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timber frame construction

5th edition

robin Lancashire and lewis taylor



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Timber frame construction

5th edition

Timber frame construction, the acknowledged 'bible' for timber frame, has been in demand consistently since its first edition in 1988. This 5th edition responds to further increases in thermal standards, evolving alternative methods of timber frame construction and the industry's migration from BS 5268 (now withdrawn) to Eurocode 5. Nearly all the illustrations have been revised.

This new edition of *Timber frame construction* comes at an exciting and challenging time for the UK construction industry. As 'zero carbon' comes ever closer, timber frame is well placed to meet these demands. We have considered improvements in elemental U-values, air tightness, thermal bridging and party wall thermal bypass, and incorporated these in this revision.

In this 5th edition, we have addressed the key areas of air tightness, thermal performance and thermal bridging by introducing an insulated service zone on the inner face of the timber frame external walls. This zone allows the vapour and air control layer to be free from service penetrations and all laps and junctions detailed well, that is, all membrane laps mechanically fixed and clamped behind battens. It also allows the installation of more insulation between the battens, which improves the U-value of the wall and helps to reduce thermal bridging.

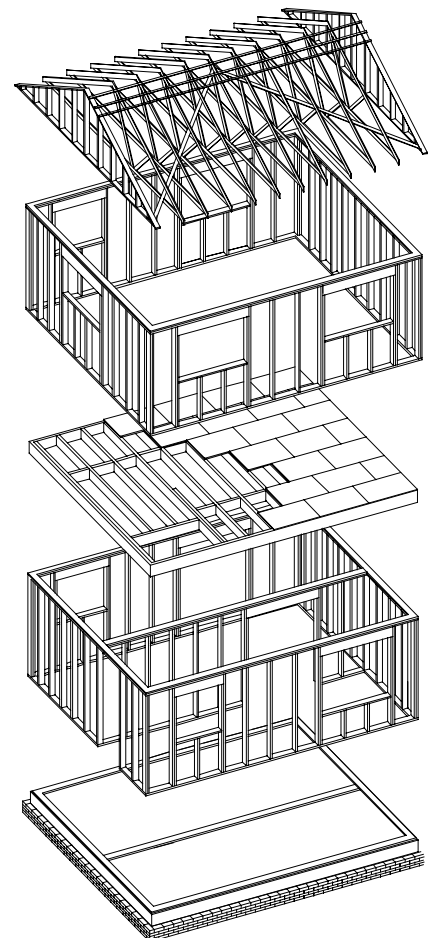
Another significant change in building design is the inclusion of U-values for party walls. The 2010 editions of the Energy section of the *Scottish Technical Standards* and *Approved Document L* for England and Wales require designers to consider the thermal performance of cavity party wall structures. In order to assume zero heat loss through the party wall, all cavities within a party wall must be filled with insulation. This poses a number of sequencing and construction difficulties for sheathing timber party walls that we explain in this new edition.

The introduction and implementation of Eurocodes is also another important driver for this revision. *Eurocode 5* and its UK National Annex will replace BS 5268-2:2002 entirely when the building regulations no longer recognise it. When published, PD 6693 *Complementary information for use with Eurocode 5* (currently in draft) will reference complementary non-contradictory information found in BS 5268. This 5th edition assumes structural design using Eurocode 5 and PD 6693, while providing margin notes for those still using BS 5268-2.

The drawings illustrate typical solutions to the design of platform frame construction to show the principles involved. They are not intended to provide a single prescriptive solution for timber frame design and other designs and details may be equally valid. The TRADA Technology. *frameCHECK* team can check designs as part of the suite of consultancy services they offer to the industry.

Timber frame construction is the core of a suite of publications from TRADA Technology covering all aspects of building in timber frame. These are listed inside the back cover of this booklet.

This booklet shows the contents and sample pages from the new edition. Take advantage of the pre-publication offers by completing the order form at the back, pre-order online at www.trada.co.uk/bookshop or phone the bookshop on 01494 569602.



