

CHAPTER 10: PAVEMENT STANDARDS

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10.00 INTRODUCTION AND GOALS

The purpose of this chapter is to provide guidance for the design and construction of pavements in accordance with criteria and standards established by IDOT and the City of Champaign. The goal is to design and construct pavements that are free from defects and will provide superior long-term performance.

10.01 ADMINISTRATION

This chapter applies to all new and existing public street pavements within the City limits and the 1-1/2 mile extra territorial jurisdiction. The following general guidelines shall apply when designing and constructing pavements:

- A. Pavement thickness for new or reconstructed streets shall meet or exceed minimum thickness requirements established by this Manual.
- B. All pavement designs shall be in general conformance with the City of Champaign Subdivision Regulations and Manual of Practice.

10.02 STANDARDS

- A. **Referenced Standards:** Design and construction standards for pavements shall comply with the requirements of the following standards:
 - 1. IDOT, Bureau of Design and Environment Manual, latest edition.
 - 2. IDOT, Highway Standards Manual, latest edition.
 - 3. IDOT, Standard Specifications for Road and Bridge Construction, latest edition.
 - 4. IDOT, Construction Manual, latest edition.
 - 5. City of Champaign Manual of Practice, latest edition. In case of conflict between standards, the City Manual of Practice takes priority over other standards.
- B. **Subgrade:** The subgrade shall be prepared in accordance with IDOT Standard Specifications for Road and Bridge Construction, except as amended or expanded as follows:
 - 1. *Soils Report:* On all new or reconstructed **arterial** class City streets, it may be required that a Soils Report be prepared by an experienced, independent materials testing firm. The Soils Report should at a minimum include the following: Location & Design section which identifies the projects location, length, existing conditions, existing and proposed pavement typical sections, stations of borings; a Soil Geology section which describes existing soil types and profiles and provides a sieve analysis of each soil boring with grain size distribution plots, Liquid Limits, Plastic Limit, % Sand, % Clay, % Silt, and subgrade support rating; copies of actual boring logs; a soil profile plot based on interpretation of boring logs; and a Conclusion and Recommendation section which includes recommendations for lime stabilization with recommended application rates of lime and water and any other subgrade stabilization alternatives.
 - 2. *Testing:* The following minimum subgrade tests shall be performed according to applicable testing standards:

- a. **Compaction:** The IDOT Standard Specifications for Road and Bridge Construction shall govern subgrade compaction. Moisture density requirements should apply to all embankment construction and to the upper 12 in. of cut sections. Testing should be performed every 100 ft. of roadway with tests alternating between lanes (i.e. 200 ft. intervals in each lane of traffic).
- b. **Subgrade Stability:** The design CBR (California Bearing Ratio) for the City of Champaign is 3%. A CBR of 3% indicates a poor or weak subgrade strength condition, which is typical of soils in Champaign. Subgrade strengths at the time of construction should be at least 6% (CBR = 6%) in the top 12 in. of the subgrade. For pavement designs that do not require a design CBR value, such as in the IDOT BDE pavement design sections, a soil support rating of "poor" should be used. Where appropriate an Illinois Bearing Ratio (IBR) of 2% shall be used for design.
- c. **DCP:** The DCP (Dynamic Cone Penetrometer) is used to estimate the in situ CBR of granular materials and fine-grained soils. The DCP can be used to determine that the recommended subgrade CBR of 6% in the top 12 in. of subgrade is obtained during construction. The DCP used for testing shall comply with the most current ASTM standard. Testing should be performed every 50 ft. of roadway with tests alternating between lanes (i.e. 100 ft. intervals in each lane of traffic).

Prepared subgrades shall be retested after the winter, when significant ponding water has been present, or when the subgrade is significantly saturated with moisture and approved by the City Engineer prior to placement of any paving materials. The City Engineer may require additional testing prior to paving if there are any apparent changes in the subgrade. Refer to Standard Attachment 10.02 for the relationship between DCP and CBR.

- d. **Proof Rolling:** In addition to stability and density testing, the City Engineer may require that the subgrade be "proof rolled" prior to approval of the subgrade and before the placement of base materials. Trucks shall be loaded as follows: 27,000 lbs. on two axles and 45,000 lbs. on three axles with the tolerance not to exceed 10%. A loaded truck shall make a single pass along each lane of street or parking subgrade at distances as directed by the City Engineer and not to exceed 10 ft. apart. Any areas of the prepared and compacted subgrade which show rutting, cracking, or rolling upon test rolling will be marked as unsuitable and will not be accepted. The unsuitable areas shall be removed and reconstructed as directed in this Chapter. Additional DCP's may be required to better define the area of deficiency.
3. **Remediation:** If subgrade compaction and stability requirements cannot be met, then, with the approval of the City Engineer, the following remediation methods shall be executed.
- a. **Unsuitable Material:** Unsuitable material in **untreated or unstabilized** subgrade shall be removed to a minimum depth of 12 in., with additional material removal as required by the City Engineer. The resultant void shall be backfilled with embankment material and compacted. The use of

additional stability methods, such as coarse aggregate and geofabrics, may be required by the City Engineer.

Unsuitable materials in **treated or stabilized** subgrades shall be removed and replaced with course aggregate. After the subgrade has been treated or stabilized, the Engineer will use a DCP to test the compacted subgrade and will determine the locations of unsuitable material that will need to be removed. The contractor shall remove the unsuitable material to a minimum depth of 18 in. with additional material removal as required by the City Engineer. The removed material shall be disposed of in accordance with Article 202.03 of the Standard Specifications. The resultant void will be backfilled with a minimum of 12 in. of coarse aggregate with a gradation of CA-1 and capped off with a minimum of 6 in. of coarse aggregate with a gradation of CA-6. The CA-6 depth should always be placed at a depth of 6 in.; however, the CA-1 depth may increase depending on the depth of unsuitable material removal. The coarse aggregate shall meet the requirements of Section 1004 of the Standard Specifications. Compaction of the coarse aggregate shall be performed to the satisfaction of the Engineer.

