

A FIRE-RATED FRAME FOR A FIRE DOOR AND METHOD OF CONSTRUCTION

This invention relates to fire-rated frames for fire doors.

A variety of different kinds of fire doors are currently available from a variety of different manufacturers. These fire doors are given a rating which relates to the period of time for which the door can withstand the spread of fire. For a door to act effectively as a fire door, both the frame and the door must be resistant to fire - at least for an appreciable quantity of time. Traditionally, fire door frames have been constructed from steel or wood. Steel frames are typically provided in those situations where the door must resist the spread of fire for more than an hour. Wooden frames, on the other hand, are typically more susceptible to attack from fire and thus are used for doors requiring a fire resistance of less than one hour.

The time for which a given material will resist the spread of fire is conventionally known as the "fire rating" of that material. For example, materials with a high fire rating typically will resist the spread of fire for more than an hour, whereas materials with a low fire rating typically will resist the spread of fire for less than an hour. Non-fire rated materials, such as aluminium door frames, provide little or no resistance to the spread of fire.

In an ideal situation, all the doors in a given building would be fire-rated. However, due to the increased cost of fire doors with respect to non-fire rated doors, it is conventional to provide a small number of fire doors at strategic positions throughout a building and non-fire rated doors for the remaining doors of the building. This is particularly true in modern offices, for example, where it is commonplace to provide a partitioned space with the entrance door to the space being fire-rated, and the doors between the partitions being non-fire rated.

Traditional fire doors, whilst being of great utility in resisting the spread of fire, are typically not very attractive. In contrast, non-fire rated doors having, for example, polished aluminium door frames are very attractive and thus are widely used as non-fire rated doors between, for example, partitions of an office space. In addition, aluminium door frames are well suited for use with a partitioning system as their relatively low weight enables them to be easily mounted in a partition wall.

Unfortunately, in the event of a fire it is commonplace for the non-fire rated doors to provide little resistance to the spread of the fire with the result that the partitioned space in the office, for example, can often be destroyed. The failure of the non-fire rated doors can occur very quickly as the relatively low melting point of between 600 to 900°C of the door frames means that they typically only survive for ten to fifteen minutes in the high temperatures that quickly result from a fire. Furthermore, even if the temperature of the fire does not rise sufficiently to cause the frame to melt, a commonplace relatively low temperature can cause the frame to be softened to such a degree that the frame can no longer support the door which can then collapse out of the frame.

In order to increase the resistance of a building to the spread of fire, it would be highly desirable to provide relatively inexpensive fire doors which are as attractive as their non-fire rated counterparts. In this way, it would be possible to provide fire doors for all of the doors of a building without significantly increasing the cost, and without reducing the attractiveness of the interior of the building.

In accordance with the invention, there is provided a fire-rated frame for a fire door, the fire-rated frame comprising a hollow outer shell and a fire-rated structure provided within the outer shell for supporting at least one fire-rated door.

In this way, it is possible to provide an attractive door frame which utilises attractive materials of low melting point without reducing the fire rating of the door

incorporating that frame. The frame according to the invention may be used with a variety of different fire doors to achieve fire ratings from half an hour to more than four hours.

Preferably, the outer shell is non-fire rated. Preferably, the outer shell is of aluminum. The fire rated structure may comprise at least one fire resistant material. Preferably, at least a portion of the fire rated structure comprises a pourable fire resistant material. The fire resistant material may be cement or calcium silicate. In any event, it is preferred that the outer shell forms a mould for the pourable fire resistant material.

The fire-rated structure may also comprise a fire rated sub-frame, which may be of steel. Preferably, the outer shell is rigidly affixed to the sub-frame at regular intervals - which may be every 600 to 800mm. In any event, it is preferred that the outer shell is attachable to a wall adjacent to the frame.

The shell may include a projecting portion projecting into the doorway defined by the frame. The projecting portion may be a door stop. In which case, it is preferred that the door stop projects a distance of 10mm or more into the doorway. Preferably, the outer shell has a thickness less than 4mm - and more preferably a thickness of between 1 and 3mm.

The fire-rated structure may comprise one or more reinforcements. The one or more reinforcements may comprise a block of fire-rated material. The block may be of steel, calcium silicate or wood. In any event, it is preferred that the one or more reinforcements comprise one or more keys which cooperate with the fire-rated structure to retain the one or more reinforcements in place. The one or more keys may comprise one or more nails, screws, channels, depressions, notches, fish tailed pieces or flexible metal strips. Preferably, the one or more reinforcements are secured

to a wall adjacent the frame. The reinforcements may also be affixable to one or more fixings for supporting the door.

