15

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Notes from Field and Office

Railway chief engineer discusses night work—Railway methods applied to highway-bridge erection—Earth fill six miles long contains 1,700,000 yd.—Pile tests in Chicago—An odd street intersection—Contractors' cost records—Garden-hose finish for concrete pavements—Water lifts sand to filters

Cost of Night and Day Work

By Hunter McDonald*

In connection with the relative cost and efficiency of night work and day work, as discussed in *Engineering News,* Aug. 17, it has been my experience that the ordinary grading contractor uses every means and argument in his power to avoid doing night work when called upon to do so by proper authority. One of his principal objections is that it requires a very good organization to handle a double shift. Furthermore, the ordinary contractor is not equipped with lighting apparatus, which is absolutely essential to handle night work successfully.

My experience, based on railway construction purely, has also been that while the contractor has proceeded to put on a night shift when required, he has not made the proper effort to get the best results. Owing no doubt to his desire not to incur the additional plant expenses, the work has been poorly lighted, and the consequent wrecks to dump trains have materially cut down the output. Contractors also claim that night work cuts down the efficiency of the day force, on account of loss of time in making repairs to tracks or equipment damaged by the night force.

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Under the best conditions of which I have knowledge, I would say that the night shift has had an output of about 85% of the day shift, but the average is considerably lower, probably around 66%. Of course, the season of the year cuts considerable figure. My experience has led me to believe that it is best to insist upon the work being sufficiently covered with plant to enable the contractor to finish within his time limit without the necessity of doing night work, and to insist on night work only as the last possible resort when the work has been delayed for other reasons over which no one has control.

In tunnel work I have found that the night shift makes practically the same progress as the day shift.

Erecting Highway Bridges Under Traffic; Michigan

By C. V. Dewart*

In addition to consultation, preparing plans and general supervision of all highway-bridge work, the Michigan State Highway Department is called upon to plan, build, maintain and pay for bridges of over 30-ft. span on the state trunk-line roads, which constitute a 5,000-mi.

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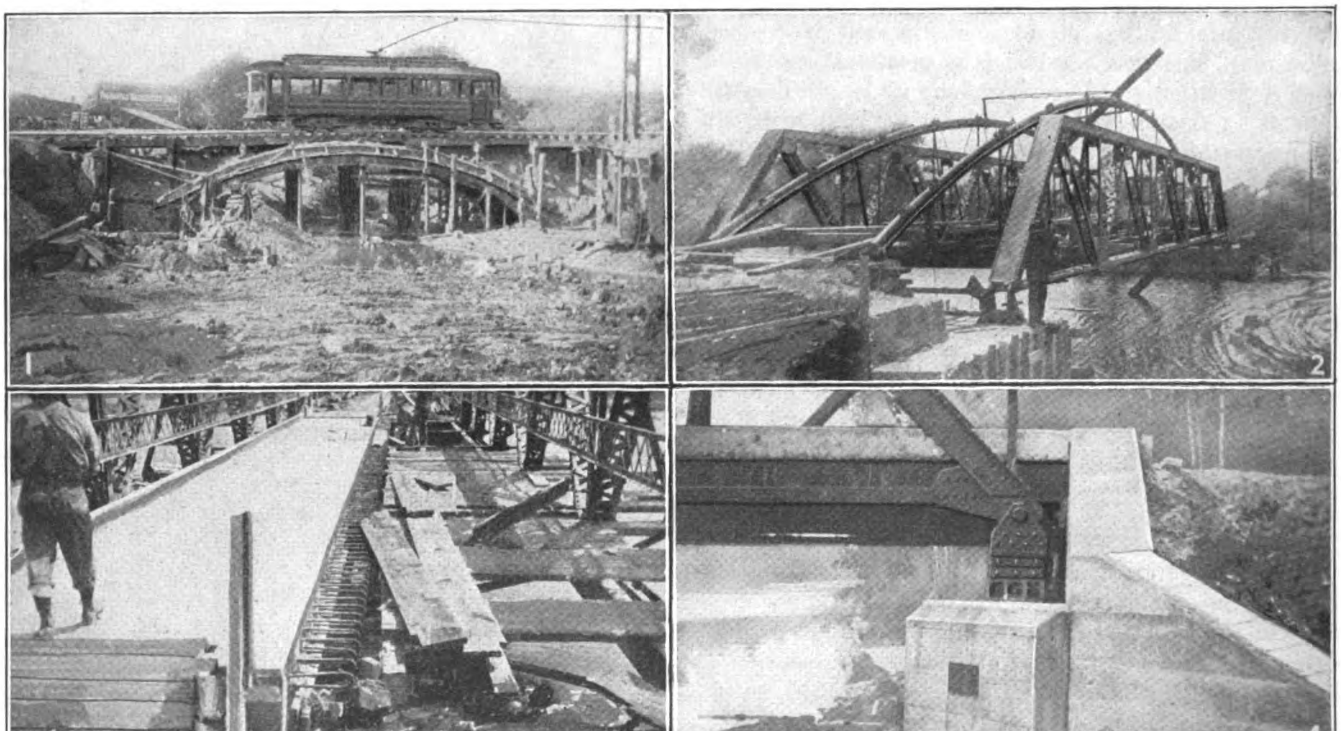

