The City of Florence follows the Boone County Subdivision Regulations as they pertain to Storm Water Regulations. The following are the regulations from the Boone County Subdivision Regulations book.

SECTION 325

Storm Water Management, Drainage and Residential Lot Grading

Storm sewer systems are designed to collect and convey storm water runoff from street inlets, runoff control structures, and other locations where the accumulation of storm water is unsafe. No storm sewer shall be permitted to run into a sanitary sewer system within a proposed subdivision.

In general, the cumulative amount of storm water runoff discharged from the boundary of the subdivision should be equal in terms of pre-development and post-development. Storm water runoff from a site or subdivision shall not adversely impact natural drainage from an uphill drainage basin or to a downhill drainage basin or adjacent properties. The property owner shall be responsible for storm water drainage facilities located on private property where runoff will be principally collected within that property and be minimally discharged over a larger area before the storm water naturally drains on adjacent properties. For isolated areas of the subdivision, where increased runoff may leave the boundary, downstream conditions must be considered to ensure that the increased runoff will not adversely impact existing drainage patterns.

Storm Water and Erosion Control rules and regulations in Boone County is broken into regions.

These regions are the Storm Water District of the Sanitation District No. 1; the City of Florence; and Unincorporated Boone County including the City of Walton. All subdivision development within Boone County must be designed and constructed per the Boone County Subdivision Regulations.

3.22

Any subdivision development within one of the above regions, must also comply with the rules and regulations of the governing body responsible for that region. When an individual rule or regulation is in conflict, the most restrictive rule shall apply. The developer must determine which region the proposed development is a part, and design and construct the storm sewer system per the applicable regulations.

All publicly maintained storm sewer systems shall be designed for peak flows calculated on the ten year (10 yr.) storm frequency. Overflows shall be designed on the one hundred year (100 yr.) storm frequency. No living area shall be affected by the one hundred year (100 yr.) storm. Safety swales shall be designed to carry all runoff away from any residential structure.

Basic Design Criteria for a Storm Drainage System

A) Degree of Protection Required- The storm drainage system shall be adequate to handle the
runoff from storms having various frequencies of occurrence for various degrees of site development, in accord with the following general categories:
1. Conservation, agricultural and low density 10 year frequency
residential (2 acre lots or larger)
2. All other residential and commercial 10 year frequency
3. Industrial areas 10 year frequency
4. For concentrated high value areas 10 year frequency
5. For flood control facilities 100 year frequency
The runoff computed from these storm frequencies shall be from the area within the subdivision and all other areas draining thereto.
B) Determination of Quantity of Runoff for Design of Storm Water Collection System-
. Each portion of the storm water drainage collection system shall be capable of handling the peak flow of runoff. For drainage areas less than one hundred (100) acres, either the "Rational Method" or Soil Conservation Service (SCS) Method may be used. For areas greater than one hundred (100) acres, either the "Soil Conservation Service (SCS) Method" or the "Regional Method" of the Kentucky Transportation Cabinet, Bureau of Highways shall be used:
1. "Rational Method" where Q = CiA
Q = peak runoff quantity in cubic feet per second;
C = runoff coefficient varying with perviousness and other characteristics of the drainage area;
I = average intensity of precipitation in inches per hour, varying with frequency of storm occurrence, duration or concentration time, and area of the tributary watershed;
A = area in acres of the tributary watershed.
A. Runoff Coefficients: The runoff coefficient is the portion of the precipitation, expressed as a decimal, that will reach a given storm water facility. Each lot within a subdivision contributes runoff from the roof, driveway, sidewalk and street.

3.23
Generally, the smaller the lot width, the less impervious area. As the lot increases in width so does the impervious area. Weighted coefficients shall be used with the impervious areas C = 0.95 and all other areas C = 0.40

Table 2 - Rational Method Runoff Coefficients for Composite Analysis

Land Use Description	**Average Percent Imperviousness**	**Runoff Coefficient (C)**
Natural and Undisturbed Areas	Varies	0.40
Single Family Residential	Average Lot Size/Width	Varies (See Below for Value)
		0.43 - 0.76
(See Below for Value)		
3 acres/300 feet	6	0.43
2 acres/200 feet	7	0.44
1 acre/100 feet	12	0.47
½ acre/100 feet	23	0.53
12,500 sq. ft./80 feet	34	0.59
9,000 sq. ft./70 feet	42	0.63
7,500 sq. ft./60 feet	44	0.64
6,000 sq. ft./50 feet	48	0.66
<6,000 sq. ft./<50 feet	65	0.76
Industrial	72	0.80

Multi-Family Residential 75 0.81
Commercial/Office 85 0.87
Impervious Areas Including;
Pavement, Roofs, Drives, Sidewalks,
etc.
100 0.95

B. Intensity of Precipitation: The "point" values of average precipitation intensity in inches per hour, for Northern Kentucky can be determined from Exhibit No. 4-904 Kentucky Bureau of Highways "Rainfall Intensity-Duration-Frequency Curves." For any given storm duration (concentration time of runoff) the curves show the average precipitation intensity of storms having 2, 5, 10, 25, 50, and 100 year frequencies or the precipitation intensity can be calculated by using the following formula and constants developed by the Kentucky Transportation Cabinet:

3.24

$I_{RI} = B/(Tc+D)^E$

Return Interval
(RI)
B D E
2 34.5848 6.9000 0.7899
5 54.0284 9.5000 0.8211
10 65.6903 10.6000 0.8262
25 87.9368 . . 12.4000 0.8499
50 100.0737 13.0000 0.8553
100 114.6446 13.8000 0.8614

C. The time of concentration is the time associated with the travel of runoff from an outer point
that best represents the shape of the contributing areas. Runoff from a drainage area usually reached a peak at the time when the entire area is contributing, in which case the
time of concentration is the time for a drop of water to flow from the most remote point in the
watershed to the point of interest. Runoff may reach a peak prior to the time the entire drainage area is contributing. Sound engineering judgement should be used to determine
the time of concentration. The time of concentration to any point in a storm drainage system is a combination of the sheet flow (overland), the shallow concentrated flow and the
channel flow, which includes storm sewers. The minimum time of concentration for any area shall be 6 minutes.

The Soil Conservation Service TR-55 method for calculating the time of concentration shall
be used.

At no time shall the Time of Concentration be greater than 30 minutes for design of storm
inlets.

2. The Soil Conservation Service (SCS) Method may be used to calculate the peak discharge
rates; develop runoff hydrographs for basins and subbasins; determine runoff volumes; and
provide inflow information to determine the required storage volume for detention and retention basins. The SCS Method is the preferred method for performing hydrologic analysis. The SCS Method will utilize the formulas, constants and data in the current manual from the U.S. Natural Resources Conservation Service. The Soil Conservation Service utilizes a 24-hour storm duration, which is considered to be acceptable for Northern
Kentucky. When the Soil Conservation Service methods are used, the Type II rainfall distribution shall be used.

For detailed information, the user is referred to the following Soil Conservation Service publications:
1. NEH-4: "Hydrology," Section 4, National Engineering Handbook;
2. TR-20: Computer Program for Project Formulation, Hydrology;

3. TR-55: Urban Hydrology for Small Watersheds;
4. TP-149: A Method for Estimating Volume and Rate of Runoff in Small Watersheds.
3. The Regional Method of the Kentucky Transportation Cabinet, Bureau of Highways (Regional Method) may be used to calculate the peak discharge rates when required by regulatory agencies such as the Kentucky Division of Water. The Regional Method will utilize the formulas, constants and data from the current Manual of Instruction of Drainage
and Design, Kentucky Transportation Cabinet, Bureau of Highways.
C) Storm water system facilities.
1. Flow times in sewers or conduits to the point of design may be determined from the hydraulic properties of the sewers upstream of that point, assuming average flow-full velocity at the proposed sewer slopes.
2. Pipe Capacities- Public storm sewer pipes shall be designed to carry peak flows as determined by the methods previously described. At the design storm the drainage system
shall be designed as open channel (non-surcharged) flow. Sizes shall be determined by Manning's formula using a range of roughness coefficients (n=0.009-0.024). For roughness
coefficients see Street, Storm, and Sidewalk Specifications.
3. Minimum Pipe Size- The minimum diameter for public storm sewer pipe shall be fifteen
inches (15") for inlet headwalls and twelve inches (12") for systems with a catchbasin at the
initial point.
4. Minimum and Maximum Velocities- Velocities in public storm sewer pipes, when flowing full
at average peak flows, shall not be less than two feet (2.0') per second and not greater than
forty feet (40') per second.
5. Pipe Grades - The sewer pipe shall be laid on gradients so that the velocity (flowing full)
shall be kept within the foregoing stated minimum and maximum unless other special provisions are made. Storm sewer pipe shall be laid on gradients so that the velocity (flowing full) shall be kept within the foregoing stated minimum and maximum, unless other
special provisions are made. Sewers on twenty percent (20%) slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:
1. Not over thirty six feet (36') center to center on grades twenty percent(20%) and up to thirty five percent (35%);
2. Not over twenty four feet (24') center to center on grades thirty five percent (35%) and up to fifty percent (50%); and
3. Not over sixteen feet (16') center to center on grades fifty percent (50%) and over.
6. Hydraulic Grades- To ensure against surface ponding or street flooding due to surcharging,
the hydraulic grade line (HGL) of the design storm in any pipe may not be higher than the
top of pipe for the ten year (10 yr.) design storm; and one foot (1') below the inlet or manhole for the twenty five year (25 yr.) check storm.
Design of all public storm sewer appurtenances shall consider the balance of energy plus

the loss due to entrance in all structures having a critical change in horizontal or vertical alignment. In no case shall the difference in invert elevations be less than the result of equal crowns when a smaller pipe empties into a larger one. In no case shall storm sewer
pipe sizes be reduced unless the upstream pipe is an approved underground detention structure.
7. Manholes (Junction Boxes)- Manholes shall be constructed in accord with Standard Construction Drawings as shown in the current city/county street specifications. Drop manholes may be required to reduce the slope of any sewer line. Pipes shall not extend more than two inches (2") into the side of the manhole, and the invert of the outlet pipe shall
be at the bottom.
8. Inlets (Catch Basins)-
Capacity: The capacity of the grate on the inlet should not be less than the quantity of flow
tributary to the inlet. Inlets at low points or sags should have extra capacity as a safeguard
for street flooding from flows overtopping the street curb. A safety swale designed for the 100 year storm shall be placed at all low points or sags. Curb openings on combination inlets should be used for overflows in the event that the grate is clogged. Special inlets may
be required for streets with steep gradients to provide the extra capacity such situations require. Pipes shall not extend more than two inches (2") into the side of the manhole, and
the invert of the outlet pipe shall be at the bottom.
Type: Combination type inlets (single or double) shall be used and installed in accord with
"Standard Construction Drawings" as shown in the current city/county street specifications.
Any catch basin not placed on a lot line or within three feet of a driveway shall use a roll type grate as shown in the Street Specifications, and capacity calculations must be based
on the type of inlet. Curb inlets and gutters shall accommodate the flow from a storm with
an intensity of four (4) inches per hour.
Location: Inlet spacing shall be based upon gutter and inlet capacity, street slope and contributing drainage area. The spacing of inlets should ensure that street drainage generated along continuous grades or in sags will not damage and flood private properties
or residential basements. For the design storm, no more than 5 cfs shall enter any grade inlet; no more than 8 cfs shall enter any sump inlet; and no more than 2.5 cfs is permitted
to flow in side yards between houses.
A. Along continuous grades (less than 2 percent) - 400 feet maximum;
B. Along continuous grades (2 percent and over) - 600 feet maximum;
C. At sag locations (draining less than 2 percent grades) - 400 feet maximum between inlets or from a high point;
D. At sag locations (draining 2 percent and over grades) -600 feet maximum between inlets or from a high point.
Special consideration should be given to storm drainage entering cul-de-sacs. Additional inlets shall be required when drainage areas and/or street slopes are excessive. In addition to an inlet provided at the low point within the cul-de-sac two (2) additional inlets shall be required along each curb prior to the entrance of the culde-sac in accord with the following criteria:
A. For street slopes less than eight (8) percent and draining more than 400 feet

of pavement; and

B. For all street slopes more than eight (8) percent and draining more than 300 feet of pavement.

9. Intersections - Storm water runoff crossing the intersection of a street shall be kept to a minimum.

10. Outfalls - When a storm sewer system outfalls into a flood plain of any major water course, the outfall must not be subject to frequent floods or backwaters. Standard headwalls and/or headwalls with wingwalls shall be constructed for all outfalls. To minimize adverse impacts on receiving channels one of the following conditions must be met: (1) the outlet velocity at a headwall or outfall of a paved channel shall be less than or equal to the natural velocity of the receiving channel or stream for the design storm; (2) structurally lined aprons or other acceptable flow spreading or energy dissipating devices shall be installed at the outlet to reduce the velocity; (3) the receiving channel shall be lined as per Article 3, Section 325 - Basic Design Criteria for Storm Water Drainage Channels, Water Courses, and Erosion Control, of these regulations for a sufficient distance to protect against erosion.

