

APPLICATION OF STANDARD PLANS

This book is a compilation of Standard Plans prepared by the Colorado Department of Transportation for use on CDOT construction projects. Others who use the CDOT Standard Plans do so at their own risk.

These Standard Plans are essential contract documents as described in subsection 105.09 of the CDOT Standard Specifications for Road and Bridge Construction book.

Standard Plans that are applicable to a specific project will be identified on the project plans and will not be physically attached to those plans. The designer who specifies any of these Standard Plans for a specific project accepts the responsibility of determining their applicability. Additional information concerning the Standards Plans are available in the CDOT Standard Specifications for Road and Bridge Construction book.

Standard Plans adopted or revised subsequent to the adoption of this book will be listed on the index of the project plans and will be physically included in the plans. The New and Revised Standards Plans may be accessed on the CDOT website here: <https://www.codot.gov/business/designsupport/standard-plans>.

These Standard Plans are adopted for use as of July 31, 2019.

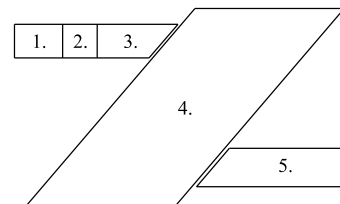
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3. FEDERAL BOULEVARD BRIDGE OVER COLFAX AVENUE | CDOT | 2011 | DENVER, CO.
4. GRAND AVENUE BRIDGE OPENING | CDOT | 2017 | GLENWOOD SPRINGS, CO.
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Computer File Information		Sheet Revisions		Colorado Department of Transportation  2829 West Howard Place CDOT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch JBK	<h2>APPLICATION OF STANDARD PLANS</h2> <p>Issued by the Project Development Branch: July 31, 2019</p>	STANDARD PLAN NO.	
Creation Date: 07/31/19	(R-X)	Date:	Comments:			APPLICATION OF STANDARD PLANS	
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Last Modification Date: 07/31/19	(R-X)					Project Sheet Number:	
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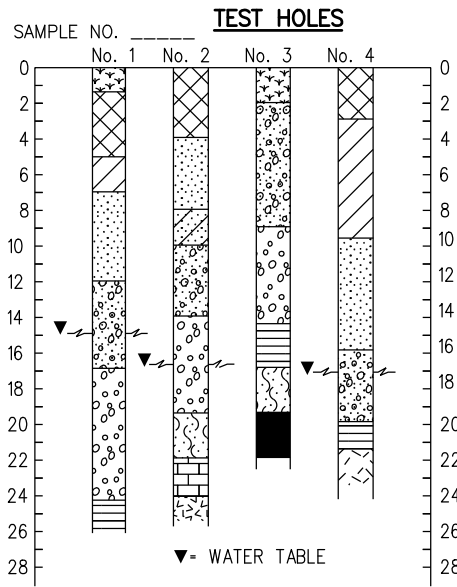
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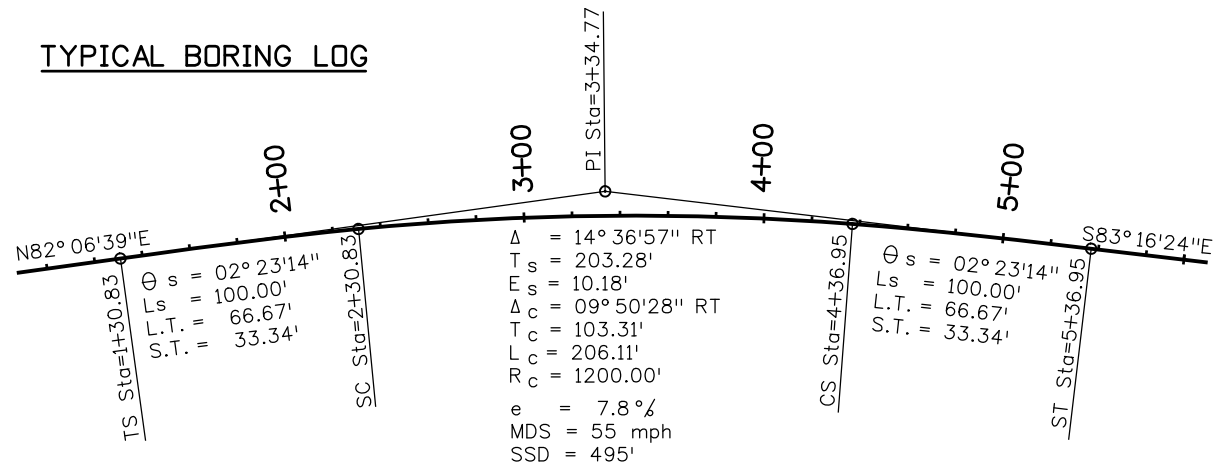
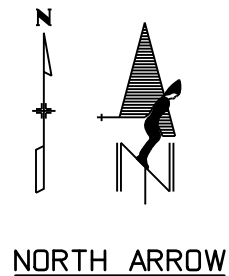
COLORADO
DEPARTMENT OF TRANSPORTATION
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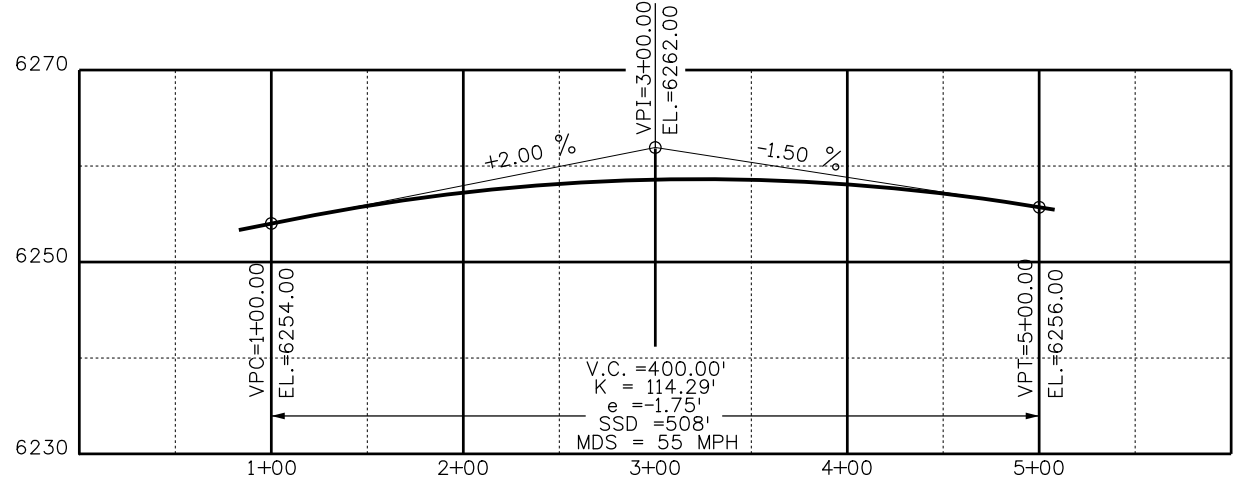
- LEGEND**
- TOPSOIL
 - OVERBURDEN
 - CLAY
 - SILT
 - SAND
 - GRAVEL
 - SHALE
 - LIMESTONE
 - SANDSTONE
 - SOLID ROCK (IGNEOUS)
 - SOLID ROCK (METAMORPHIC)
 - COAL
 - SANDY CLAY
- COMPOSITE MATERIALS ARE REPRESENTED BY COMBINATIONS OF THE ABOVE SYMBOLS, SUCH AS:



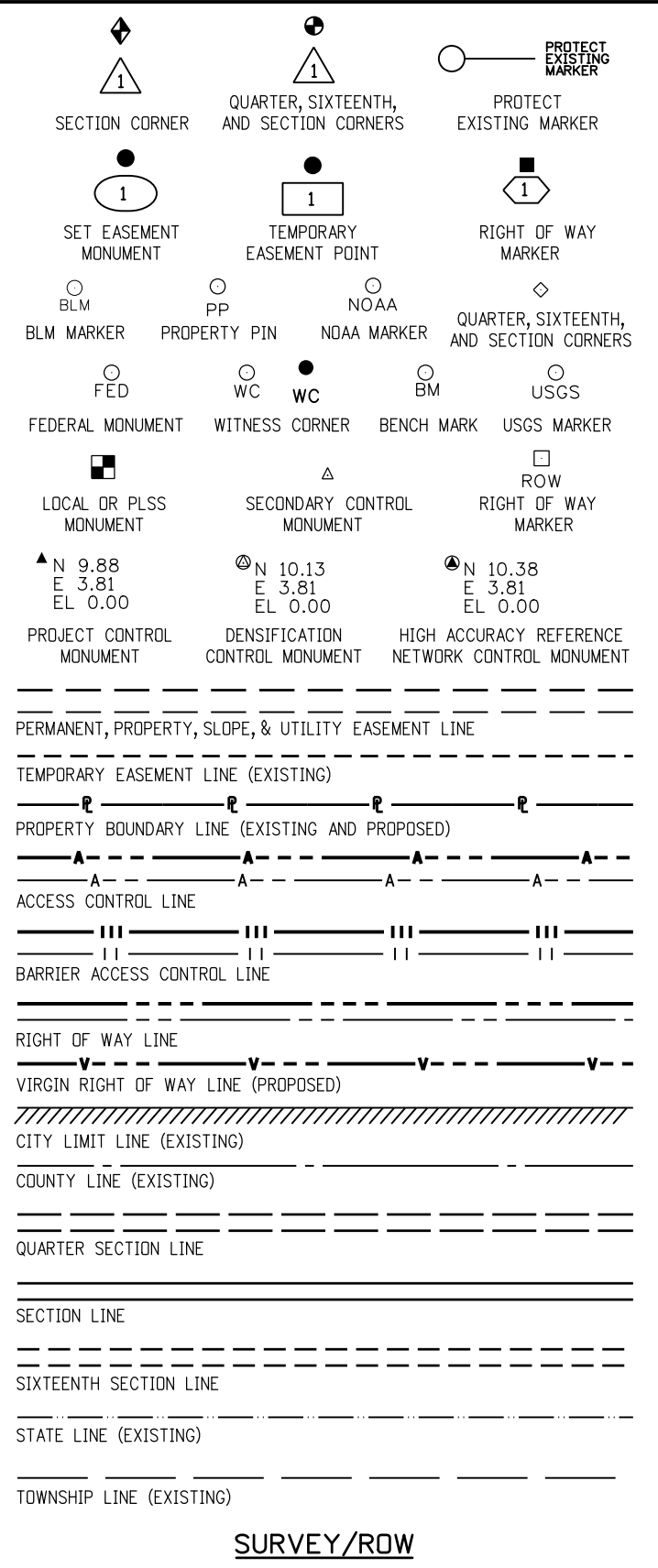
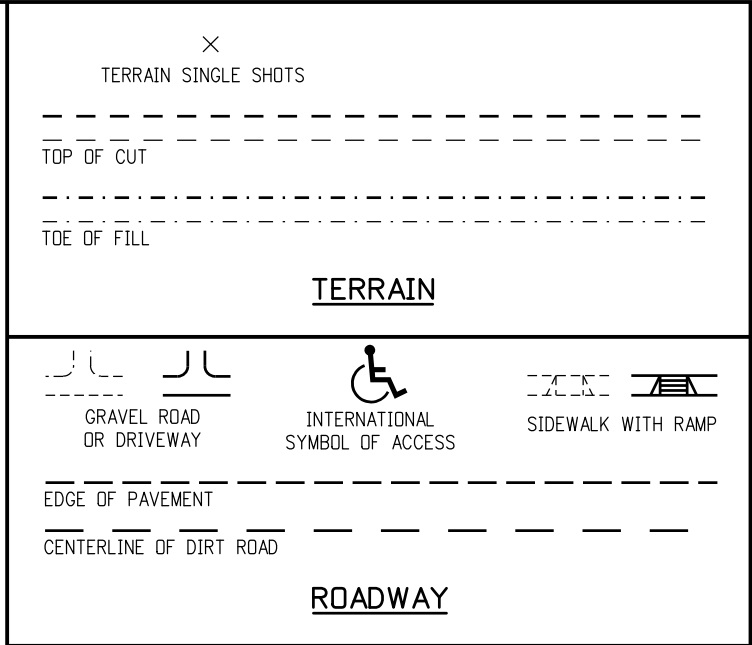
TYPICAL BORING LOG



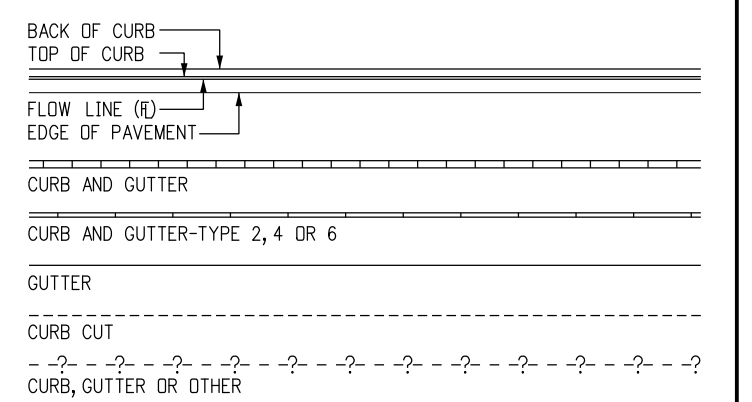
TYPICAL HORIZONTAL CURVE



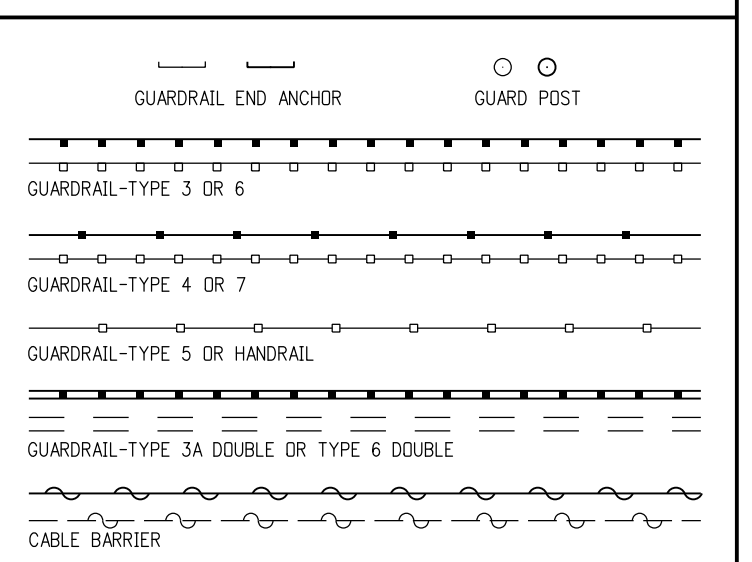
TYPICAL VERTICAL CURVE



- GENERAL NOTES**
- EXISTING FEATURES SHOWN AS SCREENED WEIGHT (LIGHT GRAY SCALE), EXCEPT AS NOTED WITH THE WORD (EXISTING). PROPOSED OR NEW FEATURES SHOWN AS FULL WEIGHT WITHOUT SCREENING, EXCEPT AS NOTED WITH THE WORD (PROPOSED).
 - THESE SYMBOLS ARE INTENDED TO EXPLAIN THE VARIOUS TOPOGRAPHIC FEATURES INVOLVED ON THE DESIGN PLAN SHEETS WHICH ARE PREPARED AT VARIOUS SCALES. NOTES ARE ADDED WHERE NECESSARY TO CLARIFY THE SYMBOL. A LEGEND IS PROVIDED IN THE PLANS FOR SYMBOLS NOT SHOWN ON THE STANDARD SYMBOLS SHEETS.
 - GUARDRAIL, CURB AND GUTTER, ETC., ARE REPRESENTED BY A SYMBOL WITH TYPE GIVEN BY NOTE.



CURB AND GUTTER



GUARDRAIL

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Project Development Branch **JBK**

STANDARD SYMBOLS

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STANDARD PLAN NO.
 M-100-1
 Standard Sheet No. 1 of 3
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ROCK, MASONRY OR MECHANICALLY STABILIZED WALL (FACE)

BRIDGE CURB

BRIDGE RAIL

BRIDGE RAIL-TYPE 3A

FLOW LINE CBC

STRUCTURES MISCELLANEOUS

STRUCTURE

COMBINATION WIRE FENCE WITH GATE

CHAIN LINK FENCE WITH GATE

BARBED WIRE FENCE WITH GATE

SOUND OR BARRIER FENCE WITH GATE

DEER FENCE WITH GATE

WOOD FENCE WITH GATE

SNOW FENCE WITH GATE

PLASTIC FENCE

SILT FENCE

DEBRIS FENCE

FENCE

HAZARD WASTE MONITORING WELL

ENVIRONMENTAL CONCERN SITE

EROSION LOG

ROCK CHECK DAM

CONCRETE WASHOUT STRUCTURE

DROP INLET EROSION PROTECTION

TEMPORARY BERM

SOIL RETENTION BLANKET

PIPE INLET EROSION PROTECTION

RIGID INLET PROTECTION

STORM DRAIN INLET PROTECTION

EROSION CHECK

EROSION LOG DITCH CHECK

SILT DIKE

SEDIMENT TRAP/DEWATERING STRUCTURE

EXISTING WETLAND PATTERN

TEMPORARY SLOPE DRAIN

STABILIZED CONSTRUCTION ENTRANCE

LDA LDA LDA LDA LDA LDA

LIMITS OF DISTURBED AREA

ENVIRONMENTAL CONCERN

HAZARDOUS WASTE SITE

NOXIOUS WEED

FLOW ARROW

ENVIRONMENTAL

METAL CONCRETE

PIPE WITH END SECTION

HEADWALL

PIPE MISCELLANEOUS

PIPES

CHECK DAM UNDER 4 FT

HEADGATE 1

DIVERSION BOX SYMBOL

SPRING SYMBOL

FLOW GAUGE

MISCELLANEOUS WATERWAYS

DITCH WITH FLOW

EDGE OF WATER, CANALS, PONDS, STREAM OR RIVER

DITCHES AND WATERWAY

MISCELLANEOUS BUILDING STRUCTURE (PRIMARY)

MISCELLANEOUS STRUCTURE (SECONDARY)

FOUNDATION OR PAD (CONCRETE OR BLOCK)

BUILDING STRUCTURES

DECIDUOUS TREE

DECIDUOUS SHRUB

TEETER TOTTER SYMBOL

SWING SET SYMBOL

CONIFEROUS TREE

CONIFEROUS SHRUB

MISCELLANEOUS TREES

BENCH

SPRINKLER HEAD

TREES GROVE

HEDGE OR SHRUB GROVE

EDGE OF WETLANDS

LANDSCAPING

RR TELEGRAPH POLE

RR SWITCH

RR GUY POLE

RR SIGNALS WITH OR WITHOUT GATE

RR CROSS BUCK SIGN

RR SIGNAL CONTROLLER CABINET

RR MISCELLANEOUS SYMBOL

RR TRACK CENTERLINE

RAILROAD

INLET TYPE 13

INLET TYPE C

INLET TYPE D

INLET VANE GRATE

INLET TYPE R XX FT LENGTH

STORM SEWER MANHOLE

MANHOLE EXISTING

STORM SEWER MISCELLANEOUS

STORM SEWER PIPE

STORM SEWER PIPE MISCELLANEOUS

STORM SEWER

BOULDER UNDER 6FT

GEOLOGY MISC SYMBOL

MINESHAFT SYMBOL

ROCK OUTCROP

BOULDER FIELD OR ROCK OVERHANG

GEOLOGY

SANITARY SEWER MANHOLE

SANITARY SEWER MISCELLANEOUS SYMBOL

SIZE, MATERIAL, OWNER

SANITARY SEWER PIPE

SANITARY SEWER PIPE MISCELLANEOUS

SANITARY SEWER

WATER SPIGOT

WATER VALVE

WATER MANHOLE

FIRE HYDRANT

WATER METER

WATER WELL SYMBOL

SIZE, MATERIAL, OWNER

WATER LINE

WATER MISCELLANEOUS LINE

WATER

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Project Development Branch **JBK**

STANDARD SYMBOLS

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STANDARD PLAN NO.
M-100-1
 Standard Sheet No. 2 of 3
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A

AAC	Aluminum Arch Culvert
AADT	Annual Average Daily Traffic
ABC	Aggregate Base Course
Abut	Abutment
ACM	Asbestos Containing Materials
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
AE	Architect-Engineer, Architecture, Engineering
AEC	Architecture, Engineering and Construction
AGA	American Gas Association
Alt	Alternate
API	American Petroleum Institute
APL	Approved Products List
Approx	Approximate
APWA	American Public Works Association
AQCC	Air Quality Control Commission
ARE	Additional Requested Element (Design/Build Terminology)
AREMA	American Railway Engineering & Maintenance-of-Way Association
AHSTA	Ahead Station
ARA	Asphalt Rejuvenating Agent
ASBI	American Segmental Bridge Institute
ASD	Allowable Stress Design
ASDP	American Society of Photogrammetry
ASR	Alkali Silica Reactivity
ASSE	American Society of Sanitary Engineering, American Society of Safety Engineers
Asst	Assistant
ATB	Asphalt Treated Base
ATM	Active Traffic Management
AUTS	Actual Ultimate Tensile Strength

B

Bk to Bk	Back to Back
BEI	By Equal Increments
BM	Bench mark
BPF	Blows per Foot
BAFD	Best and Final Offer
Bbl	Barrels
BC	Bolt Circle
Beg	Begin
Bk	Back
Bldg	Building
BLM	Bureau of Land Management

Blvd	Boulevard
BMP	Best Management Practice
BNSF	Burlington Northern & Santa Fe Railroad
Bott	Bottom
BP	Bearing Pressure
Brg	Bearing
Bk Sta	Back Station
BT	Beginning of Transition
Btwn	Between

C

℄	Centerline
C&G	Curb and Gutter
CA	Concrete Arch
CAC	Concrete Arch Culvert
CAD	Computer Aided Design, Computer Aided Drafting
CADD	Computer Aided Design and Drafting
CBC	Concrete Box Culvert
CBG	Concrete Box Girder
CBGC	Concrete Box Girder Continuous
CBGCP	Concrete Box Girder Continuous Prestressed
CBGP	Concrete Box Girder Prestressed
CBGS	Concrete Box Girder Segmented
CBR	California Bearing Ratio
CCR	Code of Colorado Regulations, as amended
CDTPG	Concrete Double-Tee Prestressed Girder
CE	Construction Engineering
CF	Cubic Feet
CFS	Cubic Feet per Second
CG	Center of Gravity
CHP	Colorado Highway Patrol
CI	Cast Iron or Concrete on Rolled I-Beam
CIC	Concrete on Rolled I-Beam Continuous
CICK	Concrete on Rolled I-Beam Continuous & Composite
CICKP	Concrete on Rolled I-Beam Continuous & Composite Prestressed
CIK	Concrete on Rolled I-Beam Composite
CIKP	Concrete on Rolled I-Beam Composite Prestressed
CIP	Cast-in-Place or Cost in Place
CIR	Cold In-Place Recycling
Clr	Clear
cm	Centimeters
CM	Corrugated Metal

CMAQ	Congestion Mitigation Air Quality
CMP	Corrugated Metal Pipe
CMU	Concrete Masonry Unit
CDC	Certificate of Compliance
Col	Column
Comp	Composite
Conc	Concrete
Conn	Connection
Const	Construction
Const Jt	Construction Joint
Cont	Continuous
Corr	Corrugated
CPE	Corrugated Polyethylene Pipe
CPG	Concrete Prestressed Girder (Precast)
CPGC	Concrete Prestressed Girder Continuous (Precast)
CPT	Corrugated Polyethylene Tubing
CR	County Road
CRF	Concrete Rigid Frame
CS	Curve to Spiral, Commercial Standard, Concrete Slab
CSC	Concrete Slab Continuous
CSG	Concrete Slab & Girder (Poured in Place)
CSGC	Concrete Slab & Girder Continuous (Poured in Place)
CSGCP	Concrete Slab & Girder Continuous Prestressed (Poured in Place)
CSGP	Concrete Slab & Girder Prestressed (Poured in Place)
Csk	Countersunk
CSL	Cross Hole Sonic Logging
CSP	Corrugated Steel Pipe or Concrete Slab Prestressed
CSPC	Concrete Slab Prestressed Continuous
CTB	Cement Treated Base
CTR	Certified Test Reports
Ctr	Center
CY	Cubic Yards
CZ	Clear Zone

D

D	Degree of Curvature, or Density
DB	Design Build
DAS	Deformed Anchor Stud
dB	decibels
DBA	Deformed Bar Anchor
Dbl	Double

GENERAL NOTES

- ABBREVIATIONS SHOULD BE UPPER AND LOWER CASE LETTERS EXCEPT WHERE ALL UPPER CASE LETTERS ARE REQUIRED.
Const Jt = Construction Joint
- ACRONYMS SHALL BE ALL UPPER CASE LETTERS.
CBC = Concrete Box Culvert
- ABBREVIATIONS SHALL BE USED ONLY WHEN THE WORDS CANNOT BE COMPLETELY SPELLED OUT DUE TO MULTIPLE FACTORS, SUCH AS A LACK OF SPACE ON THE SHEET.

