THOROUGHFARE STANDARDS AND PAVEMENT DESIGN METHODS

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SECTION I

GENERAL REQUIREMENTS

A. INTRODUCTION

The "Thoroughfare Design Standards" are intended to implement the provisions of the Subdivision Ordinance and to provide for the orderly, safe, healthy and uniform development of the area within the corporate city limits and in the extraterritorial jurisdiction (ETJ) surrounding the City of Waxahachie.

The City of Waxahachie "Standard Construction Details", "Special Provisions" and the North Central Texas Council of Governments (NCTCOG) "Standard Specifications for Public Works Construction" are considered supplemental and are part of the Thoroughfare Design Standards. The Thoroughfare Design Standards are to be considered as the minimum requirements for engineering design. Adherence to the requirements of these standards and/or approval by the City of Waxahachie or its authorized representatives in no way relieves the developer or his engineer for adequacy of design or for the completeness of the plans and specifications or the suitability of the completed facilities. Specific projects may require more stringent design standards. The City of Waxahachie may determine that design requirements other than those included in these standards are necessary and will inform the developer of such requirements before the final engineering review.

The developer shall notify the City of Waxahachie, in writing, of any known deviations from the requirements set for in the standards for thoroughfare design, construction details, or specifications.

B. THOROUGHFARE DESIGN STANDARDS

The Thoroughfare Design Standards are to be considered as the minimum requirements for engineering design. It is not intended that these standards cover all aspects of paving construction for any given development. The developer shall provide proper engineering design for all facilities not covered by these standards in accordance with good engineering practice and shall utilize first class workmanship and materials in all construction.

C. SPECIAL PROVISIONS AND STANDARD SPECIFICATIONS

The City of Waxahachie has adopted the most recent version of the NCTCOG Standard Specifications for Public Works Construction together with the Special Provisions to the Standard Specifications. These documents set forth the minimum requirements for materials and workmanship for public works construction.

D. STANDARD CONSTRUCTION DETAILS

The City of Waxahachie has adopted a set of standard construction details in order to promote uniformity of development and to facilitate maintenance of various public works facilities. The standard construction details are to be considered as the minimum requirements for materials and workmanship for public works construction.

E. INSPECTION OF CONSTRUCTION BY CITY PERSONNEL

Inspection of construction activities shall be conducted by staff of the City of Waxahachie under direction of the City Engineer or authorized representative. The City inspector shall observe and check the construction in sufficient detail to satisfy himself that the work is proceeding in general conformance with the standards and specifications for the project, but he will not be a guarantor of the Contractor's performance. The City will not accept any development until City staff has approved all construction. The developer shall be responsible for any additional expense to the City for inspection that is necessary after normal business hours, or when the improvements will be privately owned. The City will establish the rate for compensation and other expenses.

The developer will be responsible for furnishing the original reproducible engineering drawings corrected to show any revised construction conditions to the City before any improvements will be accepted. All public works improvements must accepted by the before any City Building permits will be issued.

SECTION II - GEOMETRICS

A. STREET DESIGN STANDARDS

1. Definitions

TABLE 1

Type	R.O.W.	Pavement (Face to Face)	Median (Face to Face)	Parkway Width
Major Thoroughfare, Type A	100’	6 - 12’ Lanes	14’	7’
Major Thoroughfare, Type B	100’	6 - 11’ Lanes	14’	10’
Major Thoroughfare, Type C	90’	2 - 12’ Lanes	14’	14’
Secondary Thoroughfare, Type D-1	80’	60’	None	10’
Secondary Thoroughfare, Type D-2	70’	48’	None	11’
Collector, E-1	60’	40’	None	10’
Collector, E-2	60’	36’	None	12’
Minor Residential Street, F	50’	30’	None	10’
Estate Street	60’	27’ Edge-Edge	None	16.5’

Above defined by the City of Waxahachie, Texas, Comprehensive Plan and most recent Major Thoroughfare Plan.

2. Minimum Horizontal Design Radius

Minimum Centerline Radius is defined by the design speed of the respective street. The design speed of each street In the City of Waxahachie, as defined by the Thoroughfare Plan, can be determined from Table 2.

TABLE 2

DESIGN SPEED OF EACH TYPE OF STREET

Street Type	Design Speed
Collection and Residential	30
Secondary Thoroughfare	35
Major Thoroughfare	45

The minimum acceptable horizontal centerline radius, for each respective street's design speed, is shown in Table 3.

TABLE 3

MINIMUM HORIZONTAL CENTERLINE RADIUS

Y (mph)	f	E (ft/ft)	(e + f)	R (Calculated) (ft)	R (Rounded for Design) (ft)
30	0.16	-0.02	0.14	428.57	450
35	0.16	-0.02	0.14	583.33	600
40	0.15	-0.02	0.13	820.51	850
45	0.15	-0.02	0.12	1,038.46	1,050
50	0.14	-0.02	0.12	1,388.89	1,400
55	0.14	-0.02	0.12	1,680.56	1,700
60	0.12	-0.02	0.10	2,400.00	2,400

(AASHTO P 177)

Minimum centerline design radius for residential streets shall be 250-feet for curves with a length over 125 feet long.

3. Minimum Vertical Alignment

Vertical Alignment is a function of Stopping Sight Distance (SSD), which is given by:

$$SSD = 1.47PV + \frac{V^2}{30\ (f + g)}$$

(Transportation and Traffic Engineering Handbook, Second Edition, Page 590)

Stopping Sight Distances are calculated for g - 0, rates of vertical curvature are derived from AASHTO Page 307, 312 and 316 and used (K) to determine crest curve lengths per Table 4.

The maximum grade for residential streets is 10% unless otherwise approved by the City where natural topography dictates steeper grades. The maximum grade for all other streets shall be 7.5%. The minimum grade for all streets shall be 0.40%.

TABLE 4

MINIMUM ACCEPTABLE CREST CURVE GIVEN SPEED AND DIFFERENCE IN GRADE OF ROAD

S		K	L-KA									
MPH	Ft.		A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10
30	200	30	100	100	100	120	150	180	210	240	270	300
35	250	50	100	100	150	200	250	300	350	400	450	500
40	325	80	100	160	240	320	400	480	560	640	720	800
45	400	120	120	240	360	480	600	720	840	960	1080	1200
50	475	160	160	320	480	640	800	960	1120	1280	1440	1600
55	550	220	220	440	660	880	1100	1320	1540	1760	1980	2200
60	650	310	310	620	930	1240	1550	1860	2170	2480	2790	3100

TABLE 5

MINIMUM ACCEPTABLE SAG CREST CURVE GIVEN SPEED AND DIFFERENCE IN GRADE OF ROAD

S		K	L-KA									
MPH	Ft.		A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10
30	200	40	100	100	120	160	200	240	280	320	360	400
35	250	50	100	100	150	200	250	300	350	400	450	500
40	325	70	100	140	210	280	350	420	490	560	630	700
45	400	90	100	180	270	360	450	540	630	720	810	900
50	475	110	110	220	330	440	550	660	770	880	990	1100
55	550	130	130	260	390	520	650	780	910	1040	1170	1300
60	650	160	160	320	480	640	800	960	1120	1280	1440	1600

4. Intersection Curb Radii

(a) The radius shall be thirty (30) feet at the intersection of a secondary and major, or major and major streets. See Detail, page 12.

