

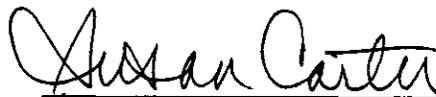
RANDOLPH COUNTY ROAD STANDARDS

Prepared for:
Randolph County Commission

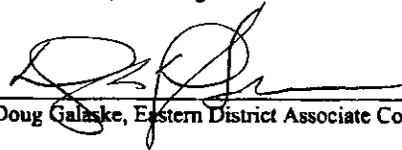
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I. INTENT OF RANDOLPH COUNTY ROAD STANDARDS:

It is the intent of the Randolph County Commission to develop a County Road Standard for the construction of all new roads which will be maintained by Randolph County. Any development which will create new roads or increase traffic on existing roads shall construct/upgrade all directly impacted roads to the specifications herein.

II. ENGINEERING REQUIREMENTS

Documents:

- 1) **Plat:** The plat included in the legal requirements shall be sufficient.
- 2) **Grading Scheme:** Engineering plans showing existing ground as well as proposed final construction grade are required.
- 3) **Physical Features:** Physical features such as water courses, ravines, bridges, culverts and structures both present and proposed shall be indicated along with proposed methodology of handling runoff. Also show existing utilities.

III. DESIGN REQUIREMENTS

A) Geometric Design Guides

- 1) Deed Right-of-Way shall be a minimum of 60 feet, additional as required by topography. Also drainage easements for maintenance shall be included.
- 2) Minimum width of Roadway Base shall be 26 feet and minimum width of Driving Surface shall be 24 feet.
- 3) All dead ends must have a Cul-de-Sac with a minimum radius of 42 feet.
- 4) Roadway shall have a minimum grade of 0.5 percent and a maximum grade of 10 percent (*unless documentation of undue hardship is presented to the commission and a variance is granted*).
- 5) Minimum site distance shall be 150 feet.
- 6) Curves shall have a minimum radius of 275 feet.

- 7) Minimum K-values shall be 30 for crest vertical curves and 40 for sag vertical curves. *K value is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in feet of vertical curve which will provide minimum sight distance.*
- 8) Crown & Superelevation
 - Crown on straight roads to be 3% on aggregate and D.A.S.T. roadways.
 - Crown on straight roads to be 2% on asphalt and concrete roadways.
 - Superelevation shall not exceed 0.06 ft/ft, with a superelevation runoff length from 50 to 100 feet. *(Superelevation not required on subdivision type development which enters into a feeder road).*
- 9) Radius for curves at intersections to be 40 feet. Radius at private entrances to be 12 feet, or a 10 foot taper. Entrance widths shall have a minimum width of 10 feet at R/W line *(see attached drawing)*. Intersections of proposed roads into existing feeder roads shall occur at a approximately 90 degrees.
- 10) Slope Grades
 - In slopes: 3:1
 - Back slopes: 3:1
 - Fill slopes: 3:1

B) Projected Traffic Volumes

Roadways to be constructed to serve new developments should be designed to accommodate projected traffic volumes based on the full development and the table below. Allowable ADT volumes given in surface specifications are based on ten percent of ADT being truck traffic. If a development is expected to increase truck traffic above ten percent of the design ADT, roadway cross-sections will be approved on a case-by-case basis.

A truck is defined by AASHTO as any vehicle having a 9,000 lb. or greater gross vehicle weight (GVW) rating of the manufacturer and vehicles having dual tires on the rear axle.

Weekday Vehicle Trip Generation for Selected Land Uses (Given as Trip-ends)		
Single-Family Detached		9.6/DU
Residential Planned Unit Development		7.4/DU
Residential Condominium/Townhouse		5.8/DU
Apartment		6.5/DU
Mobile Home Park		4.8/DU
General Office Building		
	10,000 ft ² Gross Floor Area	24.6
	50,000 ft ² Gross Floor Area	16.6
	100,000 ft ² Gross Floor Area	14.0
	200,000 ft ² Gross Floor Area	11.9
	500,000 ft ² Gross Floor Area	9.5
Shopping Center (Excluding Christmas Season)		
	100,000 ft ²	70.1
	500,000 ft ²	38.7
	1,000,000 ft ²	32.1
Business Park	14.4/1,000 ft ² Gross Floor Area	
Industrial Park per employee	3.3/employee	
County Park	3.0/acre	

Trips generated by General Office Building and Shopping Center are per 1,000 square feet. Trips generated may use linear interpolations or the graphs provided in the appendixes of this document. For purposes of this manual weekday trips will be considered the average daily trip (ADT).

DU: Dwelling Unit

One lot with a single family dwelling = 1DU

Example: A road providing access to 40 lots with single family homes will carry 40DU
 $40 \times 9.6 = \text{ADT of } 384$

One lot with a multi-family unite = 1DU/unit

Example: a duplex = 2DU, an apartment complex with 20 apartments = 20DU

C) Grade & Subgrade

All grading and subgrade preparation shall comply with applicable sections of Section 203 of *The Missouri Standard Specifications for Highway Construction*. A few applicable sections have been listed below. Although this list is not all inclusive, it will be sufficient for most projects within Randolph County.

203.4.1.3 Grading for Aggregate Type Surface Roadway. If a roadway to receive an aggregate-type surface is specified in the contract, reasonable tolerance in alignment, grade and cross-section will be permitted. A reasonable tolerance in alignment will be defined as a maximum gradual deviation of 2 feet, free from sharp breaks, made in the interest of economy and to take advantage of favorable topography. A reasonable tolerance in grade will be defined as final grade that is uniform in appearance, free from sharp breaks or humps, and within 6 inches of plan grade if such tolerance results in economy to the Commission. Economy to the Commission will not refer to each individual cut, but to the cuts that are below grade and the compensating feature of cuts that are left above grade. Loose rock on the finished subgrade over 2 inches in size shall be removed, picked up and disposed of as directed by the engineer.

203.4.16 Placement of Embankment. Roadway embankment shall be placed in layers not exceeding 8 inches, an uncompacted measurement, and shall be compacted as specified before the next layer is placed. The layers shall be placed approximately parallel to both the proposed profile grade and to the finished roadbed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. Continuous leveling and manipulating will be required during compacting operations. Construction equipment shall be routed uniformly over the entire surface of each layer. Occasional rocks and boulders greater than 24 inches shall be dispersed to allow for uniform compaction between them.

203.5.8 Compacting in Cut. Cut compaction shall be performed in all Class A material areas after removal of the roadway excavation material to the required section. A surface parallel to the pavement slope, 12 inches below the bottom of the pavement or lowest bare course, shall be temporarily exposed for the full width between roadway in slopes. The exposed material shall be manipulated and compacted to no less than the required density to a depth of 6 inches. The material above this compacted plane shall be spread in layers not exceeding 8-inch loose thickness, each layer being wetted or dried as necessary and compacted to the specified density. The entire volume of material so handled and compacted, including the 6-inch layer compacted in place, will be considered as Compacting in Cut. All Class A material having a liquid limit of 40 or more, including the 6-inch layer compacted in place shall be compacted at no less than the optimum moisture content.

203.6 Compaction of Embankment not constructed with Density or Moisture and Density Control. If compaction of embankment is a requirement of the contract but has not been specified as a pay item, the compactive effort on each layer shall consist of distributing all equipment movements over the entire embankment area and of at least three complete passes with a tamping-type roller over the entire area to be compacted. The tamping-type roller shall have tampers or feet projected no less than 6 inches from the surface of the drum and shall have a minimum load on each tamper of 250 psi of tamping area. Compactive efforts shall be continued, if necessary, until the tamping feet penetrate no more than 2 inches into the layer of material being compacted. Continuous leveling and manipulating will be required during compacting operations and the moisture content shall be adjusted as necessary, in the judgment of the engineer, to permit proper consolidation.

The County reserves the right to reject any embankment material that does not provide the required physical properties to construct a stable roadbed. Acceptance or rejection of material will be based on visual inspection. The inspector should acquaint himself with the compaction equipment to be certain adequate compactive effort is being exerted. Any questionable material shall either be rejected or tested, at the cost of the developer, to determine if the material is at optimum water content, density and compaction. The

optimum water content and density should be determined by a Standard Compaction Test and should be compacted to at least 90% of the desired dry density.

D) Surface Requirements

1) Aggregate Surface; **Maximum Projected ADT = 30**

1. Base Aggregate: Base aggregate shall be applied with a minimum thickness of 4 inches and must conform to Section 4 of this document labeled Aggregate Base Course.
2. Surface Aggregate: Aggregate for surfacing shall be Grade B Crushed stone, as specified in Section 1006 of the Missouri Highway Specifications, or shall be of the type and source approved by the County for surfacing the County Roads in the vicinity of the project. Final acceptance will be on the basis of visual examination by the engineer. Surface aggregate must be applied with a minimum thickness of 2 inches and conform to Section 310 of the *Missouri Standard Specifications for Highway Construction*.

