

ARTICLE 500 PAVEMENT DESIGN

SEC. 500.1 PAVEMENT TYPES

Street pavement sections shall be either flexible type with an asphalt concrete surface or rigid type consisting of a Portland Cement Concrete section and surface. Curb and gutter shall be Portland Cement Concrete.

Flexible pavements may be composed of a crushed stone base course with an asphaltic concrete surface.

Rigid structures shall be full depth Portland Cement Concrete to the designed thickness with a crushed stone drainage/leveling course of no less than 3 inches.

Pavement sections shall be designed in accordance with the procedures and criteria of the AASHTO Guide for Design of Pavement Structures, latest edition, and the criteria contained herein. Any conflicts shall be resolved in favor of the more stringent criteria resulting in a stronger and deeper pavement section.

References to various materials, testing and construction shall refer to the latest editions of AASHTO, ASTM, and the Standard Specifications of the Arkansas State Highway and Transportation Department.

Typical design requirements are summarized in Section 500.9 and Section 500.10 of this Article.

SEC. 500.2 PAVEMENT MATERIALS AND CONSTRUCTION

All pavement materials, construction methods, standards, time and temperature constraints, seasonal constraints, and performance requirements shall be in accordance with the 1996 edition of the AHTD Standard Specifications for Highway Construction, and this set of requirements (Article 500, Pavement Design, and Article 600, Utilities and Utility Crossings) unless specifically approved otherwise in writing by the City for a specific and individual exception. All testing shall be in accordance with Article 800, Inspections and Testing.

SEC. 500.3 SUBGRADE MATERIAL

Subgrade soils shall be all materials used for subgrade including in-situ materials and fill materials. Subgrades for pavement shall be stabilized by mechanical compaction or by other methods approved in writing by the City Engineer. Stabilization methods such as fabrics and chemical stabilization may be submitted for approval when supported by engineering data and calculations to substantiate the adequacy of the stabilization procedure.

The top 24" of the subgrade shall be a material not susceptible to frost action unless modified with cement, lime or another method approved specifically by the City Engineer to resist frost action (Soils classified as A-4 and A-5, including sandy silts, fine silty sand or lean clays are highly susceptible to frost action).

In-situ soils meeting the requirements outlined in these specifications may be utilized as subgrade material. In-situ soils used as subgrade shall be scarified to a minimum depth of 8 inches below finish subgrade, recompact, and tested as described in Section 800.5 of these specifications. Fill material for subgrade shall be placed in lifts not to exceed 8 inches compacted depth.

Methods and procedures for establishing the total depth of soil replacement and/or modification shall be specified by the design engineer and included in the project plans and specifications. The **minimum** depth of replacement shall be 24 inches in the absence of engineering data showing otherwise.

A "bridge lift" is defined as material that meets the requirements of these standards and is utilized to span areas of unsuitable material that lie below the 24 inch subgrade requirement. Bridge lift depth shall be determined by a geotechnical firm but in no case shall the lift be less than 24 inches in depth. A bridge lift will be placed in one lift in its entirety or as otherwise directed by the geotechnical firm and approved by the City and will require a "wheel roll" test prior to construction of the final 24 inch subgrade. Additional bridge lift depth may be required by the City dependent on field conditions.

The adequacy of in-situ soils and fill materials as pavement subgrade shall be evaluated based upon the soils classifications, liquid limit, plasticity index and California Bearing Ratio (CBR) values.

All soils with a liquid limit greater than 40, or a plasticity index greater than 15, or a CBR value of less than eight (8) shall be undercut and removed from the street section or improved by a designed method of stabilization accepted by the City Engineer.

Soils with a CBR of eight (8) or greater, and classified as GM or GC soil, shall be accepted as "Hillside" material and no further treatment or upgrade will be required.

Subgrade compaction requirements including the moisture density requirements shall be shown both on the plans and in the specifications (Compaction shall be a minimum of 95% standard proctor. Moisture content shall be \pm 3% optimum moisture unless otherwise supported by site specific geotechnical data and approved in writing by City Engineer).

Sampling and testing of subgrade materials shall be as set forth in Section 500.8 of these Standards.

Pavement designs that utilize a subbase course shall include test data and specifications for the subbase material in the calculations submitted to the City Engineer for review and approval.

SEC. 500.4 BASE COURSE

Base course material shall be crushed stone meeting the requirements of AHTD class 7 aggregate base course as specified in the AHTD specifications (Division 300, Bases and Granular surfaces, AHTD Standard Specifications latest edition). Base course materials shall be certified by the supplier to meet the AHTD class 7 requirements and identified as to the type of material, properties (including gradation, density and proctor), and source.

