The roadway is supported on cast-iron arched plates, with a versed sine of 3\(\frac{1}{2}\) in., and resting on the cross girders. They are 6 ft. 6 in. long, four of them stretching from kerb to kerb. The whole surface is covered with hydraulic concrete, flash to the top of the plates, and upon that 4 in. of screened gravel is placed, as a foundation for the granite pitching which forms the roadway. The footways are paved with 2 in. landings laid on sand above flat cast-iron plates. A double track of horse railroad passes over the bridge, and is carried on longitudinal sleepers with cross ties. The hand railing is of cast iron, in keeping with the Gothic tracery of the spandril filling, 10\(\frac{1}{2}\) in. wide at the top, and 3 ft. 8 in. high from the footpath level; in the centre is made the only allowance for expansion and contraction, where the railing is separated, and each end fits into a casing forming the lamp pedestal (Fig. 1)—within which it slides, without showing any open joint. With this exception, the structure has to accommodate itself to change of temperature by the varying elevation of the crown.

The passing load upon the bridge is taken at a maximum of 100 lb. per square foot, which gives a total horizontal pressure of about 200 tons, or 1\(\frac{1}{2}\) tons per square inch of section in the centre, and 1\(\frac{3}{4}\) tons at the skewbacks. The work was commenced by the city engineer, Mr. Strickland Knaus, on the 19th September, 1861; but its completion was delayed until July, 1866, in consequence of the scarcity of labour during the war. The total cost was 60,000£.

**THE WOOLWICH ARSENAL PIER.**

**PLATE LXXXVI.**

The erection of a pier at the Woolwich Arsenal, for facilitating the embarkation and debarkation of guns, was commenced in 1869 by the Hamilton Windsor Ironwork Company, of Liverpool, who constructed the work from the designs of Mr. J. W. Grover, of 9, Victoria Chambers, Westminster. In January, 1868, the general sketches were supplied by the War Office, but these differed in many important points from the structure which has since been successfully erected.

The elevation, plan, and principal details of the pier are shown in Plate LXXXVI. It has a total length of 328 ft. divided into six bays each 48 ft. long, and a head 40 ft. long and 50 ft. wide. The clear width between girders is 22 ft. 6 in., and the girders themselves are supported upon ten wrought-iron cylinders 2 ft. 4 in. in diameter. At the base the cylinders are furnished with a cast-iron shoe with a screw thread 9 in. wide upon it, and they are sunk about 16 ft. into the ground, through the gravel, which lies for a thickness of 10 ft., below the shifting mud, that forms the upper soil. The piles are filled with hydraulic concrete, and terminate with a flanged head 7 ft. 6 in. below the underside of the main girder, the intermediate space being filled with cast-iron double brackets, as seen in Figs. 1 and 3. Transverse girders 7 ft. 6\(\frac{3}{4}\) in. deep, are placed between each bracket, as shown in Fig. 3. The piles are also connected by diagonal wrought-iron bracing. The longitudinal plate girders are continuous from end to end, 4 ft. 6 in. in depth; the level of the deck of the pier is about 3 ft. below that of the top flange, and the roadway is supported upon trussed cross girders, as seen in Fig. 3. Three lines of rails are laid upon the platform converging at the pier head to a turntable 14 ft. in diameter, from which the wagons can be turned on to a pair of transverse rails, extending along the whole width of the pier head. A thirty-ton crane, with a jib 35 ft. long, commands this length of rail, from which the guns can be picked up and lowered into the vessel alongside.

The pier head is the most important work in the structure, as provision had to be made for the accommodation of the turntable and for the erection of the crane. Fig. 4 shows the plan of the arrangement adopted for the girders. It was necessary, in order to maintain the platform at one level, and to obtain sufficient space for the turntable, to reduce the depth of the girders at this place, and compensate for their reduced