

and of masonry were suspended. The wrought iron was continued; piling was driven night and day in the cast iron columns.

March 23d and 24th, 1858.—A menacing ice-breaking for forty-eight hours, followed immediately by the opening of navigation and the renewal of the work.

June 15th, 1858.—Raising of the first arch.

Oct. 23d, 1858.—Raising of the thirty-second and last arch.

Nov. 23d, 1858.—The strutting and flooring of the bridge being finished, the trial proof was made.

Dec. 2d, 1858.—The inauguration.

*Trial Proofs.*—The bridge being uniformly loaded with (8000 kil. per metre) 5365 lbs. per running foot, and consequently the piers in equilibrium (see Third Part), the flexures were as a mean 0·47 ins. for the intermediate bays, and ·63 in. for the two end arches, whose top stringers were not moored upon the abutments (see Note A).

The passage of an ordinary train upon a track gives the following maxima deflections:

Upon the exterior arch of loaded track,	·31 inches.
Upon the interior arch,	·25 "
Upon the interior arch of unloaded track,	·14 "
Upon the exterior arch,	·08 "

Which proves that the four arches are, in a certain degree, solid.

(To be Continued.)

*Description of a Pier erected at Southport, Lancashire.* By Mr. H. HOOPER, Assoc. Inst. C. E.

From the London Artizan, May, 1861.

This pier was constructed at right angles to the line of promenade facing the sea, on an extensive tract of sands reaching to low water, a distance of nearly one mile. Its length was 1200 yards, and the breadth of the footway was 15 feet. At the sea-end there was an oblong platform, 100 feet long, by 32 feet wide, at right angles to the line of footway. The superstructure was supported upon piers, each consisting of three cast iron columns, and each column was in three lengths. The lowest length, or pile proper, was sunk into the sand to the depth of 7 or 9 feet. These piles were provided at their bases with circular discs 18 inches diameter, to form a bearing surface. A gas tube was passed down the inside of each pile, and was forced 4 inches into the sand; when a connexion was made with the Water Company's mains, a pressure of water of about 50 lbs. to the inch was obtained, which was found sufficient to remove the sand from under the disc. There were cutters on the under side of the discs, so that, on an alternating motion being given to the pile, the sand was loosened. After the pressure of water had been removed about five minutes, the piles settled down to so firm a bearing that, when tested with a load of 12 tons each, no signs of settlement could be perceived. The upper lengths of the columns had cast iron bearing plates, for receiving the ends of the longitudinal lattice girders, each 50 feet long and 3 feet deep. The centre row of girders having double the duty of the outside

ones, top and bottom plates were added. The weight of wrought iron work in each bay was 4 tons 5 cwt., and of cast iron work 1 ton 17 cwt. The second bay from the shore was tested by a load of 35 tons, equally distributed, when the mean deflection of the three girders, in 24 hours, was  $1\frac{1}{2}$  inches, and there was a permanent set of  $\frac{1}{2}$  inch, on the load being removed.

The advantages claimed for this mode of construction were—1st, Economy in first cost, especially in sinking the piles, which did not amount to more than  $4\frac{1}{2}d.$  per foot. 2d, The small surface exposed to the action of wind and waves. 3d, Similarity of parts, thus reducing the cost to a minimum. 4th, The expeditious manner of obtaining a solid foundation—an important matter in tidal work. 237 piles were thus sunk in six weeks.

The estimated cost of the pier and approaches was £10,400. The works had been completed for £9319, being at the rate of £7 15s. 4d. per lineal yard. The pier was designed by Mr. Brunlees, M. Inst. C. E., and the superintendence of the construction was entrusted to the author, as resident engineer, Messrs. Galloway being the contractors.

*Proc. Inst. Civ. Eng., March 5, 1861.*

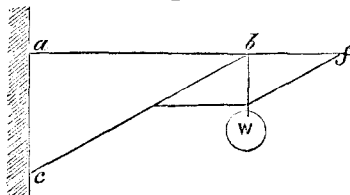
### On Lattice Girders.

From the Lond. Artizan, May, 1861.

As girders constructed with a lattice web are now becoming numerous, it is very desirable that some ready means of calculating the strength or dimensions of any lattice combination should be generally known; we therefore purpose to enter fully into an investigation of the principles of such structures. Many theories of lattice girders have been published, all on the same principle, that we shall adopt in the present paper, and they are all tolerably simple, but with the one disadvantage of being expressed by trigonometrical qualities, and this we shall especially avoid, so that our calculations may be readily comprehended by those who have not studied the elements of trigonometry.

We will commence with some preliminary remarks upon the resolution of forces, confining ourselves to the problems which have reference to our present subject.

Fig. 1.



Let  $bc$  (Fig. 1) represent a beam fixed into a wall obliquely, as shown, and let its upper end be prevented from deflecting by a flexible tie  $ab$ ; from the point  $b$  let a weight  $w$  be suspended, then will this weight be