TIMBER DEVELOPMENT UK

Build

B.40.05-04

Date Published
1 November 2024

Document Type
Timber Knowledge Sheet

Category
Build

Audience
Carpenter | Designer | Manufacturer | Installer

Theme
Internal

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External Timber Doors

External timber doors must work in a demanding environment – directly exposed to varying weather and extremes of heat and cold externally, while contending with a much more temperate climate internally.

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External timber doors

Doors are, of course, an essential component of any building. A timber external door can offer strength, security and protection against inclement weather.

Conditions

The life of a door, or a door set – where door and frame are supplied as a single unit – is often a harsh one.

In newly constructed home, an external door will often have to contend with a damp interior of the house – as the plaster and cement dry – and a dry exterior for the first few weeks of use; followed by a dry, heated interior and weather-exposed exterior for the remainder of its functional life.

Despite these climatic challenges, the door must remain secure, functional and attractive. It must not swell, shrink, or deform beyond a narrow tolerance range, and must remain true to its door frame. Locks and latches must continue to function, and the structure of the door must remain strong enough to provide effective security.

Mechanical loads on doors include:

- A heavy angular load from the door hanging from its hinges.
- Static torsion when forces push on one part of the door, such as: when it is opened with a handle or kicked from the footplate; or when the door closes on an object.
- Soft and heavy impacts, from people knocking on and striking the door, or the door striking its door jamb.
- Vibration and heavy vertical loads.

Thermal considerations include:

- Different temperatures and humidity on either side of the door – for example when it is snowy outside while the inside of the building is heated, or hot and humid outside with an airconditioned, dry interior.
- Sudden temperature changes – for example when the sun moves and casts the door into shadow after being in full sun all morning, or when the door is opened on a cold day, exposing the warm inside to the cold outside air.
- Heat absorption on the door's exterior due to dark paint colours.
- Different expansion and contraction rates for different materials in composite doors.

Moisture considerations include:

- Dry timber's hygroscopic nature: it tends to absorb moisture.
- Weather-facing doors being subject to wind, rain and dew, as well as water pooling in decorative details.
- The insides of doors being subject to high levels of moisture in new houses which are still drying out after the doors and windows are added, or while cement and plaster are drying.
- In a dry house, external doors face high differentials of moisture between the outdoors and the heated and dry interior.

Specification

Timber's hygroscopic quality means that species with small movement characteristics are most suitable for doorsets and will - along with the adhesives used - strongly influence the longevity of doorsets.

Timber selection within the species is also important. Sloping, distorted grain, knotty or tensioned grain, pith wood, juvenile wood, and wide growth rings indicating a rapid growth rate can all compromise an otherwise good design and high-performance finish.

BS EN 14220 Timber and wood-based materials in external windows, external door leaves and external doorframes. Requirements and Specifications provides guidance on specifying timber for doorsets, while **BS EN 942 Timber in joinery. General requirements** provide guidance on the movement behaviour of common tree species for non-structural timber uses.

As with all timber where movement is likely to be an issue, it is best to keep the doorset as close as possible to the moisture level required for its final installation. **BS EN 942** recommends 12% to 19% moisture content for external joinery. In summer, the timber moisture content may reduce to as little as 10% and rise as high as 25% for a weathered surface in winter.

Designs

In general, a canopy will protect a door and extend its useful life. The minimum protection is a moulding above the door to protect it from water from above. Weatherseals are required for tightness. Doorsets can be specified with a rebate on door or frame to provide anti-capillary and pressure-relief groves.

Clearance of 3mm should be incorporated around all doors to allow for moisture movement. The clearance between door and stop depends on which weatherseal is used. Weatherseals should be located so they do not foul hinges or locks.

Multi-point locks with espagnolette bolts can prevent distortion of the door while improving security, as can multi-point locking. Tapered or mushroom-headed bolts engage progressively and can help locate doors that have moved slightly.

