

## **304 CEMENT TREATED BASE**

Cement treated bases are used to improve the quality and strength of a road base. Cement treated base (CTB) has sufficient cement content to develop considerable cohesion and strength.

The strength of the cement treated base should be kept within designated strength limits. Slabs with strengths higher than specified develop wider shrinkage cracks, and the cracks are usually reflected through any bituminous pavement that is placed immediately over it. Excessive shrinkage cracks should be corrected before placing any top layers. Slabs that are too weak may not have the necessary load carrying ability.

To reduce the potential for the development of shrinkage cracks, a microcracking process should be implemented which will provide relief from the accumulation of significant tensile stresses in the CTB.

Regardless of the method of construction or the type of equipment provided, the construction of cement treated base should include:

- Properly shaped and compacted subgrade (the Standard Specifications require the subgrade to be finished in reasonably close conformity to the lines, grades, dimensions, and cross sections shown on the project plans or established by the Resident Engineer; also check the tolerance specifications)
- Uniform distribution of the cement in the aggregate
- Uniform and rapid mixing with proper moisture content
- Prompt laydown and compaction to specified uniform density within the specified time limits without compaction planes, and with a surface conforming to smoothness tolerances
- Prompt application of an effective curing seal without allowing the surface to become dry
- Microcracking after approximately two days of curing
- Maintenance of the curing seal

To achieve these results, it is necessary that sufficient equipment is provided in good working order and the contractor's personnel and ADOT Inspectors are well instructed in their responsibilities.

A wide range of aggregates and soil aggregate mixtures may be used for cement treatments. Materials that contain large amounts of clay or silt require excessive amounts of cement to develop desirable strengths and are very difficult to mix. Furthermore, extremely clean granular materials normally require excessive amounts of cement for binding purposes.

### **304-3 Construction Requirements**

#### **304-3.02 Mixing**

##### **(B) Batch Mixing**

The Standard Specifications require a stationary mixing plant. Occasionally, the Special Provisions will allow road mixing. When the stationary plant mix method is used, adequate facilities must be provided for efficiently storing, handling, and proportioning the materials. The contractor may provide either a batch type plant or a continuous mix type of plant. Either type is satisfactory provided the plant is in good condition and properly adjusted. The mix shall be observed as it leaves the plant to ensure that the color and grading is uniform. The Resident Engineer and the Inspector should give the contractor every reasonable assistance, but the responsibility is on the contractor to provide a mixture that is uniform as to grading, moisture, and cement content.

The mixing paddles and mixing chamber should be cleaned daily to prevent a build-up of hardened material that would adversely affect the efficiency of the mixer.

It is desirable, especially in hot, windy weather or when humidity is low, to place more water in the mix than the theoretical optimum. The extra water is used to offset the loss of moisture which will take place before compaction begins. However, this must be done carefully as relatively small amounts of water in excess of the optimum have serious effects on ultimate strength and stability of the base.

### **(C) Continuous Mixing**

Where road mixing is used, it is essential that proper amounts of aggregate are placed and that the aggregates are uniformly distributed along the roadway. When aggregates are placed in windrows, the windrows must be accurately sized before mixing to ensure proper proportioning of the cement, aggregate, and water. Care must be taken in sizing each windrow so that the mixer will be able to handle the entire windrow without difficulty. A continuous "V" ditch shall be cut in the top of each windrow to receive the cement. This prevents wasting over the sides of the windrow and minimizes cement losses that may occur from wind.

There should be sufficient moisture (without exceeding optimum) in the aggregate before spreading the cement to prevent loss of the cement through the voids between the aggregates.

When the aggregate is spread uniformly over the roadbed and mixed with a flat-type road mixer, the cement should be spread with a spreading device that will lay the cement over the entire surface uniformly. Cement should not be spread when the wind will cause cement loss.

When bulk cement is used, roofing paper or a trough type device should be placed on the material ahead of the cement spreader to occasionally check the cement spread. The cement spread should be checked when the cement level in the dispensing unit varies to determine if that affects the spread. When the traveling mixer is the type that does not elevate the aggregate off of the subgrade, frequent checks should be made to determine that the materials are being mixed uniformly and to the proper depth. When a flat-type mixer is used, samples for strength determination shall be taken occasionally at different depths.

When the mixture is produced in a stationary plant, suitable haul vehicles must be provided to make certain that the mixture arrives at the point of deposit without excessive moisture loss or segregation. Covers shall be provided when deemed necessary by the Resident Engineer. The laydown equipment should be ready to receive and lay the mixture as rapidly as possible.

