

Ideas on the Development of Techniques for Supporting Continuous External Clay Masonry Walls and Proposals for Detailing

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ABSTRACT

The paper proposes a number of ideas to supplement methods of supporting external leaves of cavity clay masonry walls. These have in the past been achieved by expressing horizontal members of structures and using them to support walls above.

In order to conceal these supporting elements, brick slips were used. This technique, despite the adoption of new bonding materials, is viewed with some reserve possibly due to the high failure rate of this method.

1.0 INTRODUCTION AND BACKGROUND

B.S. 5628 Part 1:1978 Clause 29.2 specifies that "Uninterrupted height and length of the outer leaf of external cavity walls should be limited so as to avoid undue loosening of the ties due to differential movements between the two leaves. The outer leaf should therefore be supported at intervals of not more than every third storey or every nine metres, whichever is less."

During the past years expressing the horizontal members of the structure (Fig. 1) on the elevations and using them to support the walls above was an established way of resolving this detail. There were obvious aesthetic limitations and problems arising from water penetration, cold bridges and consequent internal condensation were looked at with complacency and probably accepted as a price to be paid in satisfying the colossal housing needs of the past decades.

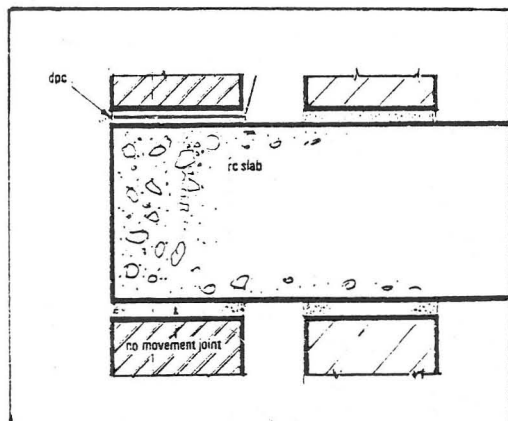


Fig. 1 Slab expressed on elevation

For aesthetic reasons, in certain cases the entire elevation was rendered or clad with various materials normally stuck on to the rendering. In other cases, the horizontal support was recessed (Fig. 2) and concealed with slips in line with the walls above and below.

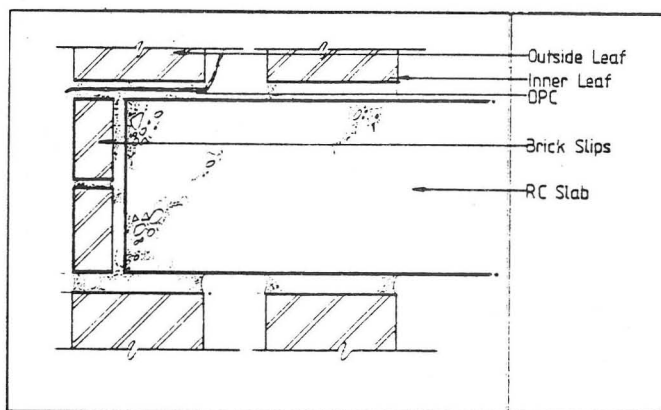


Fig. 2 Slips concealing the structural support

The problems which have been associated with the solutions illustrated above are well known, particularly when no compressible joint was provided to separate the walls from the brick slips area thereby causing movement to be transmitted onto the fragile section of bonded slips. Cladding becoming loose and eventually falling has always been visualised as a potential weakness by designers and contractors. Because of the impossibility of supervising work on site and determining the long term durability of this method, the bonding of slips onto reinforced concrete members is still viewed with reserve and used with uncertainty.

2.0 DEVELOPMENT OF NEW TECHNIQUE

Searching for an alternative which is easy to construct, durable, safe and which provides uninterrupted elevations of brick cladding, a new concept has been evolved. The technique, which uses various arrangements of rebated bricks, ("pistols", mechanically cut from standard units), laid on steel angles or concrete nib supports, has been extensively used and proved satisfactory in practice in a large number of cases.