(b) At all other Intersecting streets, the radius shall be twenty (20) feet. See Detail, page12.

Note: At Intersections with secondary collector and major thoroughfares, a 15-foot right-of-way corner clip will be dedicated at the intersection of all streets. See Detail, page 11.

5. Residential Frontage

Residential lots shall not front a secondary or major thoroughfare.

6. State Designated Roads

All state designated roads within the City of Waxahachie will conform to State Design Standards unless otherwise directed by the City Engineer.

B. MEDIAN AND LEFT-TURN LANE DESIGN STANDARDS

1. Width of Median

Refer to Table 1.

2. Required Median Opening and Left-Turn Lane

Median openings on divided thoroughfares shall be provided at all dedicated street intersections and at private drives where they conform to the City's requirements established in Section II.B.4, page 8. The median opening shall be accompanied by a left turn lane for the proposed drive or street.

3. Cost of Median Openings and Left-Turn Lanes

Median openings and left-turn lanes constructed to serve private drives and new roads shall be paved to City standards, inspected by City Inspectors, and paid for by owners served by the median openings and left-turn lanes.

4. Minimum Left-Turn Storage, Transition Length, and Median Opening Width, Location, and Spacing Requirements

a) Left-Turn Storage

All left-turn storage areas shall be ten (10) feet wide with minimum storage requirements for left-turn lanes as in Table 6.

TABLE 6

MINIMUM LEFT TURN STORAGE REQUIREMENTS

Intersecting Thoroughfares	Minimum Storage
Major with Major	150 feet
Major with Secondary	100 feet
Major with Residential	60 feet
Major with Private Drive	60 feet
Secondary with Major	100 feet
Secondary with Residential	60 feet
Secondary with Private Drive	60 feet

Note: Storage requirements listed herein are absolute minimums. Storage requirements may increase based upon actual and projected traffic demands.

b) Transition Length

The transition curves used in left-turn lanes shall be two 250-foot radius reverse curves, which will require a total transition length of 100-feet.

c) Median Openings

(1) Median openings at Intersections shall be from right-of-way to right-of-way or the intersecting street.

(2) The minimum width of mid-block median openings shall not be less than sixty (60) feet. See Detail, page 12.

d) Medians Where No Left-Turn Pocket is Needed

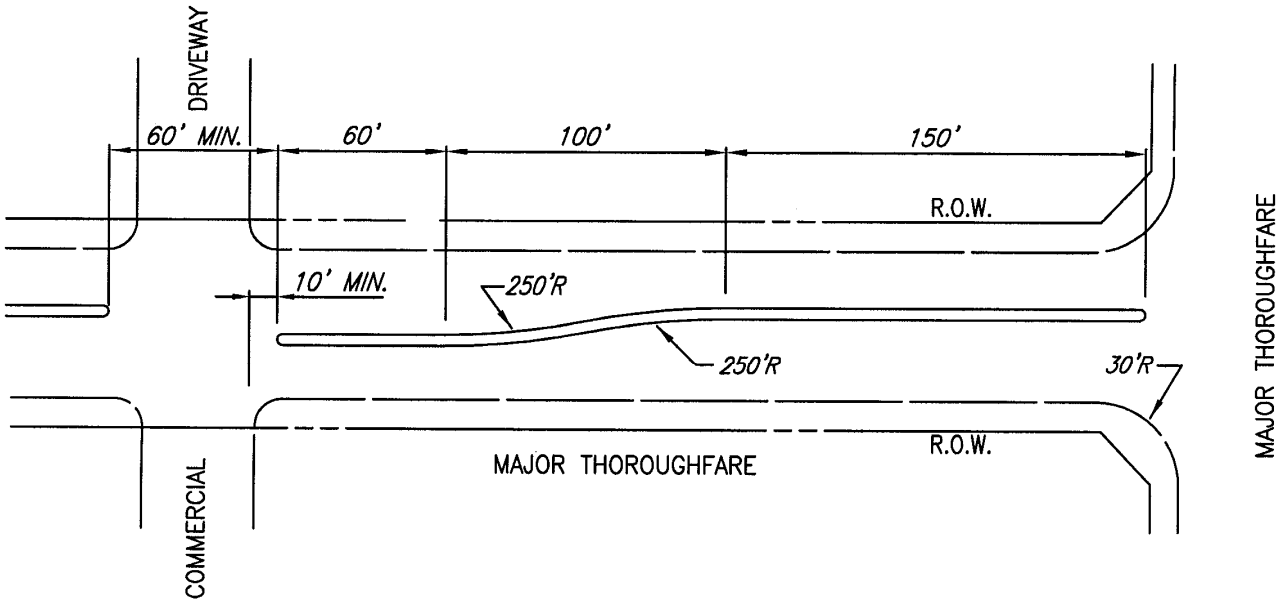
(1) If left-turn storage is provided in only one direction, (i.e., a drive opening cannot be installed for the other direction), the minimum length of median must be the required left-turn storage and transition length, plus 30-feet of median length beyond the end of the transition. See Detail, page 12.

(2) If the left turn storage is not required in either direction, but the median is simply a spacer between two median openings, the minimum length of the spacer must be 50-feet. See Detail, page 12.

