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## IVb 10

Progress in the Architecture of Reinforced Concrete Structures.

Fortschritte der Architektur der Kunstbauten in Eisenbeton.

Progrès de l'architecture des ouvrages d'art en  
béton armé.

S. Boussiron,  
Paris.

Several speakers on steel construction have very properly referred to the attempts that are being made to establish the architecture which may be regarded as proper to this material, and they have been wise to emphasise the importance, from this point of view, of collaboration between the engineer and the architect.

In steelwork — a form of construction now able to celebrate its centenary — plentiful examples dating from the earliest times may be found of fine achievements born of just such collaboration. The recommendation continues, however, to be apposite: indeed becomes all the more so when, after almost a century devoid of architectural mark, endeavours to fix the style of the age in which we live are beginning to meet with success, and when nothing should be left undone to promote that appreciation of natural beauty which the modern trend of travel for pleasure has done so much to stimulate.

Reinforced concrete should be the object of similar endeavours, and may perhaps be a more promising one by reason of the ease with which it enables a combination of the forms and sections considered best by the engineer and the architect in any given circumstances. All the works mentioned by various contributors as being representative of present trends in major reinforced concrete construction furnish evidence of efforts being made in the same direction.

It will be found, however that in the great bulk of examples the arch is placed below the roadway. This preference need occasion no surprise, for it is very natural; indeed one should always endeavour to place the roadway above the massive portion of the structure, in order that no obstacle may interfere with the view of the surrounding country. Ultimately these structures owe their lasting charm to their resemblance to the beautiful masonry bridges which have come down to us from past centuries. The largest of these concrete arches are also the most beautiful; the Elorn bridge at Plougastel by M. *Freyssinet* and the Traneberg bridge at Stockholm by M. *Kasarnowsky* owe most of their beauty to being like amplifications of masonry arches.

Conditions are less favourable where the engineer is forced by considerations of head room to adopt the type of design in which the arch comes above the roadway, but cases where circumstances compel the use of a bow-string design are fortunately rare, being instances where aesthetics have played no part in the general layout of the crossing. Some freedom can almost always be left to the engineer and the architect in the option of slightly lifting the roadway above the springings of the arch, so as not to emphasise the connection between the arch and the abutments.

The construction of a bridge of 161 m span over the Seine at La Roche-Guyon gave the author an opportunity of pursuing his endeavours to improve the aesthetics of this type of construction. It is from this point of view that the matter is mentioned here, theoretical and constructional developments being fully discussed in the general paper.

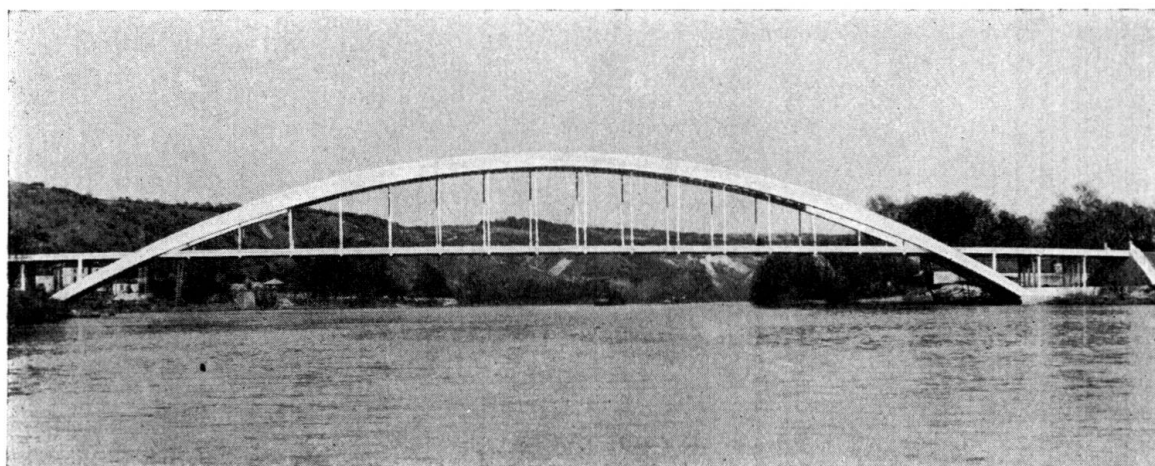


Fig. 1.

Bridge over the River Seine at La Roche-Guyon. Span: 162 m.

First as regards the type of bridge (Fig. 1). In the author's opinion the best position for a roadway which intersects the arch is such that two-thirds of the rise occurs above and one-third below the roadway. It will be noticed how little obstruction is caused to the wind by this solution, and, as we have just remarked, the cases where this amount of obstruction is inadmissible must be very rare. The arch has purposely been made very thin; its degree of slenderness being, it is believed, the largest that has hitherto been attained, for the mean depth of the section is only  $\frac{1}{80}$ <sup>th</sup> of the span, the depth being two metres in a span of 161 m. In a structure of this type, more akin to steelwork than to masonry, lightness is the quality which best emphasises the properties of reinforced concrete. It is a quality which is desirable also in order to minimise the obstruction to visibility occasioned by the intersections of the arch with the roadway. Over the whole of the length between these intersections the visibility is in fact almost as good as if the arch were below the roadway, because the light suspension bars 8.50 m apart form only negligible obstacles. The lightness thus obtained may be appreciated very well from Fig. 1.