Deg, °F, °C,	Degrees (Thermal) - Degrees Fahrenheit, Degrees Celsius
Dgn	Design or MicroStation Drawing
DH	Design Height or Avg height for qty calculations
DHV	Design Hour Volume
DHW	Design High Water
DI	Ductile Iron
Dia	Diameter
DNR	Department of Natural Resources
DOW	Division of Wildlife (Colorado)
DRCDG	Denver Regional Council of Governments
DTD	Division of Transportation Development (CDOT)
DTM	Digital Terrain Model
Dwg	AutoCAD Drawing

E

e.g.	Exempli Gratia (For Example)
EA	Environmental Assessment
EATB	Emulsified Asphalt Treated Base
EB	Eastbound
EF	Each Face
Elev	Elevation
Engr	Engineer
EPA	Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer-class rubber
Eq	Equal
ESAL	Equivalent Single Axle Load
Est	Estimate
ET	Ending of Transition
EVT	Event Point (InRoads Terminology)
EW	Each Way
E	Expansion Bearing
Exc	Excavation
Exp Jt	Expansion Joint
Ext	Exterior

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Sheet Revisions

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ACRONYMS AND ABBREVIATIONS

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STANDARD PLAN NO.

M-100-2

Standard Sheet No. 1 of 4

Project Sheet Number:

F

F Fixed Bearing
 FL Flow Line
 FAA Federal Aviation Administration
 FASB Foamed Asphalt Stabilized Base
 FCM Fracture Critical Member
 FDR Full Depth Reclamation
 Fed Federal
 FEMA Federal Emergency Management Agency
 FES Flared End Section
 FF Far Face or Front Face
 Fig Figure
 Fin Finished
 Fl Floor
 Flg Flange
 FM Factory Mutual
 FMM Field Materials Manual
 FPM Feet Per Minute
 FPS Feet Per Second
 FRA Federal Railroad Administration
 Freq Frequency
 FRP Fiber Reinforced Polymer
 FS Planned Finish Surface
 Ft Feet
 Ft Kip Foot Kips
 Ft Lb Foot Pounds
 FTA Federal Transit Administration
 Ftg Footing
 FWD Falling Weight Deflectometer

G

Ga Gage or Gauge
 Gal Gallons
 Galv Galvanized
 Gd Guided expansion bearing
 Gir, G Girder
 GIS Geographical Information System
 GL Girt Line
 GPM Gallons Per Minute
 GPS Global Positioning System
 GRI Geosynthetic Research Institute
 GRS Geosynthetic Reinforced Soil
 GSI Geosynthetic Institute

H

HAS Headed Anchor Stud
 HAZMAT Hazardous Materials
 HC Horizontal Clearance
 HCL Horizontal Control Line
 HCM Highway Capacity Manual
 Hd Head
 HDPE High Density Polyethylene
 HDPP High Density Polypropylene
 Hex Hd Hexagonal Head
 HID High Intensity Discharge (Lamps)
 HIR Hot In-Place Recycling
 HLMR Highload Multi-Rotational
 HMA Hot Mix Asphalt
 Horiz Horizontal
 HDV High-Occupancy Vehicle
 HP Horsepower
 HPC High Performance Concrete
 HS High Strength
 Ht Height
 HW High Water
 Hwy Highway
 Hyd Hydraulic

I

ICEA Insulated Cable Engineers Association
 ID Inside Diameter
 IMP Incident Management Plan
 In. Kips Inch Kips
 In. Lb. Inch Pounds
 In. Inches
 Incl Included
 Int Interior
 Inv Invert
 IRI International Roughness Index
 ISO International Organization for Standards
 ITAA Information Technology Association of America
 ITS Intelligent Transportation System
 IVHS Intelligent Vehicle Highway System

J

JB Junction Box
 JPCP Jointed Plain Concrete Pavement
 Jt Joint

K

Kip Thousand Pounds
 KSF kips per square foot
 KSI Kips per square inch
 KW Kilowatt

L

L Length, Angle (steel)
 Lb Pounds
 Lb/Ft pound per foot
 Lb/SY Pounds per square yard
 Lb-Ft pound foot
 LCCA Life Cycle Cost Analysis
 LED Light Emitting Diode
 LEED Leadership in Energy and Environmental Design
 LF Linear Feet
 LFD Load Factor Design
 LL Liquid Limit
 LLDPE Linear Low-Density Polyethylene
 LRFD Load and Resistance Factor Design
 LS Lump Sum or Length of Spiral
 Lt Left
 LTB Lime Treated Base
 LTDS Required Long Term Design Strength
 Lum Luminaire

M

m Meters
 MA Mobile Attenuator
 Maint Maintenance
 MARV Minimum Average Roll Value
 Matl Material
 Max Maximum
 MBTA Migratory Bird Treaty Act

MFBM Thousand Foot Board Measure
 Mfg Manufactured or Manufacturer
 MHT Method of Handling Traffic
 Mi Mile
 Min Minimum
 Misc Miscellaneous
 mm Millimeters
 MP Milepost
 MPH Miles Per Hour
 MR Resilient Modulus
 MR Modulus of Rupture

N

NAD North American Datum
 NAVD North American Vertical Datum
 NB Northbound, Total Number of Blocks
 NDES Recommended SuperPave™ Gyratory Design Revolution
 NDT Nondestructive Testing
 NECA National Electrical Contractors Association
 NEPA National Environmental Policy Act
 NESC National Electric Safety Code
 NF Near Face
 NFPA National Fire Protection Association
 NGS National Geodetic Survey
 NGVD National Geodetic Vertical Datum of 1929
 NHS National Highway System
 NICET National Institute for Certification of Engineering Technologies
 NIP Nail in Place
 NMAS Nominal Maximum Aggregate Size
 No Number
 Nom Nominal
 NPDES National Pollutant Discharge Elimination System
 NPT National Pipe Thread
 NS Near Side
 NTCIP National Transportation Communications for ITS Protocol
 NTP Notice to Proceed
 NTS Not to Scale

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ACRONYMS AND ABBREVIATIONS

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STANDARD PLAN NO.

M-100-2

Standard Sheet No. 2 of 4

Project Sheet Number:

O

OC On Center
 OD Outside Diameter
 DGFC Open Grade Friction Course
 DJT On-the-Job Trainee or On-the-Job Training
 Opp Hand Opposite Hand
 oz Ounces

P

PC Point of Curve
 PCA Portland Cement Association
 PCBC Concrete Box Culvert Precast
 PCC Point of Compound Curve
 PCCP Portland Cement Concrete Pavement
 PDA Pile Driving Analyzer
 PE Preliminary Engineering, or Professional Engineer or Permanent Easement
 Ped Pedestrian
 PG Profile Grade or Performance Grade
 PGL Profile Grade Line
 PI Point of Intersection
 PL, Pl Plate
 PLS Professional Land Surveyor
 PM Project Manager
 PMBB Plant Mix Bituminous Base
 PMBP Plant Mix Bituminous Pavement
 PMSC Plant Mix Seal Coat
 PDC Point on Curve
 PDSS Point of Slope Selection
 PDT Point on Tangent
 PPE Personal Protective Equipment
 PRC Point of Reverse Curve
 Proj Project or Projection
 psf Pounds per square foot
 psi Pounds per square inch
 PT Point of Tangent
 PTFE Polytetrafluoroethylene
 PTI Post-Tensioning Institute
 PUC Public Utilities Commission
 PVC Poly Vinyl Chloride (pipe), Point of Vertical Curve
 PVI Point of Vertical Intersection
 Pvmt Pavement
 PVT Point of Vertical Tangency

Q

Q Peak Discharge or Flow Volume
 QA Quality Assurance
 QC Quality Control
 QMP Quality Management Plan
 QML Qualified Manufacturers List

R

R Radius
 RA Rubble Arch
 RAC Rubble Arch Culvert
 rad radians
 RAP Reclaimed Asphalt Pavement
 RAS Reclaimed Asphalt Shingles
 RC Reverse Crown
 RCC Roller Compacted Concrete
 RCP Reinforced Concrete Pipe
 RCPC Reinforced Concrete Pipe Culvert
 Rdwy Roadway
 RE Resident Engineer or Railroad Easement
 Ref Reference
 Reinf Reinforcing
 Rem Remove or Removal
 Repl Replace
 Req Required
 Rev Revised, Revision
 RG Riveted Plate Girder
 RGC Riveted Plate Girder Continuous
 RL Reinforcement Length
 RME Region Materials Engineer
 rpm Revolutions Per Minute
 RSC Rigid Steel Conduit
 RSS Reinforced Soil Slope
 Rt Right
 RTD Region Transportation Director or Regional Transportation District
 RWIS Road Weather Information System

S

SA Steel Arch
 SAC Steel Arch Culvert
 San Sanitary
 SB Southbound
 SBA Small Business Administration
 SBG Steel Box Girder
 SBGC Steel Box Girder Continuous
 SC Spiral to Curve
 Sch Schedule
 SCS Spiral Curve Spiral
 SDG Steel Deck Girder
 SDGC Steel Deck Girder with Floor Beam System
 SDGCK Steel Deck Girder Continuous & Composite
 SDI Steel Decks Institute
 SDT Steel Deck Truss
 Sdwk Sidewalk
 Sect Section
 SF Square Feet
 SH State Highway
 Shldr Shoulder
 SHPD State Historic Preservation Office
 SHRP Strategic Highway Research Program
 Sht Sheet
 SIGN Overhead Sign
 SIGNB Overhead Sign-Butterfly
 SIGNC Overhead Sign-Cantilever
 SIGND Overhead Sign + Cantilever
 Sim Similar
 SIP Stay in Place
 SJI Steel Joists Institute
 SLT Steel Low Truss
 SMA Stone Matrix Asphalt
 SN Structural Number
 Spa Spaces or Spaced
 Specs Specifications
 SpG Specific Gravity
 Spl Splice
 Sq In Square Inches
 Sq Mi Square Miles
 Sq Square

SRW Segmental Retaining Walls
 SSE Steel Stringer-Earth Filled
 SSM Steel Stringer-Metal Plank Deck
 SSMC Steel Stringer-Metal Plank Deck Continuous
 SSPC Society for Protective Coatings
 SSS Steel Stringer-Timber Deck
 SSSC Steel Stringer-Timber Deck Continuous
 ST Spiral to Tangent
 St Straight or Street
 Sta Station
 Std Standard
 STG Steel Thru Girder
 Str Structure, Structural
 STT Steel Thru Truss
 SUSP Suspension Bridge
 SY Square Yards
 Sym Symmetrical

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ACRONYMS AND ABBREVIATIONS

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STANDARD PLAN NO.

M-100-2

Standard Sheet No. 3 of 4

Project Sheet Number:

T

T&B	Top and Bottom
T&E	Threatened & Endangered Species
T	Tons
TAS	Threaded Anchor Stud
TBC	Timber Box Culvert
TC	Tangent to Curve
TCD	Traffic Control Devices
TCP	Traffic Control Plan
TD	Timber Stringer (Untreated) Concrete Deck
TDH	Total Dynamic Head
Temp	Temporary or Temperature
Thd	Thread
THHN	Thermoplastic High Heat-resistant Nylon coated (Insulation designation for wire)
THWN	Thermoplastic High Water-resistant Nylon coated (Insulation designation for wire)
TIG	Tungsten Inert Gas (Welding)
TLA	Timber Laminated Arch (Gluelam)
TLS	Timber Laminated Stringer (Gluelam)
TLT	Timber Low Truss
TM	Timber Stringer (Untreated) Metal Deck
TMP	Transportation Management Plan
Tot	Total
TPI	Threads per Inch
TS	Tangent to Spiral, Timber Stringer (Untreated) Timber Deck
TSLAB	Timber Slab
TTC	Timber Culvert
TTD	Timber Stringer-Concrete Deck
TTM	Timber Stringer- Metal Deck
TTS	Timber Stringer- Timber Deck
TTT	Timber Thru Truss
TUNC	Tunnel-Concrete Lined
TUNR	Tunnel-Thru Rock-No Lining
Typ	Typical

U

UG	Underground
UNC	Uniform National Coarse (screw thread)
UNCC	Utility Notification Center of Colorado
UNF	Uniform National Fine (screw thread)
UNO	Unless Noted Otherwise
UPRR	Union Pacific Railroad
UPS	Uninterruptible Power Supply
USACE	United States Army Corp of Engineers
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USDDT	United States Department of Transportation
USFWS	United States Fish and Wildlife Service
USGS	US Geological Survey
Util	Utility or Utilities
UV	Ultraviolet

V

VC	Vertical Curve
VCP	Vitrified Clay Pipe
Veh	Vehicle
Vert	Vertical
VFA	Voids Filled With Asphalt
VMA	Voids in the Mineral Aggregate
VMS	Variable Message Sign
Vol	Volume
VPC	Vertical Point of Curvature
VPI	Vertical Point of Intersection
VPT	Vertical Point of Tangency

W

W/C	Water-Cement Ratio
WALL	Retaining Wall
WB	Westbound
WBS	Work Breakdown Structure
WF	Wide Flange (Steel section)
WG	Welded Girder
WGC	Welded Girder Continuous
WGCK	Welded Girder Continuous & Composite
WGCKP	Welded Girder Continuous, Composite Prestressed
WGK	Welded Girder Composite
WGKP	Welded Girder Composite Prestressed
WIMS	Weigh-In-Motion Station
WP	Work Point
WQCD	Water Quality Control Division (Colorado Department of Public Health and Environment)
WRI	Wire Reinforcement Institute
WS	Water Surface
WSN	Weighted Structural Number
Wt	Weight
WWF	Welded Wire Fabric, typically referred to very light gauge wire for crack control
WWR	Welded Wire Reinforcement

Y

Yd	Yard
----	------

SYMBOLS

400	#4 REBAR BENDING SHAPE
500	#5 REBAR BENDING SHAPE
600	#6 REBAR BENDING SHAPE
@	at
&	and
φ ∅	Diameter
°, ', "	Degrees, Minutes, Seconds
', "	Feet, inches
#	Number or Pound
ⓔ	Epoxy Coated Rebar
Ⓝ	Non-Epoxy Coated Rebar
ⓧ	Girder Label
°F	Fahrenheit
°C	Celsius
≈	Approximate
Ⓢ	Interstate Highway
Ⓡ	US Highway
Ⓢ	State Highway

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ACRONYMS AND ABBREVIATIONS

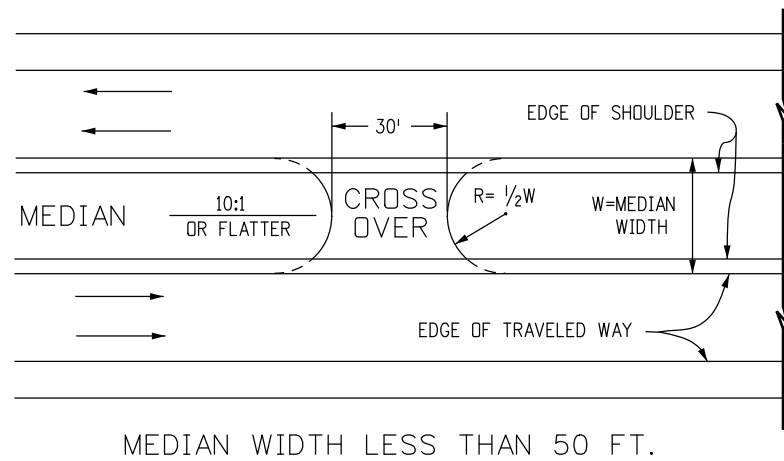
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

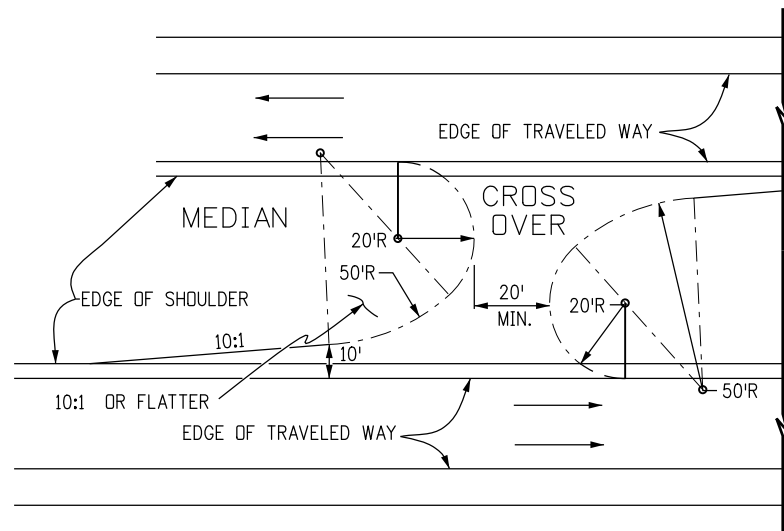
M-100-2

Standard Sheet No. 4 of 4

Project Sheet Number:



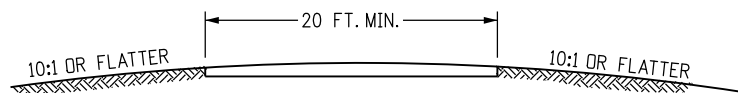
MEDIAN WIDTH LESS THAN 50 FT.



MEDIAN WIDTH GREATER THAN 50 FT.

