ALABAMA DEPARTMENT OF TRANSPORTATION

General Application Special Provision

DATE: June 10, 2024 GASP No. 22-GA0044

EFFECTIVE DATE: November 1, 2024

SUBJECT: Lime Stabilized Roadbed.

Alabama Standard Specifications, 2022 Edition, SECTION 232 shall be replaced with the following:

SECTION 232
LIME STABILIZED ROADBED

232.01 Description.

This Section shall cover the work of preparing a roadbed for an overlying base and paving structure by stabilizing it with a lime treatment. Work covered in this Section includes, but is not limited to, treating the subgrade embankment, or natural ground by scarifying, adding water and lime in the form specified herein, mixing, shaping, compacting, and finishing the mixture to the required density. Work shall be classified based on the desired outcome of the treatment as follows:

Class 1 Lime Stabilization shall consist of spreading and incorporating the specified percentage of lime in two increments in the following sequence: spreading the first increment, initial mixing, mellowing, spreading the second increment, final mixing, compacting, and finishing in accordance with these specifications. Mellowing is defined as the process of softening to a loamy consistency.

Class 2 Lime Modification shall consist of spreading the specified percentage of lime, initial mixing, mellowing, final mixing, compacting, and finishing in accordance with these specifications.

232.02 Materials.

All material furnished for use shall comply with the requirements of the appropriate Sections of Division 800, Materials.

(a) Water.

Water shall come from City or County public water supplies and meet the requirements of Article 807.03 and shall be free of injurious quantities of oil, salt, vegetable matter, or other detrimental substances.

(b) Lime.

Lime shall be hydrated lime or quicklime. Lime kiln dust (LKD) may be proposed for approval by the Contractor for Class 2 treatment. Lime products shall meet the requirements of Section 817.

(c) Soil.

Soil used in the treatment shall consist of existing roadbed material or material added as directed. Particles of aggregate larger than those passing the 3-inch {75 mm} sieve, and deleterious substances such as roots, stumps, and other vegetable matter shall be removed from the soil.

232.03 Construction Requirements.

(a) General.

The basic requirement for work under this Section is to obtain a completed layer or layers of roadbed material containing a uniform soil-lime mixture, with a smooth, closely knit surface, free from cracks, displaced or segregated areas, and constructed to the proper depth, width, and surface requirement as specified.

The application rate shall be specified on the plans and proposals, unless otherwise stated in the contract. The Engineer may adjust the dosage rate base on field performance. The application rate for the lime will be based as a percentage of the dry weight of the soil being treated. Determination of the dosage rate may vary based on the class of treatment.

For Class 1 Lime Stabilization and Class 2 Lime Modification, quantities and percentages of lime are based on preliminary soil investigation and laboratory test results when tested in accordance with ALDOT 292. The actual application rate will be established from dry density tests performed on samples taken at finished subgrade elevation just prior to beginning work. The initial tests are based on hydrated lime. If quicklime in pelletized form is used and placed directly on the roadbed, a factor of 0.833 times the hydrated lime percentage is required.

(b) Equipment.

Choice of equipment to perform the work required under this Section shall, in general, be that of the Contractor provided that the Engineer approves all equipment used to perform the lime treatment and the following minimum criteria are met:

1. Lime Spreaders.

Lime, in dry form, is to be spread fully in a single application, except as noted in this Subarticle and in Section 232.03(d). Lime is to uniformly cover the entire area at the prescribed spread rate. The spread rate shall meet the percent lime to be incorporated as indicated on the plans and proposal or as directed by the Engineer.

Lime Fines: When spreading lime finer than 3/8-inch {9.5 mm}, spread the lime uniformly on the subgrade using a mechanical spreader at the prescribed dosage rate, and at a constant slow rate of speed.

Pebble Lime: When spreading lime coarser than 3/8-inch {9.5 mm}, spread the quicklime with a motor grader such that it produces an even layer of quicklime.

When either lime fines or pebble lime are allowed, the Engineer may require the dosage rate to be increased by 1 % (by dry wt. of the soil) when spread by a motor grader to account for the reduced precision.

Lime Slurry: If spreading lime slurry, use equipment such that it will spread the slurry at the required rate by methods and equipment that have been approved. A pump shall be provided for agitating the slurry when the distributor truck is not equipped with an agitator.

Pneumatic distribution of lime is prohibited.

2. Mixers (Soil Reclaimers).

A mechanical mixer shall be self-propelled, high powered, minimum 400 HP, rotary mixers/reclaimers capable of mixing in-place to a minimum depth of 16 inches (400 mm). The cutting drum shall be a minimum 7 feet (2.1meters) in width and fitted with cutting teeth capable of cutting and homogenizing the soil (earth) and lime and be so designed that they may be accurately adjusted vertically and held in-place.