When a storm sewer or paved channel outlets onto a slope without a defined drainage channel, either a channel shall be graded and properly protected down to its convergance with the natural channel, or the outlet flow shall be dispersed on the slope using acceptable flow spreading or energy dissipating devices. Storm sewers or paved channels that outlet at or near defined drainage channels, shall be designed to outlet at as near to parallel to the channel as practical.

The outlet velocities of all headwalls shall be included in the drainage calculations. The invert of the first storm sewer appurtenance upstream of the outfall structure shall be above the elevation of the calculated one hundred (100) year flood plain. The calculated one hundred 100 year flood plain for all channels with a drainage area of more than fifty (50) acres within the project shall be shown on the Improvement Plan.

11. Culverts and Bridges - Culverts and bridges shall be designed in accordance with the methods given in the "Manual of Location and Design" published by the Kentucky Department of Highways; except that storm water quantities to be handled by the culverts and bridges shall be determined on the basis described in these standards. The allowable headwater (AHW) shall not be greater than $_{HW}/_{D}$ = 2.0.

12. Headwalls - Standard headwalls for pipe sizes twelve (12) thru twenty-four (24) inch and headwalls including wingwalls and aprons for pipes larger than twenty-four (24) inch, shall be constructed at the outfall of all storm sewers in accord with "Standard Construction Drawings" as shown in the current city/county specifications.

NOTE - All inlet headwalls shall have a warning sign that states:

DANGER
HIGH WATER

All signs shall be a minimum of 4 inches in height and 8 inches in length and be made of a reflective material.

13. Other Drainage Improvement Measures - Other drainage improvement measures may be
undertaken to provide the necessary hydraulic characteristics required for adequate

drainage. These other measures include stream bed clearing, removal or obstructions, stabilization of banks or areas to eliminate erosion, widening, deepening or realignment of
streams, construction of ponds behind dams, or other measures for adequate drainage.
14. Sub-Surface Springs - While constructing developments, sub-surface springs may be
disturbed. In these cases, it is the responsibility of the developer to adequately address the
removal of the water from the surface. This would include installing a pipe network to transfer water to a storm water structure or natural stream. Discharge of this type of water
shall not be onto the lot directed toward the street, or on any part of the lot that will pond water. It is the responsibility of the developer to correct any problems with sub-surface springs up to three (3) years after recording of the Final Plat.
15. Specifications for Construction and Materials - See *Street and Storm Drainage Construction*
Specifications.

Basic Design Criteria for Storm Water Drainage Channels, Water Courses, and Erosion Control

Open channels provide many advantages in the management and control of storm water runoff.
Such channels provide for natural infiltration of storm water into ground water supply and extend
the Time of Concentration (T_c) helping to maintain the runoff rate nearer to that which existed prior
to development. The objective of open channel flow design is: (a) to determine a channel slope
and size that will have sufficient capacity to prevent undue flooding damage during the anticipated
peak runoff period; and (b) to determine the degree of protection based on stream velocity to
prevent erosion in the drainage channel. Existing drainage channels, which will remain undisturbed, shall not be required to be reconstructed unless additional capacity and erosion control
is required.
A) Degree of Protection - Storm water drainage channels and water courses shall be adequate
to handle runoff from storms of the frequencies of occurrence shown for the degrees of site
development as follows:
1. For all subdivisions and developments twenty five year (25 yr.) frequency.
2. For main flood control channels - one hundred year (100 yr.) frequency. The runoff computed from these storms shall be that from the area within the subdivision and from all other areas considered as fully developed in accord with development planned in the County's Comprehensive Plan.
B) Determination of Quantity of Runoff - Each portion of the storm water system of drainage
channels and water courses shall be capable of handling the peak flows as determined by
the proper method previously described in Section 1.

C) Drainage Channel -Capacities- Drainage channels shall be designed to carry peak flows
as determined by the methods previously described. Channel cross-section areas shall be
determined by Manning's formula, using a value of n from the following chart.
Drainage Channel Manning<s n Values
Concrete 0.013
Earth (non-vegetated) 0.022
Rip-Rap 0.035
Rock Cuts 0.035

Grass-mowed short 0.05
Grass-tall stand 0.10
Natural Channel:
-Clean and Straight 0.030
-Stones and Some Weeds* 0.035
-Gravel and Rock 0.040
-Weedy and Winding 0.06
-Dense Weeds & Brush 0.10
*this is typical for a natural intermittent stream
When open drainage channels require various lining types to attain ultimate design capacity, the earth sections of the drainage channel and its structure shall be designed and
constructed to the ultimate design required.
D) Erosion Control for Drainage Channels - Runoff flows in open channels may cause accelerated erosion. Such erosion can be controlled by limiting velocities, changing the channel lining, and reshaping the channel to spread the flow of runoff. Methods of controlling erosion in open channels include the following:
1. Sown grass covers, seeded degradable turf reinforcing mats;
2. sod
3. permanent turf reinforcing mats;
4. aggregate channel lining (minimum KDOT Type II channel lining, underlain with filter fabric
5. aggregate filled gabion baskets or mattresses (underlain with filter fabric);
6. interlocking concrete blocks or cabled mattress (underlain with filter fabric;
7. reinforced concrete or precast paving (of at least 4" thickness);
8. energy dissipators.
*Alternate methods of channel erosion control will be considered on an individual case basis. Note
that the methods above are generally listed (and numbered) in order of increasing erosion
protection ability. The design requirements below indicate the minimum level of protection. Any
method listed above with a higher erosion protection ability than the minimums stated below will be
acceptable.
1. Design velocity should generally be greater than 1.5fps to avoid excessive deposition of sediments. When flattened slopes are unavoidable, method (7) should be used to accelerate runoff.
2. Design velocity between one-half (1.5) and five (5) feet per second:
Method (1) shall be used. the bottom and sides of the earth channel shall be seeded, mulched and fertilized to an elevation of three (3) feet above the design water surface, or three (3) feet beyond the top of the channel bank. Seeding shall be a perennial or annual mixture of grass seeds applied at a rate of 75 pounds per acre. Acceptable whole fertilizer shall be applied at a rate of 75 pounds per one thousand square feet. Where seeding is required and the soil is not capable of supporting vegetation (such as sandy soil or clay types), appropriate action shall be

taken to bring the soil to an acceptable condition which will support the growth of seed. A degradable turf reinforcing mat is recommended to help stabilize the soil until the grass has become fully established.
3. Design velocity between one-half (1.5) and five (5) feet per second:
Method (2) or (3) shall be used. the bottom and sides of the earth channel shall be sodded and pegged to remain in place, or a permanent turf reinforcing mat shall be installed and seeded. Where seeding or sodding is required and the soil is not capable of supporting vegetation (such as sandy soil or clay types), appropriate action shall be taken to bring the soil to an acceptable condition which will support the growth of seed or sod.
4. Design velocity between nine (9) and fourteen (14) feet per second:
Method (3) or (4) shall be used.
5. Design velocity between fourteen (14) and twenty (20) feet per second:
Method (4) or (5) shall be used.
6. design velocity greater than twenty (20) feet per second:
Method (5) or greater shall be used.
A method greater than the required minimum may also be necessary at bends, changes in
alignment, junctions with other ditches, and at other locations where erosion is more likely to occur.
Design velocity at the downstream end of a protected channel shall be equal to or less than the
natural velocity in the receiving channel. Energy dissipation may be necessary to reduce the
velocity prior to reintroduction into a receiving channel.
E) Drainage Channel or Water Course Relocations- In order to minimize hillside slippage near
relocated drainage channels or water courses due to drainage channel depth or character
of the earth in the drainage channel fill and side slopes, precautions shall be taken to compact the fill and side slopes, provision of under drainage, bank protection or reinforcing
or other measures. Additional easement width shall be provided at such possible slide areas.
F) Erosion Control - All subdivision developments shall have a Best Management Practices
(BMP) document prepared and submitted with the Improvement Plan. This document shall
meet the minimum requirements as stated in the current “Kentucky Best Management Practices For Construction Activities” prepared by The Kentucky Division of Water (KDOW).
Three (3) copies of the document shall be submitted and a copy shall be on site at all times.
A copy of the 401 Water Quality Certification Nationwide Permit application shall be submitted with the Improvement Plan. All graded areas are to be maintained at all times to prevent erosion and excessive runoff. Several methods used to prevent soil erosion during development are included in the current city/county street specifications. Drainage
swales, silt checks, temporary, sedimentation basins, rock check dams, etc., are to be used
and maintained during the grading operation. All collected sedimentation shall be removed
from the detention site. All slopes and graded areas are to be seeded after the grading of
that area has been completed.
Additional erosion control measures to prevent erosion and excessive runoff may be

required if necessary.
G) Mud and Debris - Until all lot and street improvements in the subdivision have been completed, the subdivider shall take such measures as are necessary to prevent erosion of graded surfaces, and to prevent the deposit of soil and debris from graded surfaces onto
public streets, into drainage channels or sewers, or onto adjoining land. All public streets shall be kept clear of mud and debris per local ordinances.
H) Specifications for Construction and Materials - In all other respects, the design, materials,
and construction shall be as specified in Sections 206, 212, 601, 610, 703, 710 of the current State of Kentucky Standard Specifications for Road and Bridge Construction and in accord with "Standard Construction Drawings" shown in the current city/county street specifications.
I) Equipment on Streets - Any equipment on any existing pavements shall be per local ordinances.

Basic Design Criteria for Stormwater Runoff Control Facilities
These regulations affect all subdivision and developments:
A) General- In order to minimize runoff damage to downstream properties, sediment pollution
of public and private waters and hydraulic overloading of existing drainage facilities, the storm water runoff from a subdivision after development shall not exceed the predevelopment
discharge from that subdivision calculated by using a undeveloped runoff
coefficient c= 0.40. Detention shall be provided for all subdivisions and developments. The
detention facility may be designed for each individual lot in commercial or industrial zones,
but regional basins are encouraged to be provided throughout the subdivision or development. All basins within residential zones must be regional. Such facilities shall be designed so that no standing water will remain in detention basins during dry weather, or the design of retention ponds that will not allow standing water to stagnate and present health hazards. In certain cases, other non-basin detention/retention techniques such as underground vault storage and ponding water on parking lots may be utilized when approved by the commission. Individual site storm water management shall be reviewed under the current Boone County Zoning Regulations. The amount of water to be detained
shall be determined by the method described in the following paragraphs using the design
criteria as referenced in Table 1 and Figures 3, 4, and 5.
Storm Water Control Facility Volume Calculations
Estimated Runoff by:
An accepted method that generates an inflow/outflow hydrograph such as the Soil Conservation Service (SCS) method or Modified Rational Method (MRM) as detailed in the
Street and Storm Drainage Specifications. It is recommended that these methods are used
through a computer program. All documentation shall be submitted for review by the Planning Commission Staff.
B) Pre-Development - Calculations - Calculate the subdivision or development site runoff

based on a 2, 10 and 50 year storm frequency. The entire acreage contributing to the runoff, shall be included in the calculations.
C) Post-Development Runoff Calculations - Calculate the proposed ultimate development

runoff based on a 2, 10 50 and 100 year storm frequency curve. The entire acreage contributing to the runoff shall be included in the calculations.
D) Storage Requirement - The amount of detention/retention required for a subdivision or
development shall be the amount determined from the inflow/outflow hydrograph as previously outlined based on the fifty year (50 yr.) storm frequency. If the Modified Rational
Method is used, the storm duration used shall be the one that produces the maximum storage.
E) Discharge from Detention Basin - The discharge from the detention/retention basin shall be
controlled by a multi-stage release outlet structure and not be greater than a pre-developed
runoff rate based on a 2, 10 and 50 year storm frequency at that particular point where the
discharge occurs. The routing of an emergency spillway shall be shown based on the one
hundred year (100 yr.) storm frequency. Trash racks may be required to be installed on the
low flow outlet in detention basins to prevent clogging.