When the mixture is produced by a single pass or multipass travel plant operating on the roadway, the length of the sections must be controlled so that the time lapse between the spreading and compacting on adjacent lanes will not exceed the time permitted.

To form a construction joint, it is generally advisable to spread the fresh mixture slightly above the desired grade, and then trim to that grade after final compaction. It is not permissible to raise the grade by placing a thin layer of mixture on a previously compacted base. Thin layers will not adhere and will form planes of weakness.

### **304-3.03 Compacting and Finishing**

If compaction has distorted the joint on a previously laid section, the material shall be cut back to a vertical cross section before the next section is placed.

All joints are to be cut vertically and into solid material. When preparing a joint in hardened material, it may be necessary to use hand methods to trim the joint.

Any moisture loss during the operation, as indicated by graying of the surface, shall be replaced promptly with fog sprays of water as often as necessary to maintain the proper moisture content in the mixture. It is best to maintain a constant moisture condition by regular applications rather than allowing the material to

surface dry before rewetting. Sprays that deliver water with such force, as to wash the cement off the aggregate, shall not be permitted.

Pneumatic rollers or vibratory compactors are considered best for compacting granular materials. Sheepsfoot rollers, followed by pneumatic rollers, are satisfactory only if the material is such that the sheepsfoot rollers will "walk out" in a reasonable number of passes. This will depend on the grading and plasticity of the aggregate and the unit weight on the feet of the roller. Sufficient tests are to be taken to ensure that the specified density of the mixture and specified strengths has been attained.

The frequency of sampling and testing should be in conformance with the Sampling Guide. However, in the early stages of the work, it is advisable to sample more frequently than is required. Finishing within contract tolerances shall be done promptly after the compaction.

To a great extent, the riding quality of the finished pavement depends on the smoothness of the cement treated base. Therefore, care shall be exercised in the spreading and trimming of the base and in checking the surface of the base.

All transverse joints should be tested with a straightedge and the results documented. Any locations in the surface that appear to be high should be checked with a straightedge and cut to proper grade before hardening of the base occurs.

Low areas cannot be corrected except by placing additional thickness of material in the overlying course. Thin lifts and feathered edges are not permitted, so removal may be warranted.

Proper spreading operations will keep the trimming to a minimum. After final shaping and compacting, the surface should be dampened and trimmed lightly, placing the trimmed material into the next lane or wasting it on the shoulders. A final pass should be made with the pneumatic or smooth-wheel roller. Normally, when spreading with blades, the longer the length of spread, the smoother will be the riding surface.

The strength of a cement treated base is affected by the density obtained. The density obtained depends on having the proper moisture content in the mixture at the time of compaction, followed by prompt and adequate compaction with the correct type and weight of the compactor. An excess of moisture may cause a spongy condition to develop under the roller. If this condition develops, a check should be made to determine if there is an excess of moisture in the base or in the subgrade under the base. Any spot that might show a spongy condition because of excess moisture shall be opened to allow the excess moisture to evaporate. Traveling mixers and water distributors should be checked for leaks that might cause wet spots in the base. Moisture determinations should be made at frequent intervals during the period of mixing, laying, and compacting.

The Standard Specifications require a maximum time lapse allowed between the time water is added to the aggregate/cement mixture and the time of final compaction. This time limit is to be strictly adhered to and very important to the strength and durability of the treated base.

### **304-3.06 Curing Seal & Microcracking**

As soon as the surface has been trimmed and given the final compaction pass, the bituminous curing seal should be applied. If for any reason the curing seal cannot be applied immediately, the surface must be kept damp by frequent applications of a fine spray of water until the curing seal is applied. A damp surface, but without any free standing water, is desirable at the time of applying the bituminous curing seal. Deep penetration of the curing seal into the cement treated base is not desired. Any traffic that would cause a pick-up or a break in the curing seal should not be permitted during the curing period of three days. If traffic should inadvertently enter onto a fresh seal and cause breaks in the seal, repairs should be made promptly.

The contractor should perform microcracking approximately two days following completion of compaction; wait up to four days if the average daily high temperature is 60°F or less. Microcracking is performed with a heavy steel drum vibratory roller operated at high frequency, high amplitude, and at a low speed for at least three passes. Additional passes may be necessary so that fine and closely spaced cracks are observed on the surface, but not to the extent that the surface becomes broken and/or displaced. Observe that adequate moisture remains present and the curing seal is re-applied as necessary to allow the CTB to heal.