Disc harrows, bucket teeth and other equipment that does not meet the above requirements shall not be permitted.

3. Water Distribution Equipment.

Water trucks may be used to spray water over the lime treated material during construction operations. Water trucks are to be equipped with spray bars equipped with positive and rapidly working cut-off valves, which uniformly spray water across the surface and do not apply water in streams or cause water to pool on the surface. Alternatively, water may be metered by adding water directly into the mixing chamber of the reclaimer.

4. Compaction Equipment.

Deep Compaction: Lime treated areas shall be compacted with a conventional sheepsfoot roller or a self-propelled tamping foot compactor-type roller weighing at least 10 tons (9 metric tons).

Surface Compaction/Seal: The compacted material should be finished by sealing with static, smooth steel-wheel or pneumatic tire rollers. The drum of smooth steel-wheel rollers shall be smooth, with no flat spots, cracked, or damaged surfaces. The use of scrapers is recommended to prevent the material from sticking to the wheels or drum. Do not use vibration during the final rolling.

5. Scarifying Equipment.

Use a grader-scarifier for the initial scarification of the soil. Use equipment capable of scarifying to the full depth of the treated layer.

(c) Preparation of the Roadbed.

The roadbed shall have been prepared in accordance with the provisions of Section 210, except as otherwise noted in Section 232. The roadbed shall be scarified to the treatment depth required for the stabilization prior to the lime application. The depth of scarification shall be carefully controlled so that the surface of the roadbed below the scarified material shall remain undisturbed and conform to the established cross-section. The scarified material shall be partially pulverized and all existing unsuitable material and material retained on a 3 inch {75 mm} sieve shall be removed.

(d) Application of Lime.

Apply the approved quantity of lime per the contract or as directed by the Engineer. For Class 1 Lime Stabilization and Class 2 Lime Modification the distribution of lime at the dosage rate specified shall be attained over a measured section until the specified percentage of lime has been spread.

In the instance that a dual application is required, the dosage rate may be adjusted by the Engineer, but shall not be less than 50 % of the total application dosage being placed in the first application, unless otherwise noted on the plans. While either hydrated lime or quicklime may be used on different segments of the project, a second application of lime must be of the same type used in the first application. After each successive pass, the material shall be incorporated into the soil with the mixing equipment per Subarticle (e) and mellowed per Subarticle (f).

Spread lime only on an area of such size that all primary mixing operations can be completed in the same day during daylight hours, except where the work is authorized to be done at night per the contract. Payment will not be made for any lime that is placed and not adequately incorporated in the same day.

No payment will be made for lime application exceeding the five percent plus tolerance. When the quantity applied is deficient by more than the allowable minus tolerance, additional lime shall be applied prior to mixing.

Application of the lime shall be accomplished by either an approved dry application or slurry application method.

1. Dry Application:

Before applying lime, if the soil is below the optimum moisture content per AASHTO T 99, bring the prepared roadway to approximately 2 percentage points above optimum moisture content using approved water sprinkling methods. Lime applied shall be spread uniformly and shall also be sprinkled with water sufficient to prevent loss of lime by wind. Excessive loss due to washing or blowing, will not be accepted for payment. Due to the dusty nature of hydrated lime, its use in dry form must be approved in writing.

2. Slurry Application:

Before applying slurry, if the soil is more than 2 % above optimum moisture content per AASHTO T 99, bring the prepared roadway to no more than 2 percentage points above optimum moisture content by aerating the soil. The proportion of lime shall be such that the dry solids content shall be at least 30 % by weight {mass}.

Lime applied by this method shall be mixed with water in approved agitating equipment. The slurry distributing equipment shall be equipped to provide continuous agitation from the mixing site until applied on the roadbed. Apply to the roadbed as a thin water suspension of slurry making successive passes over a measured section of roadway until the specified lime content is reached.

3. Application Limitations:

Class 1 Lime Stabilization and Class 2 Lime Modification:

No lime shall be applied to frozen soil or when frost is on the ground or when the ambient temperature is less than 40° F (5° C), as measured in the shade, during the mixing operation, mellowing period and compaction, without written authorization of the Engineer.

Should testing (ASTM D8459) indicate the presence of soluble sulfates within any of the desired treatment layer(s), the following guidelines shall be followed:

The impacted area(s) will be delineated by the Engineer.

Soils with between 3,000 ppm and 8,000 ppm of soluble sulfates shall be mellowed for a minimum of seven days, or as directed by the Engineer.

Lime will not be permitted to be used in soils containing soluble sulfates greater than or equal to 8,000 ppm.

