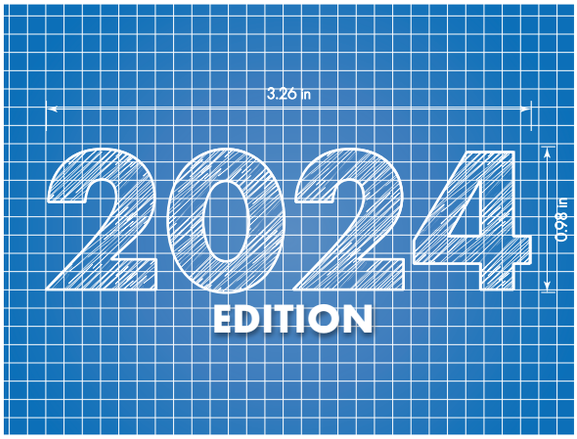











# Town of Knightdale

## *Standard Specifications and Details Manual*

**Adopted November 20, 2024**

Town of Knightdale
950 Steeple Square Court
Knightdale, NC, 27545
www.KnightdaleNC.gov

# *STANDARD SPECIFICATIONS & DETAILS MANUAL*

## *2024 EDITION*

TOWN OF KNIGHTDALE
NORTH CAROLINA

Adopted *November 20, 2024*
*RES #24-11-20-002*

950 Steeple Square Court
Knightdale, NC 27545
www.KnightdaleNC.gov

## TABLE OF CONTENTS


**Summary of Revisions** ..... **1**

**Section 1: Preliminary Considerations & Instructions** ..... **3**

**Section 2: General Provisions** ..... **4**

**Section 3: Streets** ..... **12**

**Section 4: Curb & Gutter, Driveways, Sidewalks, Greenways** ..... **20**

**Section 5: Storm Drainage** ..... **23**

**Section 6: Water & Sanitary Sewer** ..... **30**

**Standard Details** ..... **31**

Project Identification Sign ..... 2.01

SCM Identification Sign ..... 2.02

Plant Protective Fencing ..... 2.10-1

Standard Temporary Silt/Tree Protection Fence ..... 2.10-2

Alley Section ..... 3.01-1

Public Alley (Utility) Section ..... 3.01-2

Local Street Section ..... 3.02-1

Local Street Section – On Street Parking ..... 3.02-2

Main Street Section ..... 3.03

Urban Main Street Section – Separated Bike Lanes ..... 3.04-1

Urban Main Street Section – Wide Sidewalk ..... 3.04-2

Avenue Section – Buffered Bike Lanes ..... 3.05

Urban Avenue Section – Wide Sidewalk ..... 3.06-1

Urban Avenue Section – Separated Bike Lanes ..... 3.06-2

Urban Avenue Section – Buffered Bike Lanes ..... 3.06-3

Boulevard Section – Sidepaths ..... 3.07-1

Boulevard Section – Buffered Bike Lanes ..... 3.07-2

Knightdale Boulevard Section – Sidepaths ..... 3.07-3

Cul-de-sac Section ..... 3.08

Standard Shoulder Section without Sidewalk ..... 3.09

Standard Shoulder Section without Curb & Gutter ..... 3.10

Urban Streetscape Design Features ..... 3.11

Street Median Excavation, Drainage, & Backfill ..... 3.12

Standard Utility Location in Street ..... 3.13

Standard Asphalt Pavement Patch ..... 3.14

Standard Concrete Pavement Patch ..... 3.15

Street Name Sign Installation Location ..... 3.16-1

**TABLE OF CONTENTS**


Street Name Sign ..... 3.16-2
Heavy Vehicle Pavement Design ..... 3.17
Temporary Barricade for Dead End Roads ..... 3.18
Standard Pavement Widening Taper & Markings ..... 3.19
Parking Standards ..... 3.20
Root Crown Depths ..... 3.21
Tree Grate ..... 3.22
Tree Planting Island in Parking Lots ..... 3.23
Tree Pit with Grate in Sidewalk ..... 3.24-1
Tree Pit with Grate in Sidewalk ..... 3.24-2
Tree Pit with Grate in Sidewalk ..... 3.24-3
Tree Pit with Grate in Sidewalk ..... 3.24-4
Tree Planting – Single & Multi-Stem Trees ..... 3.25
Street Tree Planting ..... 3.26
Bicycle Shared Lane Marker ..... 3.27
Standard Pavement Undulation – Speed Hump ..... 3.28-1
Standard Pavement Undulation – Flat Top Speed Hump ..... 3.28-2
Standard Pavement Undulation – Raised Pedestrian Crossing ..... 3.28-3
Rumble Strips – Outside Lane ..... 3.29
Rumble Strips – Traffic Calming ..... 3.30
Fire Lane Pavement Marking ..... 3.31
Mast Arm Poles ..... 3.32
Physical Characteristics Single Lane Roundabout (Geometry) ..... 3.33-1
Physical Characteristics Single Lane Roundabout with Bypass Lanes (Geometry) ..... 3.33-2
Signing & Pavement Marking Single Lane Roundabout ..... 3.33-3
Physical Characteristics Mini-Roundabout ..... 3.33-4
Truck Movements Single Lane Roundabout & Mini-Roundabout ..... 3.33-5
Geometric Speed Checks Single Lane Roundabout ..... 3.33-6
Sight Distance Checks Single Lane Roundabout ..... 3.33-7
Miscellaneous Roundabout Details ..... 3.33-8
Other Traffic Calming Measures ..... 3.34
Curb & Gutter ..... 4.01-1
Curb & Gutter ..... 4.01-2
Curb & Gutter ..... 4.01-3
Standard Curb Drain ..... 4.02

**TABLE OF CONTENTS**


Standard Driveway Apron ..... 4.03
Concrete Sidewalk ..... 4.04-1
Concrete Sidewalk ..... 4.04-2
Brick Paver Sidewalk ..... 4.05
Wheelchair Curb Ramps – New Development ..... 4.06-1
Wheelchair Curb Ramps – New Development ..... 4.06-2
Wheelchair Curb Ramps – New Development ..... 4.06-3
Wheelchair Curb Ramps – New Development ..... 4.06-4
Wheelchair Curb Ramps – New Development ..... 4.06-5
Shared Curb Ramps/Flared – Retrofit ..... 4.06-6
Wheelchair Curb Ramps – Notes ..... 4.06-7
Truncated Domes ..... 4.07
Asphalt Curb Placement at Existing Trees ..... 4.08
Asphalt Typical Greenway Section ..... 4.09-1
Standard Precast Concrete Boardwalk ..... 4.09-2
Asphalt Typical Trail ..... 4.09-3
Public Greenway Amenities ..... 4.09-4
Greenway Directional Signage ..... 4.09-5
Brick Crosswalk ..... 4.10
Unit Paver Crosswalk ..... 4.11
Typical Handrail ..... 4.13
Typical Bench ..... 4.14
Typical Bike Rack ..... 4.15
Typical Trash Receptacle ..... 4.16
Culvert Crossing on Residential & Commercial Streets ..... 5.01-1
Culvert Crossing on Residential & Commercial Streets ..... 5.01-2
Trench for Storm Drain Pipes ..... 5.02
Standard Yard Inlet with Concrete Slab ..... 5.03
Standard Drop Inlet with Grate & Frame ..... 5.04
Standard Curb Inlet – Brick Box ..... 5.05-1
Standard Curb Inlet – Brick Box ..... 5.05-2
Standard Curb Inlet – Precast Concrete Box ..... 5.05-3
Standard Curb Inlet – Precast Concrete Box ..... 5.05-4
Standard Reinforced Concrete Headwall with Wingwalls ..... 5.06-1
Standard Reinforced Concrete Headwall with Wingwalls ..... 5.06-2

**TABLE OF CONTENTS**


Standard Concrete Block Headwall with Wingwalls ..... 5.07-1
Standard Concrete Block Headwall with Wingwalls ..... 5.07-2
Standard Brick Headwall with Wingwalls ..... 5.08-1
Standard Brick Headwall with Wingwalls ..... 5.08-2
Dimensions for Headwall with Wingwalls ..... 5.09-1
Dimensions for Headwall with Wingwalls ..... 5.09-2
Standard Manhole Ring & Cover ..... 5.10
Manhole Grade Adjustment Rings ..... 5.11
Manhole Cover within Pedestrian Paths ..... 5.12

## SUMMARY OF REVISIONS

The following revisions were incorporated into the Town of Knightdale Standard Specifications and Details Manual on November 20, 2024 via RES #24-11-20-002.

| Number | Section Title | Description |
|---|---|---|
| Section 1 | Preliminary Considerations & Instructions | Added Product Substitutions section |
| Section 2 | General Provisions | Minor revisions and updates |
| Section 3 | Streets | Updated per CTP and new details; Clarified timing of surface course placement |
| Section 4 | Curb & Gutter, Driveways, Sidewalks, Greenways | Updated per new and revised details; Revised Inspection section |
| Section 5 | Storm Drainage | Updated pipe materials; Added Inspection section |
| Section 6 | Water | Revised to include Sanitary Sewer references; Defers to City of Raleigh policies and handbook |
| Section 7 | Sanitary Sewer | Removed; Combined with Section 6 |
| 1.01 | Project Identification Sign | Renumbered to 2.01 |
| 1.02 | SCM Identification Sign | Renumbered to 2.02; Updated format |
| 2.10 | Plant Protective Fencing | Removed wood fence detail; Provided signage in Spanish |
| 2.10-2 | Standard Temporary Silt/Tree Fence Protection | New |
| 3.01 | Alley Section | Renumbered to 3.01-1 |
| 3.01-2 | Public Alley Section | New |
| 3.02-1 | Local Street Section – One Way | Revised per CTP cross sections |
| 3.02-2 | Local Street Section – Two Way | Replaced with Local Street – On Street Parking |
| 3.02-2 | Local Street – On Street Parking | New |
| 3.03 | Main Street Section | Replaced with Main Street – Bike Lanes |
| 3.04 | Avenue Section | Replaced with Urban Main Street – Separated Bike Lanes |
| 3.04-1 | Urban Main Street – Separated Bike Lanes | New – per CTP cross sections |
| 3.04-2 | Urban Main Street – Wide Sidewalk | New – per CTP cross sections |
| 3.05 | Urban Avenue Section | Replaced with Avenue – Buffered Bike Lanes |
| 3.05 | Avenue – Buffered Bike Lanes | New – per CTP cross sections |
| 3.06 | Boulevard Section | Replaced with Urban Avenue |
| 3.06-1 | Urban Avenue – Wide Sidewalk | New – per CTP cross sections |
| 3.06-2 | Urban Avenue – Separated Bike Lanes | New – per CTP cross sections |
| 3.06-3 | Urban Avenue – Buffered Bike Lanes | New – per CTP cross sections |
| 3.07 | Urban Boulevard Section | Replaced with Boulevard - Sidepaths |
| 3.07-1 | Boulevard – Sidepaths | New – per CTP cross sections |
| 3.07-2 | Boulevard – Buffered Bike Lanes | New – per CTP cross sections |
| 3.07-3 | Knightdale Boulevard – Sidepaths | New – per CTP cross sections |
| 3.08 | Cul-de-Sac Section | Increased diameter per Fire Code; Continued sidewalk |
| 3.11 | Mixed Use Areas Section | Renamed to Urban Streetscape Design Features; minor updates |
| 3.14 | Standard Asphalt Pavement Patch | Revised minimum patch width and depth |

## SUMMARY OF REVISIONS

| | | |
|---|---|---|
| 3.15 | Standard Concrete Pavement Patch | Revise minimum patch width; clarified rebar |
| 3.16 | Street Name Sign Installation | Updated to U-channel post |
| 3.17 | Street Name Sign | Renumbered to 3.16-2; updated to U-channel post |
| 3.17 | Heavy Vehicle Pavement Design | New |
| 3.20 | Parking Standards | Added parallel parking design detail |
| 3.26 | 6’ Tree Planting Mixed Use Areas | Renamed to Street Tree Planting; revised Notes |
| 3.32 | Mast Arm Poles | New |
| 4.01-2 | Curb and Gutter | Binder curb detail added |
| 4.03 | Standard Driveway Apron | Revised setback to 2 ft from property line |
| 4.04-1-2 | Concrete Sidewalks | Sub-base changed to ABC; updated per CTP cross sections |
| 4.05 | Guidelines for Brick Sidewalk | Replaced with design on previous detail 4.12 |
| 4.06-1-7 | Wheelchair Curb Ramps | Revised for ADA compliance; additional types and scenarios added |
| 4.07 | Truncated Domes | New |
| 4.09-1 | Standard Multi-Use Path Greenway | Renamed to Asphalt Typical Greenway; adjusted dimensions; added unplanted shoulder note |
| 4.09-2 | Standard Precast Concrete Boardwalk | New |
| 4.09-3 | Typical Sidepath | New |
| 4.09-4 | Public Greenway Amenities | New |
| 4.09-5 | Greenway Directional Signage | New |
| 4.12 | Typical Sidewalk Cross Section Mixed Use Areas | Renumbered to 4.05; renamed to Brick Paver Sidewalk |
| 4.14 | Typical Bench | New |
| 4.15 | Typical Bike Rack | New |
| 4.16 | Typical Trash Receptacle | New |
| 5.05-1-2 | Standard Curb Inlet | Revised to specify Brick Box option |
| 5.05-3-4 | Standard Curb Inlet – Precast Concrete Box | New |
| 5.10 | Standard Manhole Ring and Cover | Revised to specify continuous bearing around frame |
| 5.11 | Manhole Grade Adjustment Rings | New |
| 5.12 | Manhole Cover – Pedestrian Paths | New |
| 6.01 | Standard Hydrant Installation – Rural | Removed |
| 6.02 | Standard Hydrant Installation – Urban | Removed |
| 6.03 | Standard Hydrant Location | Removed |

The following revisions were incorporated into the Town of Knightdale Standard Specifications and Details Manual on December 18, 2024 via RES #24-12-18-003.

| Number | Section Title | Description |
|---|---|---|
| 3.33-1-8 | Roundabout Section | New |
| 3.34 | Other Traffic Calming Measures | New |

## SUMMARY OF REVISIONS

The following revisions were incorporated into the Town of Knightdale Standard Specifications and Details Manual on October 21, 2026 via RES #26-10-21-004.

| Number | Section Title | Description |
|---|---|---|
| 3.07-1 | Boulevard – Sidepaths | Revised appearance of sidepath material |
| 3.07-3 | Knightdale Boulevard – Sidepaths | Revised appearance of sidepath material |
| 4.09-3 | Asphalt Typical Sidepath | Renamed to Asphalt Typical Trail |

## SECTION 1 - PRELIMINARY CONSIDERATIONS & INSTRUCTIONS

### 1.01 General

The Standard Specifications as contained herein are to be utilized as minimum standards for all development (non-residential sites and/or subdivisions) and utility construction projects within the jurisdiction of the Town of Knightdale or connecting to the Town's utility system. All development projects shall also comply with the Town of Knightdale ***Unified Development Ordinance***.

The purpose of these Specifications is to present standards for typical conditions encountered. All projects which include construction of public facilities, such as storm drainage facilities or streets, require that the design services be performed by, or under the direct supervision of, a Professional Engineer, a Professional Land Surveyor, or a Professional Landscape Architect licensed to practice in the State of North Carolina. The existence of these Standard Specifications and Construction Details does in no way relieve the Professional Engineer, Professional Land Surveyor, or the Professional Landscape Architect of the responsibility to correctly adapt these standards to the actual site conditions encountered on a specific project. The Professional Engineer, Professional Land Surveyor, or the Professional Landscape Architect must review the applicable portions of these specifications and determine that these minimum standards will function correctly for the project. There may be circumstances whereby the engineer, surveyor, or landscape architect may wish to increase pipe strength classification, bedding requirements, reinforcing, depth of stone base, depth of asphalt, etc. In such situations where changes or modifications are proposed, the Town of Knightdale shall be consulted prior to completion of final design and plan submittal. This will serve to help ensure that the plan review time is minimized. Such approval shall be clearly indicated at one location on the construction drawings and labeled "Exceptions to the Standard Specifications of the Town of Knightdale."

Projects shall be constructed according to the Standard Specifications in effect at the time the project receives final approval by the Town of Knightdale for construction. The project contractor shall have at least one complete set of approved plans and these Standard Specifications at the job site at all times that work is being performed.

The Town of Knightdale will periodically update these Specifications. Updates will be made available on the Town’s website. The Town will also periodically consolidate the changes and republish the document in its entirety.

### 1.02 Product Substitutions

Trade names, brand names, and/or manufacturer's information used in these specifications are for the purposes of establishing quality. Use of other qualified manufacturers or products is acceptable provided that details are included in Construction Drawings and reviewed and approved by the Town Engineer and/or Public Works Director. Features of quality, capacity, construction, performance, appearance, size, arrangement, and general utility including economy of operation of substitutes offered, either parallel or exceed those of specified products.

## SECTION 2 - GENERAL PROVISIONS

### 2.01 General

All construction shall conform to the requirements and dimensions on the approved construction plans, Town Standard Details, the Code of the Town of Knightdale, or as stated in these Specifications.

### 2.02 Abbreviations & Definitions

**a. Abbreviations:**

AASHTO - American Association of State Highway Transportation Officials

ASTM - American Society for Testing & Materials

AWWA - American Water Works Association

NCDOT - North Carolina Department of Transportation

ANSI - American National Standard Institute

**b. Definitions:**

Where the word "Engineer" is used in these Specifications, it shall be the Town Engineer of Knightdale, the Town's Consulting Engineer as designated by the Town Manager, or an assistant or other representative duly authorized by the Town Engineer or the Town's Consulting Engineer.

Where the words “Town Representative” are used in these Specifications, it shall be the Director of Public Works of the Town of Knightdale or an assistant or other duly authorized representative of the Town of Knightdale, North Carolina.

Where the word "Town" is used in these Specifications, it shall be the Town of Knightdale, North Carolina.

Where the word "Developer" or "Contractor" is used in these Specifications, it shall be the developer of the project or his authorized contractor performing work on the site. For purposes of these Specifications, these words are to be considered synonymous. All Contractors performing construction or installation of public facilities shall be properly licensed for the work by the NC Licensing Board for General Contractors. Prior to commencing work, the Contractor shall submit proof of licensure. The Contractor shall also submit information including mailing and street address for the firm, ownership information, telephone numbers for contact during regular business hours and emergency telephone numbers for contact during nights, weekends and holidays.

Where the words "Project Engineer" are used in these Specifications, they shall mean the design engineer, land surveyor, or landscape architect retained by the developer, and the person responsible for the preparation of the final construction drawings.

## 2.03 Insurance Requirements

If work is to be performed within any Town street right-of-way or on Town owned property, the Developer/Contractor shall submit a certificate of insurance to the Town stating that coverage is in effect during the project duration. The limits of coverage shall be no less than $5,000,000 for general liability (bodily injury and property damage) plus $1,000,000 for automobile liability (bodily injury and property damage).

## 2.04 Erosion & Sedimentation Control

### a. General Requirements:

Temporary and permanent erosion control measures shall be provided in accordance with the Erosion and Sedimentation Control Plan approved by the Town. The approved Erosion and Sedimentation Control Plan shall be kept on site by the Contractor at all times that work is being performed.

All permanent erosion and sedimentation control measures shall be incorporated into the work at the earliest practicable time, and in no case shall an area remain denuded for more than 30 working days. Temporary erosion and sedimentation control measures shall be coordinated with permanent erosion and sedimentation control measures and all other work on the project to ensure economical, effective and continuous erosion and sedimentation control throughout the construction and post construction period and to minimize siltation of streams, lakes, reservoirs, and other water impoundments, ground surfaces, roadways, or other property.

### b. Seeding & Mulching:

Seeding and mulching shall be carried out immediately behind construction in accordance with the following specifications:

**SEEDING SPECIFICATIONS**

**SHOULDERS, SIDE DITCHES, SLOPES (MAX. 3:1)**

| SEEDING PERIOD | TYPE | APPLICATION RATE | |
|---|---|---|---|
| | | Per Acre | Per 1000 SF |
| Aug 15 - Nov 1 | Tall Fescue | 300# | 7# |
| Nov 1 - Mar 1 | Tall Fescue and | 300# | 7# |
| | Abruzzi Rye | 25# | 0.6# |
| Mar 1 - Apr 15 | Tall Fescue | 300# | 7# |
| Apr 15 - Jun 30 | Hulled Common Bermudagrass | 25# | 0.6# |
| Jul 1 - Aug 15 | Tall Fescue and | 120# | 2.8# |
| | *Browntop Millet | 35# | 0.8# |
| | *or Sorghum-Sudan Hybrids | 30# | 0.7# |

| SEEDING SPECIFICATIONS | | | |
|---|---|---|---|
| **SLOPES (3:1 TO 2:1)** | | | |
| **SEEDING PERIOD** | **TYPE** | **APPLICATION RATE** | |
| | | **Per Acre** | **Per 1000 SF** |
| Mar 1 - Jun 1 | Sericea Lespedeza (scarified) | 50# | 1.2# |
| | and | | |
| (Mar 1- Apr 15) | ADD Tall Fescue | 120# | 2.8# |
| (Mar 1- Jun 30) | OR ADD Weeping Love grass | 10# | 0.2# |
| (Mar 1- Jun 30) | OR ADD Hulled Common Bermudagrass | 25# | 0.6# |
| Jun 1 - Sep 1 | *Tall Fescue and | 120# | 2.8# |
| | *Browntop Millet | 35# | 0.8# |
| | *or Sorghum-Sudan Hybrids | 30# | 0.7# |
| Sep 1 - Mar 1 | Sericea Lespedeza (unhulled, unscarified) | 70# | 1.6# |
| | and Tall Fescue | 120# | 2.8# |
| (Nov 1-Mar 1) | ADD Abruzzi Rye | 25# | 0.6# |

*Temporary - Reseed according to optimum season for desired permanent vegetation. Do not allow temporary cover to grow over 12" in height before mowing, otherwise fescue may be shaded out.

Consult Wake Soil & Water Conservation District or North Carolina Division of Soil & Water Conservation for additional information concerning other alternatives for vegetation of denuded areas. The above vegetation rates are those that do well under local conditions; other seeding rate combinations are possible.

## SEEDBED PREPARATION

(1) Chisel compacted areas and spread topsoil three (3) inches deep over adverse soil conditions, if available.

(2) Rip the entire area to 6-inch depth.

(3) Remove all loose rock, roots, and other obstructions leaving surface reasonably smooth and uniform.

(4) Apply agricultural lime, fertilizer, and superphosphate uniformly and mix with soil (see below*).

(5) Continue tillage until a well-pulverized, firm, reasonably uniform seedbed is prepared 4 to 6 inches deep.

(6) Seed on a freshly prepared seedbed and cover seed lightly with seeding equipment or cultipack after seeding.

(7) Mulch immediately after seeding and anchor mulch.

(8) Inspect all seeded areas and make necessary repairs or reseedings within the planting season, if possible. If stand should be over 60% damaged, re-establish following original lime, fertilizer and seeding rates.

(9) Consult Wake Soil & Water Conservation District on maintenance treatment and fertilization after permanent cover is established.

| | | |
|---|---|---|
| *Apply: | Agricultural Limestone | - 2 tons/acre (3 tons/acres in clay soils) |
| | Fertilizer | - 1,000 lb/acre - 10-10-10 |
| | Superphosphate | - 500 lb/acre - 20% analysis |
| | Mulch | - 2 tons/acre - small grain straw |
| | Anchor | - Asphalt Emulsion @ 300 gals/acre |

**c. Construction Entrances:**

Gravel construction entrance pads shall be constructed at each point of construction access to each property. The gravel pads shall be maintained in such a manner as to prevent the deposition of mud and debris onto existing public roadways adjacent to the site.

Gravel pads shall be constructed in accordance with the latest adopted Town of Knightdale s Erosion and Sedimentation Control Ordinance and published standard detail Standard Construction Entrance.

**Special Note**: It shall be the developer's responsibility to see that the construction entrance pads are properly maintained so that mud is not tracked onto adjacent streets. In the event that the gravel construction entrances are not properly maintained, or are otherwise ineffective, **the Town Representative may issue a Stop Work Order** or any other equitable remedy provided by the Town of Knightdale UDO or NC General Statutes. The Stop Work Order, which shall remain in effect until such time as the pads are restored and replenished and until any resulting mud and debris, has been removed from the adjacent streets by the Contractor.

**d. Clearing Limits:**

All clearing limits shall be clearly identified and staked prior to any construction. The Town shall be given 24-hour notice prior to beginning clearing operations.

**2.05 Earthwork**

**a. General:**

Earthwork shall be defined as the removal of soil (including rock) from its natural location and the depositing of such material into the proper fill areas as indicated on the plan.

**b. Rock Excavation - by Blasting:**

(1) Permit - Where rock must be removed by blasting, a written permit must first be obtained from the Town of Knightdale Fire Department a minimum of 24 hours before any explosive materials or blasting agents are used within the corporate limits of the Town of Knightdale and its extra-territorial jurisdiction (ETJ). A certificate of insurance, as outlined in paragraph 2.03, must be submitted to the Town prior to any blasting operations regardless of the location of the blasting.

(2) Hours of Blasting - Blasting for rock removal shall be limited to daylight hours, no earlier than 8:00 a.m. or later than 5:00 p.m., Monday through Friday, except by special exception specifically authorized by the Fire Marshal. Blasting shall also be prohibited on all Town of Knightdale, State and Federal holidays.

(3) Blasting Procedures - Blasting for trench rock may be initiated only after the permitting requirements prescribed in (1) above of this Section have been complied with. The Contractor is also reminded of the work hour limitations for blasting, as also established in (2) above of this Section.

Blasting Procedures shall conform to all applicable local, state, and Federal laws and ordinances. The Contractor shall take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden. The Contractor shall keep explosive materials which are needed on the job site in specially constructed boxes provided with locks. These boxes shall be painted red and plainly identified as to their contents. After working hours, the boxes containing explosive material shall be removed from the job site.

Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within 500 feet of a utility, structure, or property which could be damaged by vibration, concussion, or falling rock, the Contractor shall be required to keep a blasting log containing the following information for each and every shot:

1. Date of shot
2. Time of shot
3. Foreman's name
4. Number and depth of holes
5. Approximate depth of overburden
6. Amount and type of explosive used in each hole
7. Type of caps used (instant or delay)
8. The weather

This blasting log shall be made available to the Town Representative upon request and shall be kept in an orderly manner. Compliance by the Contractor with these specifications does in no way relieve him of legal liabilities relative to blasting operations.

The Town Representative reserves the right to require removal of rock by means other than blasting where any utility, residence, structure, etc. is either too close to, or so situated with respect to the blasting hazardous.

**c. Removal of Unstable Material:**

Where unstable, organic material ("muck") is encountered in trenches or in roadways, the material shall be completely removed and replaced with suitable, thoroughly compacted material.

**d. Placement of Fill:**

Fill material for roadway embankments shall be free from stones greater than four (4) inches in size, construction material debris, frozen material, organic matter or other unstable material. Fill material placed in roadway embankments shall be placed in uncompacted lifts of eight (8) inches or less and compacted to a density of not less than 95% of maximum dry density as measured by AASHTO Method T-99. The compaction requirement shall be increased to 100% in the uppermost 12 inches of subgrade. These compaction requirements shall apply for that portion of the roadway measured from the back of curb and extending on a slope of 1 to 1 to the no cut/no fill line. Outside these limits soil may be compacted to a density of not less than 90% of maximum dry density as measured by AASHTO T-99.

In cut sections, the uppermost 12 inches of subgrade shall be scarified and recompacted to not less than 100 percent of maximum dry density as measured by AASHTO Method T-99.

Attention is called to Section 3 for the inspection and testing requirements.

**e. Compaction Tests:**

During roadway construction, the Town Representative shall require the developer or Contractor to provide compaction tests to demonstrate compliance with the compaction requirements outlined herein. Such tests may be required at any time that the Town Representative believes the compaction to be less than the required density.

All compaction testing shall be performed by a certified testing laboratory. The cost of such testing shall be borne by the developer.

## 2.06 Safety

The Contractor shall provide for and maintain safety measures necessary for the protection of all persons on the work, to include; and shall fully complying with all laws, regulations and building code requirements to prevent accident or injury to persons on or about the location of the work, including all applicable provisions of OSHA regulations. The Contractor shall protect all trees and shrubs designated to remain in the vicinity of the operations and barricade all walks, roads, and areas to keep the public away from the construction. All trenches, excavations, or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.

The Contractor shall be responsible for the entire site and the necessary protection as required by the Town and by laws or ordinances governing such conditions. He shall be responsible for any damage to Town property, or that of others, by the Contractor, his employees, subcontractors or their employees and shall correct and/or repair such damages to the satisfaction of the Town of Knightdale and/or other affected parties. He shall be responsible for and pay for any such claims against the Town.

## 2.07 Maintenance of Traffic

Existing public streets or highways shall be kept open to traffic at all times by the Contractor unless permission to close the streets, or portions thereof, is granted by the Town Representative. When allowed to close any street, the Contractor shall contact the Town of Knightdale Public Works, Fire, and Police Departments a minimum of 24 hours before fully or partially closing any street. Proper and sufficient barricades, lights, signing and other protective devices shall be installed by the Contractor when deemed necessary by the Public Safety Department or the Town Representative. All traffic control measures shall comply with the MUTCD standards and guidelines for Work Zone Traffic Control. Failure to comply will result in the issuance of a Stop Work Order.

## 2.08 Concrete

Concrete shall be only plant-mixed or transit-mixed concrete conforming to ASTM C33 for aggregates and to ASTM C94 for ready-mixed concrete. Any concrete poured that has a slump over four (4) inches as per ASTM C143, or has a batched time of more than 90 minutes, will be considered unacceptable and shall not be incorporated into the work. Concrete shall not be deposited on frozen subgrade. Concrete shall not be poured when the air temperature is falling and below 40° F and the predicted low temperature for the succeeding 24-hour period is less than 32° F. All concrete when placed in the forms shall have a temperature of between 50° and 90° F and shall be maintained at a temperature of not less than 50° F for at least 72 hours for normal concrete and 24 hours for high-early strength concrete or for as much time as is necessary to secure proper rate of curing and designed compressive strength.

Concrete shall be air entrained at five (5) percent, ±one (1) percent. Retarders and accelerators shall be used only upon approval of the Town Representative.

## 2.09 Installation of Utilities Not Furnished by the Town

The Developer shall arrange for the installation of all utilities that are not furnished by the Town or the City of Raleigh. This shall include electric service, telephone service, and, where available, cable television and natural gas. Restoration of Town right-of-way disturbed by installation of these types of utilities shall be the responsibility of the Developer. All utility installations shall be designed and installed in a manner to prevent the open cutting of public paved areas.

## 2.10 Materials

All materials incorporated in work to be accepted by the Town of Knightdale for operation and maintenance shall be new, first quality material installed in accordance with the manufacturer's instructions or these Specifications, whichever, in the opinion of the Town Representative, is more stringent or applicable.

It is the intent of this Specification to provide materials and construction methods of high standard and quality and to provide materials free from defects in workmanship and product. Substitute materials not specified may be used provided documentation (shop drawings) and samples are furnished to the Town not less than fourteen days before their scheduled delivery to the construction site. Documentation and shop drawings may be submitted electronically. The Town will issue written approval, or disapproval, of the alternate materials. The Town shall assume no responsibility for disapproving the substitute material. Current Specifications and/or the latest revisions shall apply in all cases where materials are described by these Specifications.

## SECTION 3 - STREETS

### 3.01 General

Unless otherwise provided herein, all materials and street construction methods shall conform to the applicable requirements as outlined in the ***Standard Specifications for Roads & Structures***, latest edition, as published by NCDOT.

Whenever the following terms are used in NCDOT specifications, the intended meaning of such terms shall be as follows:

"State" or "Commission" shall be replaced by" Town of Knightdale."

"Sampling and testing by Commission" shall be replaced by the words "sampling and testing by the Town or its authorized testing agent."

"Inspection by Commission" shall be replaced by "inspection by Town or its duly authorized representative."

### 3.02 Design

#### a. General:

Street design shall conform to the standards set forth in the applicable sections of the Knightdale ***Unified Development Ordinance***. Streets shall be classified as follows:

| **STREET CLASSIFICATION[1]** | |
|---|---|
| Category One | Alley<br>Local Street |
| Category Two | Main Street<br>Urban Main Street<br>Avenue<br>Urban Avenue |
| Category Three | Boulevard<br>Freeway |

[1]As defined by the ***Unified Development Ordinance***

Intersection sight distances and ensuing sight triangles shall be in accordance with the ***Unified Development Ordinance***. When any part of any sight triangle falls outside the right-of-way of either street, a sight triangle easement shall preserve the sight distances. Such sight triangle easements shall be shown on the final plat for the subdivision. Plant materials placed inside the sight triangle shall be in accordance with the ***Unified Development Ordinance***.

#### b. Soils Evaluation & Pavement Design:

Pavement design for all new streets shall be based upon subgrade soil conditions, a 20-year (minimum) design life and projected traffic loadings (ADT and percent trucks).

The pavement design and subgrade soils evaluation procedure shall include the following as a minimum:

(1) Perform standard penetration test (SPT) borings to a depth of five feet below design subgrade, or, in the case of fill sections, to a depth of five feet below existing ground. The standard penetration test borings shall be obtained along the centerline of all roadways at intervals not greater than 300 feet.

(2) Perform classification tests of representative SPT soil samples.

(3) Obtain bag samples of prevalent soils and perform moisture-density tests.

(4) Select a soil type for pavement design - usually a weaker soil among those expected to be present at subgraded level. Re-mold a sample and perform a California Bearing Ratio (CBR) using soaked values at 0.1 inch as outlined in ASTM D1833.

(5) Prepare pavement design calculations based on the soaked CBR values and typical traffic loading as prescribed for the category of the affected street.

(6) The pavement design and traffic analysis for traffic loading shall be prepared by a Professional Engineer licensed to practice in the State of North Carolina and submitted to the Town in electronic format prior to placing of any curb and gutter or crushed aggregate base course.

Soils testing work shall be performed by a qualified geotechnical engineering firm. The pavement designs shall be performed by a qualified professional engineer using standard methods developed by NCDOT, AASHTO, The Asphalt Institute, or other similar methods approved by the Engineer.

The AASHTO method requires use of a serviceability index as follows:

| **SERVICEABILITY INDEX** | |
|---|---|
| **Street Classification[1]** | **Index** |
| Category One | 2.0 |
| Category Two | 2.0 |
| Category Three | 2.5 |

[1]As defined by the ***Unified Development Ordinance***

In addition, use $S_o = 0.49$ for flexible pavement and 0.39 for rigid pavement and reliability of 98 percent for Category Three and 95 percent for Category One and Category Two.

The final pavement thickness shall be the calculated thickness, but in no case shall the thickness be less than that shown in the standard street section details, or that required by NCDOT for streets to be maintained by the State.

## 3.03 Construction Requirements

### a. General:

All roadway subgrade, storm sewer and utility construction shall be inspected and approved by the Town Representative prior to placement of the base course materials.

All streets shall be cleared and graded for the full width of the right-of-way.

### b. Placement of Aggregate Base Course:

Aggregate base course shall be placed and compacted in strict conformance with the standard requirements of NCDOT. Each layer shall be compacted to a density equal to at least 98 percent of the nuclear target density as determined by AASHTO Method T-180 as modified by NCDOT. Category One and Two streets shall have a thickness of no less than eight (8) inches. Category Three streets shall conform to the standard requirements of NCDOT.

### c. Placement of Bituminous Surface Course:

For Category One streets, specifically private alleys, the Superpave bituminous surface course pavements shall be in accordance with Type S 9.5A with a total thickness of not less than 2½ inches as shown on the standard details. The bituminous surface course material shall be placed in two lifts, each in strict conformance with the requirements of NCDOT. The second lift shall be 1¼ inch nominal thickness. For other Category One streets, including public utility alleys and local streets, requiring a combination of Type I 19.0B and Type S 9.5B, the Town will require the asphalt intermediate course (I19.0B) to be installed in a single lift of 2½ inches and the asphalt surface course (S9.5B) in a single lift of 1½ inches. The asphalt surface course shall be delayed during the period of initial residential construction activity to allow the initial course of asphalt and underlying structure to withstand a full season's freeze thaw cycle (eg. an initial course laid in the Spring/Summer/Fall of a given year will not be allowed to have the final lift placed until the Spring of the subsequent year). The final lift of asphalt shall be placed at the conclusion of the seasonal freeze thaw cycle, typically March of the following year, and only after 75 percent of the Certificates of Occupancy have been issued for the subdivision or phase of subdivision under construction, or as approved by the Town Engineer.

For Category Two streets requiring a combination of Type I 19.0B and Type S 9.5B, the Town will require the asphalt intermediate course (I19.0B) to be installed in a single lift of 2½ inches and the asphalt surface course (S9.5B) in a single lift of 1½ inches. The asphalt surface course shall be delayed during the period of initial residential construction activity to allow the intermediate course of asphalt and underlying structure to withstand a full season's freeze thaw cycle. (eg. an intermediate course laid in the Spring/Summer/Fall of a given year will not be allowed to have the final lift placed until the Spring of the subsequent year). The final lift of asphalt shall be placed at the conclusion of the seasonal freeze thaw cycle, typically March of the following year, and only after 75 percent of the Certificates of Occupancy have been issued for the subdivision or phase of subdivision under construction, or as approved by the Town Engineer. All asphalt shall be installed in strict conformance with the requirements of NCDOT.

For Category Three streets requiring a combination of Type I 19.0B and Type S 9.5B, the Town may require the asphalt intermediate course to be initially sealed with a 1½ inch layer of the asphalt surface course followed by placement of the final asphalt surface course layer at a later date. Asphalt pavement thickness shall conform to the requirements of NCDOT. Geotechnical reports and traffic volumes may be required.

For streets intended for industrial or heavy vehicle use, the Town will require an aggregate base course thickness of no less than twelve (12) inches, the asphalt intermediate course (I19.0B) to be installed in a single lift of 4 inches and the asphalt surface course (S9.5B) in a single lift of 3 inches.

The contractor shall provide temporary drains through the concrete gutter at all low points to allow the first layer of asphalt to drain and eliminate ponding at the low points. Prior to placing the final layer of surface course, the initial course shall be thoroughly cleaned and repaired. Bituminous tack shall be applied prior to surfacing to assure bond between layers, along gutters and around castings.

### 3.04 Inspection

#### a. Proof-Rolling:

The Town Representative and contractor's third-party engineer shall be present for all proof-rolling. A minimum of 24 hours' notice shall be given for inspections.

Street embankments and cut areas shall be graded and compacted as described in Section 2 of these Specifications. After all utilities and storm sewers have been installed, the subgrade shall be fine graded and restored to required grade, and then proof-rolled, utilizing a fully loaded tandem axle truck having a gross weight not less than 40,000 pounds and with the tires inflated to not less than 70 psi.

Should any "pumping" or displacement be observed during the proof-rolling, the defective area(s) shall be excavated to a depth no less than 18 inches below subgrade and backfilled with suitable material, thoroughly compacted in not less than eight (8) inch lifts of uncompacted fill. If deemed appropriate by a geotechnical engineer, geotextile fabric may be utilized below the base course material in lieu of additional excavation. The geotextile shall be installed in strict accordance to the manufacturer's recommendations with respect to overlap, depth of cover, etc. Prior to installing geotextile fabric, a copy of the manufacturer's literature shall be submitted to the Town along with the geotechnical engineer's recommendations. The locations of geotextile fabric shall be indicated on the Record Drawings.

Proof-rolling shall be repeated until there is no evidence of "pumping" or displacement.

#### b. Compaction Testing - Subgrade:

Upon completion of the proof-rolling, the Developer/Contractor shall furnish to the Town Representative a report from a certified soils testing laboratory. The report shall present the results of a Proctor analysis demonstrating that the subgrade compaction is acceptable in

accordance with standard requirements of NCDOT. The subgrade shall then be inspected by the Town Representative, and upon its acceptance and approval, the stone base course may be placed. However, no stone base may be placed prior to backfilling behind the curb.

One field density (compaction) test shall be required for each 3,000 SY of street surface and for each lift of fill material placed into the roadway embankment.

The cost of laboratory testing of subgrade compaction shall be borne by the Developer/ Contractor.

**c. Intermediate Course & Surface Course Inspection Requirements:**

Prior to placement of bituminous surface course material, a Proctor analysis shall be furnished on the Aggregate Base Course placed in the roadway. The report shall be prepared by a certified testing laboratory and shall evidence compliance with the compaction requirements. Quarry tickets shall also be presented to the Town Representative to enable a check for yield at the specified final thickness. The base material shall then be inspected by the Town Representative, and upon acceptance and approval, the bituminous surface course may be placed. Bituminous intermediate course material shall be placed and compacted in accordance with NCDOT requirements. Copies of delivery tickets shall be furnished to the Town Representative to enable a check for yield at the specified final thickness.

The frequency and number of intermediate course field density tests shall be in accordance with requirements of NCDOT or as may otherwise be directed by the Town Representative or the Engineer.

Bituminous surface course material shall be placed and compacted in accordance with NCDOT requirements. Copies of delivery tickets shall be furnished to the Town Representative to enable a check for yield at the specified final thickness.

Should there be a question as to the final thickness of Aggregate Base Course, bituminous intermediate course or bituminous surface course, the Town Representative reserves the right to require the Developer/ Contractor to provide random corings by an independent testing laboratory to demonstrate actual thickness of base, intermediate and surface courses. Core samples shall be taken by a certified testing laboratory, and the results shall be presented to the Town Representative. Should the corings reveal insufficient thickness, the Contractor shall provide additional surface course as may be required or shall furnish other remedial measures as may be acceptable to the Town Representative.

The cost of compaction testing and coring work shall be borne by the Developer.

**3.05 Pavement Marking & Signage**

The Developer shall be responsible for furnishing and installing all street identification (name) and regulatory signs. The Developer shall also be responsible for striping on all public streets constructed with development as follows:

- Stop Bars and Crosswalks - all streets - per detail 4.06;
    - If crosswalks are located on top of concrete surfaces, the contractor shall submit to the Town Representative the proposed marking paint. Chlorinated Rubber is recommended and preferred by the Town. Marking paint shall include the installation of glass beads per the manufacturer's specification and the rate and density required by MUTCD.

- Continuous Centerline Striping - double yellow line on Category Two and Category Three streets.

- Parking Stalls – where applicable (on-street).

Pavement markings and signage shall be shown on roadway and subdivision plans and shall be installed prior to the issuance of Certificates of Occupancy for the development or final acceptance of the public infrastructure.

**a. Pavement Markings:**

All pavement markings including traffic control, stop bars fire lanes and crosswalks shall be made with reflectorized thermoplastic striping with a minimum thickness in accordance with NCDOT Standard Specifications for Roads & Structures. All markings shall be 120 mil thick with the exception of symbols which shall be 90 mil thick. Parking stall striping in a private parking lot is exempt from use of thermoplastics. The thermoplastic striping type of marking material shall be applied by fusing to the pavement surface by application of heat. Materials shall comply fully with the requirements set forth in Section 1087 of the ***Standard Specifications for Roads & Structures***, latest edition, as published by NCDOT. Application of markings shall conform to the applicable requirements set forth in Section 1205 of the ***Standard Specifications for Roads & Structures***, latest edition, as published by NCDOT for permanent marking.

**b. Street Identification Signs:**

Street identification signs shall identify all streets at each intersection. Such signs shall be constructed of aluminum sheets, six (6) inch high, 0.063 inch thick and length as needed to have a two (2) inch margin before and after the lettering. The background shall be reflectorized green meeting the requirements set forth in Section 1092 the ***Standard Specifications for Roads & Structures***, latest edition, as published by NCDOT. Street name lettering shall be white, upper case, block letters four (4) inches in height. Street classification (i.e. street, avenue, etc.) shall be white, upper case block lettering, two (2) inches in height. Street signs shall be mounted at a nominal height of eight (8) feet above grade. The sign shall comply with the Town of Knightdale Standard Detail 3.16.

**c. Regulatory Signs:**

Regulatory signs shall meet the requirements of the ***Manual on Uniform Traffic Control Devices*** and any modifications thereto established by NCDOT. Materials shall meet the requirements set forth in Sections 1092 of the ***Standard Specifications for Roads & Structures***, latest edition, as published by NCDOT. The location and types of regulatory signs shall be indicated on the construction drawings.

**d. Sign Posts:**

All signs shall be mounted on a galvanized steel u-channel post with a minimum 14-gauge steel as specified in Section 1094 of the ***Standard Specifications for Roads & Structures***.

### 3.06 Cutting, Replacement, and Patching of Existing Pavement

Open cut of existing bituminous pavement or concrete pavement is generally not permitted on Town streets, designated State maintained roads, and on private driveways. Site-specific cases may be considered by the Town.

Where bituminous or concrete pavements are approved for open cut on Town streets, the pavement shall be restored with pavement replacement conforming to the applicable details 3.14 *Standard Asphalt Pavement Patch* and 3.15 *Standard Concrete Pavement Patch*.

Pavement cuts and patches within NCDOT right-of-way shall conform to the approved encroachment permit or ***Standard Specifications for Roads & Structures***, latest edition.

### 3.07 Private Irrigation Systems

Private irrigation systems proposed to be located within existing or proposed Town right-of-way shall be reviewed, and a permit to encroach upon Town right-of-way shall be issued by the Town prior to installation. The following requirements or features must be indicated on the construction drawings:

(1) All irrigation systems shall be equipped with an approved RPZ-type backflow preventer located in a freeze-proof enclosure and meeting the requirements of the City of Raleigh.

(2) All backflow preventers, control boxes, and other above ground devices shall be located outside of Town right-of-way. Only flush-type sprinkler heads and buried piping and control wiring may be located within the Town right-of-way. No sprinkler heads or other devices shall be installed within 5 feet of curbs or edges of pavement.

(3) Within the Town right-of-way, all control wiring shall be in PVC electrical conduit and installed with no less than 18" of cover, unless greater cover is required by the applicable electrical codes.

(4) All irrigation piping crossing beneath Town streets shall be encased in steel or ductile iron casing pipe, extending no less than 3 feet beyond curbs or edges of pavement with no less than 18” of cover.

(5) Sprinkler heads shall be located and adjusted so that the spray pattern does not enter the right-of-way or create a visual obstruction within sight triangles.

(6) The owner of the irrigation system shall be fully responsible for operation, maintenance and repair of the system. The owner of the irrigation system shall also be responsible for any damage to Town streets, sidewalks, landscaping or utilities resulting from failure of or

repair to the irrigation system. The Town shall not be responsible for damage of any kind to private irrigation systems or components located within Town right-of-way for any reason.

(7) The owner of the irrigation system shall maintain accurate as-built information regarding the system and shall be responsible for providing this information to the Town or any other public entity. Ownership and contact information of the irrigation system shall be provided to the Town's Director of Public Works and permanently posted on the backflow preventer enclosure, visible to the roadway.

In the event that the Town's Director of Public Works deems that the owner of the irrigation system developer failed to properly install, operate or maintain a private irrigation system within Town right-of-way, the Director will immediately revoke permission for the encroachment upon Town right-of-way. Upon revocation of permission to encroach upon Town right-of-way, water service to the irrigation system will be terminated without further notice.

### 3.08 Mailboxes

Mailboxes located within Town right-of-way for the purpose of receiving delivery from the US Postal Service shall conform to the requirements set forth by the US Postal Service. All portions of the mailbox, support, or any appurtenance thereto shall be no less than 12" from the back of curb with a minimum height from pavement to mailbox of 42-inches. The Town shall reserve the right to review mailbox location with respect to site triangles, and require relocation accordingly.

### 3.09 Urban Streetscape Design Features

Certain urban street sections require additional design features. These features shall be provided in accordance with Unified Development Ordinance Sections 7 and 11 and standard details 3.11, 4.14, 4.15, and 4.16. The Town shall reserve the right to review design feature location with respect to site triangles or other conflicts and require relocation accordingly.

## SECTION 4 - CURB & GUTTER, DRIVEWAYS, SIDEWALKS, AND GREENWAYS

### 4.01 Materials

**a. Concrete:**

Concrete for curb and gutter, driveways, or sidewalks shall be Portland cement concrete having a 28-day strength of 3000 psi when tested in accordance with ASTM C39. Detailed specifications for concrete shall conform to the specifications contained in Section 2.08 hereof.

**b. Bituminous Concrete (Asphalt):**

Asphalt for public greenways shall meet the requirements as set forth in Section 610 of NCDOT Specifications for Type S 9.5A.

**c. Joint Fillers:**

Joint fillers shall be a non-extruding joint material conforming to ASTM D1751.

### 4.02 Dimensions

The minimum thickness of a sidewalk shall be 4 inches, except at driveway crossings where the sidewalk shall be 6" thick. Sidewalks shall have a uniform slope perpendicular to the curb of ¼ inch per foot toward the curb. The utility strip between the sidewalk and the back of curb shall be less ½ inch per foot toward the roadway. Where street trees are required a subgrade of soil aggregate mixture will be required by the Town.

Curb and gutter shall be standard 30" combination curb and gutter. Rolled or valley type gutter shall not be used. Standard median curb (18-inch) may be used on entrance islands and medians.

### 4.03 Construction Methods

**a. Subgrade:**

The subgrade shall be excavated to the required depth to allow placement a minimum of 5" of aggregate base course beneath the curb 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 as specified in paragraph 2.05 and tested in accordance with paragraph 3.04.

For sidewalks a 6” subbase mixture of ABC shall be provided.

**b. Forms:**

Forms shall be set and maintained true to the required lines, grades, and cross-sectional dimensions as shown in the approved Construction Drawings. Forms shall be constructed with material of such strength and with such rigidity to prevent deflection between supports. Straight forms shall be within a tolerance of ½ inch in 10 feet from a true line horizontally or vertically. Forms shall be thoroughly cleaned of all dirt, mortar and foreign material before being used. All inside form surfaces shall be thoroughly coated with commercial quality form oil before placing concrete.

Curbing forms or "stringline" guides shall be carefully placed to assure that the curbing will be constructed to accurate grades and without creating any depressions or "bird baths. Curved sections shall be placed such that the radii are smooth and continuous and without abrupt bends.

**c. Expansion, Contraction and Control Joints:**

Contraction and control joints shall be cut to a depth equal to at least 1/3 of the total concrete thickness. Contraction or control joint spacing shall be 10 feet maximum for curbing and driveway aprons. Expansion joints for curbing shall be no more than 50 feet on centers, with the joint material extending the full depth of the concrete with the top of the filler 1/2 inch below the finished surface. Expansion and contraction joints shall be spaced such that no final curb section shall be less than 5 feet long (including repair sections). Expansion joints for sidewalks shall be spaced no greater than 50 feet apart. Sidewalks shall be finished to grade and cross-section with a float, troweled smooth and finished with a broom. Contraction joints shall be no less than 1/8 inch in width, to a depth equal to at least 1/3 of the total slab thickness and cut at intervals equal to the width of sidewalk.

**d. Driveway Aprons:**

Where driveway aprons are to be installed in an existing curb, the entire curb and gutter section shall be removed. Saw cutting and removing the curbing, leaving the existing gutter in place, shall not be allowed. Contraction, control and expansion joints shall be located as previously specified and shown on the details. The flow line of the gutter shall be maintained across driveway aprons.

**4.04 Pedestrian Crossings**

Pedestrian crossings, curb cuts and ramps shall be provided at all intersections in accordance with NC GS 136-44.14. Construction, pavement marking, etc. shall conform to Detail 4.06.

**4.05 Inspection**

No concrete shall be placed until the forms and subgrades have been inspected and authorized by the Town Representative. Offset or reference points shall be maintained in place to assure proper placement of the forms by the Town Representative. Where machine extruded curbing is used, the "stringline" shall be inspected by the Town Representative. A minimum of 24 hours' notice shall be given for inspections.

For all residential lots that require sidewalk along the road frontage, sidewalk shall be formed and ready for inspection at the time of the driveway inspection. Sidewalk may be installed prior to, but under no circumstances later than the time of the driveway installation.

The Town will require the removal and replacement of sidewalks and driveways that have been broken, cracked, excessively chipped, or misaligned. Such areas designated by the Town Representative shall be repaired at no cost to the Town. Repairs shall be made prior to the issuance of Certificates of Occupancy for the development or final acceptance of the public infrastructure.

## 4.06 Greenways

a. **General:**

All construction shall conform to the requirements and dimensions on the approved construction plans, Town Standard Details, the Unified Development Ordinance, the latest edition of AASHTO Guide for the Development of Bicycle Facilities, Section 405 of 2009 ANSI A117.1., and the Shared Use Path Accessibility Guidelines as published by the United States Access Board, or as stated in these Specifications, whichever, in the opinion of the Town Representative, is applicable.

b. **Proof-rolling of Subgrades:**

The Town Representative shall oversee the proof-roll of public greenway trails. Proof rolling shall occur at the following stages: prior to placing fill in low areas; after the preparation of subgrade prior to placing ABC; and after the placement of ABC prior to paving.

c. **Amenities:**

All greenways shall have amenities in accordance with Unified Development Ordinance Section 7 and 11 and standard detail 4.09. Placement shall be approved with Construction Drawings.

d. **Signage:**

Signage shall be provided in accordance with Unified Development Ordinance Sections 7 and 11 and standard detail 4.09. A proof of the proposed signage shall be submitted to the Town Representative for approval prior to ordering materials

e. **Boardwalks & Bridges:**

Greenway boardwalk systems shall be constructed of precast concrete and in accordance with standard detail 4.09. Other designs and materials may be allowed with prior review and approval from the Town of Knightdale.

f. **Permits:**

Greenway structures (i.e. retaining walls, boardwalks, bridges) are required to be certified by a North Carolina Professional Engineer and shall include all necessary plan documents with the final Construction Drawing set for approval. As required by NC Building Code, approved Construction Plans must be submitted with the building permit application for all greenway structures and a building permit must be obtained before construction commences.

## SECTION 5 - STORM DRAINAGE

### 5.01 Design

Storm drainage facilities shall be designed in accordance with the goals and guidelines set forth in the *Unified Development Ordinance*. The goal shall be to collect and dispose of stormwater generated upon or passing through the project location. The determination of the quantities of water that must be accommodated will be based upon peak flows from storms having the following return frequency:

| **Drainage Structure** | **Storm Event - Return Frequency** |
|---|---|
| Curb inlets & Gutters | 10-year storm |
| Storm Sewer Collector | 10-year storm |
| Detention Facility | 100-year Emergency Spillway |
| Cross Street Drainage | 100-year storm |
| Roadways in Flood Plain | 100-year storm***** |
| SCM Devices | UDO & NCDEQ Stormwater Design Manual |

***** Roadways in flood plain areas shall withstand the 100-year storm without over-topping or sustaining damage. The roadway embankments shall be fully protected from flows that may occur during a 100-year event.

Prediction of the peak flow rates resulting from a rainfall event shall be calculated using the procedure in the SCS TR-55, the Rational Method, or other calculation procedures acceptable to the Engineer. The size of storm water conduits shall be determined by utilizing the standard energy equation for inlet control or outlet control and/or headwater nomographs as published by various federal agencies such as Federal Highway Administration - HEC-5, HEC-RAS, Soil Conservation Service, etc. Calculations shall include analyses of pre- and post-development run off rates from the project for the 1-year storm event. All calculations shall be performed under the responsible charge of an appropriately licensed design professional and sealed by that professional. Storm drainage facilities shall be designed in a manner such that upstream and downstream properties are not adversely affected.

The minimum pipe size to be used within any public right-of-way shall be 15-inch diameter. All public storm drainage facilities shall be installed in dedicated street rights-of-way (i.e. pipe inlets and outlets shall be within street rights-of-way or dedicated easement). If a property owner/developer desires to extend storm drainage piping to eliminate open channels on private property, such pipes shall be installed within a stormwater easement and maintained at the adjacent property owner's or owners' expense. A manhole or junction box shall be provided at the public right-of-way boundary. Minimum widths of storm drainage easements shall be the greater of 1) the width as dictated by the appropriate following configurations listed below; or 2) the width necessary to contain the predicted 100-year water elevation plus two feet in depth:

- 20 feet for single pipes up to and including 36 inches nominal diameter or open channels up to 36 inches in top width

- 20 feet plus the maximum conduit (outside diameter at the barrel) or channel width (in feet) for single pipes or channels larger than 36 inches wide

- 10 feet from the edge line of the outside conduits where multiple parallel pipes are installed.

Erosion and sedimentation control measures shall be so designed to provide control from the calculated peak rates from a 10-year frequency storm. Discharge from drainage systems shall not be of such a velocity as to cause damages after leaving the pipe. At pipe outlets, flared end sections or head walls shall be provided with rip-rap aprons designed to reduce velocity and dissipate energy so that downstream damage does not occur.

Catch basins, yard inlets, manholes or structures shall be installed at each deflection of line or grade. No "blind" junction boxes shall be permitted. The minimum cover for reinforced concrete pipe shall be 2 feet from finish subgrade to the top of pipe under roadways and 1 foot under a non-roadway area. For polyethylene storm drainage pipe, the minimum cover shall be two times the nominal pipe diameter.

Stormwater shall not be allowed to flow across streets. Drainage shall be provided to intercept flow in the radius of an intersection, or the design of the street shall indicate a continuous grade around the radius to allow the flow to continue down the intersecting street. Water shall be picked up before the spread into the street exceeds 8 feet from the face of the curb. The inlets shall be spaced using a maximum capacity of 5 CFS per single curb inlet. No curb inlet shall be installed in the curb radius of any intersection.

Detention ponds and other SCM devices shall reference and adhere to standards set forth by NCDEQ in *Stormwater Design Manual*. Additional requirements by the Town include a maximum of 3:1 slopes on all sides of ponds, unless exempted by the Town Engineer.

## 5.02 Pipe Materials

### a. General:

All storm sewer pipes to be installed in projects within the public street rights of way belonging (or to be dedicated) to the Town of Knightdale shall be reinforced concrete pipe (RCP) or high density polypropylene (HDPP) storm drainage pipe conforming to the specifications presented herein.

If an applicant desires to use any materials other than RCP or HDPP, the applicant’s plan submittal must contain a formal request and be accompanied by complete background data to justify its use. Approval of the use of any materials other than RCP or HDPP may only be granted by the Assistant Town Manager upon the recommendation of the Town Representative and Town Engineer.

**b. Reinforced Concrete Pipe (RCP):**

RCP shall be as per ASTM C76, or the latest revision, Class III or Class IV with a minimum 15-inch diameter. All RCP shall be top quality material; no seconds or lesser quality pipe shall be used. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210 such as "Ram-Nek or a butyl rubber sealant."

**c. High Density Polypropylene Pipe (HDPP):**

HDPP storm drainage pipe shall conform to AASHTO M330 Type S or Type D. The pipe shall be smooth interior finish and be furnished in 20’ laying lengths with an integral bell for gasket, bell and spigot joints. The pipe shall be a double wall type, having a corrugated outer surface and a smooth inner surface, with Manning’s roughness not to exceed 0.010. End treatments and fittings shall meet the requirements of AASHTO M330-20.

## 5.03 Materials - Storm Drainage Structures

**a. General:**

All structures including manholes, curb inlets, catch basins, yard inlets, junction boxes, etc., shall be constructed of clay brick masonry units, cast in place reinforced concrete units, or precast concrete (waffle boxes are not acceptable). Endwalls and headwalls shall be constructed of clay brick masonry units, concrete brick masonry units, precast or structural cast-in-place concrete.

**b. Clay Brick Masonry Units:**

Clay brick shall be solid, rough, sound clay brick conforming to ASTM C32, Grade MS.

**c. Concrete Brick Masonry Units:**

Concrete brick masonry units shall be solid units meeting the requirements of ASTM C55, Grade S-II.

**d. Precast Concrete Structures:**

Precast concrete structures shall meet the requirements of ASTM C478. Structures shall have joints sealed with a pre-formed plastic gasket per Federal Specifications SS-S-00210. Manholes shall be sized in accordance with the table below.

| MANHOLE SIZE REQUIREMENTS | | |
|---|---|---|
| DEPTH RANGE | OUTLET PIPE SIZE | |
| 0’ – 12’ | 6’ | 7’ |
| 12’ – 18’ | 6’ | 7’ |
| > 18’ | 7’ | 8’ |

**e. Mortar:**

Mortar shall be proportioned as shown below for either Mix No. 1 or Mix No. 2. All proportions are by volume. Water shall be added only in the amount required to make a workable mixture.

MIX NO. 1: 1 part Portland Cement
¼ part Hydrated Lime
3¾ parts Mortar Sand (maximum)

MIX NO. 2: 1 part Portland Cement
1 part Masonry Cement
6 parts Mortar Sand (maximum)

Portland cement shall be ASTM C150, Type 1. Hydrated lime shall conform to ASTM C207, Type S. Masonry cement shall meet the requirements of ASTM C91. Mortar sand shall be standard size 4S, per requirements of the NC DOT.

**f. Castings:**

(1) General - All castings shall be of one of the manufacturers specified. If the Developer/ Contractor desires to use a casting of another manufacturer, samples of the casting(s) shall be provided to the Town Representative for review and approval. In addition to samples, the names of other users of the castings shall be furnished along with names and telephone numbers of persons whom the Town Representative may contact for an evaluation of the casting.

All castings shall meet the requirements of ASTM A48, Grade 30 iron.

(2) Curb Inlet Grate, Frame & Hood - Curb inlets shall be of the grate, frame and hood type conforming to NCDOT 840.03, Type E, F and G, based on flow direction. Castings shall be Type V-4066 (2-5) as manufactured by Vulcan Foundry Company, Southern Foundry SF-102 + SF-103 (C,E,F, or G) or US Foundry #5181. Grates with slots parallel to the curb are not permitted. Curb inlet hoods shall be embossed with “Dump No Waste! Drains to Waterways.”

(3) Grates & Frames - Cast iron grates and frames for yard inlets shall conform to NCDOT 840.16 and be of the size indicated on the approved plans. Grates and frames shall be Vulcan V-4870, Southern Foundry SF-131, US Foundry 4130+6230; or their equivalent with comparable features for other larger size openings as may be required.

Grates and frames shall only be used outside of street rights-of-way.

(4) Manhole Rings & Cover - Cast iron manhole rings and covers shall conform to NCDOT 840.54, with the words "STORM SEWER" cast on the cover. Covers shall have a minimum of two 1-inch holes. Manhole castings shall be machined to provide a continuous bearing around the full periphery of the frame. Covers shall be Vulcan V-1384, Southern Foundry SF-101 or US Foundry 669-KL or approved equivalent.

### g. Portland Cement Concrete:

Portland cement concrete used for storm drainage structures, end walls, etc. shall conform to the technical requirements presented in paragraph 2.08 of these Specifications and shall have a minimum compressive strength of 3,000 psi at 28 days. Primary structures, such as box culverts, may require concrete having a compressive strength greater than 3,000 psi and may require the submission of mix designs and testing of the concrete by an independent laboratory. These special requirements may be imposed by the Town Representative for all such structures where recommended by the Engineer.

### h. Reinforcing Steel:

Reinforcing steel shall be new billet steel conforming to ASTM A615, Grade 60, deformed.

## 5.04 Miscellaneous Materials

### a. Riprap:

Riprap shall be large aggregate of the size and class shown on the approved drawings.

### b. Steps:

Steps shall be constructed using ½ inch diameter reinforcing steel encapsulated in polypropylene material. Steps shall be designed and installed to accommodate a vertical load of not less than 400 pounds and a horizontal pullout load of at least 1,000 pounds. Steps shall have a clear width of 12 inches. If the developer or contractor desires to use a pre-cast or preformed structure, specifications shall be provided to the Town Representative for review and approval.

## 5.05 Construction Methods

### a. Trenching & Bedding for Storm Sewers:

The trench shall be excavated to the line and grade indicated on the Drawings. The trench bottom shall provide a firm and uniform support for the pipe. Where bell and spigot type pipe is used, recesses shall be excavated to receive the pipe bell.

Where the foundation is found to be of poor supporting value, the pipe foundation shall be conditioned by undercutting the unacceptable material to the required depth as directed by the Town Representative and backfilling with stone or other approved material. Where necessary, surface water shall be temporarily diverted in order to maintain the pipe foundation in a dry condition. The flow of water from such temporary diversions shall be directed into suitable erosion control devices.

### b. Pipe Laying:

Concrete pipe culverts shall be laid carefully with bells or grooves upgrade and ends fully and closely joined. Joints of concrete pipe shall be made with O-ring gasket or with plastic gasket material as specified. Joints shall be made in accordance with manufacturer’s recommendations.

Pipe which is not true to alignment, or which shows any settlement after laying, shall be taken up and relaid.

**c. Backfilling:**

The storm sewer trench shall be backfilled with approved material free from large stones or clods in 6-inch layers, loose measurement, and compacted to 95% of maximum dry density (AASHTO T-99), where the trench is within an area to be paved, or where the trench is immediately behind the curb. In streets the compaction requirement shall be increased to 100% of maximum dry density within 12" of subgrade. The backfilling shall be done on both sides of the pipe simultaneously to prevent displacement of the pipe. The backfill materials shall be moistened when necessary in the opinion of the Engineer to obtain maximum compaction. Water settling or puddling shall not be permitted. Backfill in trenches not within the limits to be paved may be compacted in 12-inch layers after backfill is one foot above the top of the pipe.

All trash, forms, debris, etc., shall be cleared from around all pipes and structures before backfilling. Backfilling around structures shall be done symmetrically and thoroughly compacted in 6-inch layers with mechanical tampers to the specified 95% density.

**d. Masonry Structures:**

Excavations shall be made to the required depth, and the foundation on which the brick masonry is to be laid shall be approved by the Town Representative. The brick shall be laid so that they will be thoroughly bonded into the mortar by means of the "shove-joint" method. Buttered or plastered joints will not be permitted. The headers and stretchers shall be so arranged as to thoroughly bond the mass. Brickwork shall be of alternate headers and stretchers with consecutive courses breaking joint. All mortar joints shall be at least 3/8 inches in thickness. The joints shall be completely filled with mortar. No spalls or bats shall be used except for shaping around irregular openings or when unavoidable to finish out a course. Competent masons shall be employed on the work, and all details of construction shall be in accordance with approved practice and to the satisfaction of the Town Representative.

Steps as shown on the plans shall be placed in all catch basins and inlets when they are greater than five feet in depth. The steps shall be set in the masonry as the work is built up, thoroughly bonded, and accurately spaced and aligned. Steps shall be set at 16 inches on center and project at least 5 inches from the face of the wall.

Inverts in the structures shall be shaped to form a smooth and regular surface free from sharp or jagged edges. They shall be sloped adequately to prevent sedimentation.

The castings shall be set in full mortar beds. All castings when set shall conform to the finish grade shown on the Drawings.

**e. Concrete Construction:**

The forming, placing, finishing and curing of Portland cement concrete shall be performed in strict accordance with all applicable requirements as contained in the ***Standard Specifications for Road & Structures***, latest edition, as published by the NC DOT.

### f. Installation of Precast Concrete Structures:

Precast concrete catch basins, manholes, junction boxes, etc. shall be installed level and plumb and upon a firm, dry foundation, approved by the Town Representative. Structures shall be backfilled with suitable materials, symmetrically placed and thoroughly compacted so as to prevent displacement and deter settlement. Castings shall be set in full mortar beds to the required finished grade.

## 5.06 Inspection Prior to Acceptance

Prior to acceptance of any development with public storm drainage infrastructure, the utility contractor shall arrange a camera inspection of all public storm drainage lines with a 3rd party camera service and then coordinate the results with the Town Representative. Any discrepancies found in violation of these Specifications shall be repaired to the satisfaction of the Town Representative prior to acceptance and prior to issuance of any Certificates of Occupancy. When inspection indicates possible excessive deflection in PP, CSP, or CAP, the contractor shall complete a deflection test by mandrel using a rigid device approved by the Town Representative. The mandrel size shall be clearly labeled and shall be sized so as to provide a diameter of at least 95% of the inside pipe diameter. If deflection exceeds 5%, the pipe shall be Section 500 - Storm Drainage - Page 13 of 14 Effective Date: June 11, 2024 evaluated to determine what corrective measures are required.

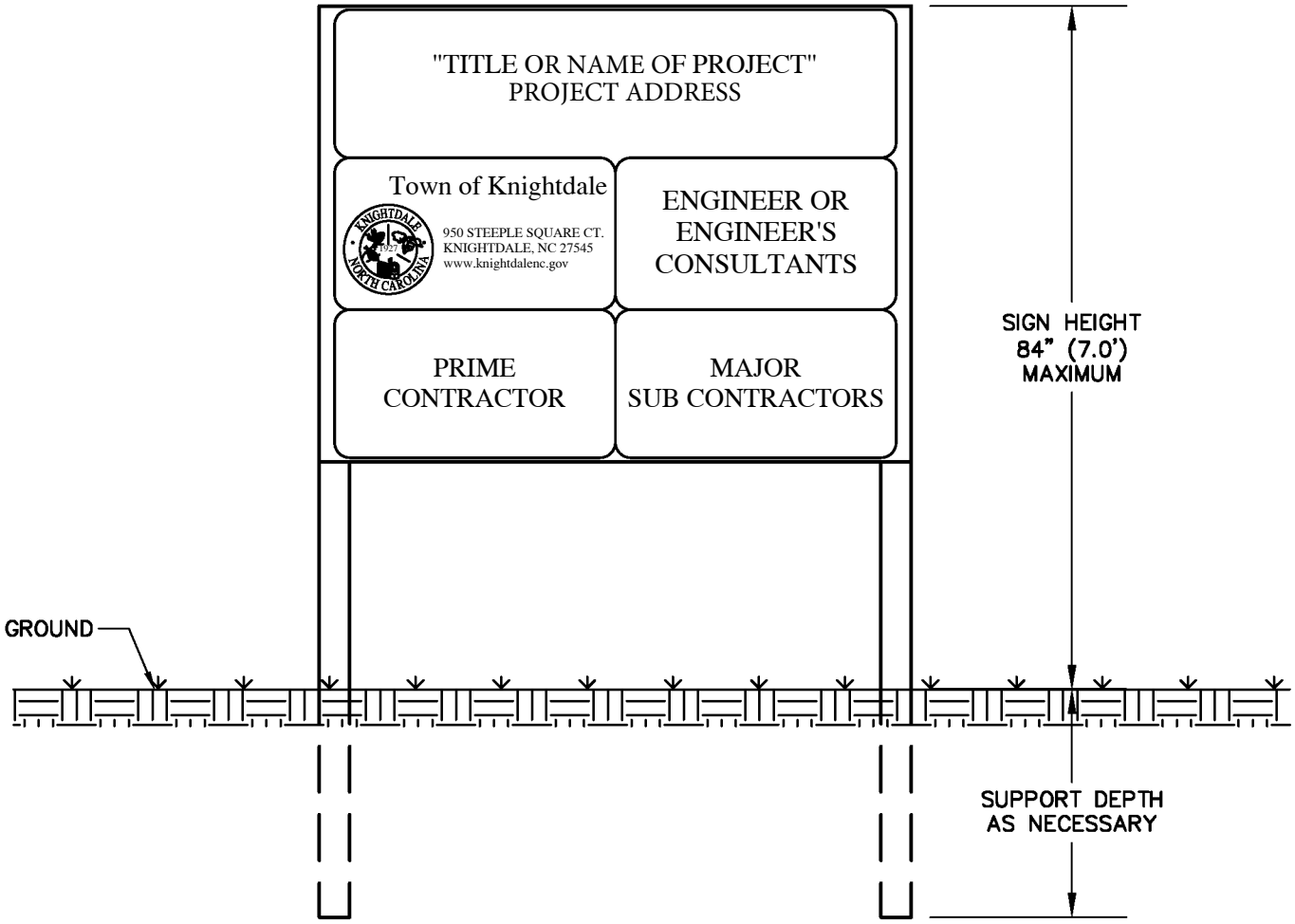
# SECTION 6 – WATER & SANITARY SEWER

## 6.01 Preliminary Considerations

In 2006, the Town of Knightdale and the City of Raleigh merged their water and sewer systems. As a result of the merger, the City of Raleigh owns and operates the water and wastewater system that provides services to residents within the urban service area designated for the Town of Knightdale. However, the Town has authority concerning when and where new water and sewer services can be extended to support growth and development within its planning and zoning jurisdiction, subject to conditions in the inter-local agreement.

In accordance with the regional utility plan, the City of Raleigh assumed sole responsibility for operating, maintaining, improving and expanding the water and wastewater collection system that serves the Town of Knightdale.

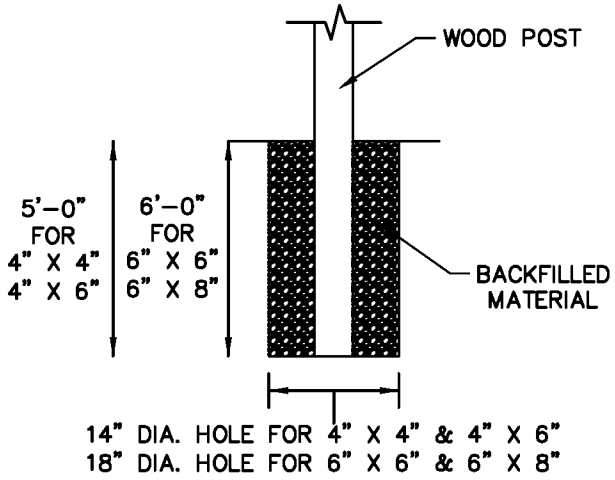
Thus, all water and sewer infrastructure, including public fire hydrants, within the jurisdiction of the Town of Knightdale shall conform to the City of Raleigh standard details and City of Raleigh Public Utilities Department Handbook, as well as the minimum design criteria set forth by the Division of Water Resources of the NC Department of Environmental Quality and the North Carolina Fire Code.




* TOTAL SIGN AREA = 32 SF/SIDE (MAXIMUM)

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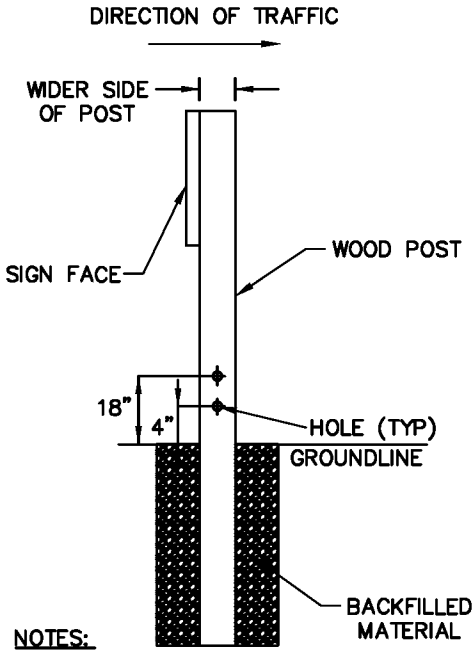
| | | |
|---|---|---|
| TOWN OF KNIGHTDALE STANDARD DETAILS | PROJECT IDENTIFICATION SIGN | STD. NO. 2.01 |




NOTE:

TREATED WOODEN POST SHALL BE PLACED IN PRE–DUG HOLE IN GROUND. BACKFILLED USING SUITABLE MATERIAL. AND TAMPED THOROUGHLY TO PROVIDE A RIGID SUB–SURFACE CONDITION AROUND THE POST.

