

## SECTION 1200 - SUBGRADE PREPARATION

1201 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work connected with subgrade preparation, prior to constructing pavements for streets, alleys, parking areas, sidewalks, drive approaches and the construction of concrete curb and curb and gutters. This section does not include the construction of any base courses.

### 1202 DEFINITIONS.

- A. Subgrade. Subgrade is defined as a well-graded and compacted surface, constructed as specified herein to the grades, lines, and cross-section shown, bladed and compacted to the specified density, preparatory to constructing pavements, or other improvements thereon.
- B. Subgrade Preparation. Subgrade preparation is the repeated operation of fine grading and compacting the subgrade until the specified lines, grades, and cross-sections have been obtained and the materials are compacted to the specified depth and density.

### 1203 CONSTRUCTION REQUIREMENTS.

- A. General. All underground work contemplated, including clearing, grubbing, and demolition, shall be completed in accordance with the requirements of Section 1100 *Grading* prior to commencement of any subgrade preparation.

Prior to beginning any work on street subgrade the contractor shall secure the services of a qualified testing agency to acquire samples of the material to be used for subgrade construction. These samples shall be analyzed to determine proctor values, liquid limits, and plasticity index. Copies of the analysis shall be provided to the City Engineer for review prior to commencing any subgrade preparation. If it is determined that fly ash modification is required the following guidelines shall be followed.

The contractors testing agency shall determine the areas to be modified, the amount of fly ash to be used (% by weight), and the depth to be tilled.

Construction of pavements on high plasticity soils shall be modified with class "C" fly ash, or replaced with lower plasticity soils. High plasticity soils shall be defined as soils with a liquid limit greater than 50 and a plasticity index greater than 30. (See section #1208)

The subgrade surface shall be brought to the specified lines, grades and cross-sections by repeatedly adding or removing material and compacting to the specified density with a suitable roller to perform these operations.

- B. Foundation Treatment. Unless otherwise specified or shown on the contract drawings, the soil below grade line in cut sections shall be scarified, broken up, adjusted to a moisture

content within the designated moisture range and compacted to the designated type of compaction.

When the depth of compaction in cut sections is shown to be more than nine inches (9") material shall be removed to within nine inches (9") of the lower limit of the compaction. The layer of material left in place shall be scarified, broken up, adjusted to a satisfactory moisture content and compacted to the designated type of compaction. This process shall be repeated until the cut section is compacted to the grade as shown on the contract drawings.

All roadway excavation in rock (shale, sandstone, limestone) shall be undercut no less than 12" for the full width of the roadway and backfilled with suitable soil or granular material. Undercut shall be unclassified excavation.

- C. **Moisture Control Requirements.** The moisture content of the soil at the time of compaction shall be as necessary to obtain the density as designated on the contract drawings unless it is determined by the engineer that the soil is unstable with that moisture content.

When the moisture content of the soil is not satisfactory to the engineer, water shall be added or the material aerated, whichever is needed to adjust the soil to the proper moisture content. In no case, shall water be added without the consent of the engineer.

- D. **Compaction Control Requirements.** Roadway embankment earth (fill) materials shall be placed in horizontal layers not exceeding eight inches (8") unless otherwise approved by the engineer and shall be compacted as specified in Section 1205 *Compaction Requirements* before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compaction. Water shall be added or removed on the approval of the engineer, in order to obtain the required density.

- 1204 **MOISTURE CONTENT REQUIREMENTS.** The moisture content of the soil at the time of compaction shall be uniform and shall be such that the soil can be compacted to the requirements of the type of compaction as designated on the contract drawings or as directed by the engineer.

If Type B compaction is specified with this moisture control, the content shall be sufficient to produce a uniform mixture of the soil and moisture. It will be determined by the engineer whether or not satisfactory compaction and moisture content is obtained.

- 1205 **COMPACTION REQUIREMENTS.**

- A. **Pavements.** The subgrade for pavements shall be compacted to a density of at least ninety-five percent (95%) of the maximum density for the material used for a depth of at least nine inches (9") below the finished subgrade elevation and within the tolerance of the moisture for the type of material at ninety-five percent (95%) of maximum density, as determined by

the standard proctor test (ASTM D698) for cohesive soils. Any further compacted layers shall be accomplished in the same manner as specified.

When Type B compaction is specified or shown on the contract drawings, the compacted density is to be such that the tamping or sheepsfoot roller, while rolling the layer or lift will walk out of the material and ride the top portion of the lift.

Subgrade compaction for curbs and pavements shall be accomplished by use of sheepsfoot rollers. The roller may be self-propelled or machine drawn. The sheepsfoot roller shall be fully loaded with liquid or solid ballast to produce adequate compactive energy to the tamping foot. The roller shall have a minimum drum diameter of 30" and a 6" minimum length of tamping feet.

