Students' Paper No. 937.

"Modern Swimming-Pool Design." †

By Edwin Lomax, Assoc. M. Inst. C.E.

Correspondence.

Mr. F. M. G. Du-Plat-Taylor observed that, as swimming-pools sometimes cost as much as £20,000 or more, their design was a subject which might well receive more attention. All the pools illustrated had vertical walls, but considerable economy could be realized by forming side slopes in the floor at the foot of the walls, and going down to the full depth required. That arrangement reduced the height of the vertical walls and was unobjectionable, provided that the slope did not project too far from the face-line of the wall.

In regard to the question of under-pressure on the floor of a pool when it was empty, he had adopted the expedient of inserting in the floor small gunmetal relief-valves in connexion with a system of shallow trenches filled with loose stone beneath the floor. The valves were of the ordinary poppet type about 2 inches in diameter, working in gunmetal seatings and covered with removable gunmetal gratings. They could be cleaned and ground-in whenever the pool was empty. No leakage in the reverse direction had occurred with those valves when the pool was full. The use of the valves enabled the floor to be designed with single reinforcement.

In his opinion rendering applied in the usual way was not a satisfactory finish for the surfaces of a swimming-pool, or for any tank. It generally developed crazing, and eventually disintegrated. The surface layer should be applied before the under layer was completely set, or should be deposited simultaneously with the under layer.

The system mentioned on p. 85 §, which was known as the "Impervious Pre-cast system," was wrongly marked in *Fig. 13* (p. 85 §) as limited to a height of vertical wall of 8 feet; it could be adapted to a height of 10 feet. By that system the polished or other ornamental surface for the wall was applied to the faces of the blocks in the factory.

The system of chlorine-sterilization was rapidly giving place to other methods, owing to the difficulty of always ensuring uniform dosage and the consequent unpleasant taste and smell.

That difficulty was, however, avoided by the "Chloramine" system. In his view a system devoid of any unpleasant taste or smell was essential, and he had found ozone to be the most satisfactory in that respect, pro-

† Journal Inst. C.E., vol. 7 (1937–38), p. 77. (November 1937.)

§ Page numbers so marked refer to the Paper. (Footnote (†) above.)—Sec. Inst. C.E.

vided that the gas was discharged directly into the water of the pool itself.

Mr. Ralph Marshall pointed out that, although the Author had referred to Continental swimming-pools and to wave-making machinery, there was no mention of what he thought was the first swimming-pool with wave-making machinery to be constructed; that pool belonged to a hotel in Budapest, and was in full operation in the summer of 1928. The pool was in connexion with the thermal bath established at the hotel, and was of the rectangular open-air type. At the shallow end was a sand beach with artificial rocks on which the waves spent themselves. He had been unable to see the wave-making plant, but from the way that the waves could originate at the deep end either at one side only or from each corner, with a period of from 2 to 3 seconds between them, it appeared as if the plant were of the plunger type, or, if it were of the hinged-shutter type, that the shutters were not all swung backwards and forwards at the same time. The normal waves produced were very strong, and the pool was supplied with life-belts around the sides, only strong swimmers being able to remain in the deep portion while waves were being produced. The artificial rocks gave a most pleasing appearance to the beach as the waves broke on it, but they might have since been removed as he saw bathers receive cuts through being swept on to them. The wave baths at Luna Park, Berlin, were, he believed, constructed shortly after the baths at Budapest, so that Hungary deserved mention as a pioneer, if not the originator, of wave baths.

Mr. John Pollok, of Nairobi, sought further information on certain points. *Fig. 12* (p. 85 §) showed a copper-strip construction-joint, and the remark was made that that type of construction-joint was used in order to "bond the work together." He was under the impression that construction-joints were used, not to bond the work together, but rather to allow free movement of the concrete; the argument being that it was better to localize any movement of the concrete rather than to allow contraction- or expansion-openings to appear haphazard in the wall. If his view of those construction-joints were correct, then the horizontal reinforcement bars should not be carried across the joints, but as far as he could ascertain it was a common practice to carry the horizontal reinforcement across those joints.

The Author laid stress on the necessity of well draining the site, and also recommended that friction between the foundation and the floor-slab should be eliminated as far as possible; but were those recommendations really carried out in general practice? A most important point, in Mr. Pollok's opinion, was the laying of the floor-slab. The Author recommended a layer of bitumen at each construction-joint; Mr. Pollok agreed that some form of watertight joint was necessary, but many

§ *Ibid.*

engineers seemed to be satisfied with "buttering" the joint with 2-to-1 cement mortar, even with a head of 15 feet of water. With a large floor-area that form of joint was not likely to prove very efficient.

