Housing Easy Guide:

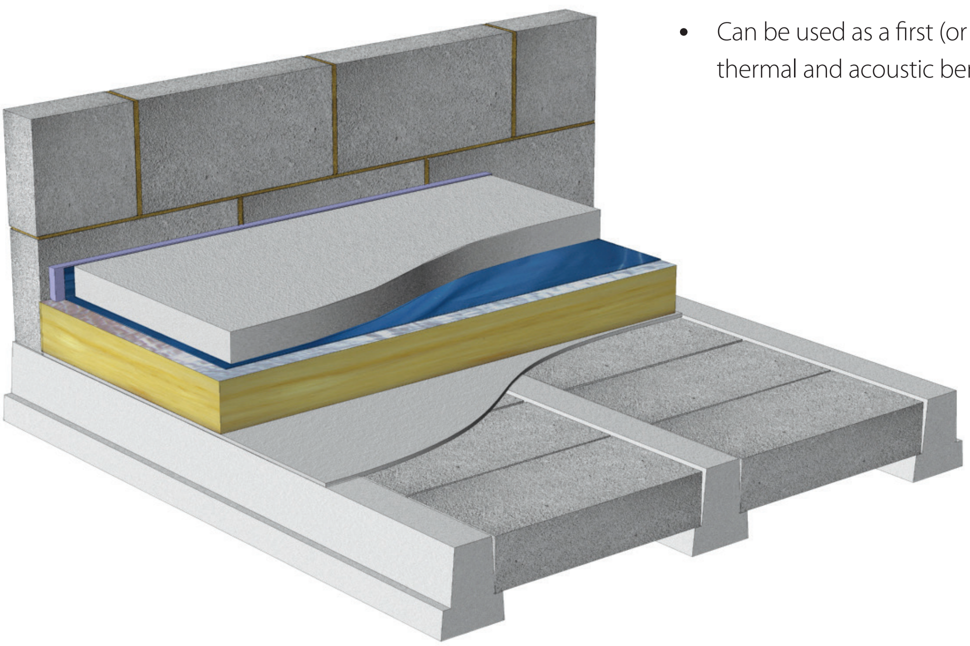
modern masonry

Beam and Block Ground Floors

This Easy Guide on beam and block floors 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 beam and block ground floors.

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: Beam and block ground floors

Beam and block ground floors are the most commonly used option in new-build homes and larger extensions. The installation is quick and requires very little ground preparation. They are also the preferred option where there is a large depth of fill below the floor and where heave/subsidence may occur – for example, close to trees. The concrete beams can span up to 8m without the need for subfloor walls, although a typical span is around 6m or less.

Key benefits

- Quick to install, with minimal ground work required
- Extremely robust and strong
- Can span up to 8m without the need for a subfloor wall
- Excellent thermal performance and works well with underfloor heating
- Overcomes ground movement problems
- All-weather method of construction
- No shrinkage, flexing, bouncing or squeaking
- Rot proof and fire resistant
- Can be used as a first (or upper) floor solution, providing thermal and acoustic benefits.