The use of additional stability methods, such as geofabrics, may be required by the City Engineer. If fully saturated conditions exist, underdrains may be required to dewater the subgrade.

- b. Lime Stabilization: Lime stabilization is recommended for remediation by the City when the Soils Report indicates that existing roadbed soils are lime reactive. The lime shall be mixed to a minimum depth of 12 in. and shall follow IDOT’s Standard Specification for Lime Stabilized Soil Mixture. Laboratory evaluation and design procedures for lime reactive soils shall follow all procedures and guidelines outlined in the latest edition of the IDOT Geotechnical Manual. Specifically, evaluation and design procedures should follow Attachment II-B, Method A of the Geotechnical Manual. The design lime content is the amount used for construction and shall be 1% above the minimum lime content. The minimum lime content is the value which provides a compressive strength gain of 50 psi over that of the untreated soil, and provides a minimum average compressive strength of 100 psi for the treated soil. Soils that do not meet these minimum requirements will not be considered for lime stabilization.

C. Pavements

- 1. *Residential Street Thickness Standard:*

Street Type	Full-Depth Asphalt Minimum Thickness	PCC Minimum Thickness
Local	9 in.	7 in.
Collector	9 in.	7 in.
Arterial	*	*

* Refer to Section 2., “Arterial Class and Industrial / Commercial Streets”, below.

Note: As per Standard Attachment 25.01, four legged intersections shall be thickened by 1 in.

2. *Arterial Class and Industrial / Commercial Streets:* These pavements shall be design pavements. Structural design for new pavements shall be in accordance with the IDOT's Bureau of Design and Environment Manual (BDE), Chapter 54, "Pavement Design." All pavement design calculations shall be submitted to the City Engineer for review and approval.
 - a. Rigid Pavements: Structural design of rigid pavements, including joints and joint placement, shall be in accordance with Section 54-4.01, "Mechanistic," of the BDE Manual except modified as follows:
 - i. Use subgrade support rating of "poor".
 - ii. Minimum design period is 30 years.
 - b. Flexible Pavements: Structural design of flexible pavements shall be in accordance with Section 54-5.01, "Mechanistic," of the IDOT BDE Manual except modified as follows:
 - i. Use subgrade support rating of "poor".
 - ii. Full-depth asphalt pavements shall be used exclusively.
 - iii. Minimum design period is 30 years.
3. *Curb & Gutter:* Refer to Chapter 8, Table A. The standard curb and gutter for all new local and collector class street construction is the IDOT B6.18 curb and gutter, except for boulevard median curbs that shall be IDOT B6.12. Curb and gutter for arterial class streets shall be a design option specific to the needs of the project.
4. *Minimum Transverse Slope:* As per Chapter 8, the minimum transverse slope shall be 3/16 in. per ft. As per the IDOT Highway Standard Drawing 606001-01, the minimum transverse cross slope on the pan of the gutter shall be 6% or 3/4 in. per ft. The minimum thickness of the curb shall be the same as the minimum thickness for the pavement throughout the curb.

D. Materials

1. *Portland Cement Concrete (PCC) Pavement:* Materials for Portland cement concrete shall conform to the IDOT Standard Specifications, except as amended or expanded as follows:
 - a. The maximum slump of PCC shall be 4 in. The slump may exceed four inches with an approved concrete mix design and with prior approval from the City Engineer. The maximum slump for slip forming methods shall not exceed 2 in.
 - b. Portland cement concrete must be produced at an IDOT-approved plant using IDOT currently approved materials for the IDOT-approved mix design.
 - c. An IDOT approved mix design specification sheet must be provided to, or on file with and approved by the City Engineer prior to use of the PCC mixture for pavement construction.
2. *Full-Depth Bituminous Concrete Pavement:* Materials for full-depth bituminous concrete pavement shall conform to the Standard Specifications for Bituminous Concrete Pavement (Full-Depth) except as amended or expanded as follows:

- a. All proposed bituminous binder and surface courses shall be designed in accordance with Superpave mix design procedures and be approved by IDOT. Evidence of IDOT approval must be submitted to the City Engineer.
- b. The bituminous surface course shall be modified with polymers unless directed otherwise by the City Engineer.
- c. An IDOT approved Quality Control / Quality Assurance (QC / QA) Plan must be submitted to the City Engineer prior to the use of a Superpave mix for pavement construction.
- d. QC / QA testing is required for all bituminous mixes on arterial class streets.
- e. Bituminous materials must be produced at an IDOT approved plant using IDOT approved materials for the IDOT approved mix design.

E. Construction

- 1. *Portland Cement Concrete (PCC) Pavement:* Construction of PCC pavement shall conform to the Standard Specifications, except as amended or expanded as follows:
 - a. The contractor shall protect the pavement against all traffic, including that of their own employees or other workers on the site, until test specimens have attained the flexural or compressive strength as specified.
 - b. The contractor is responsible to guard fresh concrete until it sets and hardens sufficiently to prevent people from writing, walking, riding bicycles or otherwise marking, defacing, or causing depressions of any type in the concrete in a permanent fashion. Any concrete so marked will be removed and replaced by the contractor at the contractor's expense.
 - c. Joints in all residential local and collector streets shall be constructed in accordance with the PCC Pavement Details and Joint Layout Details of this Chapter (See Standard Attachment 10.01), together with the following requirements:
 - i. Joint inserts or dummy joints are expressly prohibited.
 - ii. Sawing of joints shall commence as soon as the concrete has cured and hardened sufficiently to permit sawing without excessive raveling, but no later than eight hours after the concrete has been placed. All joints shall be sawed to the full depth as shown in the standard details at the end of this chapter, and before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall occur during the day or at night, regardless of weekends, holidays, or weather conditions. Contractors should make themselves aware of City noise ordinances and holiday restrictions.
 - iii. Joints shall be filled with approved Joint Sealer, approved Preformed Joint Filler, and/or approved 5 cell Preformed Elastomeric Compression Seals, depending on the type of joint.