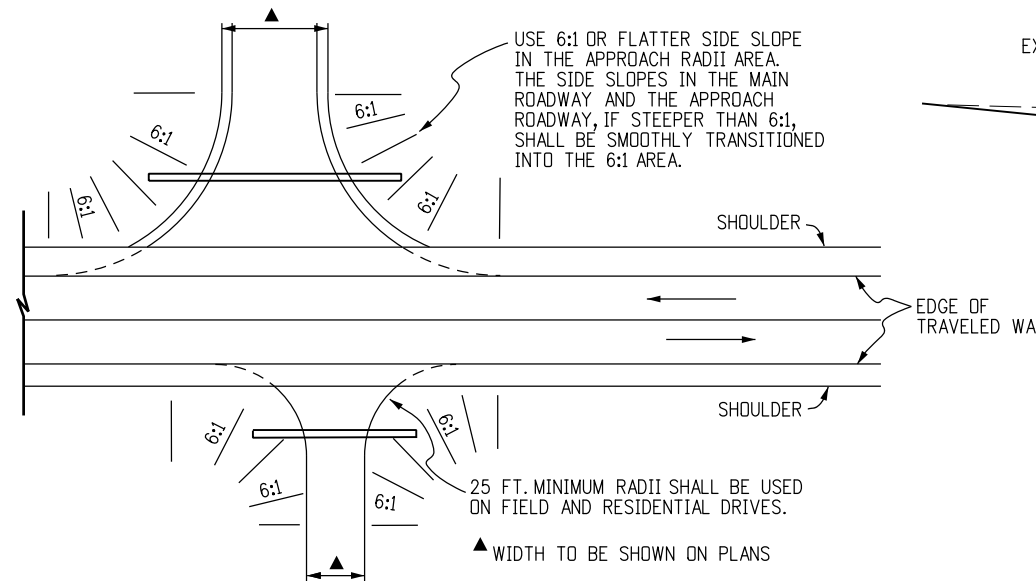
TYPICAL PLANS FOR EMERGENCY MEDIAN CROSS OVER

LOCATION OF RADIUS POINTS MAY BE ADJUSTED FOR BEST FIT



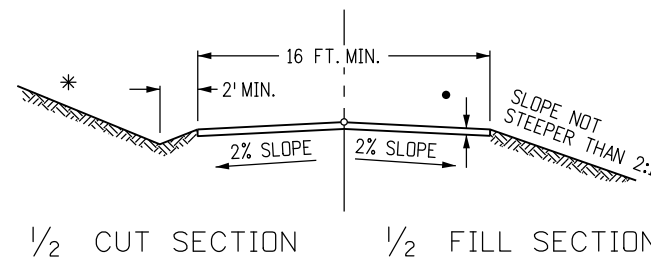
TYPICAL SECTION FOR MEDIAN CROSS OVER

ANY REQUIRED PIPE OR INLET FOR MEDIAN DRAINAGE SHALL HAVE A TRAVERSABLE DESIGN AS SPECIFIED ON THE PLANS



SIDE DRAINS SHALL BE LOCATED BEYOND THE CLEAR ZONE, OR WHEN WITHIN THE CLEAR ZONE, THEY SHALL BE INSTALLED WITH END SECTIONS CONFORMING TO A 6:1 SLOPE. FIFTY FT. RADII SHALL BE USED ON INTERSECTING ROADS, EXCEPT FOR FIELD AND RESIDENTIAL DRIVES OR UNLESS OTHERWISE SPECIFIED ON PLANS. RADII MAY BE VARIED TO SUIT FIELD CONDITIONS.

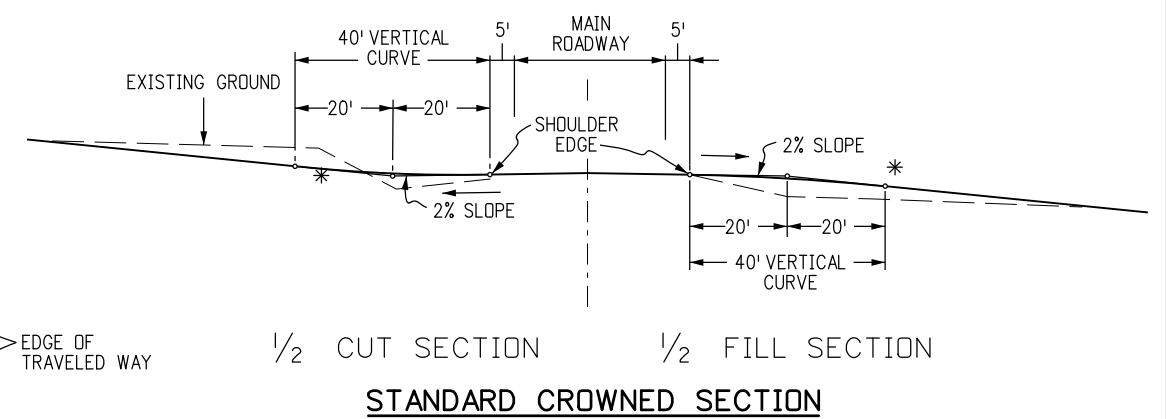
TYPICAL PLANS FOR SIDE APPROACH ROAD



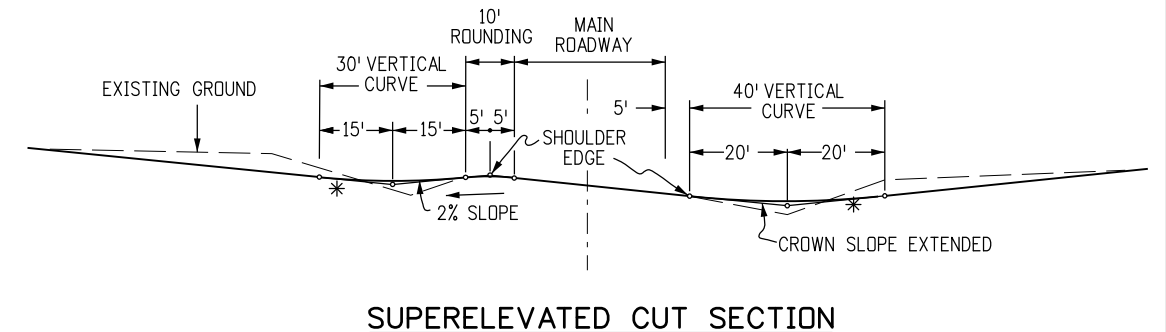
TYPICAL SECTION FOR APPROACH (ACCESS) ROAD

NOTE: ROAD APPROACHES WHICH REQUIRE HMA (ASPHALT) PAVEMENT SHALL BE PLACED AT THE FOLLOWING DISTANCES BACK FROM THE ROADWAY EDGE OF PAVEMENT:

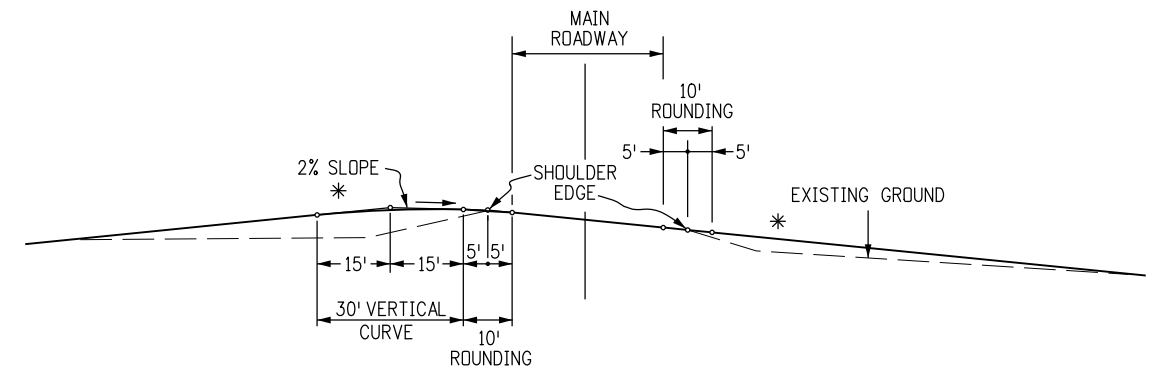
1. RESIDENTIAL OR AGRICULTURAL FIELD ENTRANCES - PAVE 4 FEET BACK.
2. THREE OR MORE RESIDENCES OR COMMERCIAL PROPERTY - PAVE 20 FEET BACK OR TO ROW LINE, WHICHEVER IS LESS.
3. PUBLIC STREET - PAVE 50 FEET BACK OR TO ROW LINE, WHICHEVER IS LESS.
4. IF EXISTING ACCESS IS PAVED, THEN FEATHER NEW ASPHALT OVERLAY A MINIMUM OF 2 FEET BACK OR AS DIRECTED BY THE ENGINEER.



STANDARD CROWNED SECTION



SUPERELEVATED CUT SECTION



SUPERELEVATED FILL SECTION

VERTICAL ALIGNMENT SIDE APPROACH ROADS INTERSECTING MAIN ROADWAY

* TANGENT SLOPE NOT STEEPER THAN 8% BEYOND THE VERTICAL CURVE. THE SLOPE MAY BE STEEPER, IF REQUIRED, TO MEET EXISTING APPROACH SLOPE. HOWEVER, APPROACH ROAD SLOPE SHOULD NOT BE STEEPER THAN EXISTING SLOPE.

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APPROACH ROADS

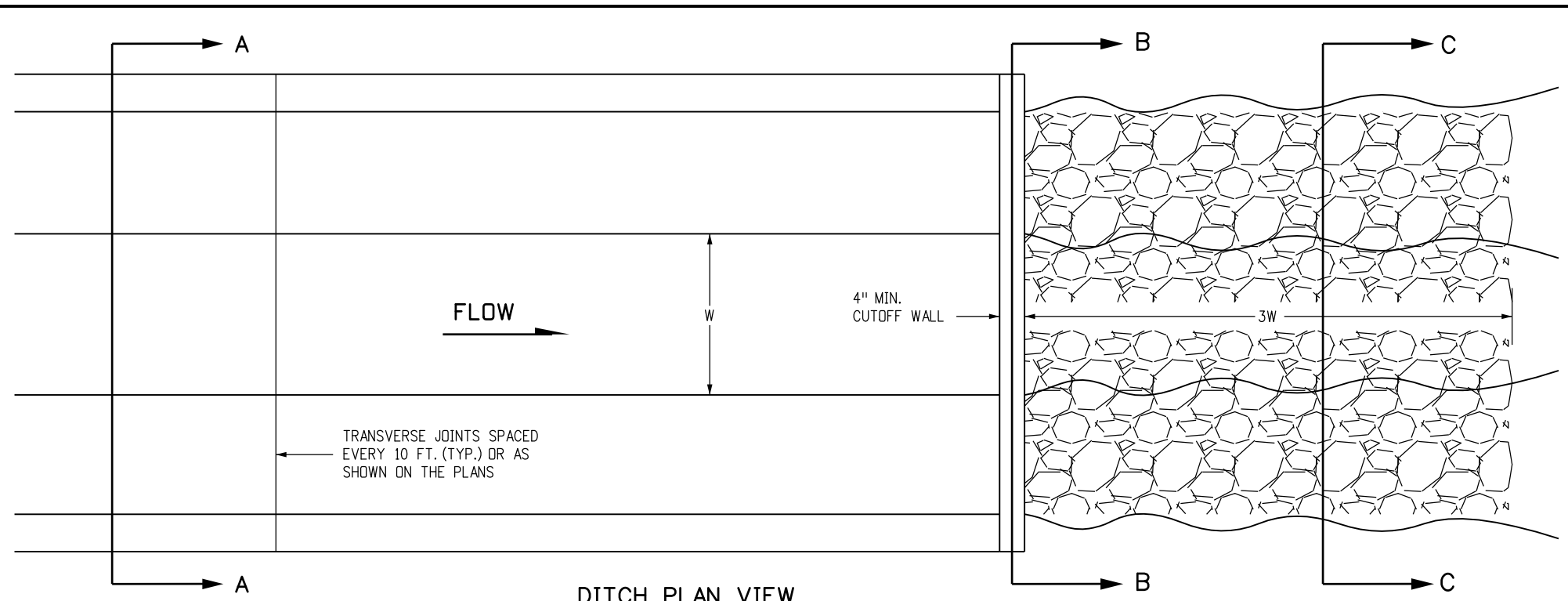
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-203-1

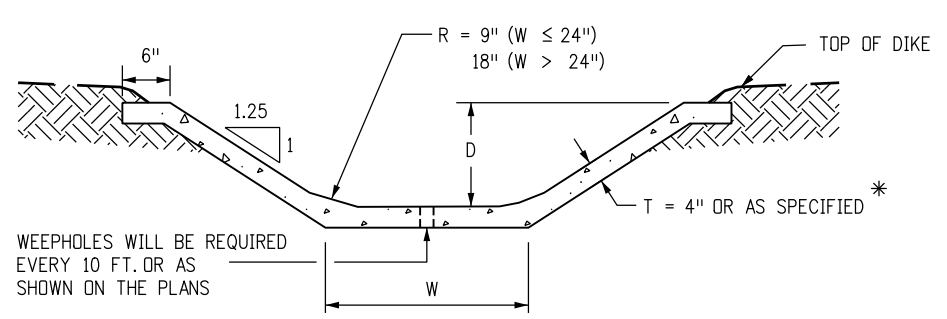
Standard Sheet No. 1 of 1

Project Sheet Number:



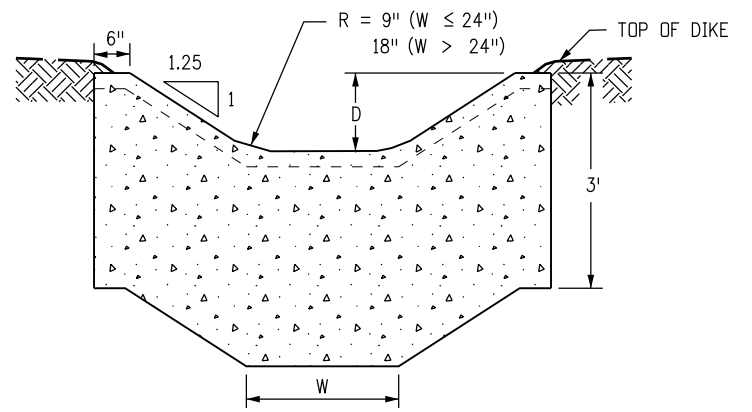
GENERAL NOTES

1. ALL DITCHES SHALL BE CONSTRUCTED TO THE LINES AND GRADES AS SHOWN ON THE PLANS, USING THE DITCH SECTION AS SHOWN ON THE PLANS, OR AS SPECIFIED BY THE ENGINEER.
2. CONCRETE LINING WILL BE PAID FOR AS CONCRETE SLOPE AND DITCH PAVING.
3. PROVIDE A CUTOFF WALL AND RIPRAP AT THE END OF CONCRETE-LINED DITCH.

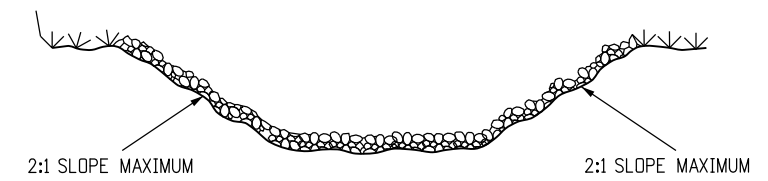


**SECTION A-A
CONCRETE-LINED DITCH**

* FOR SECTIONS WHERE $W \leq 18"$ AND $D \leq 18"$ USE $T = 3"$



**SECTION B-B
CUTOFF WALL**

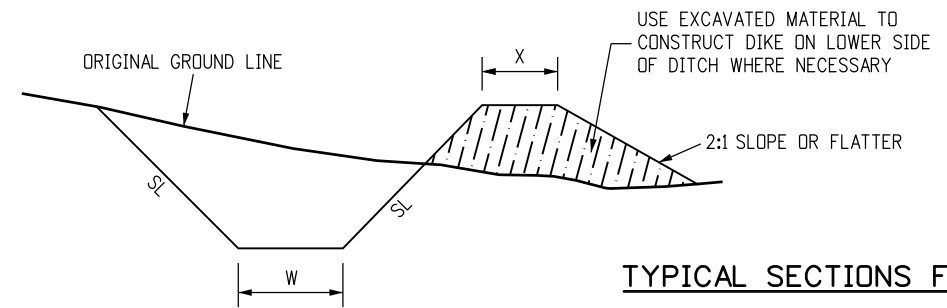


**SECTION C-C
RIPRAP-LINED DITCH**

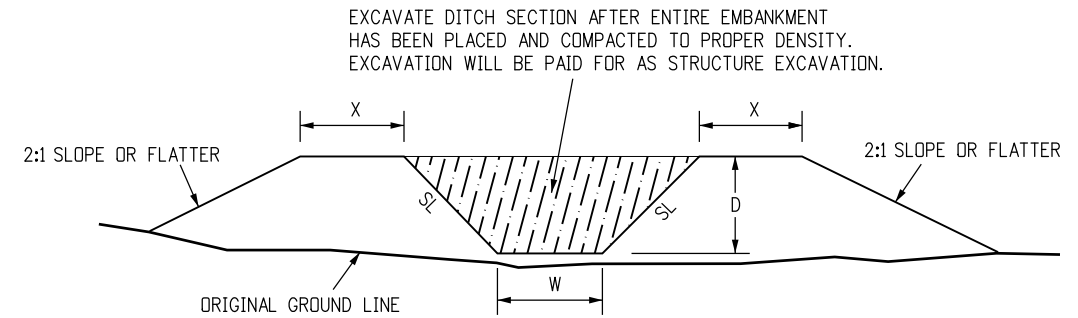
RIPRAP GRADATION SHALL BE AS SPECIFIED IN THE CONTRACT.

D (INCHES)	CU. YDS. PER 100 LIN. FT.				
	W (INCHES)				
	12	18	24	36	48
18	6.3*	6.7*	9.6	10.8	12.0
24	9.9	10.5	11.6	12.8	14.0
30	12.3	12.9	13.5	14.8	16.0
36	14.3	14.9	15.5	16.7	18.0
48			19.4	20.7	21.9

**CONCRETE-LINED DITCH
QUANTITIES**



CUT SECTIONS

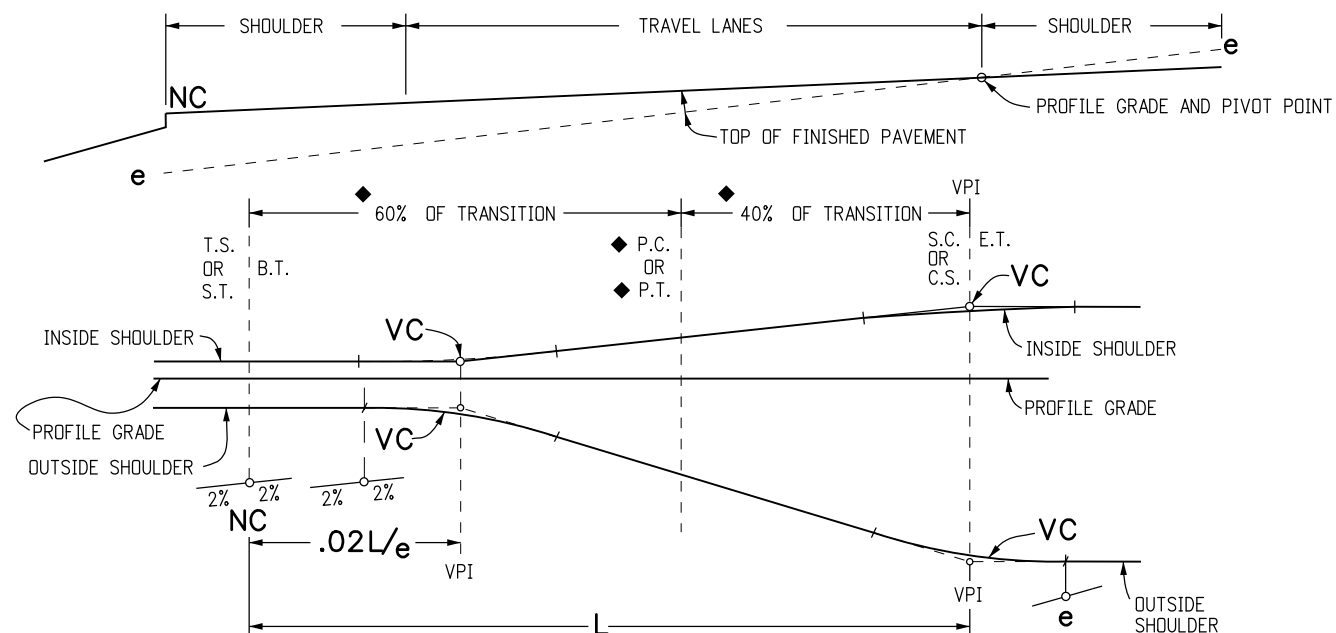


TYPICAL SECTIONS FOR DITCHES

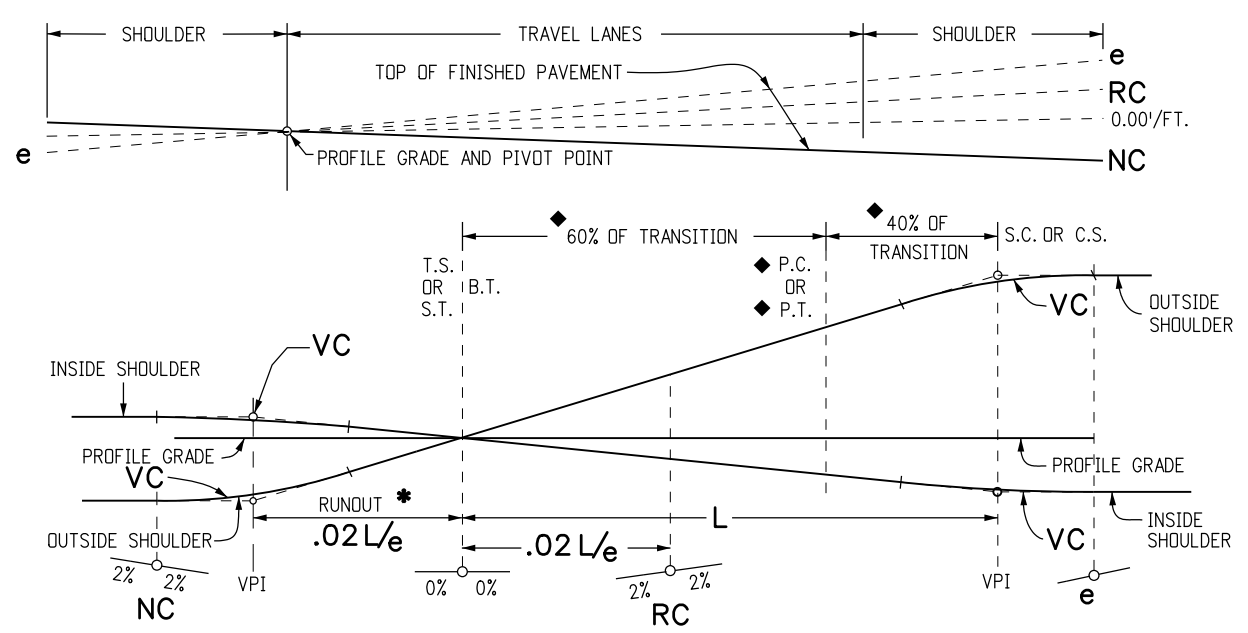
NOTE: SEE STRUCTURE NOTES ON THE PLANS FOR DIMENSIONS W, D, AND SL. DIMENSION X = W/2 WITH MINIMUM OF 2 FT. UNLESS OTHERWISE SHOWN ON THE PLANS, W = 1 FT., SL = 2:1 OR FLATTER.