Detention Basins/Retention Ponds - Standards and Specifications
A) Definition and Scope- These standards apply to permanent and temporary storm water
runoff, sediment and debris basins formed by an embankment, or excavation. These standards are limited to the installation of basins on sites where:
1. Failure of the structure will not result in loss of life, damage to homes, or interruption of use or service of public utilities.
2. Drainage area does not exceed two hundred acres (200).
3. The water surface at the crest of the emergency spillway does not exceed five (5) acres.
4. All detention basins that shall be designed and built with side-slopes no greater than 3:1 (three feet horizontal per one foot vertical), paved channel bottoms and proper outlet structures to insure no standing water during dry periods.
5. All retention ponds shall have dams that conform to the current Design Criteria For Dams and Associated Structures, Kentucky Division of Water. In cases when the top of the dam is also a publicly dedicated street right-of-way, the developer shall have a geotechnical report prepared with recommendation on the design and construction of the dam.
NOTES: a. All computations to be prepared by a Kentucky Licensed Professional Engineer. .
b. All detention areas and methods to be approved by the engineer for the city or county. In the event the city or county does not have an engineer, the approval will be by the engineer for the Planning

Commission.
c. Fencing may be required when the location of the detention area is not easily observed or in the opinion of the inspector a safety problem would exist.
d. All sedimentation must be removed from all detention basins/ retention ponds prior to acceptance by proper legislative body.

Residential Lot Grading and Drainage
A) Lot Grading - Lot grading shall be accomplished as follows: Within the limits of the public
right-of-way adjacent to street pavements, all final grading for grass strip, sidewalk, and

yards to the building structure, shall comply with minimum and maximum grades in accord
with typical sections for streets as shown in the current city/county street specifications. For
lots that drain toward the street, the areas between the right-of-way line and the curb shall
be graded so that water drains to the street at a minimum grade of 1 inch per foot
(approximately 8 percent) except where sidewalks are required (see Typical Sections). All
grading behind the street shall be done in a fashion that does not allow ponding of water
adjacent to the paved street. For lots that drain away from the street, the area between the
right-of-way line and the curb shall be graded so that water drains away from the street at
a minimum grade of ½ inch per foot (approximately 4 percent) except where sidewalks are
required (see Typical Sections). Lot areas outside of the limits of the building structure shall
be graded per the detail in the current Boone County Street, Storm, and Sidewalk
Specifications.
Temporary Driveway: All residential lots shall have a single point access and a temporary
driveway of crushed stone with fabric placed in the location of the permanent driveway. The
temporary driveway shall be constructed after completion of foundation. It shall be a
minimum of three inches (3") in depth with a separation fabric and a minimum of ten feet
(10') in width. All construction traffic to the site must utilize the temporary driveway and
shall not drive on any other portion of the lot without prior approval of the city/county
inspector.
Top Soil: If grading results in the stripping of top soil, top soil shall be uniformly spread over
the lots as grading is finished. Temporary silt barriers should be installed around stock-piled
top soil for erosion and sediment control.
Trees: As many trees as can be reasonably utilized in the final development plan shall be
retained and the grading adjusted to the existing grade of the trees where practicable.
B) Swales - Swales carry surface runoff from roofs, yards, and other areas to the rear of lots
or along common property lines to streets or other drainage areas to prevent ponding of
water near building structures or other portions of the lot. Surface drainage swales shall
have a minimum grade of two (2) percent and shall be constructed so that the surface water
will drain onto a street, storm inlet, or natural drainage area. Swales for handling lot
drainage shall be constructed as a part of final lot grading and be seeded and mulched or
sodded as soon as possible to prevent erosion.
C) Roof and Subsurface Drains - Roof downspouts, footing or foundation drains shall be

discharged onto the same parcel of land from which the water is generated. Roof
downspouts shall be directed toward drainage areas which direct water away from the
building structure. The outlet shall be no farther than twelve (12) feet from the building line,
and no closer than two (2) feet to the property lines and twenty (20) feet to the right-of-way
line. All subsurface drains shall be constructed toward the rear of the lot or connected into

the storm sewer system with the approval and inspection by city or county officials. No subsurface drain shall outlet nearer than two feet (2') to a property line Outlets for roof drains shall have erosion control in place at the outlet areas to minimize erosion on site.

Maintenance of Retention/Detention Areas

In all commercial and industrial developments the owner of each lot and/or the developer shall be responsible for properly maintaining each retention/ detention areas in order for such facility to function according its design and purpose. Maintenance for the detention/retention areas shall be noted on the Improvement Plan, including access roads. . In residential subdivisions, all Detention Basins shall be deeded to the appropriate legislative body and the area shall be shown and labeled as a Lot on the Final Plat. The deed shall be prepared by the developer and transferred to the appropriate legislative body after recording of the Final Plat. For any Retention ponds, only the appropriate easements around inlets structures and outlet structures, and a retention easement over the area of the fifty year (50 yr.) storm event shall be dedicated to the appropriate legislative body. The area of the pond or lake shall be owned and maintained by the adjoining residents. This shall include maintaining the shoreline and removing sedimentation, and shall be included in the Subdivision's Restricted Covenants.

SECTION 330

Soil Erosion and Slope Control

The developer of a proposed subdivision or development shall be required to submit to the Commission a detailed plan for erosion and/or sedimentation control. The plan shall contain proposed methods for slope stabilization, erosion control and water pollution abatement and shall be reviewed by the Commission. The Commission shall require that such a plan or part thereof be submitted with the Improvement Plan and Grading Plan.

a) Prior Grading or Disturbed Site - No Improvement Plan and/or Grading Plan may be approved where the site has been graded, stripped, excavated, devegetated or otherwise disturbed so that slipping, erosion and/or water pollution has or may reasonably be expected to occur until such conditions are corrected to the satisfaction of the Commission.

b) Soil Survey - The current "Soil Survey of Boone, Campbell and Kenton Counties, Kentucky" issued by the United States Department of Agriculture, Soil Conservation Service in cooperation with the Kentucky Agricultural Experiment Station is hereby made a part of these regulations and will be used for informational and reference purposes.

c) Erosion Control Measures - Per the current *Kentucky Best Management Practices For Construction Activities* the following shall be followed:

1. All exposed and graded land will be covered by mulch, permanent seeding, or temporary seeding, or a combination of seeding and mulch (hay, straw, or other natural fiber - spread for a 75% or greater ground coverage) within 45 days of exposure. Seeding rates, dates, and materials may be obtained from the local Natural Resources

Conservation Field Office.

2. All exposed and graded land with grades of 8% (an average of 8 feet of fall per 100 feet
of length) will be mulched at 75% or greater coverage.
3. Sediment basins (debris basins, desilting basins, or silt traps) shall be properly designed
according to runoff and sedimentation load calculations and installed during initial grading at locations which will provide the best protection from off-site damages. A multi-purpose basin used for a silt trap then converted to a detention/retention basin is encouraged if properly designed and located. This combination structure will need to be dredged periodically during construction activities and after stabilization in order to provide adequate storage.
4. Concentrated flow areas, including storm sewer entrances, will need proper water control barriers to slow the runoff for rill and gully erosion control. These barriers will be a series of pegged straw bales or properly installed silt fence and rock rip-rap where needed.
5. Site perimeter silt fence or straw bale barriers shall be installed where bare land overflow is greater than a ratio of 2% slope per 400 feet of slope length (i.e., 4%:200, 8%:100, etc.). These perimeter barriers will be installed at all toe slopes of land 8% or greater in slope and above grade overfalls (at the upper edges of grades) along site perimeters.
6. Individual building sites will need erosion control barriers (silt fence or straw bales) below all bare land sloping into established paved streets and storm sewer systems. Bale barriers are recommended for individual house site perimeters and storm sewer entrances.
7. Individual building sites will be seeded (temporary or permanent) and mulched within 45 days of disturbance where land is void of grass vegetation.
8. In areas designated by the Land Use Element of the Boone County Comprehensive Plan as Developmentally Sensitive, the applicant, property owner, or developer is encouraged to use the Hillside Development Guidelines in Section 3162 of the Boone County Zoning Regulations in order to minimize soil erosion and to assure slope stability (compliance with these guidelines is mandatory under certain circumstances as outlined in Section 3162).

D.1
APPENDIX "D"
STORM DRAINAGE SYSTEMS, EROSION CONTROL
STORM SEWERS
SCOPE OF WORK

ITEM 1.0 WORK INCLUDED
1.1 The contractor shall furnish all material, equipment, tools, and labor necessary to do the work
as shown on the contract drawings, and unload, haul and distribute all pipe, and accessories.
The contractor shall excavate the trenches and pits to the required dimensions; sheet, brace,
and support the adjoining ground or structures where necessary; handle all drainage or ground
water; provide barricades, guards, and warning lights, lay the pipe; backfill and consolidate the
trenches and pits; remove surplus excavated material; clean the site work, and maintain other

surfaces over the trenches as specified.

ITEM 2.0 MATERIALS

2.1 Pipe shall meet the following requirements:
Reinforced Concrete Pipe (RCP)
Specification: ASTM C-76 Class III or Class IV
Manning's n Value: 0.013
Polyvinyl Chloride Pipe (PVC)
Specification: ASTM D-3034 and F-679 SDR35
ASTM F-794
ASTM F-949
Manning's n Value: 0.008
Aluminized Steel Pipe Type 2
Specification: Ultra Flo or Spiral Rib
ASTM A-929
Manning's n Value: 0.013 (Ultra Flow or Spiral Rib)
0.024 (corrugated)
Galvanized Steel Pipe (Private entrance drives only)
Specification: ASTM A-929
Manning's n Value: 0.027
Annular Corrugated Profile Wall Polyethylene Pipe (PE)
Specification: ASTM F-2306
Manning<s n Value: 0.012
*All pipe must be installed per manufacturer<s specifications.
Pre-cast or cast in place storm water structures shall be cured for a minimum of five (5) days prior to
installation.

ITEM 3.0 CONSTRUCTION

D.2
3.1 No pipe shall be laid until the location has been staked by the engineer.
3.2 A trench shall be excavated and shall be equal to the outside width of the pipe plus 3/10 of the
outside width of the pipe on each side or 12 inches on each side, whichever is greater. The
wall of the trench shall be as nearly vertical as possible. If rock or other unyielding material is
encountered, it shall be excavated and foundation prepared as required under KDOT, Bureau
of Highway, Standard Specification, Section 611.06 through 611.08. In case unstable
foundation is encountered at the established grade, the unstable material shall be removed
and replaced with a suitable material to a width and depth and in a manner that will provide a
uniform and firm foundation. Storm sewers shall not be less than the diameter specified in
Article 3 of the Subdivision Regulations. Manholes or junction boxes may be precast concrete
or masonry. Boxes shall be sized to provide the space of a standard precast manhole and on
concrete footing slab 8 inches thick and walls shall not be less than 8 inches thick.
3.3 In all operations such as placing the pipe, jointing, bedding, and backfilling, care shall be
exercised and in shall be the contractor's responsibility to see that the pipes are not damaged
during the unloading or placement on the bed, or during compaction of the backfill. Any pipe

culvert which is not in true alignment and grade or which shows undue settlement after laying
or is otherwise damaged, shall be taken up and replaced without extra compensation.
3.4 Storm sewer clean-outs shall be provided at a maximum of 400 foot intervals for pipes which
have less than a four (4) foot diameter. Clean-outs may be catch basins, junction boxes or
headwalls.
3.5 Curb drainage inlets and/or catch basins shall be provided at intervals along roadways.
Maximum intervals shall meet the existing Design Standards in the current Subdivision Regulations.

4.0 BACKFILL
4.1 After the pipe is laid, backfill of granular material shall be made to a point 1 foot above the pipe.
The remaining backfill shall be controlled low strength material (CLSM) (flowable fill) or on-site
clayey soils containing no refuse, vegetable or organic matter, rock slavs or boulders, or frozen
material, and shall be placed, compacted, tested for compaction immediately after the granular
backfill. Under no circumstances shall water be permitted to rise in unbackfilled trenches after
the pipe has been placed. For backfill up to the level of 1foot over the top of the pipe, only
selected granular materials shall be used, and backfilling layers not exceeding 6 inches in
depth. The backfill shall be placed simultaneously on both sides of the pipe, and each layer
shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of lateral
displacement.
All trenches within the Public Right of Way shall be, backfilled with controlled low strength
material (CLSM)(flowable fill).
Copies of all testing reports shall be submitted to the appropriate accepting agency.

