The present invention provides a masonry wall reinforcing bracket (2) comprising an elongate inter-course shear transfer member (4), the shear transfer member (4) comprising a rebar cradling feature (6). The shear transfer member (4) may further comprise a plate (5) operative to be located within at least a perpend (22) of a masonry wall (10). The bracket may further comprise a supporting member (28) that protrudes perpendicularly from the length of the shear transfer member (4). The supporting member (28) may comprises a plate operative to be located within a bed joint (24) of the masonry wall (10). The supporting member (28) may be a stabilising foot. The rebar and brackets are used in a bond beam (10) system incorporated within the wall (10).
Fig. 3

Fig. 3a

Fig. 3b

Fig. 3c
MASONRY BRACKET, SYSTEM AND CONSTRUCTION METHOD

FIELD OF THE INVENTION

[0001] The present invention concerns reinforcing devices for masonry walls. In particular, the reinforcing devices are brackets transferring stress such as shear forces between masonry courses. The brackets in the present invention are intended to be used in masonry walls comprising reinforcement.

RELATED ART

[0002] In large buildings, masonry block walls are typically used in load-bearing frameworks. The load-bearing framework generally comprises a number of load-bearing steel and/or concrete columns and beams, between which panels of masonry blockwork are formed. Larger spans of masonry walls between the load-bearing columns, or walls with openings (e.g. for doors or windows) are more susceptible to forces perpendicular to the plane of the wall such as those exerted by wind. Excessive forces may cause failures in the structural integrity of the wall which can result in cracking or failure.

[0003] It is therefore desirable to introduce reinforcing elements that have the effect of subdividing the masonry wall panel in to smaller sub panels and also transferring wind forces, transverse pressure differences, impacts or similar lateral loads to the load-bearing framework. One common method of approaching this problem is to install vertical steel windposts within the masonry wall panel at intermediate points between the load-bearing columns. Such windposts typically extend from the bottom to the top of the masonry wall with a head portion and a foot portion secured to the beams or concrete floor slab/soffit of the framework. Windposts are typically large and cumbersome in nature making them difficult to install. Because of their cumbersome nature, windposts are also difficult to handle and are not desirable from a health and safety standpoint, where good practice and/or regulations require that building components carried by hand be of particular manageable weights, typically 20 kg or less. Windposts are also expensive, have significant procurement lead in times, and after installation, quite often fail to function to enhance their aesthetic, fire resistance, thermal insulation and/or acoustic properties.

[0004] Another method of subdividing a masonry wall panel into sub panels is to provide a horizontal reinforced concrete beam (known as a bond beam) that extends between and connects to adjacent load-bearing columns. Such bond beams are referred to in patent document GB2442543. The bond beam is typically housed within a hollowed masonry course within the masonry wall and is reinforced by one or more reinforcing bars (“rebars”) cast into the concrete. At least some of the hollowed masonry blocks may have a hole in the bottom that allows a masonry course connecting member to be driven into a perpend of a masonry course immediately below. The connecting member allows shear forces to be transferred between the courses concerned, effectively tying adjacent courses to the bond beam course, further enhancing the strength and cracking resistance of the masonry panel as a whole.

[0005] Once the rebar and connecting members are in place the hollowed masonry course is typically filled with concrete to form the bond beam. In such a bond beam, the quantity and location of the rebars is critical to the strength and bending moment resistance of the bond beam itself, and hence the characteristic design load of the wall. Several devices exist that can be used to locate a rebar within a concrete casting at one or more specific positions.

[0006] One such device is described in patent document U.S. Pat. No. 6,629,394 which discloses a rebar hanger for suspending rebars comprising a form hook for hooking on top of a concrete form, a first rebar hook for supporting a first rebar that extends away from the lower end of an inner section of the form hook and a second rebar hook for supporting a second rebar that extends downwardly and inwardly from the inner end of a brace.

[0007] Another such device is described in patent document U.S. Pat. No. 5,907,393 which discloses a reinforcing bar hanger comprising a pair of supporting arms contacting a supporting block and vertically extending hanger members terminating in a rebar cradle for receiving and supporting a rebar to be positioned within the wall.

[0008] Alternatively for short spanning walls, the rebar can simply be positioned within cleats or similar securing brackets fixed to the load-bearing columns or within suitably sized holes formed in the supporting load bearing column. Either method would provide sufficient transfer of transverse forces between the rebar and the load bearing columns. The rebar can also be positioned by casting the bond beam in stages such that a bed of concrete or similar is placed to the appropriate height within the hollow of the block before placing the rebar. However this is more labour intensive and time consuming than casting the bond beam in a single pour. It may also introduce structural weaknesses into the bond beam if the separately cast sections do not fully knit together, or the rebar is moved laterally whilst the next layer of concrete is being placed and vibrated.

SUMMARY OF THE INVENTION

[0009] The present invention provides a masonry wall reinforcing bracket comprising an elongate inter-course stress transfer member, the stress transfer member comprising a rebar cradling feature. The stress transfer member may comprise a plate operative to be located within at least a perpend of a masonry wall. The stress transfer member may act for example to transfer shear stress between a bond beam and adjacent masonry courses, or to transfer stress between a bond beam and a vertically extending reinforcing structure built into the wall.

[0010] The bracket may further comprise a supporting member that protrudes perpendicularly to the length of the stress transfer member. The supporting member may comprise a plate operative to be located within a bed joint of the masonry wall. The supporting member may be a stabilising foot.

