CHAPTER 6
PAVING DESIGN CRITERIA

6.01 GENERAL

A. All construction plans containing proposed paving in a public right-of-way shall be reviewed by the City of La Porte for all streets within the city limits.

B. All new streets installed within the city limits shall be concrete curb and gutter. New street construction that utilizes roadside ditches for storm water drainage is discouraged and must receive specific approval of the City.

C. Street design shall conform to all applicable planning tools such as the City of La Porte Development Ordinance, the Texas Manual on Uniform Traffic Control Devices, La Porte Comprehensive Plan, major La Porte thoroughfare plans, and master parks/trails plans. Other consideration for design shall include roadway function, capacity, levels of service, safety by designing forgiving roads using the American Association of State Highway Transportation Officials (AASHTO) Roadside Design Guide, pedestrian safety, and all utility locations including gas, cable and power lines. Any deviation using other materials or other design criteria shall be approved by the City Council.

D. Design shall conform to the City of La Porte construction details where applicable. These criteria shall not apply to proposed paving projects located in Texas Department of Transportation (TxDOT) or Harris County owned and/or maintained right-of-way.

E. On a case-by-case basis the City of La Porte reserves to the right to allow deviations from these design criteria. These design criteria are not intended to cover repairs to pre-existing streets or street extensions when such repair work or extensions are performed by City of La Porte in whole or in part. These criteria are not intended to cover existing streets within the City of La Porte that do not already conform to these criteria

F. These are to be considered minimum guidelines but the City of La Porte may require a Traffic Impact Analysis at no cost to the City where the City of La Porte deems it is warranted.

6.02 TYPES OF PAVED CORRIDORS

A. Principal Arterial, 6 lanes, divided roadway: Shall provide a high degree of mobility, serve relatively high traffic volumes, have limited access, have high operational speeds and serve a significant portion of through travel and traffic movement by serving as the major traffic corridors.

B. Minor Arterial, 4 lanes, divided or undivided roadway: Serve same function as principal arterials but typically have a lower traffic volume, usually have the same right-of-way of principal arterials and can therefore be expanded in the future as needed.

C. Major Collector, 4 lanes, divided or undivided roadway: Shall be used in multi-family, commercial or industrial areas as well as secondary streets.

D. Minor Collector, 3 lanes, undivided roadway: Shall be used for minor collector streets in single family residential areas or local multi-family residential, commercial, or industrial areas as well as secondary streets where defined. May have two travel lanes and a center continuous left-turn lane.

E. Local, residential, 2 lane, undivided roadway: Include internal and access streets that allow direct access to residential properties and similar traffic destinations and typically have low design speeds and low traffic volumes.

6.03 GEOMETRIC STREET DESIGN STANDARDS

A. Minimum geometric street design standards for number of lanes, lane widths, right-of-way widths, and median widths shall be as follows:

Table 6.1

	Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local 2 Lanes
Right-of-Way Width	100 feet	100 feet	80 feet	80 feet(1)	60 feet
Curb Face to Curb Face Distance(3)	80 feet	70 feet	60 feet	40 feet	28 feet
Total Paved Width of Travel Lanes - One Direction	33 feet	25 feet	24 feet	20 feet	14 feet
Median Width(2)	14 feet	30 feet	12 feet	0 feet	0 feet
Distance from Curb Face to ROW line(3)	10 feet	10 feet	10 feet	20 feet	16 feet
Distance from ROW Line to Sidewalk	2 feet	2 feet	2 feet	2 feet	2 feet
Max. Number of Lanes (one direction)	3	2	2	2	1

(1) With on-street parallel parking.
(2) Median turning lanes are included in median widths.
(3) On non-curb and gutter streets substitute 'edge of pavement' for' curb face.'

B. The design speeds shall conform to the following design standards. The posted speed limit shall never exceed the design speed. The design speed should be a minimum of 5 mph greater than the posted speed limit.

Table 6.2

Urban	
Arterials	30-60 mph
Collector	20-60 mph
Local	20-30 mph

C. The maximum grade allowed refers to the uphill or downhill slope of the street and shall conform to the following design standards:

Table 6.3

Urban Arterials							
	Design Speeds (mph)						
	30	35	40	45	50	55	60
Type of Terrain	Maximum Grades (%)						
Level	8	7	7	6	6	5	5

Table 6.4

Urban Collectors									
	Design Speeds (mph)								
	20	25	30	35	40	45	50	55	60
Type of Terrain	Maximum Grades (%)(1)								
Level	9	9	9	9	9	8	7	7	6

(1) Short lengths of grade in urban areas, such as grades less than 500 ft in length, one-way downgrades, and grades on low-volume urban collectors may be up to 2% steeper than the grades shown above.

