

SPECIFICATION

Reinforcement masonry lintels and method for construction thereof in brickwork

5 This invention relates to reinforced masonry lintels, and to a method of constructing an opening in a masonry wall using such lintels. 5

In the past when an opening is required in a brick or block masonry wall (hereinafter referred to as a "brick wall"), it is known to provide a lintel across the opening onto which the next course of bricks is laid. The lintel may be of steel, timber or reinforced concrete.

10 A number of disadvantages occur with the use of the lintel described above. The fact that the lintel is exposed means that the appearance of the opening is unsatisfactory and more importantly in the case of steel or timber, the fire rating of the wall is substantially reduced. 10

Because the wall above the lintel is considered to be dead weight on the lintel it is necessary to provide a lintel having high strength and low deflection characteristics. When the width of the opening becomes over several metres it is difficult to find a lintel having the required strength and low deflection. Thus, it is not uncommon to find cracks appearing in a wall over such an opening due to deflection of the lintel. 15

It is an object of this invention to provide a reinforced masonry lintel which may be used in the construction of openings in brick walls which overcomes the problem of an exposed steel or timber lintel, and which is lower in cost than the presently used exposed lintels.

20 It is another object of the invention to provide a reinforced masonry lintel which may be readily constructed by the workman during the laying of the brick wall. 20

According to the invention there is provided a reinforced masonry lintel comprising a first course of masonry bricks forming the bottom of the lintel, a second course of masonry bricks immediately above said first course, and a strip member positioned in the first bed joint between said first and second courses; said strip member being of sufficient length to extend past both sides of the opening over which the lintel is to be positioned; and two end-stop members, each being adapted to be attached to the strip member proximate its ends, so that an upstanding portion of each end stop member is positioned in a head joint of said second course of masonry bricks outside the opening over which the lintel is to be positioned. 25

In one form of the invention the strip member is provided with means which co-act with means carried by an end-stop member, whereby to enable attachment of the end-stop member to the strip member. 30

The invention also includes a method of constructing an opening in a brick wall which comprises constructing the abutments, and constructing thereon a reinforced masonry lintel as described above.

The invention also provides a method of constructing an opening in a brick wall using the reinforced masonry lintel described above. In the method of the invention each of the end-stop members are positioned outside the vertical lines of the opening. 35

In a particularly preferred embodiment of the invention the strip member has a series of holes along its length and each of the end-stop members are L-shaped with at least one projecting lug on a first arm which is receivable in the holes in the strip member. Because of the arrangement of the holes in the strip member it is possible to select a position for the end-stop members, on said strip member, whereby the upstanding second arm of each end-stop member corresponds to a head joint of the course of bricks above. 40

In another aspect of the invention it has been found preferable to further reinforce the lintel with stirrup members where more than two courses of bricks are to be positioned above the opening. This further reinforcing increases the load bearing capability of the lintel.

45 The stirrup members have a body portion in the form of a flat web, from which two perpendicular parallel off-set arms depend. The flat web is positioned in a bed joint (a horizontal mortar course) of the wall and is of a length whereby each of the parallel arms is received in a head joint of the wall (a vertical mortar course); one above and one below the bed joint containing the web. The positioning of the stirrup member is important and will be described in more detail hereinafter. 45

50 The strip and end-stop members and stirrups are preferably made of metal but may be formed from any material having the required tensile strength. 50

In order that the invention be more fully understood preferred embodiments will be described with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a preferred strip member;

55 Figure 2 is a side view of a preferred end-stop member capable of attachment to the strip member of figure 1; 55

Figure 3 is a side view of a stirrup member;

Figure 4 is a representation of the reinforced lintel of the invention in place in a brick wall, and showing the positioning of the members of figures 1 and 2, and some preferred positioning of the stirrups of figure 3. 60

Referring to figure 1 of the drawings there is provided a strip member 1 made of 30 mm mild steel having a plurality of holes 2 provided therein along its longitudinal axis. The strip member is designed for use in a clay brick wall and has a width of 50 mm.

65 Figure 2 of the drawings shows an end-stop member, in side elevation. The end-stop member 3 has two arms 4 and 5 and is also made of 3 mm mild steel and has a width of 50 mm. Arm 5 of the member 3 65

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carries a lug 6. The lug is cylindrical and is sized to engage neatly into a hole 2 in strip member 1.

Figure 3 of the drawings shows a stirrup member 7 in side elevation. The stirrup member 7 has two off-set parallel arms 8 and 9 joined by a web 10 which is joined to one end of each of arms 8 and 9 at right angles.