Some of the reasons which have also contributed to promoting the adoption of this idea can be listed as follows:

- a - In cases where the support is a steel angle (Figs. 8, 9, 11 and 12) the advantages are of having a virtually continuous cavity space between inner and outer leaves; considerable reduction of cold bridges through structural members; the likelihood of obtaining

a more uniform insulation of the cavity where boards or loose fill is employed; possibility of constructing satisfactory horizontal movement joints; possibility of accommodating dimensional variations of the structure by adjustments of the steel support during fixing; the rebated bricks, hiding the support, can rely on a minimum of two-thirds bearing plus a stabilising tie at the back.

- b - Due to the characteristics of a reinforced concrete nib, the thickness to be concealed requires the use of rebated bricks laid on soldier course (Figs. 6 and 7).
- c - These alternatives also rely on the bearing surface rather than bonding (Fig. 3) and therefore can be considered more advantageous

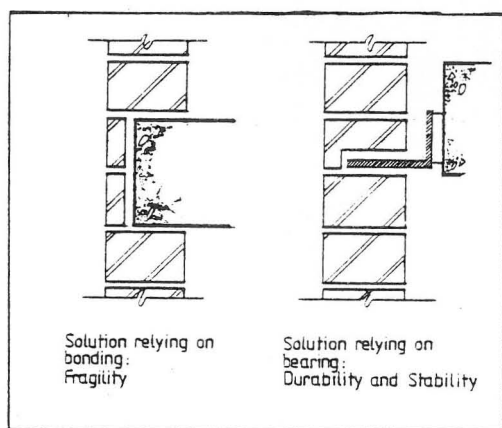


Fig. 3

than the basic solution of bonded slips.

Both the techniques described can conveniently be used to conceal structural supports over openings, spandrel panels, windows, doors, etc. (Figs. 4 and 5).

Fig. 4

Milton Keynes
Central Library
Buckinghamshire
County Architects
Detail of rebated
soldier bricks on
steel angle
support

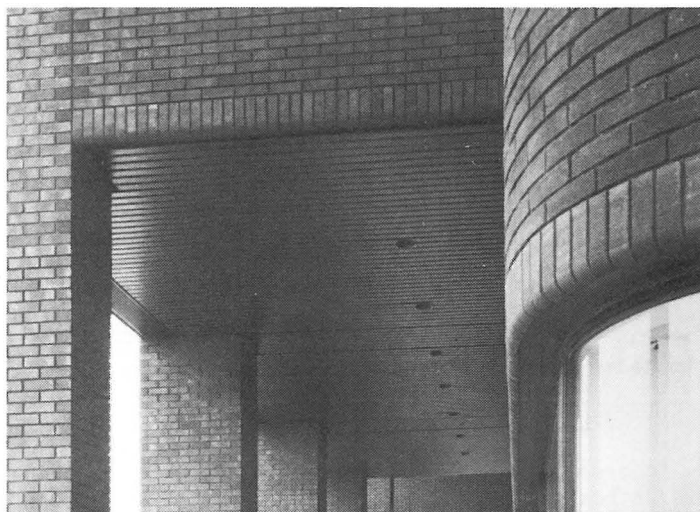




Fig. 5

Milton Keynes Central Library
The giant order and cornice,
but with an open corner,
carried out in rebated bricks.

3.0 DESIGN CONSIDERATIONS

A reinforced concrete nib would provide the most simple and economical alternative support where one or more soldier courses of bricks can be incorporated as a feature of the elevation. A number of options are shown for this alternative (Figs. 6 and 7).