Exposure of any timber end-grain should be avoided as it absorbs water more readily than the face. Exposed end grain should be sealed.

Insulation in doors can increase the risk of moisture being retained inside the door, and thus using a vapour control layer behind the inner face can prevent this problem occurring.

Specific door types have their own considerations:

Panel doors

- Panels of composite wood tend to move less than solid timber.
- Panels should not be glued, so they can move within the groove in which they are mounted, to prevent splitting.
- Panels are fitted into grooves that are generally 9mm deep at the edge, to allow for expansion across the width, and 3 mm deep at the top and bottom where expansion is less. Panels manufactured dryer than their in-use moisture content will need wider grooves to accommodate expansion.
- Panels are not usually weather tight unless the grove is sealed with a flexible, water-repellent material.
- Single-skin panel doors do not meet modern thermal requirements and a simulated panel-door skin can be constructed around an insulated core, using the same construction method as a flush door.

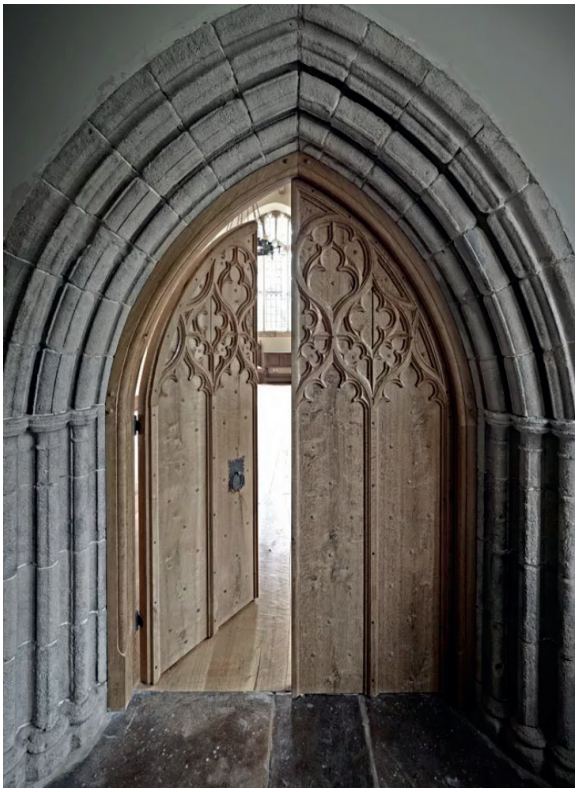

IMAGE: Hand-carved oak gothic doors by Jack Badger Ltd

Flush doors

- Flush doors have a skin on each side – usually smooth – with a light-weight core in the middle, which can include insulation and a frame.

- Flush doors should be made of the same materials and bonding on each side, as different strengths of bonding and different moisture contents of skins or the core can distort the door.
- The pattern of the frame inside the door can "telegraph" to the outside skin if the moisture is out of balance across the door.
- Finishes of different permeability on either face in the door can also cause moisture imbalance and distortion. The most vapour-resistant finish should always be on the internal face.

Boarded doors

- Single-skin boarded doors usually have tongue-and-groove boards on one side and a frame on the other.
- Single-skin boarded doors are unlikely to meet thermal requirements, though a similar visual effect can be achieved by applying a boarded face to an insulated core, with appropriate ventilation of breathable mesh behind the boards.
- Movement in boarded doors is predictable – a 4% increase in moisture across an 800mm wide door could expand the door by 1% or 8mm. Increasing moisture from 12% at manufacture to 20% in-situ could expand the door 16mm. These expansions can be eliminated by allowing 3mm expansion space for each individual board and using 100mm-wide boards. Shrinkage of boards wider than 100mm may cause the tongues to disengage from the grooves.
- Inadequate expansion provisions can cause a convex distortion, or even splitting, across the outer door face as expanding boards resist their fittings. Pre-drilling over-sized fixing holes in the boards can prevent this.

