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# VIIa 1

## The Aesthetics of Steel Bridges.

## Formgebung stählerner Brücken.

## L'esthétique des ponts métalliques.

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Increasing attention is now being paid to the aesthetic side of steel bridge design and the occasion is opportune, therefore, to draw a few examples and counter examples from the wealth of present-day practice and to examine them critically.

The fundamental principle of all architecture is to reveal closely the purpose of the structure, and to the bridge builder this means that the passage of the

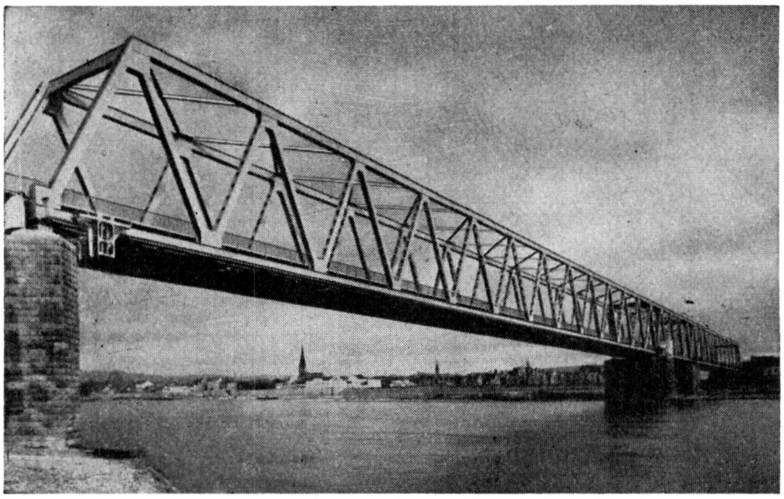

Fig. 1.
Road bridge over the Rhine at Neuwied.

roadway over an obstacle must be clearly indicated. The purpose is best fulfilled when the roadway is carried above the structure, but to repudiate every solution in which this condition is reversed would be to go too far. For instance, in the case of the Rhine bridge at Neuwied (Fig. 1) if the roadway were placed above the bridge, the access ramps would have to be several kilometres in length and would predominate instead of subserving the road itself, forming a whole which would appear as a disturbing excrescence from the flatness of the landscape. The design of the bridge should not stop at the abutments but should extend to the continuation of the roadway, for only thus will the bridge be made to merge itself into the landscape, whether mountainous or flat.

As examples of typical bridges in flat country we may take the taut and slender looking plate girder structure which carries the Reichsautobahn over the Main at Frankfurt (Fig. 2) and the road bridge over the Elbe at Meissen

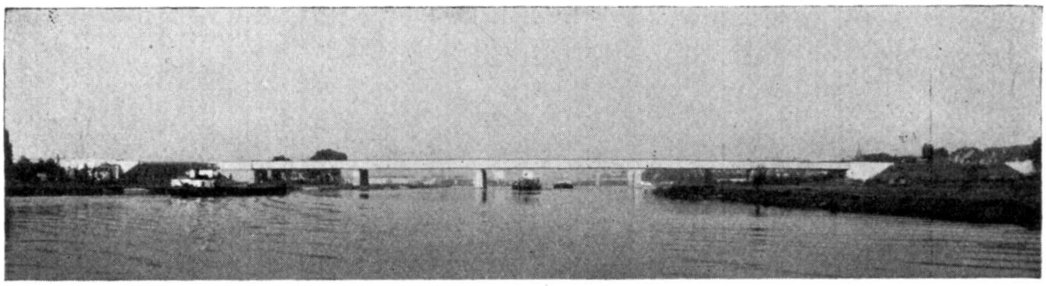

Fig. 2.

Motor road bridge over the Main at Griesheim.

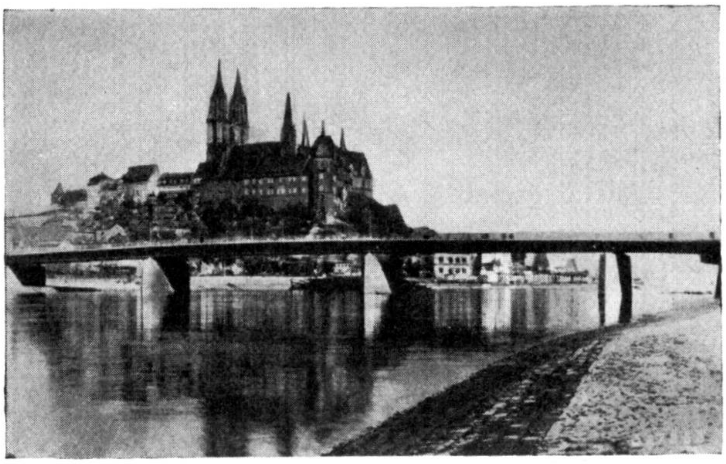

Fig. 3.

Road bridge over the Elbe at Meissen.

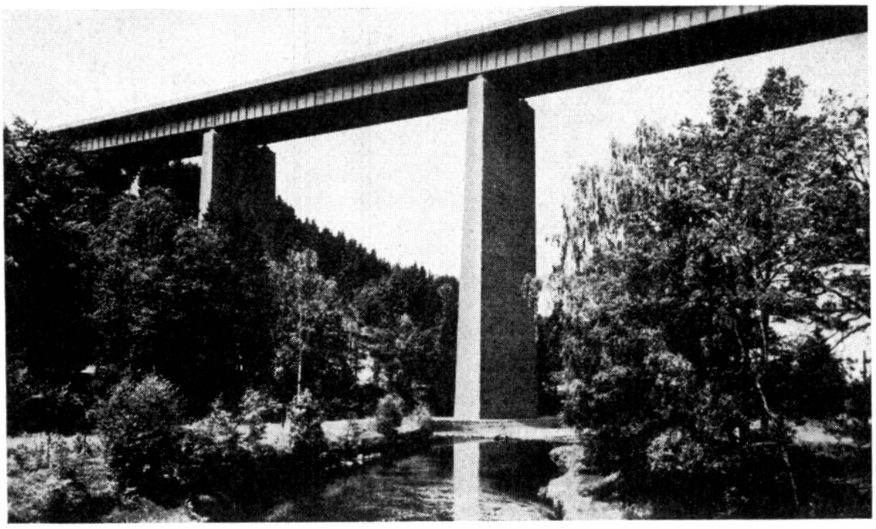

Fig. 4.

