General Street Design Guidelines

1. Right-of-Way and Pavement Widths

In newly developed subdivisions, right-of-way shall be dedicated by the developer and pavement width constructed in accordance with city requirements. The classifications of the streets shall be as determined by the City Engineer and approved by the City Council Tables 2 and 3 on the following pages provide the requirements for right-of-way and pavement widths, as well as median widths and crown or cross slope. In construction projects by the City of Cibolo, where the desired right-of-way is not available for the adequate pavement width shown in Table 2, the City Engineer will determine the pavement width to be used on the project. Said pavement width must be approved by the City Council.

TABLE 1

ROAD DEVELOPMENT

Street Classification	R.O.W	Pavement	Median Widths	Pvmt. Crown Or Cross-Slope
Local "A" (Residential)	50'	30'	---	4"
Local 'B" (Minor Collector)	60'	40'	---	4"
Collector (Major)	66'	44'	---	5 "
Primary Arterial	86'	2 @ 24'	14' paved	(1,2) ¼" per ft.
Regional Arterial	110'	2 @ 36'	14' paved	(1,2) ¼' per ft.
Marginal Access (Comm.)	40'	30'	---	4"
Marginal Access (Res.)	40'	26'	---	3"
Alleys (Commercial)	24'	---	---	0" to 7"*
Alleys (Apartments)	24'	20'	---	0" to 7"*
Alleys (Residential)	24'	18'	---	0" to 7"*

* Crown shall be inverted to facilitate drainage.

NOTES:

(1) In new subdivisions - median may be left unpaved and landscaped.

(2) When determined by the City Engineer and approved by the City Council, turning lanes and other usage of street pavement may be used in lieu of medians in either public or private development.

2. Parkways

Parkways shall be sloped a minimum of one quarter (1/4") inch per foot from the property line to the top of curb. In heavy "cut" areas this slope may be increased to one (1") inch per foot. In reconstruction projects where lot grading is not feasible, parkways may be sloped a maximum of three horizontally to one vertically from the sidewalk to the property line. If the slope exceeds this amount, a "combination type" sidewalk and retaining wall shall be constructed with the top of the wall matching the property line grade. The Design Engineer

shall determine the height and length of retaining wall considering the use and appearance of the private property. Landscaping, walls, or fences placed in the parkway shall not obstruct sight distance. Plans for such work shall be reviewed by the City Engineer and approved by the City Council.

3. Medians

a. On redeveloped streets, medians will be paved. This may be accomplished by carrying the proposed pavement across the median and then outlining the median and turning lanes with paint or traffic buttons, or it may require construction of curbs around the median with concrete or asphaltic pavement between the curbs set to top of curb elevation. In either case, the paved median shall be sloped one quarter (1/4") inch per foot from the centerline of the median to the curbs for proper drainage. The City Engineer will determine the type of median to be used. When determined by the City Engineer and approved by the City Council, turning lanes or other usage of street pavement may be used.

b. Paving of the median is not required in the construction of a primary or secondary street by a private developer. The developer is required to construct two (2) twenty four (24') foot paved roadways and to provide right-of-way for the median. The median area itself is graded off to an elevation approximately seven inches above the edge of the adjacent pavement. The earth median is to be sloped at one quarter (1/4") per foot for drainage.

c. Medians shall be continuous. Openings in the median will be provided at all public streets provided the centering spacing for such streets is at least five hundred (500') feet. If the street spacing is less than five hundred (500') feet, the median shall be open for the street with the higher functional classification. All other openings shall be made in accordance with the current standards of the Department of Public Works. When medians are open, left turn safety bays and median radii shall be provided and curbed unless approved otherwise by the Director of Public Works.

d. Special purpose medians or dividers constructed for aesthetic reasons as entrances for subdivisions, etc., will be permitted and should be designed according to the standards of this section. Dividers must be constructed according to the following standards and after which the appropriate transition shall be provided in accordance with the provisions contained herein under "Transitions". Minimum width of medians or dividers shall be fourteen (14') feet and minimum length shall be twenty-five (25') feet.

e. The nose or rounded portion of the divider shall normally be semi-circular in shape at intersections of arterial streets and bullet shaped at all other street intersections. The semi-circular nose shall have a radius equal to one half the divider width and shall be placed two feet from the proposed curb line of the arterial The bullet nose shall have two radii of fifty (50') feet joined at the nose with a radius of three feet which shall be placed five feet from the proposed curb line of the cross street. Intersection characteristics may require other modifications to the median nose as approved by the City Council. The length of the full width median shall be measured from the point of tangency of the curved nose section.

f. No signs, walls, or fences shall be placed in the median area other than approved traffic control devices unless approved by the City Council. No trees, shrubs, walls, fences, or other ground cover may be placed in the median, which will obstruct the driver's sight distance. With the approval of the Director of Public Works, trees, shrubs, or other ground cover may be placed in the median and divider area provided the full grown tree or shrub trunk diameter does not exceed four (4") inches. Said landscaping shall be in accordance with current design standards of the City Engineer and by the City Council Plans for such work shall be approved by the Director of Parks and Recreation and by the Director of Public Works.

g. Where a median or traffic divider projects across crosswalks, the median (paved or sod) shall be opened for five (5') feet at the projection of the grade of the adjacent roadway to permit wheelchair and mobility-impaired persons to utilize the crosswalk.