2) Flexible Pavement

If proposed road is to be paved, it must conform to standards as set forth in Division 400 of the *Missouri Standard Specifications for Highway Construction*. The paved roadway must provide adequate drainage. Drainage plans must be developed, signed, and sealed by a Professional Engineer licensed in the state of Missouri and approved by the county engineer before construction can begin.

The county must be notified a minimum 48 hours before paving operations begin and has the right to reject any work that does not meet the requirements specified within this document or referenced documents.

1. D.A.S.T. (Double Asphalt Surface Treatment): *(Only recommended for roadways with a 24,000 lb or less load limit)*; **Maximum ADT = 60**
 - a) Base Aggregate: Base aggregate shall be applied with a minimum thickness of 4 inches and must conform to Section 4 of this document labeled Aggregate Base Course.
 - b) Prime Coat: Prime coat shall be MC-0 applied at a rate of 0.2 gallons per square yard and conform to Section 408 of the *Missouri Standard Specifications for Highway Construction*.

- c) Surface Course: Surface course shall be RC-3 applied at a rate of 0.35 gallons per square yard and conform to Section 409 of the *Missouri Standard Specifications for Highway Construction*. It shall be covered with Grade B aggregate, as specified in Section 1003 of the Missouri Highway Specifications, at a rate of 20 pounds per square yard per surface treatment. A minimum of two surface treatments shall be applied before the roadway is opened to traffic.

- 2. Asphalt Roadway; **Maximum allowable ADT = 250** (*Maximum allowable ADT may be increased with the addition of aggregate base or asphaltic base. Allowable ADT for a modified cross-section shall be developed by a professional engineer and submitted with projected traffic volumes. All information shall be submitted to the commission with final plan and profile of proposed road.*)

When a development requires a level of dust control which cannot be obtained with an aggregate surface and when the load limit is expected to exceed 24,000 lb, the following specifications and attached cross-section shall be used.

- a) Subgrade: Subgrade requirements as outlined in Section 2 of this document shall be followed.
- b) Base Aggregate: Base aggregate shall be applied with a minimum thickness of 4 inches and must conform to Section 4 of this document labeled Aggregate Base Course.
- c) Prime Coat: Prime coat shall be MC-0 applied at a rate of 0.2 gallons per square yard and conform to Section 408 of the *Missouri Standard Specifications for Highway Construction*.
- d) Asphalt Surface: Asphalt must be applied conforming to Section 401 of the *Missouri Standard Specifications for Highway Construction* with a minimum thickness of 6 inches of BP1.

- 3) Rigid Pavement

When a developer or county engineer finds that rigid pavement is more suitable for a development due to the type of development that will be utilizing the roadway, such as commercial or industrial applications, or soil conditions found on the site, the following specifications shall be followed.

- a. Subgrade: Subgrade requirements as outlined in Section 2 of this document shall be followed.
- b. Base Aggregate: Base aggregate shall be applied with a minimum thickness of 4 inches and must conform to Section 4 of this document labeled Aggregate Base Course.
- c. Concrete: Concrete pavement shall be applied conforming to Section 4 of this document labeled Portland Concrete Pavement (PCP), with a minimum thickness of 6 inches for residential roads or roadways with a speed limit of 30 mph or less. Commercial or industrial roads with speed limits greater than 30 mph shall use minimum 8 inch PCP.

E) Technical Specifications

- 1) Aggregate Base Course (*See Attached*)
- 2) Portland Concrete Pavement (PCP) (*See Attached*)
- 3) Portland Cement Concrete (*See Attached*)

F) Drainage

- 1) Culverts at entrances to have a minimum diameter of 15" and a sufficient length to drain a 10' driving surface with 3:1 slopes, with size increase as required by runoff area and depth of ditch. Culverts across roadway to have a minimum diameter of 18", with size increase as required by runoff area. Culverts to be installed at a minimum 1% slope or at existing grade. Smaller pipes used will be approved on a case by case basis. The developer will be responsible for maintenance of smaller diameter pipes.
- 2) Ditches to have a 24" minimum depth at a 3:1 slope.

**Table for Selection of Culverts (CMP Type)
Use Minimum Size or Select from Table**

Pipe Diameter (in)	Area Drained (acres)	Gauge	Pipe Diameter (in)	Area Drained (acres)	Gauge
15	6	16	48	126	14
18	9	16	54	174	12
21	14	16	60	229	10
24	20	16	66	295	10
30	36	16	72	373	10
36	59	14	78	461	8
			84	562	8

Use CMP type culverts, HDPE or concrete pipe conforming to Missouri Highway Department Standards.

CMP must be installed with tamped backfill to top level of pipe to ensure against vertical deformation.

G) Signage Recommendations

Signage shall be placed at railroad crossings, hidden or unexpected curves, intersections, delineations and other locations as deemed necessary by the developer, Commission, or county engineer. Sign material and placement shall meet or exceed the methods currently being utilized by the county in the area of the proposed project.

- 1) Sign Placement:
 - a. Avoid placing signs on curves when possible.
 - b. Select sign placement on a cut slope rather than a fill slope when possible.
 - c. Never place signs in the bottom of ditches.
 - d. Space signs along the roadway. Don't crowd signs together. Provide 100 feet minimum spacing where possible.
 - e. Provide an unobstructed view of signs along the roadway.
 - f. Place signs behind guardrails where possible.

2) Installation Guidelines

- a. Posts should be buried in firm ground 3 feet deep.
- b. Loose or sandy soil may require deeper post placement.
- c. Use earth plate to prevent round post twisting.
- d. Breakaway sign supports should be used on roads with an ADT or predicted ADT greater than 150 within ten years of construction of the roadway.
- e. Sign panels should be bolted to the post with oversized washers.
- f. Use sign connections that prevent vandalism.

H) Vegetative Cover

All disturbed areas not surfaced are to be covered with minimum 6" of topsoil and fertilized, seeded and mulched to reestablish vegetative cover. Developer will be responsible for maintenance and vegetative care for two years or until final acceptance of erosion control by the county commission.

I) Inspection

The county must be notified prior to construction so that it may inspect as it deems necessary. A 48 hour notice must be given before surface material is placed on the roadway.

J) Project Costs

All costs to bring roads up to required standards shall be borne by developer.

REFERENCED MATERIALS

Field Guide for Unpaved Rural Roads, 2004, Kansas Local Technical Assistance Program.

Guidelines for Geometric Design of Very Low-Volume Local Roads, 2001, AASHTO.

ITE, TRIP Generation 1991.

Missouri Standard Specifications for Highway Construction, 2004, Missouri Highway and Transportation Commission.

A Policy on Geometric Design of Highways and Streets, 1990, AASHTO.

Road Name: _____

Inspector: _____

Date: _____

LEGAL DOCUMENTS ON FILE

DOCUMENT	YES/NO	COMMENTS
Conveyance of Right-of-Way		
Notice of Intended Application		
Petition for Location or Change of a County Road		

COUNTY ROAD CHECKLIST

ITEM	PASS	FAIL	COMMENTS
Aggregate Gradation			
Crown			
Road Bed Width			
Road Surface Width			
Shoulder Width			
Ditch Depth			
Ditch Width			
Ditch in Slope			
Ditch Back Slope			
R.O.W. Width			
Super elevation			
Entrance Width			
Entrance Radius			
Drainage Pipes			
Grade & Subgrade			
Surface Material			

Technical Specifications

Aggregate Base Course	Section 02722
Portland Cement Concrete	Section 03050
Portland Concrete Pavement	Section 03400

1.00 GENERAL:

- A. This specification includes work performed by contractors building facilities to be accepted by the Randolph County Commission for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the owner must be obtained before commencing construction.
- B. Request for approval of appurtenances shall be submitted to the Engineer, in triplicate, a minimum of 15 working days before applicable work is scheduled.

1.01 DESCRIPTION OF WORK

- A. Work covered under this section consists of furnishing and placing one or more courses of crushed stone aggregate on prepared subgrade.
- B. Construction of aggregate base course shall conform to the typical sections, lines, grades and thicknesses as shown on the drawings. Type 5 aggregate base shall conform to the gradation specified in the most current edition of the Specifications for highway Construction as published by MoDOT.

1.02 TESTING AND INSPECTION:

- A. Contractor will engage soil testing and inspection service for quality control testing.
- B. Referenced standards of the American Society for Testing of Materials (ASTM) apply to this section.

2.00 MATERIALS:

- A. Aggregate shall be crushed stone, and shall be the angular fragments resulting from crushing by mechanical means of calcareous or dolomitic limestone from undisturbed, consolidated deposits.
- B. The crushed stone shall contain not more than 15 percent deleterious rock and shale. Sand may be added to the crushed stone only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. Any sand, silt, and clay, and any deleterious rock and shale shall be uniformly distributed throughout the mass.