e) Medians into Developments on Public Streets

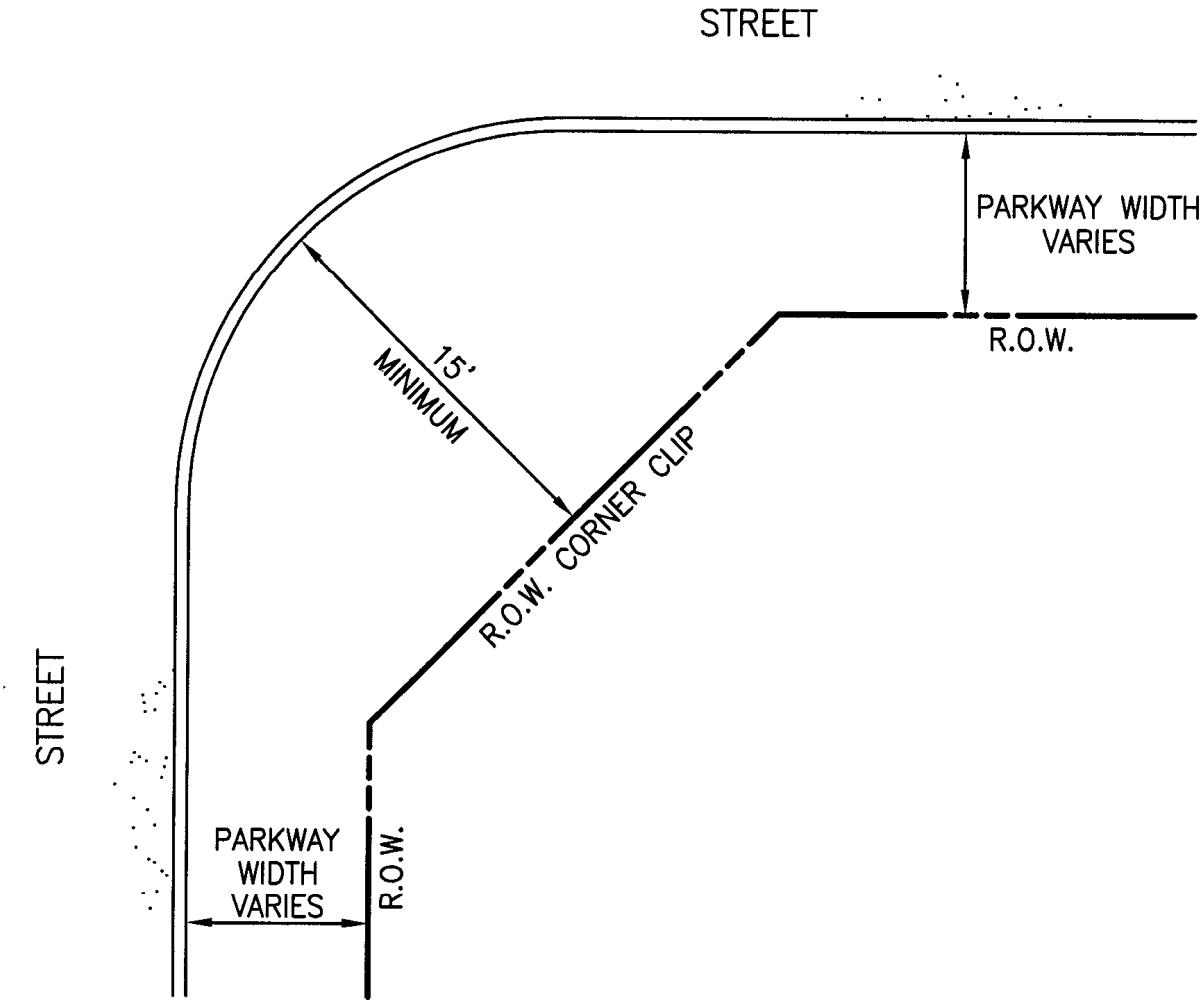
Medians installed on undivided streets at entrances to subdivisions for aesthetic or any other purpose will be a minimum of 6-feet wide.

Detail – Typical Median Opening Spacing



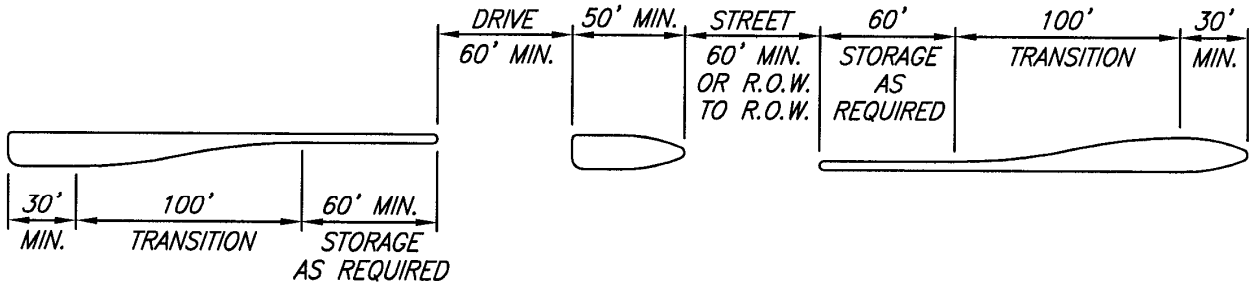
TYPICAL MEDIAN OPENING SPACING
MAJOR THOROUGHFARE

Right-of-way Corner Clip Requirement

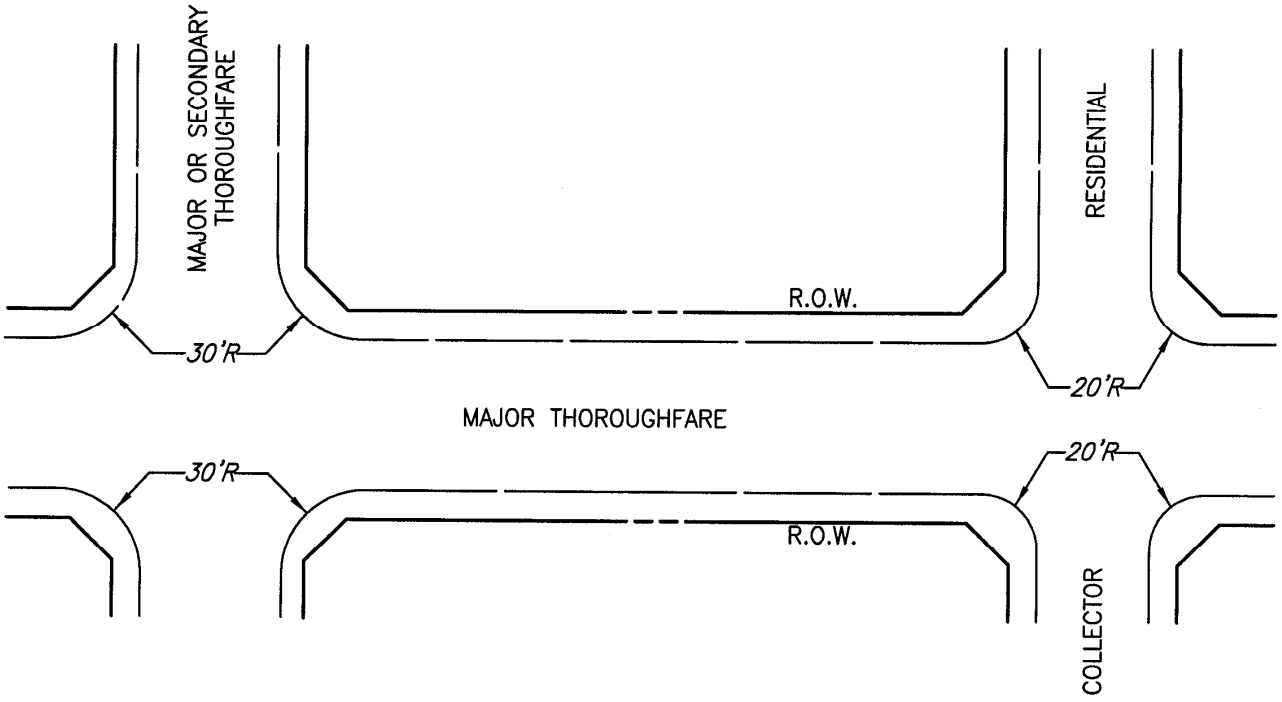


RIGHT–OF–WAY CORNER CLIP REQUIREMENT

Curb Radii at Intersection



TYPICAL MEDIAN DIMENSIONS WITHOUT
BACK TO BACK LEFT TURN POCKETS



CURB RADII AT INTERSECTION

C. ALLEY DESIGN STANDARDS

1. Alley Requirements for Developments

Alleys shall be constructed in accordance with NCTCOG Standard Details, latest edition, or as amended by the Director of Public Works.