CATCH BASINS, HEADWALLS & JUNCTION BOX
D.3
1.0 SCOPE OF WORK
1.1 The contractor shall furnish all materials, equipment and labor necessary to construct double
gutter curb inlet catch basins and junction box as shown on the attached plans and detailed
drawings.

2.0 MATERIALS
2.1 Concrete shall comply with the Street Paving Specifications. Precast or cast in place structures shall be a minimum of five (5) days old, prior to paving operation.
NOTE - All inlet headwalls shall have a warning sign that states:

DANGER
HIGH WATER

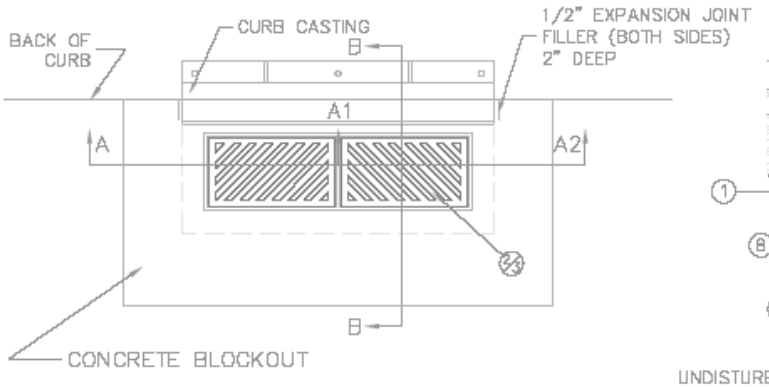
All signs shall be a minimum of 4 inches in height and 8 inches in length and be made of a
reflective material.

CITY OF FLORENCE STORMWATER PROGRAM

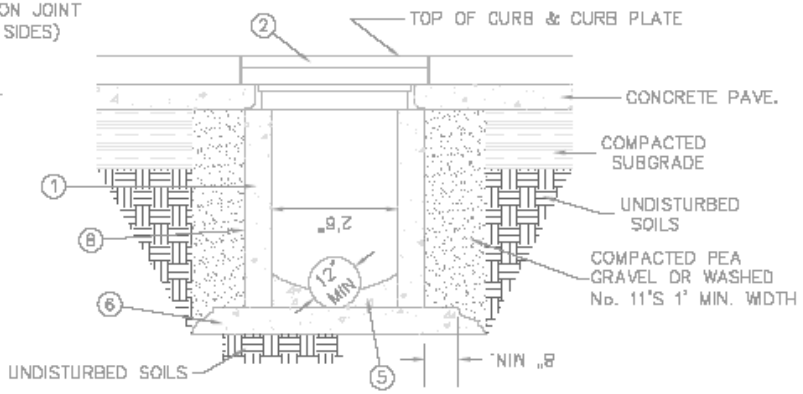
1.0 FLORENCE STORMWATER PROGRAM

1.1 The City of Florence has a comprehensive storm water program. In order to meet applicable storm water requirements, each applicant is advised to contact the Florence Water and Sewer Commission.

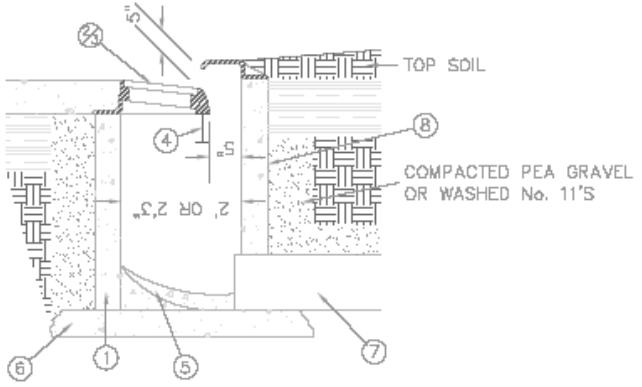
1.2 Request for Review of Detention Credit (see pages 70-76).



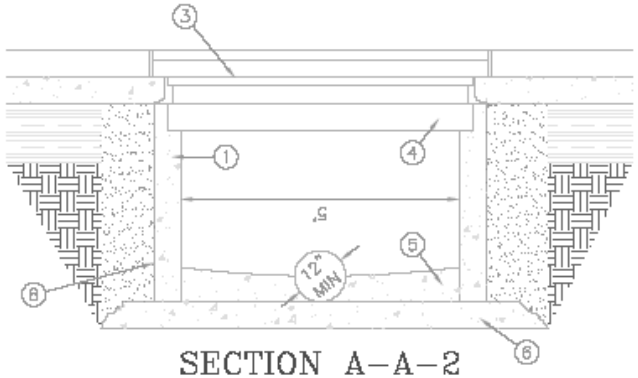
PLAN OF CATCH BASIN



SECTION A–A–1



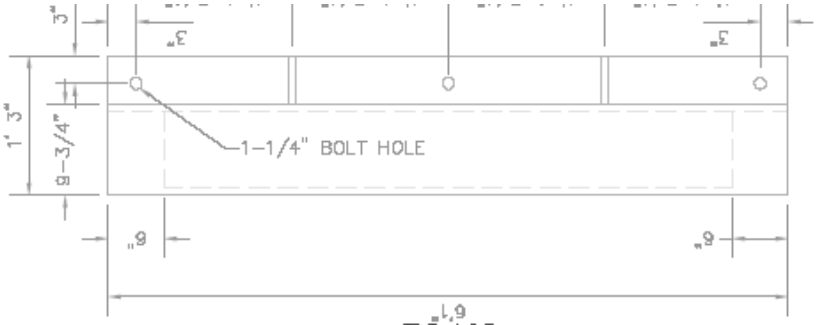
SECTION B–B



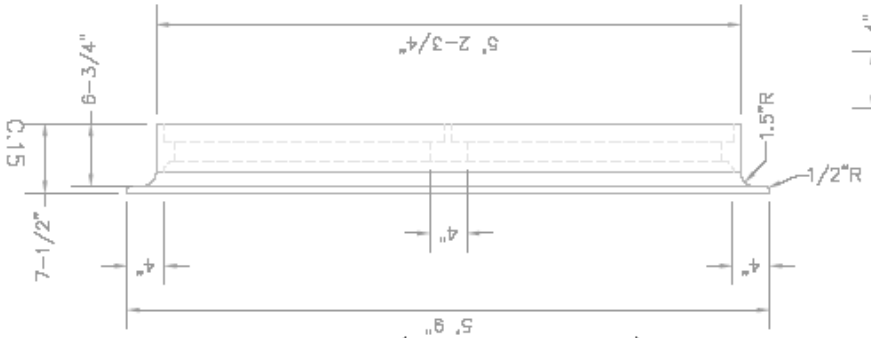
SECTION A–A–2

1. CONCRETE BRICK OR SLAB BLOCK MAY BE USED IN PLACE OF PRECAST OR CAST IN PLACE CONCRETE. SIDEWALLS SHALL BE 6" NOMINAL THICKNESS W/HORIZONTAL REINFORCEMENT EVERY 18 INCHES.
2. SINGLE INLET: FRAME, GRATE AND CURB PLATE – NEENAH R–3289–C OR APPROVED EQUAL.
3. DOUBLE INLET: FRAME, GRATE AND CURB PLATE – NEENAH R–3288–E2 OR APPROVED EQUAL.
4. S–6 X 12.5 X 6' STEEL BEAM (USE WITH SEPARATE OR BOLTED INLETS).
5. 4" MIN. DEPTH 4000 PSI AE CONCRETE WITH SCRIBED INVERT.
6. 6" MIN. DEPTH 4000 PSI AE CONCRETE EXTENDED MIN. 8" BEYOND EXTERIOR OF BOX.
7. 12" MIN. DIA. PIPE (FOR ALL PIPE TYPES AND SIZES SEE SECTION 7.0)
8. LIFT HOLES AND JOINTS SHALL NOT YIELD AN OPENING GREATER THAN THE SIZE OF AGGREGATE BACKFILL.

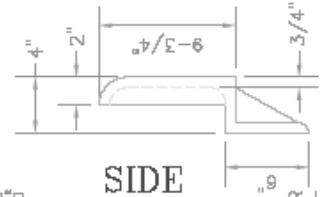
PLAN – DOUBLE



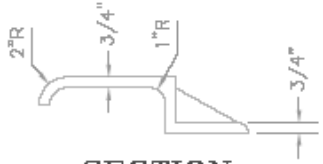
PLAN



FRAME (FRONT VIEW)



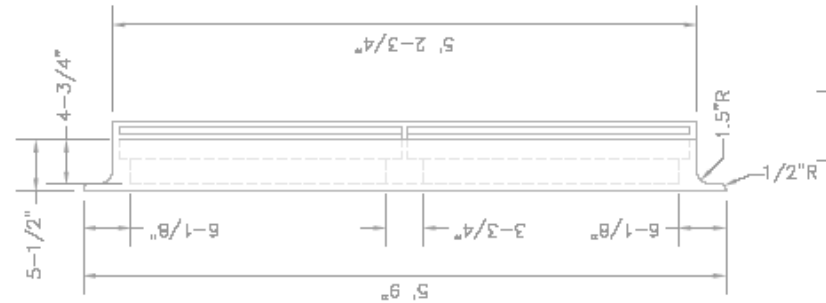
SIDE



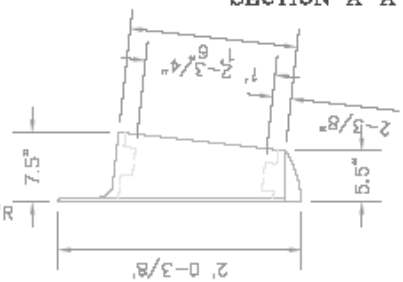
SECTION

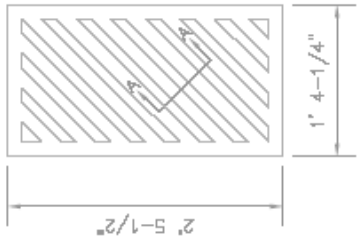
CURB PLATE

SECTION A–A



FRAME (BACK VIEW)