Preferably, the frame comprises a pair of spaced vertical jambs and a head jamb affixed thereto. The head jamb may be butt joined at each end to a respective one of the vertical jambs - in which case, each end of said head jamb may include a cut away portion directly connectable with a respective vertical jamb to form a channel for receiving at least a portion of the fire-rated structure.

Alternatively, the head jamb may be mitred at each end to a respective one of the vertical jambs - in which case, one or more interconnecting devices may be securely affixed at each end to one of the vertical jambs and to the head jamb, respectively. The outer shell may comprise internal fixing means formed therewithin, the fixing means cooperating with the one or more interconnecting devices to secure one jamb to another.

The one or more interconnecting devices may comprise a flat metal plate, attachable at each end to the fixing means of a respective jamb of a pair of jambs to be joined. Preferably, the interconnecting device is substantially "L" shaped.

Preferably, the one or more interconnecting devices comprise an "L" shaped flanged member shaped to closely abut at each end with at least a portion of a respective jamb of a pair of jambs to be joined. Preferably, the one or more interconnecting devices are hollow to allow a pourable fire resistant material, for example, to flow therethrough.

In accordance with a second aspect of the invention, there is provided a fire door comprising a frame as described herein and a fire-rated door supportable thereby.

In accordance with a third aspect of the invention, there is provided a kit for constructing a frame as described herein, the kit comprising: a hollow outer shell comprising a pair of vertical jambs and a head jamb; and a fire rated structure insertable within the hollow outer shell.

In accordance with a fourth aspect of the invention, there is provided a method of constructing a fire-rated frame for a fire door, the method comprising the steps of: constructing a hollow outer shell from a pair of vertical jambs and a head jamb; and at least partly filling the outer shell with a fire-rated structure to form the fire-rated door frame.

The constructing step may comprise the step of connecting the vertical jambs to a respective end of the head jamb. Preferably, the method comprises, prior to the filling step, the step of securing one or more reinforcements to the inside of the outer shell. The method may also comprise, prior to the filling step, the step of securing the one or more reinforcements to a wall adjacent to the frame.

In addition, the method may comprise, prior to the filling step, the step of securing one or more sub-frames to the inside of the hollow outer shell. Preferably, the method comprises the step of attaching the outer shell to the one or more sub-frames at regular intervals.

The filling step may comprise causing at least a portion of the fire-rate structure to flow into the hollow outer shell. At least the portion of the fire-rated structure may be poured into the outer shell from above the head jamb. Alternatively, at least the portion of the fire-rated structure may be pumped into the outer shell.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figures 1A and 1B show a single fire door and a double fire door, respectively, each including a fire-rated frame according to the invention;

Figures 2A and 2B are each cross-sectional views of a vertical jamb of a fire-rated frame according to a first and second embodiments of the invention;

Figure 3 shows a cross sectional view of a previously proposed door frame;

Figures 4A and 4B show a variety of reinforcements that may be employed with the frame shown in Figures 2A and 2B;

Figure 5 shows a door frame wherein a vertical jamb and a head jamb thereof have been mitred together;

Figure 6 shows a door frame wherein the vertical and head jambs have been butt joined;

Figure 7 shows a cut away head jamb for butt joining with a vertical jamb;

Figure 8 shows an intact head jamb for butt joining with a vertical jamb;

Figure 9 shows a variety of internal fixing means;

Figure 10 shows a variety of interconnecting devices;

Figure 11 shows an alternative arrangement for butt joining a pair of jambs; and

Figure 12 shows an alternative arrangement for mitred joining of a pair of jambs.

Figure 12A shows a cross sectional view of mitred joining of a fire-rated frame according to a first and second embodiments of the invention.

A further alternative arrangement for mitred joints is shown in Figure 12 and 12A

As shown in Figures 1A & 1B, a fire door 10,20 comprises a fire-rated frame 12 and a fire-rated door 14 supported by the frame 12. The fire door may comprise a single door 10, or a double door 20 having a single frame 12 and a pair of fire-rated doors 14 supported thereby. Preferably, the door frame 12 has an attractive outer surface of an attractive material, such as aluminium, that typically is also non-fire rated. The composition and construction of the fire-rated door is well known and will

not be further described herein. The frame 12 comprises a pair of vertical jambs 12a and a head jamb 12b joined thereto in a manner to be later described.

