Draft Indian Standard

ROW LOCK BOND WALLING TECHNOLOGY – CODE OF PRACTICE

1.0 Scope :

This copy lays down recommendations for the design, layout, construction of brick masonry wall with a different bond with non-modular bricks other than the conventional English and Flemish bond. The bond is applicable for load bearing as well as non-load bearing brick walls, depending upon the material properties of the bricks and the mortar.

1.1 This standard lays down the recommendations for construction of brick masonry wall with a different bond with non-modular bricks other than the….

1.2 The recommendations of this standard do not apply to walls constructed in mud mortars.

2.0 GENERAL

2.1 Brick has been one of the oldest building materials for walling. Flemish or English bond is used commonly for 230 mm thick load bearing walls. A new bond has been developed, in which a header and a closer with brick on edge creates hollowness in wall. The strength and behaviour of full scale walls constructed with this bond (named as Row-lock bond) has been compared in performance with traditional and accepted English bond walls. The walls built with rat-trap bond have been found to be cost-effective both as infill and as a load bearing wall up to 3 storeyes. Besides being cost effective, it has better functional performance in terms ofthermal and sound insulation.

2.2 The name "Row-lock-bond" has derived its origin from the concept of cavity wall (two leafs/wythes of half brick thick walls connected by metal ties). A row lock bond masonry is defined as a wall comprising of two leaves, each leaf being built of bricks placed on edge as stretchers (Row) and separated by a cavity and tied (lock) together with header bricks (bond) which ensures the structural integrity of the two leafs (Fig. 1). The bonding principle of the Rat-Trap Bond is always governed by the "Brick Cross" which is formed by the "Shiner" and "Row-Lock".

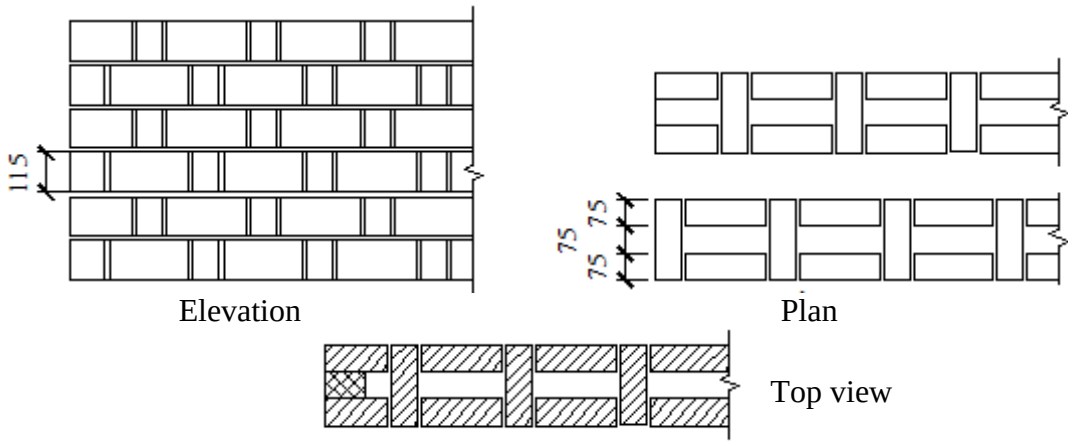


Fig.1

2.3 The ultimate strength of masonry depends on the quality of brick and the bond strength between individual bricks. The mortar joints are the weakest as well as the most expensive part of the masonry. Therefore care must be taken for economic use of cement in mortar joints, while at the same time ensuring that the masonry has adequate strength.

2.4 Row-lock bond is well known as Rat-trap bond and also as Economical bond.

2.5 Comparable with English bond wall having unit weight of 1900-1950 kg/m^3, the Row-lock bond wall has unit weight of 1600-1650 kg/m^3.

