CI/SfB
(Ff3)

January 2010

Masonry design guide

Showing you the way

Forticrete® masonry
The leading edge

ECOBLOCK®

Contents

Medici masonry,
Twelve Princess Dock, Liverpool

Introduction

The consistently high standards which Forticrete maintain throughout its extensive product range are derived from over 40 years established production experience.

This experience is augmented by a Quality Assurance scheme which guarantees:

- high durability
- low water absorption
- low drying shinkage
- colour consistency
- additional water repellence for improved weathering
- dimensional tolerances to BS EN 771-3:2003

Customer satisfaction is an integral aspect of Forticrete's approach and is expressed in a 'Customer Service Policy Statement' in the Company's Sitework Guide.

Front cover:
Florentine® masonry,
Gartnavel General Hospital,
Glasgow

Forticrete® masonry
The leading edge

Product performance

Quality assurance

Forticrete's Total Quality Management philosophy embraces every aspect of the company's activities and manufacturing processes. The company's main objective is to exceed the requirements of its own criteria, as well as those of its customers and all relevant regulatory authorities.

Forticrete has long recognised that its success is directly linked to the continued satisfaction of its customers. The company has established strict procedures to ensure that every product manufactured at each production plant throughout the UK meets the stringent requirements laid down in its quality control system. All Forticrete Masonry plants are BSI registered and operate to the requirements of BS EN ISO 9001:2000 - the National and International Standard for quality systems. On-going training and educational programs for management, technical and production personnel ensure that the company's adherence to these requirements is achieved at all levels.

Strict adherence to quality procedures creates quality products and many of Forticrete's Specification Masonry products are licensed to carry the prestigious British Standards Kitemark.

The British Standards Kitemark

The Kitemark is a BSI Certification Trade Mark. BSI licenses the use of the Kitemark on products only after it has:

i) had a sample of the product tested independently to satisfy itself that the product conforms to the marked British Standard specification.

ii) visited and assessed the manufacturer to BS EN ISO 9001:2000 and has satisfied itself that the quality system operated by the manufacturer ensures the product's continuing conformity to specification.

Weathering resistance

All Forticrete Specification Masonry products are manufactured with water repellent additives which dramatically reduce both water absorption and penetration.

These additives are incorporated in the constituent mix design and are therefore an inherent feature of the products even after cutting, splitting or texturing of the surface.

This improved ability to repel moisture greatly accelerates the drying process following inclement weather, thereby reducing the adhesion of atmospheric dirt particles which normally lead to unsightly staining.

An additional benefit during construction is a reduced initial suction of moisture from the joints, allowing improved curing of the mortar without any loss of adhesion.

Dimensional tolerances

All Forticrete Masonry Products are manufactured to the required tolerances of BS EN 771-3: 2003, Class D1; Walling Stone to BS EN 771-5: 2003 and Cast Stone to BS EN 1217. However, in conjunction with the company's Quality Assurance registration, Forticrete has targeted an improvement on the British Standard tolerances, as shown in Table 1.

Table 1 Forticrete target tolerances

Product	Length	Thickness	Height
Specification Masonry			
Textured™	+2,-2	+2,-2	+2,-2
Fairface™	+2,-2	+2,-2	+2,-2
Twinbloc™	+2,-2	+2,-2	+2,-2
Ribloc®	+2,-2	+2,-2	+2,-2
Sparstone™	+2,-2	+2,-2	+2,-2
Novastone®	+2,-2	+2,-2	+2,-2
Polished Masonry			
Florentine®	+2,-2	+1,-3	+2,-2
Venezia™	+2,-2	+1,-3	+2,-2
Medici®	+2,-2	+1,-3	+2,-2
Splitface™ Masonry			
Splitface™	+2,-2	N/A	+2,-2
Ribloc®	+2,-2	N/A	+2,-2
Sparstone™	+2,-2	N/A	+2,-2
Glazed Masonry			
Astra-Glaze®-SW™	To ASTM C90- Type 1		
Walling Stone			
Anstone®	To BS EN 771-5: 2003		
Shearstone™	To BS EN 771-5: 2003		
Cast Stone			
Dressings (see table 2)			
Regency® Ashlar	+2,-2	+2,-2	+2,-2
Standard Masonry			
Arenabloc™	+2,-2	+2,-2	+2,-2
Painting Quality	+2,-2	+2,-2	+2,-2
Commons	+3,-5	+3,-5	+3,-5

Table 2 Dimensional tolerances cast stone & precast masonry

Unit Length	Tolerance
0-600mm	±2mm
601-1000mm	±3mm
1001-2500mm	±4mm
2501-4000mm	±5mm
>4000mm	±6mm

Cut products

Forticrete is able to offer a comprehensive cutting service for the creation of special shapes and sizes.

The general tolerance on cut dimensions is ± 2mm, although in certain circumstances it is not possible to achieve this, e.g. where a shallow cut is less than 25° to a face.

The general tolerance on cut angles is ± 1.5° and taper-to-cut faces will be within ± 1mm.

Composition

Forticrete masonry products are manufactured from the highest quality raw materials which are rigorously checked for performance and consistency. This process results in high quality products which meet the demanding requirements of our customers and the appropriate regulatory standards.

To ensure consistently coloured and textured products, particular emphasis is placed on the tight control of material gradings and on-line process equipment.

Use of colour

Forticrete has pioneered the use of coloured masonry.

The colours are specially matched to cater for regional differences, so that if needed they can blend comfortably into the local vernacular.

In addition to their harmonising and economical advantages in conservation areas, the Forticrete range of colours has a wider aesthetic potential. Bands and shapes of colour can be used to create both visual devises and dramatic effects.

If combined with particular bond patterns and textures the permutations are endless.

Table 3 Typical material gross dry density Textured™, Fairface™, Sparstone™, Florentine®, Venezia™ & Standard Masonry

Face Size	Width	Ref.	Format	Gross Dry Density (Kg/m³) Specification Masonry	Standard Masonry
390x190	90	K1	Solid	2100	2000
	90	K3	Hollow	1700	1600
	140	P1	Solid	2100	2000
	140	P3	Hollow	1250	1150
	140	P2	Hi-Light®	1500	1400
	190	R3	Hollow	1240	1220
440x215	90	G1	Solid	2100	2000
	100	D1	Solid	2100	2000
	100	D3	Hollow	1550	1450
	140	H1	Solid	2100	2000
	140	H3	Hollow	1400	1400
	140	H2	Hi-Light®	1460	1450
	215	F1	Solid	2100	2000
	215	F3	Hollow	1400	1400

Manufacturing control category

BS 5628 is the British Standard Code of Practice for the design and use of masonry. It is based on Limit State Design principles which allow the designer to choose a partial safety factor γm for material (See table 4) which is in turn affected by the choice of contractor or material supplier.

As this safety factor is applied directly to structural calculations it can be seen that the design performance of masonry can be improved by choosing a manufacturer supplying products conforming to Category I Manufacture Control. The benefit in terms of this alone is in the order of a 12% increase, in the design vertical load capacity of the blockwork.

Please note that these are the partial factors of safety on material strength only.

Table 4 Partial safety factors for material strength

Manufacturing control category	Construction control category	
	Special	Normal
I	2.5	3.1
II	2.8	3.5

Air permeability

The latest amendments to Part L (Conservation of Fuel and Power) of the Building Regulations include a limit on air permeability. Forticrete products have been tested independently for air leakage and return excellent results, as summarised in Table 5.

Table 5 Air permeability

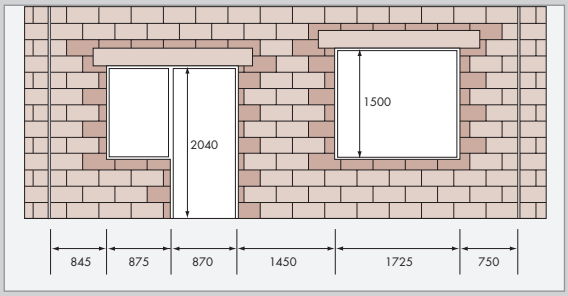
Product	Format	Air Permeability m³/hr/m²
Textured™	Solid	2.16
Textured™	Hi-Light®	2.59
Textured™	Hollow	0.58
Fairface™	Solid	2.07
Fairface™	Hi-Light®	4.66
Florentine®	Solid	0.98
Florentine®	Hi-Light®	1.42
Medici®	Solid	1.03
Anstone® Walling	Solid	0.18
Shearstone™ Walling	Solid	0.14
Regency® Ashlar	Solid	0.13

Modular design

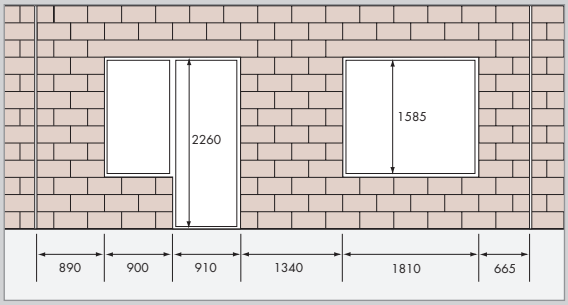
When detailing masonry panels, the designer should set out masonry units to full or half block lengths where possible to avoid unsightly and unnecessary cutting of units on site. Co-ordinating dimensions will also ensure that the masonry is properly bonded.

Figure 1, contrasts the effects of an unco-ordinated and co-ordinated approach to setting out of masonry. (Using 440 x 215mm blocks as an example).

Fig. 1 Setting out



Unco-ordinated approach



Co-ordinated approach

Tables 6 to 9 enable the vertical and horizontal co-ordination of 390 x 190mm and 440 x 215mm block face sizes to be set out at the design stage.

Use of tables

Step 1 Using the wall configuration to be considered, select the appropriate co-ordination factor column from the tables,ie CO+, CO or CO- :

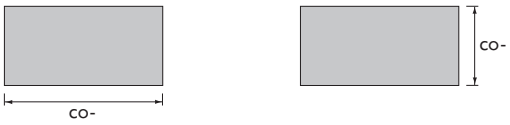
CO+ This is the co-ordinated size plus a joint (ie, actual block length or height + 2 joints)

CO This is the co-ordinated size (ie, actual block length or height + 1 joint)

Bed Joint Reinforcement should be introduced in the blockwork panels, above and below the openings in Fig 1. See also page 12.

Helpful hint

CO- This is the co-ordinated size minus a joint (ie, actual block length or height).



Step 2 From the selected co-ordination factor column, find the required blockwork dimension and then read off the related number of blocks.

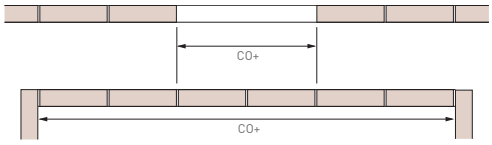
Tables are provided for guidance purposes only. Consideration should be given to allow for the discontinuation of panels when movement joints are incorporated (generally 9m externally and a maximum of 12.2m internally.)

Forticrete cannot be held responsible for errors in the final design. All dimensions should be checked by the designer. Reference should also be made to BS 8000 Part 3 'Code of practice for masonry' which covers allowable building tolerances on site.

Principles of tables

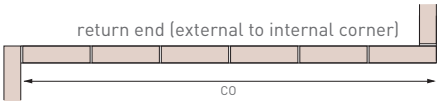
All blockwork dimensions are determined by one of three alternatives which relate to specific wall configurations.

1. Co-ordinated size plus a joint (CO+) i.e. door and window openings

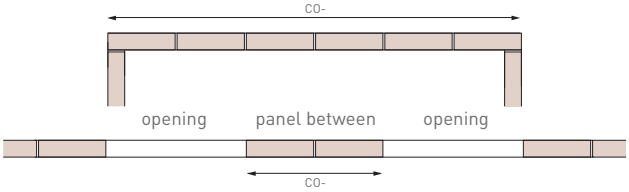


return end (internal to internal corner)

2. Co-ordinated size (CO)
i.e. block panels with opposite return ends or quoins.



3. Co-ordinated size minus a joint (CO-)
i.e. block piers or panels between openings.



Using 5mm joints

Regency Ashlar Traditional and City Bonds in the Regency range are also manufactured to larger sizes to accommodate 5mm mortar joints.

This requires careful consideration with regard to setting out and also in the use of wall ties and bed joint reinforcement.

