ORDINANCE NO. 1473-2014

AN ORDINANCE AMENDING THE CITY OF ANGOLA, INDIANA CODE OF ORDINANCES, TITLE XV: LAND USAGE, CHAPTER 150. BUILDING REGULATIONS, § 150.51 CONSTRUCTION OF STREETS

WHEREAS, the Common Council establishes by ordinance pavement standards and specifications for municipal streets within the jurisdiction of the City of Angola;

NOW, THEREFORE, BE IT HEREBY ORDAINED by the Common Council of the City of Angola, Indiana that the City of Angola, Indiana Code of Ordinances, Title XV: Land Usage, Chapter 150. Building Regulations, § 150.51 Construction of Streets (C) be repealed in its entirety and replaced with the following:

STREET CONSTRUCTION MATERIALS AND SPECIFICATIONS

Section 1. *GEOTECHNICAL ENGINEERING SERVICES AND REPORT*

(A) Geotechnical engineering services shall be performed under the supervision of a Licensed Professional Engineer registered in the State of Indiana. These services include a subsurface investigation, pavement design and preparation of a written report and shall be provided by the Developer of the project. At least one copy of the report must be submitted to the City of Angola for review. The report must bear the seal of the Registered Professional Engineer and must include, but not be limited to, the following:

(1) the AASHTO standards utilized for sampling and testing methods;
(2) graphical boring logs showing boring number, sampling method used, date of start and finish, surface elevation, description of soil and thickness of each layer, soil classification per the AASHTO method, depth to loss or gain of drilling fluid (if applicable), number of blows per foot (N-values) for each sample; and where applicable, depth to cave-in and groundwater elevations during field activities and immediately after drilling, and other lab test results;
(3) a chart illustrating the soil classification and the terminology and symbols used on the soil boring logs;
(4) a location plan showing the locations of the soil borings;
(5) a description of the existing surface conditions and summary of the subsurface conditions;
(6) a summary of all laboratory test results;
(7) recommended pavement section(s), including pavement type, layer thicknesses, etc.;
(8) a summary of the effect of groundwater on the design of the pavements;
(9) construction recommendations including, soil material and compaction requirements for site fill, soil modification/stabilization (if needed), construction backfill, and for the support of pavements;
(10) recommendations for temporary excavation and temporary protection, such as sheeting, underpinning, and temporary dewatering systems (if applicable);

(11) an evaluation of the effect of weather and/or construction on the pavement subgrade during construction.

Section 2. *FIELD INVESTIGATION*

(A) The field investigation needs to be designed to evaluate subgrade soil types, determine groundwater levels, and examine support conditions along the proposed alignment. It should be noted that before any field exploration, the locating and marking of utilities within and around the project area shall be performed at least 48 hours prior to the boring program. Buried utilities must be located prior to any excavation or drilling. It is the responsibility of the geotechnical consultant to contact "Holey-Moley" to locate and mark all known utilities in the area of the borings. Traffic control during the subsurface investigation is also the responsibility of the geotechnical consultant. The sections below summarize the minimum requirements for the field investigation.

(1) *Boring Methods.*

(a) Borings should be advanced using 3¼" I.D. (inside diameter) hollow-stem augers. Samples should be recovered in the undisturbed material below the bottom of the augers using the standard drive sample technique in accordance with AASHTO T-206. A 2" O.D. (outside diameter) by $1^{3}/_{8}$" I.D. Split-spoon samplers are driven a total of 18 inches with the number of blows of a 140-pound hammer falling 30 inches recorded for each 6 inches of penetration. The sum of blows for the final 12 inches of penetration is the Standard Penetration Test result commonly referred to as the N-value (or blow-count). Split-spoon samples should generally be recovered at 2.5-foot intervals to a depth of 10 feet, and at 5-foot intervals thereafter to the termination of the boring.

(b) Boring depths are to be a minimum of 7.5 feet below the design subgrade in cut areas. In fill areas, borings shall be drilled to a depth of 7.5 feet or 1.5 times the fill height (whichever is greater). Boring depths may need to be extended if poor soils are encountered during the investigation.

(c) In general, boring locations should be dictated by topography, proposed maximum cut/fill locations, utilities, and visible surface conditions. However, for planning purposes, borings should be drilled at a maximum spacing of 300 feet and in alternating lanes. Additional borings along the alignment should be drilled to investigate conditions such as filled drainage ways, obvious poor subgrade areas, etc. as determined by the professional engineer.