[0011] The present invention further provides a masonry wall tie bracket comprising: a rebar cradling feature for accommodating a rebar; and, an adaptor configured to secure the bracket to an elongate reinforcing member. Typically the adaptor may comprise a socket for receiving an end of a vertical rebar or a spigot for inserting into the top of a pillar within the masonry wall. The pillar may be a steel column of any suitable section, such as a box section or other tubular or I or U section or solid.
DISCLAIMER

Other preferred features of the present invention are as set out in the dependent claims. Illustrative embodiments of the invention are described below with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIGS. 1a to 1e show a bracket embodying the present invention, the bracket being shown in relation to the surrounding masonry blockwork, rebars and rebar end securing cleats.

[0014] FIG. 2 shows another form of bracket embodying the present invention.

[0015] FIGS. 3 and 3a show further brackets embodying the present invention where the brackets comprise cradling features located in different masonry courses.

[0016] FIGS. 3b and 3c are front and side views respectively of a yet further bracket.

[0017] FIG. 4 shows a cleat which may be used together with the masonry wall reinforcing brackets of the present invention.

[0018] FIGS. 5 and 6 are respectively front and side views of a cleat mounting adaptor that may be used together with brackets embodying the invention.

[0019] FIGS. 7a and 7b are side and front views respectively of a tie bracket of the present invention.

[0020] FIG. 7c is a vertical rebar cleat according to one aspect of the present invention.

[0021] FIGS. 8a and 8b show a vertical rebar being mounted into the tie bracket and cleat of FIGS. 7a-7c.

[0022] FIGS. 9a and 9b show another tie bracket of the present invention.

[0023] FIG. 10 shows the tie bracket of FIGS. 9a and 9b being inserted into a vertical reinforcement post.

DETAILED DESCRIPTION

[0024] Referring to FIGS. 1a-1c, the present invention provides a masonry wall reinforcing bracket 2 comprising an elongate stress transfer member 4 adapted and configured to extend between at least two courses 30 of masonry in use. The stress transfer member 4 further comprises one or more rebar cradling features 6. The cradling feature 6 is operative to support and locate a rebar 8 within a masonry wall 10, e.g. to allow it to be cast into a bond beam 12 formed within a course of hallowed masonry units 14. The bracket 2 is formed from a material that is stronger in tension and shear compared to the bond beam matrix material (i.e., concrete, usually) and mortar. Such a bracket 2 material could be steel or another metal, or a metallic or non-metallic composite material.

[0025] As shown, the stress transfer member 4 extends between at least two immediately adjacent masonry courses 30, but it may in principle extend through any number of masonry courses 30. In use the stress transfer member may extend outwards to one side of the bond beam only. For example, a series of brackets may be provided extending from the bond beam into the adjacent masonry course alternately above and below. Alternatively, a central portion of the bracket may be embedded in the bond beam in use, with end portions projecting into adjacent masonry courses above and below the bond beam. The projecting portions may be symmetrically or asymmetrically disposed with respect to the reinforced concrete core of the bond beam. By having the stress transfer member 4 extending between adjacent masonry courses 30, shear forces applied to the wall 10 may be transferred between masonry courses 30 and more effectively between the masonry and the bond beam, to mitigate cracking and masonry course 30 separation, ultimately dividing the wall 10 into sub-panels and increasing the characteristic design load of the wall 10.

[0026] Typically a masonry wall 10 is formed with bonded masonry whereby the perpend 22 between masonry units in one course 30 are offset horizontally from equivalent perpends 22 in the adjacent masonry course 30. The stress transfer member 4 of the bracket 2 in the present invention extends at least into a perpend 22 or a specially formed hole 16 in one masonry course 30 and at least partially into a hallowed block 14 of an adjacent masonry course 30. The bracket 2 and hallowed masonry block 14 form part of a combined masonry system. The hallowed block 14 typically comprises a hole 16 in its base through which the stress transfer member 4 extends to protrude into the cavity 18 of the hallowed masonry block 14 from below, as the hollow block is laid and afterwards. The open top of the cavity 18 allows the bracket to extend from within the hallowed block into the masonry course above. The part of the stress transfer member 4 extending into the cavity 18 of the hallowed masonry block 14 comprises one or more rebar cradling features 6.

[0027] Once the stress transfer member 4 protrudes into the cavity 18, a rebar 8 may then be located within the rebar cradling feature 6. The present invention therefore provides a combined rebar cradling feature 6 and inter-masonry course stress transfer mechanism integrated into a single bracket 2. Personnel building a masonry wall 10 reinforced by a rebar 8 therefore only have to incorporate into the masonry wall 10 a single bracket 2 in order to facilitate rebar 8 positioning and stress transfer between adjacent masonry courses 30. By having a single bracket 2 performing the functions of rebar cradling and stress transfer, the build time of a shear strengthened (or otherwise strengthened) masonry wall 10 and the number of building components required to form the wall 10 is reduced, which reduces overall building costs.

[0028] Typically, hallowed masonry blocks 14 are used to form part of a hallowed masonry course which houses one or more rebars 8 supported by one or more rebar cradling features 6 on one or more brackets 2 embodying the present invention. The brackets 2 are typically distributed horizontally at the same vertical level along the length of the wall 10, but may also be distributed at other locations throughout the wall 10. The rebar 8 typically extends the full horizontal length of the masonry wall panel and connects to the end load-bearing columns 20 using one or more cleats 26 (see FIG. 4). Because the rebar 8 and stress transfer member 4 are mechanically linked, transverse forces applied to the masonry panel are distributed through masonry courses 30 linked by the stress transfer member/s 4 to the rebar 8.