Reichsautobahn bridge at Siebenlehn.

(Fig. 3). The latter, with the picturesque Albrechtsburg in the background, illustrates that there is no need to imitate antiquity in order to harmonise the old with the new.

That the plate girder bridge is equally capable of merging into a mountainous landscape may be seen from the Autobahn bridge over the Freiburger Mulde (Fig. 4).

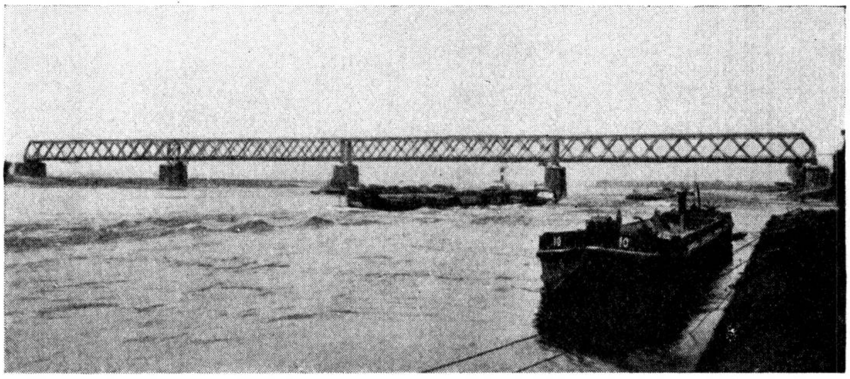

Fig. 5.

Railway bridge over the Rhine near Wesel.

A lattice girder, also, is capable of effective incorporation into either a flat or a mountainous landscape. This is illustrated by the railway bridge over the Rhine near Wesel (Fig. 5) and by the railway bridge near Freudenstadt (Fig. 6). The determining factor is not whether the bridge is solid or open webbed and not whether the country is flat or mountainous; — art consists in laborious and

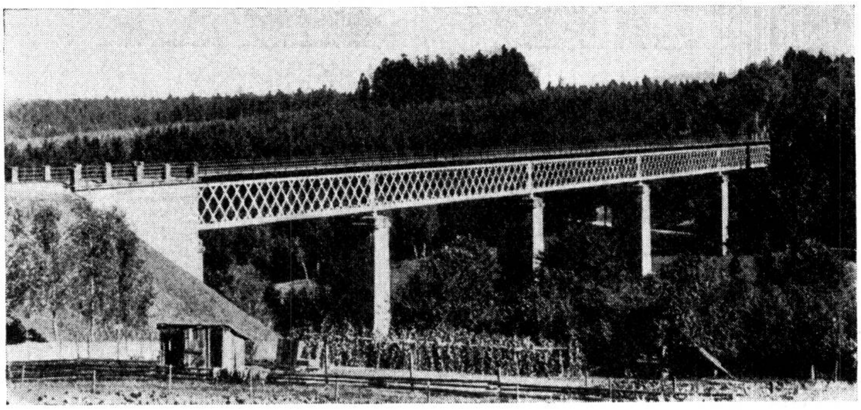

Fig. 6.

Lauterbad Bridge at Freudenstadt.

careful study to settle the height of the girders, of the spans, of the proportions of the piers and of the width of the bridge and its corbels.

In high bridges a parallel girder may very well be combined with an arch, for in such a case the arch predominates as long as an equilibrium between the abutment and the arch is obvious to the eye. The bridge over the Mälarsee near Stockholm, otherwise pleasing (Fig. 7), suffers from the defect that too little of the abutment can be seen.

The bridge over the North-East Sea Canal near Grünthal (Fig. 8) owes its appearance of boldness and elegance to the obviously right choice of the positions of the springings; at the same time the prominence given to the

Fig. 7.
Road bridge over the Mälar Lake near Stockholm.

roadway line serves to mask the disadvantage of the road passing from above to below the arch.

The result is much less happy in those arch bridges where the arch rises above the roadway but fails to free itself therefrom. Thus Fig. 9 shows the

