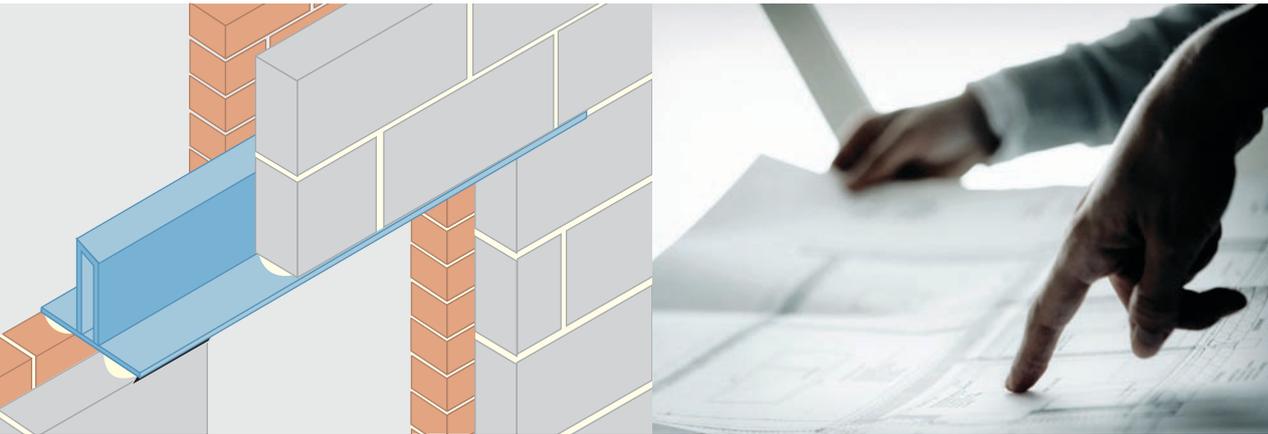


Designing with Aircrete



build with ease



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Aircrete /aerkri:t/ noun., adj.

1. autoclaved, aerated concrete (AAC) **2.** (cel)lular (con)crete (CELCON). One of the lightest forms of concrete with structural, thermal, sound, fire and freeze/thaw properties, extensively used in Europe where known as 'gasbeton'. Used in the UK since the 1950s; today known as 'aircrete'. Comprises pulverised fuel ash (PFA), sand, cement, aluminium powder, lime and water. Used as blocks in a range of thicknesses and face formats for internal and external walls above and below dpc and as infill in beam and block floors; used as a material for reinforced floor elements.



Introduction

This guide has been carefully designed to help architects and specifiers achieve the most efficient designs using H+H UK products, whether for low-rise housing or multi storey buildings.

The contents include detailed information about the structural, acoustic and thermal properties of H+H aircrete blocks, together with their freeze/thaw characteristics, moisture and fire resistance and sulfate resistance below ground level.

Also included is guidance on using aircrete in cavity, solid, internal, party and foundation walls, accommodating movement, the positioning of joist hangers, restraining straps, wall ties and lintels and using aircrete with dissimilar materials.

All H+H aircrete comply with:

- European product standard BS EN771-4 for aircrete masonry units

And can be used for design complying with:

- Building Regulations' Approved Document 'A'
- Building Regulations Part E (including Robust Details compliance)
- Masonry design codes BS 5628-1
- Masonry design codes BS EN 1996 series

All H+H aircrete products are strong, light, easy to work with and can be finished with render, tile hanging or decorative cladding. They are available in Standard, Solar, High Strength and Super Strength grades, all of which comply with BS EN 771-4. Standard, High Strength and Super Strength Grades blocks are principally for wall constructions above and below DPC (there are also Foundation Blocks for solid wall constructions below DPC). Solar Grade offers enhanced thermal performance and is principally used

in inner skins of external cavity and solid walls.

Most blocks are available in a wide range of thicknesses from 100mm up to 300mm and have the following face dimensions:

440 x 215mm for Celcon Blocks in all grades,

610 x 215mm for Celcon Plus Blocks in all grades,

610 x 270mm for Jumbo Blocks in all grades.

610 x 375mm for MultiPlate Blocks in all grades.

440 x 215mm Foundation Blocks in Standard, High and Super strength grades.

For more information, please contact our Technical Department on 01732 880580 or our Sales team on 01732 886444.