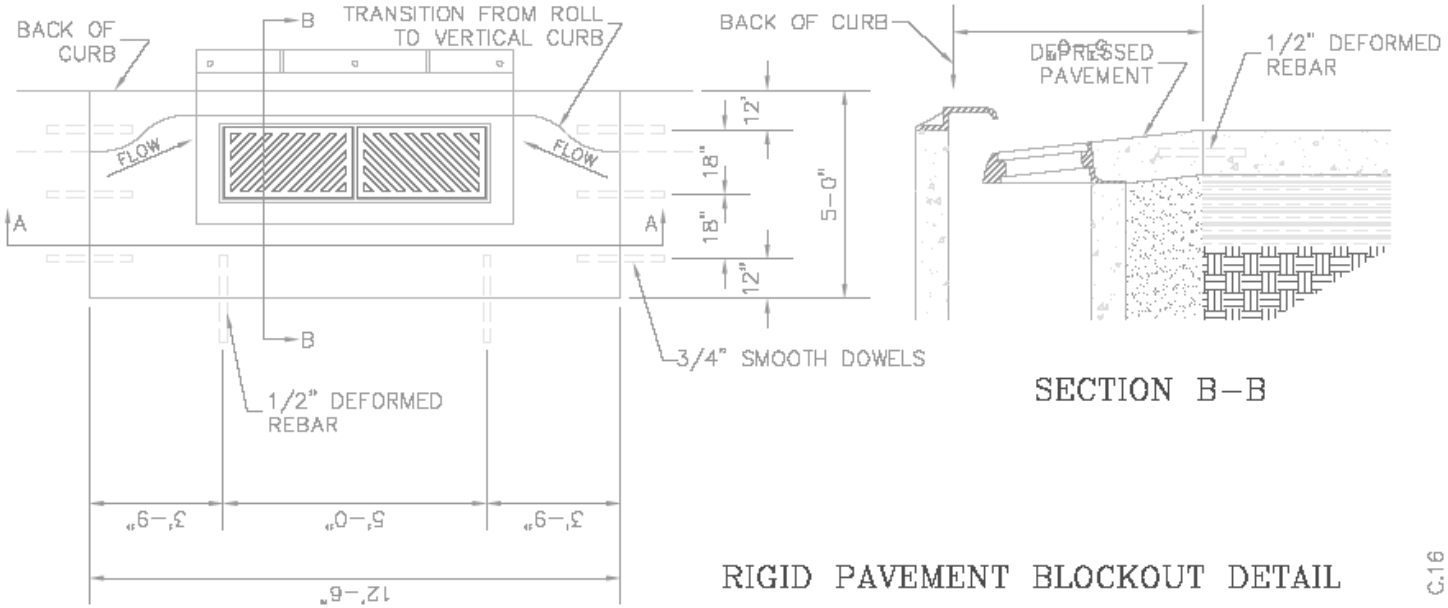




GRATE PLAN

CB CASTING DETAILS – DOUBLE

NOTE: SPECIFICATIONS PER NEENAH R-3288-E OR EQUIVALENT

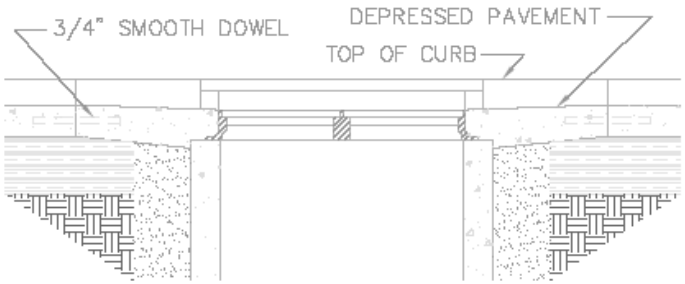


PLAN VIEW

SECTION B–B

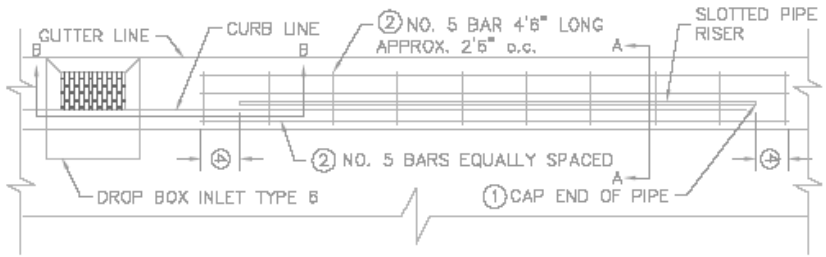
RIGID PAVEMENT BLOCKOUT DETAIL

C.16



SECTION A–A

- BLOCKOUTS SHALL BE PAVED WITH 4000 PSI AIR ENTRAINED PORTLAND CEMENT CONCRETE
- BLOCKOUTS FOR SINGLE INLET CATCH BASINS SHALL BEAR THE SAME DIMENSIONS AS THE DOUBLE INLET CATCH BASIN
- 3/4"X18" DOWELS ARE REQUIRED FOR CONCRETE PAVEMENT OR GUTTER BLOCKOUT – SEE SHEET C–10 FOR DOWEL DETAILS
- TWO 1/2"X18" PIECES OF DEFORMED REBAR ARE REQUIRED ALONG BUTT JOINT OF ISOLATION AREA



PLAN VIEW

① THE CAP SHALL BE A STANDARD MANUFACTURED ITEM FURNISHED BY THE PIPE SUPPLIER.

② ALL REINFORCING STEEL SHALL BE INCLUDED IN THE CONTRACT UNIT PRICE PER LINEAR FOOT OF SLOTTED DRAIN PIPE.

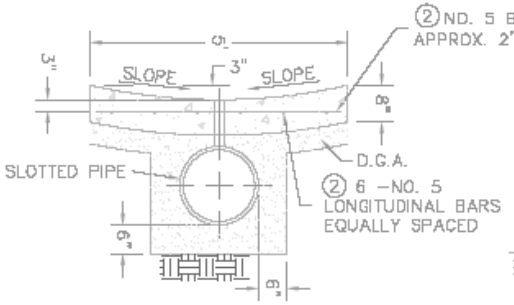
③ USE DROP BOX INLET TYPE 10 WITH VALLEY GUTTER (LIMITED TO 24" METAL PIPE SIZE), OR EQUAL.

④ EXTEND LONGITUDINAL BAR APPROXIMATELY 1'-6" PAST END OF SLOTTED DRAIN PIPE.

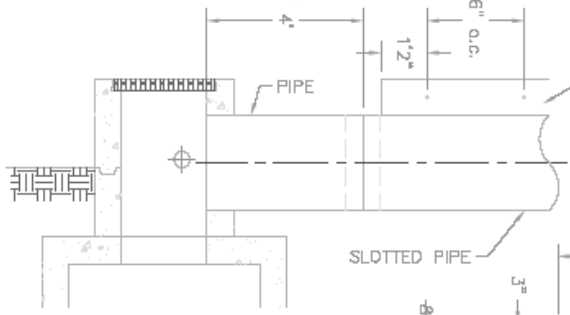
⑤ MINIMUM THROAT DEPTH FOR SLOTTED DRAIN PIPE SHALL BE 10".

⑥ CONTROLLED-LOW-STRENGTH-MATERIAL OR FLOWABLE FILL MAY BE USED FOR BACKFILL.

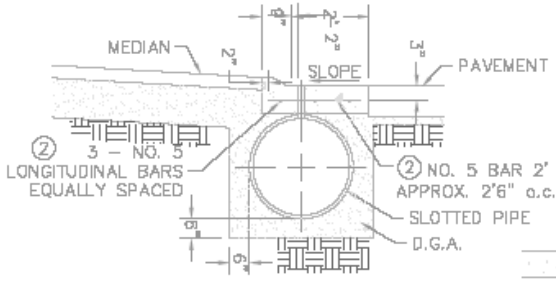
⑦ 12" MINIMUM DIA., 20' MAXIMUM LENGTH.



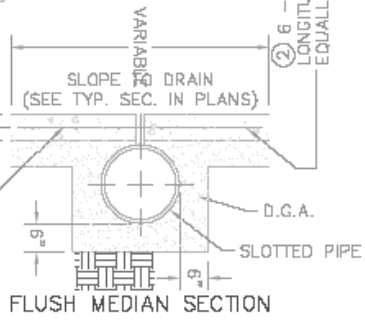
VALLEY GUTTER SECTION ③



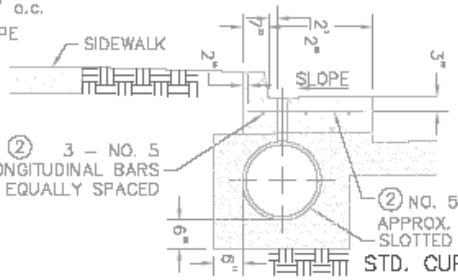
SECTION B-B



SECTION A-A
LIP CURB SECTION



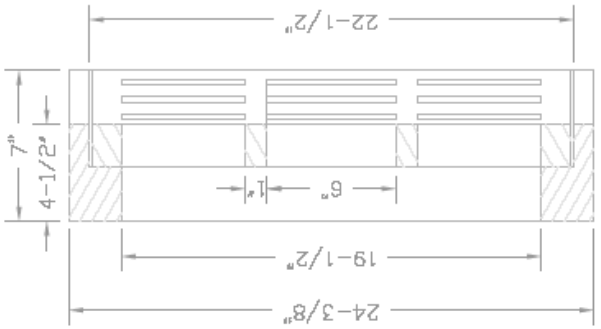
FLUSH MEDIAN SECTION



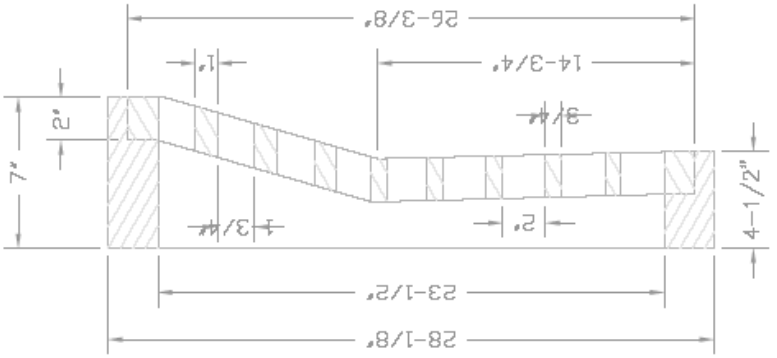
STD. CURB SECTION

SLOTTED DRAIN PIPE

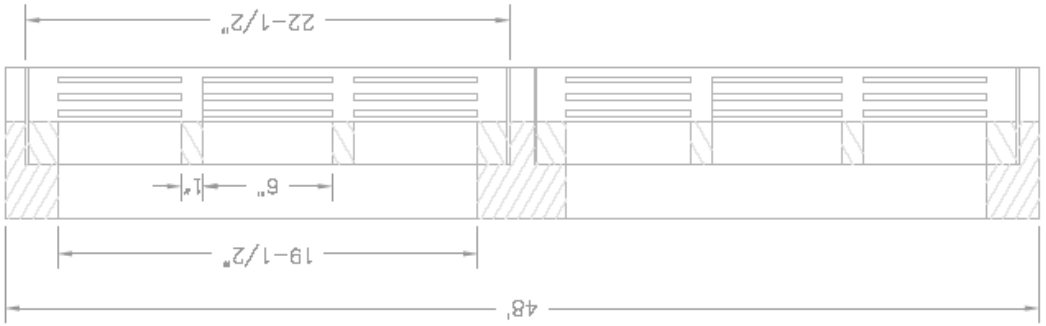
C.17



FRONT SECTION OF R-3516-1
SINGLE UNIT



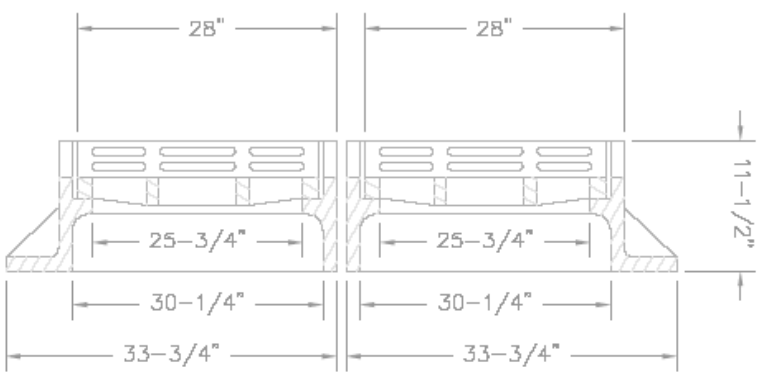
SIDE SECTION R-3516
AND R-3516-1



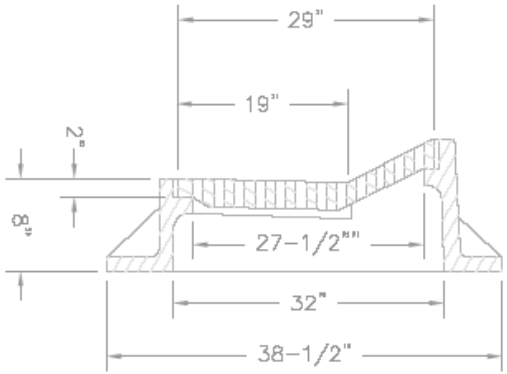
FRONT SECTION OF R-3516
DOUBLE UNIT

C.18

R-3516 INLET FRAME AND DOUBLE GRATE FOR DRIVEWAY AND MOUNTABLE CURB



FRONT SECTION



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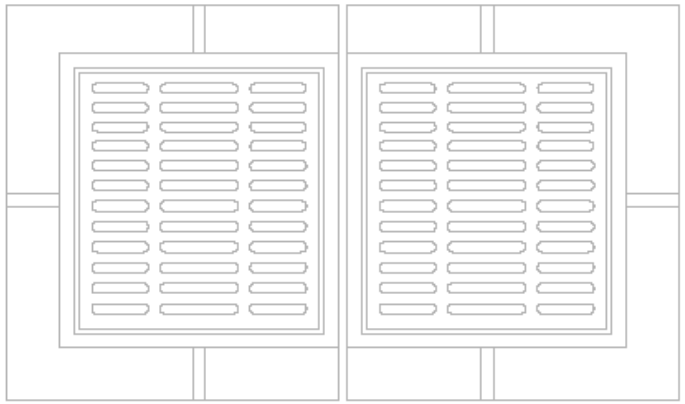
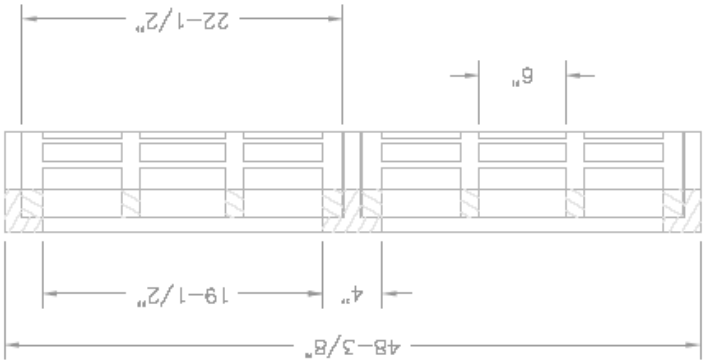