EMBANKMENT SECTIONS

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 	<h1>DITCH TYPES</h1>	STANDARD PLAN NO.	
Creation Date: 07/31/19	Designer Initials: JBK	Date:	Comments:			M-203-2	
Last Modification Date: 07/31/19	Detailer Initials: LTA			Standard Sheet No. 1 of 1		Project Sheet Number:	
CAD Ver.: MicroStation V8	Scale: Not to Scale	Units: English		Issued by the Project Development Branch: July 31, 2019			



DIAGRAMMATIC PROFILE FOR SUPERELEVATION OF INSIDE LANES



DIAGRAMMATIC PROFILE FOR SUPERELEVATION OF OUTSIDE LANES

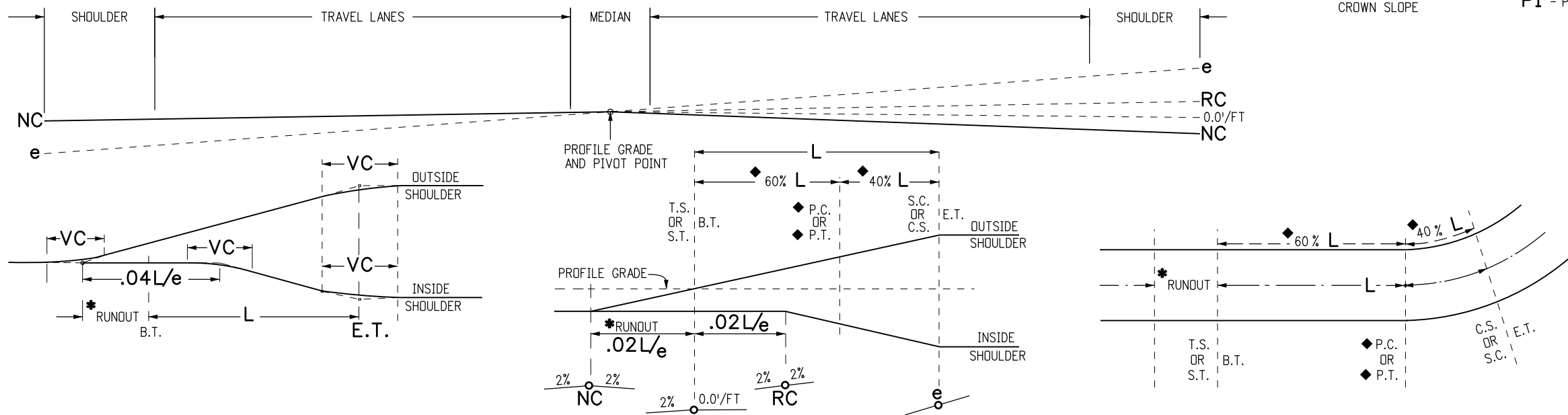
SUPERELEVATION DIAGRAMS FOR DIVIDED HIGHWAYS SHOULDER PIVOT

VC - TO OBTAIN SMOOTH PROFILES ON PAVEMENT EDGES, VERTICAL CURVES MAY BE INSERTED AT THE ANGULAR BREAK POINTS. UNLESS RESTRAINING CONDITIONS EXIST, THE LENGTH OF VERTICAL CURVE SELECTED, IN FEET, SHOULD BE AT LEAST NUMERICALLY EQUAL TO THE DESIGN SPEED, AND NO MORE THAN $.04L/e$.

- R - RADIUS OF CURVE
- V_d - ASSUMED DESIGN SPEED
- L - LENGTH OF SUPERELEVATION RUNOFF OR SPIRAL LENGTH
- NC - NORMAL CROWN SECTION
- RC - REMOVE ADVERSE CROWN, SUPERELEVATE AT NORMAL CROWN SLOPE
- VC - VERTICAL CURVE
- BT - BEGINNING OF TRANSITION
- ET - ENDING OF TRANSITION
- TS - TANGENT TO SPIRAL
- ST - SPIRAL TO TANGENT
- PC - POINT OF CURVATURE
- PI - POINT OF INTERSECTION
- PT - POINT OF TANGENT
- CS - CURVE TO SPIRAL
- SC - SPIRAL TO CURVE
- LN - TRAVEL LANE

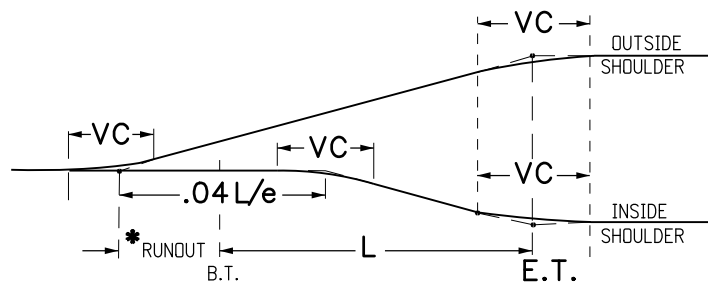
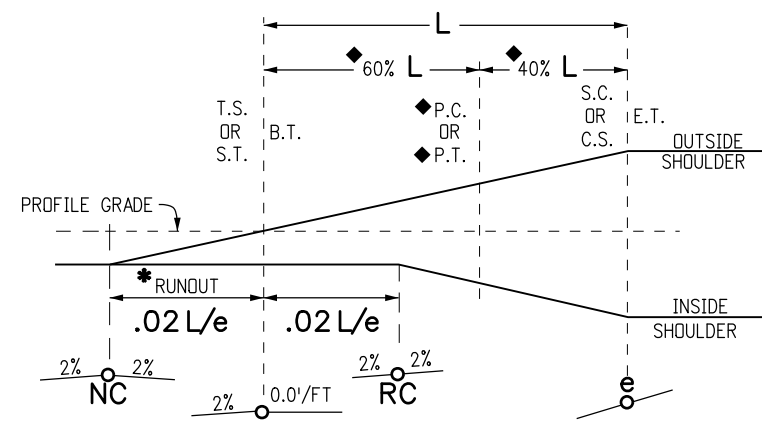
- = PIVOT
- ◆ = WHEN CURVE IS NOT SPIRALED.
- e = MAXIMUM RATE OF SUPERELEVATION IN FEET (PER FOOT OF WIDTH) FOR THE GIVEN RADIUS OF CURVE AND DESIGN SPEED.

* RUNOUT LENGTH SHOULD USUALLY BE $.02 L/e$. WHEN CONDITIONS ARE SUCH THAT THIS LENGTH IS NOT SUITABLE, THE DESIGNER SHALL CHOOSE ANOTHER LENGTH TO SUIT CONDITIONS.

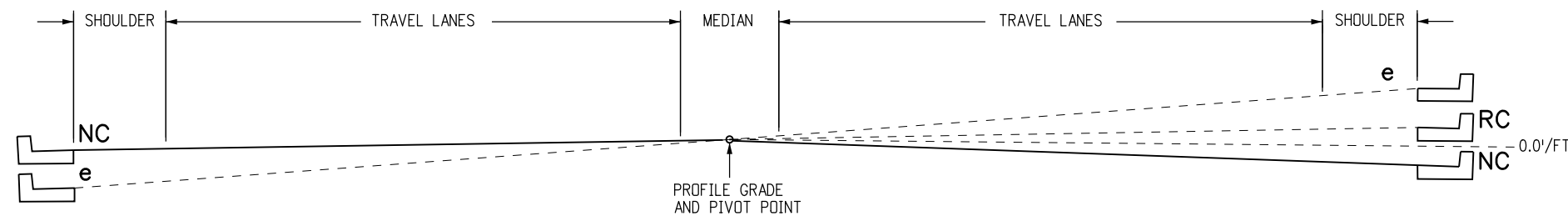
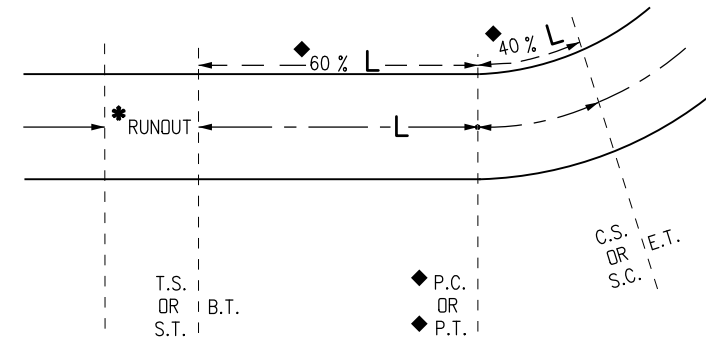


SUPERELEVATION DIAGRAMS FOR DIVIDED HIGHWAY CENTER PIVOT

Computer File Information		Sheet Revisions		Colorado Department of Transportation		SUPERELEVATION CROWNED AND DIVIDED HIGHWAYS		STANDARD PLAN NO.	
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Designer Initials: JBK		Comments: _____		CDOT HQ, 3rd Floor					
Last Modification Date: 07/31/19		_____		Denver, CO 80204		Issued by the Project Development Branch: July 31, 2019		Project Sheet Number: _____	
Detailer Initials: LTA		_____		Phone: 303-757-9021 FAX: 303-757-9868					
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		_____		Project Development Branch		JBK			



VC - TO OBTAIN SMOOTH PROFILES ON PAVEMENT EDGES, VERTICAL CURVES MAY BE INSERTED AT THE ANGULAR BREAK POINTS. UNLESS RESTRAINING CONDITIONS EXIST, THE LENGTH OF VERTICAL CURVE SELECTED, IN FEET, SHOULD BE AT LEAST NUMERICALLY EQUAL TO THE DESIGN SPEED, AND NO MORE THAN $.04L/e$.



SUPERELEVATION DIAGRAMS

$e_{max} = 4\%$

IF THE CALCULATED RADIUS FALLS BETWEEN TWO RADII, GO TO THE NEXT LOWEST RADIUS VALUE.

e (%)	V _d = 15 mph			V _d = 20 mph			V _d = 25 mph			V _d = 30 mph			V _d = 35 mph			V _d = 40 mph			V _d = 45 mph			V _d = 50 mph			V _d = 55 mph			V _d = 60 mph			e (%)
	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	R (FT.)	1 LN	2 LNS	
2.0	506-796	31	46	902-1410	32	49	1340-2050	34	51	1880-2830	36	55	2490-3730	39	58	3220-4770	41	62	4040-5930	44	67	4940-7220	48	72	5950-8650	51	77	7080-10300	53	80	2.0
2.2	399-506	34	51	723-902	36	54	1110-1340	38	57	1580-1880	40	60	2120-2490	43	64	2760-3220	46	68	3480-4040	49	73	4280-4940	53	79	5180-5950	56	84	6190-7080	59	88	2.2
2.4	271-399	37	55	513-723	39	58	838-1110	41	62	1270-1580	44	65	1760-2120	46	70	2340-2760	50	74	2980-3480	53	80	3690-4280	58	86	4500-5180	61	92	5410-6190	64	96	2.4
2.6	201-271	40	60	388-513	42	63	650-838	45	67	1000-1270	47	71	1420-1760	50	75	1930-2340	54	81	2490-2980	58	87	3130-3690	62	94	3870-4500	66	100	4700-5410	69	104	2.6
2.8	157-201	43	65	308-388	45	68	524-650	48	72	817-1000	51	76	1170-1420	54	81	1620-1930	58	87	2100-2490	62	93	2660-3130	67	101	3310-3870	71	107	4060-4700	75	112	2.8
3.0	127-157	46	69	251-308	49	73	433-524	51	77	681-817	55	82	982-1170	58	87	1370-1620	62	93	1800-2100	67	100	2290-2660	72	108	2860-3310	77	115	3530-4060	80	120	3.0
3.2	105-127	49	74	209-251	52	78	363-433	55	82	576-681	58	87	835-982	62	93	1180-1370	66	99	1550-1800	71	107	1980-2290	77	115	2490-2860	82	123	3090-3530	85	128	3.2
3.4	88-105	52	78	175-209	55	83	307-363	58	87	490-576	62	93	714-835	66	99	1010-1180	70	106	1340-1550	76	113	1720-1980	82	122	2170-2490	87	130	2700-3090	91	136	3.4
3.6	73-88	55	83	147-175	58	88	259-307	62	93	416-490	65	98	610-714	70	105	865-1010	74	112	1150-1340	80	120	1480-1720	86	130	1880-2170	92	138	2350-2700	96	144	3.6
3.8	61-73	58	88	122-147	62	92	215-259	65	98	348-416	69	104	512-610	74	110	730-865	79	118	970-1150	84	127	1260-1480	91	137	1600-1880	97	146	2010-2350	101	152	3.8
4.0	42-61	62	92	86-122	65	97	154-215	69	103	250-348	73	109	371-512	77	116	533-730	83	124	711-970	89	133	926-1260	96	144	1190-1600	102	153	1500-2010	107	160	4.0

- o = PIVOT
- ◆ = WHEN CURVE IS NOT SPIRALLED.
- e = MAXIMUM RATE OF SUPERELEVATION IN FEET (PER FOOT OF WIDTH) FOR THE GIVEN RADIUS OF CURVE AND DESIGN SPEED.
- * RUNOUT LENGTH SHOULD USUALLY BE $.02L/e$ WHEN CONDITIONS ARE SUCH THAT THIS LENGTH IS NOT SUITABLE, THE DESIGNER SHALL CHOOSE ANOTHER LENGTH TO SUIT CONDITIONS.

- R - RADIUS OF CURVE
- V_d - ASSUMED DESIGN SPEED
- L - LENGTH OF SUPERELEVATION RUNOFF OR SPIRAL LENGTH
- NC - NORMAL CROWN SECTION
- RC - REMOVE ADVERSE CROWN, SUPERELEVATE AT NORMAL CROWN SLOPE
- LN - TRAVEL LANE
- VC - VERTICAL CURVE
- BT - BEGINNING OF TRANSITION
- ET - ENDING OF TRANSITION
- TS - TANGENT TO SPIRAL
- ST - SPIRAL TO TANGENT
- PC - POINT OF CURVATURE
- PI - POINT OF INTERSECTION
- PT - POINT OF TANGENT
- CS - CURVE TO SPIRAL
- SC - SPIRAL TO CURVE

SUPERELEVATION NOTES

1. THIS STANDARD PLAN SHOWS THE REQUIRED RATES OF SUPERELEVATION FOR THE VARIOUS RADIUS LENGTHS AT DIFFERENT DESIGN SPEEDS FOR THE MAXIMUM SUPERELEVATION RATE OF 4%. ALTERNATIVE MAXIMUM RATE OF SUPERELEVATION SHALL BE USED FOR STREETS WHEN SPECIFIED ON THE PLANS.
2. USE OF $e_{max} = 4\%$ SHOULD BE LIMITED TO URBAN CONDITIONS.
3. VALUES ARE FOR DESIGN ELEMENTS RELATED TO DESIGN SPEED AND HORIZONTAL CURVATURE FOR TWO LANE AND FOUR LANE STREETS.
4. WHERE SIDE STREETS OR ROADS INTERSECT, THE RATE OF SUPERELEVATION MAY BE REDUCED TO FACILITATE A SMOOTH INTERSECTION OF THE PROFILE GRADES.
5. NUMBER OF LANES ROTATED:
 - A. ONE LANE ROTATED IS TYPICAL FOR A TWO-LANE HIGHWAY.
 - B. TWO LANES ROTATED ARE TYPICAL FOR A FOUR-LANE HIGHWAY.
6. SPIRALS ARE RECOMMENDED BELOW THE HEAVY LINE IN THE TABLES. SPIRALS ARE PERMISSIBLE BUT NOT RECOMMENDED ABOVE THE HEAVY LINES. SPIRAL LENGTHS MAY BE ROUNDED TO MULTIPLES OF 50 FEET FOR CALCULATION CONVENIENCE.

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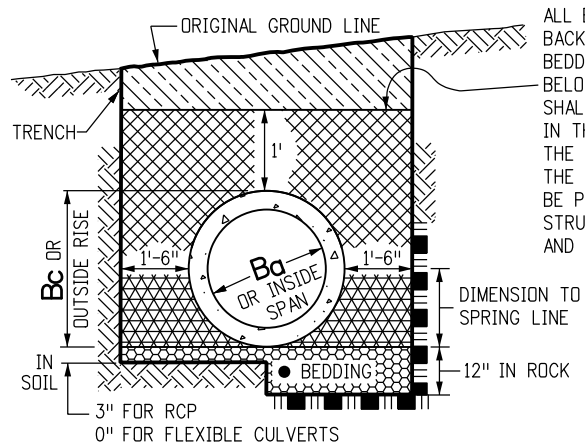
Sheet Revisions	
Date:	Comments
(R-X)	
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(R-X)	
(R-X)	

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SUPERELEVATION STREETS

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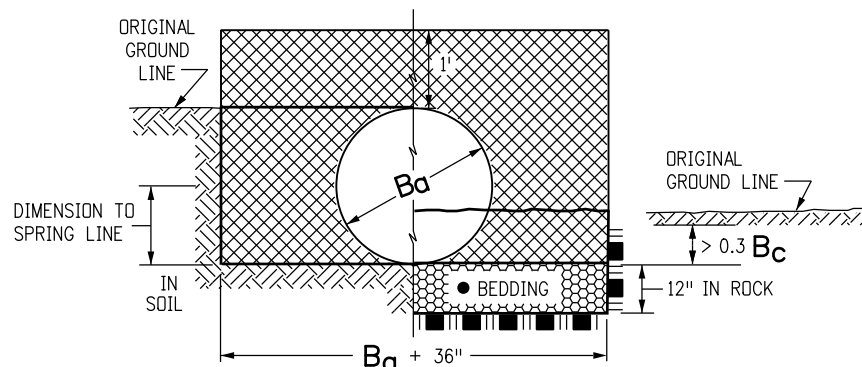
STANDARD PLAN NO.
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Project Sheet Number:



PIPE IN TRENCH

- THE BEDDING MATERIAL FOR RIGID PIPE IN SOIL SHALL BE 3 IN. OF LOOSE STRUCTURE BACKFILL (CLASS 1 OR 2). BEDDING IS NOT REQUIRED FOR FLEXIBLE PIPE IN SOIL. BEDDING MATERIAL FOR RIGID OR FLEXIBLE PIPE IN ROCK SHALL BE 12 IN. OF LOOSE STRUCTURE BACKFILL, CLASS 1.

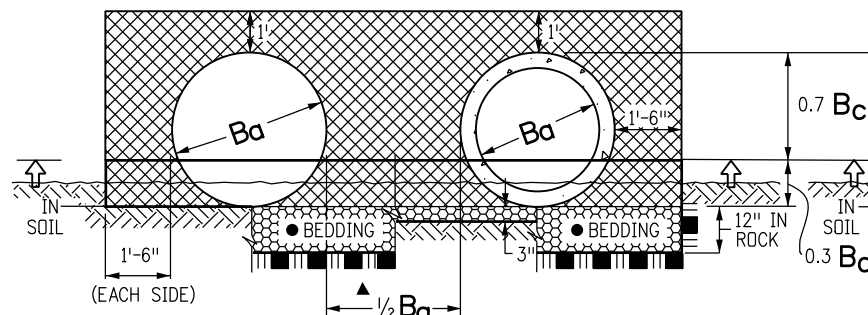
ALL EXCAVATION AND BACKFILL, INCLUDING BEDDING MATERIAL BELOW THIS LINE SHALL BE INCLUDED IN THE BID PRICE FOR THE PIPE. ABOVE THE LINE, THEY SHALL BE PAID FOR AS STRUCTURE EXCAVATION AND EMBANKMENT.



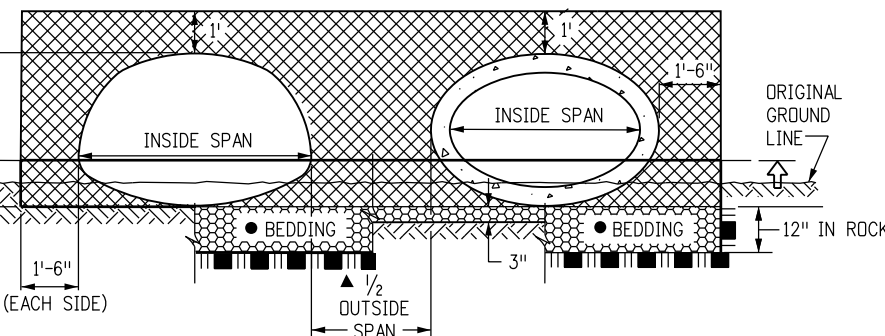
CIRCULAR PIPE

(WHERE ORIGINAL GROUND LINE IS BETWEEN $0.3 B_c$ AND $B_c + 1$ FT. ABOVE FLOWLINE)

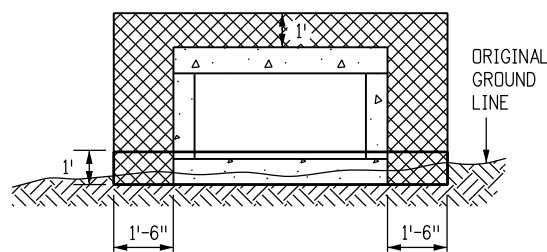
- ▲ WHEN TWO OR MORE CONDUITS ARE LAID SIDE-BY-SIDE, THEY SHALL BE PLACED SO THAT THEY ARE $\frac{1}{2}$ OUTSIDE DIAMETER, OR $\frac{1}{2}$ OUTSIDE SPAN, OR 3 FT. APART, WHICHEVER IS LESS. HOWEVER, IF END SECTIONS ARE USED, THE MINIMUM SPACING SHALL BE 1 FT. BETWEEN END SECTIONS.