2.6 As against the conventional English Bond or Flemish Bond a new masonry bond system called "Row-lock" bond (rat-trap-bond) (Fig. 2) has been propagated in the

country for the last many decades. For load bearing walls with Row-Lock bond, there is a savingof about 16 to 20% of the total number of bricks and about 40 to 50% in mortar. It is very easy to construct the brick wall using the Row-Lock bond with aesthetical rendering. This bonding system also provides for better thermal insulation properties. In terms of structural strength, it is significantly as strong as the conventional 230mm thick brick wall.

2.7 In view of the nature of brick work with full 230mm width provided for, there is no uneven edge on one side, as normally seen in case of English Bond because both inside and outside edges are kept erect & uniform in Row-Lock bond. As a result, thereis no necessity to provide plastering either externally or internally and all that would be required is neat pointing and patching on one edge of the header course to take careof the margin between 230mm notional width and 225mm actual length of the brick.

2.8 Load bearing walls up to three storeyes have been constructed with this technology successfully, houses commercial as well as Institutional buildings with restricted spans. For RC framed multi-storied buildings, reduction in dead load of walls using row lock bond masonry.

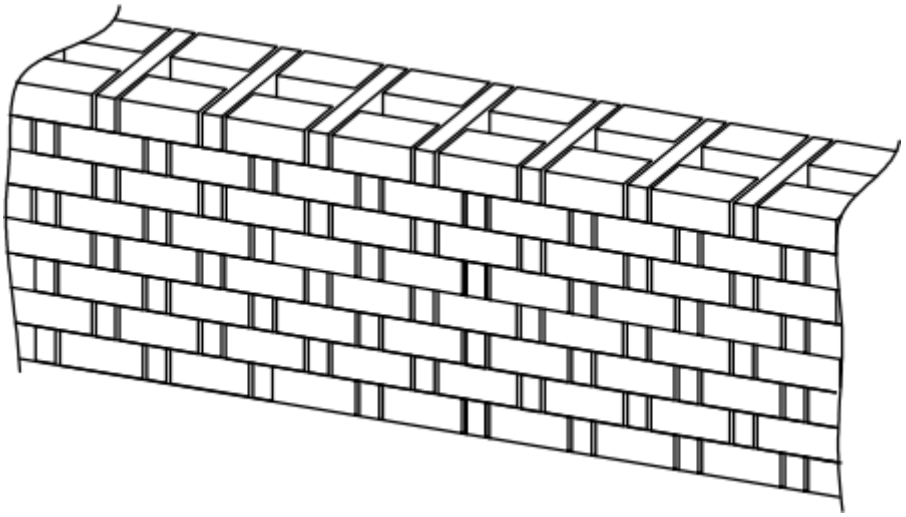


FIG. 2 ISOMETRIC VIEW OF ROW LOCK BOND STRAIGHT WALL

3.0 References :

For materials and structural design requirements Reference is made to the following standards :

i) IS 1905-1987……
ii) IS 4326-2013 ……
iii) IS 1077-1992 ……
iv) IS 1725-2013 ……
v) IS 2180-1988 ……
vi) IS 4139-1989 ……
vii) IS 12894-2002 …..
viii) IS 13757-1993 …..
ix) IS 2250-1981 ……
x) IS 2212-1991 ……

4.0 ROW-LOCK BOND TECHNIQUE

The Row-lock bond is laid by placing the bricks on edge forming a cavity of 80 mm (fora traditional brick size) with alternate course of stretchers and headers. The headers and

stretchers are staggered in subsequent layers to impart strength and stability to the walls.

a) Generally, each alternate course begins with a three-quarter bat (3/4 S), followed by a Rowlock, the intermediate course begins with a Rowlock (R), followed by a Shiner (s). (Fig. 3a)
b) Alternatively, each alternate course may begin with two Rowlocks (R), followed by a Shiner (S). The intermediate course begins with a Shiner (S), succeeded by a Rowlock (R) (Fig. 3b).
c) (Fig.3c) shows the elevation of a wall. The primary objective of bond is to give strength to masonry, but when exposed, it also creates aesthetically pleasing view.
d) This masonry technology is modular in nature, so the dimensions of the wall preferably be based on the module dimensions in multiples.