(d) Groundwater levels must be measured and recorded during boring drilling and after the competition of the drilling process.

(2) *Boring Backfill.* Upon completion of the boring program, borings drilled in "non-structural" (topsoil) areas should be backfilled with auger cuttings. However, if borings are drilled in existing roadway areas, they must be

backfilled with auger cuttings up to a minimum depth of 5 feet below the existing surface and then should be backfilled to one foot below the existing ground surface with bentonite or a material of similar properties. The remaining foot should be backfilled with pavement patch material (asphalt patch for asphalt pavements and quickset concrete for concrete pavements.)

Section 3. *LABORATORY TESTING*

(A) Samples obtained from the soil borings should be taken to a soils laboratory where they shall be classified and have the required soil testing performed. The main purpose behind laboratory testing is to classify and group subgrade material to evaluate support properties and moisture conditions that can affect the long-term pavement performance. Laboratory testing may consist of the following: grain size distribution, Atterberg Limits, moisture content, unconfined compression, California Bearing Ratio, Swell/Consolidation Tests, Loss of Ignition Test, and other tests as deemed necessary.

(1) *Soil Classification.* All samples obtained from the soil borings should be classified according to the AASHTO classification system. All samples shall be visually classified, but classification testing shall be performed on a representative sample from each major soil type. These tests include the Atterberg Limits and sieve and/or hydrometer analyses.

(3) *Moisture Content.* The natural moisture content shall be performed for every cohesive soil sample obtained from the borings. This information is used to evaluate the moisture profile at each boring location. Soil modification shall be considered as a viable option when the in-situ moisture content in the upper 1 to 2 feet of the pavement subgrade is more than 4 percent higher the optimum moisture content. See Section 8 for soil modification requirements.

(4) *Proctor Compaction Tests.* Moisture – density (Proctor) curve should be obtained for soils in cut areas that will be used as fill for the project. A proctor curve may also be needed for soils at the proposed subgrade depth if the soil varies from the cut sections. The modified Proctor compaction test should be performed according to AASHTO T-180.

(5) *Resilient Modulus or California Bearing Ratio.* The pavement design will be based on the soil's resilient modulus (M_r) determined directly from a resilient modulus test or correlated from the California Bearing Ratio (CBR) test using:

$$M_r \text{ (psi)} = 1500 \cdot CBR$$

(a) Most of the soils within the City of Angola consist of clay soil materials (72%), while sands and gravel consist of about 14%. Typical CBR values for these soil types are summarized in the table below.

Table 1: Typical CBR values.

Soil Type	CBR (%)
Natural Clay	3 to 5
Compacted Clay	5 to 7
Natural Sand or Gravel	7 to 15
Compacted Sand or Gravel	10 to 30

(b) CBR and Resilient Modulus testing should be performed in accordance with AASHTO T-93 and T-307, respectively. For most projects, one test should be sufficient. The sample to be tested shall be determined by the geotechnical consultant based on the predominance of the soil type along the alignment and sound engineering judgment. If the CBR is less than two (2), or resilient modulus is less than 3000 psi, soil stabilization shall be used as described in Section 7.

(6) *Other Tests.* Additional testing may be needed depending on the soils obtained from the field investigation. Loss on Ignition (organic content) tests shall be performed in accordance with AASHTO T-267 if samples contain soils identified as peats and/or other organic material with similar organic properties or in an area of known peat pockets in subgrade soils. Other tests, including consolidation, unconfined compression, etc. may be performed if soft clay soils are encountered.

Section 4. *PAVEMENT DESIGN STANDARDS*

(A) *General.* The pavements, which are to be constructed within public right-of-ways, shall be designed to conform to the following standards. The design method shall be based on the 1993 AASHTO Guide for Design of Pavement Structures. Alternatively, the newer Mechanistic-Empirical Pavement Design Guide may be used. The pavement design shall incorporate the results of the subsurface investigation, laboratory testing and anticipated traffic. The pavement section shall be designed by an experienced and qualified engineer licensed in the State of Indiana. The sections below provide guidance for both flexible (asphalt) and rigid (concrete) pavements.