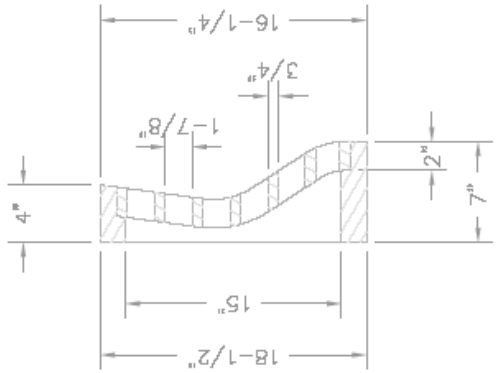
PLAN – DOUBLE SECTION

NOTE: SPECIFICATIONS PER EAST JORDAN IRON WORKS 7391 OR EQUIVALENT

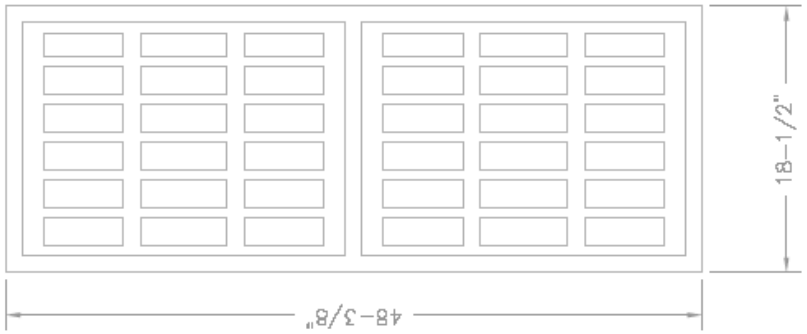
7391 CATCH BASIN CURB INLET



FRONT SECTION – DOUBLE SECTION



SIDE SECTION



PLAN – DOUBLE SECTION

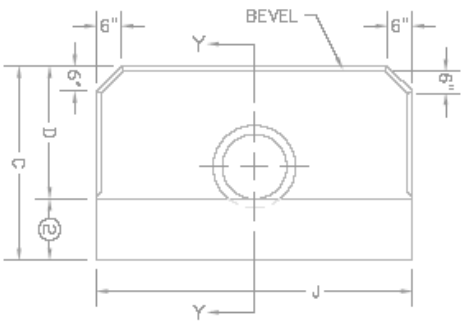
NOTE: SPECIFICATIONS PER NEENAH R-3504-F OR EQUIVALENT

C.20

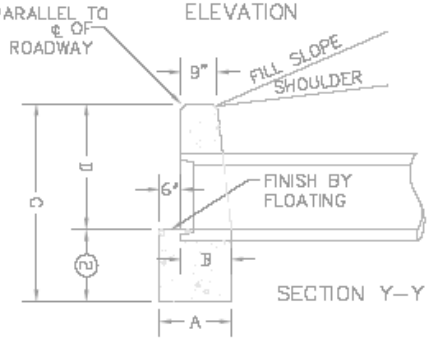
R-3504-F INLET FRAME AND DOUBLE GRATE FOR DRIVEWAY AND MOUNTABLE CURB

CONCRETE HEADWALL

HEADWALL TYPE	DIAMETER OF PIPE	HEADWALL DIMENSIONS									CUBIC YARDS CONCRETE FOR ② ONE HEADWALL	
		A	B	C	D	E	F	G	H①	J	EARTH	ROCK
STANDARD	12"	1'-8"	1'-2"	4'-0"	2'6"	–	–	–	–	6'-0"	1.05	0.87
	15"	1'-8.5"	1'-2.5"	4'-3"	2'-9"	–	–	–	–	6'-9"	1.25	1.03
	18"	1'-9"	1'-3"	4'-6"	3'-0"	–	–	–	–	7'-6"	1.48	1.23
	21"	1'-9.5"	1'-3.5"	4'-9"	3'-3"	–	–	–	–	8'-3"	1.73	1.46
	24"	1'-10"	1'-4"	5'-0"	3'-6"	–	–	–	–	9'-0"	1.99	1.69
RAISED	12"	1'-8"	1'-2"	4'-6"	3'-0"	–	–	–	–	7'-6"	1.45	1.23
	15"	1'-8.5"	1'-2.5"	4'-9"	3'-3"	–	–	–	–	8'-3"	1.69	1.43
	18"	1'-9"	1'-3"	5'-0"	3'-6"	–	–	–	–	9'-0"	1.96	1.67
	21"	1'-9.5"	1'-3.5"	5'-3"	3'-9"	–	–	–	–	9'-9"	2.25	1.93
	24"	1'-10"	1'-4"	5'-6"	4'-0"	–	–	–	–	10'-6"	2.54	2.19
STANDARD ELL	12"	1'-8"	1'-2"	4'-0"	2'-6"	2'-0"	3'-8"	3'-0"	2'-6"	4'-8"	1.19	0.99
	15"	1'-8.5"	1'-2.5"	4'-3"	2'-9"	2'-3"	3'-11.5"	3'-6"	2'-9"	5'-2.5"	1.42	1.19
	18"	1'-9"	1'-3"	4'-6"	3'-0"	2'-6"	4'-3"	4'-0"	3'-0"	5'-9"	1.67	1.41
	21"	1'-9.5"	1'-3.5"	4'-9"	3'-3"	2'-9"	4'-6.5"	4'-6"	3'-3"	6'-3.5"	1.93	1.63
	24"	1'-10"	1'-4"	5'-0"	3'-6"	3'-0"	4'-10"	5'-0"	3'-6"	6'-10"	2.22	1.89
RAISED ELL	12"	1'-8"	1'-2"	4'-6"	3'-0"	2'-9"	4'-5"	3'-9"	3'-3"	5'-5"	1.62	1.37
	15"	1'-8.5"	1'-2.5"	4'-9"	3'-3"	3'-0"	4'-8.5"	4'-3"	3'-6"	5'-11.5"	1.88	1.59
	18"	1'-9"	1'-3"	5'-0"	3'-6"	3'-3"	5'-0"	4'-9"	3'-9"	6'-6"	2.16	1.85
	21"	1'-9.5"	1'-3.5"	5'-3"	3'-9"	3'-6"	5'-3.5"	5'-3"	4'-0"	7'-0.5"	2.47	2.12
	24"	1'-10"	1'-4"	5'-6"	4'-0"	3'-9"	5'-7"	5'-9"	4'-3"	7'-7"	2.79	2.41

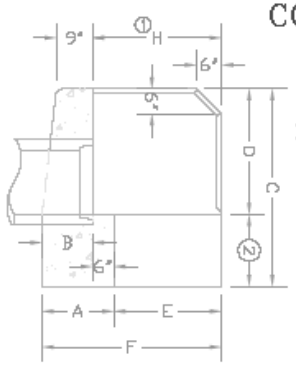


ELEVATION

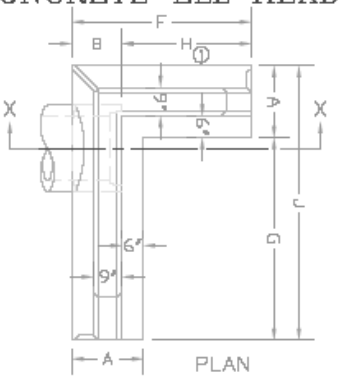


SECTION Y–Y

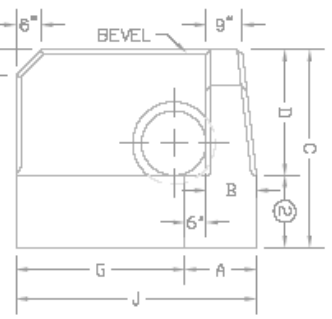
CONCRETE ELL HEADWALL



SECTION X–X



PLAN



ELEVATION

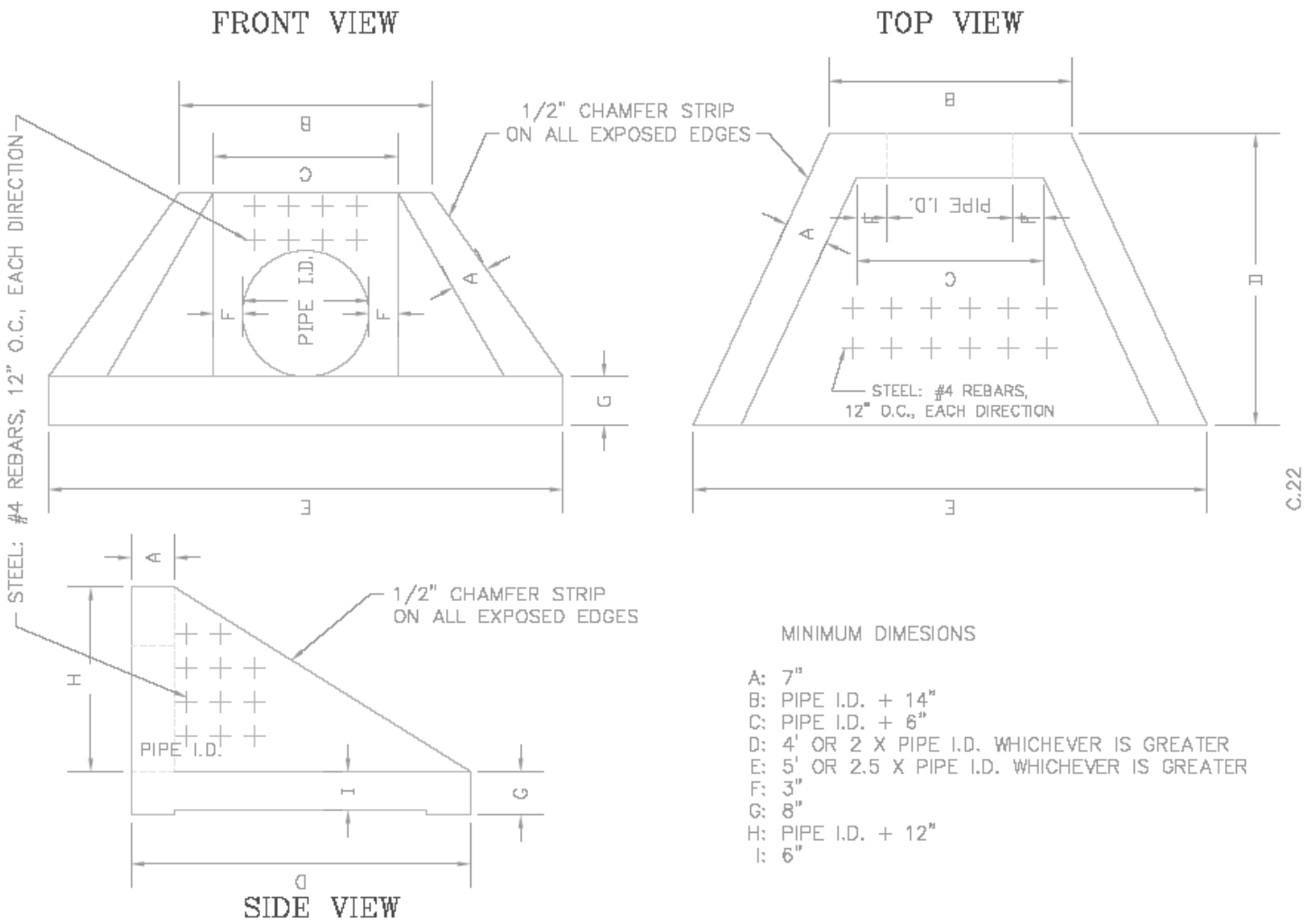
NOTES

CIRCULAR PIPE INCLUDES SLIGHTLY ELLIPTICAL CONCRETE PIPE WITH CIRCULAR REINFORCMENT.

VOLUME DISPLACED BY BARREL OF PIPE HAS BEEN COMPUTED USING INSIDE DIMENSION OF PIPE.

① THE DIMENSION AND/OR THE ANGLE OF INTERSECTION BETWEEN THE WALLS MAY BE VARIED ON CONSTRUCTION.

② VOLUME BASED ON VALUES OF 18" FOR EARTH, 12" FOR ROCK.