TYPICAL FOUNDATION FOR WOOD SUPPORTS




| POST SIZE | HOLE DIA. (IN.) |
|---|---|
| 4" X 4" | -- |
| 4" X 6" | 1 ½ |
| 6" X 6" | 2 |
| 6" X 8" | 3 |

WOOD POST MODIFICATIONS FOR BREAKAWAY FEATURES

NOTES:

1. ALL WOOD POSTS LARGER THAN 4" X 4" SHALL BE MADE BREAKAWAY BY DRILLING TWO HOLES CENTERED AT 4" AND 18" ABOVE THE GROUND LINE AND PERPENDICULAR TO THE ROADWAY.
2. ALL SUPPORTS WITHIN THE CLEAR ZONE SHALL BE BREAKAWAY UNLESS PROTECTED.

WOOD POST MODIFICATIONS FOR BREAKAWAY FEATURE

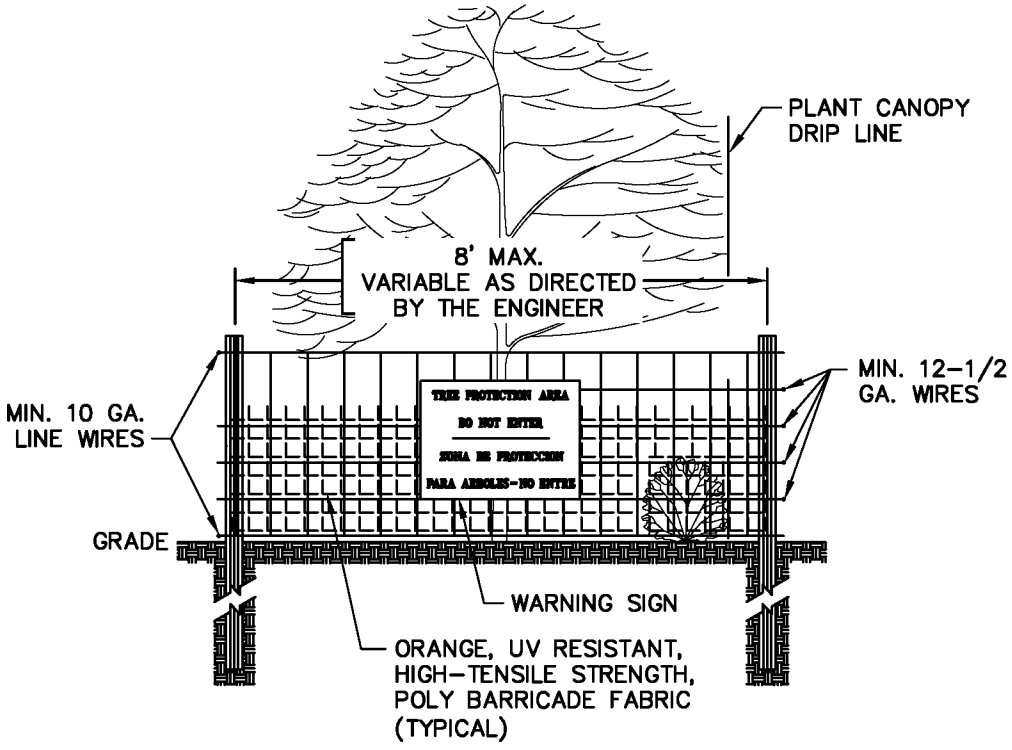



NOTES:

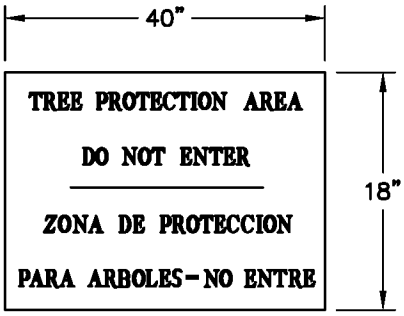
1. SIGNS SHOULD BE INSTALLED ON 4" X 4" MIN. TREATED WOODEN POST IN CONSPICUOUS LOCATION.
2. SIGNS SHOULD HAVE AN ALUMINUM BACKING MATERIAL.
3. SIGNS SHOULD CONTAIN THE ABOVE SYMBOLS AS APPLICABLE.
4. SIGNS SHOULD ALWAYS INCLUDE THE FOLLOWING ADDITIONAL INFORMATION:
   - NAME OF OWNER/PARTY RESPONSIBLE FOR MAINTENANCE
   - OWNER/RESPONSIBLE PARTY CONTACT TELEPHONE
   - KNIGHTDALE STORMWATER HOTLINE TELEPHONE: 919–217–2255
5. OWNER/RESPONSIBLE PARTY MAY SUBMIT CUSTOM SIGNAGE FOR APPROVAL.
6. SIGNS MUST BE PROPERLY MAINTAINED TO ENSURE ALL GRAPHICS STAY LEGIBLE.

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | SCM IDENTIFICATION SIGN | STD. NO. 2.02 |

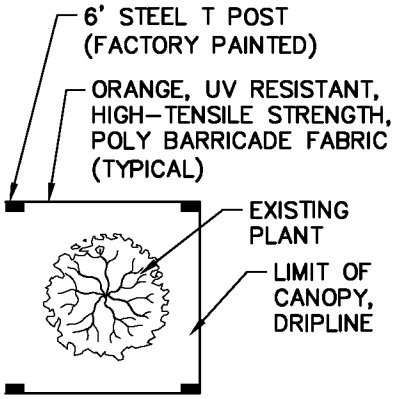



PERFORATED PLASTIC FENCE DETAIL




WARNING SIGN DETAIL

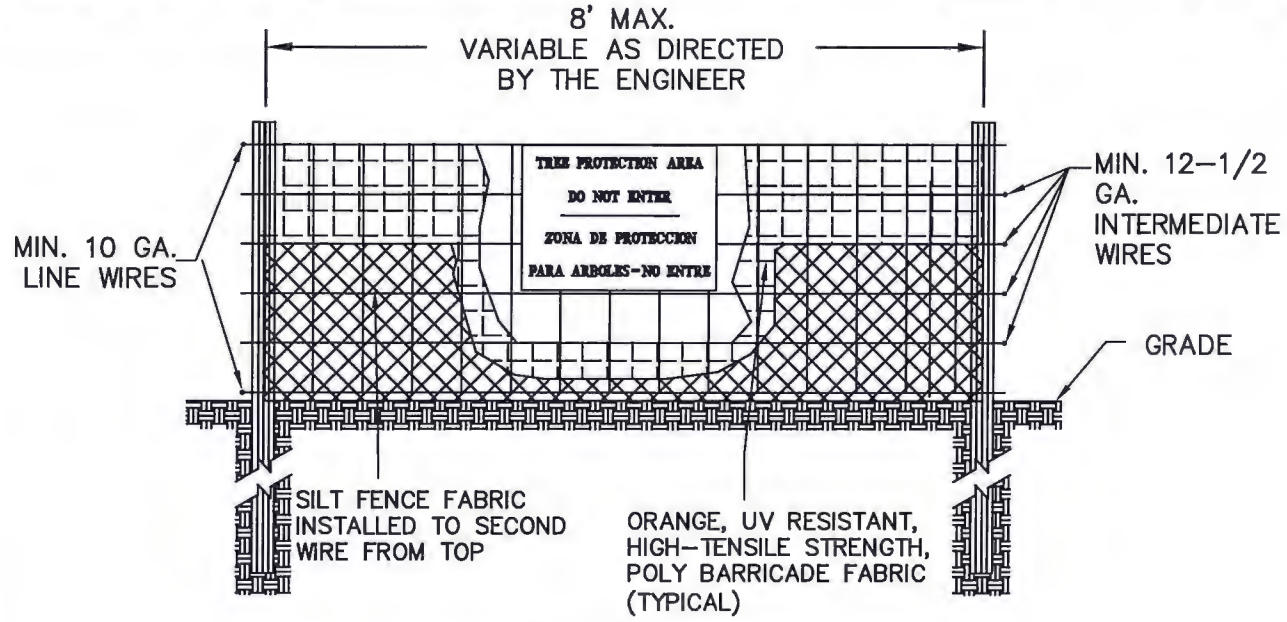
NOTES:
1. REMOVE ALL BARRIERS UPON COMPLETION OF PROJECT.
2. LANDSCAPING PLANS SHALL SHOW LOCATIONS OF ALL TREE PROTECTION FENCES.
3. ALL PLANTS TO BE SAVED SHALL BE PROTECTED BY FENCING AS SHOWN IN THIS DETAIL.
4. CONTRACTOR SHALL INSTALL FENCING PRIOR TO BEGINNING ANY CONSTRUCTION OR GRADING ACTIVITY.
5. CONTRACTOR SHALL CALL FOR INSPECTION AND APPROVAL OF PROTECTIVE FENCING PRIOR TO BEGINNING ANY CONSTRUCTION OR GRADING.
6. PROTECTIVE FENCING SHALL BE LOCATED 5' OUTSIDE DRIPLINE OF TREES AND 1' MINIMUM OUTSIDE SHRUBS OR OTHER PLANTS.



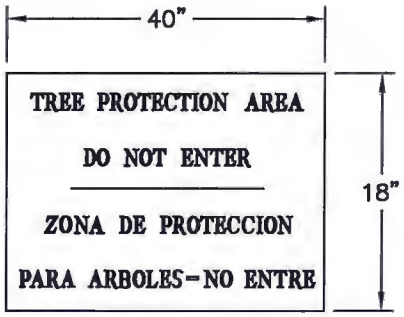

PLAN VIEW OF PROTECTIVE FENCING
AROUND SINGLE TREE- EXPAND AS NECESSARY

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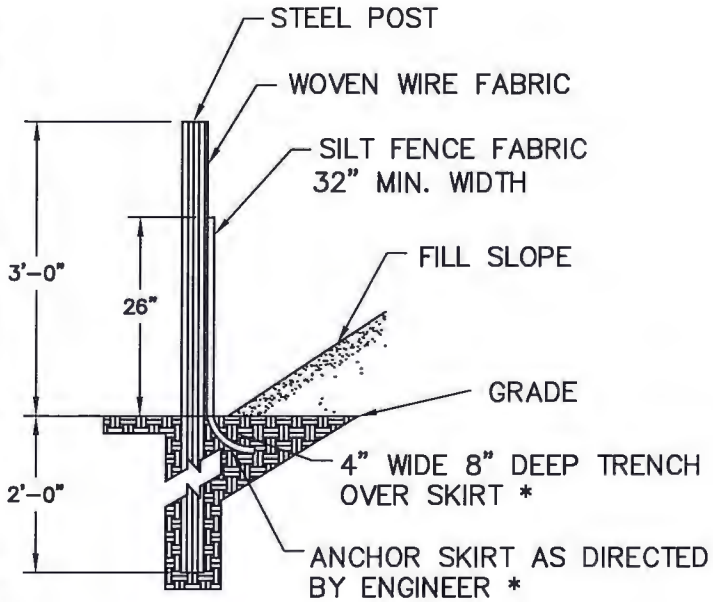
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| TOWN OF KNIGHTDALE STANDARD DETAILS | PLANT PROTECTIVE FENCING | STD. NO. 2.10-1 |




FRONT VIEW




WARNING SIGN DETAIL




SIDE VIEW

* FOR REPAIR OF SILT FENCE FAILURES, USE NO. 57 WASHED STONE

NOTES:

1. ORANGE SILT FENCE REQUIRED.
2. USE SILT FENCE ONLY WHEN DRAINAGE AREA DOES NOT EXCEED 1/4 ACRE AND NEVER IN AREAS OF CONCENTRATED FLOW.
3. ORANGE, UV RESISTANT, HIGH-TENSIL STRENGTH, POLY BARRICADE FABRIC MUST BE USED.
4. END OF SILT FENCE MUST BE TURNED UPHILL.
5. WARNING SIGNS ARE TO BE MADE OF DURABLE, WEATHERPROOF MATERIAL.
6. LETTERS TO BE 3" HIGH MINIMUM, CLEARLY LEGIBLE AND SPACED AS DETAILED IN "WARNING SIGN DETAIL" (THIS SHEET).
7. SIGNS SHALL BE PLACED AT 50' MAXIMUM INTERVALS.
8. SIGNS SHALL BE PLACED AT EACH END OF LINEAR TREE PROTECTION AND 50' ON CENTER THEREAFTER.
9. FOR TREE PROTECTION WITH AREAS LESS THAN A 200' PERIMETER, PROVIDE NO LESS THAN ONE SIGN PER PROTECTION AREA.
10. ATTACH SIGNS SECURELY TO FENCE POSTS AND FABRIC.
11. MAINTAIN TREE PROTECTION FENCE THROUGHOUT DURATION OF PROJECT.
12. ADDITIONAL SIGNS MAY BE REQUIRED BY TOWN OF KNIGHTDALE ENGINEERING DEPARTMENT BASED ON ACTUAL FIELD CONDITIONS.

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD TEMPORARY SILT/TREE PROTECTION FENCE | STD. NO. 2.10-2 |

TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | | DATE |
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STREET FEATURES:

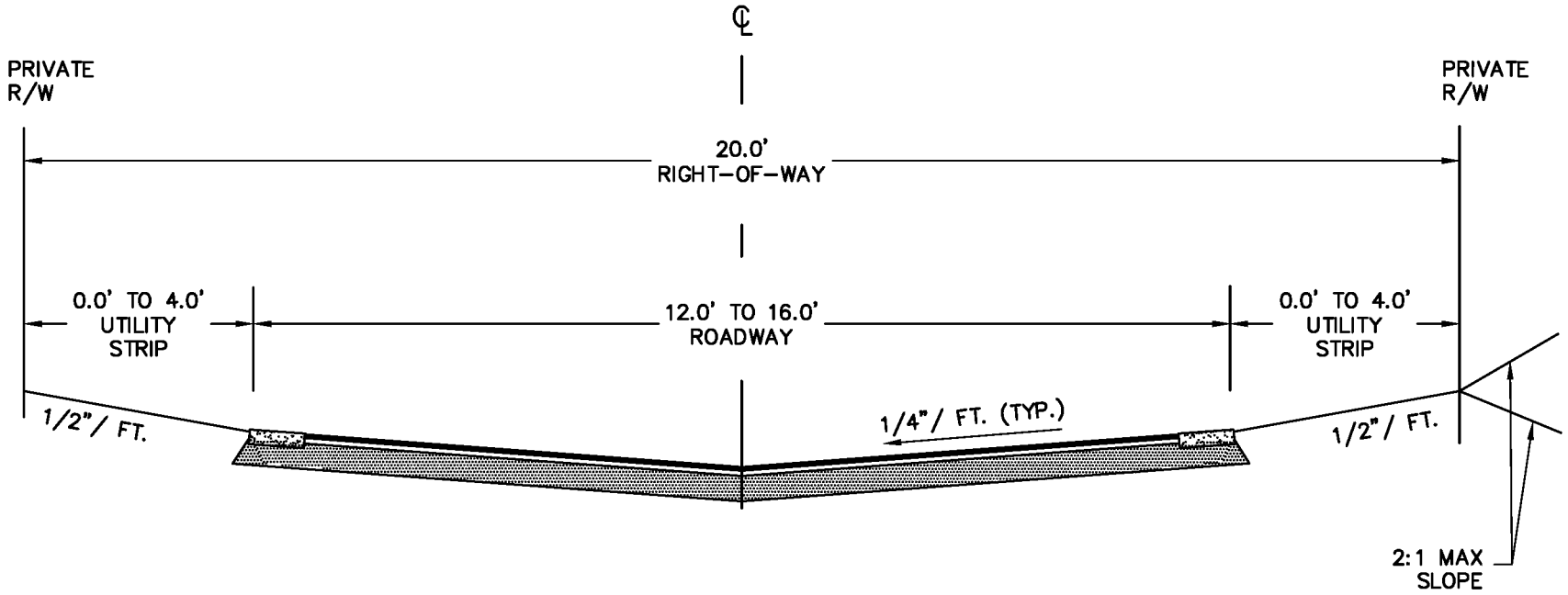
STREET WIDTH OF 12 FT. MINIMUM, 16 FT. DESIRABLE
REQUIRES 20 FT. OF RIGHT-OF-WAY
UTILITY LOCATION UNDERGROUND
TWO TO SIX BLOCKS LONG
AVERAGE SPEED OF 10 MPH

BUILDINGS & LAND USE:

RESIDENTIAL – PRIMARILY SINGLE FAMILY
COMMERCIAL

MINIMUM PAVEMENT DESIGN:

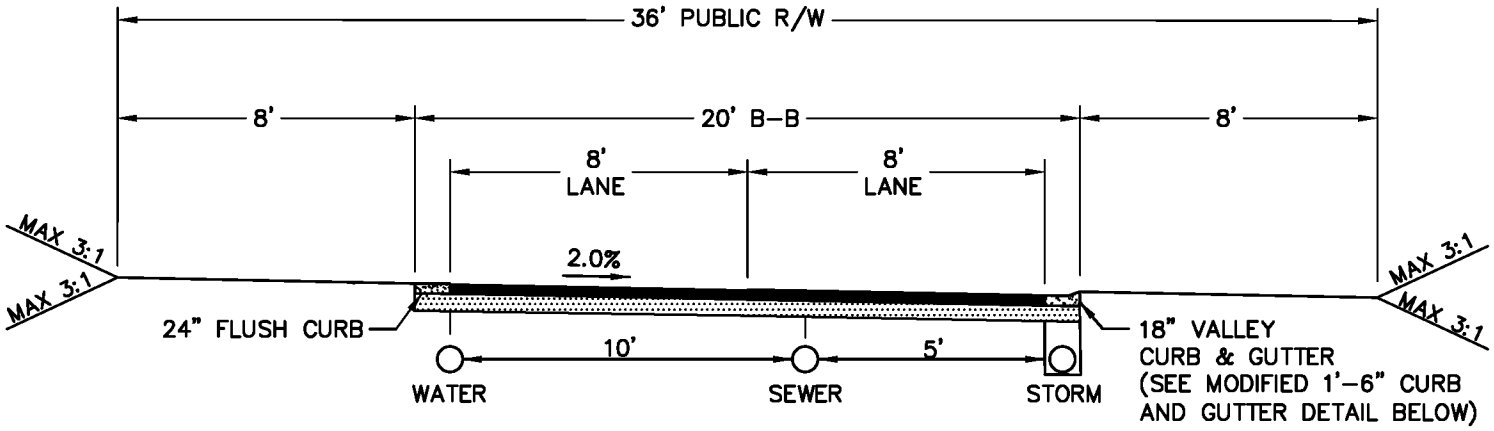
BITUMINOUS SURFACE COURSE: 2-½" S 9.5A
BASE COURSE: 8" ABC




NO SCALE

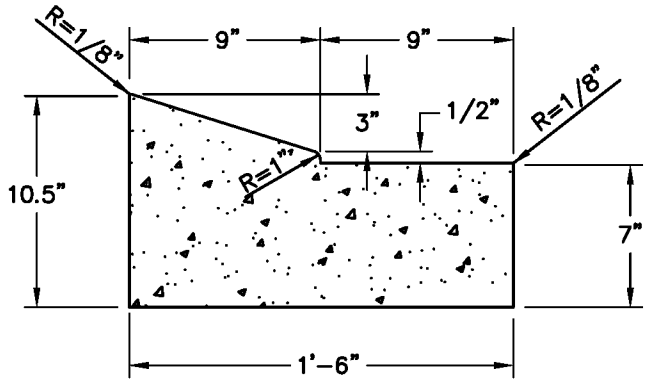
# ALLEY SECTION

STD. NO. 3.01-1




TYPICAL UTILITY ALLEY
(36' R/W, 20' B-B)

MODIFIED 1'-6" CURB AND GUTTER




MINIMUM PAVEMENT DESIGN:

BITUMINOUS SURFACE COURSE: 1 1/2" S9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

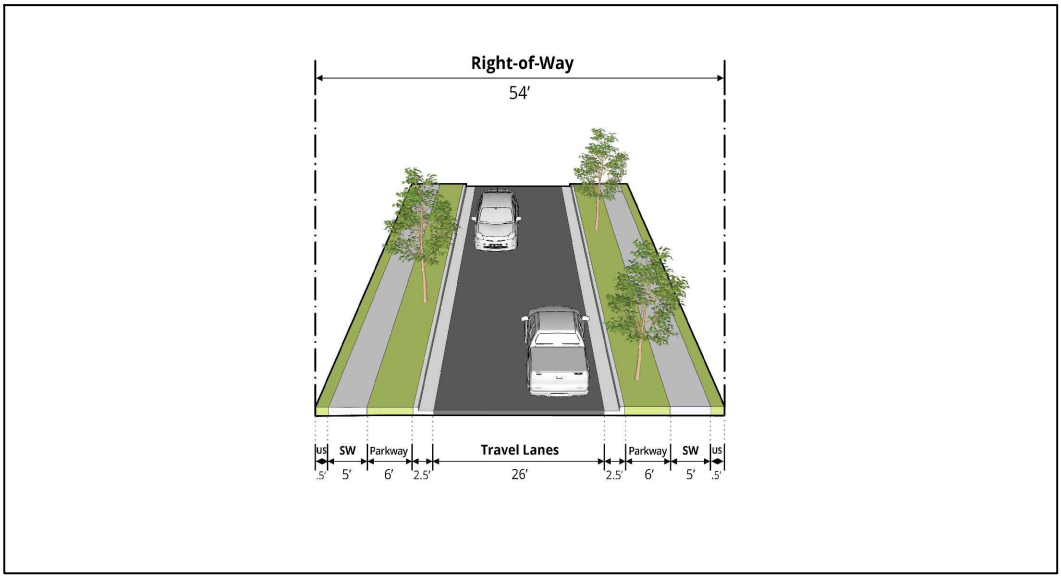
STREET FEATURES:

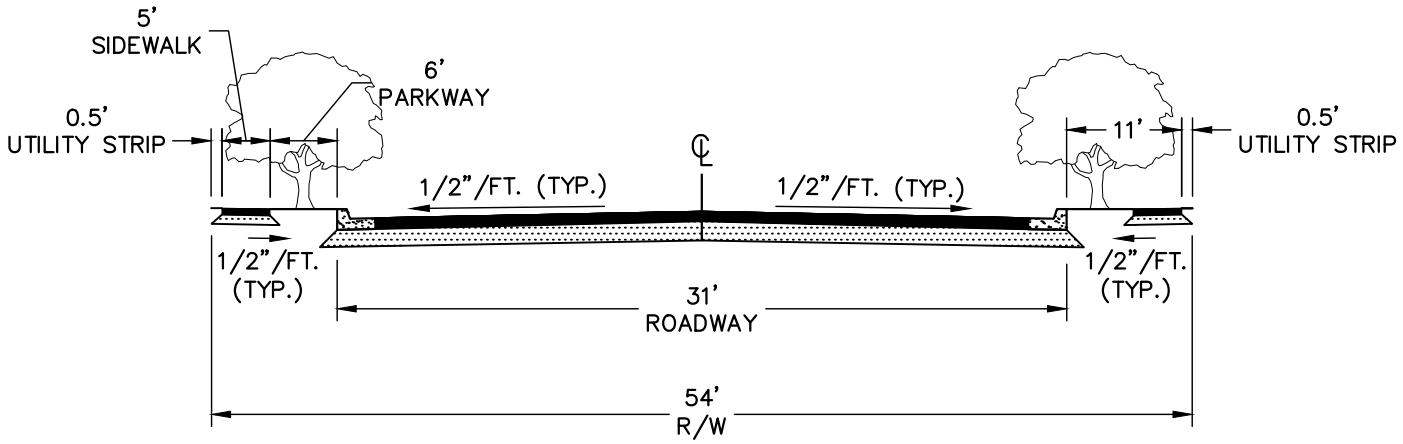
STREET WIDTH 16 FT. MINIMUM
REQUIRES 36 FT. OF RIGHT-OF-WAY
AVERAGE SPEED 10 MPH

| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | PUBLIC ALLEY SECTION | STD. NO. 3.01-2 |
|---|---|---|




NO SCALE

MINIMUM PAVEMENT DESIGN:

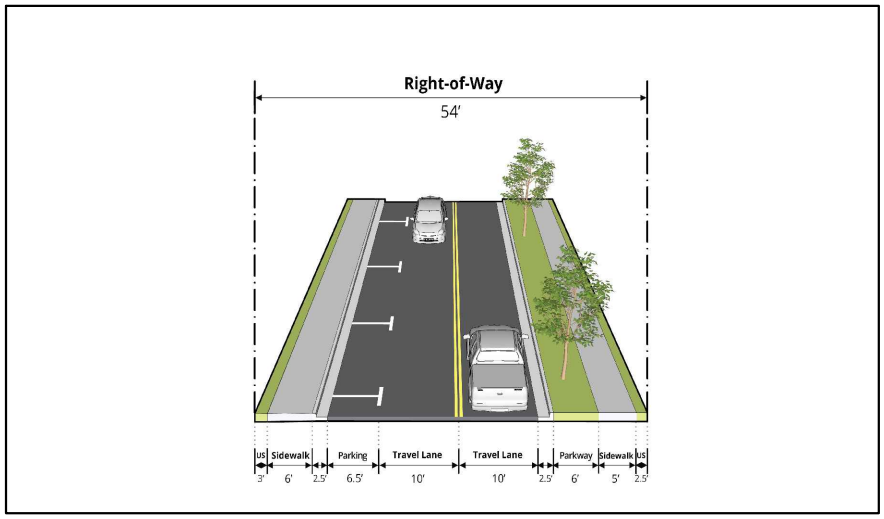
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

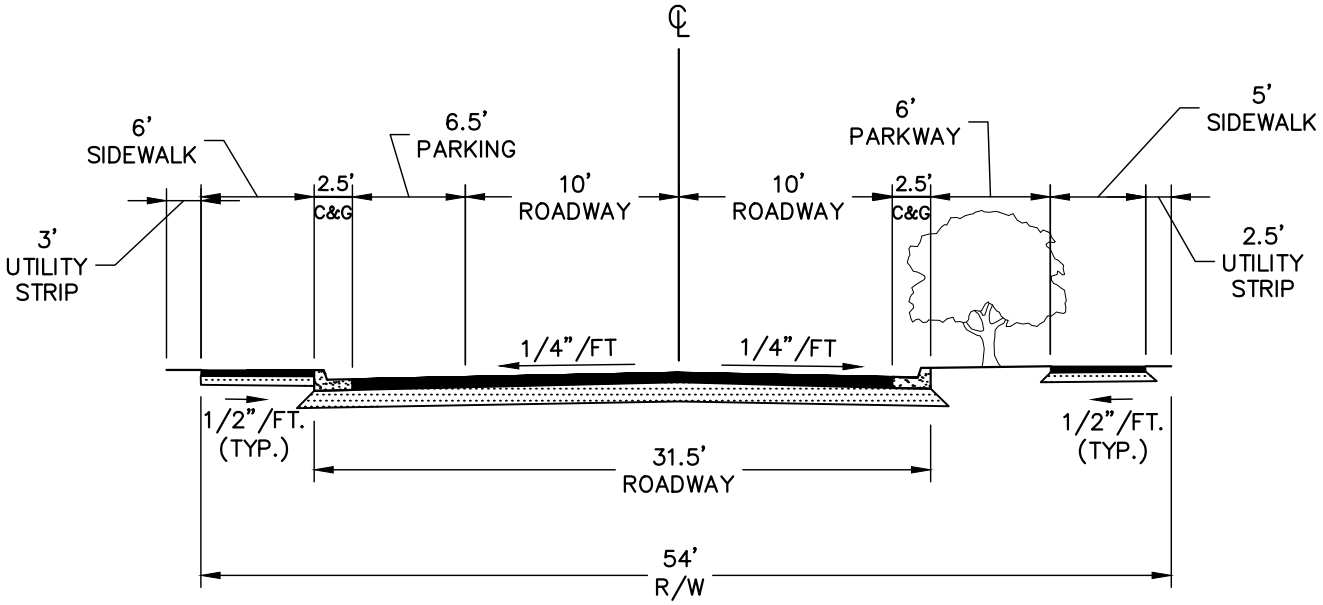
STREET FEATURES:

FLEXIBLE STREET DESIGN
COORDINATE STREET DESIGN ELEMENTS WITH TOWN STAFF
STREET WIDTH OF 20 FT. FOR ONE-WAY
STREET WIDTH OF 31 FT. FOR TWO-WAY
CURB & GUTTER
INFORMAL PARKING - ONE SIDE ONLY
PARKWAY - 6 FT. ON EACH SIDE
SIDEWALK - 5 FT. ON EACH SIDE
UTILITY STRIP - 0.5 FT. ON EACH SIDE
REQUIRES 47 FT. OF RIGHT-OF-WAY FOR ONE-WAY
REQUIRES 54 FT. OF RIGHT-OF-WAY FOR TWO-WAY
UTILITY LOCATION UNDERGROUND
AVERAGE SPEED 20 MPH
STREET TREES LOCATED IN PARKWAY

| REVISIONS | |
|---|---|
| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | LOCAL STREET - 2 LANES<br>SIDEWALKS | STD. NO.<br>3.02-1 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

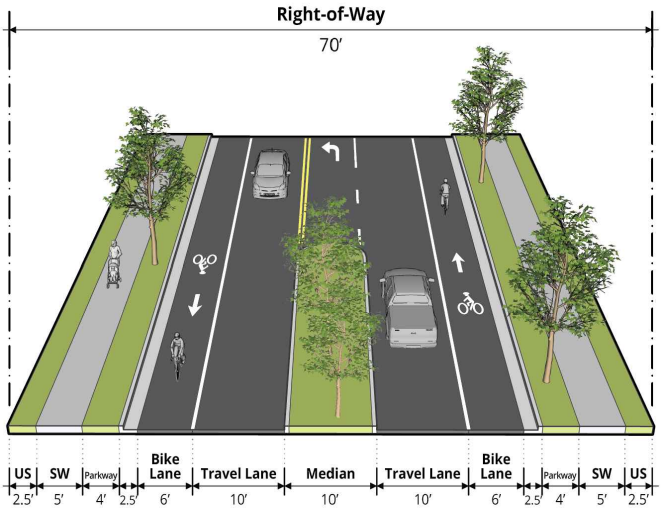
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

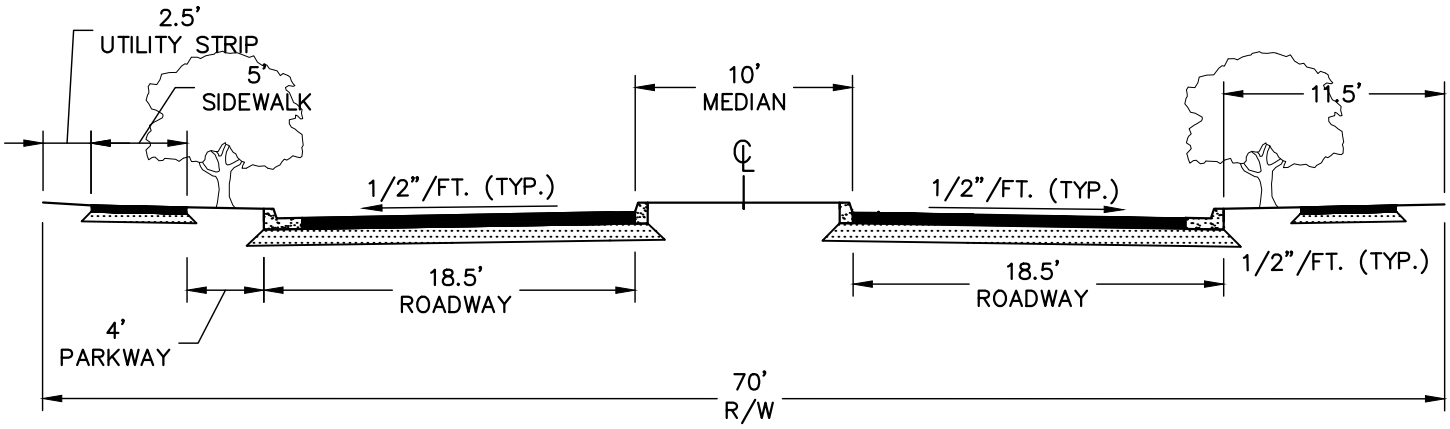
STREET FEATURES:

FLEXIBLE STREET DESIGN
COORDINATE STREET DESIGN ELEMENTS WITH TOWN STAFF
TRAVEL LANES OF 10 FT.
CURB & GUTTER
STRIPED PARALLEL PARKING – ONE SIDE ONLY
PARKWAY – 6 FT. ON ONE SIDE
SIDEWALK – 6 FT. ON PARKING SIDE; 5 FT. ON OPPOSING SIDE
REQUIRES 54 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND
AVERAGE SPEED 20 MPH
STREET TREES LOCATED IN PARKWAY
STREET TREES LOCATED ON PARKING SIDE OF STREET WILL BE PLACED IN CURB BULB OUT OR BACK OF SIDEWALK

| REVISIONS | |
|---|---|
| DATE | DESCRIPTION |
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|---|---|---|
| TOWN OF KNIGHTDALE STANDARD DETAILS | LOCAL STREET - ON STREET PARKING<br>ONE SIDE ONLY | STD. NO.<br>3.02-2 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

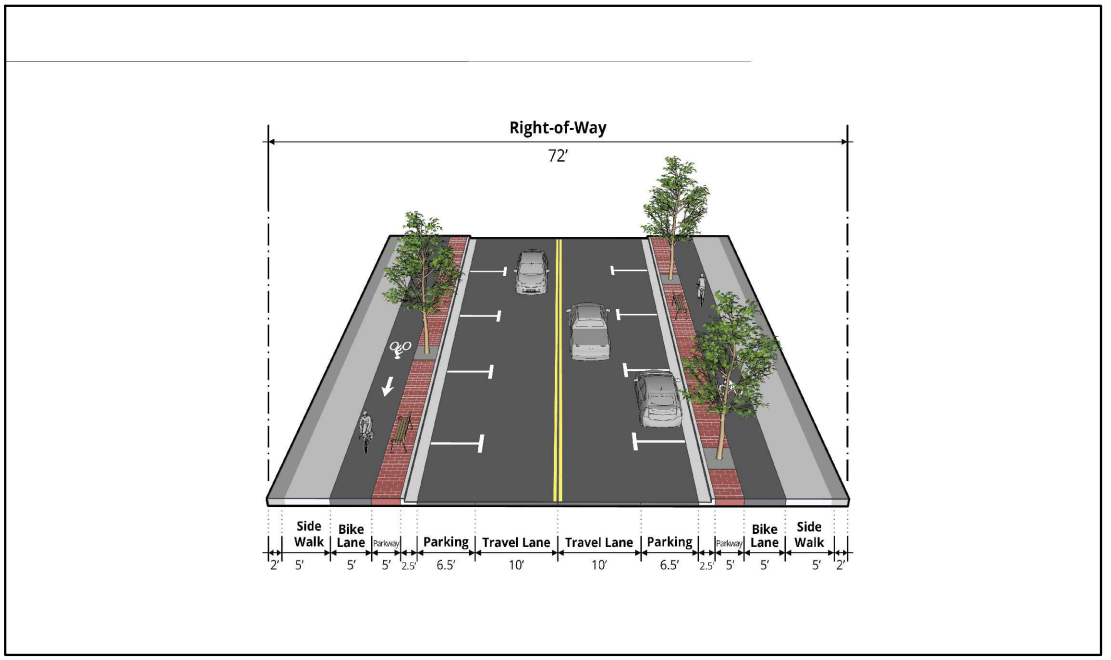
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INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

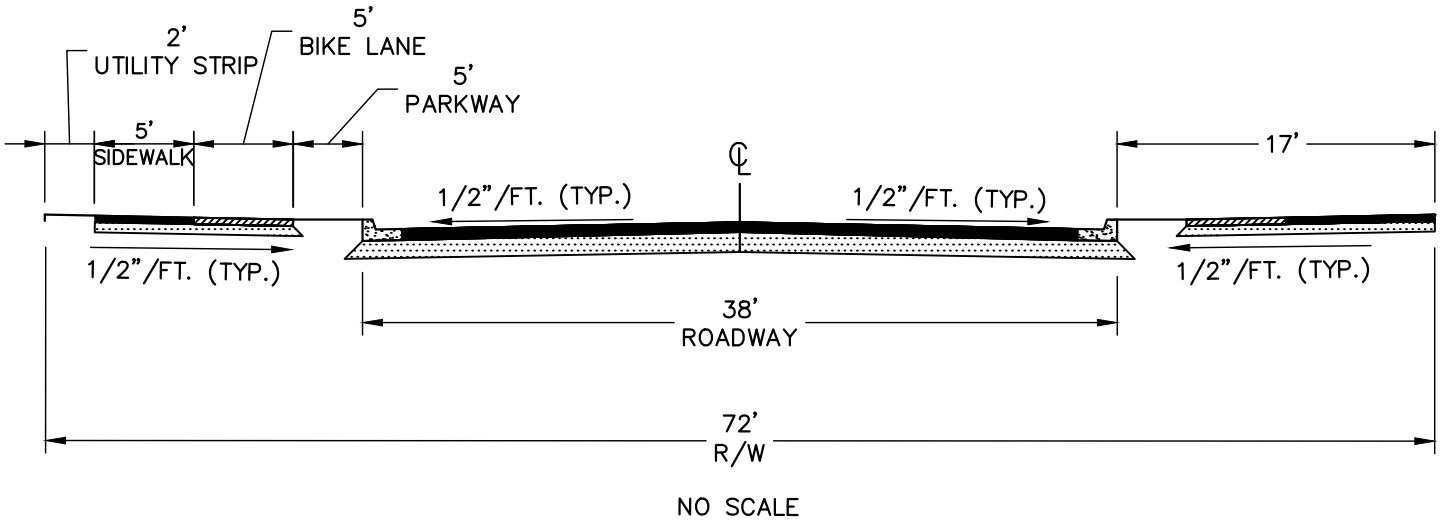
STREET FEATURES:

MEDIAN OF 10 FT.
TRAVEL LANES OF 10 FT.
CURB & GUTTER
BIKE LANE – 6 FT. ON EACH SIDE
PARKWAY – 4 FT. ON EACH SIDE
SIDEWALKS – 5 FT. ON EACH SIDE
REQUIRES 70 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND OR ALLEY
AVERAGE SPEED 20–25 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
BICYCLE FACILITY PAVEMENT MARKINGS SHALL ADHERE TO MUTCD STANDARDS

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | MAIN STREET - 3 LANES<br>BIKE LANES | STD. NO.<br>3.03 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

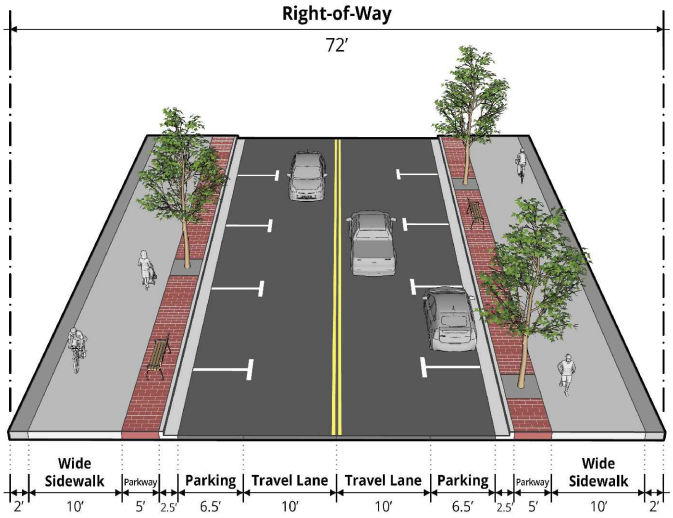
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

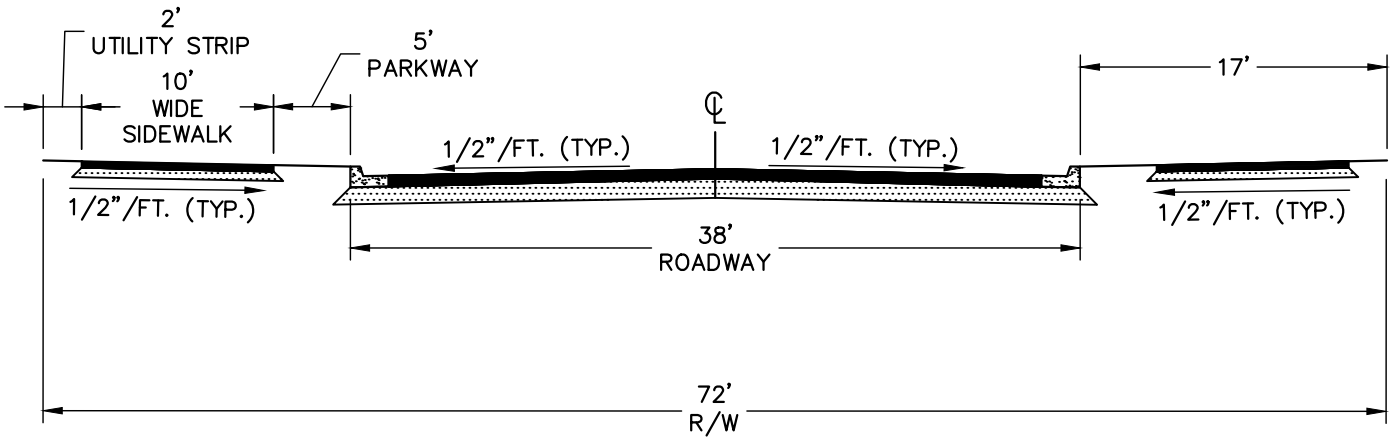
STREET FEATURES:

TRAVEL LANES OF 10 FT.
CURB & GUTTER
STRIPED PARALLEL PARKING
PARKWAY – 5 FT. ON EACH SIDE
SIDEWALKS – 5 FT. ON EACH SIDE
UTILITY LOCATION UNDERGROUND OR ALLEY
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
BICYCLE FACILITY PAVEMENT MARKINGS SHALL ADHERE TO MUTCD STANDARDS
AVERAGE SPEED 20–25 MPH
PROVIDE ELEMENTS PER URBAN STREETSCAPE DESIGN FEATURES DETAIL

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| TOWN OF KNIGHTDALE STANDARD DETAILS | URBAN MAIN STREET - 2 LANES<br>SEPARATED BIKE LANES (ABOVE THE CURB) | STD. NO.<br>3.04-1 |




MINIMUM PAVEMENT DESIGN:

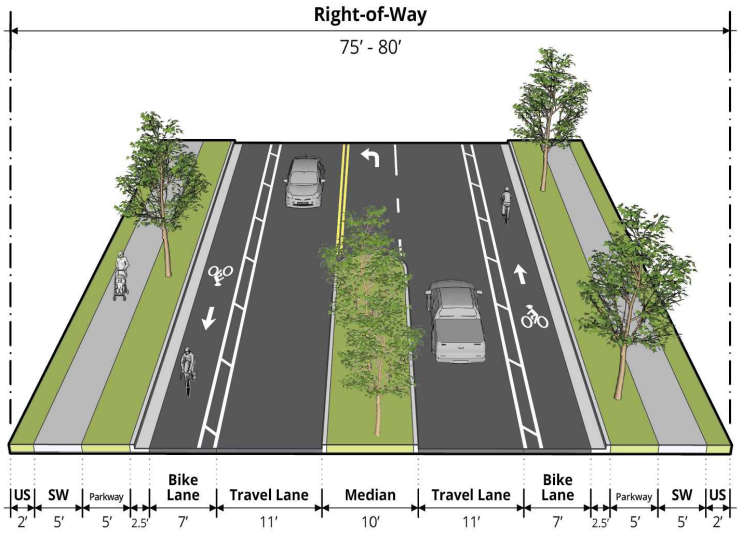
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

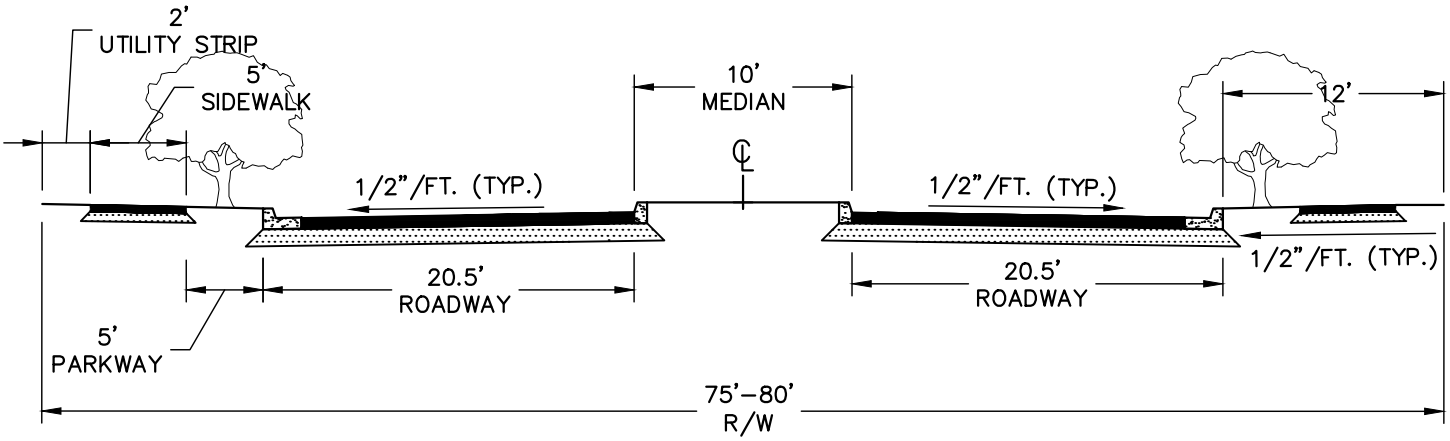
STREET FEATURES:

TRAVEL LANES OF 10 FT.
STREET PARKING 8.5 FT. FROM FACE OF CURB
CURB & GUTTER
STRIPED PARALLEL PARKING
PARKWAY – 5 FT. ON EACH SIDE
WIDE SIDEWALK – 10 FT. ON EACH SIDE
REQUIRES 72 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND OR ALLEY
AVERAGE SPEED 20–25 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
PROVIDE ELEMENTS PER URBAN STREETSCAPE DESIGN FEATURES DETAIL

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| TOWN OF KNIGHTDALE STANDARD DETAILS | URBAN MAIN STREET - 2 LANES<br>WIDE SIDEWALK | STD. NO.<br>3.04-2 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

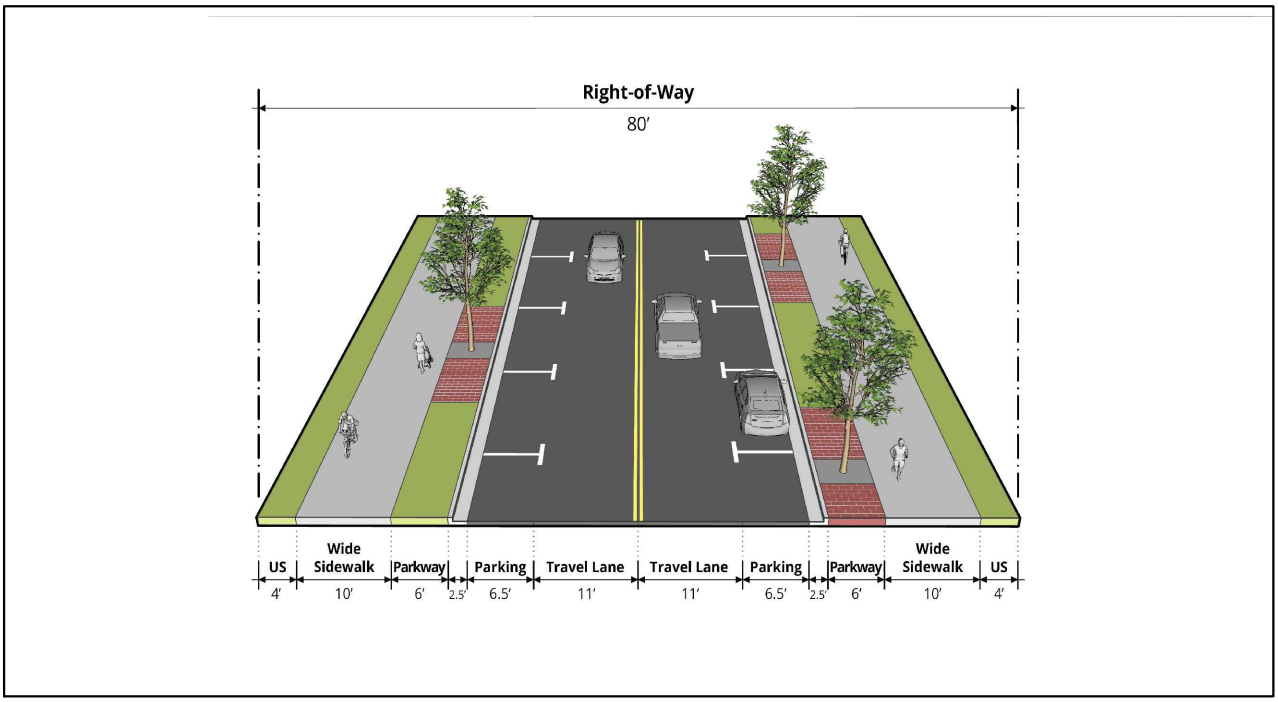
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

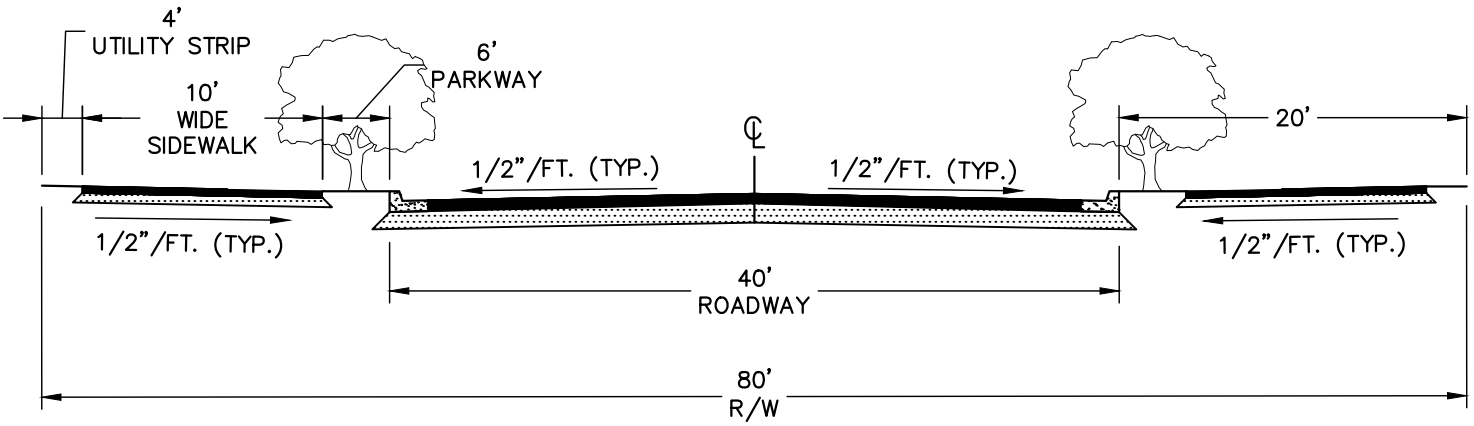
STREET FEATURES:

MEDIAN OF 10 FT.
TRAVEL LANES OF 11 FT.
BIKE LANE OF 7 FT.
CURB & GUTTER
PARKWAY – 5 FT. ON EACH SIDE
SIDEWALKS – 5 FT. ON EACH SIDE
REQUIRES 75 FT. OF RIGHT–OF–WAY
WHEN UDO APPENDIX B CALLS FOR A 10 FT. SIDEPATH, RIGHT–OF–WAY WIDTH INCREASES TO 80 FT.
UTILITY LOCATION UNDERGROUND OR ALLEY
AVERAGE SPEED 35–45 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
BICYCLE FACILITY PAVEMENT MARKINGS SHALL ADHERE TO MUTCD STANDARDS
PROVIDE ELEMENTS PER URBAN STREETSCAPE DESIGN FEATURES DETAIL

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| TOWN OF KNIGHTDALE STANDARD DETAILS | AVENUE - 3 LANES<br>BUFFERED BIKE LANES | STD. NO.<br>3.05 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

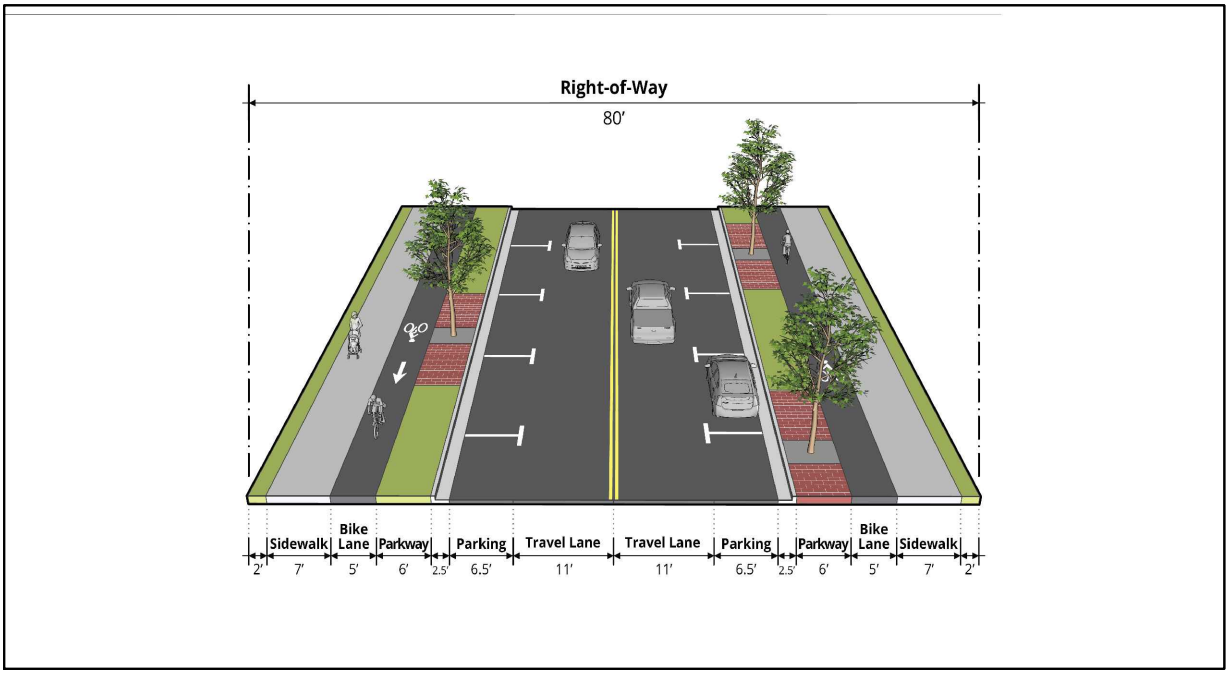
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

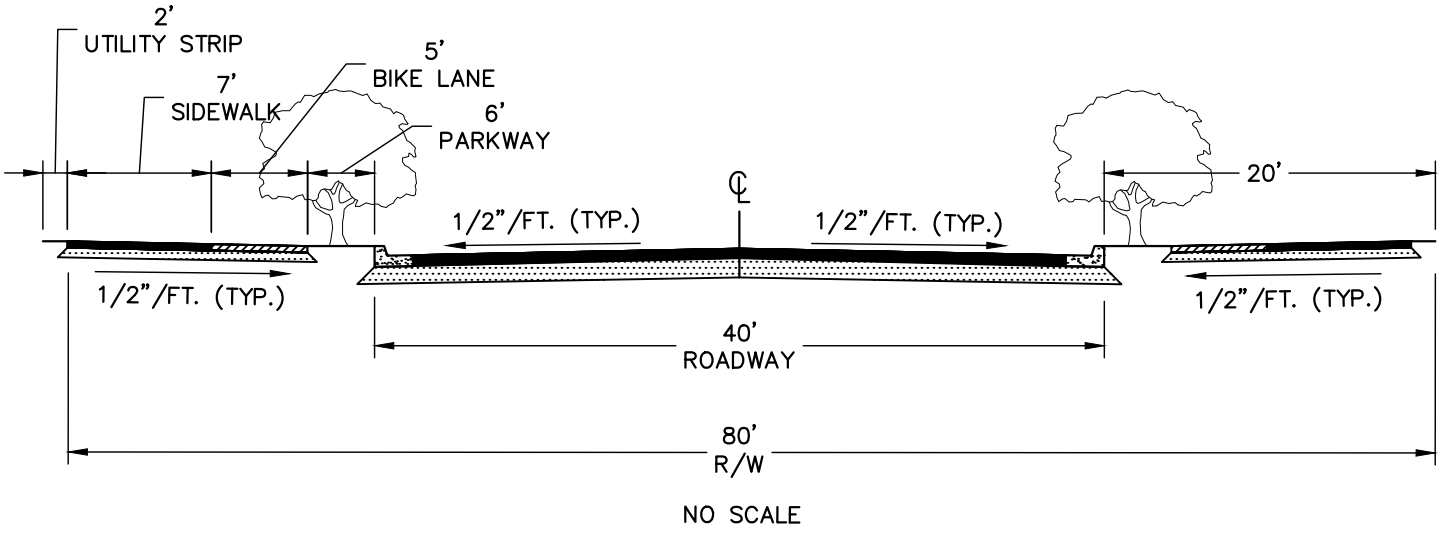
STREET FEATURES:

TRAVEL LANES OF 11 FT.
STREET PARKING OF 8.5 FT. FROM FACE OF CURB
CURB & GUTTER
STRIPED PARALLEL PARKING
PARKWAY – 6 FT. ON EACH SIDE
WIDE SIDEWALK – 10 FT. ON EACH SIDE
REQUIRES 80 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND OR ALLEY
AVERAGE SPEED 20–25 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
PROVIDE ELEMENTS PER URBAN STREETSCAPE DESIGN FEATURES DETAIL

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | URBAN AVENUE - 2 LANES<br>WIDE SIDEWALK | STD. NO.<br>3.06-1 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

STREET FEATURES:

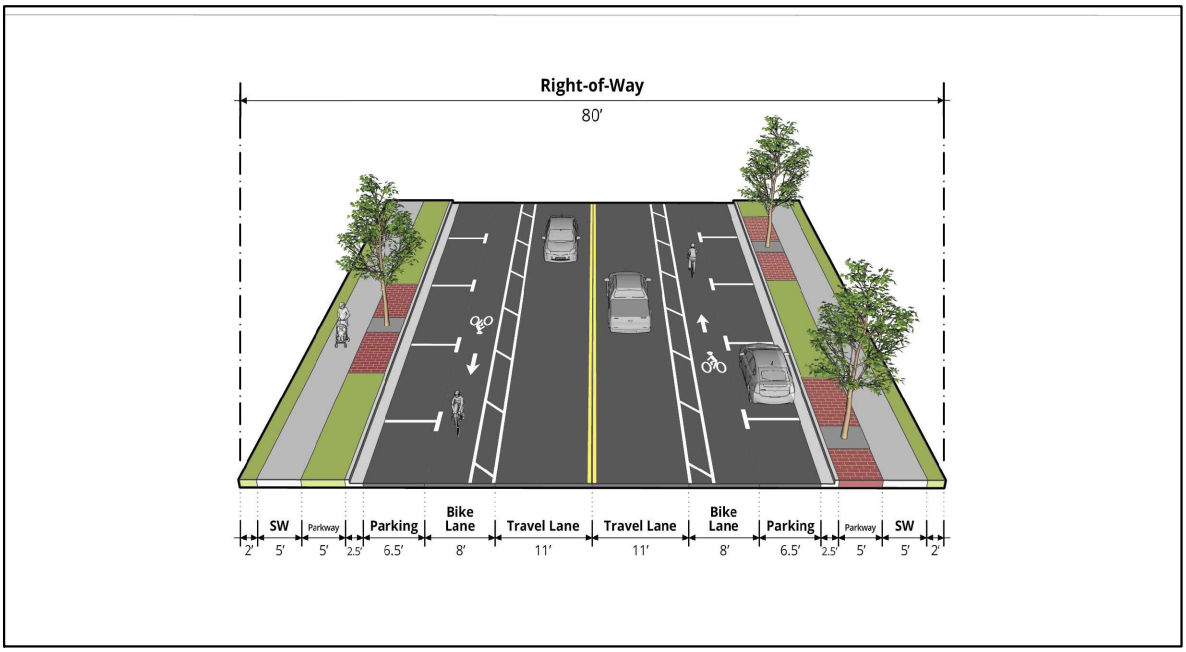
TRAVEL LANES OF 11 FT.
STREET PARKING OF 8.5 FT. FROM FACE OF CURB
CURB & GUTTER
STRIPED PARALLEL PARKING
PARKWAY – 6 FT. ON EACH SIDE
BIKE LANE – 5 FT. ON EACH SIDE
SIDEWALKS – 7 FT. ON EACH SIDE
REQUIRES 80 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND OR ALLEY
AVERAGE SPEED 20–25 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
BICYCLE FACILITY PAVEMENT MARKINGS SHALL ADHERE TO MUTCD STANDARDS
PROVIDE ELEMENTS PER URBAN STREETSCAPE DESIGN FEATURES DETAIL

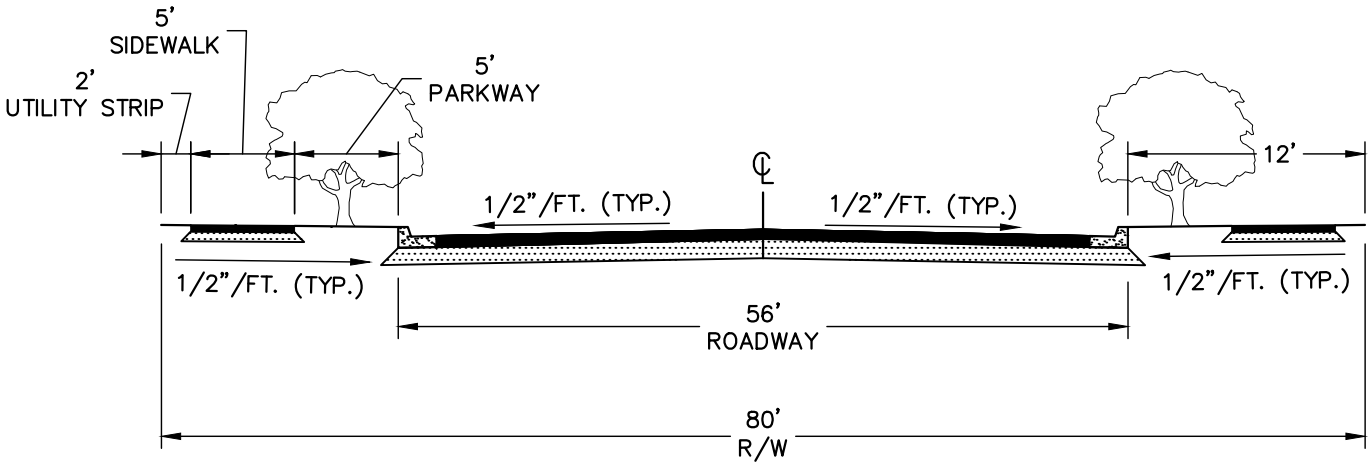
| REVISIONS | |
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TOWN OF KNIGHTDALE
STANDARD DETAILS

# URBAN AVENUE - 2 LANES
SEPARATED BIKE LANES (ABOVE THE CURB)

STD. NO.
3.06-2




NO SCALE

MINIMUM PAVEMENT DESIGN:

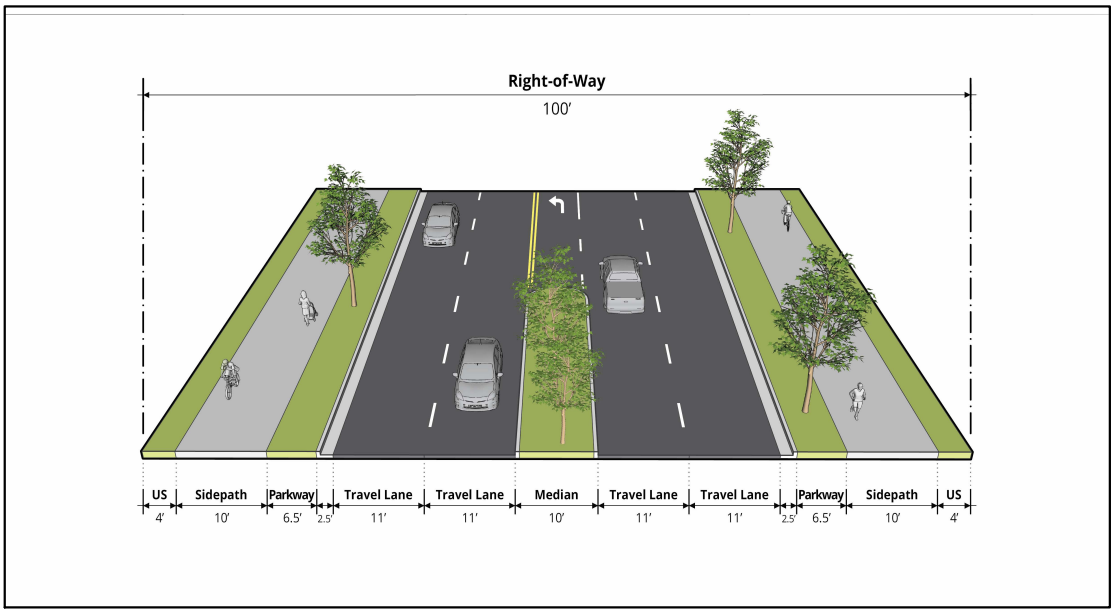
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

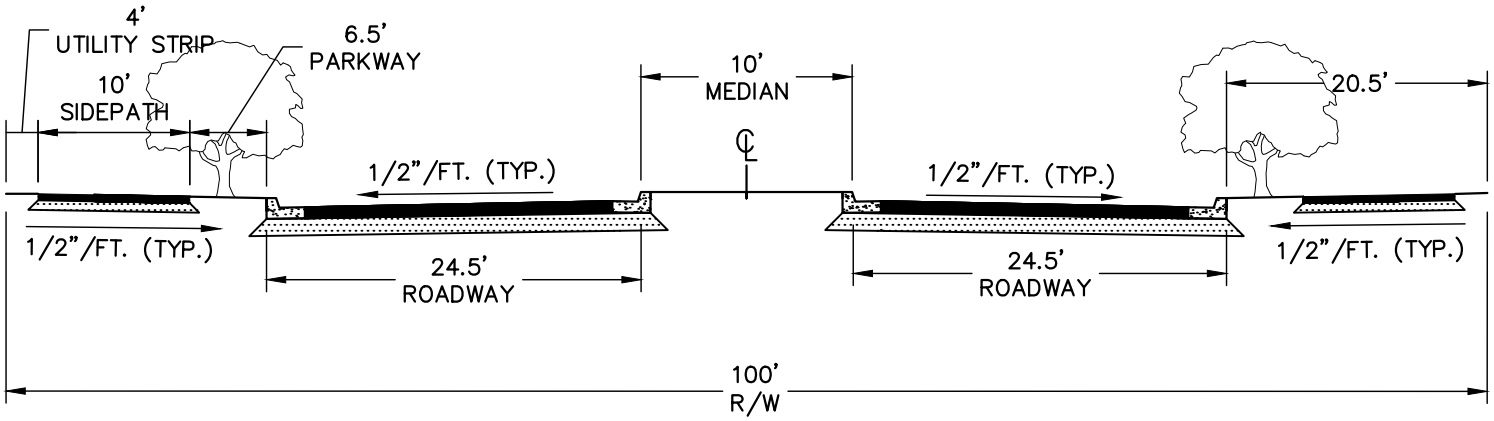
STREET FEATURES:

TRAVEL LANES OF 11 FT.
BUFFERED BIKE LANE OF 8 FT.
STREET PARKING OF 8.5 FT. FROM FACE OF CURB
CURB & GUTTER
STRIPED PARALLEL PARKING
PARKWAY – 5 FT. ON EACH SIDE
SIDEWALKS – 5 FT. ON EACH SIDE
REQUIRES 80 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND OR ALLEY
AVERAGE SPEED 20–25 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
BICYCLE FACILITY PAVEMENT MARKINGS SHALL ADHERE TO MUTCD STANDARDS
PROVIDE ELEMENTS PER URBAN STREETSCAPE DESIGN FEATURES DETAIL

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| TOWN OF KNIGHTDALE STANDARD DETAILS | URBAN AVENUE - 2 LANES<br>BUFFERED BIKE LANES | STD. NO.<br>3.06-3 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

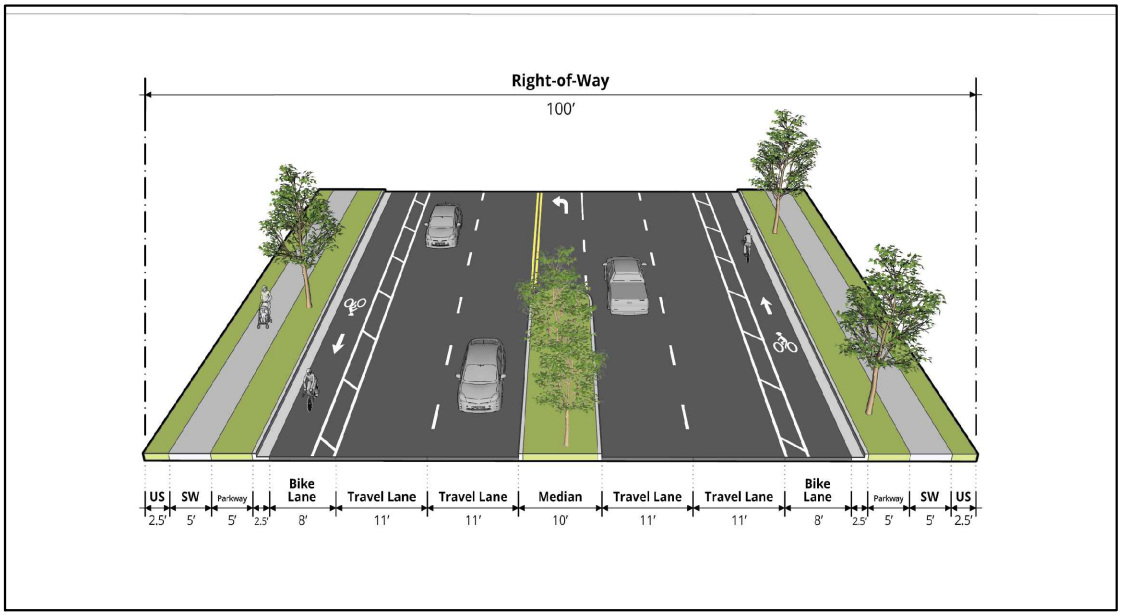
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

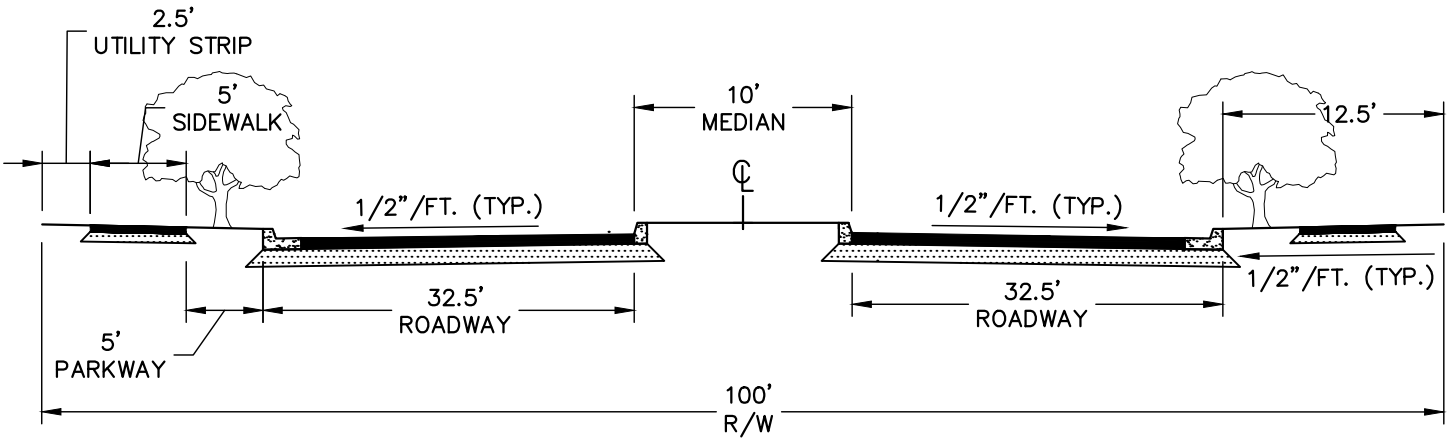
STREET FEATURES:

MEDIAN OF 10 FT.
TRAVEL LANES OF 11 FT.
CURB & GUTTER
PARKWAY – 6.5 FT. ON EACH SIDE
SIDEPATH – 10 FT. ON EACH SIDE
REQUIRES 100 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND
AVERAGE SPEED 35–45 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES

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| TOWN OF KNIGHTDALE STANDARD DETAILS | BOULEVARD - 4 LANES<br>SIDEPATHS | STD. NO.<br>3.07-1 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

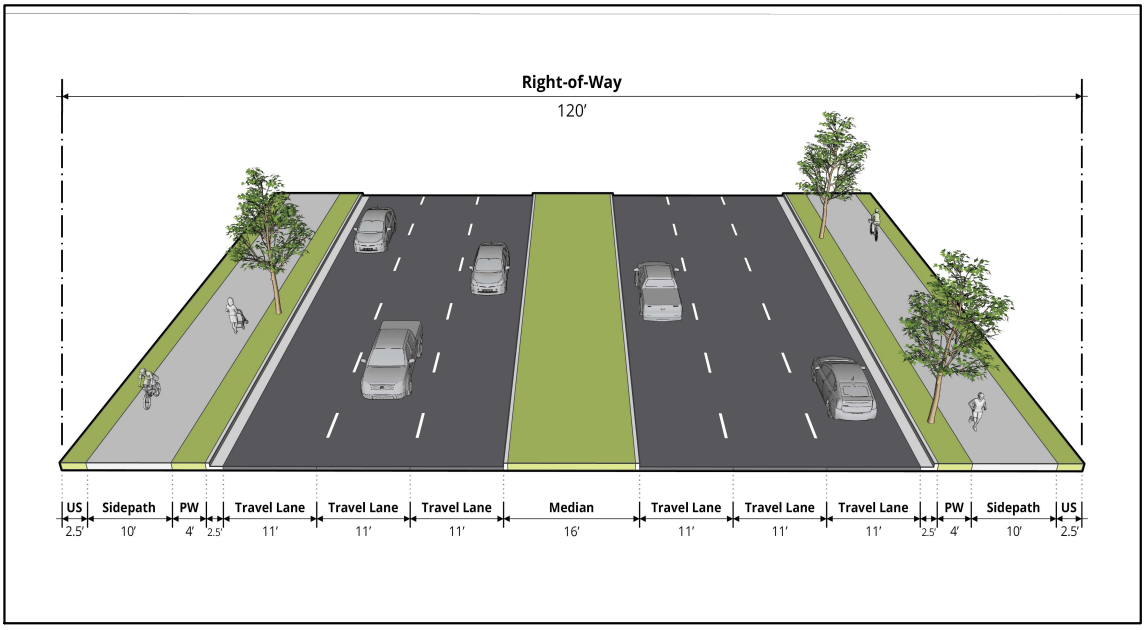
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