Table 6 Horizontal blockwork co-ordinating dimensions using 390 x 190mm blocks

No of blocks		CO+	CO	CO-
	0.5	210	200	190
1		410	400	390
	1.5	610	600	590
2		810	800	790
	2.5	1010	1000	990
3		1210	1200	1190
	3.5	1410	1400	1390
4		1610	1600	1590
	4.5	1810	1800	1790
5		2010	2000	1990
	5.5	2210	2200	2190
6		2410	2400	2390
	6.5	2610	2600	2590
7		2810	2800	2790
	7.5	3010	3000	2990
8		3210	3200	3190
	8.5	3410	3400	3390
9		3610	3600	3590
	9.5	3810	3800	3790
10		4010	4000	3990
	10.5	4210	4200	4190
11		4410	4400	4390
	11.5	4610	4600	4590
12		4810	4800	4790
	12.5	5010	5000	4990
13		5210	5200	5190
	13.5	5410	5400	5390
14		5610	5600	5590
	14.5	5810	5800	5790
15		6010	6000	5990
	15.5	6210	6200	6190
16		6410	6400	6390
	16.5	6610	6600	6590
17		6810	6800	6790
	17.5	7010	7000	6990
18		7210	7200	7190
	18.5	7410	7400	7390
19		7610	7600	7590
	19.5	7810	7800	7790
20		8010	8000	7990
	20.5	8210	8200	8190
21		8410	8400	8390
	21.5	8610	8600	8590
22		8810	8800	8790
	22.5	9010	9000	8990
23		9210	9200	9190
	23.5	9410	9400	9390
24		9610	9600	9590
	24.5	9810	9800	9790
25		10010	10000	9990
	25.5	10210	10200	10190
26		10410	10400	10390
	26.5	10610	10600	10590
27		10810	10800	10790
	27.5	11010	11000	10990
28		11210	11200	11190
	28.5	11410	11400	11390
29		11610	11600	11590
	29.5	11810	11800	11790
30		12010	12000	11990
	30.5	12210	12200	12190
31		12410	12400	12390
	31.5	12610	12600	12590
32		12810	12800	12790
	32.5	13010	13000	12990
33		13210	13200	13190
	33.5	13410	13400	13390
34		13610	13600	13590
	34.5	13810	13800	13790
35		14010	14000	13990
	35.5	14210	14200	14190
36		14410	14400	14390
	36.5	14610	14600	14590
37		14810	14800	14790
	37.5	15010	15000	14990
38		15210	15200	15190
	38.5	15410	15400	15390
39		15610	15600	15590
	39.5	15810	15800	15790
40		16010	16000	15990
	40.5	16210	16200	16190
41		16410	16400	16390
	41.5	16610	16600	16590
42		16810	16800	16790
	42.5	17010	17000	16990
43		17210	17200	17190
	43.5	17410	17400	17390
44		17610	17600	17590
	44.5	17810	17800	17790
45		18010	18000	17990
	45.5	18210	18200	18190
46		18410	18400	18390
	46.5	18610	18600	18590
47		18810	18800	18790
	47.5	19010	19000	18990
48		19210	19200	19190
	48.5	19410	19400	19390
49		19610	19600	19590
	49.5	19810	19800	19790
50		20010	20000	19990
	50.5	20210	20200	20190
51		20410	20400	20390
	51.5	20610	20600	20590
52		20810	20800	20790
	52.5	21010	21000	20990
53		21210	21200	21190
	53.5	21410	21400	21390
54		21610	21600	21590
	54.5	21810	21800	21790
55		22010	22000	21990
	55.5	22210	22200	22190
56		22410	22400	22390
	56.5	22610	22600	22590
57		22810	22800	22790
	57.5	23010	23000	22990
58		23210	23200	23190
	58.5	23410	23400	23390
59		23610	23600	23590
	59.5	23810	23800	23790
60		24010	24000	23990
	60.5	24210	24200	24190
61		24410	24400	24390
	61.5	24610	24600	24590
62		24810	24800	24790
	62.5	25010	25000	24990
63		25210	25200	25190
	63.5	25410	25400	25390
64		25610	25600	25590
	64.5	25810	25800	25790
65		26010	26000	25990
	65.5	26210	26200	26190
66		26410	26400	26390
	66.5	26610	26600	26590
67		26810	26800	26790
	67.5	27010	27000	26990
68		27210	27200	27190
	68.5	27410	27400	27390
69		27610	27600	27590
	69.5	27810	27800	27790
70		28010	28000	27990
	70.5	28210	28200	28190
71		28410	28400	28390
	71.5	28610	28600	28590
72		28810	28800	28790
	72.5	29010	29000	28990
73		29210	29200	29190
	73.5	29410	29400	29390

Table 7 Vertical blockwork co-ordinating dimensions using 390 x 190mm blocks

No of blocks	CO+	CO
1	210	200
2	410	400
3	610	600
4	810	800
5	1010	1000
6	1210	1200
7	1410	1400
8	1610	1600
9	1810	1800
10	2010	2000
11	2210	2200
12	2410	2400
13	2610	2600
14	2810	2800
15	3010	3000
16	3210	3200
17	3410	3400
18	3610	3600
19	3810	3800
20	4010	4000
21	4210	4200
22	4410	4400
23	4610	4600
24	4810	4800
25	5010	5000
26	5210	5200
27	5410	5400
28	5610	5600
29	5810	5800
30	6010	6000
31	6210	6200
32	6410	6400
33	6610	6600
34	6810	6800
35	7010	7000
36	7210	7200
37	7410	7400
38	7610	7600
39	7810	7800
40	8010	8000
41	8210	8200
42	8410	8400
43	8610	8600
44	8810	8800
45	9010	9000
46	9210	9200
47	9410	9400
48	9610	9600
49	9810	9800
50	10010	10000
51	10210	10200
52	10410	10400
53	10610	10600
54	10810	10800
55	11010	11000
56	11210	11200
57	11410	11400
58	11610	11600
59	11810	11800
60	12010	12000

Table 8 Horizontal blockwork co-ordinating dimensions using 440 x 215mm blocks

No of blocks		CO+	CO	CO-
	0.5	235	225	215
1		460	450	440
	1.5	685	675	665
2		910	900	890
	2.5	1135	1125	1115
3		1360	1350	1340
	3.5	1585	1575	1565
4		1810	1800	1790
	4.5	2035	2025	2015
5		2260	2250	2240
	5.5	2485	2475	2465
6		2710	2700	2690
	6.5	2935	2925	2915
7		3160	3150	3140
	7.5	3385	3375	3365
8		3610	3600	3590
	8.5	3835	3825	3815
9		4060	4050	4040
	9.5	4285	4275	4265
10		4510	4500	4490
	10.5	4735	4725	4715
11		4960	4950	4940
	11.5	5185	5175	5165
12		5410	5400	5390
	12.5	5635	5625	5615
13		5860	5850	5840
	13.5	6085	6075	6065
14		6310	6300	6290
	14.5	6535	6525	6515
15		6760	6750	6740
	15.5	6985	6975	6965
16		7210	7200	7190
	16.5	7435	7425	7415
17		7660	7650	7640
	17.5	7885	7875	7865
18		8110	8100	8090
	18.5	8335	8325	8315
19		8560	8550	8540
	19.5	8785	8775	8765
20		9010	9000	8990
	20.5	9235	9225	9215
21		9460	9450	9440
	21.5	9685	9675	9665
22		9910	9900	9890
	22.5	10135	10125	10115
23		10360	10350	10340
	23.5	10585	10575	10565
24		10810	10800	10790
	24.5	11035	11025	11015
25		11260	11250	11240
	25.5	11485	11475	11465
26		11710	11700	11690
	26.5	11935	11925	11915
27		12160	12150	12140
	27.5	12385	12375	12365
28		12610	12600	12590
	28.5	12835	12825	12815
29		13060	13050	13040
	29.5	13285	13275	13265
30		13510	13500	13490
	30.5	13735	13725	13715
31		13960	13950	13940
	31.5	14185	14175	14165
32		14410	14400	14390
	32.5	14635	14625	14615
33		14860	14850	14840
	33.5	15085	15075	15065
34		15310	15300	15290
	34.5	15535	15525	15515
35		15760	15750	15740
	35.5	15985	15975	15965
36		16210	16200	16190
	36.5	16435	16425	16415
37		16660	16650	16640
	37.5	16885	16875	16865
38		17110	17100	17090
	38.5	17335	17325	17315
39		17560	17550	17540
	39.5	17785	17775	17765
40		18010	18000	17990
	40.5	18235	18225	18215
41		18460	18450	18440
	41.5	18685	18675	18665
42		18910	18900	18890
	42.5	19135	19125	19115
43		19360	19350	19340
	43.5	19585	19575	19565
44		19810	19800	19790
	44.5	20035	20025	20015
45		20260	20250	20240
	45.5	20485	20475	20465
46		20710	20700	20690
	46.5	20935	20925	20915
47		21160	21150	21140
	47.5	21385	21375	21365
48		21610	21600	21590
	48.5	21835	21825	21815
49		22060	22050	22040
	49.5	22285	22275	22265
50		22510	22500	22490
	50.5	22735	22725	22715
51		22960	22950	22940
	51.5	23185	23175	23165
52		23410	23400	23390
	52.5	23635	23625	23615
53		23860	23850	23840
	53.5	24085	24075	24065
54		24310	24300	24290
	54.5	24535	24525	24515
55		24760	24750	24740
	55.5	24985	24975	24965
56		25210	25200	25190
	56.5	25435	25425	25415
57		25660	25650	25640
	57.5	25885	25875	25865
58		26110	26100	26090
	58.5	26335	26325	26315
59		26560	26550	26540
	59.5	26785	26775	26765
60		27010	27000	26990
	60.5	27235	27225	27215
61		27460	27450	27440
	61.5	27685	27675	27665
62		27910	27900	27890
	62.5	28135	28125	28115
63		28360	28350	28340
	63.5	28585	28575	28565
64		28810	28800	28790
	64.5	29035	29025	29015
65		29260	29250	29240
	65.5	29485	29475	29465
66		29710	29700	29690
	66.5	29935	29925	29915
67		30160	30150	30140
	67.5	30385	30375	30365
68		30610	30600	30590
	68.5	30835	30825	30815
69		31060	31050	31040
	69.5	31285	31275	31265
70		31510	31500	31490
	70.5	31735	31725	31715
71		31960	31950	31940
	71.5	32185	32175	32165
72		32410	32400	32390
	72.5	32635	32625	32615
73		32860	32850	32840
	73.5	33085	33075	33065

Table 9 Vertical blockwork co-ordinating dimensions using 440 x 215mm blocks

No of blocks	CO+	CO
1	235	225
2	460	450
3	685	675
4	910	900
5	1135	1125
6	1360	1350
7	1585	1575
8	1810	1800
9	2035	2025
10	2260	2250
11	2485	2475
12	2710	2700
13	2935	2925
14	3160	3150
15	3385	3375
16	3610	3600
17	3835	3825
18	4060	4050
19	4285	4275
20	4510	4500
21	4735	4725
22	4960	4950
23	5185	5175
24	5410	5400
25	5635	5625
26	5860	5850
27	6085	6075
28	6310	6300
29	6535	6525
30	6760	6750
31	6985	6975
32	7210	7200
33	7435	7425
34	7660	7650
35	7885	7875
36	8110	8100
37	8335	8325
38	8560	8550
39	8785	8775
40	9010	9000
41	9235	9225
42	9460	9450
43	9685	9675
44	9910	9900
45	10135	10125
46	10360	10350
47	10585	10575
48	10810	10800
49	11035	11025
50	11260	11250
51	11485	11475
52	11710	11700
53	11935	11925
54	12160	12150
55	12385	12375
56	12610	12600
57	12835	12825
58	13060	13050
59	13285	13275
60	13510	13500

Radius walls using standard blocks

Within certain limits, standard blocks may be laid running bond to a circular or other curved plan form. The practical limits are determined by the acceptable face width of perpends on the outer radius, and the amount of overhang between successive courses.

For requirements outside the parameters shown in the table below, Forticrete has a facility to create bespoke products. However, an exact match cannot be guaranteed due to the different manufacturing processes employed. Forticrete recommend that matching samples be compared at the design stage.

Fig. 2 Standard block used on radius wall

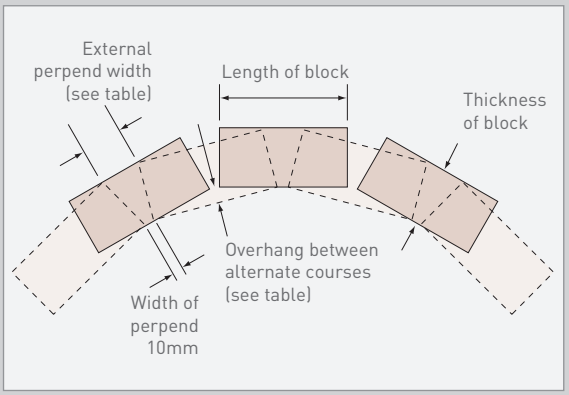


Table 10 Radius wall parameters using standard blocks

Wall radius (mm)	Block thickness 90mm length 200mm		Block thickness 90mm length 400mm		Block thickness 100mm length 225mm		Block thickness 100mm length 450mm	
	Overhang (mm)	External perpend width (mm)	Overhang (mm)	External perpend width (mm)	Overhang (mm)	External perpend width (mm)	Overhang (mm)	External perpend width (mm)
1000	5	28	20	50	6	32	22	54
1200	4	25	17	42	5	29	20	46
1400	3.5	23	14	39	4.5	26	17	42
1600	3.0	21	12	35	4	24	15	37
1800	2.5	20	11	32	3.5	22	13	34
2000	2.5	19	10	30	3	21	12	32
2500	2.5	19	10	28	2.0	17.5	8	26
3000	1.5	16	7	23	2.0	18	8	25
3500	1.0	15	6	21	1.8	17	7	23
4000	<1.0	14.5	5	20	1.5	16	6	21
4500	<1.0	14.0	4.5	19	1.0	15	5.5	20
5000	<1.0	13.5	4.0	18	<1.0	14.5	5.0	19
5500	<1.0	13.5	3.5	17	<1.0	14	4.5	18
6000	<1.0	13	3.0	16.5	<1.0	13.5	4.0	17

Overhangs

The overhang values are what can be expected if the wall is built fair-face on both sides.

Overhangs of 4mm and below are normally acceptable for fair-face work.

Perpends

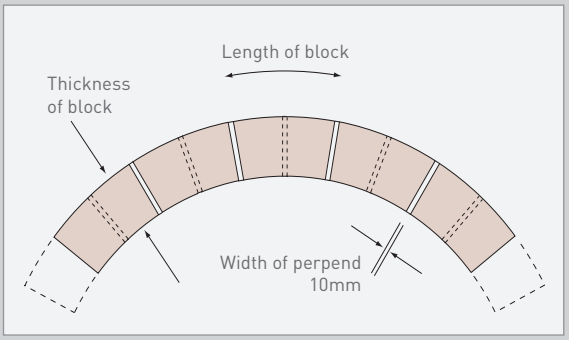
Where the blocks are only seen on the internal radius, the perpend can be kept at 10mm.

If the external radius is seen, the perpend width may be reduced by closing up on the inside face or by cutting one or both ends of the blocks on the splay.

