



Engineering Standards
and Procedures
Manual

September 17, 2018

Table of Contents

I. Administrative Procedures:

Page No.	Title
2	A. Introduction
2	B. Electronic Plan Management
2	C. Plan Review Checklist
2	D. Fees
3	E. Driveway Permits
3	F. Encroachment Permits
4	G. PE Certification Process for Streets
4	H. Bonding
6	I. Final Inspection
6	J. Street Maintenance Acceptance (into Town)
7	K. Street Lights

II. Design Criteria:

Page No.	Title
8	A. Introduction
8	B. Street Design
10	C. Storm Drainage
11	D. Utilities
11	E. Street Lighting
12	F. Signage
12	G. Landscaping
12	H. Cluster Box Units

III. Construction Specifications and Special Provisions:

Page No.	Title
14	A. General Notes
16	B. 100 Series Drawings – Miscellaneous Concrete Infrastructure
17	C. 200 Series Drawings – Street Sections
18	D. 300 Series Drawings– Storm Drainage
19	E. 400 Series Drawings – Stormwater BMP
19	F. 500 Series Drawings – Erosion Control
20	G. 600 Series Drawings – Landscaping
20	H. 700 Series Drawings – Miscellaneous
20	I. Traffic Control

IV. Standard Drawings:

100 Series - Miscellaneous Concrete Infrastructure

<u>Standard</u>	<u>Description</u>
100.1	Standard Curb and Gutter
101.1	Other Curb and Gutter
102.1	Concrete Contraction Joint
103.1	18” Vertical Curb

<u>Standard</u>	<u>Description</u>
104.1	Curb Transition 2'-6" Curb and Gutter to 2'-0" Valley Gutter
105.1	Curb Transition 2'-6" Curb and Gutter to 1'-6" Curb and Gutter
106.1	Concrete Sidewalks Details and Notes
107.1	Monolithic Concrete Curb and Sidewalk
108.1	Commercial Type II and Residential Type I Drop Curb Driveway with Sidewalk Abutting Curb (2'-6" Curb and Gutter)
109.1	Commercial Type II and Residential Type I Drop Curb Driveway with Sidewalk Abutting Curb (6"x18" Vertical Curb)
110.1	Commercial Type II and Residential Type I Drop Curb Driveway with Sidewalk Abutting Curb
111.1	Residential Drop Curb Type I Driveway with Planting Strip (2'-6" Curb and Gutter)
112.1	Commercial Drop Curb Type II Driveway with Planting Strip (2'-6" Curb and Gutter)
113.1	Residential Drop Curb Type I Driveway with Planting Strip (6"x18" Vertical Curb)
114.1	Commercial Drop Curb Type II Driveway with Planting Strip (6"x18" Vertical Curb)
115.1	Type II Modified Driveway Detail with wide Planting Strip and Standard Curb
116.1	Commercial Type IV Driveway Standard
117.1	Drop Curb Driveway – Monolithic Concrete Curb and Sidewalk
118.1	Residential Driveway (Type I) for Valley Gutter
119.1	Commercial Type II Driveway for 2'-0" Valley Gutter
120.1	Type III Driveway Entrance
121.1	Catch Basin Frame in Valley Gutter
122.1	Catch Basin Placement at Intersections
123.1	Accessible Ramp Standard with Planting Strip 2'-6" Curb and Gutter
124.1	Accessible Ramp Sections with Planting Strip 2'-6" Curb and Gutter
125.1	Accessible Ramp Standard without Planting Strip 2'-6" Curb and Gutter
126.1	Accessible Ramp Sections without Planting Strip 2'-6" Curb and Gutter
127.1	Accessible Ramp Standard 2'-0" Valley Gutter
128.1	Accessible Ramp Sections 2'-0" Valley Gutter
129.1	Accessible Ramp Standard Monolithic Curb and Sidewalk
130.1	Accessible Ramp Sections Monolithic Curb and Sidewalk
131.1	Standard Placement of Accessible Ramps and General Notes
132.1	Truncated Domes Plan and Cross-Section
133.1	Culvert Crossings on Residential and Commercial Streets
134.1	Culvert Crossings on Residential and Commercial Streets
135.1	Typical Local Residential To Local Limited Residential Street Taper
136.1	Directional Accessible Ramp

200 Series - Street Section Details

<u>Standard</u>	<u>Description</u>
200.1	Residential Local Street Parking on Both Sides of Street Typical Section
200.2	Residential Local Street Parking on One Side of Street Typical Section
200.3	Residential Local Street No on street parking Typical Section
200.4	Residential Local Street Ditch Type Typical Section
200.5	Residential Local Street Parking on One Side/Open Space on Other Typical Section
210.1	Residential Collector Street with Bike Lanes Typical Section
210.2	Residential Divided Collector Street Typical Sections
210.3	Residential Divided Collector Street with Left-Turn Lane Typical Section

<u>Standard</u>	<u>Description</u>
210.4	Residential Collector Street Ditch Type Typical Section
210.5	Residential Divided Collector Street Ditch Type with Median Ditch Typical Section
220.1	Retail/Mixed Use Local Street Parking on Both Sides of Street Typical Section
220.2	Retail/Mixed Use Local Street No Parking Typical Section
220.3	Retail/Mixed Use Local Street with Median and Parking Typical Section
220.4	Retail/Mixed Use Local Street Parking and Planting Strip on Both Sides Typical Section
230.1	Retail/Mixed Use Collector Street with Bike Lanes Typical Section
230.2	Retail/Mixed Use Collector Street with Median and Bike Lanes Typical Section
240.1	Industrial Local Street Parking on Both Sides of Street Typical Section
240.2	Industrial Local Street Parking on One Side of Street Typical Section
240.3	Industrial Local Street No Parking Typical Section
250.1	Industrial Collector Street No on Street Parking Typical Section
250.2	Industrial Collector Street with Median and No Parking Typical Section
280.1	Local Street Cul-de-sac Detail – Curb and Gutter
280.2	Local Street Hammerhead Detail – Curb and Gutter
280.3	Local Street Cul-de-sac Detail – Ditch
280.4	Local Street Hammerhead Detail – Ditch
280.5	Residential Alley One-way Operation Typical Section
280.6	Residential Alley Two-way Operation Typical Section
280.7	Residential Local Street Temporary Turnaround
285.1	Local Street Parallel Parking Layout
285.2	Parallel Parking Standards
285.3	Parking, Sidewalk, and Curb and Gutter Transitions at Residential Driveways
285.4	Parking, Sidewalk, and Curb and Gutter Transitions at Retail/Mixed Use Driveways