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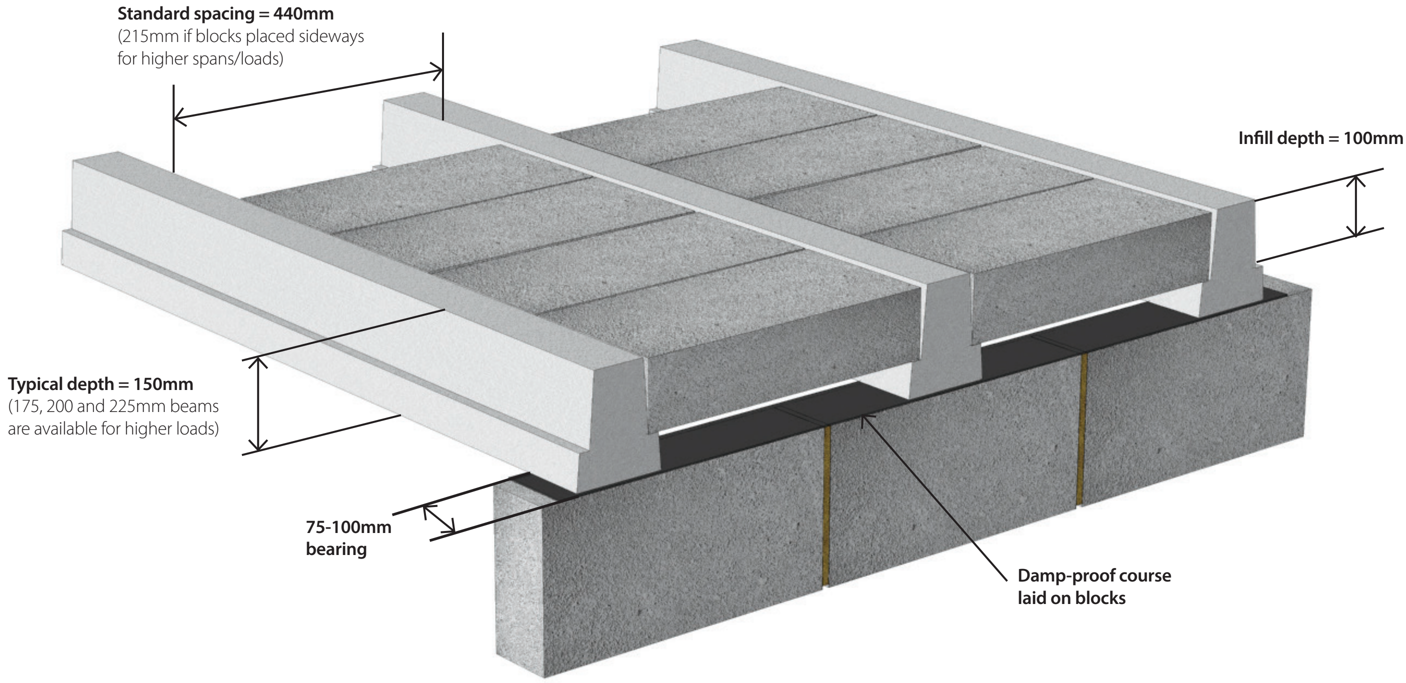
Figure 1: Basic beam and block floor layout configuration



Floor construction

The construction of beam and block floors is straightforward. The precast concrete beams are laid in rows with the ends supported by the blockwork inner leaf of a cavity wall. A damp-proof course (DPC) is located between the beams and supporting blocks to prevent rising damp (see Figure 1).

Other damp proofing is likely to be limited to a membrane (see Figure 4). The beams are supported by the inner leaf, with a bearing of 75-100mm. The profile of the beams resembles an inverted T, which provides a recess of 100mm to accommodate standard blocks on their side.

The spacing of the beams is determined by the longest side of the block – i.e. 440mm – but if greater floor strength is needed, the blocks can be turned sideways and the beams spaced at 215mm intervals. One or more beams can be placed immediately adjacent to each other requiring an in-situ concrete infill to support internal non loadbearing walls. The use of multiple beams in this way requires in-situ concrete to be placed between them (see Figure 2).

Internal loadbearing walls require a supporting wall constructed in the floor void, with appropriate footings. The ends of the beams sit on the supporting wall and overlap each other by 100mm (see Figure 3).

