

# Conservation compendium

## Part 8. Bond timbers in old brickwork

This article forms part of the Conservation compendium, which aims to improve the way engineers handle historic fabric through the study of historic materials, conservation philosophy, forms of construction and project examples. Articles in the series are written by Conservation Accredited Engineers. The series editor is James Miller.

**Lawrance Hurst**, BSc, CEng, FStructE, FICE, FCGI, FCABE, Consultant, Hurst Peirce + Malcolm LLP

**Andrew Dutton**, MA, CEng, FStructE, FICE, FConsE, Consultant, Hurst Peirce + Malcolm LLP

### Introduction

Longitudinal timbers built into solid brick walls are called 'bond timbers'. They are generally 110mm wide × 75mm high – the width and height of one brick – are built into the inner face of the wall and can be expected to be found in buildings dating from the latter part of the 17th century up to the middle of the 19th century. Their primary purpose was to hold the brickwork together while the lime mortar gained strength, but they were also useful as grounds to provide fixings for panelling or other linings, such as vertical battens to which laths were nailed for plaster. There are usually two or three levels or tiers of bond timber in each storey, with one serving the double purpose of lintels over the windows, as well as acting as a tie.

An 18th-century manual on carpentry, quoted by Martin<sup>1</sup>, explains the purpose of bond timbers:

"I may venture to affirm that the carpenter's work is the chief tie and connection of a building; it is the ligament which binds the walls together.

"The bond-timbers, which strengthen and tie the angles of a building, and prevent its separating, is the work of the carpenter. Linteling over doors and windows, with other discharges of weight, it is his care to perform.

"Bond timbers in cross walls, when settlements happen, if they are well applied, prevent the cracking of the walls, for they keep the whole together, and every part settleth alike, which would fill the building with gaps and chasms if neglected."

Larger timbers, perhaps 225mm wide × 150mm high, were built into the centre of walls at least two bricks thick. These are known as 'chain bond' and are found in more substantial buildings, but were only used for a relatively short period of time: circa 1780–1840.

Diagrams of bond timbers are shown in Figure 1.

### History

Bond timbers came into general use following the Great Fire of London in 1666 because the Act of Parliament prescribing

requirements for the rebuilding stipulated that all external and party walls were to be of brick, instead of the timber generally used in the past. Rebuilding proceeded apace with any materials that could be found and incorporated bond timbers to restrain and tie the whole together as the lime mortar matured.

However, there was clear concern about the risk of fire spread caused by timbers built into party walls. As a result, between 1708 and 1774, several London Acts were passed attempting to restrict the use of timber in these walls. Nonetheless, it appears likely that architects, surveyors and builders, who may have been confused by the flood of legislation, turned the usual blind eye and carried on with their accustomed practices. Although these Acts applied only to London, construction throughout the country tended to follow that in London.

Nicholson's *Carpenter and Joiner's Assistant* (1797)<sup>2</sup> includes a plate (Figure 2) illustrating naked flooring for a house – incidentally without a stairwell – with elevations of the front and party walls showing four levels or tiers of bond timbers in addition to wall plates under the floor joist ends. It is to be noted that one tier of the bond timbers in the front wall continues across the window openings, to be cut out later when the mortar is mature.

The bond timber which formed the lintel over the windows was often 225mm wide × 150mm high. The shrinkage of this timber as it dried out could result in all the load passing through the outer half-brick thickness of the wall, and account for bulges in the front elevations above the windows (Fig. 1c) and lamination of