Radius wall using precast curved units

The intended appearance of the radius wall will determine whether the use of standard blocks is practical or desirable. Consideration should therefore be given to the use of precast curved units to achieve the required effect.

Fig. 3 Curved block used on radius wall



Refer to information in the Precast Product brochure.

Movement control and bed joint reinforcement

Accommodation of movement

All Building materials are subject to movement due to temperature and moisture changes. Designers should therefore ensure that the effects of such movement are accommodated to prevent unsightly cracking which may further result in structural defects.

A number of factors should be considered by the designer.

- specifying a product with low drying shrinkage, e.g. Forticrete Masonry
- specifying the correct mortar
- providing control joints at suitable centres
- using bed-joint reinforcement (See page 11)
- protecting the blocks before and during construction

Detailed information is covered within BS5628: Part 3: 2005

Control joints

Control joints are vertical separations built into a wall and located where cracking may occur due to excessive stresses caused mainly by drying shrinkage.

As a general guide the joints should be at regular spacing up to 9.0m in external walls and up to 12.2m maximum for internal walls.

It should be noted that on south and east elevations, the effect of the early morning sun on these faces can raise the temperature very rapidly and cause greater movement to take place than elsewhere in the structure. It is recommended that the above rules are strictly adhered to unless further advice is taken.

Control joints may also be required at:

- changes in wall height and thickness.
- junctions with other forms of construction e.g. steel stanchions and reinforced concrete columns.
- intersections with other walls and partitions - particular attention should be given where return walls occur.
- return angles in L, T and U shaped buildings.
- chases or recesses for piping, pilasters, fixtures, etc.
- one or both sides of some large wall openings, e.g. windows, louvres or doors. However the addition of localised bed-joint reinforcement above and below openings can often eliminate the need for control joints. (See pages 11 and 12)
- movement joints in roof and floor slabs. These joints in the main structure must be continued through the wall construction. The width of the wall joint and the compressible filler should be similar to that used in the roof and floor slabs.

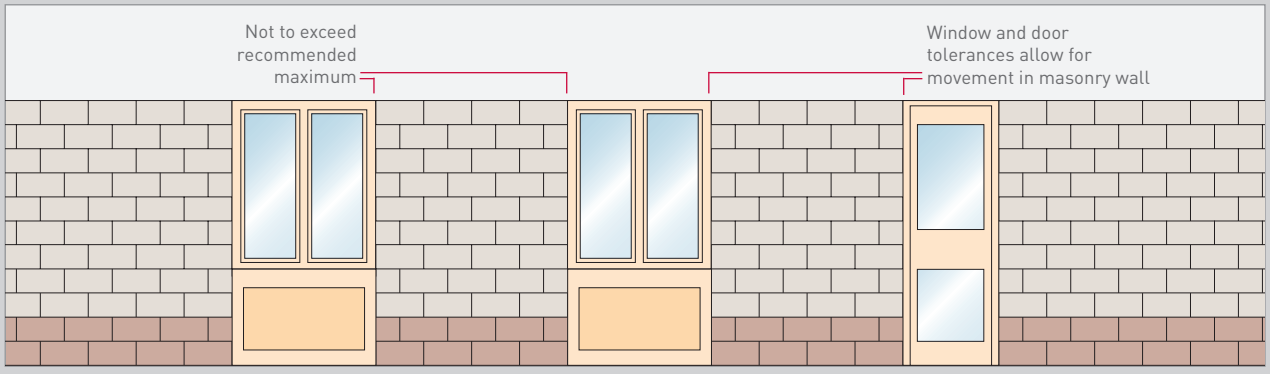
Table 11 Recommended spacing of movement control joints

Product range	Internal spacing (metres)	External spacing (metres)
Specification Masonry (except Novastone®), Polished Masonry, Splitface™ Masonry	12.2	9
Glazed Masonry, Novastone®,	6	6
Cast Stone, Walling Stone	6	6
Standard Masonry Dense,	9	6
Standard Masonry Lightweight	6	6

Slender panels of masonry are more susceptible to drying shrinkage movement because of the lack of restraint from the weight of masonry above. Therefore a totally square panel would have maximum effect in accommodating this potential movement.

Helpful hint

Fig. 4 Utilising openings for movement control



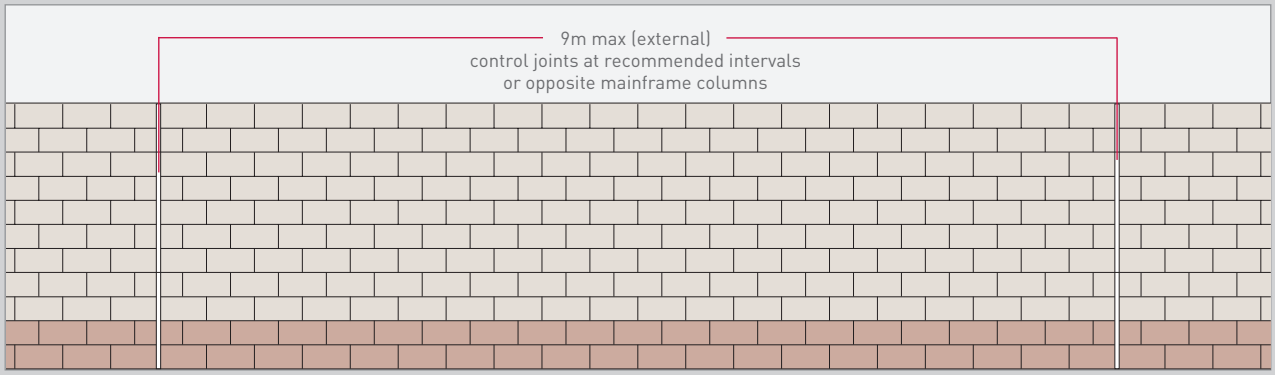
The sum of two panel lengths on either side of a corner should generally not exceed the recommendations for single panel length.

Helpful hint

The inclusion of one or two courses of a darker coloured masonry will disguise splash marks and build-up of general dirt and grime.

Helpful hint

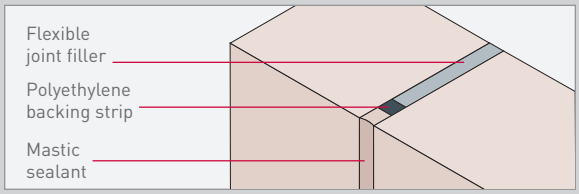
Fig. 5 Movement control joints in unbroken wall



Formation of control joints

The wall is built in the 'normal' half bond manner with the exception that on alternate courses, half length blocks are used to form a straight vertical joint.

Fig. 6 Control joint



The sealant should be one of the following or similar:

- an acrylic based sealant, such as these produced by Tremco Ltd tel: 01753 691696
- a two-part polysulphide, such as these produced by Fosroc Expandite Ltd tel: 01827 262222
- a silicone-based sealant, such as these produced by Adshead & Ratcliffe Ltd tel: 01773 826661

Internally the joint should be left open as long as possible to enable the wall to dry out thoroughly. Control joints should be carried through all finishes. With partition walls not exceeding 8m in length the unbonded detail shown in Fig. 14 on page 15 will be adequate to accommodate this movement.

In cavity walls the control joints in each leaf should be offset. The flexibility of the cavity ties is normally sufficient to compensate for the very small differential movement between two leaves. Generally, the joint spacing is greater on the inner leaf so the staggering of joints is relatively simple. Additional wall ties should be provided either side of the control joint to enhance stiffness. Fig. 8 indicates how the control joint should be constructed incorporating a standard wall tie and plastic sleeve which may be used to create a de-bonding effect, for example that supplied by Halfen, Tel: 08705 316300. (See also Figs. 9 and 10)

Horizontal control joints

Limitation on uninterrupted height

When the method of limiting the uninterrupted height is adopted in accordance with BS 5628 : Part 1, the outer leaf should be supported at intervals of not more than every third storey or every 9m, whichever is less. This method employs shelf angles and horizontal joints, which subsequently provides a means of vertical movement control. However, for buildings not exceeding four storeys or 12m in height, whichever is less, the outer leaf may be uninterrupted for its full height.

Fig. 7 Typical vertical control joint

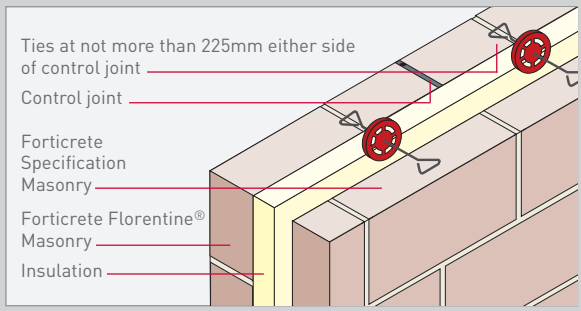


Fig. 8 Control joint with lateral restraint

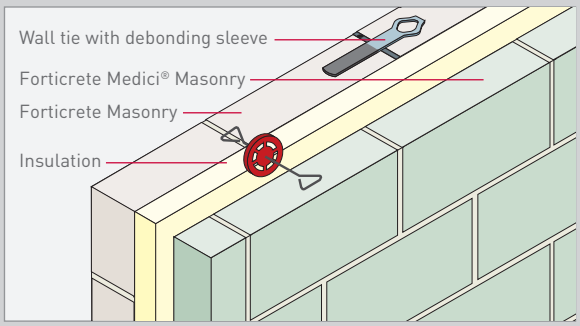


Fig.9 Control joint at column
Detail 1 - Blocks abutting column

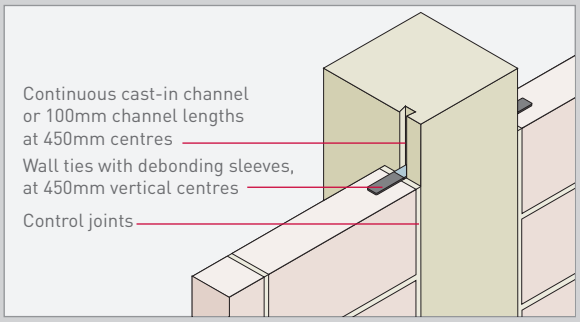


Fig.10 Control joint at column
Detail 2 - Blocks running past column

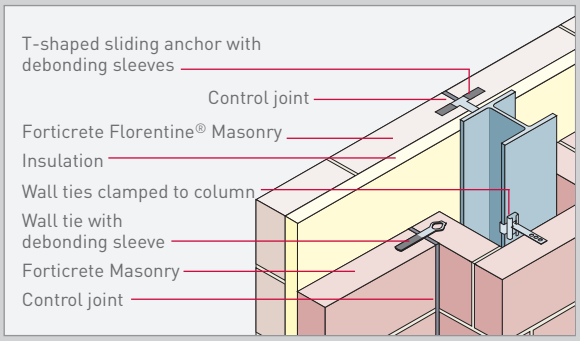
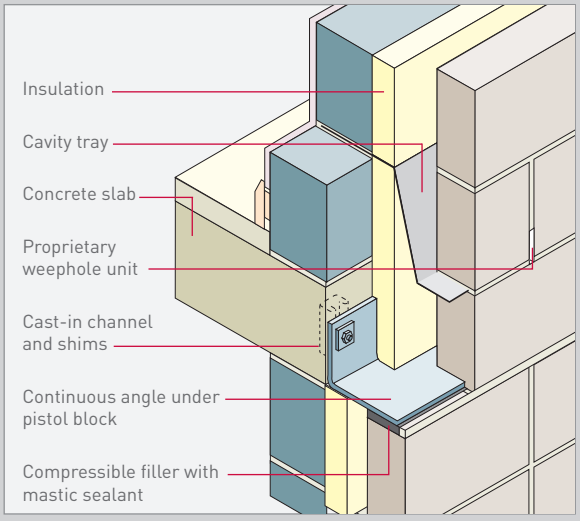


Fig.11 Horizontal movement joint



In Figure 10 Forticrete quoins may be used to form column encasement giving a stronger bond.

Helpful hint

Bed-joint reinforcement

Bed joint reinforcement is used to control the stresses induced in masonry walls, including the control of shrinkage.

Bond beams can have the same effect, but bed joint reinforcement may be more effective in controlling movement and is generally more economical.

Internal walls

Table 12 gives an indication of the relationship between the spacing of control joints and that of bed-joint reinforcement for internal walls not subject to wind loads based on experience.

Table 12 Spacing of control joints and bed joint reinforcement for forticrete masonry

Ratio L/H Panel length L (determined by control joint spacing) to panel height H	2	2.5	3	4
Limit of panel length L irrespective of panel height H	12.2m	13.6m	15.2m	18.4m
Vertical spacing of bed-joint reinforcement	no re-inforcement	every 3rd course	every other course	every course

External walls

For external walls subject to wind loading, a structural engineer must be consulted to assess the spacing of control joints and bed joint reinforcement. However, Forticrete offer a free checking service before the design is passed to the structural engineer for final approval.