- C. Gradation: The aggregates shall conform to the following gradation requirements:

	<u>Percent</u>
Passing 1 Inch Sieve	100
Passing 1/2 Inch Sieve.....	60-90
Passing No. 4 Sieve	35 -60
Passing No. 30 Sieve.....	15-35
Passing No. 200 Sieve.....	0-15

- D. Quality: The aggregate base material shall be from an approved source.

3.00 CONSTRUCTION REQUIREMENTS:

3.01 INSTALLATION:

A. INSPECTION:

- 1. Examine the areas and conditions under which the aggregate base course is to be placed for conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

2. The subgrade shall be compacted, graded and cut to proper lines, grades, and cross-sections to the satisfaction of the Inspector before placing of the base course.
3. Subgrade shall be protected from cold weather, base course shall not be placed on frozen subgrade or when the atmospheric temperature is less than 35 degrees F.

B. Placing Base Course:

1. Contractor shall be responsible for maintaining lines and grades including crown and cross-slope in base course.
2. The Contractor shall be responsible for placing the correct quantity of base material to construct a base of the required finish thickness.
3. The thickness of the compacted base course shall be as shown on the drawings.
4. The maximum compacted thickness of any one layer shall not exceed six (6) inches.
 - a. When specified compacted depth of base course exceeds 6 inches, the base course shall be constructed in two or more layers of approximately equal thickness.
 - b. No single layer shall be less than 3 inches in thickness when compacted.
5. The mixture shall be uniformly spread in successive layers of such depth that when compacted, the base will approximate the thickness specified.
6. Immediately before spreading the aggregate, the subgrade shall be wetted as directed by the Inspector.
7. The base material shall be delivered to the site for placement with the material thoroughly mixed with water to approximate moisture content for desired compaction.

C. Compaction:

1. Maintain optimum moisture content for compacting base course material during placement shaping and compaction operations.
2. Each layer shall be compacted to not less than 95% maximum dry density perASTMD698.
3. Required compaction shall be accomplished by a self-propelled smooth-wheeled roller, weighing not less than 5 tons, or other methods approved by the Owner.
4. Quality Control Testing During Construction:

Contractor shall engage a testing service to inspect and test base course layer before further construction work is performed.

D. Grading:

1. Base course material after compaction shall be cut to proper lines, grades, sections and cross-slopes as shown on the drawings.
2. Tolerances shall be plus or minus .1 of a foot.
3. Compacted areas that are below .1 of a foot of grade, additional material shall be brought in place, shaped and compacted to attain the proper thickness and subbase elevation.

E. Maintenance:

1. Protect newly graded areas from traffic and erosion.
 2. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerances.
 3. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape and compact to required density prior to further construction.
- F. Remove excess material, trash, debris and waste materials from the site.

END OF SECTION

1.00 GENERAL:

- A. This specification includes work performed by any contractors building facilities to be accepted by the Owner for operation and maintenance. Where materials or appurtenances are proposed, which are not covered by this specification, prior written approval by the Owner must be obtained before commencing construction.
- B. Request for approval of appurtenances shall be submitted to the Engineer, in triplicate, a minimum of 15 working days before applicable work is scheduled.

1.01 DESCRIPTION OF WORK:

- A. This section of the specifications covers the materials, methods of construction, and requirements necessary to complete the Portland Cement Concrete work as indicated on the Drawings or as specified herein.

1.02 TESTING AGENCY

- A. Observation and testing will be performed by a firm approved by the Owner and paid for by the Contractor.
- B. Mix Design Submittals: Prior to beginning the work and within 14 days following the notice to proceed, the Contractor shall submit to the Owner, for review, previous independent laboratory generated data detailing performance (measures of performance as defined below) of the proposed mix design. Contractor shall also provide certification that materials used and their proportions are to be essentially unchanged from the mixture for which the data was generated. If independent laboratory data is not available, the proposed mix design shall be checked by an independent laboratory acceptable to the Owner. All costs related to such testing shall be paid for by the Contractor. Since laboratory trial batches require 35 calendar days to complete, the Contractor may consider testing more than one mix design for each class of concrete. Include the following information for each mix design:
 - 1. Water/cement materials ratio
 - 2. Slump as per ASTM C 143
 - 3. Air content as per ASTM C 231 (pressure method), or ASTM C 173 (volumetric method)
 - 4. Unit weight of concrete as per ASTM C 138
 - 5. Compressive strength at 3, 7, and 28 days per ASTM C 39
 - 6. Shrinkage (length change) as measured in accordance with Section 1.01 -Testing Agency, Paragraph C. - Shrinking Testing Procedure
- C. Shrinkage Testing Procedure: Testing and reporting shall conform to the latest ASTM C 157-93 with the following modifications:
 - 1. Wet cure specimens for a period of 7 days (including the period of time the specimens are in the mold). Wet cure may be achieved either through storage in a moist cabinet or room in accordance with ASTM C 511, or through storage in lime saturated water.
 - 2. Slump of concrete for testing shall match job requirements and need not be limited to restrictions as stated in ASTM C 157 Section 7.4.
 - 3. Report results in accordance with ASTM C 157 at 0, 7, 14, and 28 days of drying.
- D. Test of cement and aggregates shall be performed to ensure conformance with specification requirements.

Manufacturer's certification that cement materials meet specification requirements and results of manufacturer's own material tests will be acceptable in lieu of tests by observation and testing firm. Aggregate testing shall be performed by independent observation and testing firm, for compliance with ASTM C33, including limits for deleterious substances, grading and physical property requirements.

E. Field quality control tests are specified in Part 3 of this section. 1.03 REFERENCE

STANDARDS A. ACI 301 - Specification for Structural Concrete for Buildings.

B. ACI 340 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

C. ACI 305 - Recommended Practice for Hot Weather Concreting.

D. ACI 306 - Recommended Practice for Cold Weather Concreting.

E. ACI 318 - Building Code Requirements for Reinforced Concrete.

F. ASTM C33 - Concrete Aggregates.

G. ASTM C39 - Compressive Strength of Cylindrical Concrete Specimens.

H. ASTM C94 - Ready-Mixed Concrete.

I. ASTM C138 - Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

J. ASTM C143 - Slump of Portland Cement Concrete.

K. ASTM C 150 - Portland Cement.

L. ASTM C157-93 - Length Change of Hardened Hydraulic-Cement Mortar and Concrete.

M. ASTM C171 -Sheet Materials for Curing Concrete.

N. ASTM C173 - Air Content of Freshly Mixed Concrete (Volumetric Method).

O. ASTM C231 - Air Content of Freshly Mixed Concrete (Pressure Method).

P. ASTM C260 - Air Entraining Admixtures for Concrete.

Q. ASTM C309 - Liquid Membrane - Forming Compounds for Curing Concrete.

R. ASTM C494 - Chemical Admixtures for Concrete.

2.00 MATERIALS

2.01 PORTLAND CEMENT:

A. The Portland Cement shall conform to A.S.T.M. Specifications C-150, Type I, or A.S.T.M. Specification C-175, Type IA air entrained cement, if approved by the Owner.

B. The portland cement used under this contract shall be a standard brand of portland cement which has been in practical use in public works and which has heretofore given satisfactory results. The cement when delivered to the site or at the location where the concrete is to be mixed, shall be stored so as to protect it from damage;

and no damaged, partially set, or lumpy cement shall be used in the work and shall immediately be removed from the premises. The cement shall be manufactured by only one mill and used throughout the entire project. Brands of cement shall not be mixed.

2.02 FINE AGGREGATE:

- A. The fine aggregate shall consist of clean, natural sand of hard, strong, durable material, free from all foreign organic material or other injurious impurities conforming to A.S.T.M. C-33. The sand shall be graded to meet the sieve analysis, as specified in section 1005.3 of the Specifications for highway Construction as published by MoDOT using the U.S. Standard sieve series, with all percentages determined by weight .

The fineness modulus of the fine aggregate shall not be less than 2.50 nor more than 3.00.

2.03 COARSE AGGREGATE:

- A. The coarse aggregate shall be clean washed and screened gravel or crushed limestone, having a specific gravity of not less than 2.56. The gravel shall be free from dust, loam, clay, alkali, or organic impurities, and free from thin porous, elongated, or laminated particles. A sample of the gravel when subjected to the sodium sulfate accelerated soundness test for freezing and thawing shall have a weighted average loss of not more than 15%. Crushed limestone aggregate shall consist of uncoated particles of sound, durable rock of uniform quality without an excess of flat, elongated, or laminated pieces.
- B. The gravel or crushed limestone shall be graded to meet the sieve analysis, as specified in section 1005.2 of the Specifications for highway Construction as published by MoDOT, using the U.S. Standard Sieve Series, with all percentages determined by weight.
- C. The use of frozen aggregates will not be permitted. When the temperature of the air permits concreting to be carried on, the aggregates must be thawed out, thoroughly removing all frost before inclusion in the concrete mixture.