Sample pages from Timber frame construction

5th edition

Revised by Robin Lancashire and Lewis Taylor

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 - D Delivery of components
 - W Walls
 - FL Floors
 - BM Breather membrane
 - RF Roof framing
 - CBF Cavity barriers and firestops to the required fire resistance
 - G General
- A3.3 Work typically undertaken by other sub contractors
 - FR Frame
 - S Services installation
 - IN Insulation
 - VCL Vapour control layer
 - L Linings
 - PFL Party floors and ceilings
 - DPC Damp proof courses, cavity trays and window/ door seals
 - BC Brick or block cladding
 - OC Other claddings
 - R Roofing

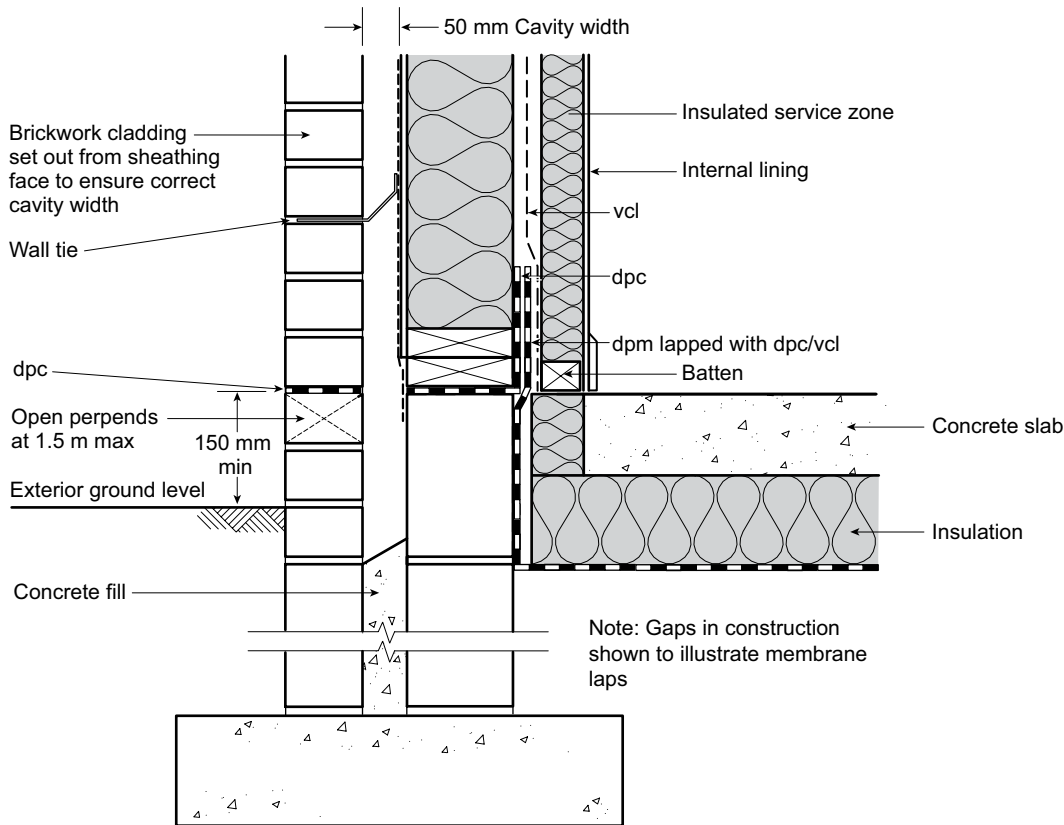


Figure 3.1 Concrete slab and insulated floor deck

in situ concrete slabs or proprietary suspended concrete beam and block infill floors with either sand and cement screeds, or floating deck finish (see *Section 3.4.1*).

Figures 3.1 to 3.8 illustrate typical details for both in situ and suspended concrete floors. Precise details vary so check manufacturer's recommendations.

