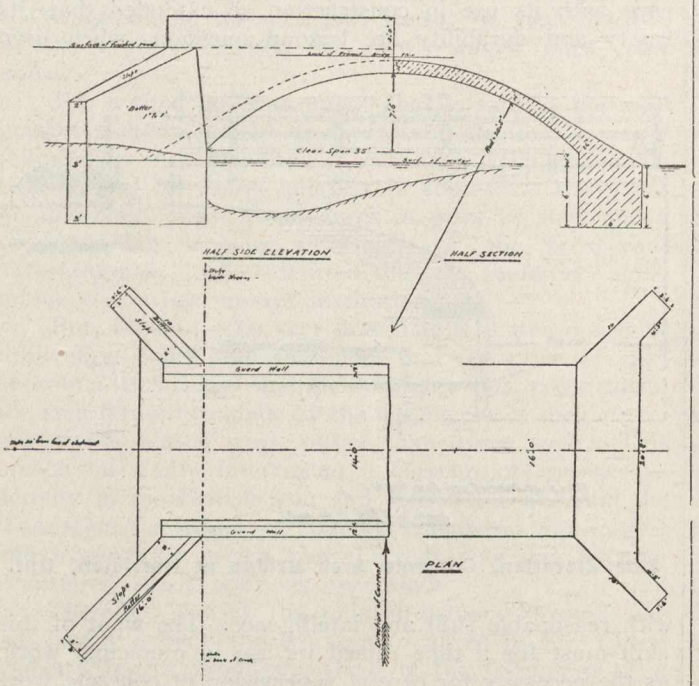
length should be made up by increasing the number of spans rather than by increasing their length. In situations presenting no unusual difficulties in obtaining safe foundations, it will often be found that two short spans of, say, 20 feet each, can be built for less money than a single span of 40 feet, and at the same time give a bridge of more pleasing appearance. In fixing the proportions

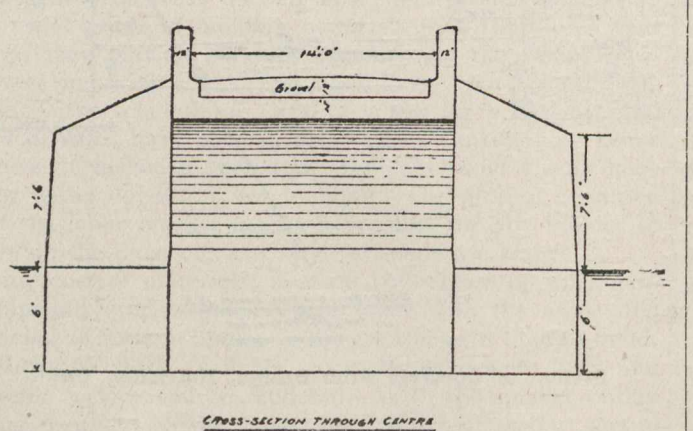


Plan, Half Side Elevation and Half Section of Concrete Bridge, at Arthur, Ont.

of the arch we cannot do better than remember the old rule that the rise should not be less than one-sixth of the span, but in many cases the formation of the ground will admit of a greater rise than this, especially if the spring of the arch be kept near the low water surface.

If the arch is low and flat, its appearance will usually be improved by making it of the three-centre form, using short curves with a radius of four feet or thereabouts at the abutments.

In an arch bridge the opening or waterway may usually be considerably smaller than would be necessary for an iron bridge, and need not be much greater than the maximum flow of the stream, as even if the arch runs full, no damage is likely to result from floating ice or timber. As the wearing surface of the roadway above the arch need be only a few inches in depth at the crown,



Section through Centre, Concrete Bridge at Arthur, Ont.

there are very few places where this form of bridge cannot be used without much change in the grade of the road.

In the construction of the piers and abutments, the cost may be kept down without impairing the quality of the work by using boulder concrete. Below ground a 1 to 6 gravel concrete may have as much as fifty per cent. of the volume of the work made up of boulders. When so used the concrete should be mixed wet, so that the stones will bed themselves in it. Towards the spring of the arch the percentage of boulders should be reduced. In the arch ring a concrete of one part cement to five parts gravel has given good satisfaction.

If the gravel available for the work is fine or sandy, part of it should be replaced with broken stone. In a flat arch, a concrete of 1 cement, 2 sand and 4 broken stone is to be preferred. In the guard walls, a gravel concrete of 1 to 8 is sufficient. The thickness of the arch ring in short-span bridges is a question about which we have little available information. The writer a few years ago built a 20-foot arch, with a low rise and a thickness at the crown of 10 inches. A month after completion it carried a 15-ton roller. In several 35-foot spans the thickness has been made fifteen inches at the crown. It would, therefore, appear that within these span limits a thickness at the crown of one-half inch for each foot of span is safe practice for highway bridges. Whether this thickness may safely be reduced under our present methods of construction is a question for further trial.

TOPOGRAPHIC MAPPING OF BOTTOM LANDS IN ILLINOIS.*

By E. W. McCrary.†

The last General Assembly of Illinois made a small appropriation for the beginning of surveys and studies of the overflow lands of the State for the purpose of acquiring a knowledge of their existing conditions and the methods by which the needed improvements may best be made. In accordance with this legislation the State Geological Survey last year began the topographic mapping of portions of the Kaskaskia, Big Muddy and Embarass Rivers, in which it co-operated with the topographic branch of the United States Geological Survey. Co-operative topographic mapping having been arranged in quadrangles adjacent to these streams, much of the control work of the regular survey has, with slight modifications, been utilized for special drainage work. This has made it possible, at the least possible expense, to produce during the past season a 5-foot topographic map on a scale of 1:24,000 of approximately 200 square miles of these river bottoms.

The purpose of the Survey in doing this work along the river courses is to furnish a detailed topographic map, sufficiently accurate to be of practical value to the engineer in the planning of any proposed drainage improvements and the estimating of costs for same. While the question of the scale has been somewhat perplexing, it is believed that the 1:24,000 scale will prove adequate for the uses for which it is intended, since it is sufficiently large to contain all detail that would be taken into account in the planning of these improvements. It has the additional advantage of permitting large sections of country to be mapped on a single sheet of paper, thereby presenting in a collected form the conditions in different sections of the bottoms. Also because of its much reduced cost, which must be considered with a limited appropriation, it has a very strong claim to consideration.

Of the 160 square miles of mapped country, a portion of the Kaskaskia River bottoms, 130 square miles are under from 1 foot to 8 feet of water several times each year. The overflow season usually begins in January, and at times lasts as late as the middle of August, which makes the season, in which the land is dry enough for cultivation, entirely too short for successful farming. It seems to be generally necessary to plant several times each spring, and even with the last planting they cannot hope for a yield to

* From Year Book of Illinois State Geological Survey for 1907.

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