2.04 WATER:

- A. The water in mixing concrete shall be clean and free from injurious amounts of oil, acids, alkalis, salts, or organic matter. The water used shall be of potable quality.

2.05 ADMIXTURES:

- A. Admixtures will be established during shop drawing phase - admixtures may include:
1. Air Entrainment: ASTM C260.
 2. Chemical: ASTM C494, Type A -water reducing. Type B - retarding. Type C - accelerating. Type D - water reducing and retarding. Type E - water reducing and accelerating. Type F - high range water reducer. Type G -high range water reducing and retarding.
 3. Shrinkage Reducing Admixture (SRA): Provide Eclipse™ Shrinkage Reducing Admixture as supplied by Grace Construction Products (or approved equal) at a rate of 1.5 gallons per cubic yard (liters per cubic meter).
 4. Fibrous Reinforcing: Provide Grade MicroFiber? as supplied by Grace Construction Products (or approved equal) at a dosage rate not less than 0.5 lb per cubic yard.
 5. The use of calcium chloride in concrete is strictly prohibited.

2.06 PREMOULDED EXPANSION JOINT:

A. The premoulded expansion joint material shall be non-extruding resilient type conforming to ASTM designation D 1751.

1. The joint filler shall be full depth of concrete section and 1/2" thick unless shown otherwise.

2.08 WATERSTOPS:

A. The waterstops shall be polyvinylchloride plastic, serrated type of the width as shown on the Drawings. Similar to "Sealtight Duo-PVC", Type No. 4332D, W.R. Meadows, Inc., Style 703 Greenstreek Plastic Products, or equal.

B. Moisture Barrier: Provide moisture barrier where indicated on the drawings or where specified herein. Barrier shall be resistant to decay similar to polyethylene of 6 mils thickness.

2.09 REINFORCING STEEL:

A. The reinforcing steel shall be rolled from new Billet-Steel Bars for Concrete Reinforcement A.S.T.M.-615 with deformations conforming to A.S.T.M.-305 and 60,000 psi minimum yield strength, A.S.T.M. A-432.

B. The reinforcing, when delivered, shall be protected from the weather. The reinforcing shall not be oiled or painted. Reinforcing with slight rust which can easily be removed with a wire brush may be used after removal of rust. All reinforcing steel unacceptable to the Owner will be immediately removed from the job site.

C. Welded wire fabric shall conform to A.S.T.M. A-185 and shall be the size and gauge shown on the Drawings.

D. All bent bars shall be accurately cold bent to conform to the approved shop drawings.

E. All bars shall be tagged and bundled. Imperishable marking tags are to be used.

F. Metal accessories, including spacers, chairs, ties, and other devices necessary for properly assembling, placing and spacing and supporting all reinforcing in place, shall be provided.

G. Reinforcing steel shall be carefully handled so that it will not become bent or otherwise damaged, shall be stored on racks, skids or other supports which will keep the steel from contact with the ground.

2.10 CONCRETE ADHESIVE:

A. Where indicated on the Drawings or requested by the Owner, SIKA Corporation, SIKADUR 32, HI-MOD LPL, or equal adhesive shall be used.

2.11 EXPOSED WALL COATINGS:

A. As specified herein or as requested by the Owner, a cement-base, aggregate type, heavy duty, coating shall be applied to exposed concrete wall surfaces. The material shall be thoro seal as manufactured by Thoro System Products or an approved equal.

2.12 SIDEWALK TEXTURING:

A. Sidewalks shall be sprinkled with "Silicon Carbide" grains as manufactured by Carborundum Company or equal.

2.13 STAIR NOSING:

1. Mixing water shall be heated to a maximum of 150 degrees F.
 2. Aggregates shall be heated until free of all ice and frost.
 3. The concrete temperature after mixing shall be between 50 degrees F and 70 degrees F if the air temperature is 25 degrees F to 45 degrees F.
 4. After the concrete is placed, it shall be covered, protected and heated so as to maintain a minimum of 70 degrees F air temperature for the first 24 hours and 50 degrees F for the next six days. Slab on grade concrete shall be protected from freezing for a period of at least 5 days.
 5. Moist conditions shall be maintained during the heating period.
 6. All covering, heating equipment, etc., shall be on hand and approved by the Owner before any concrete is placed.
- B. No concrete shall be placed on iced or frozen subgrade or when the air temperature is below 25 degrees F.
- C. Hot weather concrete work will not be permitted on exposed surfaces while air temperature exceeds 100 degrees F. Cover and protect and cool as necessary to maintain the internal temperature of the concrete below 100 degrees F. Concrete delivered to the job site while in the Ready Mix truck shall maintain a temperature less than 85 degrees F.

3.04 CURING:

- A. Curing shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury or injury from rain or flowing water for a period of not less than 5 days when normal Portland Cement has been used. Curing shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing. Curing shall be accomplished by using any of the following methods or combination thereof, as approved by the Owner.
- B. Unformed surfaces shall be covered with approved fabric, mats, burlap, or with sand, and shall be kept continually wet, or be covered with waterproof paper or polyethylene sheeting, or be coated with liquid membrane. Where formed surfaces are cured in forms, the forms shall be kept continually wet or the top forms may be loosened, as directed or approved by the Owner and water allowed to run down between the forms and concrete. If forms are removed before the end of the curing period, curing shall be continued as on unformed surfaces. Burlap shall be used only on surfaces which will be exposed in the finish work and shall be in two layers. Water shall be applied in a manner which will not damage the concrete, and shall be free from impurities which may damage or discolor the concrete.
- C. Liquid membrane-forming curing compounds, when approved by the Owner, shall be applied by power spraying equipment using a spray nozzle equipped with a wind guard. The compound shall be applied in a two-coat, continuous operation at a coverage of not more than 200 square feet per gallon for each coat or as recommended by the manufacturer. The compound shall form a uniform, continuous, adherent film that will not check, crack or peel and shall be free from pinholes or other imperfections. Surfaces subject to heavy rainfall within 3 hours after application of compound shall be re-sprayed at the rate specified above. Surfaces coated with curing compound shall be kept free of foot and vehicle traffic or other abrasions during the curing period. Membrane curing compound shall not be used on surfaces that are to receive concrete, bituminous membrane waterproofing, resilient floor covering, nor surfaces that are to be painted.
- D. Waterproof paper or polyethylene sheeting shall be placed to completely cover the concrete with enough overlap for secure anchorage around the edges. Adjoining sheets shall be lapped 6 inches and appropriately weighted, or sealed with tape or other approved means. Edge and lap anchorage shall be sufficient to prevent billowing or displacement by the wind. The sheeting material shall be no less than 4 mils thick and black in color for cold weather use and white or clear for hot weather.

- E. To facilitate rubbing of concrete, or for other reasons, forms may be removed from vertical surfaces of thick sections 48 hours after concreting, with the approval of the Owner, Extreme caution should be exercised to prevent injury of concrete surfaces and edges during form removal. Surfaces revealed by form removal before the 5 day curing period shall have one of the other curing methods applied as soon as possible after from stripping.

3.05 FORMS:

- A. The forms utilized for concrete shall be watertight, true to line and elevation, and rigidly braced so as not to be disturbed during the placement of concrete. If the forms develop any defects such as bulging, sagging, or showing signs of lateral displacement after the concrete has been placed, the concrete shall be removed and replaced correctly at the Contractor's expense. The inside of all forms shall be coated with a light, clear, paraffin based oil, which will not discolor or otherwise mar the concrete surface. The oil will be applied prior to erection of the forms; any reinforcing steel contaminated with form oil will be removed and replaced.
- B. Forms for concrete surfaces which will be visible in the finished structure shall be lined with wooden sheets such as masonite or smooth plywood. The joints of this finishing shall be neat and close. Lining damaged with hammer imprints shall not be used.

- 1. Removal of forms shall be restricted to the following minimum time requirements:

a. Floor slab (structural):	120 hours
b. Floor slab on grade:	48 hours
c. Walls:	48 hours
d. Beam bottom forms	7 days or develop at least 3,000 psi

- D. The minimum times, shown above, shall be utilized unless specific instruction to increase this time period has been requested by the Owner.
- E. Form ties shall be of the removable end, permanently embedded body type and shall have sufficient strength, stiffness, and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders. Ties shall also have water stop collars.
- F. Chamfer strips shall be placed in forms to bevel all salient edges and corners and the top edges of walls. Unless otherwise noted, bevels shall be 3/4 inch wide and shall be cast in place.