Urban Local Roads

Grades for local residential streets should be as level as practical, consistent with the surrounding terrain. The gradient for local urban streets should be less than 15%. Where grades of 4% or steeper are necessary, the drainage design shall be the critical governing design parameter. On such grades special care should be taken to prevent erosion on slopes of roadside ditches and earthen/grass lined open drainage facilities. For streets in commercial and industrial areas, grades should be less than 5% and flatter grades are encouraged.

D. Vertical curves shall be designed when algebraic difference in grade exceeds 1%. Elevations shall be shown on the construction plans at a minimum of 10 foot horizontal intervals through vertical curves. The gradient for tangents to vertical curves at railroad crossings shall be a maximum of 3.5%. All crest vertical curves shall be determined by sight distance requirements for the design speed. The minimum design speed on any vertical curve shall be based on street classification.

E. Intersections and curves shall be evaluated for adequate sight stopping distances based on the design speed.

1. Minimum stopping sight distances shall conform to the following design standards:

    a. The driver's eye height shall be assumed to be 3.5 feet above the finished pavement.
    b. The height of the object seen by the driver shall be assumed to be 2.0 feet.
    c. A deceleration rate of 11.2 feet/s^2 shall be used.
    d. A brake reaction time of 2.5 seconds shall be used.
    e. Minimum sight stopping distances shall be adjusted by the Professional Engineer of Record, when there is a presence of vertical curves within the distance needed for stopping as recommended by AASHTO's *A Policy on Geometric Design of Highways and Streets (Green Book)* where applicable.

2. Open space clips shall be established at all intersections. Unless larger clips are indicated at a particular intersection, a minimum 10-foot x 10-foot triangular open space corner clip for zoned residential areas, as measured from the projected property line, is required at the intersection of two streets. Such clips shall be part of the public right-of-way and may not be located on private property.
3. Major thoroughfares with a centerline radius of the right-of-way less than 2000 feet shall be designed in accordance with the guidelines for superelevation as specified in the AASHTO *A Policy on Geometric Design of Highways and Streets.* Signage and design speed shall be accounted for in all curved thoroughfares. The maximum rate of superelevation shall be 0.06 for urban conditions. Streets with a centerline radius of over 2000 feet are not required to have superelevation.
4. Collector and local streets horizontal curves may be designed without superelevation.
5. Minimum Curve Radii Lengths:

    a. Major thoroughfares: 2000 feet.
    b. Minor thoroughfares: 800 feet.
    c. Collector Streets: 400 feet.
    d. Local streets: 50 feet.

F. For the purposes of these design standards, tangent length is defined as the distance between the point of tangency and the point of curvature of two adjacent curves along the centerline of the street right-of-way.

1. The minimum tangent length between reverse curves shall be 100 feet on principal arterials, minor arterials, major collector streets, and minor collector streets.
2. The minimum tangent length between reverse curves shall be 50 feet on all local streets.

G. Intersections

1. Curb radii, measured from the face of curb, shall be 25 feet minimum on major and minor arterials. The minimum curb radius shall be 20 feet on collector and local streets. A minimum of a 30-foot radius will be required at skewed intersections on arterials. A minimum 25-foot radius shall be required at skewed intersections on collector and local street.
2. Streets and traffic lanes should be aligned across an intersection. Except where existing conditions will not permit, all streets should intersect at a 90 degree angle. The maximum allowable skew across an intersection shall be 5 degrees for arterial streets, and 10 degrees on all collector and local streets.
3. When turnouts are provided at an existing street, the ultimate cross section is required to the end of the curb return. Pavement transition is required to reduce the pavement width to the existing cross section.
4. Minimum intersection distances as measured nearest right-of-way line to nearest right-of-way line shall be as follows:

    a. Streets intersecting major thoroughfares: 350 feet.
    b. Streets intersecting collector: 250 feet.
    c. Streets intersecting local streets: 200 feet

5. Proposed streets shall be aligned with existing streets where possible. Offset intersections shall be avoided and shall not be permitted if the offset distance is less than 200 feet.
6. Taper rates for adding or dropping a lane shall be at a minimum of straight line tapers with a minimum of an 8:1 rate for design speeds up to 30 mph and 15:1 for design speeds up to 50 mph. For design speeds over 50 mph the Professional Engineer of Record shall submit a design providing adequate taper lengths appropriate for the corresponding design speed. The use of partial tangent tapers, symmetrical reverse curves, and asymmetrical reverse curves are encouraged and should be designed to fit the design speed of the design road but are not required.