300 Series - Storm Drain Standards

<u>Standard</u>	<u>Description</u>
300.1	NCDOT Standards Approved For Use
301.1	NCDOT Standards Approved For Use
302.1	NCDOT Standards Approved For Use
303.1	Brick Double Catch Basin 15”-36” Pipe
304.1	Concrete Wingwall with Splash Pad
305.1	Concrete Wingwall with Splash Pad
306.1	Rip Rap Aprons at Pipe Outfalls other than SWIM
307.1	Flared End Section 12” Thru 72” Pipe
308.1	Rip Rap Plunge Pool
309.1	Trench Detail for Storm Drain
310.1	Concrete Paved Ditches
311.1	Rip Rap Ditches
312.1	Subdrain Detail
313.1	Overlapping Storm Drain / Sanitary Sewer Easements
314.1	Minimum Drainage Easement Requirements for Storm Drain Pipes and Open Channels
315.1	Offset Catch Basin
316.1	Grading At Drop Inlet

400 Series – Stormwater BMP Details

<u>Standard</u>	<u>Description</u>
400.1	Bioretention Pond
401.1	Bioretention Cross-Section
402.1	Bioretention Planting Plan
403.1	Bioretention Concrete Curb Spillway
404.1	Flow Splitter Structure
405.1	Wetpond Plan
406.1	Wetpond Profile
407.1	Wetpond Cross-Section
408.1	Wetpond Littoral Shelf and Berm Detail
409.1	Wetpond Planting Plan
410.1	Wetland Plan
411.1	Wetland Section
412.1	Wetland Cross-Section
413.1	Wetland Details
414.1	Wetland Planting Plan
415.1	Enhanced Grass Swale Planting Plan
416.1	Enhanced Grass Swale Details
417.1	Grass Channel
418.1	Grass Channel Planting Plan
419.1	Infiltration Trench
420.1	Observation Well
421.1	Buffer Strip
422.1	Buffer Strip Planting Plan
423.1	Underground Sand Filter
424.1	Surface Sand Filter
425.1	Surface Sand Filter Section
426.1	Level Spreader

500 Series - Erosion Control Standards

<u>Standard</u>	<u>Description</u>
500.1	Special Erosion Control Requirements and Notes
501.1	Temporary Sediment Trap
502.1	Skimmer Sediment Basin
503.1	Skimmer
504.1	Sediment Basin
505.1	Flexible Pipe Slope Drain
506.1	Temporary Silt Ditch
507.1	Temporary Silt Fence
508.1	High Hazard Temporary Silt Fence
509.1	Silt Fence Outlet Option 2
510.1	Block and Gravel Stone Inlet Protection
511.1	Stone Inlet Protection
512.1	Hardware Cloth and Gravel Inlet Protection
513.1	Temporary Check Dam
514.1	Stabilized Construction Entrance
515.1	Construction Entrance Tire Wash

<u>Standard</u>	<u>Description</u>
516.1	Gravel and Rip Rap Filter Berm Basin
517.1	Erosion Control Dewatering
518.1	Temporary Stream Crossing
519.1	Catch Basin Inlet Protection
520.1	Slope Stability
521.1	Seeding Schedule
522.1	Seeding Schedule (Seasonal)
523.1	Construction within Creek Bank
524.1	Baffle Installation
525.1	Embankment Matting Detail
526.1	Brick Storm Structure with Temporary Pipe

600 Series - Tree Standards

<u>Standard</u>	<u>Description</u>
600.1	Tree Planting
601.1	Tree Protection
602.1	Tree Pit with Grate in Sidewalk (Plan)
603.1	Tree Pit with Grate in Sidewalk (Section)
604.1	Tree Pit with Grate in Sidewalk (Section)
605.1	Tree Pit with Grate in Sidewalk (Section)
606.1	Drip Irrigation Assembly for Tree Pit with Grate
607.1	Irrigation Detail (Turf Areas)
608.1	Irrigation Detail (Planting Beds)
609.1	Typical Valve Box Installation
610.1	Shrub Planting Bed
611.1	Median Greater than 120 Inches Excavation, Drainage, and Backfill
612.1	73 to 120 Inch Median Excavation, Drainage, and Backfill
613.1	48 to 72 Inch Median Excavation, Drainage, and Backfill
614.1	Root Crown Depths
615.1	Tree Planting Notes
616.1	Bridging Tree Roots
617.1	Temporary Tree Protection Detail
618.1	Asphalt Curb Placement at Existing Trees
619.1	Rock Chimney

700 Series - Miscellaneous Standards

<u>Standard</u>	<u>Description</u>
700.1	Typical Handrail
701.1	Handrail Warrants
702.1	Non Thoroughfare Street Name Sign
703.1	Thoroughfare Street Name Sign
704.1	Street Name Sign Installation Locations
705.1	End of Roadway Marker
706.1	End of Roadway Street Barricade
707.1	End of Roadway Marker Guard Rail Clamp Installation
708.1	Street Connectivity Sign for End of Roadway Barricade

<u>Standard</u>	<u>Description</u>
709.1	End of Roadway Street Barricade General Notes
710.1	Parking Standards
711.1	Parking Standards (Continued)
712.1	Accessible Parking and Signage Standards
713.1	Supplemental Van Accessible Sign
714.1	Supplemental Maximum Penalty Sign
716.1	Emergency Vehicle Median Crossover
717.1	Inverted “U” Rack for Bicycle Parking
718.1	Wave Rack for Bicycle Parking
719.1	Bicycle Lockers
720.1	Pavement Patching Detail
721.1	Speed Hump
722.1	Traffic Mini Circle

V. Appendix:

- Plan Review Checklist
- Driveway Permit Application
- Encroachment Permit Application
- NCDOT Driveway Permit Application
- PE Certification for Subdivision Streets
- Subdivision Prefinal Checklist
- Common Punch List Items
- Final Inspection Request Form
- Street Acceptance Application
- Street Lighting Policy
- Street Lighting Request Form

Town of Huntersville Engineering Standards and Procedures Manual

The Town of Huntersville's Engineering Standards and Procedures Manual (ESAPM) is provided as a resource that will assist in ensuring compliance with all Town requirements related to proposed land development activities inside the Town limits and within its Extraterritorial Jurisdiction (ETJ).