4. Crown and Cross-Slope

The crown cross-slope shall be as indicated for each classification of street and shall slope from the centerline of the streets as needed for proper drainage. Where drainage indicates the crown or normal cross-slope may be phased out to allow for proper drainage. The maximum cross-slope in such cases shall be one half (1/2") inch per foot from gutter to gutter of the project street. In certain cases on primary or secondary streets with horizontal curves, the pavement may be super-elevated with the pavement on one side sloping from the gutter to the median. This may be done only with the approval of the Director of Public Works and where street drainage has been adequately provided.

5. Driveway Approaches

Every lot shall be provided with adequate access to a public street by direct frontage on such street. Rear and/or side driveway access to major streets shall be prohibited.

a. In new subdivisions, driveway approaches shall be designed and constructed as required for the proposed residence or commercial building. Concrete driveway approaches are required in new subdivisions and shall be built in accordance with city specifications.
b. In the development or redevelopment of streets, driveway approaches shall be designed and constructed where deemed necessary by the City Council. The new approaches will be constructed with concrete and with the same location and width used in the existing driveway, and the city Engineer will work with the property owner when exact location and specifications cannot be defined.
c. "Head-in" parking is not preferred in construction or reconstructed. Engineer will work with the property owner to determine relocation of the driveway approach. The City shall notify the owner and document any changes in location, width, and material for the driveway.
d. The City Engineer shall be consulted regarding the size and location of commercial driveways when located on a collector or higher Type Street. The driveway shall be flared at the curb line so as to allow ingress and egress to the property by vehicles without the need of crossing into another driving lane. These flared sections may be constructed with radii equal to the distance from the property line to the curb, or by widening the edges of the driveway at the forty five (45º) degree angle. Exceptional or unusual conditions shall be referred to the City Engineer.
e. Driveways shall be constructed on a constant grade from the curb to the property line. The maximum grade that most vehicles can negotiate is twelve (12%) percent, without scraping the extremities of the vehicles. If a twelve (12%) percent grade cannot be constructed because of extreme elevation differences or short parkway widths, the driveway must be extended into the private property sufficiently to achieve the twelve (12%) percent grade maximum In such cases, the Engineer must prepare a "driveway plat" showing the driveway plan, section and profile grade. The overall length of driveway and the length of the portion of the drive to be located on private property should be shown also. The plat also contains an affidavit for signature of the property owner giving approval to the City to construct the drive on their property. The necessary signatures will be obtained by the project Inspector or other City representative prior to construction of the street.

6. Horizontal Design Requirements

Horizontal design requirements will include horizontal curves, curb return and property line return, radius requirements, and pavement transitions.

a. Horizontal curves

1. Change in alignment of a street shall be accomplished by use of simple horizontal circular curves of radii which meet the requirements of the latest edition of "A Policy on Design of Urban Highways and Arterial Streets" (American Association of State Highway & Transportation Officials). The following minimum radii and design speed in Table 3 below shall be used in the design of horizontal curves.

2. In certain instances, the radius of horizontal curvature may be restricted by the required sight distance for safe stopping or for safe operation at a street intersection. Safe stopping distance as related to sight distance will be as shown in Table 4 below.
3. Compound curves shall not be permitted unless approved by the Director of Public Works. Reverse curves should be avoided. If a reversal of direction is needed, the curves should be separated by at least one hundred (100') feet of tangent. Transitional curves may be used where comfort and safety of the motorist will be enhanced. Where a horizontal curve is used in combination with a vertical curve, adequate sight distance must be provided, and the horizontal curvature should be introduced on the upgrade of a "crest" vertical curve.

b. Property Line and Curb Returns

Where two streets intersect, certain radii are required for the curbs and for the property lines in new subdivisions or where new right-of-way is being acquired. These radii vary with the classifications of the intersecting streets and with the intersecting angle of the streets. Table 5 gives the required minimum radii for curb returns and property line returns for various types of streets, and for the interior angles of the intersecting tangents of the streets--180 degrees--P.1. Deflection Angle.