FIG. 3(a)

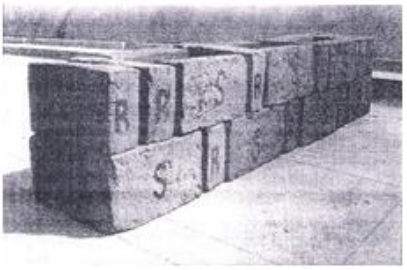


FIG. 3(b)

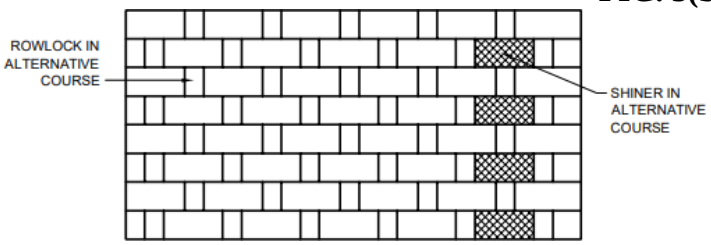


FIG. 3(C)

A Typical module detail is shown in Fig. 4(a) with conventional bricks of nominalsize 230□115□75mm. Note that the corners are strengthened with headers or stretchers without cavity. The brick adjacent to the openings has to be solid as shown in Fig.4 (b). So the opening dimension is also to be in multiple of the row lock bond module. This will be important as opening dimensions are predefined depending on the module dimension. In brickwork the cross joints in any courseshall not be less than a quarter of brick length from those in the course below or above it.

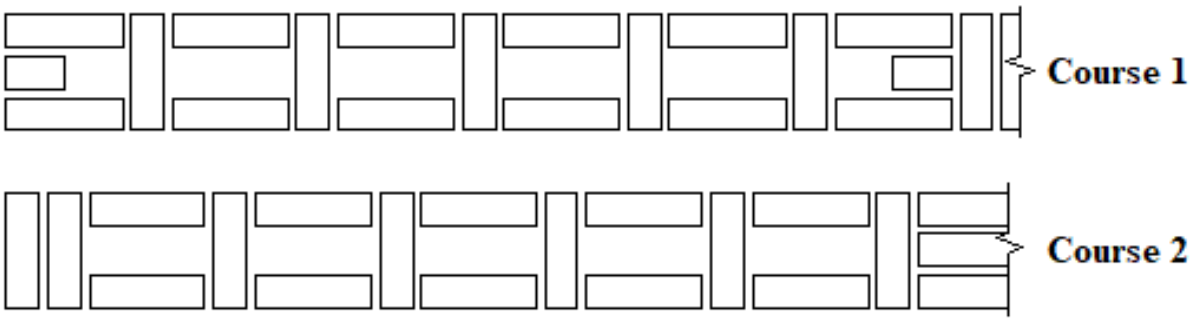


FIG. 4(A) MODULAR WALL WITHOUT OPENING.

(1 Module = Brick length + Mortar thickness + Brick thickness + Mortar thickness)

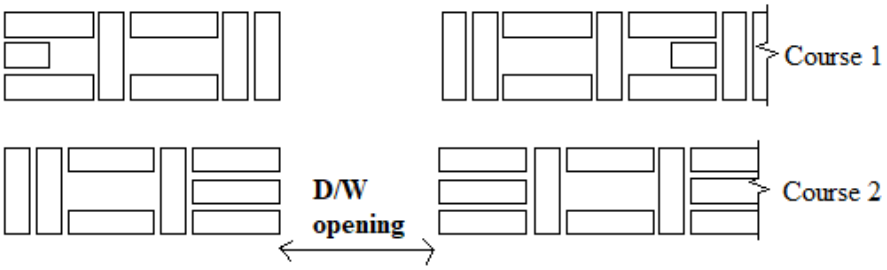


FIG. 4(B) MODULAR WALL WITH OPENING

Example : (Door/window opening = Mortar thickness + 3 units + Brick thickness + Mortar thickness)