[0029] The bracket 2 may also comprise a supporting member 28. Preferably the supporting member 28 protrudes perpendicularly to the length of the stress transfer member 4 and is typically intended to be located within a bed joint 24 of the masonry wall 10. Such a supporting member 28 when located in a bed joint 24 provides a height alignment reference for the bracket 2, and preferably acts as a foot for easy placement, support and lateral positioning of the bracket on top of an existing course 30 of blocks, immediately before the bracket is built into the blockwork. The foot 28 rests on the bed joint 24 below, and the stress transfer member can be propped against the exposed header face of the most recently laid block, preferably being pressed into pre-applied mortar (see
When the bracket 2 is in position, the one or more rebar cradling features 6 are located in alignment and at the correct uniform spacing from the bases of the hollowed masonry units 14 to support the one or more rebars 8 (FIG. 1a). Since any further brackets 2 along the length of the masonry wall 10 may also locate their supporting members 28 in the same bed joint 24, all the cradling features 6 may be vertically aligned with respect to one another providing a constant level distributed supporting platform for the one or more rebars 8.

Preferably the supporting member 28 and/or the stress transfer member 4 may take the form of plates that correspondingly allow the supporting member 28 to be accommodated within a bed joint 24, and the stress transfer member 4 to be accommodated within a perpend 22 of a masonry wall 10. The bracket 2 may be formed from a single sheet or strip of material thus allowing multiple brackets 2 to be made in a simple manufacturing process.

The bracket 2 also preferably comprises one or more apertures 32 in the stress transfer member 4 and/or the supporting member 28 that operate to allow masonry block binding material to pass through the bracket 2. By allowing masonry block binding material, typically mortar, to pass through the bracket 2, the bracket 2 is anchored within the structure of the masonry wall 10.

Masonry walls 10 may in certain circumstances require vertically extending reinforcement structures incorporated within or connected adjacent to the masonry walls 10, for example, either side of a door or window to provide extra reinforcement around nominally weakened areas of the wall. Such structures are typically formed from steel or other metals or metal alloys. In principle, the vertical extending structures may take any form, but more typically take the form of vertical rebars 70 similar to the horizontal rebars 8 used in the aforementioned bond beam 12, or vertical reinforcement pillars 78 typically formed from a hollow metal tubing. It is desirable in masonry walls 10 to mechanically tie in and link the horizontal rebars 8 (thus the one or more bond beams 12) of a masonry wall 10 to the vertical reinforcement structures in order to distribute the sheer forces acting upon one localised part of the wall to other parts of the wall 10. The present invention therefore further provides a masonry wall tie bracket 62 comprising a first portion 64 with a rebar cradling feature 6 for accommodating a rebar 8 and a second portion with an adaptor 66 configured to secure the bracket 62 to an elongate reinforcing member. The tie bracket 62 may transversely interlink and mechanically couple the horizontal rebars in the bond beam to one or more elongate vertical reinforcement structures/members, although in principle the adaptor 66 may be configured to secure the bracket 62 to other elongate reinforcing structures that are not vertical.

The following are illustrative examples of the present invention. The features and methods of any example or embodiment may be used in any compatible combination or permutation with those of any other example or embodiment described throughout this document.

The first example is a bracket 2 as shown in FIGS. 1a-1e for use in a bonded masonry wall 10. The bracket 2 in this example comprises a supporting member 28 wherein the supporting member 28 is a stabilising foot attached to the bottom end of the stress transfer member 4. The stress transfer member 4 and the stabilising foot of the bracket 2 in this example are respective limbs of a steel strip that has been bent into an L shape. Both the foot and the transfer member 4 comprise apertures 32 allowing masonry block binding material to pass through the bracket 2. It is however envisaged that the foot or transfer member 4 of the bracket 2 may equally not comprise such apertures 32 in this example.

The foot is located in a bed joint 24 beneath a first ‘bottom’ masonry course 30. When the bottom masonry course 30 is being formed, the bracket 2 is placed within the next perpend 22 due to be formed between an existing laid block of the bottom masonry course 30 and the next adjacent block of the course 30 due to be laid. The foot therefore serves in use to allow the bracket 2 to stand or be propped against the most recently laid block whilst the next block of the bottom masonry course 30 is being laid.

When the bracket 2 is placed in this manner it is fully surrounded and intimately embedded within the masonry block binding material. This is in contrast to the prior art which requires the stress transfer member to be driven down into a perpend 22 of the masonry course 30 below. Driving a member down into an already laid binding material is undesirable as, for example, anchoring holes or indentations formed in the member are not guaranteed to be completely filled by the binding material due to the possible formation of air gaps resulting from the driving action. Air gaps weaken the perpend 22 as well as weakening the mechanical bond between the stress transfer member and the binding material. The problem is exacerbated by the fact that the binding material in the perpends 22 may have already set or cured to an undesirable extent at the time the brackets are driven into the perpends 22. This means that there cannot be any substantial delay between laying the course 30 containing these perpends 22, laying the course 30 of hollowed masonry units 14 and driving in the stress transfer members 4. The same problem does not arise with the reinforcing bracket 2 illustrated in this example, which can be built into the bottom course 30 at any time prior to laying of the bond beam course 12, without adverse effect.