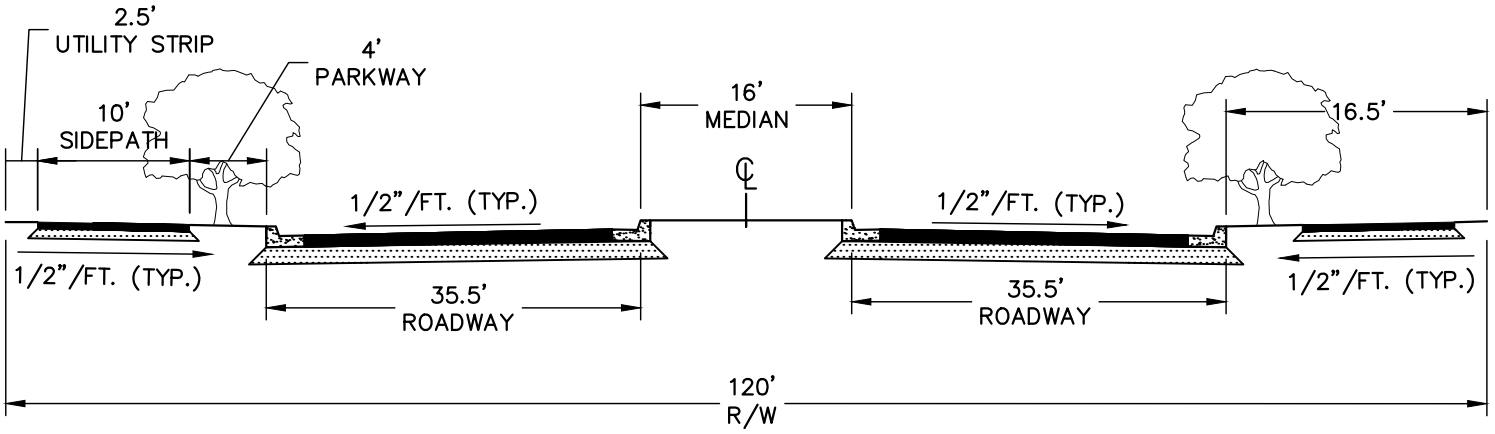
STREET FEATURES:

MEDIAN OF 10 FT.
TRAVEL LANES OF 11 FT.
BUFFERED BIKE LANE OF 8 FT.
CURB & GUTTER
PARKWAY – 5 FT. ON EACH SIDE
SIDEWALKS – 5 FT. ON EACH SIDE
REQUIRES 100 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND
AVERAGE SPEED 35–45 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES
BICYCLE FACILITY PAVEMENT MARKINGS SHALL ADHERE TO MUTCD STANDARDS

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| TOWN OF KNIGHTDALE STANDARD DETAILS | BOULEVARD - 4 LANES<br>BUFFERED BIKE LANES | STD. NO.<br>3.07-2 |




NO SCALE

MINIMUM PAVEMENT DESIGN:

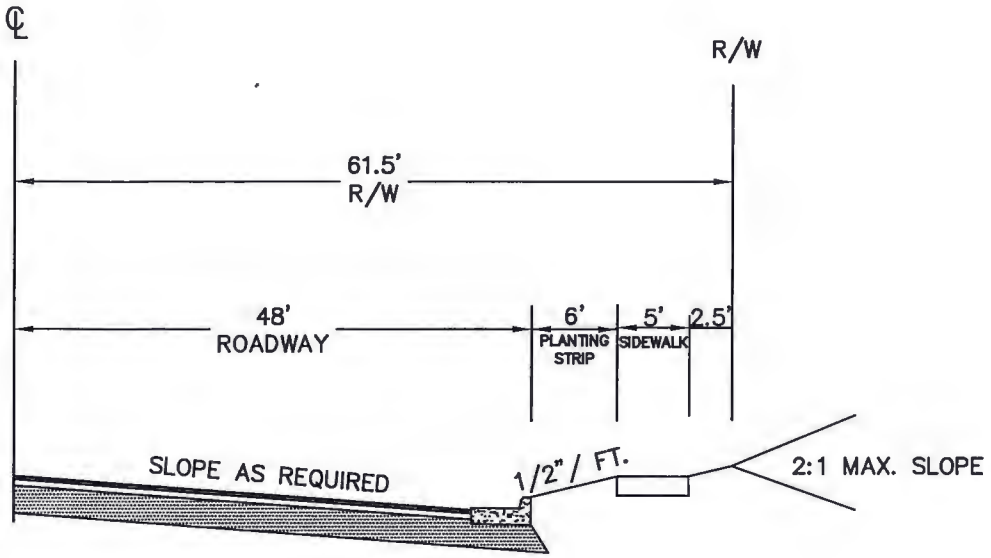
BITUMINOUS SURFACE COURSE: 1 1/2" S 9.5B
INTERMEDIATE COURSE: 2 1/2" I 19.0B
BASE COURSE: 8" ABC

STREET FEATURES:

MEDIAN OF 16 FT.
TRAVEL LANES OF 11 FT.
CURB & GUTTER
PARKWAY – 4 FT. ON EACH SIDE
SIDEPATH – 10 FT. ON EACH SIDE
REQUIRES 120 FT. OF RIGHT–OF–WAY
UTILITY LOCATION UNDERGROUND
AVERAGE SPEED 35–45 MPH
STREET TREES LOCATED IN PARKWAY
UTILITY LOCATION BEHIND CURB ON NCDOT FACILITIES

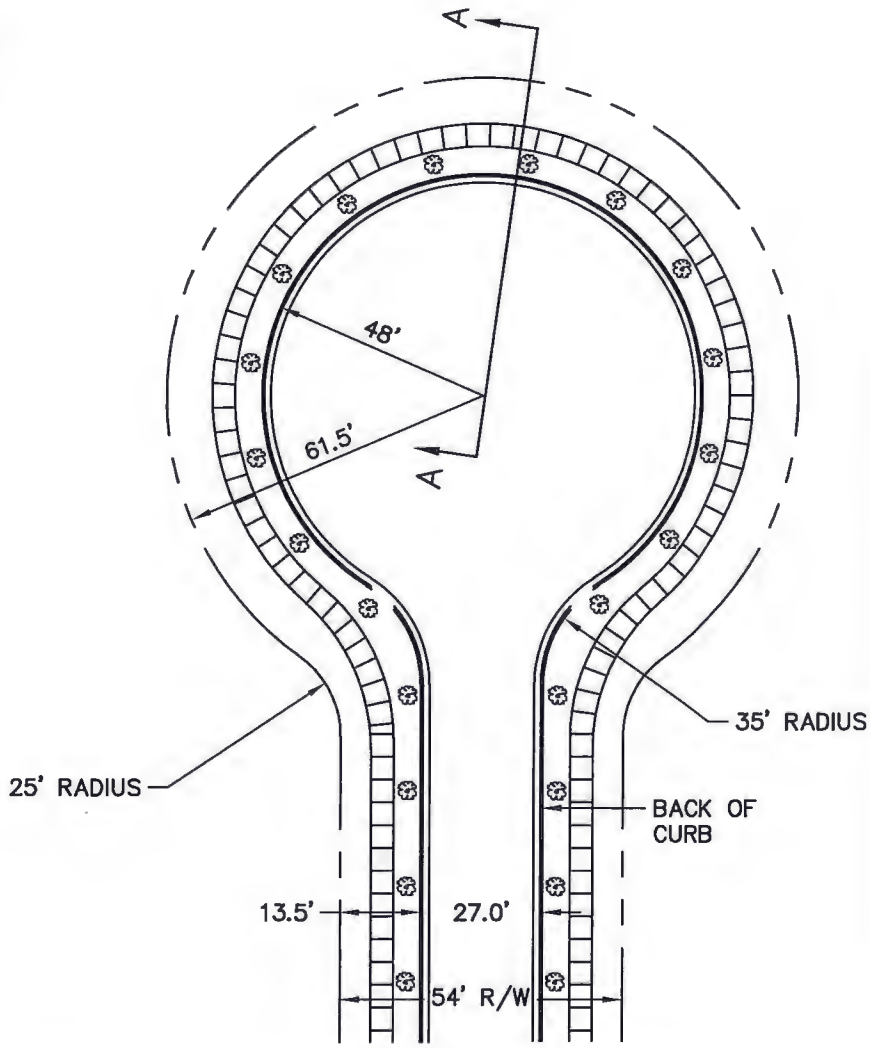
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| TOWN OF KNIGHTDALE STANDARD DETAILS | KNIGHTDALE BOULEVARD - 6 LANE MEDIAN<br>SIDEPATHS | STD. NO.<br>3.07-3 |



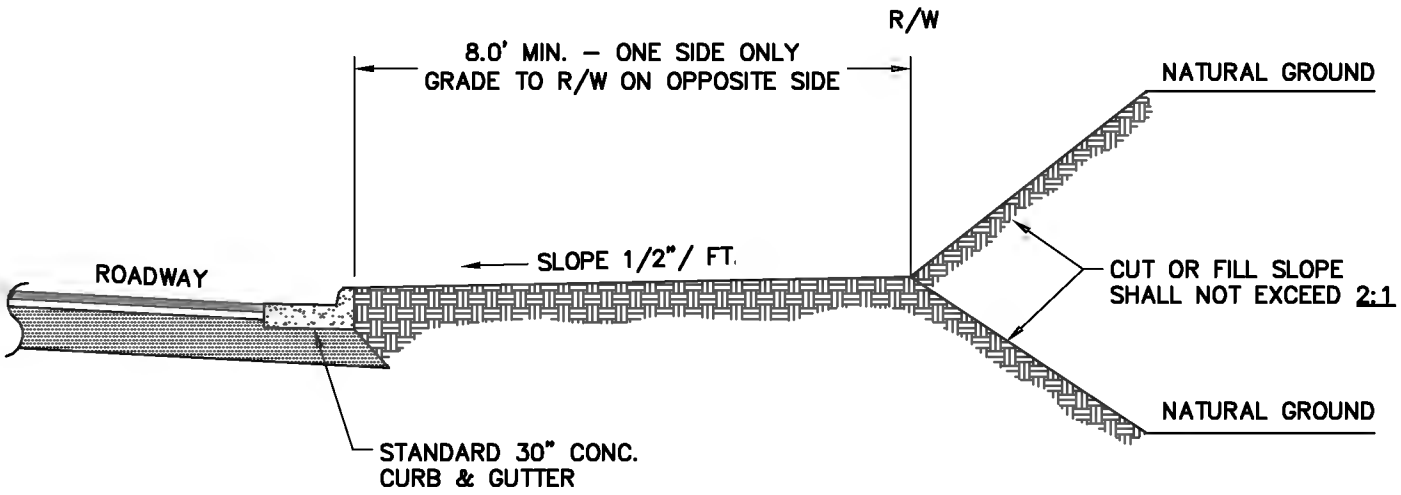

## SECTION A

| TERRAIN | MAX. SLOPE |
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| LEVEL | 2:1 |
| ROLLING | 2:1 |



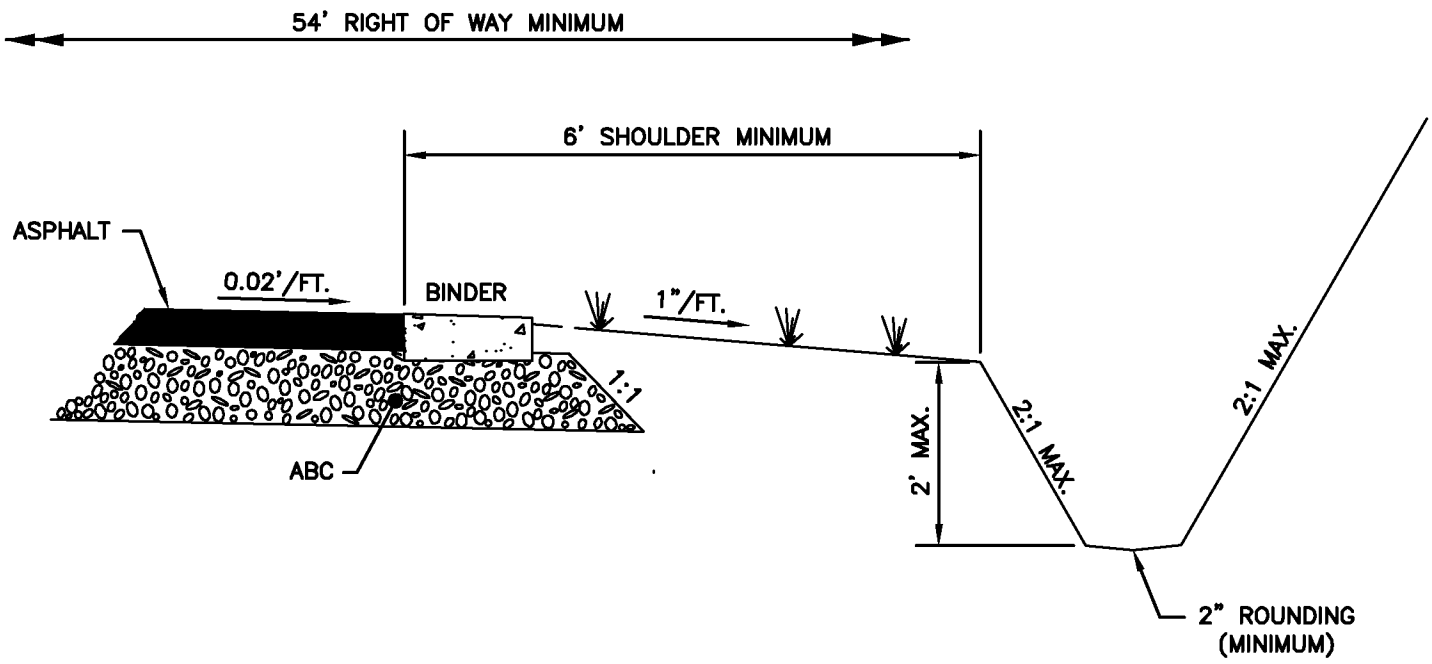

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| TOWN OF KNIGHTDALE STANDARD DETAILS | CUL DE SAC SECTION | STD. NO. 3.08 |




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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD SHOULDER SECTION<br>WITHOUT SIDEWALK | STD. NO.<br>3.09 |



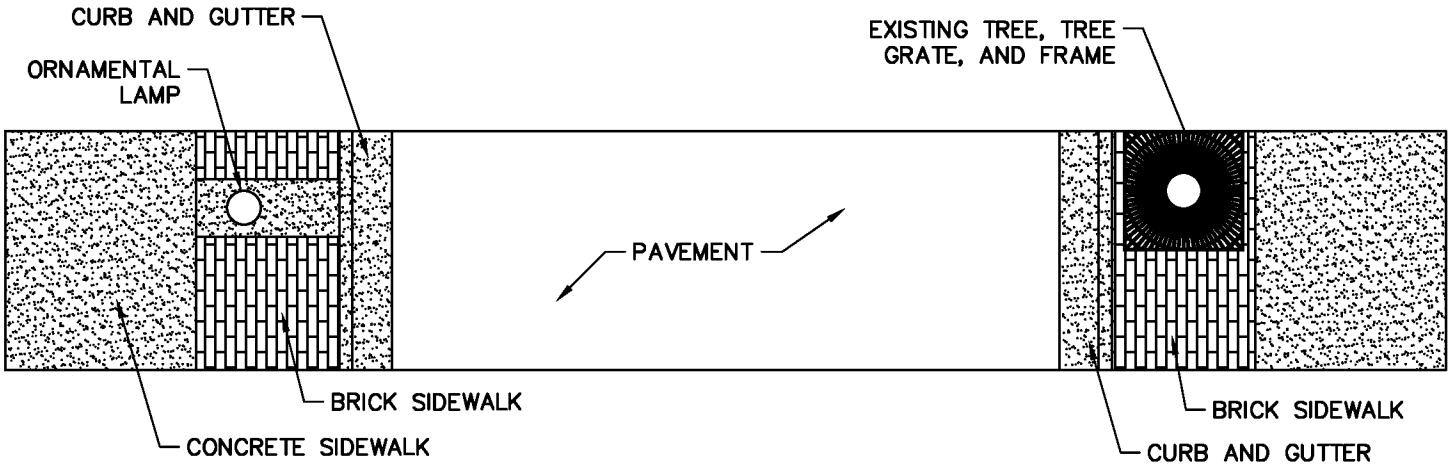

NOTE:

THIS SECTION MAY ONLY BE USED WHEN ALL OF THE FOLLOWING CONDITIONS ARE MET:

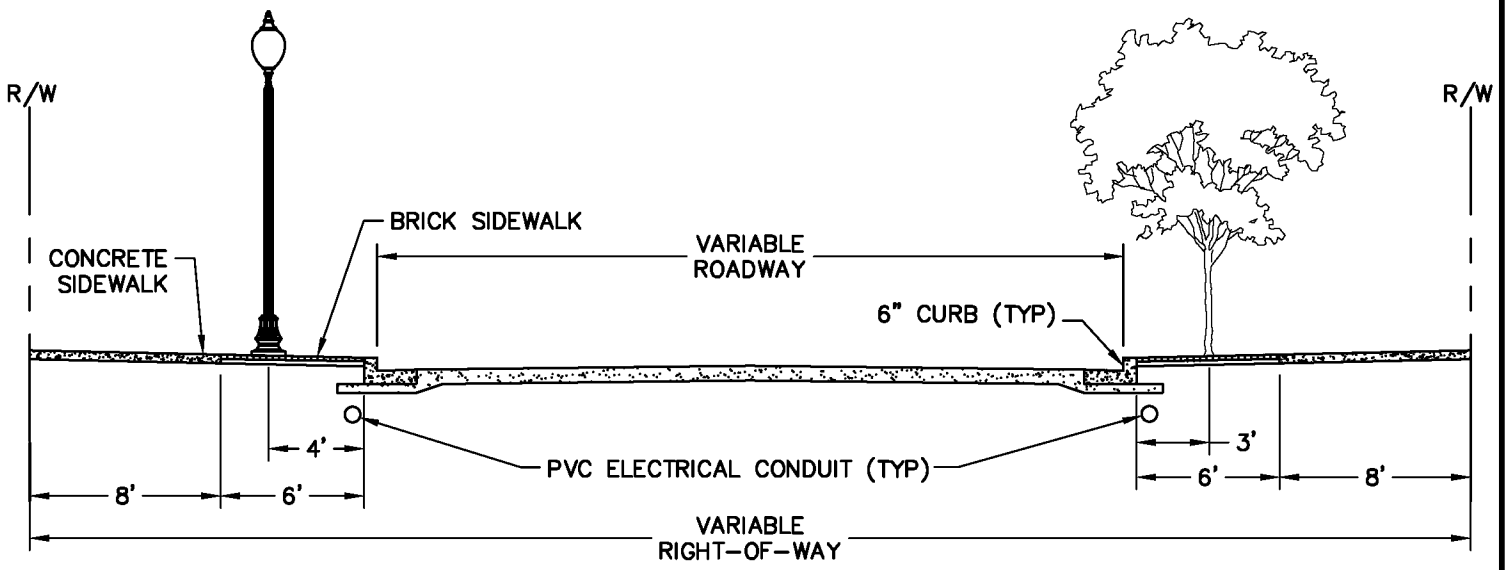
1. STREET IS EITHER A CUL-DE-SAC OR RESIDENTIAL LOOP WITH LOW AVERAGE DAILY TRAFFIC.
2. STREET IS DESIGNATED TO BE WITH BINDER CURB AS SHOWN DURING APPROVAL PROCESS.
3. STREET VERTICAL GRADE SHALL NOT EXCEED 5% AT ANY POINT.
4. SWALE SYSTEM DESIGNED TO CARRY AT LEAST THE 10 YEAR STORM.
5. VELOCITY WITHIN THE SWALE SHALL BE NON-EROSIVE.
6. DETAILED DRAINAGE CALCULATIONS REQUIRED.

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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD SHOULDER SECTION<br>WITHOUT CURB & GUTTER | STD. NO.<br>3.10 |




PLAN



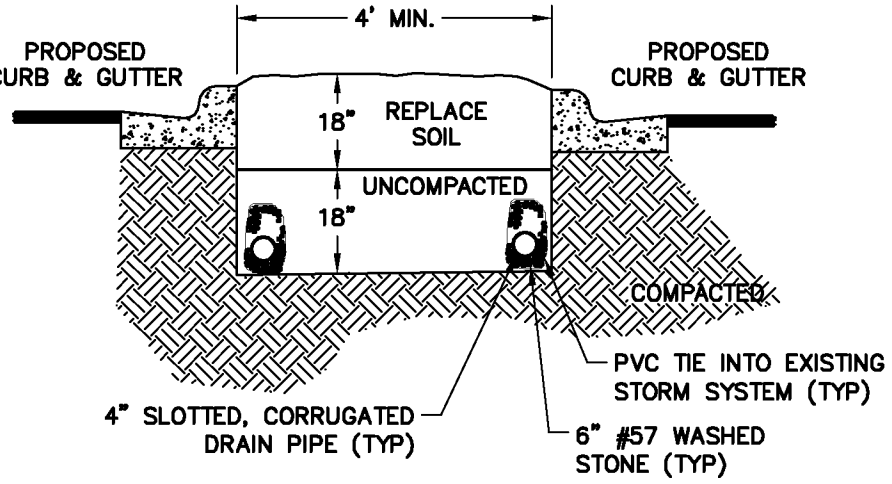

SECTION

NOTES:

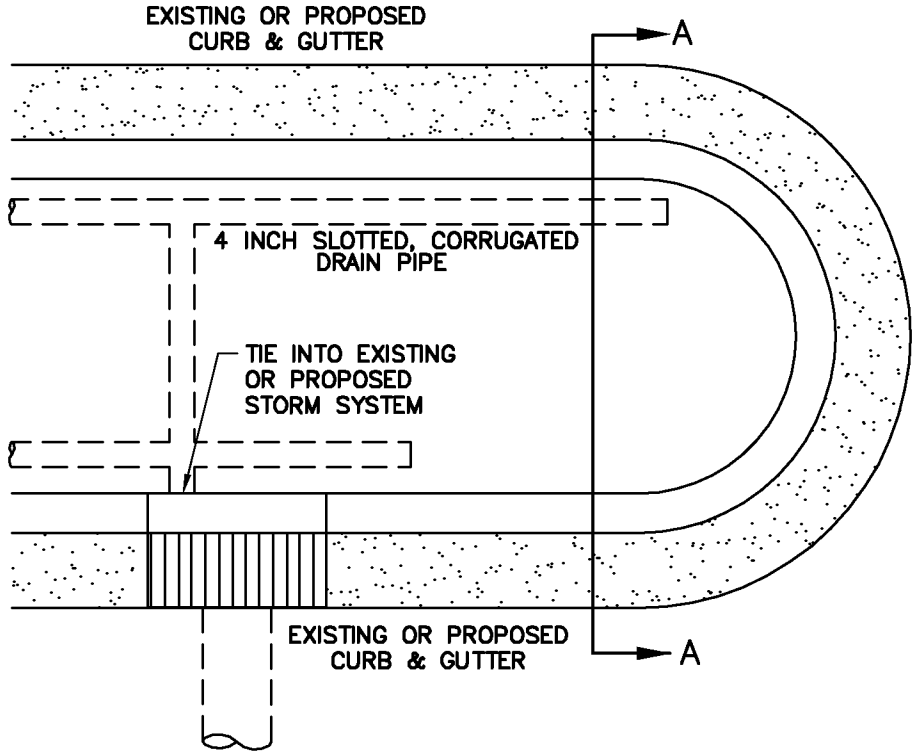
1. TO BE USED ON URBAN MAIN STREET AND URBAN AVENUE CROSS SECTIONS.
2. FOR ILLUSTRATIVE PURPOSES. FOLLOW DESIGN DETAIL FOR SPECIFIC CROSS SECTION.
3. STAMPED CONCRETE MAY BE USED IN LIEU OF BRICK PAVERS.
4. STREET LAMPS SHALL BE SPACED SUCH THAT THERE ARE NO CONFLICTS WITH STREET TREES.
5. STREETSCAPE ELEMENTS SHOULD INCLUDE BENCHES, TRASH CANS, AND BIKE RACKS.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | URBAN STREETSCAPE DESIGN FEATURES | STD. NO. 3.11 |




TYPICAL SECTION A–A




PLAN VIEW

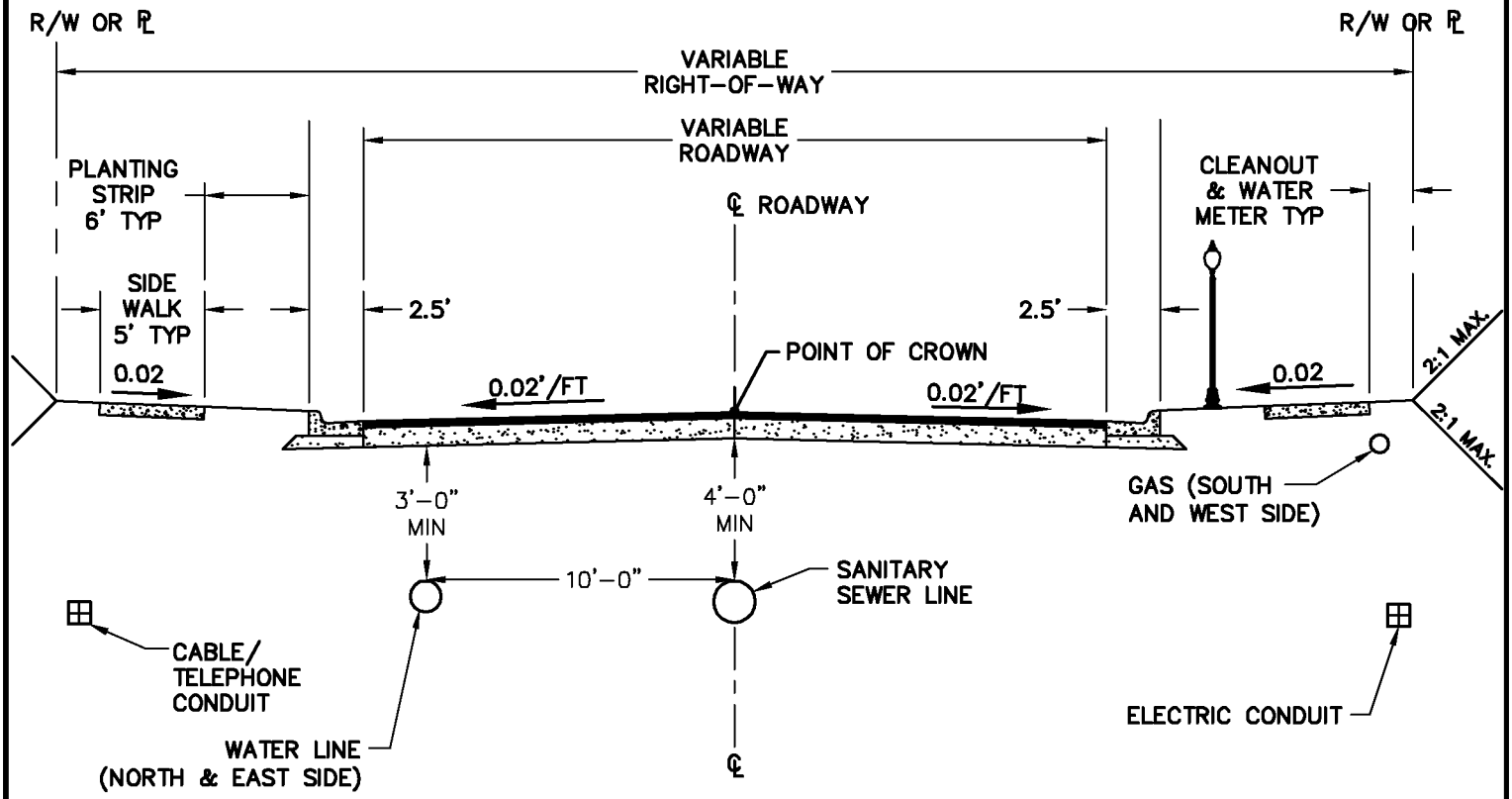
NOTES:

1. FABRIC FOR WRAPPING THE DRAINS WITH PERFORATED PIPE AND WASHED STONE SHALL BE THE NON–WOVEN TYPE, MIRAFI 140NL OR APPROVED EQUAL.

2. SUBSURFACE DRAINAGE SHALL BE INSTALLED IN ALL MEDIANS WHERE DRAIN LINES CAN BE TIED INTO EXISTING STORM DRAIN SYSTEM. A 4 INCH PERFORATED, CORRUGATED PVC DRAIN SHALL BE INSTALLED IN EACH MEDIAN AT THE BOTTOM OF THE EXCAVATED AREA. DRAIN SHALL BE COVERED WITH A MINIMUM OF 6 INCHES OF #57 WASHED STONE, THEN WRAPPED WITH THE SPECIFIED NON–WOVEN GEOTEXTILE FABRIC. SPECIAL CARE SHALL BE EXERCISED WHEN FILLING MEDIANS WITH SOIL SO AS NOT TO CRUSH OR DAMAGE THE DRAINAGE SYSTEM OR RECOMPACT THE SOIL.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STREET MEDIAN EXCAVATION, DRAINAGE, AND BACKFILL | STD. NO. 3.12 |



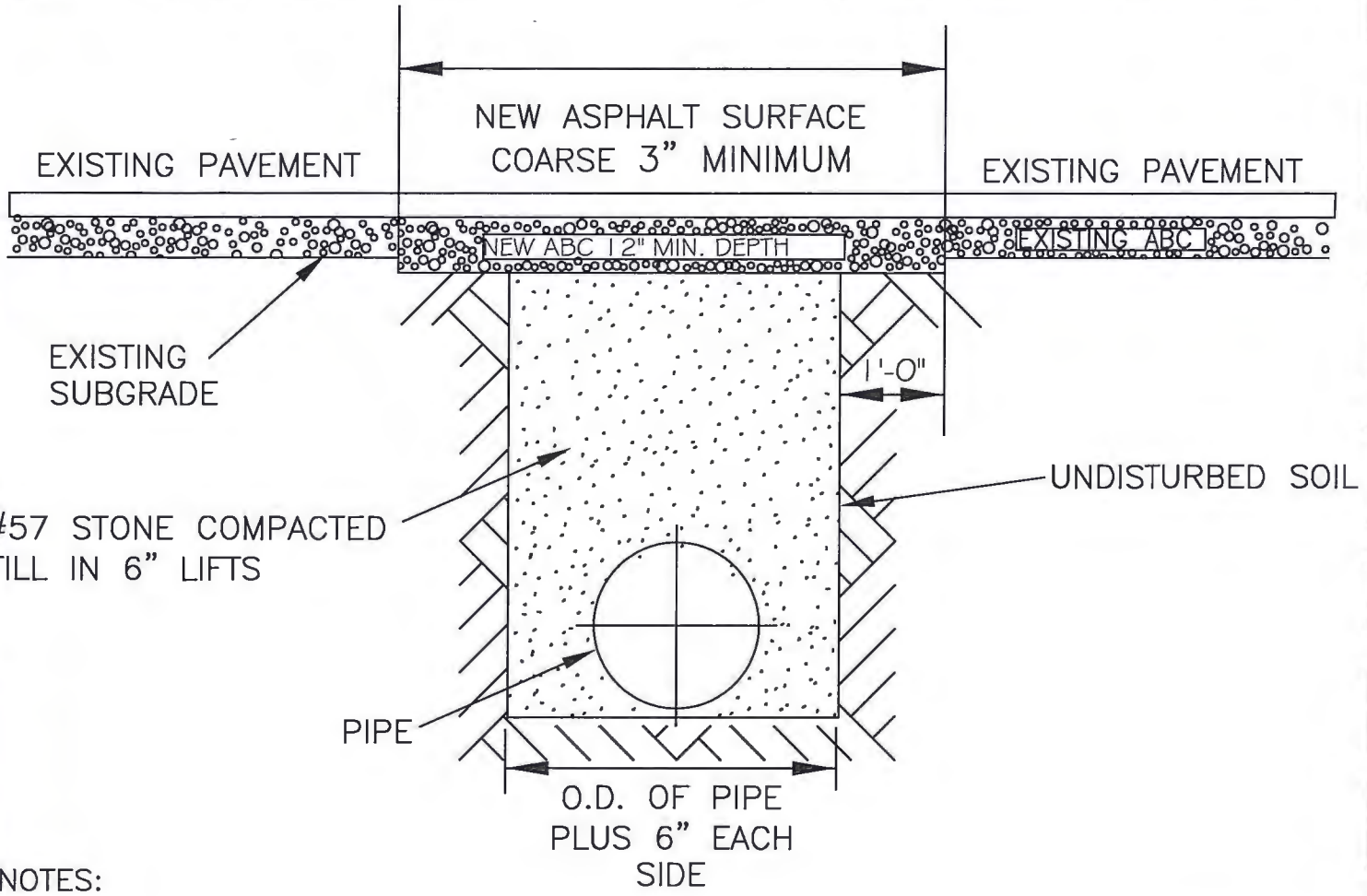

CROSS SECTION

NOTES:

1. THERE SHALL BE AN 18–INCH VERTICAL SEPARATION BETWEEN WATER AND SEWER LINES.
2. WATER AND/OR SANITARY SEWER LINES SHALL BE A MINIMUM OF TWO (2) FEET FROM THE EDGE OF THE CURB AND GUTTER.
3. ENCROACHMENT ONTO TOWN MAINTAINED RIGHT OF WAY SHALL FOLLOW CONDITIONS OF THE APPLICABLE ENCROACHMENT AGREEMENT OR FRANCHISE AGREEMENT.
4. STREET LAMPS SHALL BE PLACED SUCH THAT THERE ARE NO CONFLICTS WITH STREET TREES.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD UTILITY LOCATION IN STREET | STD. NO. 3.13 |

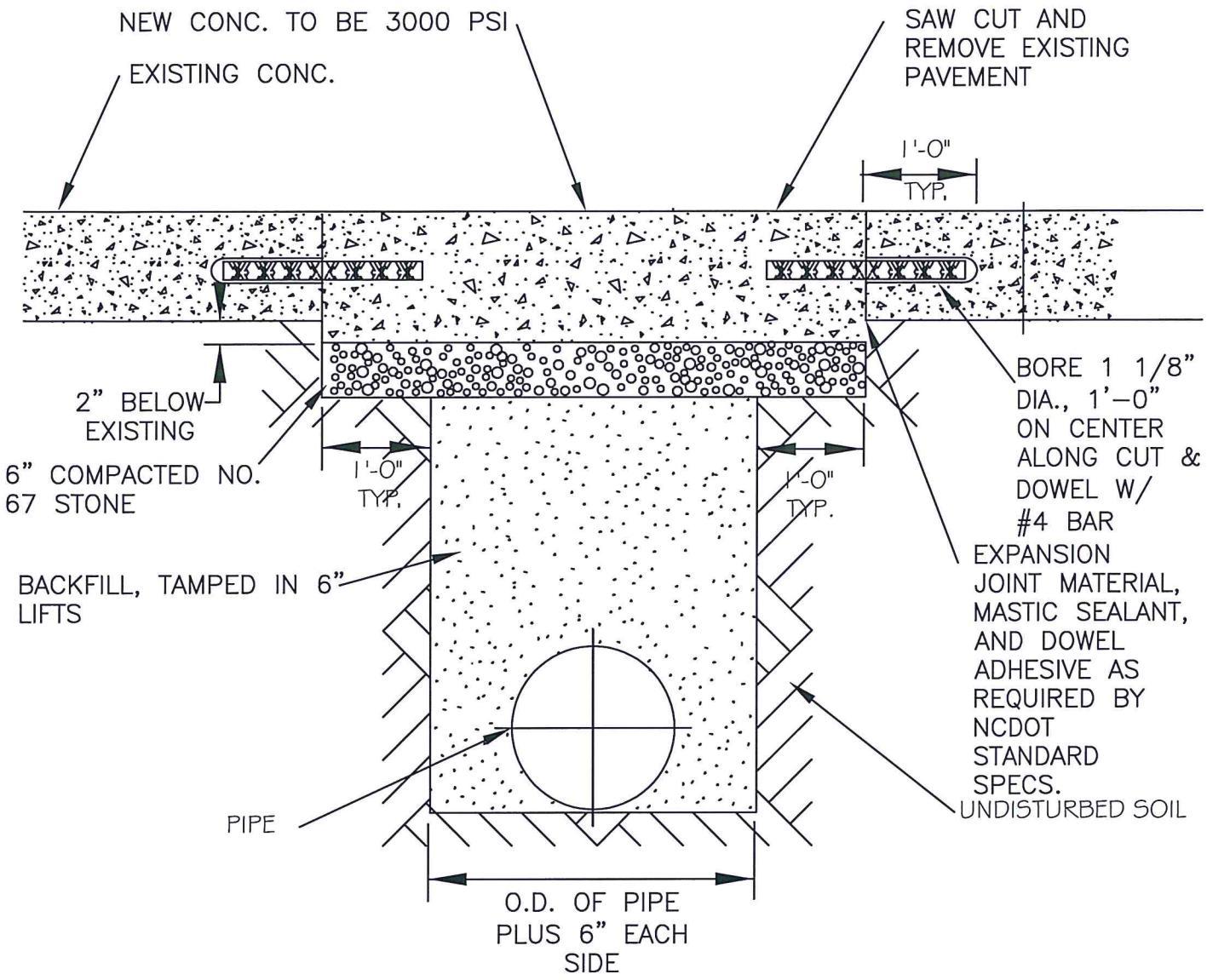



NOTES:

1. THE PAVEMENT CUT SHALL BE DEFINED BY A STRAIGHT EDGE AND CUT WITH AN APPROVED SAW CUT MACHINE.
2. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH SUITABLE MATERIAL AND COMPACTED TO A DENSITY OF AT LEAST 95% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH AASHTO T–99 AS MODIFIED BY NCDOT.
3. THE FINAL 1' OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO A DENSITY EQUAL TO 100% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH AASHTO T–80 AS MODIFIED BY NCDOT.
4. THE ENTIRE THICKNESS/ VERTICAL EDGE OF CUT SHALL BE TACKED.
5. THE SAME DEPTH OF PAVEMENT MATERIAL WHICH EXISTS SHALL BE REINSTALLED, BUT IN NO CASE SHALL THE ASPHALT BE LESS THAN 3" THICK.
6. THE ASPHALT PAVEMENT MATERIAL SHALL BE INSTALLED AND COMPACTED THOROUGHLY WITH A SMOOTH DRUM ROLLER TO ACHIEVE A SMOOTH LEVEL PATCH.
7. NO HAND PATCHING ALLOWED.
8. PAVEMENT CUTS WITHIN NCDOT ROW SHALL CONFORM TO THE APPROVED ON SITE ENCROACHMENT PERMIT.
9. MINIMUM PATCH WIDTH TO BE WIDTH OF THE ROADWAY.
10. ANY EXISTING PAVEMENT MARKINGS DISTURBED BY WORK SHALL BE REPLACED.

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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD ASPHALT<br>PAVEMENT PATCH DETAIL | STD. NO.<br>3.14 |



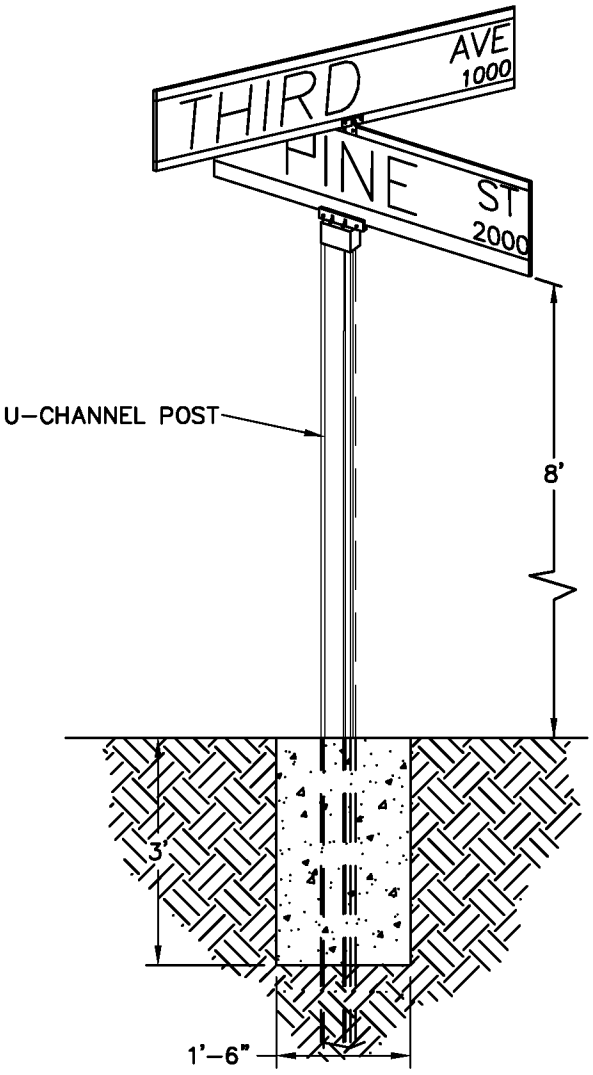

NOTES:

1. SEE TOWN OF KNIGHTDALE STANDARD SPECIFICATIONS FOR STORM DRAINAGE AND STANDARD DETAIL 5.02: "TRENCH FOR STORM DRAIN PIPES" FOR ADDITIONAL DETAILS.
2. PAVEMENT CUTS WITHIN NCDOT ROW SHALL CONFORM TO THE APPROVED ON SITE ENCROACHMENT PERMIT,
3. THE PAVEMENT CUT SHALL BE DEFINED BY A STRAIGHT EDGE AND CUT WITH AN APPROVED SAW CUT MACHINE.
4. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH SUITABLE MATERIAL AND COMPACTED TO A DENSITY OF AT LEAST 95% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH AASHTO T-99 AS MODIFIED BY NCDOT.
5. THE FINAL 6" OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO A DENSITY EQUAL TO 100% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH AASHTO T-80 AS MODIFIED BY NCDOT.
6. ANY EXISTING PAVEMENT MARKINGS DISTURBED BY WORK SHALL BE REPLACED.

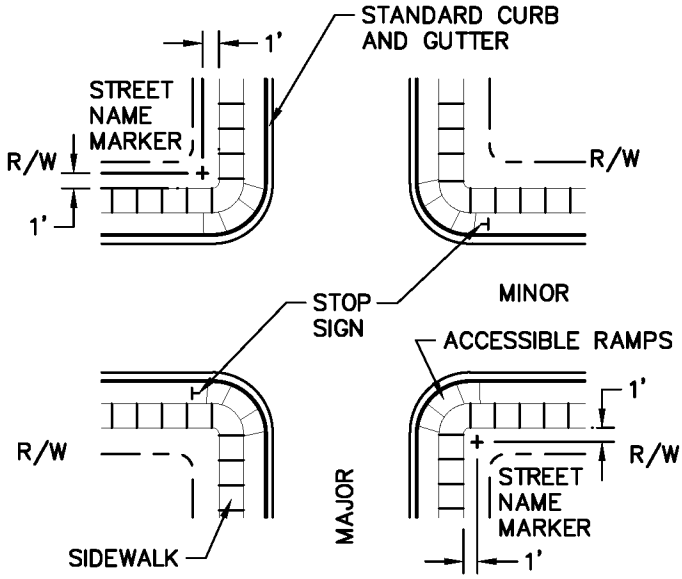
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD CONCRETE PAVEMENT PATCH DETAIL | STD. NO. 3.15 |

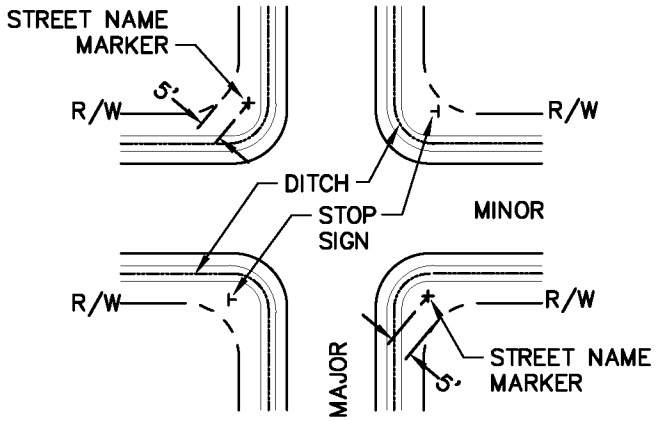
INSTALLATION OF STREET NAME SIGN



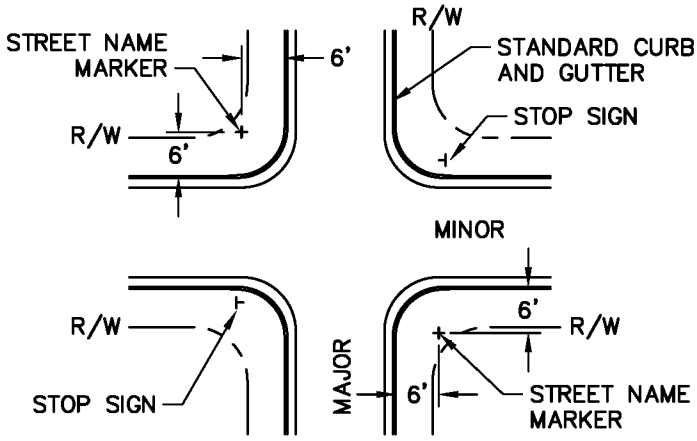

INTERSECTION WITH SIDEWALK, CURB, AND GUTTER




INTERSECTION WITH DITCHES, AND NO CURB AND GUTTER




INTERSECTION WITH CURB AND GUTTER

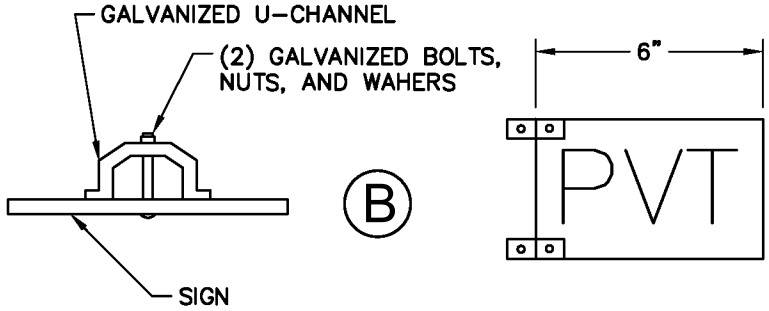


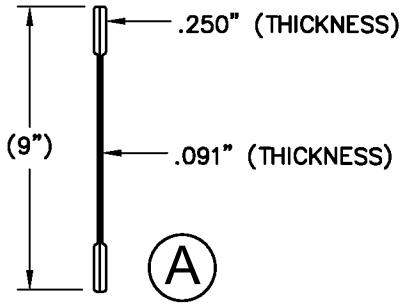

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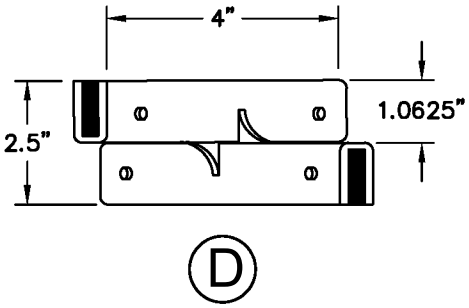
1. TWO STREET NAME MARKERS ARE REQUIRED IF THE MAJOR STREET HAS 3 OR MORE LANES.
2. ANY VARIANCE FROM THIS STANDARD MUST BE APPROVED BY THE TOWN OF KNIGHTDALE.
3. ALL DECORATIVE SIGNS MUST BE REVIEWED AND APPROVED BY THE TOWN.

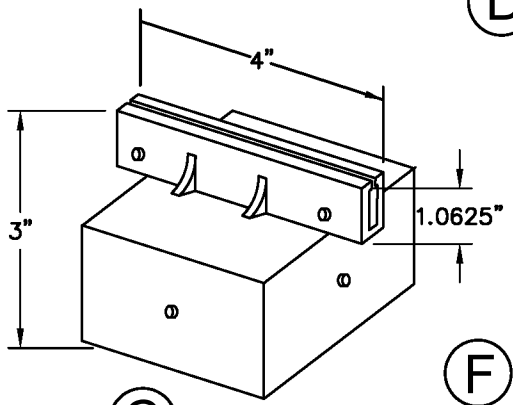
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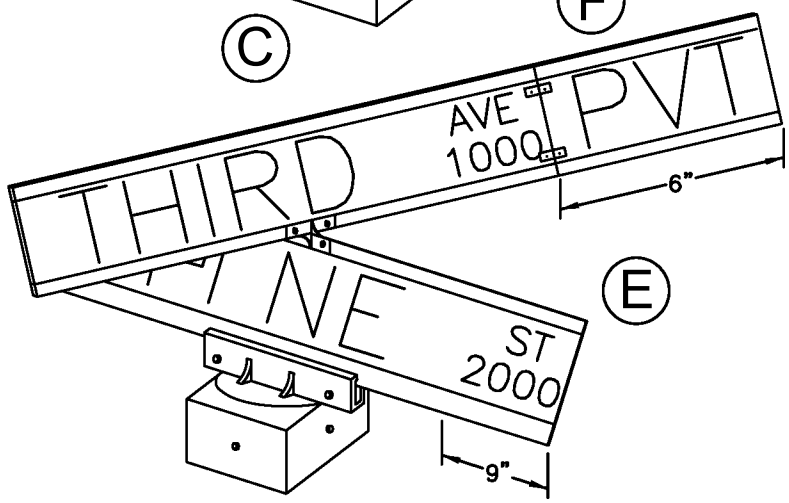
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STREET NAME SIGN INSTALLATION LOCATIONS | STD. NO. 3.16-1 |



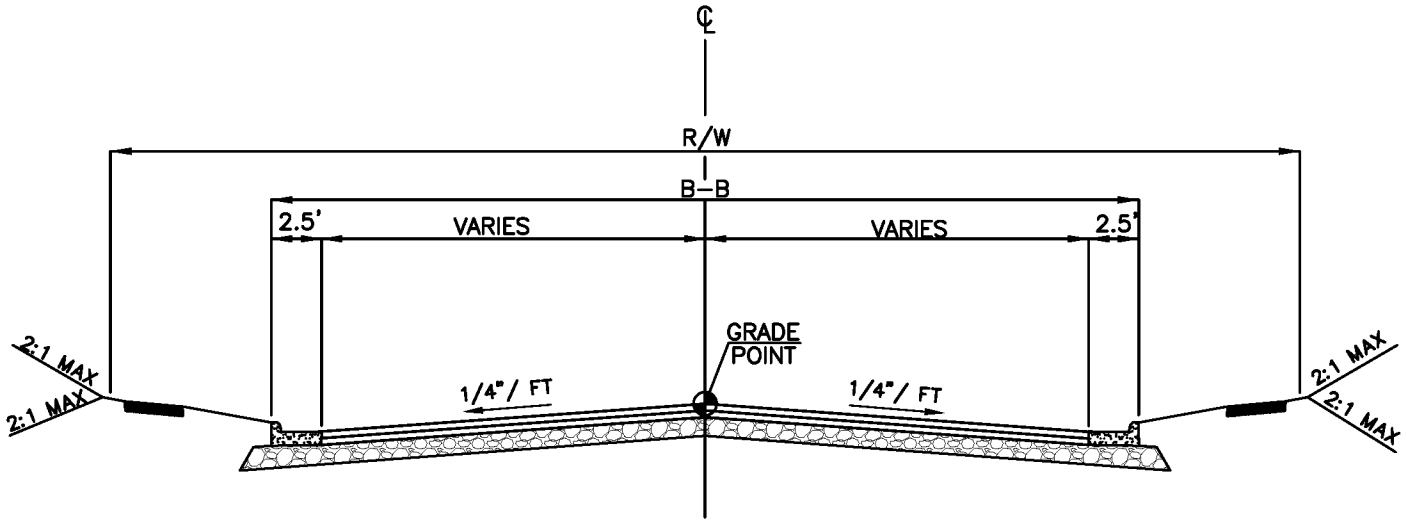



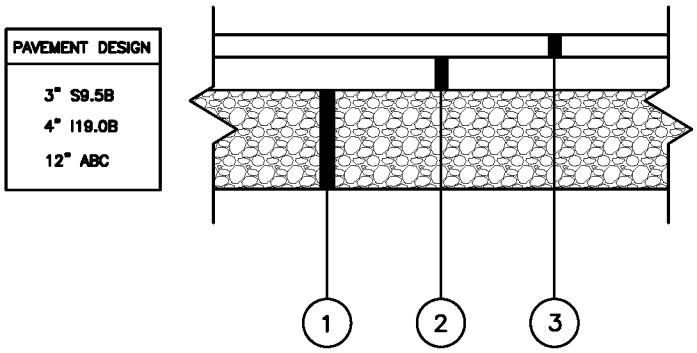

NOTES:

1. BLADES SHALL BE EXTRUDED ALUMINUM 6063T5 OR 6063T6 ALLOY .080" THICK. POST SHALL BE 10'-0" IN LENGTH, 3 LB. STEEL U-CHANNEL SUPPORTS PER NCDOT STD. 1094-1(B).
2. CAP TO BE ALUMINUM #380 ALLOY OR EQUAL SLOTTED FOR .25" EXTRUDED BLADE; 2.375" I.D. BASE, DIE CAST AND POLISHED. CAP SHALL BE TAPPED TO RECEIVE AND INCLUDE 3 STAINLESS STEEL SET SCREWS FOR POST MOUNTING AND 2 STAINLESS STEEL SET SCREWS FOR BLADE MOUNTING. SET SCREWS TO HAVE ALLEN HEADS (SEE DETAIL C).
3. BLADE SPACER BRACKET SHALL MEET SAME SPECIFICATIONS AS THE CAP WITH 2 SCREWS TO EACH BLADE MOUNTING (SEE DETAIL D).
4. THE FACE OF ALL BLADES SHALL MEET COVERED WITH ENGINEERING GRADE SHEETING WITH #2290 WHITE DIE CUT LETTERS WITH REVERSED SCREENED #708 TRANSPARENT GREEN. THE PRIMARY LETTERS SHALL BE 5" HIGH UPPER CASE, FHWA SERIES B AND PREFIX/SUFFIX LETTERS SHALL BE 2-1/2" HIGH, UPPER CASE, FHWA SERIES C. BLOCK NUMBERS SHALL BE PLACED IN THE LOWER RIGHT CORNER AND SHALL BE 2-1/2" HIGH, FHWA SERIES C. ALL MATERIALS TO BE VACUUM AND HEAT APPLIED TO A PREPARED ALUMINUM BLADE, WHICH HAS BEEN CLEANED AND ALL FOREIGN MATERIAL REMOVED (SEE DETAIL E).
5. LETTERS, NUMBERS AND SPACING SHALL CONFORM TO THE STANDARD ALPHABETS FOR HIGHWAY SIGNS, 1966 EDITION, REPRINT MAY, 1972 BY THE U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION, OFFICE OF TRAFFIC OPERATION.
6. ALL STREET NAME SIGNS ARE SUBJECT TO APPROVAL BY THE TOWN. BLOCK NUMBERS SHALL BE PROVIDED ON SIGNS AND CORRESPOND TO OFFICIALLY APPROVED ADDRESSES.
7. IF THE STREET IS INTENDED TO BE PRIVATE, A SUPPLEMENTAL PLATE IS REQUIRED. THE SUPPLEMENTAL PLATE MAY BE ATTACHED TO THE SIGN OR AN EXTENDED BLADE WITH BLACK ON YELLOW SHEETING MAY BE USED. THE SIGN SHALL HAVE BLACK LETTERS THAT SHOW PVT TO STAND FOR PRIVATE. THE LETTERS SHALL BE 2-1\2" HIGH, UPPER CASE, FHWA SERIES C, ON A BACKGROUND OF YELLOW ENGINEERING GRADE SHEETING. (SEE DETAIL F).
8. ON ALL ROADWAYS EXCEPT STREETS WITH STANDARD CURB AND GUTTER AND SPEED LIMITS EQUAL TO OR LESS THAN 25 MPH, ALL SIGNS WITHIN CLEAR ZONE SHALL BE OF A BREAKAWAY DESIGN THAT COMPLIES WITH THE LATEST EDITION OF AASHTO MANUAL FOR ASSESSING SAFETY HARDWARE (MASH)AND NCHRP REPORT 350.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STREET NAME SIGN | STD. NO. 3.16-2 |




## HEAVY VEHICLE PAVEMENT SECTION

1. BITUMINOUS SURFACE COURSE: 3" S9.5B
2. INTERMEDIATE COURSE: 4" I19.0B
3. BASE COURSE: 12" ABC

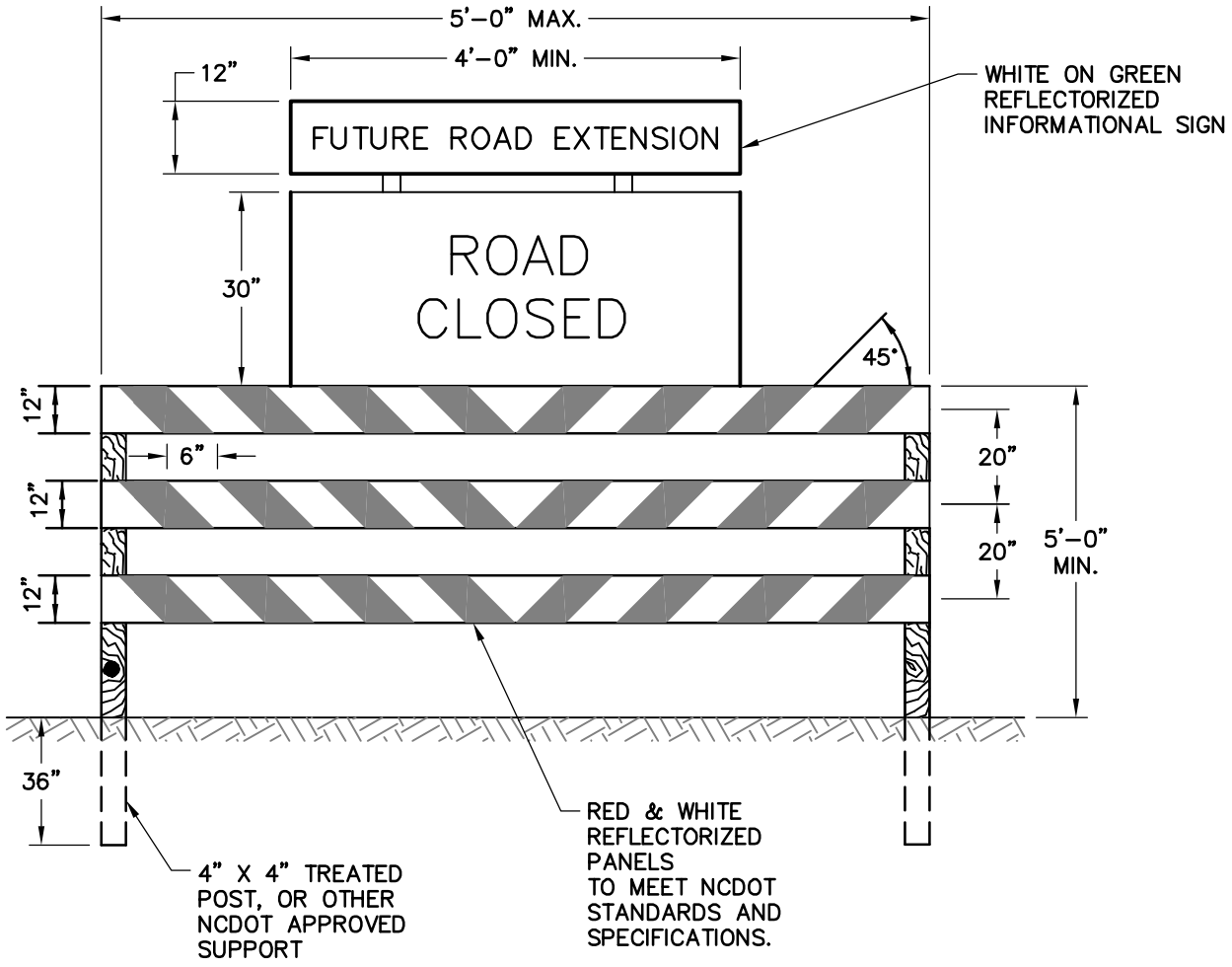
## SECTION

NOTES:

1. TO BE USED ON ANY STREET INTENDED FOR INDUSTRIAL AND HEAVY VEHICLE USE.
2. FOLLOW DESIGN DETAIL FOR APPLICABLE CROSS SECTION.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | HEAVY VEHICLE PAVEMENT DESIGN | STD. NO. 3.17 |

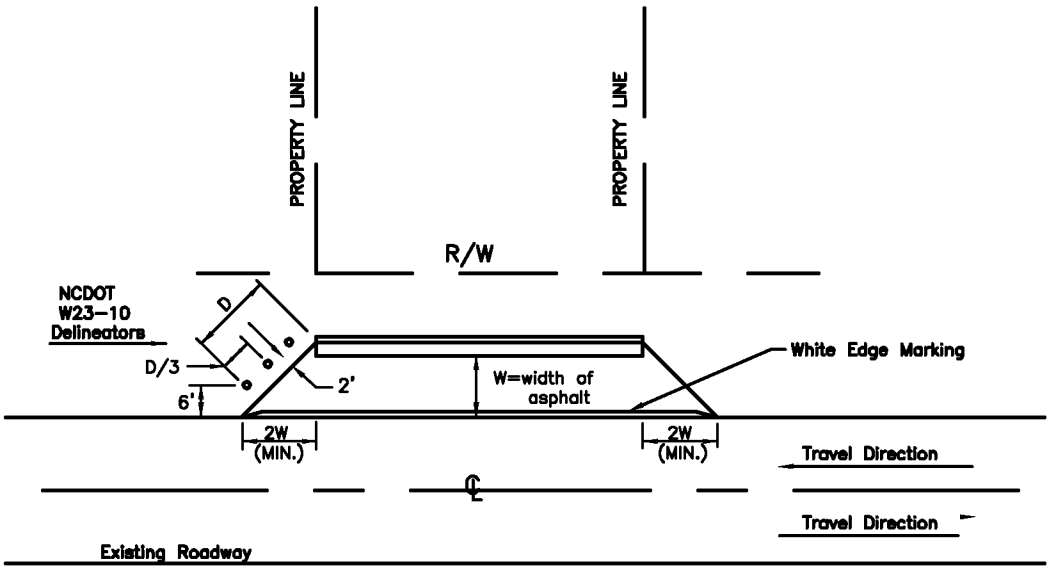



NOTES:

1. BARRICADE(S) TO BE ERECTED ACROSS ENTIRE ROADWAY INCLUDING CURB & GUTTER.
2. ADVANCE WARNING SIGN W14-1 (DEAD END) SHALL BE PLACED JUST AFTER LAST INTERSECTING STREET.
3. MARKINGS FOR BARRICADE RAILS SHALL BE REFLECTIVE AND ALTERNATE RED AND WHITE STRIPS.
4. "ROAD CLOSED" SIGN SHALL MEET SPECIFICATIONS OF M.U.T.C.D R11-2 AND BE REQUIRED ATOP EACH BARRICADE USED.

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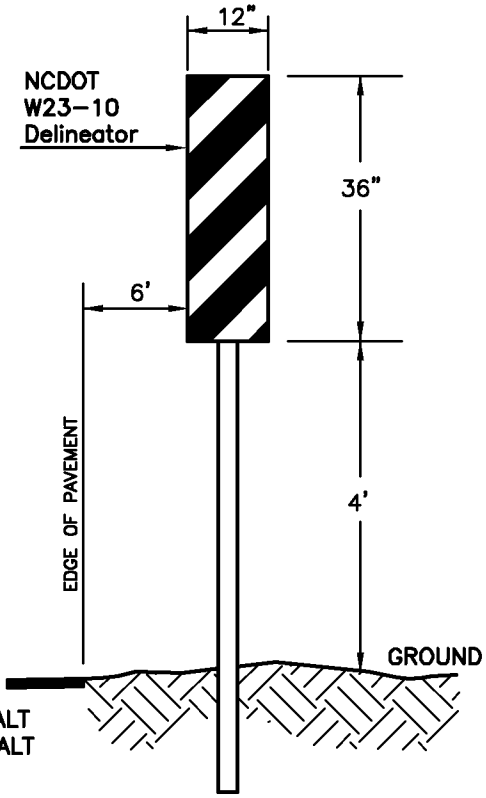
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| TOWN OF KNIGHTDALE STANDARD DETAILS | TEMPORARY BARRICADE FOR DEAD END ROADS | STD. NO. 3.18 |




PLAN VIEW

NOTES:

1. TAPER ON BOTH ENDS OF ROADWAY WIDENING SHALL BE A MININMUM 2:1. THE TOWN ENGINEER AND/OR NCDOT RESERVE THE RIGHT TO REQUIRE A LONGER TAPER IF DEEMED NECESSARY FOR THE SAFETY OF THE PUBLIC.
2. A SOLID WHITE EDGE MARKING SHALL BE EXTENDED ALONG WIDENING AT EXISTING PAVEMENT.
3. DELINEATORS SHALL ONLY BE REQUIRED AT TAPER FROM CURB TO EXISTING PAVEMENT IN DIRECTION OF TRAVEL.
4. DELINEATORS SHALL BE ORIENTED SUCH THAT THE FACE OF THE SIGN IS PERPENDICULAR TO TRAVEL LANE.




A. BOTTOM EDGE OF DELINEATOR 4' ABOVE ROADWAY.

B. THE DELINEATOR STRIPES SHALL SLOPE UPWARD SLOPE UPWARD AND OUTWARD FROM TRAFFIC.

C. DELINEATORS TO BE SPACED ON CENTERS AT 1/3 OF THE DISTANCE D SHOWN BELOW FOR NEW ASPHALT WIDTHS $\leq$ 15 FT. OR AT 1/4 OF D FOR NEW ASPHALT WIDTHS > 15 FT.

D. DELINEATORS SHALL BE MOUNTED ON BREAKAWAY POSTS.

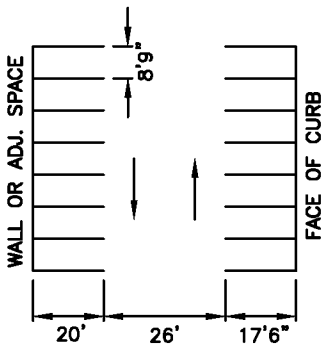
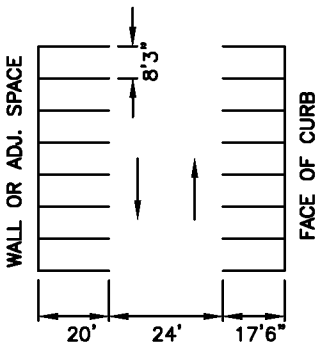
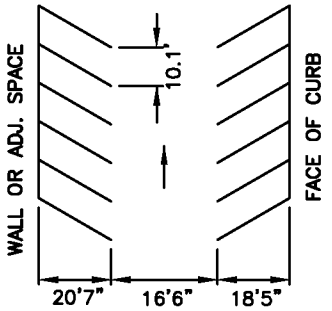
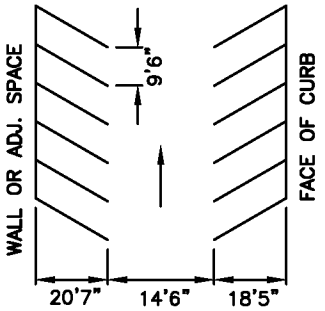
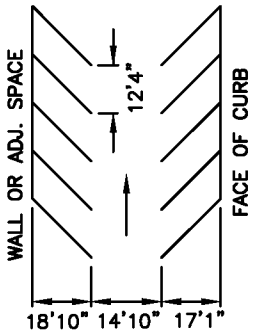
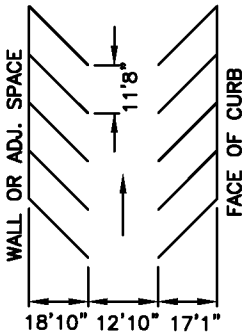
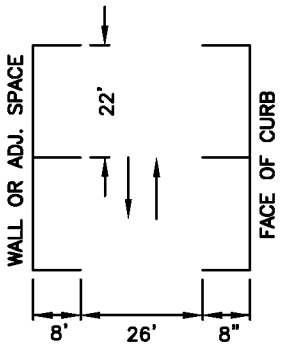
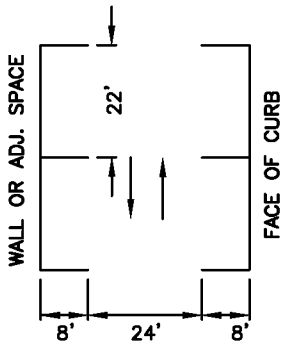
E. DELINEATORS SHALL BE REFLECTORIZED.

DETAIL

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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD PAVEMENT WIDENING<br>TAPER AND MARKINGS | STD. NO.<br>3.19 |

PLANNING & URBAN DESIGN
DESIGN STANDARDS

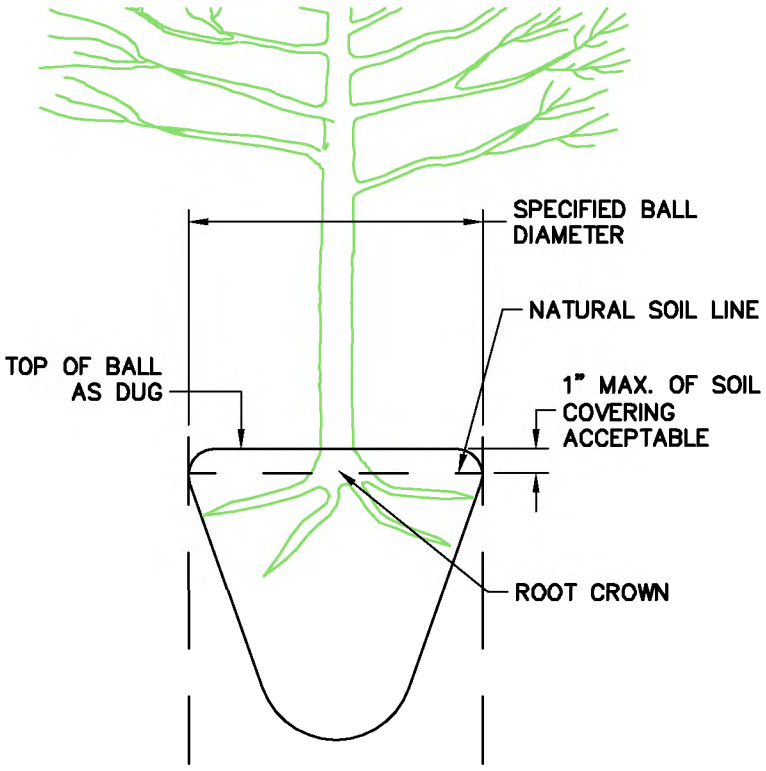
| | RECOMMENDED LOS "A" | MINIMUM LOS "C" | |
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| PARKING ANGLE 90°<br>(TWO WAY OPERATION ONLY)<br>TOTAL 63'6" |  |  | TOTAL 61'6" |
| PARKING ANGLE 60°<br>(ONE WAY OPERATION ONLY)<br>TOTAL 55'6" |  |  | TOTAL 53'6" |
| PARKING ANGLE 45°<br>(ONE WAY OPERATION ONLY)<br>TOTAL 50'9" |  |  | TOTAL 48'9" |
| PARALLEL PARKING<br>(TWO WAY OPERATION ONLY)<br>TOTAL 42' |  |  | TOTAL 40' |

NOTE:

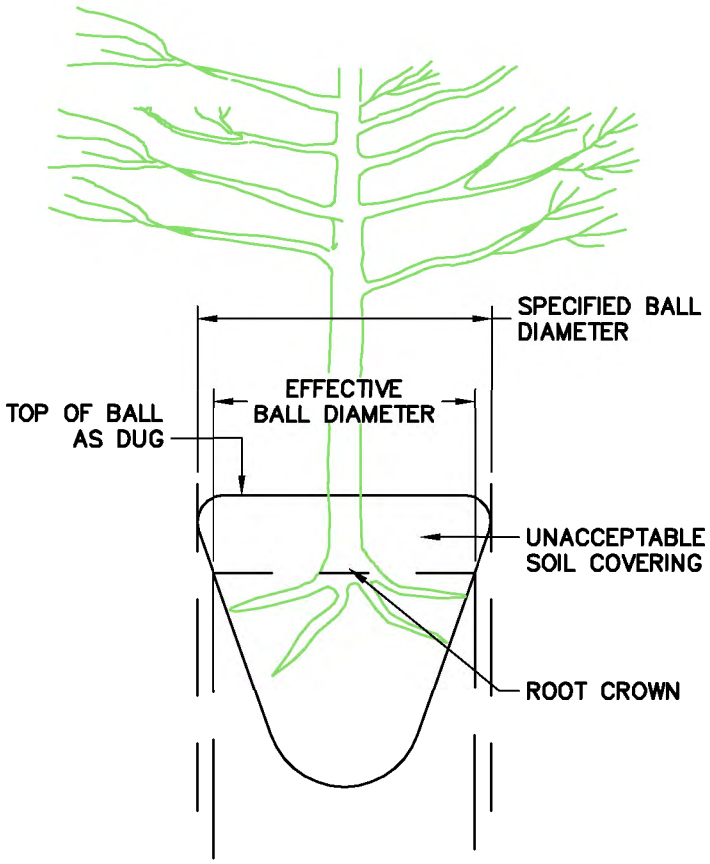
1. FOR ACCESSIBLE PARKING STANDARDS SEE TOWN UNIFIED DEVELOPMENT ORDINANCE.
2. PAVEMENT MARKINGS SHALL BE 4" WHITE PAINT TO TOWN STANDARDS.

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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | PARKING STANDARDS | STD. NO.<br>3.20 |




ACCEPTABLE CONDITION



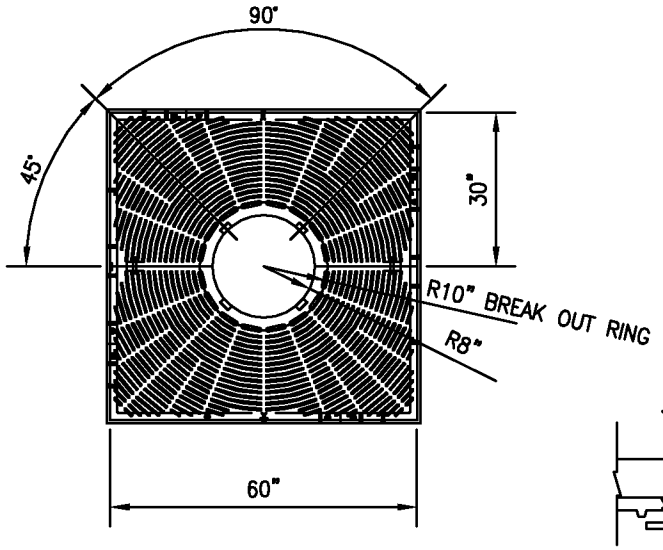

UNACCEPTABLE CONDITION

NOTE:

A ROOT COLLAR EXCAVATION FOR ALL TREES SPECIFIED WILL BE DONE BY THE TOWN TO ENSURE THAT TREES WERE NOT PLANTED/GROWN TOO DEEPLY AT SOURCE (NURSERY). LANDSCAPE CONTRACTOR SHALL HAVE SUPPLIER MARK GROUND LEVEL LINE ABOVE ROOT BALL. IF TOWN DETERMINES THAT THERE IS EXCESSIVE SOIL OVER THE ROOT CROWN, THESE TREES WILL BE REJECTED.