Ventilate the void beneath suspended concrete floors in line with at least the minimum laid down in the building regulations. Guidance on ventilation is also provided by the manufacturers. The minimum dimensions between the ground and the underside of the floor construction are shown in *Figures 3.3 to 3.8*.

The relatively light weight of a timber frame superstructure and its resistance to distortion when subjected to differential settlement make it especially suitable for sites with low ground bearing pressure, when used with a reinforced concrete raft foundation or ground beams supported on piles.

The method of fixing down the timber frame superstructure and the slab edge detail are the only points where special details are required for timber frame, see *Chapter 4*.

3.4.1 Floating ground floor decks

Floating ground floor decks are an alternative to using a screed in order to minimise wet trades. Place a layer of rigid insulation across the surface of the

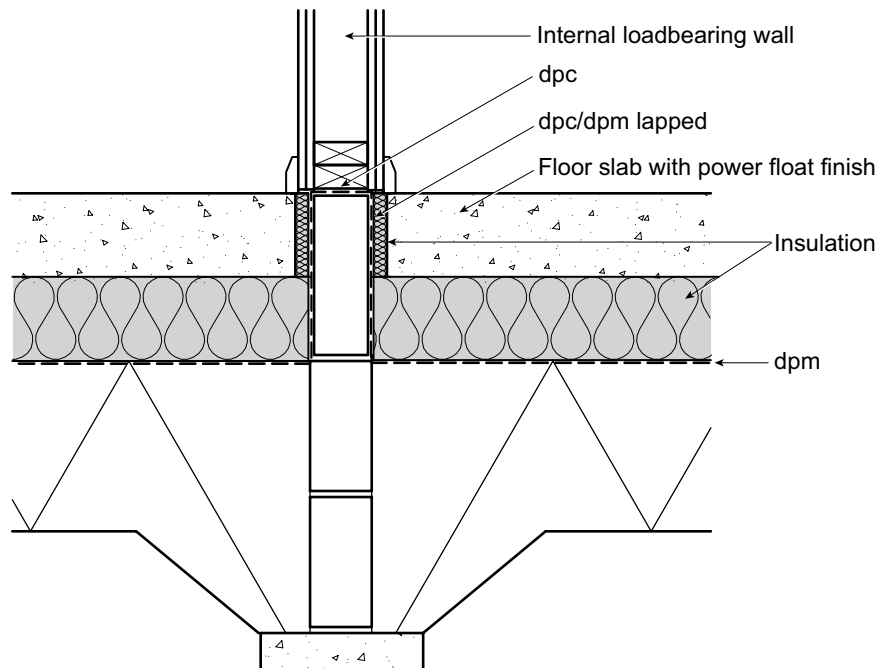


Figure 3.2 Slab detail at loadbearing internal wall.
Note: Non-loadbearing walls can be built directly from the concrete slab with a dpc beneath the sole plate (or bottom rail if no sole plate is used)

slab, followed by a wood-based board material deck. The insulation should be of sufficient density to support the floor deck, especially at the edges. It provides insulation to the slab, reduces the overall heat loss of the building and obviates the need for edge insulation to avoid thermal bridging.

