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(54) Wall reinforcement.

(57) Method of reinforcing a wall using a structural tie in the form of a length of wire (15) of corrosion resistant material, comprising a core and two externally projecting fins (4). Each fin follows a continuous helical path about the axis of the core and the tie has a substantially uniform cross-section. The diameter of the core is 2 to 6mm and the maximum diameter of the entire tie is 10mm. The tie is located in an opening formed in the mortar layer of the wall and grouted in position.

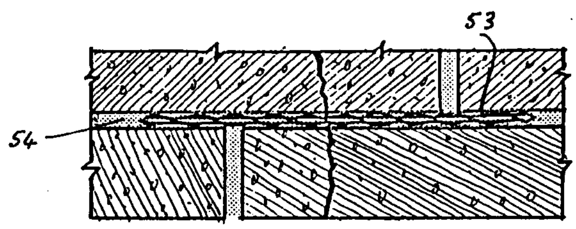

Fig 9

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This invention relates to the reinforcement of the walls. Reinforcement in this sense includes mainly the stabilisation of existing walls, but can involve new walls in certain circumstances.

One object of the present invention is to provide a system for an existing wall or wall leaf which has cracked or slipped. Another is to secure adjacent walls or wall leaves together in ways which locally reinforce the masonry materials being secured together.

According to the present invention, there is provided a method for reinforcing a wall which comprises forming a space in the wall material, locating a structural tie in the space formed and grouting or cementing the tie in position, characterised in that tie comprises a length of wire preferably of corrosion resistant material including a core and preferably two or more externally projecting fins or ridges, the diameter of the core being 2 to 6mm and the maximum diameter of the entire tie being 10mm.

For use between the inner and outer leaves of a cavity wall, the length of the wire may be perhaps between 18 and 20cm. When used for stabilisation or reinforcement in a brick wall, the length might be up to 1 or 2 metres, or about nine bricks' length.

The fins or ridges might be about 1 or 2 millimetres proud of the surface of the core or possibly they might be a distance from the core equal to the diameter of the core to leave a substantial flange providing a good grip in the surrounding wall material. However the overall cross section of perhaps 8 or 10 millimetres is sufficiently small to enable the tie to be inserted in the space left by raking out the mortar in cracked brickwork, after which the wall would be repointed around the inserted reinforcement. A tie (or ties) can easily be introduced into a long line of mortar between several bricks, and if necessary can be bent to extend both vertically and horizontally. The ease with which the tie can be bent is another advantage arising from the small core dimensions and it enables a tie to have two bends so that its two ends are parallel with each other and are joined by an intermediate portion at an angle to the two ends.

The fins give a good grip between the tie and the mortar and also define drip points from which water can drop into a cavity to avoid moisture being transferred from one wall to the other across the tie.

The tie can be easily made using a pair of rollers of novel form. The rollers will have generally cylindrical surfaces with a parallel sided slot at the centre and then as round or square section rod is fed into the nip of the rolls, the section will be first out at the edge of the slots and then deformed so that the cut material is squeezed into the gap between the rollers at their closest point to define a pair of opposed fins. No material is lost but the material is deformed to leave a generally rectangular sectioned core with fins extending from either side, and the section can then be uniformly twisted in a subsequent manufacturing step. This generally forms the subject matter of the present Applicants' EP-A-171250, from which the present Application is divided.

The method of forming the fins by a combination of shearing and squeezing forces work hardens and stretches the fin material without hardening the core material. This predisposes the material for transformation by twisting into a tight and constant helix without the need for annealing and provides maximum hardness in the fins.

If the slot is deep enough, wear on the rollers can be easily taken up by adjusting the spacing between them, and in general the width of the fins can be chosen by appropriate setting of the spacing between the rollers.

A single pass of the rollers can be sufficient to form the desired section, even with a hard metal such as stainless steel. However, a double pass enables four fins to be provided.

Another possible form of the wire is a triangular section, simply uniformly twisted along its length, with a squared off end. The corner edges of the triangular section will act nearly as well as the fins in embodiments involving embeddment in mortar.

The invention also provides for the use of a tie to provide tensile reinforcement to improve the performance of structural members made of materials in which a particularly efficient mechanical bond is necessary to transfer the stresses from the material to the reinforcing wire. Such materials may include for example portland cement and/or resin based concretes which are aerated or made with lightweight aggregates and natural organic materials such as timber. The ties may be embedded in some materials as they are cast and with others such as timber may be pressed into grooves cut in their surfaces. Since the wires are made of a corrosion resistant material such as stainless steel they can be used close to the surface of a member exposed to moisture in a corrosive environment.