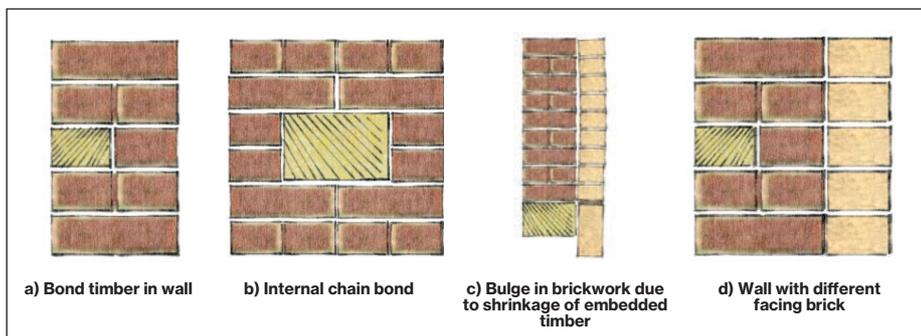
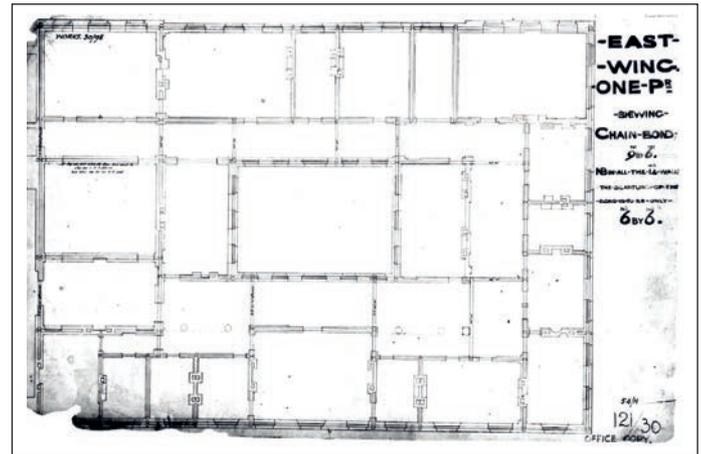
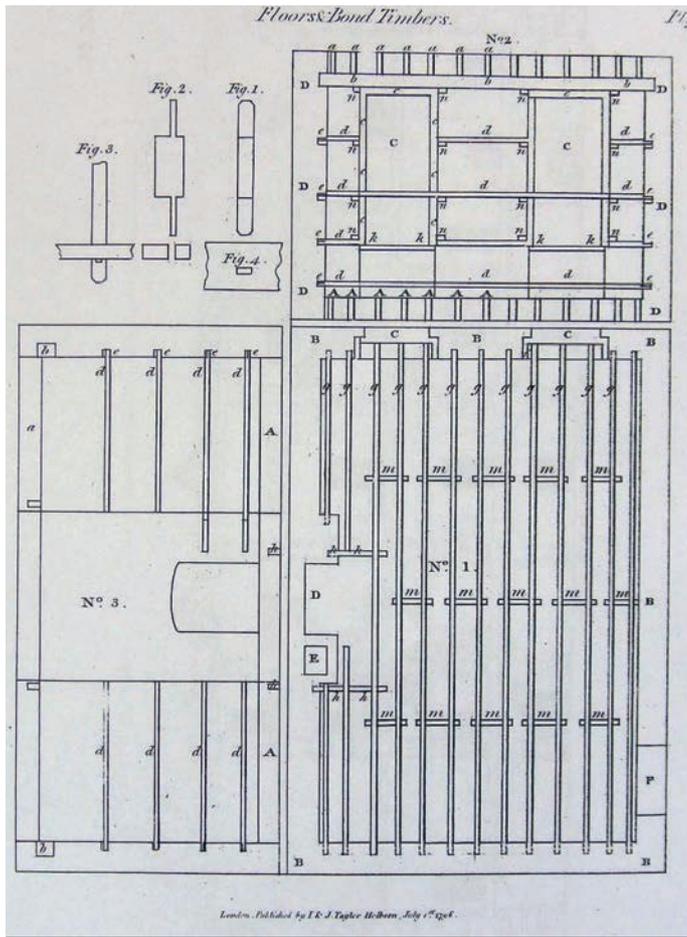


Figure 1  
Diagrams of bond timbers



**Figure 3**  
Floor plan of London Custom House (circa 1812) detailing chain bond timbers in both internal and external walls, across doorways, windows and corridors – “to be cut out afterwards”

**Figure 2**  
Plate from Nicholson's Carpenter and Joiner's Assistant (1797)

the brickwork where the outer half-brick leaf separates from the remainder of the brickwork, especially if snapped headers were used in the Flemish-bond outer skin.