5 The web 10 is shown of variable length because it is necessary to make the length of the web 10 to suit the size of brick being used and/or the pattern of brick laying. Also it is envisaged in the invention that the stirrup may extend horizontally for either a length less than a brick, or, a length greater than a brick, with the proviso that the arms 8 and 9 extend into head joints, one on either side of the web 10.

Web 10 is provided with an elongated hole (not shown) of a size which does not significantly reduce the tensile strength. The hole assists in bedding the stirrup in the bed joint.

10 The reinforced masonry lintel of the invention is shown in figure 4. The lintel spans the opening 11 in a brick wall 12.

Above the opening 11 a strip member 101 having a plurality of holes 102 along its longitudinal axis is positioned in the first bed joint. The ends of the strip 101 extend beyond both sides of the opening. An end-stop member 103 is provided adjacent each end of strip 101 and is engaged with the strip by means of a downwardly projecting lug 106 thereon which passes through one of the holes 102 in the strip. Each end-stop 103 is engaged with the strip 101 so that the arm 104 coincides with a head joint of the next course of bricks. To facilitate use of the strip 101 and end-stops 103 and to prevent relative movement during construction of the wall, the lug 106 may be flattened over after passing through the hole 102 in the strip.

Both strip 101 and end-stops 103 are of metal and are of a width less than the width of the brick, so that they are completely contained within the mortar courses.

15 If the lintel shown in figure 4 was only two brick courses in depth no further reinforcing is envisaged by the invention. However, where the lintel is more than two courses in depth it is possible, according to the invention, to further reinforce the lintel.

This further reinforcement is achieved by means of the stirrup members 7 referred to above.

In figure 4 there is shown three preferred embodiments of arrangement and positioning of the stirrup members of the invention.

Referring again to the figure there is shown a number of stirrup members 107. The stirrups 107 are positioned in the succeeding bed joints above the strip member 101. Thus the first stirrup is positioned in the second bed joint above the opening. Each stirrup 107 has two perpendicular parallel, off-set arms 108 and 109 connected by a web section 110. The downturned arm 109 of the first stirrup to be positioned must be opposed to the arm 104 of the end-stop and must extend into the same brick course as the arm 104, as shown. Also the arm 109 must be closer to the centre of the lintel than both the arm 104 of the end-stop, and the upturned arm 108.

The second stirrup is positioned with its web 110 in the third bed joint above the opening and with the same orientation as the first stirrup. The upturned arm 108 must be in the next head joint closer to the centre of the opening than the head joint containing arm 108 of the stirrup immediately below. The third stirrup is positioned in like manner in the fourth bed joint above the opening.

40 In this embodiment it will be seen that the line of stirrup 107 generally converges towards the centre of the opening. At the same time during laying of the wall, stirrups 107 are being positioned at the other end of the lintel in like manner.

It has been found that for practical purposes reinforcement is not of significant advantage after a height of brickwork greater than one half of the clear span of the opening.

45 Shown at the other side of figure 4 is a second embodiment of stirrups 207. These stirrups also have two perpendicular, parallel, off-set arms 208 and 209 and a web 210. The web 210 also has an elongated hole therein to facilitate bedding of the stirrup in the mortar course.

In this embodiment the web 210 has a length which corresponds to one and one half the times the length of the brick. The stirrups 207 are positioned in a manner similar to the stirrups 107, with the downturned arm 209 of the first stirrup being in the same brick course as the arm 104 of the end-stop 103, and closer to the centre of the opening than both the arm 104 the upturned arm 208.

50 In the drawing the first stirrup 207 is shown positioned with two full bricks between the downturned arm 209 and the arm 104. Equally preferred is the position where the stirrup 207 is moved one brick length away from the centre of the opening. Other positions for the first stirrup, either closer to the centre of the opening, or where the end-stop 103 is further away from the opening, are less preferred.

55 A third embodiment for positioning of the stirrup members is shown partly in broken lines as stirrup 307. The stirrup 307 is the same as stirrup 207 but is arranged differently in the lintel. In this embodiment of the invention the first stirrup 307 is positioned as for the first stirrup 207. The second stirrup 307 (shown as broken line) is positioned with the same orientation but with its arms 308 and 309 in the next head joints away from the centre of the opening.

60 The third stirrup 307 is positioned directly above the first, and the fourth stirrup 307 directly above the second and so on, until the required reinforcement is obtained.

