

# Table of Contents

## CHAPTER 3: SUBGRADE, SUBBASES, and BASES

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### **300 GENERAL**

#### **301 LIME TREATED SUBGRADE**

- 301-2 MATERIAL
- 301-3 CONSTRUCTION REQUIREMENTS
  - 301-3.01 PREPARATION OF ROADBED
  - 301-3.02 APPLICATION OF LIME
  - 301-3.03 MIXING
  - 301-3.04 COMPACTION AND FINISHING
  - 301-3.06 SAFETY PROGRAM

#### **302 CEMENT TREATED SUBGRADE**

- 302-3 CONSTRUCTION REQUIREMENTS
  - 302-3.03 MIXING

#### **303 AGGREGATE SUBBASE AND AGGREGATE BASE**

- 303-2 MATERIALS
- 303-3 CONSTRUCTION REQUIREMENTS
  - 303-3.01 PLACEMENT
  - 303-3.02 COMPACTION
  - 303-3.03 FINISHING
  - 303-3.04 CONTRACTOR QUALITY CONTROL

#### **304 CEMENT TREATED BASE**

- 304-3 CONSTRUCTION REQUIREMENTS
  - 304-3.02 MIXING
  - 304-3.03 COMPACTING AND FINISHING
  - 304-3.06 CURING SEAL

#### **305 LEAN CONCRETE BASE**

- 305-3 CONSTRUCTION REQUIREMENTS
  - 305-3.08 PLACING AND FINISHING
  - 305-3.09 CURING
  - 305-3.12 OPENING TO TRAFFIC

#### **306 GEOGRID BASE REINFORCEMENT**

- 306-3 CONSTRUCTION REQUIREMENTS
  - 306-3.04 GEOGRID PLACEMENT

#### **307 GEOCOMPOSITE EDGE DRAIN**

- 307-3 CONSTRUCTION REQUIREMENTS
  - 307-3.04 CONSTRUCTION METHOD

### **REFERENCES AND ADDITIONAL INFORMATION**

#### **BLANK FORMS**

There are no blank forms associated with this chapter at the present time.

### **300 GENERAL**

A highway pavement is said to be only as good as the base under it. This material is generally of lower quality than any course placed over it, but it still carries and distributes the wheel loads. The need to be concerned with its quality and finish is very important.

The thickness of the future pavement is determined by the soil-support capabilities of the underlying subgrade. The soil-support value of this material can be found in the Final Materials Design Report.

Verification testing of the subgrade material by the field office should be done quickly so that possible design changes in overlying structure sections can be analyzed. Design adjustments at this time could be very expensive. Early verification of the subgrade will provide the needed time to consider all options so that quality versus economy can be evaluated.

When the Contractor is working a pit or quarry, quality control is the Contractor's responsibility. Nevertheless, The Resident Engineer (RE) should be aware of the methods used to work the pit and produce the materials.

Most material sources contain materials that should be avoided or wasted. Blending or selection of material from various areas of the source may be required.

The Resident Engineer cannot direct that a Contractor furnished source be worked in a particular manner, but can advise the Contractor when the methods or materials may not produce an acceptable product. Comments of this type should be supported by test results.

The subgrade will be finished using natural materials. However, it may be treated with lime or cement if conditions require. Cement is normally used for the binding agent when the subgrade materials are granular, or have a very low P.I. content. In cases of high P.I., or higher degree of clay particles, lime would normally be used as the binding agent.

Geo-composite materials are being used favorably by the department throughout the state to achieve acceptable subgrade stabilization. Approval should be obtained from ADOT Materials Group prior to using geo-composite materials. There are many different types of geo-composite materials. ADOT Materials Group will select the proper geo-composite material for your application.

The time needed to check the grade for acceptance usually depends on the Contractor's method of operation. Checking grade for compliance with finishing tolerances can usually be done rapidly if it has been previously checked or string lined by the Contractor. However, the time required to check subgrade material for design acceptance (PI and material passing a #200 [75 $\mu$ m] sieve) and to decide whether design changes are necessary could cause a delay in the acceptance of a section of subgrade. The Contractor should be kept informed of subgrade test status in order to modify the operations if necessary.

If at any time that hauling equipment leaves wheel impressions due to excessive moisture or drying, the subgrade needs to be refinished and re-compacted. It may also be advisable to retest for compaction.