5.0 PROCEDURE FOR LAYING ROW-LOCK BOND WALL

5.1 Cleaning

Clean the surface where the first layer of bricks will be laid, which is usually above the plinth level. If there is soil, mud or dirt between the plinth level and the brick masonry wall the bonding of the cement mortar will be reduced causing possible dampness.

5.2 Fixing Corners

Locate and fix the corners of the wall.

5.3 Wall layout / Brick Alignment

Place two courses of bricks along the wall line without mortar and leave 10 mm gap between each brick for the mortar joint. Arrange the joints between the bricks in sucha way that only full bricks (shiners) fit. Ensure that the bonding is correct and that the "Brick Cross" is maintained.

To properly maintain the "Brick Cross", (no continuous vertical joints) first two masonry courses are laid by marking each of the Shiner and the Rowlock bricks at the centre. Place the Shiner and Rowlockbrick now in such a way that the marks are exactly matching. The remaining courses above can then be laid to match with the first two courses.

5.4 Mortar Bedding

Spread a full bed of mortar, and furrow it with a trowel. This will ensure that plenty of mortar is on the bottom of the bricks for the first course.

5.5 Corner Bricks

Carefully position the corner bricks first. Be sure to lay all bricks with the frog inside the cavity of the wall in order to create an aesthetically pleasing outer wall surface. Tap the brick with handle of trowel so that proper bond may develop and no gap is leftin joint. Half or cut pieces wherever required as closer should be used near the end walls.

5.6 Wall Aligning

As you position the corners fix a mason string at both side of the wall. Lay the top outside edge of each brick to this line. Tip the brick slightly toward you so that you cansee the edge of the course below, making sure that the lower edge of the brick is directly over the course below.

5.7 Applying Mortar

For the horizontal joints, apply mortar only to the top of the bricks already laid. Use aplywood template over cavity while spreading the mortar to avoid mortar from falling down into the wall cavity.

5.8 Checking Level

As you lay each course at the corner, check it with a mason's level for alignment. Makesure that the corner is level and plumb. Check each brick carefully, making

sure that the corner is level and plumb. Check each brick carefully, making certain that the faces of the bricks are all on the same plane. This will ensure true and straight walls.

5.9 Rechecking courses

In order to keep the joint thickness uniform, the vertical height of each course should be well determined by equal distribution among the total height to be achieved. For this purpose, a wooden gauge is used. The total height of the brick work in one day should not be more than 920 mm or 8 courses of brick on edge height.

5.10 Laying the Bricks between Corners

To ensure a good bond, do not spread mortar too far ahead of the actual laying of the bricks. When mortar is allowed to set, it will stiffen and lose its plasticity. As each brick is laid, cut off excess mortar with the trowel and work it back into the fresh mortar. Work only from one side, it is not advisable that two masons work on the same wall from two different corners and meet in the centre. This might produce an unwanted gap that will be difficult to close without distorting the correct bond.

5.11 Top Course

After completing the Row-Lock bond wall construction close the wall cavities with a top brick course. This course can be laid with headers or rowlocks depending on pre-fixed height of finished wall below slab. For lintel band, a similar one course of only headers or row locks are laid below the linitel band level.

5.12 The window sill course should also be laid with headers (row locks) only (Fig.5). The Window / Door jambs should have solid masonry.

