



**MICHAEL EVANS  
& ASSOCIATES LTD**

Civil and Structural Engineers  
& Design Consultants

34 Station Road, Draycott, Derbyshire DE72 3QB  
Tel: 01332 871840 Fax: 01332 871841 [www.mevans.co.uk](http://www.mevans.co.uk)

## Structural Calculations

In respect of

Project

**Alterations & Extension**

**12 Lindley St, Newthorpe, Notts**

Client

**Broxtowe Borough Council**

Architect

**Job No. 18-020**

**Jan 2018**

Issue no	Date	Description
1	30-Jan-18	First issue



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Sheet No.

**Alterations &  
Extension  
2**

Project.

12 Lindley St, Newthorpe, Notts

By.

RC

Checked.

NH

Issue

1

Rev

Refer to Broxtowe Borough Council drawing no. CW18.001.002 (Jan 2018)

**Dimensions are for  
design purposes only**

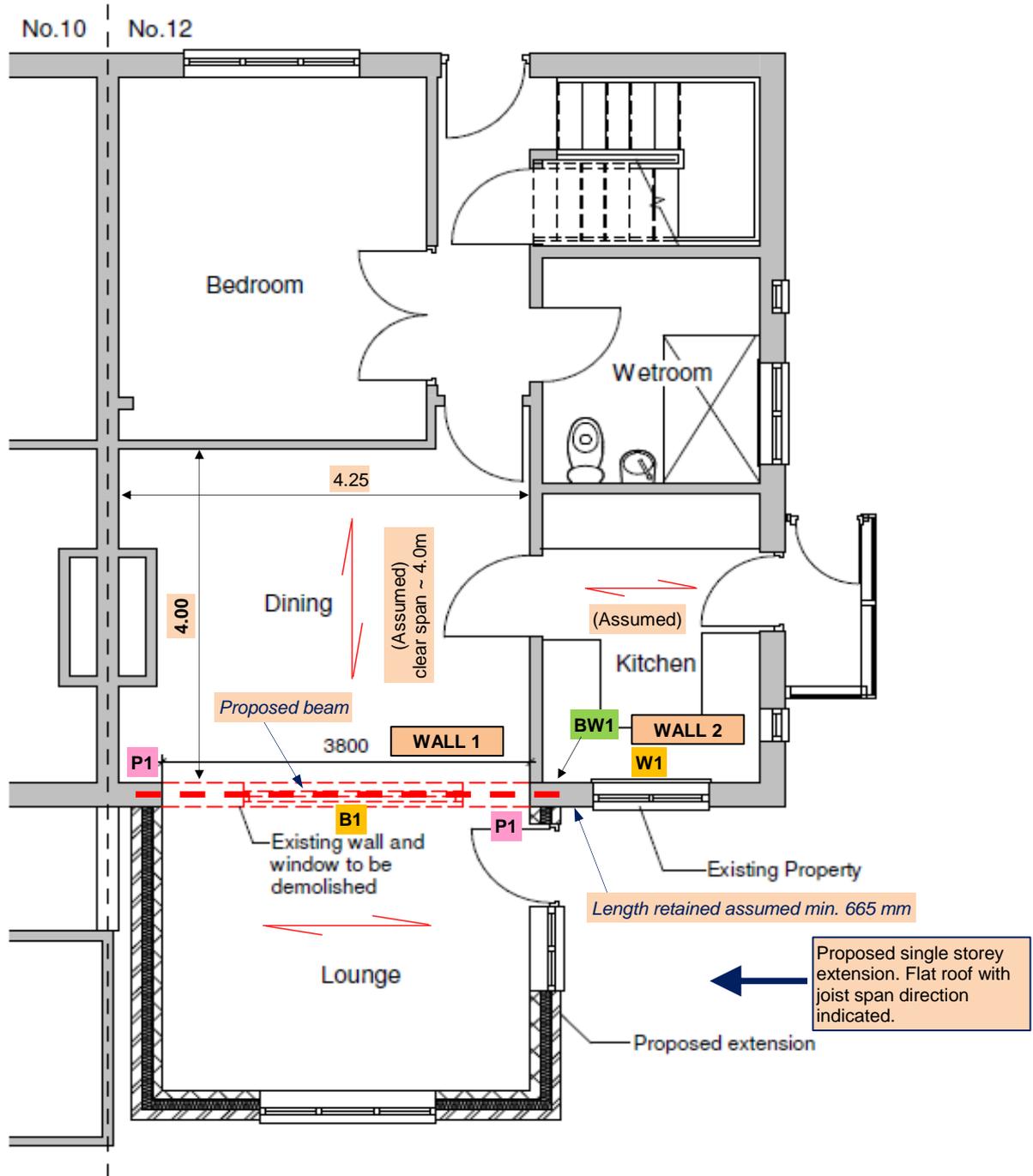
Basic loads	Load type	Components		Service Load kN/m <sup>2</sup>	Load factor	Ultimate load kN/m <sup>2</sup>	Note
		Name	UDL kN/m <sup>2</sup>				
Roof on slope	Deadload	Tiles	0.60	0.75	1.40	1.05	
		Battens, felt	0.05				
		Rafter	0.10				
Roof on plan	Deadload	Pitch= 35 °assumed		0.92	1.40	1.28	
	Liveloading	Snow		0.63	1.60	1.00	
	<b>D+L</b>			<b>1.54</b>		<b>2.28</b>	
Ceiling	Deadload	Ceil joists	0.10	0.30	1.40	0.42	
		Plasterboard	0.20				
	Liveloading		0.25	0.25	1.60	0.40	
<b>D+L</b>			<b>0.55</b>		<b>0.82</b>		
Timber floor	Deadload	Deck	0.15	0.75	1.40	1.05	
		Joists	0.15				
		Plasterboard	0.20				
Partitions		0.25					
Liveloading		1.50	1.50	1.60	2.40		
<b>D+L</b>			<b>2.25</b>		<b>3.45</b>		
Blockwork	Deadload	Block 100 thk.	1.30	1.50	1.40	2.10	γ <sub>m</sub> = 3.1 t <sub>eff(cavity)</sub> = 133
		Plaster	0.20				
Brickwork	Deadload	Brick 100 thk.	2.00	2.00	1.40	2.80	