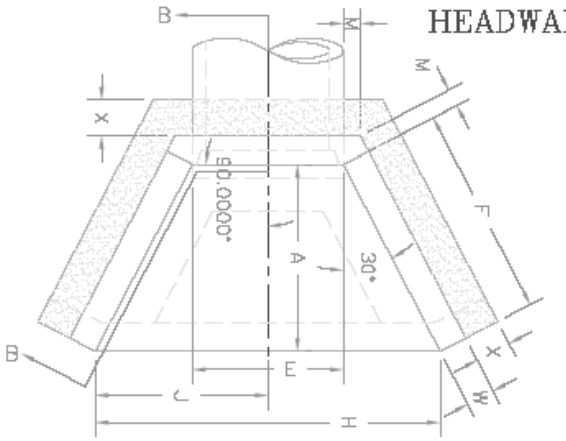
SIDE VIEW

MINIMUM DIMESIONS

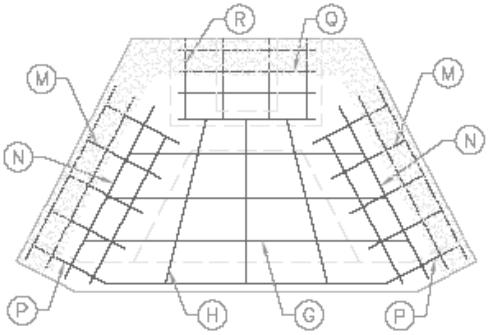
A: 7"
B: PIPE I.D. + 14"
C: PIPE I.D. + 6"
D: 4' OR 2 X PIPE I.D. WHICHEVER IS GREATER
E: 5' OR 2.5 X PIPE I.D. WHICHEVER IS GREATER
F: 3"
G: 8"
H: PIPE I.D. + 12"
I: 6"

HEADWALL DETAIL FOR 12" THRU 36" I.D. PIPE

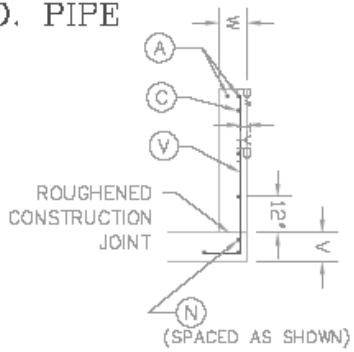
HEADWALL DETAIL 42" THRU 108" I.D. PIPE



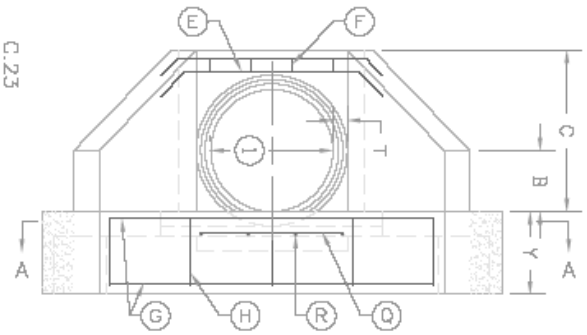
PLAN VIEW



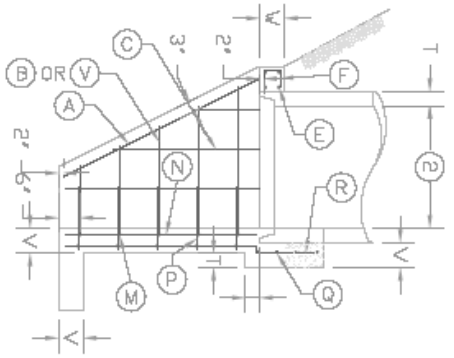
SECTION A–A



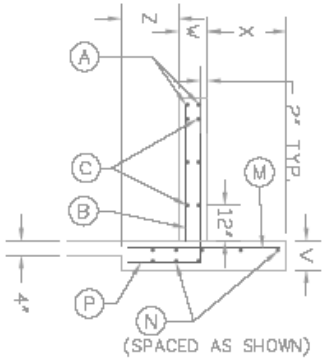
WING SECTION
42" TO 60" CIRCULAR PIPE
42" TO 72" NON–CIRCULAR PIPE



FRONT ELEVATION

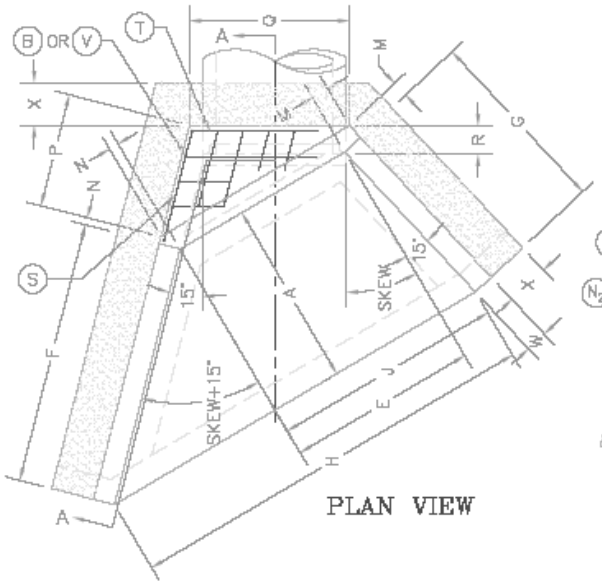


SECTION B–B

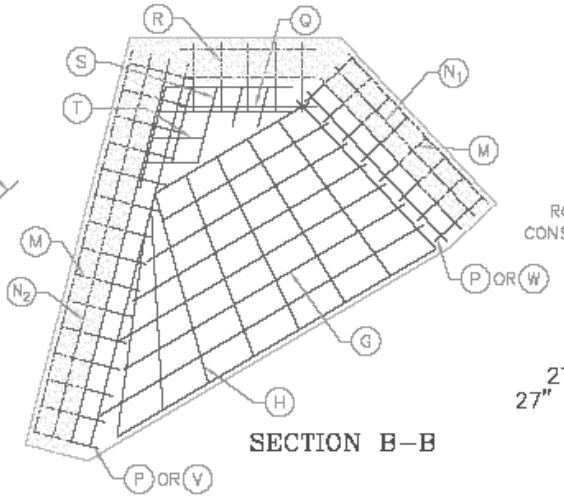


WING SECTION
66" TO 108" CIRCULAR PIPE

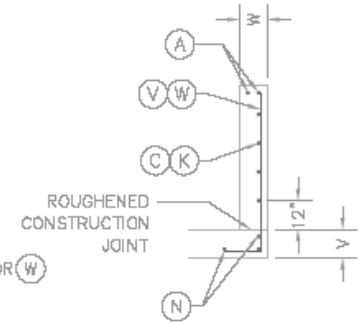
① DIAMETER OF CIRCULAR PIPE OR SPAN OF NON–CIRCULAR PIPE.
② DIAMETER OF CIRCULAR PIPE OR RISE OF NON–CIRCULAR PIPE.
3. [ ] APPLIES TO 66" DIAMETER AND GREATER (CIRCULAR PIPE).
4. SEE CURRENT STANDARD DRAWINGS RDH–200 AND 300 SERIES FOR DIMENSIONS, QUANTITIES, AND BILL OF REINFORCEMENT.
5. DIMENSIONS FROM FACE OF CONCRETE TO STEEL SHALL BE 2" CLEAR DISTANCE.
6. ENCIRCLED LETTERS, Ⓐ, INDICATE STEEL BAR LOCATIONS.
7. BARS Ⓑ, Ⓒ, Ⓖ, Ⓟ, Ⓜ, Ⓥ ARE SPACED 1'–0" O.C. ALL OTHER BARS SHALL BE EVENLY SPACED.
8. BARS Ⓑ AND Ⓥ ARE PLACED IN ORDER OF INCREASING LENGTHS, BEGINNING AT THE TOP OF EACH WING.
9. BARS Ⓒ ARE PLACED IN ORDER OF INCREASING LENGTHS, BEGINNING AT THE TOP OF EACH WING.
10. HEADWALLS LOCATED AT EDGE OF SHOULDER SHALL BE PARALLEL TO CENTERLINE OF THE ROAD.
11. APRON BETWEEN WINGS SHALL BE SLOPED IN DIRECTION OF FLOW EQUAL TO SLOPE OF PIPE. FRONT FACE OF HEADWALL AND ENDS OF WINGS SHALL REMAIN VERTICAL.