TABLE 3

HORIZONTAL CURVE RADII

Street Classification	Minimum Centerline Radius	Design Speed
Primary	1,200'	50 mph
Secondary	700'	40 mph
Collector	400'	30 mph
Local "A" or "B"	100'*	
Marginal Access (Res. or Comm.)	50'	

***See Alliterative Geometric Alignment Design in Exhibits.**

TABLE 4

REQUIRED SIGHT DISTANCE

Street Classification	On Curves	At Intersections
Primary	450'	450'
Secondary	300'	400'
Collector	250'	300'

TABLE 5

INTERSECTION CURB RETURNS & PROPERTY RETURN RADIUS (BY ROAD CLASSIFICATION)

Interior Angle	Local to Local		Collector to Local		Collector to Collector		Arterial to Local/Collector		Arterial to Arterial	
Degrees	**C.R.**	**P.L.R.**	**C.R.**	**P.L.R.**	**C.R**	**P.L.R.**	**C.R.**	**P.L.R.**	**C.R.**	**P.L.R.**
150-145	15	5	15	5	20	10	25	15	25	15
145-140	15	5	15	5	20	10	25	15	29	15
140-135	15	5	15	5	20	10	25	15	30	20
135-125	15	5	15	5	20	10	25	15	35	25
125-85	15	5	15	5	20	10	25	15	35	25

C.R. = Curb Return Radius (Minimum.)

P.LR. = Property Line Return Radius (Minimum.)

c. Transitions

Where street pavement widths change, for whatever reason, the pavement of the wider section shall be transitioned into the narrower section. Such transitions shall be described as a ratio of the computing transition length.

Case 1: Local and Collector Streets

L = 20 W where,

L = Length of transition measured along centerline of street.

W = Transition width measured as the difference in pavement width from the centerline to the pavement edge of two street sections.

Case 2: Arterial Streets

L = DW where,

L = Length of transition measured along centerline of street.

D = Design speed of street.

W = Transition width as before.

Medians or center dividers shall also be transitioned. Median transition shall generally parallel the pavement transition to a point where the median is four (4') feet wide at which point the median shall be rounded off with a two (2') foot radius. Median or divider transitions shall be designed so that abrupt offsets are not created at intersections. Specifications of transitions shall be determined by the City Engineer.

7. Vertical Design Requirements

Vertical design requirements shall include vertical curve requirements and minimum and maximum grades for the various classifications of streets.

a. Vertical Curves

A gradual transition from one roadway grade to another shall be accomplished by means of a vertical parabolic curve connecting two intersecting tangents, unless the algebraic difference

in grades is less than one point five (1.5º) percent. The minimum length of vertical curve shall be computed from the following formula and table:

L = KA where,

L = Length of vertical curve required, in feet.

A = Algebraic difference in the grades, in percent.

K = A constant related to sight distance, the geometry of a parabolic curve, vehicle speed, and safe stopping distance. (Table 6)

TABLE 6

Street Classification	K, Crest Curves	K Sag Curves
Primary	70	60
Secondary Street	70	60
Collector Street	55	55

For local and marginal streets, "K' values shall be determined considering the design speed of the street and a safe stopping or sight distance for that design speed. For flat gradients, where sight distance is not a critical determinant of the design, the minimum length of curve, in feet, shall be three times the design speed of the street in miles per hour. Any deviation from the above requirements must be justified by the design Engineer and approved by the Director of Public Works.

b. Grades

1. Tops of street curbs shall be lower than the adjacent property line so that the parkway slopes may be constructed in accordance with the standards previously discussed. The minimum and maximum grades for the various classifications of streets shall conform to the standard values.

2. The “Minimum Grade" indicated is considered the absolute minimum for proper drainage. No exceptions will be granted for this requirement. The "Unrestricted Maximum Grade" may be used generally throughout the City. It should be noted that these values are consistent with those recommended by the A.A.S.H.T.O. and are widely used throughout the country. The "Restricted Maximum Grades" may be used on Local Marginal Access, and Alleys only where certain length limitations and approach grades have been met. These values have been determined by the Department of Public Works in conjunction with the Cibolo Volunteer Fire Department. It has been determined in field tests that local fire equipment cannot negotiate grades exceeding these amounts, and private property located on or above grades exceeding these values cannot be adequately served by the Fire Dept. Grades between twelve (12%) percent and fifteen (15%) percent can be negotiated by the fire equipment depending upon the length of such grades and the approach conditions below these grades. The restrictions on using grades between twelve (12%) percent and fifteen (15%) percent are contained in Table 7.

3. The design engineer should also note maximum grades may also be restricted by drainage considerations. Streets used as drains shall have maximum flow velocities assigned to control erosion of the pavement.

