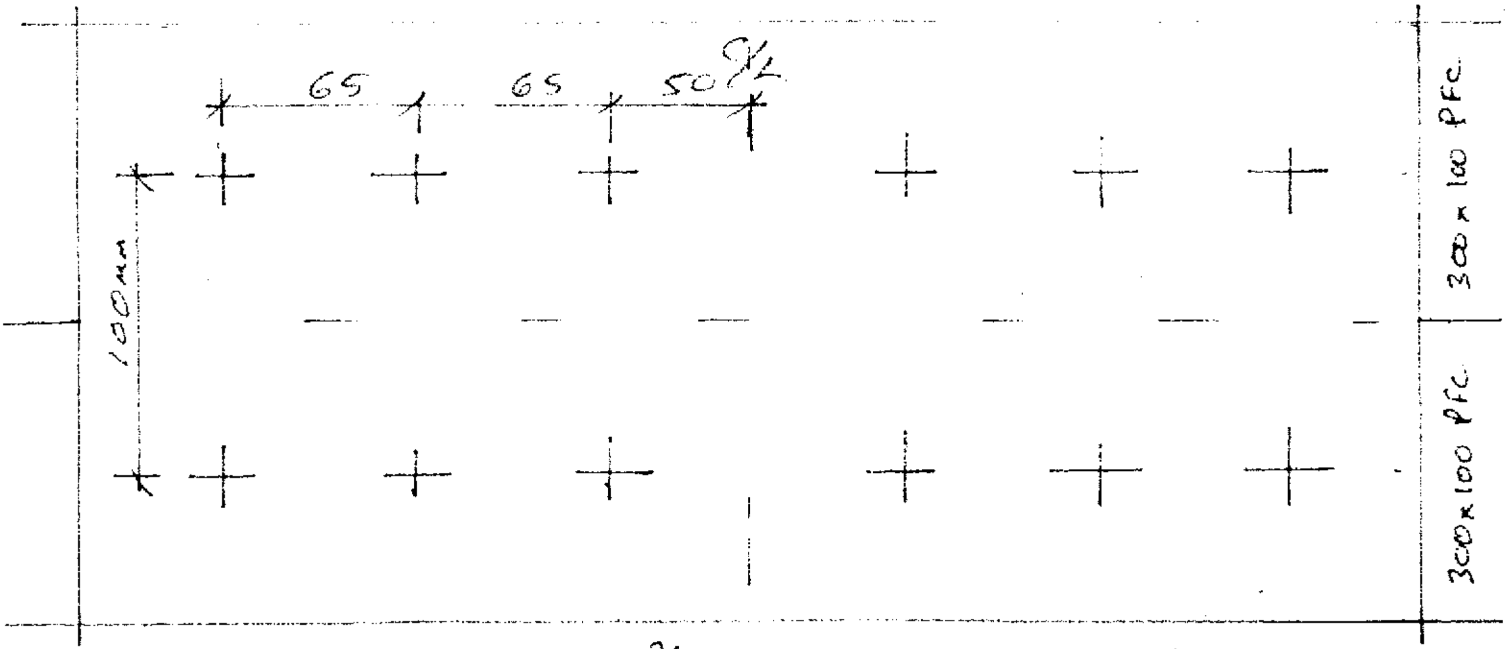
[illegible] COVER — SPLICE DETAIL AT BEAM CENTRE



Outer Flange Plates 450 x 200 x 20 (2)
Inner Flange Plates 450 x 80 x 12 (4)
Web cover Plates 260 x 220 x 10 (2)
Bolts - Grade 8.8.



27 BBB. E.F. [illegible]   SPLICE DETAIL AT BEAM CENTRE



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