

Concrete Blocks

This Easy Guide on concrete blocks aims to provide an overview of this method of construction for housing. The guidance is a practical introduction to the characteristics, performance benefits and latest design guidance for concrete blocks in construction. For detailed design guidance and requirements for regulatory/warranty compliance, refer to further guidance listed on the back page. Our series of Easy Guides for Housing is available at modernmasonry.co.uk

Introduction: Concrete blocks

Concrete blocks are the most common structural component in the construction of UK homes, and have been for over 100 years. They provide a well understood, flexible means of building low-cost, durable homes; a combination that so far remains unrivalled by other materials and methods of housing construction. Blocks also offer a number of other useful attributes, such as good acoustic performance, fire and flood resistance, and thermal mass, which helps provide a stable year-round temperature. From an environmental perspective, they are locally produced and can have a high recycled content, giving them low embodied CO₂. There are essentially two types of concrete block: aggregate blocks, which as the name suggests contain aggregates; and aircrete blocks, made from a type of concrete that contains air pores and has no aggregates larger than ground sand. Both types are well suited to housing, and are available in a range of sizes and densities, offering different structural and thermal characteristics (see Figure 1). Blocks are manufactured to the BS EN 771 standard and CE marked. All types are fire resistant i.e. classed as non-combustible.

Aggregate blocks

Aggregate blocks come in a wide range of densities and compressive strengths, which are grouped into the three categories of ultra-lightweight, lightweight and dense (see Figure 1). Ultra-lightweight and lightweight blocks are manufactured from cement together with one of a variety of natural or man-made expanded aggregates. These include: granulated or foamed blast-furnace slag, expanded clay, pumice, or shale, furnace bottom ash and fly ash from power stations. The density of the aggregate is generally proportional to the strength of the block. Ultra-lightweight and lightweight blocks are typically used in internal and external walls and applications that do not require the additional strength provided by dense aggregate blocks. They also provide a lower level of thermal conductivity, so offer slightly better insulating properties. Block weight is typically in the range of 8.5-20 kg for widths of 100mm, with lower weights offered by cellular and hollow aggregate blocks (see 'Cellular blocks and hollow blocks'). Dense aggregate blocks offer the highest levels of compressive strength, acoustic performance, thermal mass and low air permeability, which can be used to enhance year-round thermal performance and comfort.



Housing Easy Guide: Concrete Blocks



Aircrete blocks

Invented in the mid-1920s, aircrete blocks are made from cement, lime, sand, fly ash and water, which are mixed to form slurry. A small amount of aluminium powder is then added, which reacts with the lime to form tiny bubbles, causing the mixture to expand into a 'cake'. When the mixture is partially set, it is cut to form blocks and then cured in a steam autoclave. Aircrete blocks are the lightest option, giving them better insulation properties in comparison to aggregate blocks, reducing heat loss through external walls and junctions. They are a popular choice for external walls and foundations, performing a similar range of functions as aggregate blocks, but they are not suitable for applications requiring compressive strengths greater than around 9N/mm² although some aircrete products offer an equivalent compressive strength to 10.4N blocks. Their relatively light weight makes them easy to handle and work with on site.

Figure 1: Basic block types and properties

Typical block density (kg/m ³)	Aircrete block (generic description)	Aggregate concrete block (generic description)	Approximate compressive strength (N/mm ²)	Approximate thermal conductivity (W/mK)	Approximate thermal mass (ISO 13786) (kJ/m ² k)
460	Lightweight	-	2.9-3.6	0.11	46
600	Standard	-	3.6	0.15	60
730+	High strength	-	7.3-9.0	0.19	73
850		Ultra-lightweight	3.6-7.3	0.28	85
1,450	-	Lightweight	3.6-10.4*	0.6	145
1,900+	-	Dense	7.3-40	1.33	200

*17.5 N/mm² lightweight blocks are also available from some suppliers.