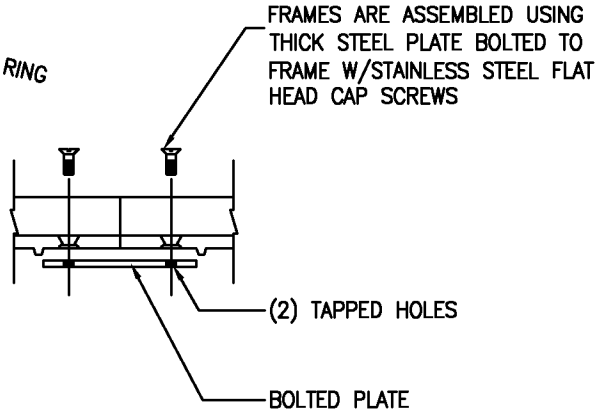
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| TOWN OF KNIGHTDALE STANDARD DETAILS | ROOT CROWN DEPTHS | STD. NO. 3.21 |




TREE GRATE W/BREAK AWAY RING

NTS




ASSEMBLY DETAIL

NOTE:
MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
FINISH: NOT PAINTED

NOTES:

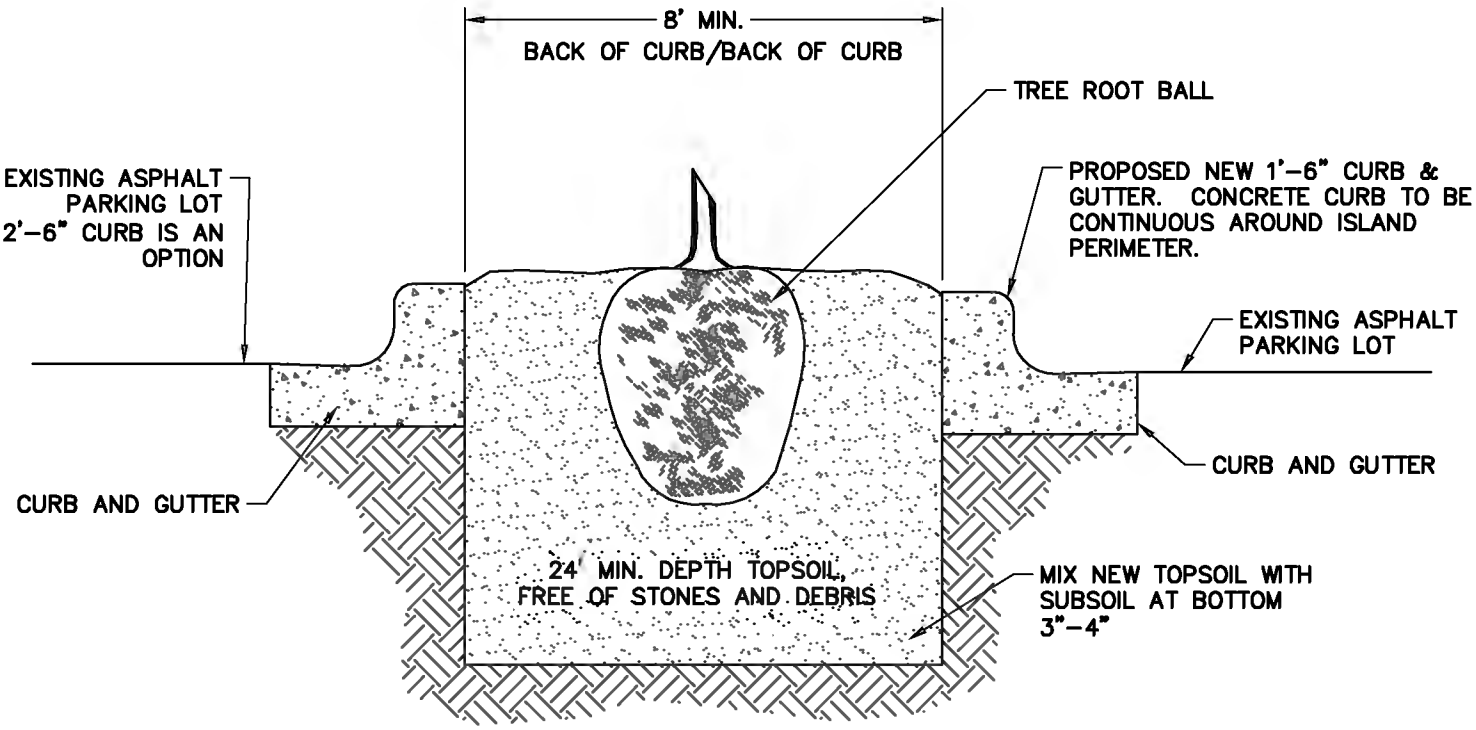
1. TREE GRATES ARE REQUIRED AT VARIOUS LOCATIONS IN TOWN TO COMPLY WITH ZONING REQUIREMENTS. ALL OTHER INSTALLATIONS OF TREE GRATES WITHIN THE R/W OF STATE MAINTAINED STREETS REQUIRE AN ENCROACHMENT AGREEMENT EXECUTED THROUGH NCDOT.
2. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
3. MATERIAL SHALL BE CAST GRAY IRON ASTM A-48, CLASS 35B WITH A NON PAINTED FINISH.
4. AN INSPECTION SCHEDULE IS NEEDED FOR TREES THAT WILL BE PLANTED IN THE STREET R/W DUE TO ZONING OR OTHER REQUIREMENTS. LANDSCAPE INSPECTION INCLUDES THE FOLLOWING:

   TREE PIT/WELL OR PLANTING STRIP INSPECTION
   SOIL MIX APPROVALS/INSPECTIONS
   TREE APPROVALS/INSPECTIONS – PRIOR TO PURCHASING THE TREES, TO BE MADE BY TOWN
   TREE PLANTING INSPECTION
   FINAL WALK THROUGH

5. ALL OF THE ABOVE INSPECTIONS WILL BE PERFORMED BY THE TOWN

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| TOWN OF KNIGHTDALE STANDARD DETAILS | TREE GRATE DETAIL | STD. NO. 3.22 |

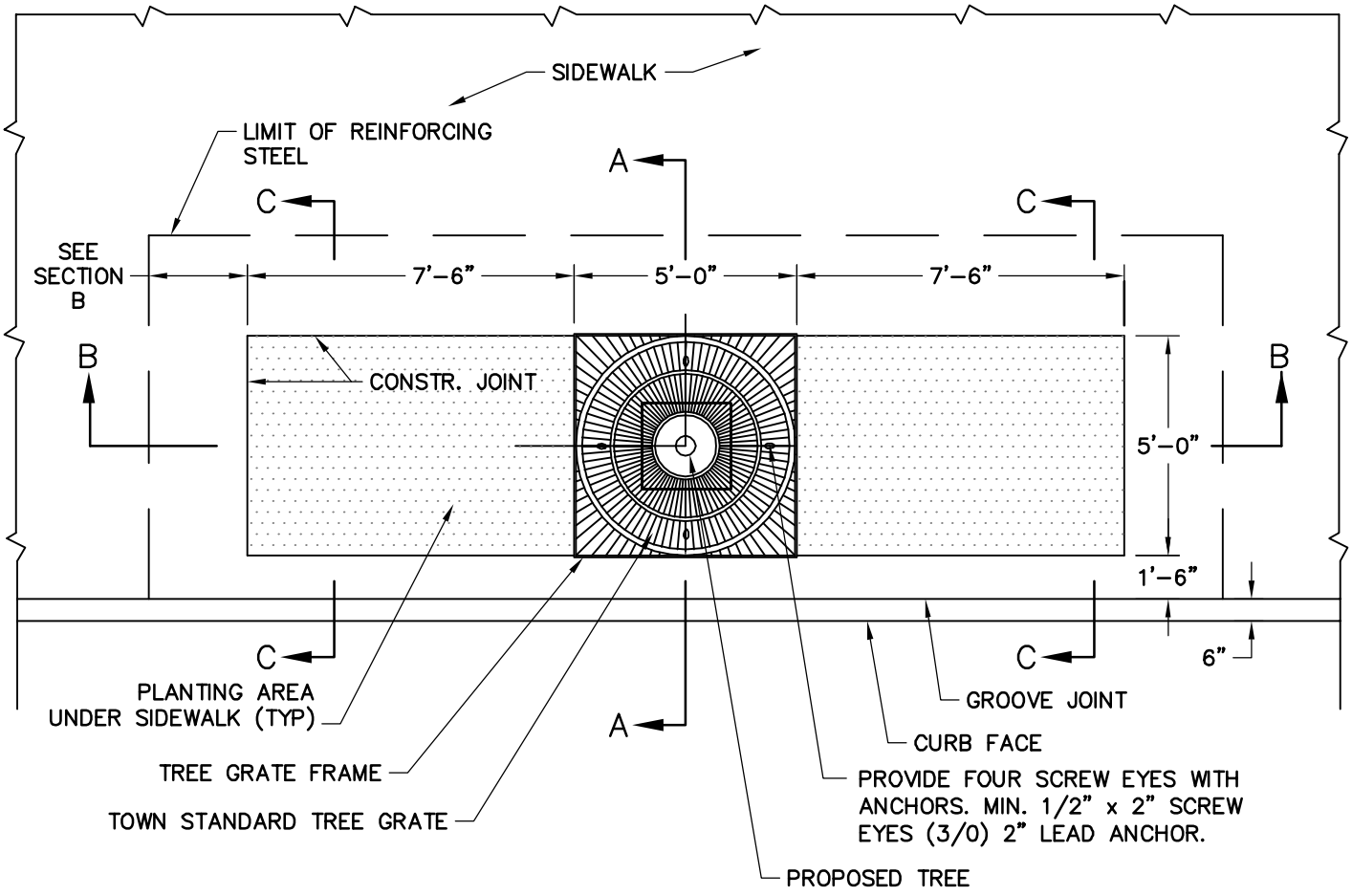



NOTES:

1. 300 SF MIN. TOTAL REQUIRED AREA PER TREE.
2. FOR NEW PLANTING AREAS, REMOVE ALL PAVEMENT, GRAVEL SUB-BASE AND CONSTRUCTION DEBRIS BEFORE PREPARING SOIL AND PLANTING TREES.
3. REMOVE COMPACTED SOIL AND ADD 24" NEW OR TOPSOIL/PLANTING MIX OR UNCOMPACT AND AMEND TOP 24" OF EXISTING SOIL TO MEET TOPSOIL/PLANTING MIX STANDARDS FOR TREES.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | TREE PLANTING ISLAND IN PARKING LOTS | STD. NO. 3.23 |

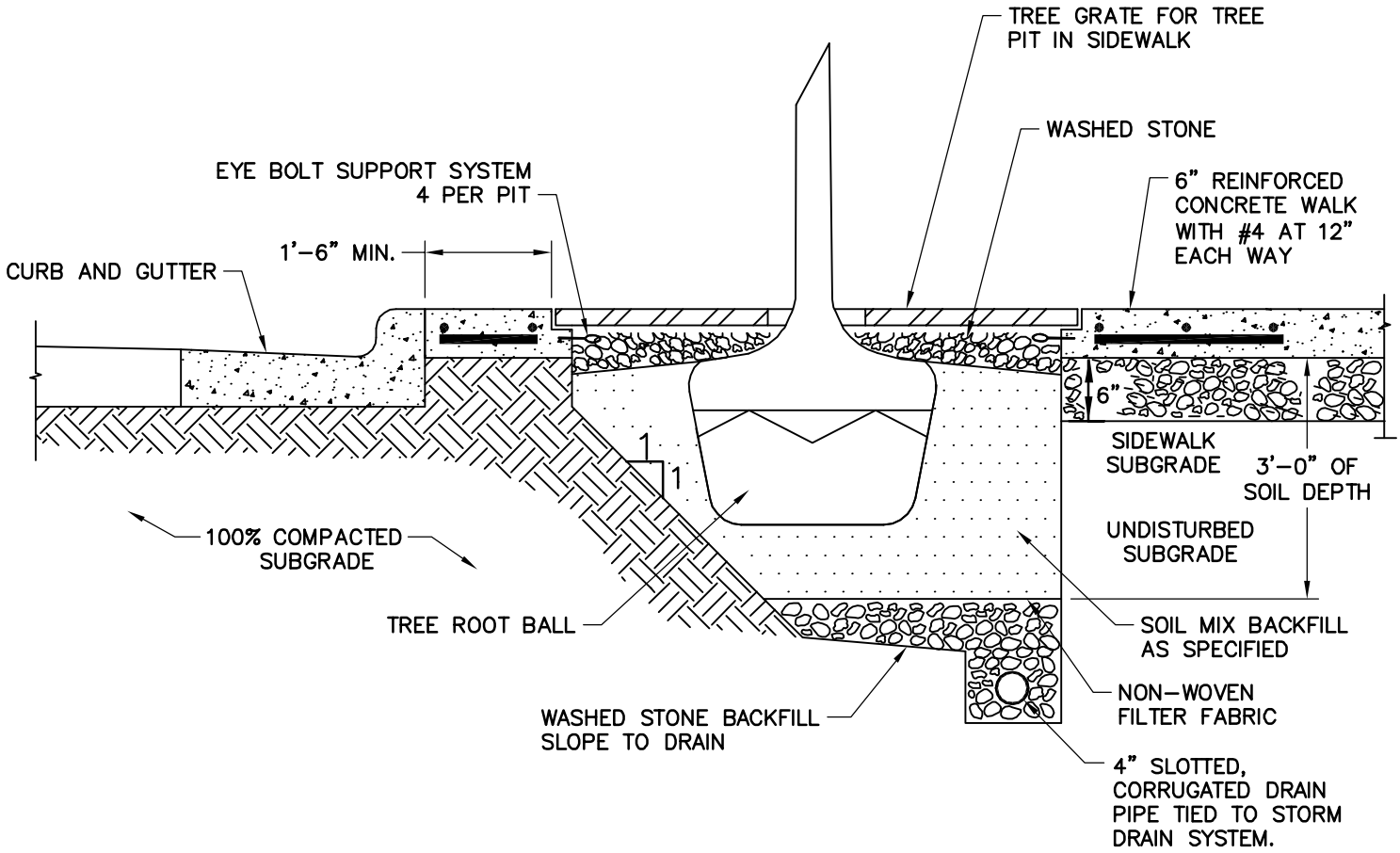



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| TOWN OF KNIGHTDALE STANDARD DETAILS | TREE PIT WITH GRATE IN SIDEWALK | STD. NO. 3.24 |
|---|---|---|




SECTION A-A

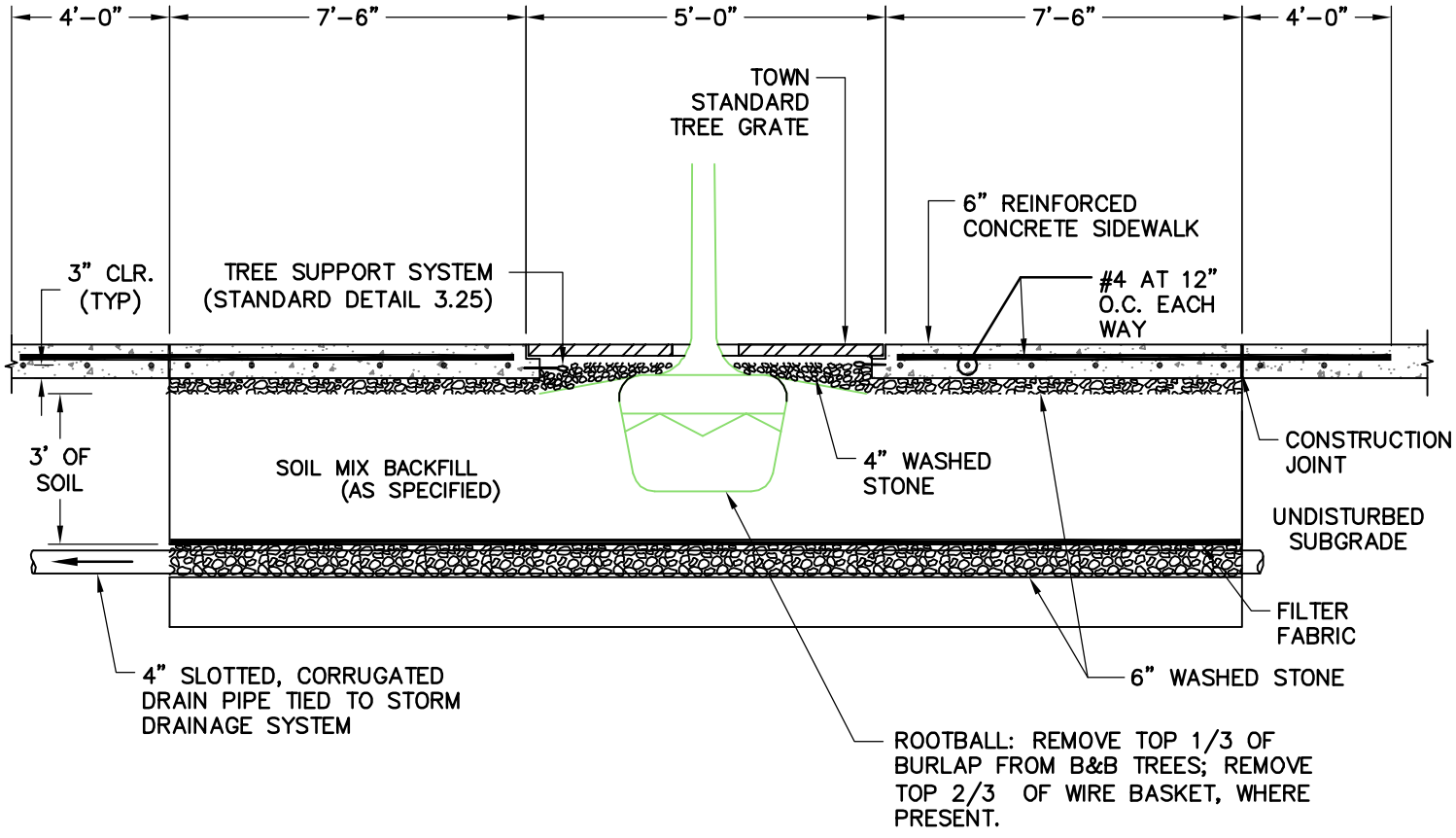
NOTE:

SIDEWALK SUBBASE SHALL BE A 70 PERCENT AGGRATE TO 30 PERCENT SANDY SOIL MIXTURE PER TOWN STANDARD SPECIFICATIONS.

| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | TREE PIT WITH GRATE IN SIDEWALK | STD. NO. 3.24 |
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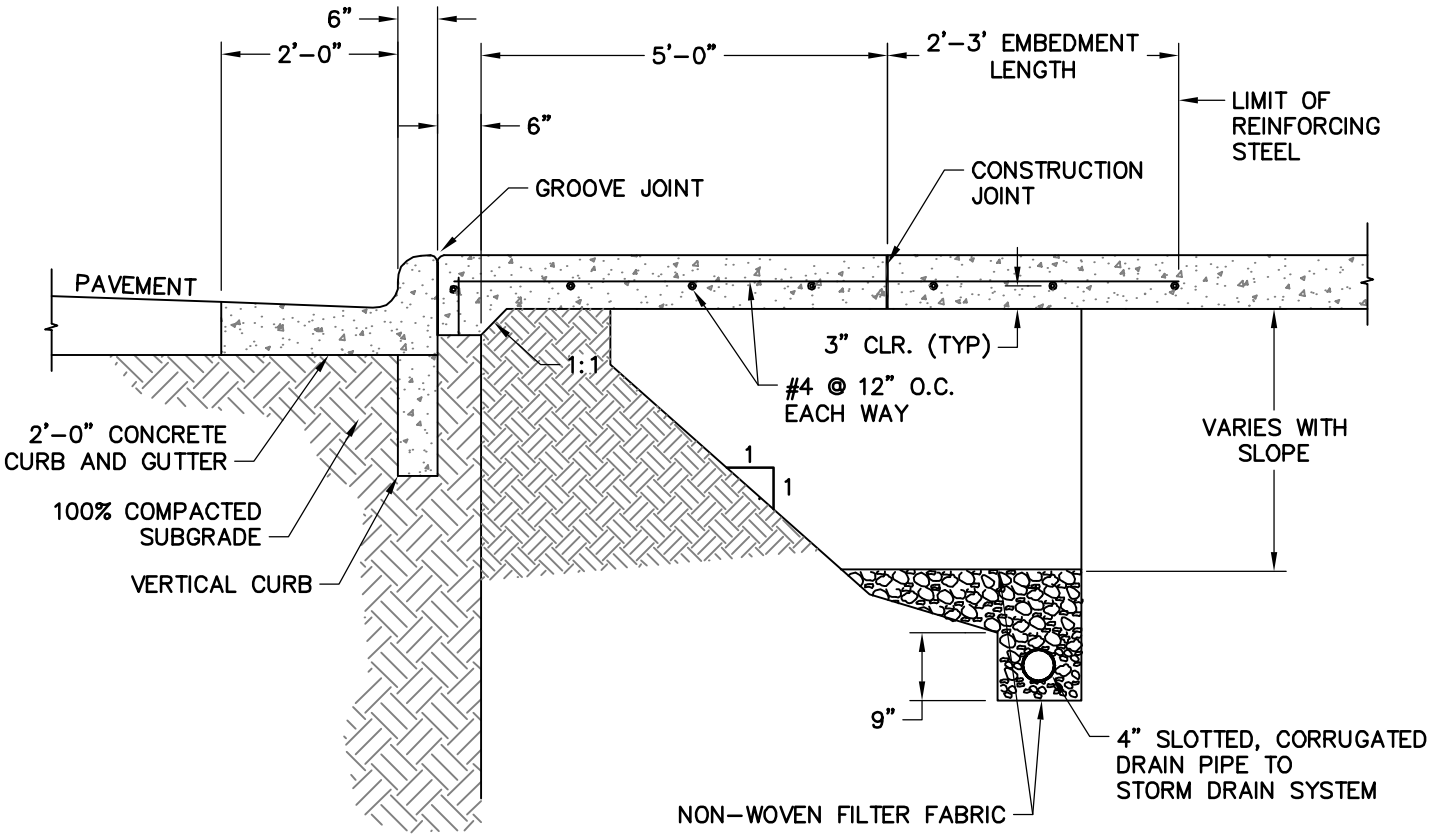



SECTION B–B

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | TREE PIT WITH GRATE IN SIDEWALK | STD. NO. 3.24 |
|---|---|---|




NOTES:

1. EXPANSION JOINTS ARE PERMITTED AT 40' MIN. SPACING AND NOT LESS THAN 12'-6" FROM CENTER OF TREE GRATE.
2. SEE STANDARD DETAIL 4.04 (2 OF 2) FOR GROOVE JOINT.
3. CONCRETE SHALL BE 3600 PSI IN 28 DAYS.
4. ALL REINFORCING STEEL SHALL BE GRADE 60.
5. USE REINFORCED STEEL BAR SUPPORTS IN COMPLIANCE WITH NCDOT STANDARD SPECIFICATION 970-4.

SECTION C-C

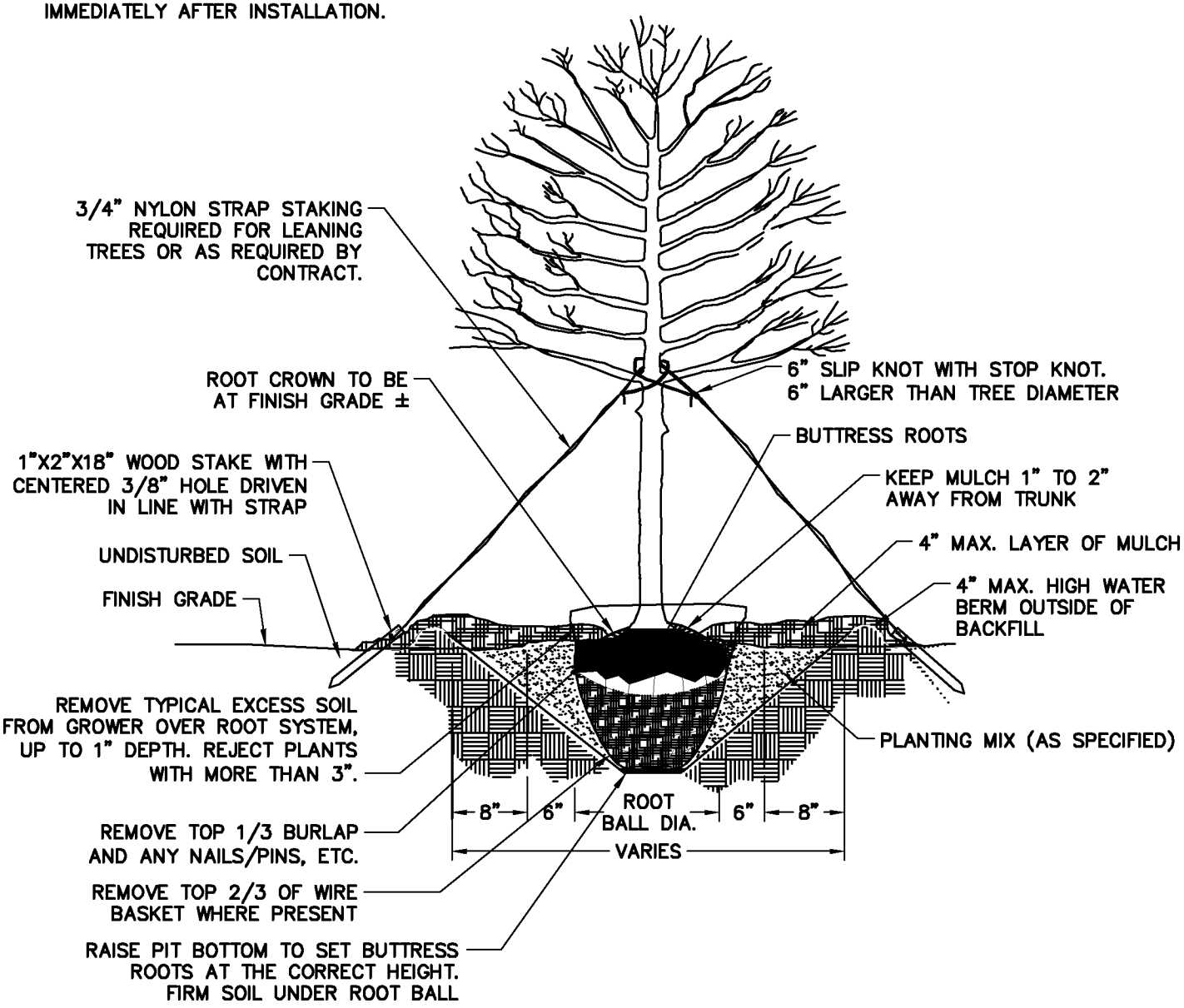
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| TOWN OF KNIGHTDALE STANDARD DETAILS | TREE PIT WITH GRATE IN SIDEWALK | STD. NO. 3.24 |
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NOTES:

1. REMOVE WIRE OR NYLON TWINE FROM BALL.
2. SOAK ROOT BALL AND PLANT PIT IMMEDIATELY AFTER INSTALLATION.




ALL TREES SHALL MEET AMERICAN STANDARD FOR NURSERY STOCK
( AMSI, 1990, PART 1, "SHADE AND FLOWERING TREES")

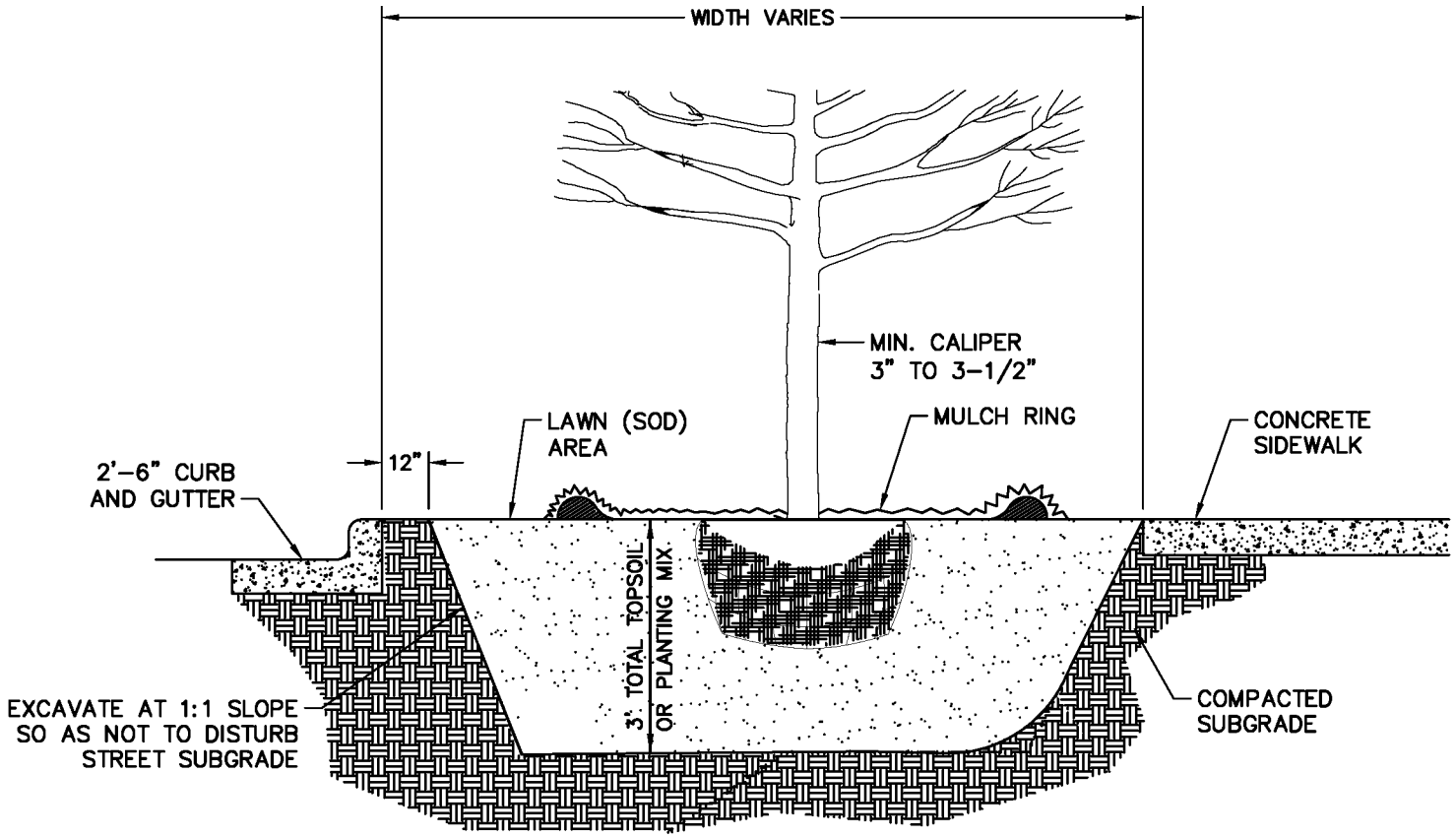
| FOR EXAMPLE: | CALIPER | HEIGHT (RANGE) | MAX. HEIGHT | MIN. ROOT BALL DIA. | MIN. ROOT BALL DEPTH |
|---|---|---|---|---|---|
| | 2" | 12–14' | 16' | 24" | 16" |
| | 3" | 14–16' | 18' | 32" | 21" |

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| TOWN OF KNIGHTDALE STANDARD DETAILS | TREE PLANTING (FOR SINGLE AND MULTI-STEM TREES) | STD. NO. 3.25 |

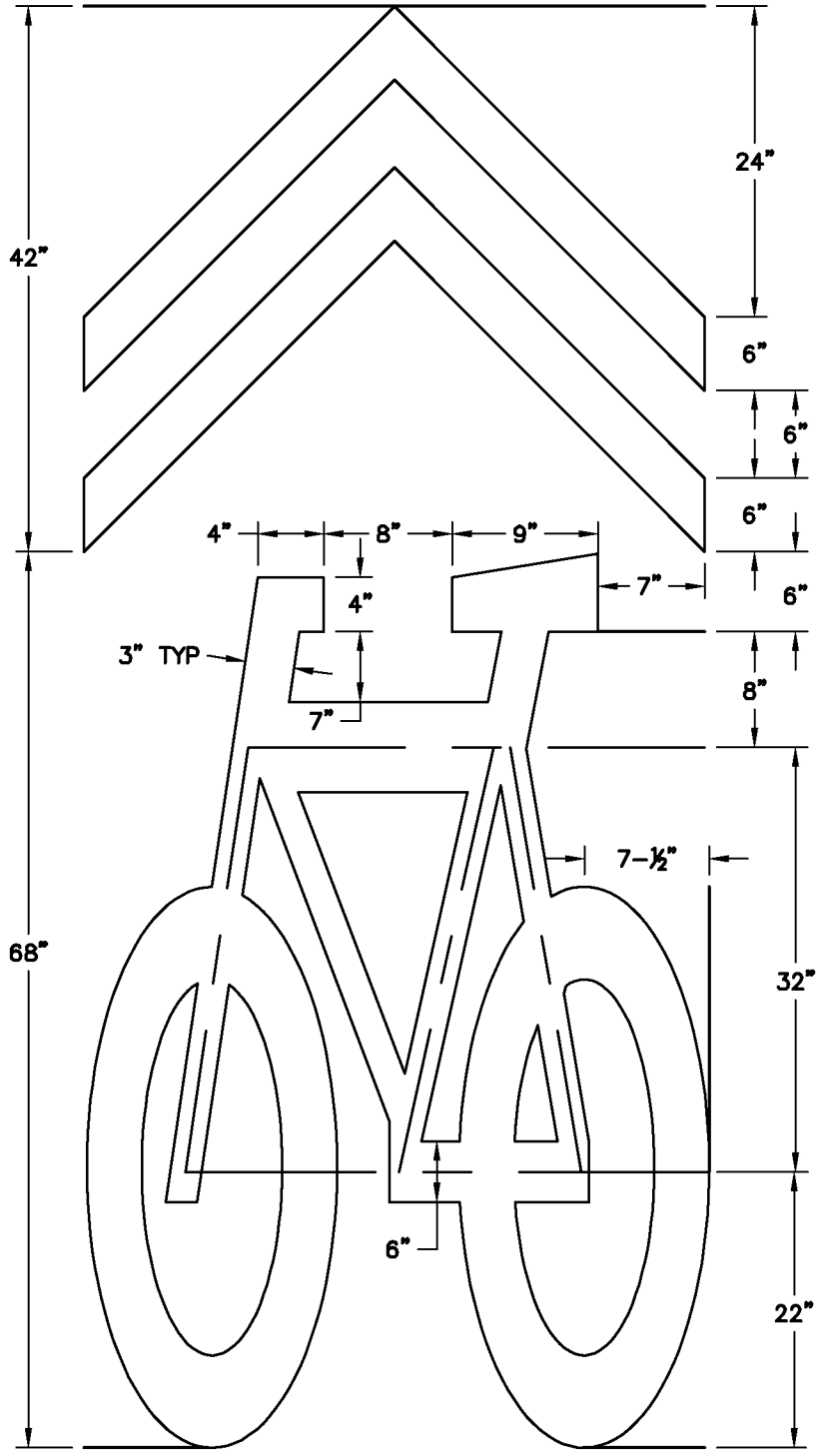
NOTES:

1. MEANT TO PROVIDE GUIDANCE ON STREET TREE PLANTING. REFERENCE SPECIFIC CROSS SECTION FOR PLANTING LOCATION AND WIDTH.
2. 6 FT. PLANTING WIDTH PREFERRED, WHERE POSSIBLE.
3. FOR NEW PLANTING AREAS, REMOVE ALL PAVEMENT, GRAVEL, SUB-BASE, AND CONSTRUCTION DEBRIS BEFORE PREPARING SOIL AND PLANTING TREES.
4. REMOVE COMPACTED SOIL AND ADD 24" NEW TOPSOIL WITH PLANT MIX OR UNCOMPACT AND AMEND TO 24" OF EXISTING SOIL TO MEET TOPSOIL WITH PLANTING MIX STANDARDS FOR TREES.
5. MULCH SHALL NOT BE STACKED AGAINST BASE OF PLANTING.



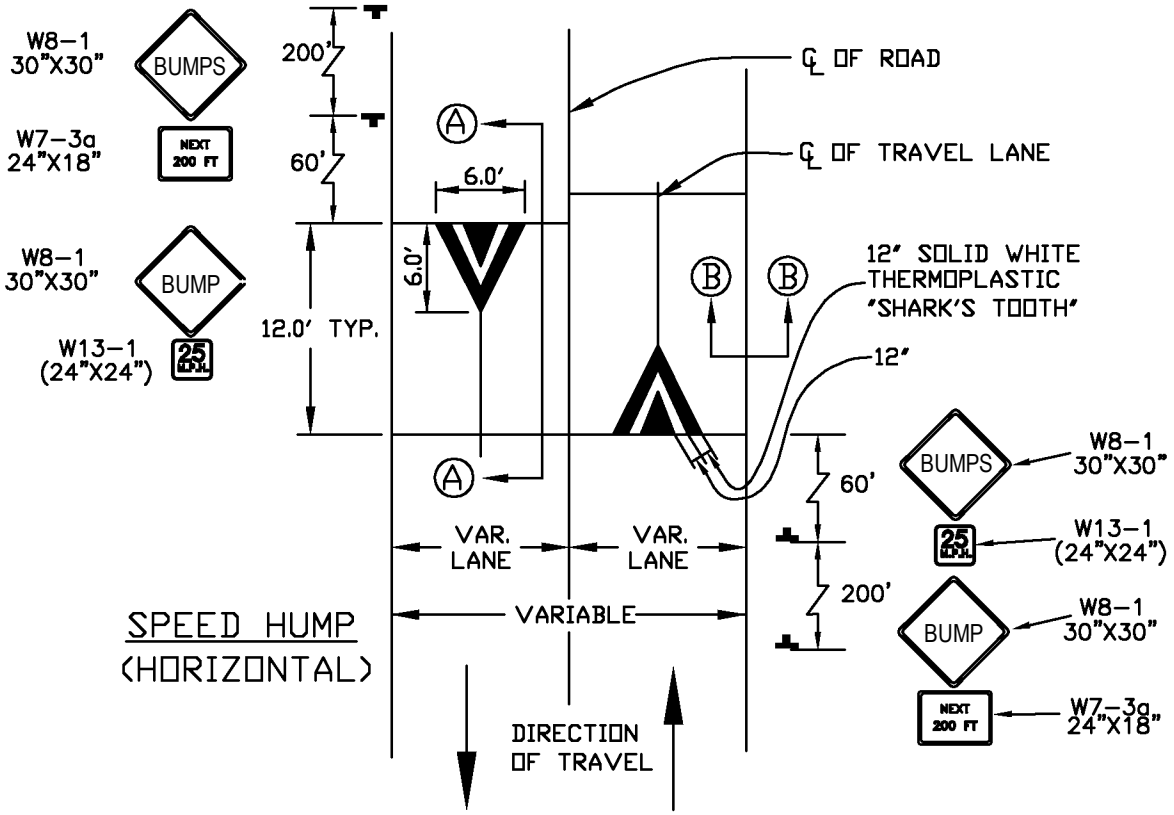

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STREET TREE PLANTING | STD. NO. 3.26 |

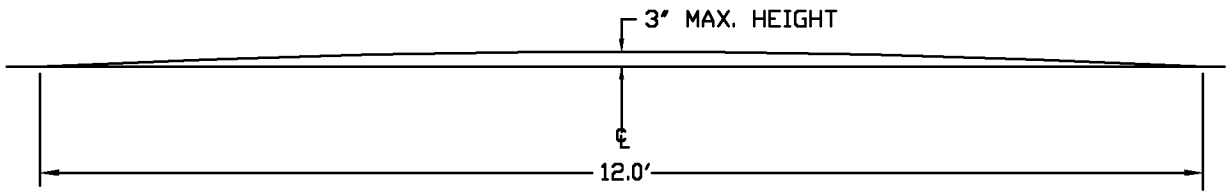



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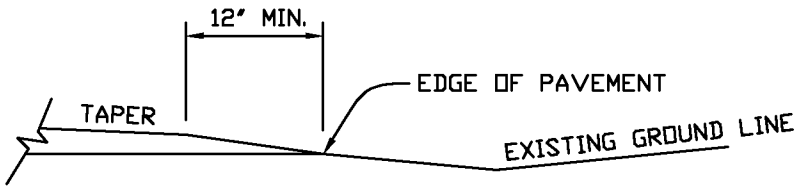
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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | BICYCLE SHARED LANE MARKER | STD. NO.<br>3.27 |




SPEED HUMP
(HORIZONTAL)




SECTION A-A

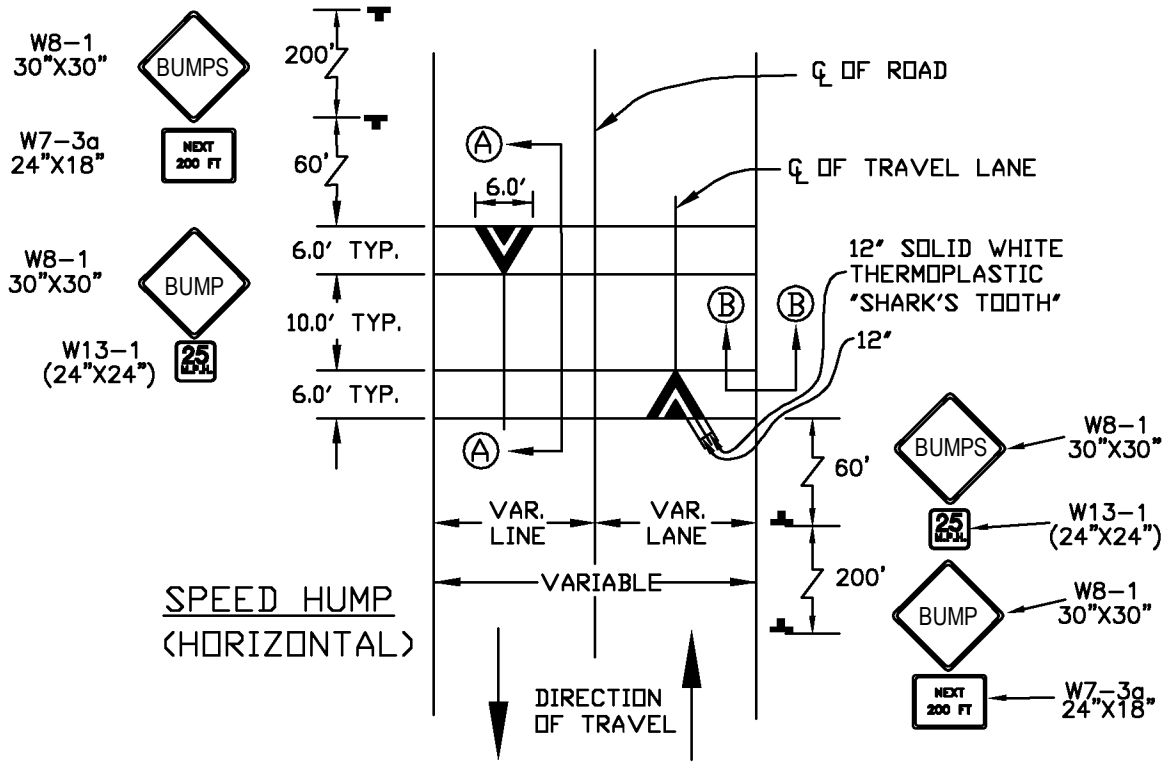



SECTION B-B

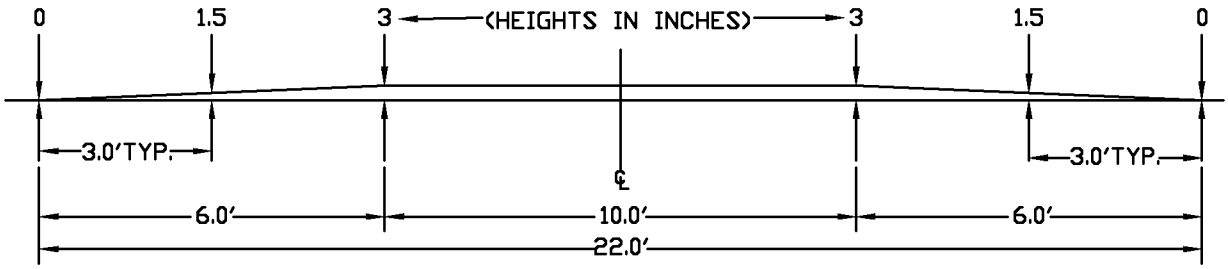
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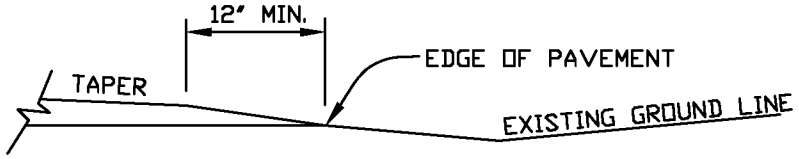
| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD PAVEMENT UNDULATION (SPEED HUMP) | STD. NO. 3.28 |
|---|---|---|




SPEED HUMP
(HORIZONTAL)




SECTION A-A

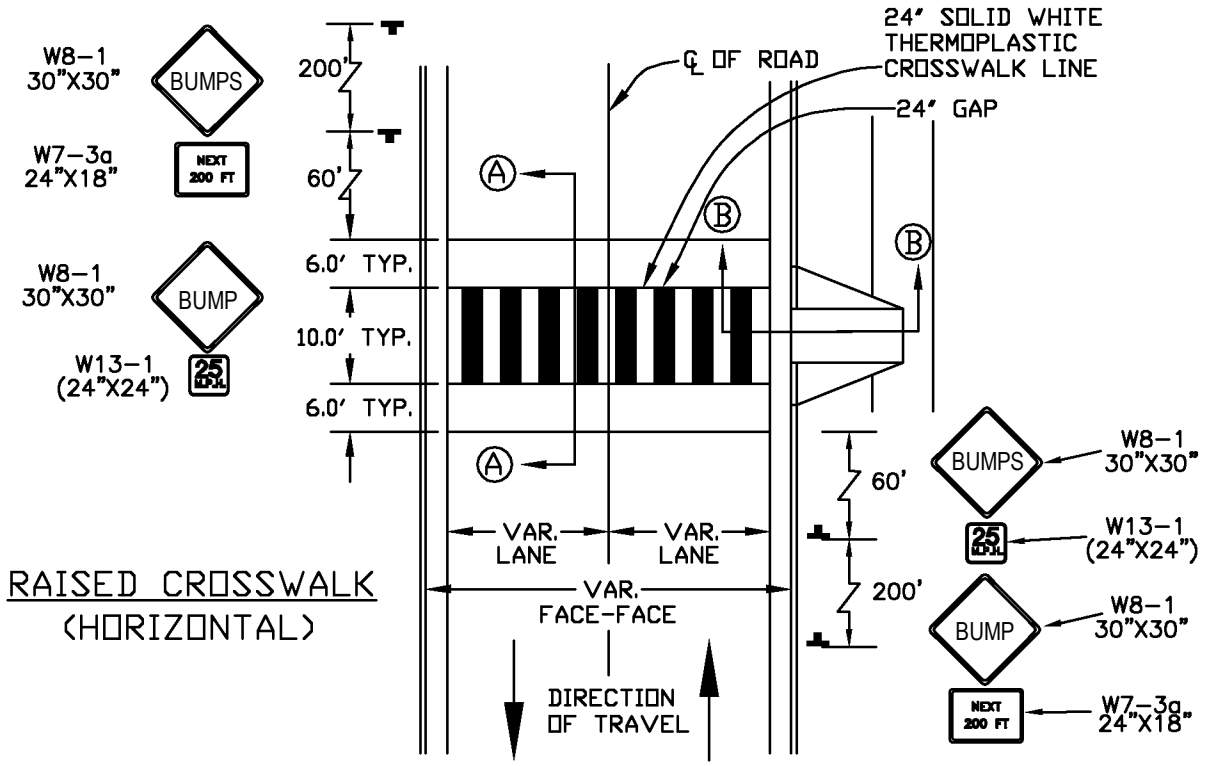



SECTION B-B

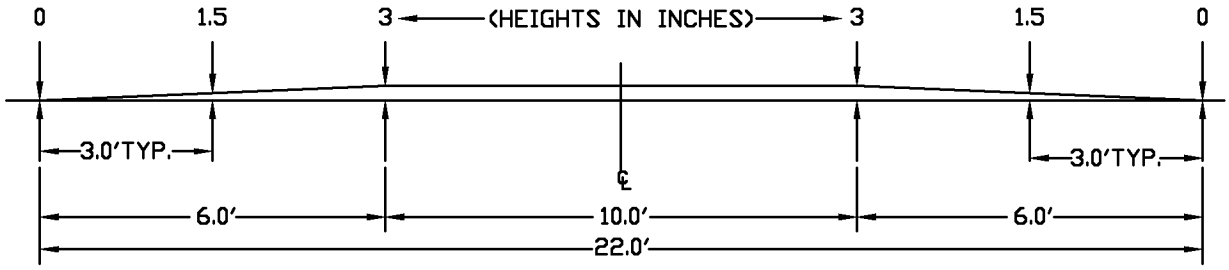
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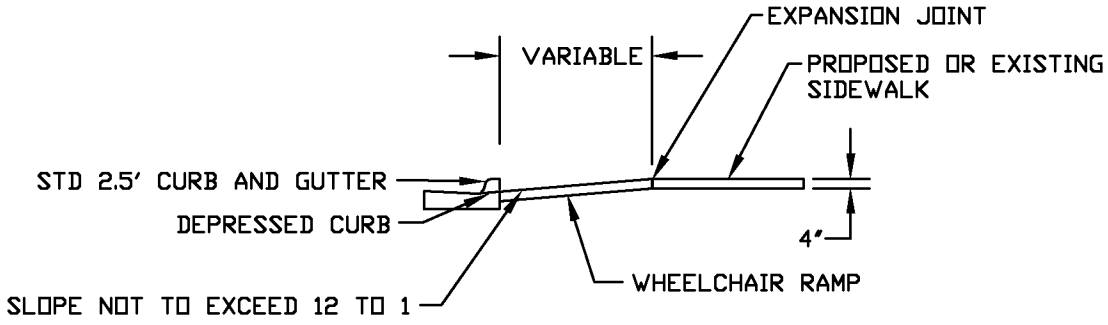
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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD PAVEMENT UNDULATION<br>(FLAT TOP SPEED HUMP) | STD. NO.<br>3.28 |




RAISED CROSSWALK
(HORIZONTAL)




SECTION A-A

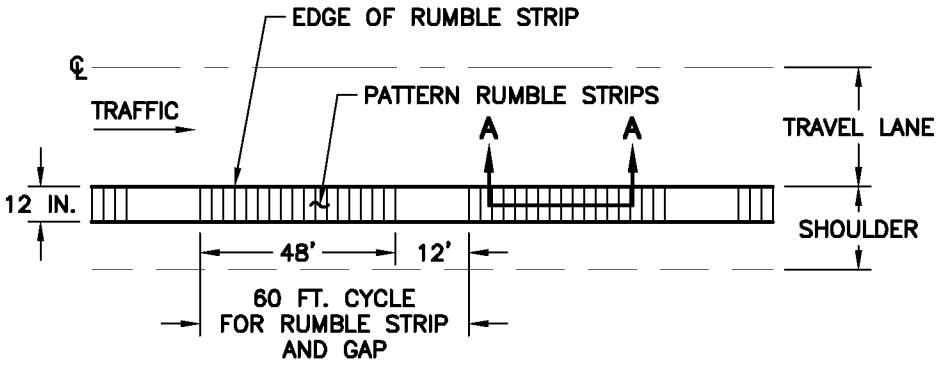



SECTION B-B

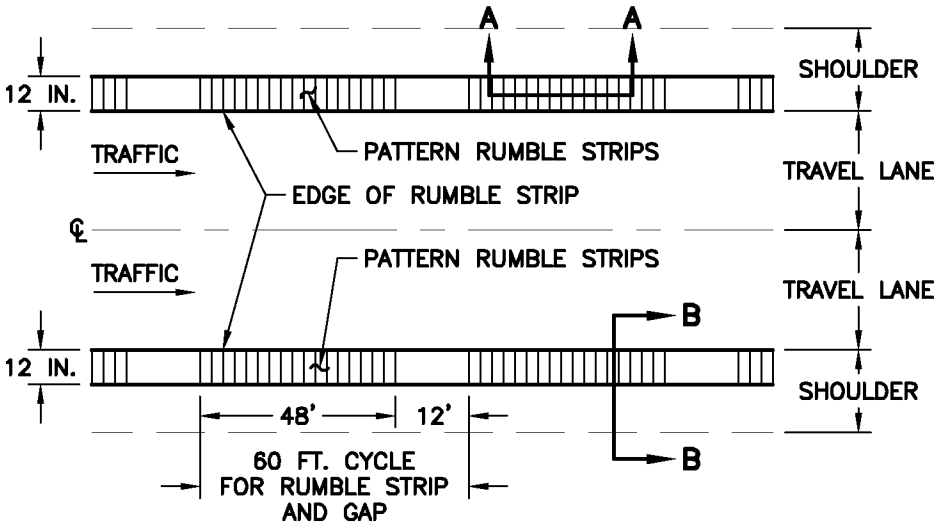
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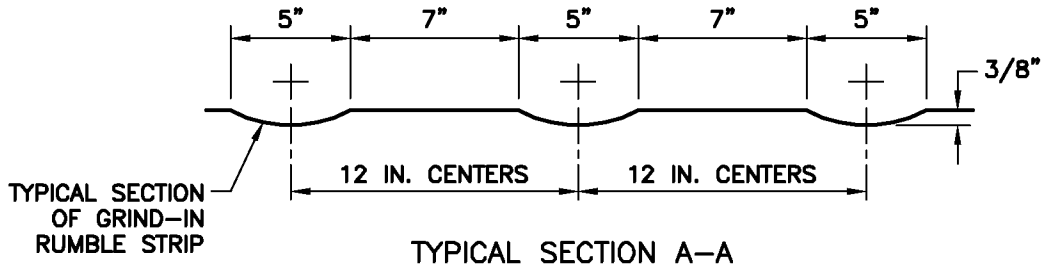
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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD PAVEMENT UNDULATION<br>(RAISED PEDESTRIAN CROSSING) | STD. NO.<br>3.28 |



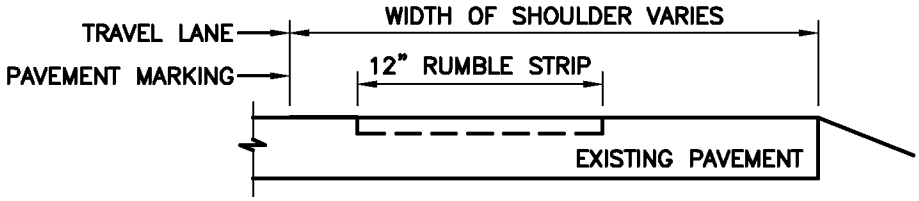

INTERMITTENT RUMBLE STRIP
TWO–LANE ROADWAY (ASPHALT)




INTERMITTENT RUMBLE STRIP
FOUR–LANE DIVIDED ROADWAY (ASPHALT)



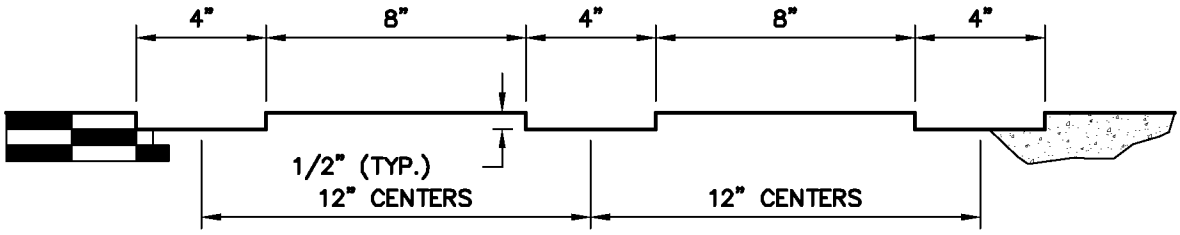

TYPICAL SECTION A–A
FOR GRIND–IN RUMBLE STRIP
ON EXISTING ASPHALT OR CONCRETE PAVEMENT




TYPICAL SECTION B–B

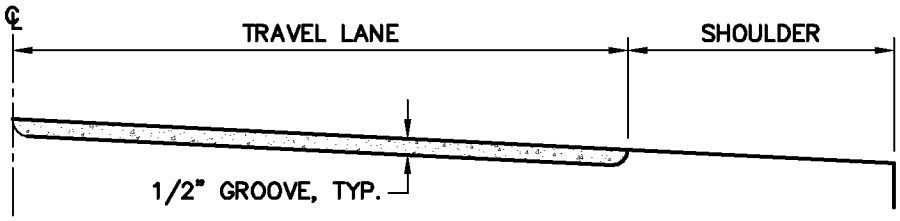
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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | RUMBLE STRIPS<br>OUTSIDE LANE | STD. NO.<br>3.29 |



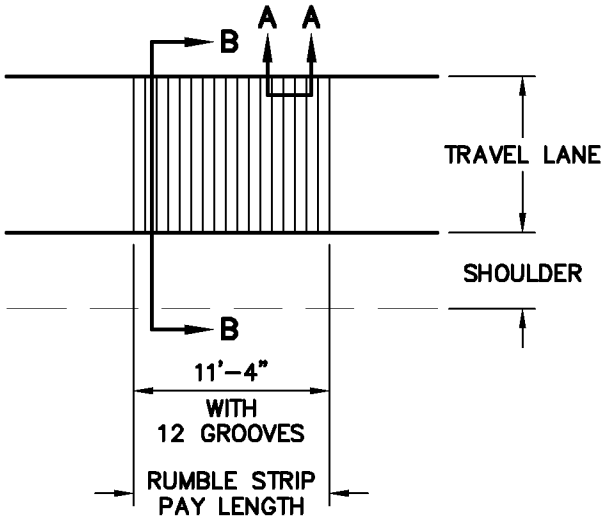

RUMBLE STRIP GROOVES IN ASPHALT OR CONCRETE SURFACE
12 STRIPS PER CLUSTER, TYPICAL

SECTION A–A
(GROOVED)




SECTION B–B
(GROOVED)

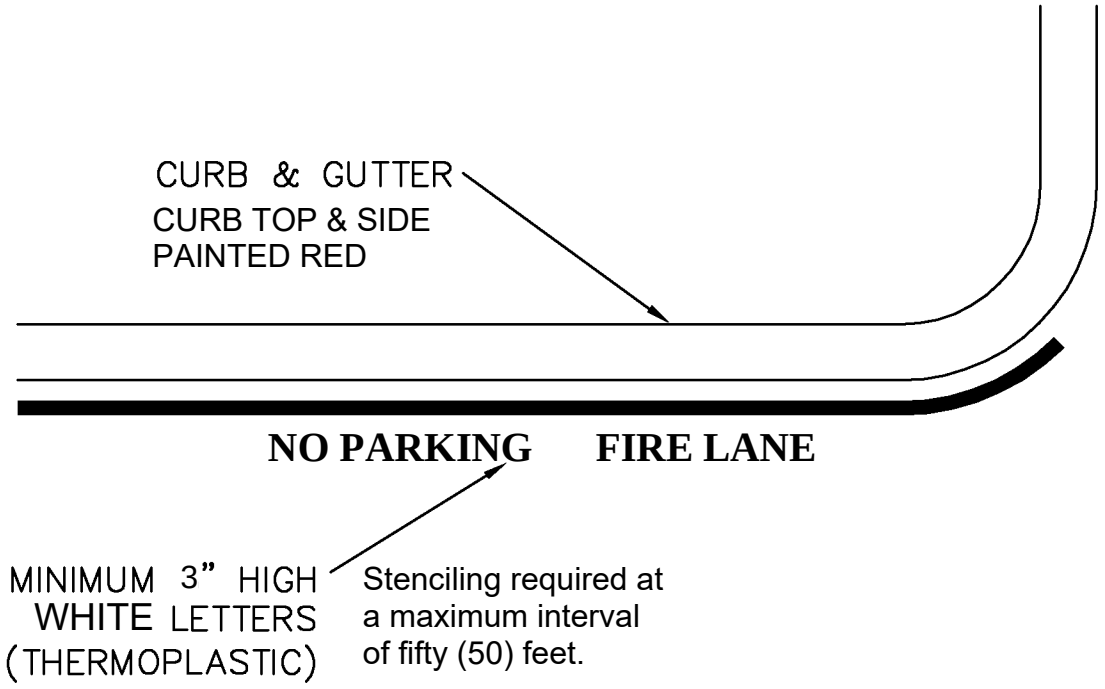
PERMANENT GROOVED RUMBLE STRIPS




TYPICAL RUMBLE STRIP CLUSTER

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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | RUMBLE STRIPS<br>TRAFFIC CALMING | STD. NO.<br>3.30 |

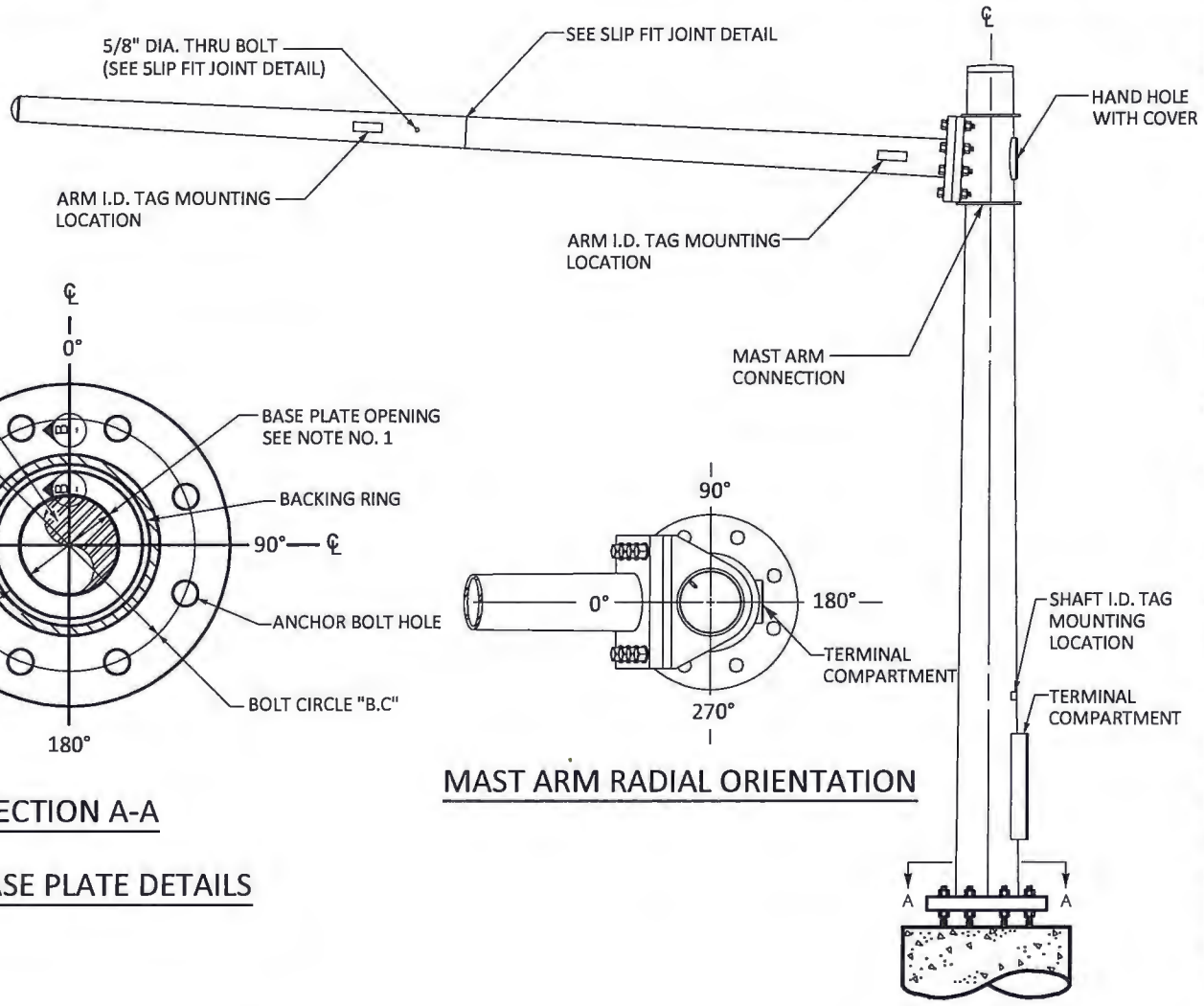



# TYPICAL FIRE LANE PAVEMENT MARKING DETAIL

Note:
1. If no curbing exists, provide a painted six (6)-inch-wide red stripe with the words "NO PARKING FIRE LANE" in white along the curb and parallel with the roadway.
2. Reference Fire Prevention Ordinance Sec. 31.35 for further detail.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | FIRE LANE PAVEMENT MARKING | STD. NO. 3.31 |







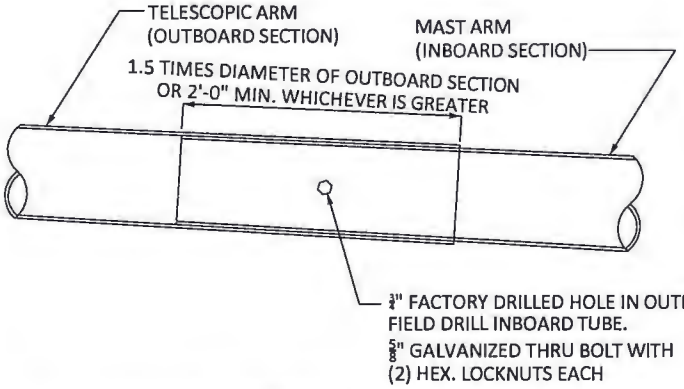
## SECTION A-A

## POLE BASE PLATE DETAILS

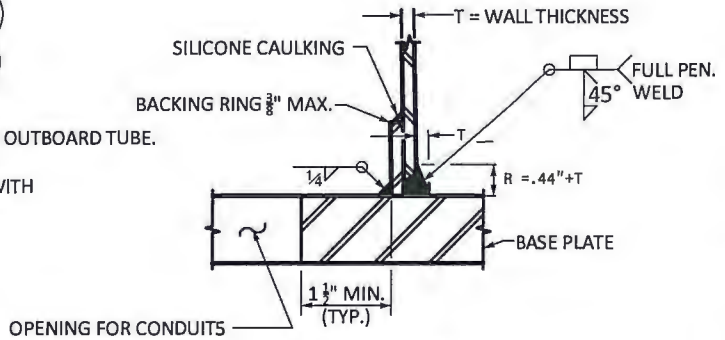



## MAST ARM RADIAL ORIENTATION

## MAST ARM POLE




## SLIP FIT JOINT DETAIL FOR MAST ARM




## SECTION B-B

(POLE ATTACHEMENT TO BASE PLATE)

## FULL-PENETRATION GROOVE WELD DETAIL

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NOTE:
OPENING IN POLE BASE PLATE SHALL BE EQUAL TO POLE BASE INSIDE DIAMETER MINUS 3½" BUT SHALL NOT BE LESS THAN 8½"



| TOWN OF KNIGHTDALE STANDARD DETAILS | MAST ARM POLES | STD. NO. 3.32 |
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TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | DESCRIPTION | DATE |
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SUBMITTAL REQUIREMENTS:

IN ACCORDANCE WITH THE GUIDANCE AND PROVISIONS OF THESE DISPLAYS, THE TOWN REQUIRES THE SUBMISSION OF A SET OF DESIGN CHECKS THAT INCLUDES:

1. HORIZONTAL GEOMETRY

2. GEOMETRIC SPEED CHECKS (FASTEST PATH CALCULATIONS)

3. DESIGN VEHICLE AND CHECK VEHICLE SWEPT PATHS

4. SIGHT DISTANCE CHECKS

# PHYSICAL CHARACTERISTICS
# SINGLE LANE ROUNDABOUT
# (GEOMETRY)

PRINCIPLES:

THE DESIGN OF A SINGLE LANE ROUNDABOUT SHOULD HAVE ENOUGH ENTRY PATH DEFLECTION TO CREATE BALANCED SPEEDS THROUGH THE ROUNDABOUT. THE USE OF LEFT OFFSET HELPS IN REDUCING SPEEDS IN ADVANCE OF THE ENTRY LINE; THIS IS ESPECIALLY IMPORTANT FOR COMPACT ROUNDABOUTS.

GEOMETRY DEFINITIONS:

1. INSCRIBED CIRCLE DIAMETER: MEASURE OF THE SIZE OF A ROUNDABOUT. GOVERNED BY NUMBER OF ENTRY AND EXIT LANES, SIZE OF DESIGN VEHICLE, AND PROPERTY CONSTRAINTS.

2. CIRCULATORY ROAD: SHALL BE 16'–18' FROM EDGE OF TRAVEL TO EDGE OF TRAVEL (EOT–TO–EOT), OR 18'–20' TO OUTSIDE FACE OF CURB (FOC).

3. LANDSCAPED CENTRAL ISLAND: A CENTRAL NON–TRAVERSABLE AREA. SIGHTLINES SHALL BE MAINTAINED AROUND THE OUTSIDE, BUT MAY BE OBSTRUCTED THROUGH THE CENTRAL ISLAND BY LANDSCSAPING.

4. TRUCK APRON: A TRAVERSABLE AREA FOR TRUCKS. SEE STANDARD DETAIL 3.33, SHEET 8 OF 8 FOR COLORED AND STAMPED CONCRETE GUIDANCE.

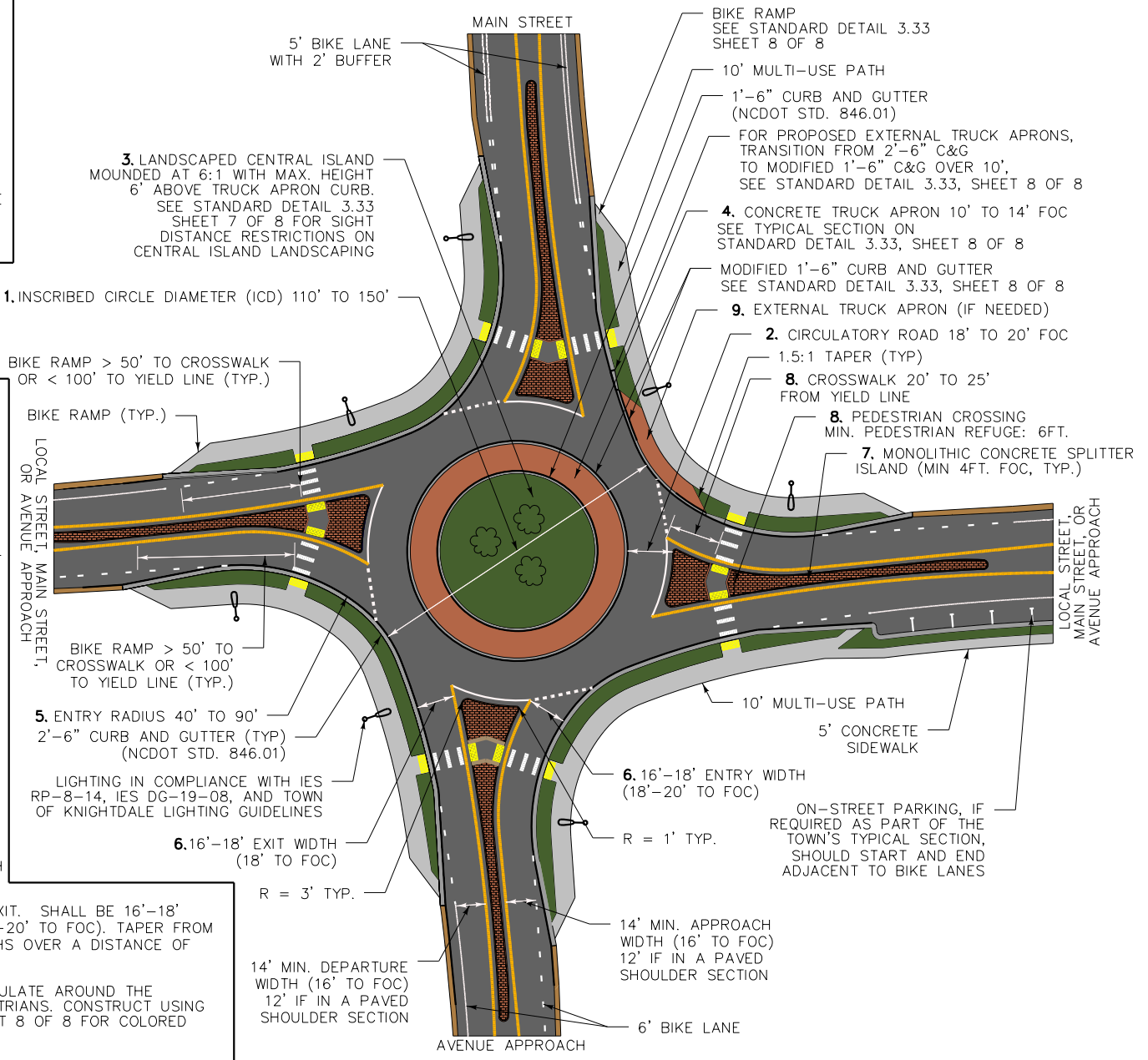
5. ENTRY RADIUS: THE SMALLEST CURB RADIUS BEFORE OR AT THE YIELD LINE. NOT THE SAME AS ENTRY PATH RADIUS OR DEFLECTION.

6. ENTRY/EXIT WIDTH: AT THE ROUNDABOUT ENTRANCE/EXIT. SHALL BE 16'–18' MEASURED FROM SPLITTER ISLAND STRIPE TO EOT (18'–20' TO FOC). TAPER FROM TYPICAL APPROACH LANE WIDTHS TO ENTRY/EXIT WIDTHS OVER A DISTANCE OF 75'–100'.

7. CONCRETE SPLITTER ISLAND: DIRECTS DRIVERS TO CIRCULATE AROUND THE ROUNDABOUT AND PROVIDES REFUGE AREA FOR PEDESTRIANS. CONSTRUCT USING NCDOT STD. 852.01. SEE STANDARD DETAIL 3.33, SHEET 8 OF 8 FOR COLORED AND STAMPED CONCRETE GUIDANCE.

8. PEDESTRIAN CROSSING: TWO–STAGE CROSSING LOCATED ONE TO TWO CAR LENGTHS (20'–25') BEHIND THE YIELD LINE. CROSSINGS SHOULD BE PERPENDICULAR TO THE TRAVEL LANE.