2. Alley Intersections

Alleys shall not intersect major or secondary thoroughfares. Alleys which run parallel to and share a common right-of-way line with a secondary or major thoroughfare shall turn away from the major street not less than one subdivision lot width or a minimum of 50-feet (whichever is greater) from the cross street intersection.

3. Alley Radius

Alley radii at street intersections shall conform to NCTCOG Standards.

D. DRIVEWAY DESIGN STANDARDS

1. Definition of Driveway Types

For purposes of interpreting the provisions of these Standards and Design Methods, the following definitions shall apply:

(a) A “residential” driveway provides access to a single-family residence, to a duplex, or to a multi-family building containing five or fewer dwelling units. These drives shall intersect residential and commercial roadways only.

(b) A "commercial" driveway provides access to an office, retail or institutional building, or to a multiple-family building having more than five dwelling units. It is anticipated that such buildings will have incidental truck service.

(c) An "industrial" driveway serves substantial numbers of truck movements to and from loading docks of an Industrial facility, warehouse, or truck terminal. A central retail

development, such as a community or regional shopping center, may have one or more driveways specially designed, signed, and located to provide access for trucks and such driveways shall be considered industrial driveways. Industrial plant driveways whose principle function is to serve administrative or employee parking lots shall be considered commercial driveways.

Note: Driveways shall always be designed to intersect the street at a 90^{o} angle.

2. Driveway Width

As the term is used here, the width of a driveway refers to the width of pavement at the property line.

(a) Residential driveways onto streets shall have a minimum width of 12-feet and a maximum width of 24-feet. Joint access residential drives shall have no less than nine (9) feet on any property. See Detail (a), page 15.

(b) Commercial/Industrial. Two-way operation: See Detail (b), page 15.

(1) Commercial driveways shall have a minimum width of twenty-four (24) feet and a maximum width of 30-feet.

(2) Industrial driveways shall have a minimum width of 30-feet and a maximum width of 40-feet. Joint access commercial/industrial drives shall have no less than Ten (10) feet on any property, with the full drive width and access pavement to the property built for the development at the same time.

(c) Commercial/Industrial - One-way operation:

(1) 90 degree drives shall have a width of 18-feet for ingress and 22-feet for egress, with the separation median width being a minimum or 4-feet and a maximum or 10-feet. See Detail (c), page 16.

3. Driveway Radius

All driveways intersecting dedicated streets shall be built with a circular curb radius connecting the 6-inch raised curb of the roadway to the design width pavement of the driveway. All driveways shall provide for barrier free access. Driveway radii shall fall entirely within the subject property so as to begin at the street curb, at the extension of the property line.

(a) 90 Degree Intersection (See Detail, page 13)

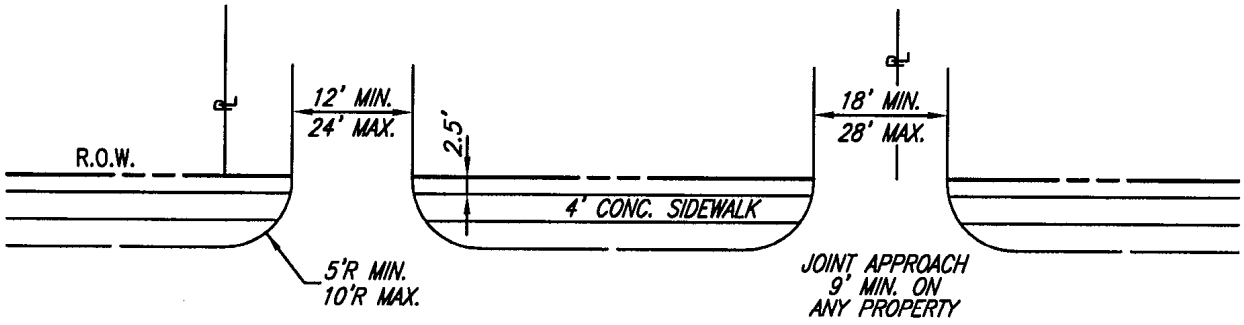
(1) The curb radii for a residential drive shall be a minimum of 5-feet and a maximum of 10-feet.

(2) The curb radii for a commercial drive shall be 20-feet.

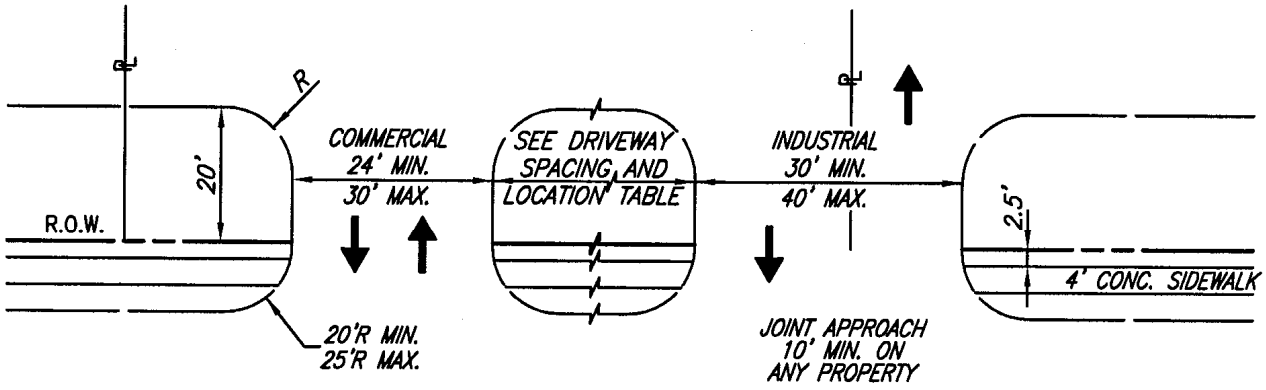
(3) The curb radii of an industrial driveway shall be 25-feet.

In order that the definition of the location of the edge of pavement for the thoroughfare may be maintained, driveway radii shall always be designed to become tangent to the street curb line. All commercial and industrial drives will have an unbroken curb length of not less than 20-feet from the right-of-way, or 30-feet from the roadway curb extending into the site on each side of the drive.