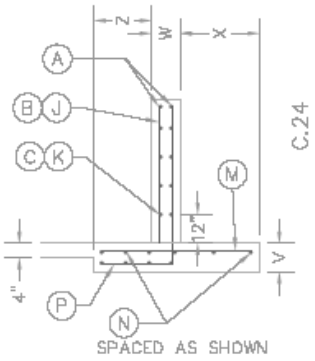
PLAN VIEW



SECTION B–B

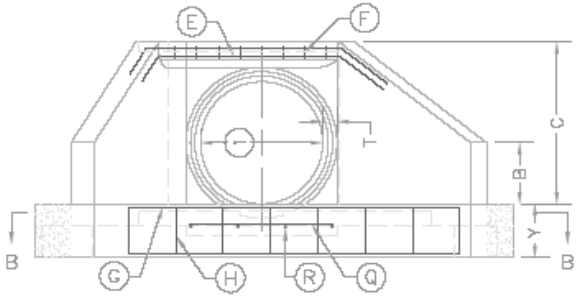


WING SECTION
27" TO 60" CIRCULAR PIPE
27" TO 72" NON–CIRCULAR PIPE

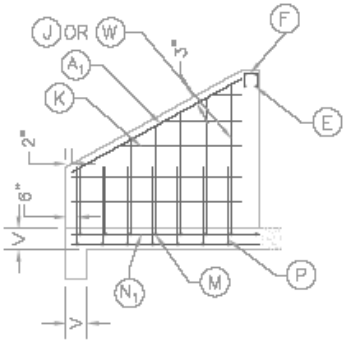


WING SECTION
66" TO 108" CIRCULAR PIPE

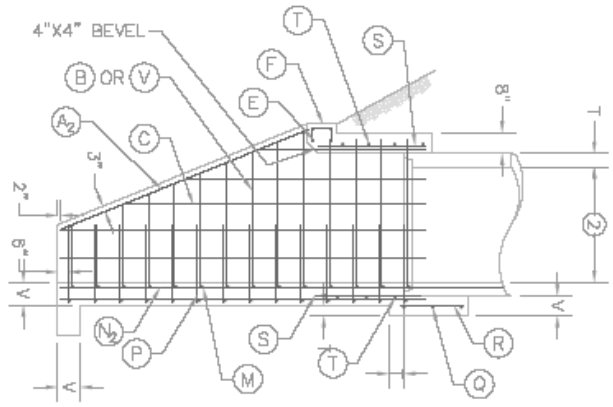
C.24



FRONT ELEVATION



SHORT WING SECTION



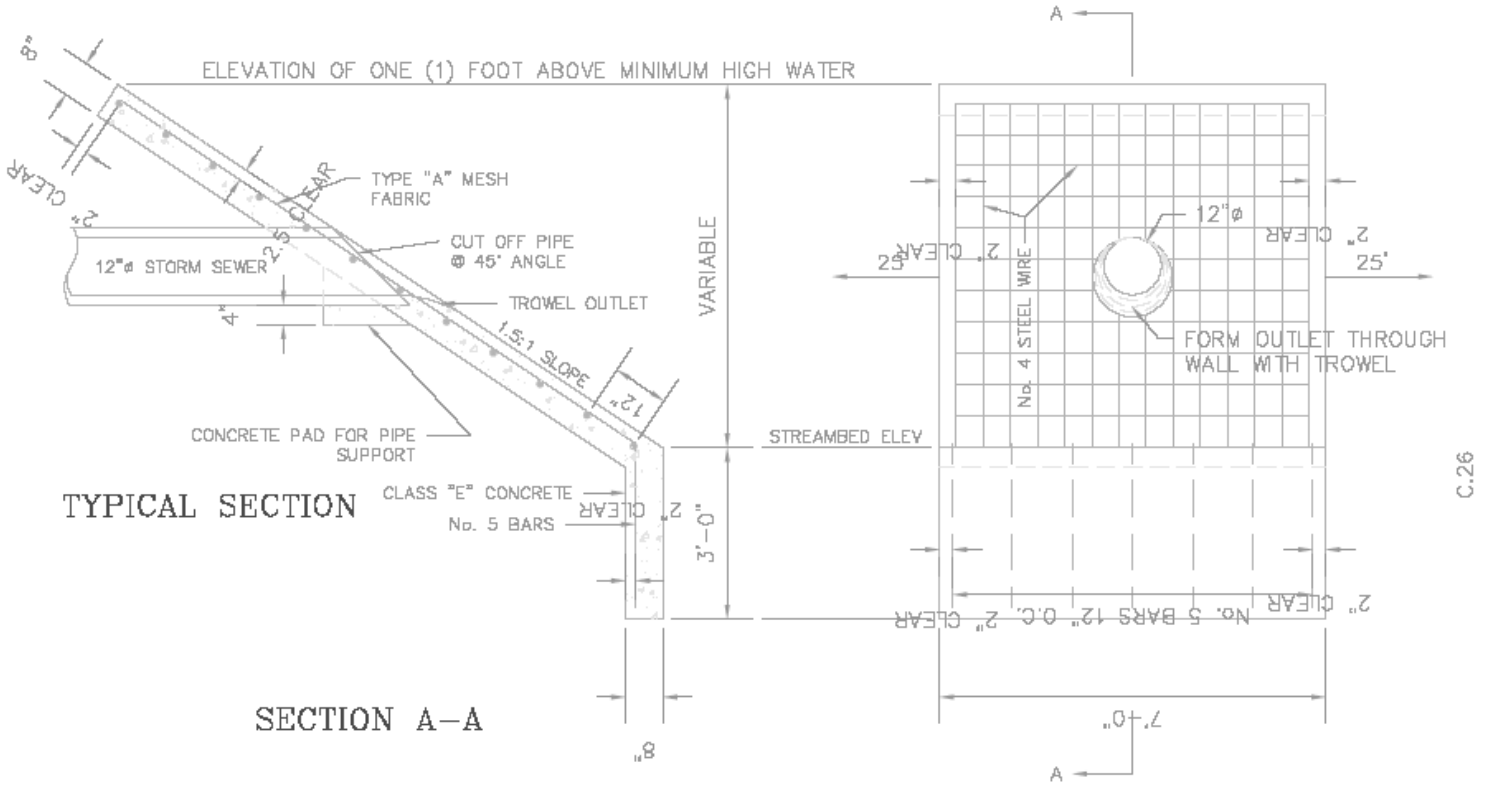
SECTION A–A

C.25

NOTES

1. ① DIAMETER OF CIRCULAR PIPE OR SPAN OF NON–CIRCULAR PIPE.
2. ② DIAMETER OF CIRCULAR PIPE OR RISE OF NON–CIRCULAR PIPE.
3. [redacted] APPLIES TO 66" DIAMETER AND GREATER. (CIRCULAR PIPE)
4. SEE CURRENT STANDARD DRAWINGS RDH–200 AND 300 SERIES FOR DIMENSIONS, QUANTITIES, AND BILL OF REINFORCEMENT.
5. DIMENSIONS FROM FACE OF CONCRETE TO STEEL SHALL BE 2" CLEAR DISTANCE.
6. ENCIRCLED LETTERS, ◯, INDICATE STEEL BAR LOCATIONS.
7. BARS Ⓑ, Ⓒ, Ⓖ, Ⓟ, Ⓜ, Ⓥ ARE SPACED 1'–0" O.C. ALL OTHER BARS SHALL BE EVENLY SPACED.
8. BARS Ⓑ AND Ⓥ ARE PLACED IN ORDER OF INCREASING LENGTHS, BEGINNING AT THE TOP OF EACH WING.
9. BARS Ⓒ ARE PLACED IN ORDER OF INCREASING LENGTHS, BEGINNING AT THE TOP OF EACH WING.
10. HEADWALLS LOCATED AT EDGE OF SHOULDER SHALL BE PARALLEL TO CENTERLINE OF THE ROAD.
11. APRON BETWEEN WINGS SHALL BE SLOPED IN DIRECTION OF FLOW EQUAL TO SLOPE OF PIPE. FRONT FACE OF HEADWALL AND ENDS OF WINGS SHALL REMAIN VERTICAL.

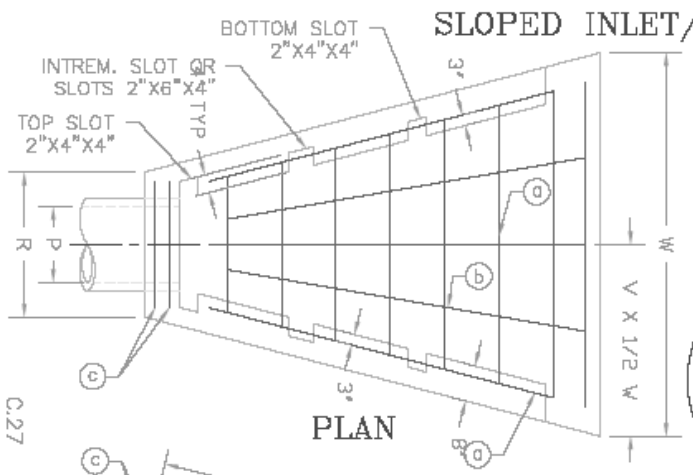
SLOPED HEADWALL



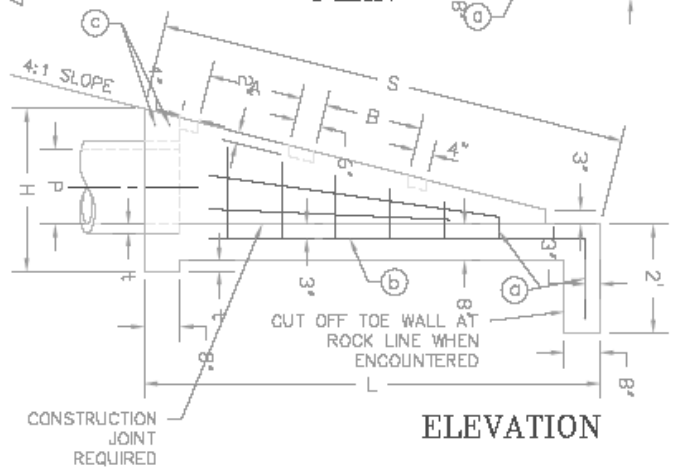
NOTE:

INCREASE WIDTH OF WALL SIX (6) INCHES FOR EACH THREE (3) INCH INCREASE IN DIAMETER OF OUTFALL PIPE.
ALL MESH FABRIC SHALL BE FURNISHED IN FLAT SHEETS.
EDGE TOOL ALL EXPOSED CONCRETE EDGES IN SLOPE WALLS.
GRADE BANK OF STREAM FROM THE HEADWALL SLOPE TO A WARPED SURFACE TO MEET THE EXISTING BANK SLOPE IN TWENTY-FIVE (25) FEET EACH WAY.

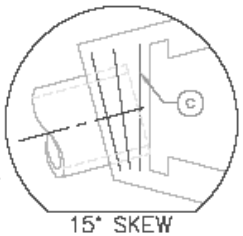
SLOPED INLET/OUTLET



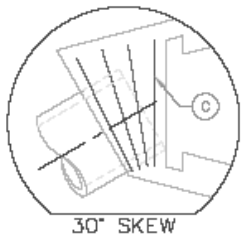
PLAN



ELEVATION

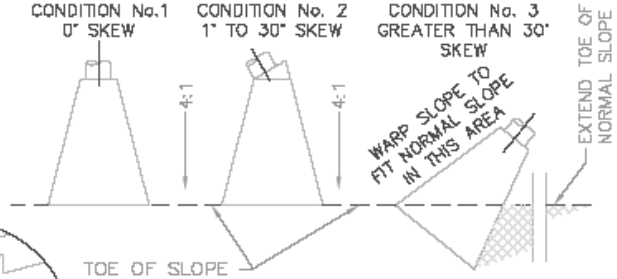


15° SKEW



30° SKEW

PLAN VIEW OF STRUCTURE LOCATIONS



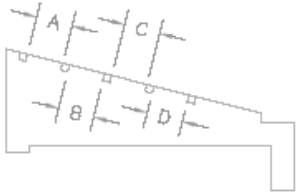
NOTES

THE MINIMUM REQUIREMENT FOR REINFORCING STEEL SHALL BE GRADE 40. FIELD BENDING WILL BE PERMITTED.

(1) ONE ADDITIONAL C BAR WILL BE REQUIRED FOR EACH 15° SKEW.

SEE CURRENT EDITION OF RDB-106.

DETAIL SHOWING LOCATION OF SLOTS FOR GRATES



A,B FOR 2 GRATES
A,B,C FOR 3 GRATES
A,B,C,D FOR 4 GRATES

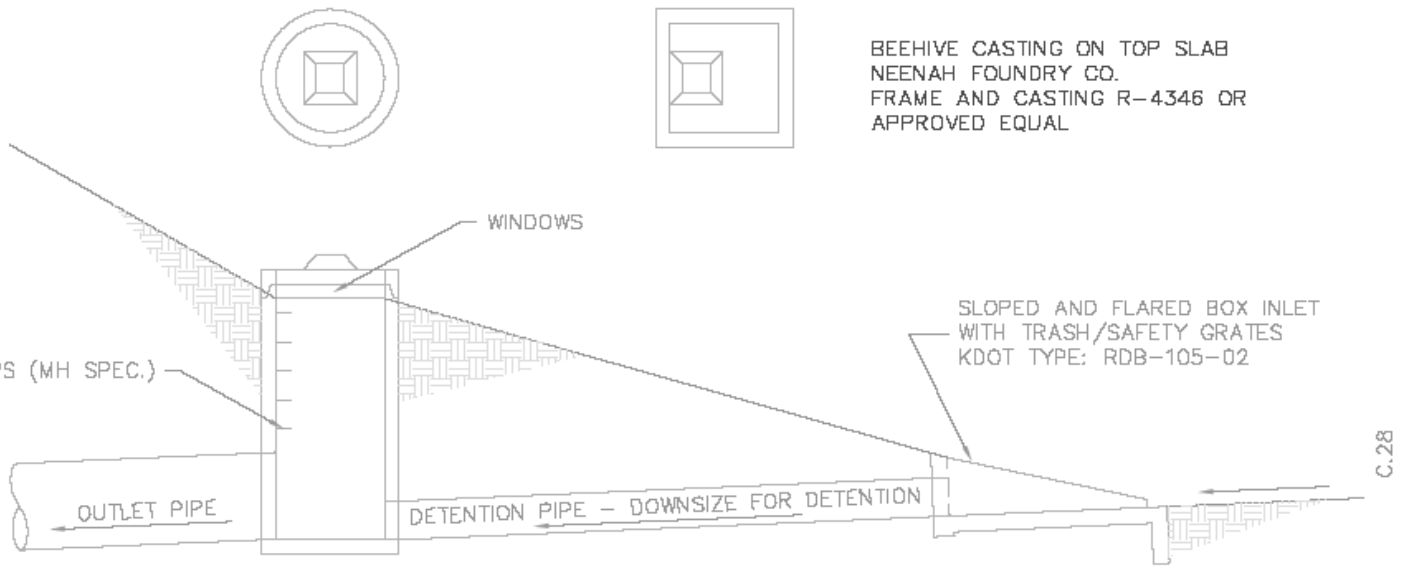
DIMENSIONS										
P	H	L	S	R	V	W	A	B	C	D
18"	3'-0"	8'-6"	8'-9.5"	2'-6.5"	3'-5"	6'-10"	1'-9"	1'-9"	–	–
24"	3'-7"	10'-8"	11'-0"	3'-0.5"	4'-2.5"	8'-5"	2'-9"	2'-9"	–	–
30"	4'-2"	12'-10"	13-2.75"	3'-6.5"	5'-0"	10'-0	2'-9"	2'-9"	1'-9"	–
36"	4'-9"	15'-0"	15'-5.5"	4'-0.5"	5'-9.5"	11'-7"	2'-9"	2'-9"	1'-9"	1'-9"

No. OF GRATES REQ'D.	
2'	3'
2	–
–	2
1	2
2	2

No. 4 REINFORCEMENT BARS NUMBER – LENGTH AND WEIGHT				CLASS A CONC.
ⓐ	ⓑ	① ⓒ	LBS.	CU. YD.
14 @ 6'-0"	3 @ 8'-6"	2 @ 2'-3"	76	1.7
18 @ 7'-6"	3 @ 10'-6"	2 @ 2'-9"	105	2.5
18 @ 9'-0"	3 @ 12'-9"	2 @ 3'-3"	137	3.6
20 @ 10'-8"	3 @ 15'-0"	2 @ 3'-9"	177	4.8

C.27

DETENTION OVERFLOW BOX
4' X 4' CONC. BOX W/ SLAB TOP
OR 4' DIA. MANHOLE WITH SLAB TOP



SAMPLE
DETENTION OVERFLOW BOX WITH SLOPED AND FLARED BOX INLET AND TRASH/SAFETY GRATES