

Subgrade.—It is recommended that if possible the subgrade for a concrete pavement be not trenched out and that it be kept higher than the berms, so as to provide drainage directly to the side ditches.

Very careful attention should be given to the rolling of the subgrade. It is recommended that a macadam type of roller be used, weighing not less than 10 tons. If the rolling at any time causes the subgrade to become wavy, the rolling should be stopped immediately over the wavy parts, and the soft material investigated. In clays this is almost always due to moisture and unless it is possible for it to dry out by the sun and wind without delaying the work, it should be removed and replaced with dry clay or other suitable material that can be rolled in a satisfactory manner. If any depressions develop they should be filled with acceptable material as the rolling progresses. Sand and sandy soils require a minimum amount of rolling.

It is recommended that the rough grading be completed very closely to the intended cross section of the subgrade and to the full width of the shoulders. Avoid shallow filling without plowing. Avoid filling narrow, deep ruts without plowing and disking. The finished subgrade immediately ahead of the concrete should be corrected to proper cross section, using a template.

Where the method of depositing the aggregates on the subgrade is followed, the subgrade should be completed fully in sections not exceeding 600 ft. in length immediately before the aggregates are deposited. The surface should be brought to true cross section, using a template or other acceptable method. The roller should be kept in constant operation while the aggregate is being delivered. Any ruts or irregularities caused by the handling of the aggregates should be filled up and thoroughly tamped. Wherever possible, hauling over finished subgrade with teams or motor trucks should be avoided.

Where necessary, to avoid formation of an objectionable layer of dust, the subgrade should be sprinkled in advance of placing materials.

Mixer.—The mixer should be of a standard paving type having a capacity of at least 2-bag batch, commonly known as size No. 14.

The mixer should be equipped with a boom and bucket or some other mechanical device that will deliver concrete of a proper consistency, also with an automatic timing device and a device that will accurately measure the water for each batch.

Water Supply.—In addition to the general recommendation of the American Concrete Institute recommended practice, the water supply should be free from injurious substances, duplicate pumping machinery should be provided, booster pumps should be provided on long pipe lines, and in all pipe lines there should be provided unions at intervals not greater than 1,000 ft. Tees for supply water to the mixer and for sprinkling should be placed at intervals not greater than 100 ft.

Time of Mixing.—Materials should be mixed at least one minute after the entire batch is in the drum. The speed of the drum should be not less than 12 revolutions per minute.

Side Forms.—Steel side forms should be used and after the forms are set the joints should be inspected carefully, using a straight edge to insure proper horizontal and vertical alignment.

Placing Concrete.—The operation of depositing, spreading, and finishing the concrete should be as nearly continuous as possible for the full width and thickness of the pavement. When delays, of sufficient length to permit the concrete deposited to attain initial set, are necessary a suitable header should be placed at right angles to the road and the concrete finished to this header to true elevation and cross-section.

The concrete may be transported from the mixer to place on the subgrade in any convenient manner which avoids the segregation of materials. Any device or method of operation which tends to segregate the materials in such a manner that later operations do not completely eliminate such segregation should not be permitted.

Placing Concrete in Cold Weather.—Every effort should be made to arrange for closing concrete road work in the fall

or on about such date as the weather bureau reports for the locality for the past ten years indicate the probability of temperatures materially below the freezing point. If circumstances necessitate continuing work for a short period after freezing weather is likely to occur, precautions should be observed which will insure positively that the concrete may not become frozen under the most extreme conditions of temperature for the period, as indicated by weather reports for the past ten years. Concrete should be protected absolutely from freezing by suitable means for at least seven days after placing.

Expansion Joints.—Expansion joints should be used only in specific cases, such as junctions between the pavement and other fixed objects.

Expansion joints when used should consist of either high grade wool felt or a fibrous material combined with a coal tar or asphalt compound. The filler should contain, by weight, not more than 8% of mineral matter and not less than 5% nor more than 25% of fibre.

Contraction Joints.—Contraction joints should not be used. Construction joints should be made at the end of each day's work or when mixing is stopped for any reason longer than one hour.

Reinforcement.—For pavements up to 18 ft. in width with good foundation the value of any practicable amount of reinforcement is questionable.

For pavements over 18 ft., and especially where foundations are not thoroughly satisfactory, reinforcements, mainly in a transverse direction, may be used to advantage.

Where reinforcement is used it should be wire mesh or separate bar reinforcement, not less than 40 lbs. per 100 sq. ft., and the proportion of transverse to longitudinal steel should be not less than 3 to 1.

The reinforcing should be placed not less than 2 in. from the finished surface of the pavement. Adjacent widths of the fabric should be lapped not less than 4 in. when the lap is made perpendicular to the centre line of the pavement and not less than 1 ft. when the lap is parallel to the centre line.

Machine Finish.—When mixtures of relatively dry consistency are used, such as those necessary to secure maximum strength as far as such strength is determined by the water content, mechanical strikers and tampers should be used. Machines should be so constructed and operated that they strike off and thoroughly tamp the concrete. They should be so constructed that they may be readily operated over the same area repeatedly. Machines to serve the purposes above indicated should be subject to the approval of the engineer. The mechanical device or devices used should be so made and operated as to leave the finished slab true to grade, crown, and surface and absolutely free from porous places.

Hand Tamping.—If a mechanical finisher is not used and the consistency of the concrete is to be as above described, after spreading the concrete should be thoroughly hand tamped by means of a tamper of the nature of a strike board operated by one or two men stationed at each end of the tamper on opposite sides of the roadway. Hand tamping should be vigorous and sufficient to consolidate the concrete in such a manner as to close all voids. The hand tamper should be followed by a final strike board and all operations carried on in such a manner as to leave the surface behind the final strike board true to grade, crown, and surface, and absolutely free from porous places.

Roller and Belt Finish.—If a medium consistency is used, the concrete should be spread, agitated, and tamped in such a manner as to insure positively the avoidance of stone pockets or porous places. It should be struck off true to grade, crown, and surface. It should then be rolled by a light hand roller of approved design operated in such a manner as to remove the surplus water and leave the surface true to grade and crown.

When hand methods of striking and tamping are used the final finishing should be executed by means of an approved belt operated in such a manner as to leave the pavement true to crown and free from waves, ridges, depressions, or other irregularities and with a uniform mat surface.

Curing.—As soon after finishing as may be possible, without marring the surface, the slab should be covered with