Detail – Driveways Width, Radius, Spacing

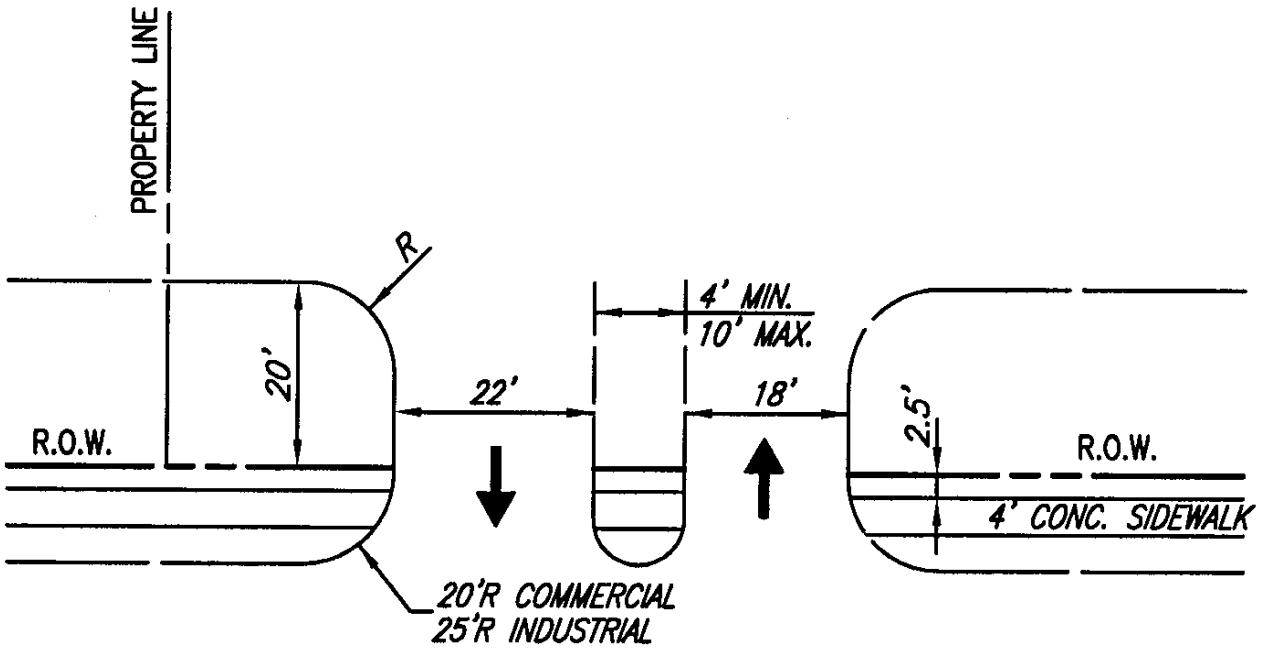


(a) DRIVEWAYS WIDTH, RADIUS, SPACING



(b) DRIVEWAYS WIDTH, RADIUS, SPACING

Detail – Driveways Width, Radius, Spacing



(c) DRIVEWAYS WIDTH, RADIUS, SPACING

4. Driveway Spacing and Location in Relation to Other Drives

(a) Residential

Driveway approaches on a tract of land devoted to one use shall not occupy more than 70% of the frontage abutting the roadway. No more than two driveway approaches shall be permitted on any parcel of property on each street.

(b) Commercial and Industrial

The spacing and location of driveways shall be related to both existing adjacent driveways and those shown on approved development plans. The spacing between driveways shall depend upon the speed limit of the Thoroughfare as per Table 7. Driveways shall not be permitted in the transition area of a deceleration lane or a right turn lane.

TABLE 7

DRIVEWAY SPACING IN RELATION TO OTHER DRIVES GIVEN THE DESIGN SPEED OF THE STREET

Design Speed (MPH)	Driveway Spacing (Ft.)
25	65
30	90
35	100
40	120
45	150
50	200

Minimum spacing shall not be more than 10-feet less than the spacings shown above. Spacings between driveways will be measured along the property line from the edge of one driveway to the closest edge of the next driveway and not from centerline to centerline.

5. Driveway Spacing in Relation to a Cross Street

(a) 90 Degree Intersection - Drive to Road

(1) Driveways that intersect at 90 degrees to a residential or "secondary street" shall be located a minimum of the drive radius from a residential street's end of curb radius.

(2) A driveway that Intersects at 90 degrees to a residential or secondary street shall be located a minimum of thirty (30) feet from a secondary or major street's end of curb radius. See Detail (a), page 20.

(3) A driveway that intersects at 90 degrees to a major street shall be located a minimum of 100-feet from any intersecting street's right-of-way. If the property length, along the street, is such that both the drive and the drive's curb radius cannot be totally within the proposed development, the drive will be situated so as to be a joint access drive. See Detail (b), page 20.

(b) 45 degree Intersection - Drive to Road

(1) If one-way angle drives are used, the radius for the driveway on a residential or secondary may not begin less than 35-feet from an intersecting street's end of curb radius.

(2) On a major street the drive shall be located a minimum of 100-feet from any intersecting street's right-of-way. If a property length, along the street, is such that both the drive and drive's curb radius cannot be totally within the proposed development, the drive will be situated so as to be a joint access drive. See Detail (c), page 20.

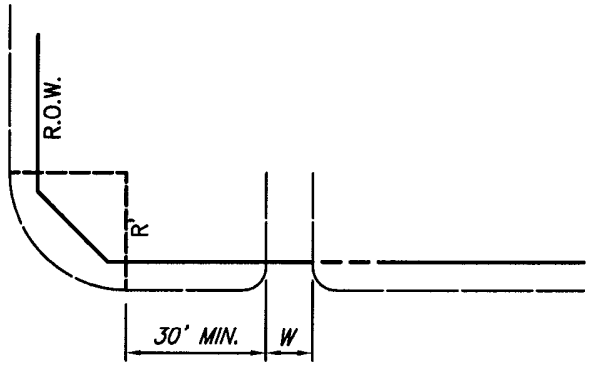
A summary of driveway widths, radii, and angle requirements are given in Table 8.

TABLE 8

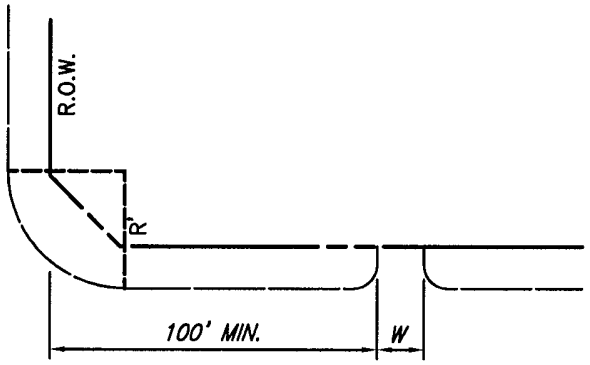
SUMMARY OF DRIVE REQUIREMENTS

	Residential	Commercial	One-Way		Industrial
			In	Out	
Width (ft)					
Minimum	12	20			30
One-way (only)					
90°			18	18	
Maximum	24	30			40
Curb Radius (ft)					
	5	5	5	5	5
90°	5 – 10	20	Same	Same	25
Intersection					
Angles (deg.)	90°	90°	90°	90°	90°
	45°	45°	45°	45°	45°