Compaction of low plasticity or non-plastic, fine-grained material shall be considered adequate when additional passes of the roller do not bring the tamping feet closer to the surface of the lift, provided the entire weight of the roller is supported on the tamping feet and none by material directly in contact with the drum.

Construction of pavements on high plasticity soils shall be modified with hydrated lime or class "C" fly ash or replaced with lower plasticity soils. High plasticity soils shall be defined as soils with a liquid limit greater than 50 and a plasticity index greater than 30.

Sand and gravel which cannot be compacted satisfactorily with a sheepsfoot roller shall be rolled with a pneumatic-tired roller. Each lift shall be rolled until no further consolidation is evident.

- B. Sidewalks. The subgrade for sidewalk pavements shall be compacted to a density equivalent to the density of the immediately surrounding soil in areas not requiring fill. In areas where fill is required, the subgrade shall be compacted to ninety-five percent (95%) of the maximum dry density as determined by ASTM D698 for cohesive soils or to seventy percent (70%) relative density as determined by ASTM D2049 for non-cohesive soils.
- C. Drive Approaches and Concrete Curb & Gutter. The subgrade for drive approaches and concrete curb and gutter shall be compacted to the same requirements as stated above in part *a. Pavements*.

1206 PROTECTION AND MAINTENANCE OF SUBGRADE. The newly finished subgrade shall be repaired from action of the elements. Any settlement or washing that occurs prior to the acceptance of the work shall be repaired and the specific lines, grades, and cross-section re-established.

The contractor shall protect all pavements, curbs, curb and gutters, and sidewalks from his subgrade operation with an earth cushion, timber planking, or both where tractors, graders, rollers, or other equipment are required to pass, or turn around. All resulting damage shall be

repaired. Any damaged work which cannot be repaired to the satisfaction of the engineer, shall be replaced by the contractor at his own expense.

1207 COMPACTION TESTING AND PROOF ROLLING. The subgrade must successfully pass compaction testing by a nuclear density/moisture measuring device and proof rolling with a loaded tandem dump truck carrying a minimum load of 16 tons. If as a result of the testing/proof rolling, the city engineer determines that further compaction is required, the contractor shall revise his methods or procedures as necessary to obtain density and stability.

## 1208 FLY ASH SUBGRADE TREATMENT

### GENERAL

The purpose of this specification is to secure a completed section of treated material which contains a uniform mixture of fly ash and pulverized material with no loose or segregated areas, has a uniform density and moisture content, and is well bound for its full depth. It shall be the responsibility of the contractor to regulate the sequence of his work, to process a sufficient quantity of material to provide full depth as shown on the Plans, to use the proper amounts of fly ash, to maintain the work, and to rework areas as necessary to meet the requirements.

- A. The contractor shall secure the services of a qualified testing agency to perform on site testing. A qualified field technician shall monitor placement, mixing, moisture content and in place density. Copies of the test results shall be provided to the City Engineer for review prior to pavement placement. All costs incurred through the use of the testing agency shall be borne by the contractor-developer.
- B. A sample of the fly ash intended for use on the project will be submitted to the testing laboratory for the purpose of developing a fly ash proctor. The fly ash supplier will submit certified laboratory analysis indicating that fly ash used on the project conforms to A.S.T.M. C618, Class C, except the supplementary optional physical requirements in table 4 will not apply and the minimum calcium oxide (CaO) content of the fly ash shall be 25%. Fly ash shall be sampled and tested in accordance with A.S.T.M. C311.

Fly ash furnished by the contractor shall comply with the requirements of A.S.T.M. C618 class C. The minimum calcium oxide (CaO) content of the fly ash shall be 25%. Fly ash shall be stored and handled in closed waterproof containers prior to distribution on a roadway or fill. Fly ash that has been partially caked or set shall not be used. A certification indicating compliance to these specifications shall be attached to or be part of the scale ticket for each load delivered. The certification shall be signed by the producer or his assigned representative.

## 1209 CONSTRUCTION REQUIREMENTS

### A. Preparation of Roadbed

The subgrade shall be trimmed as near as possible to finish subgrade elevations as shown on the plans. The contractor shall allow for potential swell of material to minimize waste during final trimming. This may require the subgrade to be trimmed to slightly below proposed finished grade depending on the soil characteristics.