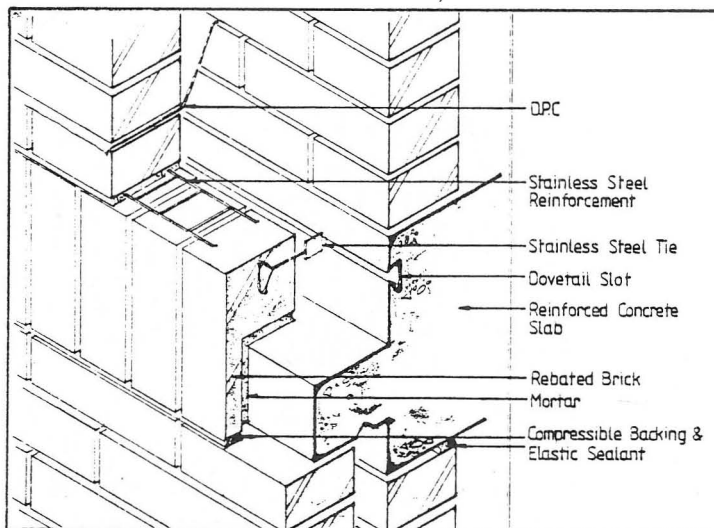


Fig. 6 Concrete nib concealed by one soldier course of rebated bricks

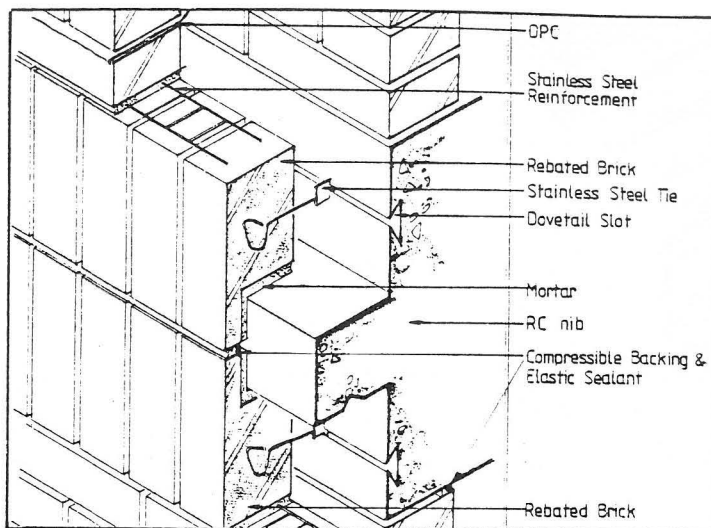


Fig. 7 Concrete nib concealed by two soldier courses of rebated bricks

In these instances provision should be made for at least two-thirds of the brick width to act as a minimum effective bearing surface; rebated bricks whose nib is not less than 25mm thick and not more than 150mm long should be used depending upon the depth of the reinforced concrete nib and mechanical strength of the bricks; ensure that the rebated bricks are applied to the reinforced concrete nib using an appropriately specified mortar mix; stainless steel ties should be anchored in the dovetail slot (cast into the reinforced concrete member and inserted within the soldier brick perpend at intervals not exceeding 300mm); stainless steel reinforcement needs to be provided in any horizontal mortar joints between different courses to improve bonding effectiveness, i.e. stack bonding/stretcher bonding where mortar joints will coincide; the damp proof membrane should be laid above the first brick course which is positioned on top of the stiffened soldier course, this for obvious reasons of stability; the damp proof course should be bedded within two layers of an appropriately specified mortar mix; the horizontal movement joint needs to be highly compressible and constructed to the manufacturer's recommendations and specifications.

Where the characteristics of the elevations do not allow the use of soldier courses and instead alternative bonding is required, the adoption of an angle, preferably of stainless steel or heavy galvanised steel, as shown on the various alternatives illustrated (Figs. 8, 9, 11 and 12) can provide a greater choice of options.

From first-hand experience resulting from the monitoring of a number of cases, the following points have emerged which are worthy of consideration when finalising one of these alternatives:

- The supporting angle should be fixed to the structure by means of bolts which allow for adjustments both vertically and horizontally (Fig. 10).