3.06 PLACING REINFORCEMENT:

- A. Reinforcement shall be accurately formed and positioned, and shall be maintained in proper position while the concrete is being placed and compacted. Unless otherwise shown on the Drawings, the details of fabrication shall conform to ACI 315 and 318. In case of conflict, ACI 318 shall govern.
- B. Approval by the Project Representative is required at the completion of placing reinforcing steel prior to the placing of any concrete.

3.07 PLACING OF CONCRETE:

- A. The placing of concrete shall be accomplished by placing in one continuous operation between the limits of the work or between properly constructed and permissible construction joints.
- B. The Contractor shall place no concrete until after observation, by the Owner, of forms, reinforcing, and embedded items. Place no concrete over water covered, muddy, frozen soil or dry soil or sub-base. Dry sub-base shall be sprinkled with water prior to the placement of concrete.

- C. In preparation for the placing of concrete, all chips, and other construction debris and extraneous matter, shall be removed from the interior of the forms. Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete in their locations, shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete. Concrete shall be placed so as to avoid segregation of the materials and displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the Owner. In case an inferior quality of concrete is produced by the use of such conveyors, the Owner may order discontinuance of their use and the substitution of a satisfactory method of placing.
- D. Concrete shall be conveyed to place of deposit by methods which prevent separation of materials. Hoppers, chutes, tubes, or pumping equipment shall be sized to insure a practically continuous flow of concrete to point of delivery without separation of materials.
- E. The maximum free fall of concrete shall be less than six feet (6').
- F. Concrete shall be placed in a continuous operation until the panel or section is completed. Concrete for walls, piers, and columns shall be placed in layers not to exceed eighteen inches (18") in depth. Layers shall be incorporated together by vibrating a minimum of three inches (3") into the previously placed layer.
- G. During the placing of the concrete, it shall be compacted by mechanical vibration obtained by mechanical power operating within the mass of the concrete, supplemented by spading tools. Vibrators shall be of a type and design approved by the Owner.
- H. The intensity of vibration shall be such as to visibly affect a mass of concrete of 1 inch slump over a radius of at least 18 inches. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. Vibration shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and in the corners and angles of the forms. Vibration shall be applied at the point of deposit and in the areas of the freshly deposited concrete.
- I. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation of aggregate. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.
- J. Vibrations shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.
- K. Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

3.08 FINISHING:

Finishing of the concrete shall be accomplished as follows:

- A. Immediately after removing the forms, all fins or irregular projections shall be removed from all surfaces exposed above ground. On all surfaces the areas of cavities produced by form ties, holes, honeycombing, broken edges or corners, and other surface defects, shall be cleaned and carefully filled, and trowelled to a true uniform smooth surface with sand-cement mortar mixed in the proportions used in the grade of concrete being furnished. Defective concrete as determined by the Owner shall be repaired by cutting out the unsatisfactory material and placing new concrete which shall be secured with keys, dovetails or anchors. Concrete for patching shall be drier than the usual mixture and shall be thoroughly tamped into place.
- B. All exposed concrete surfaces, that is, those surfaces which will be visible (except floor slabs and sidewalks) shall be finished in the following manner: Forms shall be removed from such surfaces as soon as structurally possible, as approved by the Owner and all depressions or imperfections immediately patched as described

above. The surface shall then be machine or hand-rubbed until the entire surface has a smooth, homogeneous pleasant-appearing finish of uniform texture and color. Any delay in patching or rubbing such surfaces shall be cause for rejection of the entire structure or for requiring the surfaces to be ground smooth and painted or coated with thoro-seal as specified in 2.11 of this specification.

- C. All surfaces to receive a decorative or protective coating shall be ground, rubbed and filled as necessary to provide a surface smooth enough to insure good paint coverage.
- D. No mortar cement shall be used in finishing except the mortar necessary to fill imperfections. Edging tools shall be used on all exposed top edges.
- E. The top surface of walls where exposed shall receive a smooth trowelled finish. Where the top surface joins the sides, a 3/4 inch chamfer shall be provided. All floor slabs shall receive a steel trowel finish.
- F. On pedestrian walks, before final troweling and brooming, and while concrete is still wet, apply Carborundum Company "Silicon Carbide" grains by sprinkling on at a rate of 1/4 pound per square foot and working grains with a wood float. Walks shall receive a light brush finish.

3.09 MONOLITHIC FLOOR AND SLAB FINISHES:

- A. Monolithic finish shall be applied to all interior floor slabs of building as follows:

Trowel Finish: Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise indicated, and slab surfaces that are to be covered with resilient flooring, carpet, paint or other thin film finish coating system. After screeding and consolidating concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 1/4" in 10' when tested with a 10' straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerances not exceeding 1/8" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system. Sand and cement dusting will not be permitted.

- B. Exterior Walks and Slabs:

Broomed finish shall be applied to all exterior walks and loading dock slabs. Strike off concrete and tamp with mechanical or hand screed; remove water and laitance by floating. Steel trowel concrete after it has hardened sufficiently to prevent excess fines from working to surfaces. Bring finish to smooth surface, free from defects and blemishes. Sand and cement dusting not permitted. Walks shall receive a light brush texture.

3.10 SAMPLES AND TEST:

- A. Concrete Control Tests: For strength tests of cylinders during work provide 3 cylinders for each 50 cu. yd. of concrete, a part thereof over 20 cu. yds. used on one days pour for each concrete class. Test 2 at 7 days; 2 at 28 days. Make and cure test cylinder per ASTM C31. Cure specimens under laboratory conditions except Engineer may require curing under field conditions when he considers that there is a possibility air temperature may fall below 40 degrees F. Test cylinders per ASTM C39.
- B. Testing Questionable Concrete: In event cylinders indicate that concrete does not meet specified strength requirements, Engineer reserves right to order cores from hardened concrete secured and tested per ASTM C42, or order load tests per ACI 318, or both. Costs of such cores and tests shall be borne by Contractor. If tests indicate that concrete placed does not conform to drawings and specifications, Contractor shall take

measures as directed by Engineer to correct deficiency without extra cost to Owner.

- C. Slump Test: Test should occur at the beginning of the day, whenever questionable concrete is encountered and whenever test cylinders are taken.
- D. Air Test: Test should occur whenever the air temperature changes, the aggregate grading changes and whenever test cylinders are taken.
- E. Reinforcing Steel: With each shipment of steel, submit to Engineer three (3) copies of certified mill test covering tensile strength of samples from shipment.

4.00 SHOP DRAWINGS:

Shop drawings shall be submitted in accordance with the General Conditions and General Requirements. The Contractor shall furnish certified mill tests for all bars and shall submit duplicate copies of the bar drawings and schedules for preliminary checking and copies for final approval as specified in the General Conditions and General Requirements. Bending details shall conform to the standards of the Reinforcing Steel Institute.

END OF SECTION

1.01 Scope of Work

- A. Description. This work shall consist of a pavement composed of Portland cement concrete, with or without reinforcement as specified, constructed on a prepared subgrade in accordance with these specifications and in conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the engineer.

1.02 Related Sections

- A. Section 03050: Portland Cement Concrete
B. Section 02722: Aggregate Base Course

2.0 Product

A. Forms.

Side forms, except as otherwise permitted, shall be of metal, with a base width sufficient to support the finishing equipment to be used. The height shall be equal to the edge thickness of the pavement. Each form section shall be straight and free from bends and warps. No section shall show a variation greater than 1/8 inch in 10 feet from the true plane surface on the top, and 1/4 inch in 10 feet along the face of the form. The method of connection form sections shall insure a tight, neat joint. Forms shall be clean and coated with a form release agent before concrete placement

B. Vibrators.

Vibrators used for full width vibration of the concrete shall be of the internal type. They shall not come in contact with the reinforcement, load transfer devices, subgrade or side forms. Vibrating equipment shall be operated in accordance with the manufacturer's recommendation at a frequency to provide satisfactory results, but shall not be less than 4500 impulses per minute. Hand vibrators shall have a frequency of not less than 4500 impulses per minute. The contractor shall have a satisfactory tachometer available at all times for checking the vibration frequency.

C. Surface Finishing Equipment.

1. Wire Comb. A wire comb shall not be less than 10 feet long with a single line of wires exposed to a length of approximately 4 inches. The wire shall be blue tempered and polished spring steel with nominal dimensions of 0.028 inch thick and 0.100 to 0.125 inch wide. The wires shall be spaced to provide 1/2 inch clear space between wires and securely mounted in a rigid head with the width of each wire parallel to the longitudinal center line of the head. Except for pavements finished by hand methods, the wire comb shall be mechanically operated with the length of the comb parallel to the pavement center line and capable of traversing the full width of pavement in a single pass, at a uniform speed and at a uniform depth. Final approval of the wire comb will be based on satisfactory performance during actual use. Texturing equipment, other than a wire comb, may be approved provided it produces a texture equivalent to that produced by a wire comb and upon satisfactory performance during actual use.
2. Fabric Drag. If the contract specifies concrete to be tinted, a fabric drag consisting of a seamless strip of burlap or cotton of not less than the width of the pavement shall be provided. To obtain a satisfactory finish, it may be necessary to ravel out the cross threads of the trailing 2 or 3 inches of the drag. Brooms of an approved type may be provided in lieu of a fabric drag. The brooms shall not be less than 18 inches wide, made from good quality bass or bassinet fiber not more than 5 inches long.