As shown in Figure 2A, the door frame 12 comprises a hollow outer shell 22, of aluminium for example, and an inner fire-rated structure 24. In this embodiment, the inner fire-rated structure comprises a pourable fire-rated material such as cement. Advantageously, the hollow outer shell 22 forms a mould within which the cement, for example, may be cast. The cement, or other pourable fire-rated material, provides the fire-rating for the door frame.

Figure 2B shows a second embodiment wherein the inner fire-rated structure 24 includes a fire-rated sub-frame 26, of steel for example, which is provided within the outer shell before the cement, or other suitable material, is cast therewithin. The steel sub-frame 26 includes a projecting portion 28 which may be formed integrally with the sub-frame or later attached thereto by welding, for example. The projecting portion 28 performs an important function which will later be described. Once the door frame has been assembled, the outer shell can be secured to the sub-frame at regular intervals, for example every 600-800mm, so as to physically restrain distortion of the shell during a fire. The sub-frame is preferably secured to a wall adjacent the door frame and may also include reinforcing members that can also be secured to the wall. The reinforcing members may not be necessary for lighter fire doors.

As shown in Figure 2B, the outer shell is partly filled with the sub-frame and the fire-rated structure. As an alternative, the fire-rated structure could be provided on both sides of the sub-frame within the outer shell so that the outer shell is completely filled by the fire-rated structure - as in the embodiment shown in Figure 2A.

Previously proposed aluminium door frames tend to expand when heated and the expansion can cause twisting and/or bowing of the frame. As the frame expands,

gaps can appear between the door and the frame and the fire can pass through the gap.

This problem is alleviated in the presently proposed door as the hollow outer shell, when filled with the fire-rated structure, is reinforced by the fire-rated structure such that the likelihood of bowing and/or twisting of the frame is reduced. Furthermore, the fire-rated structure helps to insulate the side of the frame away from the fire so that it heats up less quickly and thus any twisting, bowing or melting of the frame is delayed.

As mentioned above, there are currently a large number of available fire-rated doors. These doors are typically of timber or metal with composite or timber cores. Metal doors are susceptible to warping, twisting or bowing and wooden doors are susceptible to shrinking or burning. As the doors deform, gaps can appear between the door and the door frame with the result that the fire can pass between the door and the frame.

It is commonplace for door frames to include a projecting portion, known as a door stop, against which the door abuts when in the closed position within the frame. With the above mentioned previously proposed aluminium gap it is common for these door stops to melt, and failure of the door to occur as a result of the gap between the door and the frame. Figure 3 shows a cross sectional view of a portion of one of these previously proposed frames. A failure of the projecting portion 30 could give rise to a considerable gap between the door and the frame.

In order to alleviate this problem, it is preferred that the frame includes a door stop with a minimum depth of 10mm in order to protect the door edges. In the above described first and second embodiments, the door stop is formed by filling a projecting portion 32 (Figure 2A) with the fire-rated structure, or by providing a fire-rated projection 28 (Figure 2B) in the door stop. In this way, and following any melting of

the outer shell, the fire-rated structure filling the projection forms an incombustible door stop behind the door.

To reduce the likelihood of gaps being produced, it is preferred that the thickness of the outer shell 22 does not exceed 4mm. If the outer shell thickness were to be greater than 4mm, then the gap created by the melting outer shell combined with the 3-5mm clearance gap, for example, required between the door 14 and frame 12 would leave a large gap where the passage of fire is possible.

Furthermore, although the expansion and deformation of the outer shell 22 is more related to the length of time and the temperature of the fire to which it is exposed, it may generally be shown that a thicker outer shell results in a greater force in expansion, twisting and/or bowing. A thinner outer shell would expand at the same rate, but would exert less force and thus would require less fixings and be more stable. In view of this, the thickness of the outer shell must carefully be controlled. An outer shell thickness of between 1-3mm is preferred to balance economic and safety considerations.

As mentioned above, the aluminium alloys of previously proposed door frames begin to soften and melt around 600-700 degree C, which temperature can be reached within 10-15 minutes from the start of a fire. As a result of this, the traditional methods of fixing the door to the frame, or to backing plates attached to the frame are not sufficient to securely support the door when the outer shell softens and melts.