CIRCULAR PIPE IN FILL

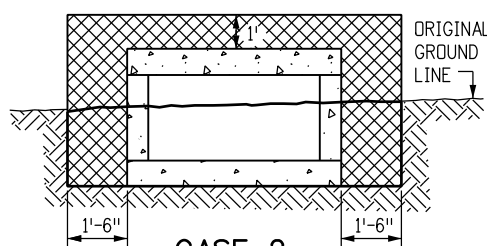


ARCH OR ELLIPTICAL PIPE IN FILL



CASE 1

APPLIES WHEN THE ORIGINAL GROUND LINE IS LESS THAN 1 FT. ABOVE THE BOTTOM OF THE BOX CULVERT. THE EMBANKMENT SHALL BE BUILT UP TO 1 FT. ABOVE THE BOTTOM OF THE BOX CULVERT AND THEN EXCAVATED TO THE BOTTOM OF THE BOX CULVERT. THIS EMBANKMENT AND EXCAVATION WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE COST OF THE WORK.

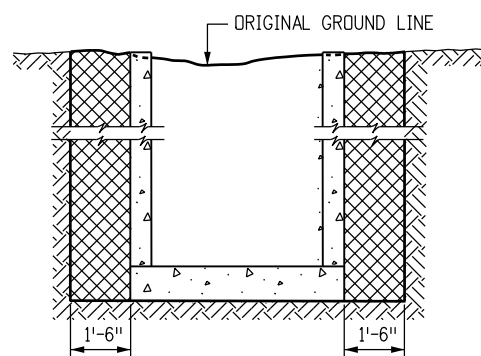


CASE 2

APPLIES WHEN THE ORIGINAL GROUND LINE IS MORE THAN 1 FT. ABOVE THE BOTTOM OF THE BOX CULVERT.

CONCRETE BOX CULVERT

IN BOTH CASES, THE TRENCH (OUTLINED BY THE THICK SOLID LINE) SHALL THEN BE EXCAVATED TO ACCOMMODATE CONSTRUCTION OF THE BOX CULVERT.



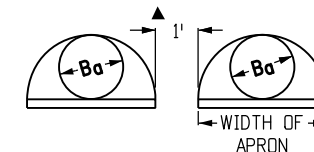
DROP INLETS AND DIVISION BOXES

GENERAL NOTES

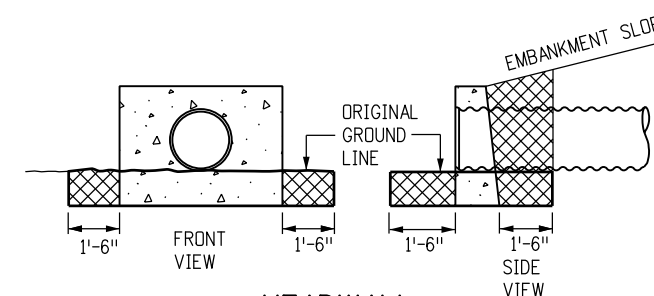
1. EXCAVATION AND BACKFILL PATTERNS DIFFERENT FROM THOSE INDICATED ON THESE SHEETS WILL BE SHOWN ELSEWHERE ON THE PLANS.
2. EXCAVATION FOR CHANNEL CHANGE OR CHANNEL IMPROVEMENT WILL BE EITHER UNCLASSIFIED EXCAVATION OR MUCK EXCAVATION AND WILL BE NOTED ON THE PLANS. EXCAVATION FROM THE CHANNEL FLOWLINE TO THE DEPTH REQUIRED FOR THE NEW STRUCTURE AND INCIDENTAL CHANNEL EXCAVATION WILL BE PAID FOR AS STRUCTURE EXCAVATION.
3. STRUCTURE FOOTINGS WHICH ARE LOCATED IN ROCK SHALL BE POURED OUT TO UNDISTURBED ROCK WITHOUT FORMING IN CONFORMANCE WITH SUBSECTION 601.09(b).
4. STRUCTURAL PLATE CULVERTS SHALL BE CONSTRUCTED AS SHOWN ON THE PLANS.
5. B_o EQUALS THE INSIDE DIAMETER OF A PIPE AND B_c EQUALS THE OUTSIDE DIAMETER OF A PIPE. FOR THIN WALLED PIPES, IT IS ASSUMED THAT $B_o = B_c$.
6. APPROXIMATE STRUCTURE EXCAVATION AND BACKFILL QUANTITIES, UP TO 1 FT. OVER THE PIPE WILL BE SHOWN ON THE PLANS, FOR INFORMATION ONLY.

LEGEND

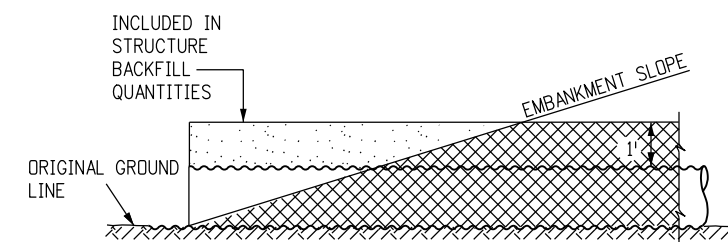
- STRUCTURE EXCAVATION LIMITS
- STRUCTURE BACKFILL, CLASS 1 OR 2, AS SHOWN ON PLANS
- STRUCTURE BACKFILL, CLASS 1
- EMBANKMENT MATERIAL
- EARTH
- ROCK
- BEDDING
- CONCRETE
- WHEN FLOW LINE OF CULVERT IS LESS THAN $0.3 B_c$ BELOW THE ORIGINAL GROUND LINE, EMBANKMENT SHALL BE BUILT UP TO $0.3 B_c$ ABOVE THE FLOW LINE AND TRENCH EXCAVATED TO THE BOTTOM OF PIPE OR AS SHOWN.



CONDUIT WITH END SECTIONS



HEADWALL



END OF PIPE

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Sheet Revisions

Date:	Comments

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 Project Development Branch JBK

EXCAVATION AND BACKFILL FOR STRUCTURES

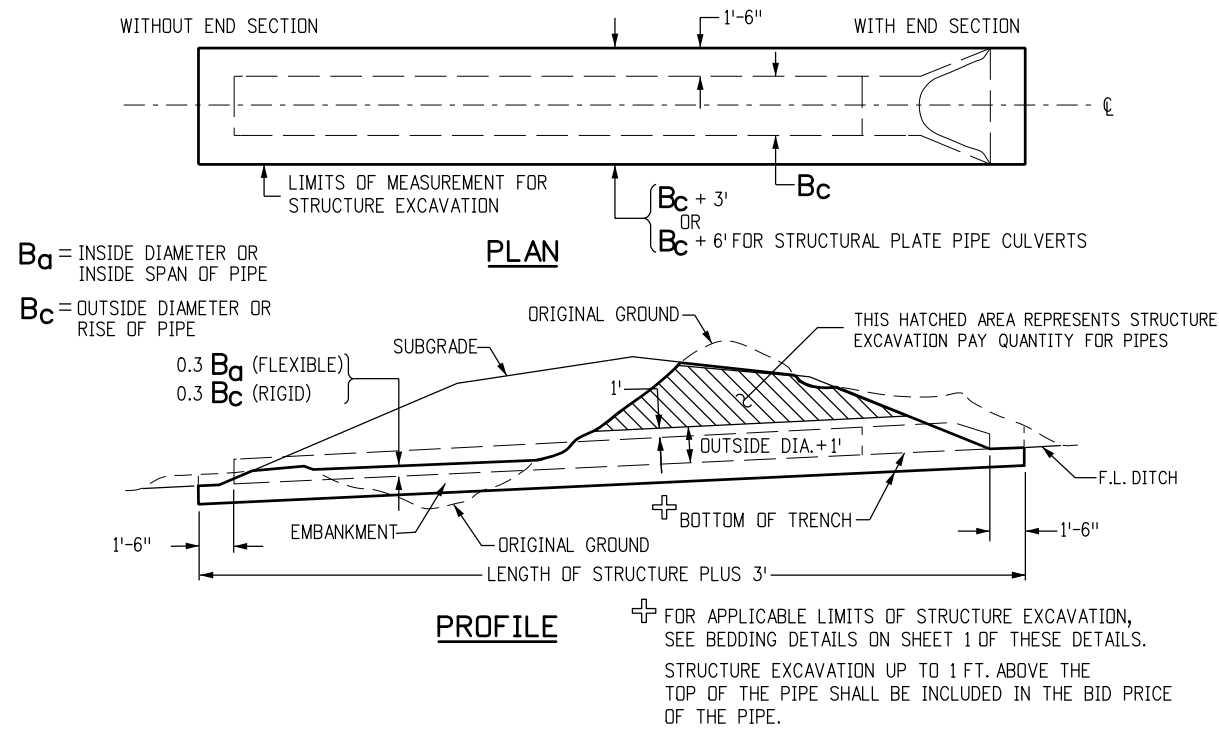
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

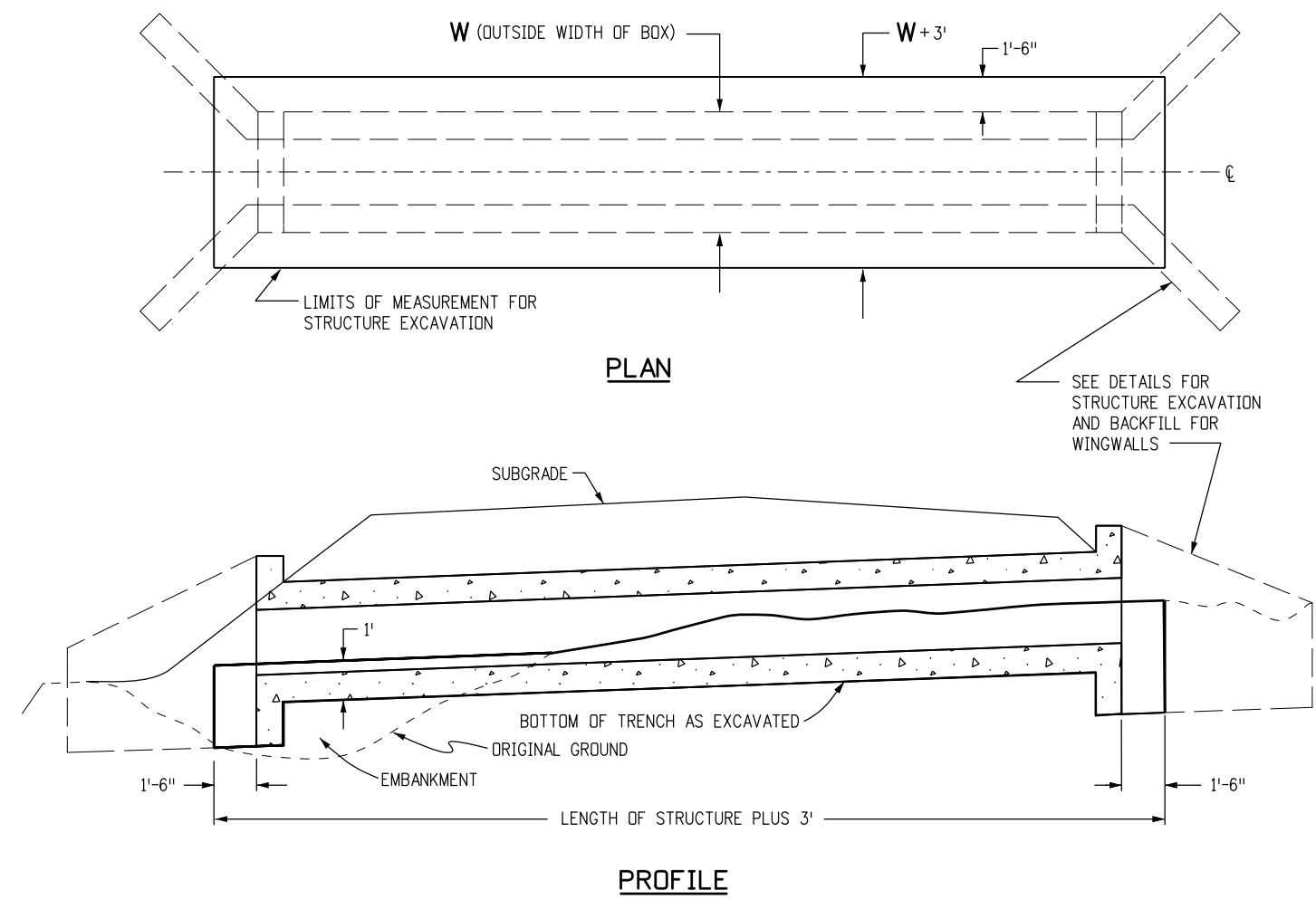
M-206-1

Standard Sheet No. 1 of 2

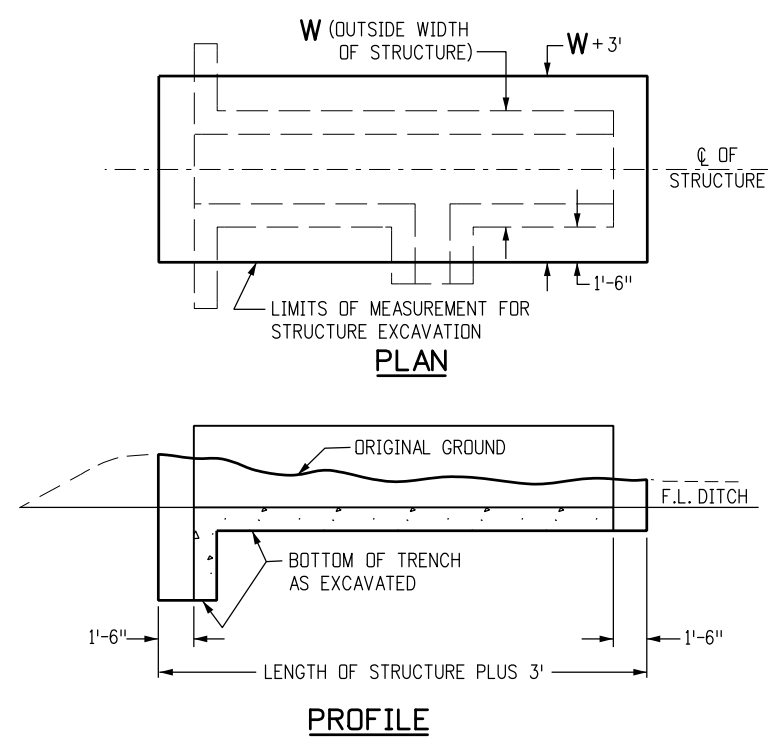
Project Sheet Number:



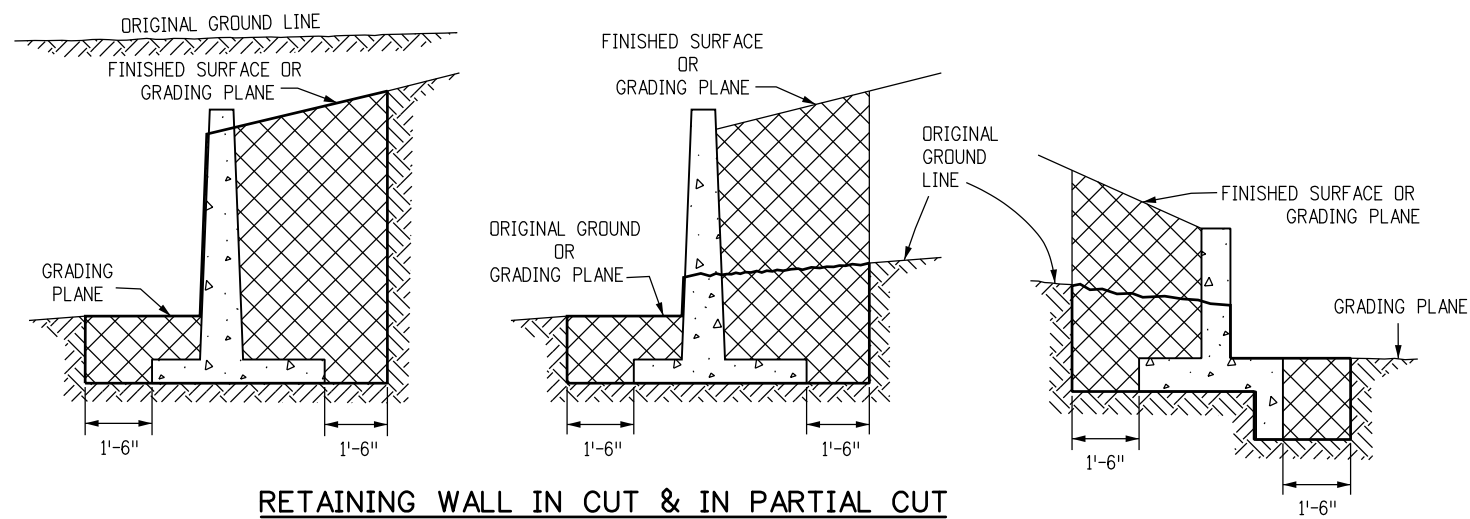
STRUCTURE EXCAVATION MEASUREMENT FOR PIPE CULVERTS



STRUCTURE EXCAVATION MEASUREMENT FOR CONCRETE BOX CULVERTS



STRUCTURE EXCAVATION MEASUREMENT FOR DIVISION BOXES



RETAINING WALL IN CUT & IN PARTIAL CUT

ANY ADDITIONAL EXCAVATION BEHIND THE LIMITS SHOWN SHALL BE FILLED WITH CLASS I BACKFILL MATERIAL. THE ADDITIONAL EXCAVATION AND BACKFILL WILL NOT BE MEASURED AND PAID FOR.

WINGWALL

LEGEND

	STRUCTURE EXCAVATION LIMITS
	STRUCTURE BACKFILL, CLASS 1 OR 2, AS SHOWN ON PLANS
	CONCRETE

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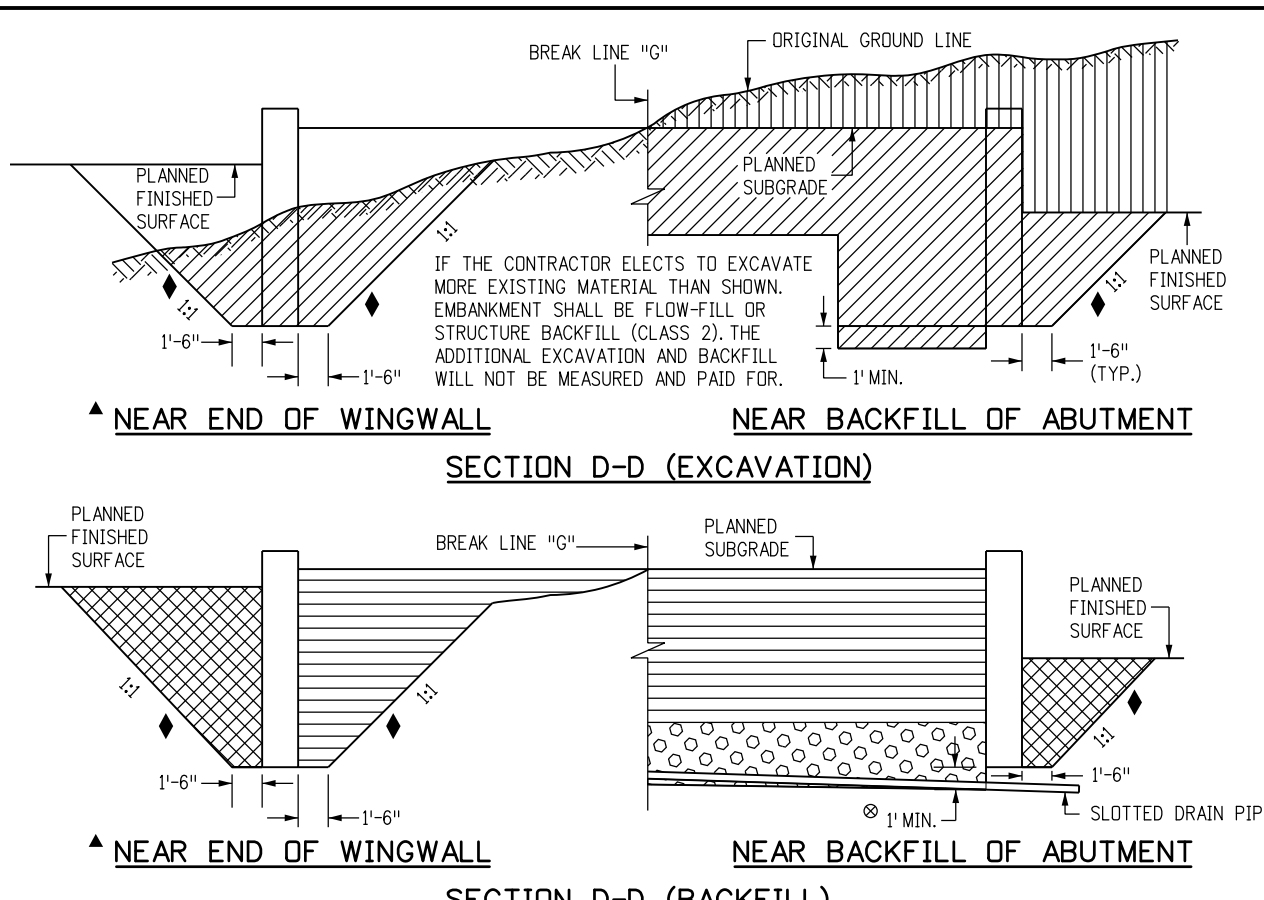
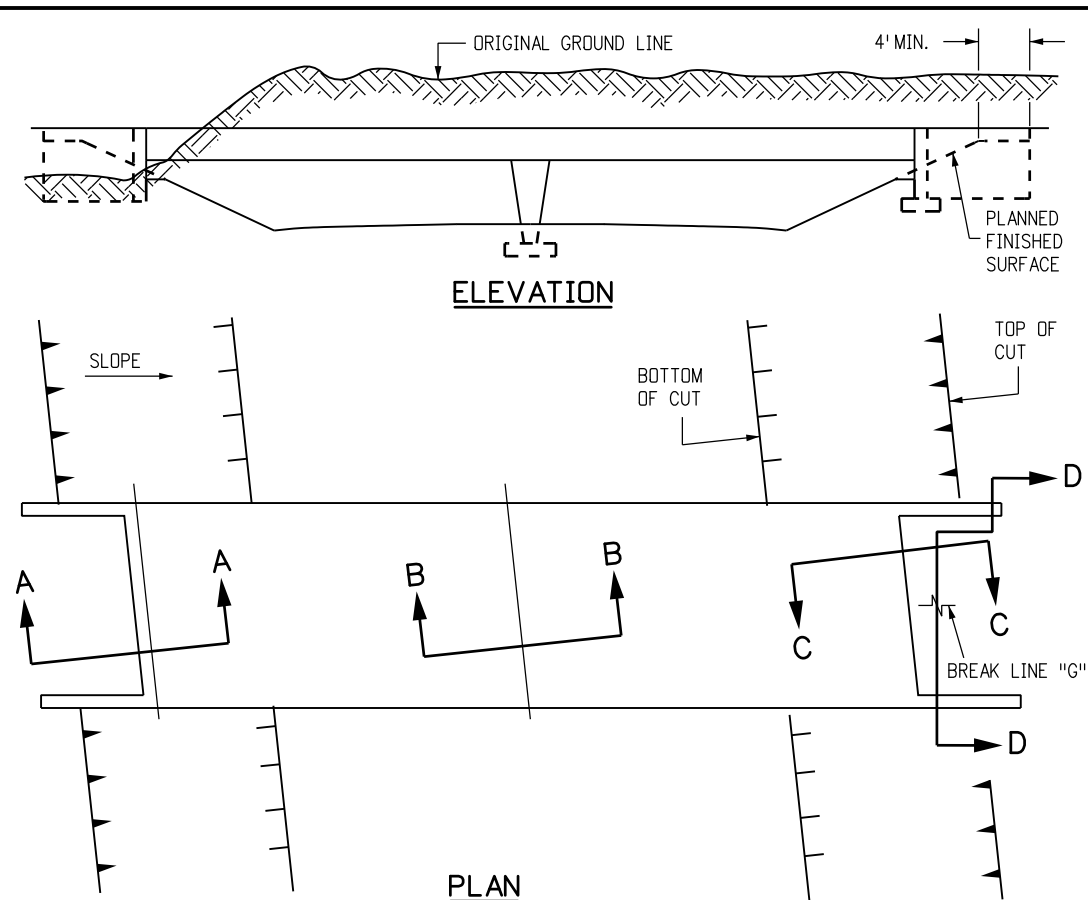
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Project Development Branch **JBK**