The base course for full depth asphalt pavement designs shall utilize plant mix bituminous base and binder courses conforming to AHTD Specifications (Division 400, Asphalt Pavements, AHTD Standard Specifications 1996 edition).

SEC. 500.5 SURFACE COURSE

The surface course for flexible pavement designs shall utilize plant mix bituminous base and binder courses conforming to AHTD Specifications (Division 400, Asphalt Pavements, AHTD Standard Specifications 1996 edition). The City will consider other design mixes, including "Superpave" mixes on an individual basis.

The surface course for rigid pavement shall be reinforced or non-reinforced (as determined by design calculations) Portland Cement Concrete as specified in the AHTD specifications (Division

500, Rigid Pavement, AHTD Standard Specifications 1996 or latest edition). Joint spacing details and specifications shall be submitted for all rigid pavement designs.

SEC. 500.6 CURB AND GUTTER

All curb and gutter shall be Portland cement concrete conforming to AHTD Standard Drawing CG-1 Type A (Curbing Details) with a minimum width of 24 inches with radius being a minimum of 2 inches. Mountable curbs will not be allowed in the City of Bentonville without written authorization of the City Engineer. Construction of all concrete curb and gutter shall utilize the following specifications:

Materials Concrete shall be Class "S" Portland Cement Concrete in accordance with Section 802 or 501, AHTD Standard Specifications with a 28-day compressive strength of 3,500 psi. Admixtures shall not be used unless specifically approved by the City Engineer. Maximum slump shall not exceed 4".

Expansion joints shall be made with preformed expansion joint filler of a nonextruding type conforming to ASTM Designation D1751 or AASHTO M153. Acceptable materials may be found on the current AHTD "Qualified Products List".

Joint sealing compound for contraction joints shall be CRS-2 Asphalt Emulsion meeting the requirements of ASTM Designation D3405 or current products listed on the AHTD "Qualified Products List".

Curing compound shall be a white pigmented membrane-forming liquid conforming to the requirements of ASTM Designation C309, Type 2.

Forms. Forms shall be made of metal or wood and shall have a depth equal to or greater than the thickness of the pavement slab. The minimum length of each section of form used shall be ten (10) feet. Each section or form shall be uniform and free from undesirable bends or warps.

The maximum deviation of the top surface of any section shall not exceed one-eighth (1/8) inch, or the inside face not more than 1/4 inch from planned alignment. The method of connection between sections shall be such that the joint thus formed shall be free from movement in any direction. Forms shall be of such cross-section and strength and so secured as to resist the pressure of the impact and vibration of any equipment which they support, without springing or settlement.

Every 10 foot length of form shall have at least three form braces and pin sockets which shall be spaced at intervals of not more than 5 feet, having the end brace and socket not more than six inches from the end of the form. Approved flexible forms shall be used for construction where the radius is 150 feet or less.

The subgrade under the forms shall be cut and compacted to a width not less than one foot behind the back of curb and gutter, removing all soft and yielding areas and replacing with suitable material compacted. Forms shall be joined neatly and in such a manner that the joints are free from play or movement in any direction. The supply of forms shall be sufficient to permit their remaining in place for at least twelve hours after the concrete has been placed. All forms shall be cleaned and oiled prior to use.

The alignment and grade elevations of the forms shall be checked by the Contractor and the necessary corrections made immediately before placing the concrete. When any form has been disturbed or any subgrade there under has become unstable, the forms shall be reset and rechecked.

Placing Concrete The subgrade shall be moist, but not muddy, at the time of placing of the

concrete. If required by the City, the prepared subgrade shall be saturated with water the previous night, or not less than 6 or more than 20 hours prior to placing the concrete. If the subgrade subsequently becomes too dry, it shall be sprinkled again ahead of placing the concrete, in such a manner as not to form mud or puddles of water.

Contractor shall give the City Engineer at least twenty-four (24) hours advance notice before placing concrete, and the subgrade shall be checked and approved by the City Engineer or his/her designated representative before any concrete is placed.

The concrete shall be mixed in quantities required for immediate use and shall be deposited on the subgrade to the required depth and width of the curb and gutter in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The concrete shall be placed as uniformly as possible in order to minimize the amount of additional spreading necessary. While being placed, the concrete shall be vibrated with suitable tools so that the formation of voids or honeycomb pockets is prevented.

