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HIGHWAY BRIDGES AND CULVERTS.

The question of municipal highway bridges and culverts grows in importance concurrently with the increased attention given to the matter of good roads; in fact it is the cost of these highway accessories that brings the cost of road improvement higher in one locality than another, and while thought and discussion is being given, in many municipalities, to good road construction, it is an established fact, as recently exemplified by the many disasters accompanying the spring freshets, that there is a dire need for general improvement in small bridges and culverts.

A recent bulletin issued by the Office of Good Roads, U.S., by Chas. H. Hoyt and William H. Burr, takes up the whole question of highway bridges and culverts in a concise manner. Some abstracts are presented herewith. A practice which has been in vogue and which has had an injurious effect, especially in the design of highway bridges, is the method of inviting bids upon the bidder's own plans without having a competent and disinterested engineer to pass upon the designs submitted. The total weight of the steel and the amount of shop work necessary to make good, strong connections determine largely the real as well as the economical cost of the bridge. The desire to secure the contract encourages the effort, under such conditions, to make the design light enough in weight to get the contract regardless of whether the bridge is designed to carry its load with a fair factor of safety.

Still a third matter which also has had an injurious effect upon the design of bridges, and which should be avoided in all cases, is the determination of those acquiring the bridge not to pay more than a fixed amount, which has been decided in advance, without sufficient information, such as reliable engineering inspection, preliminary plans, and estimates. The plan to be observed should consist of the following steps:—

(1) The services of a capable bridge engineer should be secured.

(2) The foundations should be tested to determine suitability, bearing power and economy.

(3) The location should be determined with a close approximation and a profile of a centre line made, showing also the results obtained by testing the foundations.

(4) The load which the bridge may be called upon to carry safely, anticipating reasonably the demands and growth of the future, should be decided upon. All highway bridges, at least those on main roads, should be designed to carry concentrated loads, such as road rollers or traction engines weighing from 10 to 15 tons each, with a reasonable factor of safety. Unfortunately for the traffic of to-day many of the present highway bridges were designed to carry only moderate uniform loads, and on this account for their light appearance and their inadequacy to meet present demands.

(5) After these facts have been determined, the engineer will be able to prepare plans for the foundations, abutments, piers, and the bridge itself, all of which may be designed to meet economically the conditions of the location selected. An estimate of the cost may be made and this should in all cases be used as the basis for an appropriation for the bridge.

The amount of attention and skill to be given to the foundations for any structure depends, first, upon the size and importance of the structure proposed, then upon the loads it must carry, and finally upon its type. To avoid misunderstanding, it may be stated that the word "foundation" is used throughout this bulletin to mean the natural bed or material upon which rest the footings for the piers or abutments for a bridge, or the walls or floor of a culvert. This bed may be either rock, sand, gravel, clay, or any other natural material, or an artificial foundation prepared of logs or other material, or it may be piles driven to support the structure.

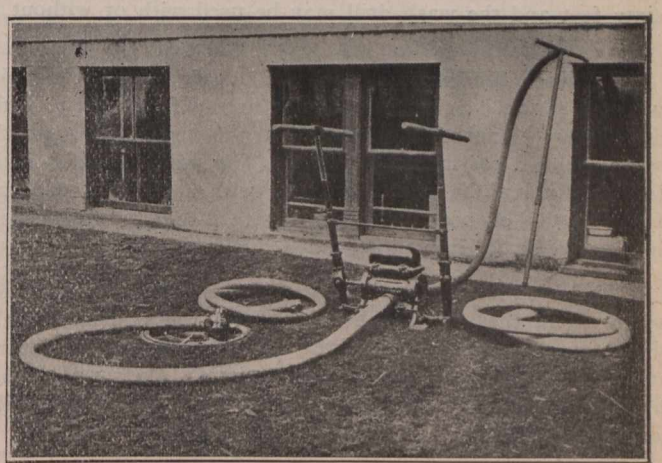

Fig. 1.—Wash-Drill Outfit for Testing Foundations.

For many of the smaller box culverts of spans varying from 2 feet to 8 feet and carrying only ordinary loads, the ordinary earth foundation is sufficient in most cases, with proper protection against undermining by currents of water. Where the streams are sluggish, however, or where the culverts are located in swamps and the foundations are soft and wet, a few logs from 10 to 12 inches in diameter, which are placed below in trenches and upon which the footings rest, add much to the stability of the foundation.

The logs, as shown in Figure 1, may be placed close together, or in many cases it will be sufficient to place them about 3 feet apart, centre to centre. The advantages of this type of foundation are that it distributes the pressure and tends to prevent uneven settlement or tipping of the side walls.

The suitability of foundations for the more important structures can be safely determined only by tests. This can be done best by digging test pits wherever conditions