(B) *Asphalt Pavements.* Asphalt pavements shall consist of Hot Mix Asphalt (HMA). Note that there are many different pavement sections that will adequately support the anticipated traffic for the given subsurface conditions. Therefore, the designer has some flexibility in determining the recommended pavement section components based on cost, availability of materials, local practice, etc. Thus, there is no standard pavement section recommended in this ordinance, but the following minimum pavement sections for both Residential and Industrial/Commercial streets are shown in Table 2 below. Underdrains shall be used if the long-term water level is within 2 feet of the bottom of the pavement section. Underdrains shall meet the requirements of INDOT Standard Specification 718 and be installed on both sides of the proposed roadway or street.

Table 2: Minimum Asphalt Pavement Section.

Street Classification	**Minimum Asphalt Pavement Section**
Residential Mixture Type B	1.5 inch - Asphalt Surface – 9.5 mm 3 inches - Asphalt Base – 25 mm 8 inches - Aggregate Base
Industrial and Commercial Mixture Type B	1 inch - Asphalt Surface – 9.5 mm 2 inches – Asphalt Intermediate – 19.0 mm 3 inches - Asphalt Base – 25.0 mm 8 inches - Aggregate Base

The aggregate base layer shall consist of INDOT No. 53 aggregate placed and compacted over a properly prepared subgrade as described in Section 6. Recycled Portland cement concrete may be used in place of No. 53 aggregate provided that it meets the INDOT gradation and class requirements for No. 53 aggregate. The use of recycled Portland cement concrete as aggregate base must be approved by the Street Commissioner and the City Engineer prior to construction.

(C) *Concrete Pavements.*

(1) All concrete pavements shall be jointed reinforced concrete pavements (JRCP) rather than plain jointed concrete pavements (PCP) unless otherwise approved by the City Engineer. A "Joint Plan" showing the longitudinal construction joints and sawed transverse joints as well as the corresponding rebar and dowel reinforcement shall be submitted to the City Engineer prior to construction for approval.

(2) The minimum thickness of concrete pavement for residential streets shall be six (6) inches. The minimal thickness of concrete pavement for all industrial and commercial streets shall be eight (8) inches. All concrete pavements shall be underlain by a minimum thickness of four (4) inches of INDOT No. 53 aggregate sub base. Underdrains shall be used if the long-term water level is within 2 feet of the bottom of the aggregate sub base. Underdrains shall meet the requirements of INDOT Standard Specification 718 and be installed on both sides of the proposed roadway or street.

Section 5. *PAVEMENT CONSTRUCTION STANDARDS*

(A) No work shall begin until the plans have been approved by the Angola Board of Public Works and Safety, and until the contractor meets with the Street Commissioner and the City Engineer.

(1) *Subgrade Preparation.* The pavement area shall be adequately stripped to remove all topsoil and any other organic material. Proof rolling shall be performed to locate any soft or loose areas that need to be treated or removed prior to placement of engineered fill or pavement base course materials. Proof rolling should consist of repeated passes of a loaded, pneumatic-tired vehicle such as a tandem-axle dump truck or scraper. All pumping, spongy, and yielding material, which does not readily compact,

shall be removed from within slope-stake limits and to such depths as necessary. Alternatively, the use of geogrids and compacted aggregate base (INDOT No. 53) may be used to "bridge" marginal subgrade. Geogrids shall consist of Tensar TriAx TX140, TX160, or equivalent and shall be placed on the subgrade and covered by a minimum of 12 inches of INDOT No. 53 aggregate.

(2) All excavations shall be adequately shored to avoid damage to the existing pavement structure, its approaches, adjacent roadway, embankments, tracks, buildings, or other property.

(3) All rock greater than 6 inches in diameter shall be removed or broken off at least 6 inches below the subgrade surface. Holes or depressions resulting from the removal of unsuitable material shall be filled with either INDOT No. 53 aggregate or INDOT No. 2 stone "choked" with 2 inches of INDOT No. 53 stone or B-borrow material and compacted to conform to the surrounding subgrade. During subgrade preparation, adequate drainage shall be provided at all times to prevent water from standing on the subgrade.

(4) The subgrade shall be constructed uniformly transversely across the width of the pavement including shoulders or curbs unless shown otherwise on the plans by compacting the soil to 95% of the maximum dry density determined by a Modified Proctor per AASHTO T-180. Final grading must be performed by a "motor grader" or "CMI" machine rather than a bulldozer or other equipment.

(5) The subgrade shall be checked by the Street Commissioner and the City Engineer for conformance to the approved plans. The contractor may not place any sub base, compacted fill or aggregate on the subgrade until approved by both the Street Commissioner and the City Engineer. See Section 7. if soil modification/stabilization is needed.