The copper-strip vertical joint in the walls and the omission of a proper watertight seal at the floor-joints were the weak points common to reinforced-concrete water-tanks, whether they acted as storage-reservoirs or as swimming-pools.

Mr. E. F. Roberts, of Dunedin, N.Z., referring to p. 83 §, where it was stated that "possible shrinkage of the earth backing makes it advisable to design the reinforcement for both cases," asked whether it would not be possible, in cases where suitable material was available, to load the wall with sand backfill? In that case shrinkage would not occur and lateral pressure would always exist. Mr. H. J. Nichols, in a Paper † entitled "Frame Arch Spans for Railway Loading," suggested the use of sand in a similar way behind the vertical walls of rigid-frame bridges.

The Author, on p. 84 §, made the following statement: "Owing to the large volume of concrete there will be a correspondingly large shrinkage." That statement appeared to require modification, shrinkage being dependent more on length than on cross-sectional area.

Amplification of the description of joints in the floor-slabs would be appreciated. What was the purpose of the rubber hose in the left-hand diagram of *Figs. 14* (p. 87 §)? At a point where four slab corners met, how were the joints of the bent copper strips effected? Were they joined? If so, information on the matter would be appreciated, as such attempts as he had seen to join those strips at that place appeared to be too rigid to allow any movement, and liable, if the strips were securely bonded to the concrete, to cause cracking of the corners of the slabs. Would the Author give a specification for suitable bitumen for those joints?

The Author, in reply, agreed with Mr. Du-Plat-Taylor that the design of swimming-pools was a subject which might well receive more attention, particularly in view of the National Fitness Campaign and the necessity for designing such buildings as central features of comprehensive schemes for physical training and recreation. The question of effecting economies by forming side slopes in the floor was a matter for individual design; that suggestion could only be adopted with safety at the deep ends of large open-air pools. With reference to the question of whether or not rendering was a satisfactory finish for the lining of a swimming-pool, the Author pointed out that such a finish was by no means ideal, but, where initial cost was a primary consideration, it would be permissible to use the method. In his opinion, it could be expected to last at least 20 years.

Mr. Pollok's remarks regarding the copper-strip construction-joint were quite correct. Such a joint would "link the work together" rather

§ *Ibid.*
† Indian Railway Technical Paper No. 294. Calcutta, 1935.

than act as a bond. His remarks as to reinforcement bars not being carried across joints, however, were hardly applicable to swimming-pool design, as such joints were used in mass concrete walls, and were not necessary in thin reinforced-concrete walls used in connexion with swimming-pools. The Author's recommendation that friction between the foundation and the floor-slab should be eliminated as far as possible was stressed in view of the fact that such conditions were not found in general practice. The absence of such conditions was one reason for the failure of the floor-slab.

The possible use of sand backfill, suggested by Mr. Roberts, was quite sound, but it was hardly applicable to a small swimming-pool design, as the actual saving would be very slight. The Author could not agree that the shrinkage of concrete was entirely dependent upon length rather than volume. The rubber hose referred to in the left-hand diagram of *Figs. 14* was intended to allow movement between the floor- and base-slabs whilst still maintaining a water-tight compressible jointing material. The joints of the bent copper strips were so arranged that no four corners met. The joints were thus of T pattern, and no attempt was made to join the strips rigidly. It was, however, possible to effect a floor-slab junction with bent copper strips by arranging one continuous joint to base over the other continuous joint at different levels in the slabs. No detailed specification of the bitumen was available for construction-joints, as the Author considered that any bitumen suitable for use in the joints of reinforced-concrete road-slabs could be used for the purpose, the temperature-range being so low, if arrangements were made to protect the pool when empty against overheating in hot weather.

Paper No. 5137.

"The Reduction of Carrying Capacity of Pipes with Age." †

By Cyril Frank Colebrook, Ph.D., B.Sc. (Eng.), Stud. Inst. C.E., and Assistant Professor Cedric Masey White, Ph.D.

Correspondence.

Mr. M. R. Barnett observed that the theoretical reasoning in the Paper was based principally on the experiments made and the conclusions arrived at by Mr. A. A. Barnes, M. Inst. C.E., in his Paper on "Discharge of Large Cast-Iron Pipe Lines in relation to their Age." * The Authors of the present Paper characterized that work as "probably the most reliable of the ageing experiments carried out in Great Britain."

† Journal Inst. C.E., vol. 7 (1937–38), p. 99 (November 1937).
* Minutes of Proceedings Inst. C.E., vol. ccviii (1918–19, Part II), p. 1.