- iv. Portland cement concrete curb and gutter shall be constructed in accordance with IDOT Standard Specifications.
 - v. Tie bars may be omitted along longitudinal joints on local streets (≤ 28 ft. wide) except that bars must be used on all “stand alone” tied curb and along all longitudinal “cold” construction joints.
 - vi. Jointing adjacent to manhole casting lid assemblies and curb frame and grate assemblies shall follow Standard Attachment 25.01.
2. *Full-Depth Bituminous Concrete Pavement:* Construction of full-depth bituminous concrete pavement shall conform to the Standard Specifications, except as amended or expanded as follows:
- a. Portland cement concrete curb and gutter shall be constructed in accordance with IDOT Standard Specifications.
 - b. The bituminous concrete surface course shall have a minimum thickness of 1-1/2 in.
 - c. Refer to Standard Attachment 10.03 for termination detail for bituminous concrete pavement.

F. Testing

1. *Portland Cement Concrete (PCC) Pavement:* Testing of PCC pavement shall conform to the Standard Specifications, except as amended or expanded as follows:
- a. Compression tests of the concrete are required as described in the IDOT Construction Manual and as specified as follows:
 - i. The testing method shall be AASHTO T23 and AASHTO T22, except that 6 in. by 12 in. cylindrical specimens may be used. Note: 2 cylinders are required for an approval test.
 - ii. The testing frequency is two tests with two cylinders per 250 ft. per lane, or four cylinders per day, whichever is greater.
 - iii. Test specimens shall attain a minimum compressive strength of 3,500 lbs. per square inch (psi) in 14 days or sooner.
 - iv. When evaluating deficient concrete strength, the current ACI Building Code Requirements for Structural Concrete (see Evaluation and Acceptance of Concrete—Laboratory-Cured Specimens) shall be followed.
 - b. Flexural strength tests of the concrete shall comply with IDOT, “Manual of Instructions for Concrete Proportioning and Testing”, three point testing method and as follows:
 - i. The testing frequency shall be 2 tests with 2 beams per 250 ft. per lane, or 4 beams per day, whichever is greater.
 - ii. Test specimens shall attain a minimum flexural strength of 650 lbs. per square inch in 14 days or sooner.

- c. Test specimens must be clearly marked to indicate the following:
Name of the Subdivision (if applicable), Engineer, Street Name, Pavement Location, Date and Time, Material Supplier, Air Content, Slump, Air Temperature, Concrete Temperature, Mix Design Number.
 - d. Upon request of the City Engineer, surface smoothness tests may be required. Tests shall be conducted per the most recent IDOT standard spec that includes straight edge (surface smoothness) test procedures.
2. *Full-Depth Asphalt Concrete:* The following tests shall be made when constructing full-depth asphalt concrete pavement:
- a. Density: Compaction tests must be made in accordance with Section 406.16 of the Standard Specifications. If the in-place lift density is found to be deficient, subject to the approval of the City Engineer, the owner shall either:
 - i. Remove and replace the deficient sections to the required pavement strength; or,
 - ii. Post a three year cash bond in the amount of 100% of the estimated cost to remove and replace the deficient pavement. The cost shall be estimated for the end of the review period, i.e. inflate the cost. The bond form shall be approved by the City Attorney.
 - iii. Refer to Section G below for pavements constructed out of specification.
 - b. Thickness: Pavement cores for verification of pavement thickness shall be taken at the rate of 1 per 250 ft. per lane at locations designated by the City Engineer. If pavement thickness is deficient, subject to approval of the City Engineer, the subdivider shall either:
 - i. Remove and replace the deficient pavement section(s) to the planned thickness; or,
 - ii. Pay to the City an amount based upon the amount which would have been deducted from a contractor's payment for the work, pursuant to Section 407.10 of the Standard Specifications as now or hereafter amended.
 - iii. Refer to Section G below for pavements constructed out of specification.
 - iv. Pavement deficiencies of thickness in excess of 10% shall be removed and replaced to plan thickness.
 - c. Upon request of the City Engineer, surface smoothness tests may be required. Tests shall be conducted per the most recent IDOT standard spec that includes straight edge (surface smoothness) test procedures.

G. Pavement Constructed Out of Specification

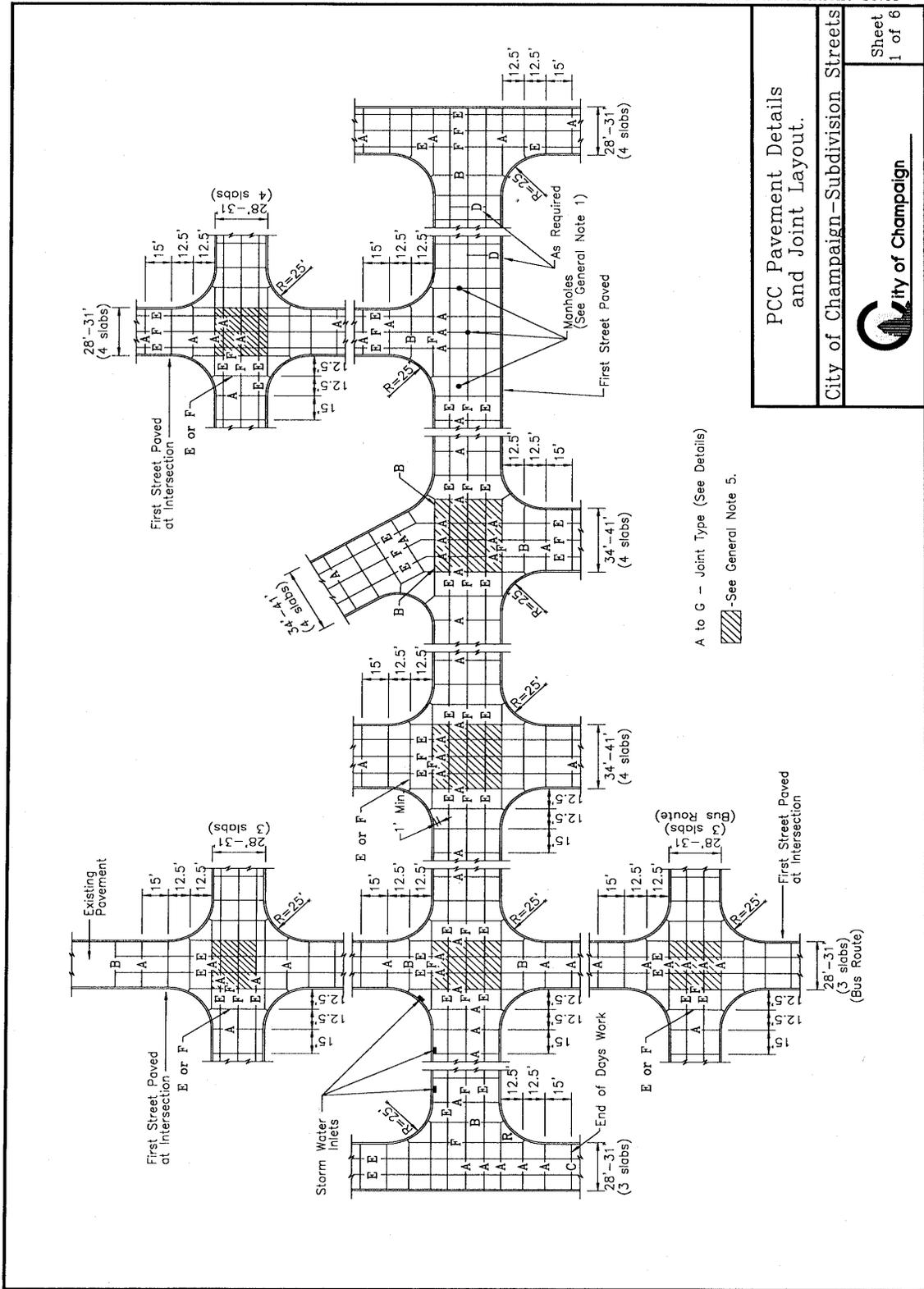
- 1. The City Engineer shall determine if pavement is out of specification by reviewing the materials, testing, strength, appearance, etc. While it is understood that random cracks may appear in concrete pavement, this should be a rare