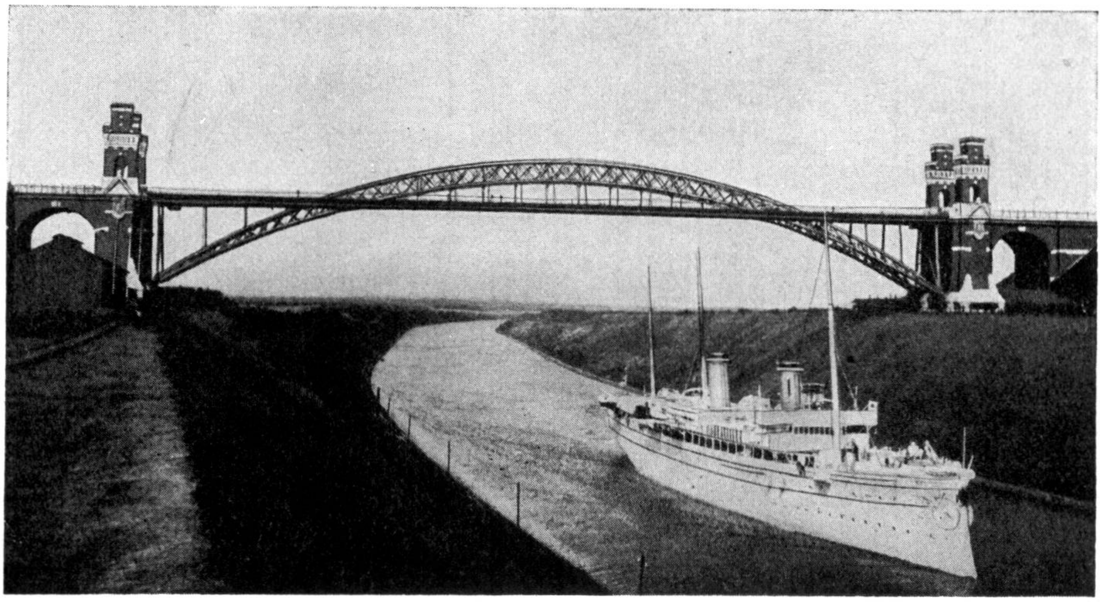

Fig. 8.
Road bridge over the North-East Sea Canal at Grünthal.

road bridge at Coblenz before reconstruction and Fig. 10 indicates how its appearance has since been improved by lifting and widening the floor. Whereas, in this bridge, all three openings are equal at 96 m, in the case of the Rhine bridge at Mainz the span increases from 87 m at the banks to 102 m in midstream; but few people looking at the bridge will be aware that its faultless harmony is the result of this increase in the spans. Fig. 11 shows the bridge after its reconstruction. Originally the abutments carried toll houses and the

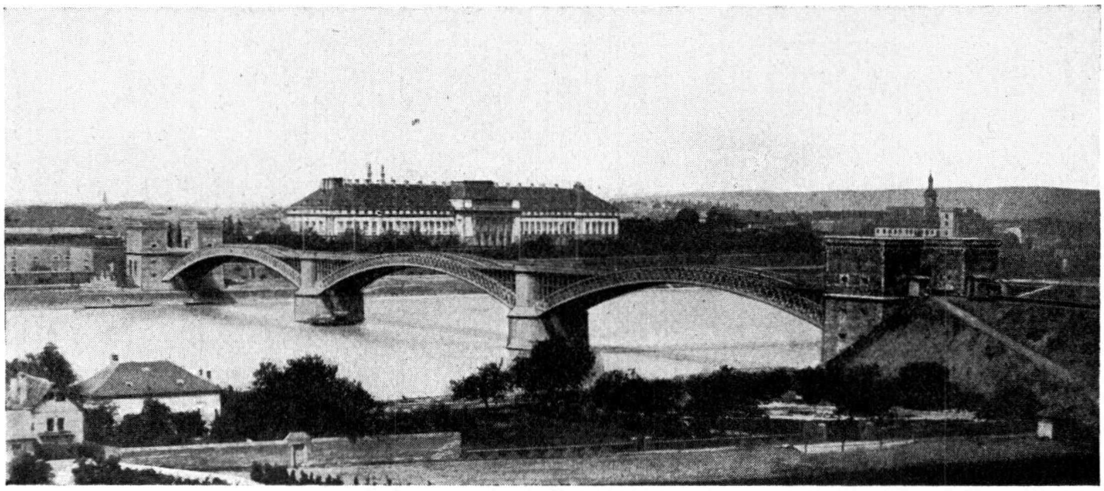

Fig. 9.

Road bridge over the Rhine at Coblenz before reconstruction.

piers ornamental pilasters which broke up the pleasant swing of the roadway and also its connection with the access ramps. The horizontal lines intersected the vertical, with mutual interference. To-day, however, the roadway, which it is the purpose of the structure to carry, clearly dominates the whole.

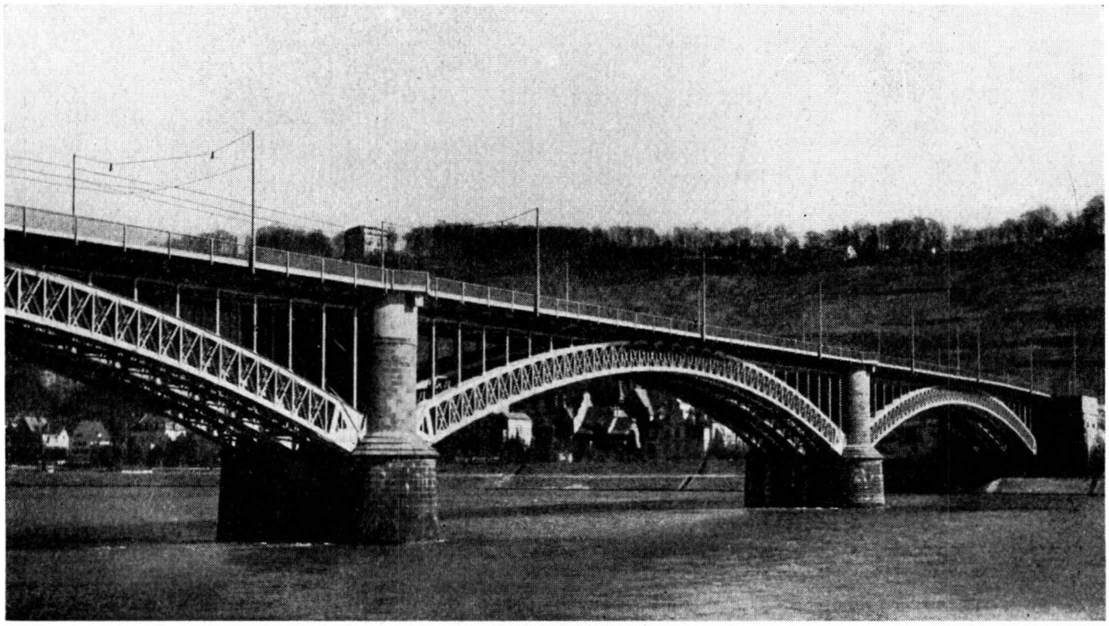

Fig. 10.

