

for careful attention to discover any movement of piers or abutments. Rollers of expansion bearings require careful cleaning to preserve them and allow proper operation. It is advisable to sweep and clean the bridge seats as often as necessary, since a considerable amount of mud usually is washed down from the roadway and, gathering around the steel, tends to induce rapid rusting.

The practical test of observing the bridge during the passage of a heavy load may result in the discovery that the various parts appear to be loose and that the entire structure appears to be working or moving. If there are a number of adjustable members in the trusses and lower laterals, it is probable that the tightening of such, while no load is on the structure, will cure any apparent looseness, while, if the bridge is fully riveted, it is desirable that close attention be given the various joints to see that rivets are still tight. If a number of loose rivets are found, it is best to cut them out and redrive so as to produce a tight joint.

Careful attention should be given to the drainage of the floor. If the bridge has a concrete floor, the drains should extend through and beyond the concrete for a distance of one or two inches and should be so placed that the drip does not strike any part of the steelwork. Drains less than three inches in diameter should not be used and they should be cleaned out at frequent intervals. Where drains have been omitted from a floor, it is desirable that holes be drilled along the curb at the low points and that suitable drains be concreted into place. The proper drainage of the floor prevents the water running off each end of the bridge where it either damages the approach roadway or carries dirt down the ballast wall to litter up the bridge seats. The bridge seats should also be examined, preferably after a rainstorm, to see if they are sloped so as to drain the water and not allow it to gather where it might assist corrosion.

Should any member of the structure be accidentally crippled while in service, the best method of repair requires careful consideration, but as a general principle, it is advisable to entirely remove the damaged part and renew it. Sections which have been subjected to heavy punishment are not reliable and a new member completes the repair in the most satisfactory manner. A slight fire on part of the structure may reach and affect some of the members and yet not cause the collapse of the bridge. The effect of such heat treatment on the strength of the steel is so uncertain that it is very desirable to remove the members which have been heated. Wooden floors of various descriptions are in some cases bad fire hazards and may imperil the entire structure. The danger to structures from fire due to nearby material or buildings is evidently not as great outside the cities, yet it is desirable that such points be kept in mind during inspections. Wood lying around on the ground under the structure, or driftwood in the river, may be the cause of trouble, if allowed to accumulate. A few dollars paid out in clearing away and carefully burning such material is usually well spent. The river above and below the site of the bridge should be inspected to see that the channel is not changing or the banks being carried away in such a manner as to sooner or later interfere with the security of the approach roadway or the abutments. Such an occurrence demands prompt attention and the supply of an ample quantity of rip-rap or the excavating of a new river bed to afford a proper escape for the water.

During repairs to the structures or flooring where traffic has to be maintained on busy roads, adequate precautions to prevent accidents to pedestrians and vehicles should be carefully taken. Proper fencing is imperative and the customary lights provided at night.

In many cases the carrying capacity of a bridge of slender appearance is seriously questioned merely because of its looks. A light steel bridge which was well built, and is properly maintained, is practically speaking, safe to-day to carry any load that can be moved along the highway. The weak part of the entire structure is usually the floor, and if that is sound, a little care is all that is required to pass the load across the bridge. It is thus possible in many instances to so maintain a bridge as to lengthen its working life and postpone the day when the expense of renewal must be considered.

In conclusion, the painting and maintaining of steel highway bridges resolves itself into a large number of small but nevertheless important details which, with proper attention, will result in the appearance of the structures being always pleasing to the eye and the constant care which is given them, will lengthen the life of the steel and prove an economy to the owners of the structure. Our highways are to receive more careful attention in the future than they have in the past and to be in accordance with that evidence of care which the roads reflect, it is imperative that the steel bridges be efficiently looked after and their maintenance kept up to the same degree of excellence.

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ROAD CONSTRUCTION AS GOVERNED BY TRAFFIC REQUIREMENTS.

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TRAFFIC affects the location, grades, width and foundation of a road. It affects the decision as to the nature of surfacing to be selected. It also affects the character and the cost of maintenance. As a matter of public necessity, the roads must be made fit to bear the traffic which passes over them, and which is steadily changing in character and increasing in volume.

The practice of construction and maintenance of roads to-day is of a much more scientific nature than previously. The effects of the modern mechanically propelled traffic, especially in and around cities, requires very careful consideration, and it is left to road engineers to devise ways and means best to deal with it. Despite the change that has taken place in the methods of transport on our roads, the percentage of self-propelled vehicles to the total volume of traffic is still comparatively small, and the difficulty has still to be faced of constructing roads which will serve effectively every kind of traffic.

Construction.—Traffic affects foundations. Many road materials have been unjustly condemned when the real difficulty lay in the foundation and not in the surface material. Surfacing is secondary to foundations. It is the foundation that carries the loads coming on the road surface, where, by peculiarities of the road crust, the strains are more or less distributed at the time they reach the subgrade, and the supporting power of the foundation must be sufficient under the most unfavorable conditions likely to occur to safely resist these strains. Therefore, to determine many of the questions on foundations, it is necessary to know the kind and amount of the strains to be borne by it.

If the traffic is to be local farm and light traffic, the dependence for foundation may be placed wholly on the earth subgrade. To this end, there must be thorough drainage of the soil underlying the road. The surface for such traffic, having regard for foothold for horses, may