All major work needed to complete the roadway to the design cross section should be completed before the subgrade is accepted. Major work includes operations that will cause re-excavation within an area where the base or pavement will be placed, or operations that will result in contamination or disturbance of the base or pavement.

Examples of work that should be completed prior to aggregate base placement include:

- all cross drains and edge drains;
- all storm drain pipes;
- all conduit crossings for electrical, landscape irrigation, and freeway management;
- system components; and
- all utility relocation work.

Exhibit 300-1 shows a typical pavement section.

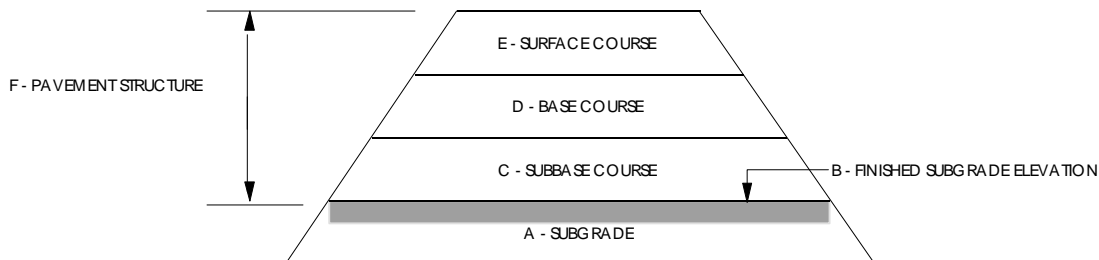
### Finishing Tolerances

The standard specifications will provide the allowable tolerances that must be met by the Contractor in order for the Resident Engineer to accept the base or subbase work. The Inspector and the Contractor should string line the grade together for acceptance. Tolerances may vary depending upon the type of surface being placed (i.e., Portland cement concrete pavement or asphaltic concrete pavement).

### TYPICAL PAVEMENT SECTION

- A. Subgrade - The roadbed materials beneath the pavement structure. May be constructed from existing project materials or from imported borrow.
- B. Finished Subgrade Elevation - The top prepared surface of the subgrade.
- C. Subbase Course - One or more layers of specified material of design thickness, placed on a subgrade to support a base or surface course. A subbase is not often used.
- D. Base Course - One or more layers of specified material of designed thickness, placed on a subbase course or a subgrade to support a surface course.
- E. Surface Course - The upper portion of the pavement structure consisting of a mixture of mineral aggregates and bituminous material or Portland cement concrete. This includes all wearing courses (e.g. asphaltic concrete friction course).
- F. Pavement Structure - The combination of subbase course, base course, and surface course placed on the subgrade to support the traffic load.

Exhibit 300-1. Typical Pavement Section



## **301 LIME TREATED SUBGRADE**

The subgrade may be treated to improve its ability to support traffic loads. The improved load carry capability occurs because the lime admixture reduces the volume change characteristics and plasticity of the soil.

### **301-2 Materials**

The Special Provisions will specify which type of lime to use. Two kinds of lime may be used for lime treatment: dry hydrated or commercial (granular or pelted) quicklime.

Dry hydrated lime has had water added and chemically combined. Quicklime has not been combined with water.

The Standard Specifications allow the use of lime from different sources, but not from different sources to be mixed. The problem with mixing lime from different sources is that they may react differently and result in non-uniformity. Hydrated lime and quicklime cannot be mixed together, even if they are from the same source, because of the very different water demands, curing time, and general handling procedures.

Whatever kind of lime is used, it must be kept dry and free flowing. Storage time should be as short as possible.

### **301-3 Construction Requirements**

#### **301-3.01 Preparation of Roadbed**

Before adding lime, the subgrade material to be treated is scarified, pulverized, mixed, and windrowed or re-laid. It may be necessary to remove oversize material (see Standard Specification Subsection 301-3.01).

Windrows should be sized so that the mixer can easily process all the material at once. This may mean that several windrows will be needed. Running the mixer at its capacity limit, generally, means the mixer has to slow down to achieve thorough mixing. Even with the slow down, a nonuniform mix may result.

#### **301-3.02 Application of Lime**

The Special Provisions will specify the application rate for adding lime to the treated material. Whether applied to a windrow or on the shaped grade, the lime is applied by a mechanical device that can be adjusted to provide the correct spread within 10% of the amount specified.