Road bridge at Coblenz after reconstruction.

It is not always that nature offers the bridge builder valleys anywhere nearly symmetrical in cross section, but where symmetry is lacking there need be no hesitation in exploiting the lack — which may, indeed, be a source of special charm. The design for the Autobahn bridge over the Saale near Lehesten (Fig. 13) is characterised by the fact that the span increases towards one side and that the roadway is on a gradient, making it possible to increase the height of the girder to correspond with the increase in span.

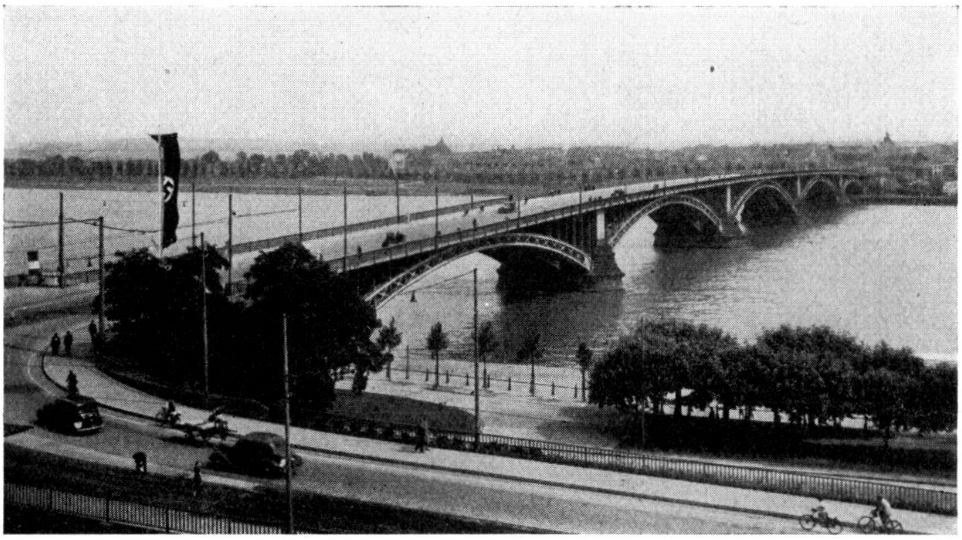

Fig. 11.
Road bridge over the Rhine near Mainz after reconstruction.

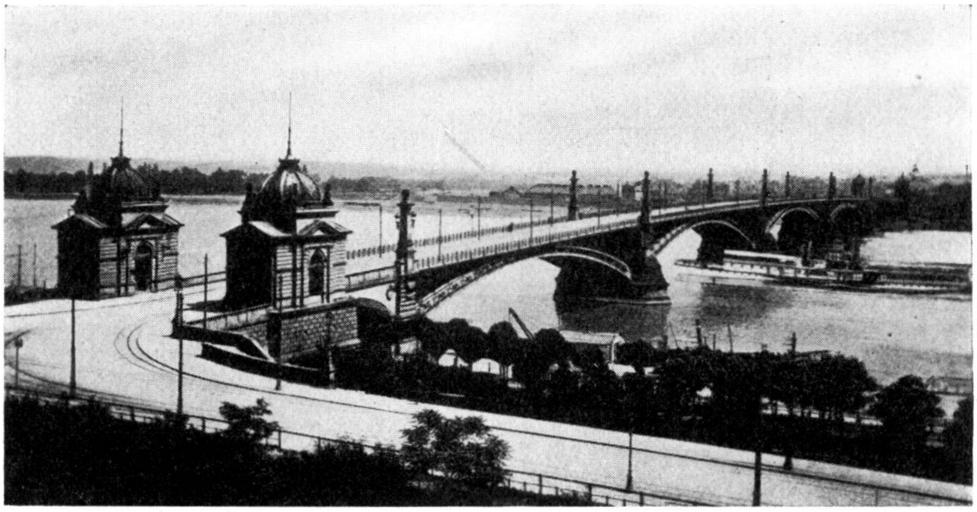

Fig. 12.
Road bridge over the Rhine near Mainz before reconstruction.

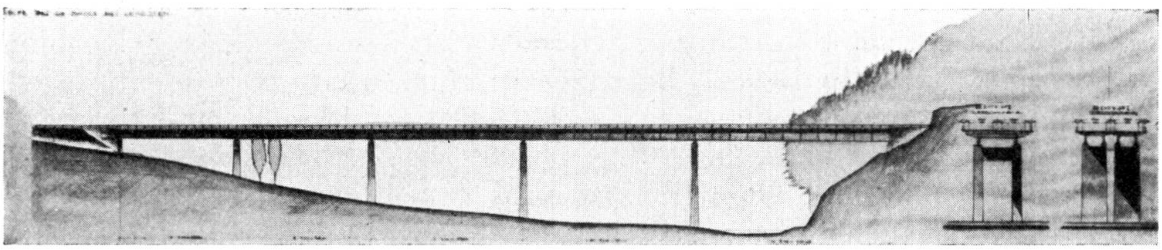

Fig. 13.
Design for a motor road bridge near Lehesten.