occurrence. Cases of numerous cracks, shrinkage or otherwise, shall be subject to removal and replacement per the direction of the City Engineer. At the discretion of the City Engineer, pavements with moderate defects may be secured by a long-term bond in lieu of removal.

2. Bonds for securing repair and replacement of pavement initially failing to meet standards shall meet the following criteria:
 - a. If the subdivider is allowed to post a bond in lieu of repair and replacement of pavement which does not meet the design and testing criteria set forth in these regulations, the bond shall secure the removal and replacement of the deficient pavement within 60 calendar days of the City's demand to replace the same.
 - b. If at any time within the three year bond period, two or more random cracks, shrinkage cracking, spalling, or durability cracking appear within a panel of Portland cement concrete pavement, that panel shall be removed and replaced.
 - c. If at any time within the three year bond period, two or more cracks, raveling, or stripping appear within a section of full-depth asphalt concrete pavement that entire section shall be removed and replaced to the full thickness of pavement.
3. The bond shall be secured by cash in an amount equal to 100% of the City Engineer's estimate of removal and replacement costs. The bond and security shall be in a form approved by the City Attorney.
4. The bond shall be executed by the subdivider or the subdivider's contractor.

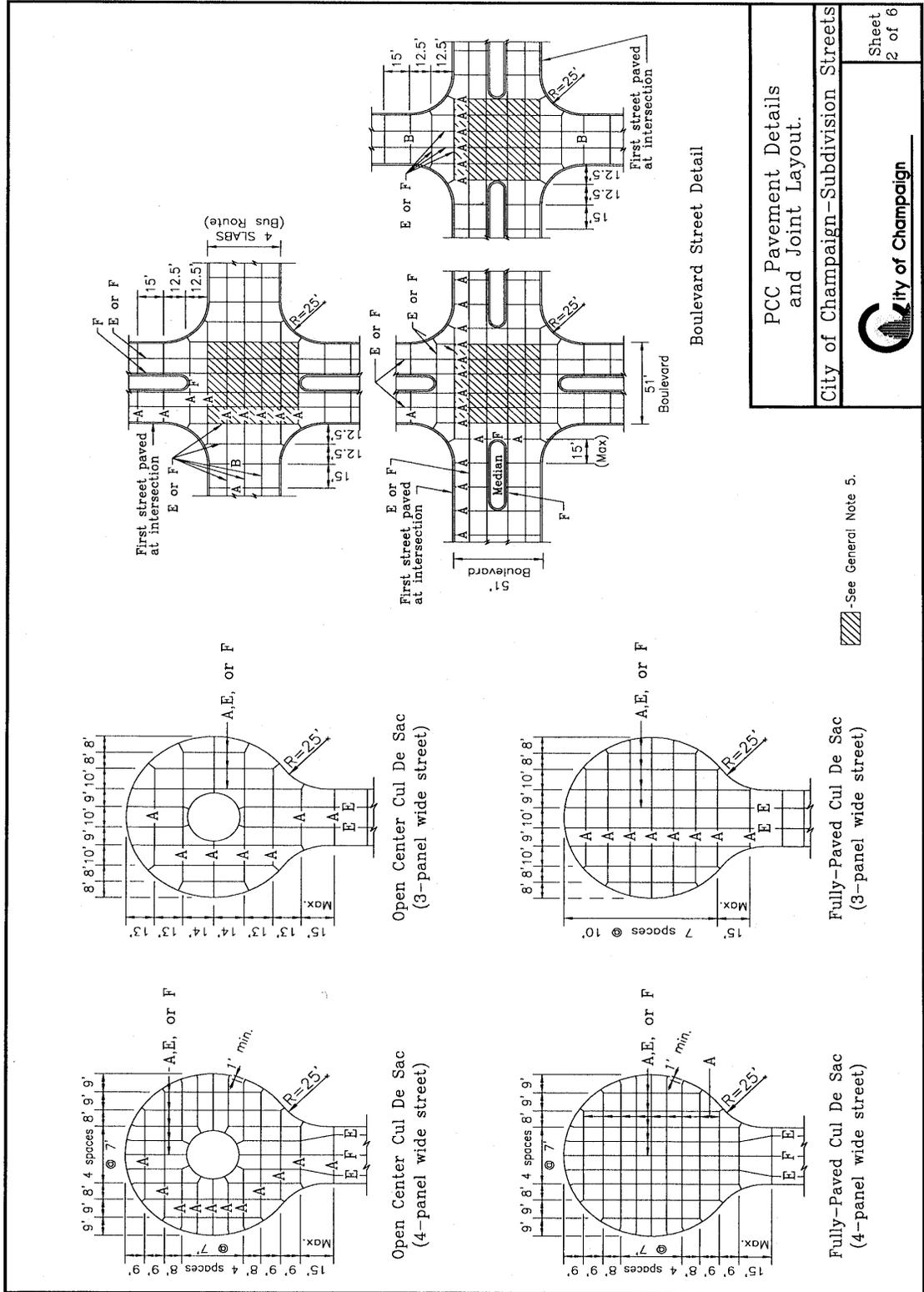
10.03 STANDARD ATTACHMENTS

- Standard Attachment 10.01 – PCC Pavement Details and Joint Layout (6 pp.)
- Standard Attachment 10.02 – CBR & Dynamic Cone Penetrometer Relationship
- Standard Attachment 10.03 – Asphalt Pavement Termination Detail



A to G - Joint Type (See Details)
 [Hatched Pattern] - See General Note 5.

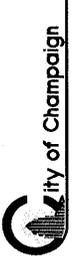
PCC Pavement Details and Joint Layout.	
City of Champaign - Subdivision Streets	
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-See General Note 5.

PCC Pavement Details
and Joint Layout.

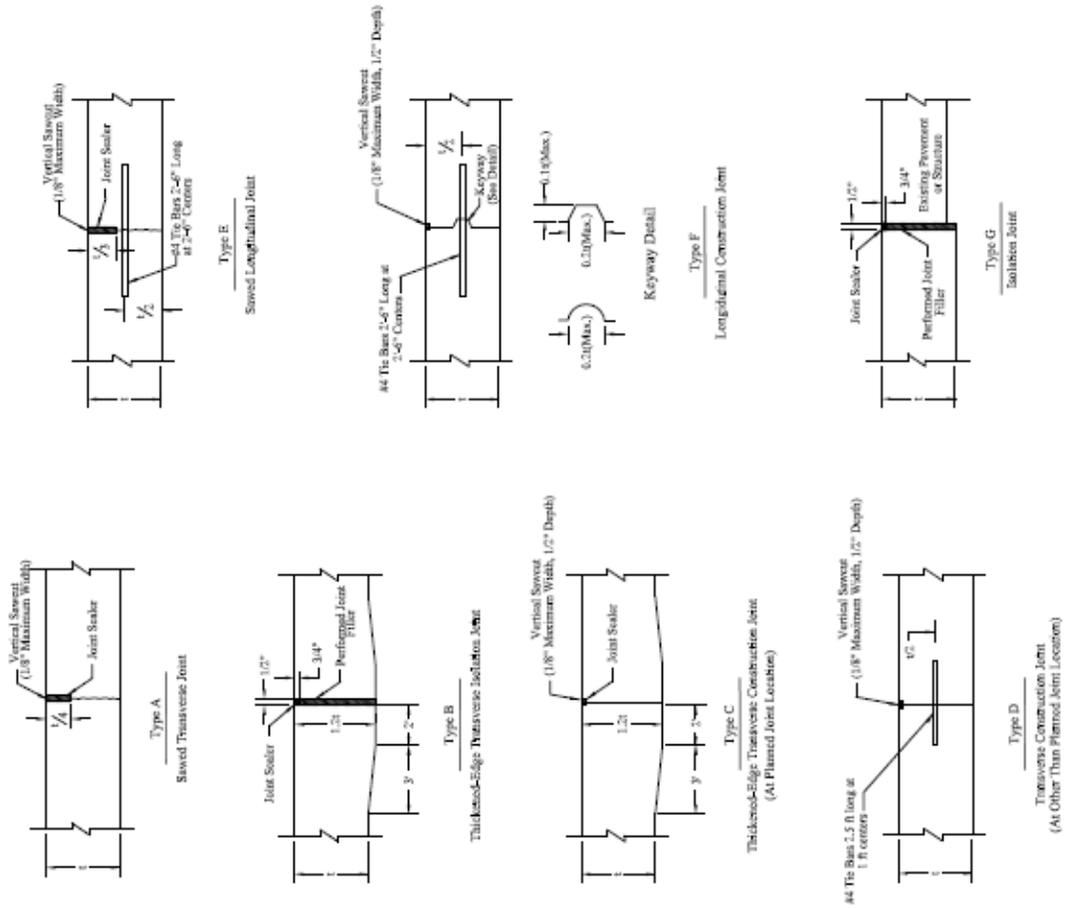
City of Champaign-Subdivision Streets



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General Notes

1. Pavement slabs with manhole castings within the pavement limits shall be jointed as shown in the details.
2. All transverse joints must be continuous across the pavement and extend through curbs, except tied transverse construction joints.
3. Transverse joint spacing shall not exceed 15 feet.
4. All joints must be sealed with joint sealer meeting the requirements of Section 750 of the Illinois Department of Transportation "Standard Specifications for Road and Bridge Construction."
5. The pavement thickness at the intersection of four-legged intersections shall be increased by 1 inch over that of the thickest adjacent pavement structure.