Spreading of the lime when the wind or other weather conditions are unfavorable will not be permitted. Dust shall be controlled by the Contractor so that it is kept within the confines of the construction limits. Take necessary precautions to protect personnel from dust created by the lime application and mixing operation, such as the proper use of proper PPE and applicable training.

Do not spread dry lime on standing water.

(e) Initial Mixing.

Mix the lime to the depth the contract specifies or as directed by the Engineer. The lime and water shall be incorporated uniformly into the soil. The mixing and watering operation shall be continued until a homogeneous mixture is obtained. Additional water, if necessary, shall be added and mixed into the mass to ensure hydration and hasten mellowing per Subarticle (b)3.

After satisfactory mixing is obtained for Class 1 Lime Stabilization and Class 2 Lime Modification, the layer shall be reshaped to approximate line, grade and section and sealed with a light roller to protect the treated layer during the mellow period.

(f) Mellow Period.

Class 1 Lime Stabilization and Class 2 Lime Modification:

The lime-soil mixture should mellow sufficiently to allow the chemical reaction to modify, break down, the material. The duration of the mellow period is dependent on a soil's plasticity as determined according to AASHTO T 90.

The mixture shall be left to mellow a minimum period of 24 hours but not to exceed 72 hours, unless otherwise directed by the Engineer. The Contractor may elect to submit testing that demonstrates a shorter mellow period is sufficient for approval.

During this period the entire surface of the stabilized layer shall be kept moist by sprinkling water and at no time allowed to become dry or dusty.

If a dual application of lime is required, the second application may be applied per Subarticle (d) following a minimum 24-hour mellow period, unless otherwise directed by the Engineer. Once the second application of lime is placed, it will then be subjected to an initial mix per Subarticle (e) followed by a 24-hour mellow as stated herein, or as directed by the Engineer, before proceeding to the final mixing.

(g) Final Mixing.

Mix the lime to the depth the contract specifies or as directed by the Engineer. Add water, as needed, to raise the moisture content of the soil. If compaction [Subarticle (h)] cannot be completed within the same day of mixing, the surface of the layer shall be sealed with a rubber-tired or non-vibratory smooth drum roller before suspending that day's operation. Mixing may continue the following day, weather conditions permitting.

Class 1 Lime Stabilization and Class 2 Lime Modification:

Following the required mellow period, the layer shall then be remixed as prescribed in the initial mixing operations according to Subarticle (e). Mixing shall continue until 100 % of material by dry weight {mass}, exclusive of gravel and stone, will pass a 2-inch {50 mm} sieve and 60 % will pass a Number 4 {4.75 mm} sieve.

(h) Compaction.

Compaction of the mixture using density controls, unless otherwise specified on the plans. Compacted density requirements will be as specified in Section 306. Standard weights {masses} will be established on the project using material from the completed mixture, as directed by the Materials and Tests Engineer. The standard weight {mass} sample will be obtained and the standard weight {mass} established the same working day as the compaction tests are run.

Compaction shall begin immediately after the required final mixing per Subarticle (g) operation has been completed. Prior to compaction, sprinkle or aerate the treated material to adjust the moisture content during compaction so that it is no more than 2.0 percentage points below optimum and 3.0 percentage points above optimum.

Compaction operations shall be completed within 72 hours after it was begun and so conducted as to provide uniform compaction from bottom to top of the layer. The mixture shall be aerated or watered as necessary to obtain the specified moisture content so that it is no more than 2.0 percentage points below optimum and 3.0 percentage points above optimum of the laboratory specified optimum moisture content. If compaction cannot be completed in the same day started, the surface shall be sealed by rolling with a rubber-tired or non-vibratory smooth drum roller before suspending that day's operation and the compaction continued the following day.

If compaction cannot be obtained within the 72-hour limit noted in this Subarticle, the section involved shall be reprocessed by adding 25 % additional lime, based on the percentage of lime added prior, but not less than 1 percent, and the compaction operation restarted, all of which shall be at the sole expense of the Contractor.

Throughout the entire compaction operation, depressions, defective areas, or soft spots which develop shall be corrected immediately by scarifying the area, adding lime when required, or removing the material and reshaping and compacting in accordance with these specifications at the expense of the Contractor.

(i) Shaping, Finishing & Testing.

The surface of the layer shall be smooth and conform to the lines, grades, and cross sections shown on the plans or established by the Engineer. Surface requirements shall be as specified in Subarticle 230.03(e).