H. Minimum lane transition lengths shall meet or exceed requirements of the *A Policy on Geometric Design of Highways and Streets*. Pavement width transitions shall conform to the following design standards:

1. Minimum deceleration lengths for auxiliary turning lanes on grades of less than or equal to 3%, with an accompanying stop condition, for design speeds of 30, 40, 45, 50, 55 mph are 230, 330, 430, 550 and 680 feet respectively. These lengths exclude the taper lengths.
2. Taper lengths should be calculated for roads with design speeds greater than or equal to 45 mph by using taper lengths (L) equal to 0.6 times the design speed (S) multiplied by the offset (W), $L=0.6SW$. For design speeds less than 45 mph, the taper length (L) equals the offset multiplied by the design speed(s) squared, then divided by 155, $L=WS^2/155$. The distance for tapers should be lengthened

if the road is curved based on recommendations from the Professional Engineer of Record.

I. Left Turn Lanes

1. Minimum storage bay lengths need to be supplied for at least two 19 foot passenger vehicles. If there is a presence of more than 10% trucks in the average daily traffic, then the storage bay length should be for one passenger car and one 30 foot truck.
2. Mid-block left turn lanes may be allowed if a Traffic Impact Analysis and the Planning and Zoning Commission recommends their use in relation to a proposed development. Left turn lanes shall be provided at the intersection of public street rights-of-way.
3. Deceleration and taper lengths for left turn lanes shall comply with the parameters set forth in these design criteria.
4. The City of La Porte reserves the right to require that a Traffic Impact Analysis be submitted for any proposed development when the City deems that a benefit could be derived from such a study.

J. On major and minor arterials esplanade openings may be spaced a minimum of 1000 feet apart. Median openings shall conform to the following design standards:

1. For median openings including left turn lanes, the storage and taper lengths mentioned in these design criteria shall apply.
2. The median opening at the intersection of two streets shall be at least the width of the minor right-of-way plus 10 feet. These median openings may be wider based on lane configurations or traffic volumes. In such cases sufficient traffic analysis and data should be presented along with design.
3. Variations to these criteria may be granted on a case by case basis by the City of La Porte.

K. Cul-de-sac Pavement

1. Residential minimum pavement radii for the cul-de-sac bulb as measured to the face of curb shall be 50 feet.
2. Commercial and industrial minimum pavement radii for the cul-de-sac bulb as measured to the face of curb shall be 60 feet.
3. Right-of-way radius shall be clear of permanent obstructions.
4. The distance from the face of curb of a cul-de-sac to the right-of-way line shall be a minimum of 11 feet.
5. Curb radii at the transition to the cul-de-sac shall have a typical radius of 25 feet in single family residential areas and 35 feet in all other areas as measured at the face of curb.
6. The length of a cul-de-sac is defined as the distance from the centerline of the intersecting pavement to the center of the cul-de-sac bulb measured along the centerline of the street right-of-way. Maximum length of cul-de-sac local streets for residential subdivisions shall be 600 feet. Dead end collectors and dead-end major and minor thoroughfares shall not be allowed.
7. The City of La Porte reserves the right to require shorter maximum lengths of commercial and industrial cul-de-sacs or dead-end streets where high traffic volumes are present.

L. The design of on street parking shall conform to the following design criteria:

1. All on-street parking shall be parallel parking only.
2. On-street parking spaces shall be striped with white paint.

3. The width of on-street parking spaces shall be a minimum of 8 feet in width as measured from the inside of the painted stripe to the face of curb when allowed or approved by special design and with study by and consultation with the Planning Department.