3. Concrete Saw. If sawed joints are required, equipment shall be provided complete with either an abrasive wheel or a diamond-edge water-cooled blade, capable of providing a groove of the specified dimensions in the hardened concrete.
4. Equipment for Sealing Joints. An approved double boiler-type heating kettle equipped with a mechanical agitator and a satisfactory temperature indicating device will be required. The equipment shall be capable of heating the joint sealing material uniformly without damage.

3.0 Weather Limitations & Protection.

A. Weather Limitations.

Unless otherwise authorized in writing by the engineer, mixing and concreting operations shall be discontinued when a descending ambient temperature away from artificial heat reaches 40° F and not resumed until an ascending ambient temperature away from artificial heat reaches 35° F. If approval has been granted for the contractor to place the concrete while the ambient temperature is at or lower than 40° F, the contractor shall take precautionary measures to prevent damage by freezing, such as heating mixing water, heating aggregates or applying heat directly to the contents of the mixer. Aggregates shall not be heated higher than 150° F, and the temperature of the aggregates and mixing water combined shall not be higher than 100° F, when the cement is added. Unless otherwise authorized, the temperature of the mixed concrete when heating is employed shall not be less than 50°F and not more than 70° F at the time of placement. Cement or fine aggregate containing lumps or crusts of hardened material or frost shall not be used. Concrete shall not be placed upon a frozen subgrade except with written approval of the engineer.

B. Protection.

All concrete shall be effectively protected from freezing for a period of at least 5 days after it has been placed or until a minimum compressive strength of 3000 pounds per square inch as been attained. Protection will be required for not more than 10 days. Regardless of precautions taken, the contractor shall assume all risks, and all frozen concrete shall be replaced at the contractor's expense.

4.0 Joints.

Joints shall be of the specified type and dimensions, and constructed at the locations shown on the plans or as approved by the engineer. Where joints are preformed, the form or joint shall be set and securely fastened to insure the joint being in the required position when the concrete is finished. Dowels and tie bars in their final position shall be parallel to the subgrade and perpendicular to the line of the joint. Dowel supporting assemblies shall conform to Missouri Standard Plans for Highway Construction 2004 section 502.10F and 502.05F. The concrete shall be placed so that it will not displace or disarrange the joint installations.

A. Expansion Joints.

Expansion joints shall extend for the full cross section of the concrete pavement. Filler placed prior to the placement of the concrete shall be installed with a removable cap or edging bar to serve as a guide for edging the joint and protection for the filler during the placing and finishing of the concrete. Joints constructed after the placement of concrete shall be sawed full depth and the exposed edges shall be ground to a chamfer of 3/8 inch. The filler shall rest snugly on the subgrade from form to form. Upon removal of the forms, any struts or fins of concrete extending across the joint shall be removed to the full width of the joint and the full thickness of the pavement.

B. Construction Joints.

Construction joints shall be made at the close of each day's work or when the work is stopped or interrupted for more than 30 minutes. No transverse construction joint shall be constructed within 10 feet of an expansion or contraction joint. For transverse contraction joint spacing of 20 feet or less, the transverse construction joint shall be located within the normal sequence of contraction joint spacing as shown on the plans. Construction joints shall be constructed perpendicular to the top surface and the centerline of the pavement. Construction joints may be formed with a timber header or may be sawed full depth. The final joint shall conform to the cross section of the pavement. Before paving operations are resumed, all surplus concrete and other refuse shall be removed from the subgrade.

C. Contraction Joints.

Contraction joints shall conform to Missouri Standard Plans for Highway Construction 2004 section 502.05 F. Transverse joints shall be placed as shown, on 15' centers, with a dowel configuration that conforms to the table below. A minimum of one longitudinal joint shall be placed in the center of the driving service for any roadway with two lanes of traffic with a tie bar configuration as shown on standard plans and conforming to the table below. Additional longitudinal joints shall be added for every additional lane of traffic, or between the exterior driving lane and all paved parking or a curb and gutter configurations.

Slab depth (in)	Diameter, In. or bar number	Total Length, In.	Spacing, in. Center to center
		Dowels	
6	5/8	12	12
7	7/8	14	12
8	1	14	12
9	1 1/8	16	12
10	1 1/4	16	12
		Tie Bars	
6	#4	30	30
7	#4	30	30
8	#4	30	30
9	#5	30	30
10	#5	30	30

D. Sawing.

Unless otherwise provided, all transverse contraction and all longitudinal joints in the pavement shall be sawed to a minimum depth of 1/4 the pavement thickness and shall be 1/4" in width. If the groove for poured type transverse joints is cut prior to removal of the forms, the groove shall be cut as close as is practicable to the pavement edge, and the resulting crescent shaped plug in the groove, immediately adjacent to the form, will be acceptable. For intersections and irregular pavement, joints shall be sawed at locations as approved by the engineer. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling. All joints shall be sawed before uncontrolled shrinkage cracking takes place. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. The engineer reserves the right to have the contractor install preformed type joints on multiple width construction when the use of sawed joints fails to prevent random cracking.

E. Sealing Joints.

All sawed contraction joints and sawed or formed expansion joints shall be sealed with joint sealing material before the pavement is opened to any traffic, including construction traffic.

Immediately prior to sealing, the joints shall be thoroughly cleaned and dried. The sealing material shall conform to AASHTO M173 and be heated to the pouring temperature recommended by the manufacturer. Any material which has been heated above the maximum safe heating temperature will be rejected. The sealing material shall be installed in such a way as to fill the joint opening uniformly from the bottom to approximately 1/8" from the top. Any excess material shall be removed from the pavement surface.

- F. Joint Filler at Railroad Crossings. Bituminous filler for use between railroad crossing approach slabs and the timber crossing shall be an approved commercial bituminous mixture. The mixture shall be tamped into a firm and compacted state.
- G. Material for Joints: All material used for joint construction including Dowel Bars, Tie Bars, and Joint Filler shall comply with Missouri State Standards for Highway Construction" 2004 Section 1057 and all other applicable sections.

5.0 Curing

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface and exposed edges of the newly placed concrete shall be covered and cured in accordance with one of the following methods. The concrete shall not be left exposed for more than 30 minutes between stages of curing or during the curing period.

- A. White Pigmented Membrane.
After the free water has left the pavement surface, the entire surface shall be sealed by hand or machine spraying with a uniform application of white pigmented membrane curing material. The contractor shall provide satisfactory equipment to insure uniform coverage of curing material, without loss, on the pavement at the rate of one gallon for each 150 square feet. If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the contractor will be required to apply additional curing material to the affected portions. All areas cut by finishing tools subsequent to the application of the curing material shall immediately be given new applications at the rate specified above. If hair-checking develops before the membrane can be applied, the concrete shall be initially cured with wet burlap covering is placed.
- B. Waterproofed Paper, Polyethylene Sheeting and Polyethylene-Burlap Sheeting.
As soon as the concrete has set sufficiently to prevent marring, the top surface of the pavement shall be covered with units of waterproofed paper, white polyethylene sheeting or white polyethylene-burlap sheeting, which shall be lapped not less than 6 inches. If polyethylene-burlap sheeting is used, the burlap shall be thoroughly dampened prior to placing and shall be placed next to the concrete. All coverings shall be so placed and weighted that they remain in contact with the pavement surface and edges for not less than 72 hours after the concrete has been placed. If hair-checking develops before the covering can be applied, the concrete shall be initially cured with wet burlap before the covering is placed.
- C. Burlap.
The top surface of the pavement shall be temporarily covered with thoroughly damp burlap after the concrete has set sufficiently to prevent marring of the surface. Burlap shall, in the judgment of the Engineer, be of such construction and condition as required to adequately maintain free moisture on the surface of the concrete with they type of system being used to provide water. Burlap shall be handled in such manner that contact with earth or other deleterious substances is avoided. All new or contaminated burlap and all burlap which has been used for purposes other than the curing concrete shall be thoroughly washed before being used. The burlap shall be kept thoroughly wet until removed for application of the final curing material. Neither the top nor the edge of the pavement shall be left unprotected for more than 30 minutes. When the burlap is removed, curing shall be continued by one of the approved methods.