EXCAVATION AND BACKFILL FOR STRUCTURES
 Issued by the Project Development Branch: July 31, 2019

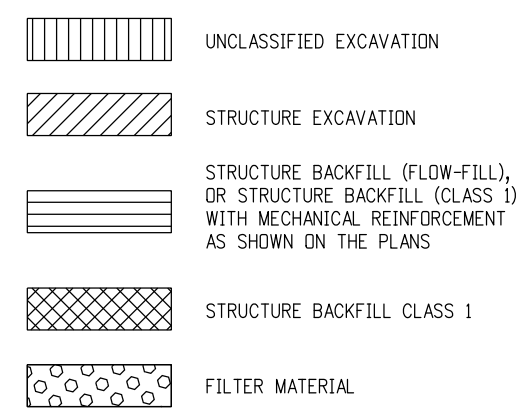
STANDARD PLAN NO.
M-206-1
Standard Sheet No. 2 of 2
 Project Sheet Number: _____



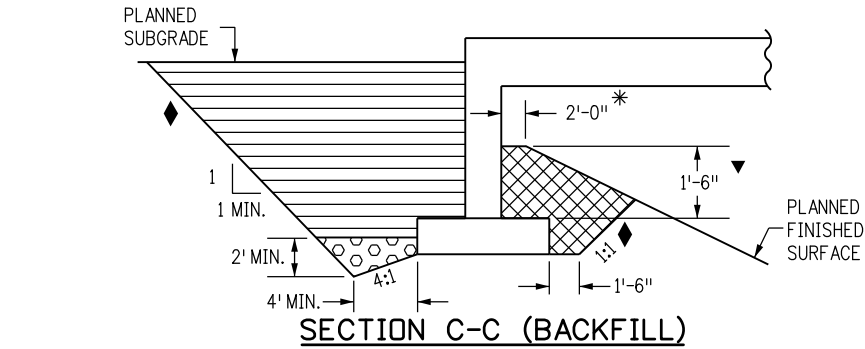
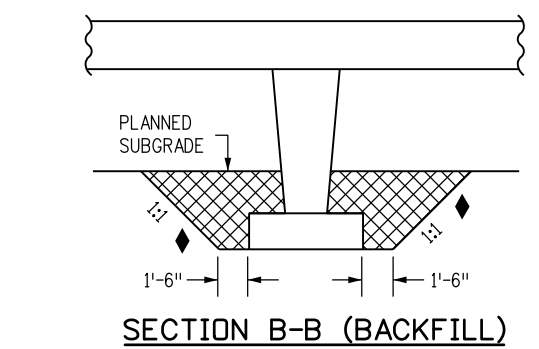
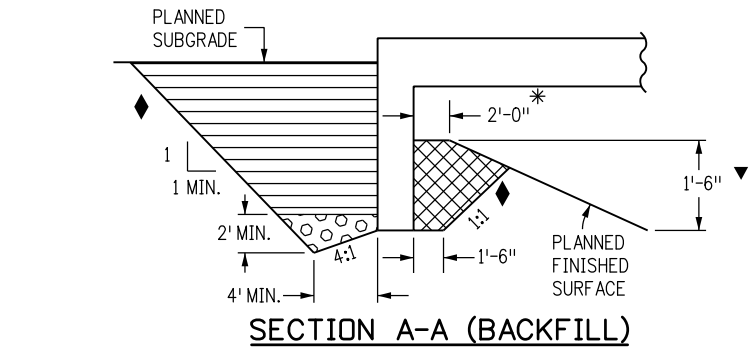
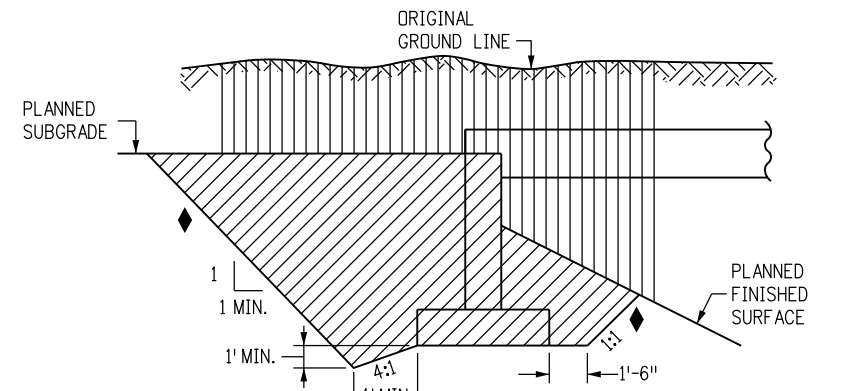
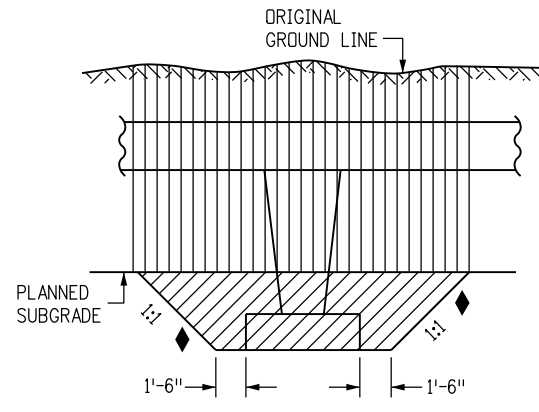
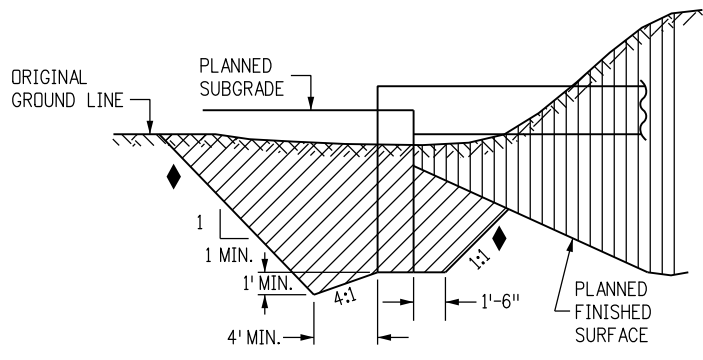
GENERAL NOTES

- EXCAVATION AND BACKFILL PATTERNS DIFFERENT FROM THOSE INDICATED ON THIS SHEET WILL BE SHOWN ON THE PLANS.
- STRUCTURE FOOTINGS WHICH ARE LOCATED IN ROCK SHALL BE POURED OUT TO UNDISTURBED ROCK WITHOUT FORMING, IN CONFORMANCE WITH SUBSECTION 601.09(b).
- STRUCTURE EXCAVATION FOR SLOPE PAVING NOT SHOWN.

LEGEND

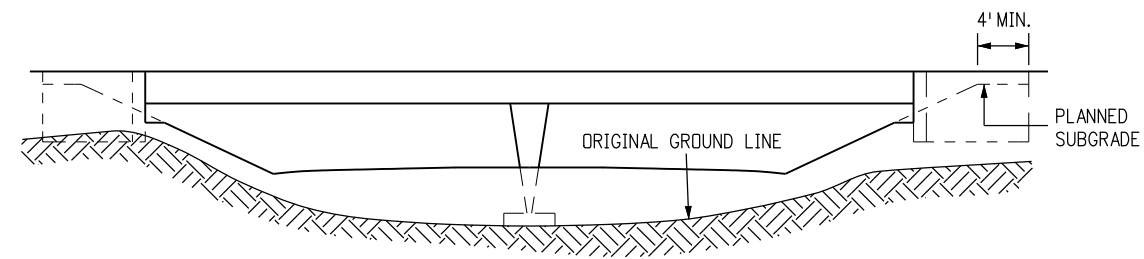


- ▲ FOR PURPOSES OF QUANTITY CALCULATIONS THIS TEMPLATE APPLIES TO END OF WINGWALL.
- ⊗ SLOPE TO DRAIN.
- ◆ SLOPE FOR PAY LIMITS OF EXCAVATION AND BACKFILL.

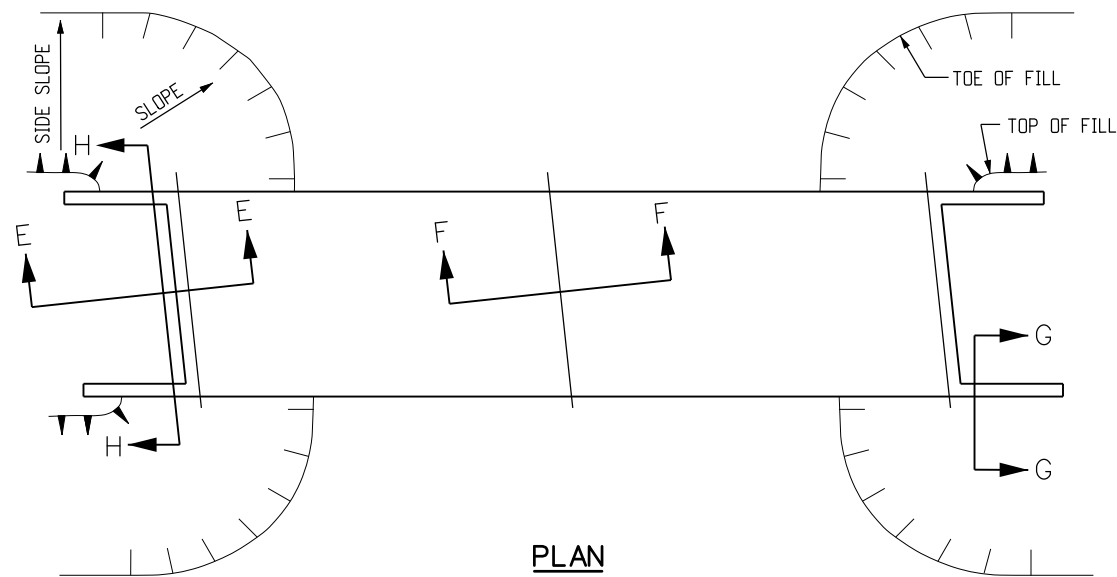


- * MINIMUM BERM DIMENSION
- ▼ MINIMUM EMBEDMENT OF ABUTMENT, IN STRUCTURE BACKFILL

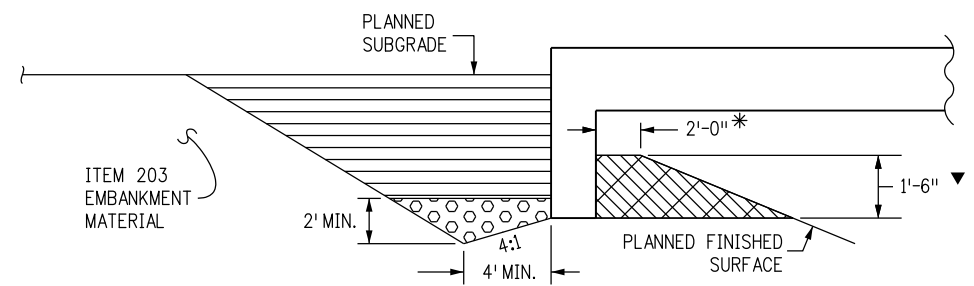
Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	EXCAVATION AND BACKFILL FOR BRIDGES Issued by the Project Development Branch: July 31, 2019	STANDARD PLAN NO.	
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Detailer Initials: LTA		(R-X)					
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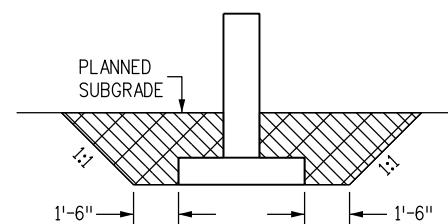
ELEVATION



PLAN

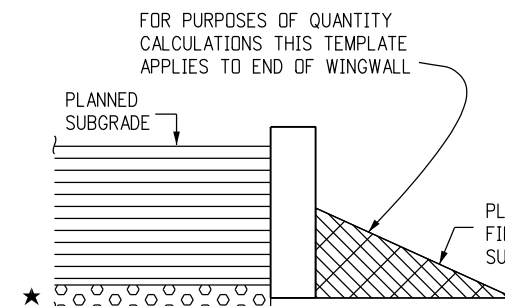


SECTION E-E (BACKFILL)



SECTION F-F (BACKFILL)

* MINIMUM BERM DIMENSION
 ▼ MINIMUM EMBEDMENT OF ABUTMENT INTO STRUCTURE BACKFILL

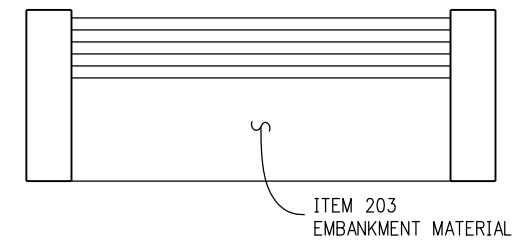


SECTION G-G (BACKFILL)

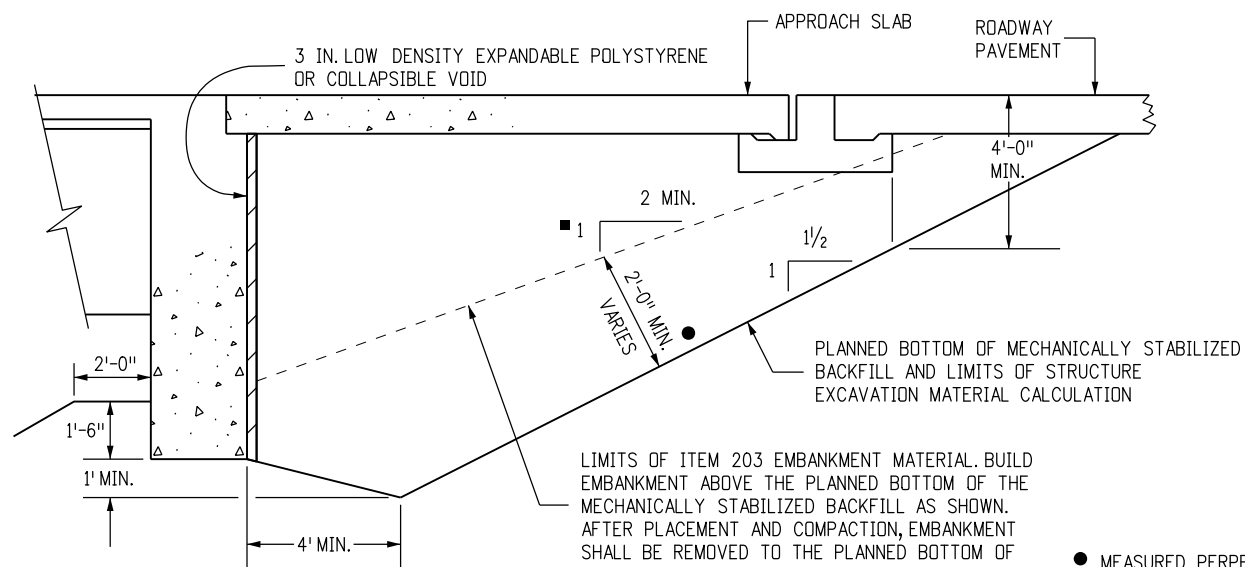
★ FILTER MATERIAL IS ONLY USED IN AREA NEAR THE ABUTMENT AND NOT AT THE END OF THE WINGWALL

LEGEND

- STRUCTURE BACKFILL (FLOW-FILL), OR STRUCTURE BACKFILL (CLASS 1) WITH MECHANICAL REINFORCEMENT AS SHOWN ON THE PLANS
- STRUCTURE BACKFILL CLASS 2 (ON-SITE CLASS 2 MATERIALS MUST MEET CLASS 1 REQUIREMENTS)
- FILTER MATERIAL

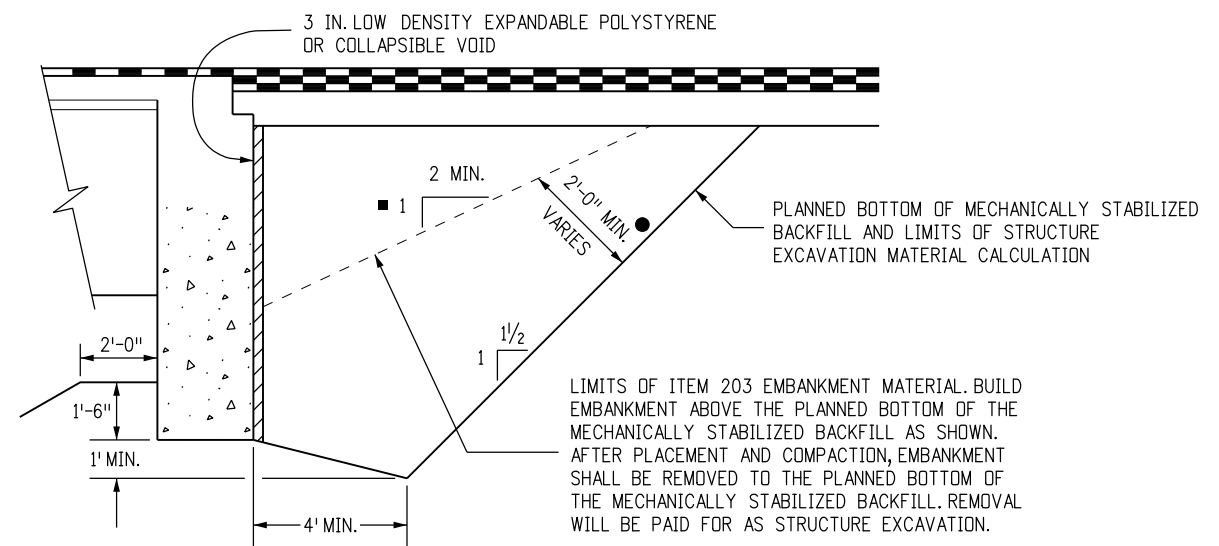


SECTION H-H (BACKFILL)



DETAIL 1

(WITH APPROACH SLAB)



DETAIL 2

(WITHOUT APPROACH SLAB)

LIMITS OF ITEM 203 EMBANKMENT MATERIAL. BUILD EMBANKMENT ABOVE THE PLANNED BOTTOM OF THE MECHANICALLY STABILIZED BACKFILL AS SHOWN. AFTER PLACEMENT AND COMPACTION, EMBANKMENT SHALL BE REMOVED TO THE PLANNED BOTTOM OF THE MECHANICALLY STABILIZED BACKFILL. REMOVAL WILL BE PAID FOR AS STRUCTURE EXCAVATION.

- MEASURED PERPENDICULAR TO PLANNED BOTTOM OF MECHANICALLY STABILIZED BACKFILL.
- PAYMENT BASED ON 2:1 SLOPE. ADDITIONAL QUANTITIES SHALL BE INCLUDED IN THE WORK.

LIMITS OF ITEM 203 EMBANKMENT MATERIAL. BUILD EMBANKMENT ABOVE THE PLANNED BOTTOM OF THE MECHANICALLY STABILIZED BACKFILL AS SHOWN. AFTER PLACEMENT AND COMPACTION, EMBANKMENT SHALL BE REMOVED TO THE PLANNED BOTTOM OF THE MECHANICALLY STABILIZED BACKFILL. REMOVAL WILL BE PAID FOR AS STRUCTURE EXCAVATION.

GENERAL NOTES

1. EXCAVATION AND BACKFILL PATTERNS DIFFERENT FROM THOSE INDICATED ON THIS SHEET WILL BE SHOWN ELSEWHERE ON THE PLANS.
2. STRUCTURE FOOTINGS WHICH ARE LOCATED IN ROCK SHALL BE POURED OUT TO UNDISTURBED ROCK WITHOUT FORMING IN CONFORMANCE WITH SUBSECTION 601.09.
3. STRUCTURE EXCAVATION FOR SLOPE PAVING NOT SHOWN.