When the designer is prevented by conditions laid down by other agencies from following his own rules the problem of creating a harmonic structure becomes almost insoluble. The Rhine bridges near Maxau and Speyer (Fig. 14) are subject to unfortunate conditions of this kind, for the curvature of the river causes the navigation channel to lie on one side and the river must

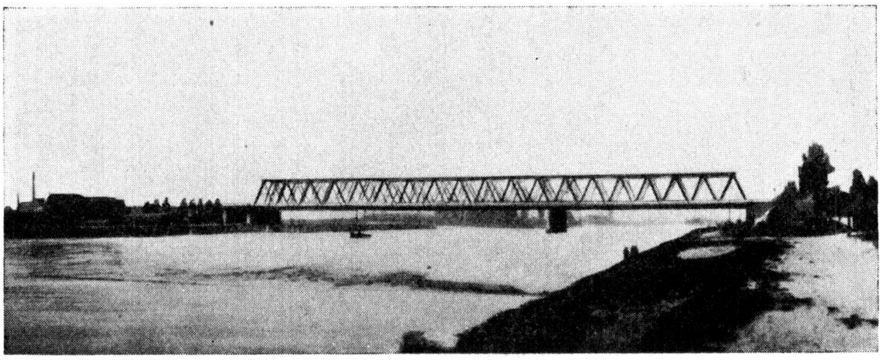

Fig. 14.
Bridge over the Rhine at Maxau.

be placed accordingly; to an onlooker, however, this lack of symmetry is incomprehensible as the reason for it is not apparent. It was found that the dominating horizontal lines of a beam bridge would emphasise the lack of symmetry least, whereas an arch (Fig. 15) would have emphasised it more.

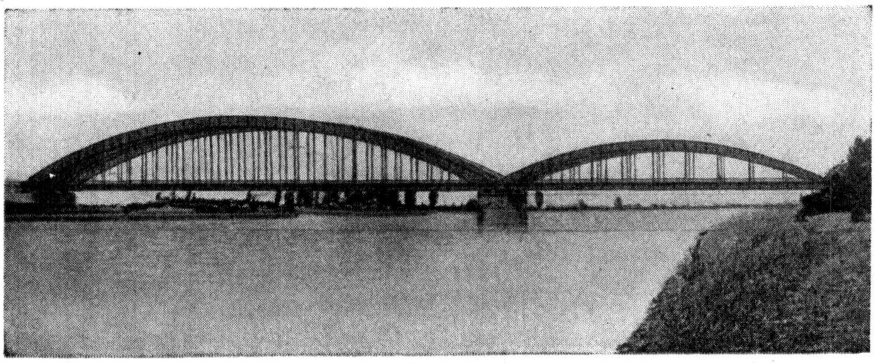

Fig. 15.
Design for bridge over the Rhine at Maxau.

Bridges over several openings must be unified into a closed line. Note the difference in this respect between the old lattice bridge at Cologne (Fig. 16) — despite the disturbing superstructures over its piers — and the jagged outline of the bridge across the Danube at Floridsdorf (Fig. 17).

Another way that the unity of line of a bridge may be completely broken is through lack of repose in the outline of the booms, as in the case of the Hassfurt bridge over the Main (Fig. 18). The road bridge at Wesel (Fig. 19), again, loses something through the circumstance that the booms rise above the river piers, and the disturbance caused by the dropping of the line of the roadway at these same places is a further defect.

How neat the old girder bridges with thin members could be has already been illustrated in the lattice bridge at Cologne. Hence the revived use of solid webbed girders, and the quest for means of filling the spaces in trussed girders so as

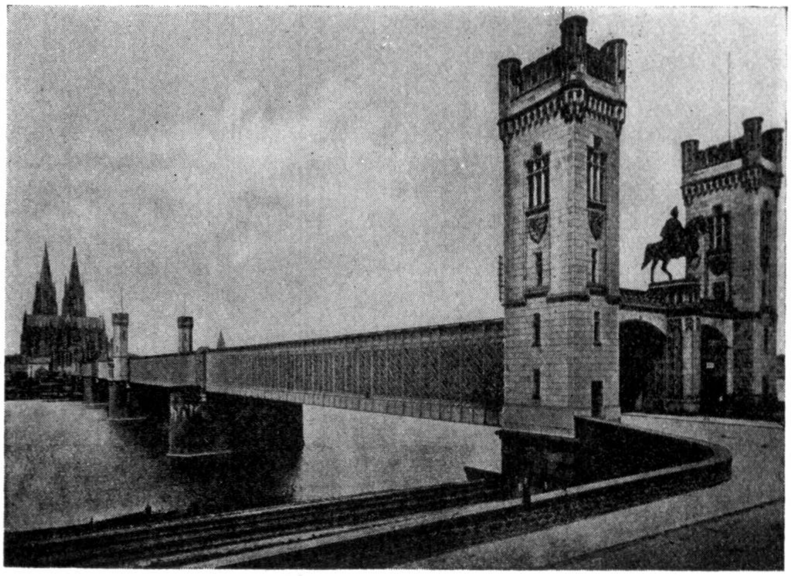

Fig. 16.

Old railway bridge over the Rhine at Cologne.

to recapture the attractiveness of the old fine-membered lines. The reintroduction of the truss with simple diagonals only is a step in this direction.

The truss with diamond (rhombic) lattice is more effective in that the girder takes on more the appearance of a wall. In the Rhine bridge at Mannheim

