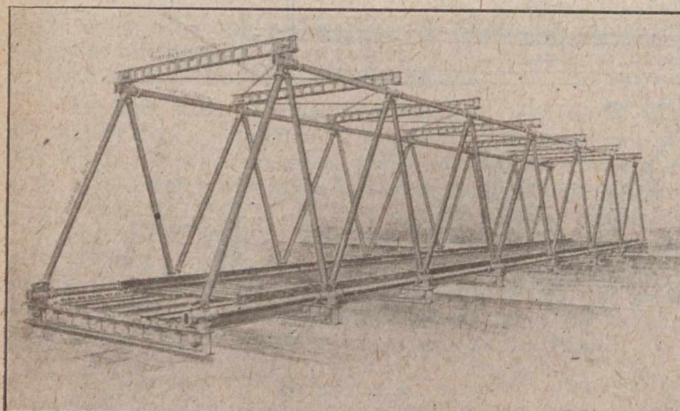
of this again were about two-thirds as many panels as in the span itself. The last panel was counterweighted with some of the decking and a small live load of men, the forward end of the bridge being in skeleton only. The trolley was then manhandled slowly forward, with the forward bridge seat slightly raised, and on reaching its final position the structure was lowered. The trolley and counterweight spans were rapidly dismantled, and the stringers, solid planking and hand-railing put in place. The total labor allowance for a 120-ft. span was about 2,000 man-hours.



TYPICAL INGLIS BRIDGE

The other long span types were also erected without falsework and usually without a counterbalancing arm, and as the system of tackle was identical in principle in all spans over 30 ft. to a maximum of 180 ft., it will later be discussed in detail.

**The 60-Ft. Span**

The 60-ft. type was originally of Class A strength, but by using $1\frac{5}{16}$-in. diameter black bolts at the panel points in place of $1\frac{3}{16}$-in. diameter bolts, it was subsequently in Class AA category and could carry single tanks. Its girders were Warren trusses, the complete span being shipped in five pieces per truss—namely, 2A, 2B and 1C (see Drawing No. 3), all joints being staggered, only a single 7-in. channel and 8 by ⅝-in. plate being needed at each splice. Each main member was composed of two 8-in. channels.

By the omission at will of any of the B or C pieces, the overall length of 64 ft. could be reduced to 55 ft. 4 ins., 51 ft. 0 ins., 42 ft. 4 ins., 38 ft. 0 ins. or 29 ft. 4 ins. as required.

The cross-beams, consisting of 12-in. I's at 40 lbs., were spaced in pairs between (but close to) the panel points, and had their depth at ends reduced to 7½ ins. to avoid fouling diagonals. They were bolted by their angles through the vertical centre line of trusses, and wind-bracing flats were bolted to their lower flanges. Five of them extended far enough beyond trusses to allow lateral vertical braces against upsetting of trusses.

The 4-in. decking was laid longitudinally and flared out for 4 ft. at 30 degs. at end of trusses, in the usual way, to join a graded earth roadway.

**The 85-Ft. Span**

The 85-ft. standard span was of similar type, but had a total depth of 8 ft. 6 ins. The main chords were of two 5 by 4 by ¾-in. angles, stiffened with a vertical web plate. This type was often used near Etaples in crossing the tidal river. Two spans were usually sufficient. Two bridges were used for highway traffic, but a third one was erected for the eventual use of the narrow gauge (60-cm. or 24-in. gauge), upon which the B.E.F. would have had to rely had they lost St. Pol in the great "Battle of France," which started March 21st, 1918. Actually, rails were not laid nor the approaches graded.

The chords of this type had greater lateral stiffness than those of the 60-ft. type, and it was quite common to launch them singly in cantilever; that is, the two trusses were erected on shore and bolted end to end. Truss 1 was then pushed and rolled until its far end reached a pier in mid-stream. The erection bolts were then removed and four special cradle rollers attached to the lower flange of Truss 1. Truss 2 was then slid along this "track." This method was particularly useful in multi-span bridges, as the tackle system of launching was only at its best in one-span bridges, where the height of its mast was of most use.

**Hopkins Bridge**

The Hopkins 120-ft. span was the largest, longest and had the highest load-bearing capacity of any of these G.H.Q. highway bridges. The method of its erection is shown by Drawings Nos. 1 and 2.

The erection on shore was carried out with no equipment beyond the necessary wrenches and 2-in. hemp rope, with suitable block and tackle. After laying out with camber, as shown, the party was divided into four, one for each end of each truss. All diagonals were hoisted by inserting first only one bolt per gusset plate and swinging in a vertical plane. The angles used as gallows with which to hoist the 15-in. channels of the top chord were later used as hand-rail posts. Used as originally designed, they gave insufficient clearance for hoisting and were actually used with an extra plate to give height, the plates being those later used for fastening the floor cross-beams to the diaphragms.

The largest span of this type ever erected in the field was at Havrincourt, after the Canal-du-Nord operations of September 27th to October 10th, 1918. The clear span was 180 ft. and to avoid excessive strains and also excessive length of tackle, the span was partly counterbalanced by erecting 60 ft. of false or cantilever panels. The bridge then was still in equilibrium, without tackle, when overhanging about 120 ft., with the help of some decking as counterweight.

It will be observed that when the bridge was being rolled forward all stresses were reversed and the upward thrust of the rollers tended to distort the 15-in. channels of the lower chord. This was taken up by using an 18-in. 75-lb. R.S.J. floor stringer as a stiffener. In the normal case of a 120-ft. span on eight panels, only the two centre panels were thus stiffened, but in this extreme (Havrincourt) case, panels 4 to 12 were all stiffened, and the beams removed after crossing the roller to avoid overloading of the overhang.

Bridges of this type were launched in skeleton. The trusses were complete, and also the wind-bracing in the upper horizontal plane, but in place of the floor cross-beams and stringers, we had only a few pieces of decking wedged in place, with the diagonal tension taken up by means of wire ropes and turn-buckles. In the Havrincourt bridge, tarpaulins were slung below the flooring gang to save men and tools.

The bridge was launched from and supported by special rollers with a diameter of 12 ins. and a length of about 3 ft. 6 ins., as the two 15-in. channels of the lower chord were separated, and double latticed internally with 2½ by 2 by ¼-in. angles. Later a rocker was bolted under one end.

A footpath about 3 ft. wide was built on the outside of each truss, the angle-irons of its floor being spaced at 3 ft. centres, and only each alternate floor angle had an upright angle as support for the 1¼-in. diameter gas-pipe hand-rail. (See Drawing No. 2.)

A railing was also fastened inside of trusses (to guide road traffic) at an elevation of about 3 ft. The 5-in. decking was laid crosswise on the lower flange of 15-in. channels, and on two 18-in. 75-lb. I-beams spaced 6 ft. 6 ins. apart. These R.S.J.'s were set with tops of stringers about 2 ins. above tops of cross-beams, thus allowing small beveled plates to be riveted on the uncut lower flanges of the stringers and simplifying erection.

The floor was erected by means of a light steel trolley which ran on upper flanges of inner 15-in. channels. To facilitate erection the stringers were made only 14 ft. $11\frac{1}{16}$ ins. out to out on a panel length of 15 ft., and two ¼-in. fillers were later inserted. The cross-beams at side were