**NOTES:**

- Information used in this design was gathered during site visit done on 24 January 2018.
- The external masonry wall has total thickness (including finish) of around 300mm. Double leaf wall with 50mm cavity and 3.6N blockwork inner leaf is assumed for strength check.
- Roof assumed of trussed rafter construction at above-specified pitch.



∴ Schematic arrangement - Proposed Ground Floor Plan



**Notes:**

- Span direction of ceiling/roof joist over
- Beam/trimmer over floor plan



> Rear elevation of house indicating approximate location of beam B1



∴ Summary

> Beam and Padstones

**Dimensions are for  
design purposes only**

Ref	Beam / Column	Clear span	1 end	2 end	Total
		[mm]	[mm]	[mm]	[mm]
B1	2/260 x 90 x 35PFC (275) bolted together @ 1.0m c/c, wt of each beam ~140kg	3800	150	150	4100

If floor joists are to be supported by beam as assumed:  
 1) beam may be inserted so as joists are located between flanges, or  
 2) beam positioned under joists creating a downstand, or  
 3) an 8mm plate welded to bottom flange of inner beam to receive trimmed floor joists.

Ref	Padstones
P1-inn	435x100x225 Deep Engineering Brick
P1-out	Not required

- Padstone in inner leaf

- Padstone in outer leaf

Wall Panel BW1 (assumed 665mm long retained)

Demolish and rebuild in min. 7.3N/mm<sup>2</sup> blockwork. However, if floor joists are NOT supported by beam B1, existing inner leaf panel (assumed 3.6N/mm<sup>2</sup> blockwork), is still Adequate.

Existing Foundation to be inspected and confirmed by the Local Building Control Officer.



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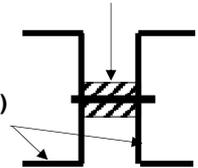
> **Consider beam B1 (Over removed grd flr masonry external wall, Dining Area)**

Clear span = 3800 mm; Effective span say, L = 3950 mm Spacer tube 26.9dia x 3.2 CHS with M16 threaded bar @ 1.0m c/c

Loading: Inner Outer

Roof	8.0 / 2 @ 2.09 =	8.4	
Roof at 1st floor	0.6 / 2 @ 2.09 =		0.6
1st floor	4.1 / 2 @ 2.25 =	4.6	
Brick (assumed)	2.8 / 1 @ 2.00 =	5.6	
Brick	2.8 / 1 @ 2.00 =		5.6
Self weight		0.4	0.4
		19.0 +	6.6 kN/m =

Beam B1  
2 No 260 x 90 x 35PFC (275)  
bolted together



**Sum Ratio**  
25.6 kN/m 2.9

+ Inner leaf:

L = 3.950 m UDL = 19.0 kN/m L<sub>e</sub> = 1.0 L = 3.950 m m<sub>LT</sub> = 0.925