A range of detail drawings is available in CAD and in PDF format on our website www.hhcelcon.co.uk





Structural Design

Design of Low Rise Housing

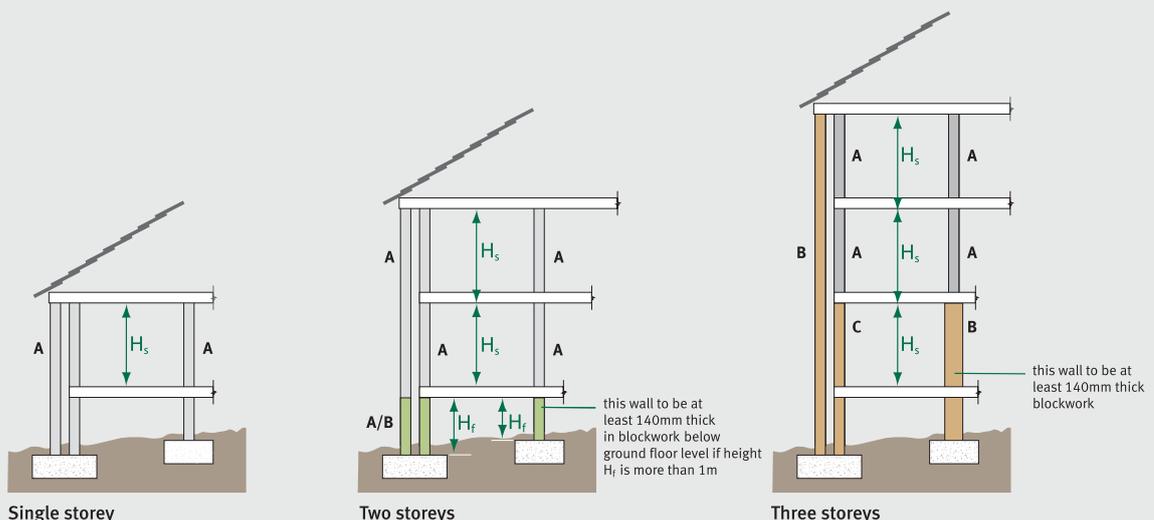
The Building Regulations Approved Document 'A' for England and Wales, Section 1 to the Technical Handbook to the Building (Scotland) Regulations and BS 8103-2 (Structural design of low rise buildings – Part 2 Code of Practice for Masonry Walls of housing) set out simple design guidance for low rise housing. These give block strength requirements for certain types of buildings in accordance with European Standards. All H+H products meet the requirements for low-rise housing and the Approved Document 'A'.

The structural requirements of Approved Document 'A' are summarised (drawing 1), where, for two storey housing the minimum strength for blocks is 2.9N/mm^2 and for three storey housing, the lowest storey is 7.3N/mm^2 , whilst 2.9N/mm^2 is retained at the two upper levels. Thus, all grades of H+H aircrete can be used where 2.9N/mm^2 blocks are shown (drawing 1) and blocks from the higher strength grades range can be used at the lower storey of a three-storey building. It should be remembered that structural calculations can still be carried out, which may lead to a more economic solution.

Declared Compressive Strength Values of H+H aircrete

	Solar Grade	Standard Grade	High Strength Grade	Super Strength Grade
BS EN 771-4	2.9N/mm^2	3.6N/mm^2	7.3N/mm^2	8.7N/mm^2

1





Designing with Higher Strength blockwork

The highest strength required for blocks in BS 8103-2 and in Approved Document A (structural guidance) to the Building Regulations, is 7.3N/mm^2 for three storey dwellings. Where the layout of the dwelling is outside this guidance or it is greater than three storeys, a structural design calculation is necessary.

When designing in accordance with BS 5628-1 or Eurocode 6, account will be taken of a number of factors. To calculate how much load any given wall can take, the following are considered:

- 1 The basic strength of the masonry (f_k), which will depend on the block size, block strength and mortar strength.
- 2 The material safety factor and the quality control of the blocks used as well as the site workmanship.
- 3 The wall configuration, (which is independent of the block type).

Material safety factor

H+H Higher Strength range qualify for category 1 'Manufacturing Control'. The material safety factor will vary according to the level of control and testing in manufacturers' factories. H+H's Quality Assurance System means we test at more frequent intervals and Higher Strength blocks qualify for category 1 'Manufacturing Control' classification to BS EN 771-4. Consequently, with this greater confidence the designer, by using H+H blocks, can reduce the level of safety for design in accordance with the design standard.

The characteristic compressive strength of masonry bonded with thin layer mortar may be taken as the value given for mortar strength class M12 (mortar designation(i)) in BS5628-1.

Guidance on structural design using Eurocode 6 can be found at www.eurocode6.org.

Key: Min strength

A 2.9N/mm^2 where H_s is 2.7m max

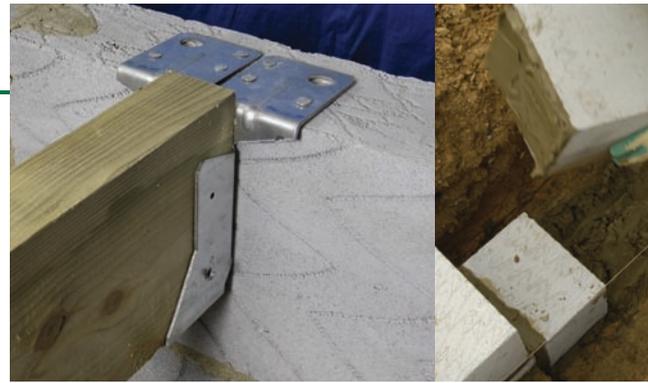
A/B H_f less than or equal to 1m – 2.9N/mm^2
 H_f greater than 1m – 7.3N/mm^2