9. EXTERNAL TRUCK APRON: MAY BE USED AS NEEDED TO ACCOMMODATE LARGE DESIGN VEHICLES RIGHT TURN SWEPT PATH. TRANSITION FROM 2'–6" C&G TO MODIFIED 1'–6" C&G OVER 10'. CONSTRUCT CONCRETE EXTERNAL TRUCK APRON TO BE THE SAME DEPTH AS THE TRUCK APRON. EXTERNAL TRUCK APRONS SHOULD NOT PASS THROUGH CROSSWALKS. SEE STANDARD DETAIL 3.33, SHEET 8 OF 8 FOR COLORED AND STAMPED CONCRETE GUIDANCE.




GENERAL NOTES:

SHIFT FROM TOWN TYPICAL SECTION DIMENSIONS TO THE DIMENSIONS SHOWN IN THIS DETAIL USING THE APPROACH AND DEPARTURE TAPER LENGTHS AS SHOWN IN NCDOT ROADWAY DESIGN MANUAL (RDM) FIGURE 8–11

USE $A = WS^2/60$ (WHEN S LESS THAN/EQUAL TO 40 MPH)
USE $A = WS$ (WHEN S GREATER THAN 40 MPH)
A = APPROACH OR DEPARTURE TAPER LENGTH
W = WIDTH OF LATERAL SHIFT
S = DESIGN SPEED

FOR ROUTES MAINTAINED BY NCDOT, AN ENCROACHMENT AGREEMENT FROM NDCOT DIVISION OFFICE IS REQUIRED. COORDINATE WITH NCODT DIVISION OFFICE FOR DESIGN REVIEW.

REFER TO NCDOT ROADWAY DESIGN MANUAL SECTION 8.10.3 FOR STORM DRAIN DESIGN GUIDANCE.

REFER TO NCHRP REPORT 1043 FOR ADDITIONAL ROUNDABOUT DESIGN GUIDANCE.

STD. NO. 3.33

TOWN OF KNIGHTDALE
STANDARD DETAILS

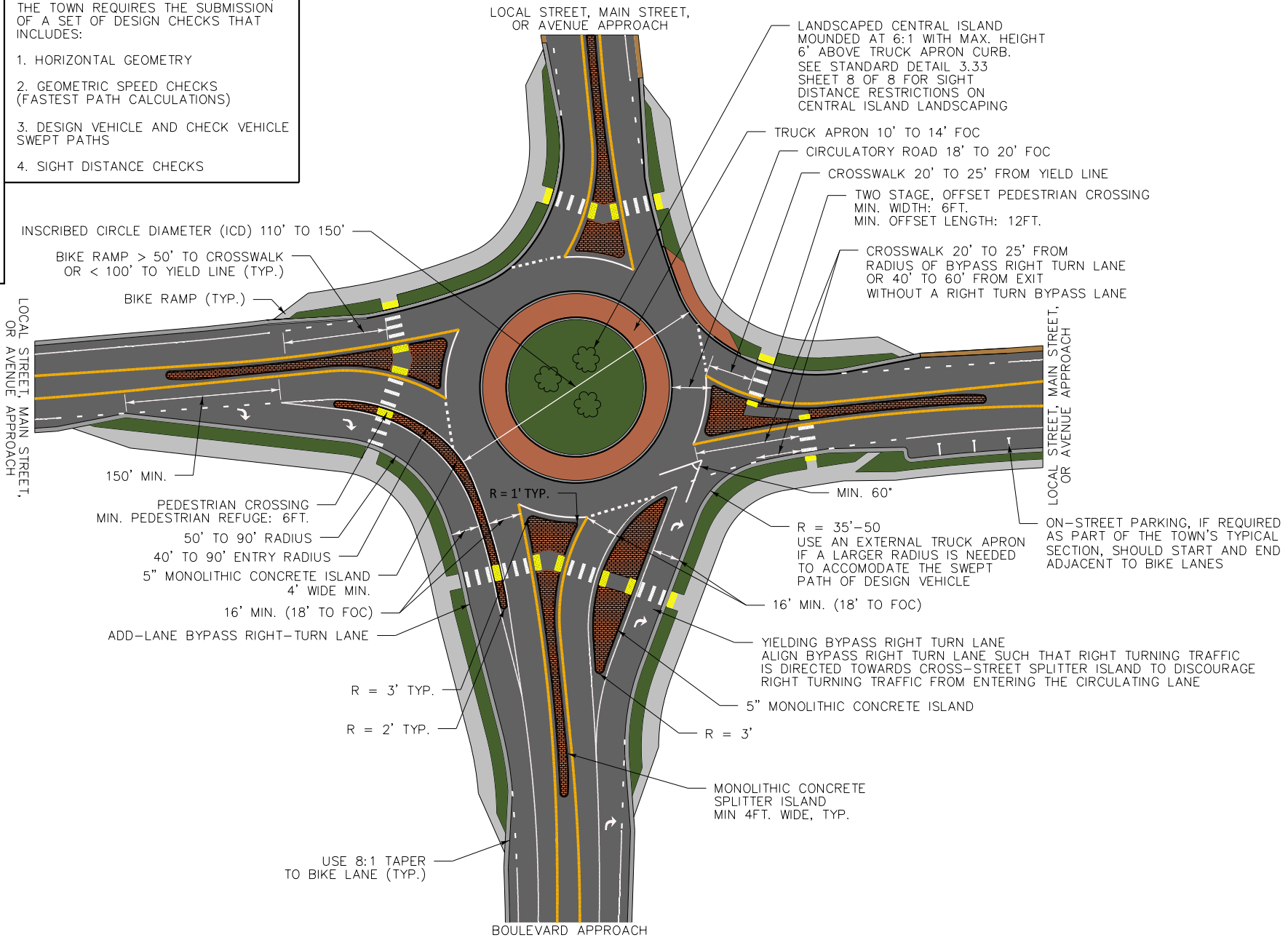
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SUBMITTAL REQUIREMENTS:

IN ACCORDANCE WITH THE GUIDANCE AND PROVISIONS OF THESE DISPLAYS, THE TOWN REQUIRES THE SUBMISSION OF A SET OF DESIGN CHECKS THAT INCLUDES:

1. HORIZONTAL GEOMETRY
2. GEOMETRIC SPEED CHECKS (FASTEST PATH CALCULATIONS)
3. DESIGN VEHICLE AND CHECK VEHICLE SWEPT PATHS
4. SIGHT DISTANCE CHECKS

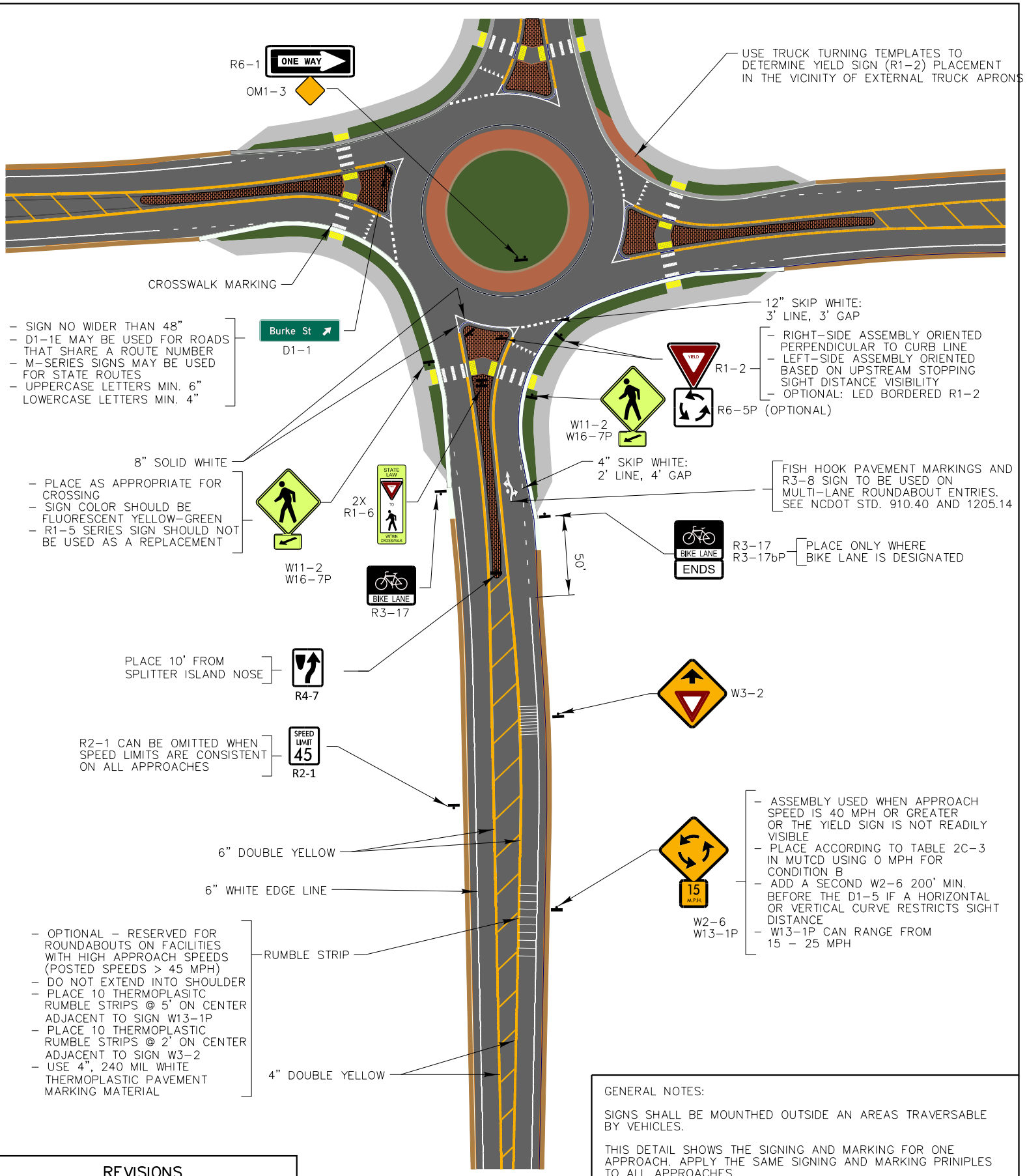
# PHYSICAL CHARACTERISTICS
## SINGLE LANE ROUNDABOUT WITH BYPASS LANES
## (GEOMETRY)




GENERAL NOTES:

SEE STANDARD DETAIL 3.33, SHEET 1 OF 8 FOR DESIGN PRINCIPLES, GEOMETRY DEFINITIONS, SUBMITTAL REQUIREMENTS, AND ADDITIONAL ROUNDABOUT DESIGN GENERAL NOTES

STD. NO. 3.33




GENERAL NOTES:

SIGNS SHALL BE MOUNTHED OUTSIDE AN AREAS TRAVERSABLE BY VEHICLES.

THIS DETAIL SHOWS THE SIGNING AND MARKING FOR ONE APPROACH. APPLY THE SAME SIGNING AND MARKING PRINIPLES TO ALL APPROACHES.

REFER TO THE MUTCD AND NCDOT STANDARD DRAWINGS (DIVISION 09 - SIGNING AND DIVISION 12 - PAVEMENT MARKINGS, MARKERS AND DELINEATION) FOR ADDITIONAL SIGNING AND MARKING GUIDANCE.

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TOWN OF KNIGHTDALE
STANDARD DETAILS

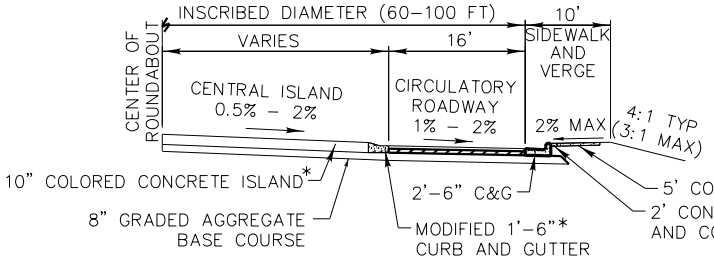
# SIGNING AND PAVEMENT MARKING SINGLE LANE ROUNDABOUT

STD. NO.
3.33

TOWN OF KNIGHTDALE
STANDARD DETAILS

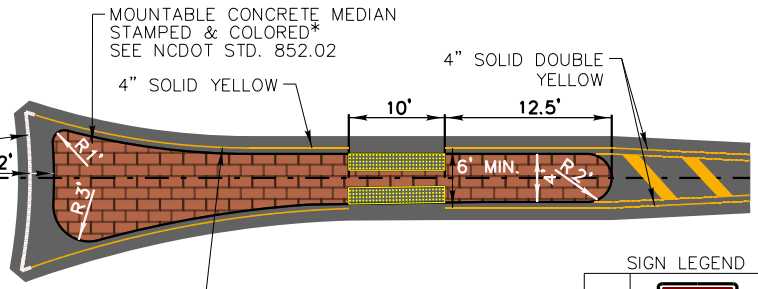
PHYSICAL CHARACTERISTICS
MINI-ROUNDABOUT

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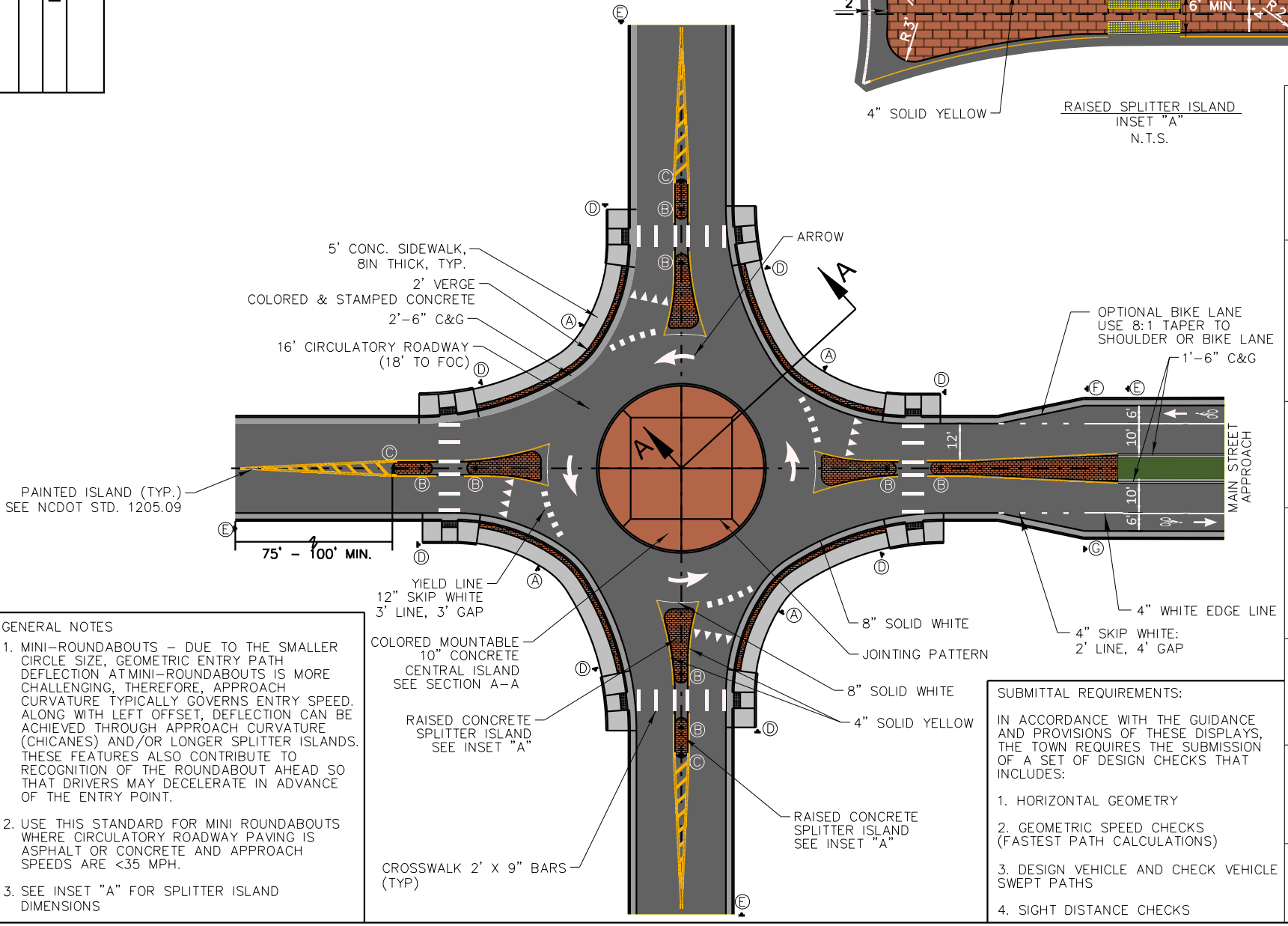



ROUNDABOUT TYPICAL SECTION
SECTION A–A
N.T.S.

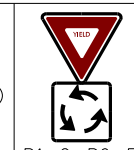
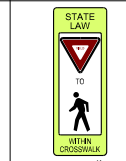
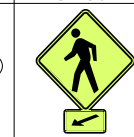
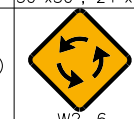
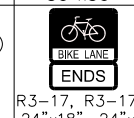
* NOTE: SEE STANDARD DETAIL 3.33, SHEET 8 OF 8 FOR COLORED AND STAMPED CONCRETE SPECIFICATIONS AND MODIFIED 1'–6" CURB AND GUTTER DETAILS




RAISED SPLITTER ISLAND
INSET "A"
N.T.S.




SIGN LEGEND

| | | |
|---|---|---|
| Ⓐ |  | R1–2, R6–5P 36"x36"x36" 30"X30" |
| Ⓑ |  | R1–6 12"x36" FLUORESCENT YELLOW–GREEN |
| Ⓒ |  | R4–7c 18"x30" |
| Ⓓ |  | W11–2, W16–7p 30"x30", 24"x12" |
| Ⓔ |  | W2–6 30"x30" |
| Ⓕ |  | R3–17, R3–17bP 24"x18", 24"x8" |
| Ⓖ |  | R3–17 24"x18" |

GENERAL NOTES

1. MINI–ROUNDABOUTS – DUE TO THE SMALLER CIRCLE SIZE, GEOMETRIC ENTRY PATH DEFLECTION AT MINI–ROUNDABOUTS IS MORE CHALLENGING, THEREFORE, APPROACH CURVATURE TYPICALLY GOVERNS ENTRY SPEED. ALONG WITH LEFT OFFSET, DEFLECTION CAN BE ACHIEVED THROUGH APPROACH CURVATURE (CHICANES) AND/OR LONGER SPLITTER ISLANDS. THESE FEATURES ALSO CONTRIBUTE TO RECOGNITION OF THE ROUNDABOUT AHEAD SO THAT DRIVERS MAY DECELERATE IN ADVANCE OF THE ENTRY POINT.
2. USE THIS STANDARD FOR MINI ROUNDABOUTS WHERE CIRCULATORY ROADWAY PAVING IS ASPHALT OR CONCRETE AND APPROACH SPEEDS ARE <35 MPH.
3. SEE INSET "A" FOR SPLITTER ISLAND DIMENSIONS

SUBMITTAL REQUIREMENTS:

IN ACCORDANCE WITH THE GUIDANCE AND PROVISIONS OF THESE DISPLAYS, THE TOWN REQUIRES THE SUBMISSION OF A SET OF DESIGN CHECKS THAT INCLUDES:

1. HORIZONTAL GEOMETRY
2. GEOMETRIC SPEED CHECKS (FASTEST PATH CALCULATIONS)
3. DESIGN VEHICLE AND CHECK VEHICLE SWEPT PATHS
4. SIGHT DISTANCE CHECKS

STD. NO. 3.33

TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | | | |
|---|---|---|---|
| DESCRIPTION | | | DATE |
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# TRUCK MOVEMENTS SINGLE-LANE ROUNDABOUT AND MINI-ROUNDABOUT

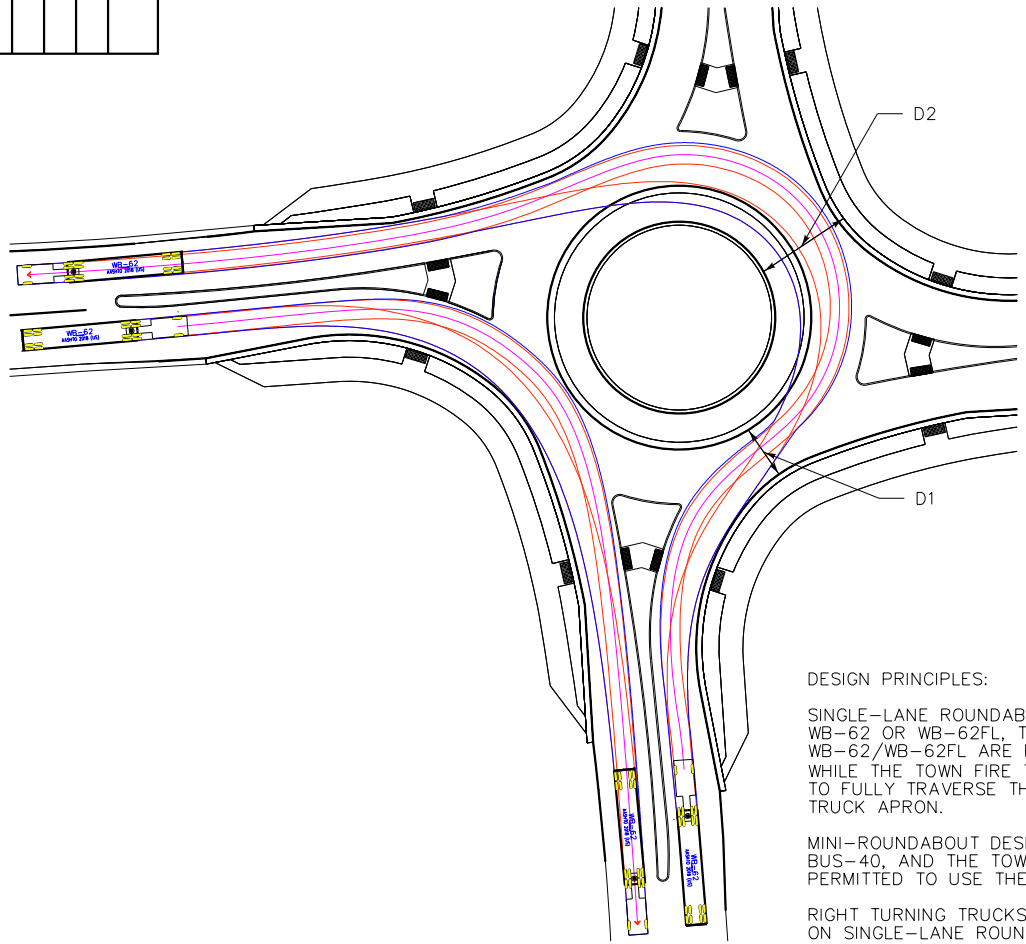
| TURNING WIDTH REQUIRED FOR SINGLE-LANE ROUNDABOUTS ('D' IN FT) | | | | | |
|---|---|---|---|---|---|
| INSCRIBED CIRCLE DIAMETER | DESIGN VEHICLES | | | | |
| | D1 (EOP) | | | D2 (FOC) | |
| | SU-30 | BUS-40 | FIRE TRUCK | WB-62 | WB-62FL |
| 110 | 14* | 15 | 14 | 32 | 39 |
| 120 | 14* | 15 | 14 | 30 | 36 |
| 130 | 14* | 14 | 14* | 27 | 33 |
| 140 | 14* | 14 | 14* | 26 | 30 |

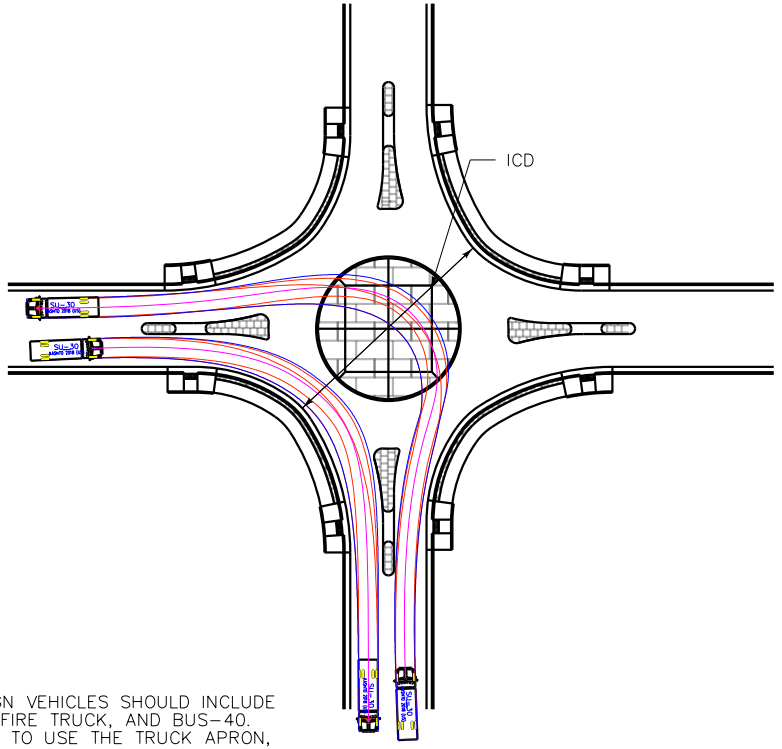
NOTE: THE VALUES PROVIDED ABOVE ARE FOR GENERAL GUIDANCE.
*14 FT MINIMUM EOP/18 FT FOC

| MIN. RIGHT TURN RADIUS | |
|---|---|
| SU-30 | 30 FT |
| BUS-40 | 25 FT |
| FIRE TRUCK | 16 FT |
| WB-62 | DETERMINED BY AUTOTURN |
| WB-62FL | DETERMINED BY AUTOTURN |

| MINI-ROUNDABOUT ICD REQUIREMENTS FOR VEHICLE U-TURNS AND LEFT TURNS (LT) | | | | |
|---|---|---|---|---|
| INSCRIBED CIRCLE DIAMETER | DESIGN VEHICLES | | | |
| | SU-30 | BUS-40 | FIRE TRUCK | WB-62 |
| 60 | LT-ONLY | NO | LT-ONLY | NO |
| 65 | LT-ONLY | LT-ONLY | LT-ONLY | NO |
| 70 | LT-ONLY | LT-ONLY | YES | NO |
| 80 | LT-ONLY | LT-ONLY | YES | LT-ONLY |
| 90 | YES | YES | YES | YES |
| 100 | YES | YES | YES | YES |

TABLE NOTE: SPLITTER ISLANDS SHOULD BE MOUNTABLE OR TRIMMED AS NEEDED BASED ON SWEPT PATHS




DESIGN PRINCIPLES:

SINGLE-LANE ROUNDABOUT DESIGN VEHICLES SHOULD INCLUDE WB-62 OR WB-62FL, THE TOWN FIRE TRUCK, AND BUS-40. WB-62/WB-62FL ARE PERMITTED TO USE THE TRUCK APRON, WHILE THE TOWN FIRE TRUCK AND BUS-40 SHOULD BE ABLE TO FULLY TRAVERSE THE ROUNDABOUT WITHOUT USING THE TRUCK APRON.

MINI-ROUNDABOUT DESIGN VEHICLES SHOULD INCLUDE SU-30, BUS-40, AND THE TOWN FIRE TRUCK, ALL OF WHICH ARE PERMITTED TO USE THE TRUCK APRON.

RIGHT TURNING TRUCKS ARE NOT TO USE THE TRUCK APRON ON SINGLE-LANE ROUNDABOUTS. WHERE ENTRY, EXIT, OR CIRCULATING WIDTHS BECOME EXCESSIVE FOR RIGHT TURNS, CONSIDER USING AN EXTERNAL TRUCK APRON. EXTERNAL TRUCK APRONS SHOULD NOT PASS THROUGH CROSSWALKS.

GENERAL NOTES:

1. CHECK LEFT, THROUGH, AND RIGHT TURN MOVEMENTS FOR EACH RELEVANT DESIGN VEHICLE.

2. D1: CIRCULATORY ROADWAY SHOULD BE 18FT TO 20FT MEASURED FROM THE FACE OF CURB

STD. NO. 3.33

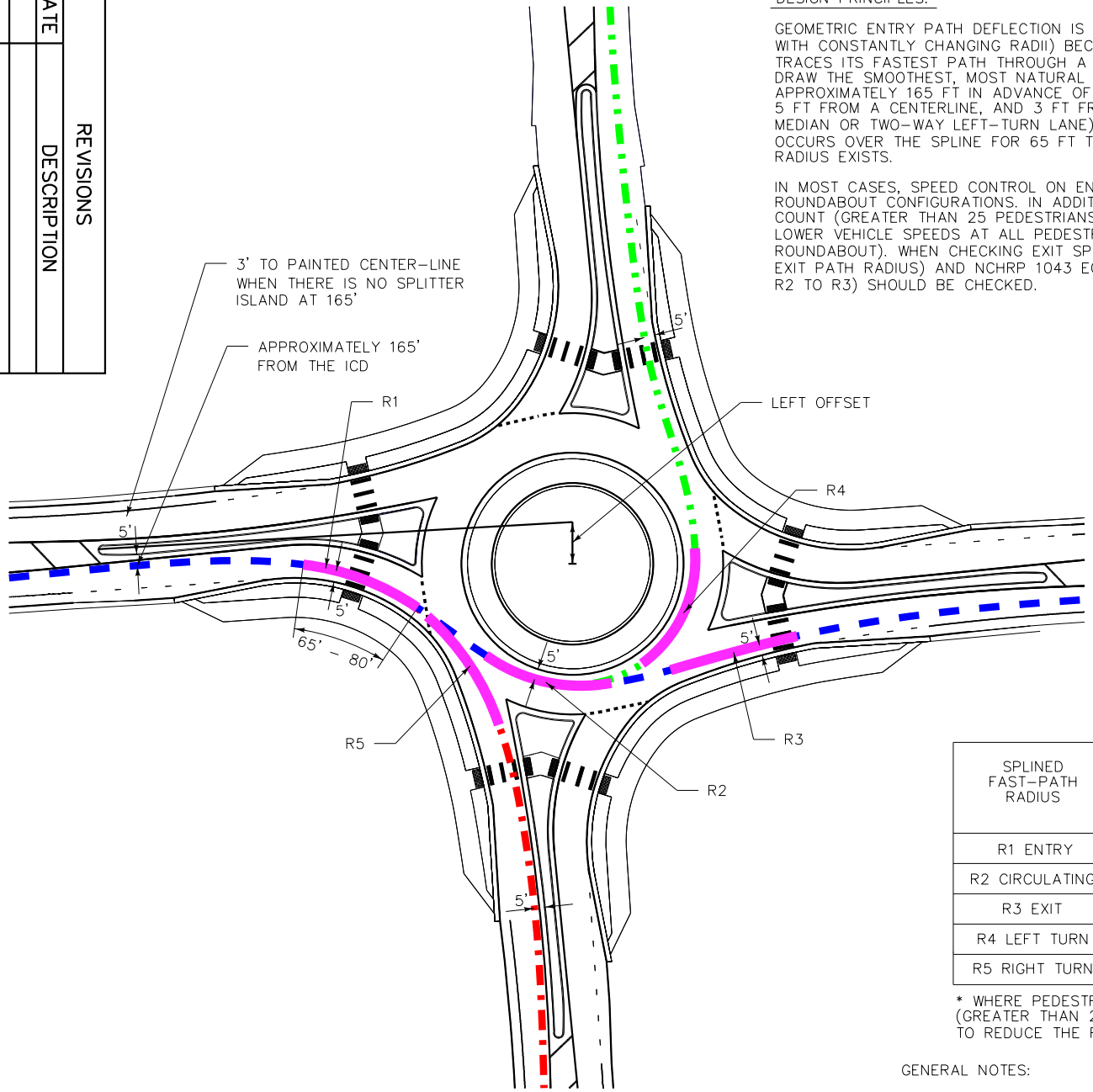
TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | | |
|---|---|---|
| DESCRIPTION | | DATE |
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GEOMETRIC SPEED CHECKS
SINGLE LANE ROUNDABOUT

STD. NO. 3.33






DESIGN PRINCIPLES:

GEOMETRIC ENTRY PATH DEFLECTION IS BEST REPRESENTED BY A CONTINUOUS SPLINE (A CURVE WITH CONSTANTLY CHANGING RADII) BECAUSE THIS MOST CLOSELY APPROXIMATES HOW A VEHICLE TRACES ITS FASTEST PATH THROUGH A ROUNDABOUT. A SPLINE ALSO ALLOWS ANALYSTS TO DRAW THE SMOOTHEST, MOST NATURAL VEHICULAR PATH. IT IS DRAWN FROM A STARTING POINT APPROXIMATELY 165 FT IN ADVANCE OF THE ENTRY LINE, WITH AN OFFSET OF 5 FT FROM CURBS, 5 FT FROM A CENTERLINE, AND 3 FT FROM OTHER PAVEMENT MARKINGS (SUCH AS A PAINTED MEDIAN OR TWO-WAY LEFT-TURN LANE). THE CRITICAL ENTRY PATH RADIUS, REFERRED TO AS R1, OCCURS OVER THE SPLINE FOR 65 FT TO 80 FT, NEAR THE YIELD POINT, WHERE THE TIGHTEST RADIUS EXISTS.

IN MOST CASES, SPEED CONTROL ON ENTRY IS THE MOST IMPORTANT FASTEST PATH CRITERIA FOR ROUNDABOUT CONFIGURATIONS. IN ADDITION, IF A LOCATION HAS A SIGNIFICANT PEDESTRIAN COUNT (GREATER THAN 25 PEDESTRIANS PER HOUR), STEPS SHOULD BE TAKEN TO FACLITATE LOWER VEHICLE SPEEDS AT ALL PEDESTRIAN CONFLICT AREAS (INCLUDING EXIT SPEEDS FROM THE ROUNDABOUT). WHEN CHECKING EXIT SPEEDS, BOTH THE PREDICTIVE METHOD (BASED ON THE R3 EXIT PATH RADIUS) AND NCHRP 1043 EQUATION 9.7 (WHICH ACCOUNTS FOR ACCELERATION FROM R2 TO R3) SHOULD BE CHECKED.

| SPLINED FAST-PATH RADIUS | RECOMMENDED RADIUS FOR SINGLE-LANE ROUNDABOUT (FT) | RECOMMENDED RADIUS FOR MINI-ROUNDABOUT (FT) |
|---|---|---|
| R1 ENTRY | 120FT TO 165FT | 100FT TO 165FT |
| R2 CIRCULATING | 70FT TO 120FT | 70FT TO 100FT |
| R3 EXIT | 120FT TO 300FT* | 90FT TO 150FT |
| R4 LEFT TURN | TRUCK APRON R.+5FT | CENTER ISLAND R.+5FT |
| R5 RIGHT TURN | 70FT TO 100FT | 50FT TO 90FT |

* WHERE PEDESTRIAN USE OF AN EXIT CROSSWALK IS FREQUENT (GREATER THAN 25 PEDESTRIANS PER HOUR), ADJUST EXIT RADII TO REDUCE THE R3 TO <200FT.

GENERAL NOTES:

1. R1, R2, R3 PATH TO FOLLOW NATURAL SPLINE.
2. GEOMETRIC ENTRY SPEED USUALLY GOVERNED BY R1 RADIUS, BUT MAY BE GOVERNED BY R5 RADIUS.
3. ON DESIGNS THAT CANNOT ACHIEVE DEFLECTION USING CENTRAL ISLAND AND APPROACH ALIGNMENT OFFSET TO THE LEFT OF CENTER-LINE, ADD REVERSE CURVES ON THE APPROACH SPLITTER ISLAND, SEPARATED BY A SHORT TANGENT 50FT TO 100FT. APPROACH CURVE RADII TO BE SIZED USING AASHTO GREEN BOOK TABLE 3-13, MINIMUM RADII AND SUPERELEVATION FOR LOW-SPEED STREETS IN URBAN AREAS TO MAINTAIN NORMAL CROWN.

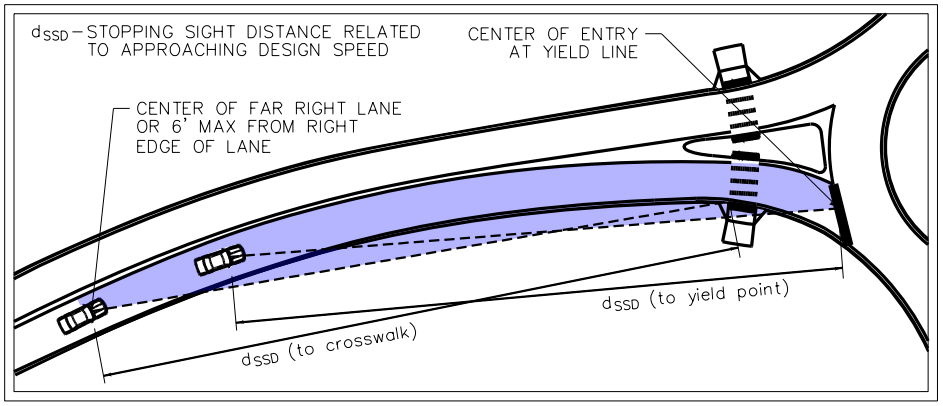
TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | | |
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| DESCRIPTION | | DATE |
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SIGHT DISTANCE CHECKS
SINGLE LANE ROUNDABOUT

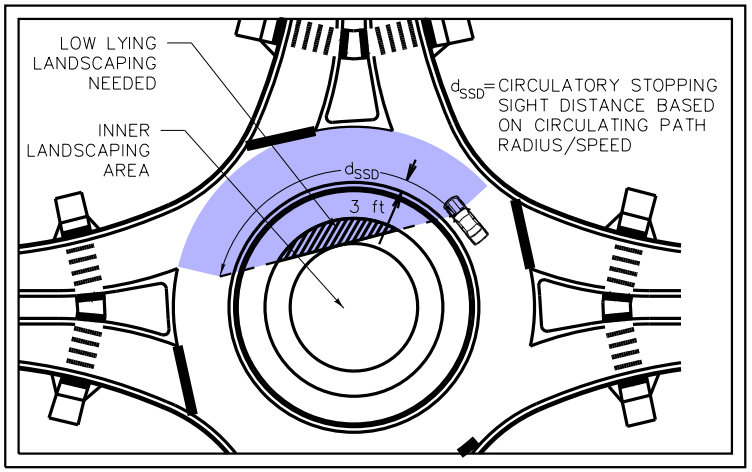
STD. NO. 3.33

APPROACH STOPPING SIGHT DISTANCE



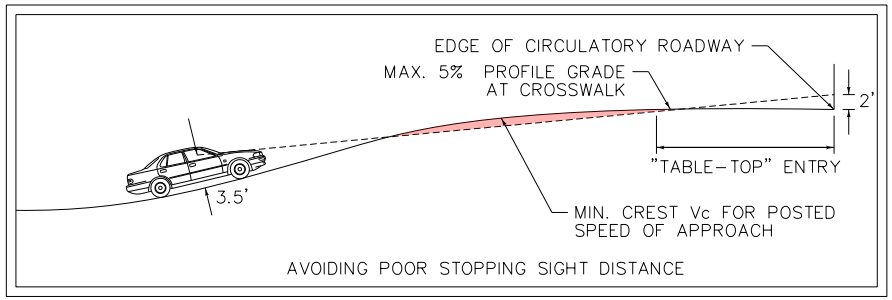

* SSD VALUES BASED ON APPROACH POSTED SPEED AND AASHTO GREEN BOOK CHAPTER 3.2 – SIGHT DISTANCE

CIRCULATING STOPPING SIGHT DISTANCE

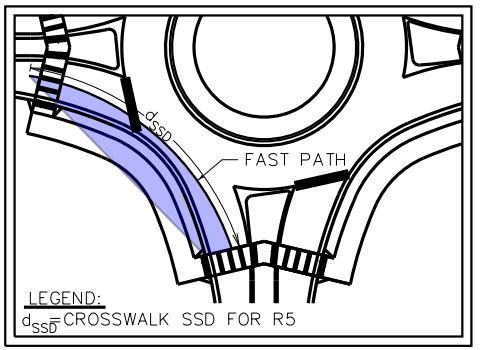



* SSD VALUES BASED ON APPROACH POSTED SPEED AND AASHTO GREEN BOOK CHAPTER 3.2 – SIGHT DISTANCE

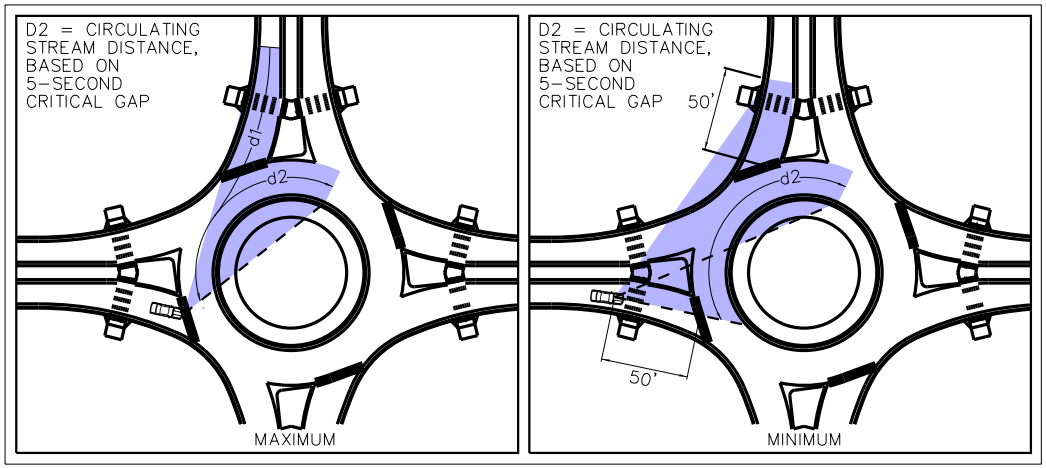
VERTICAL SIGHT DISTANCE




STOPPING SIGHT DISTANCE TO THE DOWNSTREAM CROSSWALK



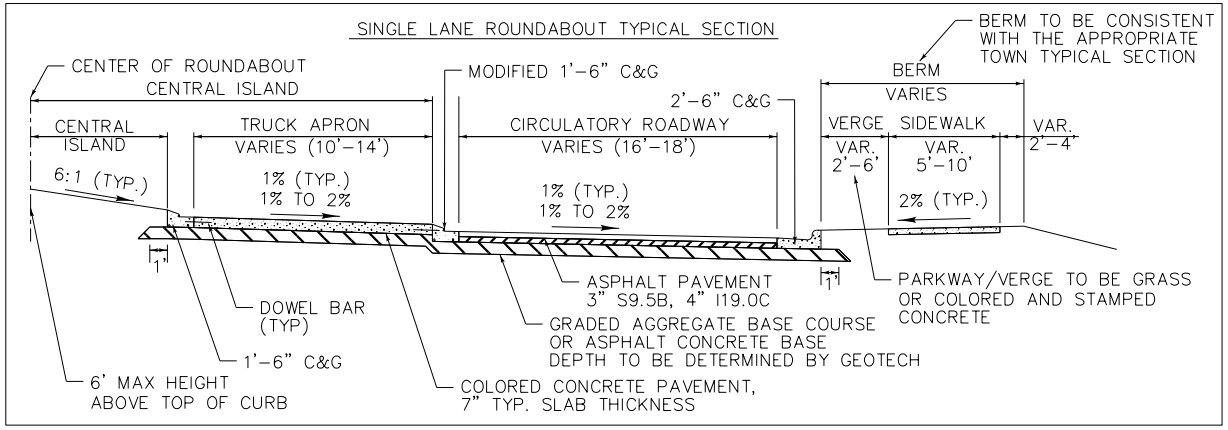

ENTERING AND CIRCULATING INTERSECTION SIGHT DISTANCE

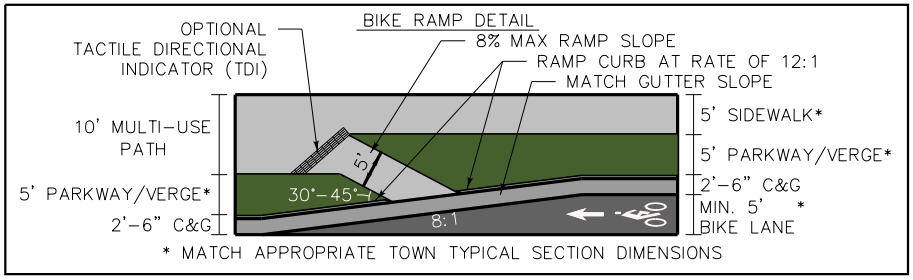


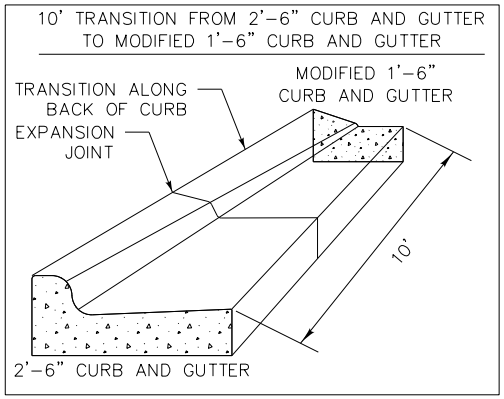
TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | DESCRIPTION | DATE |
|---|---|---|
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MISCELLANEOUS
ROUNDABOUT DETAILS




COLORED AND STAMPED CONCRETE SPECIFICATIONS:

ALL CONCRETE TRUCK APRONS SHOULD BE COLORED CONCRETE BUT NOT STAMPED.

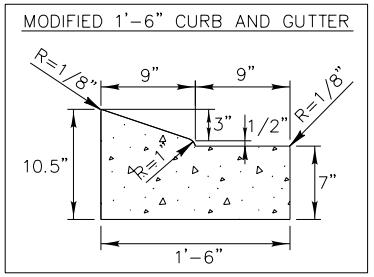
ALL CONCRETE SPLITTER ISLANDS AND CONCRETE VERGES BETWEEN CURB AND PEDESTRIAN SURFACES SHOULD BE COLORED AND STAMPED.

ALL CONCRETE SURFACES THAT ACCOMODATE PEDESTRIAN TRAFFIC (SIDEWALK, MULTI-USE PATH) SHOULD NOT BE COLORED OR STAMPED.

CONCRETE COLOR SHOULD BE FEDERAL STANDARD COLOR 10076 ACCORDING TO AEROSPACE MATERIAL SPECIFICATION STANDARD 595 (AMS-STD-595).

STAMPED CONCRETE SHOULD BE RUNNING BOND OR HERRINGBONE AND IS SUBJECT TO APPROVAL BY THE TOWN OF KNIGHTDALE.

COLORED CONCRETE SHOULD BE AN INTEGRAL CONCRETE MIX (MIXED IN THE TRUCK). SUBMIT COLORED CONCRETE SPECS AND PATTERN SHOP DRAWINGS TO THE TOWN OF KNIGHTDALE FOR REVIEW.



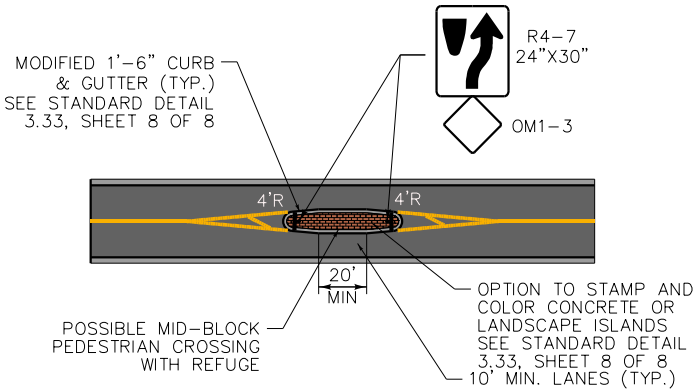

STD. NO.
3.33

TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | | | |
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| DESCRIPTION | | | DATE |
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# OTHER TRAFFIC CALMING MEASURES

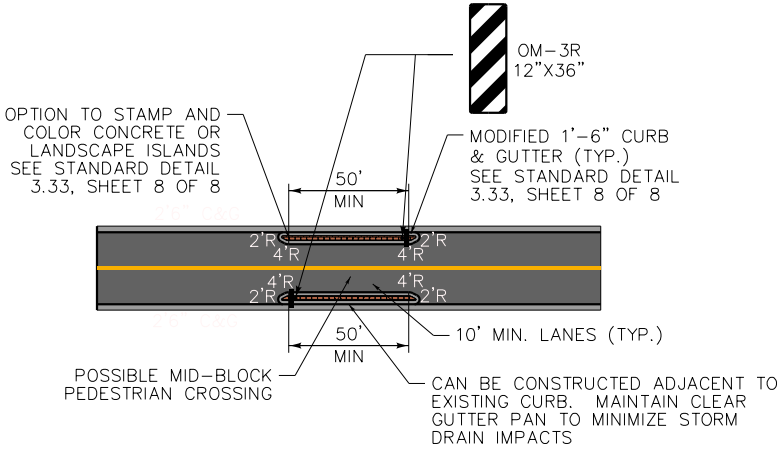
## MEDIANS




WHILE MEDIANS PROVIDE LESS TRAFFIC CALMING PERFORMANCE THAN CHICANES, THEY ARE STILL GOOD TRAFFIC CALMING MEASURES THAT HAVE A WIDER RANGE OF APPLICATIONS SINCE MEDIANS CAN BE LONGER AND REQUIRE LESS TAPER LENGTH.

USE $A=WS^2/60$ TO CALCULATE TAPER LENGTHS – SEE FORMULA BELOW.

## CHOKERS




CHOKERS PROVIDE TRAFFIC CALMING MEASURES THROUGH THE ENCOURAGEMENT OF LOWER SPEEDS THROUGH THE PINCH POINT. SHORTER PEDESTRIAN CROSSING DISTANCES ARE POSSIBLE IF A MID-BLOCK CROSSING IS PROVIDED.

## CHICANES

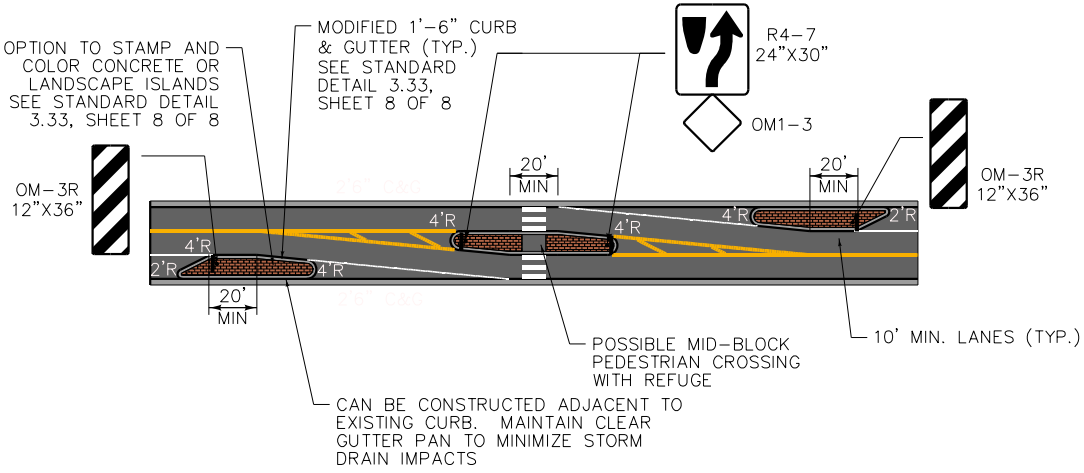
CHICANES ARE APPROPRIATE TRAFFIC CALMING MEASURES FOR COLLECTORS AND LOCAL STREETS.

CHICANES ARE MOST APPROPRIATE FOR ROADWAY FACILITIES WITH POSTED SPEEDS EQUAL TO OR LESS THAN 25 MPH.

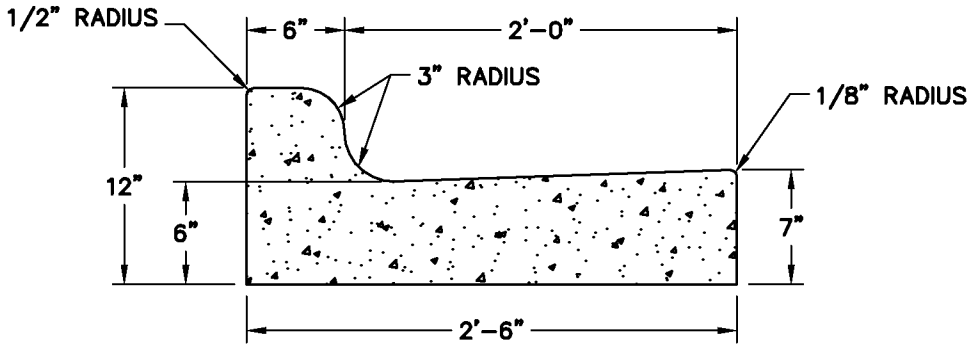
THE DESIGN SPEED FOR CHICANES SHOULD BE THE SAME DESIGN SPEED USED DURING THE ORIGINAL ROADWAY DESIGN. VERIFY THAT ALL PROPOSED TRAFFIC CALMING MEASURES CAN BE SAFELY NAVIGATED BY EMERGENCY VEHICLES.

FOR SIGHT DISTANCE AND VISIBILITY PURPOSES, CHICANES ARE NOT RECOMMENDED FOR INSTALLATION ON ROADWAY SECTIONS WITH GRADES IN EXCESS OF 6%.

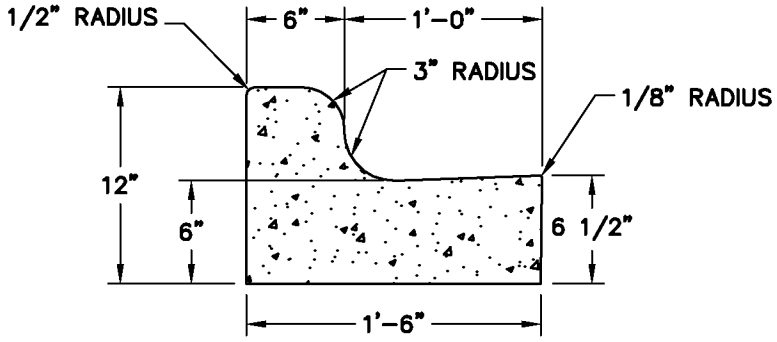
USE $A=WS^2/60$ TO CALCULATE TAPER LENGTHS, WHERE
A = APPROACH OR DEPARTURE TAPER LENGTH
W = WIDTH OF LATERAL SHIFT
S = POSTED SPEED
NOTE: USE POSTED SPEED AS OPPOSED TO DESIGN SPEED WHEN CALCULATING TRAFFIC CALMING MEASURE TAPER LENGTHS.



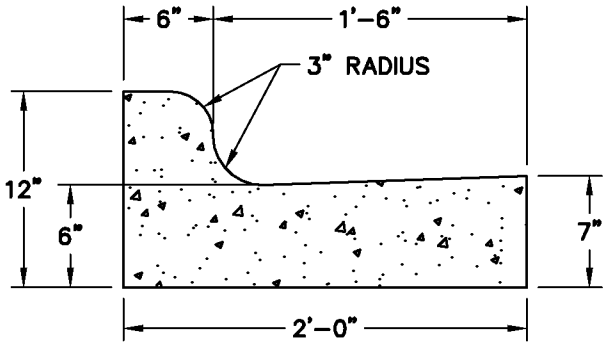

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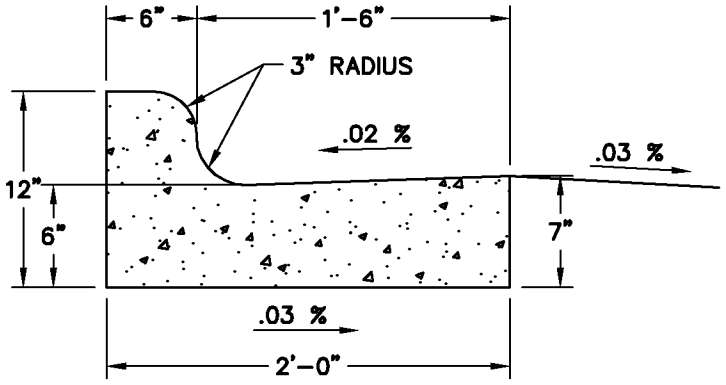

STANDARD 2'-6" CURB AND GUTTER




1'-6" STANDARD CURB AND GUTTER




2'-0" STANDARD CURB & GUTTER

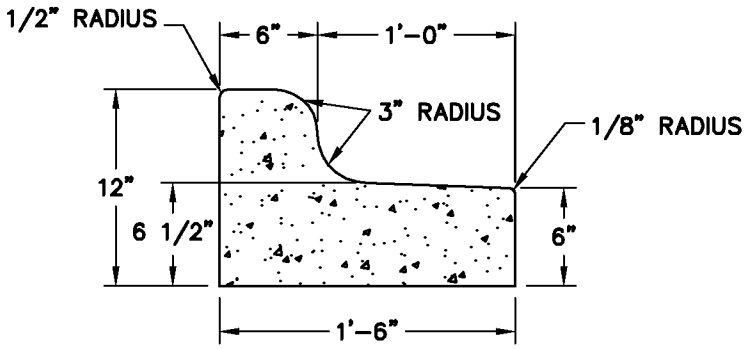



SLOPE FOR VARIABLE
SUPER ELEVATION RATES

| REVISIONS | |
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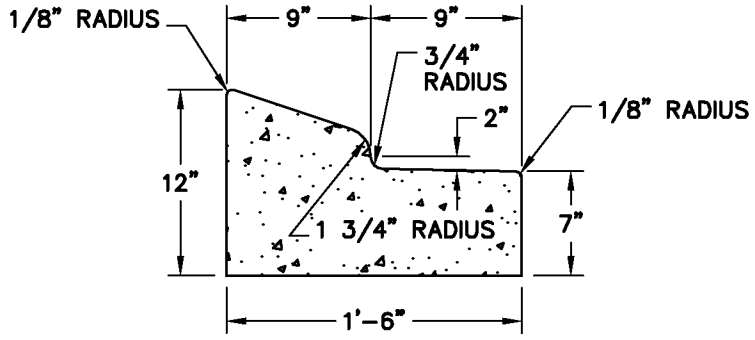


| TOWN OF KNIGHTDALE STANDARD DETAILS | CURB AND GUTTER | STD. NO. 4.01 |
|---|---|---|




1'-6" MEDIAN CURB AND GUTTER

TO BE USED IN MEDIANS WHEN LANES ARE SLOPED FROM ISLAND OR AS SPECIFIED BY THE TOWN ENGINEER.

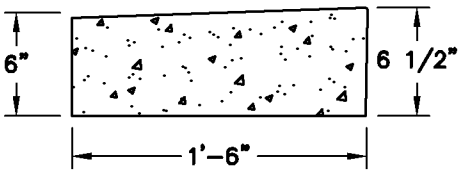



1'-6" MOUNTABLE CURB AND GUTTER

TO BE USED IN MEDIANS ONLY WHEN SPECIFIED BY THE TOWN ENGINEER.

1'-6" BINDER CURB

TO BE USED IN ALLEYS ONLY WHEN SPECIFIED BY THE TOWN ENGINEER.

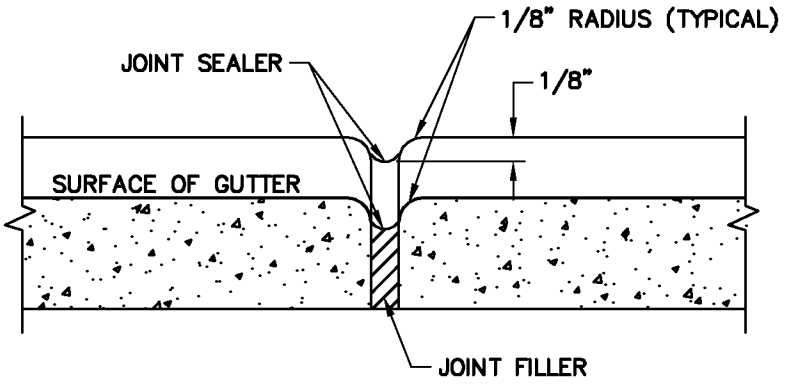



1'-6" STANDARD CURB AND GUTTER

| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | CURB AND GUTTER | STD. NO. 4.01 |
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TRANSVERSE EXPANSION JOINT

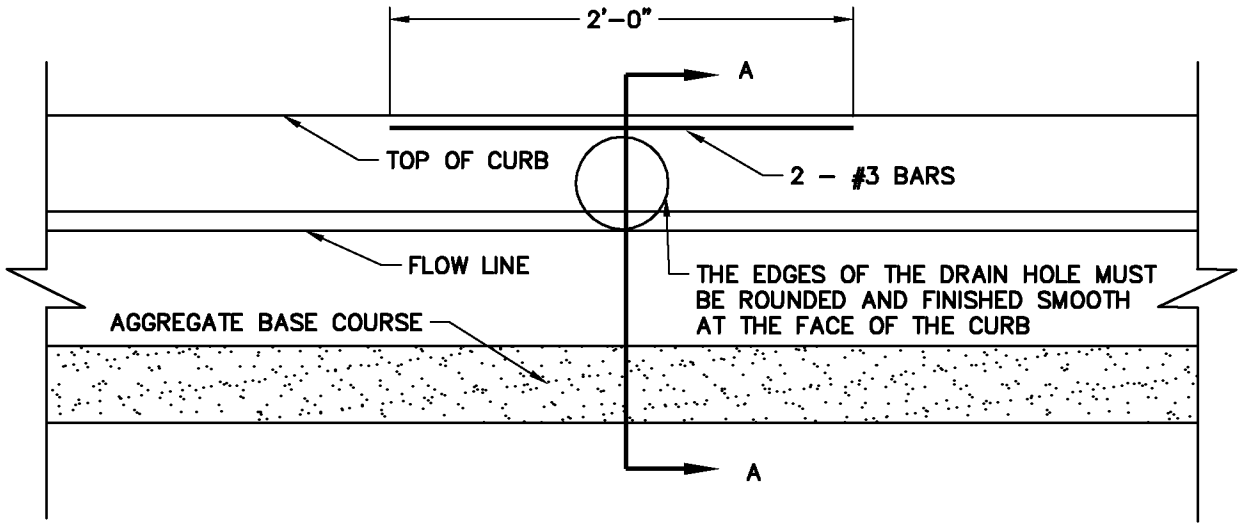
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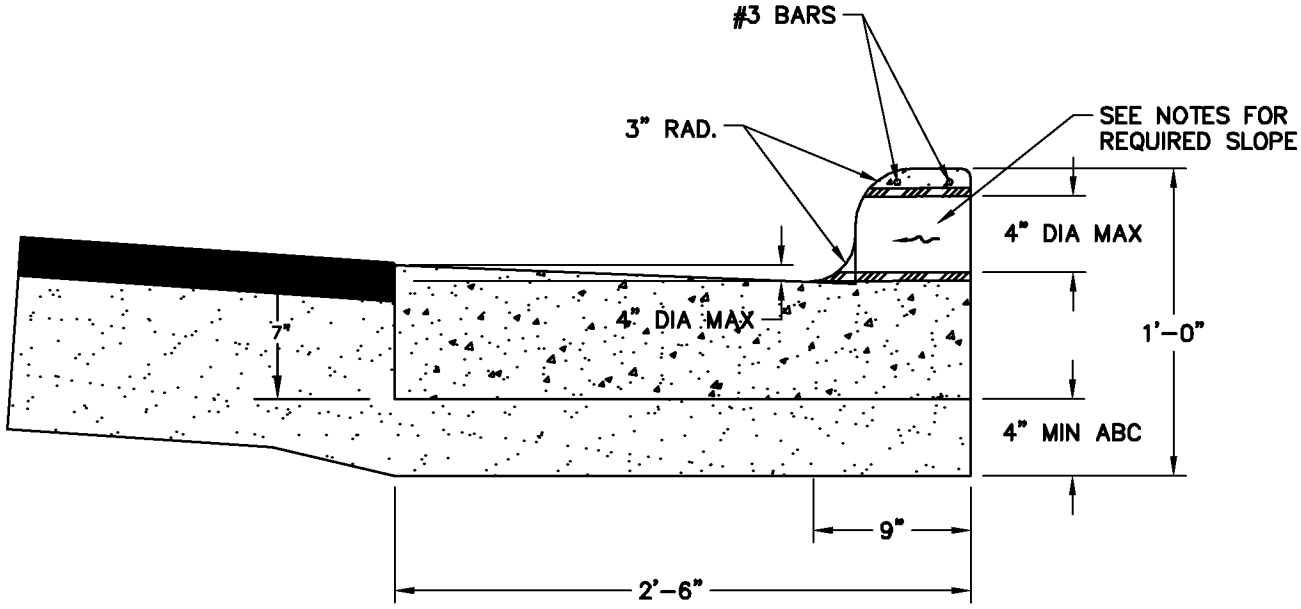
1. CONTRACTION JOINTS SHALL BE SPACED AT 10–FOOT INTERVALS. JOINT SPACING MAY BE ALTERED BY THE ENGINEER TO PREVENT UNCONTROLLED CRACKING.
2. CONTRACTION JOINTS MAY BE INSTALLED BY THE USE OF TEMPLATES OR FORMED BY OTHER APPROVED METHODS. WHERE SUCH JOINTS ARE NOT FORMED BY TEMPLATES, A MINIMUM DEPTH OF 1–1/2" SHALL BE OBTAINED.
3. ALL EXPANSION JOINTS SHALL BE SPACED AT 90–FOOT INTERVALS, AND ADJACENT TO ALL RIGID OBJECTS. JOINTS SHALL MATCH LOCATIONS WITH JOINTS IN ABUTTING SIDEWALK.
4. CONCRETE COMPRESSIVE STRENGTH SHALL BE 3600 PSI IN 28 DAYS.
5. CURB SHALL BE DEPRESSED AT INTERSECTIONS TO PROVIDE FOR FUTURE ACCESSIBLE RAMPS.
6. TOP 6" OF SUBGRADE BENEATH THE CURB AND GUTTER SHALL BE COMPACTED TO 100% STANDARD PROCTOR DENSITY.

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | CURB AND GUTTER | STD. NO. 4.01 |



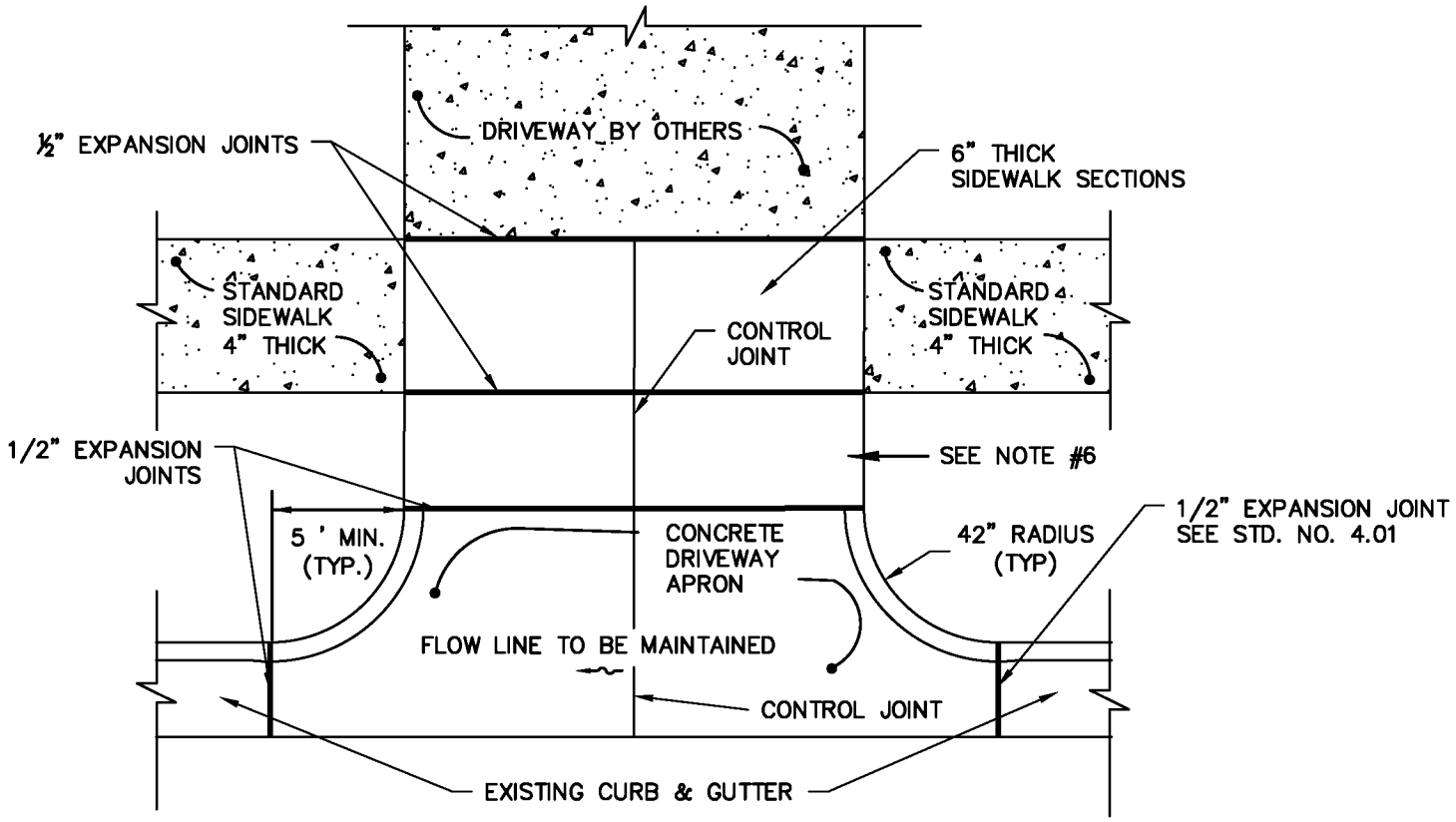

SECTION A-A

NOTES:

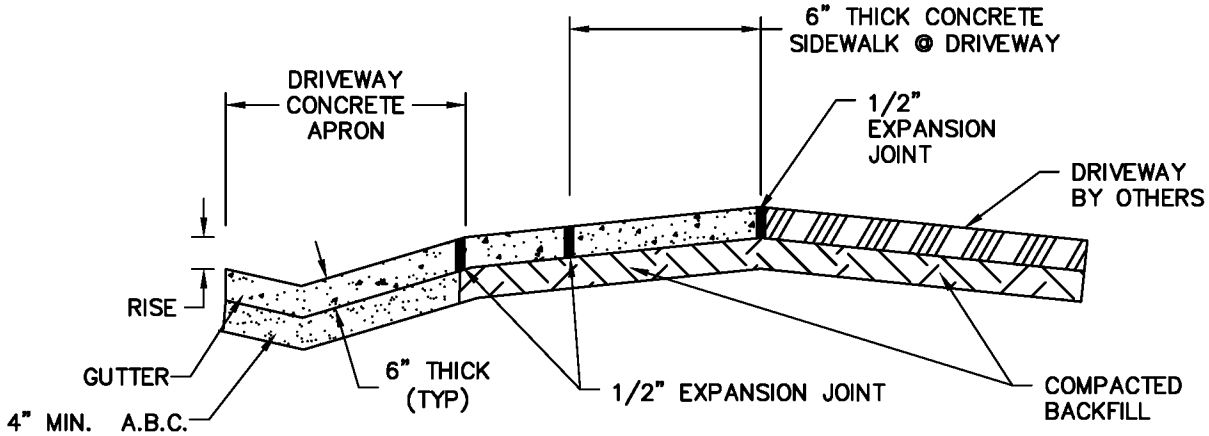
1. CURB DRAINS SHALL NOT BE CONSTRUCTED WITHIN 10' OF CONTRACTION OR EXPANSION JOINTS.
2. OPENING GRADE MAY VARY BETWEEN A MAXIMUM SLOPE OF 1/2" PER FT AND A MINIMUM OF 1/4" PER FT.
3. MORE THAN ONE HOLE MAY BE INSTALLED PROVIDED THE HOLES ARE LOCATED WITH 18" SPACING.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD CURB DRAIN | STD. NO. 4.02 |




PLAN VIEW



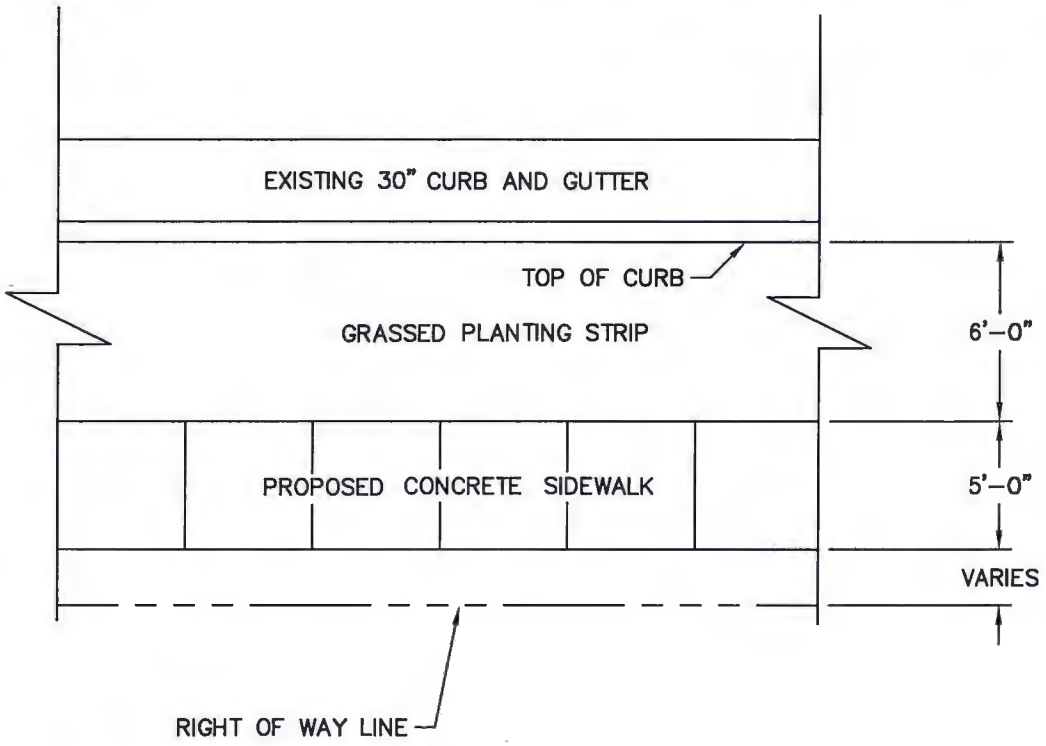

TYPICAL SECTION

NOTES:

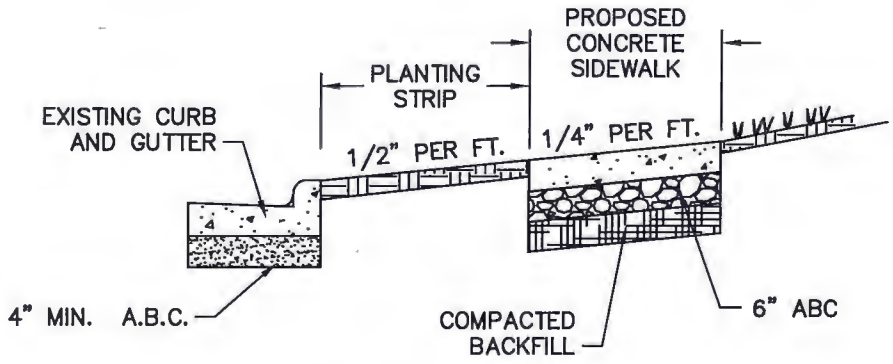
1. RESIDENTIAL DRIVEWAYS TO BE 12' TO 18' WIDE AT RIGHT-OF-WAY.
2. COMMERCIAL DRIVEWAYS TO BE A MAXIMUM OF 36' WIDE AT RIGHT-OF-WAY.
3. CONCRETE SHALL BE 3000 P.S.I.
4. CONTROL JOINTS NOT TO EXCEED 10' ON CENTER.
5. CURB RADIUS SHALL NOT RISE MORE THAN 1 (ONE) INCH.
6. IF THE DRIVEWAY SECTION BETWEEN THE SIDEWALK AND THE DRIVEWAY APRON IS 18" OR LESS THE SIDEWALK WILL BE WIDENED TO THE APRON AND AN EXPANSION JOINT ELIMINATED.
7. DRIVEWAY SHALL BE A MINIMUM OF 2 FEET FROM PROPERTY LINES.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD DRIVEWAY APRON | STD. NO. 4.03 |




PLAN VIEW




TYPICAL SECTION

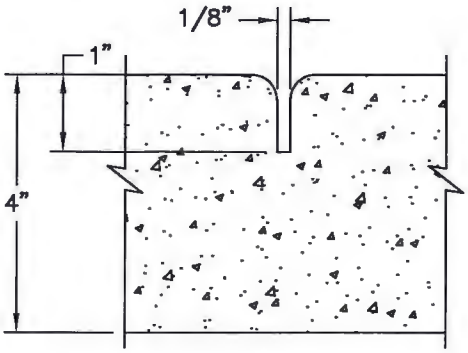
NOTES:

1. TRANSVERSE EXPANSION JOINTS TO BE A MAXIMUM OF 50 FEET APART.
2. CONTROL JOINTS TO BE AT 5 FEET O.C.
3. ALL CONCRETE TO BE FINISHED WITH CURING COMPOUND.