W = 75.0 kN<sub>serv</sub> M = 37.0 kNm<sub>serv</sub> R = 37.5 kN<sub>serv</sub>

γ<sub>f</sub> say = 1.50 W = 112.4 kN<sub>ult</sub> M = 55.5 kNm<sub>ult</sub> R = 56.2 kN<sub>ult</sub>

Try 1 260 x 90 x 35 PFC (code 5) grade 275 weight ~ 137 kg 260 90 D/B= 2.889

Class= Plastic T= 14 p<sub>y</sub> = 275 N/mm<sup>2</sup>; Z<sub>x</sub> = 364 cm<sup>3</sup>; S<sub>x</sub> = 425 cm<sup>3</sup>; I<sub>x</sub> = 4730 cm<sup>4</sup>

Shear check P<sub>v</sub> = 0.6p<sub>y</sub>A<sub>v</sub> = 0.6 x 275 x 8 x 260 = 343 kN

F<sub>v</sub>/xP<sub>v</sub> = 56.2 / 343 = 0.16 < 0.6 Low shear OK

Mc check Plastic M<sub>cx</sub>=p<sub>y</sub> S<sub>x</sub>= 116.9 1.2 p<sub>y</sub> Z<sub>x</sub> = 120.1 1x M<sub>cx</sub> = 1 116.9 = 116.9 kNm

MA / 1M<sub>cx</sub> = 55.5 / 116.9 = 0.47 OK

Mb check

r <sub>y</sub>	λ	u	x	v	β <sub>w</sub>	λ <sub>LT</sub>	λ <sub>0</sub>	η <sub>LT</sub>	p <sub>E</sub>	φ <sub>LT</sub>	p <sub>b</sub>	Le limit
2.8	140.1	0.9	17.20	0.69	1.0	91.6	34.3	0.40	241	306	140	0.968

M<sub>A</sub>=M<sub>ULT</sub> = 55.5 kNm Mb = p<sub>b</sub> S<sub>x</sub>= 59.6 1 Mb = 59.6 kNm

MA/(1Mb/mLT) = 55.5 / (59.6 / 0.925) = 0.86 OK

Deflection Deflection limit to 14 mm and L/ 360 I<sub>x</sub> = 4730

d<sub>D+L</sub> =  $\frac{5 \times 75.0 \times 3950^3}{384 \times 205 \times 4730 \times 10000}$  = 6.2 mm = L/ 637 OK

+ Outer leaf:

L = 3.950 m UDL = 6.6 kN/m L<sub>e</sub> = 1.0 L = 3.950 m m<sub>LT</sub> = 0.925

W = 26.2 kN<sub>serv</sub> M = 12.9 kNm<sub>serv</sub> R = 13.1 kN<sub>serv</sub>

γ<sub>f</sub> say = 1.50 W = 39.3 kN<sub>ult</sub> M = 19.4 kNm<sub>ult</sub> R = 19.6 kN<sub>ult</sub>

Try 1 260 x 90 x 35 PFC (code 5) grade 275 weight ~ 137 kg 260 90 D/B= 2.889

Class= Plastic T= 14 p<sub>y</sub> = 275 N/mm<sup>2</sup>; Z<sub>x</sub> = 364 cm<sup>3</sup>; S<sub>x</sub> = 425 cm<sup>3</sup>; I<sub>x</sub> = 4730 cm<sup>4</sup>

Shear check P<sub>v</sub> = 0.6p<sub>y</sub>A<sub>v</sub> = 0.6 x 275 x 8 x 260 = 343 kN

F<sub>v</sub>/xP<sub>v</sub> = 19.6 / 343 = 0.06 < 0.6 Low shear OK

Mc check Plastic M<sub>cx</sub>=p<sub>y</sub> S<sub>x</sub>= 116.9 1.2 p<sub>y</sub> Z<sub>x</sub> = 120.1 1x M<sub>cx</sub> = 1 116.9 = 116.9 kNm

MA / 1M<sub>cx</sub> = 19.4 / 116.9 = 0.17 OK

Mb check

r <sub>y</sub>	λ	u	x	v	β <sub>w</sub>	λ <sub>LT</sub>	λ <sub>0</sub>	η <sub>LT</sub>	p <sub>E</sub>	φ <sub>LT</sub>	p <sub>b</sub>	Le limit
2.8	140.1	0.9	17.20	0.69	1.0	91.6	34.3	0.40	241	306	140	0.968

