7 ▪ STREETS AND SIDEWALKS

7.01 *General*

a. Reference Chapter 8 - Streets and Greenways of the City of Belmont Land Development Code for additional requirements.

b. The latest revision of the NCDOT "Standard Specifications for Roads and Structures" shall apply unless otherwise specified herein.

c. All streets (private and public) shall be designed and constructed to City standards unless NCDOT Standards are applicable. NCDOT Standards shall be applicable on all existing state roads, extensions of existing state roads, or roads expected to be maintained by the state.

7.02 *Design Controls and Criteria*

a. Design speed is the maximum safe speed that can be obtained on a street when conditions are favorable enough for the design features of the street to control. The design speed chosen for a street shall be logical with respect to topography, the adjacent land use, and the classification of the street.

b. Once selected, all pertinent features of a street, such as width, curvature, sight distance, access points and parking shall be related to the design speed. See Table 7-2 of this section.

c. Vehicles

(1) Streets shall be designed such that the traveling paths of vehicles do not conflict with the physical constraints of the street or hinder the other users of the street. The applicable category of design vehicle is based upon the classification of the street. At a minimum, all streets and intersections shall be designed to accommodate a SU-40 design vehicle. If regular commercial vehicles are expected, the design shall be adjusted to accommodate a WB-40 design vehicle.

(2) Residential Main Streets, Local Streets, Parkside Drives, and Minor Streets can be subject to both passenger cars and trucks. These streets shall accommodate single-unit trucks such as solid waste collection and fire protection vehicles.

(3) Arterial type streets (Boulevards, Avenues, and Main Streets) shall meet the design needs of all commercial vehicles.

d. Pedestrians

(1) Measures shall be employed to facilitate pedestrian use of a roadway and help to reduce pedestrian-vehicular conflicts. More information on pedestrian characteristics and facilities can be found in FHWA's "Pedestrian Facilities Users Guide".

e. Bicycles

(1) Measures shall be employed to facilitate bicyclist's use of a roadway, and help promote bicyclist/motor vehicle safety and operation. More information on bicyclist characteristics and bike facilities can be found in AASHTO's "Guide for Development of Bicycle Facilities".

7.03 *Roadway*

a. Pavement Design

(1) A pavement design will be required for all Boulevards, Avenues and Main Streets (arterials). At a minimum, the pavement materials and thicknesses shall meet the requirements of residential streets per Table 7-1.

(2) The pavement design and traffic analysis shall be signed and sealed by a NC Professional Engineer, and shall be submitted for approval.

(3) Approved pavement design methods include those most current as accepted by NCDOT.

(4) Rigid pavement design shall follow the most current AASHTO Method or the Portland Cement Association Method.

(5) Pavement design shall be based on subgrade soil conditions, a 20 year design life, and projected traffic loading.

(6) Subgrade conditions shall be based upon corrected soaked CBR values at 0.1 inch penetration per ASTM D1883.

(7) Soil samples used for these CBR tests shall be obtained at intervals not greater than 500 feet. Typically, a subdivision will require 2 to 3 soil samples as a part of the pavement design. Additional soil samples may be required at the discretion of the City for subdivisions with greater than 100 lots.

(8) Boring logs and scaled drawings designating boring locations with CBR tests and other pertinent data shall accompany the pavement design.

(9) Residential Main Streets, Parkside Drives, and Minor Streets do not require pavement design calculations and shall conform to the minimum thicknesses specified in Table 7-1.

Table 7-1 – Minimum Base, Intermediate, and Surface Course Thicknesses

Classification		Base Course	Intermediate Course	Surface Course
Boulevards and Avenues	All	*	*	*
Main Street	Non-Residential	*	*	*
Residential Main Streets, Local Streets, Parkside Drives and Minor Streets	Residential	8” ABC	2.0” S9.5B or SF9.5A	1.5” SF9.5A
Rear Alleys and Lanes	All	8”ABC	None	1.5” SF9.5A

Note: * indicates pavement cross sections must be designed on a case by case basis.

b. Lane Widths & Cross Slope

(1) All streets except Residential Main Streets, Parkside Drives, and Minor Streets shall have pavement lane markings in accordance with the latest revisions of the MUTCD unless otherwise approved by the City Engineer.

(2) Bike lanes shall be incorporated into street design as required by the City.