As shown the orientation of the stirrups 107, 207 and 307 is the same for all stirrups at a particular end of the lintel.

65 While the theoretical explanation of the invention is still to be conclusively proved, it is believed the

strength of the masonry lintel of the invention relies on the reinforcing against slippage of one brick course relative to another, when a load on the lintel causes deflection. The inclusion of stirrups at the location of maximum shear stresses in the lintel enables the brickwork to act as a web or diaphragm such that the compressive stress in the brick-work at the top of the lintel is resolved into tensile forces in the steel at the bottom of the lintel.

The following examples are provided to further illustrate the invention. Throughout the examples reference to mortar compositions is by the ratios of cement: lime: sand.

EXAMPLE 1

Five reinforced masonry lintels were constructed using traditional size metric pressed bricks. The mortar composition was 1:2:9 which is a usual mortar strength for wall construction above damp-proof course.

The strip member was embedded in the first bed course above the opening and the end-stop members and strip members were formed from 3mm mild steel. A connector member having four lugs thereon was used in specimen no. 5 to connect two strip members together. Two lugs from the connector were located in two holes of each of the strip members.

The specimens were tested at 28 days age to determine their ultimate strength, the nature of cracking and the load at which cracking first appeared, mode of failure, deflection under load, the performance of the steel components and the ease with which the system could be assembled and installed in the brick-work.

Results of Example 1 Ultimate Loads

Specimen No.	Height of Lintel mm (1)	Clear Span mm	Maximum load kN (2)	Maximum Uniformly Distributed load kN/m
1	253	1670	11.95	14.31
2	334	2650	9.40	7.09
3	253	1210	23.06	38.12
4	253	1670	11.95	14.31
5	425	3610	9.20	5.10

NOTES: (1) Height of Lintel above strip member
(2) Single Centre point load

Load Deflection Performance, for specimens 1-4

Load kN	Specimen No. Deflection mm.			
	1	2	3	4
1.30	0.00	0.00	0.00	0.44
2.40	0.08	0.22	0.15	0.36
3.40	0.08	0.22	0.15	0.36
4.70	0.36	1.40	0.35	0.66
5.70	0.49	2.35	0.45	1.05
6.25	—	3.17	—	1.28
6.80	0.63	3.66	0.60	1.48
7.40	0.78	4.02	0.68	1.72
8.00	0.94	4.32	0.72	1.92
8.55	1.16	4.74	0.80	2.18
9.10	1.42	5.13 (470)	0.86	2.43
9.75	1.60	Collapse 470	0.94	2.79
10.40	1.78		1.02	3.02
10.93	1.95 (54)		1.18	3.25
11.45	3.50		1.37	35.1 (570)
12.03	Collapse 575		1.45	6.20
12.60			1.54	Collapse 575
13.20			(1.67)	
13.80			1.82	
14.35			1.94	
14.90			2.02	
15.55			2.52 (750)	
16.20			5.50	

16.73	5.95	
17.25	6.20	
17.87	6.60	
18.50	6.90	
5 19.00	7.40	5
19.50	8.10	
20.13	9.65	
20.75	9.52	
21.28	10.00+	
10 21.80	(1060)	10

Load Deflection Performance, Specimen No. 5

Load kN	Deflection mm	
15		15
1.30	0.00	
1.92	0.11	
2.24	0.18	
2.56	0.27	
20 3.06	0.36	20
3.40	0.45	
3.74	0.57	
4.51	0.89	
4.89	1.19	
25 5.32	1.38	25
5.70	1.72	
5.89	(2.25)	
6.08	4.38	
6.27	4.62	
30 6.61	4.80	30
6.80	5.00	
6.99	5.32	
7.19	5.71	
7.38	5.92	
35 7.80	6.14	35
8.00	6.47	
8.20	6.78	
8.40	6.99	
8.60	7.40	
40 8.80	7.80	40
9.10	8.28	
9.30	10.00	
	Collapsed at 465	

NOTE: Brackets indicate first appearance of cracks.

The results indicate a substantial load bearing capacity and the system was installed quite readily during construction of the wall.

EXAMPLE II

In this example it was desired to remove as far as possible the structural role of the tensile bond of the mortar to the brick and to the steel.

Twelve specimens were constructed using traditional size metric pressed bricks and a mortar of 1:8:12 composition. Bond strength of the mortar was so low as to be virtually zero.

A further two specimens were built in which bond was completely eliminated by separating the bed and head joints with a plastic membrane.