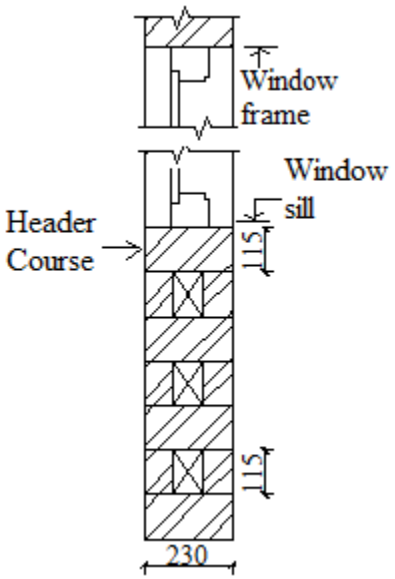


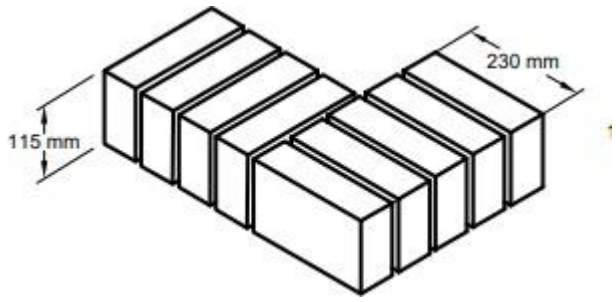
Fig.5 VERTICAL SECTION

5.13 Figure 6 shows the sequence of construction of the corner:-

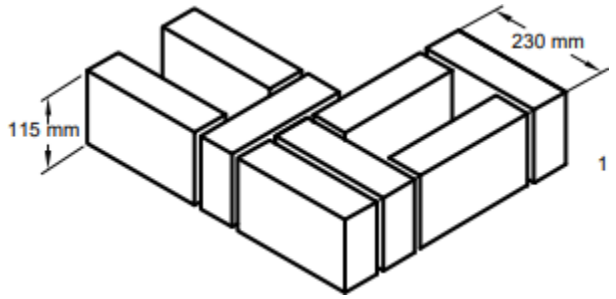
5.13.1 1st Brick course with brick on edge. (Fig.6a).

5.13.2 2nd, 4th, 6th, 8th, 10th courses will be similar. (Fig.6b).

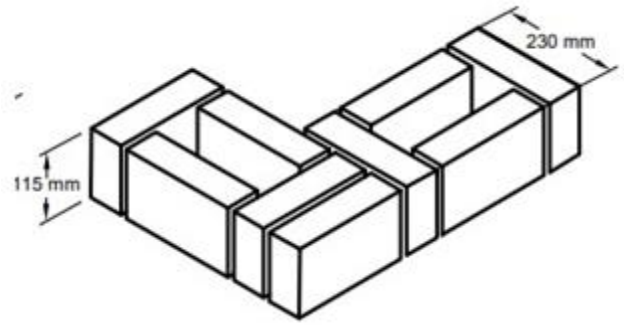
5.13.3 3rd, 5th, 7th, 9th, 11th courses will be similar. (Fig.6c).



6(A) COURSE 1



6 (B) COURSE 2,4,6 (even course)



6 (C) COURSE 3,5,7 (odd courses)

6.0 Mortar Joint

6.1 Care should be taken that all the mortar joints between bricks shall be full and well compacted.

6.2 Joints shall not be more than 10 mm thick.

6.3 Where pointing or plaster has to be carried out, the joints shall be racked to a depth of 15 mm so as to have good bond of plaster or pointing.

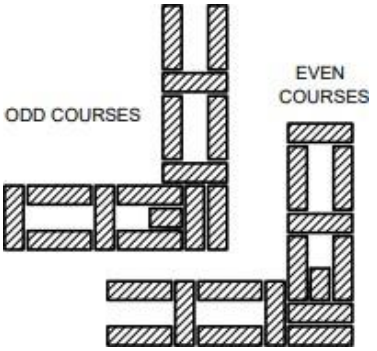
6.4 If the pointing or plastering is not required then the joints shall be struck flush and finished at the time of laying the bricks.