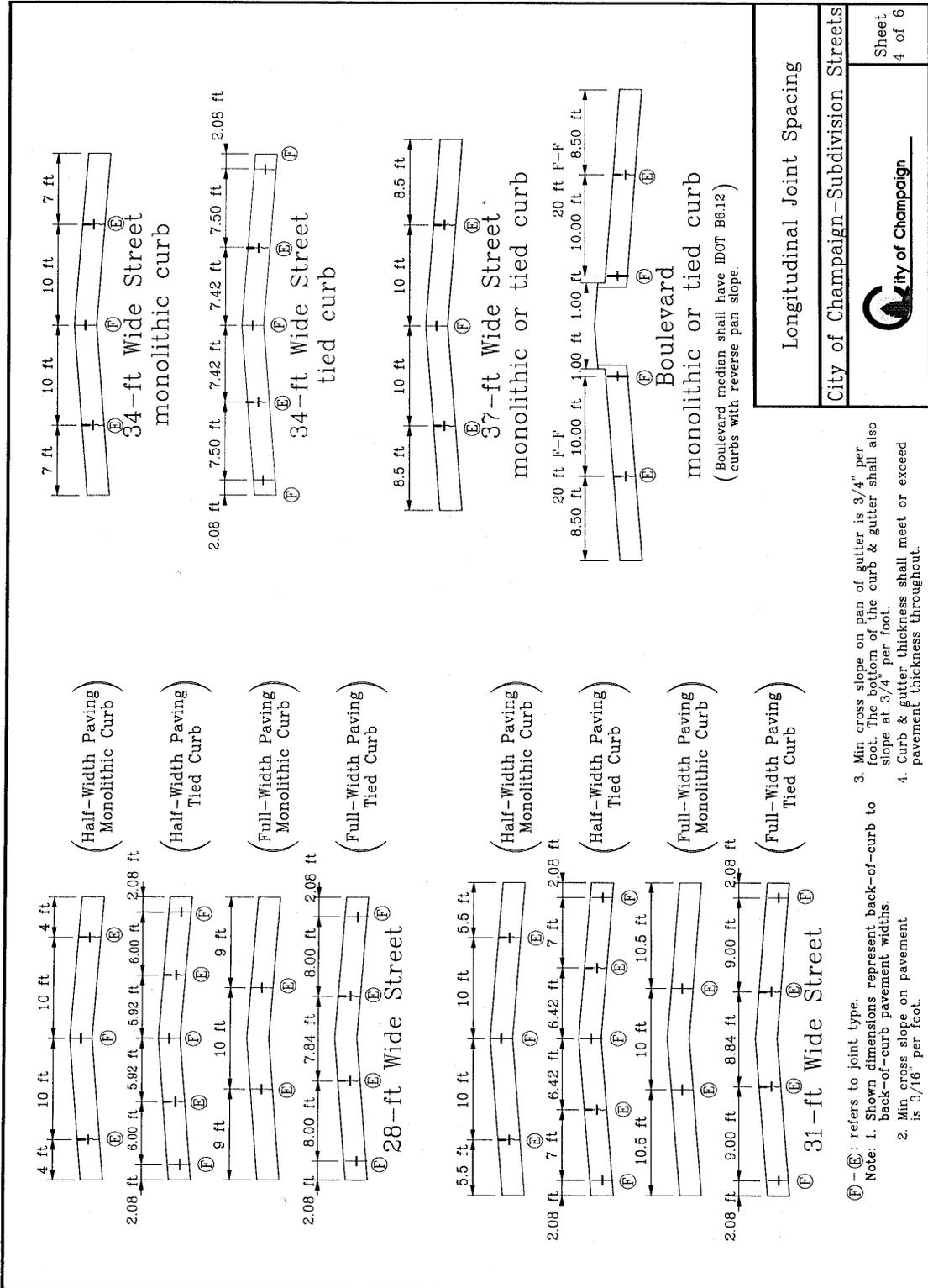
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PCC Pavement Details
and Joint Layout.

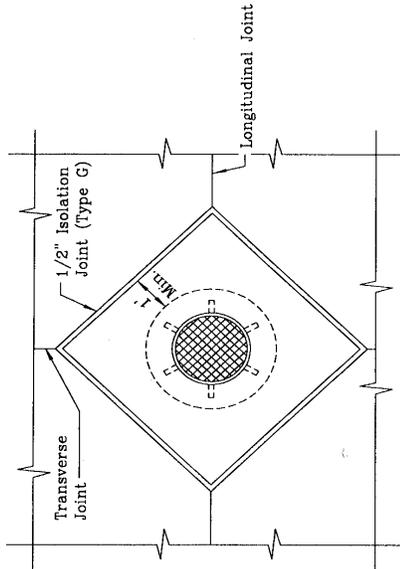
City of Champaign-Subdivision Streets



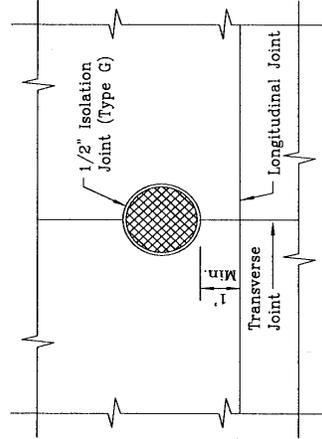
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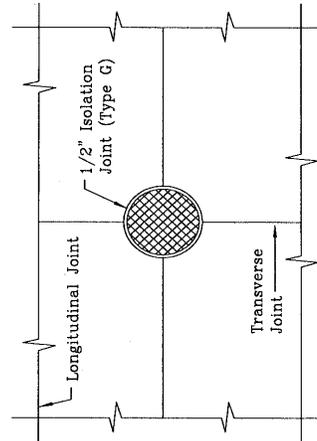
Longitudinal Joint Spacing	
City of Champaign-Subdivision Streets	
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Detail of Manhole Located At Intersection of Joints (Manhole With Flanges)