Block strength

For dwellings of one or two storeys, blocks with a compressive strength of 2.9N/mm² or higher are generally suitable for the inner leaf of cavity walls (refer to Building Regulations - Approved Document A). For three storeys or where the storey height is greater than 2.7m, blocks with a compressive strength of 7.3N/mm² or more may be needed for specific parts of the structure. However, structural design may show that lower strength blocks are acceptable. In addition to structural loading, specific project circumstances, such as the need for sulphate resistance for blockwork below ground, can also determine the strength requirement.

Block sizes

Blocks are produced in a broad range of sizes, but for general building work the most commonly used is referred to as a standard block and measures 440mm x 100mm x 215mm (see Figure 2). Usefully, this is the same length as two bricks and the height of three bricks with 10mm mortar joints. Alternative widths are available to meet particular design needs (see Figure 3), although some of the options may be specific to either aircrete or aggregate blocks only.

In addition to the standard face size of 440mm x 215mm, there are several alternative options that can improve site productivity. In general, the lower weight of aircrete enables blocks with a larger face size to be specified while still meeting manual handling requirements (see 'Large format aircrete blocks'). Aggregate concrete blocks can be specified with slightly smaller face sizes, helping to reduce weight and aid handling, which can be useful when working with dense blocks. Figure 4 shows the main options.

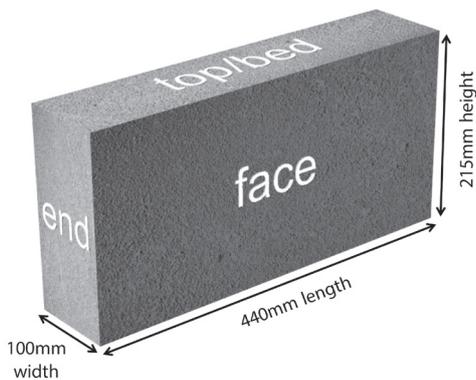


Figure 2: Standard block dimensions

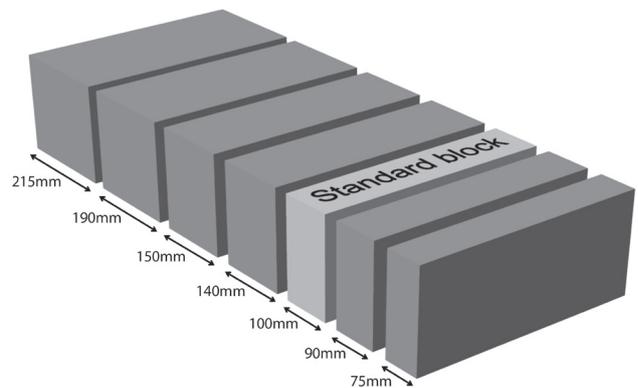


Figure 3: Commonly available block widths for general construction (width options may vary with face size and block type)

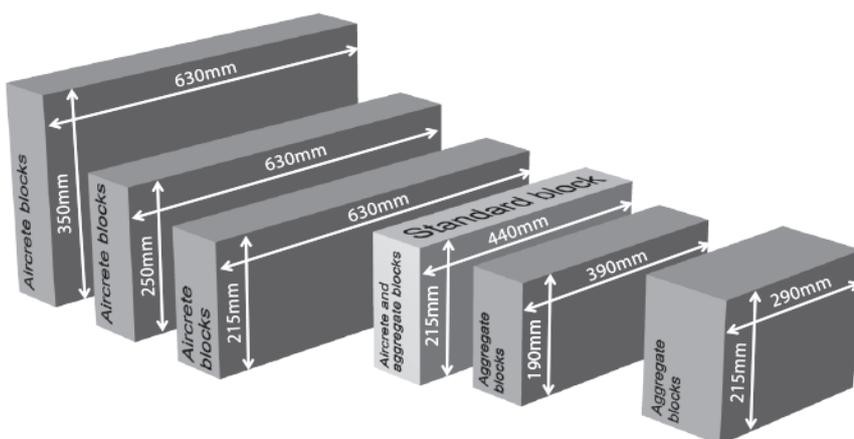


Figure 4: Commonly available face-sizes for general construction (foundation blocks not included)