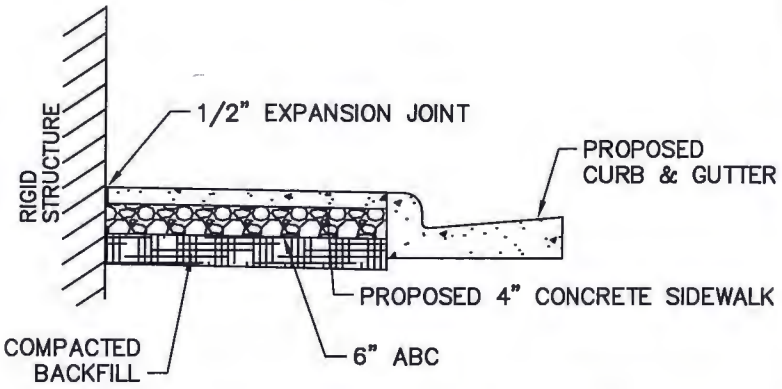
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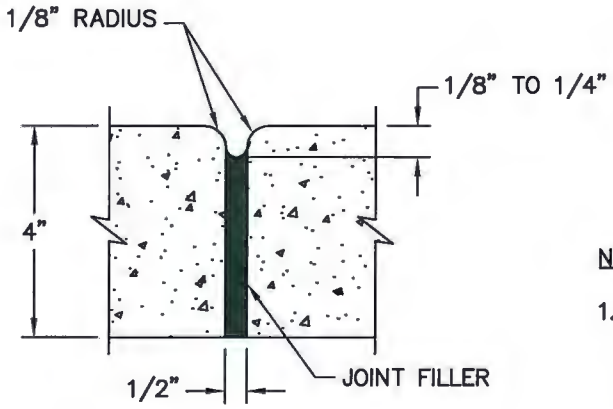
| TOWN OF KNIGHTDALE STANDARD DETAILS | CONCRETE SIDEWALKS | STD. NO. 4.04-1 |
|---|---|---|




GROOVE JOINT IN SIDEWALK




DETAILS SHOWING EXPANSION JOINTS IN CONCRETE SIDEWALK




TRANSVERSE EXPANSION JOINT IN SIDEWALK

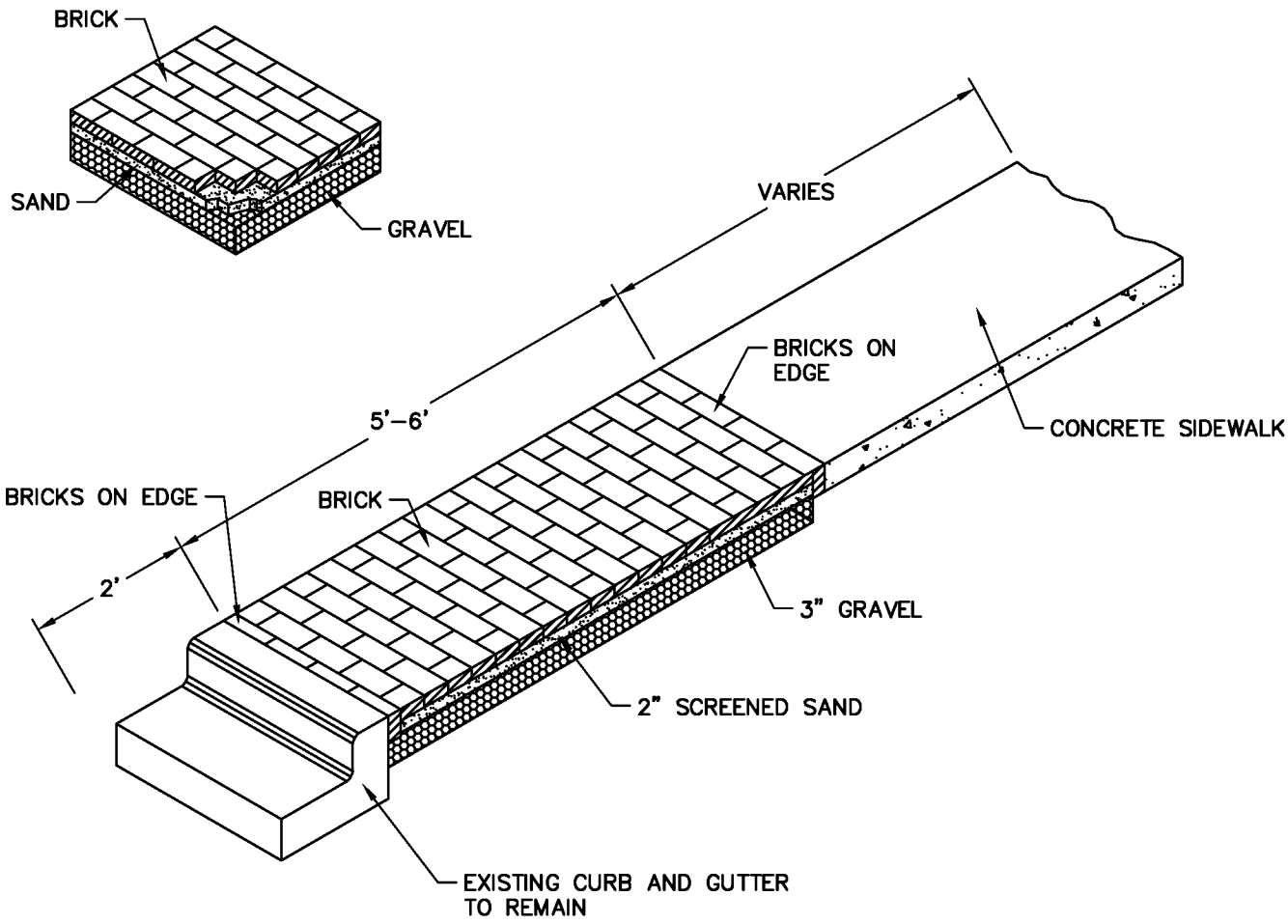
NOTES:

1. A GROOVE JOINT 1" DEEP WITH 1/8" RADII SHALL BE REQUIRED IN THE CONCRETE SIDEWALK AT 5' INTERVALS. ONE 1/2" EXPANSION JOINT WILL BE REQUIRED AT 45' INTERVALS NOT TO EXCEED 50' AND MATCHING EXPANSION/CONSTRUCTION JOINT IN ADJACENT CURB. A SEALED 1/2" EXPANSION JOINT WILL BE REQUIRED WHERE THE SIDEWALK JOINS ANY RIGID STRUCTURE.
2. SIDEWALK AT DRIVEWAY ENTRANCES TO BE 6" THICK.
3. WIDTH OF SIDEWALK SHALL CORRESPOND TO STREET CROSS SECTION BUT SHALL BE 5' AT A MINIMUM.
4. SIDEWALK ADJACENT TO CURB AND GUTTER IN PARKING LOT OR ALONG STREET SHALL BE 6' WIDE AT A MINIMUM.
5. SIDEWALK TO BE POURED TO END OF RADIUS AT INTERSECTING STREETS.
6. CONCRETE COMPRESSIVE STRENGTH SHALL BE 3600 PSI IN 28 DAYS.

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | CONCRETE SIDEWALKS | STD. NO. 4.04-2 |
|---|---|---|




NOTES:

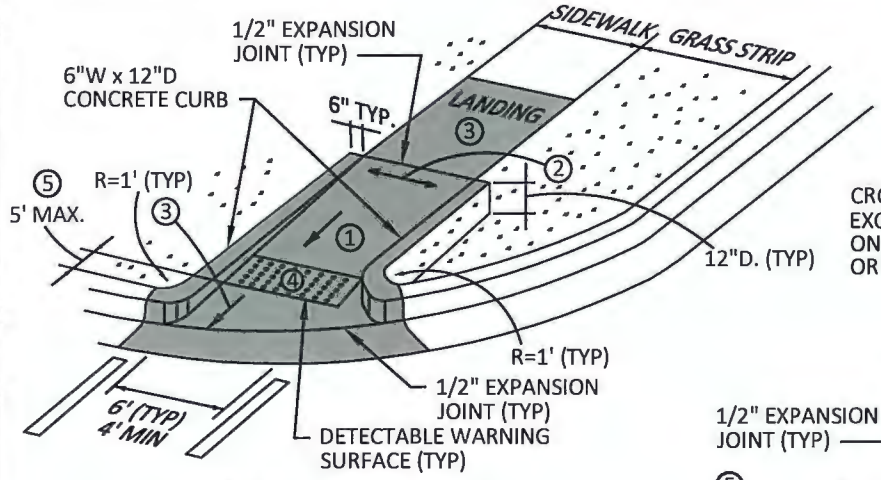
1. STAMPED CONCRETE OR ASPHALT MAY BE USED IN LIEU OF BRICK PAVERS WITH PRIOR REVIEW AND APPROVAL FROM THE TOWN OF KNIGHTDALE.
2. TO BE USED ON URBAN MAIN STREET AND URBAN AVENUE CROSS SECTIONS WHERE SIDEWALKS AND TREE PLANTINGS ARE COMBINED.
3. FOR ILLUSTRATIVE PURPOSES. FOLLOW DESIGN DETAIL FOR SPECIFIC CROSS SECTION.
4. PAVERS SHALL BE HANOVER PREST BRICK OR EQUIVALENT.
5. PATTERN IS RUNNING BOND.
6. PRIOR TO INSTALLATION, CONTRACTOR TO SUBMIT PLAN OF LAYOUT INCLUDING COLOR AND SIZE FOR TOWN APPROVAL.

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | BRICK PAVER SIDEWALK | STD. NO. 4.05 |
|---|---|---|

PAY LIMITS FOR CURB RAMP

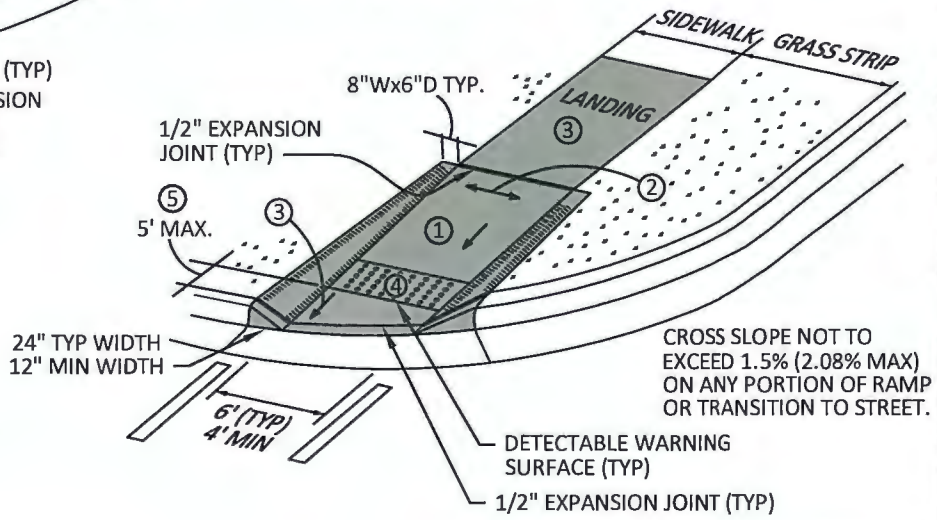



## TYPE N-1 (CURB TYPE)

| CONCRETE DEPTH | |
|---|---|
| RAMP/FLARE | 6" |
| LANDING | 4" |

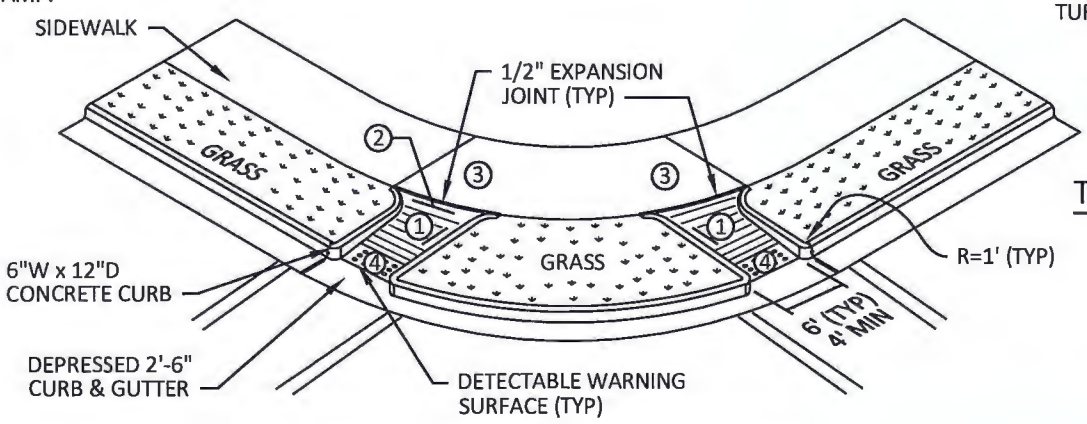
CROSS SLOPE NOT TO EXCEED 1.5% (2.08% MAX) ON ANY PORTION OF RAMP OR TRANSITION TO STREET.

1. 7.5%; 8.33% (1:12) MAX RAMP SLOPE
2. 1.5%; 2.08% (1:48) MAX CROSS SLOPE
3. CURB RAMPS REQUIRE A (4'-0") MINIMUM LANDING WITH A MAXIMUM CROSS SLOPE AND LONGITUDINAL SLOPE OF 1.5 (2.08% MAX) WHERE PEDESTRIANS PERFORM TURNING MANEUVERS. SLOPE TO DRAIN TO CURB.
4. RAMPS AND DOMES SHALL BE INSTALLED THE SAME WIDTH AS THE SIDEWALK.
5. IF LENGTH EXCEEDS 5', TRUNCATED DOMES SHALL BE INSTALLED ALONG THE BACK OF THE CURB COVERING THE FULL WIDTH OF THE RAMP.



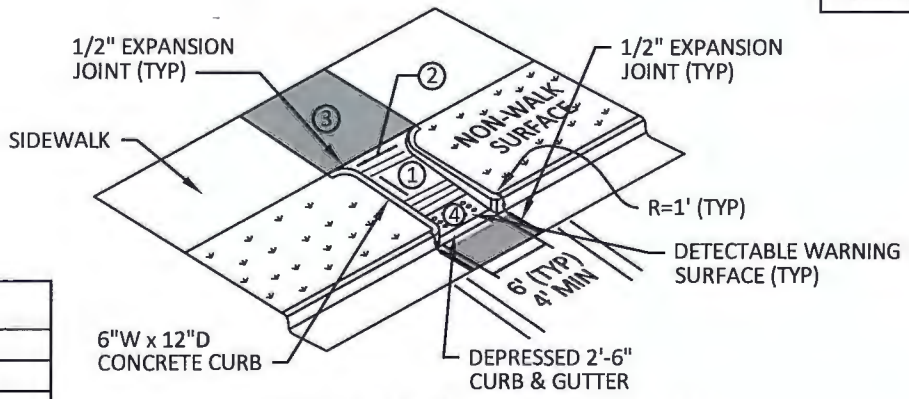

## TYPE N-1A (FLARE TYPE)

NOTE: USE SMALL FLARES ONLY WHEN A CURB TYPE DIRECTLY CONFLICTS WITH APPROACHING VEHICULAR TURNING MOVEMENTS.




## TYPE N-2 (RADIUS)

| CONCRETE DEPTH | |
|---|---|
| RAMP/FLARE | 6" |
| LANDING | 4" |



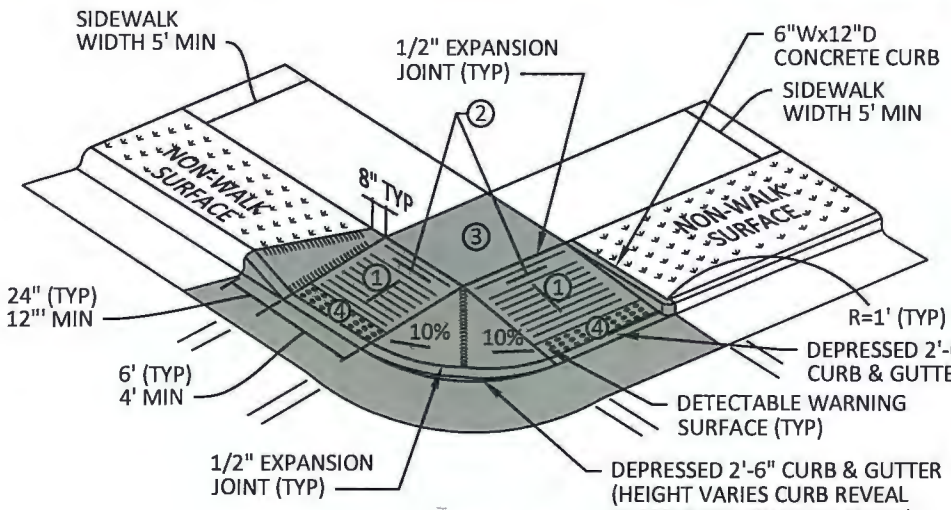

## TYPE N-2 (TEE INTERSECTION)

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | WHEELCHAIR CURB RAMPS (NEW DEVELOPMENT) | STD. NO. 4.06-1 |

PAY LIMITS FOR CURB RAMP



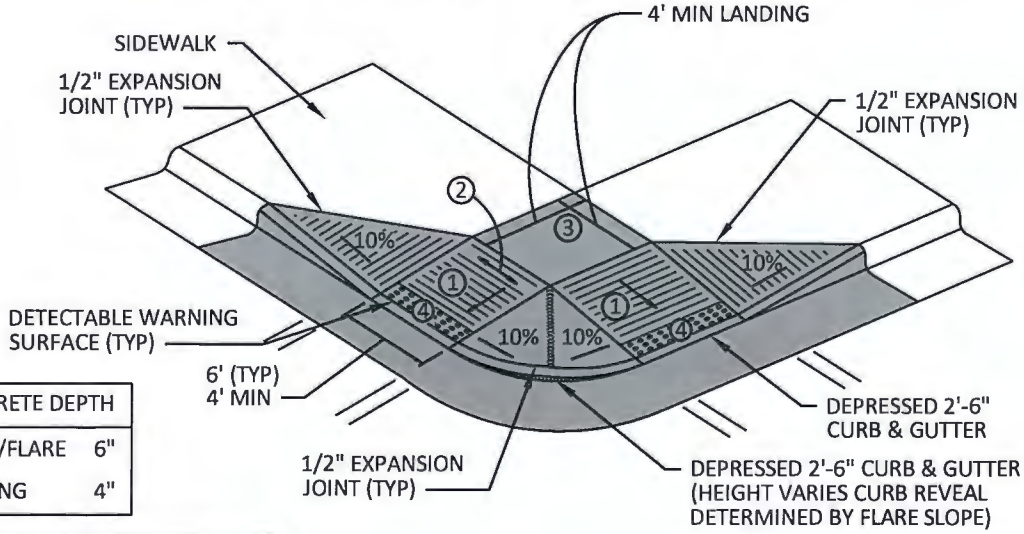

## TYPE N-3

NOTE: USE SMALL FLARES ONLY WHEN A CURB TYPE DIRECTLY CONFLICTS WITH APPROACHING VEHICULAR TURNING MOVEMENTS.

| CONCRETE DEPTH | |
|---|---|
| RAMP/FLARE | 6" |
| LANDING | 4" |

CROSS SLOPE NOT TO EXCEED 1.5% (2.08% MAX) ON ANY PORTION OF RAMP OR TRANSITION TO STREET.

1. 7.5%; 8.33% (1:12) MAX RAMP SLOPE
2. 1.5%; 2.08% (1:48) MAX CROSS SLOPE
3. CURB RAMPS REQUIRE A (4'-0") MINIMUM LANDING WITH A MAXIMUM CROSS SLOPE AND LONGITUDINAL SLOPE OF 1.5 (2.08% MAX) WHERE PEDESTRIANS PERFORM TURNING MANEUVERS. SLOPE TO DRAIN TO CURB.
4. RAMPS AND DOMES SHALL BE INSTALLED THE SAME WIDTH AS THE SIDEWALK.
5. SIDEWALK WIDTH TO MATCH CORRESPONDING STREET SECTION.




| CONCRETE DEPTH | |
|---|---|
| RAMP/FLARE | 6" |
| LANDING | 4" |

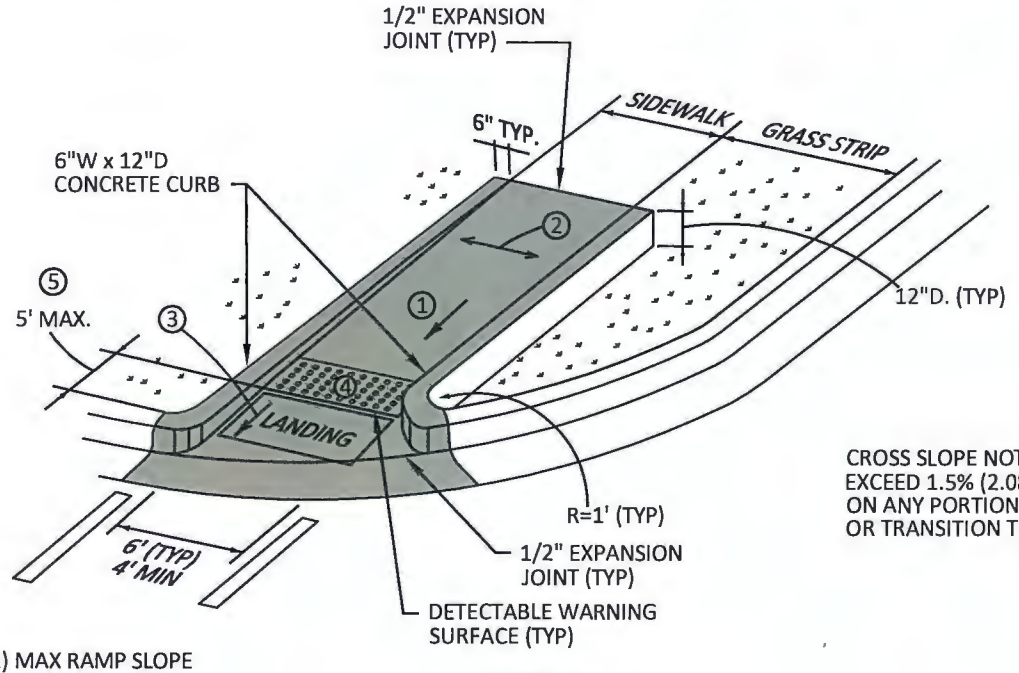
## TYPE N-3A
## (COMMERCIAL/RETAIL USE)

| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | WHEELCHAIR CURB RAMPS (NEW DEVELOPMENT) | STD. NO. 4.06-2 |
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PAY LIMITS FOR CURB RAMP

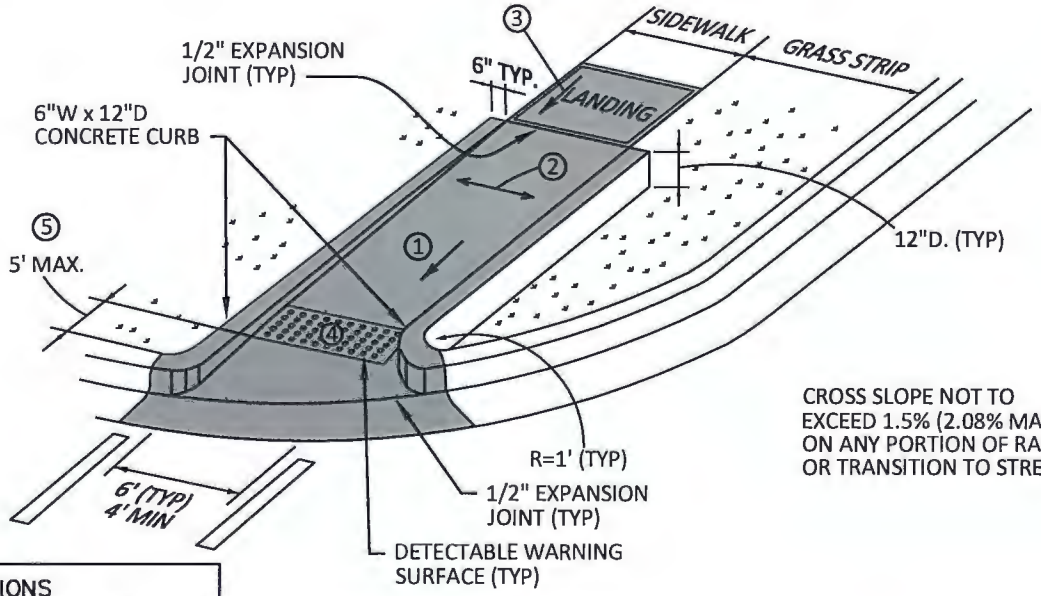



CROSS SLOPE NOT TO EXCEED 1.5% (2.08% MAX) ON ANY PORTION OF RAMP OR TRANSITION TO STREET.

## TYPE N-4

1. 7.5%; 8.33% (1:12) MAX RAMP SLOPE
2. 1.5%; 2.08% (1:48) MAX CROSS SLOPE
3. CURB RAMPS REQUIRE A (4'-0") MINIMUM LANDING WITH A MAXIMUM CROSS SLOPE AND LONGITUDINAL SLOPE OF 1.5 (2.08% MAX) WHERE PEDESTRIANS PERFORM TURNING MANEUVERS. SLOPE TO DRAIN TO CURB.
4. RAMPS AND DOMES SHALL BE INSTALLED THE SAME WIDTH AS THE SIDEWALK.
5. IF LENGTH EXCEEDS 5', TRUNCATED DOMES SHALL BE INSTALLED ALONG THE BACK OF THE CURB COVERING THE FULL WIDTH OF THE RAMP.

| CONCRETE DEPTH | |
|---|---|
| RAMP/FLARE | 6" |
| LANDING | 4" |




CROSS SLOPE NOT TO EXCEED 1.5% (2.08% MAX) ON ANY PORTION OF RAMP OR TRANSITION TO STREET.

## TYPE N-4A

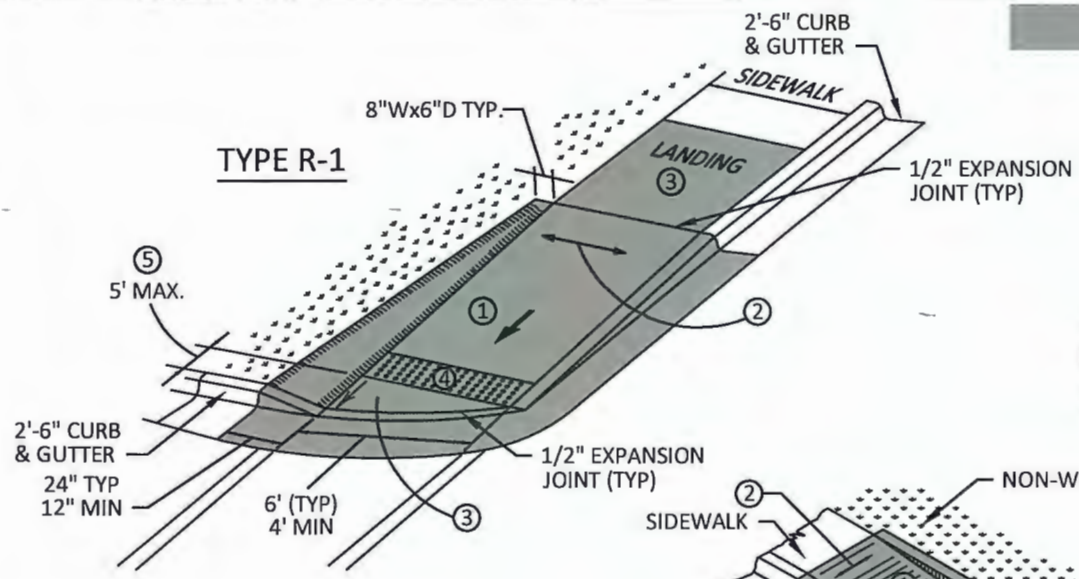
| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | WHEELCHAIR CURB RAMPS (NEW DEVELOPMENT) | STD. NO. 4.06-3 |
|---|---|---|

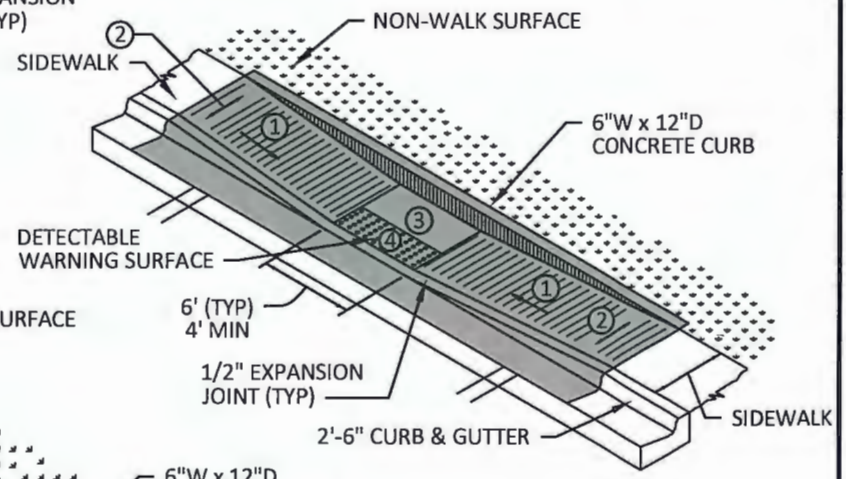
PAY LIMITS FOR CURB RAMP

## TYPE R-1



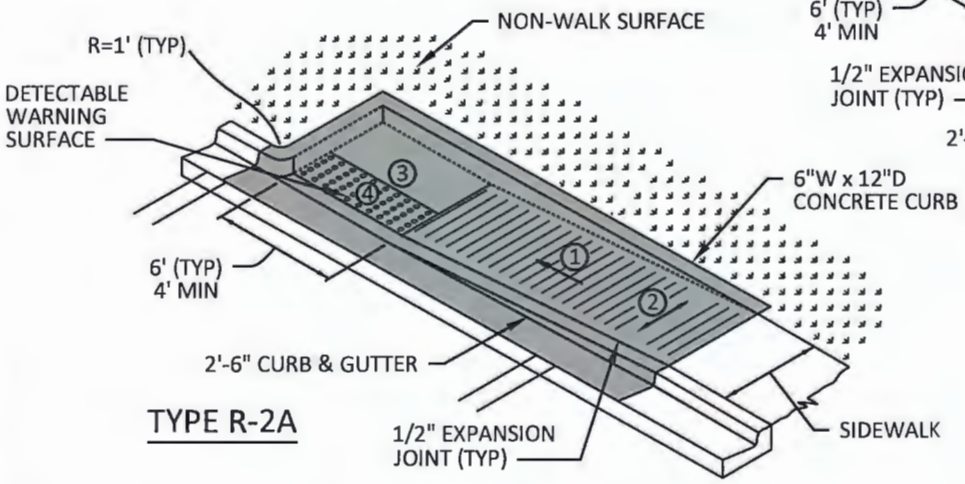

| CONCRETE DEPTH | |
|---|---|
| RAMP/FLARE | 6" |
| LANDING | 4" |

CROSS SLOPE NOT TO EXCEED 1.5% (2.08% MAX) ON ANY PORTION OF RAMP OR TRANSITION TO STREET.




## TYPE R-2

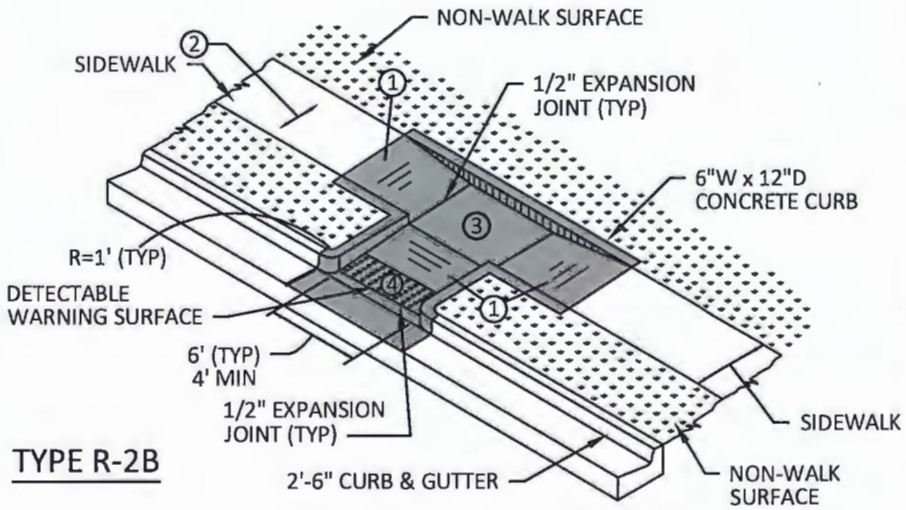
(USE ONLY WHERE WATER WILL NOT POND WITHIN LANDING)




## TYPE R-2A

| CONCRETE DEPTH | |
|---|---|
| RAMP/FLARE | 6" |
| LANDING | 4" |

1. 7.5%; 8.33% (1:12) MAX RAMP SLOPE
2. 1.5%; 2.08% (1:48) MAX CROSS SLOPE
3. CURB RAMPS REQUIRE A (4'-0") MINIMUM LANDING WITH A MAXIMUM CROSS SLOPE AND LONGITUDINAL SLOPE OF 1.5 (2.08% MAX) WHERE PEDESTRIANS PERFORM TURNING MANEUVERS. SLOPE TO DRAIN TO CURB.
4. RAMPS AND DOMES SHALL BE INSTALLED THE SAME WIDTH AS THE SIDEWALK.
5. IF LENGTH EXCEEDS 5', TRUNCATED DOMES SHALL BE INSTALLED ALONG THE BACK OF THE CURB COVERING THE FULL WIDTH OF THE RAMP.



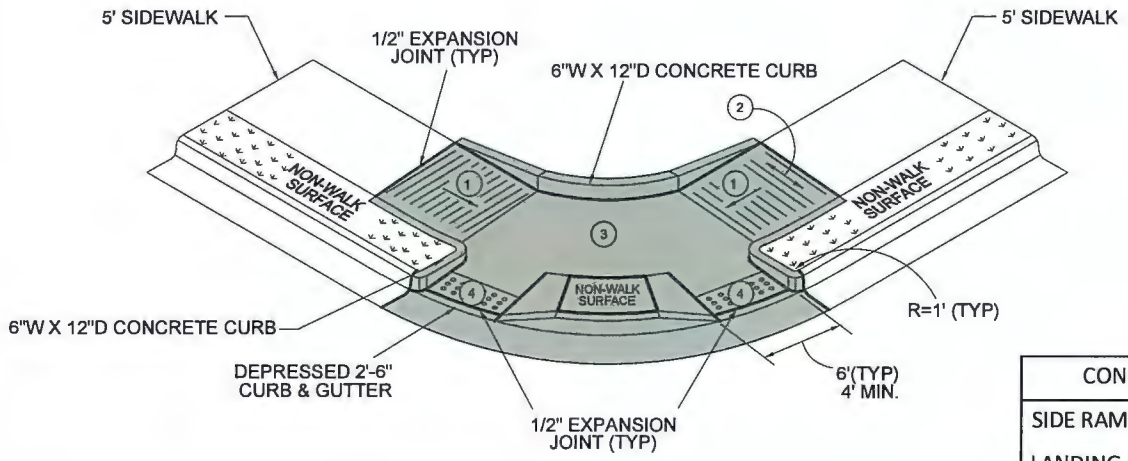

## TYPE R-2B

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| TOWN OF KNIGHTDALE STANDARD DETAILS | WHEELCHAIR CURB RAMPS (NEW DEVELOPMENT) | STD. NO. 4.06-4 |
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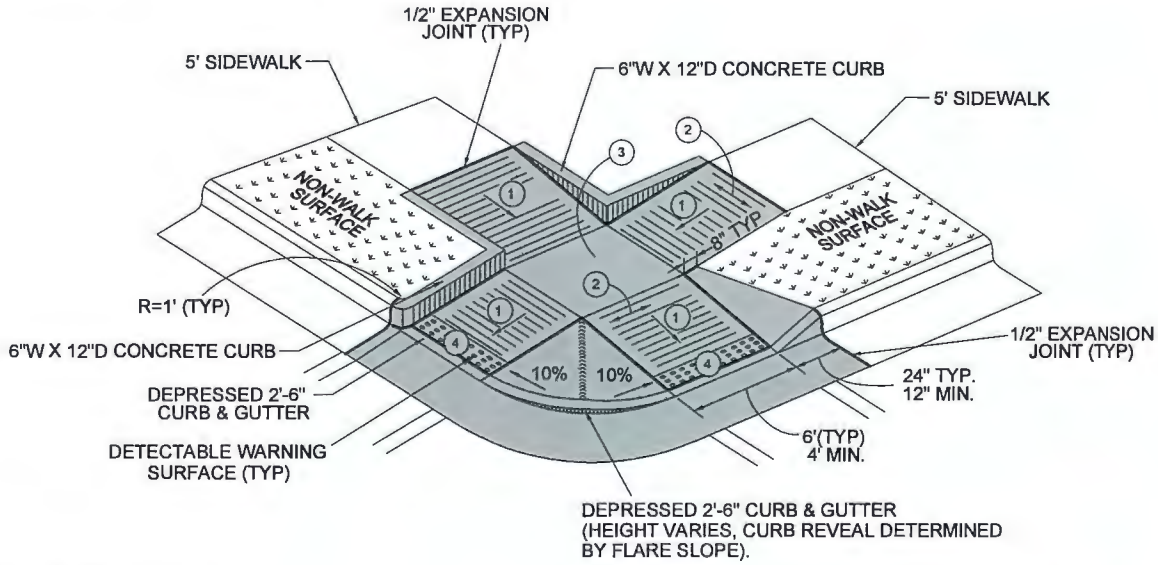
PAY LIMITS FOR CURB RAMP




| CONCRETE DEPTH | |
|---|---|
| SIDE RAMPS | 4" |
| LANDING & OPENINGS | 6" |

## TYPE R-3

1. 8.33% (1:12) MAX RAMP SLOPE
2. CROSS SLOPE: 2.00%
3. CURB RAMPS REQUIRE A (4'-0") MINIMUM LANDING WITH A MAXIMUM CROSS SLOPE AND LONGITUDINAL SLOPE OF 1.5 (2.08% MAX) WHERE PEDESTRIANS PERFORM TURNING MANEUVERS. SLOPE TO DRAIN TO CURB.
4. RAMPS AND DOMES SHALL BE INSTALLED THE SAME WIDTH AS THE SIDEWALK.
5. SIDEWALK WIDTH TO MATCH CORRESPONDING STREET SECTION.



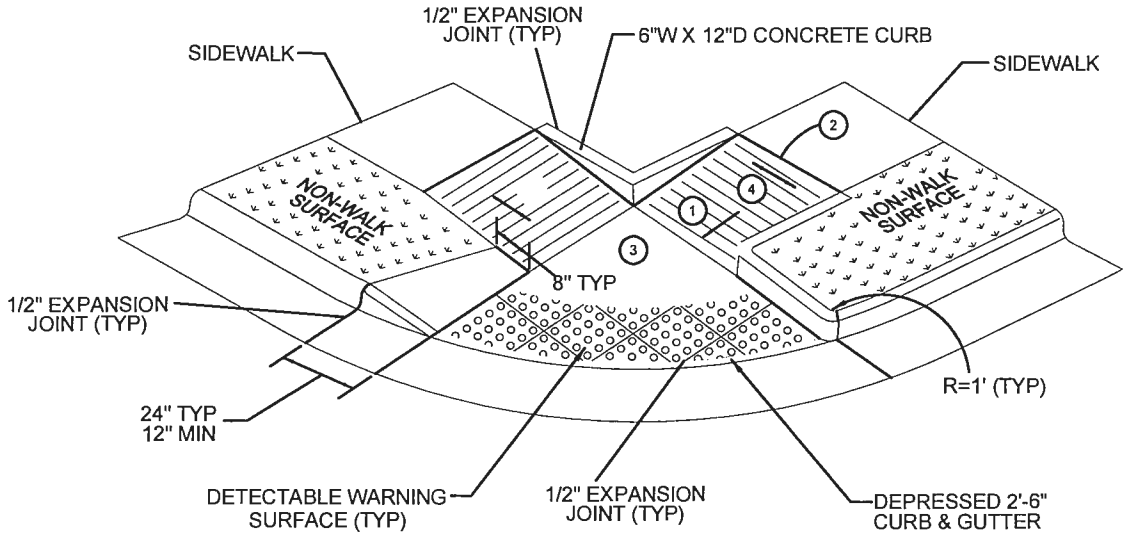

## TYPE R-4

| CONCRETE DEPTH | |
|---|---|
| SIDE RAMPS | 4" |
| LANDING & OPENINGS | 6" |

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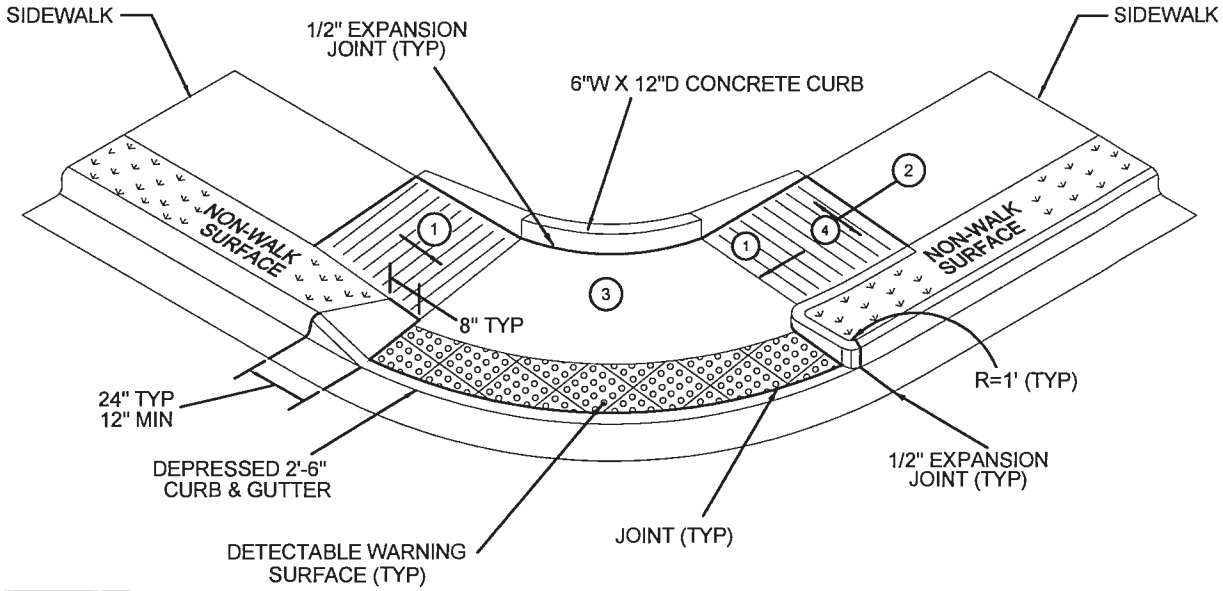
| TOWN OF KNIGHTDALE STANDARD DETAILS | WHEELCHAIR CURB RAMPS (NEW DEVELOPMENT) | STD. NO. 4.06-5 |
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SMALL RADIUS LESS THAN 15'

| CONCRETE DEPTH | |
|---|---|
| SIDE RAMPS | 4" |
| LANDING & CURB RAMPS | 6" |

1. 8.33% (12:1) MAX RAMP SLOPE
2. CROSS SLOPE: 2.00%
3. CURB RAMPS REQUIRE A (4'-0") MINIMUM LANDING WITH A MAXIMUM CROSS SLOPE AND LONGITUDINAL SLOPE OF 2.00% WHERE PEDESTRIANS PERFORM TURNING MANEUVERS. SLOPE TO DRAIN TO CURB.
4. RAMPS SHALL BE INSTALLED THE SAME WIDTH AS THE SIDEWALK.




LARGER RADIUS 15' OR GREATER

PAY LIMITS FOR CURB RAMP

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**ONLY TO BE USED WITH TOWN OF KNIGHTDALE APPROVAL.**



| TOWN OF KNIGHTDALE STANDARD DETAILS | SHARED CURB RAMPS/FLARED (RETROFIT) | STD. NO. 4.06-6 |
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1. KNIGHTDALE STANDARD CURB RAMPS HAVE BEEN DEVELOPED IN ACCORDANCE WITH THE AMERICANS WITH DISABILITIES ACT (ADA) AND PUBLIC RIGHT OF WAY ACCESS GUIDELINES (PROWAG).

2. CURB RAMPS SHALL BE PROVIDED AT LOCATIONS AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER. SIDEWALK ACCESS RAMPS SHALL BE LOCATED AS INDICATED IN THE DETAIL, HOWEVER, THE LOCATION MAY BE ADJUSTED IN COORDINATION WITH THE TOWN OF KNIGHTDALE WHERE EXISTING LIGHT POLES, FIRE HYDRANTS, DROP INLETS, ETC. AFFECT PLACEMENT.

3. DOUBLE WHEELCHAIR RAMPS ARE TO BE INSTALLED AT ALL PUBLIC STREET INTERSECTIONS WHERE SIDEWALK IS REQUIRED.

4. THE WALKING SURFACE SHALL BE SLIP RESISTANT. THE COLOR FOR THE DETECTABLE WARNING AREA SHALL BE YELLOW FOR CONTRAST.

5. NO SLOPE ON THE SIDEWALK ACCESS RAMP SHALL EXCEED 1"/FT (12:1) IN RELATIONSHIP TO THE GRADE OF THE STREET.

6. ALL RAMPS SHALL BE INSTALLED THE SAME WIDTH AS THE SIDEWALK. IN NO CASE SHALL THE WIDTH OF THE SIDEWALK ACCESS RAMP BE LESS THAN 48".

7. USE CLASS A (3000 PSI) CONCRETE WITH A SIDEWALK FINISH IN ORDER TO OBTAIN A ROUGH NONSKID SURFACE.

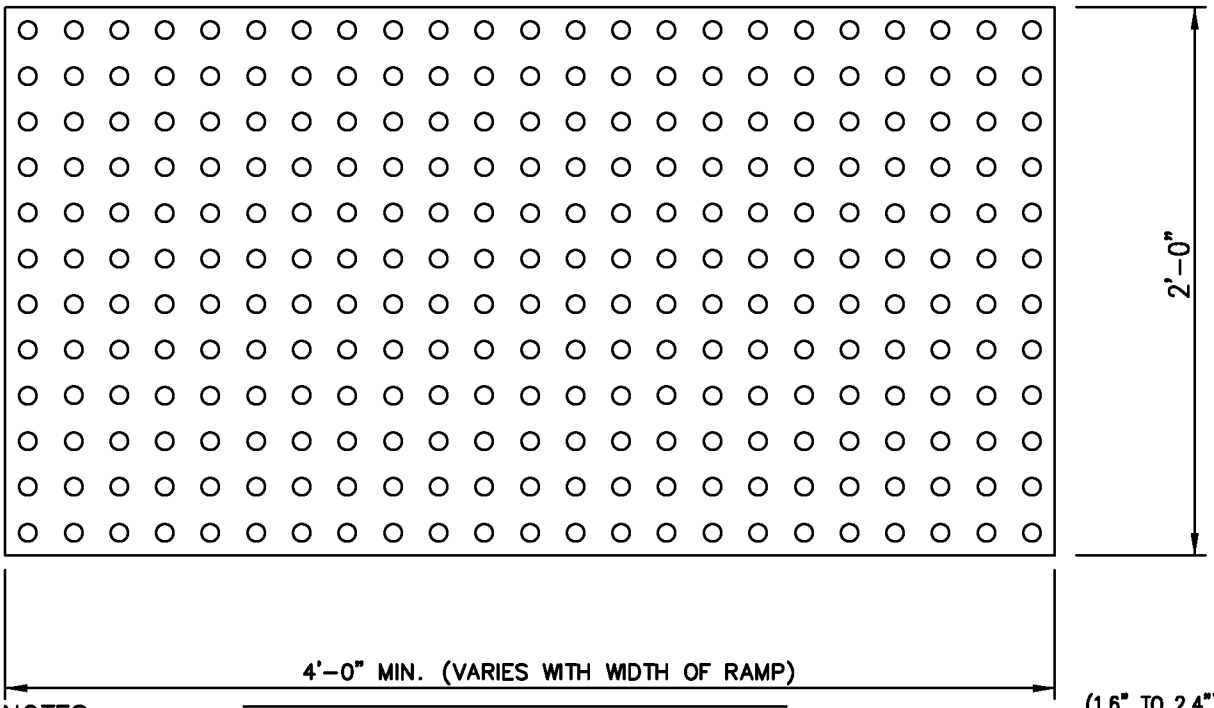
8. A 1/2" EXPANSION JOINT INSTALLED FULL DEPTH WILL BE REQUIRED WHERE THE CONCRETE SIDEWALK ACCESS RAMP JOINS THE CURB AND ALSO WHERE NEW CONCRETE ABUTS EXISTING CONCRETE.

9. CURB RAMPS SHOULD BE PLACED PARALLEL TO THE DIRECTION OF TRAVEL.

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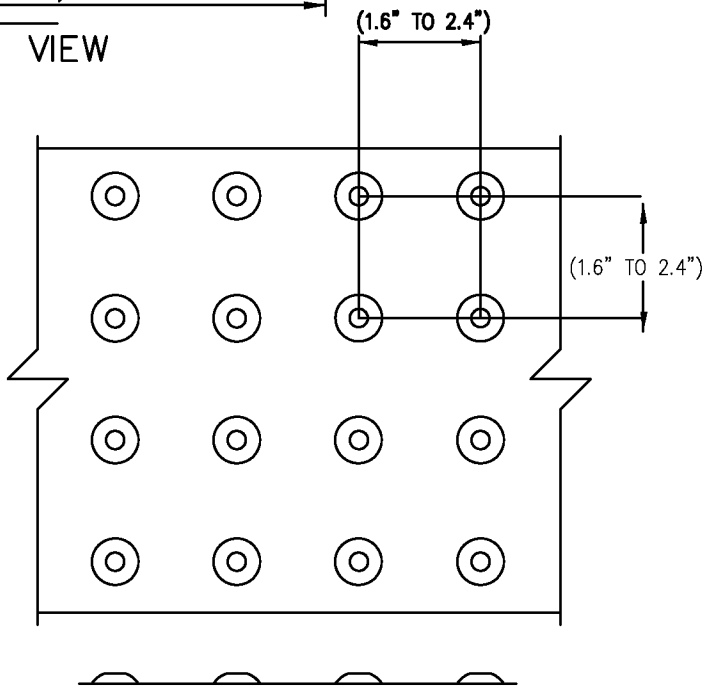
| TOWN OF KNIGHTDALE STANDARD DETAILS | WHEELCHAIR CURB RAMP NOTES | STD. NO. 4.06-7 |
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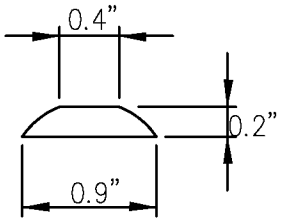

TRUNCATED DOME PLAN VIEW

NOTES:

1. ALL MATS SHALL BE REPLACEABLE MATS. PLASTIC MATS CAN BE EITHER SURFACE APPLIED OR WET-SET FRAMES THAT ACCEPT THE PLASTIC MATS. (NO PRE-CAST PAVERS, ETC.)
2. WIDTH OF DETECTABLE WARNING AREA SHALL BE A MINIMUM OF 4 FEET AND VARY WITH WIDTH OF RAMP.
3. LENGTH OF DETECTABLE WARNING AREA SHALL BE 2 FEET REGARDLESS OF SECTION WIDTH.
4. DETECTABLE WARNING AREA CAN BE SQUARE WHERE USED IN A CURB RADIUS.
5. DETECTABLE WARNING DOMES SHALL BE ALIGNED ON A SQUARE GRID IN THE PREDOMINANT DIRECTION OF TRAVEL TO PERMIT WHEELS TO ROLL BETWEEN DOMES.
6. DETECTABLE WARNING AREA SHALL BE COLORED YELLOW IN ALL LOCATIONS.




TRUNCATED DOME SPACING

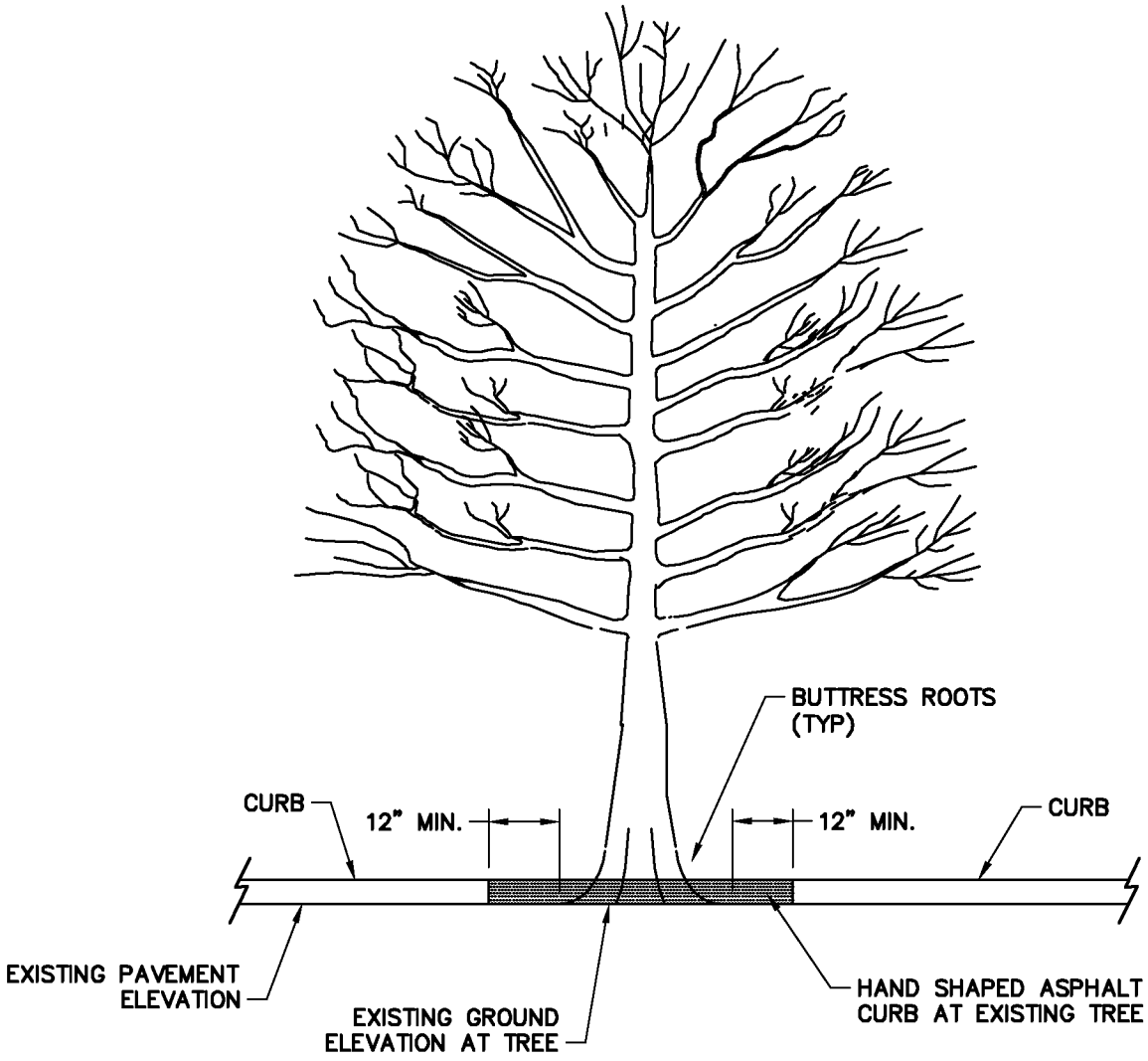



TRUNCATED DOME SECTION

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| TOWN OF KNIGHTDALE STANDARD DETAILS | TRUNCATED DOMES PLAN AND CROSS SECTION | STD. NO. 4.07 |

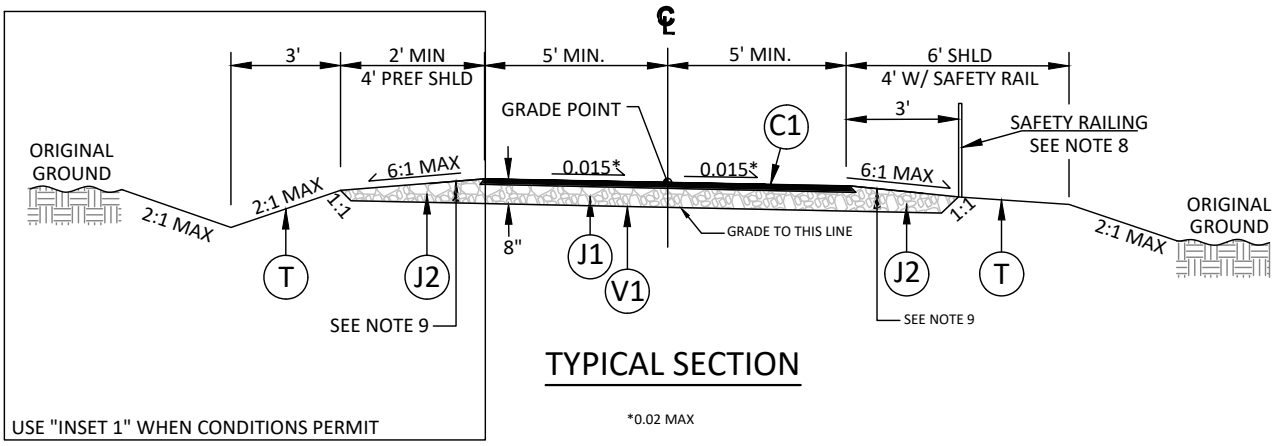



NOTES:

1. CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR EXISTING TREES.
2. WHERE EXISTING TREES ARE WITHIN 4' OF THE PROPOSED BACK OF CURB, THE PROPOSED CURB SHALL END A MINIMUM OF 12" FROM THE TREE'S BUTTRESS ROOTS.
3. CONTRACTOR SHALL COORDINATE WITH THE TOWN TO IDENTIFY TREES FOR WHICH THIS DETAIL APPLIES PRIOR TO CONSTRUCTION NEAR THE TREE(S).
4. NO TREES SHALL BE REMOVED UNLESS CLEARLY SPECIFIED ON THE PLANS OR IDENTIFIED BY THE ENGINEER.
5. AVOID FILL PLACEMENT NEAR TREE.

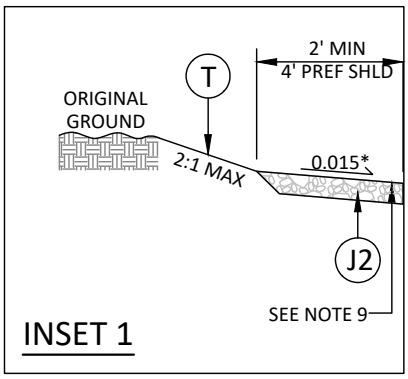
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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | ASPHALT CURB PLACEMENT<br>AT EXISTING TREES | STD. NO.<br>4.08 |




## TYPICAL SECTION

*0.02 MAX




INSET 1

| PAVEMENT SCHEDULE | |
|---|---|
| C1 | 2" ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B AT AN AVERAGE RATE OF 220 LBS. PER SQ. YD. OR 110 LBS. PER SQ. YD. IN EACH OF TWO LAYERS |
| J1 | 6" AGGREGATE BASE COURSE |
| J2 | VARIABLE DEPTH AGGREGATE BASE COURSE |
| T | EARTH MATERIAL |
| V1 | GEOTEXTILE FOR PAVEMENT STABILIZATION |

## TABLE 1 - MAXIMUM RUNNING SLOPE AND TRAIL SEGMENT LENGTH

| RUNNING SLOPE | MAX LENGTH OF SEGMENT |
|---|---|
| 1:20 (5%) | 200 FT |
| 1:12(8.33%) | 30 FT |

NOTES:

1. TRAIL WIDTH TO BE DETERMINED BY THE TOWN OF KNIGHTDALE
2. WHEN CONDITIONS PERMIT, USE 6' SHOULDER IN FILL SECTIONS AND 4' SHOULDER IN CUT SECTIONS. USE MINIMUM 2' SHOULDER IN CUT AND FILL SECTIONS. FOR CUT SECTION CONDITION SHOWN IN "INSET 1" , APPLY ENGINEERING JUDGEMENT TO DETERMINE IF UPHILL SIDE REQUIRES A SWALE.
3. PROVIDE MINIMUM 2' SHOULDER OF UNPLANTED AGGREGATE BASE COURSE.
4. TRAILS OR TRAIL SEGMENTS OF ANY LENGTH MAY BE CONSTRUCTED WITH RUNNING SLOPES/VERTICAL GRADES UP TO 1:20 (5%). TO ACCOMMODATE STEEP TERRAIN, TRAILS MAY BE DESIGNED WITH STEEPER SECTIONS OF CONSTRAINED LENGTH AS SHOWN IN TABLE 1. RESTING INTERVALS WITH FLATTER GRADES ARE REQUIRED BETWEEN TRAIL SEGMENTS ANY TIME RUNNING SLOPE EXCEEDS 1:20 (5%). RESTING INTERVALS SHALL BE LOCATED ON UPHILL SIDE OF TRAIL IF ONLY PROVIDED ON ONE SIDE.
5. TO ENSURE THAT A TRAIL IS NOT DESIGNED AS A SERIES OF STEEP SEGMENTS, NO MORE THAN 30% OF THE TOTAL LENGTH OF TRAIL MAY HAVE A RUNNING SLOPE/VERTICAL GRADE OF 7.5% (8.33% OR 1:12 MAX). RESTING INTERVALS MUST BE PROVIDED FREQUENTLY AS THE RUNNING SLOPE INCREASES.
6. RUNNING SLOPE/VERTICAL GRADE RECOMMENDATIONS MAY NOT BE ABLE TO BE ACHIEVED FOR TRAIL REPLACEMENT PROJECTS. FOR THESE TYPE OF PROJECTS, REPLACEMENT OF EXISTING CONDITION IN KIND IS SUFFICIENT.
7. TYPICAL CROSS SLOPE SHALL BE 1.5% (2.08% OR 1:48 MAX). CROSS SLOPE DIRECTION VARIES. SLOPE SHOULDERS FOR POSITIVE DRAINAGE WHICH MAY REQUIRE CONTINUING PAVEMENT OR SHOULDER SLOPE UNTIL TIE-IN WITH NATURAL GROUND. SEE PLAN SHEETS AND CROSS SECTIONS.
8. WHEN CONDITIONS PERMIT, SHOULDERS TO MATCH CROSS SLOPE OF TRAIL AND SIDE SLOPES TO BE 3:1 OR FLATTER.
9. PROVIDE A SAFETY RAIL FOR THE FOLLOWING CIRCUMSTANCES WITHIN 6' OF THE EDGE OF PAVEMENT: 1) SLOPE > 3:1 AND DROP OF 6'; 2) SLOPE > 2:1 AND DROP OF 4'; 3) SLOPE > 1:1 AND DROP OF 1'.
10. CONTRACTOR IS RESPONSIBLE FOR RE-ESTABLISHING ALL SLOPES DISTURBED DURING CONSTRUCTION.
11. PROOF ROLLING SHALL OCCUR IN PRESENCE OF THE OWNER OR THE OWNER'S TESTING AGENCY AT THE FOLLOWING STAGES: 1)PRIOR TO PLACING FILL IN LOW AREAS; 2) AFTER THE PREPARATION OF SUBGRADE PRIOR TO PLACING ABC; 3) AFTER THE PLACEMENT OF ABC PRIOR TO PAVING.
12. PAVEMENT EDGE SLOPES ARE 1:1 UNLESS OTHERWISE NOTED.
13. NO ABOVE-GROUND UTILITIES OR UTILITY SURFACE COVERS/PLATES/MANHOLES SHALL BE LOCATED WITHIN THE TRAIL AND SHALL BE A MINIMUM OF 2' FROM THE EDGE OF TRAIL. RAISED MANHOLES SHALL BE A MINIMUM OF 4' FROM THE EDGE OF TRAIL.

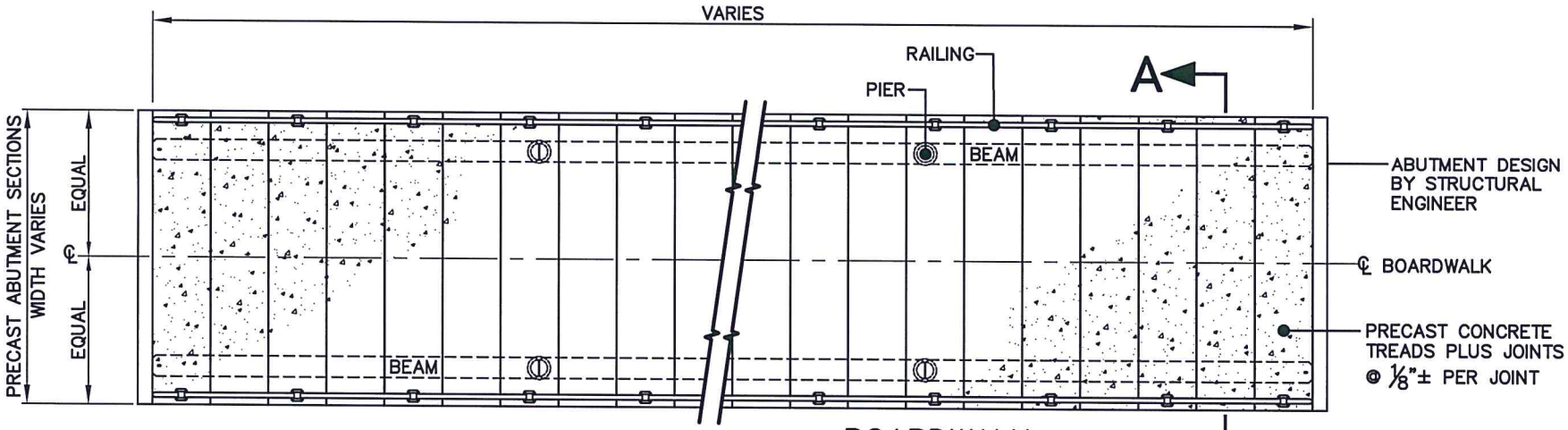
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TOWN OF KNIGHTDALE
STANDARD DETAILS

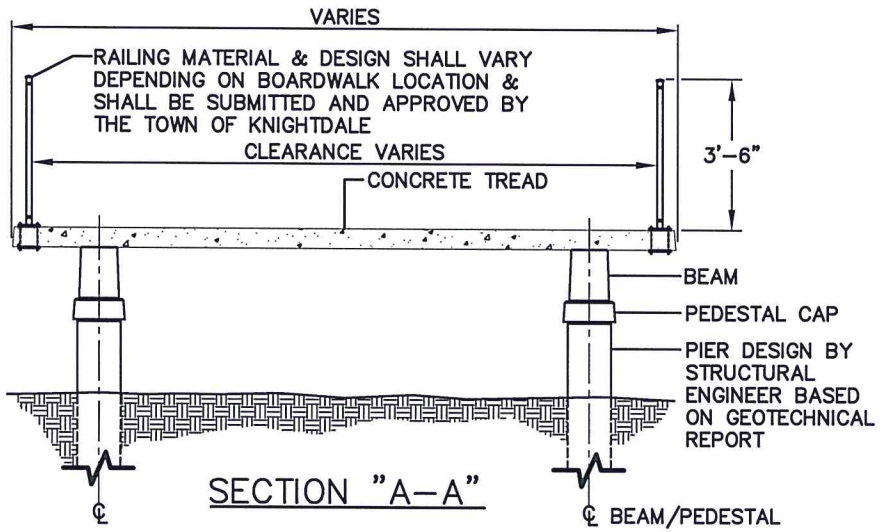
# ASPHALT TYPICAL GREENWAY SECTION VARIABLE WIDTH (10' MIN)

STD. NO.