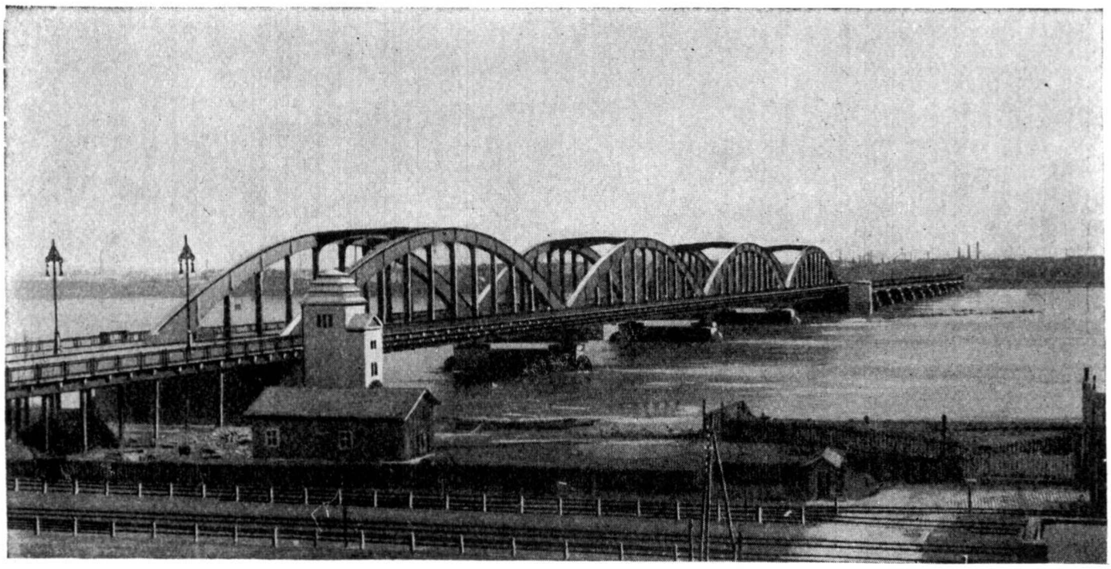

Fig. 17.

Bridge over the Danube at Florisdorf.

(Fig. 20) the end posts are carried to the full height of the girder. This gives a somewhat harsh appearance and it is better therefore, to finish off the end posts at half the height as in the railway bridge at Wesel (Fig. 21). An end portal with a kink in the uprights pleases neither the engineer nor the layman.

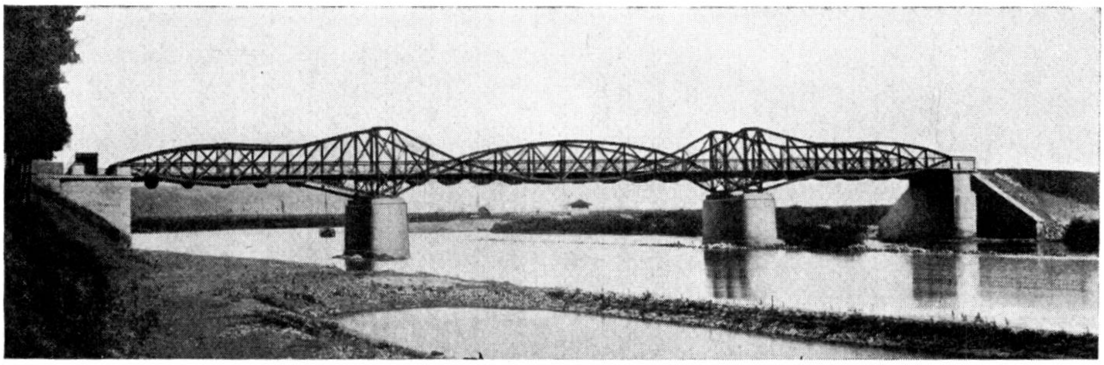

Fig. 18.
Road bridge over the Main at Hassfurt.

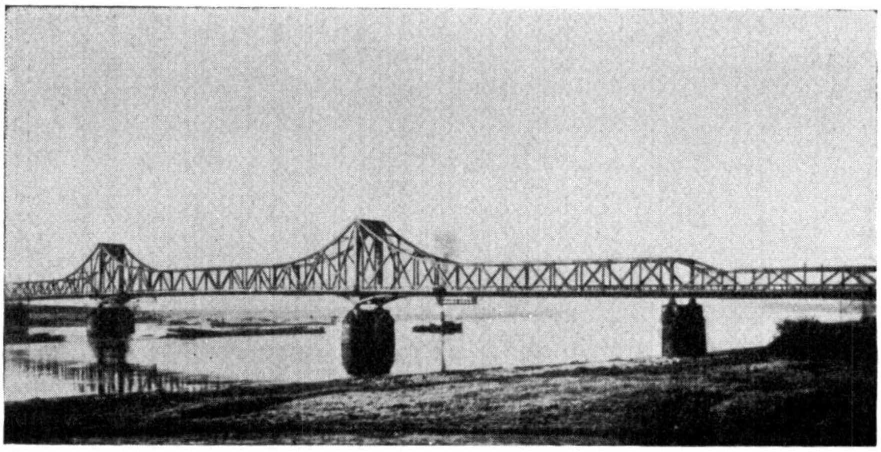

Fig. 19.
Road bridge at Wesel.

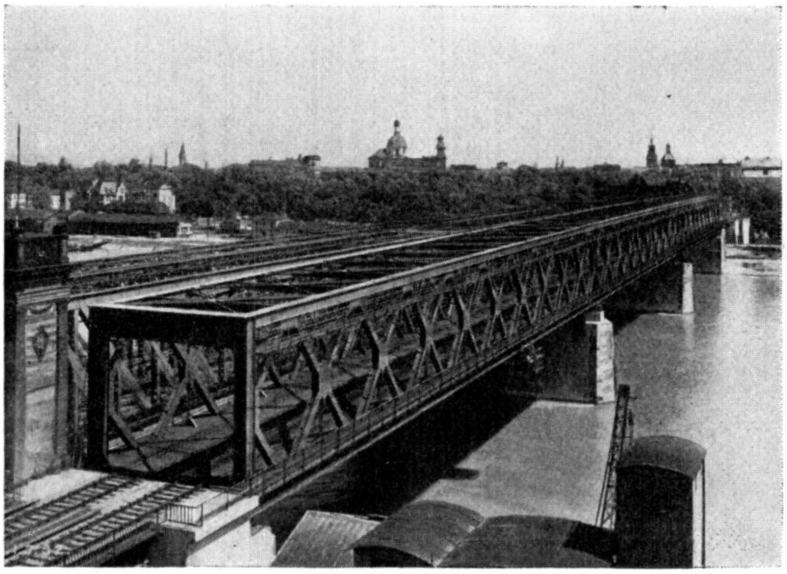

Fig. 20.
Road bridge over the Rhine at Ludwigshafen.