It is the Town's goal that the ESAPM present clear and concise technical requirements, policies, and procedures while providing the guidance and details necessary for an effective and efficient process.

The ESAPM is intended as a supplement to the Town Zoning Ordinance, Subdivision Ordinance, Planning Design Manual and Water Quality Design Manual. County, State, and Federal agencies may also have additional requirements not provided for or referenced within this manual. This manual does not relieve the design professional of the responsibility to correctly incorporate the provided information. It is the Design Engineer's responsibility to provide technical adequacy of the design using engineering judgment, experience, and sufficient knowledge in providing all related design elements.

The Town of Huntersville's Director of Engineering & Public Works shall be responsible for incorporating revisions as deemed appropriate based on a continual review of the ESAPM. Copies of the manual will be made available for a fee through the Huntersville Engineering & Public Works Department. The ESAPM is also available for online viewing on the Town of Huntersville website.

<https://www.huntersville.org/195/Standards-Manual>

Where discrepancies exist between this manual and any adopted Town Ordinance, the Ordinance shall govern. The latest revision of the "NCDOT Standard Specifications for Roads and Structures" and the "NCDOT Design Manual" shall apply to all roadway and storm drainage construction unless otherwise specified herein this manual.

This manual was created to capture most, but not all, scenarios related to development within the Town of Huntersville. Town of Huntersville Engineering & Public Works reserves the right to enforce standards not included within this manual, which uphold the Town's initiative to maintain a safe environment for its citizens.

I. Administrative Procedures

A. Introduction

Processes and procedures for various plan review and development standards are discussed in this section. Each section provides information on the process, standard, or the plan review agency to contact regarding that process.

B. Electronic Plan Management

The Town along with Mecklenburg County utilizes an electronic plan management (EPM) process. The EPM system is a web-based work flow tool that allows architects, engineers, and designers the ability to oversee the plan review and permitting process. This EPM process is required for all new or proposed modifications to existing plans. Additional plan submittal processes/requirements can be found on the Mecklenburg County Land Development webpage at

<https://www.mecknc.gov/LUESA/WaterandLandResources/LandDevelopment/Pages/Default.aspx>

Along with the submission of plans through the EPM process, an application for plan review is required. For plan review applications, contact the Town of Huntersville Planning Department at 704-875-7000 or at <https://www.huntersville.org/228/Planning-Department>.

Note: The Town Planning Department maintains their own plan review checklists. The duration of the plan review varies by review agency. Plan calculations and details are reviewed at this stage.

C. Engineering Plan Review Checklist

The engineering plan review checklist is a detailed list of the items to be reviewed by the Town Engineering and Public Works Department. The preliminary plan must include, at a minimum, the information described in the Town's Subdivision Ordinance and/or other applicable ordinances, and meet the corresponding engineering requirements outlined in the Engineering Plan Review Checklist. A copy of the Engineering Plan Review Checklist is included in the Appendix.

D. Fees

Fees for plan review are set and collected by the Mecklenburg County Land Use and Environmental Service Agency (LUESA) and/or Town of Huntersville Planning Department. Fees vary by the type and size of development and are updated on an as needed basis. Plan review fees can be found at the below web addresses:

<https://www.mecknc.gov/LUESA/WaterandLandResources/LandDevelopment/Pages/Fees.aspx>

<https://www.huntersville.org/528/Permits-Process>

E. Driveway Permits

Town Driveway Permit

A Town of Huntersville Driveway Permit is required for all new or proposed modifications to connections to Town streets except an individual single family residence. A copy of the Town Driveway Permit Application is in the Appendix. Reference the Town's fee schedule for driveway permit fees. If a property owner is proposing to do work within Town maintained right-of-way, a Town Encroachment Permit may be required. Contact the Town Engineering and Public Works Department at 704-766-2220 to confirm if a permit is needed.

Note: Two signed original copies of the driveway permit application along with two sets of plans are required for submission to the Town Engineering and Public Works Department. A separate encroachment permit is not needed if a driveway permit has been obtained.

NCDOT Driveway Permit

When accesses and/or driveways to North Carolina Department of Transportation (NCDOT) maintained facilities are proposed or are proposed to be modified, contact the NCDOT Division 10 District 2 office at (980) 523-0000. Forms are available on the web at <http://www.ncdot.gov/>. The Town will review the NCDOT driveway permit applications for accesses proposed within the Town of Huntersville. Reference the Town's fee schedule for driveway permit fees.

F. Encroachment Permits

The Town of Huntersville requires that an encroachment permit be obtained when construction activity, including installation of temporary or permanent structures, is proposed under, on, or over property in which the Town has property rights. Property rights include but are not limited to street rights of way, utility easements, or other owned property. An Encroachment Permit is required regardless of any other approvals (excluding a driveway permit), such as building permits or Planning Department entitlements.

Encroachment Permit applications and associated fees are processed through the Town of Huntersville Engineering and Public Works Department. A copy of the Town of Huntersville Encroachment Agreement is included in the Appendix.

G. PE Certification Process for Subdivisions and Streets

The Town of Huntersville requires that all streets proposed to be taken over by the Town for maintenance be reviewed, inspected, and certified by a licensed professional engineer registered in the state of North Carolina for adequate construction. A preconstruction meeting with the Town Engineer and/or Town Construction Engineer is required. Review of street construction by the certifying Engineer is required throughout the construction process. PE Certification is required for all developments in which the first submittal of the Town sketch plan or construction plans (if no sketch plan was submitted) occurred after the adoption of this manual on November 16th, 2009. A copy of the PE Certification requirements is included in the Appendix.

All sketch plans and construction plans submitted to the Town for subdivision approval must have the following statement on the cover sheet of the plan set:

The Town of Huntersville requires that all streets proposed to be taken over by the Town for maintenance be reviewed, inspected, and certified by a licensed professional engineer registered in the state of North Carolina for adequate construction. Review of street construction by the certifying Engineer is required throughout the construction process. Refer to the Town of Huntersville Engineering Standards and Procedures Manual for additional information including the required certification form.

H. Bonding

The following list contains information regarding the bonding process including minimum amounts, duration, and security type.