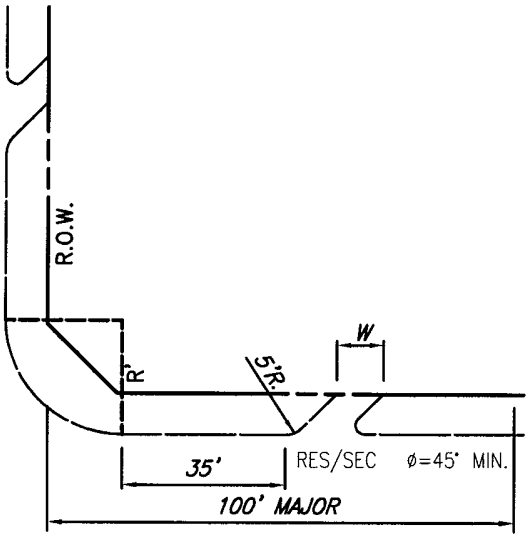
Detail – a, b & c Angel Drive



(a) DRIVE INTERSECTING A RESIDENTIAL OR SECONDARY



(b) 90° DRIVE INTERSECTING A MAJOR



(c) ANGLE DRIVE

E. PUBLIC RIGHT-OF-WAY VISIBILITY

1. Street/Drive Intersection Visibility Obstruction Triangles-Frontage Plan/Profile

A landscape plan showing the plan/profile of the street on both sides of each proposed drive/street to the proposed development with the grades, curb elevations, proposed street/drive locations, and all Items (both natural and man-made) within the visibility triangles as prescribed below shall be provided with all site plans, if they are not on engineering plans that are submitted at the same time. This profile shall show no horizontal or vertical restrictions (either existing or future) within the areas defined below.

Obstruction/Interference Triangles-Defined

No fence, wall, screen, billboard, sign, structure, foliage, hedge, tree, bush, shrub, berm, or any other item, either manmade or natural shall be erected, planted, or maintained in a position, which will obstruct or interfere with the following minimum standards.

(a) Vision at all intersections where streets intersect at or near right angles shall be clear at elevation between 2½-feet and 9-feet above the average gutter elevation, except single trunked trees, within a triangular area formed by extending the two curb lines from their point of intersection, 45-feet, and connecting these points with an imaginary line, thereby making a triangle. If there are no curbs existing, the triangular area shall be formed by extending the property lines from their point of intersection 30-feet and connecting these points with an imaginary line, thereby making a triangle. (see Detail, page 23)

(b) Definitions for desirable minimum sight distance requirements for non-residential streets, commercial driveways, and industrial driveways that intersect at or near right angles are presented below (see Detail, page 24). The values presented are minimum sight distances which would permit the following:

- T-Upon turning left or right, an exiting vehicle could accelerate to the operating speed of the street.

The desirable minimum sight distances are based on the premise that the approaching driver can observe the intersecting vehicle 2.5 seconds before he must apply the brakes

and travel the minimum stopping distance for his approach speed. They are, therefore, particularly applicable to arterial streets. Actual sight distances provided at Intersections should be much greater than these minimum values if practical. The minimum sight distance triangle shall also apply to visibility obstructions at intersections.

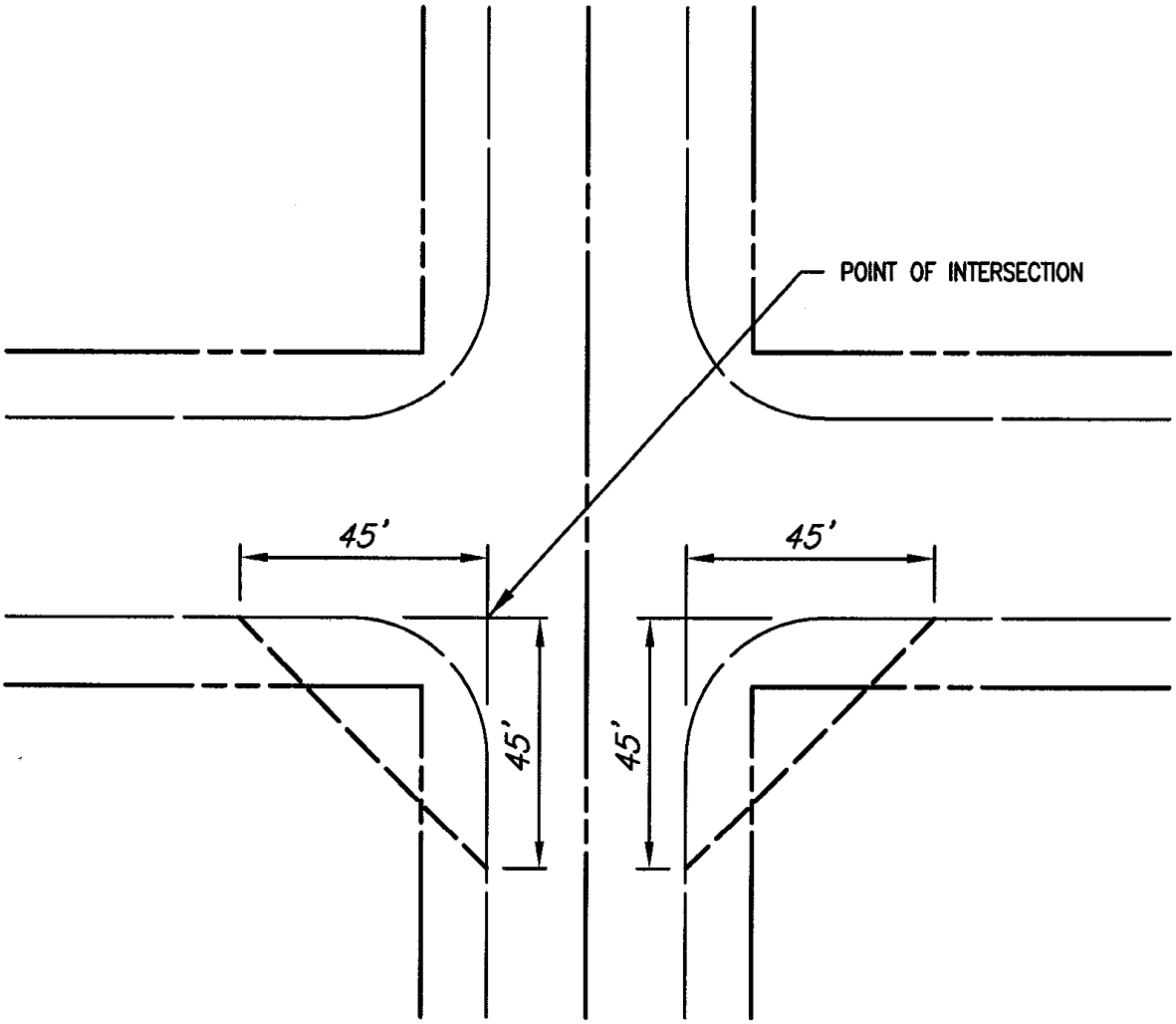
Conditions for Intersection Sight Triangle-Plan/Profile:

- In the plan view, the horizontal clear area at the Intersection of a proposed street/drive shall be defined as being within a triangular area formed by:

(1) A line that is on the centerline of the proposed street/drive, beginning at the Intersecting street's tangent curb and continuing for a distance of 15-feet back into the proposed street/drive to the end point.