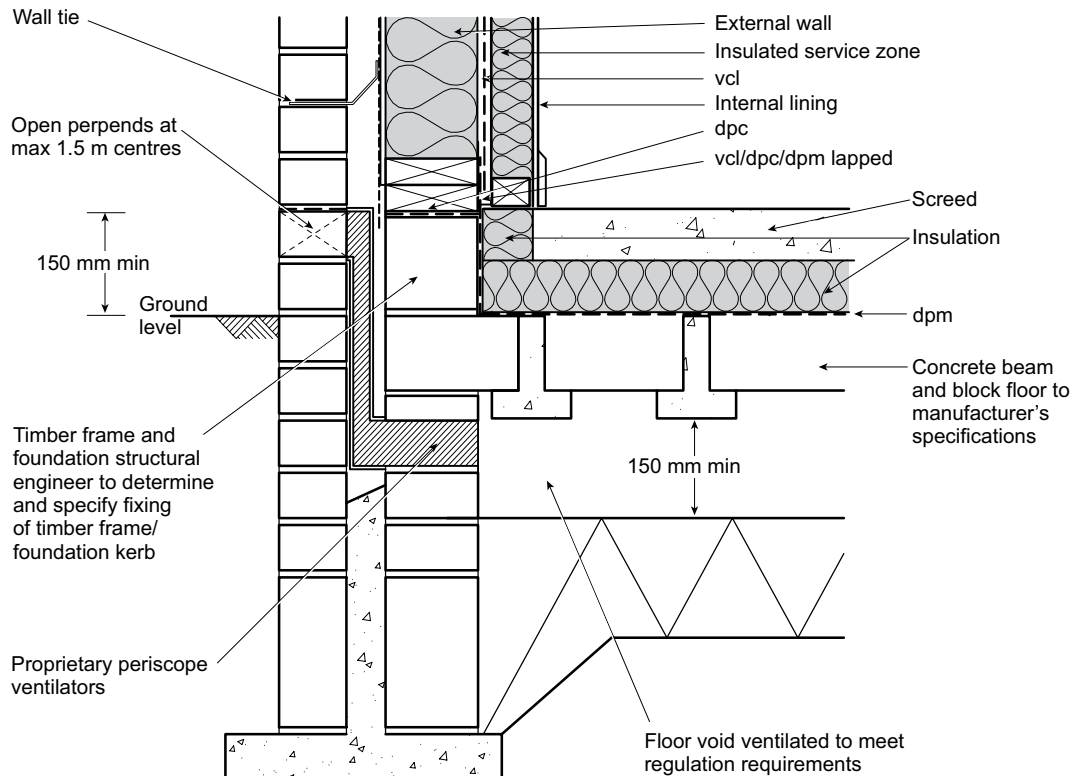


Figure 3.3 Concrete beam and block floor with screed and insulation; at external wall

Where battens are installed to the outer face of the timber frame, the orientation can be either vertical (Figure 4.24) or horizontal (Figure 4.25). Installing battens in a horizontal orientation would reduce repeat thermal bridging to node points only, and also help to support the insulation material and minimise any risk of slumping. If masonry cladding is to be used, consideration would need to be given to the installation of wall ties.

4.4.1.3 Continuous internal insulation

Rigid foam insulation boards can be installed over the inner face of the external wall studwork in addition to insulation between the studs (Figure 4.26). This method provides continuity of insulation over the studwork and so reduces repeat thermal bridging. On the inside face of the rigid insulation,

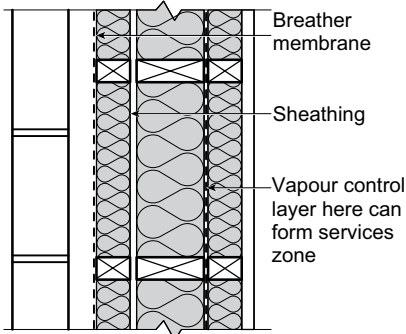


Figure 4.24 Vertical planted battens (horizontal section)