Housing Easy Guide: Concrete Blocks

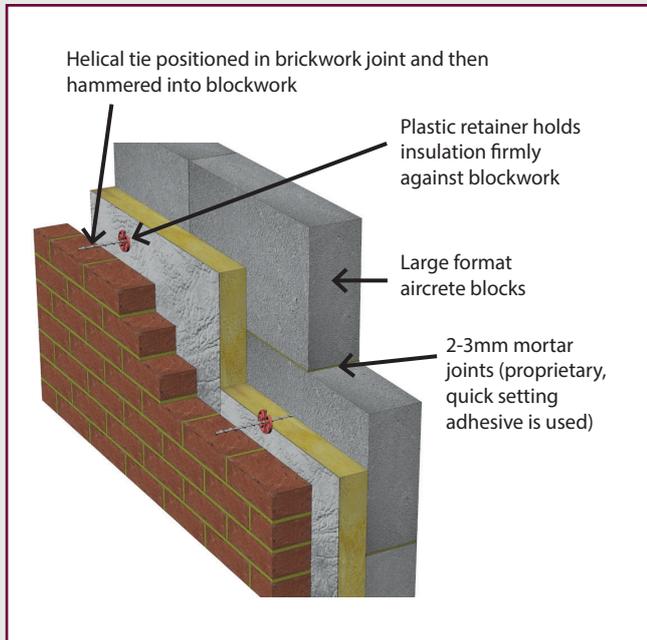


Figure 5: Thin-joint construction wall ties (large format blocks)

Large format aircrete blocks/thin-joint construction

The relatively light weight of aircrete makes possible the manufacture of large-format blocks that can also be produced to a high standard of dimensional accuracy (see Figure 4). This allows much thinner mortar joints of only 2-3mm, using a special adhesive that starts setting in around 10-20 minutes and reaches full strength in only 2-3 hours; conventional mortar takes around 24 hours before further loading can be applied. The system, known as thin-joint, enables faster build times and is capable of delivering around 3m (or one storey height) per day, as compared to the 1.5m (seven courses) recommended for standard blocks with traditional mortar joints.

It is also possible to build the inner thin-joint leaf of a cavity wall independently of the outer leaf, by the use of purpose-made helical wall ties that do not have to be installed as the blocks are laid (see Figure 5). Instead, they are fitted by hammering them directly into the blockwork as the outer leaf is constructed (they do not need to align with the block joints). The ability to build the inner leaf independently means follow-on trades can start work sooner

in a weatherproof environment, while retaining the flexibility of on-site construction. The thermal characteristics of large-format blocks are the same as for other aircrete blocks, although the thinner mortar joints afford a small reduction in thermal bridging compared to standard mortar joints.

Foundation blocks

Foundation blocks are specifically designed for use below ground level and provide a fast and convenient means to construct a base to support cavity and solid walls, plus beam and block floors. They are available in both aircrete and aggregate formats, providing resistance to moisture, freeze/thaw and sulphate attack, while also offering a useful level of thermal performance. Compressive strengths are in the range of 3.6-7.3N/mm², for aircrete and aggregate blocks. A higher strength option of 10.4N/mm² or more is available but limited to aggregate blocks. Foundation blocks come in a range of sizes that will span cavity walls of varying widths (see Figure 6). Many foundation blocks can also be used above ground, for solid wall construction.