D. Opening to Traffic.

The concrete pavement shall not be opened for light traffic until the concrete is at least 72 hours old and has attained a minimum compressive strength of 3000 pounds per square inch. The pavement shall not be opened to all types of traffic until the concrete is at least 72 hours old and has attained a minimum compressive strength of 3500 pounds per square inch. If high early strength concrete is used, the pavement may be opened to all types of traffic when the concrete has attained a minimum compressive strength of 3500 pounds per square inch. Compressive strength will be determined by tests made in accordance with Missouri Department of Transportation methods. Pavement shall be cleaned prior to opening to traffic.

6.0 Air Entrainment

If air-entrained concrete is specified, the designated quantity of air by volume shall be a minimum 5 percent, or 6 percent when coarse aggregates is used. There shall be no intentional deviations from the designated air content. An occasional deviation in the air content exceeding to operating tolerance may be permitted if, in the judgment of the engineer, the deviation is such that it will not seriously affect the serviceability of the concrete.

Air-entrained concrete shall be used for the construction of the following items:

1. All retaining walls and bridge units except culvert type structures and seal courses
2. Concrete median barriers
3. All piles (not including cast in place)
4. Concrete pavement
5. Approach slab and paved approach
6. Sidewalk and steps
7. Curb, gutter, curb and gutter and surface drain basins and drains.
8. Concrete pedestals for signs, signals and lighting

7.0 Aggregate Base

A Type 5 aggregate base shall be used and conform to section 1007 of Missouri Highway and Transportation Commission's Standard Specifications for Highway Construction 2004 and current revisions.

Type 5 aggregate base shall be placed under all pavements, including shoulders, and should be compacted to standard maximum density. Standard compaction test should be conducted for a minimum of 1/100 L.F. of roadway or as per the Engineer. Field density will be determined in accordance with AASHTO T191 or AASHTO T310. Volume of the test hole may be reduced as necessary to accommodate available testing equipment. If nuclear density test methods are used, moisture content will be determined in accordance with AASHOT T 310, except a moisture correction factor will be determined for each aggregate in accordance with MoDOT Test Method TM35. All compaction test shall be coordinated by the contractor with the engineer and should be considered as part of unit price for construction of concrete pavement.

END OF SECTION

APPENDIXES

Typical Aggregate Cross Section

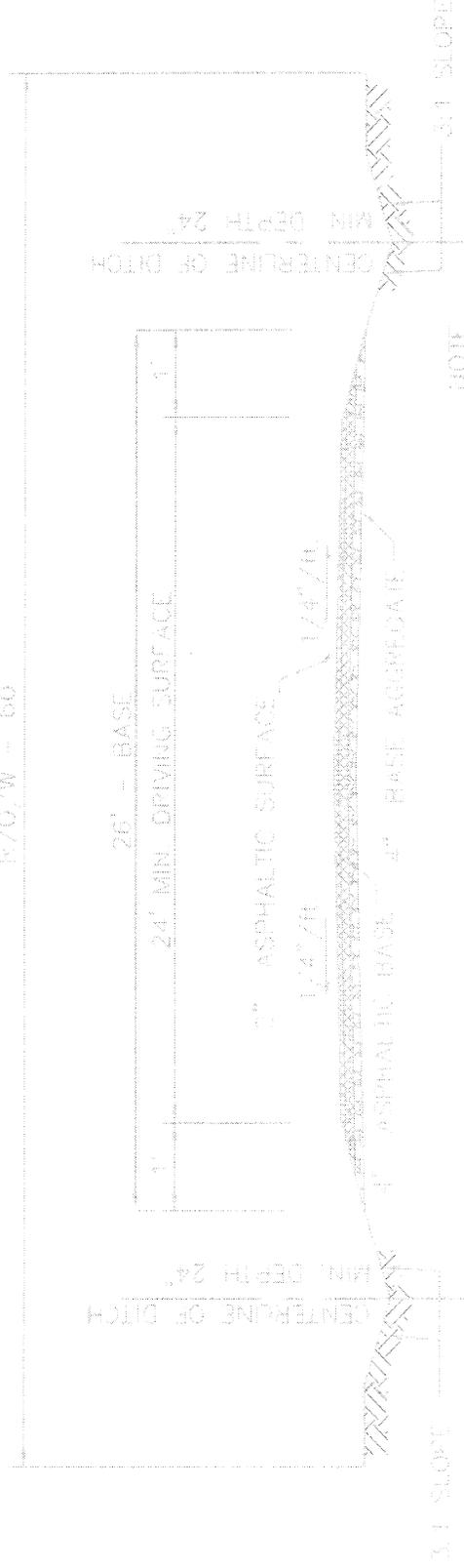
Typical Asphalt Cross Section

Typical Concrete Cross Section

General Office Building Traffic Generation Graph

Shopping Center Traffic Generation Graph

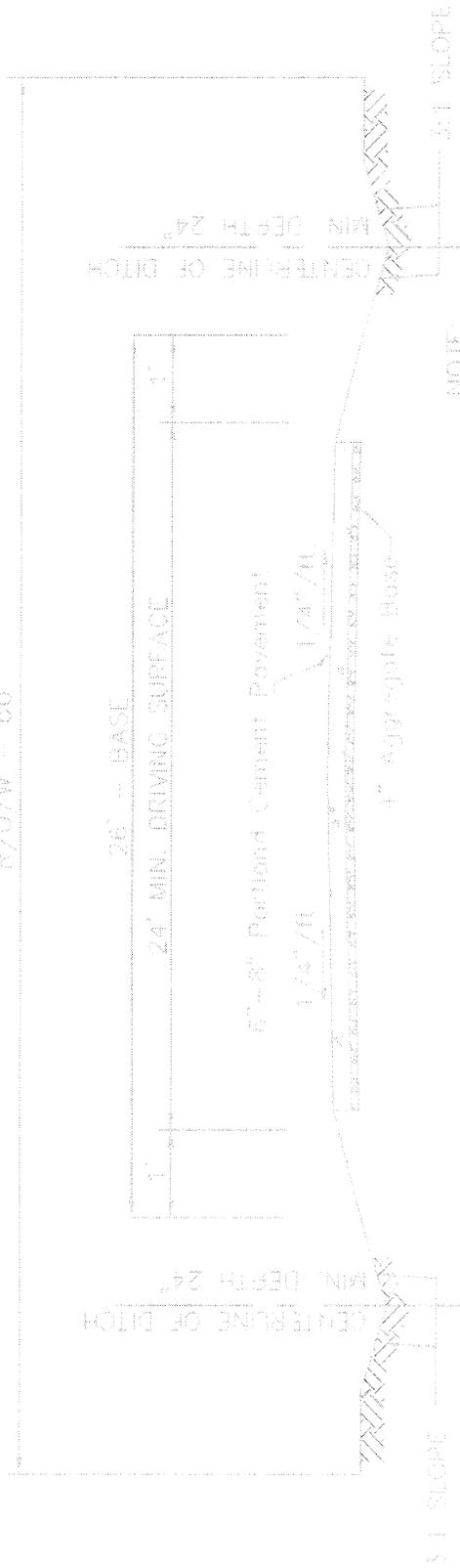
R/O/W = 60'



TYPICAL SECTION

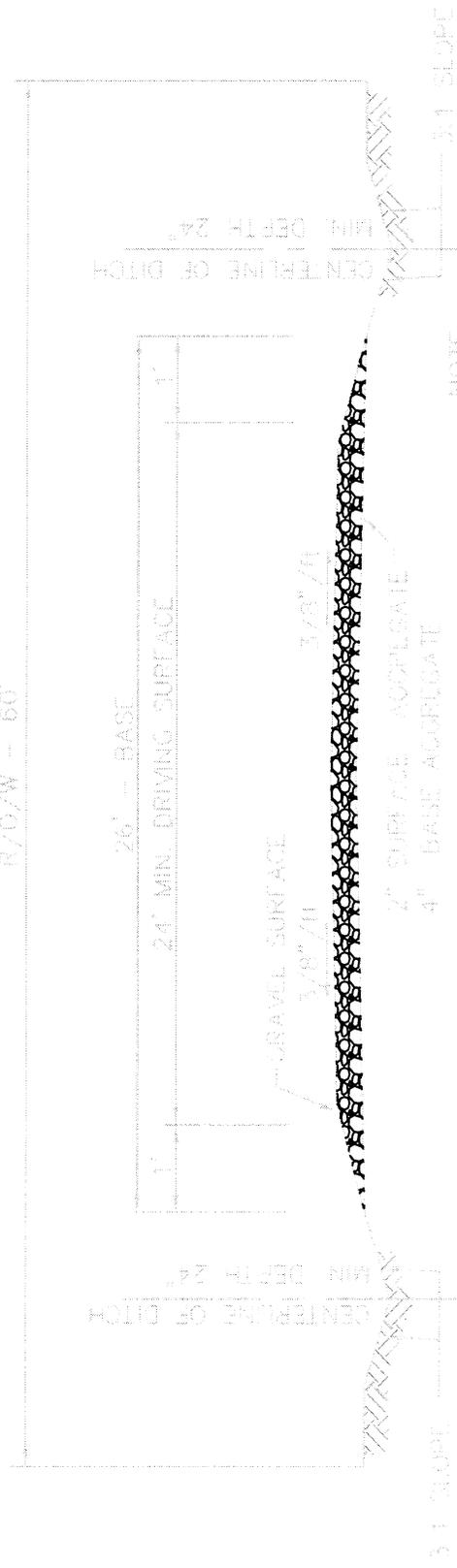
NOTE:
DIMENSION FROM EDGE OF SHOULDER TO CL DITCH VARY IN DISTANCE, TYPICAL BOTH SIDES.
SIDE SLOPES 3:1