6.04 PAVEMENT STRUCTURE REQUIREMENTS

A. The pavement structure for all roadways outside of zoned industrial areas shall be designed based on soil data from the site, anticipated traffic volume, desired service life of the proposed pavement. The Professional Engineer of Record is responsible for ensuring that the pavement structure is designed to withstand the anticipated loads that are expected on the roadway. All roadways outside of zoned industrial areas shall be designed to adequately handle the design vehicle weight. Such criteria shall be used to design the roadway when these data, in sum, recommend a pavement larger than the minimums below.

B. Local residential streets shall be concrete and shall have a minimum thickness of 6 inches with No. 4 rebar spaced at 24 inches on-center or No. 3 rebar spaced at 18 inches on-center, and shall have a minimum of 6 inches of stabilized subgrade. Such construction shall follow the City of La Porte standard details.

C. All collector streets shall be concrete and shall have a minimum thickness of 7 inches with No. 4 rebar spaced at 24 inches on-center, and shall have a minimum of 8 inches of stabilized subgrade. Such construction shall follow the City of La Porte standard details.

D. Major thoroughfares shall be concrete and shall have a minimum thickness of 8 inches with No. 4 rebar spaced at 18 inches on-center, and shall have a minimum of 8 inches of stabilized subgrade. Such construction shall follow the City of La Porte standard details.

E. The subgrade shall be stabilized per the recommendations of the geotechnical engineer and shall be compacted to 95% Standard Proctor density.

F. For the pavement structure for all public roadways inside zoned industrial districts, the concrete pavement design and the calculation of its thickness shall be based on AASHTO design procedures for rigid pavements and shall be based on independent studies of projected truck traffic, projected passenger vehicle traffic, geotechnical investigations, anticipated vehicle loading by design vehicle and with consultation with the Planning Department. Prior to any pavement design the developer shall consult with the City of La Porte.

G. The use of rebar dowels or the use of saw-cutting procedures to expose existing steel in concrete pavement is required to create a minimum of 12 inches of overlap of reinforcing steel when making a connection of a proposed concrete street to an existing concrete street or road. When the existing street has no exposed steel the following shall apply:

1. Dowels should be No. 4 rebar, 24 inches long, embedded 12 inches and epoxied into the existing concrete. Applicable spacings shall be the same as the rebar spacings mentioned in these design criteria for the various concrete thicknesses.

H. Dead-end streets and concrete paved streets designed to be extended in the future shall have paving headers and 15 inches of reinforcing steel exposed beyond the pavement (coated with asphalt and wrapped with burlap), or dowel type expansion joint for future pavement tie-in.

I. Pavement extensions shall connect to the existing pavement with a pavement undercut and a minimum steel overlap of 12 inches.

J. All concrete paving to be removed shall be removed to either an existing joint or a saw-cut joint. Sawed joints shall meet the requirements set out in this section. If utilizing epoxied rebar dowels is difficult, not possible or where existing conditions prohibit the use of dowels, saw-cut to a minimum depth of 2 inches and remove existing concrete to expose a minimum of 12 inches of longitudinal steel, in good condition, with an

equivalent cross-sectional area of steel equal to the proposed pavement steel. Tie this exposed steel to the new steel in the proposed street and pour the new concrete over both.

K. Materials

1. Concrete: All roadway concrete shall have a minimum of 3000 psi unconfined compressive strength at 28 days. Concrete pavement mix designs shall meet flexural requirements of at least 500 psi at 7 days and 600 psi at 28 days.
2. Reinforcing steel: Grade 40, ASTM A615 (minimum).
3. Any and all special, non-standard materials such as bomanite or concrete pavers, special signage, etc, whose use is approved by the City and that are installed by the developer shall be maintained by the developer or the homeowner's association. If said maintenance is turned over to the City of La Porte, then maintenance shall be undertaken using standard materials and methods.