TABLE 7

Minimum & Maximum Street Grades

Street Classification	Minimum Grade	Unrestricted Maximum Grade*	Restricted Maximum Grade**
Primary	0.3%	6%	Not applicable
Secondary	0.3%	7%	Not applicable
Collector	0.3%	8%	15%
Local	0.3%	12%	15%
Marginal Access	0.3%	12%	15%
Alley	0.3%	12%	15%

***** A.A.S.H.T.O. values

****** Determined by the Department of Public Works in conjunction with the San Antonio Fire Department. It has been determined in field tests that local fire equipment cannot negotiate grades exceeding these amounts, and private property located on or above grades exceeding these values cannot be adequately served by the Fire Dept.

8. Pavement Design

A. Soil Borings

Prior to the design of pavements, the City Engineer shall secure the services of an independent geotechnical laboratory selected by the City Engineer to perform soil borings and to determine the character of the subgrade soils. Sufficient soil borings shall be performed to prepare a soil profile which is representative of the actual soils encountered over the length of the project, and to provide the design engineer with sufficient information for a good engineering design. Fees charged for soil borings shall be paid by the developer. Copies of the laboratory report and the pavement design calculations shall be submitted to the City Engineer for review and approval. If during construction of the project, soil conditions differ substantially from those shown on the soil profile, additional pavement section may be altered accordingly.

B. Subgrade Classification

a. Strength of subgrade soils shall be determined by one of the three following accepted methods:

b. Resistance Value - This is a measure of the stability of soils or pavements as determined by a "Stabilometer" which measures the materials resistance to plastic deformation. R-Values are determined by test methods outlined in either AASHTO T190 or ASTM 2844.

c. CBR - (California Bearing Ratio) This is a measure of the shearing resistance, or load bearing value, of a soil as determined by forcing a three square inch plunger into a cylinder of the soil. CBR values are obtained by test methods outlined in either AASHTO T193 or ASTM 1883.

d. Triaxial Strength Class: This method classifies soils and base materials by a triaxial shear test in which the specimen is encased in an impervious membrane, subjected to a confining pressure, and then loaded axially to failure. Triaxial Strength Class can be determined by test methods outlined in AASHTO T 212, or Texas Department of Transportation Test Method "Tex- 117-E".

C. Pavement Structure

The design of pavement structures shall be in accordance with the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures, 1993 or latest approved edition. The pavement design report shall be prepared and signed by, or under the supervision of, a professional engineer registered in the State of Texas. The following design requirements shall be used for pavement design:

a. Length of Service Life – Pavement shall be designed for a twenty-year (20-year) service life.

b. Traffic Load, Reliability and Pavement Structures – The traffic load is cumulative expected 18-Kip equivalent single axle loads (ESAL) for the service life. The following 18-Kip ESAL Reliability Level and Pavement Structure shall be used in the design of streets for each street classification:

Pavement Specifications

Street Classification	18-Kip ESAL	Reliability Level	Minimum Pavement Structure	Maximum Pavement Stucture
Primary and Secondary Arterials	3,000,000	R-95	SN = 3.80	SN = 5.76
Collector and Type "B" Streets	2,000,000	R-90	SN = 2.92	SN = 5.08
Type "A" Streets - w/Bus Traffic	1,000,000	R-70	SN = 2.58	SN = 4.20
Type "A" Streets - w/out Bus Traffic	100,000	R-70	SN = 2.02	SN = 3.18

Traffic loads for primary and secondary arterials, collector and local Type "B" strreets shall include bus traffic.

c. Serviceability – The serviceability of a pavement is defined as the pavement's ride quality and its ability to serve the type of traffic (automobiles and trucks) that use the facility. The initial serviceability index of (p0) for flexible pavements shall be 4.2 and for rigid pavement shall be 4.5. The minimum terminal serviceability index (Pt) for local streets shall be 2.0 and for collectors and arterials shall be 2.5. A standard deviation (S0) for flexible pavement shall be 0.45 and for rigid pavement shall be 0.35.

10. Bridges and Other Structures

Except as modified by more specific criteria in the Cibolo Design and Construction Manual, the following general standards shall be applicable.

A. Bridges and culverts for vehicles over channels and at grade separations shall be designed in accordance with the AASHTO Standard Specifications for Highway Bridges, latest edition. Truck loading for live load consideration shall be H-20 or HS-20 for streets classified as Primary, Secondary, or Collector. Streets classified as Local NB" or Local "A" may be designed for H-15 or HS-15 truck loading. Railroad structures shall be designed in accordance with the American Railway Engineering Association, latest edition, and in accordance with the special requirements and loadings of the particular, Railroad Company involved.