In view of this, it is preferred that additional reinforcements are provided behind the outer shell 22 which are used to hold hinges and other hardware securely to the wall even after the outer shell 22 has melted. For fire ratings above 90 minutes where temperatures are in excess of 900°C the reinforcements could be of steel or calcium silicate, for example. For fire ratings of less than 90 minutes, timber or timber based

(e.g. MDF, chipboard, hardboard) material, for example, can be used. Other suitable materials will be apparent to persons skilled in the art.

The reinforcements can be glued, nailed, screwed or wedged within the outer shell of the frame. Preferably, the reinforcements have one or more grooves, channels or hollows to provide one or more keys with which the fire-rated structure can cooperate to firmly hold the reinforcements in place. Screws, nails or metal straps (for example) can be provided for securing the reinforcements to a wall adjacent the frame.

Figures 4A and 4B show a variety of reinforcements that may be employed with the frame shown in Figures 2A and 2B. As mentioned above, the reinforcements may be of any one (or more) of a variety of different materials. In Figure 4A(1) the reinforcement 32 comprises a block which has a pair of screws or nails 34 fixed thereto in order to provide a key which can cooperate with the fire-rated structure 24 to hold the reinforcement in place within the frame. Figures 4A(2) and (3) show reinforcements with an alternative key comprising an illustrative pattern of projections, channels and/or depressions 34. Figures 4A(4) and (5) show alternative fixings comprising a metal fish tail 36 and a flexible metal strap 38, respectively. The fixings shown in Figures 4A(4) and (5) provide a means for securing the reinforcement to a wall adjacent the frame as well as providing a key that can cooperate with the fire-rated structure.

Figure 4B(1) shows another reinforcement comprising a "slot-in" metal plate that may be slotted into a portion of the outer shell. Alternative reinforcements are shown in Figures 4B(2) and (3). Figures 4B(2) and (3) show a substantially C-shaped slot-in member 40 with an attached metal strap 38, that can also be slotted into the outer shell. As shown in Figure 4B(4) the slot-in member 40 may be provided with a number of apertures 41 which can cooperate with the fire-rated structure to hold the reinforcement in place.

Figure 4B(5) illustrates a variety of different reinforcements comprising, from left to right, a reinforcement with keys comprising a bent end and a fish tail 36, a reinforcement with keys comprising a pair of flexible metal strips 38 which can be secured to the wall, a reinforcement with keys comprising a single longitudinal flexible metal strip 38 which can be secured to the wall, a reinforcement with keys comprising a pair of fish tails 36, a reinforcement of "T"-shaped cross section with a key comprising a plurality of holes, and a reinforcement having keys comprising a pair of bolts or screws 34.

For lighter doors, the reinforcement may be between 0.5mm-2mm thick. For heavier doors, the reinforcement may be between 4-7mm thick. The reinforcement may be of wood, steel, calcium silicate or any other suitable material. As an alternative, expansion bolts - for example - can be used to secure the hinges, for example, directly to the wall (i.e. through the aluminium frame) without the use of reinforcements.

From the above, it will be apparent that the outer shell is not intended to provide any structural support for the door. Rather, the outer shell purely functions as a mould for the inner fire-rated structure as well as being cosmetically attractive. Support of the door is achieved by attaching the door to the reinforcements which are fixed either to the fire-rate structure or directly to the wall.

As mentioned above, in order to avoid gaps between the door and the frame, it is required to fill the outer shell 22 completely with the inner fire-rated structure. Accordingly, it is preferred that the corners of the frames are fully filled with the fire-rated structure. It is also preferred that the finished frames, when assembled from the vertical and head jambs, are architecturally acceptable and not unsightly with exposed screws, for example.

Upper corners of the vertical jambs 12a can be mitred to the head jamb 12b, as shown in Figure 5, or can be butt joined as shown in Figure 6. A variety of different methods may be used.

If the vertical 12a and head 12b jambs are to be butt joined then, as shown in Figure 7, in order to ensure that the corner of the frame can be fully filled with the fire-rated structure when the vertical and head jambs are butt joined, a portion of the door stop 32 of the head jamb 12b must be removed to create a "through" channel 42 at the back of the jamb which allows the fire-rated structure to fill both the vertical 12a and head 12b jambs of the frame. As shown in Figures 8(a) and (b), the vertical jamb 12a cannot simply be butted against the head jamb 12b as this would cause the space behind the vertical jamb to be interrupted by the head jamb. This interruption at the top of a 7ft high door frame would be very difficult to fill with the fire-rated structure. Obviously, such considerations are not applicable to mitred joints.