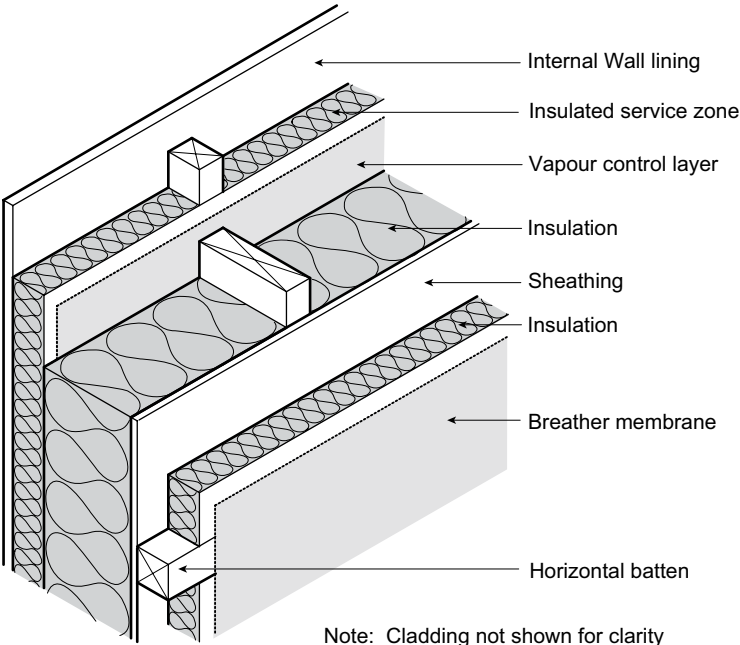


Figure 4.25 Horizontal planted battens

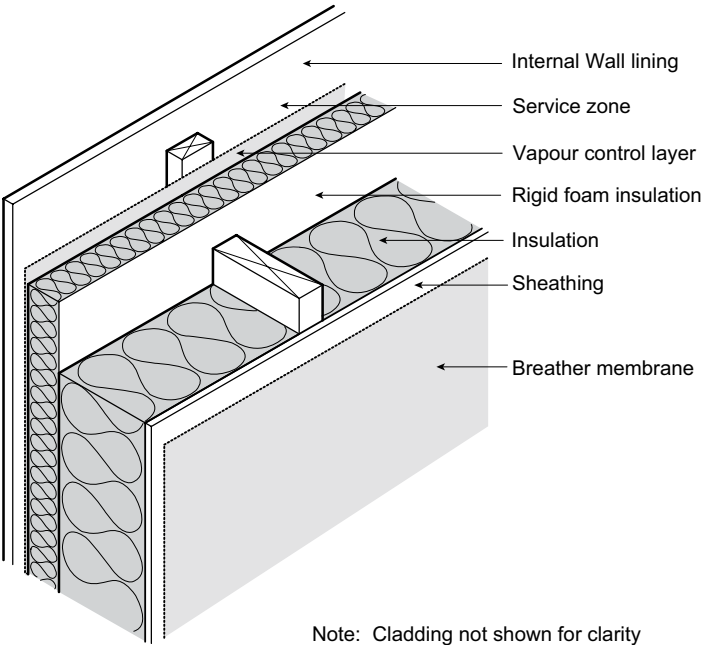


Figure 4.26 Continuous internal insulation

timber battens are used to retain the insulation and separate the vapour control layer, as well as providing fixing for the internal linings.

Many of the methods discussed above can be added to conventional timber frame construction, or the alternative timber frame structures listed below.

4.4.2 Structure

4.4.2.1 Studs

When trying to achieve better thermal performance from a timber frame wall structure, one possible option is to increase the depth of the studs to more than 140mm, to allow more insulation to be installed. Studs up to 200mm deep could be used, although practical issues should be considered for these thicker section sizes.

A possible alternative is to use engineered timber I-joists (Figure 4.27) or open-web joists (Figure 4.28) as studs. These are available in section sizes ranging from around 200mm up to 500mm deep and so allow significant quantities of insulation to be used. Typically the web of a timber I-joist is constructed from a thin engineered timber board material. This reduces the cross section of timber that bridges the insulation and further helps to improve the thermal performance of the wall. Blown fibre or cellulose insulation products have become popular insulation choices for these walls.

Another possible alternative to increased stud depth is the use of a twin-leaf external wall (Figure 4.29). Two separate timber stud wall frames are used to create a deep external wall section, typically with sheathing on the outer faces of each stud frame. The stud frames can be positioned to create as large wall void for insulation as required. Blown fibre or cellulose insulation products have become popular insulation choices for these walls.