B. Clearance for grade separations involving truck traffic shall be a minimum of fourteen (14') feet six (6") inches (14' - 6") vertically. Horizontal clearance to barrier curbs, piers, retaining walls, etc., shall be a minimum of two (2') foot (2'-0") from the back of curb where sidewalks are not provided. Clearances over railroad tracks shall be a minimum of twenty two (22') feet six (6") inches (22'-6") vertically. Horizontal clearances at railroads shall be a minimum of eight (8') feet six (6") inches (8'-6") from centerline of track to face of pier or other obstacle. However, where this clearance is less than twenty feet (20'-0"), a "crash wall" may be required. Vertical clearance for bridges and culverts over channels shall meet the requirements for freeboard as outlined in the Cibolo CDesign and Construction Manual

drainage standards. For structures in this category, energy losses and backwater elevations at the structure may require investigation if so determined by the City Engineer.

C. Roadway widths of bridges shall conform to the standards for streets, unless otherwise designated by the City Engineer. Curbs adjacent to sidewalks shall be a minimum of five (5') foot width on bridges and shall be constructed with the area standard parapet wall and railing on the outside of the bridge. Sidewalks in underpasses shall be six (6') feet in width but will not require more than the standard seven (7") inch curb.

D. Culvert sections used as drainage conduits, retaining walls related to overpasses or underpasses, or to protect private property, shall be designed under the AASHTO Standard Specifications for Bridges, latest edition.

E. Appropriate values of earth weights and earth pressures based on laboratory studies of actual site conditions shall be used. Live loads, if applicable, shall be incorporated into the design.

F. Standards of recognized agencies, such as the Texas Department of Transportation, may be utilized in the design of bridges, culverts, and other structures provided that the design criteria satisfies the conditions found at the project site and contained herein. Approval of the City Engineer will be required for use of such standard designs.

General Fire Hydrant Design Guidelines

1. Fire Hydrants

a. Every residential subdivision, commercial, business, or industrial park or subdivision within the corporate and extraterritorial jurisdiction of the City of Cibolo, as part of the water distribution system, shall be provided with fire hydrants of the type specified by the City. Fire hydrants shall be located at street corners, as well as other locations along a street to maintain the minimum distance as specified in the table and notes below, unless specifically approved otherwise by the City Engineer to accommodate the design of a subdivision.

b. In addition, within commercial, business or industrial areas of the city, fire hydrants shall be within three hundred (300') feet of each lot or as specified in the table and notes below, unless a greater or lesser distance is required by the city. Each part of the structure is required to be within four hundred (400') feet of a fire hydrant following a path on which hose from a fire department pumper truck would be laid (As the crow walks, not as the crow flies). If required, a private fire hydrant shall be installed to meet the required distances, or distances as specified in the table and notes below, at a cost to the business and property owners.

c. Fire hydrants and their outlets shall be suitable for use with the City's designated Fire Department equipment and shall meet AWWA standards.

d. Every subdivision within the corporate and extraterritorial jurisdiction of the City of Cibolo, as part of the water distribution system, shall be provided with fire hydrants of the type specified by the City, and every lot shall be within four hundred (400') feet, as measured along public streets, of each fire hydrant. Fire hydrants shall be located at street corners, as well as other locations along a street to maintain the minimum distance requirement between fire hydrants, unless specifically approved otherwise by the City to accommodate the design of a subdivision.

e. Within commercial business, or industrial areas of the city, fire hydrants shall be within three hundred (300') feet of each lot unless a greater or lesser distance is required by the city. Each part of the structure is required to be within five hundred (500') feet of a fire hydrant following a path on which hose from a fire department pumper would be laid (As

the crow walks, not as the crow flies). If this is not possible, a private fire hydrant shall be installed to meet the required distances at a cost to the business and property owners.

Fire hydrants and their outlets shall be suitable for use with the City's Fire Department equipment and shall meet AWWA standards.