The stress transfer member 4 extends completely across the full depth of the masonry blocks of the bottom masonry course 30 and resides within a perpend 22 existing between two blocks of the bottom course 30. The foot is accommodated in the bed joint 24 underneath a block of the bottom course 30.

The stress transfer member 4 of the bracket 2 further extends upwards into a second or ‘bond beam’ course 12 of the bonded masonry wall 10. The bond beam course 12 is formed of hollowed masonry blocks 14 laid on top of the bottom course 30 with a further bed joint 24 in between. When the wall 10 around the bracket 2 is complete the foot acts to hold the bottom course 30 to the bond beam course 12 and any other subsequent laid course 30 mechanically linked by the stress transfer member 4.

The stress transfer member 4 protrudes through an aperture 16 in the base of a hollowed block 14 of the bond beam course 12 and into the cavity 18 formed from the hollowed centre of the hollowed block 14. The part of the stress transfer member 4 that protrudes into the cavity 18 of the hollowed block 14 comprises two rebar cradling features 6. The stress transfer member 4 of the bracket 2, in this example, also protrudes into the perpend 22 of a course 30 immediately above the hollowed masonry course 14, although it is entirely feasible that a stress transfer member 4 may in principle vertically extend through any number of adjacent laid masonry courses 30.
Each rebar cradling feature 6 may be an inwardly recessed slot 34 with an opening along a long edge 38 of the stress transfer member 4. Each slot 34 may further comprise a retaining lip 36 serving to provide confinement of the rebar 8 in directions traverse to the wall 10. Each slot 34 is sized such that a rebar 8 may enter the slot 34 and pass over the retaining lip 36 into a retaining section of the slot 34. The slots 34 in this example are open into opposing long edges 38 of the stress transfer member 4 and are separated vertically along the length of the stress transfer member 4. Thus in this example the bracket 2 acts to cradle two rebars 8. Each slot 34 comprises a stopping edge 40 at the inner end of the slot 34 opposite to the retaining lip 36 and opening. The stopping edges 40 of the two slots 34 in this example therefore face in opposing directions.

Once both rebars 8 are located in the cradle features of the stress transfer member 4, the hollowed block 14 maybe filled with a suitable material (e.g. concrete or similar cementitious material) to solidify in the hollowed block 14, cement the rebar 8 and bracket 2 in place, and form a compression resistant matrix in which the rebars and mid-portions of the brackets are embedded. The cradling features 6 are located relative to the supporting member 28 so that the rebars 8 are positioned at the correct location within the hollow of the bond beam course 14 as required according to the design of the finished bond beam.

The bracket 2 in this example is made from steel strip or sheet steel cut to an elongate rectangular shape. The foot is formed by simply bending the rectangle or strip at one end of the base to form an L shape. By having the foot and stress transfer member 4 of the bracket 2 formed from the same piece of steel, the bracket 2 may be formed cheaply and simply. Typically the steel has a thickness between 3 to 4 mm. The width of the bracket 2 is ideally not wider than the plan width of the masonry blocks so that when the bracket 2 is introduced into the masonry wall 10 structure it is hidden from the outside. Preferably the material of the bracket 2 does not occupy an excessive proportion of the perpend 22 horizontal cross-section, so that sufficient binding material is present to form a strong mechanical bond with the bracket 2, and/or so that the bracket 2 does not form a significant plane of weakness in the perpend 22. At least the part of the stress transfer member 4 that extends through the hollow block base aperture 16 has a width that allows a rebar 8 to be slid down between the inner sides of the hollowed block 14 and the outer edge 38 of the shear transfer member 4 into the recessed slot opening/s.

The foot in this example protrudes outwardly from the stress transfer member 4 in a single direction. This provides a clearly identifiable directional alignment feature to the bracket 2. When bricklayers are placing subsequent brackets 2 further along a masonry course 30, they may simply align the feet in the same direction as the previously placed brackets 2 such that the equivalent cradling slots 34 are correctly aligned vertically and horizontally with respect to each other, with corresponding slots all facing in the same direction.

Typically the widths of the foot and stress transfer member 4 are between 30 to 60 mm, preferably 40 mm. The length of the stress transfer member 4 is typically 500 to 700 mm, preferably 610 mm and the length of the foot is typically between 40 to 100 mm, preferably 70 mm.

Following from the first example is a second example embodying the present invention as shown in FIG. 2. Instead of a stabilising foot, the bracket 2 comprises one or more perpendicularly protruding supporting members 28 along its length, spaced from the ends of the stress transfer member 4.

The supporting members 28 in the second example are intended to be accommodated within a masonry wall bed joint 24. Similarly to the first example, the supporting members 28 in the second example provide height reference to the bracket 2, which gives corresponding height reference to the at least one rebar 8 located in the supporting cradles 6 of the bracket 2.

Following from the previous examples is a third example embodying the present invention as shown in FIG. 3. In this example, brackets 2 (not shown) similar to those of the first example are utilised within the masonry wall 10. Some of the brackets in this example are extended length brackets 3 that comprise stress transfer members 4 that extend into two hollowed masonry block courses 14. The stress transfer members 4 of these extended length brackets 3 comprise at least two sets of rebar cradling features 6 (two sets of one bar each, as shown), each cradling set located at different positions along the length of the stress transfer member 4 to coincide with the cavities of the separate hollowed masonry block courses 14. Thus the extended length brackets 3 are intended to engage with two sets of one or more rebars 8, each rebar 8 set being disposed within a different hollowed masonry course 14.

