The bridge over the lagoon at Venice

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The Bridge over the Lagoon at Venice.

Die Brücke über die Lagune in Venedig.

Le pont de la lagune de Venise.

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This remarkable structure (Fig. 1) is a bridge 22 m wide and almost 4 km long, which was constructed in the relatively short period of eighteen months by the Società Anonima Italiana Ferro-Beton of Rome, and it is mentioned here as an example of a well-planned job.

Figs. 2, 3, 4 and 5 show the progress of construction. A beginning was made at a point practically midway between Venice and Marghera. Fig. 2 shows the

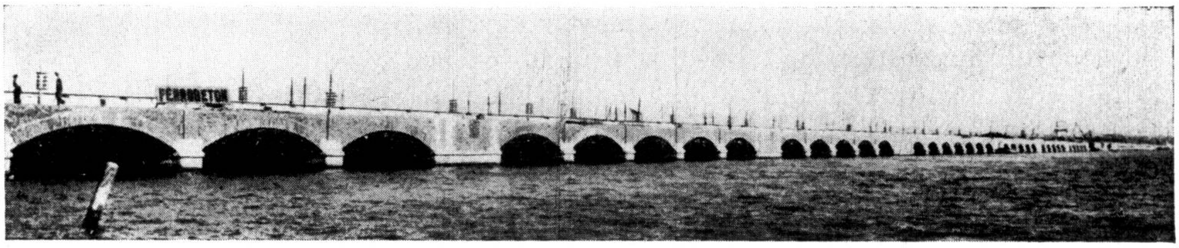

Fig. 1.

driving of the piles; Fig. 3 the construction of the piers; Figs. 4 and 5 that of the arches.

The mechanical plant comprised twelve travelling bridge cranes in two groups, the first group working towards the right, and the second towards the left, and the following details will be given in respect of one of these groups. The first of the bridge cranes was used for driving the steel-sheet-pile cofferdams; the second carried two grabs which were used for excavating a pit measuring 40 m $\times$ 2 m; the third crane carried two moveable electric pile drivers capable of a daily output of up to 1000 linear metres of Considère piles 30 cm $\times$ 30 cm in cross section. The fourth crane was used for constructing the piers, the fifth for placing the masonry blocks, and the sixth for withdrawing the sheet piles.

In this way, at a cost of 300000 man-days in the course of twelve months, a total length of 200 km of piles was driven, 20000 m³ of concrete were poured, 10000 m³ of masonry were placed and the arches were completed.

The following particulars of the piers may be given. The small parabolic openings in the piers were provided, not only with a view to saving concrete and stone, but in order to minimise obstruction to the current in the lagoon. In this connection the author may be allowed to mention a problem which arose at

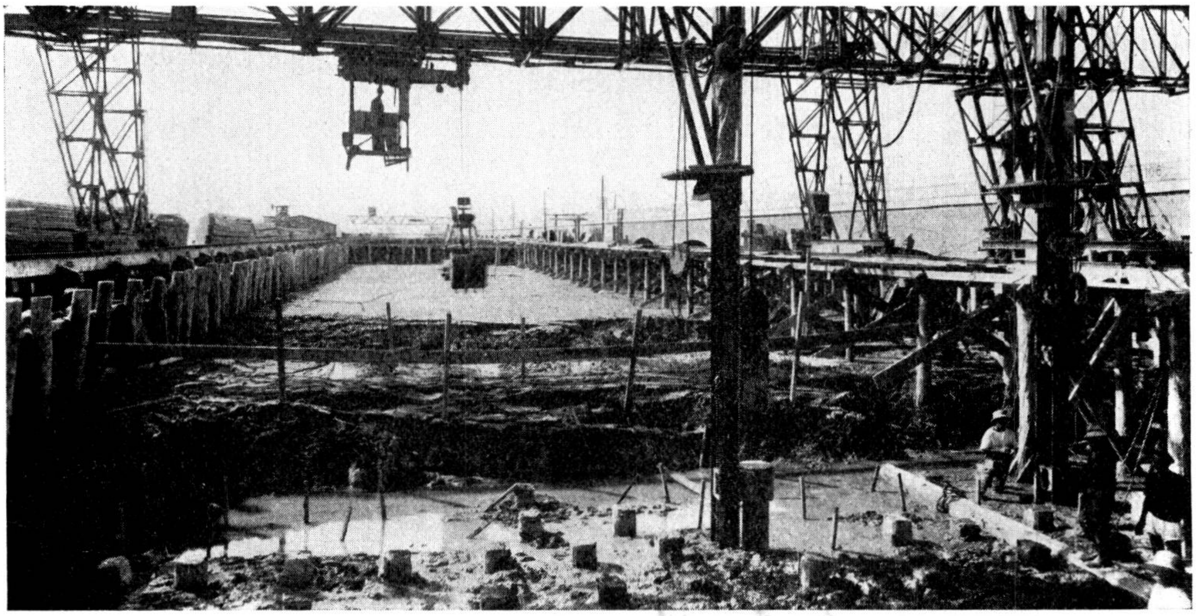

Fig. 2.