(3) Normal crown cross slopes for the pavement section shall be 0.02 foot per foot. When superelevation is permitted, the cross slope shall not exceed 0.04 foot per foot.

c. Curb and Gutter

(1) Curb and gutter shall be required on all streets.

(2) On all public streets, median curb shall be standard 18 inch mountable curb, and all other curb and gutter shall be standard 30 inch. Valley curb shall be used on public streets only with specific approval of the City.

(3) Straight forms shall not be used for forming curb and gutter in curves.

(4) All curb and gutter shall be backfilled with soil approved by the City Inspector within 48 hours after construction to prevent erosion.

(5) Materials deemed by the City Inspector as unsuitable for backfill purposes shall be removed and replaced with select backfill materials.

d. Sidewalk

(1) Sidewalks shall be constructed within the street right of way or within a dedicated sidewalk easement in accordance with City policy. Sidewalks shall be installed at the time of roadway construction unless otherwise approved by the City Council.

(2) The minimum thickness of a sidewalk shall be 4 inches. A 6 inch depth is required at locations where a driveway crosses a sidewalk, at street intersections (along the length of radius curb returns), and in the handicap ramps. Sidewalks shall have a uniform slope toward the roadway of 0.02 foot per foot. The utility strip between the sidewalk and the back of curb shall slope at ¼ to ½ inch per foot toward the roadway.

(3) Sidewalks shall typically be a minimum width of 5 feet. Refer to the Land Development Code for locations where wider sidewalks are required.

(4) Where sidewalks and/or greenways intersect any section of curb and gutter, a wheelchair ramp shall be installed.

(5) Sidewalk curb ramps with yellow detectable warning dome mat shall be provided in accordance with NCDOT standards.

7.04 *Design Elements*

a. Horizontal Alignment Controls

(1) Superelevation shall not be used on streets other than Boulevards.

(2) The maximum and minimum radii of curves for each roadway class are specified in Table 7-2.

(3) Horizontal and vertical curves shall be designed concurrently so as to encourage uniform speed, and accent or preserve the significant natural features of the land.

b. Vertical Alignment Controls

(1) The minimum grade allowed on any street shall be 0.50%.

(2) The maximum grade allowed when approaching an intersection is 5% for the last 100 feet of pavement before the intersection. The maximum grades allowed per street type classification are listed in Table 7-2.

(3) Vertical curves shall produce a design which provides adequate sight distance and are adequate for drainage. To meet these criteria, the vertical curves are designed to

curve at rates specified in Table 7-2. The product of the curvature rates and the algebraic difference in adjoining grades is the basis for the minimum length of curves, but shall never be less than the minimum lengths provided in Table 7-2.

(4) The design of crest vertical curves shall focus on providing sufficient sight distance.

(5) Sag curves which are too gradual can create substandard drainage conditions within the curve. The rate of vertical curvature is to ensure that a minimum grade of 0.003 ft./ft. is obtained within a 50 foot distance from the level point. In addition, sag vertical curves in cut situations shall be avoided to prevent potential problems associated with the ponding of water.

Table 7-2 – Horizontal & Vertical Curve Criteria

			Horizontal Curve Controls		Vertical Curve Controls			
Street Classification	Posted Speed (MPH)	Design Speed (MPH)	Maximum . Superelevation (ft/ft)	Radii (ft)	Maximun Grade	Length - Crest	Length - Sag	Minimum Length (ft)
Boulevard	35	40-50	0.04	490-930	9%	55xA	55xA	120
Avenue	35	35-45	0.04	225-665	9%	28xA	35xA	120
Main Street	25	25-35	Normal Crown	140-375	9%	20xA	28xA	100
Other	25	25-35	Normal Crown	90-230	10%	18xA	18xA	75

Notes:
1) A = Algebraic difference in grades.
2) Intersections between different roadway classification shall use the curb radius required for the higher classification.

c. Traffic Control

(1) All streets, including alleys and lanes, require traffic signs and pavement markings. Traffic signs and pavement markings shall be marked in accordance with the latest revision of the MUTCD unless otherwise approved by the City.

(2) A pavement marking plan showing description and placement of traffic signs, pavement markings, and specialty signs shall be submitted with all roadway and subdivision plans

(3) The pavement markings for all streets, both public and private, shall be thermoplastic in accordance with NCDOT standards. Exception of the use of thermoplastic may be granted in the case of private parking stalls.

