

convenient part of the structure in order to facilitate the recording of the action of the paint during its life.

The selection of a paint for steel bridges is a problem that possibly all have been called upon to solve at one time or another. To be satisfactory, a paint must fulfil many exacting requirements which may be enumerated as follows: It must be low in price; it must be readily obtained in convenient quantities and in satisfactory containers; it must completely hide the surface of the steel in two coats; should cement itself together and stick to damp or dry metallic surfaces; should expand and contract without cracking the film; should present a hard, tough outer surface; should be impervious to water or gases; should be unaffected by sunshine, heat, frost, dew or climatic changes; should be unaffected by ordinary mechanical abrasion; should wear evenly; should fail by gradual wear and not by disintegration; should leave a good surface for repainting; should not require an unreasonable amount of skill or muscle in application; should be homogeneous; should dry properly; should not be readily ignited; should have power to absorb and remove moisture or dampness from the metal; should have properties that will prevent corrosive action of traces of water in contact with the metal and should not stimulate corrosion of the steel. In connection with the last requirement it would be well to state that paints made from certain materials have been found to slowly produce rusting of the steel in small patches.

While these requirements are numerous and apparently difficult to fulfil, it is possible to-day to purchase in any locality the necessary ingredients which, when combined, will produce a perfectly reliable paint for steel structures. There are also on the market to-day a number of ready-mixed paints which the manufacturers recommend as a protection for structural steel. For many years a red lead and linseed oil paint has been extensively used for priming and field coats for a large number of bridges. At times there has been a tendency to abandon such coverings of proven merit in favor of more modern proprietary paints, but usually, after unfavorable experience with the newer ideas, a return is made to the red lead. Where objection is made to the bright color of red lead in the finishing coat it is suggested that the third coat be darkened by the addition of lampblack. If pure lampblack is used in the final coat, the life of the paint will not be shortened.

[Mr. Hogarth exhibited four specimens of steel angle sections painted with red lead, each specimen illustrating a different degree of surface deterioration and the variation that may occur in the quality of material built into a structure, emphasizing the necessity for careful inspection.]

Maintaining Steel Highway Bridges.—A steel highway bridge requires the proper careful attention due to that class of structure. Changes are constantly occurring in various parts of its members and thorough semi-annual inspections are imperative if the structure is to continue in a safe condition for public travel.

The inspection in the spring should be undertaken with a view to ascertaining the general condition of the structure and also to lay out and decide on the manner of carrying out whatever work is to be done at the bridge during the following summer. The fall inspection should be made with a view to estimating the cost of whatever repairs may be required during the following summer.

Many instances could be cited where an inspection of a bridge has revealed a serious condition of affairs due to broken sections which, if unattended to, might result in serious damage or complete collapse of the structure. Until recently, many of the structures built were pin-

connected and were provided with tension members composed of square rods with a welded eye at each end. Indifferent workmanship in forming the weld creates a weak spot which, after a few years of service, becomes apparent when the weld breaks open. If there are two bars in the member there is still sufficient strength available to carry the structure pending immediate repairs, but in no case should unnecessary chances be taken and if the inspector is in any doubt as to the ability of the structure to stand up, the best course to pursue is to close the bridge till repairs are completed. The manner in which steel sometimes breaks is very difficult to account for, and frequent inspection is the only way in which the safety of the bridge can be certified to. Steel is the same as any other commercial product and carelessness in manufacture is reflected in the action of the finished article.

The semi-annual inspections should include every portion of the bridge—the handrail, the approaches and the river channel. Attention to the condition of the approach handrails to discover loose or decayed sections is advisable. Notice boards calling the attention of fast travellers to certain laws may be in place, but are in all probability illegible, due to disappearance of the paint. In many cases these boards are still necessary. They should be painted with easily read type and placed conspicuously so as to impress the public and obtain compliance with the stated request. The fact that a notice board cannot be read, usually results in a lack of observance of a very necessary restriction on the speed of horses crossing a bridge.

The trusses should be inspected to see if they are still in line and the chords carefully examined to discover any twists or deflection and ascertain if the camber is true and uniform or irregular. All tension members should have quality of stress in each, tested by springing them with a sharp blow of the hand and particular attention to the joints of such members should be given. The posts and lateral struts should be straight and free from twists. All lateral bracing is to be examined to see that it is straight and tight, and taking such stresses as it should. In some bridges lateral members are adjustable and where such is the case, all nuts had best be tightened to a good full bearing. After the nut is tightened it should be secured by burring the thread of the bolt in two or three places with a centre punch or chisel.

Some of the pin-connected spans are detailed with the floor beams hung from the pins by a "U" bolt. A careful examination should be made to see that all nuts are tight and sound, and threads burred to prevent slackening. Also that no cracks have developed or corrosion taken place in any part of the connection. These connections should be all carefully cleaned since they are usually located in such a manner that considerable debris from the roadway is caught and held against the steel so that water is retained and assists rusting. In pin-connected bridges, any pins which indicate movement should be noted, and nuts should be examined for tightness. Any members having closed sections which catch and retain water should have proper drain holes drilled. Look for loose rods, hangers and braces and other defects of a like character which require adjusting in order that each of the different parts may have proper bearings and carry its proportion of the load. Observe the structure during the passage of a heavy load and note any undue vibration or deflection which, if followed up, may lead to the discovery of a defective part. Carefully examine the connections between stringers and floor beams and floor beam and truss. See that rivets are tight and connection angles sound. The expansion and fixed end shoes and anchor bolts also call