4.09-1




BOARDWALK
PLAN VIEW



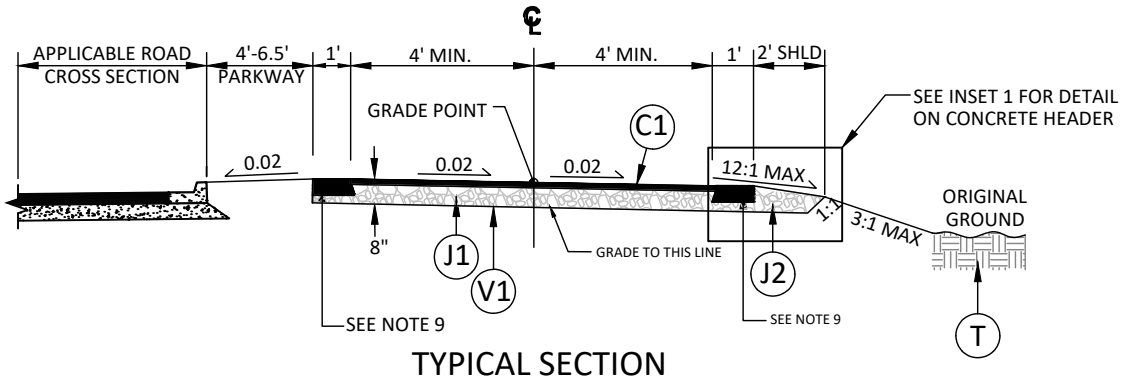

SECTION "A-A"

NOTES:

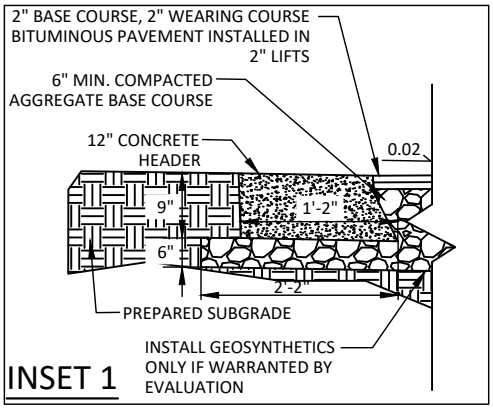
1. BOARDWALK SYSTEM (BEAMS, TREADS, AND CURBS IF APPLICABLE) MUST BE PRECAST CONCRETE. WALKING SURFACE (TREADS) SHALL BE MADE OF PRECAST CONCRETE, AND SUPPORTED BY PRECAST CONCRETE BEAMS.
2. COLOR AND FINISH TEXTURE SHALL BE INTEGRAL AND MUST BE SUBMITTED FOR APPROVAL.
3. PRECAST CONCRETE TREADS SHALL BE STRUCTURAL LOAD BEARING ELEMENTS AND SHALL INTERLOCK WITH ONE ANOTHER VIA A "TONGUE AND GROOVE" CONNECTION.
4. TREADS SHALL MAINTAIN A "BOARDWALK APPEARANCE", SPECIFICALLY MEANING EACH TREAD SHALL HAVE A WIDTH: LENGTH RATIO RANGING FROM A MINIMUM OF 3:1 TO A MAXIMUM OF 14:1.
5. ALL BOARDWALK CONNECTORS SHALL BE NON-CORROSIVE, AND HIDDEN FROM VIEW. METALLIC CONNECTORS ARE NOT ACCEPTABLE FOR THIS PROJECT.
6. THE DESIGNER OF THE BOARDWALK, FOUNDATION AND RAILING SYSTEM SHALL BE A QUALIFIED REGISTERED PROFESSIONAL ENGINEER LICENSED IN THE STATE OF NORTH CAROLINA.
7. BOARDWALK DESIGN CRITERIA:
   - AASHTO LRFD GUIDE SPECIFICATIONS FOR THE DESIGN OF PEDESTRIAN BRIDGES, 2ND EDITION
   - AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR HIGHWAY BRIDGES, 5TH EDITION.
   - AMERICAN CONCRETE INSTITUTE 2005 – BUILDING CODE AND COMMENTARY.
   - RAILINGS (WHEN REQUIRED BY CODE) SHALL BE SUITABLE FOR PEDESTRIAN TRAFFIC AND SHALL BE A MINIMUM OF 42 INCHES ABOVE THE TREAD / DECK SURFACE.
   - RAILING TO BE ATTACHED BY POST TO DECK TOP WITH A BASE PLATE OR MOUNTED TO SIDEWALK OR SUPPORTING BEAM SIDES.
   - A 4-INCH SPHERE CANNOT PASS THROUGH THE LOWER 34 INCHES OF THE RAIL SYSTEM AND AN 8-INCH SPHERE MUST NOT PASS THROUGH THE THE UPPER AREA OF THE RAIL SYSTEM FROM 34" TO 42" HEIGHT.
   - RAILINGS MUST RESIST A UNIFORM LOAD OF 50 POUNDS APPLIED PER LINEAR FOOT OR A SINGLE CONCENTRATED LOAD OF 200 POUNDS APPLIED IN ANY DIRECTION AT THE TOP OF EACH RAIL.
   - RAILINGS SHOULD PROVIDE SAFETY TOE RAIL OR CURB.
   - RAILINGS NEED TO BE SUBMITTED AND APPROVED BY THE TOWN OF KNIGHTDALE.
8. OTHER DESIGNS/MATERIALS MAY BE ALLOWED PER TOWN OF KNIGHTDALE REVIEW AND APPROVAL

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD PRECAST CONCRETE BOARDWALK (PLAN & SECTION VIEW) | STD. NO. 4.09-2 |




## TYPICAL SECTION




INSET 1

## PAVEMENT SCHEDULE

| | |
|---|---|
| C1 | 2" ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B AT AN AVERAGE RATE OF 220 LBS. PER SQ. YD. OR 110 LBS. PER SQ. YD. IN EACH OF TWO LAYERS |
| J1 | 6" AGGREGATE BASE COURSE |
| J2 | VARIABLE DEPTH AGGREGATE BASE COURSE |
| T | EARTH MATERIAL |
| V1 | GEOTEXTILE FOR PAVEMENT STABILIZATION |

## TABLE 1 - MAXIMUM RUNNING SLOPE AND TRAIL SEGMENT LENGTH

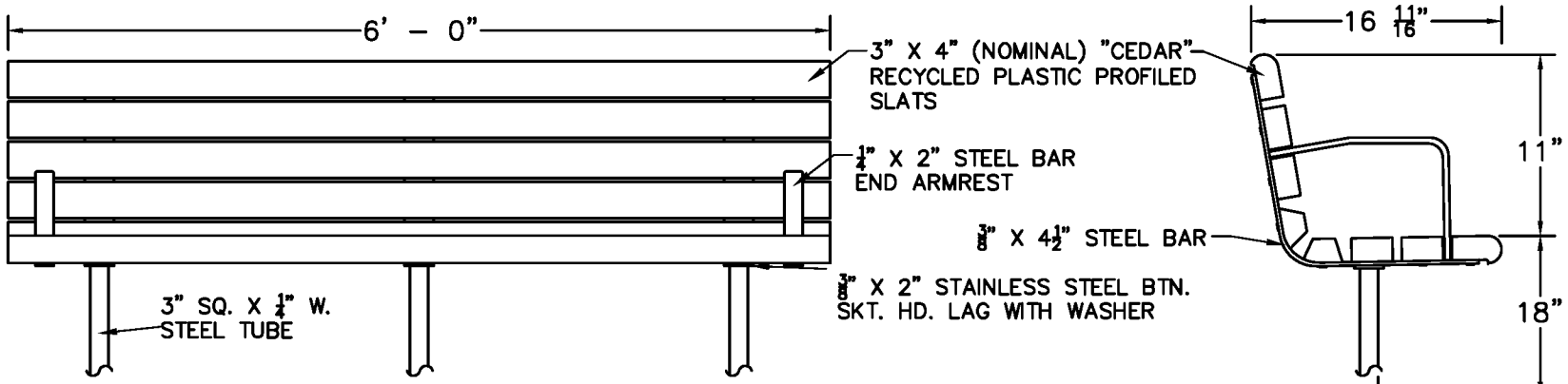
| RUNNING SLOPE | MAX LENGTH OF SEGMENT |
|---|---|
| 1:20 (5%) | 200 FT |
| 1:12(8.33%) | 30 FT |

NOTES:

1. TRAIL WIDTH TO BE DETERMINED BY THE TOWN OF KNIGHTDALE
2. PROVIDE MINIMUM 2' SHOULDER OF UNPLANTED AGGREGATE BASE COURSE.
3. TRAILS OR TRAIL SEGMENTS OF ANY LENGTH MAY BE CONSTRUCTED WITH RUNNING SLOPES/VERTICAL GRADES UP TO 1:20 (5%). TO ACCOMMODATE STEEP TERRAIN, TRAILS MAY BE DESIGNED WITH STEEPER SECTIONS OF CONSTRAINED LENGTH AS SHOWN IN TABLE 1. RESTING INTERVALS WITH FLATTER GRADES ARE REQUIRED BETWEEN TRAIL SEGMENTS ANY TIME RUNNING SLOPE EXCEEDS 1:20 (5%). RESTING INTERVALS SHALL BE LOCATED ON UPHILL SIDE OF TRAIL IF ONLY PROVIDED ON ONE SIDE.
4. TO ENSURE THAT A TRAIL IS NOT DESIGNED AS A SERIES OF STEEP SEGMENTS, NO MORE THAN 30% OF THE TOTAL LENGTH OF TRAIL MAY HAVE A RUNNING SLOPE/VERTICAL GRADE OF 7.5% (8.33% OR 1:12 MAX). RESTING INTERVALS MUST BE PROVIDED FREQUENTLY AS THE RUNNING SLOPE INCREASES.
5. RUNNING SLOPE/VERTICAL GRADE RECOMMENDATIONS MAY NOT BE ABLE TO BE ACHIEVED FOR TRAIL REPLACEMENT PROJECTS. FOR THESE TYPE OF PROJECTS, REPLACEMENT OF EXISTING CONDITION IN KIND IS SUFFICIENT.
6. TYPICAL CROSS SLOPE SHALL BE 2.0% (2.08% OR 1:48 MAX). CROSS SLOPE DIRECTION VARIES. SLOPE SHOULDERS FOR POSITIVE DRAINAGE WHICH MAY REQUIRE CONTINUING PAVEMENT OR SHOULDER SLOPE UNTIL TIE-IN WITH NATURAL GROUND. SEE PLAN SHEETS AND CROSS SECTIONS.
7. WHEN CONDITIONS PERMIT, SHOULDERS TO MATCH CROSS SLOPE OF TRAIL AND SIDE SLOPES TO BE 3:1 OR FLATTER.
8. CONTRACTOR IS RESPONSIBLE FOR RE-ESTABLISHING ALL SLOPES DISTURBED DURING CONSTRUCTION.
9. PROOF ROLLING SHALL OCCUR IN PRESENCE OF THE OWNER OR THE OWNER'S TESTING AGENCY AT THE FOLLOWING STAGES: 1)PRIOR TO PLACING FILL IN LOW AREAS; 2) AFTER THE PREPARATION OF SUBGRADE PRIOR TO PLACING ABC; 3) AFTER THE PLACEMENT OF ABC PRIOR TO PAVING.
10. PAVEMENT EDGE SLOPES ARE 1:1 UNLESS OTHERWISE NOTED.
11. NO ABOVE-GROUND UTILITIES OR UTILITY SURFACE COVERS/PLATES/MANHOLES SHALL BE LOCATED WITHIN THE TRAIL AND SHALL BE A MINIMUM OF 2' FROM THE EDGE OF TRAIL. RAISED MANHOLES SHALL BE A MINIMUM OF 4' FROM THE EDGE OF TRAIL.
12. DO NOT PLANT TREES WITHIN 2'-0" SHOULDER, RECOMMENDED 6'-0" DISTANCE FROM TRAIL EDGE OR GREATER IF SWALE OR SCM IS PRESENT.

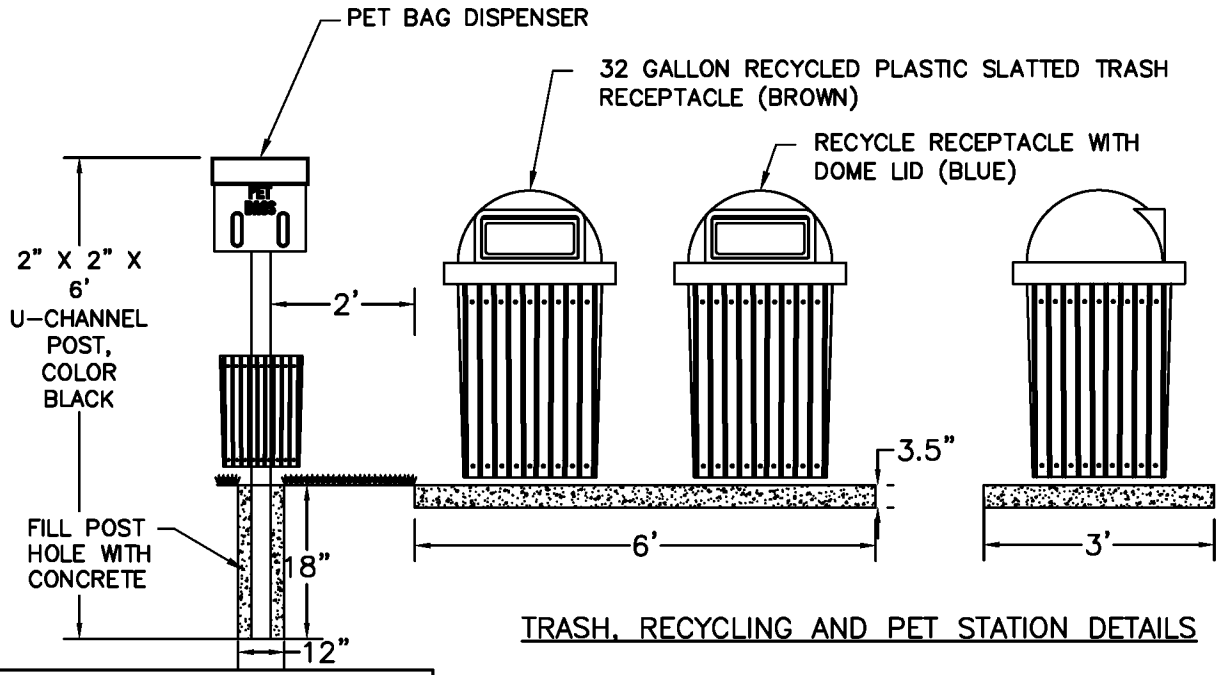
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| TOWN OF KNIGHTDALE STANDARD DETAILS | ASPHALT TYPICAL TRAIL | STD. NO. 4.09-3 |




FRONT VIEW

SIDE VIEW



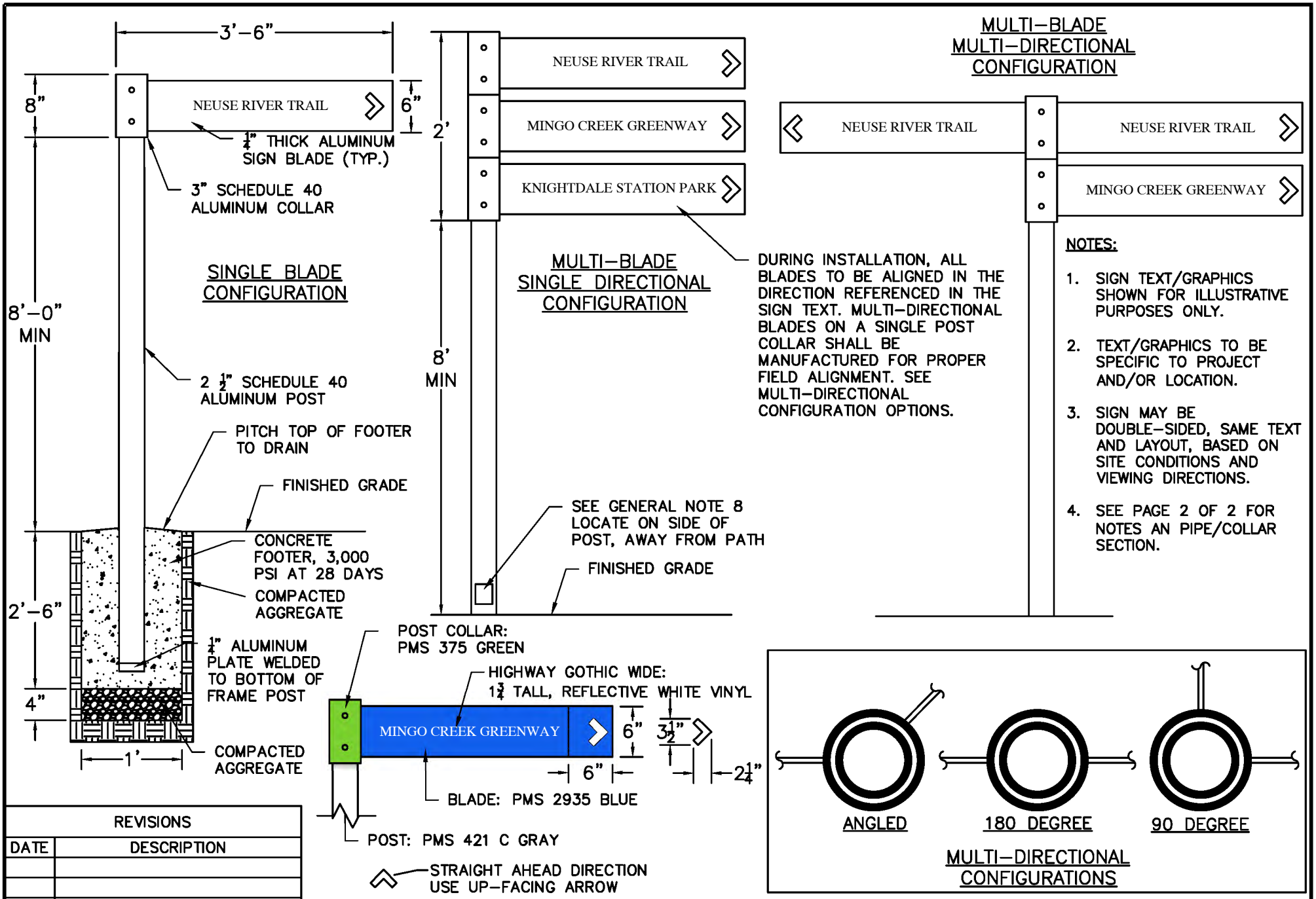

TRASH, RECYCLING AND PET STATION DETAILS

NOTES:

1. BENCHES SHALL BE KAY PARK RECREATION CONTOUR BENCH WITH BACK, 6 FT., RECYCLED PLASTIC (BROWN), OR APPROVED EQUIVALENT.
2. TRASH RECEPTACLE SHALL BE TREE TOP PRODUCTS 32 GALLON, SLATTED, RECYCLED PLASTIC (BROWN), NO. 4ZK5003 WITH DOME LID AND PUSH DOOR, OR APPROVED EQUIVALENT.
3. RECYCLING RECEPTACLE SHALL MATCH TRASH RECEPTACLE, WITH USE OF BLUE DOME LID.
4. PET WASTE STATION SHALL BE TREE TOP PRODUCTS STANDARD ROUND PET WASTE STATION, 10 GALLON, RECYCLED PLASTIC (BROWN), OR APPROVED EQUIVALENT.
5. BENCHES, DOG STATION, TRASH AND RECYCLE RECEPTACLES TO BE INSTALLED BY THE CONTRACTOR IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND DETAILS.
5. SURFACE OR INGROUND MOUNT OF FIXTURES TO BE INDICATED AND APPROVED IN PLAN REVIEW.
6. AMENITIES TO BE PLACED IN ACCORDANCE WITH UDO AND APPROVED CONSTRUCTION PLANS.

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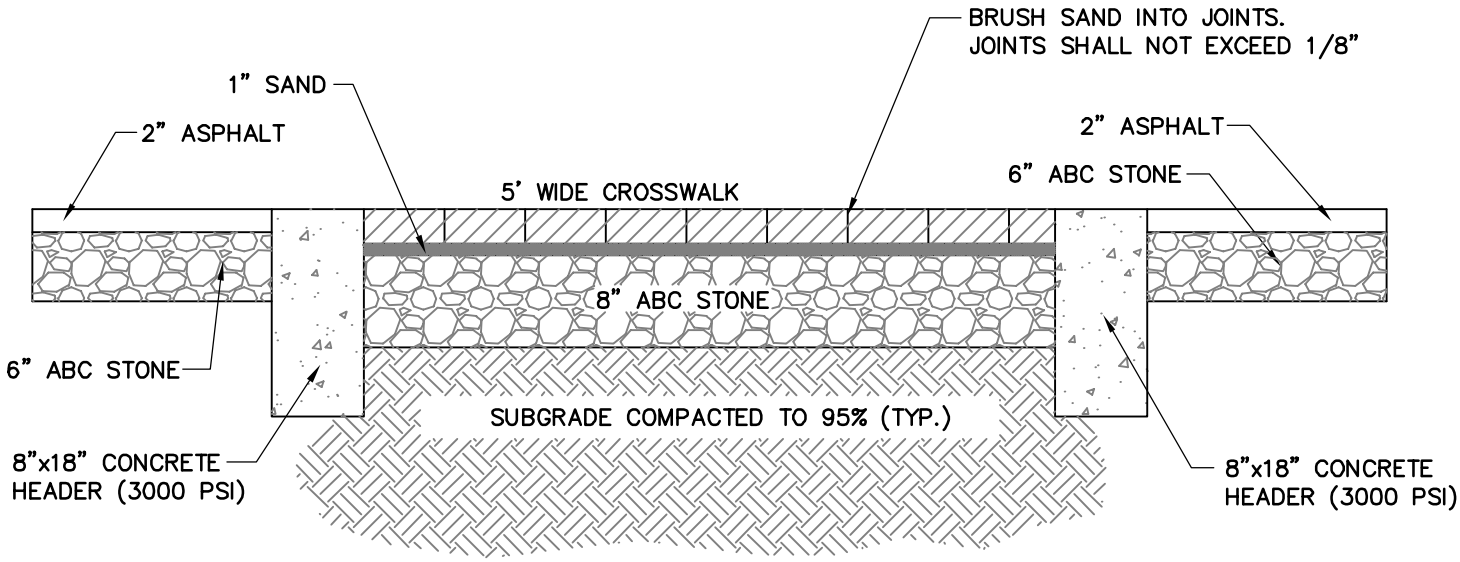

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TOWN OF KNIGHTDALE STANDARD DETAILS

# GREENWAY DIRECTIONAL SIGNAGE

STD. NO. 4.09-5

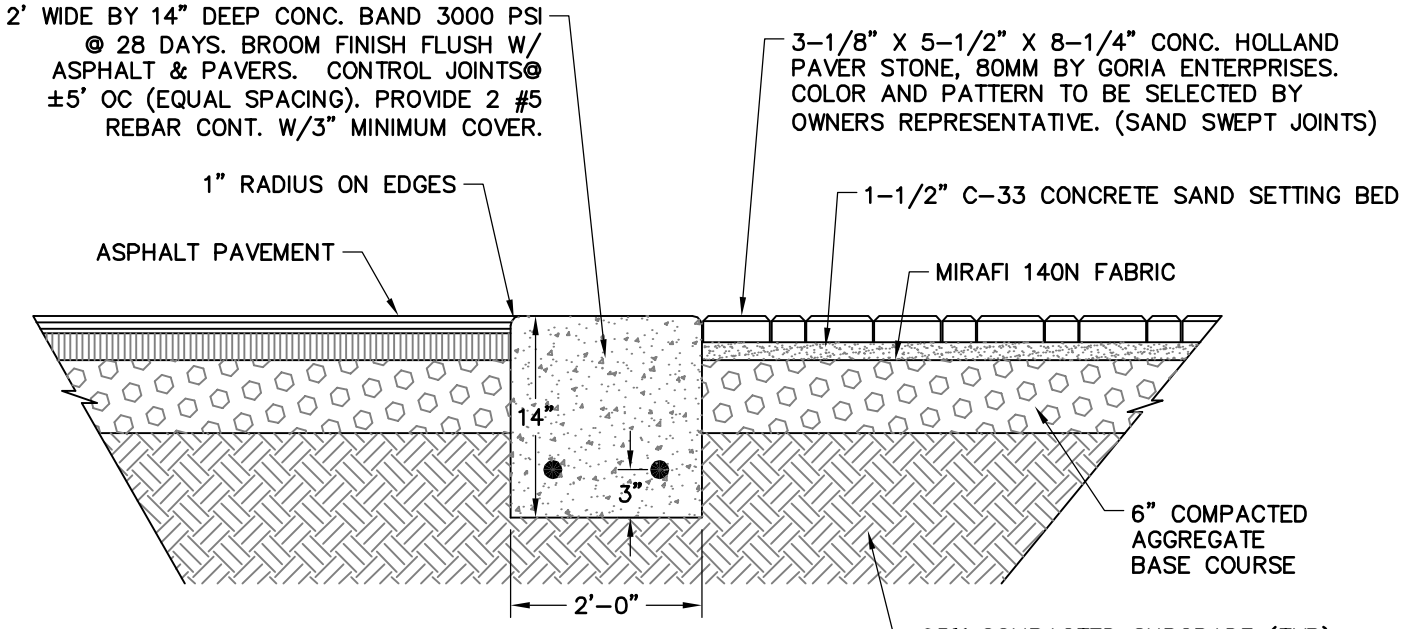



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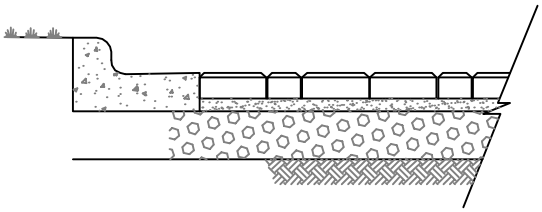
1. STAMPED CONCRETE OR ASPHALT MAY BE USED IN LIEU OF BRICK PAVERS.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | BRICK CROSSWALK | STD. NO. 4.10 |




SECTION @ CONCRETE BAND



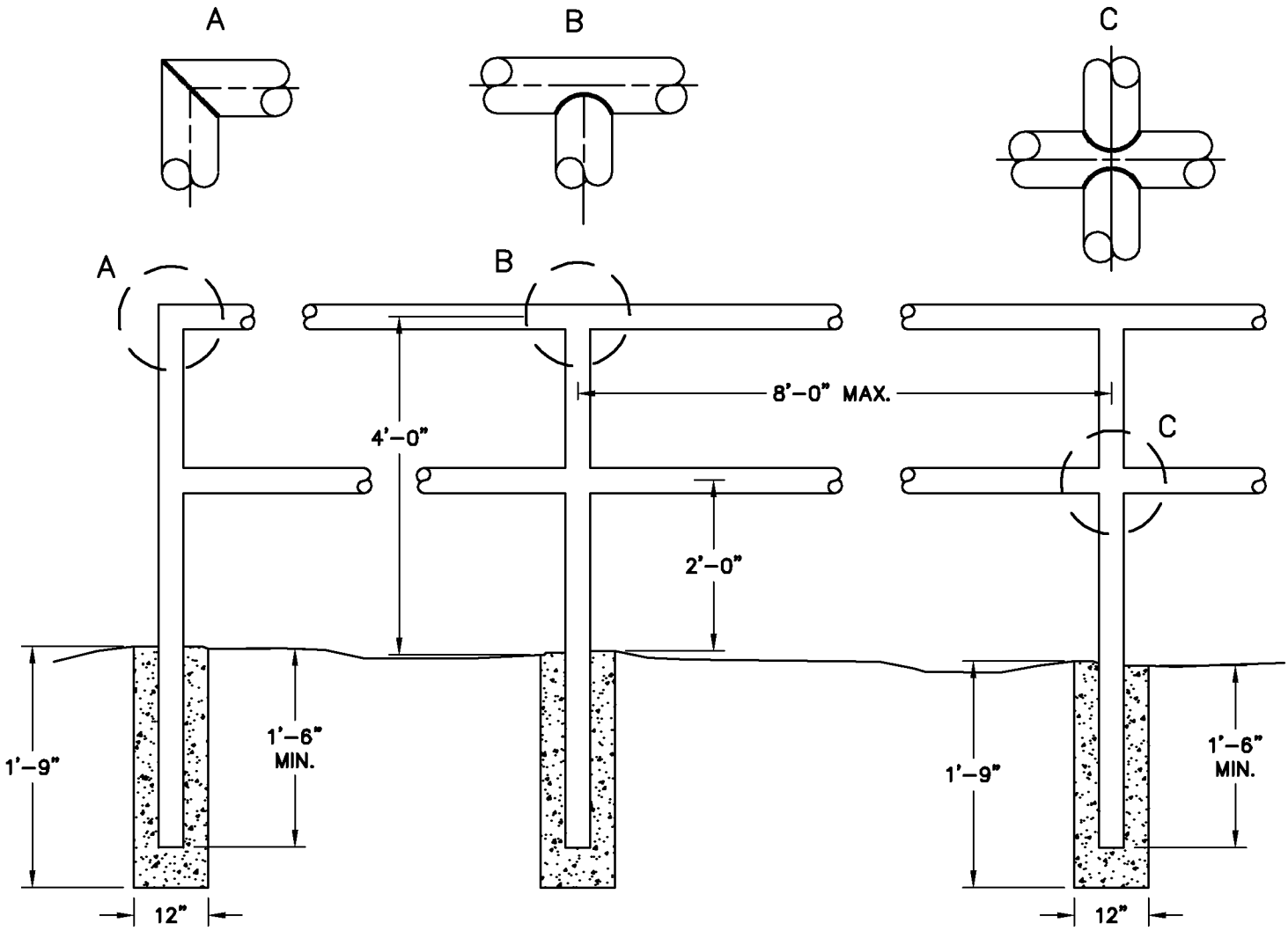
SECTION @ CURB & GUTTER

NOTE:

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| TOWN OF KNIGHTDALE STANDARD DETAILS | UNIT PAVER CROSSWALK | STD. NO. 4.11 |

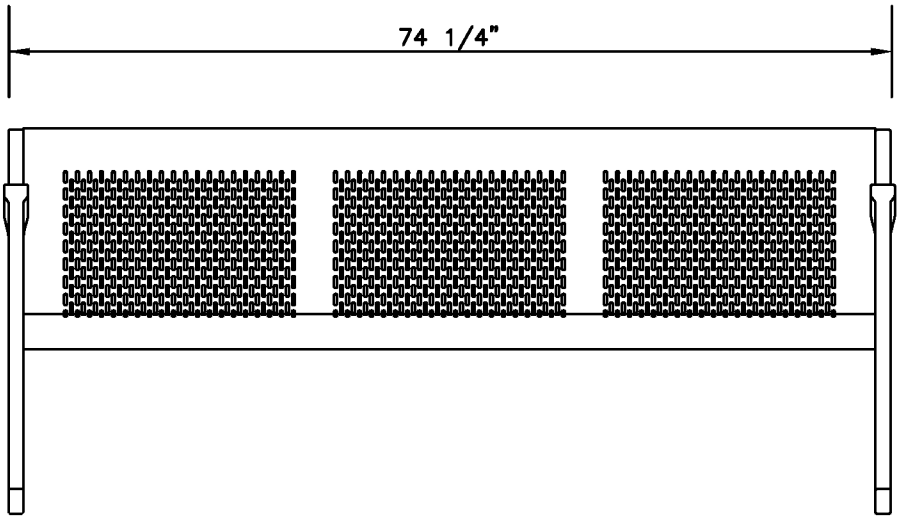


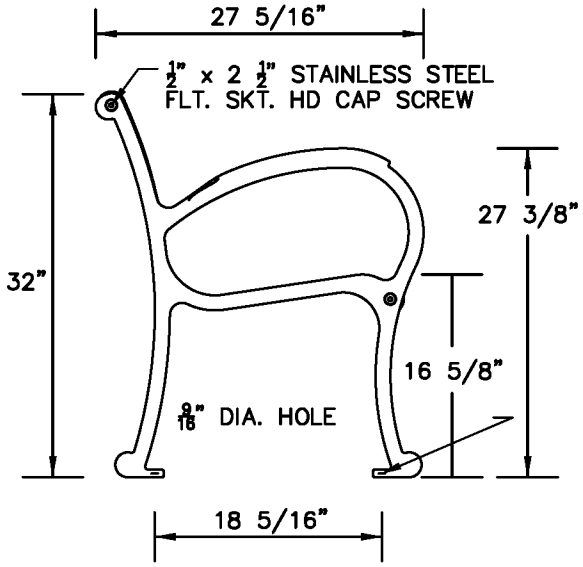

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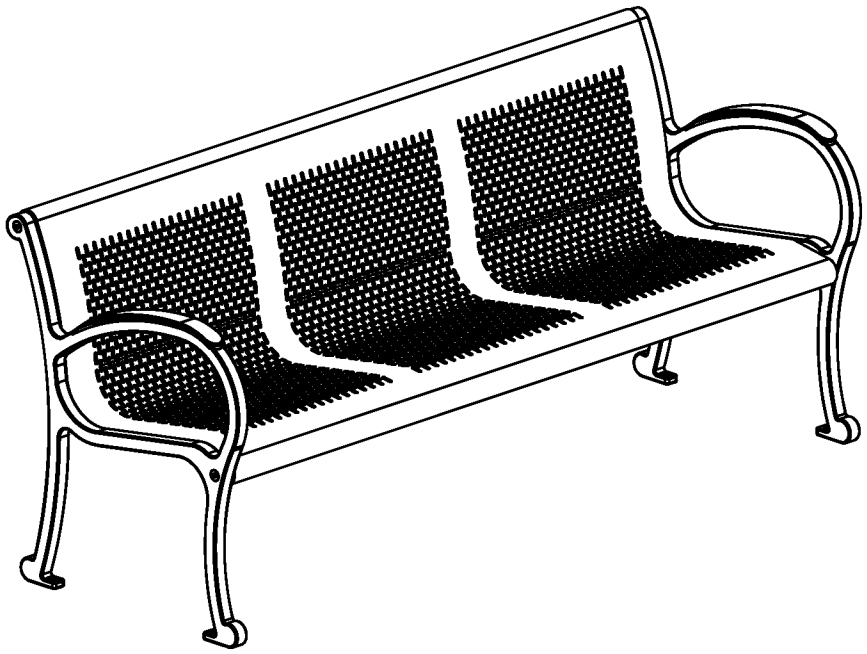
1. ALL CONCRETE TO BE 3600 PSI COMPRESSIVE STRENGTH.
2. TYPE OF PIPE TO BE USED IS 1-5/8" MAX. O.D. BLACK IRON, LOW CARBON PIPE.
3. ALL JOINTS TO HAVE A 1/2" FILLET WELD.
4. AFTER INSTALLATION, PAINT ASSEMBLY WITH BLACK ALL WEATHER ENAMEL.
5. TO BE USED AS REQUIRED BY THE TOWN ENGINEER.

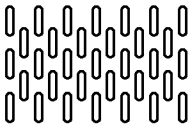
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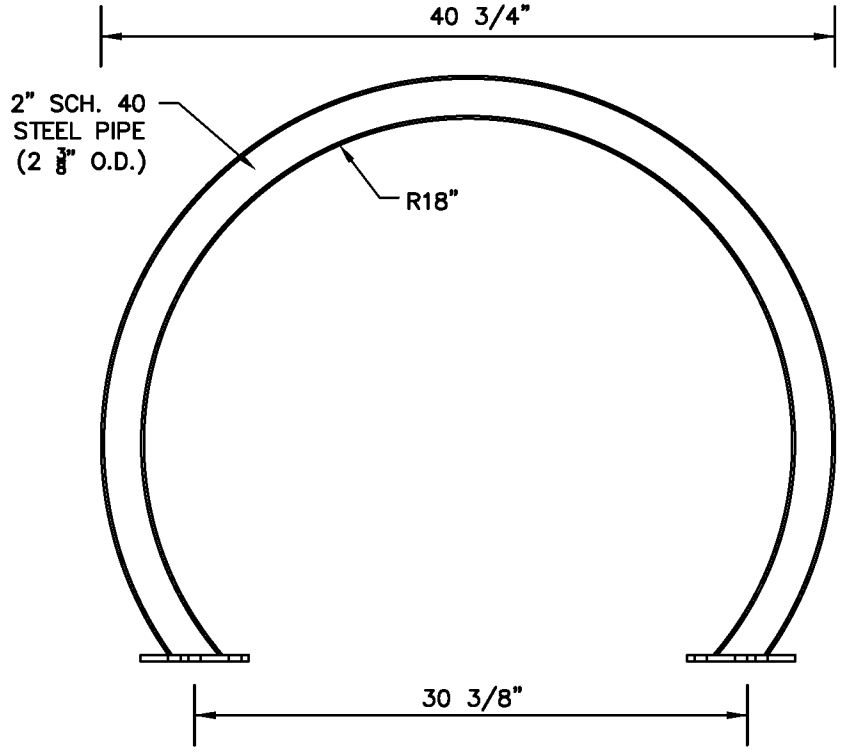
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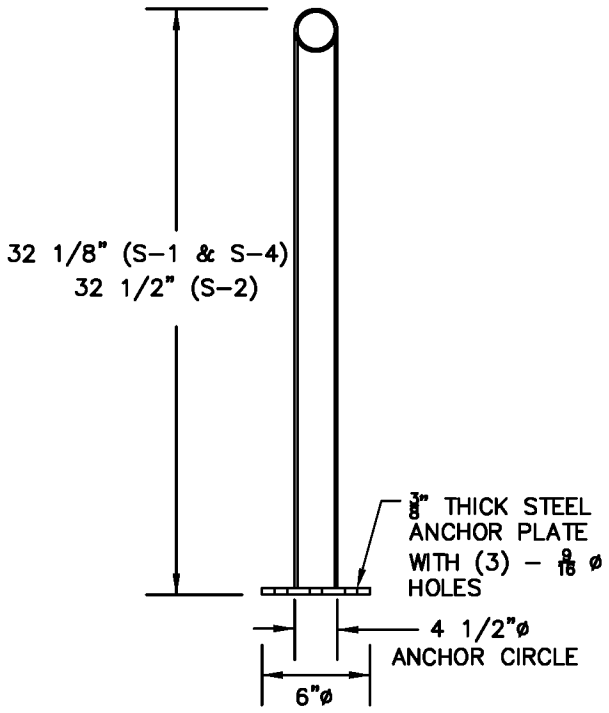
NOTES:

1. BENCH SHALL BE DUMOR 169 SERIES 6 FT. STEEL PERFORATED SEAT (BLACK), OR EQUIVALENT.
2. OTHER DESIGNS MAY BE ALLOWED PER TOWN OF KNIGHTDALE REVIEW AND APPROVAL.
3. BENCH TO BE INSTALLED BY CONTRACTORS IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND DETAILS.
4. ALL STEEL MEMBERS COATED WITH ZINC RICH COATING THEN POLYESTER POWDER COATED.

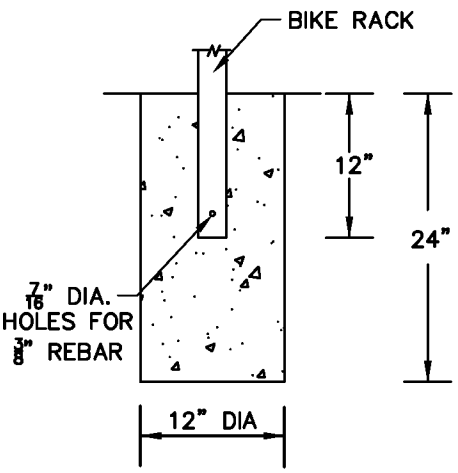
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| TOWN OF KNIGHTDALE STANDARD DETAILS | TYPICAL BENCH | STD. NO. 4.14 |

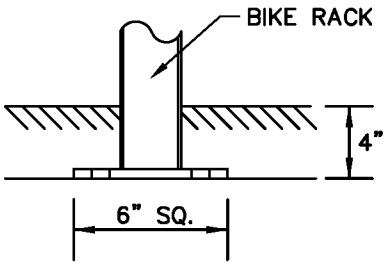


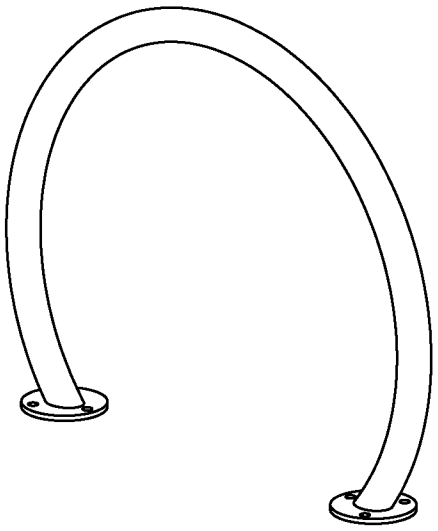

S-2 SURFACE MOUNT




S-1 EMBEDMENT




S-4 SUB FLOOR

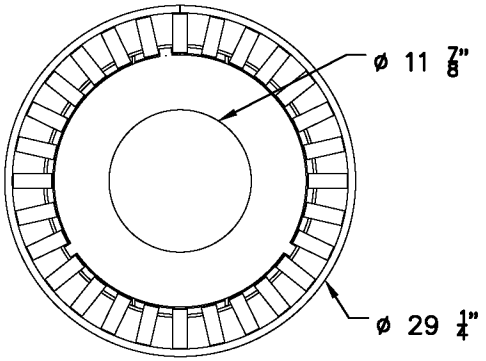


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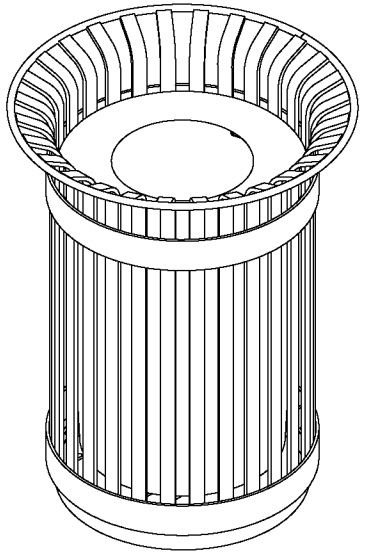
1. BIKE RACK SHALL BE DUMOR 292 SERIES POWDER COATED (BLACK), OR EQUIVALENT.
2. OTHER DESIGNS MAY BE ALLOWED PER TOWN OF KNIGHTDALE REVIEW AND APPROVAL.
3. BIKE RACK TO BE INSTALLED BY CONTRACTORS IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND DETAILS.
4. ALL STEEL MEMBERS COATED WITH ZINC RICH EPOXY COATING THEN FINISHED WITH POLYESTER POWDER COATED.
5. 1/2" X 3 3/4" EXPANSION ANCHOR BOLTS PROVIDED FOR OPTIONS S-2 & S-4.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | TYPICAL BIKE RACK | STD. NO. 4.15 |

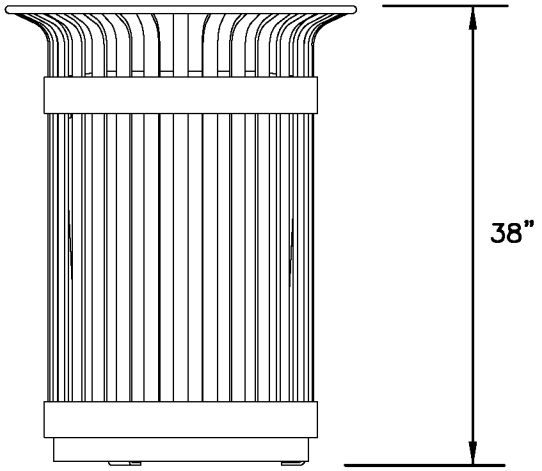



TOP VIEW



NOTES:

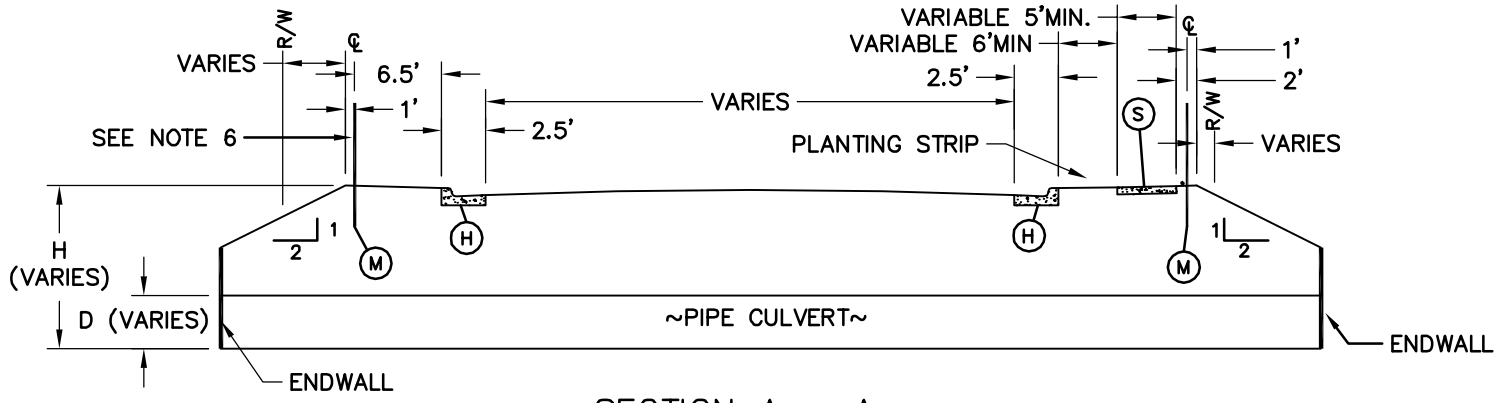
1. TRASH RECEPTACLE SHALL BE MAGLIN STEEL FLAT BAR, 32 GALLON, WITH DOME LID (BLACK GLOSS), OR EQUIVALENT.
2. OTHER DESIGNS MAY BE ALLOWED PER TOWN OF KNIGHTDALE REVIEW AND APPROVAL.
3. TRASH RECEPTACLE TO BE INSTALLED BY CONTRACTOR IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND DETAILS.



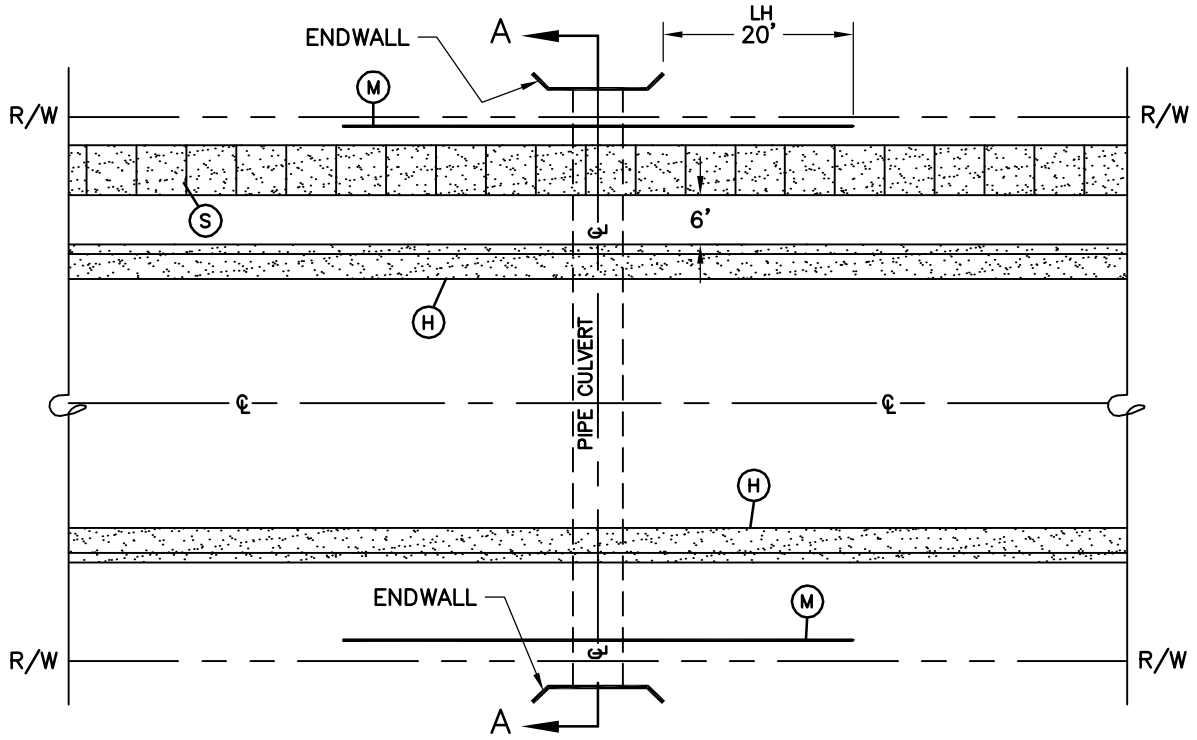

SIDE VIEW

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| TOWN OF KNIGHTDALE STANDARD DETAILS | TYPICAL TRASH RECEPTACLE | STD. NO. 4.16 |




SECTION A – A




PLAN VIEW

LH = DISTANCE FROM END OF WINGWALL TO END OF HANDRAIL.

(H) 2'–6" CURB AND GUTTER, STANDARD DETAIL 4.01

(M) HANDRAIL, STANDARD DETAIL 4.13

(S) 5'–0" SIDEWALK, MINIMUM STANDARD DETAIL 4.04

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| TOWN OF KNIGHTDALE STANDARD DETAILS | CULVERT CROSSING ON RESIDENTIAL AND COMMERCIAL STREETS | STD. NO. 5.01 |
|---|---|---|

NOTES:

1. UNLESS OTHERWISE DETERMINED BY THE TOWN ENGINEER, THE MEASURES ILLUSTRATED SHALL BE USED WHEN CULVERT DIAMETER, D, IS GREATER THAN OR EQUAL TO 24 INCHES AND WHEN THE DIFFERENCE IN ELEVATION BETWEEN THE CULVERT INVERT AND THE TOP OF SLOPE, H, IS GREATER THAN OR EQUAL TO 5 FEET.
2. INSTALLATION OF 2'–6" CURB AND GUTTER MAY NOT BE REQUIRED WHEN AN ADEQUATE CLEAR ZONE IS PROVIDED FOR VEHICLES WITH A MAXIMUM OF 6:1 SLOPE (SEE TABLE 1).
3. INSTALLATION OF HANDRAIL MAY NOT BE REQUIRED WHEN A 10–FOOT PEDESTRIAN CLEAR ZONE IS PROVIDED BEHIND THE SIDEWALK WITH A MAXIMUM OF 6:1 SLOPE. WHERE NO SIDEWALK IS REQUIRED, INSTALLATION OF HANDRAIL MAY NOT BE REQUIRED WHEN A 15–FOOT PEDESTRIAN CLEAR ZONE IS PROVIDED BEHIND THE CURB WITH A MAXIMUM OF 6:1 SLOPE.
4. FOR CULVERT CROSSINGS WITHOUT ENDWALLS, LH SHALL BE MEASURED FROM THE OUTSIDE OF THE NEAREST WALL OF THE CULVERT BARREL.
5. WHEN NECESSARY, AS DETERMINED BY THE TOWN ENGINEER, ADDITIONAL MEASURES MAY BE REQUIRED.
6. INSTALLATION OF HANDRAIL IS REQUIRED ON BOTH SIDES OF STREET IF SIDEWALK IS REQUIRED ON BOTH SIDES.
7. INSTALLATION OF HANDRAIL IS REQUIRED ON BOTH SIDES OF STREET IF NO SIDEWALK IS REQUIRED EXCEPT WHEN A 15–FOOT PEDESTRIAN CLEAR ZONE IS PROVIDED BEHIND THE CURB WITH A MAXIMUM OF 6:1 SLOPE.
8. INSTALLATION OF HANDRAIL IS REQUIRED ON THE SIDEWALK SIDE OF STREET IF SIDEWALK IS ONLY REQUIRED ON ONE SIDE OF STREET.
9. DESIGN ADT IS CALCULATED ASSUMING A TRIP GENERATION OF 13 DAILY TRIPS PER SINGLE FAMILY DWELLING UNIT.

TABLE 1.
CLEAR ZONE DISTANCES
LOCAL, COLLECTOR, AND COMMERCIAL STREETS

| DESIGN ADT | CLEAR ZONE FROM EDGE OF PAVEMENT | |
|---|---|---|
| | TANGENT SECTION | CURVE (WITHIN 125' OF CULVERT) |
| UNDER 750 | 10' | 15' |
| 750 – 1500 | 12' | 18' |
| 1501 – 6000 | 14' | 21' |
| OVER 6000 | 16' | 24' |

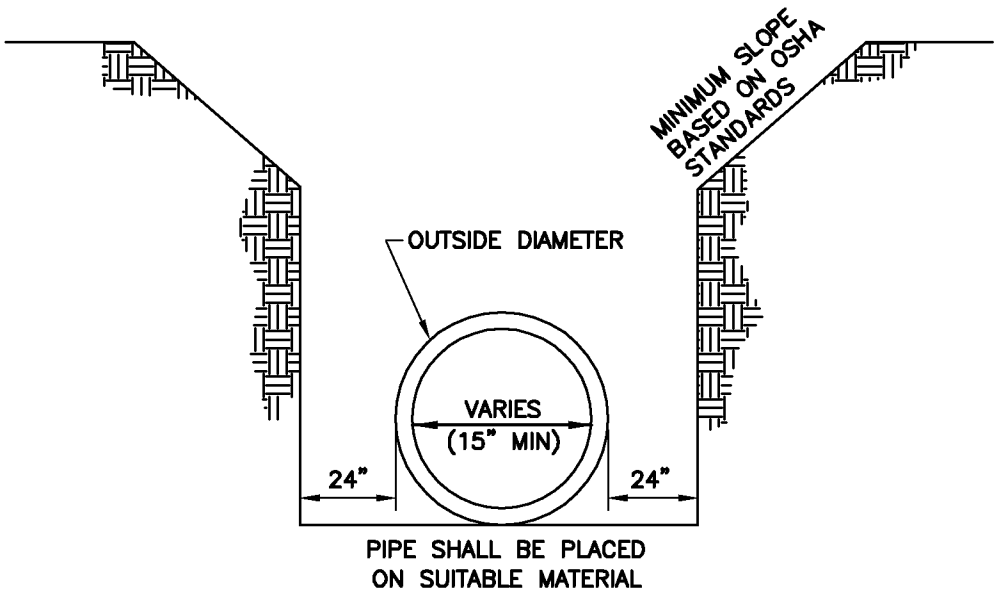
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| TOWN OF KNIGHTDALE STANDARD DETAILS | CULVERT CROSSING ON RESIDENTIAL AND COMMERCIAL STREETS | STD. NO. 5.01 |

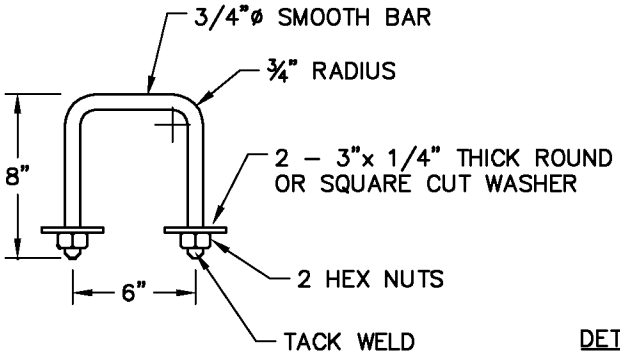
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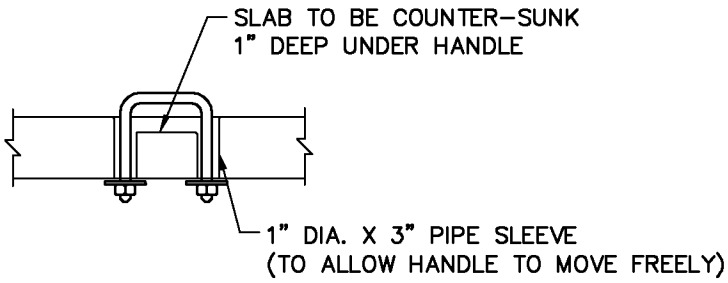
1. A MINIMUM OF 24" FROM OUTSIDE DIAMETER OF PIPE TO SIDE OF TRENCH MUST BE ALLOWED FOR COMPACTION OF FILL MATERIAL. BACKFILLING OF TRENCHES SHALL BE ACCOMPLISHED IMMEDIATELY AFTER THE PIPE IS LAID. THE FILL AROUND THE PIPE SHALL BE PLACED IN LAYERS NOT TO EXCEED 6". UNDER NO CIRCUMSTANCES SHALL WATER BE PERMITTED TO RISE IN UNBACKFILLED TRENCHES AFTER THE PIPE HAS BEEN PLACED. COMPACTION REQUIREMENTS SHALL BE ATTAINED BY THE USE OF MECHANICAL TAMPS ONLY. EACH AND EVERY LAYER OF BACKFILL SHALL BE PLACED LOOSE AND THOROUGHLY COMPACTED INTO PLACE.
2. ALL BACKFILL MATERIAL SHALL HAVE AN IN PLACE COMPACTED DENSITY OF AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DENSITY.
3. THE FINAL 24" OF BACKFILL MATERIAL SHALL BE COMPACTED TO 100% OF THE STANDARD PROCTOR MAXIMUM DENSITY.
4. ALL TRENCHING OPERATIONS SHALL MEET OSHA STANDARDS.
5. BACKFILL MATERIAL BENEATH ROADWAY SHALL BE SELECT BACKFILL MATERIAL.



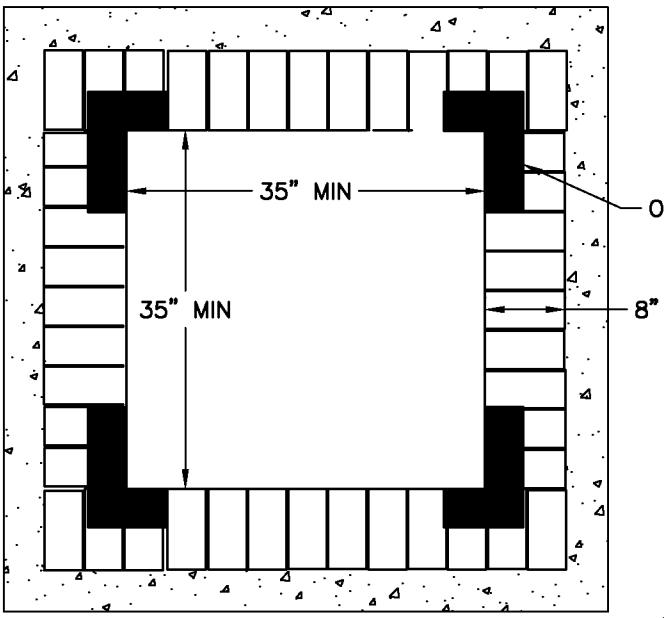

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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | TRENCH FOR<br>STORM DRAIN PIPES | STD. NO.<br>5.02 |

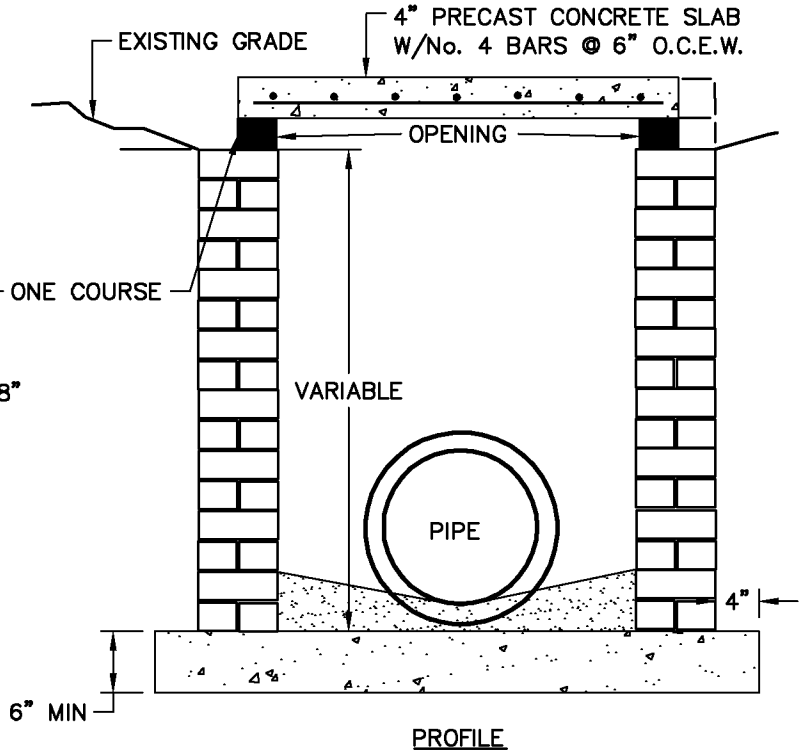



DETAIL OF HANDLE



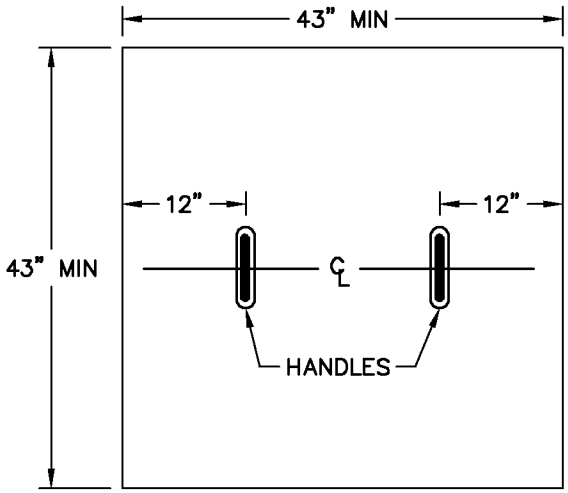

PLAN VIEW




PROFILE

NOTES:

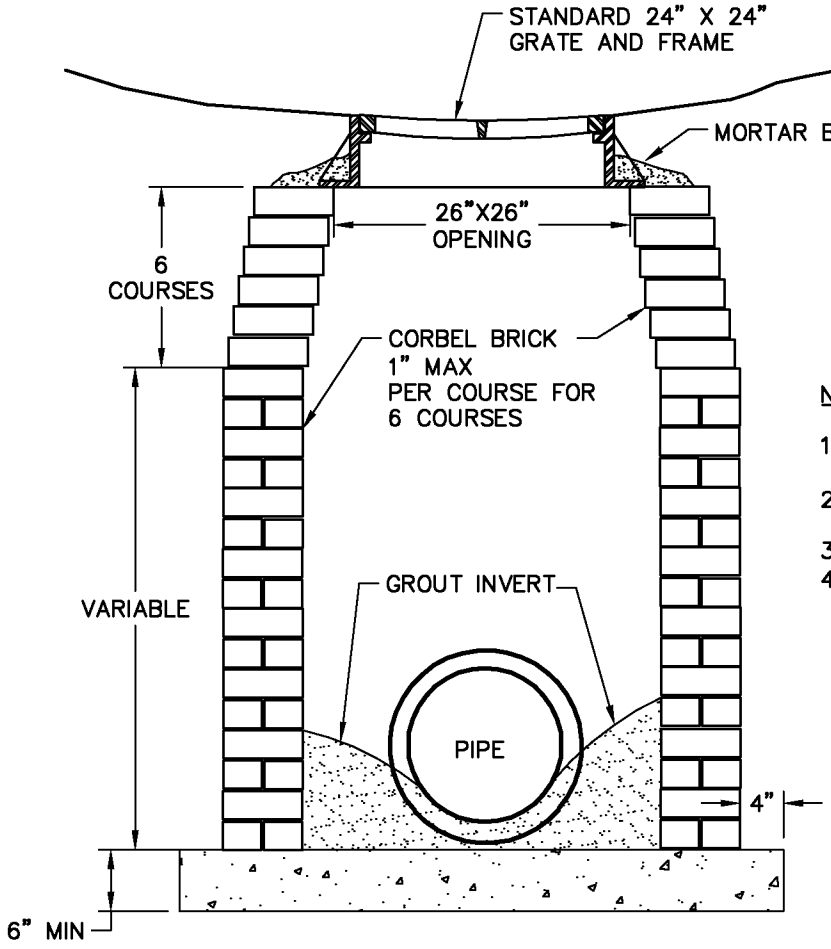
1. EITHER SOLID BRICK, SOLID BLOCK OR PRECAST CONRETE MAY BE USED.
2. PRECAST CONCRETE WALLS SHALL BE 6" THICK MINIMUM.
3. ALL CONCRETE SHALL BE 3000 P.S.I.
4. FOR 24" PIPE AND LARGER USE PIPE DIA. PLUS 12" AS INSDE DIMENSIONS.




PRECAST CONCRETE SLAB

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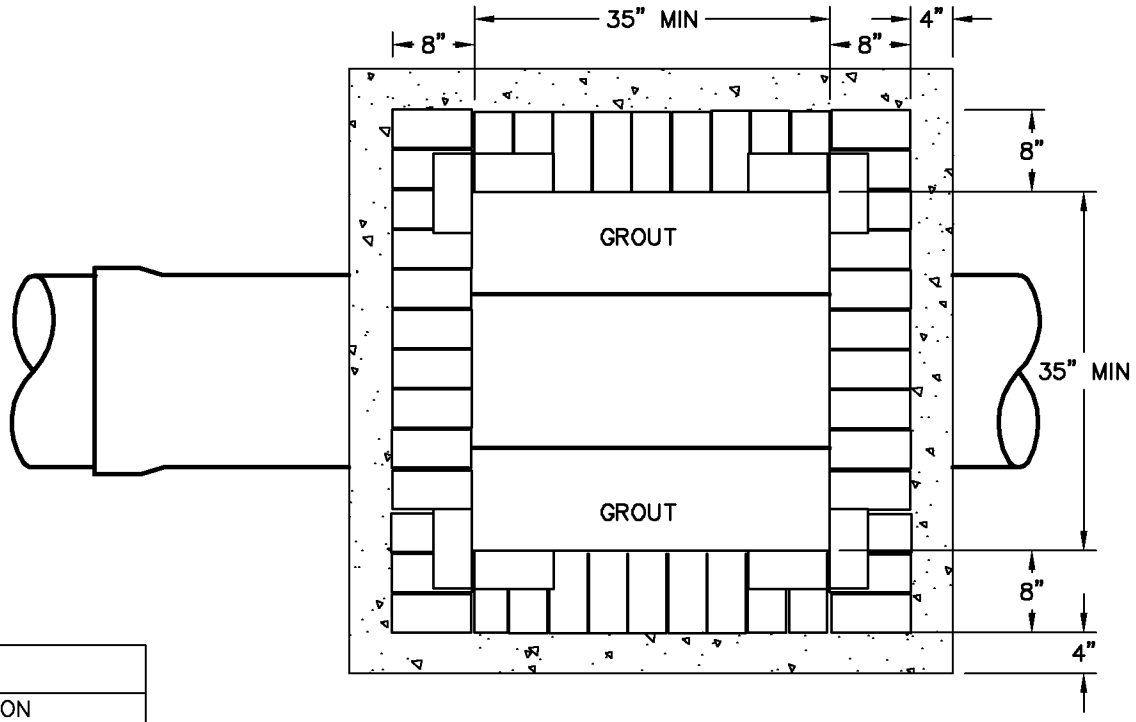
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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD YARD INLET<br>WITH CONCRETE SLAB | STD. NO.<br>5.03 |




PROFILE

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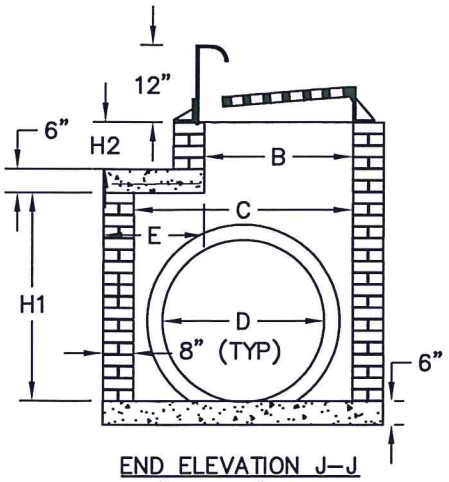
1. EITHER SOLID BRICK, SOLID BLOCK, OR PRECAST CONRETE MAY BE USED.
2. PRECAST CONCRETE WALLS SHALL BE 6" THICK MINIMUM.
3. ALL CONCRETE SHALL BE 3000 P.S.I.
4. FOR 24" PIPE AND LARGER USE PIPE DIA. PLUS 12" AS INSDE DIMENSIONS.



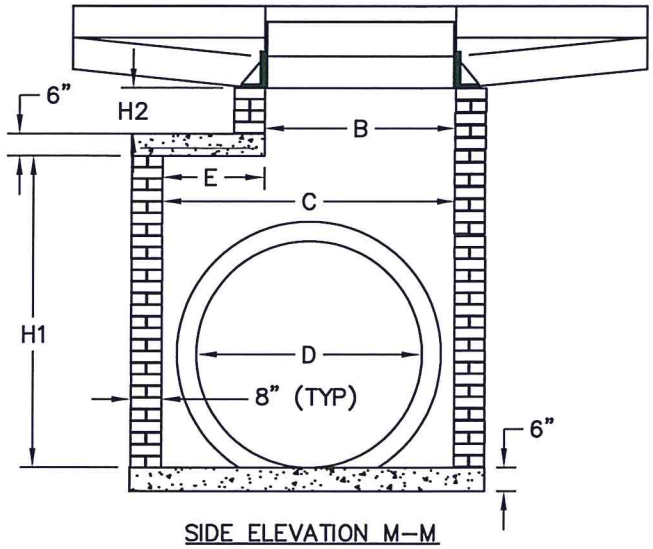

PLAN VIEW

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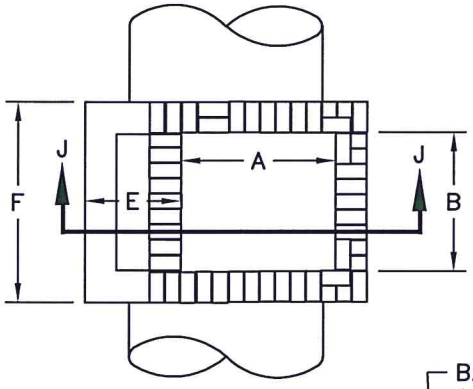
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| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD DROP INLET<br>WITH GRATE AND FRAME | STD. NO.<br>5.04 |



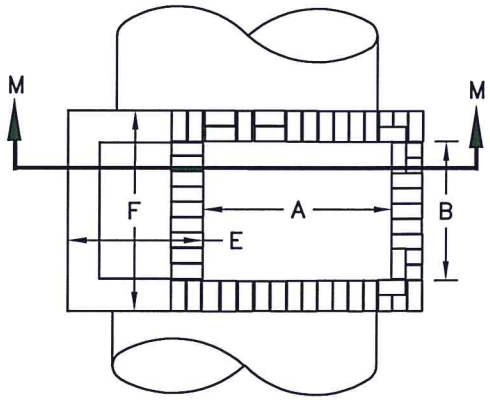

END ELEVATION J–J
WHERE 30" TO 36" PIPE IS USED



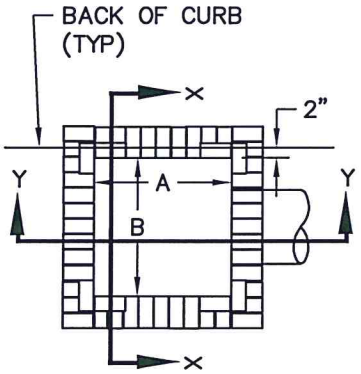

SIDE ELEVATION M–M
WHERE 42" TO 54" PIPE IS USED



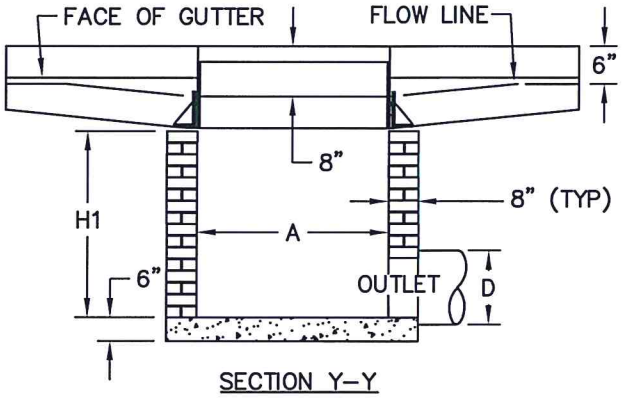

PLAN



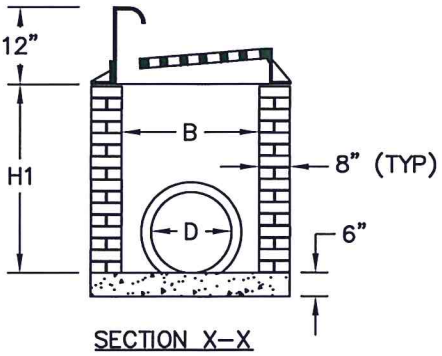

PLAN




PLAN VIEW




SECTION Y–Y




SECTION X–X

NOTES:

1. MORTAR JOINTS SHALL BE 1/2" THICK.
2. ALL CONCRETE SHALL BE 3000 P.S.I.
3. BASE SLABS SHALL BE FORMED PRIOR TO PLACING OF CONCRETE.
4. USE TYPE "A" GRATE AT SAG POINTS, OTHERWISE USE TYPE "B" OR "C" FOR THE APPROPRIATE FLOW DIRECTION.
5. MASONRY UNITS MAY BE JUMBO BRICK, CONCRETE BRICK, OR SOLID CONCRETE BLOCK.
6. ALL WALLS GREATER THAN 6' IN DEPTH SHALL BE CONSTRUCTED 12" THICK.