The ties can also assist in the transfer of loads from the end of one structural member into another structural member which may be of a dissimilar material.

The invention may be carried into practice in various ways, and certain embodiments will now be described by way of example with reference to the accompanying drawings of which:-

Figures 1, 2, 3 and 4 are perspective views showing the configuration of four rods, any of which may be used in accordance with the invention;

Figure 5 is a sectional elevation illustrating a method of manufacture of a rod of cross section similar to that shown in Figure 1, from a round section bar;

Figure 6 is a section that can be achieved from the rod of Figure 5;

Figures 7 and 8 are sketches illustrating various uses of a tie between two walls as they are being built;

Figures 9 and 10 are an elevation and a section of brickwork reinforced by a rod as shown in any of Figures 1 to 4; and

Figure 11 shows cracks and a lintel in brickwork for which the reinforcement of Figures 13 and 14 is suitable.

The rod shown in Figure 1 is straight and of constant cruciform cross section, the arms of the cruciform being uniformly twisted about the axis of the rod and forming helical ribs or fins 4 around the central solid core of the rod. The rod shown in Figure 2 is of constant triangular cross-section and is uniformly twisted with a pitch of approximately twice the maximum cross-sectional dimension of the rod. Figure 3 shows a straight bulbous rod of varying circular cross section, having annular rings 8 in the form of truncated spheres. Uses of the above described rods as wall ties, and mortar reinforcing bars will be described below, but firstly the important features of each of the types of rod will be outlined.

Figure 4 shows a rod having one end formed with axially arranged flat sections 9 alternately in planes at right angles to their neighbours.

The helical ribs 4 of the rod shown in Figure 1 served to provide a strong grip of the rod within mortar over short distances of embedment or penetration; the curves 6 of the rod shown in Figure 2, the rings 8 of the rod shown in Figure 3, and the sections 9 in Figure 4, also provide a strong grip of the respective rod when set within mortar. A further feature of the helical ribs 4 is that they provide the rod with natural drip features which hinder the passage of water in an undesirable direction ie. from an outer to an inner wall, along the surface of the rod by providing localised downward inclinations due to the helix angle of the ribs, even when the general axis of the rod is slightly inclined upwardly; the twists 6 and the rings 8 of the rods shown in Figures 2 and 3 and the plates 9 of the rod shown in Figure 4 respectively also provide a profile giving this feature.

The helical ribs 4 of the Figure 1 embodiment may be as shown in Figure 1 with two opposed thick ribs 11 alternating with thinner ribs 12; but alternatively the uniform section may be as shown in Figure 6 with four equally circumferential spaced ribs 13 extending from the sides of a square.

The bending of the rod about the axes perpendicular to the general axis of the rod of Figure 5 is easier in a direction parallel to the plane of the thicker ribs 11. Therefore since the helix transposes this being axis through one complete revolution per helix pitch, this relatively easy bending of the rod can be achieved in all directions perpendicular to the general axis of the rod, without variation in axial strength at any point along the rod since the cross sectional area of the rod remains constant. This ease of bending of the type of rod shown in Figures 1 and 5 or 6 enhances flexibility of the rod thus enabling settlement of walls between which the rod is fixed to be accommodated.

The overall diameter of the rods is such as to enable the rods to be incorporated within a mortar layer of a wall, ie. about 4-8mms in a layer about 8-14mms thick. The rods are made from a strong flexible non-corrosive material such as copper or stainless steel so that a rod of the diameter as stated above may hold an outer wall against wind suction and pressure yet flex readily to accommodate different settlement of walls between which the rod is affixed and not corrode after long exposure to the atmosphere or encasement in mortar.

In a simple form of the invention, the wire is merely a uniformly twisted length of triangular cross-section, with a squared-off end.

Uses of the rod shown in Figure 1 will now be described and it will be appreciated that rods of the types shown in Figures 2, 3 and 4, may be similarly utilised as well as those described in the preceding paragraph.

