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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

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CHAP. V.

ROADBED CONSTRUCTION.

ARTICLE 23.—MASONRY BRIDGE PIERS.

The material most commonly used for masonry pier construction is stone, although in certain cases brick may be cheaper and also satisfactory; but wherever there are strong currents of water or jams of ice or logs, brick is hardly suitable, as the individual pieces are liable to displacement; but concrete piers are becoming quite common in certain parts of America, the compact and simple form of a pier lends itself readily to concrete construction, the ebb and flow of tides will not affect well made concrete whereas it has a disastrous effect often even on the heaviest class of masonry, percolating through the many joints loosening the stones and mortar; concrete piers are usually much cheaper than first-class masonry work, and even the compromise of a pier with the sides and top of stone and the interior of concrete, offers considerable saving. In designing piers located in river beds we have three special questions to study, namely, the dimensions and construction of the coping, the batter of the sides to insure stability, and the design of the cutwaters; of course the question of foundations enters into designing this class of work even more seriously than with structures built on land, but the subject of foundations will be taken up in a more general way applicable to all structures.

(1) The coping dimensions will be determined by the width apart of the trusses, the size of the bed-plates, and the loads to be carried locally on the masonry work, the variation would be for single track roads, from say 4 feet by 16 feet under coping for small deck trusses to as large as 12 feet by 40 feet for long through spans. The coping should project two or three feet beyond the bed-plates at the ends, and six inches to two feet at the sides, depending on the weight of the span. Copings should consist of an 18-inch thickness of very strong carefully made concrete, surfaced with a layer of 1 to 1 mortar before the concrete has set, or if of stones, they should be large, well-bedded, cut all over the top surfaces by fine pointing, pean hammering, or in some way giving a good surface for the bed-plates; the vertical joints should be cut and preferably the beds also; but the faces look better with the quarry face left on, if the rest of the pier is rock faced ashlar. They should be dowelled into place, or clamped to one another, and so arranged that the pedestal plates of the bridge trusses will come *exactly* on the centre of a large stone, or if one stone cannot be found large enough to distribute the load, a large, deep pedestal block should be cut for the purpose and placed on top of the coping; for very large trusses, a steel pedestal is constructed to distribute the load over several coping stones (*e.g.*, new Victoria Bridge). Coping plans showing the exact size and position of each stone should be furnished the contractors, and it is a mooted question, whether better results as to exact surface, etc., can be obtained by bedding in mortar, or by shimming up the whole coping to an exact level on wooden chips, then pointing up all the outer bed and vertical joints, and pouring liquid grout into the receptacle of interior joints and beds thus formed until every crevice is filled, the latter plan is probably preferable, if care is taken to have the joints and beds open enough to secure their being thoroughly filled, particularly the beds.

(2) The batter of the sides is usually 1 in 12 or 1 in 24 and is a matter of appearance, as vertical piers would look top heavy, but in each case a calculation should be made for stability, under the most unfavorable circumstances; considering the stability in direction of the railway line, the forces acting would be (*a*) the wind blowing at 45° to the direction of truss, on the truss, train and pier, at say 40 lbs. per square foot, the force of a fully braked train covering one or two spans depending on the location of the expansion rollers, at say, 10 per cent. of the weight of the train, and vertical loads which would consist of a *loaded* span and the weight of the pier itself; the resultant of these forces should not fall appreciably outside the middle third of the base, (*b*) with the wind as before, but

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.