M<sub>A</sub>=M<sub>ULT</sub> = 19.4 kNm Mb = p<sub>b</sub> S<sub>x</sub>= 59.6 1 Mb = 59.6 kNm

MA/(1Mb/mLT) = 19.4 / (59.6 / 0.925) = 0.3 OK

Deflection Deflection limit to 14 mm and L/ 360 I<sub>x</sub> = 4730

d<sub>D+L</sub> =  $\frac{5 \times 26.2 \times 3950^3}{384 \times 205 \times 4730 \times 10000}$  = 2.2 mm = L/ 1823 OK

Adopt 2/260 x 90 x 35PFC (275) bolted together @ 1.0m c/c, weight of each beam ~140kg



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> **Padstones**

**Padstone table (MEA.T.01). All loads are at ultimate**

Padstone Ref.	Loading area			Reaction $kN_{ult}$	Wall Strength				Without Padstone			With Padstone				Check	
	L1	L2	Load		Mortar	Basic	$f_k$	$\gamma_m$	$L_o$	$W_o$	$C_o$	$L_{ps}$	$W_{ps}$	$D_{ps}$	Code		$C_{ps}$
	m	m	$N_{ult}/m$			$kN/m^2$	$kN/m^2$		mm	mm	$kN_{ult}$	mm	mm	mm			$kN_{ult}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
P1-inn	From B1-inner leaf			56.2	M4	3.6	3.5	3.1	150	90	19	435	100	225	E	61	OK
P1-out	From B1-outer leaf			19.6	M4	20	5	3.5	150	90	24					No	OK

(2)&(3)are spans of gross loading area; (5)=[(2)\*(3)\*(4)]/4;(12)  $C_o$ : Capacity without padstone  $C_o = 1.25*(8)*(10)*(11)/(1000*(9))$ ; (17)  $C_{ps}$ : Capacity of padstone  $C_{ps} = 1.25*(8)*(13)*(14)/(1000*(9))$ , but if (12)>(5) then (17)="No" meaning do not need; (18)=OK when (17)≥(12).

> **Consider blockwork strength.**

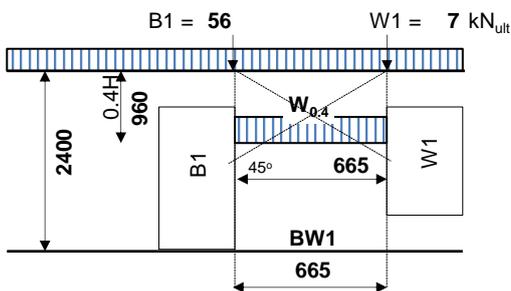
**Blockwork Strength table (MEA.T.07). All loads are at ultimate**

Location of wall	Load on roof & floor						Load on Wall		Total load $kN/m$	Wall Strength							Check
	Roof		Sub roof		1st floor		H	Load		Mortar	Basic	$f_k$	End	$t_{eff}$	$\beta$	$C_w$	
	m	$kN/m^2$	m	$kN/m^2$	m	$kN/m^2$	m	$kN/m^2$			$kN/m^2$	$kN/m^2$				$kN/m$	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Wall 1	8.00	3.10					3.8	2.10	20	M4	3.6	3.5	1.00	133	0.77	87	OK
Wall 2	4.00	3.10					3.8	2.10	14	M4	3.6	3.5	1.00	133	0.77	87	OK
BW1	8.00	3.10			4.10	3.5	3.8	2.10	27	M4	7.3	6.4	1.00	133	0.77	159	OK

(8) Height of wall in total; (14) = [(3)\*(2) + (5)\*(4) + (7)\*(6)]/2 + (8)\*(9); (10) Total vertical load on masonry; (12) Basic capacity; (15) Reduction factor  $\beta$  - BS 5628. Table 7; (16) Capacity of wall  $C_w = 1000 * \text{block thk.} * f_k * \beta / (1000 * \gamma_m)$ ;

- **Check compression of BW1**

(assumed 3 courses length retained, ie, 665mm long)



$w = 27 \text{ kN/m}_{ult}$

Restrained by return wall

$w_{0.4} = 64 / 0.67 + 27 = 123 \text{ kN/m}_{ult} < 206 \text{ kN/m}_{ult} \text{ OK}$

**Adopt min 7.3N/mm<sup>2</sup> blockwork + M4 mortar**

Hence,

**Replace inner leaf with min. 7.3N/mm<sup>2</sup> blockwork.**

**However, if floor joists are NOT supported by beam B1, existing inner leaf panel (assumed 3.6N/mm<sup>2</sup> blockwork), is Adequate.**