### B. Equipment

The machinery, tools, and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to beginning of construction operations. Pulveration of existing subgrade and blending of the mixture shall be accomplished by use of a drum-rotary type tiller equipped with an adjustable water proportioning system. Initial compaction shall be achieved using a self-propelled sheepsfoot compactor having a minimum operating weight of twelve tons with a minimum centrifugal force of 24 tons. Rubber-tired or smooth-wheeled rollers shall be used for final compaction of the stabilized section. All machinery, tools and equipment used shall be maintained in satisfactory and workmanlike manner. Fly ash shall be stored and handled in closed weatherproof containers until immediately before distribution. Fly ash exposed to moisture prior to mixing with recycled material shall be discarded.

### C. Application

The fly ash shall be spread in an approved manner at the rate specified. Care shall be taken to prevent the fly ash from flowing off the area to be treated. The fly ash shall be distributed at a uniform rate in such a manner as to minimize the scattering of fly ash by wind. Fly ash shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing fly ash becomes objectionable to adjacent property owners or significantly reduces the amount of fly ash incorporated into the work.

### D. Moisture Control

The required moisture content will be established by the contractors testing agency based on laboratory tests on the materials and specific fly ash content to be used for the treatment. Water shall be introduced directly into the rotary mixing drum during the tilling procedure. Final moisture content of the mix, immediately prior to compaction shall be uniform and not exceed plus or minus three percentage points of the optimum moisture content of the mix. If the moisture content exceeds the specified limits, additional fly ash may be added to lower the moisture content

to the required limits. Lowering the moisture content by aeration following addition of fly ash will not be allowed. If the moisture contents are below the specified limits, additional water shall be added and uniformly blended with the mixture. Additional fly ash added to lower the moisture content shall be at the expense of the Contractor.

E. Mixing

The pulverized subgrade material and fly ash shall be thoroughly mixed and the mixing continued until a homogenous, friable mixture of pulverized subgrade material and flyash meeting the specified size requirements is obtained. The subgrade material shall be pulverized through use of the specified equipment. Depth of pulverization shall be as designated. The pulverized subgrade material and fly ash shall be mixed thoroughly until a uniform mixture is obtained. All clods shall be reduced in size by mixing until the pulverized subgrade material-fly ash mixture meets the following size requirement when tested.

Sieve Size	Percent Retained
1"	0
1/2"	50

F. Compaction

Compaction of the mixture shall begin immediately after mixing and confirmation that the moisture content is within the specified range. The specified compaction shall be obtained within 1 hour after the incorporation of the fly ash. The material shall be sprinkled as necessary to maintain the specified moisture content. Compaction of the mixture shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted to the specified density.

All non-uniform (too-wet, too dry or insufficiently treated) areas which appear shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and recompacting.

The stabilized section shall be compacted to a minimum of 95% of the combined materials maximum dry density.

In addition to the requirements specified for density, the section shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests will be made by the testing agency field technician. If the material fails to meet the density requirements, the Engineer may require it be reworked as necessary to meet those requirements and/or require the Contractor to change his construction methods to obtain required density on the next section. Additional fly ash will be added to the areas that are reworked at no additional cost to the owner, and the amount required shall be determined by the testing agency field technician. Should the section, due to any reason or cause, lose the required stability, density and finish before

the surface is placed or the work is accepted, it shall be reprocessed, recompact and finished at the sole expense of the Contractor. Reprocessing shall follow the same patterns as the initial stabilization including the addition of fly ash.

G. Finishing and Curing

Following the compaction of the stabilized section the treated section will be trimmed to the required lines and grade by means of equipment which is automatically controlled with regard to grade. The surface shall then be compacted with a smooth wheel or pneumatic tired roller.

The Engineer may waive the use of automatically controlled equipment on projects containing narrow or irregular dimensions where operation of the automated equipment is impractical. Finishing of these areas may be as set forth above or the surface will be lightly scarified during finishing operations and bladed to a uniform grade and cross section to eliminate and imprints left by the equipment.

After the fly ash treated section has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods.

1. Maintain in a thorough and continuously moist condition by sprinkling.
2. Apply an asphaltic prime coat.

H. Weather Limitations

Fly ash mixing operations shall not be performed when the subgrade is frozen or when the ambient air temperature is less than 35 degrees F. The Contractor shall be responsible for protection and quality of the fly ash modified subgrade mixture under any weather conditions.

At cooler temperatures additional passes may be required to reduce the nominal size of the soil agglomerates to less than 1". Multiple passes of rollers may also be required to achieve specified densities in cooler weather conditions.

I. Proofrolling

Proofrolling with a loaded tandem dump truck carrying a minimum load of 16 tons will be required before acceptance of finish subgrade. Subgrade failures will be repaired by incorporating additional fly-ash into the subgrade. The use of fly-ash trimmings to correct areas of failure will not be permitted.