COMPOSITE BRICK CONSTRUCTION.

Numerous examples of composite construction of brick with reinforced-concrete framing illustrate the success of this combination.

Slight diagonal shear-cracks have developed in the plaster in many cases, but in a well-constructed frame brick curtain walls have proved perfectly safe. Diagonal bond might be beneficial in preventing or reducing cracks in curtain walls.

General practice appears to favour solid curtain walls with a cement-plaster coat on the exterior surface to prevent penetration of moisture.

The use of poilite or galvanized-iron sheets under the band to bridge the cavity in brick curtain walls leads to malpractice, in that these sheets frequently cover the greater portion of the wall, leaving only a narrow external strip for bonding the band and the brickwork.

REINFORCED-CONCRETE CONSTRUCTION.

With few exceptions, reinforced concrete has withstood the earthquake with remarkable success Three distinct types in this district, when well designed and well constructed, have behaved admirably,—

(*a*) A building with mushroom head columns, flat slab, drop-panelled construction, with brick curtain walls (three stories and basement) survived almost without a flaw.

(*b*) Current practice in plain beam and column frame with reinforced-concrete curtain walls is exemplified in two buildings (one of three and one of two stories).

(*c*) The haunched beams and reinforced-concrete curtain walls in reinforced-concrete frame of a two-story building show the least effect of strain of any buildings in the town.

Foundations.—In general, spread footings tied together, continuous spread footings, or raft foundations are favoured in this locality. The spread footing is the usual form, the raft foundation being reserved for buildings with extensive basements. Each type has proved eminently satisfactory.

Basements suffered no damage beyond slight cracks in the floor.

Ground Floor.—It is evident that the heaviest stresses are concentrated in the ground-floor framing, and this, owing to extensive window and door areas, is usually the least rigid portion of the structure.

Little comparative data can be obtained relative to the respective merits of flexible and rigid ground-floor-frame construction. All the largest buildings, with their reinforced-concrete or brick curtain and partition walls, belong, in effect, to the rigid type.

The failure of two particular single-storied buildings appears to argue against the theory that flexibility of construction is a desideratum. Resonance is always to be feared, and then the alternating stresses on the columns, particularly just above floor-level and below beam-junction, tend to crush and disintegrate the concrete, permitting greater strain of each successive oscillation of the building. In one case the heavily reinforced bearing-walls, although still fairly sound, show evidence of heavy strain. The possibility of overstressing the steel in these circumstances appears by no means remote.

If it is not possible to brace each bay in a series of ground-floor shops or offices, then one or more symmetrically situated bays should be stiffened sufficiently to take the horizontal thrust. Alternatively, it may prove more economical to provide greater rigidity by strengthening columns, using haunched beams, or providing knee-bracing. It is inadvisable to provide rigid bracing of too local a nature in a building of any magnitude. Due consideration must be given to the type of adjoining buildings, and provision made for extra stresses likely to be incurred therefrom.

Columns.—In the three instances of failure of reinforced-concrete buildings the weakness has lain in the columns—one through faulty design and construction, and the other two through undue flexibility. Where steel columns and caps are used as interior and street-line supports the greatest caution must be observed in the provision of means to resist horizontal thrust. Particular attention must be paid to those portions of concrete columns directly above and below the points of restraint. Liberal use of hoops or bands at these sections and greater care in holding the steel in place in the forms are recommended.

Beams.—In spite of palpable errors of design and construction, in only one instance has there been any evidence of beam or girder failure. In fact, these members err more on the side of uneconomical strength and weight. Lack of bearing-area, eccentric bearing, and inadequate anchorage at wall-columns, &c., are the most patent defects.

Curtain Walls.—Four-inch curtain walls reinforced with $\frac{1}{4}$ in. rods horizontally and vertically at 12 in. to 18 in. centres have proved entirely satisfactory. The diagonal shear-cracks seen in brick curtain walls point to the economy of using less steel with diagonal reinforcement; but this saving would perhaps be offset by more expensive construction.

Fire-resistance.—The reinforced-concrete shell of one building with heavy concrete parapet walls survived the earthquake unscathed (basement and three floors). That the interior of this building was subjected to intense heat is indicated by the melted wire glass. No water was played on this fire. Where the concrete was dense the steel has been protected, and only the surface skin suffered; but wherever honeycomb formation is apparent the material is spalled, disintegrated, and severely damaged to a depth of 3 in. and more. This honeycomb formation is most pronounced at the junction of successive pours in the boxing. In another building the same weakness has developed in an incipient form in the columns, the fire aggravating the fault in the original construction.