Such an extended length bracket 3 provides stress transferring mechanical connection between two sets of one or more rebars 8. Such a bracket 3 may be useful for interconnecting rebars 8 running at different height levels, for example, when one set of rebars 8 cannot extend fully between adjacent load-bearing columns 20 due to the presence of an opening 42 in the masonry wall 10 such as a door or a window. The extended length bracket 3 thus provides a means to interlink one or more rebars 8 running at height levels not horizontally inline with the wall opening 42 to one or more rebars 8 interrupted by the opening 42. FIG. 3a shows another extended length bracket 3 with two sets A, B of rebar cradling features 6 and two cradling features in each set. This can be used for example to form a stress transfer connection between two bond beams positioned one above the other, each bond beam comprising two rebars. Parallel bond beams such as this may be used for example to support cantilevered loads attached to a wall, with load supporting frames or brackets spanning between and anchored to the bond beams. Of course, other numbers of sets of rebar cradling features and other numbers of rebar cradling features within each set can be provided as desired and to suit different purposes as required.

FIGS. 3b and 3c show another form of bracket 2a for use where the bond beam is to be tied into adjacent blockwork for stress transfer on one side only, e.g. where the bond beam forms a lintel above an opening such as for a window or door. The stress transfer member 4 is made shorter than that shown in FIGS. 1a-1c and the rebar cradling features 6 are positioned relative to the foot 8 so that the foot 8 rests on the floor of the cavity 18 in the hollowed blocks so as to position the rebar cradling features at the correct height. The upper end of the stress transfer member 4 therefore extends into the course above, similarly to the example of FIGS. 1a-1c, but part of the bracket 2a extends downwardly of the bond beam. To prevent the foot 8 of the bracket 2a from being incorrectly built into a bed joint in the manner of the bracket 2 (instead of resting on the base of the cavity 18 as intended) the end of the
foot is split into two parts with one part 8b being angled upwardly with respect to the other part 8b. The tips of the parts 8a, 8b are separated by a distance (e.g., 20 mm) greater than the mortar joint thickness (which is typically 10 mm). The foot is therefore too wide to be built into a mortar joint. 

[0050] In any of the previous examples there may also be included a cleat 26 which mechanically joins an end of a rebar 8 to a load bearing column 20 (see FIGS. 1 and 4). The cleat 26 comprises a backplate 44 from which at least one rebar securing feature 46 protrudes outwardly and acts as a pocket to securely house the end section of a rebar 8.

[0051] A typical cleat rebar securing feature 46 would be a cylindrical tube as shown in FIG. 4. The rebar is a sliding fit within the tube to allow longitudinal movement of the rebar, e.g., to accommodate thermal movement or shrinkage of the blockwork infill in the load bearing framework. Instead of the column 20, the baseplate may be secured by suitable fasteners to any other suitable load bearing structure, for example, to bond a beam reinforced masonry infill similar to those described in our patent specification nos. 2440531 and 2442543.

[0052] The back plate of the cleat 26, may have a hole 48 formed in line with the bore of the tube. The back plate hole 48 is sized such that the rebar 8 to be housed in the securing feature 46 may pass through the hole 48. In this manner, the entire cleat 26 may be fed over the rebar 8. Because the rebar 8 may pass all the way through the cleat 26, the back plate of the cleat 26 does not hinder the placement of the rebar 8 when being maneuvered into its final operating position. Once the rebar 8 is located into its final operating position, the cleat 26 may then be brought into contact and secured to the load bearing columns 20. The securing feature 46 of the cleat 26 protrudes outwardly from the back plate into the masonry wall 10 to an extent that it can secure the rebar 8 once the cleat 26 is secured to the column 20 and the rebar 8 is in its final operating position.

[0053] A similar hole 50 may also be formed in the load bearing column 20 coinciding with the position of the back plate hole 48 to further facilitate lateral movement of the rebar 8 when the rebar 8 is being placed into its final operating position. This is advantageous, for example, when a cleat 26 is already fixed to the load bearing column 20 before the rebar 8 is in its final operating position. In this manner, the cleat 26 and column 20 form a cleating system.

[0054] Alternatively, the rebar can be provided in at least two separate lengths. An end of each length can be poked into a respective cleat pocket without the need to form a hole in the back plate 44 or in the column 20. The rebar ends are poked almost fully home, merely leaving a suitable clearance between the rebar end and the base of the pocket to allow for the anticipated relative movement. The remainder of the rebars can then be maneuvered into the bracket cradling features 6, e.g., over the retaining lips 36 and into the retaining sections of the slots 34. The lengths of the rebar sections are such that their free ends overlap in this position. The overlapping ends can be secured together by wire ties or the like, to hold them in the correct position whilst the bond beam concrete is poured, compacted and cured in the hollowed masonry block course 14. The length of the overlap is made sufficient so that tensile stress in one section of reinforcement can be transmitted via shear stress at the interface to the surrounding cementitious matrix and then to the next section of reinforcement, without shear failure occurring between the matrix and the reinforcement ends (i.e., without the reinforce-

[0055] FIGS. 5 and 6 show a mounting adaptor 52 for a cleat which in turn receives rebar ends. Thus the cleat may be as shown schematically in FIG. 4. Preferably the cleat is of the kind for receiving a pair of rebar ends one above the other; generally as shown in our patent no. 2442543. The cleat mounting holes 18, 23 shown in that patent may be elongated transversely of the base plate rather than being generally circular as shown. This allows for increased adjustability when fixing the cleat to a load bearing structure. The adaptor 52 has a base plate 54 with four mounting holes 58 as shown, for receiving fasteners suitable for securing the adaptor to a load bearing structure. These fasteners may be, for example, bolts in the case of a steel structure or expansion bolts in the case of a reinforced concrete load bearing pillar or wall slab. The mounting holes 58 are elongated longitudinally of the base plate, to permit height adjustment of the adaptor.