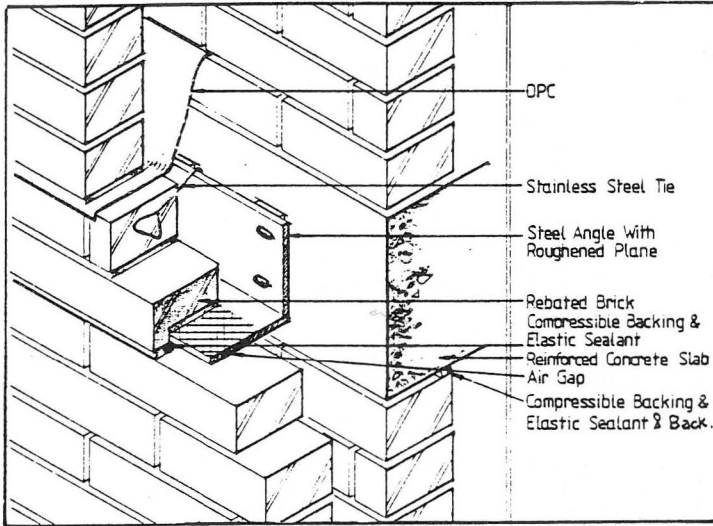


Fig. 8
Steel angle concealed by rebated bricks on flat

Fig. 9
Steel angle concealed by one soldier course of rebated bricks

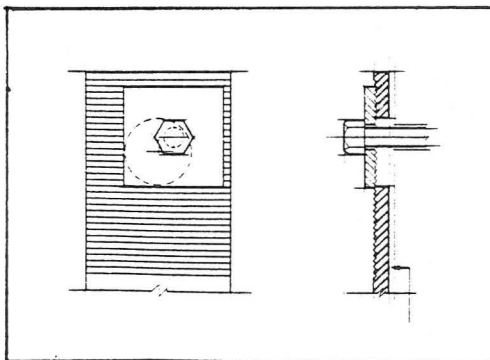
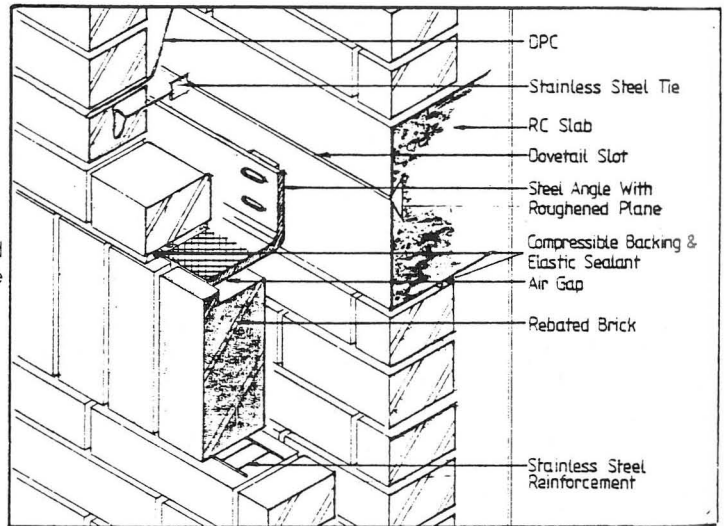


Fig. 10
Device allowing considerable fixing adjustment in vertical and horizontal directions

- In some instances, angles are produced by press/bending of steel sheets and their surface can be extremely smooth. In order to provide an acceptable degree of roughness of the plane of the support, it is advisable that a stainless steel wire mesh is welded on to it.
- In all cases the rebated bricks are laid on to the roughened angle using appropriately specified mortar mix.
- The suggested depth of the brick rebate should not be more than the sum of the thickness of the steel angle plus the mortar bed.
- The first course of soldier bricks, or at least the first two of stretchers, will need to be anchored as shown (Figs. 8, 9, 11 and 12) by using any of the ties available and suitable for this purpose.

