Correspondence.

Mr. J. D. ATKINSON drew attention to the fact that the conditions laid down for the allowable depth of the main girders of the Khedive Ismail bridge seemed to have been particularly onerous, so that the bearings were liable to be flooded from time to time, with the added inconveniences of silt and sand being deposited in all corners and angles which could harbour it. The capitals of the piers, which had been fixed at R.L. 19·50 metres, had been topped during the flood of 1934. The maximum level of the water at the bridge had been about R.L. 19·68 metres on 8 and 9 September, calculated from a recorded maximum level of 20·09 metres at Roda gauge, which was 4·2 kilometres upstream of the bridge, and the gauge at the Ismailia canal-head, on the same day, which was 7 kilometres downstream. The flood of 1934 had been high; in fact, the level reached at Wadi Halfa had been the highest of which there was a record, but owing to the accelerated filling of the basins in Upper Egypt, and to the storing of a certain amount of water in the Assuan reservoir during the peak of the flood, the resulting levels at Cairo (that was, at Roda gauge) had only been moderately high. They had been exceeded thirteen times in the last 52 years, and by as much as 0·86 metre in the highest flood. It therefore appeared that the roller-path of the swing-span would, under such high floods, be liable to be covered with water to any depth up to about 1·00 metre, as from Figs. 8, Plate 7, the level of the roller-path appeared to be about R.L. 19·30 metres. Mr. Atkinson.

Mr. E. D. KIBBLE observed that when officiating as State Engineer, Perak, in 1931, he had had frequent occasion on his tours of inspection to visit the Iskandar bridge works during a period which included the founding of pier No. 2 and the flood of December, 1931. The two points which had struck him were that considerable expenditure would have been saved if more time and money had been devoted to preliminary investigations, and if the Consulting Engineers had been more familiar with local climatic conditions. With regard to preliminary investigations, it was always difficult to persuade governments and public bodies of the importance and ultimate economy of expenditure for such purposes. With due respect to the Consulting Engineers, he suggested that their design with short spans was more suitable for an Indian river, where nearly the whole of the river-bed was exposed for months on end, enabling caissons to be erected and sinking started in the dry. In the Malay Mr. Kibble.

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/240/1935/405/2612782/imotp_1935_15248.pdf by g

Mr. Kibble. Peninsula conditions were different, and although there was a very great difference between the maximum and the minimum flow in the rivers, as stated on p. 343, the dry and wet seasons were not sharply defined, and therefore engineers could not rely on getting undisturbed possession of a river-bed for a long continuous period. In the case of the Iskandar bridge it would be seen that a substantial island had had to be made for each pier except No. 6, which was on a portion of the bank only covered in high floods. Had more preliminary borings been made and a design with larger spans prepared, the piers might have been so sited as to be founded on nearly level rock. With fewer piers and different siting the excessive expenditure on pier No. 2 would have been saved, as well as the cost of the additional islands. The extra cost of the superstructure and of larger piers should not have been excessive. With regard to pier No. 2, he fully agreed, from a knowledge of local conditions, with the decision to sink small cylinders below the caisson. Apart from the question of the merbau tree, it was, in his opinion, very doubtful whether grouting would have proved effective in the material in which the caisson had been embedded at the time.

A minor question which arose in connection with the superstructure was whether a finishing coat of bituminous paint would stand if applied on top of the original coat of red-lead paint, as stated on p. 361. In his experience there was no objection to the use of bituminous paint over red-lead paint, but the decision had been queried at the time, and it would be of interest to have the views of other engineers and of chemists.

Messrs. Coales and Clarkson. Messrs. COALES and CLARKSON, in reply to the Correspondence, agreed with Mr. Kibble's remarks stressing the importance of the preliminary reconnaissance. It was probable that the multi-span design had been chosen partly on account of the apparent lack of difficulty in the foundations. They would suggest that the ratio of cost of sub-structure to superstructure might be 60 : 40 rather than 50 : 50 when the economics of a design were under consideration. It was unlikely that there would be large unforeseen extra cost in a superstructure, but, from experience, additional cost was probable in the foundations of any civil engineering work. The steelwork was protected by two coats of bituminous paint applied on a red lead under-coat; that had proved satisfactory, and gave a 3-year life before repainting became necessary. When the work was cleaned ready for repainting, the red lead under-coat was found in good condition.