2. Fire Flow

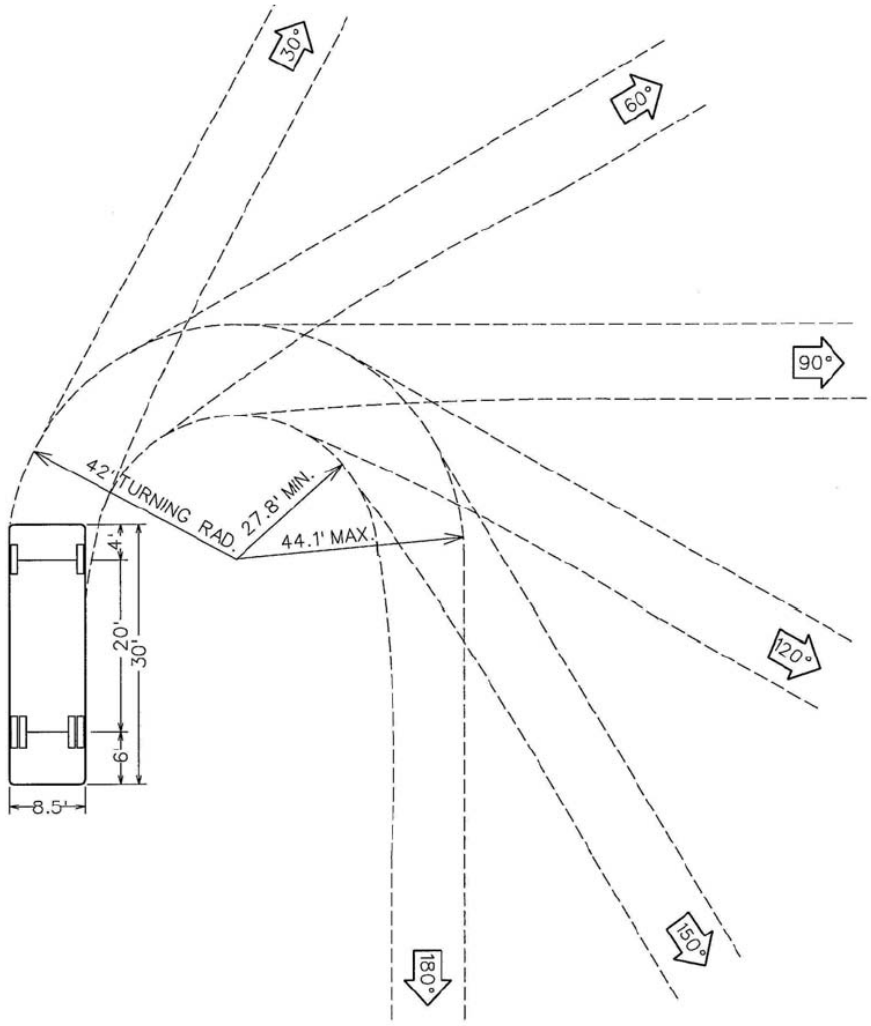
When determining the required fire flow, number and distribution of fire hydrants and the maximum distance from any point on a street frontage to a fire hydrant, the standards of the City of Cibolo Fire Code, as amended, shall be applicable.

3. Turning Radius & Dead-End Fire Apparatus Access Road Turnaround Design Criteria

A. When determining if adequate turning radius is available for emergency vehicles to enter and exit a site, the templates depicted in Figures 4-7 shall be utilized and referenced on all Fire Prevention Plan details.