Detail of Manhole Located At A Transverse Joint



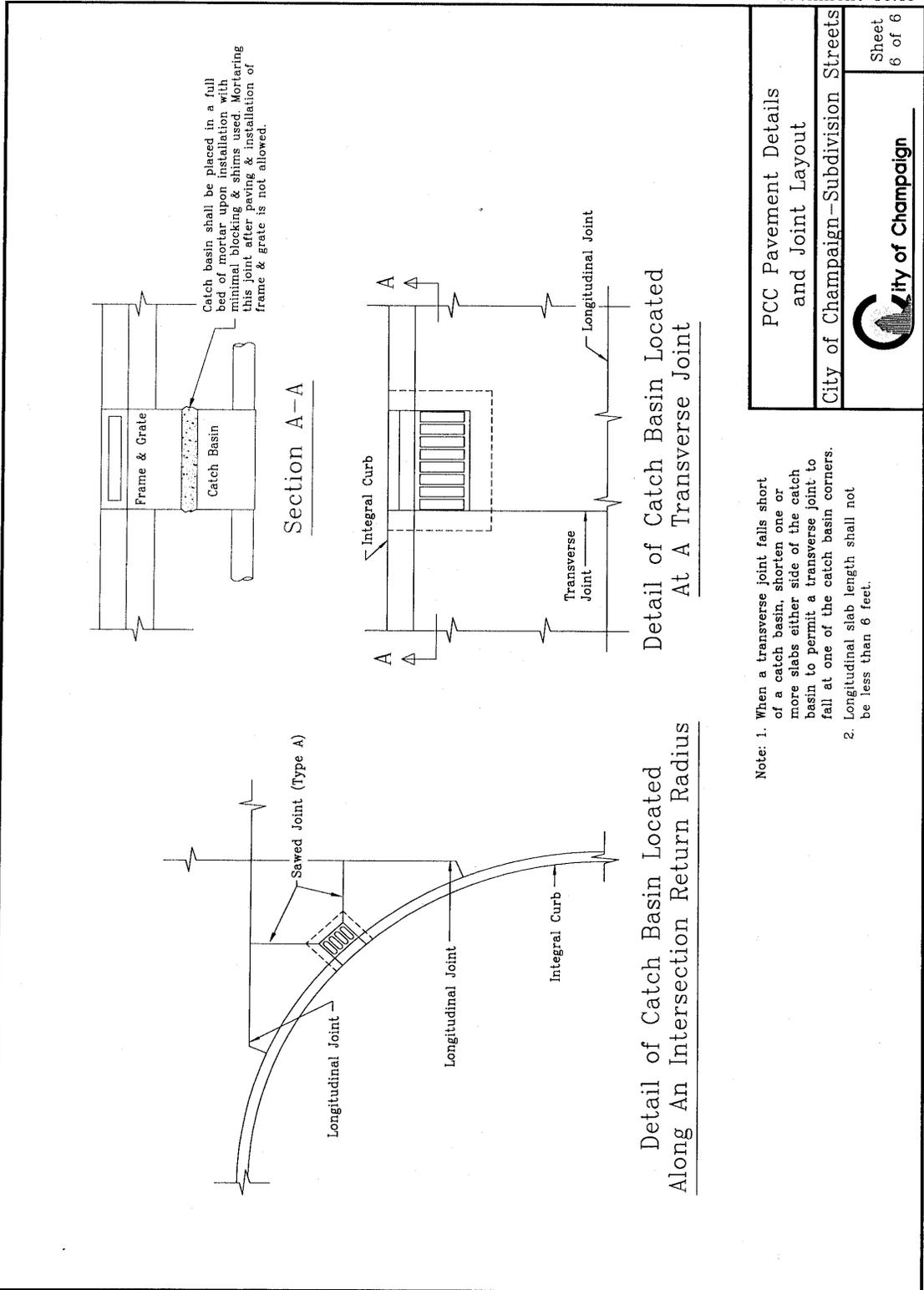
Detail of Manhole Located At Intersection of Joints (Manhole Without Flanges)

- Note: 1. Details for non-telescoping manhole castings.
 2. The transverse joint spacing shall be shortened on one or more slabs on either side of the manhole to permit a transverse joint to fall at the center of the manhole.

PCC Pavement Details and Joint Layout

City of Champaign-Subdivision Streets

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Note: 1. When a transverse joint falls short of a catch basin, shorten one or more slabs either side of the catch basin to permit a transverse joint to fall at one of the catch basin corners.
 2. Longitudinal slab length shall not be less than 6 feet.