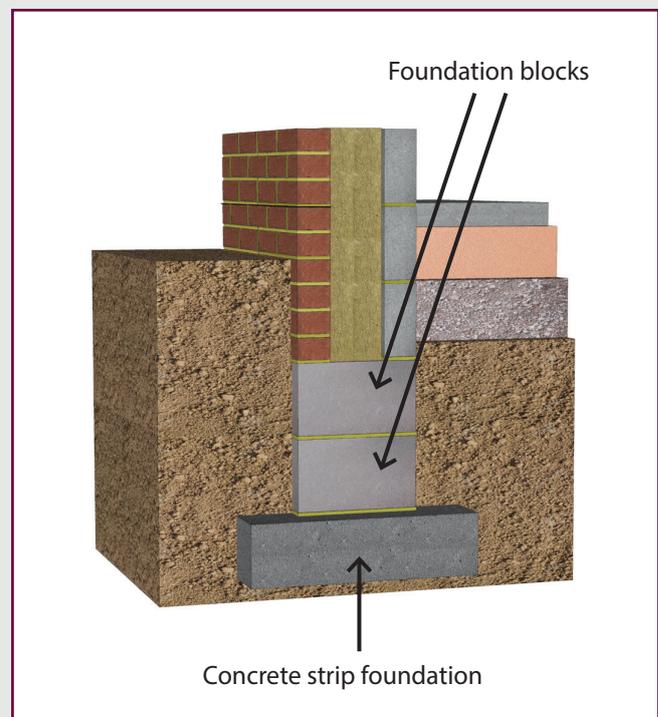


Figure 6: Foundation blocks supporting a cavity wall

Concrete coursing blocks

Concrete coursing blocks have a reduced height, typically 65mm (the same height as a standard brick), and are used for infilling small areas in walls so that a consistent level (coursing height) can be maintained when laying blocks. For example, they may be used in conjunction with lintels, above windows or doors and when installing a beam and block floor (see Figure 7). They are generally suitable for all types of construction above and below damp-proof course (DPC) level, helping to simplify the build process and reducing the need to cut blocks on site. Coursing blocks are manufactured in aggregate and aircrete formats, both of which are available in a range of strengths and sizes to complement whichever block type is being used for the general build.