Four of the specimens collapsed during handling and setting up for testing because of the weakness of the mortar type used. The specimens tested were all of 1210 mm clear span, and included one half brick length stirrups in successive courses of brickwork, arranged convergingly. The end-stop members were plates welded to the strip member, and all were made from 3mm mild steel. Specimens numbers 6-8 were 5 courses in height, 9 and 10 were 4 courses in height and 11-13 were 3 courses in height. The area of steel used for tensile reinforcement was 75 mm².

The specimens were tested at seven days age to determine their ultimate strength, the load at the appearance of the first cracks, the failure mode and the performance of the steel components.

Results of Example II

<i>Specimen No.</i>	<i>Height of Lintel (1)</i>	<i>Load at 1st crack</i>	<i>Max load kN</i>	<i>Maximum Uniformly Distributed load kN/m</i>	
5					5
6 (3x1)	0.344m	14.00	38.75	32.02	
7 (3x2)	0.344m	11.00	33.20	27.44	
10 8 (3x3)	0.344m	12.00	35.00	28.93	10
9 (2x1)	0.258m	9.00	30.90	25.54	
10 (2x3)	0.258m	11.00	32.00	26.45	
15 11 (1x1)	0.172m	13.00	21.00	17.36	15
12 (1x2)	0.172m	12.00	18.00	14.88	
13 (1x3)	0.172m	2.00	19.30	15.95	

NOTES: (1) Height of lintel above strip member

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EXAMPLE III

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In this example it was desired to increase the strength of the end-stops. In Example I the end-stop bent back at ultimate load causing crumbling of the mortar against which the stop was pressing.

The end stops were changed from 3mm to 5mm in thickness. The mortar was increased in strength to a 1:1:6 composition, to see whether a further increase in mortar strength would result in a change in the mode of failure.

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Four brick lintels were built in traditional size metric bricks. The lintels were 1210mm in clear span by 4 courses in depth. The steel reinforcement used was the same as that used in Example II except that the end-stop was increased to 5mm thickness.

The specimens were tested after 28 days.

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Results of Example III

<i>Specimen No.</i>	<i>Maximum load kN</i>	<i>Maximum Uniformly Distributed load kN/m</i>	<i>Average Maximum Uniformly Distributed kN/m</i>	
35				35
14	23.98	39.64	40.54	
15	23.44	38.74	40.54	
16	26.16	43.24	40.54	

The test showed that a small increase in ultimate strength occurred.

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For Example II the load was applied to the specimens by a load cell through timber packers and a reaction frame and measured by hydraulic pressure gauge. The hydraulic assembly was calibrated against an Avery DCJ 100kN A grade compression machine regularly calibrated in accordance with NATA requirements. Avery is a Registered Trade Mark. Loads were applied at 1/3 points on the beam through a load spreading frame designed to simulate a uniformly distributed load.

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In Examples I and III the specimens were built on a concrete floor with the abutments resting on 2 sheets of plywood to prevent any bond occurring between the lintel and points of support. A 100 x 50 mm batten was rested on flat on the top edge of the brickwork and the loads applied at the centre point by a hydraulic load cell powered by a hand pump, and measured on a 1000 psi hydraulic gauge which was calibrated at the conclusion of each test series against an Avery DCJ 100 kN A grade testing machine that is regularly calibrated in accordance with NATA requirements.

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The lintels were measured for deflection at the centre of the span using a 20mm Mitotoyo dial gauge. Record was made of the appearance of the first cracks (assumed to coincide with a sudden reduction in the load carried at the same instance as an increase in deflection occurred). Load was applied in most cases until collapse of the lintel occurred.

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It is noted in the above Examples that in none of the tests did bricks fall or dislodge from the bottom row of bricks beneath the strip member even after severe cracking and deflection had occurred at near ultimate loads. It is therefore considered that the resistance to bending of the brickwork provided by the system is such as to make loss of such bricks unlikely in normal service conditions.

The examples above show that the masonry lintel of the invention is capable of providing a substantial load bearing capacity.

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Many variations to the preferred embodiments of the invention will be readily appreciated by those skilled in the art. Such variations are within the scope of the invention and include many different methods of attaching the end-stop members to the strip member. The specification describes two ways, welding and locating of a lug in a hole on the strip member. Also preferred is the case where the end-stop

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member has two projecting lugs which are not symmetrical with the upstanding arm, so that turned end-for-end on the strip, a different positioning of the upstanding arm is obtained for location of the lugs in the same two holes. Also possible is the formation of the end-stop members and strip members as an integral unit that is, the end-stops are connected during forming of the unit. Such a system would clearly work but would be difficult to install for the bricklayer.