The search for a new way of shaping the panels of a truss is a problem of modern engineering which calls for solution through the combined efforts of the engineer and the architect. But the principle of combining a beam with an

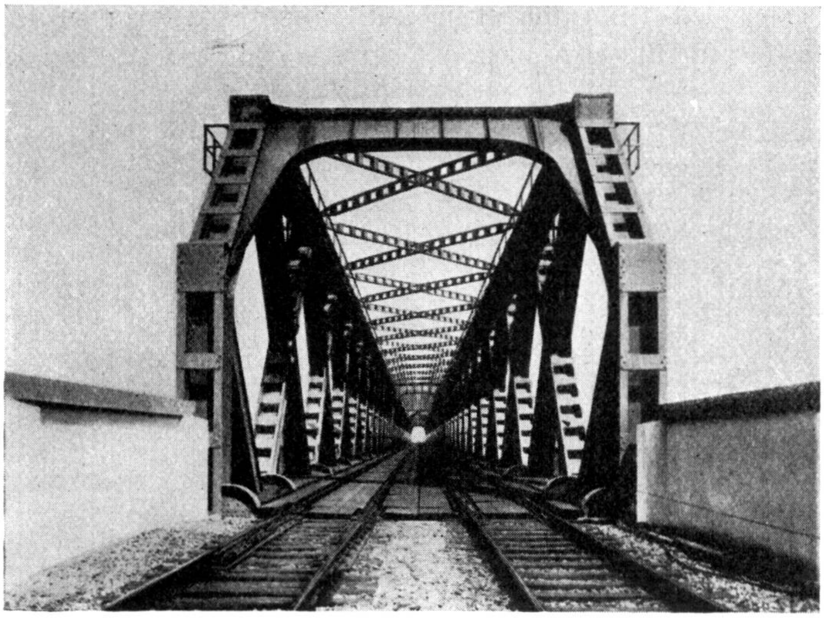

Fig. 21.

Railway bridge at Wesel.

arch seldom leads to happy results — for how is the spectator to know that an arch with a tie has vertical reactions similar to a beam? And who is to answer his question whether it is the arch or the stiffening girder that is the

Fig. 22.

Footbridge at Oberschöneweide.

principal member? It is only in a girder bridge strengthened with an arch, when one principal opening is specially emphasised by the arch, that this type of bridge can be satisfactory. Fortunately we have learned to avoid arbitrary mixtures of arches and beams, and opposing curves in the lines of the booms, while for such a structure as the footbridge at Oberschöneweide (Fig. 22) our technical terminology has not even a name. In the North Elbe bridge at Hamburg (Fig. 23) the roadway appears to the layman as if it were an afterthought incidentally suspended from the structural parts. Structures of this kind are largely responsible for the false idea, not yet everywhere dead, that a steel bridge

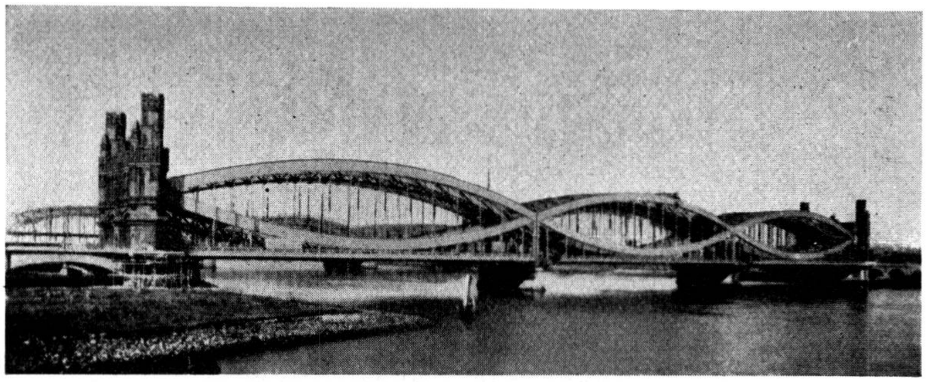

Fig. 23.

Bridge over the Elbe at Hamburg.

is no more than a makeshift for adoption where a massive bridge cannot be built.

Nor can a mixture of beam and suspension bridge give satisfaction. In the Main bridge at Bamberg (Fig. 24) the suspension boom, which is the most purely tensile member, has its central portion functioning as the upper flange

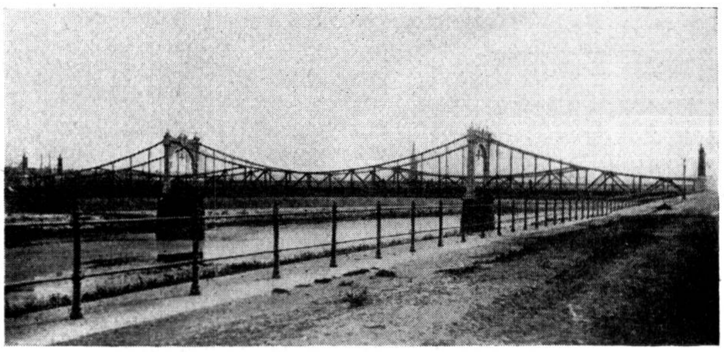

Fig. 24.

Road bridge over the Main at Bamberg.

of a beam, and therefore as a compression member: hence the confusion in the result, for no member ought to be called upon to serve two contrary functions at the same time.