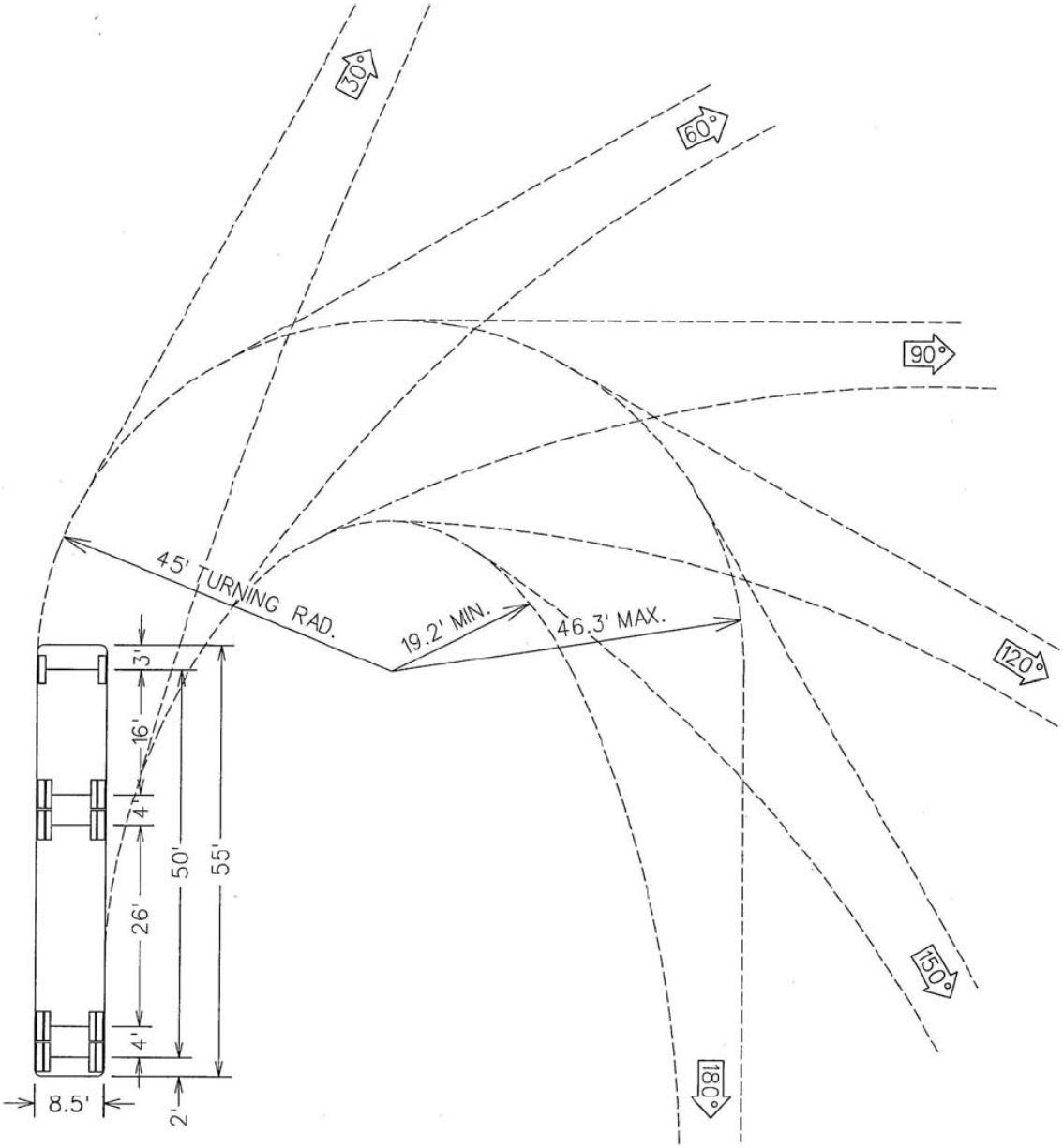
B. When determining if an alternative emergency vehicle turnaround design may be utilized, refer to the applicable sections of the City of Cibolo Fire Code, as amended, for alternative design solutions..

FIGURE 4
SINGLE UNIT TURNING DESIGN TEMPLATE



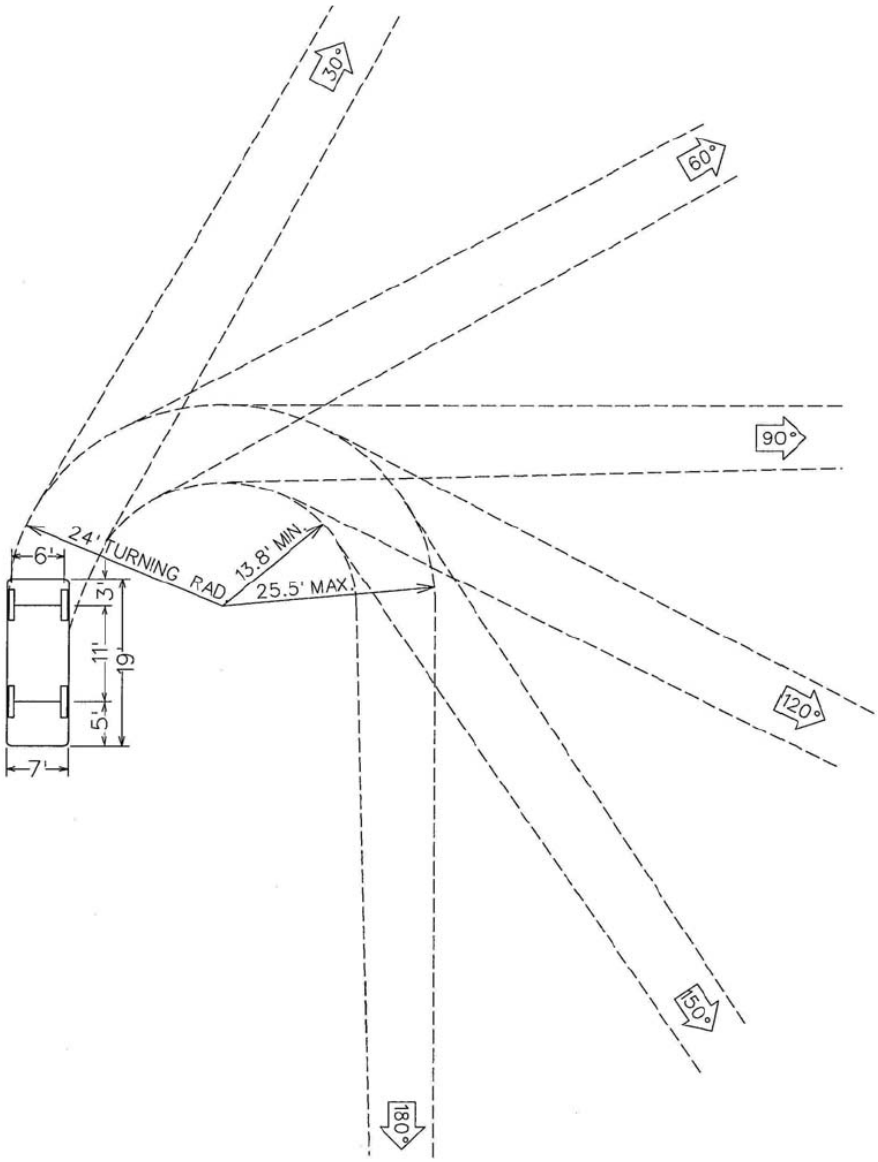
Radius = 42'
Scale: 1" = 20'