(2) A line that is parallel to and 5-feet out from the intersecting street's curb, beginning at the centerline of the proposed street/drive and continuing for a distance "T" as prescribed in Table 9, to the end point.

Detail – Horizontal Clear Triangle



HORIZONTAL CLEAR TRIANGLE

Table 9

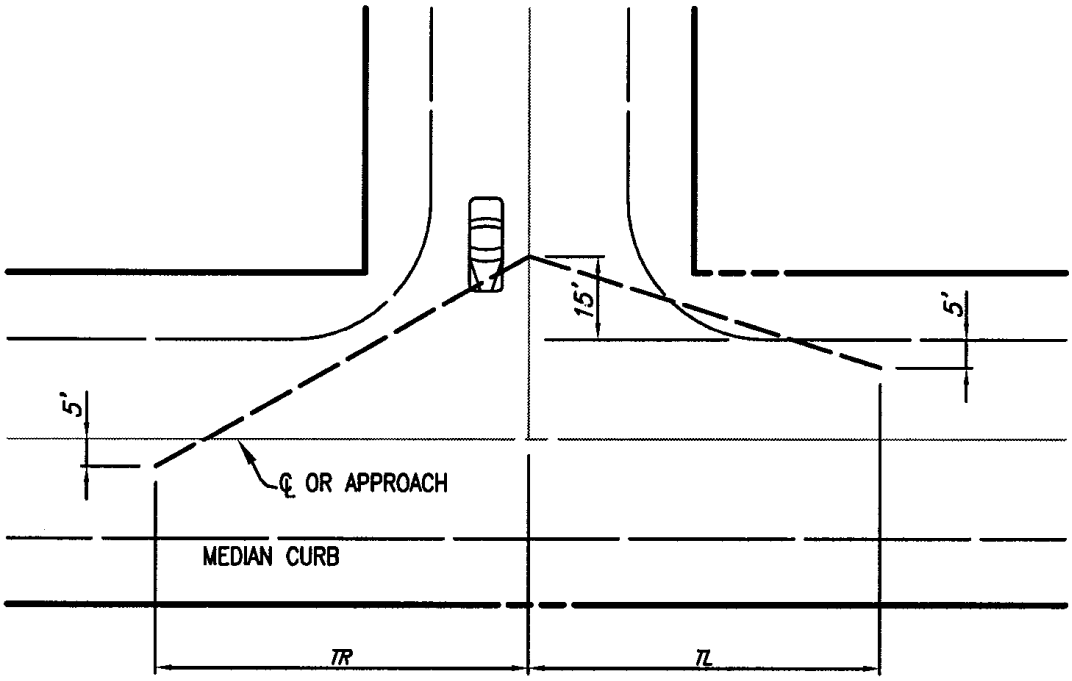


TABLE 9

MINIMUM SIGHT DISTANCE FOR A CAR AT AN INTERSECTION

MPH	I
30	110 + 200=310
35	130 + 250=380
40	130 + 325=475
45	165 + 400=565
50	190 + 475=665

(AASHTO P138, BRAKE REACTION DISTANCE + STOPPING SITE DISTANCE)

(3) A straight line that connects the end point of an:

- That is on the centerline and 15-feet back into the proposed street/drive, and the end point of a
- That is a distance "T" along and 5-feet out from the existing street's curb from the centerline or the proposed street/drive.

In the profile view, the clear window shall be defined as being within the horizontal clear area and clear between 2.5 feet and 9 feet above the average pavement elevation.

Note: Single trunked trees within the triangles and in the median shall be allowed and spaced so as to not cause a "picket fence" effect. Because of the large variation of ways in which trees can be planted, the spacings will be decided upon by the City Engineer and the developer at the time of review of the landscape plans. Any other Item that obstructs these lines so as to interfere with the above requirements will not be allowed.

TABLE 9

MINIMUM SIGHT DISTANCE FOR A CAR AT AN INTERSECTION
(For Level-Two Lane Streets)

MPH		T				
30	.....	110	+	200	=	310
35	.....	130	+	250	=	380
40	.....	130	+	325	=	475
45	.....	165	+	400	=	565
50	.....	190	+	475	=	665

AASHTO P138, Break Reaction Distance + Stopping Site Distance

The aforementioned restrictions also apply to streets which do not intersect at right angles, except that the triangle dimensions shall not necessarily be minimum requirements. In such cases the City Engineer shall have the authority to vary such requirements as he deems necessary to provide safety for both vehicular anti pedestrian traffic.

2. R.O.W. Obstructions Outside The Visibility Triangles

(a) Foliage of hedges, trees and shrubs in public right-of-ways which are not governed by Zoning Ordinance of the City, or the above triangles shall be maintained such that the minimum overhung above a sidewalk shall be 7-feet, the minimum overhang above a street shall be 14-feet.

(b) All other areas within the street right-of-ways shall be clear at elevations between 2½-feet and 9-feet above the average street grade,

(c) Plants In the public right-of-way that will grow over 30-inches (when mature) above the adjacent street's curb will conform to all of the above requirements, where applicable. All landscape plans shall show the locations and type of such plants, and show each of the prescribed triangles.

(d) Ground elevations, within both triangles, will be shown by contour lines.

Note: No plantings over 30-inches above the adjacent gutter elevation are allowed In the median for the length of the left turn stacking space unless specifically agreed upon by the City Engineer.

3. Alley Visibility Obstructions

No fence, wall, screen, billboard, sign, structure, or foliage of hedges, trees, bushes, or shrubs shall be erected, planted or maintained in any alley right-of-way. Foliage or hedges, trees, bushes, and shrubs planted adjacent to the alleys right-of-way which are not governed by the above triangles or by Zoning Ordinance of the City, shall be maintained such that the minimum overhang or encroachment shall be 14-feet above the alley surface at the edge of the pavement.

4. Exceptions

The provisions of this manual shall not apply to, or otherwise interfere with, the following:

(a) Placement and maintenance of traffic control devices under governmental authority and control.

(b) Existing and future screening requirements Imposed by the City Council.

(c) Existing and future City, State and Federal Regulations.

SECTION III - PAVEMENT STRUCTURE

A. GENERAL

Factors which influence the performance of street and thoroughfare pavement include the subgrade upon which the pavement structure rests, the quality of materials used to construct the pavement and the type and amount of traffic using the facility. In designing a pavement which will provide a reasonable degree of performance during an expected life, certain of these factors can be predetermined. The load bearing capacity of the subgrade can be determined by making a soils engineering investigation of the site for the proposed pavement. The strength of the pavement can also be established by specifications and quality control during construction. A reasonable estimate can also be made of the traffic including the number of equivalent 18-Kip axial loads anticipated during the expected life of the pavement.