Figure 7 shows a wall tie 15 comprising a rod of the type shown in Figure 1 which is bent in two places 16 in equal, but opposite directions so that the tie 15 has a cranked middle portion 17 and two end portions 18 and 19 all of which portions have co-planar axes, the axes of end portions 18 and 19 also being parallel. The length of the cranked portion 17 is such that when the end portions 18 and 19 of the tie are embedded in mortar layers of parallel inner and outer brick walls 21 and 22 respectively, the bends are just within the cavity 23 between the walls yet each is adjacent the face of a different wall. Difference in level between the walls 21 and 22 is accommodated by the natural rotation of the tie 15 about the axis of one of its end portions 18 when rested on the course of one of walls 21 so that the cranked portion 17 swings around until the other end portion 19 rests on the required course of the other wall 22. This rotation does not affect either the thickness of the tie ends to be accommodated within the thickness of the mortar - since the rod section is effectively contained within a circular envelope - or the relative positions of the bends 16 with relation to the cavity faces of the walls.

The figure shows alternative positions of the end 19 for different levels of the bricks on the wall 22.

The helical ribs or fins 4 of the cranked portion 17 provide drip points, as described above, which prevent water running across the cavity bridge throughout a range of rotational positions of the tie 15, even when there is a slight back fall (of up to 15°) of the cranked portion. Thus, the range of acceptable arc of rotation of the tie is approximately 210° if one considers both sides of a vertical datum. Good location of the end portions 18 and 19 within the mortar beds is also achieved by the helical ribs 4 when the mortar sets around them.

Figure 8 shows the tie 15 in use as described above, but performing the additional function of locating a slab 25 of insulation material for example foamed plastics, at one side of the cavity 23. The location of the slab 25 is achieved by pushing one end of the tie 15 through the slab like a skewer, until the bend lies within the slab and the slab is axially located on the tie 15 both the helical ribs 4 and by the bend.

The rods shown in Figures 1-4 can be used as mortar reinforcing rods as shown in Figures 9, 10 and 11. A crack as shown at 51 or 52 in Figure 11 can be reinforced by removing about a quarter - say 25mm - into the wall, of the layer of mortar for some distances to each side of the crack, positioning the rod 53 longitudinally between the bricks, and repointing the wall as shown at 54 in Figures 9 and 10. Brick lintels can also be reinforced using the above method and by overlapping the rods as at 55, the reinforced bricks can be made to act as beams.

The inserted reinforcing rods may be long enough to extend through the length of at least 2, and perhaps 3 or 4 bricks, or even 9 bricks as shown in Figure 11.

The preferred helical rod shown in Figure 1 is conveniently produced from square, rectangular, or round, section austenitic stainless steel wire by a single or double pass rolling-shearing process shown in Figures 5 followed by twisting. The rollers 56 and 57 are each approximately 150mm in diameter and each has a rectangular section circumferential groove 58 around its mid portion. The very pronounced fins, which are required to provide a good anchorage within mortar, are formed by shearing and squeezing the material in the area of A so that it is transferred to the adjacent area of B of the fin. The fins become work hardened due to the above process, but the core remains unhardened, thus giving a desirable configuration of hardened fins with good cutting and wear resistant properties, and an unhardened core with good flexibility. Because the space between the rollers 60 and 62 can be adjusted it is possible to alter the fin thickness. Sharpening of the cutting edges 59 of the grooves 58 is possible by use of a grinding stone between the sides of the grooves while the rollers are rotated. The bevels 60 can also be sharpened by application of a square grinding stone to the groove away from the common tangential space between the two rollers. The groove depths are made to allow for a substantial amount of re-sharpening resulting in a reduction in roller diameter and hence groove depth. Further adjustablility of the rollers can be achieved by dividing them along the line marked x-x so that they may be bolted together with shims inserted, thus enabling the cutting space between the edges to varied, and hence different size wire to be accommodated.

A single pass would produce a section as shown dotted in Figure 5. A second pass with the rod rotated through 90° could produce the four-finned section shown in Figure 6. In each case material is cut and squeezed from the original section to the fins.

Uniform twisting follows to leave a long length of formed wire which can be cut into suitable lengths and cranked as necessary.

Claims

1. A method for reinforcing a wall which comprises forming a space in the wall material, locating a structural tie in the space formed and grouting or cementing the tie in position, characterised in that tie comprises a length of wire (15) of corrosion resistant material including a core and externally projecting fins or ridges (4), the diameter of the core being 2 to 6mm and the maximum diameter of the entire tie being 10mm.

2. A method as claimed in Claim 1, characterised in that the space is formed in a mortar layer (54).

3. A method as claimed in Claim 1 or Claim 2, characterised in that the space is formed as the wall is being built.

4. A method as claimed in Claim 1 or Claim 2, characterised in that the space is formed in an existing mortar layer (54).

5. A method as claimed in any preceding Claim, characterised in that the space is formed in the two leaves (21,22) of a cavity wall.