FIGURE 5
WB-50 TURNING DESIGN TEMPLATE



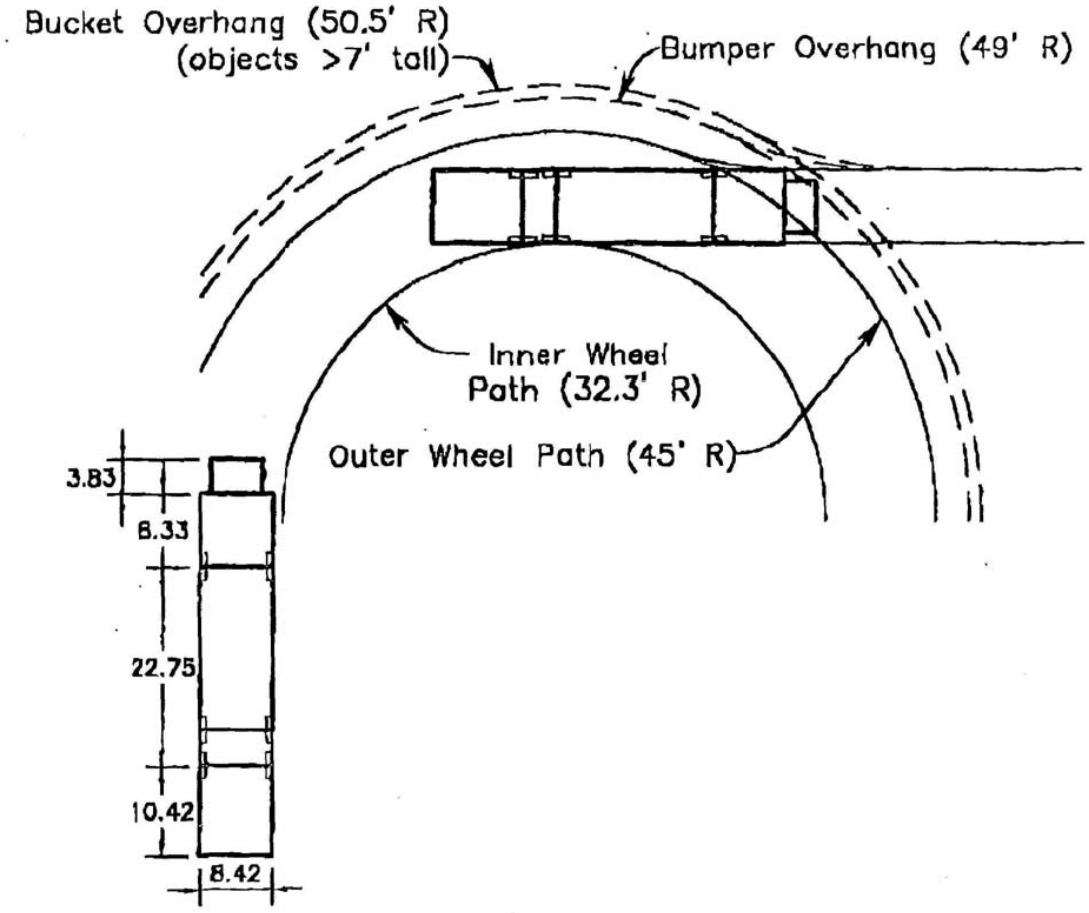
Radius = 45'
Scale: 1" = 20'

FIGURE 6
PASSENGER CAR TURNING DESIGN TEMPLATE



Radius = 24'
Scale: 1" = 20'

FIGURE 7
FIRE LADDER TRUCK
TURNING DESIGN TEMPLATE



Radius = 45'
Scale = 20'