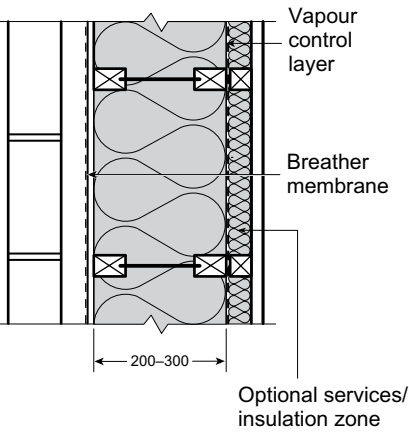


Figure 4.27 I-joists used as studs (horizontal section)

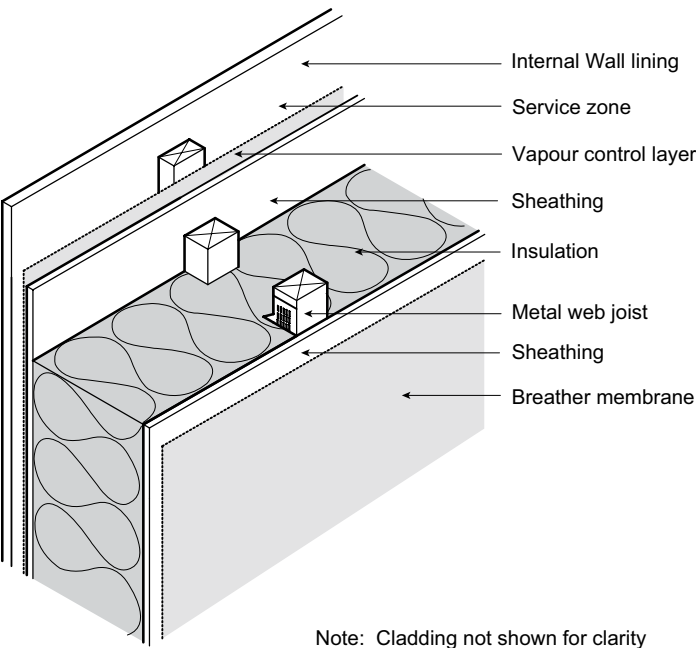


Figure 4.28 Open-web joists used as studs

Note: Cladding not shown for clarity

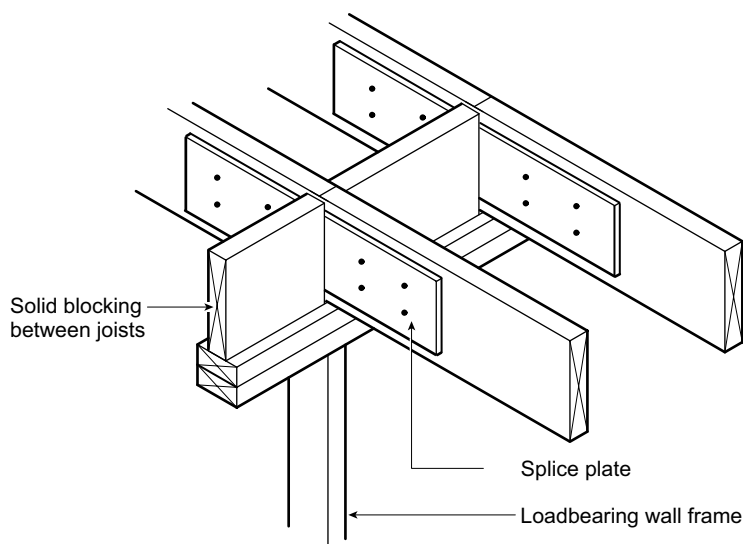


Figure 6.5 Joining joists end to end

Note: The use of sheet types of floor deck precludes lapping joists on supports when joining them, unless the junction occurs beneath a wall to the upper storey. Abut joists end to end and check bearing. Use splice plates or short lengths of plywood or OSB to give additional stiffness

6.3.1 Notching and drilling

For notching and drilling solid timber, follow the guidance in *Section 10.2*. For engineered timber components, follow the manufacturer's third party approved guidance.