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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD CURB INLET BRICK BOX | STD. NO. 5.05-1 |
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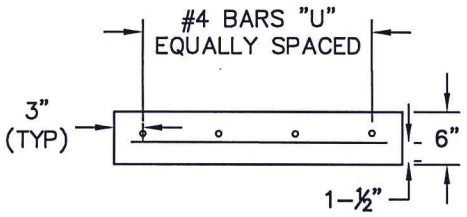
TOWN OF KNIGHTDALE
STANDARD DETAILS

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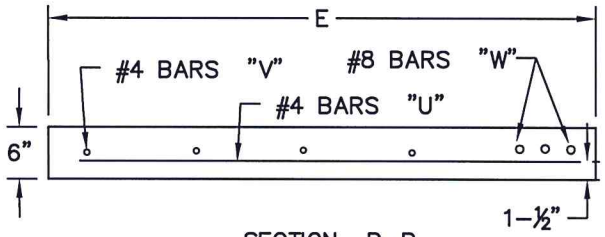
STANDARD CURB INLET
BRICK BOX

STD. NO. 5.05-2

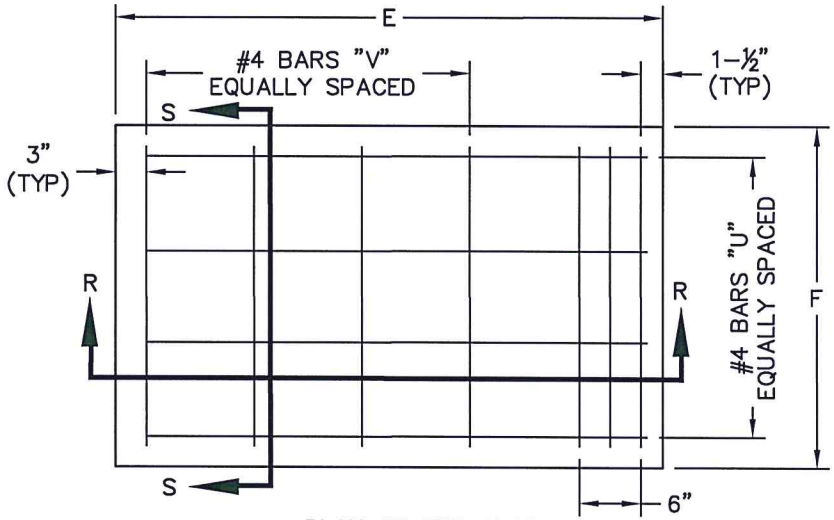




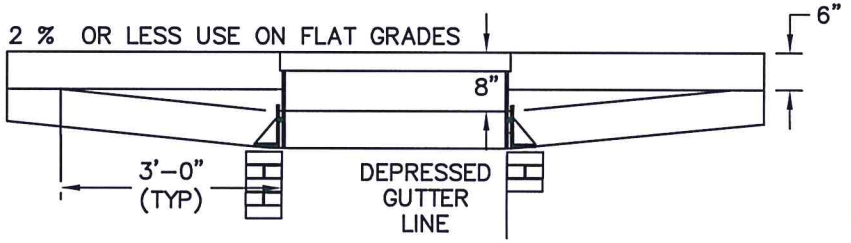

SECTION S–S



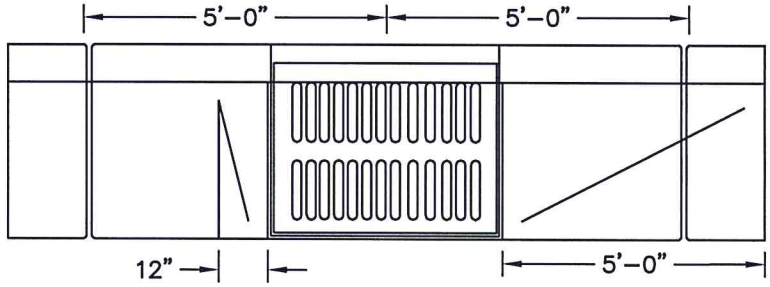

SECTION R–R



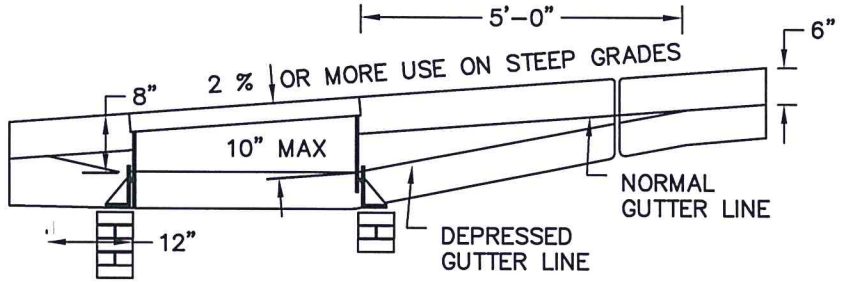

PLAN OF TOP SLAB




ELEVATION
NORMAL CURB & GUTTER ON LIGHT GRADES



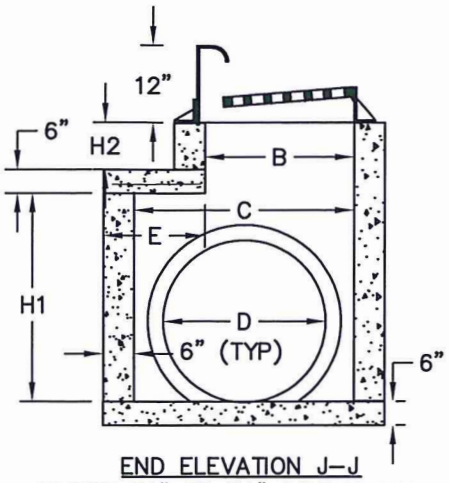

PLAN
CURB & GUTTER WITH CATCH BASIN ON STEEP GRADES



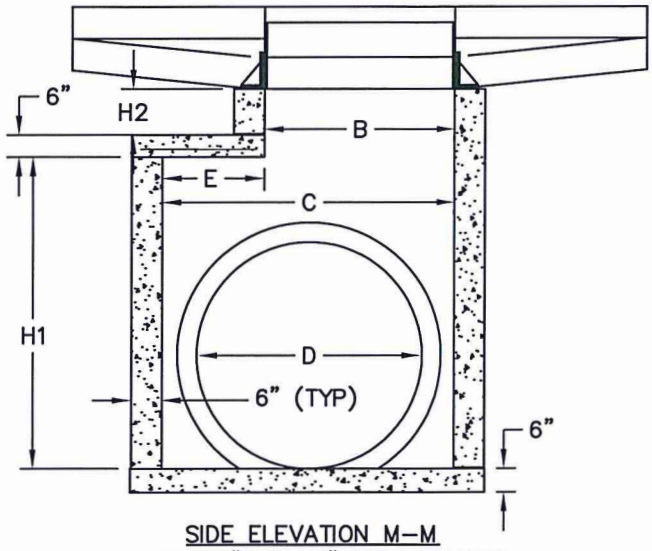

ELEVATION
NORMAL CURB & GUTTER ON STEEP GRADES

DIMENSIONS AND QUANTITIES FOR BRICK CATCH BASINS

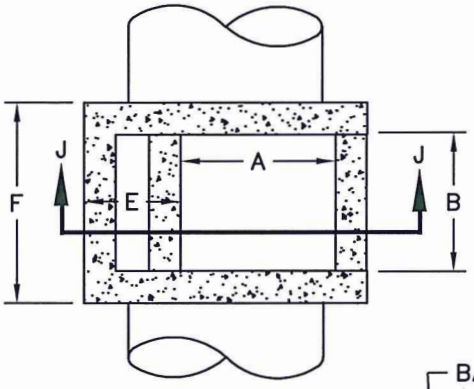
| DIMENSIONS FOR BOX AND PIPE | | | | | | | COVER DIMENSIONS | | REINFORCING | | | | | | | CUBIC YARDS OF CONCRETE IN BOX | | | BRICK MASONRY | | DEDUCTIONS FOR ONE PIPE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | BARS "U" | | BARS "V" | | BARS "W" | | TOTAL LBS | | | | H1 | | | |
| PIPE D | SPAN A | WIDTH B | WIDTH C | SPAN G | HEIGHT MIN H1 | HEIGHT H2 | E | F | NO | LENGTH | NO | LENGTH | NO | LENGTH | | TOP SLAB | FLOOR | TOTAL | CU YDS | PER FT Ht | CM | RC |
| 15" | 3'–0" | 2'–2" | | | 2'–6" | | | | | | | | | | | | | | | 0.321 | 0.0308 | 0.047 |
| 18" | | | | | 2'–10" | | | | | | | | | | | | | | | ABOVE | 0.0442 | 0.065 |
| 24" | | | | | 3'–4" | | | | | | | | | | | | | | | MIN H1 | 0.0794 | 0.113 |
| 30" | | | 3'–4" | | 3'–2" | VARIABLE | 1'–10" | 4'–4" | 4 | 1'–6" | 3 | 4'–1" | 3 | 4'–1" | 4'–1" | 45 | | | | | 0.1224 | 0.170 |
| 36" | | | 3'–10" | | 3'–8" | | 2'–4" | 4'–4" | 4 | 2'–0" | 4 | 4'–1" | 3 | 4'–1" | 4'–1" | 49 | | | | | 0.1760 | 0.230 |
| 42" | | | | 4'–5" | 4'–4" | | 2'–1" | 3'–6" | 4 | 1'–9" | 3 | 3'–3" | 3 | 3–3" | 3'–3" | 38 | | | 0.3231 H2 | | 0.2400 | 0.323 |
| 48" | | | | 5'–0" | 4'–10" | | 2'–6" | 3'–6" | 4 | 2'–6" | 4 | 3'–3" | 3 | 3'–3" | 3'–3" | 40 | | | | | 0.3131 | 0.460 |
| 54" | 3'–0" | 2'–2" | | 5'–7" | 5'–4" | | 3'–3" | 3'–9" | 4 | 3'–0" | 6 | 3'–3" | 3 | 3'–3" | 3'–3" | 48 | | | | | 0.3958 | 0.580 |



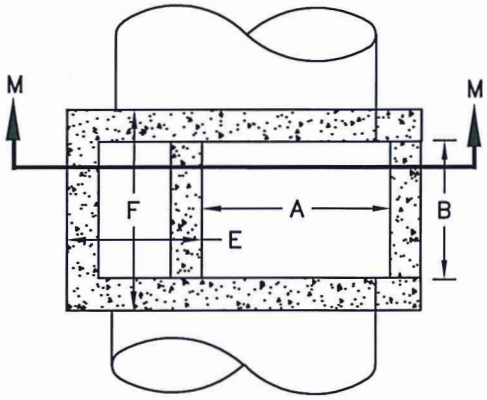

END ELEVATION J–J
WHERE 30" TO 36" PIPE IS USED



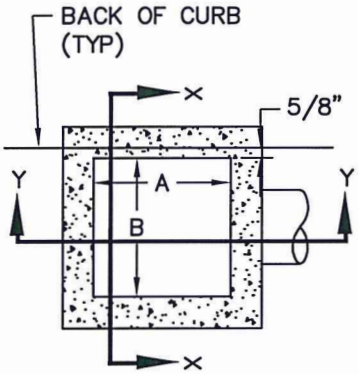

SIDE ELEVATION M–M
WHERE 42" TO 54" PIPE IS USED



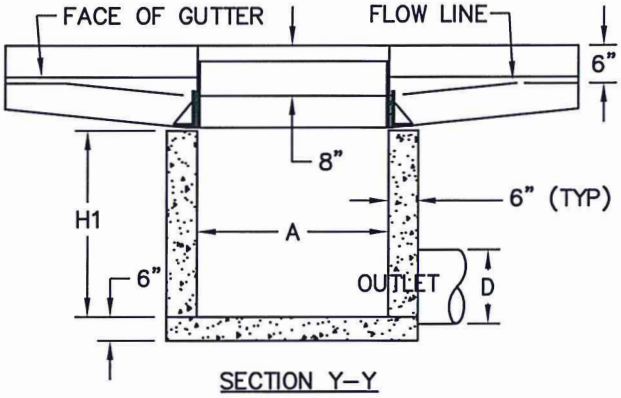

PLAN



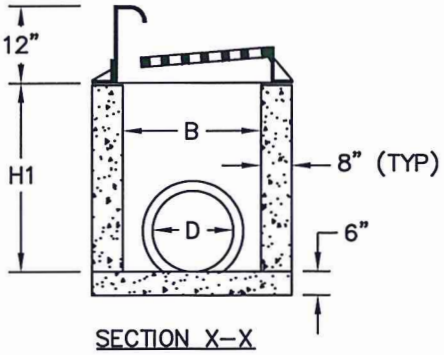

PLAN




PLAN VIEW




SECTION Y–Y




SECTION X–X

NOTES:

1. ALL CONCRETE SHALL BE 3000 P.S.I.
2. BASE SLABS SHALL BE FORMED PRIOR TO PLACING OF CONCRETE.
3. USE TYPE "A" GRATE AT SAG POINTS, OTHERWISE USE TYPE "B" OR "C" FOR THE APPROPRIATE FLOW DIRECTION.
4. ALL WALLS GREATER THAN 6' IN DEPTH SHALL BE CONSTRUCTED 12" THICK.
5. WAFFLE BOXES ARE NOT ALLOWED WITHOUT PRIOR APPROVAL FROM THE TOWN OF KNIGHTDALE

| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD CURB INLET PRECAST CONCRETE BOX | STD. NO. 5.05-3 |
|---|---|---|

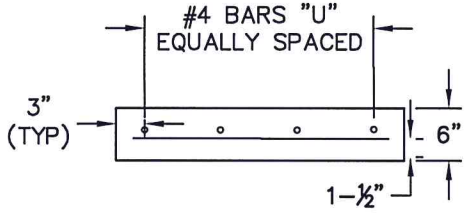
TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | DESCRIPTION | DATE |
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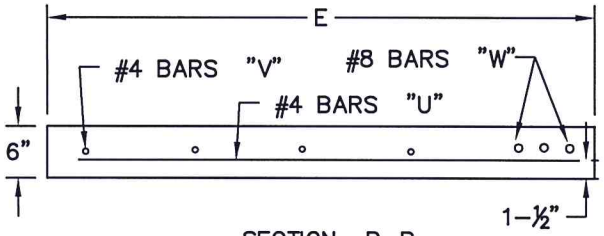
STANDARD CURB INLET
PRECAST CONCRETE BOX

STD. NO. 5.05-4

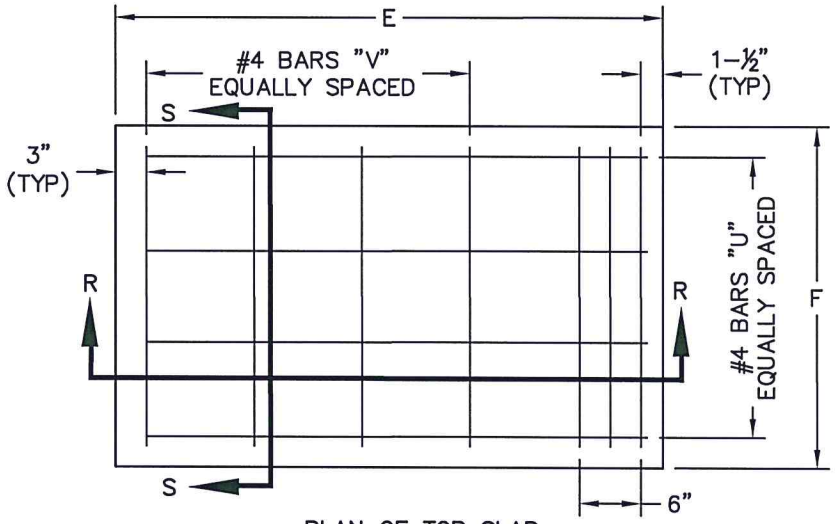
4 of 4



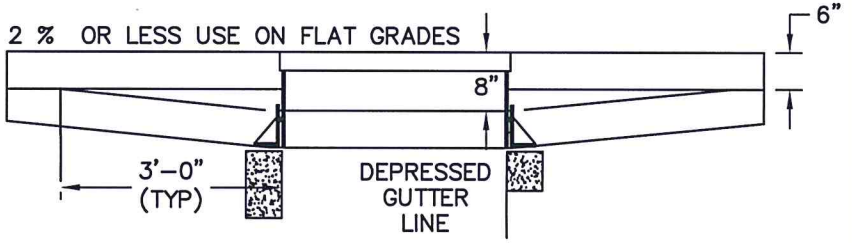

SECTION S–S



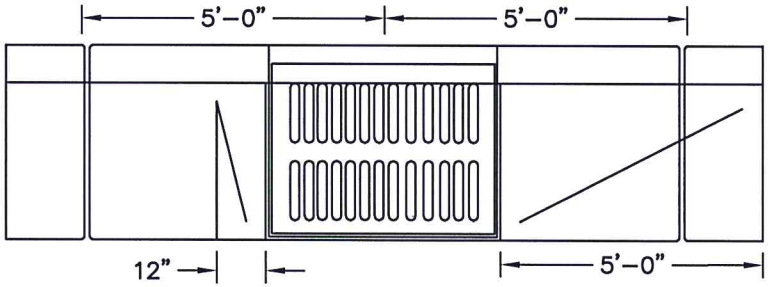

SECTION R–R



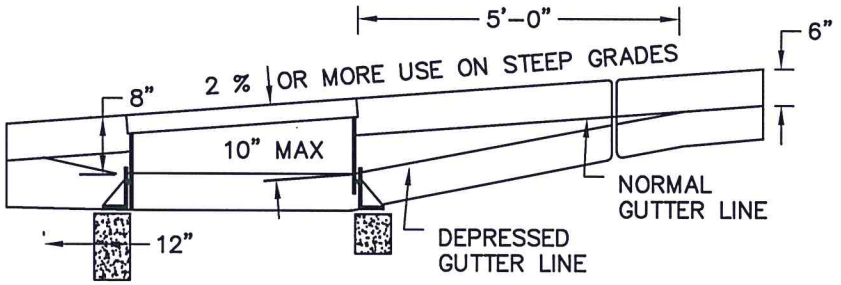

PLAN OF TOP SLAB




ELEVATION
NORMAL CURB & GUTTER ON LIGHT GRADES



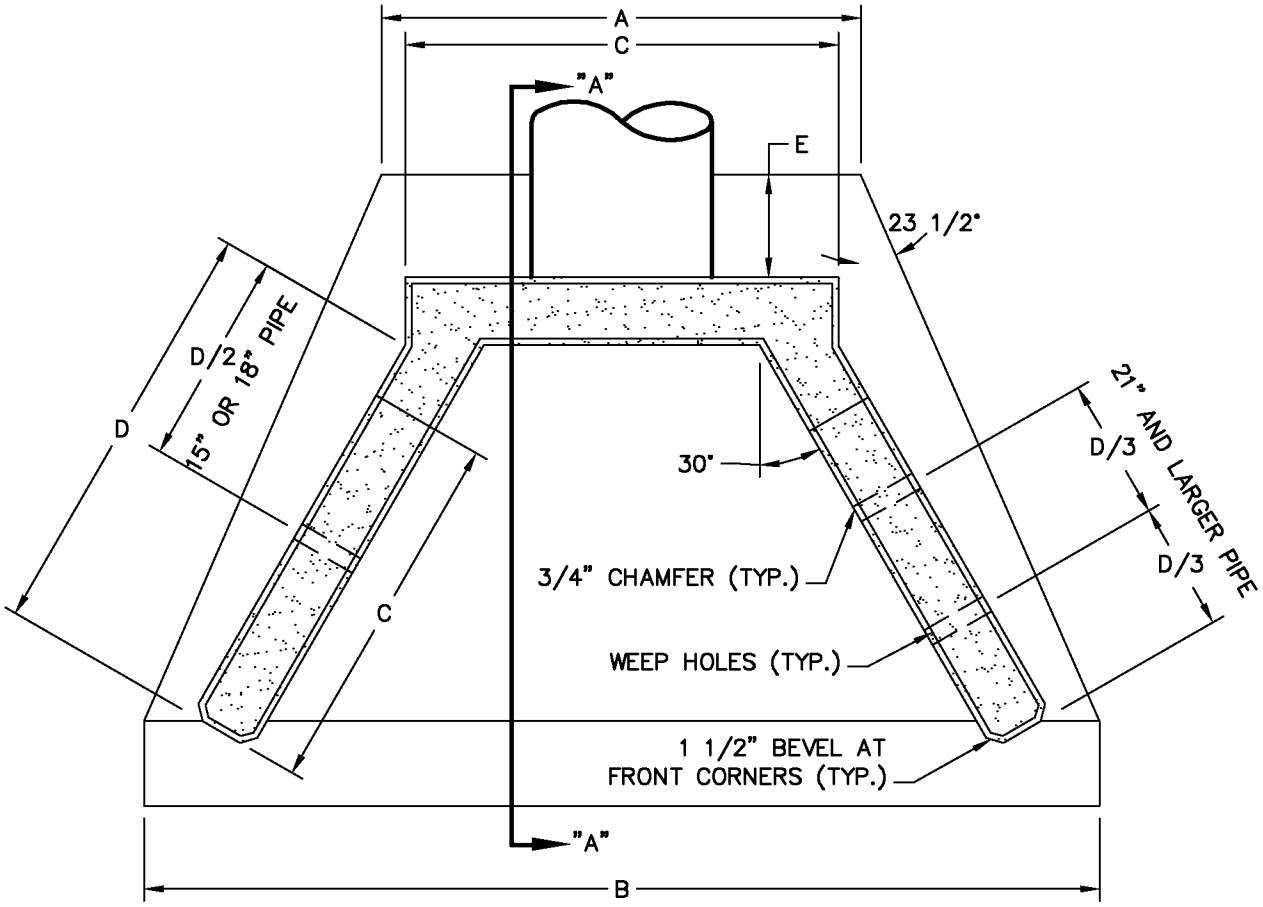

PLAN
CURB & GUTTER WITH CATCH BASIN ON STEEP GRADES



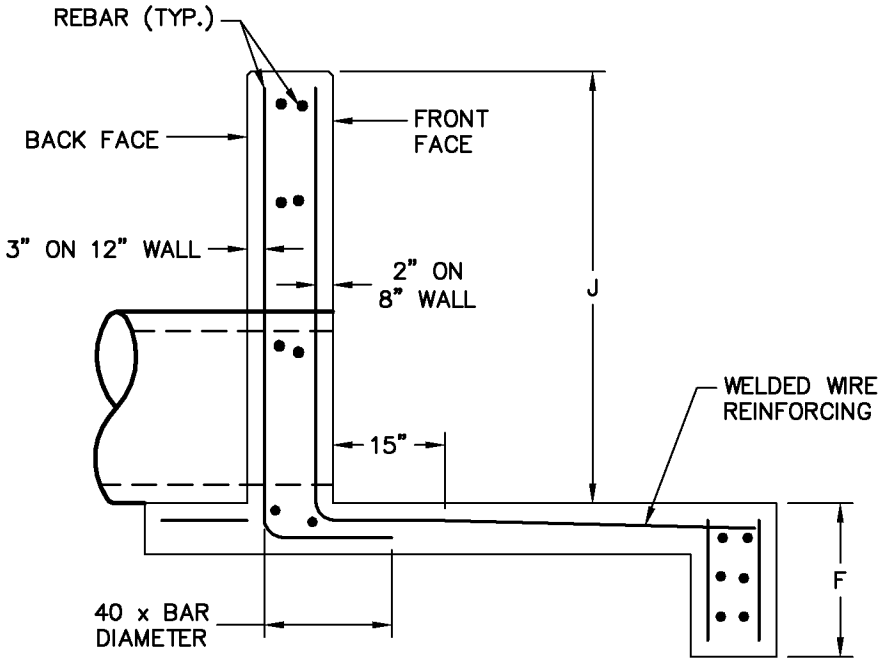

ELEVATION
NORMAL CURB & GUTTER ON STEEP GRADES

DIMENSIONS AND QUANTITIES FOR BRICK CATCH BASINS

| DIMENSIONS FOR BOX AND PIPE | | | | | | | COVER DIMENSIONS | | REINFORCING | | | | | | | CUBIC YARDS OF CONCRETE IN BOX | | | BRICK MASONRY | | DEDUCTIONS FOR ONE PIPE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PIPE | SPAN | WIDTH | WIDTH | SPAN | HEIGHT | HEIGHT | | | BARS "U" | | BARS "V" | | BARS "W" | | TOTAL LBS | | | | H1 | | | |
| D | A | B | C | G | MIN H1 | H2 | E | F | NO | LENGTH | NO | LENGTH | NO | LENGTH | | TOP SLAB | FLOOR | TOTAL | CU YDS | PER FT Ht | CM | RC |
| 15" | 3'–0" | 2'–2" | | | 2'–6" | | | | | | | | | | | | | | | 0.321 | 0.0308 | 0.047 |
| 18" | | | | | 2'–10" | | | | | | | | | | | | | | | ABOVE | 0.0442 | 0.065 |
| 24" | | | | | 3'–4" | | | | | | | | | | | | | | | MIN H1 | 0.0794 | 0.113 |
| 30" | | | 3'–4" | | 3'–2" | VARIABLE | 1'–10" | 4'–4" | 4 | 1'–6" | 3 | 4'–1" | 3 | 4'–1" | 4'–1" | 45 | | | | | 0.1224 | 0.170 |
| 36" | | | 3'–10" | | 3'–8" | | 2'–4" | 4'–4" | 4 | 2'–0" | 4 | 4'–1" | 3 | 4'–1" | 4'–1" | 49 | | | | | 0.1760 | 0.230 |
| 42" | | | | 4'–5" | 4'–4" | | 2'–1" | 3'–6" | 4 | 1'–9" | 3 | 3'–3" | 3 | 3–3" | 3'–3" | 38 | | | | 0.3231 H2 | 0.2400 | 0.323 |
| 48" | | | | 5'–0" | 4'–10" | | 2'–6" | 3'–6" | 4 | 2'–6" | 4 | 3'–3" | 3 | 3'–3" | 3'–3" | 40 | | | | | 0.3131 | 0.460 |
| 54" | 3'–0" | 2'–2" | | 5'–7" | 5'–4" | | 3'–3" | 3'–9" | 4 | 3'–0" | 6 | 3'–3" | 3 | 3'–3" | 3'–3" | 48 | | | | | 0.3958 | 0.580 |




TOP VIEW

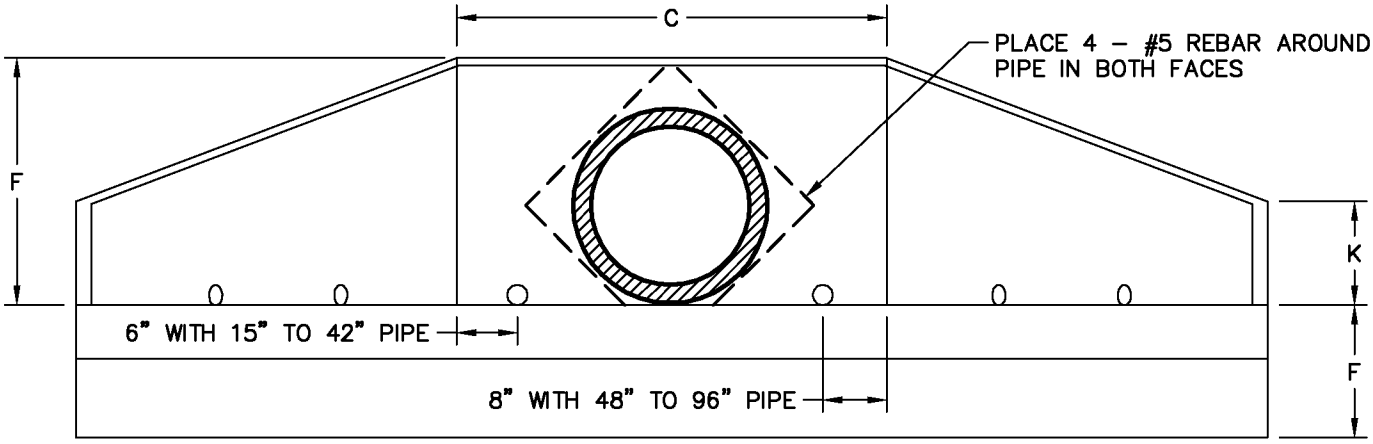



SECTION "A–A"

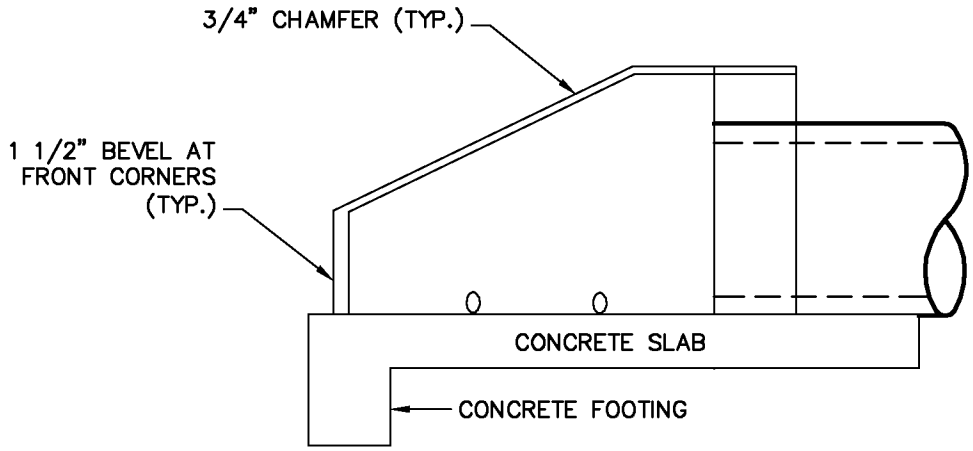
| REVISIONS | |
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|---|---|---|
| TOWN OF KNIGHTDALE<br>STANDARD DETAILS | STANDARD REINFORCED CONCRETE<br>HEADWALL WITH WINGWALLS | STD. NO.<br>5.06 |




FRONT ELEVATION




LEFT SIDE ELEVATION

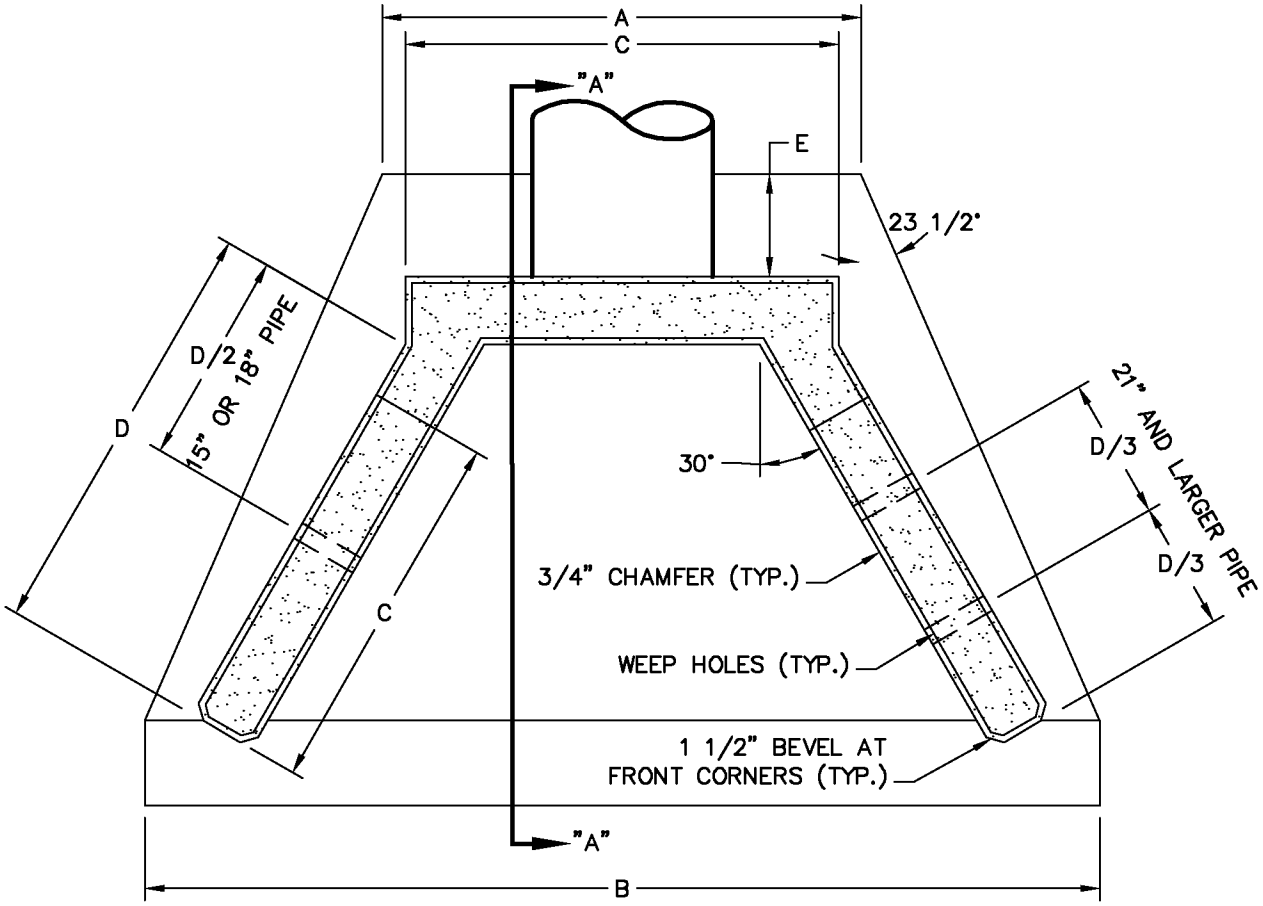
NOTES:

1. SEE STANDARD DETAIL. 5.09 FOR DIMENSIONS.
2. PLACE 1 CUBIC FOOT OF WASHED STONE BEHIND EACH WEEP HOLE.

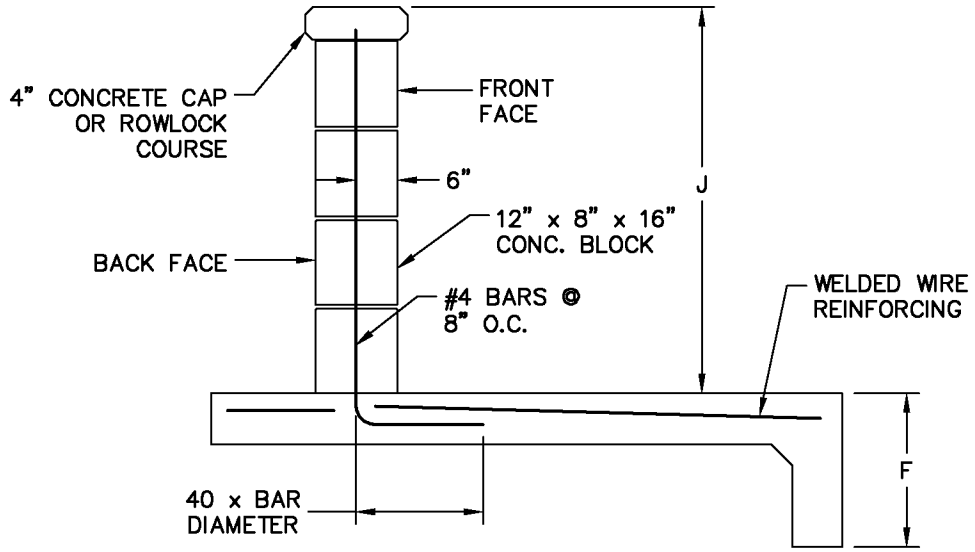
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD REINFORCED CONCRETE HEADWALL WITH WINGWALLS | STD. NO. 5.06 |
|---|---|---|




TOP VIEW




SECTION "A–A"

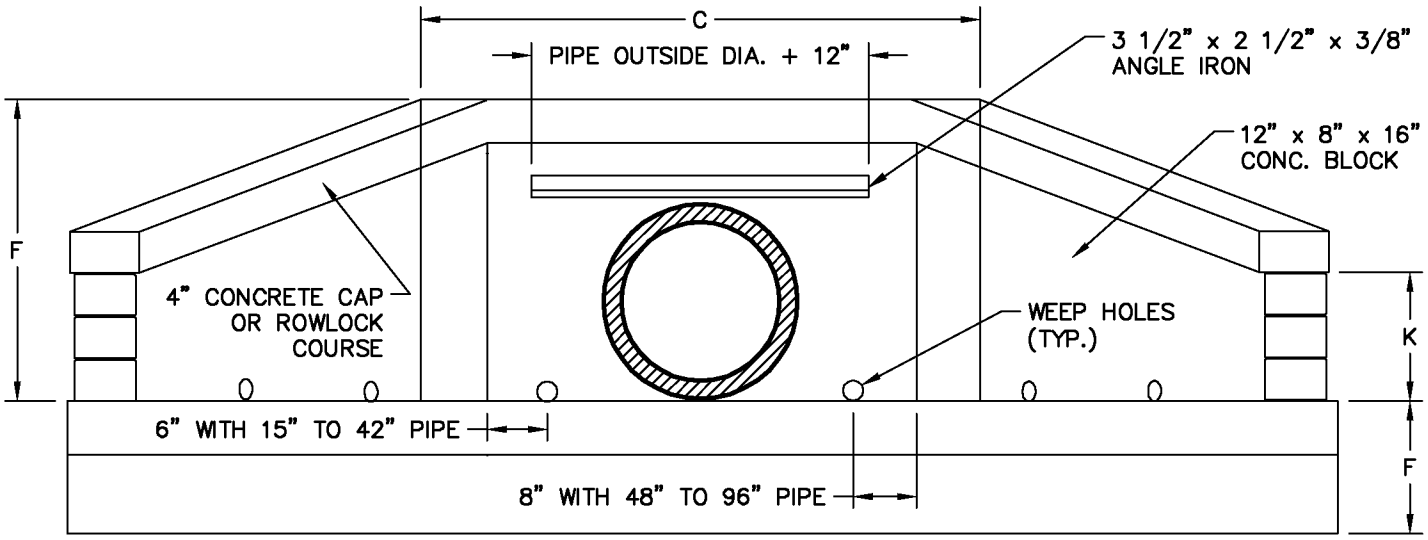
NOTES:

1. SEE STANDARD DETAIL 5.09 FOR DIMENSIONS.
2. PLACE 1 CUBIC FOOT OF WASHED STONE BEHIND EACH WEEP HOLE.
3. FILL EACH CAVITY COMPLETELY WITH 3000 P.S.I. CONCRETE. THE CONC. SHALL NOT FALL MORE THAN THE HEIGHT OF 5 LAYERS OF BLOCK.

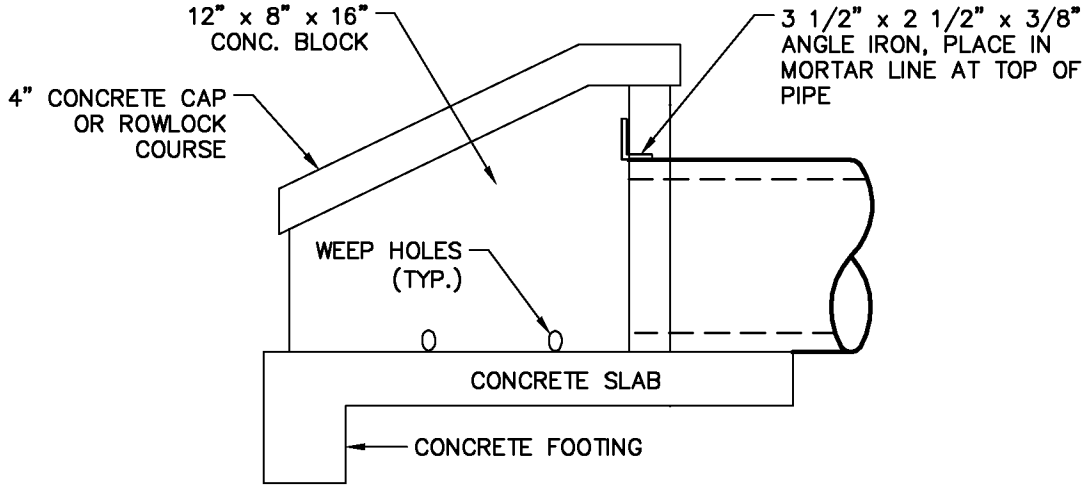
| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD CONCRETE BLOCK HEADWALL WITH WINGWALLS | STD. NO. 5.07 |
|---|---|---|




FRONT ELEVATION




LEFT SIDE ELEVATION

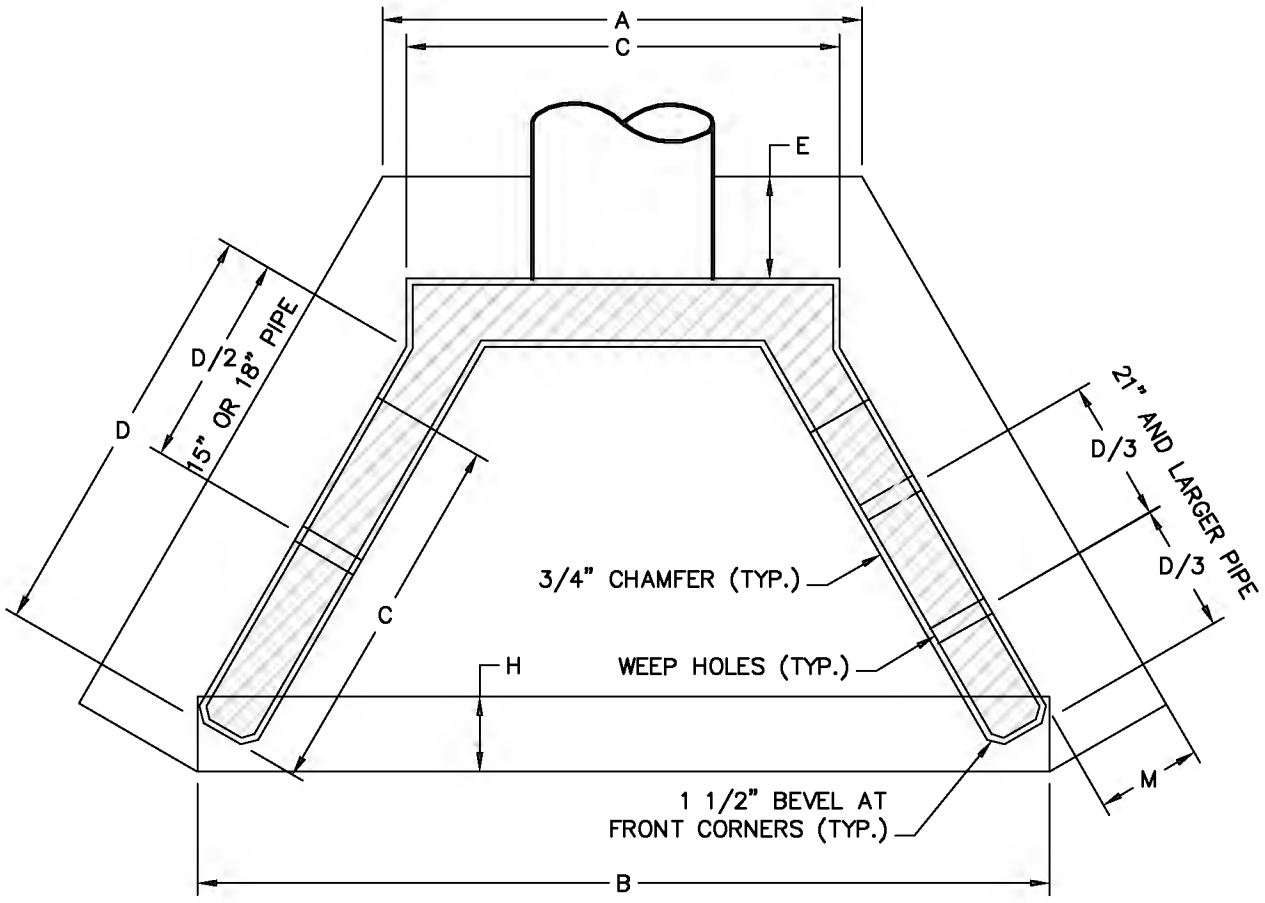
NOTES:

1. SEE STANDARD DETAIL 5.09 FOR DIMENSIONS.
2. PLACE 1 CUBIC FOOT OF WASHED STONE BEHIND EACH WEEP HOLE.

| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD CONCRETE BLOCK HEADWALL WITH WINGWALLS | STD. NO. 5.07 |
|---|---|---|




TOP VIEW

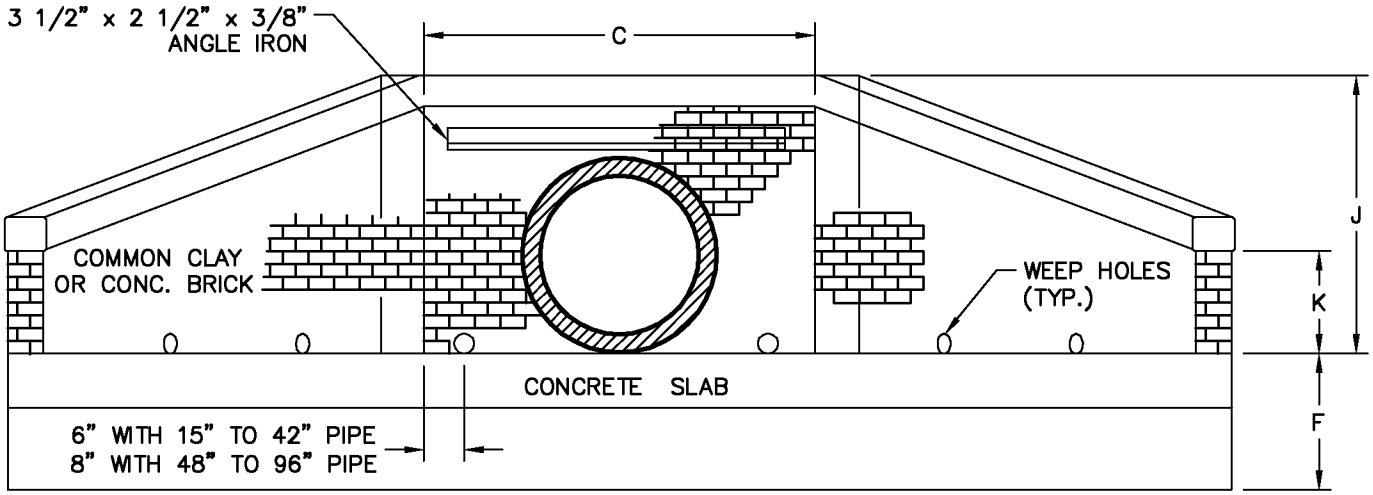
NOTES:

1. SEE STANDARD No. 5.09 FOR DIMENSIONS.
2. PLACE 1 CUBIC FOOT OF WASHED STONE BEHIND EACH WEEP HOLE.

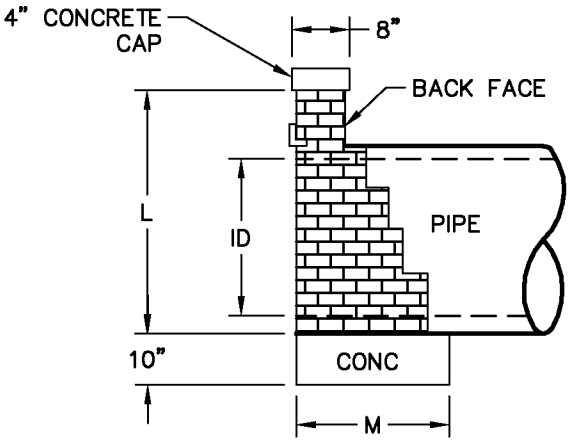
| REVISIONS | |
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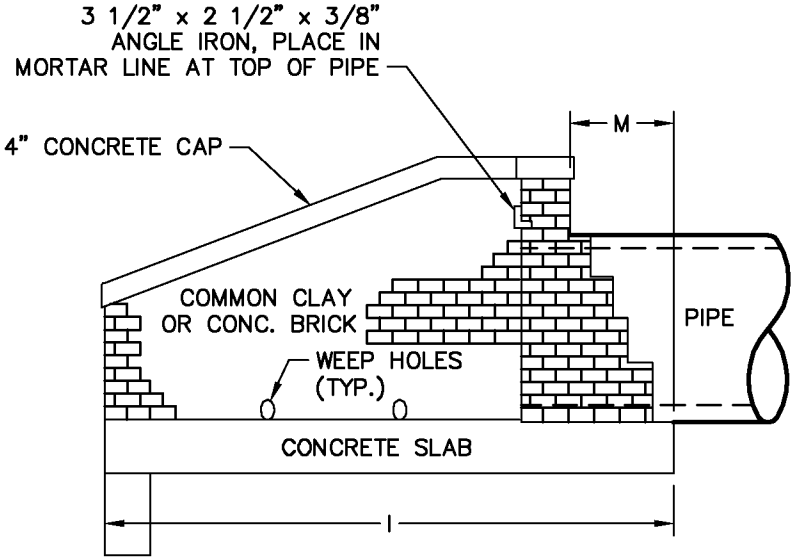
| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD BRICK HEADWALL WITH WINGWALLS 48" RCP AND UNDER (WITHOUT REINFORCING STEEL) | STD. NO. 5.08 |
|---|---|---|




FRONT ELEVATION




END ELEVATION




SIDE ELEVATION

| COMMON DIMENSIONS | | |
|---|---|---|
| ID | L | M |
| 15" | 2'-5" | 1'-8" |
| 18" | 2'-8" | 1'-8" |
| 24" | 3'-4" | 2'-0" |
| 30" | 3'-9" | 2'-4" |
| 36" | 4'-3" | 2'-4" |
| 42" | 4'-11" | 2'-8" |
| 48" | 5'-7" | 3'-0" |

NOTES:

1. ADD THE COMMON DIMENSIONS TO OVERALL LIST ON STANDARD DETAIL 5.09 FOR BRICK HEADWALLS.
2. THE COMMON DIMENSIONS ARE FOR END WALLS FOR BRICK H.W. WITH 48" R.C.P. & UNDER.
3. ANGLE IRON AS SHOWN SHALL BE REQUIRED ONLY WHEN CORROGATED METAL PIPE IS USED.
4. ONE CUBIC FOOT OF STONE REQUIRED BEHIND EACH WEEP HOLE.

| REVISIONS | |
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| DATE | DESCRIPTION |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD BRICK HEADWALL WITH WINGWALLS 48" RCP AND UNDER (WITHOUT REINFORCING STEEL) | STD. NO. 5.08 |
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TOWN OF KNIGHTDALE
STANDARD DETAILS

| REVISIONS | | |
|---|---|---|
| | DESCRIPTION | DATE |
| | | |
| | | |
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DIMENSIONS FOR HEADWALL WITH WINGWALLS

STD. NO. 5.09



DIMENSIONS FOR SINGLE PIPE HEADWALLS

| PIPE SIZE | SHELL THICKNESS | WALL THICKNESS | SLAB THICKNESS | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15" | 2 1/2" | 8" | 6" | 4'–10" | 9'–4" | 3'–7" | 4'–2" | 1'–0" | 1'–6' | 3'–8' | 8" | 5'–8" | 2'–7" | 1'–0" |
| 18" | 2 1/2" | 8" | 6' | 5'–5" | 10'–5" | 3'–11" | 4'–11" | 1'–0" | 1'–6' | 4'–5' | 6' | 6'–3" | 2'–11" | 1'–0" |
| 24" | 3" | 8" | 6' | 6'–4" | 12'–4" | 4'–6" | 6'–3" | 1'–0" | 1'–6' | 5'–9" | 6' | 7'–5' | 3'–6" | 1'–0" |
| 30" | 3 1/2" | 8" | 6" | 7'–3" | 14'–3" | 5'–1' | 7'–7" | 1'–0" | 1'–6' | 7'–1" | 6' | 8'–7" | 4'–1" | 1'–0" |
| 36" | 4" | 8" | 6" | 7'–5" | 15'–1" | 5'–8" | 7'–10" | 1'–6' | 2'–0" | 7'–4" | 6' | 9'–4' | 4'–8" | 1'–6" |
| 42" | 4 1/2" | 8" | 6" | 8'–4" | 17'–0" | 6'–3" | 9'–2" | 1'–6' | 2'–0" | 8'–9" | 6' | 10'–6" | 5'–3" | 1'–6" |
| 48" | 5" | 8" | 6" | 9'–4" | 18'–11" | 6'–10" | 10'–6" | 1'–6' | 2'–0" | 10'–0" | 6' | 11'–7" | 5'–10" | 1'–6" |
| 54" | 5 1/2" | 8" | 6" | 10'–1" | 19'–9" | 7'–5" | 10'–9' | 1'–6' | 2'–0" | 10'–3' | 8" | 11'–10" | 6'–5" | 2'–0" |
| 60" | 6" | 12" | 6" | 10'–10" | 22'–5" | 8'–0" | 12'–1" | 2'–0" | 2'–6" | 11'–7" | 8" | 14'–0" | 7'–0" | 2'–0" |
| 66" | 6 1/2" | 12" | 8" | 11'–9" | 24'–4" | 8'–7' | 13'–5" | 2'–0" | 2'–6" | 12'–11" | 8" | 15'–2" | 7'–7" | 2'–0" |
| 72" | 7" | 12" | 8" | 12'–5" | 25'–1" | 9'–2" | 13'–7" | 2'–0" | 2'–6" | 13'–1' | 8" | 15'–3" | 8'–2" | 2'–6" |
| 78" | 7 1/2" | 12" | 8" | 13'–4" | 27'–0" | 9'–9' | 14'–11" | 2'–0" | 2'–6" | 14'–5" | 8" | 16'–5' | 8'–9" | 2'–6" |
| 84" | 8" | 12" | 8" | 13'–11" | 27'–9' | 10'–4' | 15'–1" | 2'–0" | 2'–6" | 14'–7" | 8" | 16'–7" | 9'–4" | 3'–0" |
| 90" | 8 1/2" | 12" | 8" | 14'–10" | 29'–9" | 10'–11" | 16'–6" | 2'–0" | 2'–6" | 16'–0" | 8" | 17'–10" | 9'–11' | 3'–0" |
| 96" | 9" | 12" | 10" | 15'–10" | 30'–6" | 11'–6" | 16'–8" | 2'–0" | 2'–6" | 16'–2" | 12" | 17'–11" | 10'–6" | 3'–6" |
| 102" | 9 1/2" | 12" | 10" | 16'–11" | 32'–10" | 12'–1" | 18'–0" | 2'–0" | 2'–6" | 17'–6" | 12" | 19'–4" | 11'–1" | 3'–6' |
| 108" | 10" | 12" | 10" | 17'–6' | 33'–8' | 12'–8" | 18'–3" | 2'–0" | 2'–6" | 17'–9" | 12" | 19'–7' | 11'–8" | 4'–0" |
| 114" | 10 1/2" | 12" | 10" | 18'–5" | 35'–10" | 13'–3" | 19'–7" | 2'–0" | 2'–6" | 19'–1" | 12" | 21'–0" | 12'–3" | 4'–0" |
| 120" | 11" | 12" | 10" | 19'–5" | 37'–10" | 13'–10" | 20'–11" | 2'–0" | 2'–6" | 20'–0" | 12" | 22'–2" | 12'–10" | 4'–0" |

TOWN OF KNIGHTDALE
STANDARD DETAILS

DIMENSIONS FOR HEADWALL WITH WINGWALLS

STD. NO. 5.09

2 of 2

| REVISIONS | DESCRIPTION | DATE |
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NOTE:

1. ALL DIMENSIONS FOR WING WALLS NOT LISTED ABOVE SHALL BE AS SHOWN FOR SINGLE PIPE HEADWALLS.
2. THE MINIMUM DISTANCE BETWEEN PIPES IN A DOUBLE PIPE HEADWALL IS 2'–0".

DIMENSIONS FOR SINGLE PIPE HEADWALLS

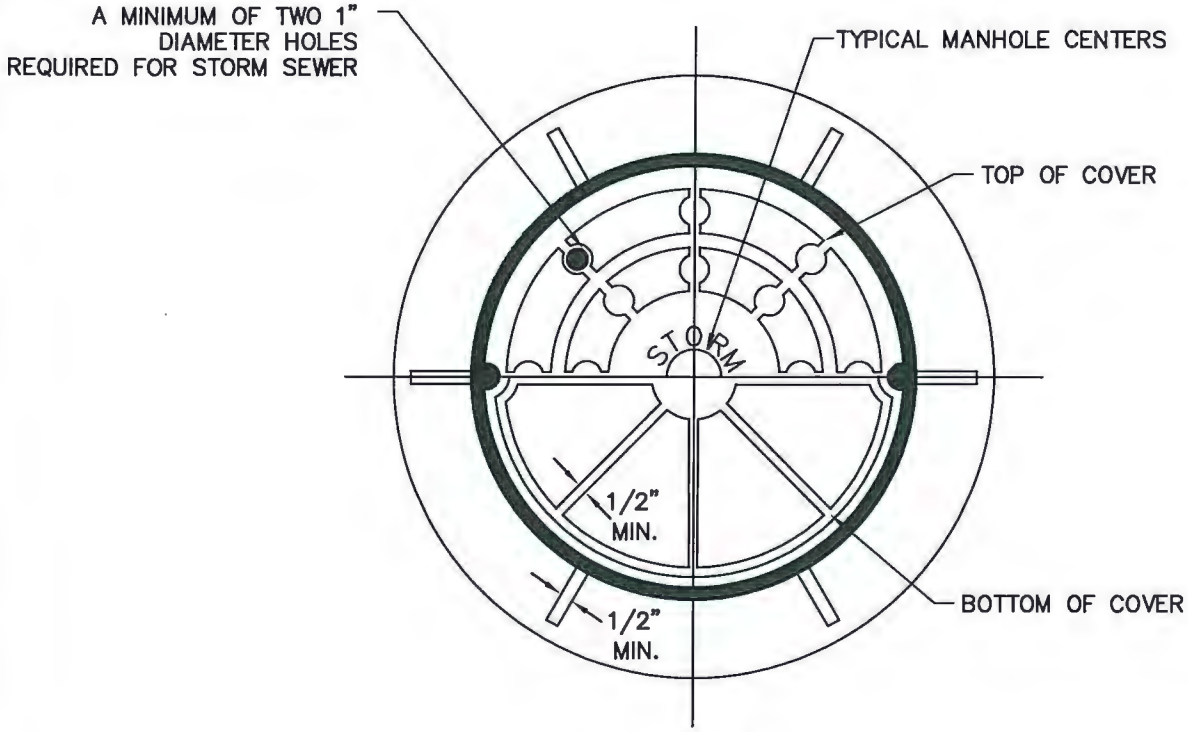
| PIPE SIZE | BACK FACE | | | FRONT FACE | CUBIC YARDS OF CONC. |
|---|---|---|---|---|---|
| | WALL REINFORCEMENT | | SLAB REINFORCEMENT | HORIZONTAL AND VERTICAL | |
| | HORIZONTAL | VERTICAL | | | |
| 15" | No.3 @ 12" O.C. | No.3 @ 12" O.C. | 6–6 X10–10 WW | No.4 @ 18" O.C. | 1.61 |
| 18" | " | " | " | " | 1.96 |
| 24" | " | " | " | " | 2.67 |
| 30" | " | " | " | " | 3.49 |
| 36" | " | " | " | " | 4.21 |
| 42" | " | " | " | " | 1.9 |
| 48" | " | " | " | " | 6.33 |
| 54" | " | No.4 @ 12" O.C. | " | " | 7.23 |
| 60" | " | " | " | " | 11.25 |
| 66" | No.4 @ 12" O.C. | " | 6–6 X 6–6 WW | " | 14.67 |
| 72" | " | " | " | " | 15.75 |
| 78" | " | " | " | No.4 @ 12" O.C. | 18.04 |
| 84" | " | No.5 @ 12" O.C. | " | " | 19.32 |
| 90" | " | " | " | " | 21.92 |
| 96" | No.5 @ 12" O.C. | No.6 @ 12" O.C. | " | " | 26.38 |
| 102" | " | " | " | " | 32.26 |
| 108" | " | " | " | " | 34.21 |
| 114" | " | No.8 @ 12" O.C. | " | " | 40.78 |
| 120" | " | " | " | " | 44.97 |

DIMENSIONS FOR DOUBLE PIPE HEADWALLS

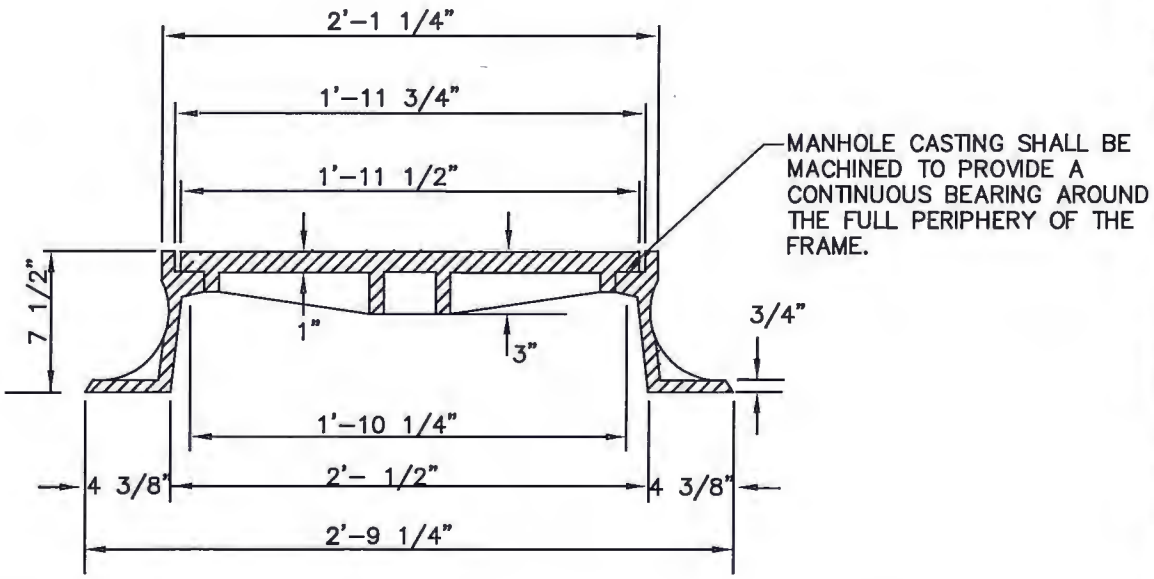
| H | I | J | K | CUBIC YARDS OF CONC. |
|---|---|---|---|---|
| 8'–6" | 13'–0" | 7'–3' | 8'–9" | 2.24 |
| 9'–4" | 14'–4" | 7'–10" | 9'–5" | 2.7 |
| 10'–10" | 16'–10" | 9'–0" | 10'–7" | 3.64 |
| 12'–4" | 19'–4" | 9'–2" | 11'–9" | 4.72 |
| 13'–1" | 20'–9" | 11'–4" | 12'–11" | 5.75 |
| 14'–7" | 23'–3" | 12'–6" | 14'–1" | 7.05 |
| 16'–2" | 25'–9" | 13'–8" | 15'–3" | 8.52 |
| 17'–6" | 27'–2" | 14'–10" | 16'–5" | 9.74 |
| 18'–10" | 30'–5" | 16'–0" | 18'–4" | 14.74 |
| 20'–4" | 32'–11" | 17'–2" | 19'–6" | 19.44 |
| 21'–7" | 34'–3" | 18'–4" | 20'–8" | 20.96 |
| 23'–1" | 36'–9" | 19'–6" | 21'–10" | 23.89 |
| 24'–3" | 38'–1" | 20'–8" | 23'–0" | 25.59 |
| 25'–9" | 40'–8" | 21'–10" | 24'–2" | 28.95 |
| 27'–4" | 42'–0" | 23'–0" | 25'–4" | 35.30 |
| 29'–0" | 44'–11" | 24'–2" | 26'–11" | 42.53 |
| 30'–2" | 16'–4" | 25'–4" | 28'–1" | 45.15 |
| 31'–8" | 49'–1" | 26'–6" | 29'–6" | 53.26 |
| 33'–3" | 51'–8" | 27'–8" | 30'–9" | 58.59 |

THE WORDS 'STORM SEWER' MUST BE CAST ON THE COVER.




*PLAN VIEW*

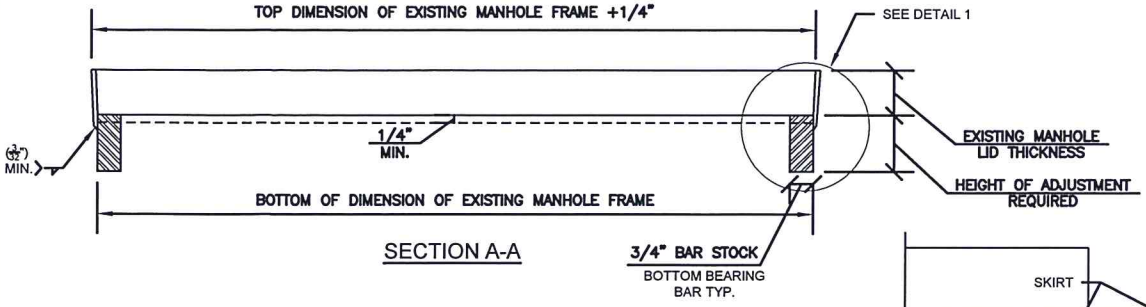



*SECTION*

| MINIMUM AVERAGE WEIGHT | |
|---|---|
| RING | 190 |
| COVER | 120 |
| TOTAL | 310 |

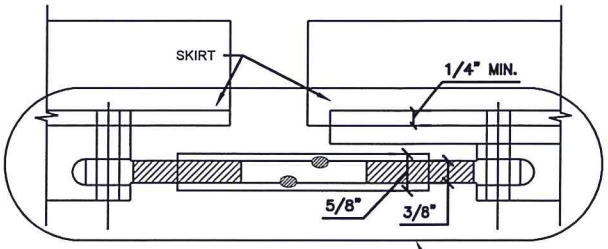
| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | STANDARD MANHOLE RING & COVER | STD. NO. 5.10 |



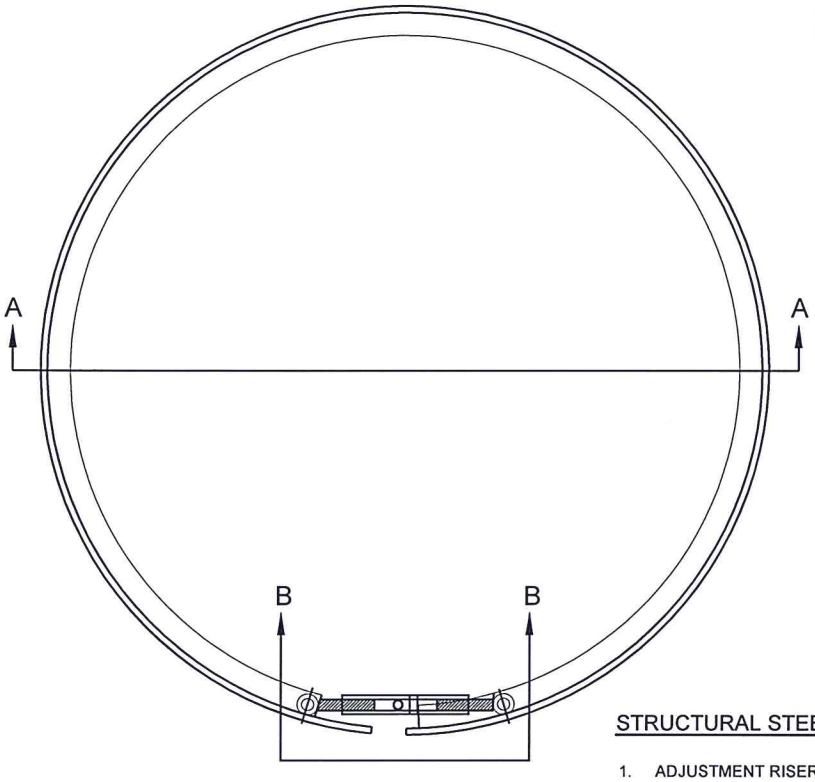

SECTION A-A

3/4" BAR STOCK BOTTOM BEARING BAR TYP.

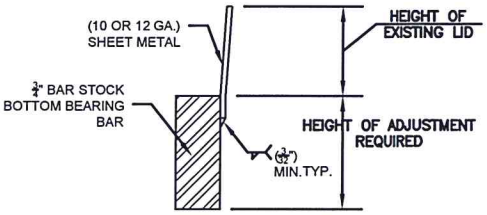



VIEW B-B

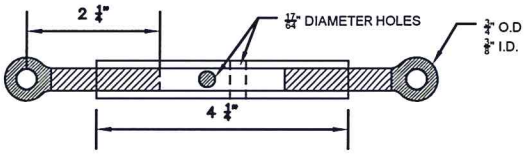
SEE DETAIL 2



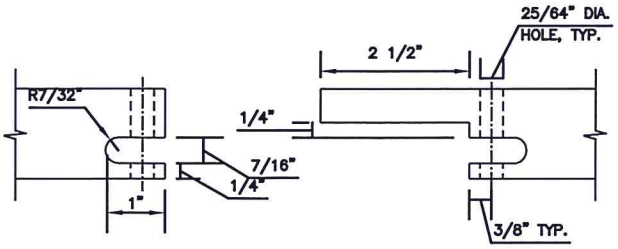

PLAN VIEW




DETAIL 1




DETAIL 2a-EXPANDING LINKAGE




DETAIL 2b-EXPANDING LINKAGE

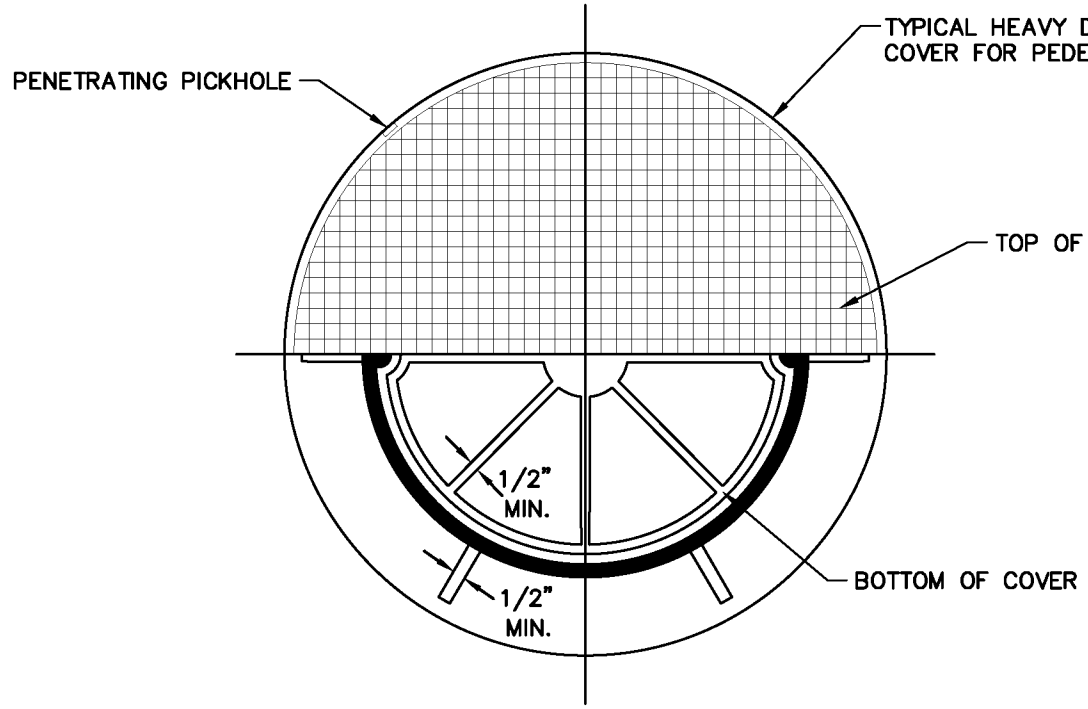
## STRUCTURAL STEEL GRADE ADJUSTMENT RISERS - TYPE 1

## STRUCTURAL STEEL GRADE ADJUSTMENT RISER NOTES:

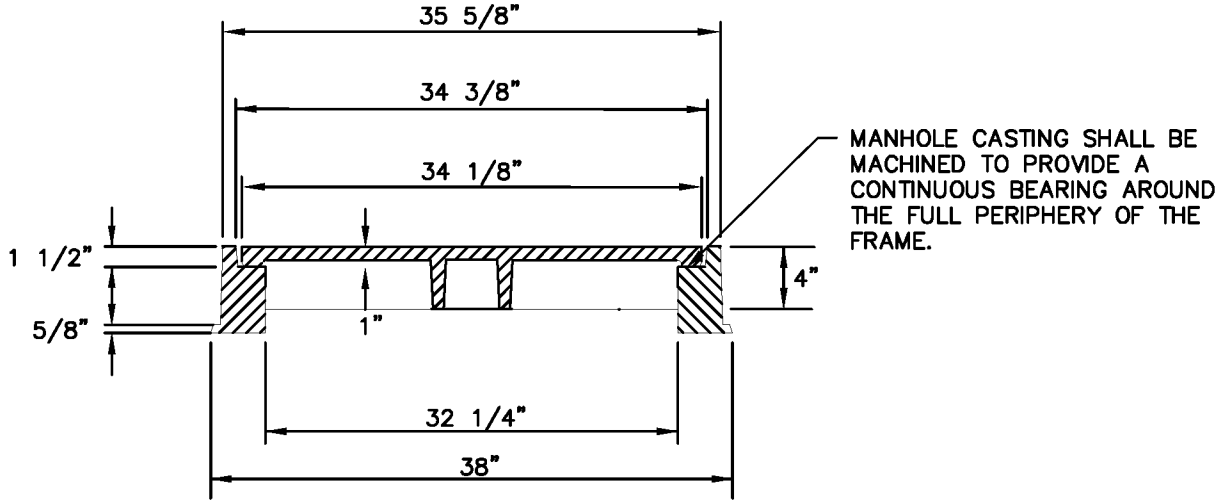
1. ADJUSTMENT RISER HEIGHT RANGE IN 1/4" INCREMENTS:
   - MINIMUM HEIGHT ADJUSTMENT = 2 3/4"
   - MINIMUM HEIGHT ADJUSTMENT = 5 3/4"
2. ADJUSTMENT RISER DIAMETER MINIMUM 13 1/2" TO 52".
3. PROVIDE STRUCTURAL STEEL CONFORMING TO ASTM A36-12 FOR RISER BAR.
4. SKIRT THICKNESS:
   - IF RISER HEIGHT IS EQUAL OR GREATER THAN LID THICKNESS PLUS 1/2" USE 10 GA ASTM A653 G90 SHEET METAL FOR SKIRT. ENDS OF SKIRT SHOULD OVERLAP 3/4" AT MEAN DIAMETER.
   - IF RISER HEIGHT IS LESS THEN LID THICKNESS PLUS 1/2" USE 12 GA ASTM A653 G90 SHEET METAL FOR SKIRT. ENDS OF SKIRT SHOULD TOUCH AT MINIMUM DIAMETER.
5. PIVOTED LINKAGE SHOULD EXPAND AND CONTRACT THE RISER PLUS AND MINUS 1/2" DIAMETER GIVING A FULL ONE INCH DIAMETER VARIATION WITHOUT BINDING. ATTACHMENT OF LINKAGE SHALL PIVOT ON 3/8" 304 STAINLESS STEEL ROLL PINS (14,000 LB DOUBLE SHEER STRENGTH).
6. TURNBUCKLE MATERIAL IS A.I.S.I. 12L 14 STEEL COLD DRAWN ZINC PLATED WITH YELLOW DICHROMATE FINISH DIPPED IN LINEBACKER RUST INHIBITOR.
7. RIGHT & LEFT ROD ENDS SHALEE BE FORGING A.I.S.I. C-1030 STEEL HEAT TREATED BHN 240, AND ZINC PLATED WITH DICHROMATE FINISH (3/8-16).
8. WELD STRUCTURAL STEEL IN ACCORDANCE AWS D1.3-2008 STRUCTURAL WELDING CODE - SHEET STEEL AND AWS D1.1-2000 STRUCTURAL WELDING CODE - STEEL.
9. PROVIDE ADJUSTMENT RISERS WHICH EXPAND TO THE FULL CIRCUMFERENCE OF THE ORIGINAL FRAME AND ALLOWS NO MOVEMENT.
10. CUSTOM FABRICATE EACH ADJUSTMENT RISER TO FIT THE EXISTING DIMENSIONS OF EACH MANHOLE. CAREFULLY MEASURE TOP AND BOTTOM DIAMETER OF HOLE, LID DIAMETER, LID THICKNESS, AND HEIGHT OF EACH EXISITNG LID AND PROVIDE THIS INFORMATION TO THE FABRICATOR. CLEARLY MARK EACH ADJUSTMENT RISER FOR PLACEMENT LOCATION. UPON DELIVERY OF ADJUSTMENT RISERS, VERIFY ALL DIMENSIONS AND LOCATION BEFORE INSTALLATION BEGINS.
11. FABRICATION TOLERANCES:
    - BOTTOM OUTSIDE DIMENSION +/-1/8"
    - TOP INSIDE DIMENSION +/-1/8"
    - LID THICKNESS +/-1/16"
12. MANHOLE FRAME MUST BE CLEANED. REMOVE ALL DEBRIS ON ALL SURFACES THE RISER TOUCHES. INSTALL THE STEEL ADJUSTMENT RISERS SECURELY TO THE EXISTING FRAME BY EXPANDING THE PIVOTED TURNBUCKLE USING A SCREWDRIVER AS A LEVER.
13. CHECK FOR FULL BEARING OF LOWER RISER BAR SECTION ON EXISTING FRAMES DURING INSTALLATION.

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | MANHOLE GRADE ADJUSTMENT RINGS | STD. NO. 5.11 |
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PLAN VIEW




SECTION

| MINIMUM AVERAGE WEIGHT | |
|---|---|
| RING | 240 |
| COVER | 260 |
| TOTAL | 500 |

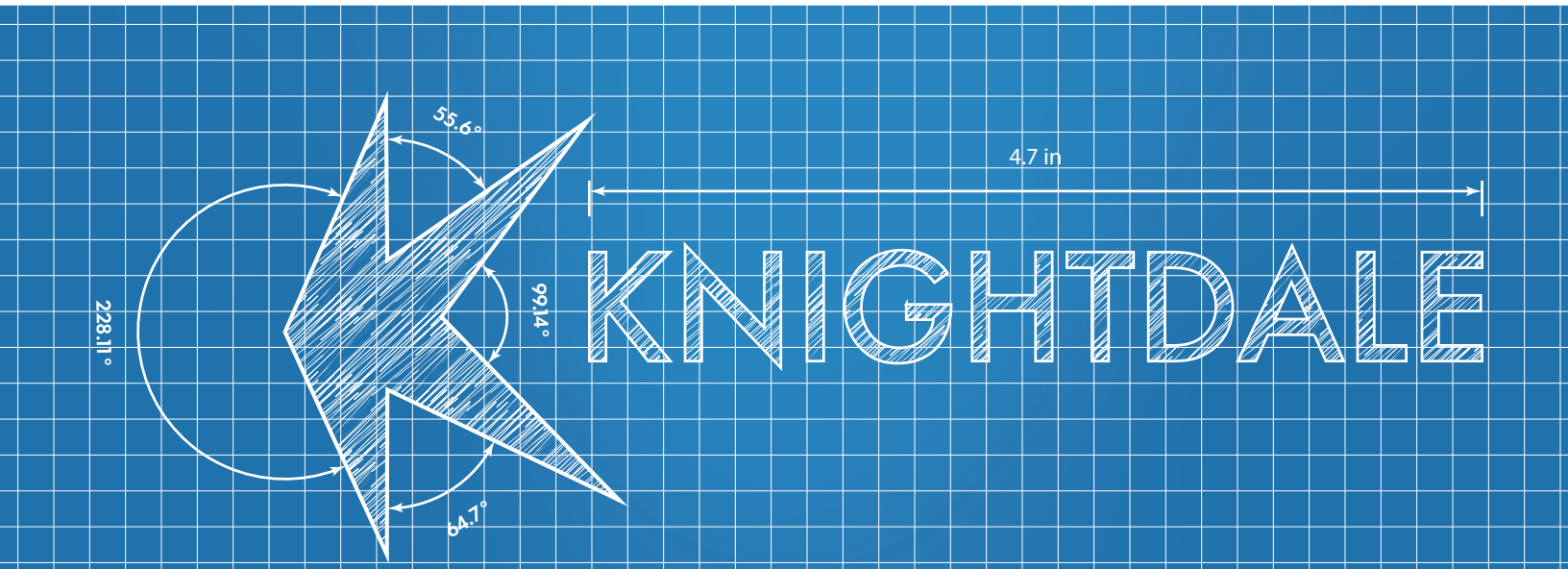
NOTES:

1. APPLICABLE TO STORM SEWER ONLY
2. WHEN ABLE, MANHOLES SHOULD BE AVOIDED IN PEDESTRIAN PATHS
3. IF UNAVOIDABLE, USE FLUSH, HEAVY DUTY RATED COVER
4. CHANGE DIMENSIONS, AS APPLICABLE
5. MANHOLE COVER TO BE US FOUNDRY TYPE AC OR APPROVED EQUIVALENT

| REVISIONS | |
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| TOWN OF KNIGHTDALE STANDARD DETAILS | MANHOLE COVER - PEDESTRIAN PATH | STD. NO. 5.12 |






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