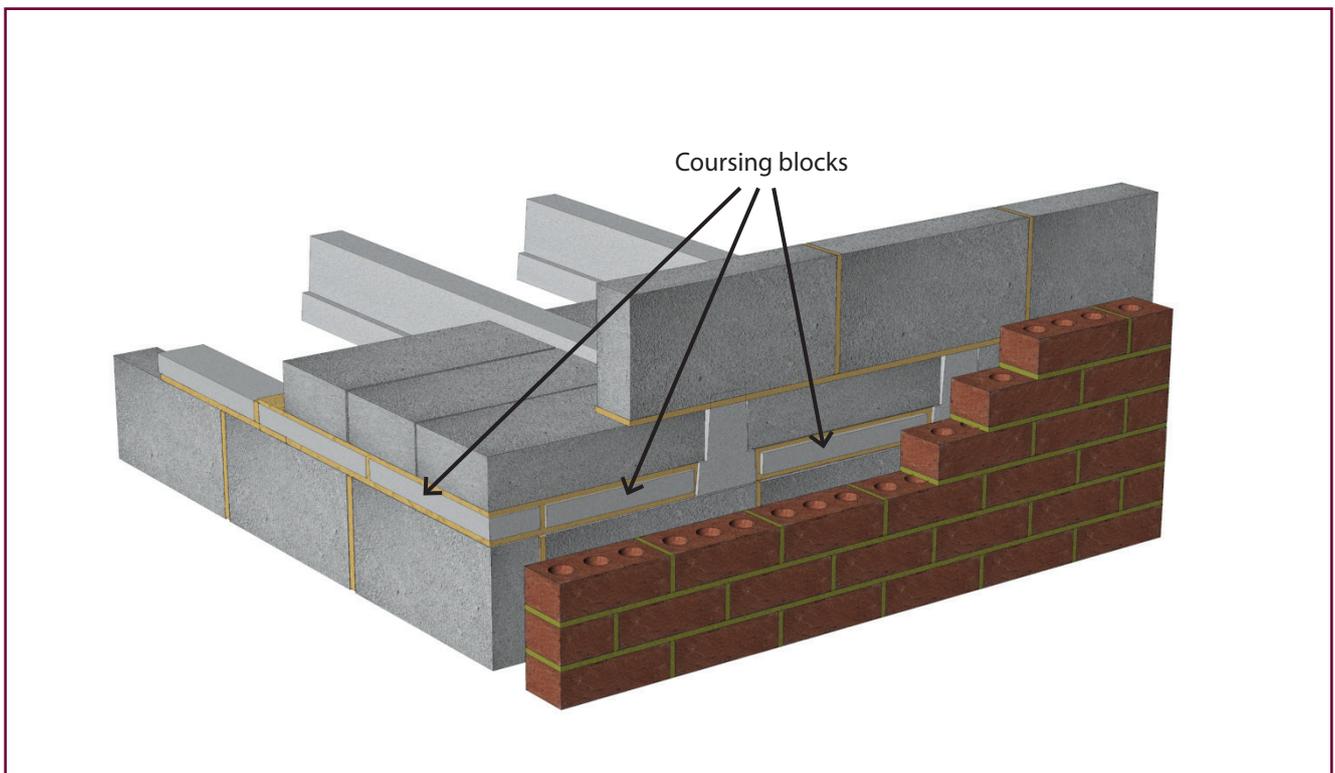


Figure 7: Example of coursing blocks being used with a beam and block floor

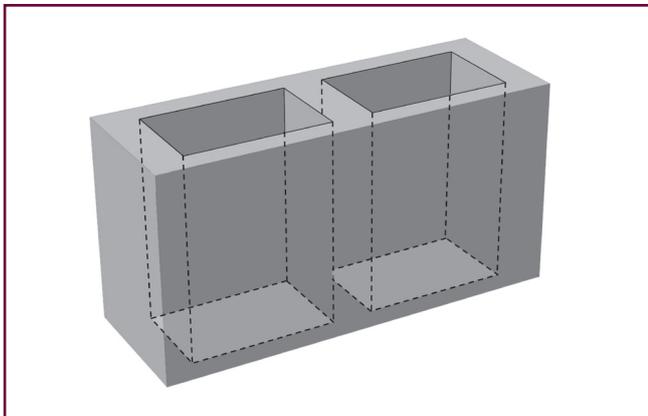
Paint grade blocks

Paint grade blocks are manufactured with a close texture, making them suitable for painting. The close texture helps to deliver a smooth, low-maintenance finish when left unpainted but slight variations in colour may be discernible. Blocks are usually supplied on the basis of one good face and end.

Facing blocks

Facing blocks are available in a large variety of colours and textures for use both externally and internally. They combine decorative appeal with the inherent strength and durability of concrete, while also providing a maintenance-free finish. Facing blocks are intended for projects where colour consistency and texture are important. Blocks are usually supplied on the basis of one good face and end.

Housing Easy Guide: Concrete Blocks

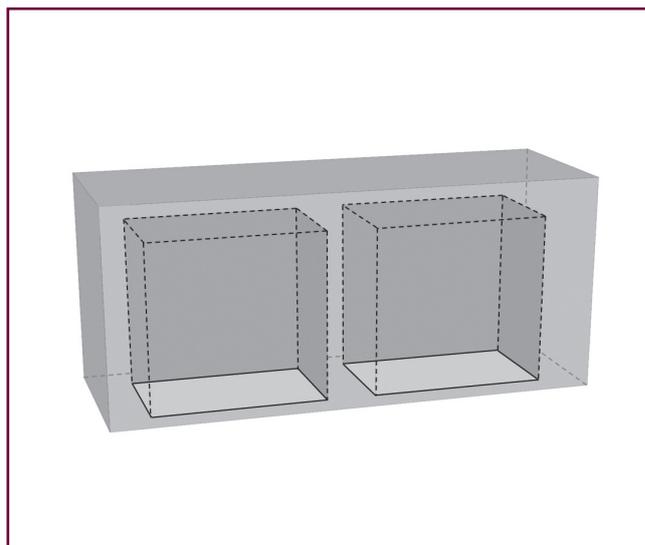


Hollow blocks (aggregate blocks only)

Hollow aggregate blocks contain one or more voids that pass through from top to bottom. They are available in a range of sizes and strengths and have around 30%-40% the weight of a solid block of the same size, making manual handling easier. Hollow blocks are suitable for general-purpose construction and are often used in agricultural and commercial applications. A useful benefit is the ability to build very strong reinforced walls by filling all or some of the cores with poured concrete and steel rebar. They can typically be used above and below DPC level.