Although the subgrade and traffic vary for different locations, the plasticity index (P.I.) of the subgrade and the street or thoroughfare type (Minor Type F-1, Secondary Type D-1, etc.) reflect to a degree these factors. Standard pavement sections are established, therefore, for certain subgrade conditions and street type and are included in the manual in Table 10, "Standard Street and Thoroughfare Pavement Design". Unusual design conditions may be encountered which will preclude the use of Table 10. Also, alternate designs accompanied by calculations and data based on accepted pavement design procedures will be reviewed, studied and considered by the City of Waxahachie Department of Public Works.

B. STANDARD STREET AND THOROUGHFARE PAVEMENT DESIGN

Table 10 shows the required pavement thickness for either rigid pavement or flexible pavements and the subgrade requirements for certain soil conditions and for various street and thoroughfare types within the City of Waxahachie. The procedure for using this table requires that a soils investigation be made including obtaining soil auger borings, classifying the soils encountered and determining the strength and physical properties of the underlying and supporting soils system in the laboratory by means of Atterburg Limits, optimum moisture content, and unit dry weight. For each soil classification encountered, the plasticity index shall be calculated and depending on whether the P.I. is less or more than the critical percentage shown, the subgrade design shall consist of a 6-inch compacted subgrade or a lime treated subgrade as shown in Table 10. Table 10 also presents the recommended pavement thickness of Portland cement

concrete pavement and asphaltic concrete pavement for the various street and thoroughfare types.

C. ALTERNATE PAVEMENT DESIGN

The Department of Public Works will consider an alternate pavement design in lieu of selecting a design from Table 10, particularly when there are circumstances which warrant an individual design. Certain recognized factors which affect the design of street and thoroughfare pavement are as follows:

1. Traffic

One of the important factors influencing the design of pavement structure is the magnitude and number of load applications expected during the life of the pavement. Streets of similar type have essentially the same magnitude and number of load applications during the life of the facility. The minor street, for example, carries some city bus traffic and practically no truck traffic and its primary function is to provide access to adjacent property. The number of load applications expected during the life of the minor street pavement is considerably less than that of the major and secondary thoroughfares.

Major and secondary thoroughfare types perform additional roles to those of the minor streets. The major thoroughfare carries major traffic movements within and near the metropolitan area including truck and bus traffic, commuter traffic and industrial traffic. Secondary thoroughfares serve as collectors from residential, commercial and industrial subdivisions, serve as internal traffic arteries within a particular area of the City and essentially handle the same type of traffic as the major thoroughfares.

2. Soils and Subgrade

The subgrade is the top of the usual grading operation in the construction of a street pavement, including the subgrade treatment, upon which the sub-base, or pavement is placed. The subgrade should be compacted to at least 90 percent of Standard Density at or slightly above optimum moisture to a depth of 6 inches. Subgrades having a plasticity index of 15 or greater are treated with lime or cement and then compacted to ninety-five (95) percent of Standard Density. To predict the performance of the subgrade when subjected to traffic loads, samples and tests of the natural soil shall be made. Soil engineering investigations for the design of street pavement shall include auger borings, classification of

the materials encountered and determining the strength and physical properties of the underlying and supporting soils system.

Two basic types of pavement shall be used in the construction of streets in the City of Waxahachie. These include the rigid type pavement and the flexible type pavement. The support that the underlying soil layers gives to a Portland cement concrete pavement measured at the top of the subgrade or sub-base is expressed as the Modulus of Subgrade Reaction, k. This value for a particular soil shall be obtained by means of a plate bearing test or an approximation of the k value and can often be accurately approximated by correlation of soils data. The k values for various soil types are approximated in Table No. 11.

Under flexible type pavement the ability of the subgrade to support traffic loads is expressed as the California Bearing Ratio, commonly referred to as the CBR. Another method of measuring the ability of the subgrade to support the traffic load is the Texas Triaxial Compression Classification.

To develop additional strength in the pavement subgrade, the existing soil may be treated with hydrated lime or cement. Normally, the treatment consists of adding four percent to six percent by unit dry weight to the existing subgrade. In addition to adding strength to the subgrade, lime or cement treatment also reduces the tendency of the soil to volumetric change by forming a moisture barrier and reducing moisture fluctuations in the underlying soils. Subgrade treatment is also an aid in speeding up construction by providing a "working table" for the contractor.

All laboratory tests and field procedures in the use of lime and cement to treat the subgrade under streets and thoroughfares should be performed under the supervision of a registered engineer.

3. Wheel Loads

Alternate pavement designs submitted to the Department of Public Works shall be based on axle loads. These include the Passenger Vehicle, P, the Single Unit Truck, SU, and the Semi-Trailer Combination, WB-50.

TABLE 10

CITY OF WAXAHACHIE, TEXAS
STANDARD STREET AND THOROUGHFARE PAVEMENT DESIGN

Facility Type	Pvmt. Width	Usual Crown	Rigid Pavement			Flexible Pavement		
			Subgrade Requirements		Conc. Pvmt.	Subgrade Requirements		Asphalt Conc. Pvmt.
			P.I. Less Than 20	P.I. = 20 or Greater		P.I. Less Than 20	P.I. = 20 or Greater	
Alley	10’ – 20’	3” Inverted	6” Compacted	6” Lime Treated	See NCTCOG Standards	Not Permitted		
Minor Type F	30’	5” Parabolic	6” Compacted	6” Lime Treated	6”	6” Compacted	6” Lime Treated	7.5”
Collector Type E-2 (Multi-Family)	36’	6” Parabolic	6” Compacted	6” Lime Treated	7”	6” Compacted	6” Lime Treated	9.5”
Collector Type E-2 (General Retail)	36’	6” Parabolic	8” Compacted	8” Lime Treated	8”	Not Permitted		

TABLE 10 - STANDARD STREET AND THOROUGHFARE PAVEMENT DESIGN
(Cont.)

Facility Type	Pvmt. Width	Usual Crown	Rigid Pavement			Flexible Pavement		
			Subgrade Requirements		Conc. Pvmt.	Subgrade Requirements		Asphalt Conc. Pvmt.
			P.I. Less Than 15	P.I. = 15 or Greater		P.I. Less Than 20	P.I. = 20 or Greater	
Collector E-1 (Industrial & Commercial)	40	6" Parabolic	8" Compacted	8" Lime Treated	8"	Not Permitted		
Secondary Thoroughfare D-2	48	6" Parabolic	8 Compacted	8" Lime Treated	8"	Not Permitted		
Secondary Thoroughfare D-1	60	8" Parabolic	8" Compacted	8" Lime Treated	8"	Not Permitted		
Major Thoroughfare, Type C	2-24'	¼"/Ft.	8" Compacted	8" Lime Treated	8"	Not Permitted		
Major Thoroughfare, Type B	2-33'	¼"/Ft.	8" Compacted	8" Lime Treated	8"	Not Permitted		
Major Thoroughfare – Type A	2-36'	¼"/Ft.	8" Compacted	8" Lime Treated	8"	Not Permitted		

NOTE: (1) Twenty-eight day concrete strength of rigid pavement to be not less than 3000 p.s.i.

TABLE N0. 11

APPROXIMATE K VALUES

Approximate Modulus of Subgrade Reaction, k	Type of Soils
100	silts and clays
200	sandy soils
300	sand – gravels