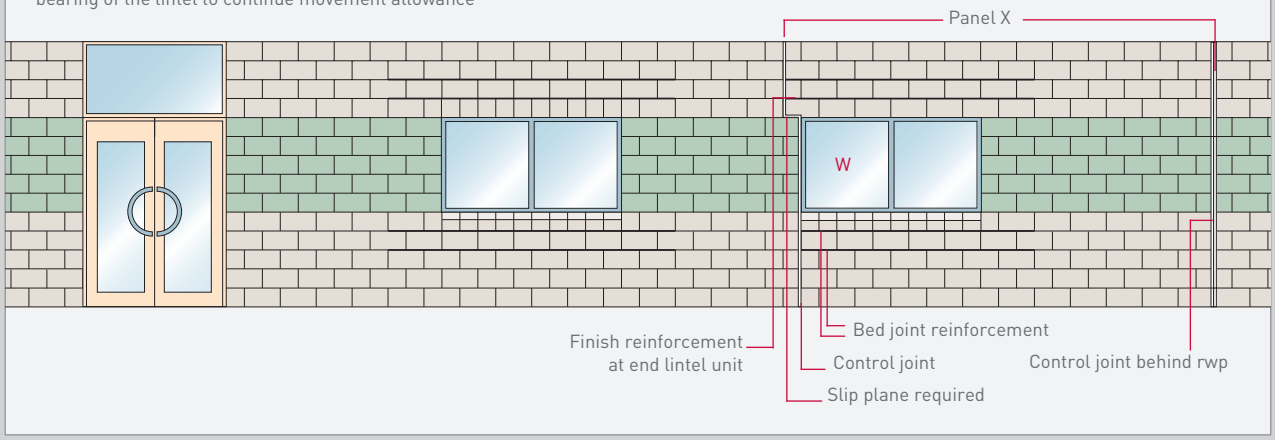
In walls which have door and window openings, bed-joint reinforcement will eliminate the use of frequent control joints. Reinforcement should be provided in the first and second courses above and below all openings and should extend no less than 600mm either side of the opening (See Fig. 12). Other uses of bed joint reinforcement are near the top of the structural walls abutting concrete roofs, and in providing additional strength to parapet (upstand) walls.

Alternatively, in Fig 12 the control joint adjacent to window W on panel X could be omitted if bed-joint reinforcement is incorporated in every course throughout the length between the door and the joint behind the rainwater pipe.

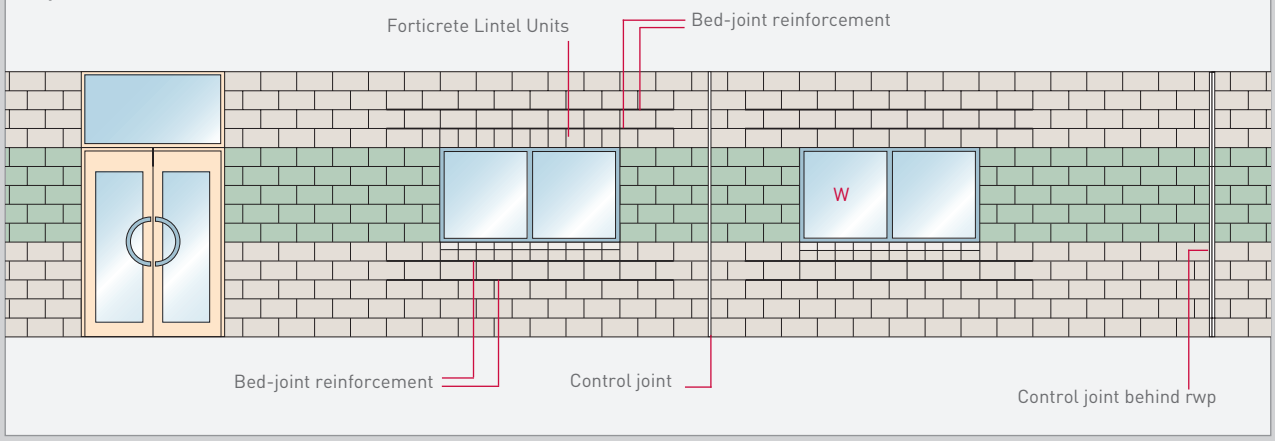
Where bed-joint reinforcement is required to enhance structural performance e.g. improving the flexural strength of stack bonded construction, it should be of the wire weld (ladder) type. Care must be exercised in selecting the correct width of reinforcement which should be approximately 40mm less than the width of the masonry unit. It is also important to ensure that the reinforcement is fully bedded in mortar and adequate adhesion between blocks is maintained.

Fig. 12 Control joints and bed joint reinforcement

Option 1: This method of aligning control joints with openings is often used but should always be checked by the project engineer to confirm stability. A slip plane should always be incorporated under the end bearing of the lintel to continue movement allowance



Option 2: Preferred detail



A DPC inserted under bearing of lintel over window W in option 1 is required as a slip plane to accommodate the movement which will occur at the discontinuation of the control joint.

Helpful hint

Ensure that due consideration is given to the thickness of bed joint reinforcement when used in conjunction with 5mm mortar joints (as with Regency Ashlar Traditional and City Bonds), especially at corner detailing and lapping of reinforcement.

Helpful hint

Stack bonding

Stack bonding has a distinctive uniform bond pattern that is particularly suitable for panels in framed structures. It is often provided for aesthetic appearance without consideration for its design limitations. Stack bonding is economical to lay as it eliminates the need for cutting blockwork. However, the following criteria should be considered carefully when using a stack bond pattern.

The lack of cross bonding from the block directly above or below each unit will affect the flexural strength of the panel considerably. The compressive strength will also be reduced slightly.

In stack bond masonry, heavy concentrated loads will be carried down to the support by the particular vertical tier or "column" of masonry under load, with little distribution to adjacent masonry.

It is for this reason that BS 5628 does not recognise stack bonding as a "normal masonry bond pattern" when indicating calculation values for use by the designer/engineer.

Experience has shown that for blockwork masonry, Bed Joint Reinforcement should be included at every other course (450mm centres) for the full height of the stack bonded panel, and also for the width of the panel between columns or movement joints.

The reinforcement must not bridge the movement joints.

Alternatively bond beams can be used to restrain the panel against flexural failure. In effect, Bed Joint Reinforcement in alternate courses, will give the stack bond pattern a similar stability to that of a stretcher bond pattern.

It is important that when using this form of construction technique, a structural engineer must be consulted.

Brick and block banding

Over recent years, walls combining both clay and concrete masonry have become increasingly popular. If chosen, due account should be taken to accommodate differential movement.

Two design approaches can be used. BS 5628 suggests that slip planes be incorporated at the junction of the two dissimilar materials. However, this would seem to considerably reduce the flexural strength of the wall. The second approach is to tie the dissimilar materials together using Bed Joint Reinforcement, which reinforces the interface sufficiently to withstand the stresses induced by differential movement.

In either case it is advisable to ensure that movement joints are spaced at approximately 6m centres. Unfortunately little research has been carried out which would justify either design approach. Although both approaches have been used, slip planes are mostly incorporated on full height panels where shelf angles are used. To our knowledge no failures in this type of construction have been reported. This may be due to the low drying shrinkage of Forticrete masonry.

For further information please contact the Technical Department on 0800 262136.

The use of bed joint reinforcement

Bed joint reinforcement may be used for a variety of purposes and locations, as set out in Table 13 below either for structural applications or crack control only.

Typical manufacturers

Expamet Building Products Tel: 01429 866 655
BRC Building Products Ltd. Tel: 01785 240029

Table 13 The use of bed joint reinforcement

Purpose/location	Ladder type for structural applications	Expanded metal type for crack control only (below & above openings and tying)
Increased panel sizes (refer to table 12)	•	
Alternative to using windposts	•	
Increased movement joint spacing	•	
Feature courses, corbles, plinths	•	•
Collar joint walls	•	•
Corner and 'T' junction pieces	•	•
Stack bonded panels	•	
Differential movement control	•	•
Brick/block banding	•	•
Above and below openings	•	•

Fixings and detailing

Fixings

Aggregate concrete blocks provide an ideal substrate for many types of fixings. This ranges from light, medium and heavy-duty fixings. Although it is generally easier to fix into solid blockwork, it is possible to fix into the solid portion of hollow blockwork with certain light and medium duty fixings. Alternatively, for a stronger connection, it is possible to fill the hollow portion of the blockwork with concrete for the units that require the fixing. This technique would allow a substantial fixing to be applied to the hollow unit once filled with concrete and allowed to set.

For light duty use, plastic plug and screw type fixings are ideal and can achieve adequate pull out strengths for general applications. Pull out strengths will vary between different strengths and density of blockwork. It is therefore advisable to consult Forticrete's Technical Department for guidance and typical pull out strengths.

Medium duty applications will generally require a heavier gauge fixing than the light duty option. This will obviously depend on the fixing requirement.

Heavy duty fixings should be considered carefully. The most common form of fixing is the chemical anchor or resin bonded rod. It is generally not advisable to use expanded anchor bolts on aggregate concrete blocks due to the action of the fixing, which tends to put excessive strain onto the blockwork when trying to expand. It may be possible to use expanding anchor type fixing for light or medium duty applications, bearing in mind the above caution. This should be discussed with Forticrete's Technical Department, to ensure suitability of the product in question.

It is possible to substitute hollow blockwork with solid blockwork in areas where fixings are necessary. An example is blockwork next to a roller shutter door. Fixing strength is critical because vibration from the motion of the door may put extra stress onto the fixings. The solid blocks would obviously enhance the pull out strengths giving full restraint to the shutter door. However, it may also be necessary to reinforce the bed joints with Bed Joint Reinforcement to cope with the stresses imposed on the surrounding blockwork. Alternatively, the hollow blockwork could be filled with concrete at the position where the fixing is needed to ensure total stability. It may be necessary to consult with a Structural Engineer for this type of detailing, as there may be a need for specialist types of fixings in certain installations.

When fixings have to be considered after the completion of the building, there are numerous additional factors to consider.

These include:

- the range of blockwork strengths
- the possibility of voids if unknown
- the variable quality of mortar
- the difficulty of avoiding mortar joints when the surface is rendered or plastered
- the correct choice of fixing system to suit loading and whether hollow, Hi-Light® or solid blocks are the supporting background

Fig. 13 Position of fixings

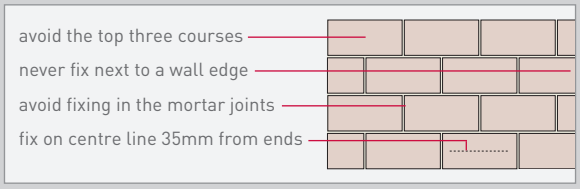


Figure 13 is a useful indicator of where to locate fixings within a blockwork wall. It may be used at the design stage, during construction, as well as after the building has been occupied.

Table 14 Pull out loads

Rawplug Fixing	Block Designation	Average Ultimate Load (kN)	SWL (kg)
8mm Rawl-in-one	Solid 7N	1.22	30
	Hollow 7N	1.38	35
	Hi-Light® 7N	1.42	35
10mm Rawl-in-one	Solid 7N	2.14	50
	Hollow 7N	1.26	30
	Hi-Light® 7N	1.61	40
8mm Rawlbloc	Solid 7N	1.92	45
	Hollow 7N	2.24	55
	Hi-Light® 7N	1.83	45
10mm Rawlbloc	Solid 7N	1.81	45
	Hollow 7N	2.73	65
	Hi-Light® 7N	2.68	65
8500 Rawlnut	Solid 7N	4.25	105
	Hollow 7N	2.41	60
	Hi-Light® 7N	2.6	65
1055 Rawlnut	Solid 7N	5.53	135
	Hollow 7N	6.36	155
	Hi-Light® 7N	5.44	135
M10 R-kem Resin (inc. dia. 15 x 95 mesh sleeve)	Solid 7N	11.1	270
	Hollow 7N	6.3	155
	Hi-Light® 7N	7.6	190
Fischer Fixing	**Block Designation**	**Average Ultimate Load (kN)**	**SWL (kg)**
SX Plug	Dense 7N	3.58	52
	Lightweight 7N	3.7	54
UX Plug	Dense 7N	2.17	32
	Lightweight 7N	1.8	25
M Unit	Dense 7N	5.83	85
	Lightweight 7N	4.9	71
FIP 380C	Dense 7N	11.1	283
	Lightweight 7N	5.5	140
FIS V360S	Hi-Light®	10.53	265
KD8	Hi-Light®	8.75	214
FHY	Hi-Light®	7.2	184
SXS	Hi-Light®	2.04	31
FU	Hi-Light®	3.33	51

Provision for services and fittings

When making provision for services and services fittings, designers should ensure that none of the functions of the wall are impaired by fixings, chases or holes.

The designer should consider the effects of chasing on stability, bearing in mind the recommendations of BS 5628 : Part 3, particularly where walls or leaves are constructed of hollow units. In walls or leaves constructed of solid units, the depth of horizontal chases should not normally exceed one-sixth of the thickness of the single leaf at any point, whilst the depth of vertical chases should not normally exceed one-third of the thickness of the single leaf at any point. The cutting of holes up to approximately 300mm square in the wall to accommodate items of equipment may be permitted. See Sitework Guide for further clarification.