Regulations

External doors and their frames are measured for physical performance, thermal performance, sound insulation, security, and resistance to the elements. While a door may meet any specified criteria, the real test is the door and its frame working together. For this reason, it is often advisable to specify doorsets – units comprising door and door frame – on new builds and renovations.

Doorsets should display a CE Mark or the new UKCA or UKNI mark to show that they have met the following standards depending on their use:

- **BS EN 14351-1 Windows and doors**
- **BS EN 16034 Pedestrian doorsets, industrial commercial garage doors and windows**
- **PREN 14351-2 Windows and doors**
- **BS EN 14600 Doorsets and openable windows with fire resisting and/or smoke control characteristics.**

Doors intended to meet **Assessment and Verification of Constancy of Performance (AVCP) Level 3** or lower can self-certify. AVCP Level 1 doors that are used for emergency exits and other high-risk uses must be verified by a Notified Body – an independent assessment organisation that will inspect the manufacturing facility and products on a regular basis to ensure the standard is being met.

Doors must also meet these standards for specific performance elements:

- Thermal performance, when included in the performance test for the wall where they are fitted, to support a U-value calculation: **BS EN ISO 10077-1 Thermal performance of windows, doors, and shutters – calculation of thermal transmittance – Part 1: General** and / or **BS EN ISO 10077-2 Thermal performance of windows, doors, and shutters – calculation of thermal transmittance – Part 2: Numerical method for frames**.
- Acoustic performance (except in Scotland, unless specified due to site conditions): **BS EN ISO 10140-2 Acoustics. Laboratory measurement of sound insulation of building elements – Application rules for specific products**.
- Mechanical performance: **BS 644:2012 Timber Window and Doorsets: Fully finished factory-assembled windows and doorsets of various types. Specification**.
- Security performance according to **PAS 24 Enhanced security performance requirements for doorsets in the UK** and **Approved Document Q: Security – Dwellings**

Building Regulations in England, Wales, and Northern Ireland and, in Scotland, Technical Standards, provide further local requirements for:

- Fire performance, including locks, hardware and opening direction.
- Access, accessible thresholds, and door widths for access by people with disabilities.

Installation

As poor site storage can negatively affect a door's durability, fit, and performance, minimise the time doors are stored on site prior to installation by scheduling delivery as close to installation as possible.

If doors must be stored on site, keep them flat and level with support along their full length and width by at least three bearers, to prevent distortion, with spacers to protect any ironmongery from damage. Apply two coats of finish to all surfaces on unfinished doors immediately on delivery and keep pre-finished doors in their protective packaging. Maintain the moisture content of the doors by storing them in a warm, dry place.

Doors should be installed after a building has dried out following wet trades. Doors installed on a property that is still drying out may swell, distort, or stick as they take up moisture from the air, or may shrink after installation, leaving gaps once the building and door dry.

If doors must be installed before the house is dry, specifying more robust doors or door protection may preserve the door and its performance. Careful consideration of the fit of the door relative to its moisture content and relative humidity of the air may also protect the door.

Ideally, door furniture, letter slots, glazing, locks, peepholes, and other modifications are installed under controlled conditions in the factory. Making these modifications on-site risks introducing points of potential water ingress or drafts. Fitting door locks through joints such as a mortice-and-tenon may weaken the structure of the door and threaten its long-term stability.

Poorly fitting weatherboards or weather seals, their poor design or omission can affect the bottom of the door leaf or threshold and allow drafts or water into the building.

Using weather strips to protect the door will improve its resilience.

Finishes

Finishing treatments are important to the performance of the door, as well as being decorative.

High-build exterior stains – finishes that leave a thicker layer on the surface than other finishes – and good quality, flexible exterior paints are the finishes of choice.

Thin or brittle finishes – like penetrating oils, seals or stains, and brittle paints and varnishes are unlikely to provide adequate protection. This is particularly true for doors that face the sun where the drying effect can cause distortion of the door, resin bleed from some woods and blistering of the finish.