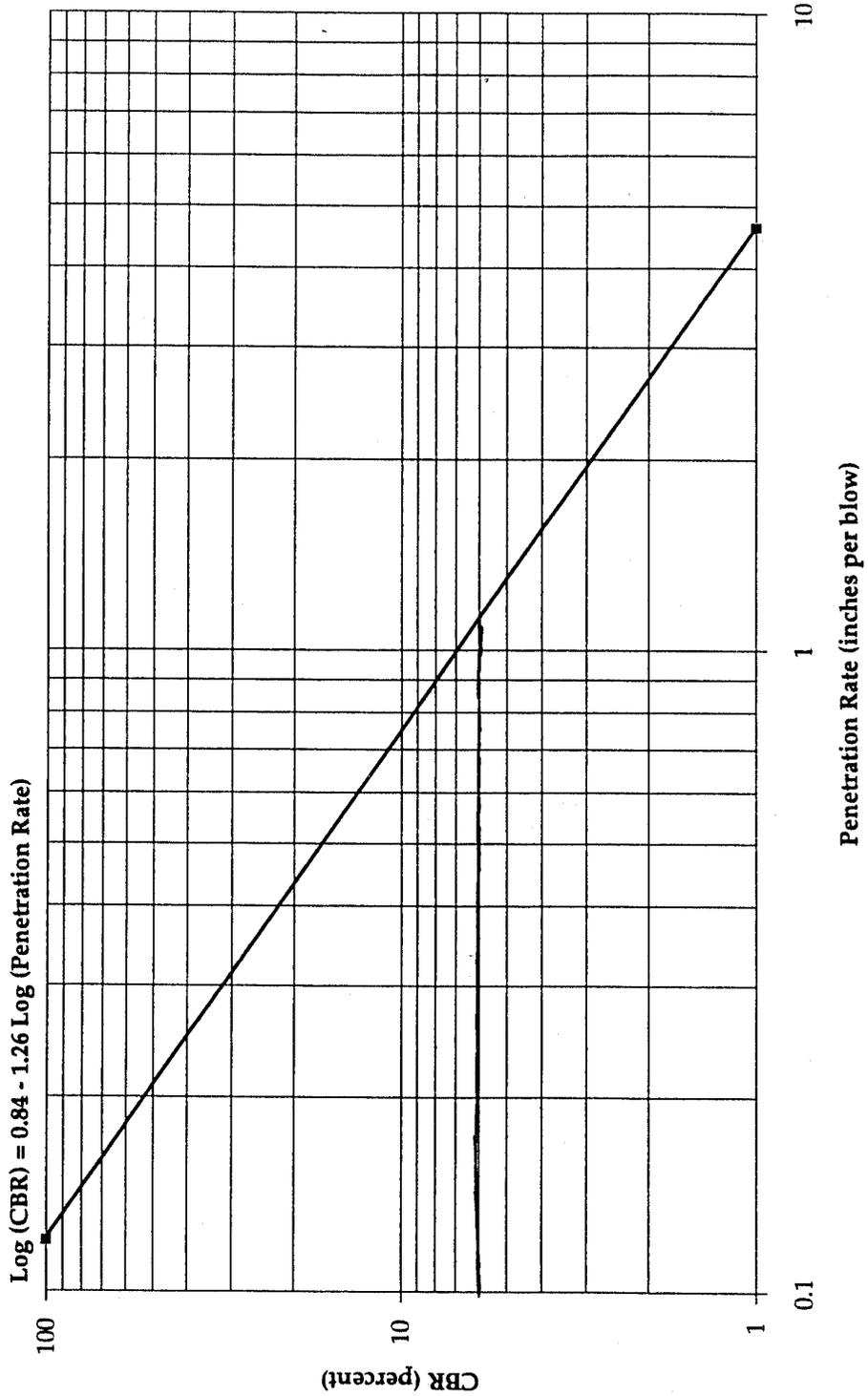
PCC Pavement Details and Joint Layout

City of Champaign - Subdivision Streets

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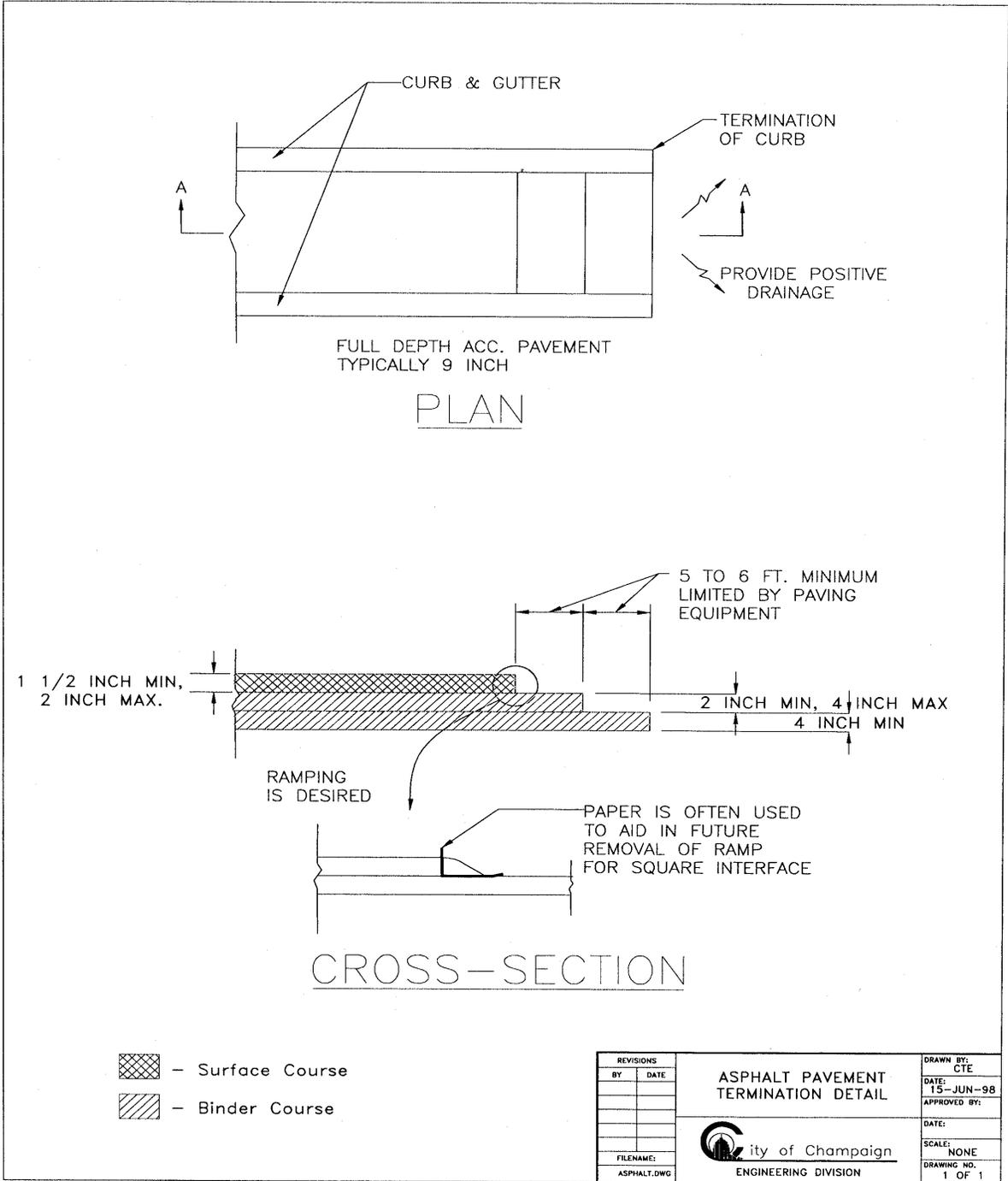
Figure 3.4. CBR - Dynamic Cone Penetrometer Relationship.



$\text{Log}(6) = 0.84 - 1.26 \text{Log}(P_n)$
 $.077815 = 0.84 - 1.26 P_n$
 $\text{Log } P_n = 0.04909$
 $P_n = 10^{0.04909} = 1.12 \text{ in. per blow} = 0.893 \text{ blow per in.} = 10.72 \text{ blow per ft.}$

CHAPTER 10: PAVEMENT STANDARDS

Standard Attachment 10.03



Standard Attachment 10.03