1. Release of the final subdivision plat will not occur until the improvements required for the area of the final plat are constructed and a final inspection has been performed and found to be in conformance with the plans approved by the Town, or a security has been posted with the Land Development Bond Coordinator of the applicable department and all required documents are received in their entirety.
2. Securities shall be posted for a minimum of six months with a two year maximum. The security shall be posted and remain in force until the construction is complete and found to be in conformance with the plans approved by the Town. The security will be reevaluated when an extension to the security is being considered.
3. Upon receipt of a notice from the bond holder, a final inspection will be made by the Town Engineer to check completeness of the project.
4. One type of security may be replaced by another type of security in certain situations. The amount of the replacement security will be based on the Town's Engineer Estimate of the work remaining. If the estimate of work results in a lower amount, the replacement security will be treated as a reduction. Certain situations will require an increase in a security and in such cases the replacement security shall be required to equal the higher amount.

5. If Mecklenburg County and the Town have different bonding or security requirements, the higher minimum amount shall apply.
6. A one-time reduction in security will be allowed if requested in writing by the principal party of the security. Additional reductions may be approved at the discretion of the Town Engineer. However, the security shall never be less than 15 percent of the total bond or \$20,000 for the Town unless approved by the Town Engineer.
7. Securities in the form of a Letter of Credit must be drawn on a full service bank in Mecklenburg County.
8. The applicant will be required to post a maintenance bond per Town requirements before the security for completion of subdivision is released.

I. Final Inspection

A final inspection of all streets to be turned over to the Town for maintenance must be inspected by the Town or Town designated inspector. Contact the Town Engineer or Town Construction Engineer for scheduling of final inspections.

When a phase/map of a subdivision reaches 75% occupancy, the phase/map will be considered eligible for acceptance by the Town. The Town may consider acceptance at an occupancy as low as 60%; however, in the case of early acceptance (<75%), the developer will be required to post a 2 year maintenance bond. The procedures for requesting a final inspection are as follows:

1. Submit an executed “Request for Final Inspection Form”, along with a “PE Certification for Subdivisions and Streets” form. (refer to Appendix).
2. A representative from the Town and/or Mecklenburg County will proceed with the Final Inspection.
3. Necessary repairs will be marked in the field, and indicated on a punchlist, which shall be valid for a period of thirty days.
4. When the necessary repairs have been completed, the Town should be contacted to verify the repairs have been completed.
5. When all conditions have been met, the developer may then proceed with requesting the Town to accept the streets for maintenance.

J. Street Maintenance Acceptance

The Town of Huntersville may consider the acceptance of privately owned streets upon the written request of the owning entity. Streets will only be accepted in their entirety or by block and street construction must be completed at time of petition.

To initiate the acceptance procedure, the following information shall be submitted to the Town Manager’s Office:

1. A letter to the Town Manager requesting that the Town consider accepting subject streets for public maintenance; and

2. One copy of the recorded map(s) of the subject street(s); and
3. One completed “Application for Street Maintenance Acceptance” form(s) of the subject Street(s) or, in the case of existing streets petitioned by residents, a “Street Maintenance Acceptance Petition” signed by eighty (80) percent of the street’s residents;
4. For new streets petitioned by subdivider, written verification from Town Engineering Department that the street(s) have been constructed according to the required standard and completed.
5. The associated right-of-way shall be deeded to the Town.

Once the required information and form have been submitted, an inspection of the subject street(s) shall be conducted by the Town. The Town shall notify the owning entity of all construction deficiencies identified by the Town. Upon correction of the deficiencies, the Board of Commissioners shall then consider the acceptance of the subject street(s).

Petitions for acceptance will be presented to the Board of Commissioners on a quarterly basis. The Board of Commissioners of the Town of Huntersville shall not adopt any resolution accepting a new street unless:

- The Board receives a report from the Town Manager that all conditions of street acceptance are met.
- The Board of Commissioners determines that such street corresponds in its location and aligns with a street shown on preliminary subdivision plat formally approved by the Planning Board of the Town of Huntersville or that said street was established as a public street prior to the adoption of this policy and therefore not subject to this policy.

The street acceptance policy includes streets, curbs, gutters, sidewalks, and all items located within the right-of-way. A copy of the Street Acceptance Policy and application form are found in the Appendix.

K. Street Lights

Request Procedure

For neighborhood street lights, individual street lights, or to have the Town pay for street light bills, neighborhoods must complete and submit a request form provided by the Town of Huntersville. The Town will record and log each request at the time it is submitted to the Town Manager’s office. The lighting must be located within a public street right-of-way. Streetlights are installed and billing paid by the Town on a chronological basis, as funding is available.

After a field survey has been completed, a financial spreadsheet estimating the cost of the project shall be completed by the Town Manager, or designated official. After the request is received and reviewed by Town staff, the contact person on the request form will be notified of any action regarding their request.

For neighborhood lighting requests, the neighborhood will be provided with a street lighting design for signature and approval. At least 75 percent of the residents on the streets are required to approve the plan before authorization will be given to the Utility Company to install streetlights. It is recommended that every resident review the street lighting design whether or not that signature is required. Only one signature per household is required.

When a completed petition is submitted to the Town Manager's office, streetlights will be installed, as funding is available. A copy of the Street Lighting Request form and policy is located in the Appendix.

II. Design Criteria

A. Introduction

The following sections present minimum design criteria for the design of public streets, storm drainage, street lighting, street and roadway signage for traffic regulation and street identification, and landscaping. **These sections should be reviewed in conjunction with Town Standard details and the Engineering Plan Review Checklist, also located within this manual.**

B. Street Design

Site specific variables or design limitations may result in street designs that differ from these criteria. In those circumstances, it is at the discretion of the Town’s review team to present the alternative design to the Planning Director and Director of Engineering for approval.