Fig.14 Junction between loadbearing cavity wall and internal wall

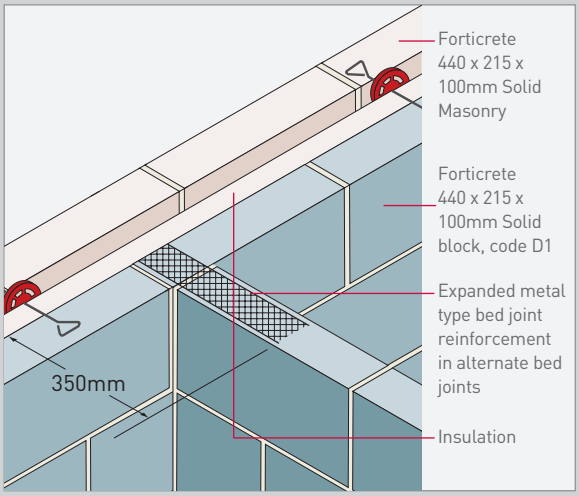


Fig.15 Intersection of two loadbearing walls

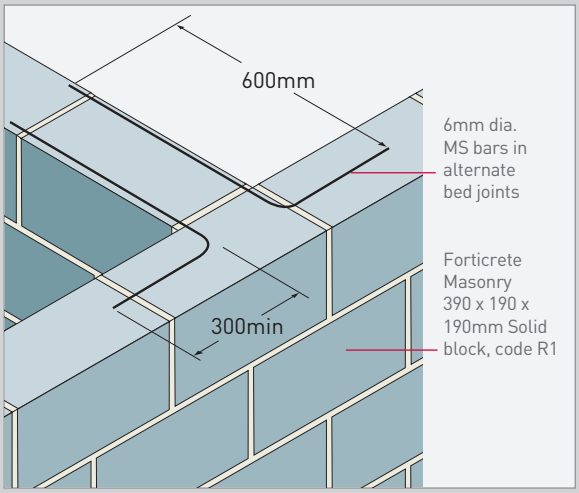


Fig.16 Sliding anchor and movement detail at floor slab

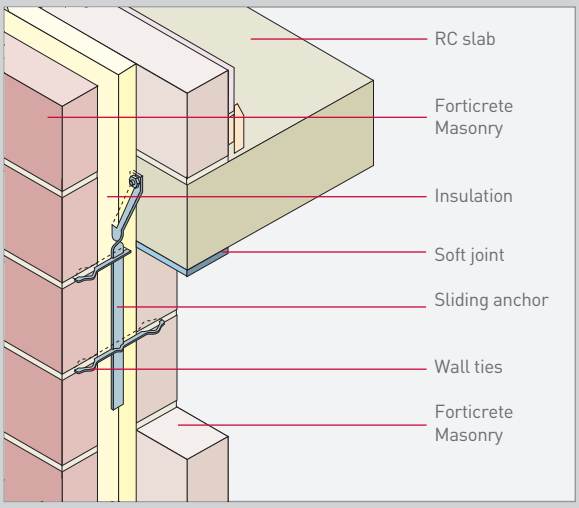


Fig.17 Junction of steel column with cavity wall

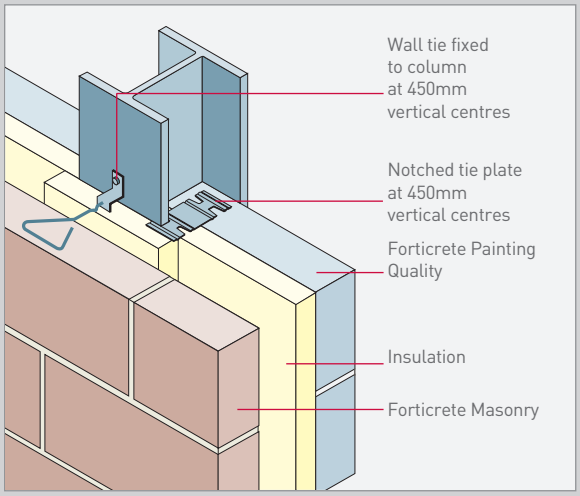


Fig.18 Junction of concrete column with blockwork

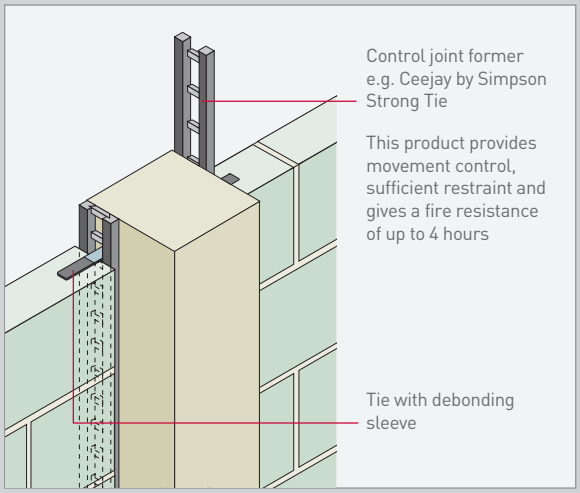


Fig.19 Junction of non loadbearing wall with concrete slab - with head restraint

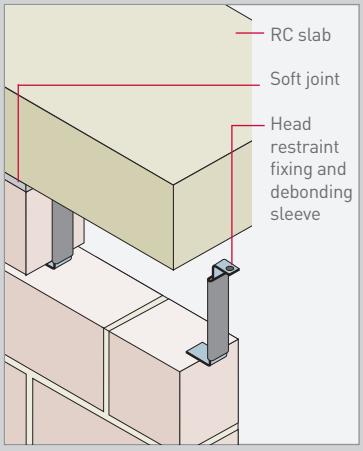


Fig.20 Junction of non loadbearing wall with concrete slab - without head restraint

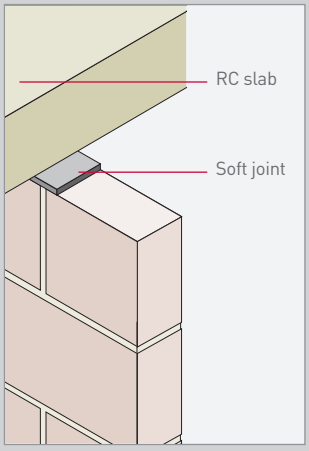


Fig.21 Masonry wall and strip foundation detail

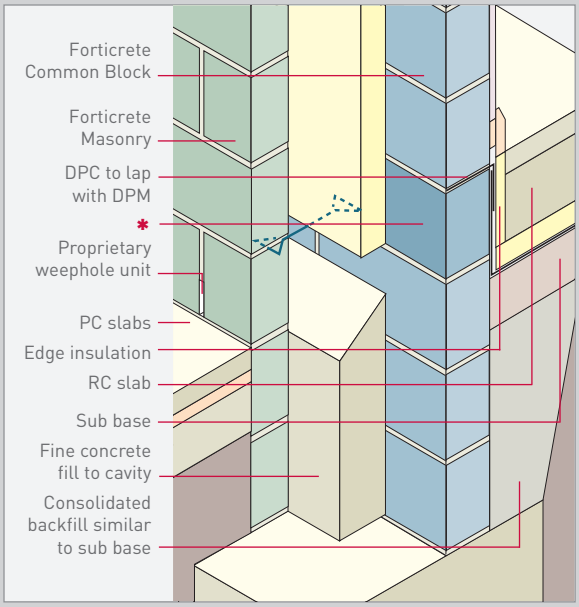
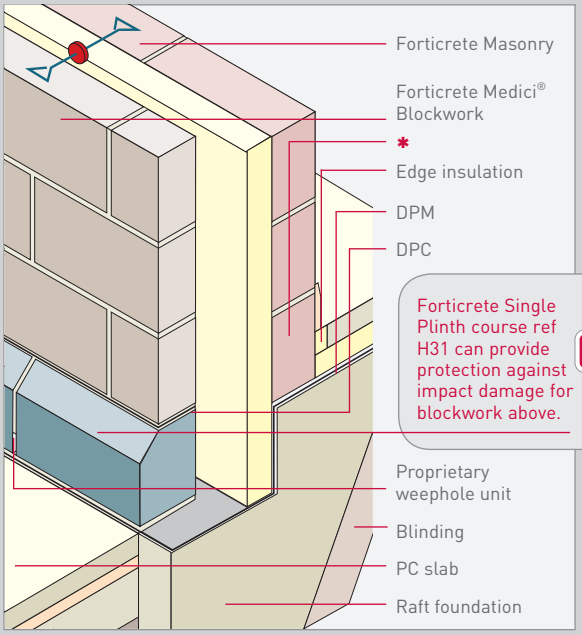


Fig.22 Masonry wall and raft foundation detail



Helpful hint

Forticrete Single Plinth course ref H31 can provide protection against impact damage for blockwork above.

Fig 21: Overall insulation thickness will be determined by buildings location and type of insulation material.

Fig 21/22: *Course of insulating blockwork, if structurally acceptable, to maintain thermal continuity.

Fig 23: Direction of cavity tray fall depends on degree of exposure. If high exposure, the tray should discharge to outer leaf as shown.

Fig 23/24: *Courses of insulating blockwork to maintain thermal continuity.

Helpful hint

Fig.23 Detail at parapet

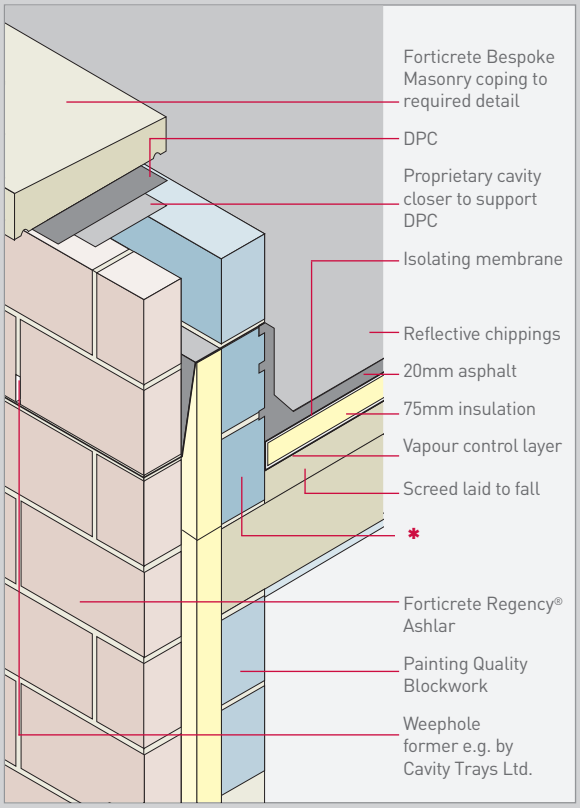


Fig.24 Detail at eaves

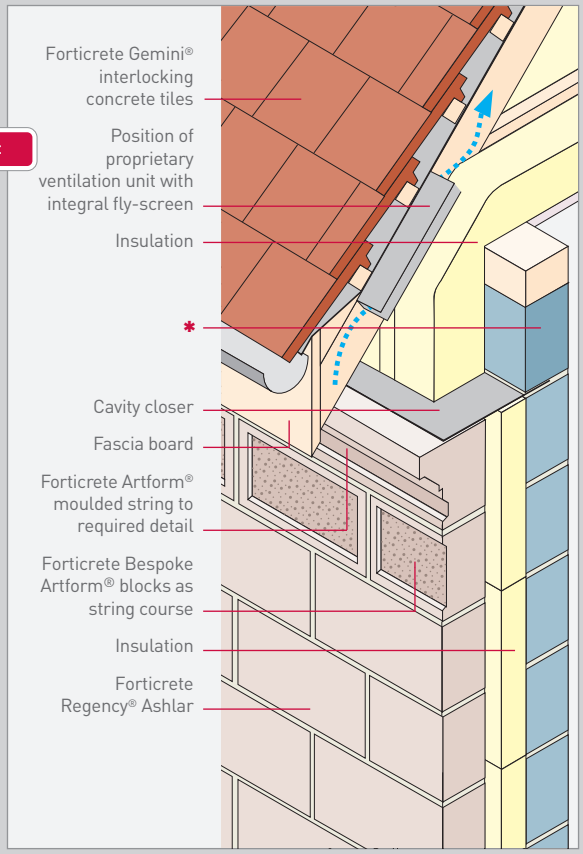
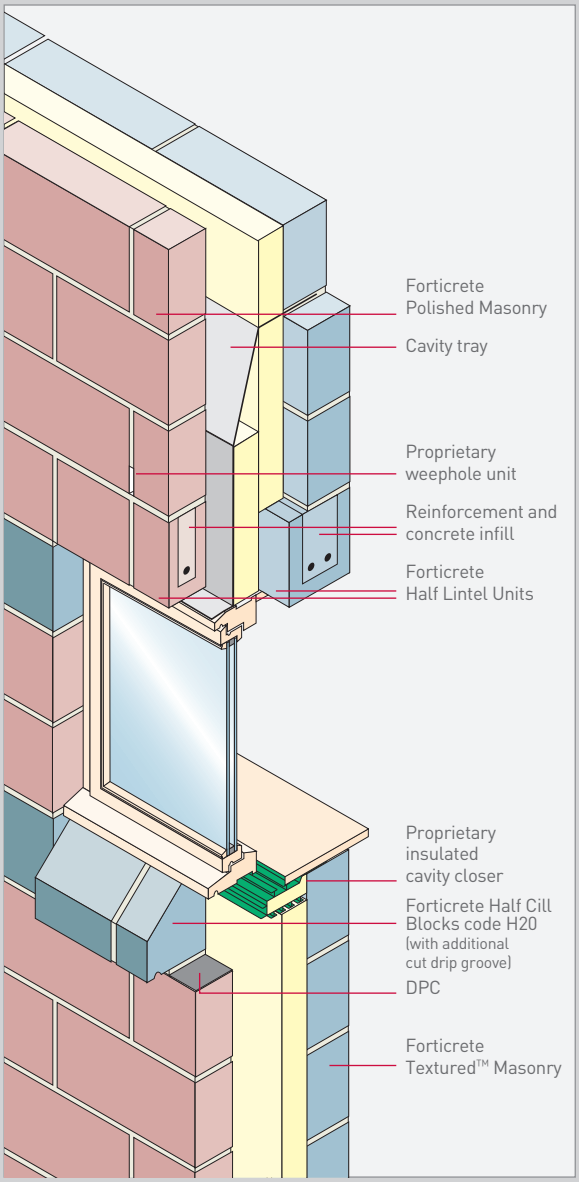


Fig.25 Lintel and cill detail alternative 1



If Textured or Polished Masonry is used, ensure that return ends, reveal blocks etc have been similarly specified to ensure a uniform finish.

