CONCRETE ROAD CONSTRUCTION*

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CONCRETE pavements present many characteristics totally unlike other forms of the more permanent types of pavement. A concrete pavement has a hard, rigid, monolithic surface and is properly to be classed as sheet pavement. Practically all the other forms of rigid-surface pavement are of block type while all other types of pavement are somewhat resilient. The fact that concrete pavements are composed of large, monolithic slabs, makes it necessary to consider certain features of construction not usually important in other forms of pavement.

The strength of concrete to resist stresses of all character depends on the strength of the matrix or mortar holding the aggregate together, assuming of course, that we use an aggregate of sound, hard particles. The concrete being made of various size particles, it is necessary that none of them be loosened under the action of climatic or traffic conditions.

Preparation of Subgrade

It is practically impossible to formulate specific directions for the preparation of subgrades, that will be of general application. Every section of road involves problems that are complicated by financial, geological and physical conditions, each of which must be treated in conjunction with the completed aim. The necessity, or at least the desirability, of spending more time and money upon thorough preliminary investigation cannot be too strongly emphasized. Such expenditure is in the end a real economy.

The most common cross-sections of subgrade are as follows:—

1. Subgrade parallel to wearing surface.
2. Subgrade crown somewhat less than concrete wearing surface.
3. Flat subgrade. In this case the crown is given by varying the thickness of the concrete. This is the one most generally used.

Whatever form is used, however, the sub-base should be made of uniform texture and should be finished true and kept true to the specified outline—that is, free of tracks, holes and ruts—until the concrete is laid.

Shoulders

Experience in various localities with shoulders along concrete roadways has been variable. This is without doubt due to the variation of traffic, as regards kind and density. Where shoulders will not stand up under the turn-out of traffic along a concrete road, an additional width should be considered, or the use of a crushed stone shoulder is recommended. The width of shoulder to edge of embankment should not be less than 4 ft.

Crown

Unlike some types of pavement, concrete surfaces are undamaged by water unless it finds its way into the subgrade. Theoretically, with perfectly surfaced concrete, only a slight side fall is required. Data that is available would indicate that in case of uniformly thick pavements, the amount of centre longitudinal failure, has varied directly with the amount of crown. With few exceptions, the crowns most generally used range between 1/65 to 1/100 of the width of the pavement.

Grades

There would appear to be no reliable information on the relative slipperiness of concrete pavements. Generally speaking, concrete road is less slippery than other classes, especially after only a slight rain has fallen. It would appear that it is a matter of placing the concrete on the grades rather than a problem of grades.

Thickness

Specifications generally call for concrete roads 6 to 8 ins. thick. It should be borne in mind that owing to the monolithic structure of concrete, it is necessary to have the cross-section true to grade so that additional concrete need not be employed to fill the depressions and uneven places in the subgrade.

Handling and Hauling Materials

Materials to be handled for concrete road construction are as follows: (1) Gravel and crushed stone; (2) sand; (3) cement; and (4) water.

Gravel, crushed stone and cement are usually handled by wagon, motor truck or industrial railway, all of which prove satisfactory within their limits. The difference in cost ordinarily seems not great, but there may be conditions that justify a choice of one method in place of the others.

Water, it should be remembered, is used for at least three essential purposes in building concrete roads: (1) To wet the subgrade; (2) to mix the concrete; (3) to keep the concrete moist for several days after placing.

The average requirements based on available figures would indicate that approximately ¼ to ¾ of a ton of water is required to construct 1 cu. yd. of concrete.

Aggregates

Success in the construction of concrete highways will largely depend upon the materials used. All roads, permanent types or otherwise, must be designed and built to withstand three different destructive agencies—traffic, weather and structural stresses. The wearing resistance of concrete roads subject to given conditions of traffic and weather, will depend upon the following factors: (1) The properties of the concrete materials; (2) proportions and consistency of mix; (3) thoroughness of mixing; (4) method of placing; (5) surface finish conditions of seasoning; and (6) age of concrete.

The aggregate constitutes 75% to 85% of the material in concrete roads, hence the resistance to weather and traffic and the final integrity of the structure depend largely on the aggregate and the way in which it is incorporated.

Sand

For concrete road construction generally, the sand that is used is much coarser than that used in building construction. The purpose of using coarse sand is not only to obtain strength and density, but to prevent the formation of a thin layer of fine sand and cement near the surface.

Sand should be free from vegetable or organic matter. Frequently sand will be entirely satisfactory in appearance and yet be worthless for concrete. Defective sand may be taken from too near the surface of the deposit, or a quantity of vegetable matter may be allowed to mix with the sand due to carelessness in regard to keeping the pit clean. In most cases, deposits show a distinct line of demarcation between the section containing vegetable matter and that of the clean aggregate, and the former should be entirely removed before an attempt is made to load the material.

The voids in aggregates are largely a function of the shape and grading of the particles. Low voids should be secured, since the strength and the working ability of the concrete will thus be greatly improved. A well-graded natural sand, with coarse aggregate screened out, will show voids as low as 25%; in a poorly graded sand, the voids may be as high as 38%. The voids in crushed stone frequently run to 50%.

Gravel

The use of gravel in the most recent specifications calls for screening into sand and gravel, then recombining in proportions according to voids. Pit-run gravel generally contains sand in excessive proportion to gravel. If gravel contains 40% sand and very rich mix is used, say, 1: 3½, a fair concrete can sometimes be produced, but it is always cheaper

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