6.5 In most of the cases particularly for exposed brick work it is essential to clean the day's work on the same day on which brick work is laid and all mortar droppings should be cleaned.

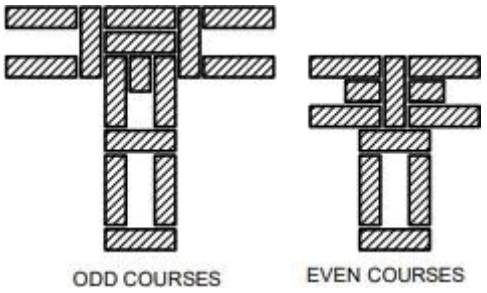
6.6 For vertical joints a thickness of 10mm is recommended. The reduction of approximate 2mm to the horizontal joints is possible because the contact area is much smaller at the side than at the bottom. Care must be taken to ensure that the entire vertical joint is properly filled with mortar; otherwise the brick masonry wall is prone to leakages.

7.0 JUNCTIONS

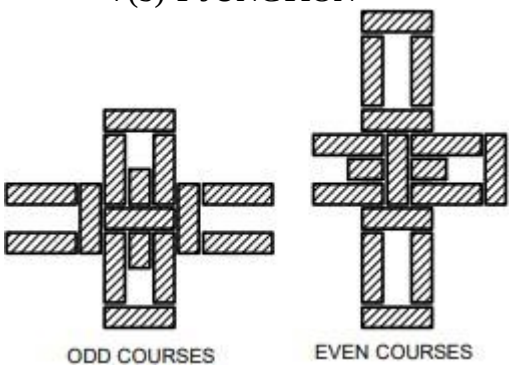
a) (Fig 7a) shows L Junction.
b) (Fig.7b) shows T Junction.
c) (Fig.7c) shows Cross Junction.
d) (Fig.7d) shows Obtuse angle joint



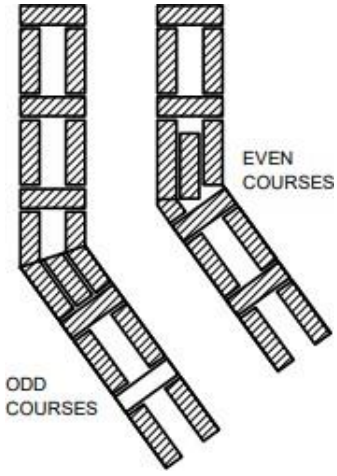
7(a) L JUNCTION



7(b) T JUNCTION



7(c) CROSS JUNCTION



7(d) OBTUSE ANGLE JOINT.

FIG. 7

8.0 PRECAUTIONS

8.1 Only good quality bricks without cracks, deformations or any other fault must be used. Special attention must be given to the opposite side of the frog. It must be smooth and uniform. Bricks used should be dust & dirt free.

8.2 Only bricks of the same dimensions should be used. Bricks from two different kilnsmay vary in dimensions.

8.3 The frog of the brick must always be facing the wall inside.

8.4 For proper alignment of the Row lock bond wall, masonry strings must be used atboth face.

8.5 The vertical mortar joints must be applied directly to the brick before placing it. This requires some special skill, but defines the strength as well as the stability of the Row lock bond wall. Applying the mortar joint directly to the brick is a basic skill requirementof a mason and that determines the speed of work.

8.6 A "Brick Cross" is important for a proper Row lock bond masonry wall.

8.7 Cavities of Row-lock bond must be closed or made solid by a layer/course of only headers or rowlocks for:

a) First course after DPC/Plinth band.
b) Sill level.
c) Lintel Level (below lintel band, wherever band is provided).
d) Top most Course below slab.

8.8 The total wall height must be divided into the appropriate number of brick layers in order to maintain a uniform horizontal mortar joint thickness, including the accommodation of the top closer brick layer. Accordingly, the height of openings must be in multiples of the Rowlock course height to avoid incorrect details at the lintellevel.