B & C 7.3N/mm^2

Notes

1. If H_s is not more than 2.7m, the compressive strength of blocks used in the wall should be as indicated by the key.
2. If H_s is more than 2.7m, the compressive strength of blocks used in the wall should be at least Condition B, or as indicated by the key whichever is greater.
3. If the external wall is solid construction, the blocks should have a compressive strength of at least that shown for the internal leaf of a cavity wall in the same position.
4. Timber roof construction, 12m max span.
5. Timber or concrete floor, 6m max span.
6. Wall lengths 12m max.

This diagram is taken from Figure 12 and Table 5 of BS 8103-2.



Structural Design continued

Restraint and connections

Walls should be adequately restrained at the level of intermediate floors, and at the roof. Detailed guidance is contained in Building Regulations Approval Document A, Section 1 of the Technical Handbook to Building (Scotland) Regulations, BS8103-1, Eurocode 6 and PD6697:2010.

Where floor joists bear onto the supporting walls and joist hangers have not been specified, then cut aircrete or H+H Coursing Units should be used to infill between the joists. All H+H blocks can easily be cut to size on site.

Where joists run parallel to the wall, the three joists nearest the wall should be connected to it by metal restraining straps, 30 x 5mm in cross section, and located at maximum 2m centres. These straps should have an anchorage turn-down at the wall face of at least 100mm, and there should be diagonal strutting between the three joists. In order that the restraining straps are able to act in compression, as well as in tension, there should also be adequate packing fixed between the wall and the first joist (drawing 2).

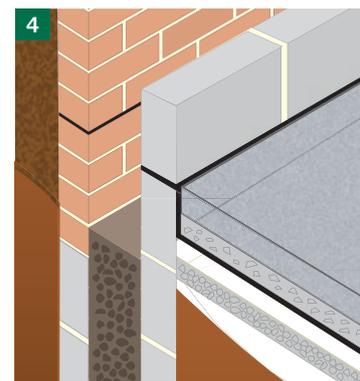
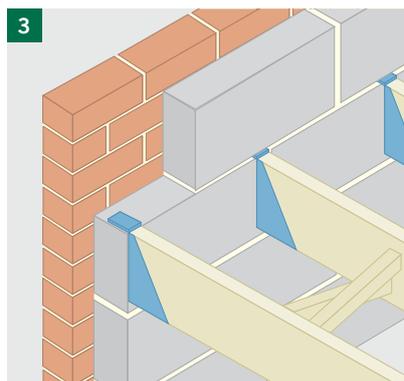
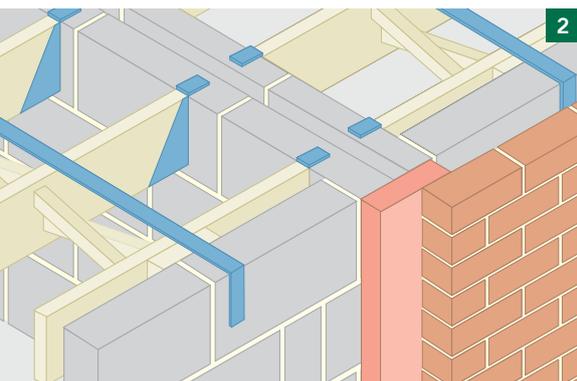
Joist hangers

Joist hangers should comply with BS EN 845-1, and should be clearly marked on the underside of the joist flange with the minimum crushing strength of the block for which they are intended to be used. The type and size of hanger must be selected to suit the span and dimensions of the joist to be supported. Suitable proprietary types are available to suit all aircrete strengths.

When hangers are to be built in, care should be taken to ensure their back plates are tight up against the surface of the wall (drawing 3). Also in accordance with the hanger manufacturer's recommendations, the masonry flanges must be held in position by a sufficient height of masonry above. Restraint type hangers should be provided every 2m OR the joists strapped as in BS 8103-1 at a maximum of 2m centres. The above flange masonry should be allowed to mature adequately before the hangers are loaded.

For roof and/or wall connections at gables and at separating walls, restraint-type straps of the same specification, and installed in the same manner as described previously, should be used. These straps should be positioned at maximum 2m centres at rafter (gable verge line) level, and at truss tie (ceiling) level.

For further guidance see Section 1c of Approved Document A to the Building Regulations (England & Wales), and BS 8103-2.





Foundation Blocks

Cavity foundations (drawings 4 and 5)

H+H aircrete can be used for both the internal and external leaves of cavity foundations.

Solid foundations (drawings 6 and 7)

Foundation Blocks of 215mm thickness and upwards can be used for solid foundations. The foundation blocks used should be at least the thickness of the wall it supports.

