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Bemerkungen über Stahlbrücken in Dänemark.

Remarques sur les ponts métalliques au Danemark.

Steel Bridges in Denmark.

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In many countries the developement of design for main girders of bridges is known to be in the direction of preference for the solid webbed girder over the lattice girder even for considerable spans.

While the current preference for maximum possible simplicity of form may be a partial explanation of this, it is certainly an exaggeration to state, as is done in various quarters, that solid webbed construction is, preferred merely because it is, so to speak, the fashion at the present time.

According to experience in bridge construction in Denmark during the last ten years, the following may be taken as an outline of the situation now obtaining.

Up to 35 metres span the amount of material used does not vary appreciably whether for solid webbed or framed girders, and where this is the case the solid webbed girder will clearly be the more economical. For larger spans — that is, up to 60 to 70 metres in the case of beam bridges and up to about 120 to 140 metres in arched bridges — a greater expenditure on material is as a rule necessitated for solid webbed construction, but the cost is usually not greater than for framed construction because the cost of manufacture and frequently also the cost of erection per ton is lower. Finally, the solid webbed girder with its smaller surface area is cheaper to maintain.

To attain the full economic advantage of solid-webbed construction it would be desirable to introduce more rational estimate of construction and maintenance, and with this object in view a few figures are given below which must be taken into consideration when making a more rational comparison between solid-webbed and framed girders, namely:

a) Number of rivets per ton of steel work.

b) Weight of rivets per ton of steel work.

c) Exposed surface area per ton of steel work.

The following are the values of these quantities on various bridge works in Denmark:

	Span m	Steel weight tons m	No. of rivets per ton	Weight of rivets kg per ton	Exposed surface sq. m per ton
(1) Warren girders with diagonals and verticals	36.0	0.78	204	45	10
(2) Plate-girders	32.9	0.86	87	38	8
(3) Parabolic truss-girders with diagonals and without verticals and without continuous rivet lines (rolled sections)	67.0	0.97	65	21	12
(4) Bow-string bridges with stiffening plate-girder	67.6	1.03	190	48	12
(5) Parallel lattice girders with posts and 4 systems of crossing members . .	64.5	1.10	154	38	12
(6) Parallel girders with diagonals and posts	70	1 75	150	48	13
(7) plate-girders	60	1.86	75	40	6.5

The longitudinal beams referred to in 4), in a road bridge 8 metres wide (Fig. 1), represent a form of bridge girder which is frequently applied. In order still further to simplify and cheapen bridge constructions of this

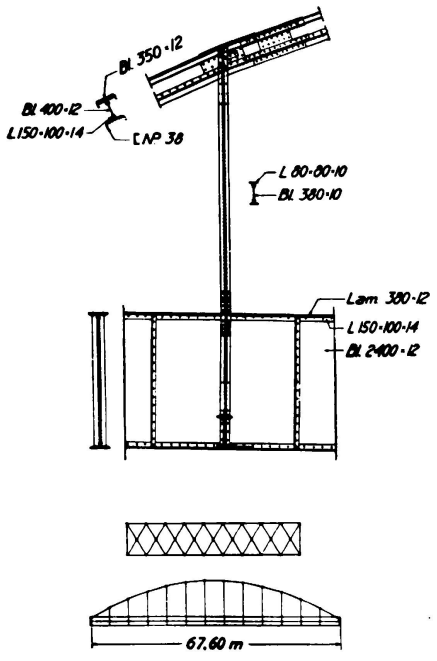

Fig. 1.

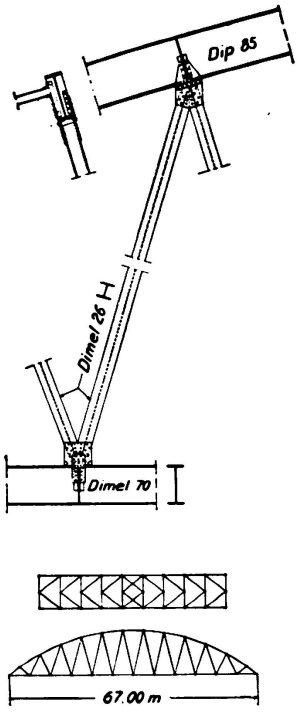

Fig. 2.

order of magnitude the form of girder referred to in 3) and represented in Fig. 2 was designed, consisting of parabolic girders with diagonal members but no verticals. Hitherto this form of girder has been very infrequently applied in steel construction, but systems similar to this have several times been carried out in reinforced concrete under the designation of arches with inclined suspen-

ders (see *O. F. Nielsen:* Arched girders with inclined suspension members. Publications of the I. A. B. S. E., Vol. I., 1932, p. 355).

The system shown in Fig. 2 offers the following advantages as a form of girder for steel construction:

a) The maximum thrust is approximately constant throughout the length of the boom, so that no changes in cross section are necessary and the boom can, therefore, be formed from a rolled I-section without continuous rivet-lines. The upper boom may be curved where this is an advantage as regards appearance.

b) All the web members carry considerable tensile forces resulting from the dead load, so that the additional loading due to traffic causes no compressive forces or only small ones. Eeach bar may be formed from a relatively light I-section, so that continuous rivet-lines are eliminated.

c) As a result of the small forces in the diagonal members the connections can be very easily carried out, either by riveting or by welding. Fig. 2 shows an example of riveted construction.

A comparison between line 3) and 4) in the table shows that the parabolic girder means a considerable simplification in comparison to the bow-string girders, an advantage which in the case of light road bridges up to about 70 metres span may always be realised.

Summary.

Wide spans in solid web construction requirer in general more material than lattice constructions. Jar the purpose of calculating the economical advantage, which as a rule is with plated constructions, a mumber of fundamental comparison figures are given, which were derived from various bridge constructions in Denmark.

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