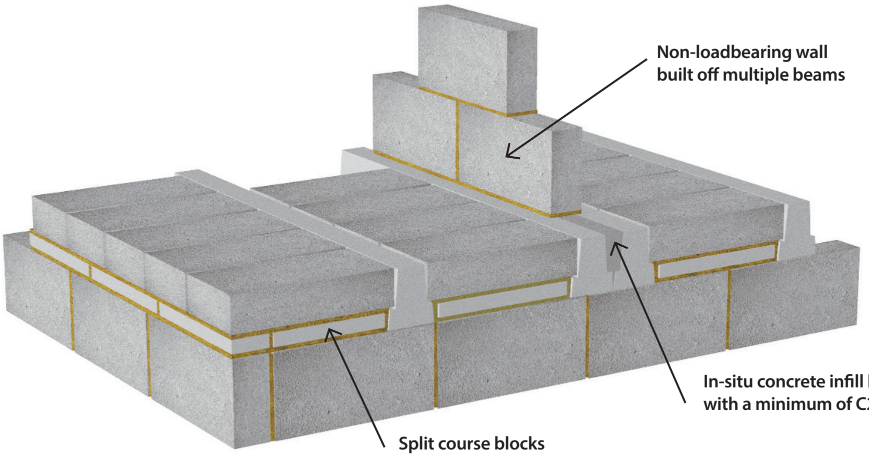


Figure 2: Supporting internal non-loadbearing walls

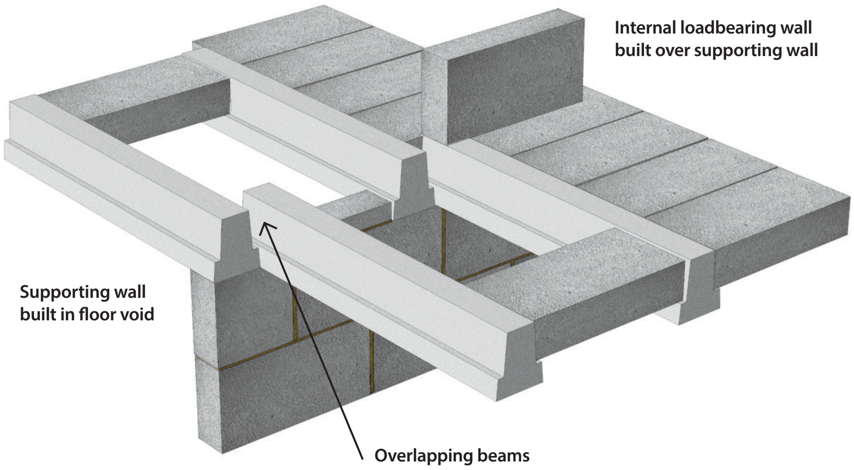


Figure 3: Supporting internal loadbearing walls

The beams

The beams are made from pre-stressed concrete and manufactured in standard lengths, available in 50mm increments. Typically they are 150mm deep, but for larger spans and loads deeper beams of 175mm, 200mm or 225mm can be used. To ensure loads are transmitted safely, beams must be used in accordance with the manufacturer's guidance, and compliant with design standards.

The blocks

Standard size blocks are normally used (440mm x 215mm x 100mm) although larger aerated floor blocks are also available. In terms of strength, 100mm aggregate blocks conforming to BS EN 771-3 must provide either 7.3 N/mm^2 or greater compressive strength. This requirement will be meet by blocks with a 3.5 KN transverse strength that have been tested in accordance with British Standards. Most block manufacturers provide BBA certificates to confirm the strength of their products. Aircrete and aggregate blocks can be used, with densities ranging from around 600kg/m^3 to 2,000kg/m^3. 'Split course' blocks are used to make up heights and infill between the beams (see Figure 2). They are available in a range of thicknesses to suit different beam depths, but for a standard 150mm beam, they are generally 385mm long, 100/140mm wide and 40mm deep, with a minimum compressive strength of 7N/mm^2. 'Closure blocks' specifically designed to fit between the ends of beams can also be used to help speed up floor edge construction.

Ventilating the floor void

The void under the floor should be ventilated in accordance with the Building Regulations. Requirements will generally be met with a void of at least 150mm deep that is adequately ventilated to remove moisture and prevent any build-up of ground gases such as methane. The openings should be at least 1,500mm^2 per linear metre or 500mm^2 per m^2 of floor (whichever is greater) and should ideally be achieved with openings on at least two opposite sides.

Levelling screed and grouting

The blocks need to provide a relatively smooth and flat surface for the insulation, with a tolerance of about 5mm or less over a 2m span, measured with a straight edge. This is about the same as the upward camber of the concrete beams (which is a normal feature), so a levelling screed may or may not be needed, but is generally recommended. In practice, the grout used to infill between blocks can also act as a levelling screed, so the two jobs can be tackled together. Typically a 4:1 sharp sand/cement grout is brushed into all joints and left overnight to provide a rigid construction ready for laying the insulation.

Floor insulation

Floor insulation is supplied in boards with a standard size of 2.4m x 1.2m. These are most commonly made from expanded or extruded polystyrene, polyurethane foam (PUR) or polyisocyanurate (PIR). Expanded polystyrene is the cheapest option but gives a lower level of thermal performance than PUR and PIR. Extruded polystyrene offers a level of performance that lies between the two. The choice of material is one of the factors that determine the thickness of insulation needed, along with the required U-value and the perimeter-to-area ratio (P/A) of the floor. Insulation manufacturers provide look-up tables to simplify the calculation process and also generally offer a free calculation service or online U-value calculator. As a rough guide, around 150mm of PUR/PIR insulation or 200mm of expanded polystyrene insulation is needed to achieve the notional Part L1A ground floor U-value of 0.13W/m^{2}K with a worst-case P/A ratio of approximately 0.7. A more relaxed U-value and/or lower P/A ratio requires less insulation. For example, a U-value of 0.18W/m^{2}K with a P/A of 0.4 will require approximately 90mm of PUR/PIR or 125mm of expanded polystyrene.