Favorable weather is very important to the process. Cold weather will slow the reaction of the lime, and freezing will deprive the mix of the water needed. Rain can result in too much water that can either stop the process by dilution or wash out the lime. Windy conditions may cause safety and environmental problems especially when quick lime is used.

#### **301-3.03 Mixing**

Water is to be added only through the mixing machine so that optimum moisture can be closely controlled.

Quicklime needs more water than hydrated lime because the larger particles have to slake and become fine enough to hydrate. Slaking is the sloughing and falling apart of large pieces until only a fine powder results. A curing period is often necessary.

The tolerance specification for the lime applied should be followed closely because the benefit of adding extra lime is not proportional to the amount added. A minor increase is unnecessarily expensive without a proportional increase in quality. A minor decrease in the lime greatly decreases the quality.

After mixing and laying, the finished subgrade is to be kept moist (not sloppy wet) until the bituminous curing seal is applied. The cure should be applied as soon as possible.

All traffic, including the Contractor's and ADOT's, must be kept off the treated area for three days.

### **301-3.04 Compaction and Finishing**

Lime treated material should be compacted to a density of at least 100 percent of the maximum density unless the Special Provisions specify otherwise.

### **301-3.06 Safety Program**

Both kinds of lime must be handled carefully because they can cause severe chemical burns, especially to the eyes. The Standard Specifications require the Contractor to have first-aid treatment available. The minimum precautions are described in the Standard Specifications.

The Resident Engineer is responsible for providing the same first-aid facilities for ADOT employees. If a satisfactory arrangement can be worked out, it is acceptable for ADOT personnel to use the Contractor's safety facilities.

## **302 CEMENT TREATED SUBGRADE**

The specification requirements and construction practices related to cement treatment are similar to those of lime treatment.

### **302-3 Construction Requirements**

The Special Provisions will specify the application rate for adding cement to the treated material. Cement must be applied by a mechanical device that can be adjusted to provide the correct spread within 10% of the amount specified.

Cement treatment differs from lime treatment in the following areas:

1. The amount of cement that can be spread is limited to an area that can be mixed and compacted in a half-day work shift. This restriction is related to the rate at which cement will hydrate and set up and should be strictly adhered to.
2. The words related to thoroughness of mixing are different, but both specifications promote uniformity. The cement specification warns of cement balls. They are to be eliminated by continuing the mixing of the cement until all the balls have been broken.
3. The cement treatment specification has a limitation of 2 1/2 hours of time that can elapse from the time water is added to the final compaction and trimming. This time restriction must be complied with and is related to the rate at which cement will set up.
4. There is no delay allowed for the application of curing seal on a cement treated subgrade. Prompt sealing is important to preserve the moisture needed for continued hydration. Also, rapid repair of a damaged curing seal or treated subgrade is stressed. Only light construction traffic is permitted on the curing seal. This means that it cannot be used as a haul road.
5. Lime is a greater safety hazard than cement. Lime requires a detailed safety program to be reviewed and approved by the engineer.

Cement treated subgrade is more sensitive to moisture. This means that not only is the curing seal important, but care must be taken to prevent over wetting during the mixing process.

#### **302-3.03 Mixing**

Do not allow the mixer to be overloaded. Mixers are most efficient when operated at the rated mixing capacity. Attempts to force a little more in because the windrows are too large are self-defeating. Either a non-uniform mix will result or the mixing time will be increased to more than it would have taken if windrows were properly sized.

## **303 AGGREGATE SUBBASE AND AGGREGATE BASE**

### **303-2 Materials**

The Special Provisions may allow use of salvaged asphaltic concrete or Portland cement concrete materials for aggregate subbase and aggregate base. Requirements for salvaged materials are not the same as Standard Specifications for aggregate subbase and aggregate base. The contractor may request use of salvaged materials on a project where specifications were not included in the Special Provisions. A copy of the normal requirements can be obtained from Contract and Specifications Section. If Special Provisions do not include salvage material specifications, then the engineer should contact Materials Group before initiating a Supplemental Agreement to allow use of salvage material for aggregate subbase and aggregate base.

All material sources will fall into one of the following categories:

- Department Furnished Source,
- Contractor Furnished Source, or
- Commercial Source.