Corrosion resistance may also be a desirable characteristic of the system and this may be achieved by means known in the art, such as galvanising, or by selecting a corrosion resistant material having the desired tensile strength, such as certain grades of stainless steel.

A masonry lintel is provided for brick wall in which a metal strip member is embedded in the bed course above an opening. To the strip is attached two upstanding metal flanges 4 which are positioned in head joints outside the line of the edges of the opening.

Stirrup members 3 may be provided in subsequent bed joints to reinforce the brickwork of the lintel.

CLAIMS

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1. A reinforced masonry lintel comprising a first course of masonry bricks forming the bottom of the lintel, a second course of masonry bricks immediately above said first course, a strip member positioned in the first bed joint between said first and second courses, said strip member being of sufficient length to extend past both sides of the opening over which the lintel is to be positioned, and two end stop members, each being adapted to be attached to the strip member proximate its ends, so that an upstanding portion of each end stop member is positioned in a head joint of said second course of masonry bricks outside the opening over which the lintel is to be positioned.

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2. A reinforced masonry lintel as claimed in claim 1 wherein the strip member has means which coact with means carried by an end-stop member whereby to enable attachment of the end-stop member to the strip member.

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3. A reinforced masonry lintel as claimed in claim 2 wherein the strip means has a series of holes therein adapted to receive one or more projections on an end stop member whereby to attach the end stop member to the strip.

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4. A reinforced masonry lintel as claimed in any one of claims 1 to 3 further including one or more stirrup members associated with each end-stop member and positioned in succeeding bed joints of the lintel; said stirrup members having a web portion and at each end thereof a pair of perpendicular off-set parallel arms which extend into head joints above and below the bed joint in which the web is situated; the arm of each stirrup member which extends below the bed joint being closer to the centre of the opening when the lintel is in position, than both the other arm of the stirrup member and the upstanding arm of the end-stop member with which it is associated.

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5. A method of constructing an opening in a brick wall comprising constructing the abutments; and constructing thereon a reinforced masonry lintel as claimed in any one of the preceding claims.

6. A reinforced masonry lintel substantially as herein described with reference to the drawings.

member has two projecting lugs which are not symmetrical with the upstanding arm, so that turned end-for-end on the strip, a different positioning of the upstanding arm is obtained for location of the lugs in the same two holes. Also possible is the formation of the end-stop members and strip members as an integral unit that is, the end-stops are connected during forming of the unit. Such a system would clearly work but would be difficult to install for the bricklayer.

Corrosion resistance may also be a desirable characteristic of the system and this may be achieved by means known in the art, such as galvanising, or by selecting a corrosion resistant material having the desired tensile strength, such as certain grades of stainless steel.

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Stirrup members may be provided in subsequent bed joints to reinforce the brickwork of the lintel.

CLAIMS

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1. A reinforced masonry lintel comprising a first course of masonry bricks forming the bottom of the lintel, a second course of masonry bricks immediately above said first course, a strip member positioned in the first bed joint between said first and second courses, said strip member being of sufficient length to extend past both sides of the opening over which the lintel is to be positioned, and two end stop members, each being adapted to be attached to the strip member proximate its ends, so that an upstanding portion of each end stop member is positioned in a head joint of said second course of masonry bricks outside the opening over which the lintel is to be positioned.

2. A reinforced masonry lintel as claimed in claim 1 wherein the strip member has means which coact with means carried by an end-stop member whereby to enable attachment of the end-stop member to the strip member.

3. A reinforced masonry lintel as claimed in claim 2 wherein the strip means has a series of holes therein adapted to receive one or more projections on an end stop member whereby to attach the end stop member to the strip.

4. A reinforced masonry lintel as claimed in any one of claims 1 to 3 further including one or more stirrup members associated with each end-stop member and positioned in succeeding bed joints of the lintel; said stirrup members having a web portion and at each end thereof a pair of perpendicular off-set parallel arms which extend into head joints above and below the bed joint in which the web is situated; the arm of each stirrup member which extends below the bed joint being closer to the centre of the opening when the lintel is in position, than both the other arm of the stirrup member and the upstanding arm of the end-stop member with which it is associated.

5. A method of constructing an opening in a brick wall comprising constructing the abutments; and constructing thereon a reinforced masonry lintel as claimed in any one of the preceding claims.

6. A reinforced masonry lintel substantially as herein described with reference to the drawings.

