joint, Fig. 2, where one plate laps over the other, simply, there being

Fig. 1.

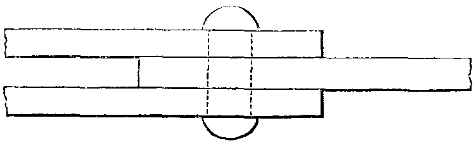
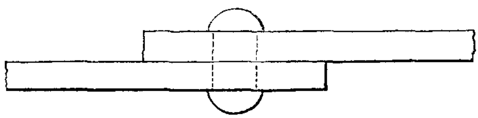


Fig. 2.



two distinct sections sheared through in the one case, and only one in the other. The average resistance to fracture drawn from these experiments, is for each square inch of sectional area of the rivet 35·10 tons for a chain joint, and 18·82 tons for a lap joint.

The communication is accompanied by three drawings, Nos. 4517–19, from which Plate 15 has been compiled.

Mr. Doyne said, that he had made several experiments on the strength of rivets, by means of an hydraulic press, the results of which were given in the paper; from these experiments he had found, that the breaking strength was, as nearly as possible, in direct proportion to the sectional area. The method of calculating the strain on lattice beams was similar to that for all other bridges. Supposing a bridge, constructed on this principle, to be loaded at the centre with half its breaking weight, the strain on each lattice would then be the same; but when the load was uniformly distributed, the strain on the lattices was very different, increasing from the centre towards the end, in a certain ratio. If the load was placed in the centre, the proportions of the bottom decreased towards the ends, in the ratio of the ordinates of two converging lines; therefore, as the strain was brought on at equal intervals of distance, the strain induced by each lattice was equal; but when the load was laid uniformly over the bridge, the bottom decreased in the ratio of the ordinates of a parabola; consequently the strain increased on the lattices as they approached the end, in some ratio governed by these different proportions of the bottom. Mr. Wild had studied the subject very carefully, and might perhaps give the Institution some further information, and formulæ for accurately determining the strength of such structures.

Mr. C. H. Wild said, he thought the advantages of a continuous web, over a lattice, had been underrated in the paper. Although, in a lattice bridge the metal in the sides might, for all diagonal strains, be nearly as well distributed as in the continuous web, yet it must not be forgotten, that in a tubular bridge, the web itself exerted considerable resistance to compression and extension. This advantage in tubular girders was considerable, the strains derived therefrom being in some cases as much as 10 per cent. of the whole. Lattice bridges did not possess this advantage, as the lattices acted merely in keeping the top and bottom flanges apart, and gave no resistance to horizontal tension, or compression.

In a lattice bridge loaded uniformly, the strains on the lattices increased in direct proportion to their distance from the centre, the strains on the top and bottom being, at any place, as the rectangle of the segments.

Mr. BIDDER said, he had had to deal with the subject of lattice bridges for many years, and he thought their construction was much too complex. Mr. Doyne had stated in his paper, that the top was brought into compression, and the bottom into tension, the only object of the lattice being to bring these two parts into their relative action. By what contrivance this could be effected, with greater economy, than in a plate bridge, Mr. Bidder could not conceive. In a plate bridge the sides of the girder had the advantage of communicating a considerable portion of strength to the bridge, as well as transmitting the strain from the top to the bottom. From a consideration of all the circumstances, the result he had arrived at was, that there could not be any economy of material in such a bridge as that under discussion; and he thought, that in a simple girder bridge, the same quantity of material would be found to give more resistance and strength, than it could by any possibility do in a lattice bridge. In the present instance, a simple girder bridge might have been erected for less money, and a brick arch for still less, than was stated to have been expended for the lattice bridge, and either would have answered the purpose quite as well as it did. At the same time, he did not wish to detract from the merits of Mr. Doyne's paper; that gentleman had brought the subject candidly and fairly forward, but, in stating his opinion, Mr. Bidder was merely exercising his functions as a member of the Institution, and with a desire to guard the younger members of the profession from adopting this form and disposition of material, which he had proved from extensive experience, to be anything but economical.

Mr. MAY remarked, that there was an important element affecting the question of cost which had not been noticed; this was the difference in the cost of bar iron and boiler plate, the former of which might generally be obtained for about five-eighths of the price of the latter, and it was at the same time more convenient to handle. Although there might be more weight of iron consumed in the construction of a lattice bridge than in others, the cost might, on this account, be less, still giving the same strength to bridges of equal span. He merely threw this out as a suggestion, that, under certain circumstances, lattice bridges could possibly be constructed more economically than boiler-plate bridges.

Mr. Doyne said, he would not attempt to deny that a more economical bridge than the one under consideration, might possibly have been constructed; but he did not think a boiler-plate bridge, of equal span, could have been erected at the same cost. Although he admitted, that the continuous web, in boiler-plate bridges, did add considerably to the strength of a bridge, yet this increase of strength was not at all in the ratio of the amount of material used. In wrought-iron bridges, the boiler plates frequently cost from £7 to £10 a ton, and the labour from £15 to £20 per ton; therefore it was of more importance to save labour than mere weight of iron. In the present case the bars were purchased at the lowest price; each one was cut to a template of the same length, and sent through a self-acting punching machine, and the whole of them were punched by two men in three days, being a much less amount of labour than would have been necessary for a boiler-plate bridge. If he had again to erect a similar bridge, he should do so before the earth was excavated from beneath it, by which an expense of about £500 for scaffolding would be avoided.

Mr. Bidder said, that admitting the strength of the top and bottom of the lattice beams to be equal to that of a boiler-plate bridge, economy of material must be looked for in the sides, which it was said would, if spread out into a continuous web, only be one-fifth of an inch in thickness. Now, he considered that one-quarter of an inch would have been sufficient for such a bridge as that under discussion, which, it must be remembered, only carried a public road over the railway, and not the railway itself. He thought the strength of this bridge, according to calculation, was not equal to that of one constructed on the tubular principle, and that generally it was not equal to a bridge of that construction, for if labour was saved in the construction, material must be sacrificed.