Helpful hint

Fig.26 Lintel and cill detail alternative 2

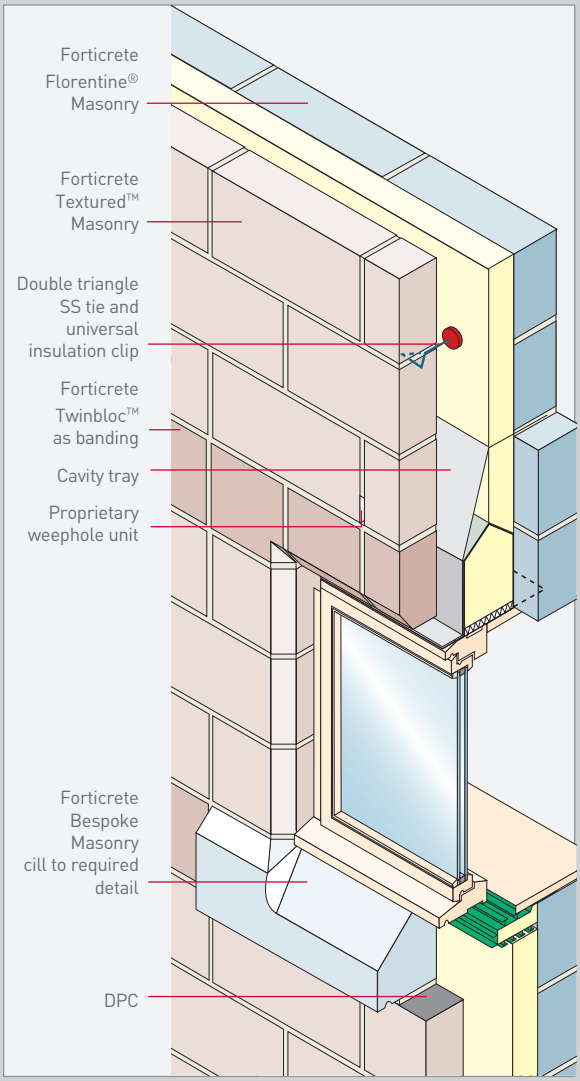
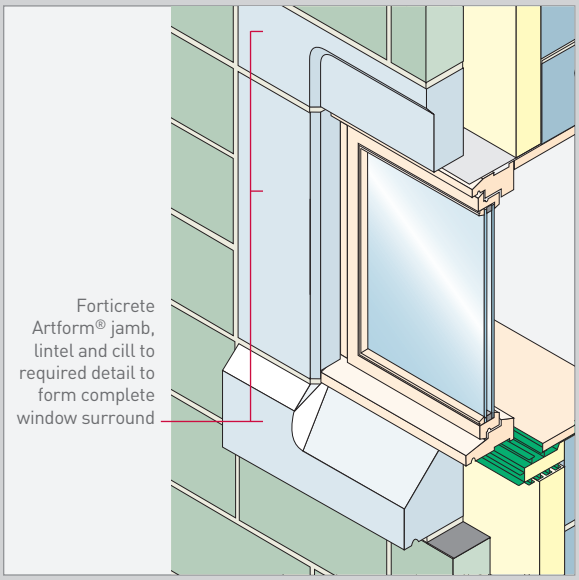


Fig.27 Lintel and cill detail alternative 3



To eliminate stress and differential movement, bed joint reinforcement should be provided for two courses above and below all openings and should extend no less than 600mm either side of the opening.

*Fig 29 Bed joint to allow for a maximum deflection of 5mm for steel support lintel.

Helpful hint

Fig.28 Cast Stone Decorative Head with supporting lintel detail

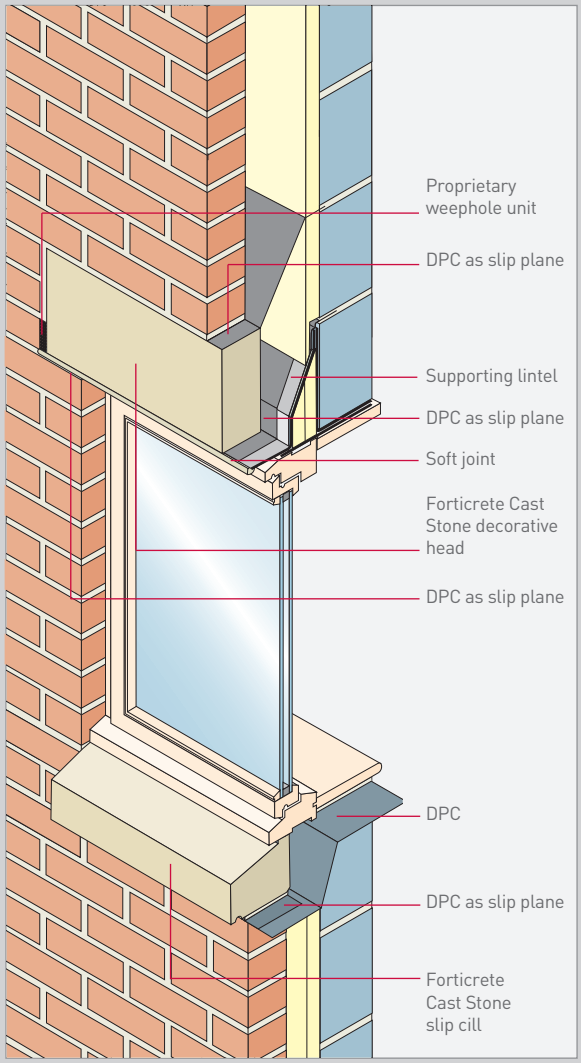
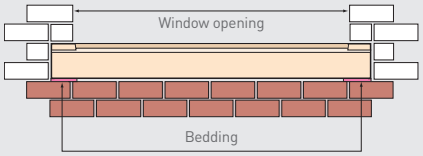


Fig 30: Stooled Cills should be bedded according to BS 8000 part 3 i.e. the ends only should be mortar bedded during construction, followed by the pointing of the remaining joint when the construction is completed.

Helpful hint



(dpc removed for clarity)

Fig.29 Cast Stone Decorative Head with relieving lintel detail

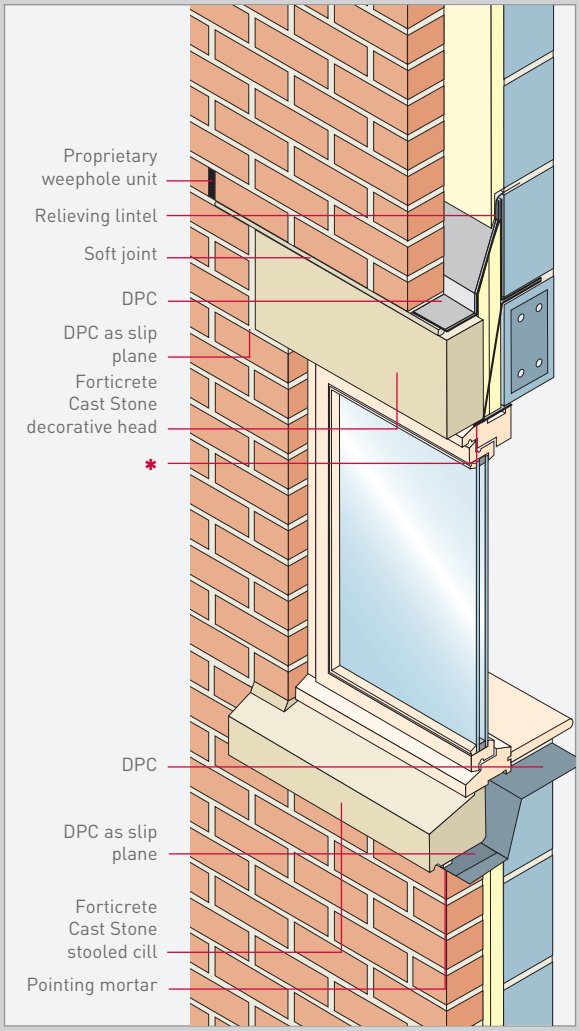
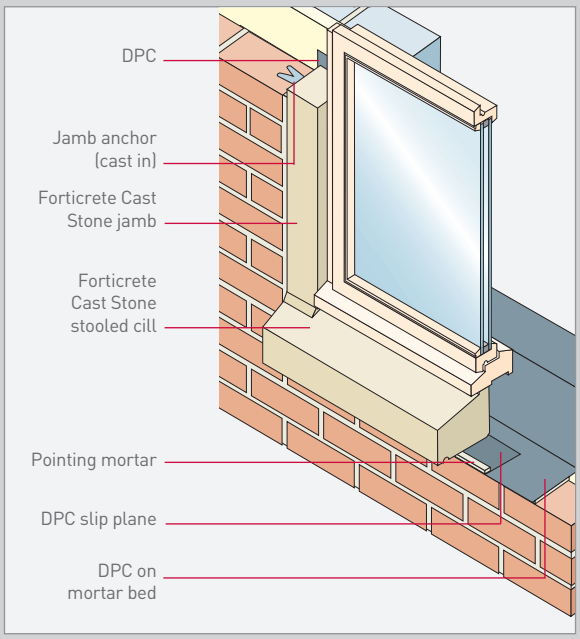


Fig.30 Cast Stone stooled cill detail



Structural performance

Hollow block dimensions and void percentages 390 x 190mm blocks

Fig.31

90 K3 21.93% Void

Infill concrete
0.0190m³/m²
(45.60kg/m²)

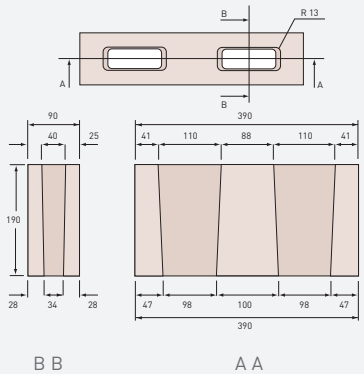


Fig.32

140 P3 43.95% Void

Infill concrete
0.0586m³/m²
(140.64kg/m²)

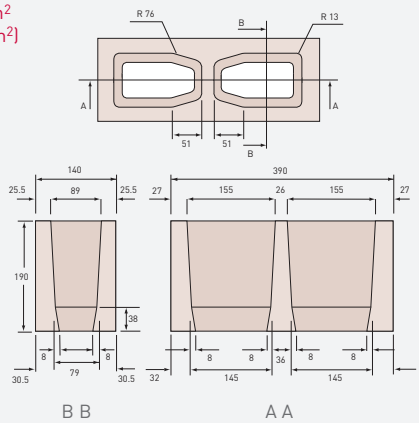
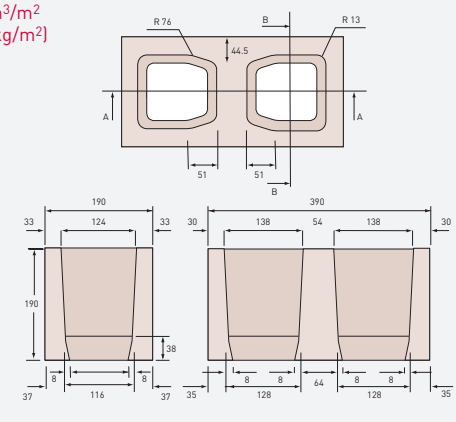


Fig.33

190 R3 41.39% Void

Infill concrete
0.0750m³/m²
(180.00kg/m²)



Hollow block dimensions and void percentages 440 x 215mm blocks

Fig.34

100 D3 27.26% Void

Infill concrete
0.0261m³/m²
(62.64kg/m²)

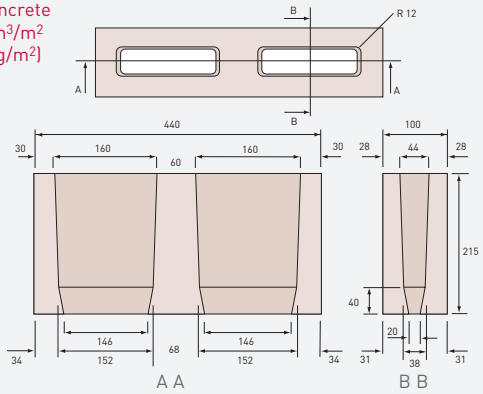


Fig.35

140 H3 34.00% Void

Infill concrete
0.0456m³/m²
(109.44kg/m²)

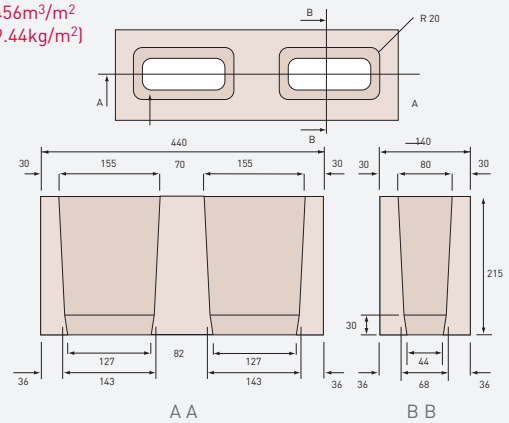
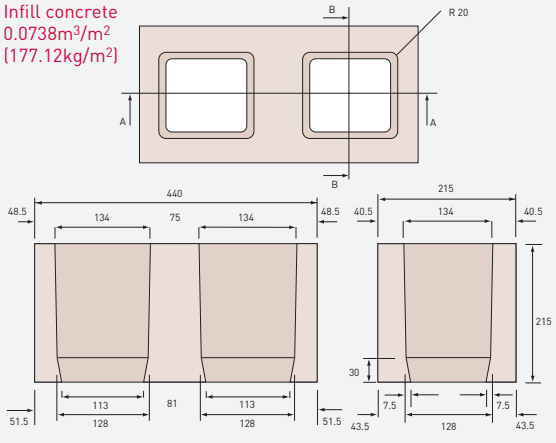


Fig.36

215 F3 35.5% Void

Infill concrete
0.0738m³/m²
(177.12kg/m²)



The stringent quality control and testing procedures applied to all Forticrete products allows the specifier confidence in applying the design criteria for safe and economical walling construction. These criteria include the strength of the masonry unit, its height/thickness ratio and the type of mortar used.

The dimensional characteristics of concrete blocks allow the construction of walls of very high strength and stability, to the extent that the characteristic compressive strength of a wall constructed from 7.3 N/mm^2 Forticrete blockwork 100mm thick can be equal to that using 20 N/mm^2 compressive strength bricks.