The vertical 12a and head 12b jambs may be joined by a variety of methods. For example, they may be welded together. However, this method is only really suited for those frames which would be painted later to cover any weld marks that might occur during the joining. The welding can be spot welded (from the back, for light doors) or fully welded. This would leave a joint line visible from the outside of the door frame. If this joint line is not acceptable to the client then the joint can be filled with metal putty and sanded smooth. Alternatively, the joint can be fully welded on the outside of the frame and sanded smooth.

Screw fixing of corner joints may be used as an alternative to welding in those circumstances where no welding work or screws must be visible from the outside of the frame. Internal fixing means such as ribs, fins or protrusions may be formed within the outer shell 22 of the vertical 12a and head 12b jambs so that they can be fastened together by one or more of a variety of interconnecting devices 44. Figures 9(1) to

9(6) show, in ghost, a variety of internal fixing means 46 that may be formed within the outer shell 22.

As shown in Figure 10, the interconnecting devices 44 can be straight (Figure 10(1)), or for more rigid frames "L" shaped devices can be used (Figure 10(2)). The "L" shaped devices can be flat (Figure 10(2)), or shaped with flanges (Figure 10(3), 10(6) & 10(8)), or bent to fit within the projecting portions of the two jambs (Figure 10(4) & 10(5)). The devices may also include one or more strengthening arms (Figure 10(7)).

An alternative arrangement for butt joints, for example, is shown in Figure 11. As shown, one or more channels 48 are formed within the outer shell 22 that are each capable of receiving a screw therein. The jamb (in this example the head jamb 12b) to be affixed to the other jamb (in this case a vertical jamb 12a) is provided with a corresponding number of screw holes 50 which allow the screws to be threaded into the channels of the other jamb. As mentioned above, it is important to ensure that a channel 42 is maintained between the two jambs to allow the fire-rated structure to fill the jambs.

A further alternative arrangement for mitred joints is shown in Figure 12 and 12A. As shown, an internal sleeve 52 may be provided each end of which may be slid within a respective jamb to be joined. The sleeve may comprise a hollow "L"-shaped body (Figure 12(1)), an "L"-shaped body open on one face (Figure 12(2)), an "L"-shaped body of similar shape to that of the outer shell (Figure 12(3)), and may include one or more expanding means 54 to allow for adjustment of the sleeve width (Figure 12(4)).

Any of the sleeves or interconnecting devices described above may be of metal, wood, or even thermo-setting plastic as the sleeves and interconnecting devices only function to hold the jambs in place during the insertion of the fire-rated

structure. Once the fire-rated structure has been installed, the function of the sleeves and interconnecting devices has been performed.

It will be understood that the invention has been described herein by way of example only, and that modifications may be made within the scope of the invention.

For example, whilst embodiments have been described herein in relation to an aluminium outer shell, it should be noted that other materials may be employed instead. Similarly, whilst the fire-rated structure described herein includes a material such as cement, it will be understood that other materials may be utilised instead (calcium silicate, for example).

CLAIMS

1. A fire-rated frame for a fire door, the fire-rated frame comprising a hollow outer shell and a fire-rated structure provided within the outer shell for supporting at least one fire-rated door, wherein the fire-rated structure comprises one or more reinforcements.
2. A frame according to Claim 1, wherein the outer shell is non fire-rated.
3. A frame according to Claim 1 or Claim 2, wherein the outer shell is of aluminium.
4. A frame according to any of Claims 1 to 3, wherein the fire rated structure comprises at least one fire resistant material.
5. A frame according to any of Claims 1 to 4, wherein at least a portion of the fire rated structure comprises a pourable fire resistant material.
6. A frame according to Claim 5, wherein the fire resistant material is cement.
7. A frame according to Claim 5, wherein the fire resistant material is calcium silicate.
8. A frame according to any of Claims 5 to 7, wherein the outer shell forms a mould for the pourable fire resistant material.
9. A frame according to any of Claims 4 to 8, wherein the fire-rated structure also comprises a fire rated sub-frame.
10. A frame according to Claim 9, wherein the fire-rated sub-frame is of steel.