### Chain bond

Towards the end of the 18th century, in more substantial buildings, bond timbers were built into the centre of walls. This had two purposes: to avoid potential disruption due to eccentricity when a bond timber in the internal face shrinks or rots; and to remove the timber to a location where it would be less liable to burn or char if a fire occurs. This chain bond was generally of a larger section, two or three courses deep and one brick wide, but of course the wall had to be at least three bricks thick (Fig. 1b).

“Chain timbers imply those which are completely buried in the wall, so that no part of them is seen after the brickwork is raised to a higher level”<sup>3</sup>. This definition, originally published in 1826, explains why chain bond comes as a surprise to most people concerned with alterations to late 18th and early 19th-century buildings. Until parts of the brickwork are cut away for some

purpose, it is entirely concealed.

The one place that it can be seen in cross-section is in the reveals of door and window openings, following removal of the linings. The puzzle as to why a substantial timber is built into the centre of a pier only a few feet wide is explained when it is appreciated that the chain bond was continuous through openings, and indeed even across corridors, to maintain the stability of the building under construction; it was cut out afterwards.

One of Laing's drawings for the London Custom House, construction of which started on site in 1812, uniquely details the chain bond at one floor level in the east wing (Figure 3). The drawing, held in the National Archives at Kew, shows timbers across window openings in the external walls, across doorways in the internal walls and even across corridors, noting that they are “to be cut out afterwards”. This confirms their purpose – to hold the walls in position while the lime mortar matured.

Our practice uncovered an example at the Duke of York's Headquarters in London (by John Sanders, 1801–03), when a 9in. ×

6in. timber was exposed in the centre of the relatively narrow piers between the windows when the shutter boxes were removed.

The fascinating drawing of construction in progress at Chelsea Hospital, used by Sir John Soane (Figure 4) to illustrate one of his Royal Academy lectures, shows the chain bond across the window openings as well as other details of construction.

Bond timbers were also used in foundations (Figure 5), as evidenced by the 9in. wide × 6in. high longitudinal void our practice found in the centre of the brick wall above the footings of the Duke of York's Headquarters, where a chain timber had entirely disappeared, although it had not led to any ‘inconvenience’.

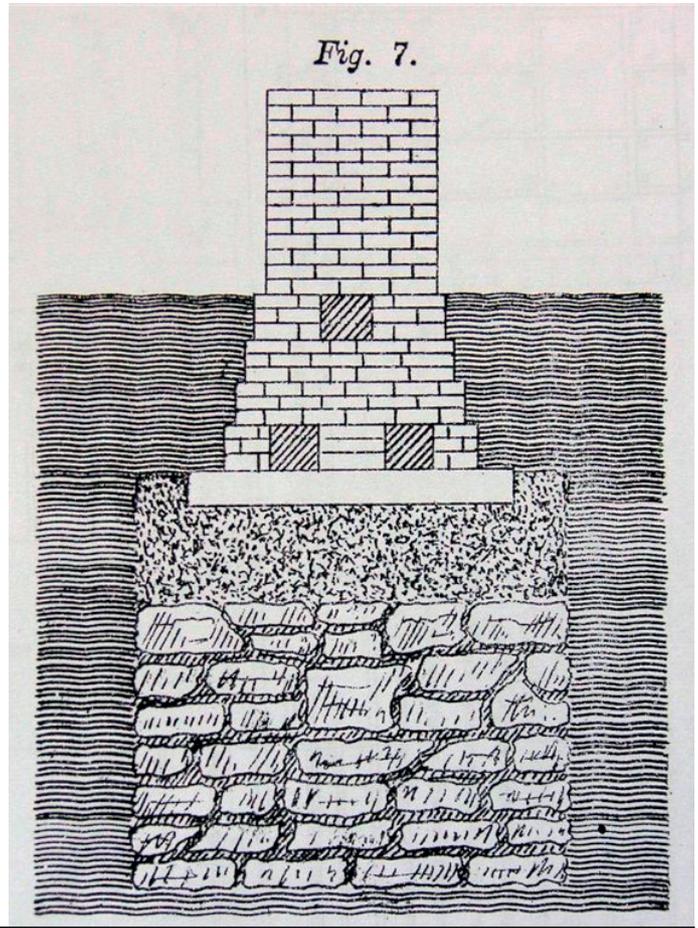
There has, however, been at least one case of collapse when a pier containing a void left where a chain timber had rotted was being underpinned. The local stress in the brickwork beside the void as underpinning proceeded was too much.