(4) Traffic control and street name signs within subdivisions which will be maintained by the City shall be consistent with the MUTCD. Requests for specialty signs shall be submitted to and approved by the City.

d. Lane Configuration

(1) Tapers shall be used as necessary in street design. Approach tapers are used to shift lanes laterally. The following equations shall be used as applicable:

$$L = W x S$$

Where : L = Length in feet

S = Speed in miles per hour

W = Lateral offset in feet.

e. Intersections

(1) Streets shall intersect each other at right angles whenever possible. The minimum desirable intersection angle is 80 degrees. At no time shall a street intersect any other street at less than 60 degrees.

(2) Curb radii shall be designed to satisfy the turning radius of the predominant design vehicle using the roadway. Minimum radii are listed in the Land Development Code.

(3) Streets with medians shall be designated to allow for proper turning movements for a SU-40 design vehicle.

f. Pedestrian Crosswalks

(1) All locations which are designated for pedestrian traffic crossings shall be designated as a crosswalk with pavement markings and signage. The type and placement of signage and markings shall be consistent with MUTCD.

g. Non-Residential Driveways

(1) Standard concrete driveway aprons shall be used when the ADT for the driveway is less than 300 vehicles.

(2) Street type turnouts shall be used when the driveway ADT is greater than the above listed conditions or when access by larger trucks must be accommodated. A minimum radius of 30 feet shall be used in these cases. Lesser radii may be used for street type turnouts with deceleration lanes. The maximum grade allowed when approaching an intersection is 5% for the last 30 feet before the edge of the intersection.

(3) Non-residential driveways that are unpaved shall have a minimum 20 foot paved surface strip measured from the back of the driveway apron.

h. Residential Driveways

(1) Residential drives shall be 12 to 20 feet wide be located a minimum of 10 feet from the point of tangency of curb radii of street intersections.

i. Parking Lots

(1) Parking lots shall be designed to provide safe maneuverability of vehicles. A minimum parking stall dimension of 9 feet by 18 feet shall be provided. Handicap parking spaces shall be a minimum of 8 feet wide with a 5 foot lane adjacent to the space properly marked with signage in accordance with the N.C. Building Code.

(2) At locations where sidewalk abuts a parking bay which is 18 feet deep, the sidewalk shall be a minimum width of 6 feet.

(3) A minimum pavement structure consisting of 8 inches of ABC stone and 2.5 inches of SF9.5A asphalt shall be used in the travel aisles on parking facilities for multi-family (excluding duplex and triplex) developments, and non-residential developments. Access drives for these facilities shall also meet this minimum pavement standard. A minimum of 6 inches of ABC stone shall be required for parking stalls.

(4) Specifications for pervious pavement are to be provided by the project design engineer and are subject to City approval.

(5) All paved parking facilities shall be striped with 4 inch white lines.

(6) On all parking lot facilities, cut and fill slopes shall not begin immediately at the back of curb; a minimum 4 foot shoulder is required behind the back of curb.

j. Fire Lanes

(1) Fire lanes shall be installed and inspected in accordance with the public street requirements and the fire code. The Fire Marshal shall have the authority to designate fire lanes as deemed necessary for Fire Department access. The requirements for installation of a fire lane shall be subject to the fire code.

(2) Fire lanes shall be a minimum width of 20 feet and shall be properly marked and signed to designate the access as a "FIRE LANE" as specified by the Fire Marshal. The surface of the fire lane shall be paved with a minimum of 8 inches of ABC stone and 2.5 inches of SF9.5A asphalt.

7.05 *Materials*

a. Thicknesses

(1) The following material standards represent the minimum acceptable standards of the City. Pavement designs must consider existing soil types and geotechnical conditions. The City will review pavement designs.

b. Base Course

(1) The material for the base course of the street must be crusher-run stone with aggregates ranging from one and 1½ inch diameter particles to dust and must meet the standards of Section 1010 of the NCDOT Standard Specification for Roads and Structure.

(2) The material shall consist of tough durable aggregate, containing sufficient fines to ensure a well-bonded and uniform base after compaction.

(3) The mixing and shaping of the base course material must be performed with a power-driven motor grader, equipped with a blade not less than 10 feet long.

(4) Compaction requirements shall be attained by the use of mechanical compaction methods. Each 6 inch layer of backfill shall be placed loose and thoroughly compacted into place.