Cellular blocks (aggregate blocks only)

Cellular blocks contain one or more blind cavities – in other words, the voids do not pass fully through like a hollow block, allowing a full bed of mortar on one face, and thereby making construction easier. They can be used in one or both leaves of cavity walls up to three storeys, making them a lower-weight alternative to solid aggregate blocks. For example, a typical standard dense cellular 140mm-wide block can weigh up to 7 kg less than its solid counterpart, while providing similar properties. Other applications include internal partitions and infill walling for framed structures. Further benefits include improved thermal properties and a saving in materials, helping to enhance environmental performance. Cellular blocks are available in compressive strengths from 2.9-10.4N/mm², but are more commonly available within the range of 3.6-10.4N/mm².



Sustainability

Blocks can contain a high level of recycled material – and approximately 44% of the energy used to make cement comes from waste-derived fuels. Overall, the UK concrete and masonry industry uses around 107 times more waste than it produces.

In terms of embodied CO₂, it is a common misconception that the average masonry house contains a lot more than an equivalent timber-frame house. Actually, the difference is very small, and at most around 4% (NHBC Foundation, 2011). This is because, with the exception of the timber frame and the inner leaf of blockwork in the masonry house, all the other materials used are essentially the same for both options.

The thermal mass inherent in concrete blocks can be used to keep homes cool in the summer and warm in winter aiding comfort and fabric performance. See 'Further Guidance' for more information.

Thermal bridging and masonry construction details

In modern housing design, the need to minimise thermal bridging is as important as good airtightness and effective insulation, all of which are essential for achieving good fabric energy efficiency. The term ‘thermal bridging’, describes heat loss that occurs within the building envelope where an area has significantly higher heat loss than the surrounding fabric due to the geometry or the presence of materials with poor insulating properties– thereby creating a bridge for heat to escape. Common examples of a thermal bridge include lintels, balconies and the junction between floors and walls. In addition to impacting energy efficiency, the resulting cold patch can attract condensation, which may in turn lead to a mould problem.

While some thermal bridging is inevitable in all forms of housing, its impact can be greatly reduced by careful attention to the detailing and construction of junctions. For homes built using concrete blocks i.e. masonry construction, this is most easily addressed through the use of standardised, high-performance construction details that are freely available from a number of sources. Each detail has its own calculated heat loss rating (psi value) for use in SAP, and is also accompanied by a simple 2D drawing showing how it is constructed, along with dimensions and specification of key components (see Figure 8 for examples).

Use of these details offers an easy win, as they provide a low-cost means of enhancing thermal performance and are fully compliant with the Building Regulations. The alternative option of using unverified construction details will attract a significant performance penalty in the SAP assessment, resulting in up to a 60% increase in heat loss from junctions than would otherwise occur. It will also require greater effort and cost to be spent on other aspects of the design to compensate for the loss of performance and ensure that the fabric energy efficiency target set by Part L1A of the Building Regulations is achieved.

Sources of high-performance masonry construction details:

- Local Authority Building Control (LABC): Details for aggregate and aircrete block construction
- Concrete Block Association: Details for aggregate block construction
- Constructive Details Limited: Details for aircrete block construction.