Computer File Information

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 Project Development Branch JBK

EXCAVATION AND BACKFILL FOR BRIDGES

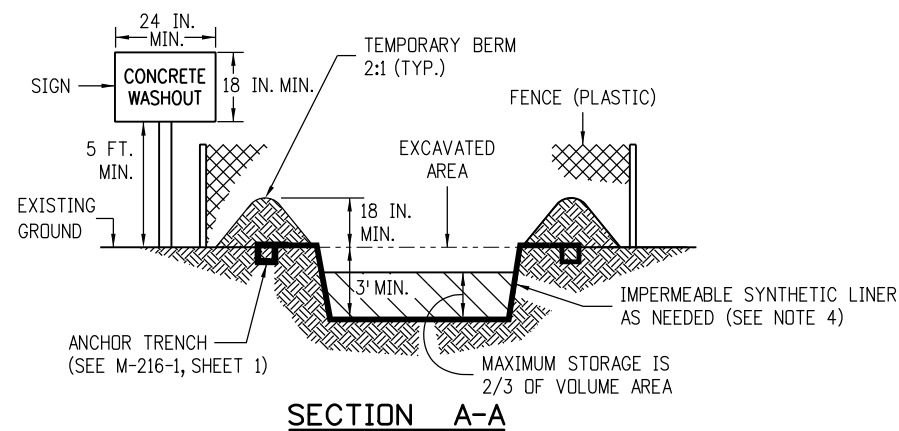
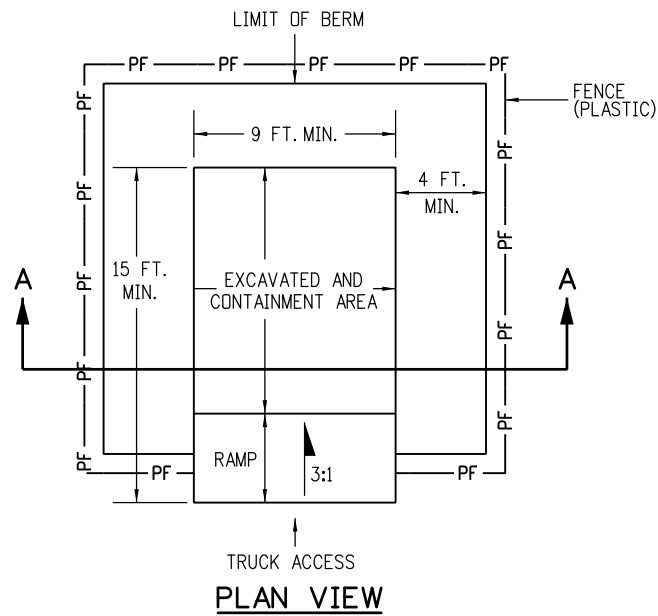
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-206-2

Standard Sheet No. 2 of 2

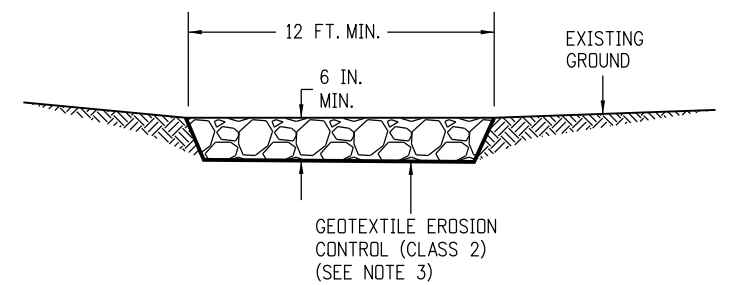
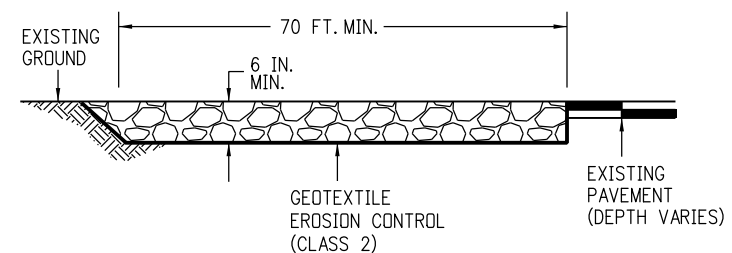
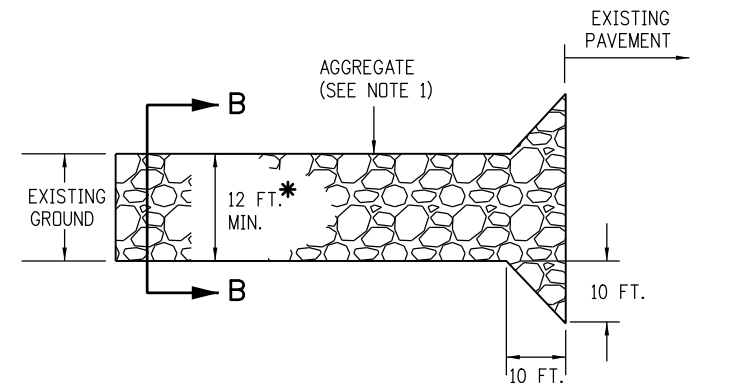
Project Sheet Number:



NOTES:

1. A FENCE (PLASTIC) CONFORMING TO SECTION 607 SHALL BE INSTALLED AROUND THE CONCRETE WASHOUT AREA, EXCEPT AT THE OPENING.
2. THE CONCRETE WASHOUT SIGN SHALL HAVE LETTERS AT LEAST 3 INCHES HIGH AND CONFORM TO SUBSECTION 630.02.
3. ALL MATERIALS AND LABOR TO COMPLETE THE CONCRETE WASHOUT STRUCTURE SHALL BE INCLUDED IN THE COST OF WORK AND NOT PAID FOR SEPARATELY.
4. THE BOTTOM OF EXCAVATION SHALL BE A MINIMUM OF FIVE FEET ABOVE GROUND WATER. IF NOT, THE BOTTOM OF EXCAVATION SHALL BE IN ACCORDANCE WITH 208.02 (j).
5. THE PAY ITEM NUMBER FOR CONCRETE WASHOUT STRUCTURE (EACH) IS 208-00045.

CONCRETE WASHOUT STRUCTURE



NOTES:

1. AGGREGATE SHALL CONFORM TO SUBSECTION 208.02 (i).
2. THE CONTRACTOR SHALL PROTECT CURB AND GUTTER THAT CROSSES THE ENTRANCE FROM DAMAGE, WHILE NOT BLOCKING FLOW OF WATER THRU STRUCTURE. PROTECTION OF THE CURB AND GUTTER SHALL BE INCLUDED IN THE COST OF WORK AND NOT PAID FOR SEPARATELY.
3. GEOTEXTILE SHALL CONFORM TO SUBSECTION 712.08.
4. ALL MATERIALS AND LABOR TO COMPLETE THE VEHICLE TRACKING PAD SHALL BE INCLUDED IN THE COST OF WORK AND NOT PAID FOR SEPARATELY.
5. THE PAY ITEM NUMBER FOR VEHICLE TRACKING PAD (EACH) IS 208-00070.

VEHICLE TRACKING PAD

Computer File Information	
Creation Date: 07/31/19	
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

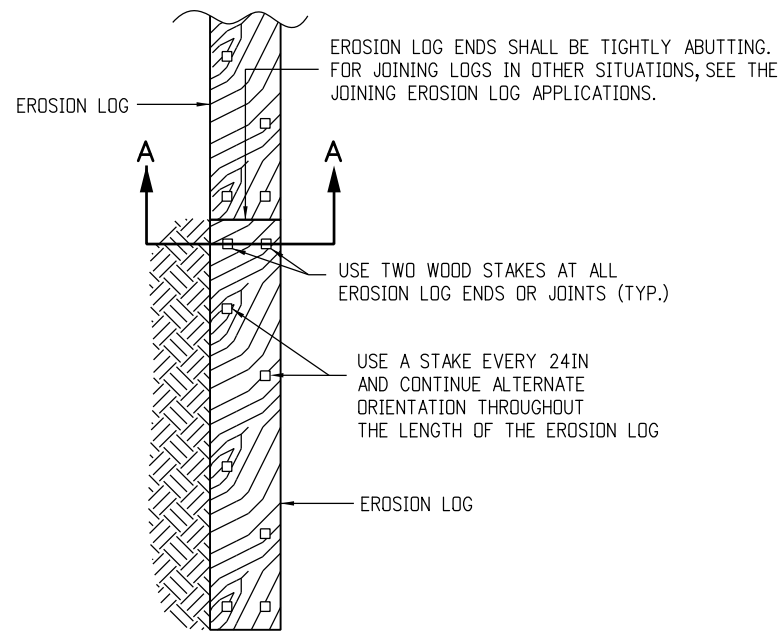
Colorado Department of Transportation
 2829 West Howard Place
 CDDT HQ, 3rd Floor
 Denver, CO 80204
 Phone: 303-757-9021 FAX: 303-757-9868

Project Development Branch **JBK**

**TEMPORARY
EROSION CONTROL**

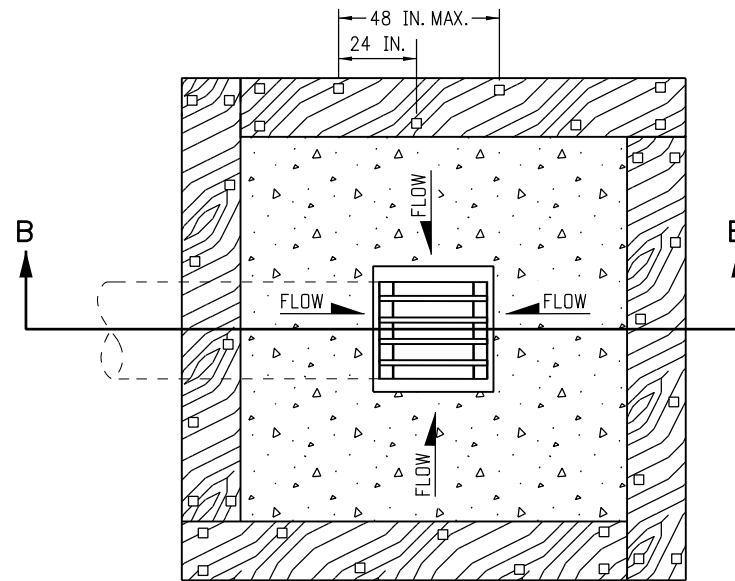
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO. M-208-1
Standard Sheet No. 1 of 11
Project Sheet Number:

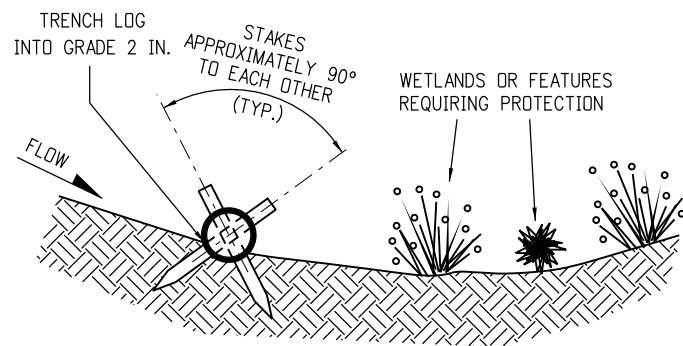


PLAN VIEW

EROSION LOGS PAY ITEMS	
NUMBER	DESCRIPTION
208-00012	TYPE 1 (9 IN.)
208-00002	TYPE 1 (12 IN.)
208-00013	TYPE 1 (20 IN.)
208-00007	TYPE 2 (8 IN.)
208-00008	TYPE 2 (12 IN.)
208-00009	TYPE 2 (18 IN.)
208-00022	TYPE 3 (9 IN.)
208-00023	TYPE 3 (12 IN.)
208-00024	TYPE 3 (20 IN.)



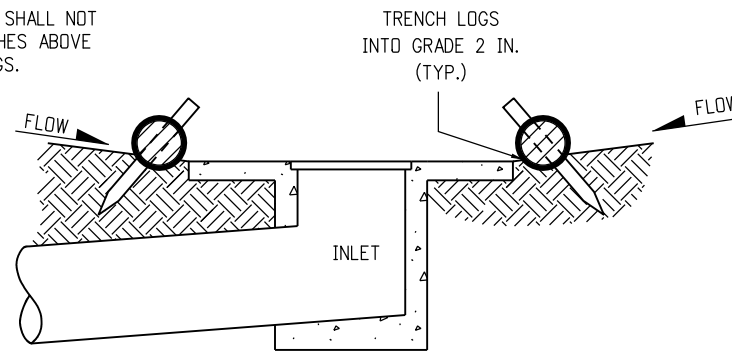
PLAN VIEW



SECTION A-A

TYPICAL STAKE INSTALLATION

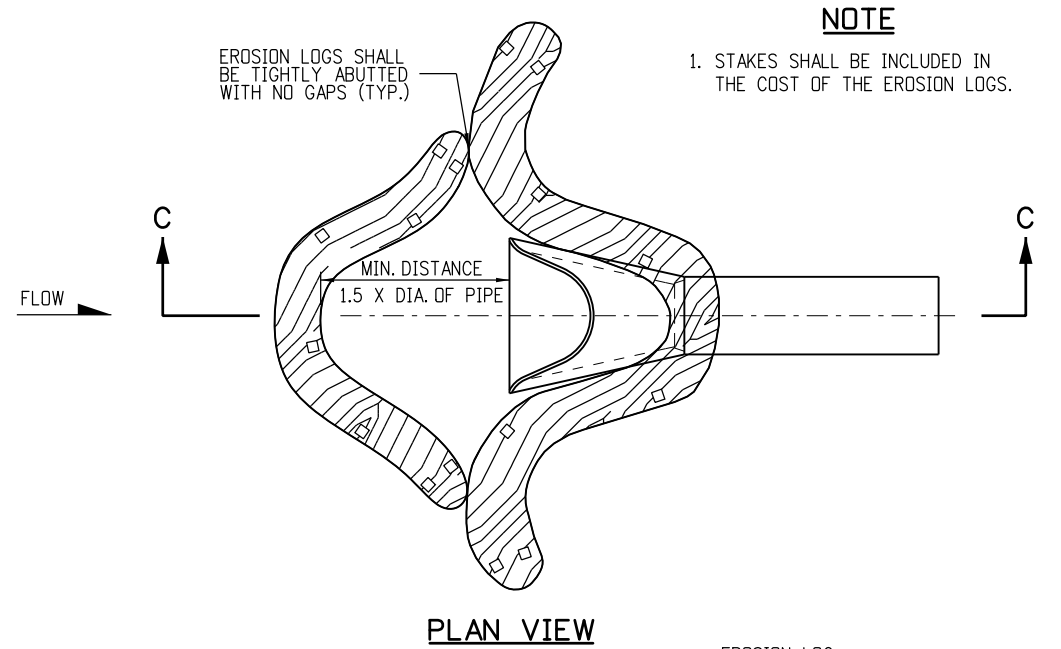
NOTE: THE TOPS OF ALL STAKES SHALL NOT EXTEND MORE THAN 2 INCHES ABOVE THE TOPS OF EROSION LOGS.



SECTION B-B

EROSION LOG FILTER AT DROP INLET

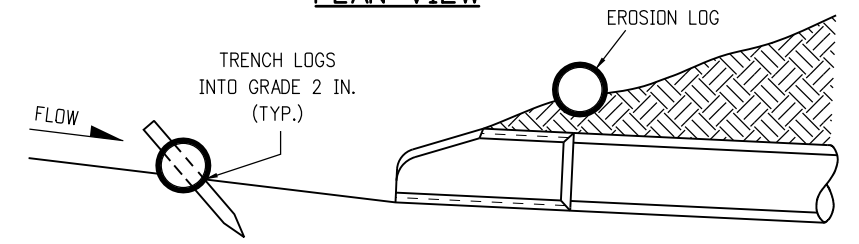
NOTE: LOCATE EROSION LOGS AT THE OUTSIDE EDGE OF THE CONCRETE APRON.



PLAN VIEW

NOTE

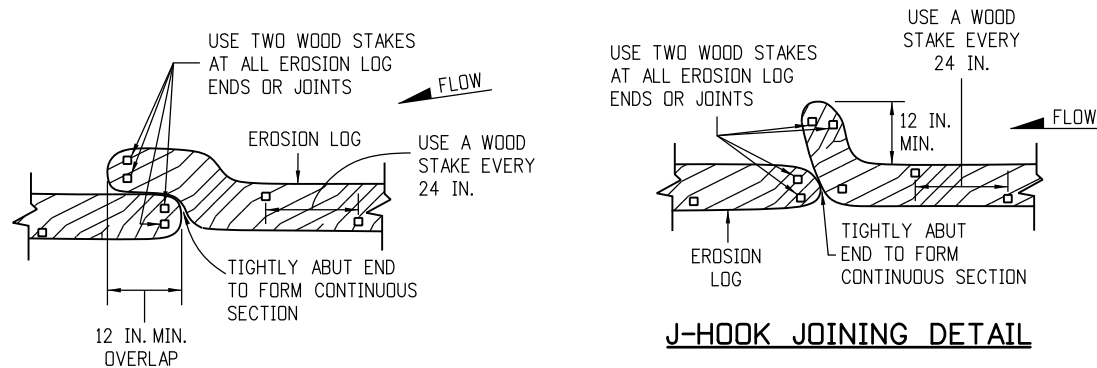
1. STAKES SHALL BE INCLUDED IN THE COST OF THE EROSION LOGS.



SECTION C-C
(NOT ALL LOGS SHOWN)

NOTE: TOP OF STAKE SHALL NOT EXTEND PAST TOP OF EROSION LOG MORE THAN 2 IN.

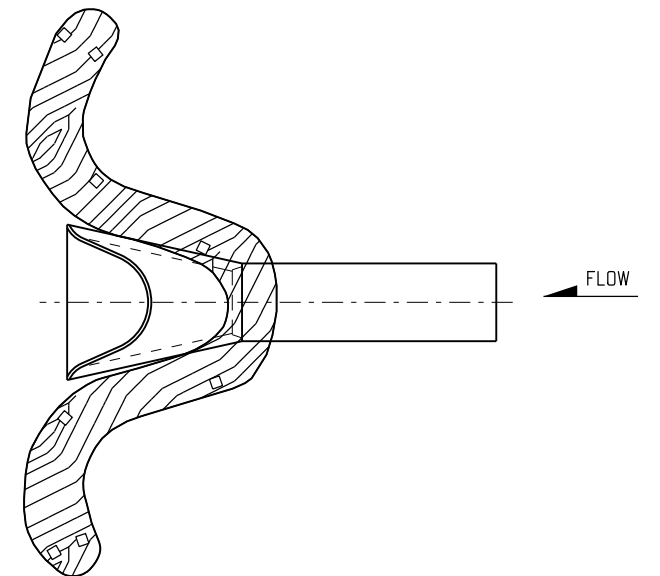
EROSION LOG CULVERT INLET PROTECTION



OVERLAP JOINING DETAIL

J-HOOK JOINING DETAIL

JOINING EROSION LOG APPLICATIONS



EROSION LOG CULVERT OUTLET PROTECTION

EROSION LOG APPLICATIONS

Computer File Information	
Creation Date: 07/31/19	
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

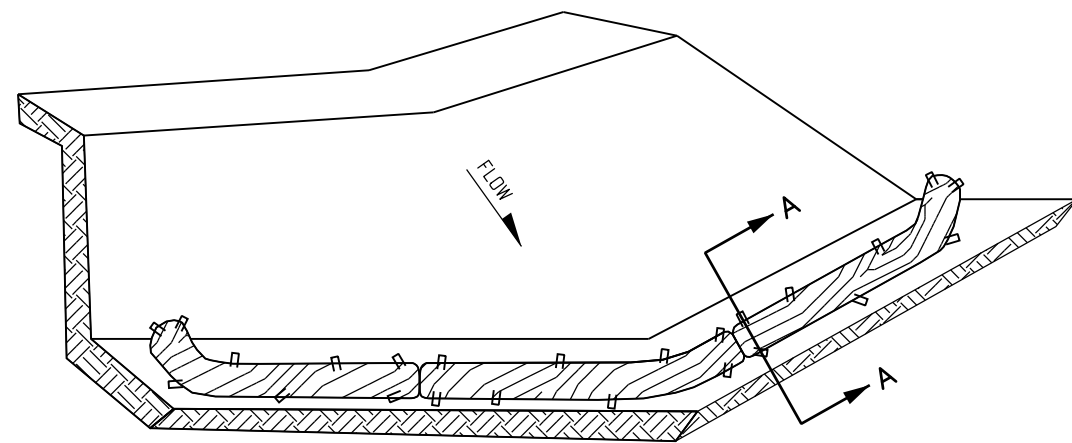
Colorado Department of Transportation
 2829 West Howard Place
 CDDT HQ, 3rd Floor
 Denver, CO 80204
 Phone: 303-757-9021 FAX: 303-757-9868
 Project Development Branch **JBK**

**TEMPORARY
 EROSION CONTROL**
 Issued by the Project Development Branch: July 31, 2019

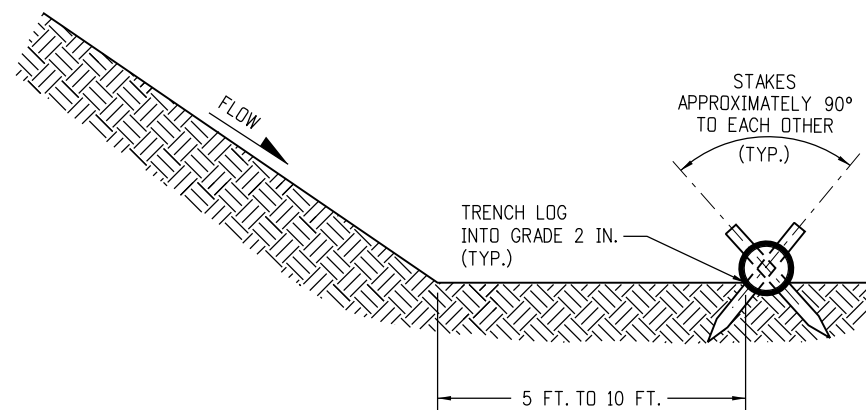
STANDARD PLAN NO.
M-208-1
 Standard Sheet No. 2 of 11
 Project Sheet Number:

NOTES

1. SILT FENCE SHALL HAVE A MAXIMUM DRAINAGE AREA OF ONE-QUARTER ACRE PER 100 FEET OF SILT FENCE LENGTH; MAXIMUM SLOPE LENGTH BEHIND BARRIER IS 100 FEET.
2. SILT FENCE USED AT TOE OF SLOPE SHALL BE PLACED 5 TO 10 FEET BEYOND TOE OF SLOPE TO PROVIDE STORAGE CAPACITY.
3. SILT FENCE SHALL BE PLACED PARALLEL TO THE CONTOUR WITH ENDS FLARED UP SLOPE.
4. THE MAXIMUM LENGTH OF EROSION LOGS OR SILT FENCES WITHOUT A FLARED END TURNING UPSLOPE IS 150 FEET.