[0056] The mounting adaptor 52 further comprises a cleat receiving flange 56 welded to and extending perpendicularly from the base plate 54 at its longitudinal midline. The cleat receiving flange 56 has a pair of horizontally elongated mounting holes 60 suitably spaced to receive fasteners (e.g., nuts and bolts) for securing the cleat to it. Therefore the mounting adapter 52 allows a bond beam containing blockwork wall to be built alongside and secured to a load bearing structure such as a pillar, column or wall slab; ends of the bond beam rebars being secured to the load bearing structure via the cleat and mounting adaptor. Where the blockwork wall continues away from the load bearing structure in either direction, a pair of cleats may be mounted back-to-back on either side of the receiving flange 52. These can thus receive rebars of a pair of bond beams aligned end-to-end. This contrasts with a masonry infill secured to a load bearing structure in which the cleat is directly mounted, in which the infill is in line with the load bearing structure, rather than to one side of it. The cleat and mounting adaptor can be combined into a unitary welded assembly, for example with tubular cleat pockets welded directly to one or both sides of the receiving flange 56.

[0057] FIGS. 7a and 7b show an example of a tie bracket 62 of the present invention comprising a first elongated portion 64 similar to the stress transfer member 4 shown in FIGS. 1a-e, 3 and 3a. The first portion 64 comprises one or more rebar cradling features 6 similar to those described above and shown in FIGS. 1a-e, 3 and 3a, except that the retaining lip 36 is located at the top of the slot 34 so that the tie bracket 62 hangs from the one or more horizontal rebars as shown in FIGS. 8a and 8b. The tie bracket 62 also comprises a second elongated portion that acts as an adaptor 66 configured to
secure the bracket 62 to an elongate reinforcing member. The adaptor 66 is nominally disposed beneath the first portion, and acts as a socket to sit on top of and house a vertical rebar 70 as shown in FIGS. 8a and 8b. In principle, however, the cradle retaining lip 36 may be located at the bottom of the slot 34 and/or the adaptor 66 may extend upward from the first portion to house the bottom of a vertical rebar. Typically the tie bracket 62 is formed from a rigid material such as steel or other metal.

[0058] The adaptor 66 as shown in FIGS. 7a-b and 8a-b comprises a cylindrical tube adaptor with a cylindrical hole 68 with a closed top end and an open bottom end. The bottom end opening of the tube and the internal diameter of the tube are sized to accommodate a vertical rebar 70 so that the adaptor 66 can be slid on to the vertical rebar 70 and form a tight (close sliding) fit. When the tie bracket 62 has been located on to the vertical rebar 70, the first portion 64 comprising the rebar cradling features 6 stands proud from the top end of the vertical rebar 70. In principle however, the tubular adaptor 66 may be formed from any suitable rigid material and may be of any cross-sectional shape that fits a vertical rebar 70. A cylindrical vertical rebar 70 and a cylindrical tubular adaptor have the advantage that once the adaptor is located upon the rebar, the tie bracket 62 can be rotated about the longitudinal axis of the vertical rebar 70. Having the tie bracket 62 rotatable about the rebar 70 and a generally flat transverse cross-section to the first portion, allows a person building the masonry wall 10 to lay the masonry bond beam blocks and locate the horizontal rebars 8 in position with the long dimensions of the tie bracket 62 transverse cross-sections initially aligned longitudinally of the bond beam cavity 18, for ease of positioning the horizontal rebars 8. Once the horizontal rebars 8 are in position, each tie bracket 62 is then simply rotated so that the rebar cradling features 6 can hook over and hang the tie bracket 62 off the horizontal rebars 8.

[0059] Similarly to the brackets described previously, the first 64 and/or second portion of the tie bracket 62 may also comprise one or more apertures 32 that operate to allow masonry block binding/filling material to pass through the tie bracket 62 and thus anchor the tie bracket 62 within the structure of the masonry wall 10 and to the vertical rebar 70. Once the tie brackets 62 have been rotated into position over the horizontal rebars 8 as described above, they are preferably shaken, vibrated or tapped downwardly to ensure close engagement with the horizontal rebars 8 and penetration of the binding/filling material such as wet concrete into the bracket apertures 32.

[0060] The present invention also provides a vertical rebar cleat 72 which is shown in FIG. 7c. The cleat 72 comprises a base plate 74 with fixing holes and an outwardly extending tubular portion 76. The tubular portion 76 is similar to that of the adaptor 66 of the tie bracket 62 and protrudes outwardly normal from the plane of the base plate. The tubular portion of the vertical rebar cleat 72 comprises cylindrical hole 68 that is sized to accept and closely fit a vertical rebar 70. Typically, the cleat 72 is placed upon and affixed to a horizontal supporting structure that supports the masonry wall. Preferably the vertical rebar cleat 72 is sized in the plane of the base plate 74 to allow the cleat 72 to be fully accommodated within a vertical through-hole made within a masonry block. When used in a preferred method of constructing a masonry wall, the cleat 72 is positioned so that the vertical through-hole of a block in the first course of masonry block work sits over and surrounds the cleat 72. A vertical rebar 70 is then inserted into the tubular portion 76 of the vertical rebar cleat. Successive masonry block courses are then subsequently formed over the first masonry course, wherein the masonry block of each masonry course immediately above the rebar 70 comprises a through hole to accommodate the vertical rebar 70.