For use in designing Residential and Retail/Mixed-Use streets

Posted Speed Limit	*20*	25	30	35	40	45
Stopping Sight Distance* (feet)	115	155	225	285	350	415
Intersection Sight Distance - Left-Turn Movement From Stop*and** (feet)	225	280	365	425	485	545
Intersection Sight Distance - Right-Turn From Stop*and** (feet)	195	240	315	370	420	475
Minimum Horizontal Radius (Normal Crown) (feet)	110	200	430	675	980	1470
Minimum K value for Crest Vertical Curves	7	12	24	37	56	81
Minimum K value for Sag Vertical Curves	17	26	43	58	75	94
Maximum Longitudinal Grade	10 percent					
Maximum Longitudinal Grade within 100 feet of intersection (measured from intersecting street nearest edge of pavement of travel way)	5 percent					
Intersection Angle Range	75 to 105 degrees					

* Values will need to be adjusted for grades of more than 3 percent

** Values to be adjusted for streets with more than two total lanes

20 Only allowed in TND, TOD, TC Zoning.

Design standards that apply for the ETJ are taken from the latest edition of the NCDOT design manual *Subdivision Roads*. Any revisions to *Subdivision Roads* will supersede the design standards given in the Town of Huntersville Engineering Standards and Procedures Manual for ETJ streets. However, under no circumstances shall an NCDOT/ETJ standard be less restrictive than what is required by the Town of Huntersville.

Provisions of adequate stopping sight distance may require use of larger K values than the minimums listed above. The Town of Huntersville reserves the right to prescribe more stringent sight distance standards and/or means to achieve adequate sight distance than those listed above. Recordation of sight distance easements may be required on plats prior to approval.

The minimum distance between two horizontal curves is 50 feet. Longer distances may be needed based on the specifics of the roadway design.

Minimum curb and right-of-way radius measured from face of curb (when intersecting streets have different classification, use the more restrictive):

- Residential Local Street – 20 feet
- Residential Local Street to Residential Alley – 10 feet
- Residential Collector – 25 feet
- Retail/Mixed-Use Local – 25 feet
- Retail/Mixed-Use Collector – 25 feet
- Industrial Local and Collector – 35 feet

For minimum intersection separation, refer to block length minimums in the Zoning or Subdivision Ordinance. When distances in those ordinances are not specified, use the following criteria:

- Along local streets – 125 feet
- Along collector streets – 350 feet

Intersection offsets/separation from a thoroughfare, at signalized intersections, or at intersections that may become signalized in the future may need to be greater than these minimums and will be determined by the Town and/or NCDOT on a case-by-case basis.

Design criteria for arterial streets and thoroughfares shall be established jointly by the Town Engineer and the NCDOT on a case-by-case basis using the latest edition of the American Association of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highway and Streets and/or NCDOT Roadway Design Manual.

Intersection corner easements – A minimum 35 foot x 35 foot triangular maintenance easement (measured along right-of-way lines) shall be provided at each intersection corner where any street type intersects a collector or thoroughfare. A minimum 15 foot x 15 foot triangular maintenance easement (measured along right-of-way lines) shall be provided at each intersection corner where two local streets intersect. An additional 10 foot x 70 foot triangular maintenance easement shall be provided at intersections connecting to NCDOT maintained roadways (measured along right-of-way lines). Driveways (no formal right-of-way) to serve a single project may be required to provide triangular maintenance easements as determined on a case by case basis. Other triangular maintenance easements or sight distance requirements may be required by the NCDOT or the Town at all intersections.

Refer to the NCDOT Subdivision Roads Minimum Construction Manual for development criteria for sites located within the Town's Extraterritorial Jurisdiction (ETJ) within these areas governed by the Town of Huntersville Engineering Standards and Procedures Manual and the NCDOT Subdivision Roads Minimum Construction Standards Manual. The more restrictive standard shall apply.

Sidewalks and Driveways

1. Planting strip adjacent to sidewalk shall be graded to one half inch per foot (min.) up to one and one quarter inch per foot (max.), except where excessive natural grades make this requirement impractical. In such cases, the Town Engineer may authorize a suitable grade.
2. Sidewalk widths shall be a minimum of five feet unless otherwise specified.
3. Accessible ramps are required where sidewalks intersect curbing at any street intersection and curbed driveway connections.

Roundabouts

Refer to the Manual on Uniform Traffic Control Devices (MUTCD) for roundabout signage and pavement markings.

C. Storm Drainage

1. In addition to this manual, all storm drainage design shall conform to the standards and specifications as provided in the Charlotte-Mecklenburg Storm Water Design Manual, and NCDOT Standards Specifications for Roads and Structures. If conflicts occur, the more restrictive standard shall govern.
2. Reinforced concrete pipe may be used in all storm drain applications. High Density Polyethylene Pipe (HDPE) may be substituted for pipe diameters of 48 inches or less as approved by the Town Engineer. Culverts 60 inches in diameter or greater may be Corrugated Aluminized Metal Pipe (CAMP) or aluminum with a minimum 14 gauge metal subject to approval of the Town Engineer.
3. The minimum cover for all pipes is two feet measured from the final surface. Special applications for less than two feet of cover will be reviewed and approved by the Town Engineer individually. The maximum cover for storm drainage pipes shall at a minimum comply with the requirements of the NCDOT Roadway Design Manual, Part I, Section 5, and "Drainage Design". Storm pipe design that exceeds these criteria may be approved at the discretion of the Town Engineer.
4. All storm drain structures over three feet six inches in height must have steps in accordance with standard details set forth in this manual.
5. All graded creek banks and slopes shall be at a maximum of two feet horizontal to one foot vertical (2:1) and not to exceed ten feet without terracing or the slopes shall be designed by a Professional Geotechnical Engineer and approved by the Town Engineer on a case by case basis.
6. Adequate storm drainage shall be provided throughout the development by means of storm drainage pipes or properly graded channels. All pipes shall be of adequate size and capacity, as approved by the Town Engineer, to carry all storm water in its drainage area. More detail on adequate drainage in checklist.

7. In accordance with the Town Zoning Ordinance, the Town Engineer or duly authorized designee shall review the drainage plan for compliance with the standards contained in the current edition of the Town of Huntersville Engineering Standards and Procedures Manual and the Charlotte-Mecklenburg Storm Water Design Manual and all other relevant and appropriate standards established by the Town Engineering Department.
8. Sub-surface drainage shall be provided where the ground water level is likely to be near the surface. In capillary soils, the water level should be four to six feet below the surface to prevent the rise of moisture into the subgrade. Subdrains shall be used to lower ground water in low areas in the street.
9. All Storm Drainage Easements must extend down stream of flared end sections to an appropriate property line or buffer. Overlapping of storm drainage easements shall be approved by the Town Engineer on a case by case basis.
10. Storm Drainage Easements shall be provided for all storm drainage pipes and shown on site plans, construction plans and plats with widths specified in detail 314.1. The following note shall be placed on all grading plans and plats; "The purpose of the storm drainage easement (SDE) is to provide storm water conveyance. Buildings are not permitted in the easement area. Any other objects which impede storm water flow or system maintenance are also prohibited."
11. In areas where the Floodway Regulations are applicable, the Future Conditions Flood Fringe Line, FEMA Flood Fringe Line, Community Encroachment Line, and FEMA Encroachment Line shall be shown on the preliminary plan and the final plat. An application for a Floodlands Development Permit shall be submitted to Mecklenburg County in accordance with the requirements set forth in the Town/County Floodway Regulations.