FIGS. 1 TO 4. ERECTING HIGHWAY BRIDGES UNDER TRAFFIC IN MICHIGAN
Fig. 1—Concrete arch erected under traffic. Fig. 2—Steel trusses of new bridge erected outside old bridge. Fig. 3—Concrete floor of new bridge laid half at a time. Fig. 4—Bridge abutment properly designed

system connecting all of the principal cities of the state. During the last three years the state has built (or is building) 80 bridges ranging in cost from $2,000 to $40,000.

The maintenance of traffic on railroad bridges while under reconstruction is general, but until a few years ago the maintenance of traffic on highway bridges under the same conditions was unusual. The trunk-line bridges we have built, with few exceptions, are on main traveled roads, and in many cases, such as the Whitefish River bridge near the town of Rapid River, the bridge under construction is the only connecting link for miles around. Add to this the greatly increased automobile and through traffic, also the fact that when the state does the work the local inhabitants expect more than if they were doing it themselves, and there is reason enough to justify our policy of maintaining travel on all trunk-line bridges. The exceptions to this rule are few.

Maintenance of traffic during construction of an arch can be done by pouring one-half of the arch ring at one time and then turning traffic to the completed half, as illustrated in Fig. 1. This is becoming fairly common in the construction of large bridges. When time is too short to allow proper setting of the arch ring, this method may still be followed by boxing around the supports of the old bridge, where they pass through the arch ring. The full width of the arch ring may be poured at one time, and as soon as it has set sufficiently to carry the load the old bridge supports may be cut off on the line of the extrados, shifted to the arch ring, the holes in the ring poured and the backfill made.

For concrete arches and small-span bridges, however, there is comparatively little difficulty encountered. Generally traffic may be maintained in these cases by grading down the approaches to a short temporary wooden span on one side of the proposed bridge site.

Long-span steel bridges present an entirely different problem. Our pony-truss designs, which are standard for spans from 70 to 100 ft. inclusive, have the trusses placed about 3 ft. farther apart than the ordinary old-style trusses and may be erected complete with the new trusses outside of the old and the new floor system underneath the old.

The trusses in this case may be erected by three distinct methods: (1) By building falsework under each panel point and proceeding in the usual manner; (2) by the construction of temporary supports for the trusses, which are erected one at a time in a horizontal position alongside of the old bridge and then swung into a vertical position (the same set of supports is then used on the opposite side of the bridge); (3) by the use of hangers supported from the top chord of the old bridge the new trusses are erected in their final position without the use of falsework of any kind below, as shown in Fig. 2.

In the second and third cases the floor-beams and lateral sway bracing are swung into place from below. Next all plank and stringers of the old bridge are removed from one-half of the roadway only and stringers for the new bridge placed on this side, maintaining travel on the opposite side of the bridge. Then the old floor system is replaced, traffic restored to this side, the old floor removed on the opposite side and the second half of the floor system completed in the same manner as described for the first half.