L. The following table provides a summary of the minimum street volume operating ranges by street classification:

Table 6.5

Street Classification	Operating Volume Range (Vehicles Per Day)
Principal Arterial	20,000 – 60,000
Minor Arterial	5,000 - 30,000
Collector	1,000 – 15,000
Local	0 – 5,000

6.05 GRADING AND LAYOUT REQUIREMENTS

A. Minimum gradient on any gutter shall be 0.30%.
B. See Chapter 5 of the Public Improvements Criteria Manual (PICM) for inlet spacing.
C. The maximum allowable slope for driveways shall be 5%.
D. The algebraic sum of grades to an inlet at an intersection should not exceed 1%.
E. All new residential and local streets poured with a curb and gutter arrangement shall have a minimum of a 4 inch rollover, lay down curb or approved equal. All new collector and arterial streets poured with a curb and gutter arrangement shall have the standard 6 inch stand up type curb. A standard 6 inch stand up curb shall be used at all intersection and shall extend to the end of the return radius of the intersection. A standard 6 inch curb shall be used immediately adjacent to all storm sewer inlets; where necessary 4 inch rollover curbs shall be transitioned to a 6 inch curb at the inlet.
F. The minimum grade line around a cul-de-sac shall be 0.70%.
G. The amount of cross slope over the pavement section shall be 2% sloping away from the crown of road or centerline.
H. When connecting to an existing curbed street, the gutter lines for the proposed and existing streets shall be matched.
I. Proposed top of curb elevations should be designed to match the top of the curb at an of an existing street in cases where a proposed street is being connected to an existing street.
J. Top of curb elevations shall be shown on the construction plans along with a detail of the type of curb used.
K. Gutter line elevations for vertical curves shall be shown on the construction drawings in cases where a railroad track is being crossed. Where railroad crossings are not at right angles to the pavement, vertical curves should be calculated for each curb line and should be posted at 10 foot intervals of the centerline of the road on the construction drawings in both plan and profile view. The grade of the railroad track shall be matched with the centerline of the road at the intersection of the crossing.

6.06 TRAFFIC CONTROL DEVICES

A. Standard Type III barricades shall be permanently installed by the developer at the end of all dead-end streets not terminating in a cul-de-sac, and at all turnouts. These barricades shall meet at least the minimum requirements of the *TMUTCD*. The erection of these Type III barricades shall not preclude the installation of other decorative fencing or landscaping behind the barricade for the purposes of maintaining private property, safety, aesthetics etc.

B. Traffic signage locations, street signage locations, and pavement markings shall be shown on the paving overall layout in the construction drawings. The construction drawings should include pavement marking details thereunto appertaining where applicable.

C. Pavement markings shall be shown on the final construction plans for a project. Reflectorized paint with supplemental reflectors, or approved equal, shall be used on all major thoroughfares and on major collector streets. Turn lanes shall have proper pavement markings. All pavement markings shall conform to the *TMUTCD* .

D. A blue reflectorized raised pavement marker or button is required at all fire hydrants and shall be located 6 inches off the pavement centerline toward the fire hydrant.

E. The developer shall install requisite traffic control devices when a signal is warranted by a traffic study.

6.07 SIDEWALKS

A. Sidewalks meeting Americans with Disabilities Act (ADA) parameters are required on each side of all public streets. The developer shall be responsible for the installation of all sidewalks in a new development in residential or other areas as required. This shall include but not be limited to along parks, drainage channels, public utility easements and detention ponds. The standard sidewalk width shall be 4 feet but when the sidewalk is set adjacent to the back of curb where allowed or where existing conditions dictate, at 6 foot wide sidewalk shall be used. The developer is responsible for obtaining any and all agreements with the public utilities for the installation of sidewalks across applicable easements.

B. Sidewalk wheelchair ramps shall be required at all intersections and 90 degree bends in the street and shall adhere to ADA design criteria. All wheelchair ramps shall be brick of concrete with a brick stamp.

C. Sidewalk construction in an esplanade shall be at the esplanade noses only and shall conform to the following parameters: A transverse concrete sidewalk, 6 inches thick, shall be constructed in all esplanades as a pedestrian refuge area. All concrete sidewalks in esplanades shall be 6-10 feet wide as measured from the esplanade nose. Patterned concrete or brick stamp may be used. Any ramps associated with sidewalks in an esplanade shall conform to ADA design criteria.

D. Sidewalks should be set back a minimum of 2 feet from the right-of-way line to allow for utility maintenance activities.

E. Expansion joints shall be placed a maximum of every 30 feet in concrete sidewalks.

F. Concrete sidewalks shall have a minimum thickness of 4 inches with No. 3 rebar spaced at 18 inches on-center each way. No wire mesh shall be allowed.

G. Specialty sidewalks such as brick sidewalks or other non-standard sidewalk material must receive special approval from the City.