February 3rd, 1852.

JAMES SIMPSON, *Vice-President, in the Chair.*

The following candidates were balloted for, and duly elected:—

Captain Christopher Claxton, R.N.; Captain Henry Cunliffe Owen, R.E.; Lieut. Edward Fraser, B.E.; Lieut. William Kendall, B.E.; and Peter Paterson, as Associates.

After the renewed discussion on Mr. Jee's paper, which occupied the greater part of the evening, Mr. Hawkshaw brought forward the paper he promised at the last meeting.[1]

No. 865 A.—"Description of a Cast-Iron Viaduct, or Colonnade, constructed at Salford." By JOHN HAWKSHAW, M. Inst. C.E.

IN effecting a junction, in the year 1842, between the Liverpool and Manchester, Manchester and Leeds, and Manchester and Bolton Railways, at Salford, it became necessary to carry the Junction Railway, either through the station of the Manchester and Bolton Company, or parallel with and close to it.

There existed almost insuperable objections to passing through the station, which, besides being already too narrow, was bounded on both sides by public streets, so that it was imperative to devise other means of accomplishing the object. The difficulty was at length overcome, by an agreement with the authorities of the town, for which an Act of Parliament was afterwards obtained, for permission to place a line of cast-iron columns along the centre of Upper Booth Street, and by using these columns for a support on one side, and the existing brick viaduct, which ran along the north side of the street, as a support for the other, to construct thereon a viaduct to carry the railway, in such a manner, as to allow the street beneath to remain open to the public, as before, the only obstruction being the columns, placed in a line along the middle, which, with the superstructure above, had the effect of converting one-half of the street into a covered way.

The columns are placed in pairs, opposite to each pier of the viaduct, and transverse girders are fixed across from each column, and let into the brickwork of the viaduct, belonging to the Manchester and Bolton Company. The columns forming each pair, stand 7 feet apart, from centre to centre, and the spaces between each pair, and consequently between each pair of transverse girders resting upon them, are 29 feet in width; these spaces are each crossed by four longitudinal girders, so arranged as to be 7 feet

[1] Vide *ante*, page 238.

apart, from centre to centre, and the uniform spaces, of 7 feet wide, between all the transverse and longitudinal girders, are filled in with flat brick arches set in cement, on which, after being ballasted, the permanent way was laid.

The outer longitudinal girder carries a high screen, or fence, composed of cast-iron plates, each 9 feet high, 5 feet broad, and 1 inch thick, overlapping each other for about 6 inches, but so as to present a smooth surface next the street, and the plates, besides being firmly bolted down to the girders, are securely fastened together, at the overlapping joints, by iron rivets.[1]

The position of the columns happening to be exactly over the line of the common sewer of the street, it became necessary to construct a new sewer, and to take the foundations for the columns down to the sound bottom, a depth of about 15 feet.

The total length of the viaduct is 728 feet, and the width 27 feet: the width of Upper Booth Street, along which it is erected, is 53 feet.

The iron-work was cast and erected by Messrs. Ormerod and Sons, St. George's Foundry, Manchester.

The entire cost of the work, including the foundations, brick-work in cement, ballasting and laying the permanent way, the construction of the new sewer, and repaving the street, was £10,500.

An arrangement was made with the contractor for the iron-work, that a girder of each description should be broken, in order that the actual breaking weight and deflection might be ascertained.

The experiments on the strength of the girders were conducted under the superintendence of, and by means of an apparatus devised for the purpose by, Mr. Eaton Hodgkinson, and as they were made with great care, and in a mode which insured the strain being applied exactly at the centre of the girders, and also for the force and deflection being accurately measured, it may be useful to note the results that were obtained.[2]

The dimensions of the longitudinal girders were :—

	Feet.	Inches.
Extreme length	28	9
Depth in the centre	2	6·5
Thickness of the vertical web, in the centre		2
Width of the bottom flanch	1	0·1
Thickness of ditto		2
Width of the top flanch		5.1
Thickness of ditto		2·3

[1] It was in this cast-iron screen, or parapet, that Mr. Hawkshaw first observed the results of tight bolting down, in counteracting the usual effects of the contraction and expansion of iron.—*Sec. Inst. C. E.*

[2] A description of this apparatus is given in Hodgkinson's edition of "Tredgold on Cast-Iron."—*Sec. Inst. C. E.*

In the trial of one of the girders, of these dimensions, the points of support were 27 feet 5 inches apart, and the results of the experiment were as follow :—

Weight in the middle of one Girder.	Equal to a Weight, uniformly distributed over one Girder, of	Deflection in the middle of the Girder.
Tons.	Tons.	Inches.
18·4	36·8	·31
35·2	70·4	·61
52·0	104·0	·87
68·8	137·6	1·16
76·6	153·2	1·29

This girder broke with a load of 76·6 tons in the centre.

The dimensions of the transverse girders were :—

	Feet.	Inches.
Extreme length	24	6
Depth in the centre	3	0
Thickness of the vertical web in the centre . .		3·29
Width of the bottom flanch	1	11·9
Thickness of ditto		3·12

The top flanch was dispensed with, for convenience of construction.

In the trial of one of the girders, of these dimensions, the points of support were 23 feet 1 inch apart, and the results of the experiment were as follow :—

Weight in the middle of one Girder.	Equal to a Weight, uniformly distributed over one Girder, of	Deflection in the middle of the Girder.
Tons.	Tons.	Inches.
26·8	53·6	·10
52·0	104·0	·20
85·6	171·2	·35
119·2	238·4	·51
152·8	305·6	·68

This girder was not broken : the experiment being stopped on account of the apparatus being overstrained.

By calculation (using Mr. Hodgkinson's formula and a co-efficient of 26) the longitudinal girder should have been broken by a load of 58·33 tons in the centre ; whereas, the load by which it was broken was 76·6 tons ; the difference being probable due to the strength of the vertical rib, the dimensions of which exceeded the proportions of girder to which the formula is more especially adapted.