8.9 It is also convenient to provide conduit & electrical box outlets. The chase with mechanical cutters will notdamage the wall.

8.10 To improve earthquake resistance the walls must be reinforced with steel bars at all corners, opening (door and windows), T-junctions etc. as per IS 4326 and filled witha M-20 / 1:2:4 concrete. Earthquake resistance will further improve if a vertical steel bar is inserted at every 1 m distance and filled with concrete. (Named as confined masonry technology).

8.11 During the laying of bricks, the brick work shall be protected from any lateral forceand from the rains.

8.12 Care should be taken for its proper curing period of 7 days.

8.13 Row-lock bond should not be used where clay bricks of good quality and uniform size are not available. However, in this case, concrete bricks or good flyash bricks that are more uniform in size, quality and appearance can be used.

8.14 Row-lock bond masonry has to be made by well trained and skilled masons.

8.15 Very smooth/ polished brick edge surface are not suitable for Row Lock Bond masonry workdue to poor mortar brick bonding capacity.

9.0 TOOLS

The Row-lock bond is different variant of brick wall bonding. Basically the same working tools, as for other brick works are required. The only tool that is additional is a "template" that helps to avoid mortar from falling into the wall cavity (**Fig.8**)

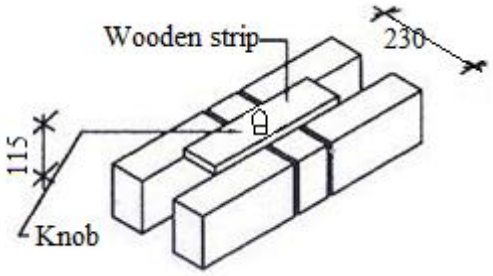


FIG. 8

10.0 MODULAR PLANNING

A good quality Row-lock bond is made of full rowlock and full shiner bricks only. Except at corner no half brick should be used, otherwise the basic bonding principles of the so called "Brick Cross" (no continuous vertical joints) cannot be maintained. Therefore,the length and height of a wall and all door and windows must be modular. One moduleof rat-trap bond consists of 3 bricks: 1 rowlock and 2 shiners as shown in the FIG. 4(A & B)

11.0 *Other Properties Consideration*

11.1 *Thermal Stresses*

The coefficients of linear expansions of brick vary from $5 \square 10^{-6}$ to $11 \square 10^{-6}$ per degree Celsius. Variations of temperatures tend to produce linear changes in walls which, when restrained, may lead to internal stress resulting in cracks especially when the walls exceed 30 to 40 M in length. The effects to these stresses should be taken into consideration for a proper design or the expansion joint be provided wherever feasible.

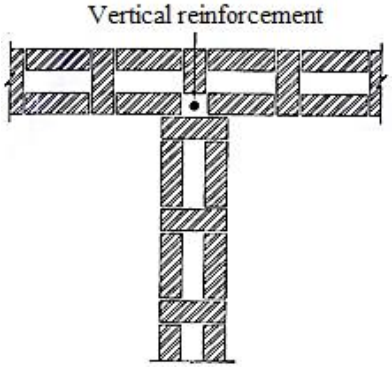
11.2 *Shrinkage Crack*

To confine cracks to the joints and to dissipate shrinkage into large number of fine joints, it is desirable that the mortar used should be weaker than the bricks. Cracks due to shrinkage normally occur near the openings or where the vertical or horizontalsection of a wall changes. A long wall with few openings will tend to show wider cracks above and below the openings. Steel reinforcement may be embedded in brick work at points where cracking is likely to occur.