D. Utilities

Avoid placement of sewer manholes in gutter pans, the crown of the road, wheel paths, wheelchair ramps, and over stormwater lines.

Avoid placement of water lines under roadway pavement.

Water valves shall not be placed in curbing.

E. Street Lighting

1. Light Spacing

Street lights shall be spaced a minimum of 250 feet to 300 feet on average to be eligible for transfer to the Town street lighting account. There is no guarantee that the Town will accept the lights – refer to street lighting ordinance.

2. Major Pedestrian Areas within Public Rights-of-Way

If an engineering evaluation indicates major pedestrian activities exist within public right-of-way, the Engineering and Public Works Department may determine that special lighting should be specified. A lighting plan and cost estimate for the special lighting would be developed, and if funds are available to implement the plan, then the Engineering and Public Works Department would coordinate the authorization and installation of the special lighting plan.

F. Signage

All regulatory, warning, and guide roadway signage shall be consistent with the Manual on Uniform Traffic Control Devices (MUTCD), the North Carolina Supplement to the MUTCD or as specified in this manual. All street name markers are also to be designed in accordance with 700 series standard drawings. All street name markers shall be nine inch tall extruded aluminum blades and utilize high intensity white prismatic reflective sheeting.

Certain street name markers within the Town limits shall include the Town logo. The Town logo shall be included to all street name markers that meet the following criteria:

- 1) Town Center zoning district
- 2) Intersections of Town streets with major or minor thoroughfares. Major and minor thoroughfares are defined on the Charlotte Regional Transportation Planning Organization (formerly the Mecklenburg-Union Metropolitan Planning Organization) Thoroughfare plan. (A PDF of the thoroughfare plan map can be found on the web at <http://www.crtpo.org/>.)

G. Landscaping

Refer to Article 7 Part A of the Town of Huntersville Zoning Ordinance regarding landscaping requirements.

While landscaping can be installed at street intersections, it shall not block the sight distance of vehicles at the intersection. Sight distance for an intersection shall be calculated in accordance with Section II. B. of this manual. Trees should not be planted within 40 feet of an intersection radius return measured along the street along the main or side street of intersections or commercial development driveways.

Trees shall not be planted in permanent drainage easements or within 10 feet of a masonry drainage structure. (This does not apply to Stormwater BMP's.)

H. Cluster Box Units (CBU's)

Mail cluster box units shall be placed outside of the line of sight (determined by intersection sight distance measurements), sight distance triangles and intersection corner easements. They shall not be placed between the subdivision entrance and its first street intersection. It is best to avoid placing CBU's on the main entrance road to a subdivision, however, special cases may apply.

When locating CBU's near on-street parking, do not place units directly adjacent to the on-street parking. CBU's shall be behind the sidewalk in such cases.

When placing CBU's within the green zone, units shall be oriented perpendicular to the street.

Access easements shall be required for all CBU's located outside of the right-of-way and/or common open space.

The ultimate goal in determining locations for mail cluster box units is to avoid placing the CBU in any way which encourages driving on the wrong side of the street and/or hinders handicap accessibility. The above standards are included to supplement the requirements of the United States Postal Service and shall be followed in addition to USPS standards.

III. Construction Specifications and Special Provisions

A. General Notes

The following specifications and special provisions are intended to be used in conjunction with Town of Huntersville Standard Drawings, NCDOT Roadway Standard Drawings, and NCDOT Standard Specifications for Roads and Structures for all development within the Town of Huntersville and the Town of Huntersville ETJ unless otherwise directed by the Town Engineer.

1. Unless otherwise specified in this manual, **all work and materials shall conform to the latest edition of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.**
2. All backfill material shall be non-plastic in nature, free from roots, vegetative matter, waste, construction material or other objectionable material. Said material shall be capable of being compacted by mechanical means and the material shall have no tendency to flow or behave in a plastic manner under the tamping blows or proof rolling.
3. Materials deemed by the inspector as unsuitable for backfill purposes shall be removed and replaced with select backfill material.
4. Compaction requirements shall be attained by the use of mechanical compaction methods. Each six inch layer of backfill shall be placed loose and thoroughly compacted into place.
5. ALL concrete used in the public right-of-way for streets, curb and gutter, sidewalks and drainage structures, etc. shall have a minimum compressive strength of 3600 PSI at 28 days. This requirement shall be provided regardless of any lesser compressive strength specified in the North Carolina Department of Transportation Standard Specifications for Roads and Structures. The contractor shall prepare concrete test cylinders in accordance with Section 1000 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures at the direction of the project inspector. All equipment and cylinder molds shall be furnished by the contractor. It shall be the responsibility of the contractor to protect the cylinders until such time as they are transported for testing. Testing for projects shall be performed by an independent testing lab, at no cost to the Town. The contractor shall provide equipment and perform tests on concrete for a maximum slump and air content as defined in Section 1000 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures. These tests shall be performed at a frequency established by the inspector. Materials failing to meet specifications shall be removed by the contractor.
6. Concrete or asphalt shall not be placed until the air temperature measured at the location of the paving operation is at 35 degrees Fahrenheit and rising by 10:00 a.m. Concrete or paving operations should be suspended when the air temperature is 40 degrees Fahrenheit and descending. The contractor shall protect freshly placed concrete or asphalt in accordance with Sections 420 (Concrete Structures), 600 (Asphalt Bases And Pavements), and 700 (Concrete Pavements And Shoulders) of the North Carolina Department of Transportation Standard Specifications for Roads and Structures when the air temperature is at or below 35 degrees Fahrenheit and the concrete has not obtained an age of 72 hours.
7. Plant all street trees in the middle of the planting strip unless otherwise noted on the standard detail.