Omission of mortar from the vertical cross-joints (perpends) in solid foundations

A wall below ground level which is backfilled both sides is not subject to any of the lateral loads which could apply above ground, and may be laid with mortared horizontal bed joints and then simply butted together. This is confirmed in the Building Research Establishment (BRE) Information Paper (IP) 7/05; "...for below-ground construction – unless the masonry forms a retaining wall or basement walls – plain-ended units can be used with unfilled vertical joints so long as the units are built with their ends closely butted together to stop the passage of vermin."

Frost resistance

H+H Foundation Blocks have exceptionally good frost resistance. BBA appraisal includes assessment of the resistance of the blocks to the freeze/thaw conditions likely to occur below ground level (BBA method of assessment and test, MOAT 12).

Where external finishes, such as render, are terminated at DPC, exposed aircrete should be protected using bituminous paint, suitable for external use, or similar surface coating, applied from 150mm below soil level up to DPC (drawings 6 and 7)

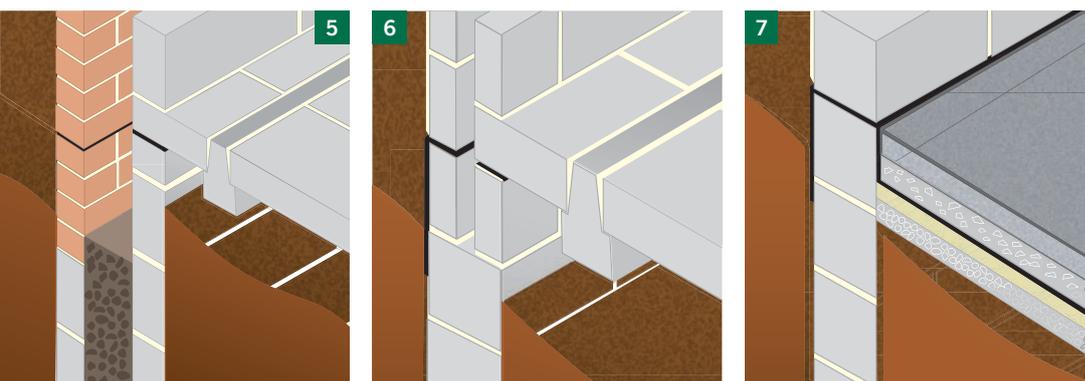
Soil conditions

The raw materials used in the production of H+H Foundation Blocks give them their excellent resistance to sulfate attack and frost damage, thus making them ideal for use below ground in soil conditions unsuitable for many other types of masonry. Sulfates in clay soils and associated ground water are defined in BRE Special Digest 1, 2005 table 2. H+H aircrete can be used in classes up to and including DS4. BBA certificate 01/3816 confirms that for Class DS5 or contaminated sites tanking is necessary. Building control should be able to advise on local soil conditions and whether the soil/ground water conditions require further advice.

Improved thermal insulation

H+H Foundation Blocks below ground will reduce the heat loss from ground floors, which is most critical at the perimeter.

The use of Foundation Blocks significantly improves the linear thermal bridging at the floor junction.



External Walls



Solid walls

Due to aircrete's closed cell structure it has an excellent resistance to water penetration, therefore enabling it to be used in the construction of solid external walls. This is recognised in:

- Approved Document C.
- PD6697 where for conditions up to and including severe exposure (exposure zone 3) rendered 215mm H+H aircrete is acceptable where similar walls of brick or dense concrete masonry would need to be thicker.
- This is also confirmed in our BBA Certificate 01/3816.

Cavity walls

In an external cavity wall construction, each leaf predominately meets specific requirements. The external leaf protects the structure from the penetration of moisture, whilst the inner leaf provides the main structural support of the building. H+H aircrete fulfils both of these requirements.

Loadbearing

For the loadbearing inner leaf aircrete offers a choice of solutions and strengths:

- Two storey housing – Solar Grade 2.9N/mm² and Standard Grade 3.6N/mm² grade blocks are normally more than adequate to meet structural requirements.
- Multi-storey construction walls or piers under high vertical loads – Higher Strength blocks may be required.

For further information, see drawing 1 page 2.

Wall ties

Wall ties should be adequately stiff yet sufficiently flexible to allow some relative movement between the two leaves. The type of tie will depend on whether the cavity width is up to or over 100mm. Ties should conform to BS EN 845-1. For further advice contact our Technical Services Department.