As soon as the new trusses are completely riveted, the old bridge may be removed complete or blocked up at the floor-beams and removed piecemeal. The former method is much preferable, however, when there is some place where the old bridge can be used to advantage. It may be relocated on some near-by road of lesser importance crossing the same river, without knocking it down and then reërecting. All this may be done with very little if any interruption to traffic, provided forethought is used in the arrangement of floor planking.

With the old bridge removed and the plank of the old bridge relaid on the new floor joists, it is a simple operation to remove the plank on one half of the roadway at a time, pour the concrete floor on this half, then turn traffic to the completed half of the concrete floor and pour the concrete of the second half. A standard concrete floor with a vertical construction joint along the center line of the road is shown in Fig. 3.

We find that the second and third methods, or some modification of the two, have resulted or would have resulted in a very material reduction in cost of erection for nearly all cases, and in some cases we have found that the third method of erection has cost less with traffic maintained than the first method without traffic.

It is often necessary to erect the new trusses below their final elevation in order that the new floor-beams may be placed without interference to the old floor system. Our standard steel bridges up to 80-ft. span with plate expansion supports have a minimum depth of casting of 6 in., and for spans of 80 ft. and over a minimum depth of casting of 12 in. under the fixed end, or at the expansion end 6 in. under the rollers and 6 in. of geared segmental rollers. By the omission of castings and rollers at the start, from 6 to 12 in. may be gained for erection purposes. Stringers framed into the floor-beams constitute another advantage in this case; the top flange of the floor-beams of the new bridge may be erected in the same plane as the bottom flange of the floor-beams of the old bridge without interference.

All this generally provides plenty of room to complete the erection of the new bridge without jacking up the old bridge and thereby making a very objectionable hump in the roadway during the entire time of erection. The elevation of the old floor is not changed until the new bridge is completely erected. It is then only a matter of a few days to remove the old bridge, relay the wooden floor and jack the new bridge up to its final elevation. It is of primary importance to design the bridge seats in such a manner as to provide plenty of room for the jacks (see Fig. 4).

Too much cannot be said against the usual practice of boxing in or "pocketing" an end pedestal. How much has been preached against this practice, and yet how very few of the abutment seats that have been built recently are of the proper design! The cost is no more; the fault lies either in ignorance or in the total disregard of the requirements of an abutment. "Pocketing" a bridge seat accumulates dirt and corrosion, interferes with erection and maintenance and is altogether wrong from an æsthetic point of view.

With a little care in designing and staking out a bridge, the abutments and piers may be built up complete without in any way interfering with the old bridge or its foundations. This is certainly worth while whenever it can be done.

Notes from Field and Office

Michigan pony-truss highway bridges have inside knee-bracing at every panel point—Hunting leaks in water mains—Construction features used by concrete building firm—Asphaltic-concrete paving at Fort Wayne—Tangent of compound curve—Contractor's daily reports—Station work on the Alaskan Ry.

Standard Pony-Truss Bridges for Michigan Highways

By C. V. Dewart*

The standard pony-truss designs of the Michigan State Highway Department have inside knee-bracing at every panel point. These knee-braces are connected to the vertical posts directly underneath the top chord and have a batter toward the roadway of about 1 on 6. They are connected to the web (and not to the top flange) of the floorbeam. The hand railing is connected to the battered braces as shown by Fig. 1. Many arguments have been advanced against this method of construction, but we believe we have effectively answered all. There is greater weight in the floorbeams, but only in the floorbeams. To offset this we have less weight in inside knee-bracing than there would be in outside bracing because no horizontal member is required in the brace. The added length of floorbeam provides a greater width of roadway, for although the nominal width may be only 18 ft., measured from outside to outside of curb, there is actually about 19 ft. clear width at 3 ft. above the crown of the roadway and about 20 ft. clear width at 6 ft. above the roadway.