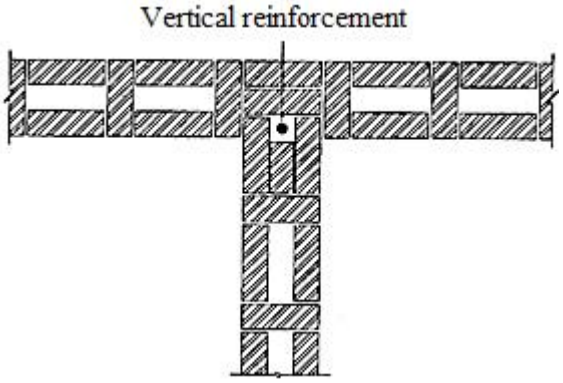
12.0 EARTHQUAKE RESISTANCE PROVISION

12.1 A load bearing wall structure with Row-lock bond is safe provided it satisfies the requirements mentioned in IS 4326.

12.2 The earthquake resistant measures required for load bearing structures can be adopted in walls built with Row lock bond. The hollow core created in Row lock bond facilitates in use of vertical reinforcement at corners and junctions for earth-quake resistance (Fig.9 a&b and Fig.10 a,b & c).

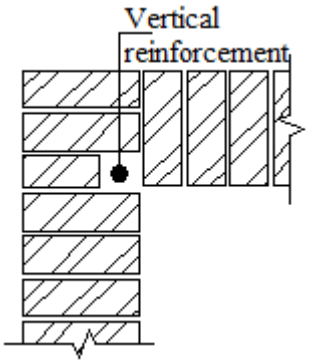


(9a) ODD COURSES

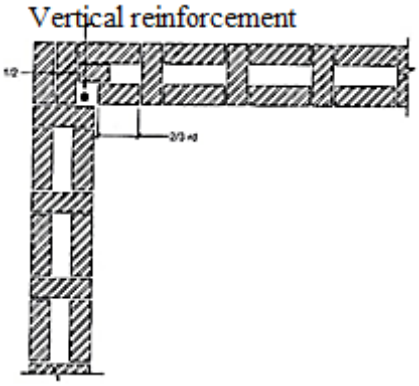


(9b) EVEN COURSES

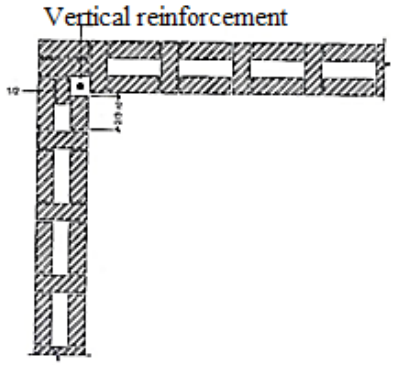
FIG.9 VERTICAL REINFORCEMENT AT T JUNCTION



(10a) IST COURSE (BRICK ON EDGE).



(10b) EVEN COURSES (2, 4, 6,.....)



(10c) ODD COURSES (3, 5, 7, ...)

FIG.10 VERTICAL REINFORCEMENT AT L JUNCTION

12.3 Vertical reinforcement as per design should preferably be placed at 125 mm fromthe inner face of the corner.

12.4 An alternative method for providing vertical reinforcement at T and L junction in high seismic areas is given in Fig.11 (a&b) and Fig.12 (a&b).

12.5 For earth-quake resistance besides vertical reinforcement at corners, junctions, horizontal bands at plinth level, lintel level and roof level, can be comfortably providedin this bond (FIG.12 a,b & c).

12.6 Wherever the concrete band is provided the lower course has to be header course. Header course closes all the cavities and becomes the base.

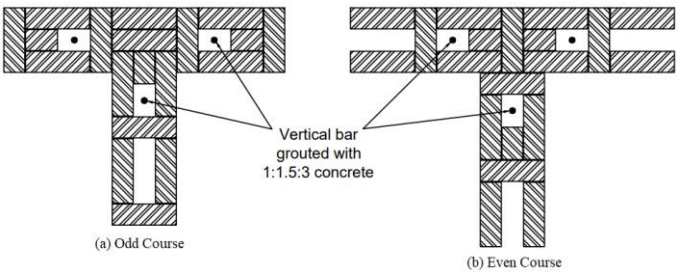


FIG.11