The concrete shall be especially well vibrated and tamped against the forms along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been adjusted to the required grade and alignment.

Mechanical Placement. Curb and gutter placed by slip-form or extruding equipment will be accepted providing it complies with all of the above requirements other than forms.

Finishing. The curb shall be tooled to the required radii as soon as possible after the concrete takes its initial set. The gutter shall be shaped with a wood float at least 4 feet long. After the face forms and templates are removed, the joints shall be tooled and the surface shall be finally finished with a hard bristle broom to remove all imperfections without additional mortar or dryer. In all cases, the resulting surface shall be smooth and of uniform color, free from sags, twists or warps and true to the specified lines and grades shown on the plans.

Expansion joints, formed with bituminous preformed expansion joints one-half inch thick or as specified on the plans and precut to exact cross section of curb, shall be placed at all driveway radii, intersection radii, stationary structures and at intervals of not more than one hundred ninety-five (195) feet, and at the location shown on the plans or standard drawings, so that they are not moved by depositing and compacting the concrete at these joints. Preformed expansion joint filler shall be of nonextruding type and shall conform to ASTM Designation D1751 or AASHTO M153. Acceptable materials may be found on the current AHTD "Qualified Products List". Material shall completely separate concrete the full width and depth of the curb and gutter cross-section.

Contraction joints shall be sawed or formed with templates at intervals not greater than 15 feet and at the location shown on the plans or standard drawings and shall be sawed to a depth of 1-1/2" and a width of 1/4". Asphaltic material used in filling these joints shall be as specified in Section 501 AHTD Standard Specifications or as approved by the City Engineer. Contraction joints in proposed medians shall match the location of joints in pavement.

Templates shall be 1/4" thick, cut to the configuration of the curb section shown on the plans. Templates shall be secured so that depositing and compacting the concrete does not move them. Unless otherwise shown on the plans, and as soon as the concrete has hardened sufficiently, the templates shall be rounded with an edging tool of 1/8" radius.

Curing. Immediately after the finishing operation has been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured according to Section 501 of AHTD Standard Specifications.

Cold Weather Protection. Cold weather protection shall be as specified in Section 501 AHTD Standard Specifications.

Backfilling. After curing, the curb shall be immediately backfilled to within 4" of the top curb to eliminate any possibility of washing beneath the curb. The remaining 4" shall be topsoil.

Driveway Entrance. At all entrances to residences or commercial buildings the concrete curb shall be removed by saw cutting of either side of the entrance. All driveway entrances shall require a minimum of 2 foot formed and poured transition that will tie to the saw cut curb. Removal of curb by sledgehammer without first saw cutting shall not be allowed. The practice of excavating behind the curb and gutter and then backfilling with the broken curb section concrete is not acceptable. Any backfill shall be Class 7 crushed limestone.

SEC. 500.7 SUBSURFACE DRAINAGE

The requirement for drainage layers, subsurface drainage, and underdrains shall be evaluated by the design engineer on an individual project basis. Pipe underdrains shall be installed at all locations where subsurface moisture will affect the stability of the subgrade or result in unsatisfactory pavement performance.

Special attention is called to the typical need for all streets in cut sections and on hillsides to include subsurface drainage systems. The design engineer shall be required to perform, or acquire, geotechnical and subsurface investigation to determine the need of subsurface drainage for each street and segment thereof to be designed and constructed.

SEC. 500.8 PAVEMENT SECTION DESIGN REQUIREMENTS

Unless specifically authorized in writing by the City Engineer as an exception for a specific project, all pavement sections shall be designed in accordance with the AASHTO Guide for Design of Pavement Structures, latest edition.

In lieu of formal design for "Residential" and "Local" streets the designer may use the minimum criteria as provided in Section 500.9 and Section 500.10.

A minimum design period (traffic analysis/forecast) of 20 years shall be used for pavement section design. A formal traffic study with projections and supporting data shall be submitted for all street classifications to provide minimum ESAL criteria.

All street designs shall use a factor of 4.5 for the Initial (present) serviceability index. All street designs shall use a factor of 2.5 for the terminal serviceability index.