Tables 15-19 give limiting dimensions for internal non loadbearing panels

BS 5628: Part 3 gives guidance for non load bearing internal partitions not subject to wind load. The limiting dimensions and recommended block thickness shown in tables 15 to 19 are based on this Code of Practice. Consideration should be given to the following:

- the size and location of openings
- the use of the building, which may necessitate some wind load to be considered
- location of control joints
- fire resistance
- sound reduction

Comparing a 100mm block and a 215mm block (using table 15 - lateral restraint at base and ends only)

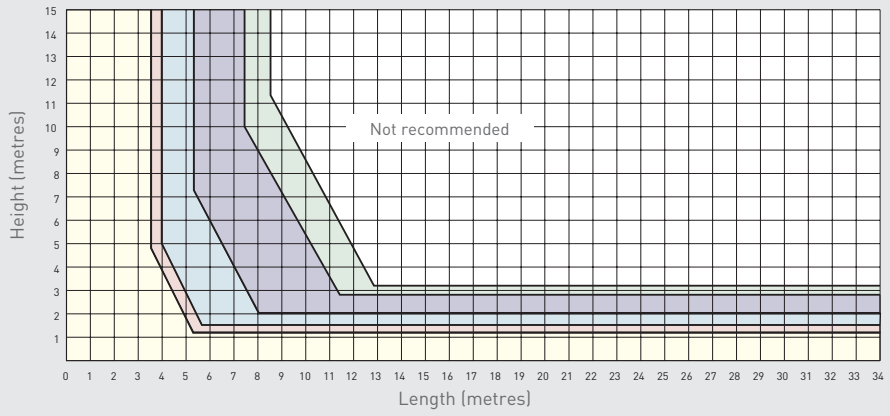
Example 1 a 100mm block wall 15m high may be 4.0m in length, whereas a 215mm block wall 15m high may be 8.5m in length.

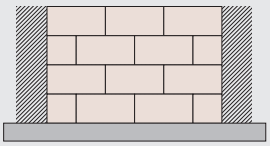
Example 2 a 100mm block wall 4m high may be 4.5m in length, whereas a 215mm block wall 4m high may be 12.5m in length.

Key: recommended thickness

90mm 100mm 140mm 190mm 215mm

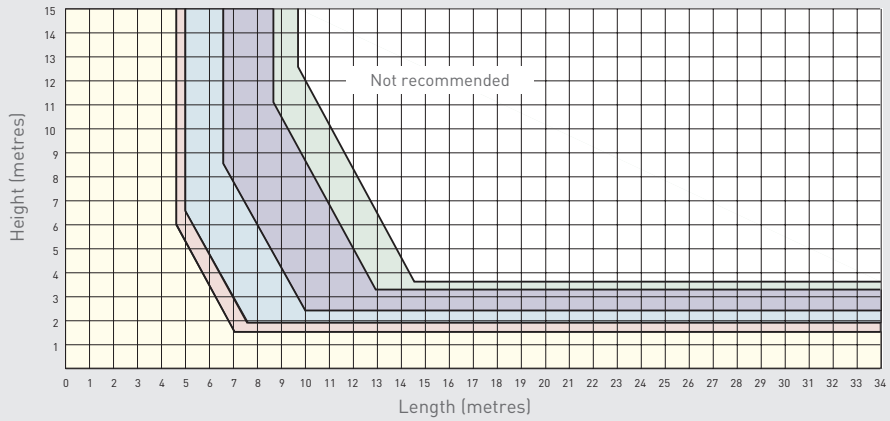
Table 15 Limiting dimensions

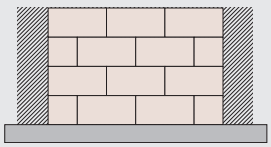




Fairface™ or painted walls having adequate lateral restraint at ends and base only.

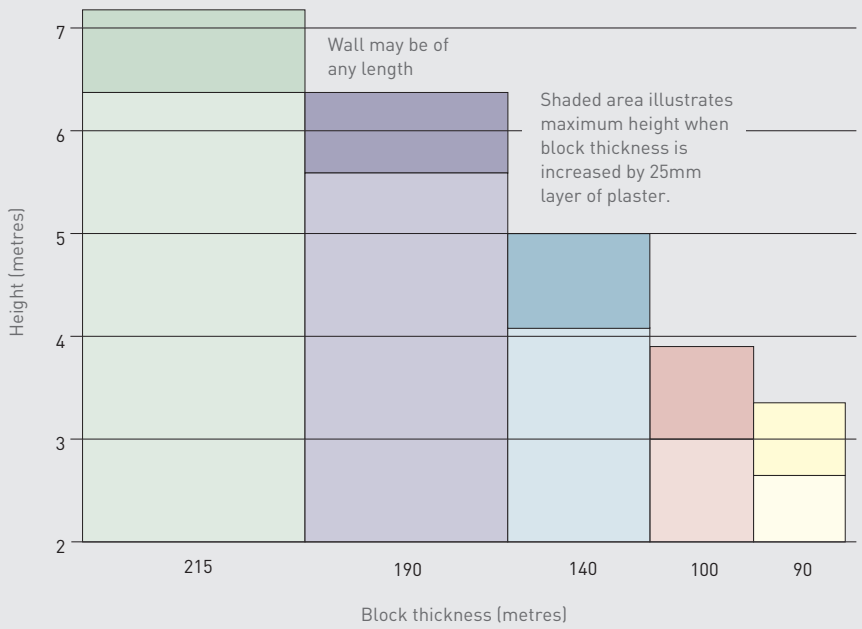
Table 16 Limiting dimensions

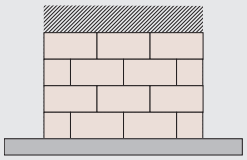




Walls having adequate lateral restraint at ends and base only and 13mm plaster both sides.

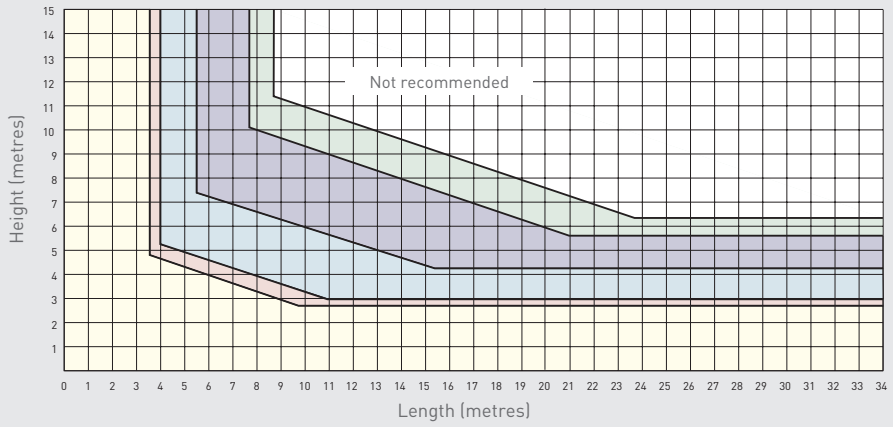
Table 17 Limiting dimensions

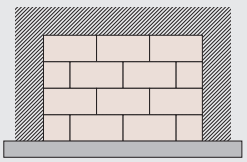




Walls having adequate lateral restraint at top and base only.

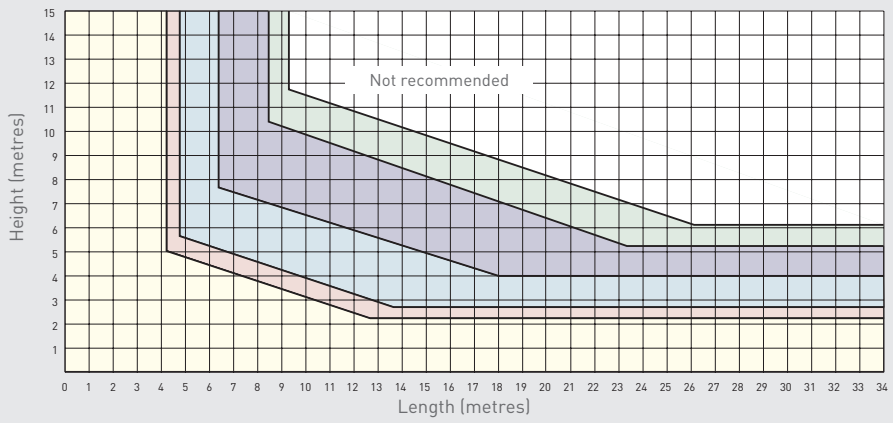
Table 18 Limiting dimensions

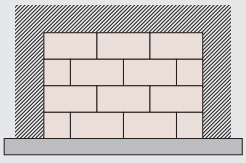




Walls having adequate lateral restraint at both ends, top and base.

Table 19 Limiting dimensions





Walls having adequate lateral restraint at both ends, top and base with 13mm plaster both sides.

Reinforced masonry lintels

Forticrete reinforced masonry lintels may be used to span openings in wall panels whilst maintaining the appearance of the block units. Tables 9, 10, 11 and 12 provide an indication of the loading that the lintels can sustain for a given span.

The lintels should be designed in accordance with

BS 5628 Part 2 'Code of Practice for the Use of Reinforced Masonry'. The tables have been developed applying the recommendations of this British Standard. The infill assumed is a C32/40 concrete with 10mm aggregate size.

The values given within the tables are for guidance only. The reinforcement quantities and the application of the lintel should be approved by the project Structural Engineer.

The safe working loads within the tables are assumed uniformly distributed and a partial factor of safety on loading of 1.50 has been adopted to convert the lintels' ultimate strength to the safe working loads indicated. The span of the lintel is typically the distance between the centre line of the bearings. To achieve durability for Exposure Situation E3 (BS 5628 Part 2), stainless steel reinforcement is required as indicated with an *.

Note: Spans indicated within the tables represent the structural span of the lintel only.

The end bearing of the lintels should be calculated paying due allowance to the compressive strength of the blockwork at the bearings and the anchorage requirements of the reinforcement at the bearings. In some cases the ends of the reinforcement may require a full hook to achieve the required bond length. For further advice on the design and application of Forticrete lintel units, refer to the Forticrete Technical Department.

Fig.37 Lintel Units

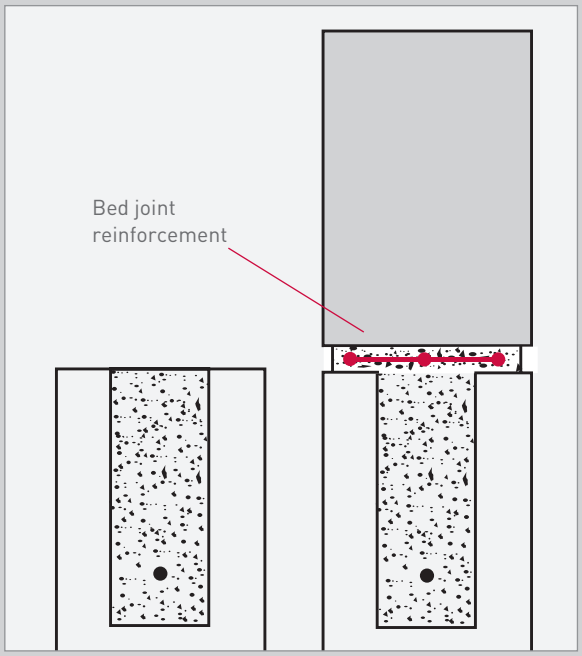


Table 20 390 X 190mm lintel unit with one course of masonry and bed joint reinforcement above

Lintel Width	Block Ref	Reinforcement (high yield)	ULS Moment (kNm)	ULS Shear (kN)	Safe UDL in kN/m for span (mm 600	900	1200	1500	1800	2100	2400
90	K28/K14	1H6*	3.2	5.1	11.3	7.6	5.7	4.5	3.8	3.2	2.8
		1H8*	5.4	5.3	11.8	7.9	5.9	4.7	3.9	3.4	2.9
		1H10*	7.8	5.5	12.2	8.1	6.1	4.9	4.1	3.5	3.1
140	P28/P14	1H6*	3.3	7.8	17.3	11.6	8.7	6.9	5.4	4.0	3.1
		1H8*	5.7	8	17.8	11.9	8.9	7.1	5.9	5.1	4.4
		1H10*	8.5	8.2	18.2	12.1	9.1	7.3	6.1	5.2	4.6
190	R28/R14	2H6	6.4	10.6	23.6	15.7	11.8	9.4	7.9	6.7	5.9
		2H8	10.7	10.9	24.2	16.1	12.1	9.7	8.1	6.9	6.1
		2H10	15.5	11.4	25.3	16.9	12.7	10.1	8.4	4.2	6.3

Table 21 390 X 190mm lintel unit only

Lintel Width	Block Ref	Reinforcement (high yield)	ULS Moment (kNm)	ULS Shear (kN)	Safe UDL in kN/m for span (mm 600	900	1200	1500	1800	2100
90	K28/K14	1H6*	1	1.9	4.2	2.8	2.1	1.7	1.4	1.2
		1H8*	1.3	2.1	4.7	3.1	2.3	1.9	1.6	1.3
		1H10*	1.3	2.3	5.1	3.4	2.6	2.0	1.7	1.5
140	P28/P14	1H6*	1.1	2.9	6.4	4.3	3.2	2.6	1.8	1.3
		1H8*	1.7	3.1	6.9	4.6	3.4	2.8	2.3	2.0
		1H10*	2	3.3	7.3	4.9	3.7	2.9	2.4	2.1
190	R28/R14	2H6	1.9	3.9	8.7	5.8	4.3	3.5	2.9	2.3
		2H8	2.4	4.3	9.6	6.4	4.8	3.8	3.2	2.7
		2H10	2.4	4.7	10.4	7.0	5.2	4.2	3.5	2.9