Grading

1. Proposed street rights-of-way shall be graded to their full width for ditch type streets and a minimum of eight feet behind the curb for curb and gutter sections.
2. Fill embankments shall be constructed in accordance with section 235 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures and placed in successive lifts not to exceed more than six inches in depth for the full width of the cross-section, including the width of the slope area. No stumps, trees, brush, rubbish or other unsuitable materials or substances shall be placed in the right-of-way. Each successive six inch layer shall be thoroughly compacted by the sheepsfoot tamping roller, 10-ton power roller, pneumatic-tired roller, or other methods approved by the Town Engineer. Embankments over and around all pipe culverts shall be of select material, placed and thoroughly tamped and compacted as directed by the Town Engineer or his representative.

Roadway Base

1. All roadways shall be constructed with a base course as detailed on the applicable Town of Huntersville Standard Detail Drawing.
2. The material for the aggregate base course (ABC) shall be in conformance with Section 520 – Aggregate Base Course of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.
3. An asphalt concrete base course, as detailed on the Standard Detail Drawing may be substituted in lieu of an aggregate base course and shall be in accordance with all applicable articles of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.
4. Asphalt concrete base course (ACBC) shall be used for widening strips less than five feet in width.

Roadway Intermediate and Surface Course

1. Plant mixed asphalt shall conform in all respects to Section 610 of the NCDOT Standard Specifications for Roads and Structures.
2. The final one and one half inch lift of asphalt surface course for residential subdivision streets shall be withheld until a minimum of 75 percent of the development is occupied (occupied means a certificate of occupancy has been issued) (All documentation to be provided by the developer and approved by the Town Engineer or designee). All known base failures shall be repaired prior to application of the final one and one half inch lift of asphalt surface course.
3. The Town Engineering and Public Works Department shall be given at least a 48 hour notification to inspect the first lift of surface course deficiencies. Prior to application of the final layer of asphalt, all deficiency repairs are to be monitored and accepted by the Town Engineer or designee.

4. The Town Engineering and Public Works Department shall be notified prior to using recycled plant mixes.
5. Failure to meet any of the requirements of this manual may result in the delay or prevention of street acceptance by the Town of Huntersville or NCDOT.

Sidewalks and Driveways

1. Sidewalks shall be constructed with concrete having a minimum compressive strength of not less than 3600 P.S.I. concrete. The sidewalk shall be at least six inches thick where sidewalk crosses a driveway and at least four inches thick in all other locations. The subgrade shall be compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test. The surface of the sidewalk shall be steel trowel and light broom finished and cured with an acceptable curing compound. Tooled joints shall be provided at intervals of not less than five feet and expansion joints at intervals of not more than 45 feet. The sidewalk shall have a lateral or cross slope of one-quarter inch per foot.
2. Planting strip adjacent to sidewalk shall be graded to ½ inch per foot (min.) up to 1 ½ inch per foot maximum, except where excessive natural grades make this requirement impractical. In such cases, the Town Engineer may authorize a suitable grade.
3. Sidewalk widths shall be a minimum of five feet unless otherwise specified.
4. Approval of sidewalk construction plans must be obtained as part of the plan review process. A recorded permanent public sidewalk easement is required for all sidewalk located outside public right-of-way; the width of the easement shall be specified by the Town. The sidewalk easement must be recorded with the Mecklenburg County Register of Deeds prior to issuance of a certificate of occupancy for the corresponding building(s).
5. Accessible ramps are required where sidewalks intersect curbing at all street intersections and curbed driveway connections.

B. 100 Series Drawings – Miscellaneous Concrete Infrastructure

Drawings in this series include details for curb and gutter, sidewalks, driveways, accessible ramps, culvert crossings, and street tapers. The following list provides information in addition to that included in the standard drawings in this series.

1. All curb and gutter shall be backfilled with soil approved by the Inspector within 48 hours after construction to prevent erosion.
2. All concrete shall be cured with 100 percent Resin Base, white pigmented curing compound which meets ASTM Specifications C-309, Type 1, applied at a uniform rate at one gallon to 400 square feet within 24 hours of placement of the concrete.
3. Straight forms shall not be used for forming curb and gutter in curves.
4. All excess concrete on the front edge (lip) of gutter shall be removed when curb and gutter is poured with a machine.

C. 200 Series Drawings – Street Sections

Drawings in this series include details for street typical sections including pavement design, cul-de-sacs, parallel parking space location/layout, alleys, and hammerheads.

1. All asphalt cuts shall be made with a saw when preparing street surfaces for patching or widening strips.
2. All subgrade shall be compacted to 100% of the maximum density obtainable with the Standard Proctor Test to a depth of twelve (12) inches, and a density of 95% Standard Proctor for depths greater than twelve (12) inches. All tests shall be performed by developer at no cost to the Town.
3. Paper joints shall be used to seal the ends of an asphalt pour so that future extensions can be made without causing rough joints.
4. When placing asphalt against existing surfaces, a straight edge shall be used to prevent “humping” at that location.
5. Stone shall be primed if paving is not complete within seven days following stone base approval.
6. Surfaces shall be tacked when asphalt is being placed over existing asphalt streets or adjoining concrete, storm drain and sanitary sewer structures.
7. Sweeping of the stone base and/or application of a tack coat may be required near intersections. These requirements will be established by the Town/NCDOT Inspector based on field conditions.
8. A canvas cover or other suitable cover shall be required for transporting plant mix asphalt during cool weather when the following conditions are present:
 - a. Air temperature is below 60 degrees Fahrenheit.
 - b. Length of haul from plant to job is greater than five (5) miles.
 - c. Other occasions at the Inspector’s discretion when a combination of factors indicates that material should be covered in order to assure proper placement temperature.
9. Roadside ditches shall conform to NCDOT standards unless otherwise specified by Town along Town maintained roads.

D. 300 Series Drawings – Storm Drainage

Drawings in this series include NCDOT standards approved for use, catch basins, wingwalls, riprap aprons, flared end section pipe, riprap plunge pools, trench drains, paved ditches, subdrains, overlapping of easements, minimum drainage easements, and grading at drop inlets. The following list provides information in addition to that included in the standard drawings in this series.