[0061] For masonry walls 10 where the one or more horizontal bond beams 12 are to be formed within courses not immediately adjacent to the bottom masonry block course, several vertical rebars 70 may be required to be tied together to form a composite vertical rebar extending up to and into the bond beam masonry block course. Tying together several shorter rebars 70 rather than having a single long vertical rebar 70 extending over multiple masonry block courses is advantageous because a person building the masonry wall with a single long vertical rebar 70 will have difficulty sliding the masonry blocks with the vertical through holes over the rebar 70. The blocks would need to be lifted up and over the vertical rebar 70 so that the vertical though hole of the block accommodated the rebar 70. By successively tying one or more shorter vertical rebars 70 together, for example no longer than the depth of 2 masonry courses, the person laying the masonry courses can place the blocks with the vertical through holes over the shortened vertical rebar 70 in a simpler manner and then, once the masonry block is in place, tie another vertical rebar 70 to the existing rebar 70 so that the rebar 70 is extended on a progressive course by course basis.

[0062] Vertical rebars 70 may be tied together via a number of methods including simple tying using one or more wires or clips to form an overlap joint complying with accepted building regulations or practice, or by using joining brackets with two or more connected rebar accommodating tubular portions, similar to the adaptor 66 of the tie bracket 62 in FIGS. 7a-b. The tubular portions of such joining brackets may either be located end on or adjacent to each other, each tubular portion having respective open and closed ends in opposite configuration to the other tubular option so that the joining bracket may accommodate rebars 70 inserted into the joining bracket from opposite directions.

[0063] In a preferred method of constructing a masonry wall 10 with one or more horizontal rebars 8 and one or more vertical rebars 70, the masonry wall 10 is nominally built course by course as described above. In each course, the masonry block/s in-line with the vertical rebars are threaded over the vertical rebars so that the rebars protrude through the vertical though holes of the blocks. Once the block is laid and the vertical rebars protrude through the through hole, other vertical rebars may be secured to the existing vertical rebars to form a composite extended rebar as described above. When the masonry blocks accommodating the vertical rebars are in place and any required vertical rebar extensions are attached, the block may be filled or bonded in accordance with the general construction of the masonry course. For the adjacent masonry course 30 immediately below the intended bond beam course 12, the vertical rebars 70 protruding into the course are designed or cut to end beneath the start of the subsequent bond beam course 12. Preferably the top end of the vertical rebars 70 stop within the block of the masonry course but may in principle extend into the bed joint 24. The adaptors 66 of the tie brackets 62 are then placed upon the end of the vertical rebars 70 so that the tie brackets 62 securely engage the vertical rebars 70 such that the first portions 64 of the tie brackets 62 protrude into where the next bond beam masonry course is to be laid. As stated above, preferably the
long dimension transverse cross-section of the tie brackets 62 are initially aligned longitudinally of the bond beam cavity 18. Once the adjacent masonry course below the bond beam course 12 is finished, the hollowed masonry blocks 16 of the bond beam course 12 are laid upon a bed joint 24, together with any other shear transfer brackets 2 according to the present invention as described above. The hollowed masonry blocks 16 of the bond beam course are as described above and preferably comprise a U-shaped longitudinal cavity. The masonry blocks immediately above the tie brackets 62 comprise a vertical through hole sized to accept and allow the tie brackets 62 to protrude through the through hole into the cavity of the U-shaped masonry blocks 14. The vertical through hole may be similar to the hole 16 in the base of the hollowed masonry block 14 as described above, or any other suitable hole such as one formed by removing a portion of the base at one end of a hollowed masonry block 14. Where the vertical rebars extend upwardly from the bond beam, the open tops of the U-blocks allow the brackets 62 to pass upwardly from the bond beam space directly into the hollow block interiors in the course above. Alternatively the tie brackets 62 may be fitted onto the vertical rebars 70 after the hollowed masonry blocks 14 of the bond beam course have been put in place. Once all of the masonry blocks of the bond beam course 12 are in position, the horizontal rebars 8 are located into the rebar cradling features 6 of the shear transfer brackets 2 and the rebar cradling features 6 of the tie bracket 62 are hooked onto the horizontal rebars 8 by lifting and rotating the tie bracket 62. The vertical through holes of the hollowed masonry blocks 14 and corresponding blocks of the adjacent course below are then backfilled with wet concrete. The longitudinal U shaped cavity 18 formed by the hollowed masonry blocks 14 is then filled with concrete to form the completed bond beam 12.