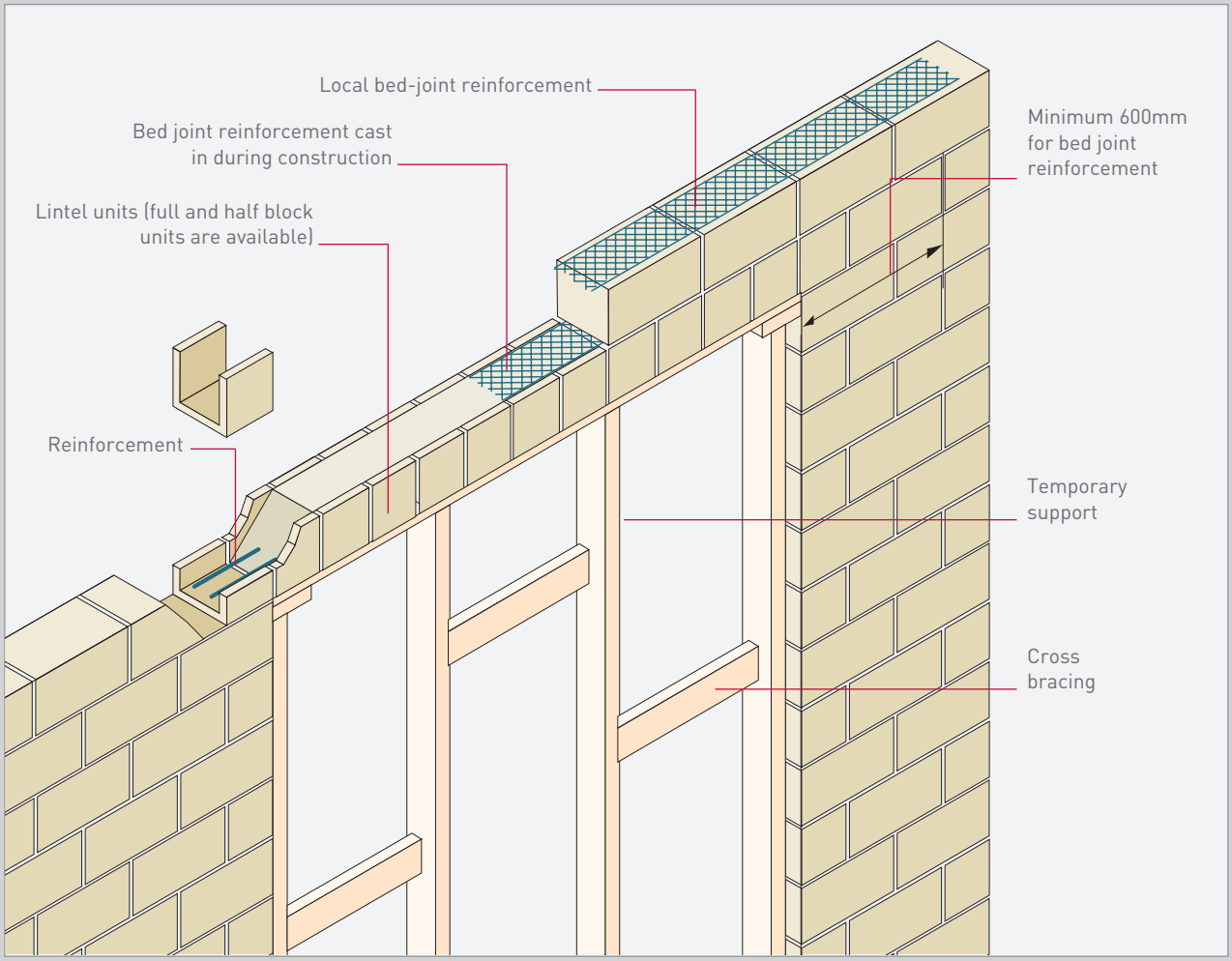
Table 22 440 x 215mm lintel unit with one course of masonry and bed joint reinforcement above

Lintel Width	Block Ref	Reinforcement (high yield)	ULS Moment (kNm)	ULS Shear (kN)	Safe UDL in kN/m for span (mm 600	900	1200	1500	1800	2100	2400
100	D28/D14	1H6*	3.8	6.5	14.4	9.6	7.2	5.8	4.8	4.1	3.5
		1H8*	6.6	6.7	14.9	9.9	7.4	6.0	5.0	4.3	3.7
		1H10*	9.6	6.9	15.3	10.2	7.7	6.1	5.1	4.4	3.8
140	H28/H14	1H6*	3.8	8.9	19.8	13.2	9.9	7.9	6.3	4.6	3.5
		1H8*	6.6	9	20.0	13.3	10.0	8.0	6.7	5.7	5.0
		1H10*	9.9	9.3	20.7	13.8	10.3	8.3	6.9	5.9	5.2
190	A28/A14	2H6	7.4	12.3	27.3	18.2	13.7	10.9	9.1	7.8	6.8
		2H8	12.3	12.7	28.2	18.8	14.1	11.3	9.4	8.1	7.1
		2H10	17.5	13.1	29.1	19.4	14.6	11.6	9.7	8.3	7.3
215	F28/F14	2H6	7.6	13.8	30.7	20.4	15.3	12.3	10.2	8.8	7.0
		2H8	12.9	14.1	31.3	20.9	15.7	12.5	10.4	9.0	7.8
		2H10	19.1	14.6	32.4	21.6	16.2	13.0	10.8	9.3	8.1

Table 23 440 X 215mm lintel unit only

Lintel Width	Block Ref	Reinforcement (high yield)	ULS Moment (kNm)	ULS Shear (kN)	Safe UDL in kN/m for span (mm 600	900	1200	1500	1800	2100	2400
100	D28/D14	1H6*	1.3	2.6	5.8	3.9	2.9	2.3	1.9	1.6	1.2
		1H8*	2	2.8	6.2	4.1	3.1	2.5	2.1	1.8	1.6
		1H10*	2.2	3	6.7	4.4	3.3	2.7	2.2	1.9	1.7
140	H28/H14	1H6*	1.3	3.4	7.6	5.0	3.8	3.0	2.1	1.6	1.2
		1H8*	2.1	3.5	7.8	5.2	3.9	3.1	2.6	2.2	1.9
		1H10*	2.7	3.7	8.2	5.5	4.1	3.3	2.7	2.3	2.1
190	A28/A14	2H6	2.3	4.8	10.7	7.1	5.3	4.3	3.6	2.8	2.1
		2H8	2.8	5.2	11.6	7.7	5.8	4.6	3.9	3.3	2.6
		2H10	2.8	5.6	12.4	8.3	6.2	5.0	4.1	3.4	2.6
215	F28/F14	2H6	2.5	5.3	11.8	7.9	5.9	4.7	3.9	3.0	2.3
		2H8	3.9	5.7	12.7	8.4	6.3	5.1	4.2	3.6	3.2
		2H10	4.2	6.1	13.6	9.0	6.8	5.4	4.5	3.9	3.4

Fig.38 Lintel Units



Cover for reinforcement

Note that BS 5628: Part 2 requires that cover for durability is measured from the insitu concrete only, whereas cover for fire resistance may include the thickness of the masonry lintel/bond beam units.

Sequence of construction

The sequence of trough lintel construction is as follows:

- Build the blockwork to the soffit height of the lintel
- Provide temporary propping to the lintel units
- Lay the lintel units with a 10mm wide x 20mm deep temporary spacer in each joint. Temporary joint spacers can be of any material which provides adequate retention of the concrete infill and can be removed for pointing (e.g. polystyrene)
- Fit plastic spacers to the reinforcement to ensure correct concrete cover
- Place reinforcement as appropriate
- Complete in-situ filling, tamping by hand
- After curing period strip propping, remove temporary joint spacers and point joints carefully to match surrounding blockwork

- The minimum specification for infill concrete is:
- Aggregate: 10mm (maximum)
- Concrete strength: C32/40 (minimum)
- Slump: 75mm (minimum)

Helpful hint

To achieve the figures in Tables 20 and 22, for a lintel unit with one course of masonry and bed joint reinforcement above, both the reinforcement and the course of masonry must be bedded into the concrete during construction, in a single operation, and left to cure.

Fire resistance

The fire resistance of the building fabric is in some ways the most important of all the performance properties in blockwork design, as it can affect more than just mere comfort. Provision has to be made not only for the stability of the structure but also for the safety of the occupants.

Table 24 Fire resistance for specification masonry, polished and standard masonry (with class 1 aggregates as BS 5628 part 3)

*Product code	Load-bearing cavity wall	Load-bearing single leaf wall	Non load-bearing cavity wall	Non load-bearing single leaf wall
K1	1 hr	1 hr	6 hrs	2 hrs
P1	6 hrs	2 hrs	6 hrs	4 hrs
R1	6 hrs	4 hrs	6 hrs	6 hrs
P2	4 hrs	2 hrs	6 hrs	3 hrs
K3	4 hrs	0.5 hrs	4 hrs	1 hrs
P3	4 hrs	2 hrs	6 hrs	3 hrs
R3	4 hrs	2 hrs	6 hrs	4 hrs
G1	1 hr	1 hr	6 hrs	2 hrs
D1	6 hrs	2 hrs	6 hrs	2 hrs
H1	6 hrs	3 hrs	6 hrs	4 hrs
A1	6 hrs	4 hrs	6 hrs	6 hrs
F1	6 hrs	6 hrs	6 hrs	6 hrs
D2	4 hrs	2 hrs	6 hrs	2 hrs
H2	4 hrs	2 hrs	6 hrs	3 hrs
D3	4 hrs	2 hrs	6 hrs	2 hrs
H3	4 hrs	2 hrs	6 hrs	3 hrs
A3	6 hrs	3 hrs	6 hrs	4 hrs
F3	4 hrs	2 hrs	6 hrs	4 hrs

* The product codes above have been taken from the Specification Masonry range. However, the fire ratings above can be taken as consistent for all Forticrete products with the same thickness as the code description, providing the product in question utilises a Class 1 Aggregate (Limestone). For further information on products utilising a Class 2 aggregate (Granite etc) please contact the Forticrete Technical Department.

Table 25 Fire resistance for Splitface™ masonry (with class 1 aggregate as BS 5628 part 3)

Product code	Load-bearing cavity wall	Load-bearing single leaf wall	Non load-bearing cavity wall	Non load-bearing single leaf wall
S30	1 hr	1 hr	6 hrs	2 hrs
S4	1 hr	1 hr	6 hrs	2 hrs
E54	1 hr	1 hr	6 hrs	2 hrs

Table 26 Fire resistance for Anstone® & Shearstone™ walling stone (with class 1 aggregate as BS 5628 part 3)

Product code	Load-bearing cavity wall	Load-bearing single leaf wall	Non load-bearing cavity wall	Non load-bearing single leaf wall
100	6 hrs	2 hrs	6 hrs	2 hrs
140	6 hrs	3 hrs	6 hrs	4 hrs
215	6 hrs	6 hrs	6 hrs	6 hrs

Helpful hint

The outer shell thickness of Forticrete trough lintels can be allowed for when determining fire resistance. Therefore the fire ratings can be assumed as the overall thickness of the lintel/bond-beam including concrete infill.

Table 27 Fire resistance table for regency ashlar cast stone (with class 1 aggregate as bs 5628 part 3)

Product code	Load-bearing cavity wall	Load-bearing single leaf wall	Non load-bearing cavity wall	Non load-bearing single leaf wall
A1	6 hrs	2 hrs	6 hrs	2 hrs
A3	6 hrs	4 hrs	6 hrs	6 hrs
A90	6 hrs	2 hrs	6 hrs	2 hrs
A4	6 hrs	4 hrs	6 hrs	6 hrs
A70	6 hrs	2 hrs	6 hrs	2 hrs
A60	6 hrs	2 hrs	6 hrs	2 hrs
A80	6 hrs	2 hrs	6 hrs	2 hrs

References and bibliography

Mandatory requirements

The Building Regulations 2000

The Building Standards (Scotland) Regulations 1990 (Amended 2001)

Construction Design & Management (CDM) Regulations 1994

Construction - (Health, Safety & Welfare) Regulations 1996

Environmental Waste Act 1997

Official documents

Manual to the Building Regulations 2000

Approved documents

A Structure

B Fire

C Site Preparation and Resistance to Moisture

D Toxic Substances

E Resistance to the Passage of Sound

F Ventilation

L Conservation of Fuel and Power

M Access & facilities for disabled people

Approved Document to Support Regulation 7 (Materials & Workmanship)

British Standard references

BS 476:	Fire tests on building materials and structures
BS 1217:	Specification for cast stone
BS 1243:	Specification for metal ties for cavity wall construction
DD140:	Wall ties
BS 1881:	Testing concrete
BS 5250:	Code of practice for control of condensation in buildings
BS 5262:	Code of practice for external renderings
BS 5492:	Code of practice for internal plastering
BS 5606:	Guide to accuracy in building
BS 5628:	Code of practice for use of masonry (Parts 1,2 and 3)
BS 5642:	Cills and copings
BS 5977:	Lintels
BS EN 771-3:2003:	Specification for aggregate concrete masonry units
BS EN 771-5:2003:	Specification for manufactured stone masonry units
BS 6399:	Loading for buildings
BS 6457:	Specification for reconstructed stone masonry units
BS 8000:	Workmanship on Building Sites (Part 3)
BS 8110:	Structural use of concrete
BS EN ISO 9000:	Quality management and quality assurance standards
BS EN ISO 9001:2000:	Quality systems. Model for quality assurance in production, installation and servicing

Other publications

Chartered Institute of Building and Services Engineers -
CIBSE Guide A

Construction Fixings Association -
Fixings for brickwork and blockwork

Concrete Block Association -
Safe Handling and Use of Concrete Blocks

Concrete Block Association -
Aggregate Concrete Blocks for Use in Sulphate Soil Conditions

Health and Safety Committee -
HSE Construction Sheet No 37 (Handling of Building Blocks)

Notes

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www.forticrete.co.uk

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