R/O/W = 60'



TYPICAL SECTION

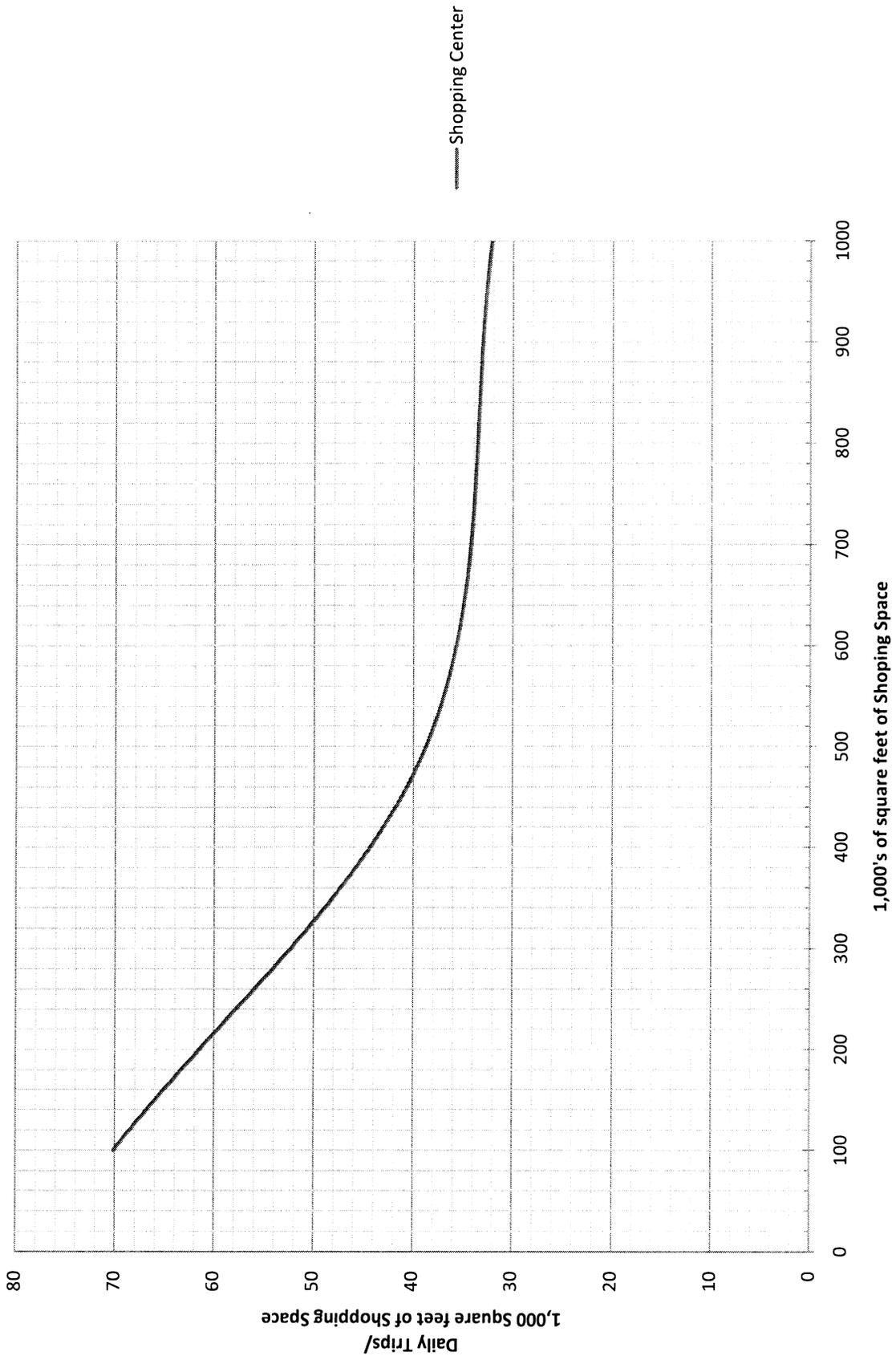
R/O/W - 60'



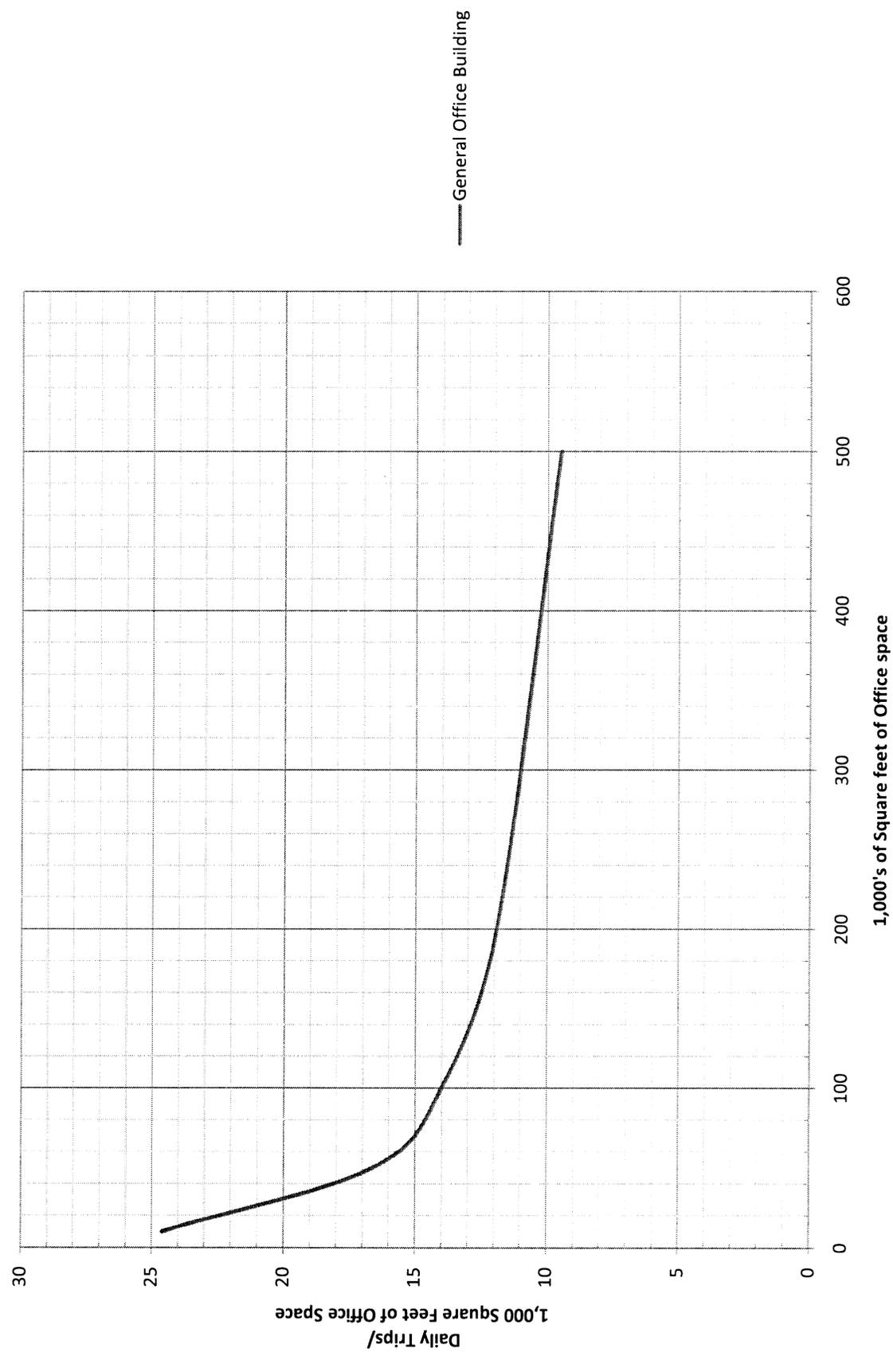
NOTE
DIMENSION FROM EDGE OF
SHOULDER TO CENTERLINE OF DITCH
VARY IN DISTANCE. TYPICAL
BOTH SIDES.
SIDE SLOPES 3:1

TYPICAL SECTION

Shopping Center



General Office Building



General Office Building