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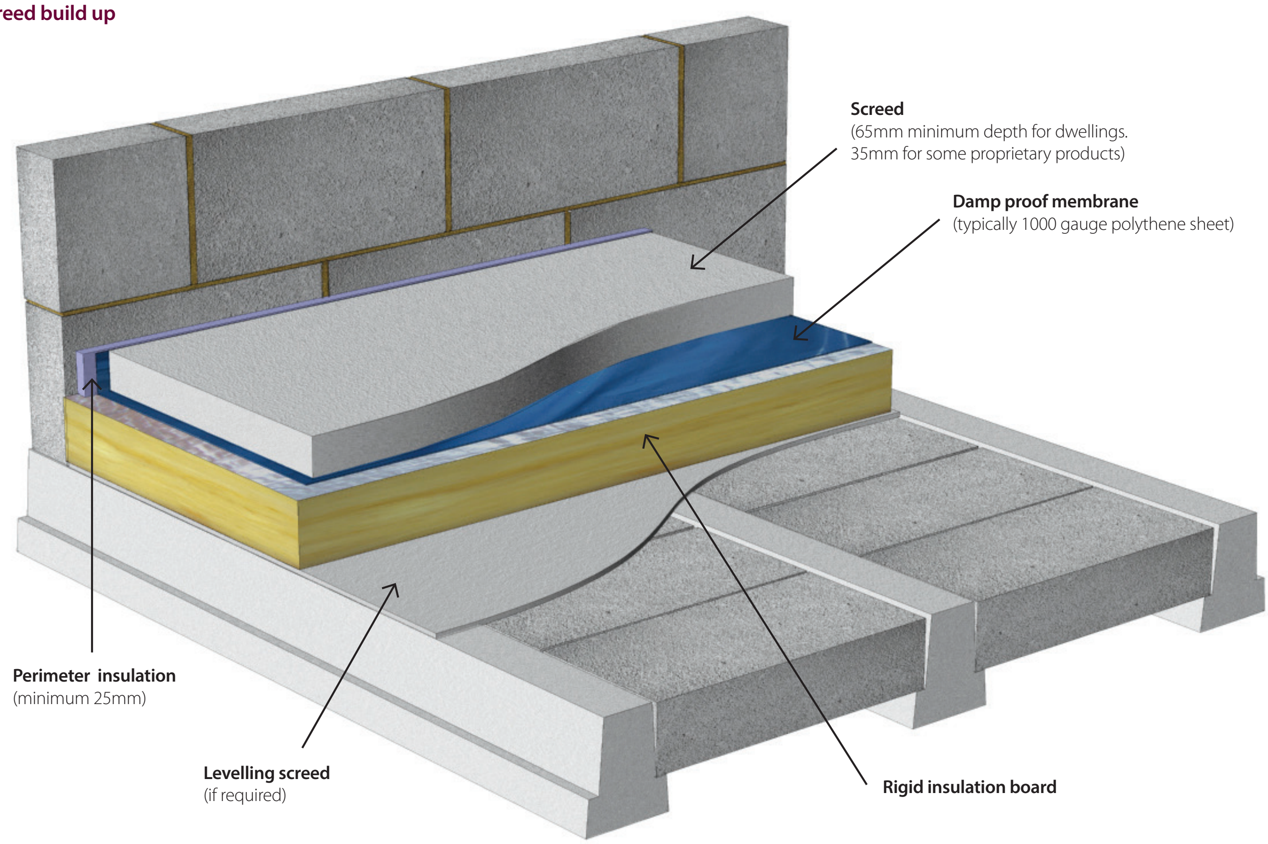
Damp proof membrane (DPM)

The DPM, which may sometimes be referred to as a vapour control layer, separating layer or slip layer, is located on the top surface of the insulation (see Figure 4). This keeps warm, moist room air on the warm side of the insulation, preventing the risk of condensation within the floor structure. It also acts as a protective barrier for the insulation, reducing damage from wet screed. Any particular requirements for the vapour control layer will be specified by the insulation manufacturer, but will typically need a 1,000-gauge polythene sheet to be placed over the insulation board. However, there are insulation products available that incorporate a resilient facing material, enabling the screed to be applied directly.