When the Contractor furnishes pits, the Resident Engineer has the responsibility to approve the source in writing. Conditions for the Resident Engineer's approval are detailed in Section 1001-4 of the Standard Specifications.

The Resident Engineer is required to observe the Contractor's sampling of the pit and may furnish general comments about any special treatment or restrictions. The Contractor is responsible for both the quality and quantity of material in their own pits, but the Resident Engineer is expected to monitor the pit operations and assist the Contractor in producing a quality product.

### **Stripping Pits**

When clearing or stripping of a pit is required at a Department Furnished Source, the Resident Engineer should direct where the waste is to be placed. Stripping may be deposited beyond the area intended for use, but not beyond the pit right-of-way boundaries. A survey should be performed to establish pit boundaries beforehand. Some material sources may have environmental restrictions that are shown in the licensing agreement. See the Standard Specifications for final placement of stripping.

The crushing plant should not be erected over a portion of the pit containing usable material unless there is a large surplus of material in the pit area. It is the responsibility of the Contractor to select a location that will enable them to produce the quantities required.

### **Haul Roads**

When the Contractor prepares an environmental statement for an aggregate source, all haul roads must be included. No other roads are to be used for hauling or access.

Haul roads are to be kept to a minimum and must be located in such a manner as to cause the least amount of damage to the natural vegetation. In order to promote the best possible public relations, the owners of all lands traversed should be contacted before actual work in any pit or on any haul road is started. Fences are not to be cut or gates left open without the owner's permission. After completion of the pit use, the pit and haul roads should be cleaned up, and all damages repaired as required by the specifications, pit agreements, and the owner's requirements.

When the Contractor furnishes the pit or a private pit is obtained, the Contractor is expected to provide evidence in writing that the owner is satisfied with cleanup and/or restoration work.

### **Inspection of Aggregate Production**

In the production of subbase and base course aggregates, if for any reason it is deemed advisable to depart from the requirements of the Standard Specifications or Special Provisions, a supplemental agreement shall be submitted. If it is found that the grading specifications or some other test requirements cannot be met, the District Engineer and Materials Group shall be advised without delay. Even one day's delay could be expensive, due to the large quantities that can be produced in a single day.

The Contractor's operations in the pit shall be in accordance with both the Standard Specifications and any environmental requirements. The Contractor shall be required to operate in such a manner as to produce a uniform product with a minimum of waste and leave the pit in such a condition that future use of the pit will not be adversely affected.

Sufficient tests shall be made during the production of base materials to determine the quality of the produced material. The Contractor should be aware of any unsatisfactory test results and should make any necessary corrections in their operation. The final placement of any material that does not meet the specifications should never be permitted. When test results indicate that material does not meet specifications, the Contractor will be required to make corrections to bring the material produced into compliance.

### **Sampling**

Material samples of any type should always be taken by, or at the direction of, experienced personnel that are aware of the proper methods of obtaining representative samples. Production of base material requires close control. It is extremely important that the specifications covering the amount of material passing the #200 (75  $\mu$ m) sieve and the plasticity index of the material are rigidly enforced.

Information pertaining to material sampling frequency, methods, and testing may be found in the Materials Testing Manual and in the Materials Policy & Procedures Directives Manual.

Subsection 106.07 of the Standard Specifications requires a sampling device on all secondary crushers and screening plants. This device is a requirement to reduce the physical problems of obtaining a representative sample in a safe manner and without interrupting the Contractor's operation. The sampling device should be tested under operating conditions before production is started. The Contractor should be advised of this requirement at the preconstruction conference.

### **Stockpiling and Handling of Aggregates**

Stockpiles shall be located within the right-of-way limits of pit areas or within an area that the Contractor has secured from the owner for that purpose. The site should not be subject to flooding or an excessive amount of blowing dust (such as on the downwind side of an asphalt or crushing plant).

The Standard Specifications do not have requirements for stockpiling aggregates, but there are stipulations against segregation of materials.

The following comments pertaining to stockpiling are generally accepted as good practice in the industry:

1. In order to minimize segregation, stockpiles must be constructed in layers, rather than in cones, and the thickness of the layers should not exceed 5 feet (1.5 meter).