6. A method as claimed in any of Claims 1 to 4, characterised in that the space is formed in a single leaf, optionally spanning a zone of weak-

ness such as a crack (51,52).

7. A method as claimed in Claim 6, characterised in that a series of overlapping ties (55) are grouted into the space formed.

8. A method as claimed in any preceding Claim, characterised in that the tie has a substantially uniform cross-section and two or more fins or ridges (4) which follow a continuous helical path about the axis of the core.

9. A method as claimed in any preceding Claim, characterised in that the fins or ridges (4) are equiangularly spaced about the core and extend equally from the core in a radial direction.

10. A method as claimed in Claim 8 or Claim 9, characterised in that the fins (4) are formed by repositioning material from the wire and subsequently twisting the wire (15).

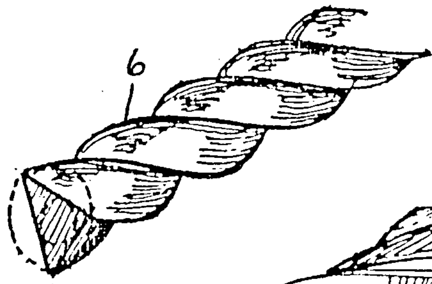

Fig. 2

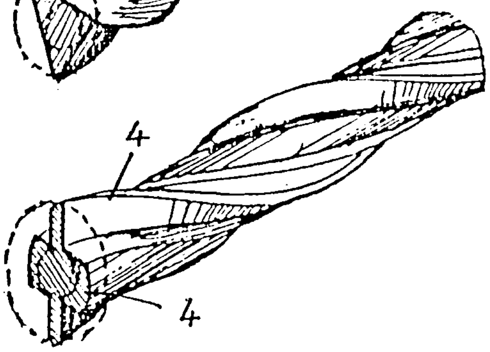

Fig. 1

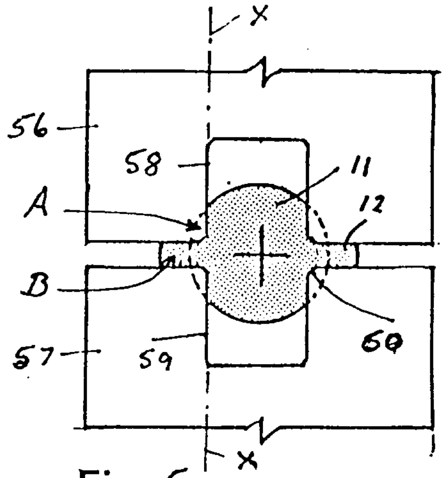

Fig 5

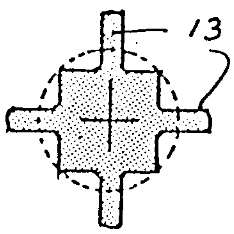

Fig 6

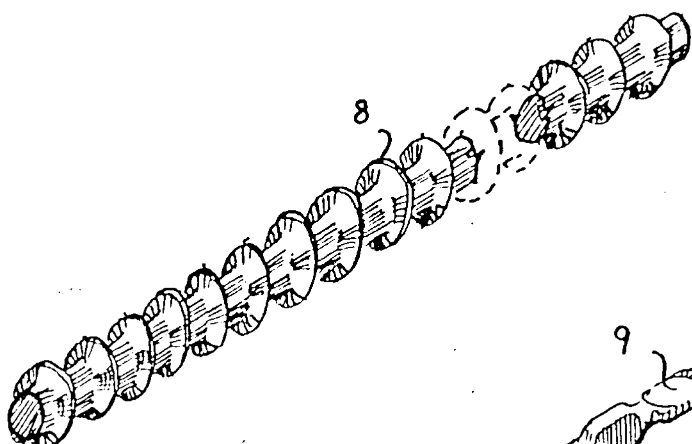

Fig. 3

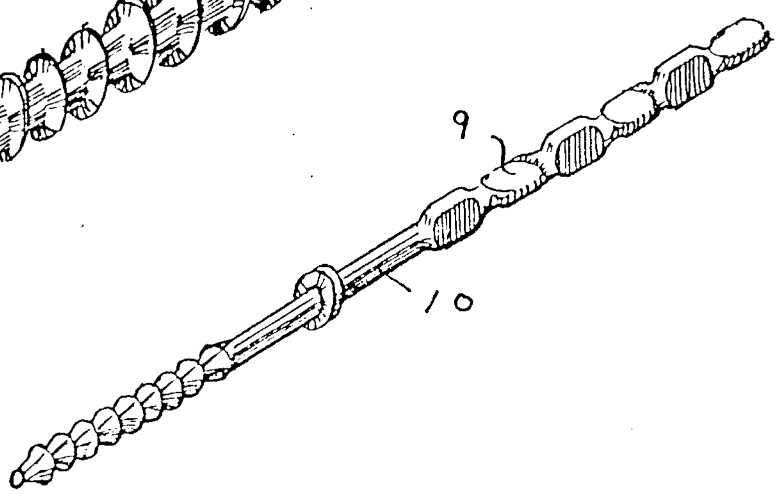

Fig. 4

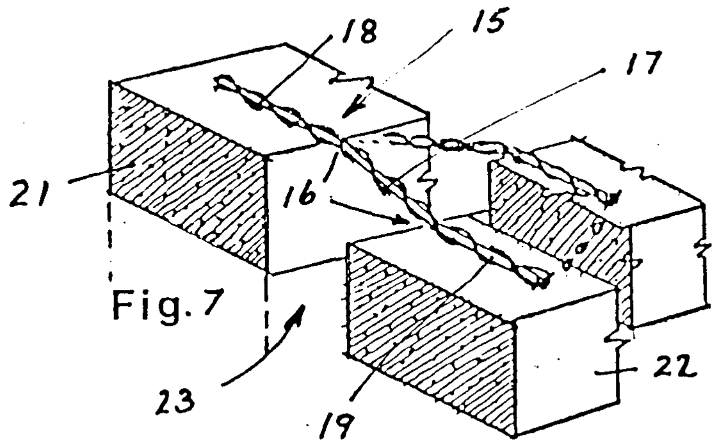

Fig. 7

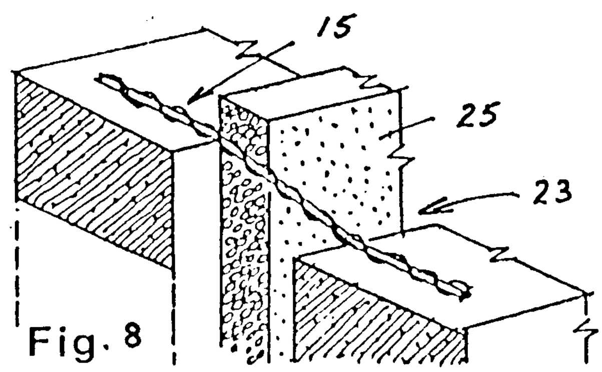

Fig. 8

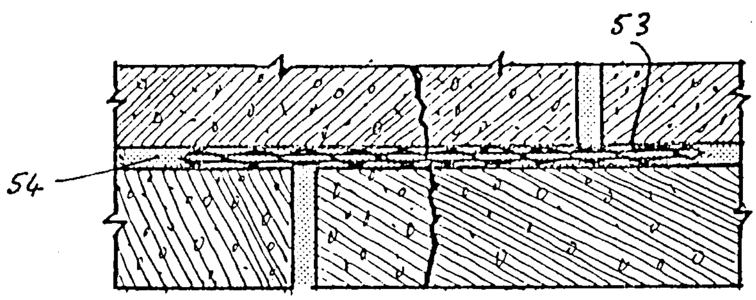

Fig 9

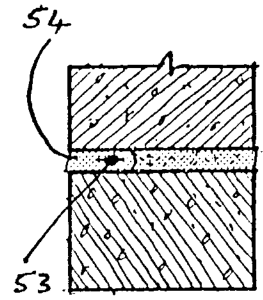

Fig 10

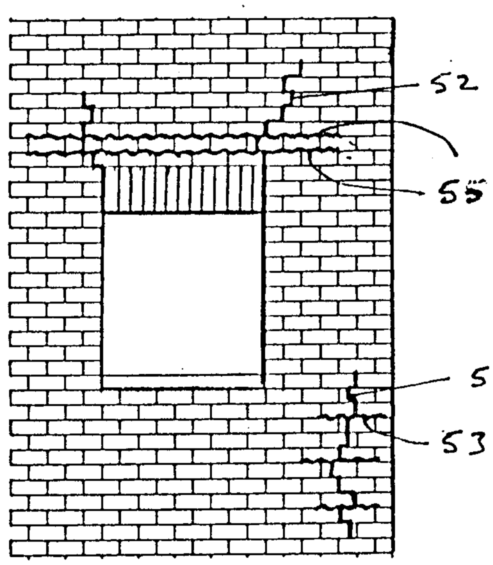

Fig 11