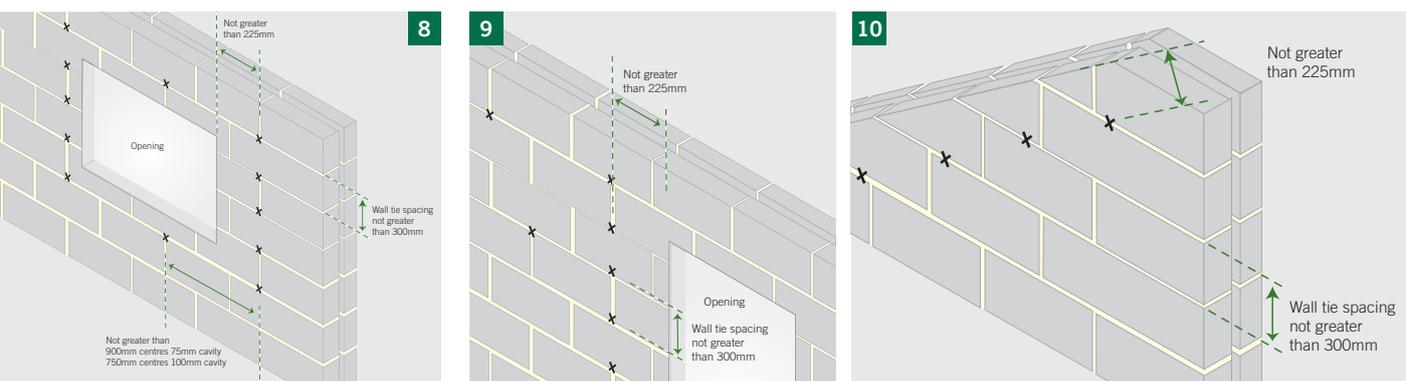
In external cavity walls, ties should have a minimum embedment of 50mm into each leaf. For walls in which both leaves are 90mm or thicker, the ties should be at a maximum spacing of 900mm horizontally and 450mm vertically, (density of 2.5 ties/m²), and the ties should be evenly distributed over the wall area, normally in a staggered pattern (drawing 8).

Additional ties should be provided in the following situations:

- Within 225mm of the vertical edge of all window and door openings (drawings 8 + 9).
- At vertical unreturned edges, including movement joints.
- At sloping unreturned edges, such as at the roof verge (drawing 10).
- At narrow piers.

See Eurocode 6 and PD6697 for further details.

Where Sound Insulation considerations apply, eg. Separating and Flanking Walls, contact our Technical Services Department for further information.



* Compressive strength values quoted are to the European Standard BS EN 771-4.



Lintels

Blockwork should be set out to ensure that, wherever possible, all lintels bear upon full blocks, not onto a short length of cut block (Eurocode 6). The bearing should normally be at least 150mm in length.

Where stresses under lintel bearings are likely to exceed permissible values, for example, where there are large concentrated loads, concrete spreaders or padstones should be incorporated (drawing 11) also see Eurocode 6.

In accordance with general good practice, the provision of a slip plane between the lintel and the bearing should be considered (see under 'Slip Plane' page 11).

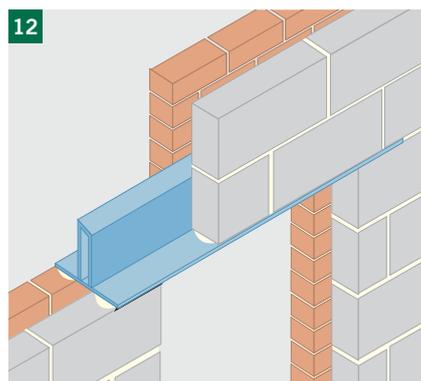
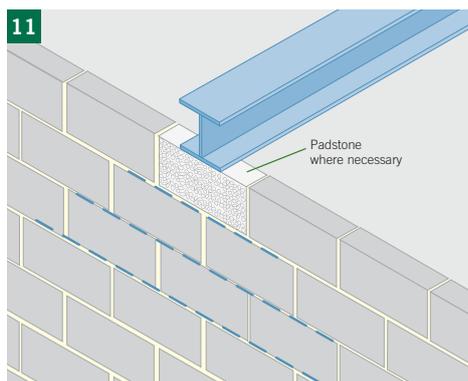
Cold bridging at openings can be minimised by the use of lintels that allow the blocks to be continued across the opening (drawing 12). This also facilitates easy fixing for battens and rails.

Lintels for Solid Walls

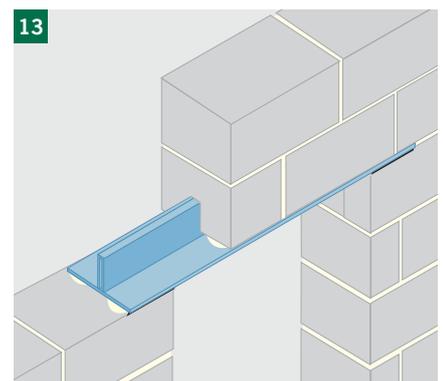
We recommend 'combined' type lintels with a 100mm block either side. Alternatively, aircrete can easily be chased-out on site to accommodate proprietary metal lintels (drawing 13).

Lintels for internal partition walls

Light-duty lintels may be used when opening widths and loadings permit.