2. If stockpiles are formed with a conveyor belt, they are to be leveled at intervals in order to avoid "coning". The same suggestion is applicable to stockpiles formed by stackers.
3. Crawler tractors should not be used on stockpiles because of breakdown of the aggregate due to the abrasive action caused by the steel tracks.
4. If the stockpiling methods or methods of handling will contribute to segregation, the Contractor should be advised of the problem and probable consequences of having material fail the grading specifications.

### **303-3 Construction Requirements**

#### **303-3.01 Placement**

Watering of base courses must be done with care. Excess watering is wasteful, but more importantly, it may result in serious damage to the subgrade. Most of the water that falls on granular material penetrates to the subgrade almost immediately and this could create serious problems. This "sponginess" and resultant movement under wheel loads is usually first noticed as excessive looseness of base materials. The Inspector should be on guard for any soft spots that may develop in the roadway following rains or excessive watering. If this condition should occur, a thorough investigation shall be made and corrective measures taken before paving.

The subgrade upon which the first course is to be constructed must be thoroughly compacted and shall conform to the required cross section and grade. Subbase and base materials are usually more expensive than the material in the subgrade and should not be needlessly used to correct irregularities in the subgrade.

Each layer of material must be finished to the required tolerance in order to avoid unnecessary use of the more expensive material to properly finish the grade.

When finishing to blue tops, the machine operator has a tendency to hit right on grade at the blue top, and be high in between. This condition should always be looked for and can be checked quickly by means of a string line. The Contractor should be aware of this and make adjustments or corrections during the grade check.

If soft spots are found in the subgrade, they shall be corrected. If springs or seeps are present, they shall be drained by the use of perforated pipe or by other acceptable means. A sufficient amount of subgrade shall be approved ahead of the placement of base at all times.

#### **303-3.02 Compaction**

Each layer of base course applied to the roadway must be watered and compacted to the required density prior to the placement of successive lifts.

In most cases, pneumatic rollers or vibratory rollers will be used to compact the base material. The most positive means of determining the adequacy of water and compactive effort is by taking density tests. More frequent testing at the beginning of the work will usually pay off by preventing over-watering and over-rolling and by providing the Contractor and Inspector with a "feel" for the material. During compaction, it is important that the Inspector closely observe the performance of the material. If it compresses and springs back (a condition known as "pumping") the subgrade has been over-saturated and will require repairs.

If water from either rain or the Contractor's operation has penetrated the base course and saturated the subgrade prior to paving, proof rolling should be performed. This will require the Contractor to run heavy equipment over the base material with the Inspector checking for "pumping." Any "pumping" areas observed must be repaired prior to paving. It cannot be overemphasized that the Inspector needs to be alert to over watering which can damage the subgrade.

### **303-3.03 Finishing**

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross section true to line and grade within the specified tolerance.

Upon completion of leveling the surface to the desired smoothness, the aggregate base should be watered and rolled to the required density. A string line is an effective tool to use in checking the grade and cross section of the compacted base for acceptance.

When asphaltic concrete is placed directly on subgrade, the use of a leveling device is not required. However, it is extremely important to finish the subgrade to as smooth and uniform a plane as possible.

Thickness measurements shall be made and recorded following the compacting of each course and prior to placing any succeeding course. The method and frequency of these measurements shall be as indicated in the Sampling Guide Schedule of the Materials Testing Manual.

### **303-3.04 Contractor Quality Control**

The Special Provisions may require the Contractor to perform *special* quality control measures necessary to provide acceptable quality in the production, hauling, and placement of materials. Quality control is always the responsibility of the Contractor.

### **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 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.

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

- a 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);
- a 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; and
- prompt application of an effective curing seal without allowing the surface to become dry.

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 amount of cement to develop desirable strengths. These materials 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 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 strength and durability of the treated base.

### **304-3.06 Curing Seal**

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.

## **305 LEAN CONCRETE BASE**

Lean concrete base is rarely used on ADOT projects. Lean concrete base (LCB) is made with concrete aggregate and sufficient cement (about three sacks) to achieve a strength of at 500 psi (3.5 MPa) in seven days. Mix design, testing, and inspection are handled the same as with concrete paving. Water reducers, fly ash, and air entrainment agents are allowed, but are not generally required.

On some projects, the use of air entraining agents has caused tearing of the base surface. It is advisable to be alert to this possibility. As it gains strength, the lean base will crack naturally. No attempt should be made to control or seal the cracks.