It was possible to amplify the remarks on the subject of scour given in the reply to the Discussion, for it had been found after 4 years' observations that, whilst there was a small seasonal scour

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/240/1935/405/2612782/imotp_1935_15248.pdf by g

followed by silting round all the river-piers, it was of no practical importance. Messrs. Coales and Clarkson.

Mr. F. W. STEPHEN, in reply to the Discussion and Correspondence, stated that in his experience flanged rollers were not looked upon with any favour by bridge-manufacturers, as they did not allow for the same fine adjustment in erection as plain rollers, and required a higher degree of accuracy in fabrication. The lower roller-path also had to be machined on its inner circumference, which added to the cost of manufacture. Mr. Webster mentioned the tendency of rollers to work outwards, but the general opinion held was that if the rollers were coned in the proper ratio to the diameter of the roller-path the tendency was negligible. He recollected one case where, owing to the axles being tight in the rollers and the adjusting nuts in the live ring not being properly locked, certain rollers got out of position, but the defect was easily remedied, after easing the axles, by tightening-up the adjusting nuts while the ring and rollers were in motion. As generally accepted, the number of rollers provided was in excess of requirements, but the specification laid down a maximum pressure under the combined dead and live loads and any combination of eccentric loading, and the number provided was strictly in conformity with those conditions. The operation of a bridge of that type by electric power precluded the introduction of any hydraulic relief from the maximum dead load while swinging; that tended to make the hydraulically-operated bridge require much less complicated mechanism, both in rotation and wedging. Mr. Stephen.

The question was raised by Mr. Wilson of the stresses in the materials of the old bridge. The only records available were so indefinite on that point that it was difficult to say with any degree of accuracy what limiting stresses had been adopted when the bridge had been designed. It might, however, be considered that, giving full value to the continuity of the main girders, the designers worked to the stress of 5 tons per square inch. After the repairs had been carried out, as mentioned on pp. 366–7, the restricted loading eased the stress considerably; even under the passage of light vehicles, however, considerable oscillation, due to the continuity of the main girders, was noticeable. It might be of interest to mention that flange-stresses up to 6 tons per square inch were allowed during the stage of demolition when the main girders were acting as cantilevers.

The depth to which the piers had been sunk and the order in which the works had been carried out was mentioned by Mr. Hawkins; in that connection Mr. Stephen would like to point out that the swing-pier had originally been intended to be founded at the full depth of R.L. 7·00 metres, but owing to the difficulty encountered in

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/240/1935/405/2612782/imotp_1935_15248.pdf by g

Mr. Stephen. demolishing the steelwork of the old foundation inside the new caisson it had been decided to complete the foundation at R.L. 6·20 metres, which was 80 centimetres above the pre-arranged level. With regard to the order in which the piers were sunk, that would usually be governed by the time required for the fabrication and delivery at site of the necessary steelwork, both of caissons and superstructure. The intermediate piers and abutments would usually have priority of sinking, owing to the fact that manufacture and delivery of the fixed spans would be considerably ahead of the swing-span materials, and consequently the early completion of the ordinary piers and abutments would allow of the erection of the fixed spans being proceeded with. On the other hand, roller-paths and mechanical details of the swing-span required longer for preparation in the drawing office, fabrication, temporary erection, and testing in the shops than the simpler parts of the structure, and the period allowed for construction was usually well advanced by the time the swing-span materials could be delivered at the site.

Mr. Atkinson referred to the onerous conditions laid down in connection with the allowable depth of the main girders and the fact that the bearings and turntable were liable to be submerged during high flood. In the case of the old bridge that question did not arise, as, the bridge being of the through type and with a road-level of R.L. 24·50 metres, ample space had been available for the floor-slab and the depth of the cross girders, leaving the pier-caps well above flood-level. In the case of the new bridge, however, that point had required special consideration; as a bridge of the deck type had been decided upon and it had been considered undesirable that any material change should be made in the roadway-level, the level of R.L. 20·50 metres had been fixed for the underside of the steelwork as allowing for the minimum reasonable depth of main girders of the type and proportions proposed. It had been realized that the bearings and turntable would be partly submerged at high-flood periods, but as the lowest motor-platform had been placed at R.L. 21·50 metres, no permanent damage would result.

Downloaded from http://ftp.nowpublishers.com/jmipi/article-pdf/240/1935/405/2612782/imotp_1935_15248.pdf by gu