THE PENRITH BRIDGE; GREAT WESTERN RAILWAY, NEW SOUTH WALES.

PLATE IV.

PLATE IV. shows the construction of a bridge erected by the Government of New South Wales, to carry the Great Western Railway of that colony across the river Nepean, at a point 32 miles north-east of Sydney. At the end of 1864, about 72 miles of this line were opened for public traffic, the total length in course of construction being 230 miles, connecting Goulburn on the south-east, and Bathurst on the north-east, with Sydney.

Designed by Mr. Whitton, engineer in chief to the Government Railway Department of Sydney, the drawings of this bridge were sent to England, and submitted to Mr. John Fowler for his examination and approval, and, with the exception of slightly varying the section of iron in the top and bottom flanges of the main girders, no material alteration was made in the original design.

The bridge is constructed with three openings, each of them having a clear span of 186 ft. The piers are 12 ft. wide on the underside of the girders, and 198 ft. apart from centre to centre, thus affording a bearing on each pier of 12 ft. The main girders are 25 ft. 6 in. apart in the clear, or 28 ft. 6 in. from centre to centre, and each girder is continuous throughout, the entire length being 594 ft., with an effective depth of 11 ft. 6 in. The top and bottom tables are constructed of the box form, as shown in the cross section, Fig. 4; the bottom member is 3 ft. wide, and 1 ft. 4 in. deep, the greatest sectional area being 220 square inches on the piers, and the least, 80 square inches on the abutments. The side of the box member is made good with plates $\frac{5}{16}$ in. thick, and a central web, of the same strength, divides it into two compartments, through its entire length. The whole is put together with angle irons 4 in. by 4 in. by $\frac{1}{2}$ in. thick. The main webs are $\frac{1}{4}$ in. thick, 7 ft. deep, and are connected with the top and bottom members of the main girder by angle irons. The webs are 2 ft. $2\frac{1}{2}$ in. apart, and are strengthened internally with angle irons, and plate stays every 3 ft.

The construction of the top member is identical with that of the bottom, excepting that the upper plates are curved, the more effectually to resist compressive strains, as well as to give a better finish to the elevation, and the section of metal varies from 90 square inches at the abutments to 180 square inches at the centre of the first span, decreasing to 175 square inches over the piers, and 120 square inches in the centre of the middle span.

These main girders are 13 ft. deep over all, and parallel throughout; but the straight lines of their elevation are broken by the curved strips of angle iron seen in Fig. 1, which tend greatly to lighten the appearance of the structure, and which is the only purpose they serve.

The cross girders, which carry and transfer the dead and rolling loads, are placed 3 ft. apart from centre to centre. On them is laid a close planked roadway and 3 in. of ballast, which, with a double permanent way, makes up a constant dead load of $2\frac{1}{2}$ tons per foot run, or a total load of 1485 tons over the whole bridge. Horizontal on the upper side to which the roadway is secured, these cross girders have a gradually increasing depth underneath, from the points of support to the centre, the least depth being 1 ft. 3 in., the greatest 1 ft. 9 in.

The form and construction of these cross-beams are shown in Figs. 3 and 4, where it will be seen that they are built up with a $\frac{1}{4}$ in. plate flange 7 in. wide at top and bottom, rivetted to a web of the same thickness with the help of angle irons 3 in. by 3 in. by $\frac{1}{2}$ in. The web is stiffened twice in its length with a **T**-iron strip, and the beam rests at each end upon the projection left by the difference between the width of the bottom flange of the main girder and its web. To this latter each end of each cross girder is rivetted by eight 1 in. rivets, the angle irons of the bottom flange of the cross girder being turned at right angles, and extended for a distance of 2 ft. 6 in. against the side of the main girder.

The bed plates on the piers and abutments consist of double tables of cast iron, each $2\frac{3}{4}$ in. thick, 3 ft. 9 in. wide, 4 ft. long in the abutments, and 12 ft. on the piers, planed perfectly true on the inner sides, to insure uniformity of bearing. Between these plates, cast-iron rollers, also turned true, are placed, these rollers being 4 in. in diameter, and 8 in. apart from centre to centre. The rollers are at liberty to revolve freely, and they are kept in their proper position by distance strips of wrought iron, which have holes 1 in. in diameter drilled through them, to receive the axles of the cast-iron rollers. Upon these bed plates, arranged as described, the whole superstucture of the bridge rests, and as the