Figure 4: Typical insulation and screed build up



Beam and block upper floors

The beam and block system is widely used for ground floors but is also well suited to upper floors, where it offers a number of performance advantages over alternative timber based options. These centre on the resilience and solidity concrete provides, resulting in:

- Acoustic separation is excellent between floors and squeaking floor boards are avoided; a regular source of irritation to home owners and amongst the most common complaints in new properties.
- Fire resistance: concrete has a much better fire rating than timber, reducing risk to occupants and providing the potential to decrease insurance premiums.
- Thermal mass is provided which helps to lower the risk of summer overheating by absorbing heat inside the dwelling during the day and releasing it during the night when windows can be opened for ventilation and cooling.
- Robustness and longevity; beam and block flooring will easily last 120 years and probably a lot longer. Concrete is an inherently durable material that is resilient to rot, water damage and general wear and tear.

In terms of installation, fixing any product at height should only be carried out by qualified installers and there are many companies that have a good track record of installing beam and block upper floors. All members of the Precast Flooring Federation adhere to its Code of Practice, which has been compiled by Health and Safety experts. The Code gives a guide to the current good practice for the installation of all types of precast flooring i.e. beam-and-block, hollowcore, etc. It is available to download at ***www.precastfloors.info***.

Installing services is relatively straightforward; beam and block suppliers will provide 'ceiling clips' that sit on the shoulder of the floor beam, dropping beneath the level of the floor and are typically suited to a 50 x 38mm batten. This leaves a void between the soffit of the floor and the top side of the batten, allowing services to be run to the underside of the floor.

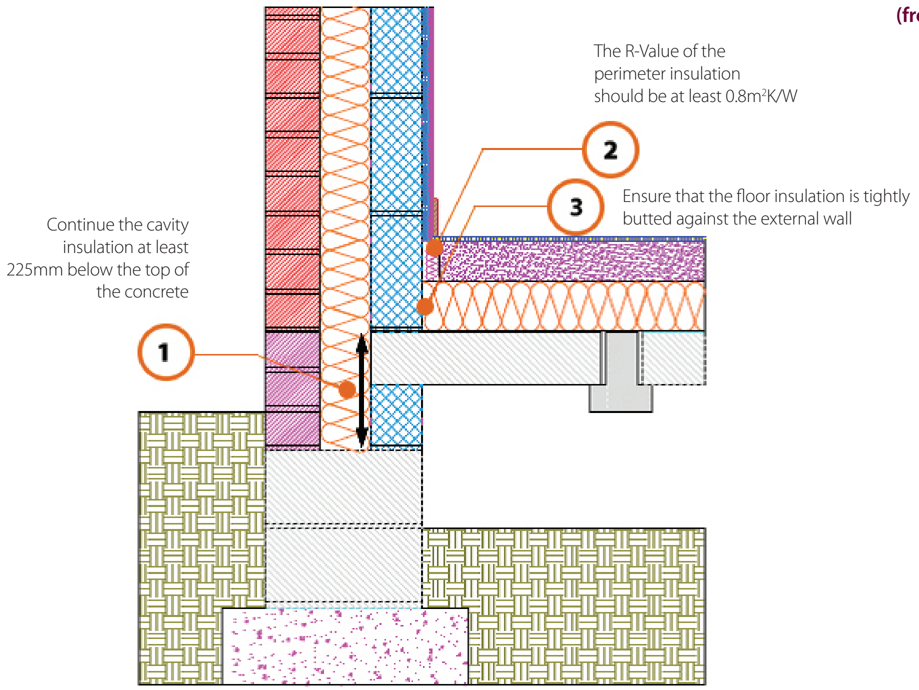
The cost of installing a beam and block upper floor is moderately higher, although it should be remembered that it represents a premium product with performance to match. It is suited to most types of masonry housing, particularly self-build projects, high quality developments and any project where performance is a key driver.

Thermal bridging and 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 masonry housing this is most easily addressed through the use of standardised, high-performance construction details that are freely available from a number of sources (see right). 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 5 for an example).

Figure 5: Example construction detail for the junction between a cavity wall and a beam and block ground floor (from the LABC website).



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 the fabric energy efficiency target set by Part L1A of the Building Regulations is achieved.

The key sources of high-performance masonry construction details are the:

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

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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 E: Resistance to the passage of sound*

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

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

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

BS 8103-1:2011 – *Structural design of low-rise buildings. Code of practice for stability, site investigation, foundations, precast concrete floors and ground floor slabs for housing*

BS EN 15037 – *Precast concrete products. Beam-and-block floor systems.*

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

NHBC Standards – *Part 5.2: Suspended ground floors*

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*

Precast Flooring Federation: *www.precastfloors.info*

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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