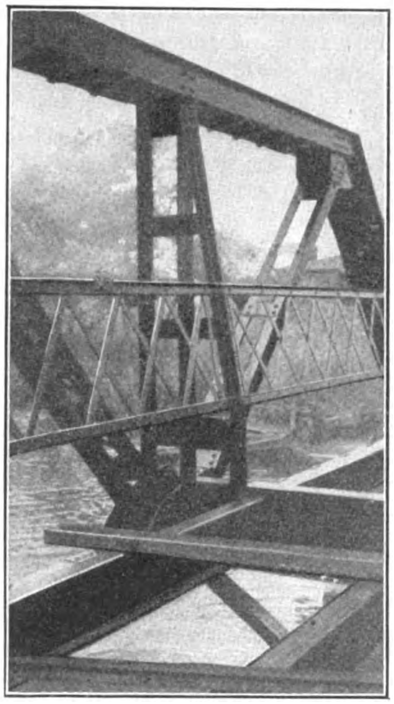

FIG. 1. MICHIGAN STANDARD PONY-TRUSS BRIDGE

It is obvious that any lateral loading and any tendency to sway in the top chord must be conducted to the floorbeams, and the more directly these stresses are transmitted to the floor beams the better. An outside knee-brace is therefore of little or no value unless it is braced through or around the lower chord and connected to both the top and bottom flanges of the floorbeams. Otherwise the floorbeam connections get all the stress and vibration transmitted from the top chord.

The usual specification calls for a sufficiently increased radius of gyration in the top chord, and vertical posts strong enough, to carry the assumed lateral loading. Bridges designed in this way, however, have failed to attain the desired result. The weak spot is in the floorbeam connection. It is impracticable to construct a floorbeam connection that will transfer overturning moment, such as is delivered from the top chord to the floorbeam without knee-bracing. Does it not seem more reasonable to spread the base of the post, or in other words, the points of support of the top chord, to some proportion of the distance from top chord to floorbeam?

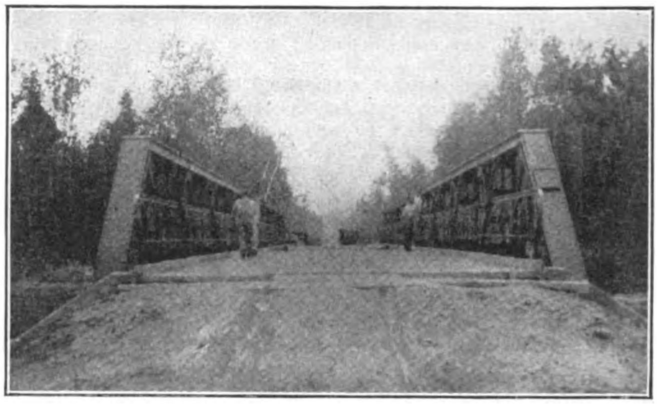

FIG. 2. PINE RIVER BRIDGE, MICHIGAN

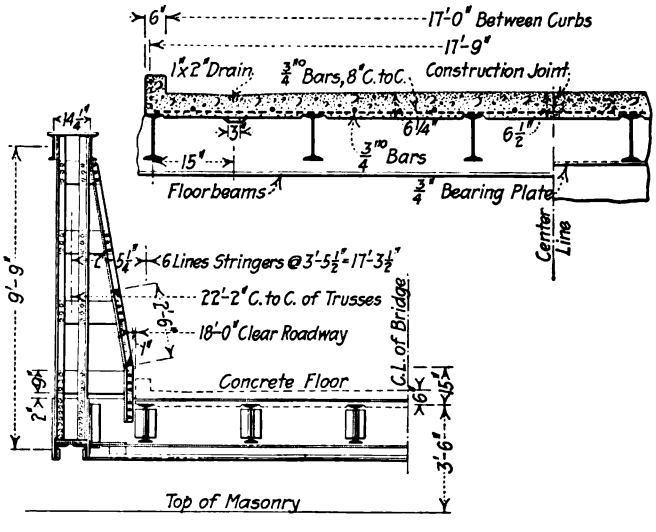

FIG. 3. DETAIL OF KNEE-BRACE

The advantages of this construction are many. Sidewalks may be added without interfering with the design. The bridge is improved in general appearance, and the cramped uncomfortable feeling of driving too close to the truss members is relieved. The lower chord and pedestals of the bridge are far enough away from the roadway so that they do not catch the drip and dirt. On account of the trusses being farther apart, they may be erected outside old-style trusses without interfering with traffic (see *Engineering News,* Oct. 26, 1916).

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