Subgrade soils shall be all materials used for subgrade including in-situ materials and fill materials. The investigation and evaluation of subgrade soils shall be an integral component of all pavement designs and shall include the following minimum requirements:

- A. Geotechnical: All testing and geotechnical work shall be provided by a firm approved by the City Engineer and provided at the expense of the developer or the design engineer. The geotechnical firm shall provide copies of all test results, reports, soils classifications and subsurface drainage requirements directly to the City Engineer.
- B. Sampling and Testing: The investigation and sampling of soils shall conform to AASHTO T 86 (ASTM D420) or latest revision and test procedures referenced therein. The sampling of in-situ subgrade soils may be accomplished by boring or excavation of test pits. The minimum sampling and testing frequency shall be one (1) density test, one (1) liquid limit, one (1) plasticity index, one (1) gradation and soils classification and one (1)

CBR for each 500 feet of street or section thereof, or change in subgrade material, with a minimum of three sets of tests per project. The minimum depth of boring or excavation for in-situ materials shall be four (4) feet below the top of the elevation of the final compacted subgrade. Additional depth shall be required when deemed necessary by the design engineer or the City Engineer.

For import material, the minimum sampling and testing frequency shall be one (1) density test, one (1) liquid limit, one (1) plasticity index, one (1) gradation and soils classification and one (1) CBR per supplier. Said test results shall be within 90 days of import placement and initial testing. If date of information provided is more than 90 days prior to import placement, new samples and testing will be required and results from field density tests will not be accepted until updated information provided.

Additional sampling and tests will be requested when deemed necessary by the City Engineer. The specific locations for all additional samples shall be determined by the City Engineer's representative.

- C. Soil Classification: Subgrade soils shall be classified in accordance with AASHTO system and the Unified Soil Classification system. All tests required for the classification of the soils shall be performed and reported unless specifically waived by the City Engineer.
- D. Load Bearing Strength: Load bearing strength of soils shall be determined by the California Bearing Ratio (CBR) test in accordance with AASHTO T 193 or ASTM D 1883. The frequency and location for samples for CBR tests shall be as noted in Section 500.8 (B) above with the specific sample for the CBR test taken at the proposed finished subgrade elevation.

Subgrade support capacity for all pavements (resilient modulus for flexible pavements and modulus of subgrade reaction for rigid pavements) shall be determined from the load bearing strength (CBR) of the soils based upon the correlation contained in the AASHTO guide for the design of Pavement Structures except where other correlation data are approved in writing by the City Engineer.

(Ord. of 7-20-1999, § 4)

SEC. 500.9 PAVEMENT DESIGN CRITERIA SUMMARY

General Design Requirements

Design period shall be 20 year minimum

Formal traffic study with projections and supporting data shall be submitted for design of all street classifications to provide minimum ESAL criteria

Initial (present) serviceability index factor shall be 4.5

Terminal serviceability index factor shall be 2.5 minimum

All designs shall be in accordance with the AASHTO Guide for Design of Pavement Structures, latest edition

Structural Number Layer Coefficients

| Pavement Materials | Min. Thickness of course (inches) | Structural Coefficient per inch thickness |
|-------------------------------|--|--|
| Asphaltic Concrete Surface | 3 | .44 |
| Asphalt Concrete Binder | 2 | .44 |
| Asphalt Stabilized Base | 4 | .34 |
| Crushed Stone Base (Flexible) | 6 | .14 |
| Crushed Stone Base (Rigid) | 3 | .14 |
| Portland Cement Concrete | 6 | * |

SEC. 500.10 TYPICAL PAVEMENT DESIGNS

In lieu of formal designs, the following minimum street pavement sections may be used; however, the City reserves the right to require a formal design for any street section.

| | Flexible Composite | Rigid* |
|---|---------------------------|------------------|
| 1. Residential Streets (ADT to 1000 and ESAL of 10) | 3" surface 6" base | 6" PC 3" base |
| | (Minimum SN = 3.0) | |
| 2. Local Streets (ADT to 4000 and ESAL of 40) | 3" surface 8" base | 6" PC 3" base |
| | (Minimum SN = 3.0) | |

*All rigid pavement designs require a joint layout plan and associated details.

ALL OTHER STREET CLASSIFICATIONS SHALL REQUIRE FORMAL DESIGN

1. Formal designs may be performed (are encouraged) by the design Engineer to determine specific pavement sections required for specific subgrade and specific project requirements and these designs submitted to the City Engineer for review. Soils testing is required in compliance with the Pavement Design Standards and a minimum acceptable subgrade CBR value of 8 shall be required to utilize the minimum sections shown above.
2. Joint spacing and joint design shall be in accordance with the AASHTO Guide for Design of Pavement Structures.
(Ord. of 7-20-1999, app. B)