The pure suspension bridge which the engineer is naturally inclined to use for long spans is all the more attractive in appearance because it is obvious that the towers carry the suspension cable, the roadway hangs from the suspension ties, and the stiffening girder carries the loads. How great are the constructional possibilities of such a design is illustrated by the towers for the Philadelphia-Camden bridge (Fig. 25) and by the Rhine bridge at Cologne-Mülheim (Fig. 26).

Fig. 25.
Philadelphia. — Camden bridge.

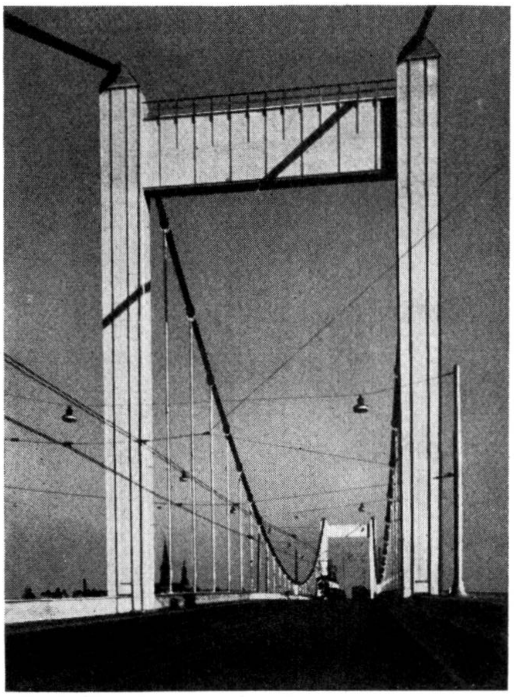

Fig. 26.
Bridge over the Rhine at Cologne-Mülheim.

The abutments and piers are a constituent part of a bridge, and it is often a matter of lively debate whether steel, masonry or concrete piers are to be preferred for these. In this respect the bridges for the Autobahn have given rise to an entirely new problem on account of their great width. The problem is not yet mastered, though some attractive solutions to it are now on record such as the Sulzbach bridge (Fig. 27) and the bridge over the Kleine Striegis (Fig. 28).

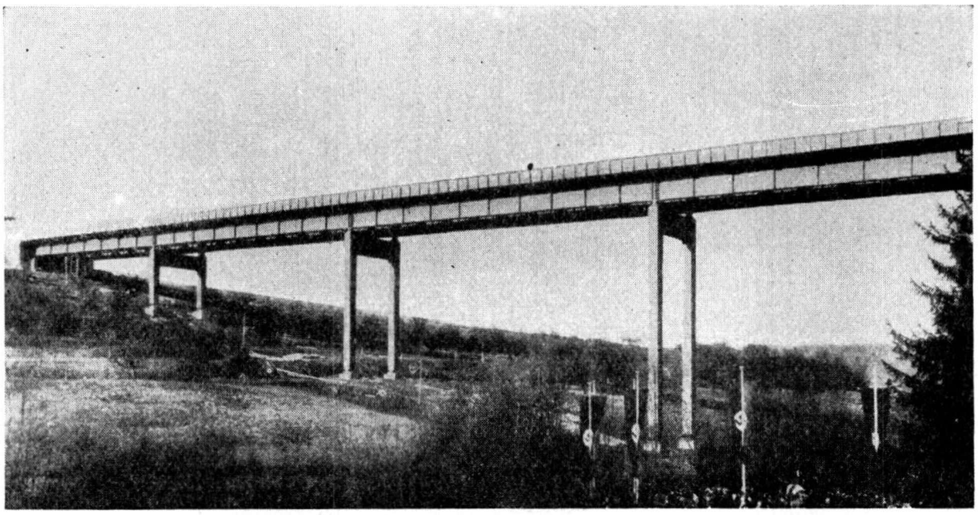

Fig. 27.

Motor road bridge over the Sulzbachtal.

The trend of design in steel bridge work is marked by a striving after clarity and truth in expression, and the problem of the bridge engineer is to choose from among those possibilities of statics and materials the ones which most naturally

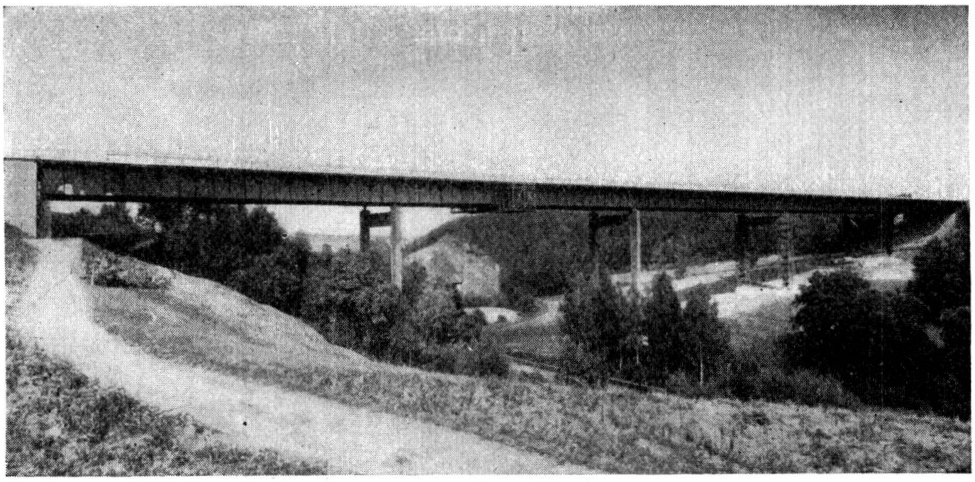

Fig. 28.

Bridge over the Kleine Striegis.

fulfil their purpose. A bridge is not a structure that stands alone but is part of a line of communication. It becomes a work of art when as a whole, and in all its members, it clearly expresses its purpose of carrying and guiding traffic.