the time of the competition for this bridge: assume a uniform and practically endless current of water and assume that in this current there is a pier of cross sectional area A; the shape of this area is to be so arranged that the disturbance

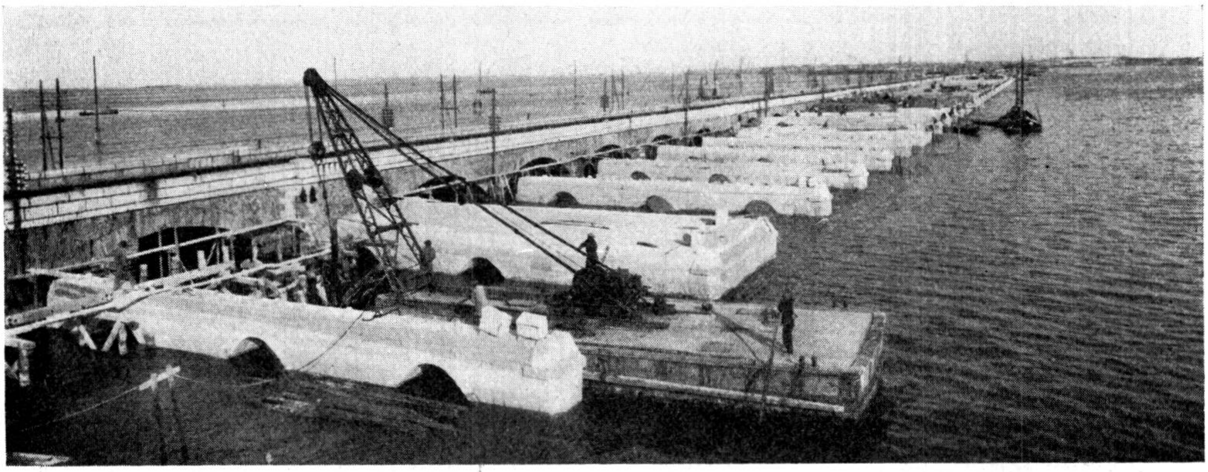

Fig. 3.

of the current is reduced to a minimum. If, now, it is remembered that the magnitude of this disturbance depends on the difference E in the kinetic energy T and T′ before and after the erection of the pier, it will be found that E is independent of the shape of the area A, and is not a function of the perimeter, but is a linear function of the area.

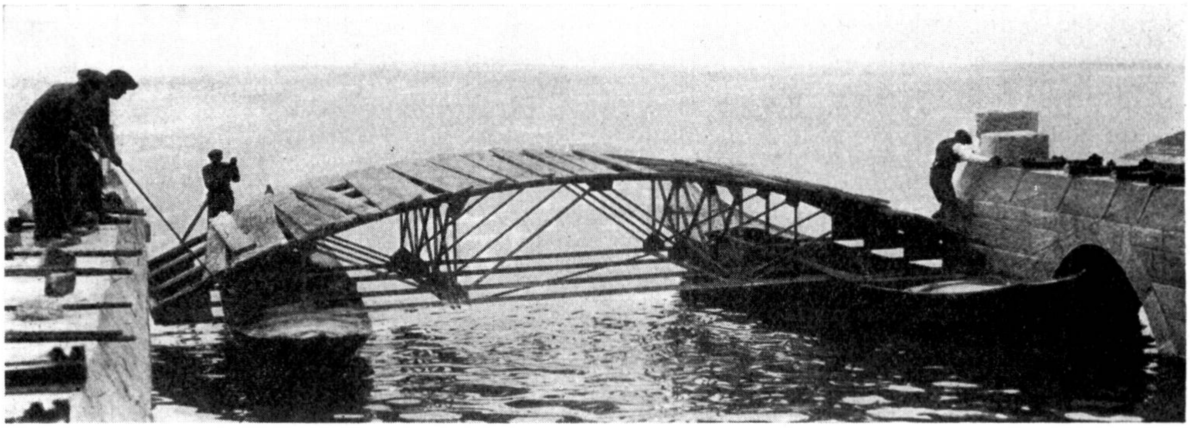

Fig. 4.

From the hypotheses based on a potential of current, it follows that the best solution is that in which the area A of the pier is minimised, and this was in fact the solution adopted.

Fig. 5.

It should also be noticed that the two face walls of the arch afford bracing to the piers, the stability of which would otherwise appear precarious in view of the heavy live load, and the fact that there are only vertical piles. These arguments were confirmed by a number of measurements carried out on the site to study the effect of horizontal loads on the vertically driven piles.

Special attention was paid in the construction to temperature and shrinkage stresses. Making the usual assumption that tensile stresses cannot be resisted and that as a result of the limited cross section or resisting moment which is statically effective the longitudinal force will fall outside the core, it was calculated that adequate safety was assured, and this was confirmed by observations on the finished work.[1, 2]

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[1] See *G. Krall:* Intorno al calcolo degli sforzi di temperatura nelle volte in calcestruzzo o muratura. Il Cemento Armato, 1936, N° 3.

[2] See *A. Signorini:* Sul profilo delle pile da ponte. Rendiconti Accademia da Lincei. Vol. XII, p. 579—581, 1930.