### Disillusion with timber bond

By 1830, disillusion was setting in, as indicated by a carpentry manual<sup>4</sup>:

“Building new timber into a wall is often a cause of decay, as the lime and damp brick-work are active agents in producing putrefaction, particularly where the scrapings of roads are used instead of sand for mortar. Hence it is that bond-timbers, wall-plates, and the ends of girders, joists and lintels are so frequently found in a state of decay.”

Insecurity in the front wall of a building at Great George Street in London, when undergoing alterations for the Institution of Civil Engineers, was attributed in *The Builder* in 1847 to “the slight bond timbers across the windows so that the whole front was in a dangerous state”<sup>5</sup>.



These concerns about decay of bond timbers, along with further restrictions on their use imposed in the 1844 London Building Act (due to their contribution to the spread of fire) resulted in them ceasing to be built into brick buildings after that date. Sometimes hoop iron laid in the bed joints was used in place of bond timbers, but only in substantial buildings.

**Figure 4**  
Drawing of construction work in Long Ward at Chelsea Hospital (circa 1814) showing chain bond timbers across window openings

**Figure 5**  
Chain bond timbers in foundations of buildings in Lancaster Place (Pasley, 1826)

### Modern implications and actions

Engineers are advised to be wary when working on brick buildings dating from the late 18th century to the middle of the 19th century and to be alert for chain bond timbers, or the voids they have left.

If you encounter bond timbers when working on an existing building, they should be checked by drilling to see if they are sound. Often they appear to be solid when exposed by the removal of plaster, but behind a shell of sound timber are completely rotten. If they are sound, there is no reason why they should not be left undisturbed; if they are decayed, then they should be removed in short lengths and replaced by new brickwork pinned in to make good the wall.

If you discover voids left where there had been chain bond, consider filling them with a grout compatible with the rest of the wall.

Lamination of the brickwork can be detected by sounding the wall with the heel of a hand from the outside and, sometimes, by gaps opening up in the reveals of the windows. Laminated walls can be tied by using resin-fixed pins drilled through the mortar joints from the outside.

### Acknowledgements

This article is based on a paper presented at the Second International Congress on Construction History at Queens' College Cambridge in 2006<sup>6</sup>. Further details and suggestions for further reading can be found in the paper.

Fig. 3 is reproduced with the consent of the National Archives. It is in Works 30 and relates to the London Custom House.

Fig. 4 is reproduced courtesy of the Trustees of Sir John Soane's Museum.

### References

- 1) Martin T. (1820) *The Circle of the Mechanical Arts*, London, UK: John Bumpus
- 2) Nicholson P. (1797) *The Carpenter and Joiner's Assistant*, London, UK: I & J Taylor
- 3) Pasley C. W. (1862) *Outline of a Course of Practical Architecture*, Chatham, UK: Royal Engineer Establishment
- 4) Tredgold T. (1828) *Elementary Principles of Carpentry* (2nd ed.), London, UK: J Taylor
- 5) Anon. (1847) 'The alterations at the Institution of Civil Engineers', *The Builder*, 6 March, p. 114
- 6) Hurst L. (2006) 'The Rise and Fall of the Use of Bond Timbers in Brick Buildings in England', *Proc. Second International Congress on Construction History*, Cambridge, 29 March–2 April [Online] Available at: [www.arct.cam.ac.uk/Downloads/ichs/vol-2-1633-1654-hurst.pdf](http://www.arct.cam.ac.uk/Downloads/ichs/vol-2-1633-1654-hurst.pdf) (Accessed: May 2015)