Fig. 11

Steel angle/bricks arrangement showing positioning of ties and damp proof course

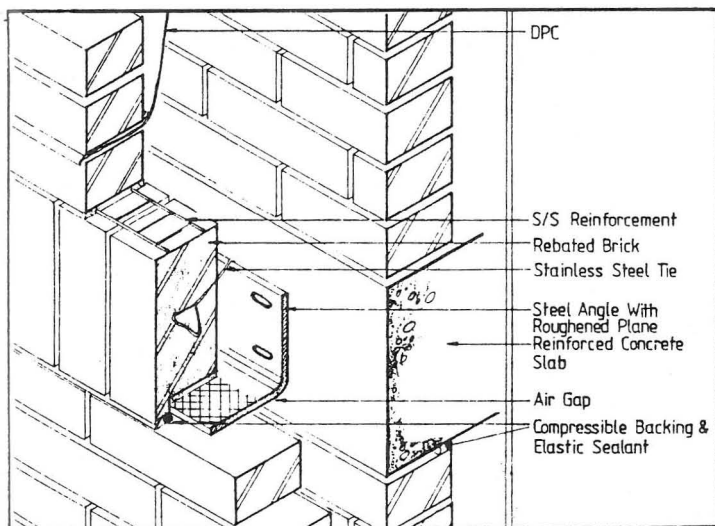
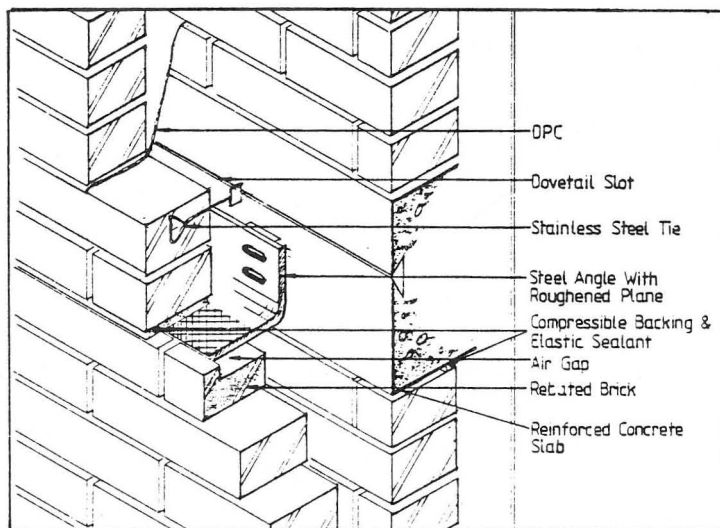


Fig. 12

Alternative showing brick reinforcement, tying, etc.

- The damp proof membrane should be positioned above the courses as mentioned in previous paragraphs.

In each of these cases the detail should be checked for structural stability by a qualified structural engineer.

4.0 OTHER DETAILS REQUIRING ADDITIONAL FIXING

Additional reinforcement or fixing should be considered in very exposed situations where brickwork is likely to be influenced or affected by differential movements of a varied nature, including situations where the bonding arrangement does not comply with Clause 3.12.1 of C.P. 121 Part 1:1973. In particular, this applies where stack bonding brickwork is being considered or where coping to parapet walls is built with an unsatisfactory bonding arrangement.

In the first case it would be essential to reinforce all horizontal courses and tie the vertical perpend at intervals of not more than 300mm (Fig. 13).