(B) *Fill Placement and Compaction.*

(1) All fill should be clean and free of organic material, debris, deleterious materials and frozen soils. Samples of the proposed fill materials should be tested prior to initiating the earthwork and backfilling operations to determine the classification, the natural and optimum moisture contents and maximum dry density and overall suitability as a fill.

(2) All grade-raise fill shall be compacted to at least 95% of the maximum dry density determined by a Modified Proctor per AASHTO T-180. To achieve the recommended compaction of the structural fill, the fill should be placed and compacted in layers not exceeding eight (8) inches in loose thickness.

(3) Care must be exercised during grading and fill placement operations. The combination of heavy construction equipment traffic and excess surface moisture can cause pumping and deterioration of the near surface soils. The severity of this potential problem depends to a great extent on the

weather conditions prevailing during construction. The contractor must exercise discretion when selecting equipment sizes and also make a concerted effort to control construction traffic and surface water while the subgrade soils are exposed. Heavy construction equipment (i.e., dump trucks, scrapers, etc.) be rerouted away from the pavement areas when possible.

(C) *Asphalt Pavements*. Asphalt should be placed and compacted in lifts no greater than three and one-half (3 ½) inches in loose thickness. Tack coats shall be applied in accordance with INDOT Standard Specification No. 406. The HMA mixture shall be compacted with proper equipment, which includes: Three Wheel, Pneumatic Tire, Tandem, or Vibratory Roller. Suggested number of passes for each lift at a maximum of 2.5 mph is listed below, but compaction needs to be approved by a field density test (per Section 7).

(1) Three Wheel – 2 to 4 passes
(2) Pneumatic Tire – 2 to 4 passes
(3) Tandem – 2 passes
(4) Vibratory Roller – 6 passes

(D) *Concrete Pavements.*

(1) The concrete mix and producer must be approved by the City Engineer before construction begins. Concrete shall not be placed on frozen sub base and shall be placed when the ambient temperature is 35°F and above. Placement of concrete pavements shall be by the slip form or formed methods. Concrete shall be thoroughly consolidated against the faces of all forms or adjacent concrete surfaces. Hand placed concrete shall be thoroughly consolidated with the use of a vibrator. Vibrators shall not operate in any one location to bring excessive mortar to the surface, and shall not come in contact with a dowel bar assembly, subgrade, sub base, or forms. Forms may be removed as soon as the concrete has hardened sufficiently.

(2) The paver shall spread, consolidate, and shape the freshly placed concrete in one (1) complete pass to provide a dense and homogeneous pavement. The paver shall be of sufficient weight and power to construct the specified JRCP, at an adequate variable forward speed, and without transverse, longitudinal, or vertical instability. The paver shall be equipped with an automated steering and elevation control system.

(3) The paver shall consolidate by vibrating the concrete for the full width and depth of the pavement. Vibration shall be accomplished by internal vibrators, which have a variable frequency range of 7,000 to 12,000 vibrations per min. The amplitude of vibration shall be between 0.025 inches and 0.06 inches. The vibrators shall be spaced and operated to achieve acceptable consolidation.

(4) The Contractor shall be responsible for the protection of the existing joints from the intrusion of fresh concrete mortar, and for any damage to existing pavement caused by the operation of mechanical equipment. Concrete

materials that fall on or are worked into the joints or surface tines of an existing slab, shall be removed immediately. Concrete shall not be mixed, placed, or finished when the natural light is insufficient.

Section 6. *QUALITY CONTROL / QUALITY ASSURANCE*

(A) Construction field-testing shall be performed by an independent commercial testing laboratory hired by the City of Angola. QC/QA shall be performed throughout the construction phase of the project to ensure quality standards. The following standards shall be followed unless specified otherwise by the Street Commissioner and the City Engineer.

(1) Field density tests shall be performed on compacted base aggregate to make sure proper compaction is reached. Field density tests shall be performed in place using a nondestructive nuclear gage method in accordance with ASTM D6938-10. Frequency of compaction tests shall be no less than every 200 feet in alternating lanes if a two-lane roadway or no less than 200 feet in each direction for a multi-lane roadway on each lift of fill and the required compaction must be obtained on each lift before placing another lift. The location of the compaction tests shall be determined by the Street Commissioner and the City Engineer.