6.3.2 Trimmers and beams

Floor depth beams or trimmers can be fabricated by nailing or bolting floor joists together so that they act structurally as one unit (*Figure 6.6*). *Eurocode 5 Span tables* does not yet include tables for trimmers and trimmer joists.

For engineered timber joists, follow the manufacturer's guidance when double joists are to act as one unit.

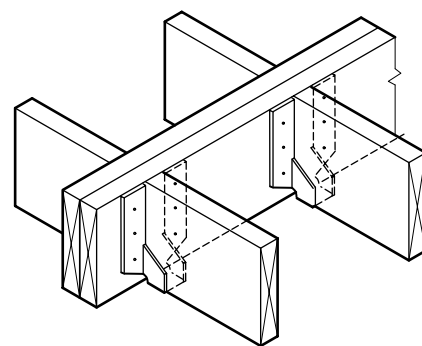
When long spans and/or larger loads have to be supported, beams of greater depth may be required. Alternatively, trimmers and beams can be of a structural timber composite, hardwood or steel flitch beams. Where beams and trimmers are of greater depth than the floor thickness, both downstand and upstand arrangements can be used. These must be provided with adequate protection against fire (*Figure 6.7*). Steel beams can be used but can be difficult to place and fix in the timber structure and will also need fire protection.

Beams and trimmers in floor construction will require additional studs or posts in the timber wall panels to support them and transfer their load to the foundations. When small panel construction is used it is often possible to locate a panel junction beneath the beam or trimmer so that the connected studs form a post to provide support. In large panel structures (or where panel junctions do not coincide) provide additional studs or posts in the wall panels (*Figure 6.8*). Consider the implications of the actual deflections of long span trimmers and beams to ensure that deflections do not impose load onto non-loadbearing wall elements and that combined joist and beam

Variations when using BS 5268

Span tables, 2nd edition includes tables for sizing trimmers and trimmer joists.

BS 8103-3 includes tables giving sizes/spans of trimmers, trimming joists and fixing schedules.



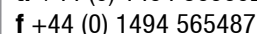
Note: Multiple joists nailed together to a designed nailing pattern may avoid deep downstand beams. Joists are shown fixed with proprietary joist hangers. Alternatively a timber ledger can be nailed to the side of the double joist and the abutting joists notched over it. Ledger nailing should be calculated and notch size approved by engineer

Figure 6.6 Double joists used to form a floor depth beam

Variations when using BS 5268

A design example for a steel flitch beam is included in TRADA Technology's *Timber frame housing: UK structural recommendations*⁽⁷⁾.

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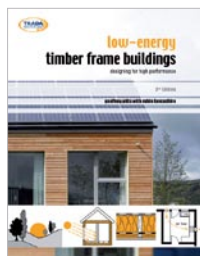
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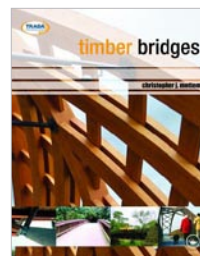
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There is now an increasing focus on improving the sustainability and energy efficiency of buildings. New timber frame buildings are particularly well placed to meet these requirements, because they use a truly sustainable material, offering high insulation values and good airtightness.

The fourth edition reflects significant growth in the market for timber frame buildings, and incorporates changes in building regulations. All sections have been revised to reflect current best practice and regulatory requirements.

This fifth edition reflects significant changes in regulations and best practice:

- Insulation in external walls is increased. TRADA Technology recommends a service zone on the inside face to accommodate additional insulation and relocated services.
- Alternative forms of construction are described for external walls.
- Thermal performance of party walls is enhanced with cavity insulation.
- Structural engineers are switching to Eurocode 5.

TRADA Technology is an independent consultancy company providing a wide range of commercial and training services to the timber and construction industries. Prior to 1994 it was wholly owned by TRADA, the Timber Research and Development Association. It is now a member of the BM TRADA Group of companies and is TRADA's appointed provider for its research and information programmes, and for the administration of its membership services.

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