11. A frame according to Claim 10, wherein the outer shell is rigidly affixed to the sub-frame at regular intervals.
12. A frame according to Claim 10 or Claim 11, wherein the outer shell is bolted to the sub-frame every 600 to 800mm.
13. A frame according to any preceding claim, wherein the outer shell is attachable to a wall adjacent to the frame.
14. A frame according to any of Claims 1 to 13, wherein the shell includes a projecting portion projecting into the doorway defined by the frame.
15. A frame according to Claim 14, wherein the projecting portion is a door stop.
16. A frame according to Claim 15, wherein the door stop projects a distance of 10mm or more into the doorway.
17. A frame according to any preceding claim, wherein the outer shell has a thickness less than 4mm.
18. A frame according to Claim 17, wherein the outer shell has a thickness of between 1 and 3mm.
19. A frame according to Claim 1, wherein the one or more reinforcements comprise a block of fire-rated material.
20. A frame according to Claim 19, wherein the block is of steel.
21. A frame according to Claim 19, wherein the block is of calcium silicate.
22. A frame according to Claim 19, wherein the block is of wood.

23. A frame according to any of Claims 1, 19 to 22, wherein the one or more reinforcements comprise one or more keys which cooperate with the fire-rated structure to retain the one or more reinforcements in place.
24. A frame according to Claim 23, wherein the one or more keys comprises one or more nails, screws, channels, depressions, notches, fish tailed pieces or flexible metal strips.
25. A frame according to any of Claims 1, 19 to 24, wherein the one or more reinforcements are secured to a wall adjacent the frame.
26. A frame according to Claim 25, wherein the reinforcements are affixable to one or more fixings for supporting the door.
27. A frame according to any preceding claim, wherein the frame comprises a pair of spaced vertical jambs and a head jamb affixed thereto.
28. A frame according to Claim 27, wherein the head jamb is butt joined at each end to a respective one of the vertical jambs.
29. A frame according to Claim 28, wherein each end of said head jamb includes a cut away portion directly connectable with a respective vertical jamb to form a channel for receiving at least a portion of the fire-rated structure.
30. A frame according to Claim 27, wherein the head jamb is mitred at each end to a respective one of the vertical jambs.
31. A frame according to claim 30, comprising one or more interconnecting devices securely affixed at each end to one of the vertical jambs and to the head jamb, respectively.

32. A frame according to Claim 31, wherein the outer shell comprises internal fixing means formed therewithin, the fixing means cooperating with the one or more interconnecting devices to secure one jamb to another.
33. A frame according to Claim 31 or Claim 32 when dependent upon any of Claims 5 to 7, wherein the one or more interconnecting devices are hollow to allow the pourable fire resistant material to flow therethrough.
34. A frame according to Claim 31 and Claim 32, wherein the one or more interconnecting devices comprise a flat metal plate, attachable at each end to the fixing means of a respective jamb of a pair of jambs to be joined.
35. A frame according to any of Claims 31 to 35, wherein the interconnecting device is substantially "L" shaped.
36. A frame according to Claim 31 and Claim 32, wherein the one or more interconnecting devices comprise an "L" shaped flanged member shaped to closely abut at each end with at least a portion of a respective jamb of a pair of jambs to be joined.
37. A fire door comprising a frame according to any preceding claim and a fire-rated door supportable thereby.
38. A kit for constructing a frame according to Claim 1, the kit comprising: a hollow outer shell comprising a pair of vertical jambs and a head jamb; and a fire rated structure insertable within the hollow outer shell.
39. A method of constructing a fire-rated frame for a fire door, the method comprising the steps of: constructing a hollow outer shell from a pair of vertical jambs

and a head jamb; and at least partly filling the outer shell with a fire-rated structure having one or more reinforcements to form the fire-rated door frame.

40. A method according to Claim 41, wherein the constructing step comprises the step of connecting the vertical jambs to a respective end of the head jamb.

41. A method according to Claim 39 or 40, comprising, prior to the filling step, the step of securing one or more reinforcements to the inside of the outer shell.

42. A method according to Claim 41, comprising, prior to the filling step, the step of securing the one or more reinforcements to a wall adjacent to the frame.

43. A method according to any of Claims 39 to 42, comprising, prior to the filling step, the step of securing one or more sub-frames to the inside of the hollow outer shell.

44. A method according to Claim 43, comprising the step of attaching the outer shell to the one or more sub-frames at regular intervals.

45. A method according to any of Claims 39 to 44, wherein the filling step comprises causing at least a portion of the fire-rate structure to flow into the hollow outer shell.

46. A method according to Claim 45, wherein at least the portion of the fire-rated structure is poured into the outer shell from above the head jamb.

47. A method according to Claim 45, wherein at least the portion of the fire-rated structure is pumped into the outer shell.