1. All concrete shall be at least 3600 PSI. Prior approval from the Town Engineer shall be obtained in order to use pre-cast storm drainage structures in any street right-of-way.
2. Concrete pipe used within the street right-of-way shall be a minimum of Class III Reinforced Concrete Pipe, with a minimum diameter of fifteen inches (eighteen inches minimum on cross drain culverts). Installation of Class IV or higher concrete pipe shall be identified on the As-Built Plan and the Town Inspector shall be given documentation and notification of this information prior to construction.
3. Concrete mortar joints shall be used for joining all concrete pipes. The pipe shall be clean and moist when mortar is applied. The lower portions of the bell or groove shall be filled with mortar sufficient to bring the inner surface flush and even when the next joint is fitted into place. The remainder of the joint shall then be filled with mortar and a bead or ring of mortar formed around the outside of the joint. The application of mortar may be delayed until fill is completed when the pipe is larger than thirty inches.
4. Performed joint sealer, which conforms to AASHTO specification M-198 for Type B flexible plastic gaskets, may be used in lieu of the mortar joining method.
5. Under no circumstances shall water be permitted to rise in un-backfilled trenches after the pipe has been placed.

High Density Polyethylene Pipe (HDPE)

1. All trenches in the street right-of-way shall be backfilled with suitable material immediately after the pipe is laid. The fill around all pipes shall be placed in layers not to exceed six inches and each layer shall be compacted thoroughly.
2. Any installation within the maintenance limits of the Town is subject to the approval of the Town Engineer/Public Works Director.
3. The product used shall be corrugated exterior/smooth interior pipe (Type S), conforming to the requirements of AASHTO Specification M294 (latest edition) for Corrugated Polyethylene Pipe.
4. Bell and spigot joints shall be required on all pipes inside the right-of-way. Bells shall cover at least two full corrugations on each section of pipe. The bell and spigot joint shall have an "O" ring rubber gasket meeting ASTM F477 with the gasket factory installed, placed on the spigot end of the pipe. Pipe joints shall meet all requirements of AASHTO M294.
5. All HDPE pipe installed must be inspected and approved by the Town's Inspector prior to any backfill being placed. The Town Engineer or his designee must be present during the backfilling operation.

6. Backfill material used to install HDPE pipe within the street right-of-way shall be Select Material, Class II-IV, as defined by Section 1016-3 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures. Upon submittal of written certification of material suitability by a licensed geotechnical engineer, NCDOT Class I Select Material may be used. All backfill material shall be approved by the Town inspector prior to placement of the material within the Town street right-of-way.
7. The minimum length of HDPE pipe permitted for use shall be four feet. HDPE flared end sections are not allowed.
8. All HDPE pipe installed shall be third party certified and shall bear the Plastic Pipe Institute's (PPI) certificate sticker.

Installation of Reinforced Concrete and Corrugated Metal Pipe

1. All backfill shall be non-plastic in nature, free from roots, vegetative matter, waste, construction material or other objectionable material. Said material shall be capable of being compacted by mechanical means and shall have no tendency to flow or behave in a plastic manner under the tamping blows or proof rolling.
2. Materials deemed by the Engineer as unsuitable for backfill purposes shall be removed and replaced with select backfill material.
3. Backfilling of trenches shall be accomplished immediately after the pipe is laid. The fill around the pipe shall be placed in layers not to exceed eight inches, each layer shall be thoroughly compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test (a density of 100 percent Standard Proctor is required for the top eight inches).
4. Compaction requirements shall be attained by the use of mechanical compaction methods. Each layer of backfill shall be placed loose and thoroughly compacted in place.

E. 400 Series Drawings – Stormwater BMP

Drawings in this series include bioretention, flow splitters, wetponds, wetlands, grass swales, grass channels, infiltration ditches, observation wells, buffer strips, sand filters, and level spreaders.

F. 500 Series Drawings – Erosion Control

Drawings in this series include sediment traps, skimmers, pipe slope drains, silt ditches/fences, inlet protection, check dams, construction entrances, filter berm basins, dewatering, stream crossings, slope stability, seeding schedules, construction within creek banks, baffles, embankments, and brick storm structures.

1. The contractor shall do that which is necessary to control erosion and to prevent sedimentation damage to all adjacent properties and streams in accordance with the appropriate Mecklenburg County Erosion and Sedimentation Control Ordinance.

G. 600 Series Drawings – Trees

Drawings in this series include tree plantings/protection, tree pits, irrigation, valve boxes shrub plantings, medians, root crown depths, planting notes, bridging tree roots, asphalt curb placement at existing trees, and rock chimneys.

H. 700 Series Drawings – Miscellaneous

Drawings in this series include concrete control monuments, handrails, street name signs, end of road devices and markers, parking standards, accessible parking signage, roundabout signage, emergency vehicle median crossovers, bicycle racks and bicycle lockers.

I. Traffic Control

The contractor shall maintain two-way traffic at all times when working within existing streets. The contractor shall place and maintain signs, danger lights, and barricades and furnish watchmen or flagmen to direct traffic in accordance with the latest edition Work Area Traffic Control Handbook (WATCH), Work in the right-of-way of State System Streets may require additional traffic control provisions.

Refer to the Work Area Traffic Control Handbook (WATCH) for traffic control needs for work within the road right-of-way.

References

1. North Carolina Department of Transportation, most recent edition, Standard Specifications for Roads and Structures.
2. North Carolina Department of Transportation, most recent edition, Roadway Standards Drawings.
3. City of Charlotte Department of Transportation, most recent edition, Work Area Traffic Control Handbook (WATCH).
4. City of Charlotte Storm Water Services-Mecklenburg County Storm Water Services most recent edition, Charlotte-Mecklenburg Storm Water Design Manual.
5. American Association of State Highway and Transportation Officials most recent edition, A Policy on Geometric Design of Highways and Streets.
6. North Carolina Department of Transportation, Roadway Design Manual, latest edition.
7. North Carolina Department of Environment and Natural Resources most recent edition, Erosion and Sediment Control Planning and Design Manual.
8. Charlotte-Mecklenburg BMP Design Manual, latest edition.
9. Mecklenburg County Storm Water Services, most recent edition, Administrative Manual for Implementation of the Post-Construction Storm Water Ordinance.
10. Mecklenburg County Board of County Commissioners, most recent edition, Mecklenburg County Soil and Sedimentation Control Ordinance.
11. Manual of Uniform Traffic Control Devices for Streets and Highways, Federal Highway Administration, latest edition.