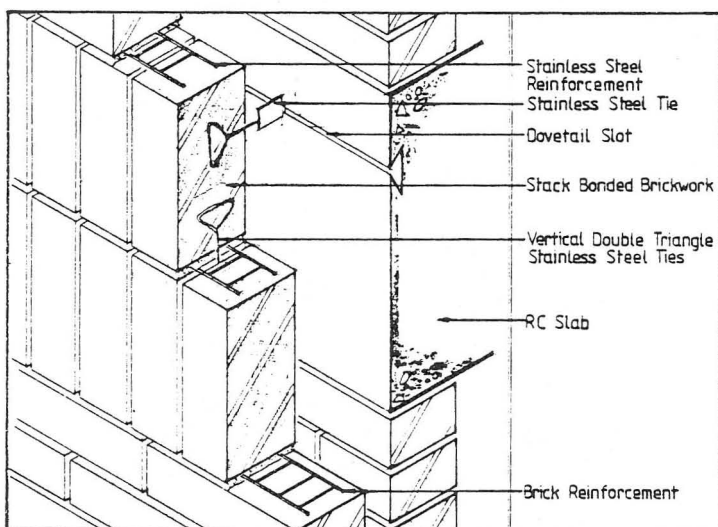


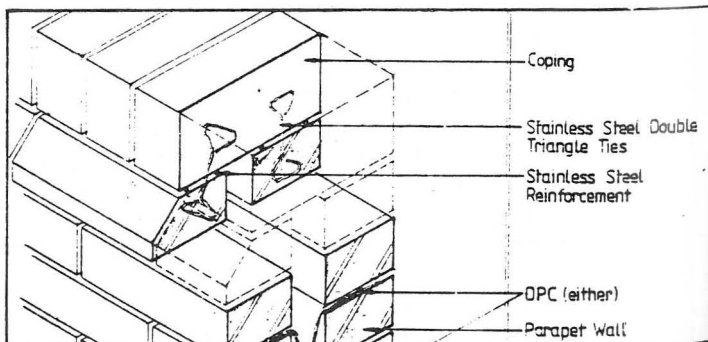
Fig. 13

Reinforcement and tying for stack bonded brickwork

For parapet wall copings it is advisable to tie the coping units to the courses below in order to obtain a better and heavier monolithic section of wall which would remain more stable and not move onto the slip plane provided by the damp proof course below it (Fig. 14).

Fig. 14

Tying/reinforcement of coping to parapet wall



Similar conditions and requirements would also apply to other details such as cills, sloping or corbelled brickwork, etc. (Fig. 15).

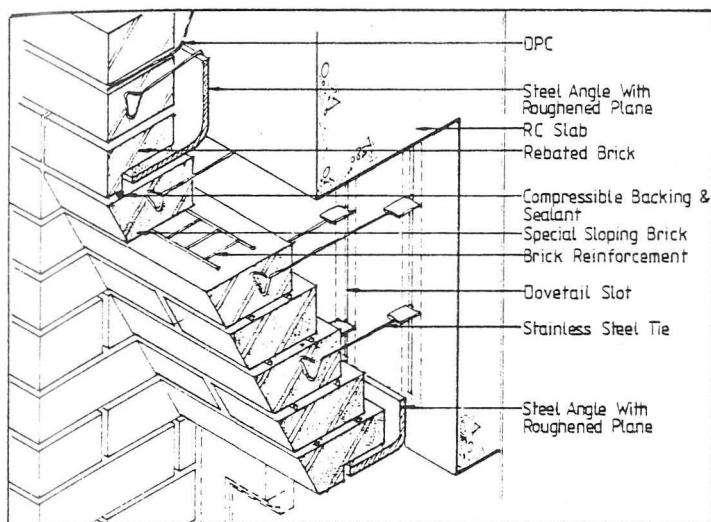


Fig. 15

Tying/reinforcement of sloping brickwork for a window head

5.0 CONCLUSIONS

Changed methods of use of brick masonry within the building envelope, namely the reduction in thickness of walls, have produced a reduction in stability which has become evident in recent times and continues to give rise to certain problems.

New methods have and will need to be found to compensate for these problems. In particular, the necessity to support the external leaf without interrupting the aesthetics of continuous panels of brickwork, originated the idea to use steel angles or concrete nibs on which rebated bricks of various types are arranged and fixed to the structure rather than bonded around it.

The most important aspect of this technique is to make sure that the rebated bricks are well tied to their support to make up for the reduction in bearing surface and to achieve stability. In consideration also of the contained thickness of the clay brick external leaf and consequential limited protection to the ties, it is essential to consider using stainless steel fixings and appropriately specified mortar mixes to assure trouble-free, long term durability.

Suitably positioned vertical movement joints should be provided, taking into consideration all other factors which determine the occurrence of movements.

REFERENCES

C.P. 121 Part 1:1973 - Code of Practice for Walling

B.S. 5628 Part 1:1978 - Code of Practice for Structural use of Masonry

B.D.A. Technical Note No. 4 - 1971

Fixing for Buildings - Publication No. 8 - Harris & Edgar

B.S. 3921:1974 - Specifications for Clay Bricks and Blocks

B.S. 4254:1967 - Specifications for Two Parts Polysulphide Based Sealants
for the Building Industry