For clarity additional insulation not shown



For clarity additional insulation not shown

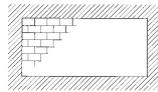


Internal Walls

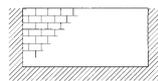
Deflection head

Where a non-loadbearing internal wall is below a floor which is likely to experience deflection or thermal movement, provision should be made at the head of the wall to avoid such movement placing a load on the wall (drawing 14).

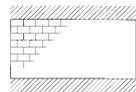
Limiting dimensions for internal non-loadbearing walls



Walls restrained** at both ends and top.



Walls restrained** at both ends.



Walls restrained** at top.

Minimum Block Thickness (mm)*

Height (m)	Length (m)						
	3	4	5	6	7	8	9
2.4	75	75	75	75	75	75	75
2.7	75	75	75	75	75	75	75
3.0	75	75	75	75	75	75	75
3.3	75	75	75	75	75	75	75
4.0	75	75	75	75	75	75	100
6.0	75	100	100	100	100	140	140

Minimum Block Thickness (mm)*

Height (m)	Length (m)						
	3	4	5	6	7	8	9
2.4	75	75	75	100	100	140	140
2.7	75	75	75	100	100	140	140
3.0	75	75	75	100	140	140	140
3.3	75	75	75	100	140	140	140
4.0	75	75	100	100	140	140	140
6.0	75	100	100	140	140	140	200

Maximum height (m) for panel of any length

wall block thickness (mm)	plastered	unplastered
100	3.8	3.0
140	5.0	4.2
150	5.3	4.5
215	7.3	6.4

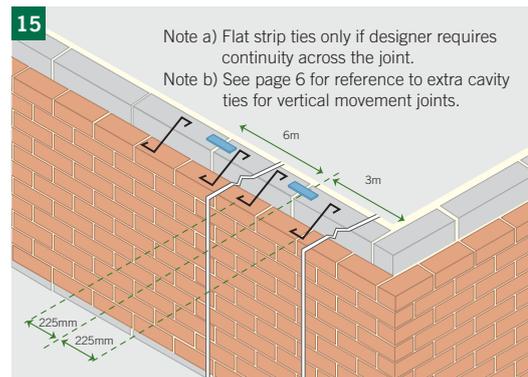
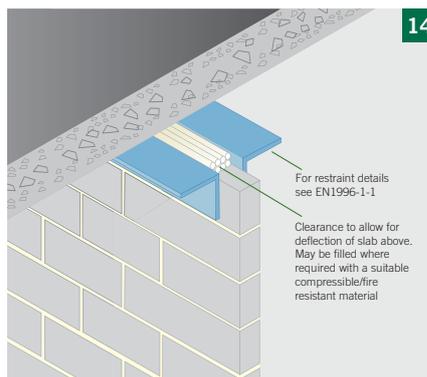
These figures have been developed by H+H and calculated in accordance with EN1996-1-1 (Annex F).

* if unplastered, increase block thickness required by 25mm.

** Restraint: See EN1996-1-1 and Appendix C for restraint details.

For further information please contact the H+H Technical Department. Consideration should be given where appropriate to the following factors:

- the effects of architectural features such as openings, chases etc.
- the accommodation of movement.
- any temporary support which may be required prior to plastering.





Movement Control

Accommodation of movement

The risk of cracking in walls due to drying shrinkage and/or thermal movement can never be totally eliminated from any type of masonry and provisions such as movement joints and bed joint reinforcement (BJR) only act to reduce the risk of cracking. Similarly, when they are not used, the risk increases.

For all masonry work movement joints and/or BJR may need to be provided. These should be incorporated at the design stage and although PD 6697 (Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2) states that movement joints are not normally provided in internal walls of low rise housing (unless significantly long runs of wall are involved), the risk of cracking does however increase where:

- wall panels are shallow (length exceeds three times the height),
- lengths approach or exceed 6m,
- the ends of the wall are bonded-in,
- the mortar is over strong, or
- the work gets over-wet during construction.

General considerations

In the design of walls, movement should be accommodated by following the recommendations of BS EN 1996-2 and PD 6697, which can be summarised as follows.

With the exception of solid external walls or outer leaves, movement joints are not normally provided in drylined constructions as any cracking caused by drying shrinkage is not normally of any structural significance and will not be visible. However, where wall lengths exceed 6m, the following should be considered.

H+H aircrete block walls in excess of 6m should be designed as a series of panels separated by movement joints at maximum 6m centres. Alternatively, the wall panel can be reinforced either negating the need for or increasing the distance between Movement Joints. Where the masonry is continuous at an internal or external corner, the first joint from the corner should be positioned within 3m of the corner (drawing 15).

