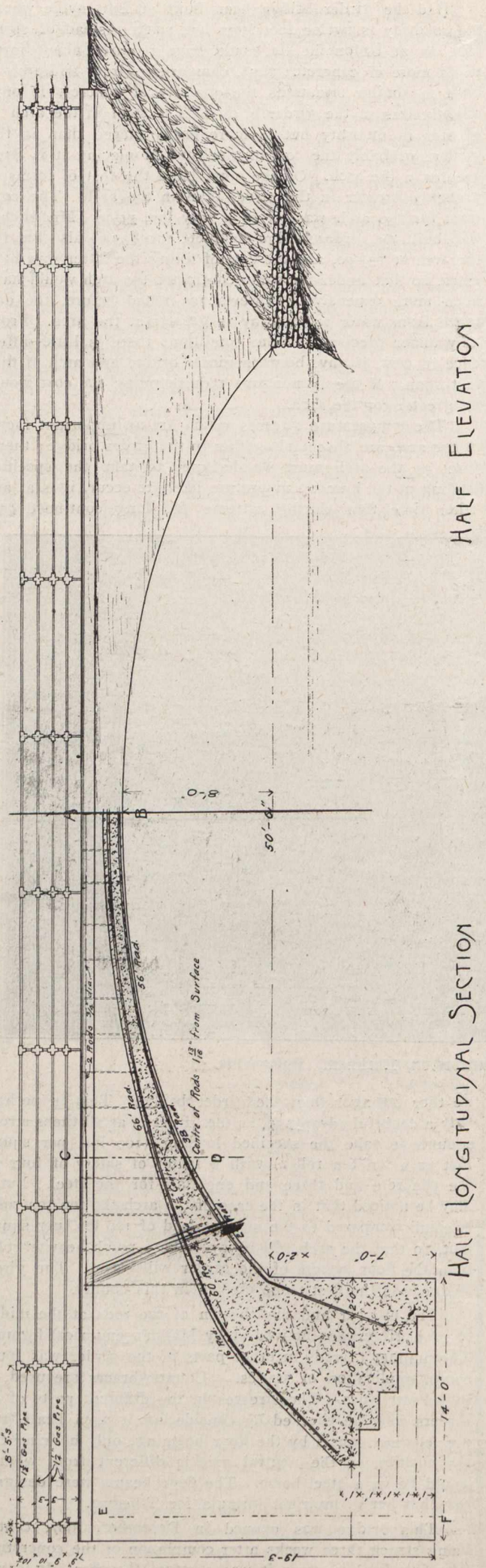
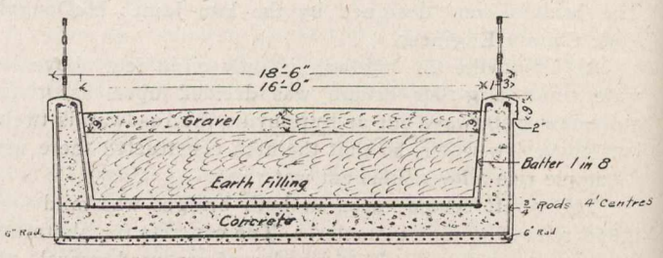


Arch Bridge, Buttonville, Ont.

crete beam. In this case the permanent deflection at the middle of the bridge was 1-100 inch as measured at the time.

We are unable to show detail plans of the Unionville bridge, and we substitute instead a plan of a girder bridge of thirty feet span designed under the same engineer, and now being erected near Weston, which shows the details of design for this form of bridge.

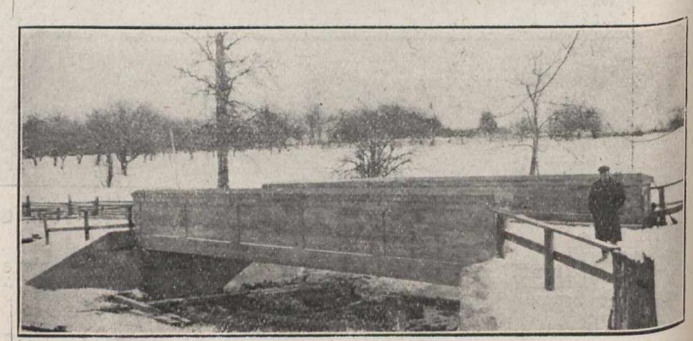
The concrete arch at Buttonville was designed by the method of Professor Cain, founded upon the theory of elasticity. The following tables show the stresses for loading over one half the arch (the worst case) and for temperature stresses. The temperature of the concrete when being placed was taken to be from 45 to 50° Fahrenheit, and it was supposed to be subject to a rise or fall of temperature of



SECTION AT CD

Arch Bridge.

40° F. from this temperature at the time of setting. It will be noticed from the diagrams and tables that the stresses in the concrete, due to the weight of arch and to any possible position of specified load are always compressive, since the arch is so designed that the line of pressures comes always within the "middle third" of any section perpendicular to it, so that if it were not for temperature stresses no reinforcement would be necessary. Moreover, the tensile stresses due to changes of temperature could be eliminated by sufficiently increasing the uniform load, i.e., by increasing the depth of earth filling over the arch, for the stresses due to uniformly distributed load being everywhere compressive tend to counteract the tensile stresses. In the present case it was found cheaper to place steel to take the tensile stresses than to allow the compressive stresses to be thus increased. We see from these considerations why very



Concrete Girder Bridge

heavy masonry arches, if properly designed, have no tensile strains and need no reinforcement. Even a load over one half the arch decreases tensile stress everywhere except in those due to a fall of temperature on the extrados near the skewbacks.

The greatest tensile stresses, at the intrados near the crown and at the entrados near the skewbacks, are produced by a fall of temperature. This is therefore the condition which governs the amount of steel reinforcement to be used and to a large extent the dimensions of the arch ring. This being the case it will be seen that the concrete of the arch ring should not be placed in very warm weather in order that the fall of temperature should be small from the temperature of setting, the point at which no temperature stresses are induced.

The intrados is a five centred curve. It lies between the segment of a circle passing through the springings and the crown, and a semi-ellipse through the same three points, but