EXTERIOR WALLS OF MASONRY

MOISTURE PENETRATION

1. GENERAL

1.01 This section covers the general subjects of design and construction of exterior masonry walls above grade from the standpoint of resisting cracking and moisture penetration. Of numerous factors which influence the resistance of walls to cracking and leakage, the most important from Bell System experience appears to be the quality of workmanship. This is particularly evident where walls are exposed to prolonged driving rains and wide variations of temperature.

1.02 The suggestions outlined in this section may be considered applicable generally to nonbearing panel and curtain walls of skeleton framed structures as well as to load bearing walls. It is recognized that walls of structures in localities subject to earthquakes or hurricanes require special reinforcing treatment, the details of which are generally covered by provisions of local Building Codes.

1.03 This section is revised and reissued to include additional recommendations, changes in certain wording and rearrangement of the text. Arrows are used to indicate changes throughout the text.

2. CONSTRUCTION

2.01 Experience indicates that resistance to moisture penetration in walls above grade has been proportionate to their ability, due to strength and ruggedness, to accommodate movement, and at the same time to avoid rupture resulting from normal vibration or expansion and contraction. Good qualities of resistance to cracking are usually attained by constructing the walls solidly, without voids, using appropriate masonry units, properly mixed mortar, solidly filled joints and vigilant inspection. The permeability of masonry walls to moisture penetration appears to depend almost wholly upon the quality of workmanship. The use of standard quality units and first class workmanship are the first requirements for weather-tight masonry walls. While the selection of brick for exterior walls is often influenced to some degree by considerations of color and texture for architectural effect, it is important that qualities of durability be taken into account. Bricks that are unduly soft or porous, or that have a considerable content of calcium sulfate are usually subject to excessive surface erosion. Tests for these properties are suggested where the characteristics of brick under consideration for a given project are in doubt.

2.02 Concrete masonry units such as block, brick and tile have been successfully used in telephone buildings as backing for exterior brick walls, for constructing interior partition walls and for constructing exterior walls of repeater stations, community dial offices, garages, and storerooms. Concrete masonry lends itself to a variety of surface finishes for both exterior and interior walls. Painted concrete blocks would appear to be a satisfactory wall finish for switchrooms. Painted concrete block walls have been used extensively for interior partitions in certain accounting center buildings.

2.03 Where concrete masonry is used as backup or partitions in structural frame buildings, the masonry should be securely anchored to the structural members by adequate rustless metal ties. Where one concrete masonry wall joins another, either of concrete masonry, cast-in place concrete or other masonry, the two walls should be securely bonded with a masonry bond or with very substantial metal ties. This also applies to partition walls. Joining two walls together without bonding or tying, regardless of the masonry material used, will usually result in the formation of cracks. The provision of a limited number of beveled vertical joints extending the full height of the wall where concrete masonry is used in exposed partitions of lengths in excess of fifty feet is usually effective in limiting cracking due to temperature stresses to these joints.

2.04 It is important that maximum durability of bond between brick and mortar be obtained to resist separation cracks. Experience indicates that the bond strength is generally greatest where bricks having moderate absorption are used with lime-cement mortar or with certain premixed (patented) masonry mortars. Numerous views have been advanced as to the proper ingredients required to produce satisfactory mortar, such as using seasoned slacked lime, - also the percentages of lime and cement considered most desirable.

There seems to be some thought that a volume of lime equaling the volume of cement is a normally maximum lime content. This is on the basis of avoiding excessive erosion due to weathering and of maintaining a reasonably high compressive strength of the mortar consistent with securing proper bond as indicated above. Consideration might be given to certain admixtures of hardening and waterproofing compounds that may have been found to reduce mortar shrinkage and efflorescence and to increase the bond strength. Thorough mixing of the mortar is essential in acquiring uniform, homogeneous and workable consistency; also it tends to reduce initial shrinkage. Mortar should have high water-retaining capacity and plasticity. To insure a good bond the brick should have a low rate of suction when placed in the wall. To secure this low rate of suction, when absorbent bricks are used, they should be thoroughly wetted and not allowed to dry out before they are placed in the wall. The wetting of absorbent bricks before laying, the use of mortars of moderate or high water-retaining capacity and the use of bricks of high absorption as backing for bricks of low absorption are essential aids in obtaining walls which are resistant to moisture penetration. These aids are not of significant value, however, unless accompanied by a careful filling of the mortar joints.