(2) Field density tests shall also be performed on asphalt pavement materials to make sure proper compaction is reached. Field density tests shall be performed in place using a nondestructive nuclear gage method with a frequency at the rate of one test every 200 feet per lane for each asphalt course.

(3) For concrete pavements, an American Concrete Institute (ACI) certified concrete field testing technician, Grade 1, should be on-site to direct all sampling and testing. The fresh concrete shall be monitored during placement for conformance with the plans and specifications. Testing shall include slump, air content and ambient and concrete temperature for each 100 cubic yards (or fraction thereof) of fresh concrete in accordance with the appropriate AASHTO test method listed below.
   (a) Air Test: AASHTO T-152 or ASTM C-173
   (b) Making and Curing Test Specimens: AASHTO T-23
   (c) Sampling Fresh Concrete: AASHTO T-141
   (d) Slump: AASHTO T-119

(4) In addition, four (4) test cylinders shall be cast for compression testing. Two of the cylinders shall be tested at 7 days, and two (2) tested at 21 days.

(5) The contractor and City Engineer will conduct an inspection of the new pavement for any damage, including freezing or random cracks. The inspection and all necessary repairs shall be completed prior to opening the pavement to non-construction traffic.

Section 7. *SOIL MODIFICATION / STABILIZATION*

(A) The purpose of subgrade modification is to create a working platform for construction equipment, which is commonly performed when the subgrade consists of moist soft clays or most loose granular soils. If the in-situ moisture content is more than 4 percent higher than the optimum moisture content, soil modification shall be required. If conditions allow, the moisture content of the subgrade shall be lowered by scarification and air-drying. Otherwise, the use of chemical treatment as indicated in Table 3 shall be performed. The purpose of subgrade stabilization is to enhance the strength of the subgrade. As indicated in Section 4.4, soil stabilization shall be used if the CBR is less than two (2) or the resilient modulus is less than 3,000 psi. The pavement design engineer should refer to the *Design Procedures for Soil Modification or Stabilization* by INDOT for details regarding both soil modification and stabilization. The minimum pavement sections indicated in Table 2 shall still apply even if the soil is modified or stabilized as described below.

(B) When chemical modification or stabilization of subgrade soils is being required, the following criteria may be used for chemical selection based on the index properties of the soils.

Table 3: Criteria for Chemical Selection.

Subgrade Conditions	**Chemical for Modification/Stabilization**	**Typical Quantity by Weight (%)**
Clay content > 20% and PI > 10	Quick or Hydrated Lime	4 to 6
Clay content ≤ 20% and PI ≤ 10	Cement	3 to 6

(C) Note that blends of lime and Class C Fly ash, or cement and Class C Fly ash may also be used based on laboratory testing. The Eades and Grim pH test shall be used to determine the optimum lime content. Laboratory testing shall be performed to determine the appropriate chemical mixture rates and how the soil reacts with the proposed chemicals, especially swelling. The laboratory results must be submitted to the City Engineer for final approval for use in the project. When soil modification is used, it shall be required for the full roadbed width including shoulders or curbs.

(D) The chemical modifier shall be stored and handled in accordance with the manufacturer's recommendations. Mixing of the chemical modifier and soil shall be performed by rotary speed mixers or disc harrow to a depth of 14 inches until a uniform mixture is obtained. Compaction shall begin as soon as practical after mixing. Lime modified soils shall be compacted within 24 hours after mixing, and cement modified soils shall be compacted within 3 hours after mixing. Proofrolling of the treated subgrade is required before placing aggregate base or new fill. Additional testing using a Dynamic Cone Penetrometer may be required as directed by the Street Commissioner and the City Engineer. Pavement materials may not be placed until curing is complete. Additional guidance may be obtained from the INDOT Standard Specifications, Section 215.

PASSED AND ADOPTED by the Common Council of the City of Angola, Steuben County, Indiana this 4th day of August 2014.

Richard M. Hickman

Richard M. Hickman, Mayor

Attest:

Debra A. Twitchell, Clerk-Treasurer

This ordinance presented by me, the Clerk-Treasurer of the City of Angola, Indiana to the Mayor at the hour of 12:12 ~~a.m.~~/p.m. this 5th day of August 2014.

Debra A. Twitchell, Clerk-Treasurer

This ordinance signed and approved by me, the Mayor of the City of Angola, Indiana this 5th day of August 2014.

Richard M. Hickman

Richard M. Hickman, Mayor