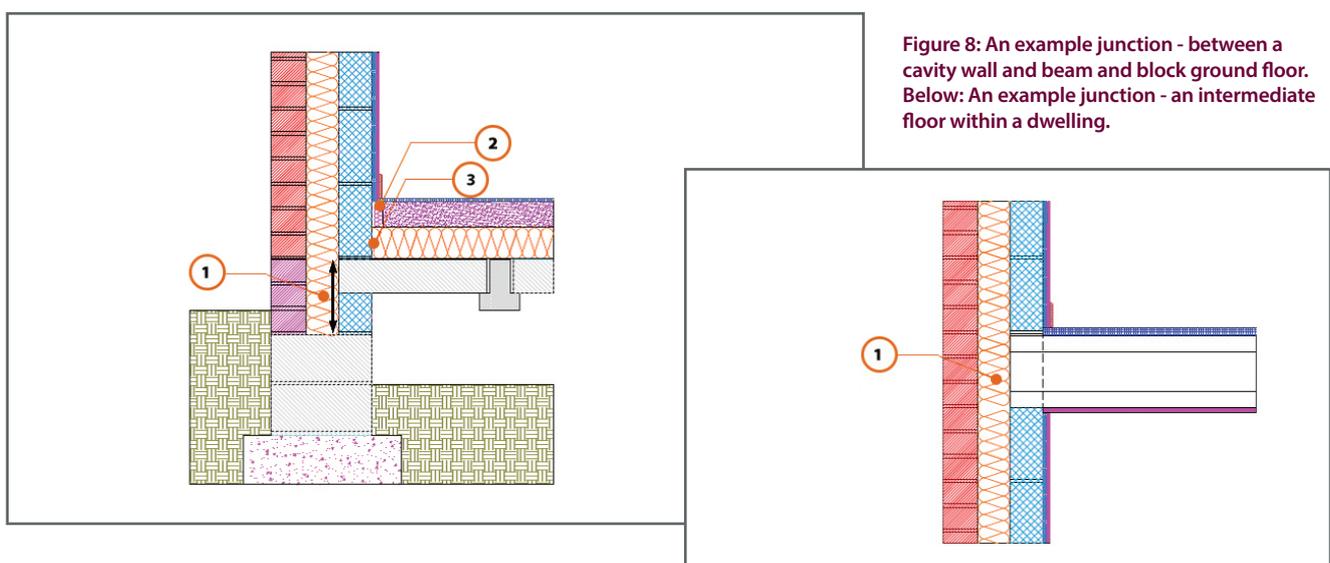


Figure 8: An example junction - between a cavity wall and beam and block ground floor. Below: An example junction - an intermediate floor within a dwelling.

Housing Easy Guide: Concrete Blocks

Suggested further guidance for regulatory compliance and new-build warranty purposes:

Building Regulations Approved Document –
Part A: Structure

Building Regulations Approved Document –
Part B: Fire safety

Building Regulations Approved Document –
Part L: Conservation of fuel and power

BS EN 771 - *Specification for masonry units, parts 3 and 4*

BS 5628 - *Code of practice for use of masonry, part 3*

BE EN 1996:2006 – *Design of masonry structures to Eurocode 6*

PD 6697:2010 – *UK supporting document to BS EN 1996:2006*

NHBC Standards – *Part 2: Introduction to the standards and technical requirements*

NHBC Standards – *Part 6: Superstructure (excluding roofs)*

Sources of further information

Guidance from The Concrete Centre.

Download all of these guides from
www.concretecentre.com/publications

Masonry Junctions – best practice tips and illustrated guidance, Zero Carbon Hub, 2011.

Thermal Performance Part L1A, The Concrete Centre, 2016.

How to design masonry structures to Eurocode 6 (Introduction/Vertical Stability/Lateral Stability), The Concrete Centre, 2014.

Thermal Mass Explained, The Concrete Centre, 2015.

Concrete and Fire Safety, The Concrete Centre, 2018.

How to Achieve Good Levels of Airtightness in Masonry Homes, The Concrete Centre, 2011.

Further information on specific building products

The Aircrete Products Association: www.aircrete.co.uk

The Concrete Block Association: www.cba-blocks.org.uk

Brick Development Association: www.brick.org.uk

Mortar Industry Association: www.mortar.org.uk

British Precast Buyers Guide: www.britishprecast.org

About these Easy Guides

This series of guides has been authored by Tom De Saulles, The Concrete Centre, on behalf of Modern Masonry. Tom would like to thank the Modern Masonry technical working group, the Concrete Block Association and the Aircrete Products Association for their contributions in developing these guides.

To download the Housing Easy Guides and to access information about masonry construction visit www.modernmasonry.co.uk

The Modern Masonry Housing Easy Guides are part of the Better Built in Blockwork campaign to share best practice for the design and construction of high performance housing.

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