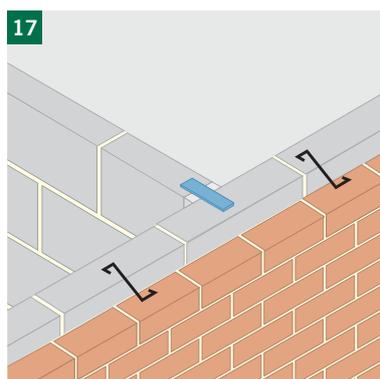
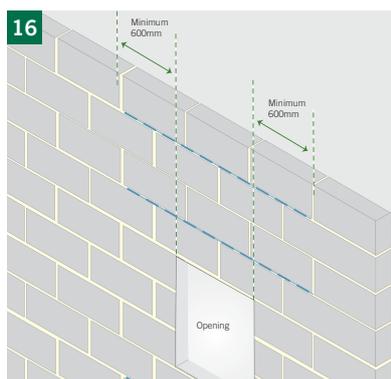
Other areas needing particular attention are:

- Openings, or changes of wall height, thickness or direction.

- Shallow walls (where the length of a panel exceeds three times its height).
- Normally dissimilar materials should not be bonded together but should be separated by forming a vertical movement joint or by incorporating a horizontal slip plane.

Additionally, the following points of good practice should always be observed.

- Overstrong mortars should be avoided. Generally, a Class M4 (Designation (iii) mix, (1:1:6 cement:lime:sand) is the strongest that should be used above DPC.
- All blocks (as with other materials) should be protected, i.e. the normal good practice of:
 - covering the tops of partly-built walls;
 - at the end of the day's work;
 - during wet weather;
 - once the wall has been completed but before the shell is weather-tight, thus preventing saturation of the wall. This will ensure minimal drying out movement.
- Use of bed joint reinforcement above and below openings (see section on bed joint reinforcement below) (drawing 16).



Movement Control continued



Location of movement joints

Where movement joints are required they are best positioned:

- At intersecting walls and columns (drawing 17 page 9).
- At changes of wall height or thickness, or where chases occur.
- To coincide with movement joints in adjacent elements of structure (floor or roof).
- At junctions of dissimilar materials.
- Where architectural or structural features create a 'weak' section ie. at a junction with a structural column (drawings 18 + 19).

Note: Movement joints are not normally required below DPC level.

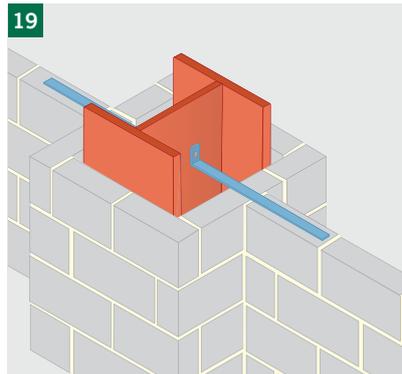
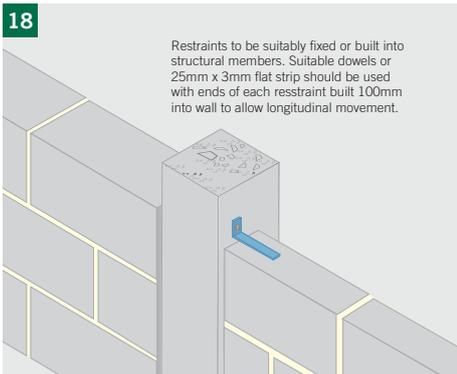
Construction of movement joints

Straight, un-bonded vertical joints are the most common type of movement joint, and can be formed by butting the H+H aircrete blocks against both sides of a strip of rigid or flexible filler (such as polyethylene foam). A flexible sealant may be applied as required to maintain air tightness (drawing 15).

Movement joints should normally be continuous through all surface finishes. Stop beads can be used to end the finish at either one or both edges of the joint. Alternatively, a proprietary type of cover strip can be used, or an architrave can be pinned to one edge of the joint (drawing 20).

Where design stability considerations require continuity across the joint, proprietary movement ties should be set in vertical centres not exceeding 450mm. These should be set parallel to the plane of the wall. For traditional mortar joints proprietary types of slip-ties with one end sleeved are available. Wall ties or ties with anchored ends, for example fish-tail ties, should not be used since this would result in bonding of the joint, which would prevent accommodation of movement.

Movement ties specifically for thin joint blockwork are designed to fit into a 10mm wide movement joint and flex to allow for movement.





Bed joint reinforcement

The use of bed joint reinforcement can reduce the risk of cracking caused by a concentration of stresses. Its use can also be extended so that where a movement joint would otherwise be advisable, but not desirable, e.g. where aesthetic or practical reasons do not allow, the wall panel may be reinforced through its length (drawing 21). This applies particularly to separating walls which should not contain a movement joint. For specific advice contact our Technical Department.

Reinforcement laid in horizontal bed joints is particularly appropriate for areas of high stress, for example at openings and under concentrated imposed loads. Any such reinforcement should be of adequate length to distribute stresses to nearby movement joints or into adjacent areas of blockwork, extending, for example, at least 600mm into the adjacent blockwork each side of an opening (drawing 16).