Another question which has long occupied the author's thoughts, in reference to bridges where the arch comes above the roadway is that of bracing. In his opinion large cross bars, or any kind of triangulation, are unsuitable; he considers that they interfere with the general sense of a free invitation to passage, which is characteristic of this type of structure. In long span bridges, especially, every component ought to flow in the direction of the span.

The solution adopted in the La Roche-Guyon bridge is shown in Fig. 2. Considerations of rigidity undoubtedly called for some kind of lattice work, but here the necessary triangulation has been provided in the form of members of multiple

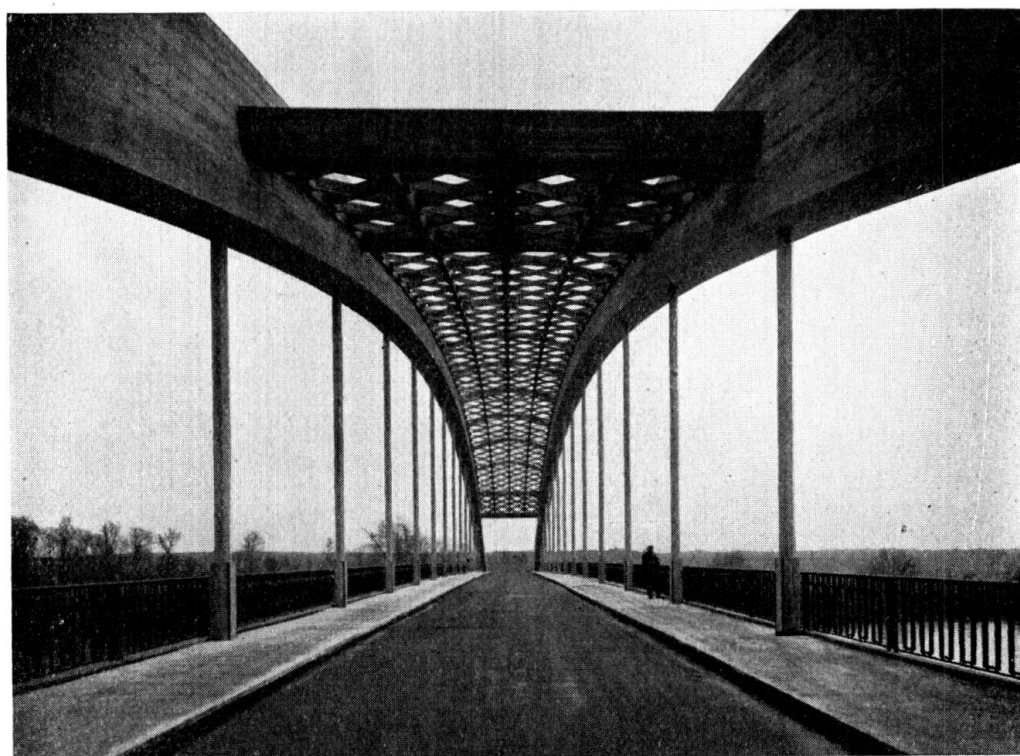


Fig. 2.

lattice construction, more suggestive of the open mesh work of a ceiling than of lattice girders proper. Moreover (apart from the two first struts which form the entrance portal) no other cross piece is to be seen throughout the length of the bridge; the lattice work is carried by arches which spring successively without interruption, along the whole extent of approximately 100 m. It is true that the erection of these lattice members is more expensive than that of a smaller number of bars of heavier section, but by comparison with the total cost of work of this magnitude the difference is small.

The author would hesitate to suggest that equal merit might not be claimed by other solutions of the aesthetic problem; he feels, nevertheless, that the I.A.B.S.E. may be interested in this example of endeavours to make headway as regards this difficult problem appertaining to that type of reinforced concrete bridge in which the arch comes above the roadway. Fig. 3 shows the setting of the bridge in the surrounding country.

It will be granted that in a structure possessing a degree of slenderness greatly in excess of any hitherto obtained some form of overhead bracing was essential.

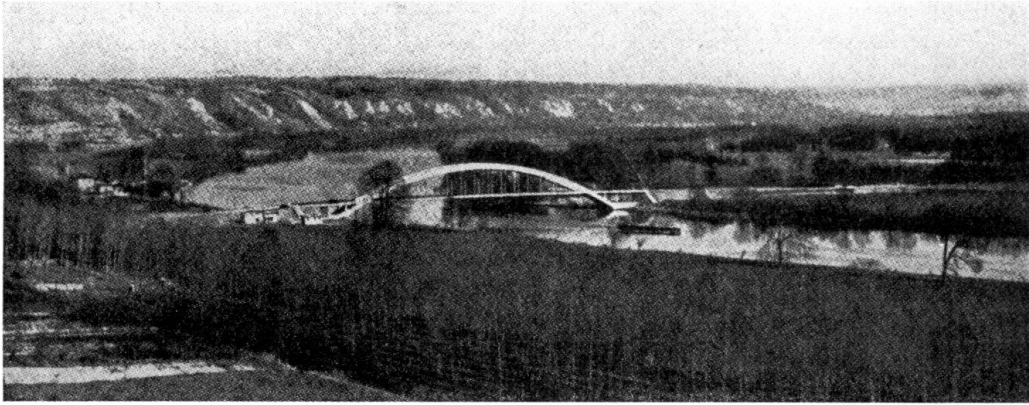


Fig. 3.

The author would gladly have dispensed with this if it had been possible and has made every effort so to arrange it as not to contradict the impression of slenderness.