TYPES OF FLOORS FOR LIGHT HIGHWAY BRIDGES.

IN the latest annual report of the Illinois State Highway Commission the question of floors for steel highway bridges is reported upon. The suggestions given concerning them are given below:

The largest item of expense in connection with the upkeep of steel bridges not having concrete or other permanent floors, is that of floor maintenance. Until a few years ago, the floor almost universally specified for country highway bridges consisted of white or burr oak plank, from 2½ to 3 inches in thickness. When first-class material could be obtained at a cost of $25 per thousand feet board measure, such floors proved to be fairly economical if not subjected to heavy traffic. But now it is almost impossible to obtain at any price a good quality of white or burr oak bridge plank.

The lightest concrete floor that can be designed to carry modern traffic with safety weighs 40 pounds or more per square foot, and in order to protect such a floor from excessive wear and to distribute concentrated loads sufficiently so that they will not produce local failure, a wearing surface of gravel, macadam or brick weighing a minimum of 50 pounds per square foot is necessary.

Steel bridges carrying plank floors are rarely, if ever, designed to carry more than the dead weight of the bridge itself, which includes about 12 pounds per square foot for the floor, and a live load of 100 pounds per square foot, provided by law.

To place a concrete floor on a steel bridge, designed to carry a plank floor, would impose, therefore, an additional dead load on the structure amounting to the difference between 90 pounds per square foot, the weight of the concrete floor and wearing surface, and 12 pounds per square foot, the weight of a plank floor, or about 78 pounds per square foot.

The proposed floor must weigh but little more than the floor for which the structure was designed; it must not be unduly expensive, and it must be as durable as possible.

The material which best meets these requirements seems to be timber treated with creosote oil to prevent decay. All woods treated with creosote oil seem to resist decay equally well. Any wood may, therefore, be used which is susceptible to the creosote treatment and which will resist the wear coming upon it.

For existing wood floor steel bridges, located in or near cities, which carry a considerable amount of traffic, it is recommended that a creosote wood block pavement be laid on creosoted pine sub-plank. Such a floor weighs about 30 pounds per square foot. This is about 18 pounds per square foot in excess of the floor weight a majority of wood floor steel bridges are designed to carry. However, as this type of floor is very much smoother and stiffer than the ordinary plank floor, the reduction of vibration due to heavy moving loads is greatly decreased. This is a factor of safety which will balance somewhat the greater dead weight of the structure. However, a careful investigation of the strength of the bridge should be made before a floor of this character is laid.

At present prices for material this type of floor can be laid for about four times the cost of a 3-inch plank floor. If proper materials and workmanship are used, there is little question but that such a floor will last 12 years or more, possibly 25 or 30 years.

For existing bridges in good condition and of proper design, located on roads at some distance from a city, carrying a moderate amount of traffic, a floor consisting of 3-inch creosoted sub-plank on which is placed a wearing surface about three-quarters of an inch thick of fine gravel or stone chips flushed with heavy asphaltic filler will be found serviceable and economical. Such a floor, if properly constructed, will present a smooth, elastic surface which will reduce vibration. A floor of this character weighs but a few pounds per square foot more than a 3-inch oak plank floor and is far more durable. The wearing surface will probably require renewal at intervals of from 2 to 6 years, depending upon traffic conditions. As the wearing surface may readily be renewed by day labor, at a cost of about 50 cents per square yard, the item of maintenance is small compared with the cost of maintaining an untreated plank floor. There is no reason why a floor of this character should not last as long as a creosoted block floor, providing the sub-plank is kept protected from wear by a properly maintained wearing surface.

For existing country highway bridges, in good repair and of sufficient strength, where traffic is light and little wear comes upon the floor, creosoted oak plank with no special wearing surface can often be used. Red oak can be used to advantage for this purpose, as it is readily susceptible to treatment with creosote oil, wears less than a softer wood and will probably last as long, as far as decay is concerned, as any other creosoted timber.

In this connection it is worthy to note that the rate of wear on an ordinary plank floor greatly increases with the age of the plank, owing to the softening of the wood as decay advances. As the creosote treatment protects the plank from decay, a floor of this character will wear better than a floor of untreated material, as the wood remains hard and resistant until decay sets in.

In the light of the above discussion it is, therefore, well to hold in mind the following points:

1. Old steel bridges are rarely, if ever, strong enough to carry with safety a concrete floor.

2. For existing steel bridges in good condition and of satisfactory design, located in cities or elsewhere where traffic is heavy and ordinary plank floors rapidly wear out, it will be found economical to refloor with creosoted sub-plank and creosoted blocks.

3. For existing steel bridges in good repair and of satisfactory design, carrying moderate traffic, but yet where wear is of considerable importance, it will be found economical to use creosoted plank with a bituminous wearing surface.

4. For existing steel bridges in locations where an ordinary plank floor rots rather than wears out, a creosoted plank floor with no special wearing surface will be found economical.

If a proper selection of floor is made, and the material used is subjected to rigid specifications and inspection, this floor should in most cases outlast the steel bridge on which it is placed.

A proposal is on foot to build a bridge across the harbor of North Sydney, Australia, in conjunction with a new underground railway system. This bridge will be the third largest in the world as regards length of span, and the first as regards headway for shipping. The specification provides that it shall consist of nickel-steel cantilevers supporting centre girders, also of nickel steel. The shore arms of the cantilevers will be some 500 ft. long, and the cantilever arms 520 ft. long, the length of the centre girder being 560 ft. The approaches to the bridge will consist of steel arch spans of the three-hinged spandrel braced type.