Where a wall is supported by a floor or beam, which itself may be subject to deflection, the first two courses of the wall should be reinforced (drawing 22). In all cases, masonry-grade reinforcement should be used (plastering grade types are not suitable) and it should be installed in accordance with the manufacturers recommendations.

In recognition of the fact that Thin Joint mortar is stronger than a traditional 1:1:6 (or its equivalent) mix, our recommendations for Thin Joint constructions is that bed joint reinforcement be generally included in every second course.

Wall junctions

Normally walls should be bonded at returns and junctions unless a movement joint is required. However, where a section of wall has to be constructed after other work has been completed, the bonding can be replaced by a straight joint provided ties are built-in across the joint. This method of jointing is also preferable to bonding in situations where differential movement is likely to occur, for example, where sections of wall are constructed on different foundations.

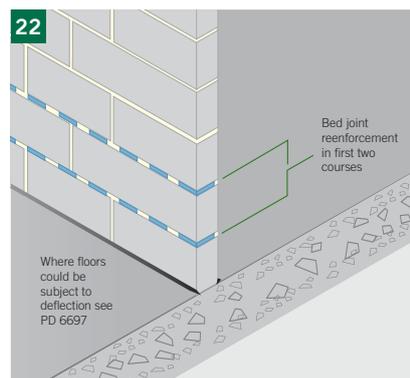
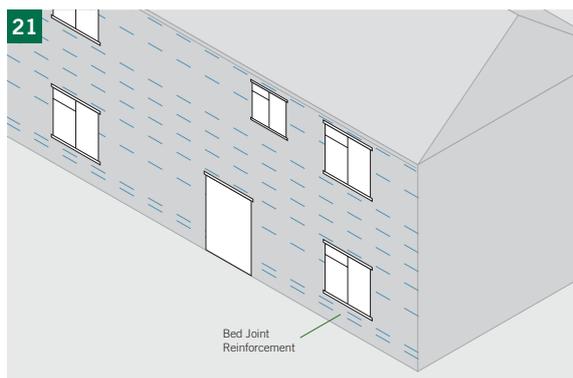
Dissimilar materials

Where H+H aircrete blocks abut other materials (e.g. brickwork, steel etc.), differential movement can occur. Where dissimilar materials bear onto H+H aircrete blocks (e.g. cast in-situ concrete slabs, precast concrete beams or floor units, and lintels), the use of a separating layer or 'slip plane' at the bearing or bed joint reinforcement should be considered.

Slip plane

A slip plane is a sliding joint (a typical example would be a smooth DPC type material or building grade polythene) used to separate parts of the structure having different movement.

For example, the combined effects of drying shrinkage and the thermal movement of a concrete roof slab cast directly onto a block wall could cause cracking in the upper courses of the wall. The use of a slip plane between the top of the wall and the slab would help to prevent this. The most common use for slip planes is under the bearings of long lintels, precast concrete beams and in-situ concrete slabs.





Fire resistance

Fire resistance

All H+H products have excellent resistance to fire. Extensive use has proved their capability in real fires, not only as fire-break walls, but also as protective cladding for other forms of construction, such as steel frame.

BBA certificate 01-3816 confirms that H+H aircrete is classified as non combustible (as defined in the National Building Regulations) and have a reaction to fire of Class A1 to BS EN 13501-1.1.

Fire resistance ratings

A 100mm H+H aircrete block wall is fire resistant up to 4 hours in non loadbearing situations and 2 hours (Standard or Higher Strength Grades) in loadbearing situations.

Where H+H aircrete is used in cavity wall constructions, the thicknesses shown below may be reduced. Contact the Technical Services Department for further advice.

Designers may also use BS EN 1996-1-2 EN1996-1-2 (Eurocode 6: Part 1-2).

Fire resistance – solid partition walls

Aircrete offers excellent fire resistance. A solid partition wall means there is no build up of combustible material in the cavity, which can generate a flue effect in stud partitions.

Fire resistance – Beam and Block floors

When finished with 13mm plasterboard, beam and block floor systems can provide one hour's fire resistance, meeting the requirements of the Building Regulations.

Examples of Fire resistance from BS EN 1996-1-2

	Minimum block Thickness excluding finishes*							
	Loadbearing wall				Non-Loadbearing wall			
	up to				up to			
Fire resistance (hours)	1	2	3	4	1	2	3	4
Solar Grade range (mm)	100	125	150	150	75	75	100	100
Standard and Higher Strength Grade ranges (mm)	100	100	140	150	75	75	75	100

* Block Sizes indicated may not be stocked items.

For further information, to check our most up-to-date product range or to find your nearest stocking merchant, please visit our website www.hhcelcon.co.uk or contact the following departments:

Sales

For sales enquiries or to find your local stockist please contact

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Fax: +44 (0)1732 887013

Technical

For technical enquiries please contact

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