### **305-3 Construction Requirements**

#### **305-3.08 Placing and Finishing**

LCB is placed and finished the same as Portland cement concrete pavement, except surface texturing is not required.

The base is mixed in conventional concrete mixers, hauled to the grade in open bed dump trucks, and placed with a slip form paver. Dump trucks are used primarily because of the speed with which they can be loaded and unloaded.

The Special Provisions or Project Plans will supply the width of base. This is usually the full width of the Portland cement concrete pavement (PCCP) plus an added increment for edge support. A smooth float finish is all that is required.

#### **305-3.09 Curing**

White pigmented curing compound is applied as soon as finishing is completed. Another application of curing compound may be specified just before placing the PCCP. The last coat must be protected from damage because it serves as a bond-breaker between the base and the pavement.

#### **305-3.12 Opening to Traffic**

Keeping all traffic off the LCB for at least 72 hours, including the Contractor and ADOT, is very important because of the low strength developed by the base. Even after 72 hours have elapsed, traffic should be restricted to the absolute minimum needed to complete the PCCP.

## **306 GEOGRID BASE REINFORCEMENT**

Geogrids have become an alternative to subgrade stabilization via lime or cement. The geogrid material can improve the ability of the subgrade to carry traffic loads and reduce rutting or pavement failure over weak soils. ADOT's Materials Section has incorporated in their Design Manual an increase of 10 to the R-value, which is used for accepting subgrade soils, when using a geogrid. Also, to improve the separation between the base and subgrade materials and avoid loss of fine material into the base, a Separation Geotextile Fabric may be used (refer to Section 1014-4 of the Standard Specifications). However, the benefits of geogrid performance depend upon correct installation as well as proper design.

### **306-3 Construction Requirements**

#### **306-3.04 Geogrid Placement**

The Standard Specifications give detailed installation instructions. Additional instructions should be available from the manufacturer or local supplier. The Resident Engineer should obtain this information and review it before construction begins.

Adequate anchoring is required to prevent haul trucks from pushing or shifting the geogrid out of position.

Always back-dump fill onto the geogrid and spread the material over the geogrid. Dump subsequent loads on top of the leveled fill material and advance by spreading.

Longitudinal joints should be located the same as pavement joints. See Standard Specification Subsection 406-6 for longitudinal joint requirements.

Should the geogrid be damaged in any way during or after installation, it can be repaired by patching. The recommended repair procedures are to place a piece of geogrid over the damaged area and extend the geogrid 3 feet (1 meter) beyond, in all directions.

Since geogrids are made of polymers (plastics) they will break down or become brittle under exposure to sunlight as a result of the ultraviolet (UV) radiation. Therefore, it is crucial to avoid unprotected storing of these types of materials or rolling them out on the grade until the contractor is ready to cover them with the base materials.

**307 GEOCOMPOSITE EDGE DRAIN**

Today's pavement design may include the use of a geocomposite edge drain. An edge drain system is a very efficient way to remove water trapped in the aggregate base and/or subbase. The Project Plans and Standard Specifications are very clear concerning the installation of an edge drain system.

**307-3 Construction Requirements****307-3.04 Construction Method**

Detailed installation instructions should be available from the manufacturer or local supplier. The Resident Engineer should obtain this information and review it before construction begins.

A critical component of the edge drain system is the outlet pipes. All outlet pipes should have:

- soil-tight joints,
- positive grade for proper drainage, and
- resistance to deformation from installation and construction loading.

If the edge drain is damaged or torn, it can be repaired by taping over small areas or by placing a geotextile material over larger areas and then taping. Waterproof tape must be used, and a patch must have a 4-inch (100 mm) overlap. All patches must provide a watertight seal.



**REFERENCES AND ADDITIONAL INFORMATION**

\* *Workbook for Field Sampling and Testing for Earthwork (Course Number 101R)*, Arizona Department of Transportation, Phoenix, AZ

\* *Workbook for Subgrade and Base Course Inspection (Course Number 104)*, Arizona Department of Transportation, Phoenix, AZ

\*\* *Materials Testing Manual*, Arizona Department of Transportation, Materials Group, Phoenix, AZ

*Policy and Procedure Directives Manual*, Arizona Department of Transportation, Materials Group, Phoenix, AZ

\* - individual copies recommended for inspection staff

\*\* Appendix C - individual copies recommended for inspection staff