2.05 In constructing solidly built walls free from voids, all joints, both vertical and horizontal, are completely filled with mortar, and the use of cored, hollow or porous brick or hollow tile is generally avoided. It is desirable that the size of backup brick match that of the face brick as closely as practicable in order that all courses and joints may be maintained uniform throughout the wall and permit proper bonding with brick headers. Tight joints are essential to watertight masonry. Bed joints should be full and level and not furrowed. Head joints should be carefully buttered to fill the joints solidly. Face brick should be back-plastered before the backup units are laid to provide a barrier to any water which may find its way through the outside four inches of the wall.

2.06 The amount of water which will enter cracks in the face of the wall can be reduced, if all joints on the exterior face of the wall are tooled to give a concave finish. This should be done with a round tool slightly larger than the joint, before the mortar hardens, and with pressure sufficient to compress the mortar and create a firm bond between the mortar and the units at the face of the wall. Raked, stripped and struck joints greatly increase the chance for the development of leaks. In making these joints, there is a tendency to open up the body of the mortar and draw it away from the masonry unit, forming small ledges upon which water can collect. Joints that are excessive in width, rough cut, struck or raked out tend to accumulate water for capillary induction to the wall interior. For average conditions it is expected that joints will be in order of 3/8 inch, but are preferably not over 1/2 inch in width. Joints which are uniform and tooled with pressure slightly concave or flush have provided the most satisfactory weathering qualities.

2.07 Further procedures to assure rapid shedding of rain from exterior wall surfaces include the minimizing of projecting masonry courses and cornices, or avoiding them entirely. Where they occur, consideration might be given to flashing their upper surfaces with lead coated copper dripped at outer edges. Projecting sills are provided with drip grooves under their outer edges; also, the use of slip sills (same width as window opening) is generally avoided since they do not afford adequate bond with the wall masonry. Sills are preferably wider than the wall opening.

2.08 Moisture penetration around window frames is minimized by providing flashing at window heads and by caulking with oakum followed with elastic caulking compound to solidly fill the joint between frames and masonry reveals. Special attention directed to making the heads of windows tight against moisture penetrating between the masonry and the lintel, and between the lintel and the window frame, will be an important factor in reducing maintenance.

2.09 Plaster applied directly to inside surfaces of solid walls is subject to disintegration by dampness in the wall or by condensation due to low temperature of the wall when the room air is moist and relatively warm. This condition would be particularly prevalent in switchrooms where induced humidity is provided during the winter season. Furred surfaces of hollow tile or galvanized lath arranged for plastering, or of structural glazed tile so installed as to provide an air space are recommended to avoid moisture penetrating to the finished wall surface, also to prevent condensation.

2.10 As regards the smaller types of buildings such as community dial, which generally have gable or hip roofs and relatively minor areas of exposed wall, various types of wall construction have been employed which differ from the foregoing procedures. Whether or not the small structures can justify the same treatment as the larger types may depend upon local conditions. In some cases 8-inch thick outer walls and 4-inch

thick inner walls have been constructed, leaving 2-1/2 inches air space between and bonding the separated walls with rustless metal ties.

2.11 In general, walls that feature, for example, running bond, vertical indented or projecting architectural motifs involving continuous vertical joints, corbeling, or that otherwise require considerable cutting of the bricks, have not proved satisfactory from the standpoint of resisting moisture penetration.

2.12 Due to the severe exposure of roof structures such as stair bulkheads and penthouses, it is suggested that consideration be given to entirely encasing them with sheet copper having standing seams to accommodate movement due to temperature changes. The exposed surfaces of stair bulkheads may be materially reduced by inclining their upper surfaces to correspond with the rake of the stairs.

2.13 Spandrel waterproofing membrane composed of bituminous saturated fabric has been found to disintegrate, whereas sheet copper has indicated good qualities of durability.

2.14 Where the foregoing procedures conflict with, or are exceeded by corresponding requirements of local or state legislation, the legislated requirements should, of course, apply.

3. TEMPORARY REAR WALLS

3.01 In connection with the construction of temporary rear walls and other walls subject to removal and relocation by reason of growth, consideration is given to the use of fire resistant materials which are economical as to first cost, are readily removed, and are wholly or partially salvageable for relocation and re-use.

3.02 Materials and methods which have been used satisfactorily for this purpose include steel decking placed vertically, concrete block, hollow tile, prefabricated concrete panels, and in locations of mild climates, steel studs with metal lath and cement plaster. This is not intended to be a complete listing of all the materials and methods but does indicate some of the many possibilities in this connection, keeping in mind, however, the requirements for fire and weather protection.