The thickness of the lime stabilized layer will be determined from measurements taken at intervals not to exceed 200 feet {60 m} for projects less than one mile in length and taken at intervals not to exceed 500 feet (150 m) for projects greater than one mile in length. The thickness of the entire layer(s) shall not vary more than 3 inches {75 mm} plus or minus from that shown on the plans. Any section deficient by more than 3 inches {75 mm} shall be reconstructed immediately in accordance with these specifications. Any section exceeding the 3 inch {75 mm} tolerance shall have additional lime added to correct the deficiency and shall be remixed to the specified depth and width in accordance with these specifications. In each case, such reconstruction and additional lime added shall be at the sole expense of the Contractor.

(j) Protection, Curing, & Maintenance.

Upon completion of the compaction and finishing of each layer, no equipment or construction vehicles other than watering equipment shall be permitted on the finished layer for the number of days listed here, unless otherwise authorized or stated herein.

Minimum Curing Requirements [1]

Untreated Material	Min. Curing Days (March 16th - November 30th)	Min. Curing Days (December 1st - March 15th)
PI ≤ 20	2	3
PI > 20 and PI < 35	4	5
PI ≥ 35	7	7

1. Proof rolling may be substituted as an indicator of adequate curing, subject to the Engineer's approval.

For sections that impact local traffic, completed sections of the lime-treated soil may be opened earlier to lightweight local traffic by demonstrating that the treated sections have hardened sufficiently to prevent marring or distorting the surface. Under such circumstances, the Contractor will ensure curing is not otherwise impaired.

Throughout the cure period, the surface of the treated section shall be kept moist. It shall be the Contractor's responsibility to provide sufficient water and equipment to maintain a moist surface of all partially constructed or completed lime stabilized layers until a succeeding layer has been placed thereon or until final acceptance of the project.

The Contractor may, on a layer to be covered by a conventional base or subbase layer, substitute at his expense an acceptable prime coat in lieu of watering during the curing period noted above. If the prime coat will be exposed to local traffic, it shall be thinly covered with an ALDOT No. 8, per Section 801.11(d), effectively producing chipseal.

The Contractor shall be responsible for the protection and maintenance of the treated layer until it is covered by another layer or the completion of the project. Any damage to the treated layer due to other phases of construction or any cracking or other defects that may occur due to any cause or reason before being covered by the next layer shall be repaired to the full treatment depth without additional compensation. An alternate repair method may be used if approved in writing.

232.04 Method of Measurement.

The actual area of the roadbed stabilized as ordered, for each specified compacted depth, completed to the thickness and cross-section shown on the plans or directed, will be measured in square yards {square meters}. All calculations of areas measured for payment shall be based on measurements made to the nearest 0.1 yard {0.1 meter} with areas calculated to the nearest square yard {square meter}. The length will be measured along the surface of the completed roadbed at its center point. The width will be the top surface width of the completed roadbed specified on the plans or directed, measured perpendicular to the center line of roadbed. Additional areas required for cross overs, turnouts, etc., shall be measured by length and width along the surface of area processed.

Lime actually incorporated in the work will be measured by the ton {metric ton}. In cases where Pure Quicklime (CaO) is slaked on the jobsite to produce a lime slurry, the pay quantity for lime will be measured in tons {metric tons} of hydrated lime as calculated using the certified lime purity for each truckload as follows:

TOTAL TONS {METRIC TONS} HYDRATED LIME PRODUCED = (A x B x 1.32) + A (1.0 - B)
Where: A = tons {metric tons} of Quicklime delivered
B = certified percent purity
Note: 1.32 = ratio of Molecular weights {masses} for Hydrated Lime (74) and Pure Quicklime (56)

232.05 Basis of Payment.

(a) Unit Price Coverage.

Lime Treated Soil: The ordered and accepted area of lime stabilization, measured as noted above, will be paid for at the contract unit price bid per square yard {square meter} of the class and depth specified. Said unit price bid shall be full compensation for all scarifying, pulverizing, mixing, shaping, watering, compacting, and application of lime and for all equipment, tools, labor, and incidentals necessary to complete and maintain the work.

Lime for Lime Treated Soil: The accepted quantity of lime actually incorporated in the work except as noted herein, measured as provided above, will be paid for at the contract unit price per ton {metric ton} for lime, which price shall be payment in full for furnishing, transporting, storing, handling, preparation of slurry, and spreading; and for all equipment, tools, labor, and incidentals needed for completion of the work.

Any additional soil material required to bring the roadbed to plan grade and section, and any unsuitable material excavated, will be measured and paid for under the appropriate item of Unclassified Excavation or Borrow. No direct payment will be made for blading, shaping, compacting, and like operations.

(b) Payment will be made under Item No.:

232-A Lime Stabilization, Class _____ , ___ inches {mm} Thick - per square yard {square meter}
232-B Lime - per ton {metric ton}