[0064] FIGS. 9a and 9b show another example of tie bracket 62 similar to the tie bracket 62 shown in FIGS. 7a-b and 8a-b. In this alternative version of the tie bracket 62, the adaptor 66 is a spigot adapted to secure the tie bracket 62 to a vertical reinforcing post or pillar 78. Similarly to the tie bracket 62 shown in FIGS. 7a-b and 8a-b, the first portion 64 of the tie bracket 62 shown in FIGS. 9a-b and 10 comprises rebar cradling features 6 with retaining lips 36 at the top of the cradle 6 that operate to allow the tie bracket 62 to hang upon horizontal rebars 8. In this example of a tie bracket 62, the adaptor is configured to be located and housed within the hollow interior of a typically tubular vertical reinforcing pillar 78, e.g. having a rectangular cross-section and a corresponding rectangular cross-sectioned inner hole. In principle however, a tie bracket 62 may be adapted to be placed over the pillar in a similar fashion as the tie bracket 62 in FIG. 7a-b. The adaptor of the tie bracket 62 in the example shown in FIGS. 9a-b, as further shown in FIG. 10, is inserted into the hollow interior of the vertical reinforcing pillar 78. The tie bracket 62 may also comprise an at least partially circumferential stopping lip 80 with at least one cross-sectional dimension greater than a corresponding dimension of the pillar hole. The adaptor 66 of the tie bracket 62 is inserted into the pillar 78 until the stopping lip 80 comes into contact with the top of the pillar 78.

[0065] Preferably, the cross-sectional shape of the adaptor 66 may be made to fit into a variety of vertical reinforcing pillars 78. Where the cross-section of the adaptor 66 does not form a close fit with the inner cross-section of the vertical pillar, spacing strips 82 may be attached to the adaptor 66 of the tie bracket 62 by welding or any other suitable fixing method so that the adaptor 66 forms a close fit with the inner hole of the vertical reinforcing pillar 78.

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1. A masonry wall reinforcing bracket comprising an elongate inter-course shear transfer member, the shear transfer member comprising a rebar cradling feature.

2. A bracket as claimed in claim 1 wherein the shear transfer member comprises a plate operative to be located within at least a perpend of a masonry wall.

3. A bracket as claimed in claim 1 or 2 further comprising a supporting member.

4. A bracket as claimed in claim 3 wherein the supporting member protrudes perpendicularly to the length of the shear transfer member.

5. A bracket as claimed in claim 3 or 4, wherein the supporting member comprises a stabilising foot.

6. A bracket as claimed in any of claims 3-5 wherein the supporting member comprises a plate operative to be located within a bed joint of the masonry wall.

7. A bracket as claimed in any preceding claim wherein the shear transfer member extends completely across at least one masonry course and at least partially into at least one adjacent masonry course in use.

8. A bracket as claimed in any preceding claim formed from a single sheet of material.

9. A bracket as claimed in any preceding claim formed from a metal, or a metallic or non-metallic composite material.

10. A bracket as claimed in any preceding claim wherein the rebar cradling feature is a slot opening into a long edge of the shear transfer member.

11. A bracket as claimed in claim 10 wherein the slot comprises a retaining lip.

12. A bracket as claimed in claim 10 or 11 further comprising two or more slots wherein the opening of at least one slot is located at an opposing long edge to that of at least another slot.

13. A bracket as claimed in any preceding claim comprising one or more apertures operative to anchor the bracket in binding material such as mortar, in use.

14. A masonry system comprising in combination at least one bracket as claimed in any preceding claim and a hollowed masonry block.

15. A masonry system as claimed in claim 14 further comprising a rebar.

16. A masonry wall comprising the masonry system as claimed in claim 14 or 15.

17. A method of forming a masonry wall structure comprising the bracket as claimed in any of claims 1 to 13, comprising the steps of locating the bracket such that:

   1) at least part of the shear transfer member protrudes into an interior region of a hollowed masonry block in a first masonry course; and,

   2) at least part of the shear transfer member protrudes into an adjacent second masonry course.

18. A method as claimed in claim 17 in which at least part of the shear transfer member protrudes through a base aperture into the interior region of the hollowed masonry block.

19. A method as claimed in claim 18 in which at least part of the shear transfer member protrudes into a perpend of the second masonry course.

20. A method as claimed in claim 17 in which at least part of the shear transfer member protrudes through a joint between adjacent said hollowed masonry blocks into the interior region of those blocks.

21. A method as claimed in any of claims 17-20 in which at least part of the shear transfer member protrudes from the interior region upwardly into a third masonry course.

22. A method as claimed in any of claims 17-21 wherein the bracket comprises a supporting member, further comprising the step of locating the supporting member at a bed joint.

23. A method as claimed in claim 22 further comprising the step of locating a rebar in the cradling feature of the shear transfer member.

24. The method of claim 23 wherein one end of the rebar is received in a cleat or socket attached to or in a load bearing structure.

25. The method of claim 23 wherein the rebar comprises two overlapping lengths.

26. The method of claim 25 wherein opposite ends of the rebar are received in respective cleats or sockets attached to or in a load bearing structure.

27. A masonry wall tie bracket comprising:

   a) a rebar cradling feature for accommodating a rebar; and,

   b) an adaptor configured to secure the bracket to an elongate reinforcing member.

28. A bracket as claimed in claim 27 or 28 wherein the adaptor comprises a tube.

29. A bracket as claimed in claim 27 wherein the adaptor is configured to secure the bracket to an elongate reinforcing member orthogonal to the length of the rebar.

30. A bracket as claimed in claim 29 wherein the tube comprises a cylindrical inner hole.

31. A bracket as claimed in claim 27 or 28 wherein the adaptor comprises a spigot for insertion into a hollow elongate reinforcing member.

32. A bracket as claimed in claim 31 wherein the adaptor further comprises a spacer.