(5) The base shall be compacted by rolling with ring or temping roller and with pneumatic tired roller. When completed, the base course must be smooth, hard, dense, unyielding, and well bonded.

(6) All subgrade shall be compacted to 100% of the maximum density obtainable with the Standard Proctor Test to a depth of 8 inches, and a density of 95% Standard Proctor for depths greater than 8 inches.

(7) Stone base shall be primed if placement of asphalt intermediate course is not completed within seven days following stone base approval.

c. Intermediate Course

(1) The material for the intermediate course of the street shall be Superpave S9.5B or SF9.5A conforming to the general, material, and construction specifications of Section 609 and Section 610 of the NCDOT Standard Specifications.

d. Surface Course

(1) The material for the surface course of the street must be Superpave SF9.5A meeting the requirements in Section 609 and Section 610 of the NCDOT Standard Specifications.

(2) The final surface course shall not be installed until after one year or if 50% of the lots on the street have received a certificate of occupancy for the building, whichever is sooner.

e. Tack Coat

(1) Tack coat shall be asphalt or asphalt cement and shall meet the general, material, and construction specifications of Section 605 of the NCDOT Standard Specifications.

(2) Surfaces shall be tacked when asphalt is being placed over existing asphalt layers or adjoining concrete, storm drains, and manholes.

f. Portland Cement Concrete

(1) Concrete for curb and gutter, driveways, and sidewalks shall have a minimum 28 day compressive strength of 3,600 psi meeting the requirements of Section 1000 of the NCDOT Standard Specifications.

g. Joint Filler

(1) Filler shall be a non-extruding joint material conforming to ASTM C1751.

h. Concrete Curing Agents

(1) Agents shall be free from any impurities which may be detrimental to the concrete and meet Section 1026 of the NCDOT Standard Specifications.

i. Aggregate for Portland Cement Concrete

(1) Aggregate shall meet the requirements for fine and course aggregate of Section 1014 of the NCDOT Standard Specifications.

j. Portland Cement

(1) Cement and admixtures shall meet the requirements of Section 1000 of the NCDOT Standard Specifications.

k. Water

(1) Water for mixing or curing the concrete shall be free from injurious amounts of oil, salt, acid, or other products injurious to the finished product.

l. Concrete Pavement

(1) Concrete pavement shall meet the general, material, and construction specifications of Section 700 of the NCDOT Standard Specifications.

m. Concrete Pavers

(1) Pavers may be used on privately maintained streets.

(2) The City will not maintain decorative type paved street surfaces such as pavers or imprinted designs within public right of way, unless installed by the City.

7.06 *Construction and Inspection*

a. Streets

(1) No base material shall be placed on a roadway until the storm sewer, subgrade, utilities, and all appurtenances have been inspected and approved by the City.

(2) The City may require field density testing of the subgrade soils by a certified testing firm. The firm shall perform sufficient Proctor tests to evaluate the compaction characteristics of various soils used in the roadbed. The Inspector may also require field density testing of the ABC used and an asphalt mix formula before either is inspected or approved.

(3) The subgrade shall be compacted as described in these standards.

(4) Inspection of the subgrade prior to placement of base course, and inspection of the base course prior to placement of asphalt shall be performed by proof rolling and/or field density testing at the direction of the City.

b. Curb and Gutter, and Sidewalks

(1) No concrete shall be placed until the subgrade and forms and have been approved by the City.

(2) The surface of sidewalks shall be finished to grade and cross section with a float, toweled smooth and finished with a broom.

(3) Subgrade shall be excavated to the required depth, and shaped to the proper cross-section. Where tree roots are encountered, they shall be removed to a depth of 1 foot for the full width of the excavation. The subgrade shall be stable and thoroughly compacted.

(4) Forms shall be set and maintained true to the required lines, grades, and dimensions. Forms shall be constructed with material of such strength and rigidity to prevent any appreciable deflection between supports. Straight forms shall be within a tolerance of 1/2 inch in 10 feet from a true line horizontally or vertically.

(5) Grooved contraction joints shall be cut to a depth equal to at least 1/3 of the total slab thickness. The joint shall be no less than 1/8 inch in width and cut at intervals equal to the width of the sidewalk.

(6) Expansion Joints shall be a 1/2 inch joint filled with joint filler and placed between all rigid objects and placed no farther than 50 feet apart for sidewalks and curb and gutter, extending the full depth of the concrete with top of the filler 1/2 inch below the finished surface.

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