ISOMETRIC VIEW



SECTION A-A

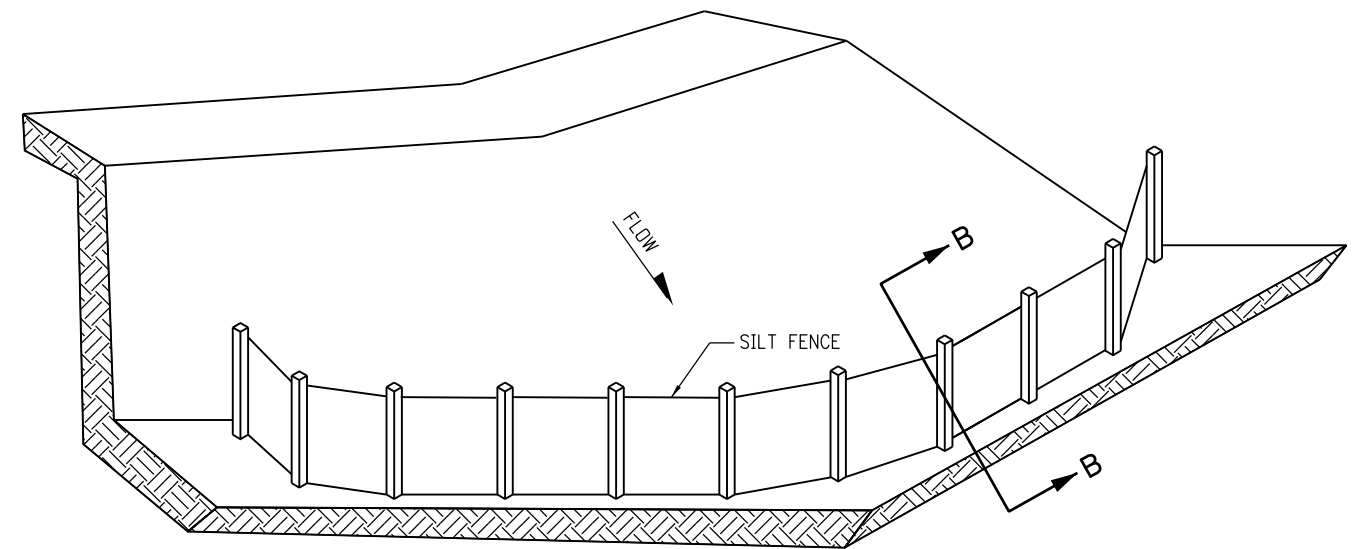
NOTE: THE TOPS OF ALL STAKES SHALL NOT EXTEND MORE THAN 2 INCHES ABOVE THE TOPS OF EROSION LOGS.

EROSION LOGS PAY ITEMS	
NUMBER	DESCRIPTION
208-00012	TYPE 1 (9 IN.)
208-00002	TYPE 1 (12 IN.)
208-00013	TYPE 1 (20 IN.)
208-00007	TYPE 2 (8 IN.)
208-00008	TYPE 2 (12 IN.)
208-00009	TYPE 2 (18 IN.)
208-00022	TYPE 3 (9 IN.)
208-00023	TYPE 3 (12 IN.)
208-00024	TYPE 3 (20 IN.)

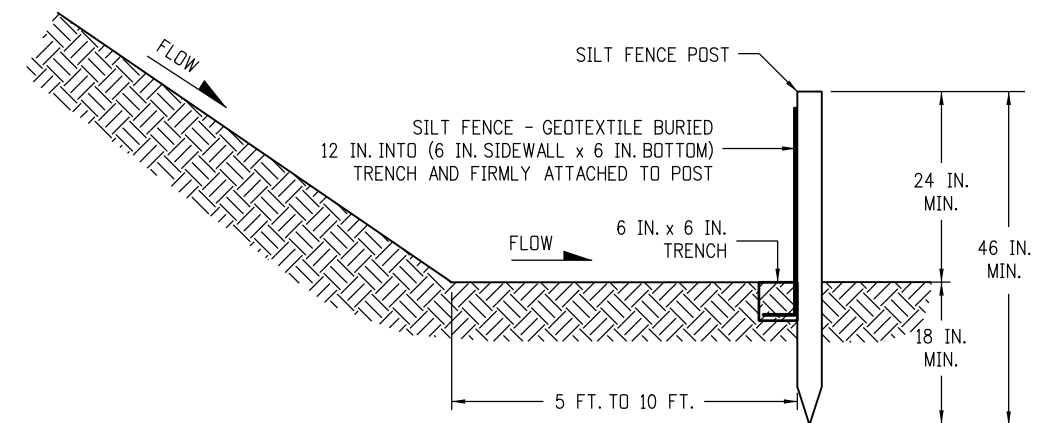
NOTES:

1. EROSION LOGS USED AT TOE OF SLOPE SHALL BE PLACED 5 TO 10 FEET BEYOND TOE OF SLOPE TO PROVIDE STORAGE CAPACITY.
2. EROSION LOGS SHALL BE PLACED ON THE CONTOUR WITH ENDS FLARED UP SLOPE.
3. SEE SHEET 2 OF 11 FOR JOINING LOGS DETAIL.

EROSION LOG TOE OF SLOPE PROTECTION



ISOMETRIC VIEW



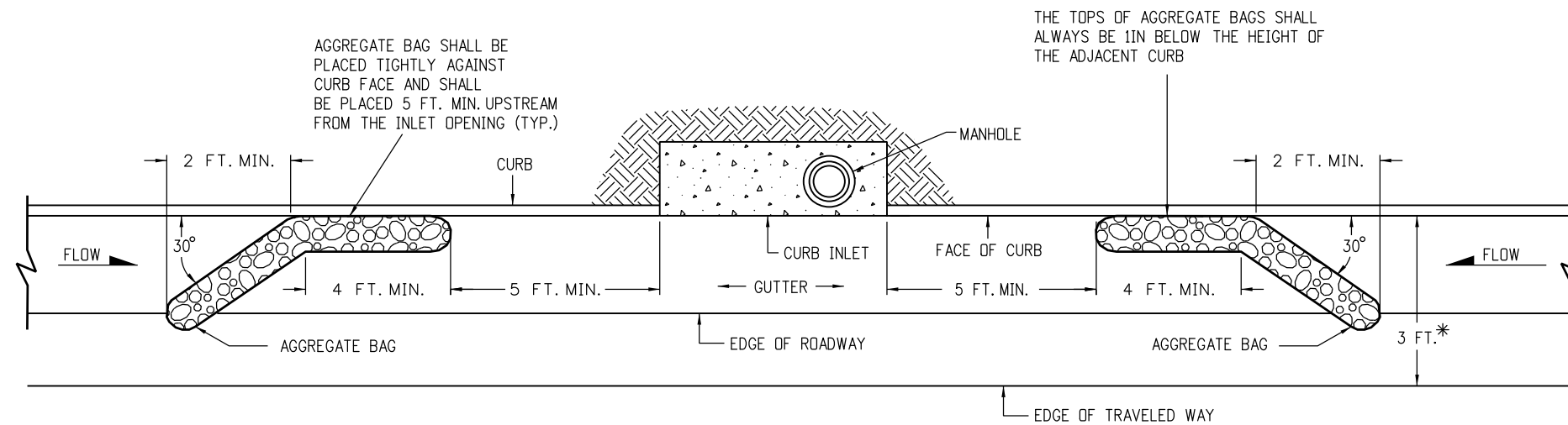
SECTION B-B

SILT FENCE TOE OF SLOPE PROTECTION

NOTE: THE PAY ITEM NUMBER FOR SILT FENCE (LF) IS 208-00020.

TOE OF SLOPE PROTECTION APPLICATIONS

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.	
Creation Date: 07/31/19	(R-X)	Date:	Comments:			Issued by the Project Development Branch: July 31, 2019	M-208-1
Designer Initials: JBK	(R-X)			JBK			
Last Modification Date: 07/31/19	(R-X)						
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)					Project Sheet Number:	



AGGREGATE BAG SHALL BE PLACED TIGHTLY AGAINST CURB FACE AND SHALL BE PLACED 5 FT. MIN. UPSTREAM FROM THE INLET OPENING (TYP.)

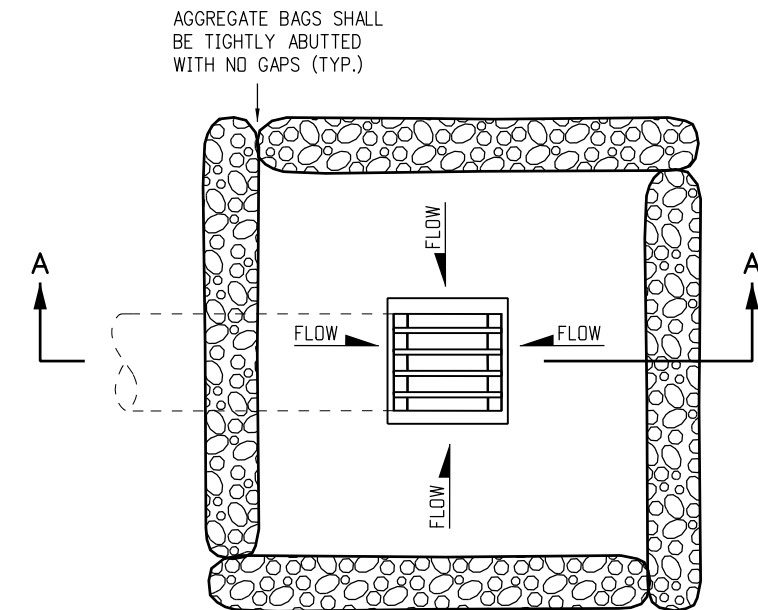
THE TOPS OF AGGREGATE BAGS SHALL ALWAYS BE 1IN BELOW THE HEIGHT OF THE ADJACENT CURB

PLAN VIEW

* NOTE: USE AGGREGATE BAGS ONLY WHEN THERE IS A MINIMUM CLEARANCE OF 3 FEET FROM THE EDGE OF THE TRAVELED WAY (INCLUDING CONDITIONS DURING DETOURS) TO THE FACE OF CURB.

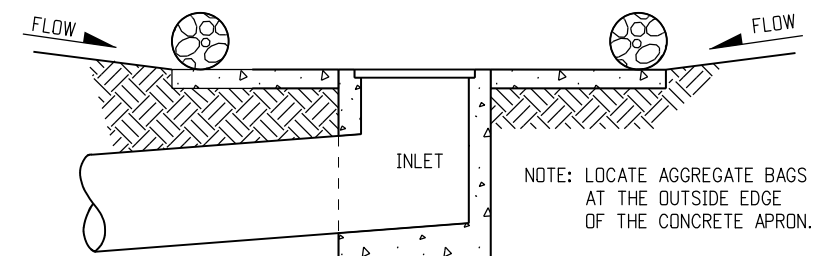
LENGTH (L) OF INLET FT.	NUMBER OF AGGREGATE BAGS UPSTREAM OF INLET
0 - 5	1
6 - 10	2
L > 10	3

AGGREGATE BAGS AT STORM DRAIN INLET (TYPE I)



AGGREGATE BAGS SHALL BE TIGHTLY ABUTTED WITH NO GAPS (TYP.)

PLAN VIEW



NOTE: LOCATE AGGREGATE BAGS AT THE OUTSIDE EDGE OF THE CONCRETE APRON.

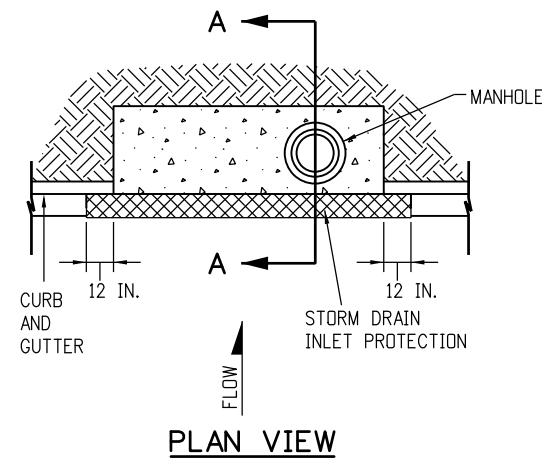
SECTION A-A

AGGREGATE BAGS AT DROP INLET

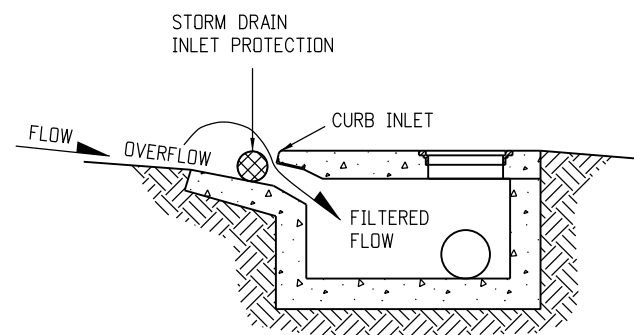
AGGREGATE BAG APPLICATIONS

NOTE: THE PAY ITEM NUMBER FOR AGGREGATE BAG (LF) IS 208-00035

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.	
Creation Date: 07/31/19	(R-X)	Date:	Comments			Issued by the Project Development Branch: July 31, 2019	M-208-1
Designer Initials: JBK	(R-X)						
Last Modification Date: 07/31/19	(R-X)						
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)					Project Sheet Number:	



PLAN VIEW

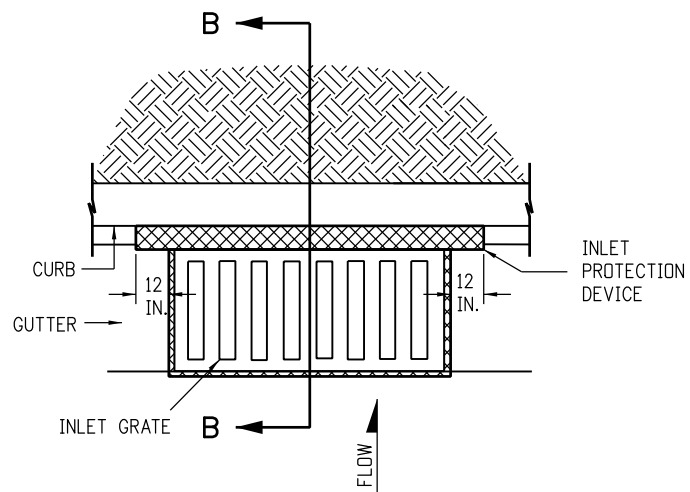


SECTION A-A

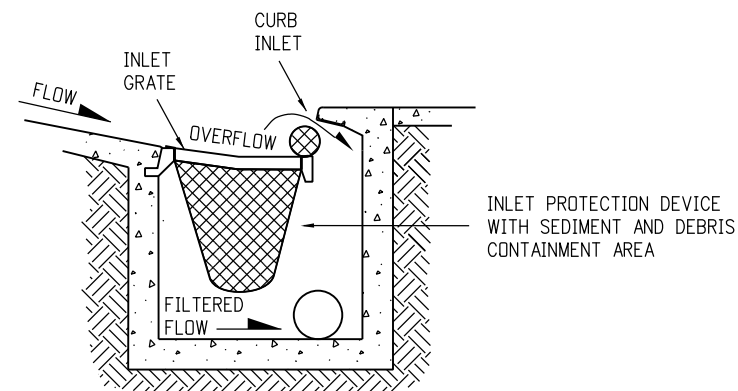
STORM DRAIN INLET PROTECTION (TYPE I)

NOTES:

1. INLET PROTECTION DEVICE SHALL EXTEND 12 INCHES PAST EACH END OF THE INLET.
2. THE PAY ITEM NUMBERS FOR STORM DRAIN INLET PROTECTION (TYPE I) ARE 208-00051 (LF), 208-00053 84 INCHES (EACH), 208-00057 144 INCHES (EACH), AND 208-00058 204 INCHES (EACH).
3. FOR STORM DRAIN INLET TYPES I AND II, IF THERE IS A MINIMUM CLEARANCE OF 3 FEET FROM THE EDGE OF THE TRAVELED WAY TO THE FACE OF CURB, USE THE AGGREGATE BAGS AT STORM DRAIN INLET (TYPE I) DETAIL ON SHEET 4 INSTEAD.



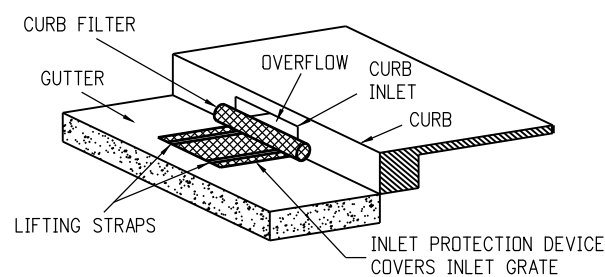
PLAN VIEW



SECTION B-B

OPTION A

STORM DRAIN INLET PROTECTION (TYPE II)

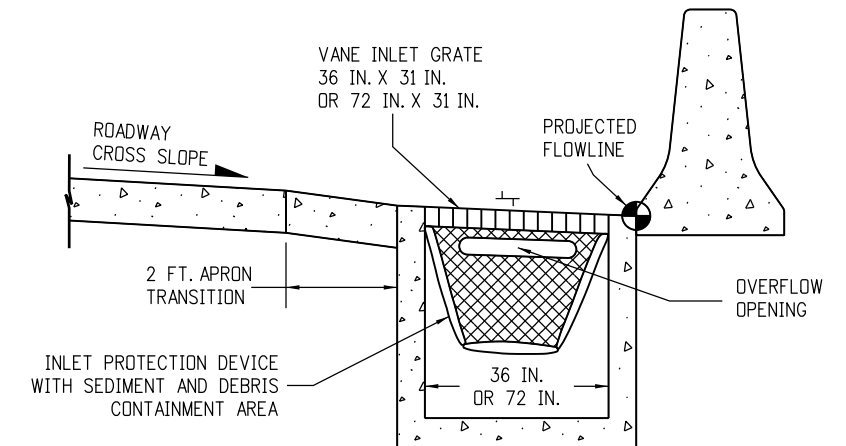


ISOMETRIC VIEW

OPTION B

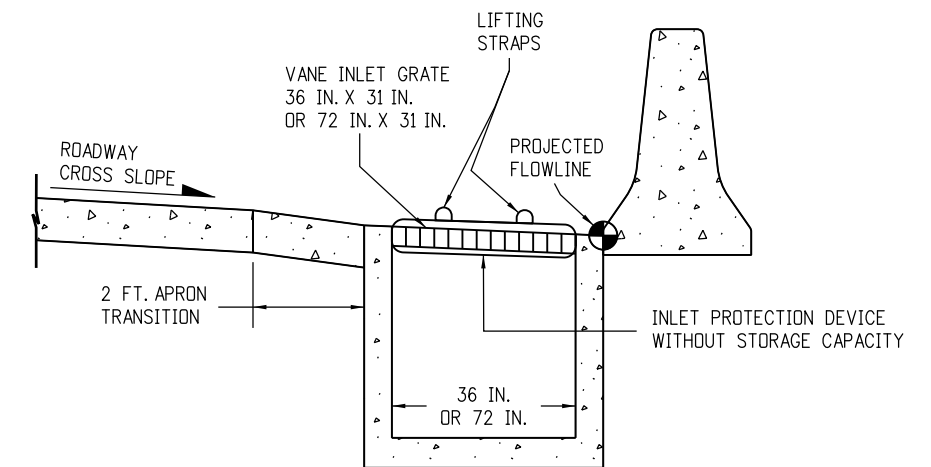
STORM DRAIN INLET PROTECTION (TYPE II)

NOTE: THE PAY ITEM NUMBERS FOR STORM DRAIN INLET PROTECTION (TYPE II) ARE 208-00054 (EACH).



OPTION A

STORM DRAIN INLET PROTECTION (TYPE III)



OPTION B

STORM DRAIN INLET PROTECTION (TYPE III)

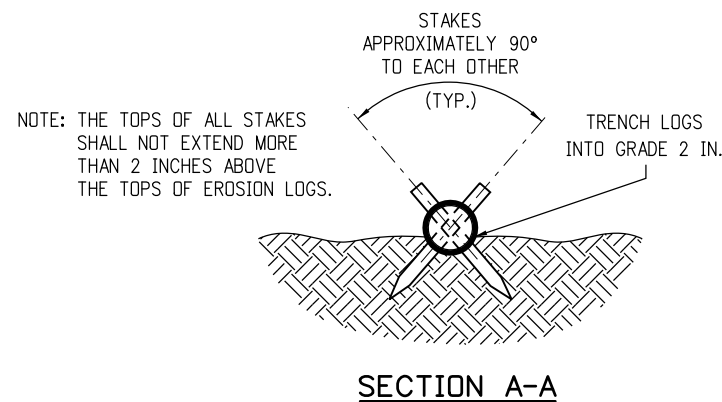
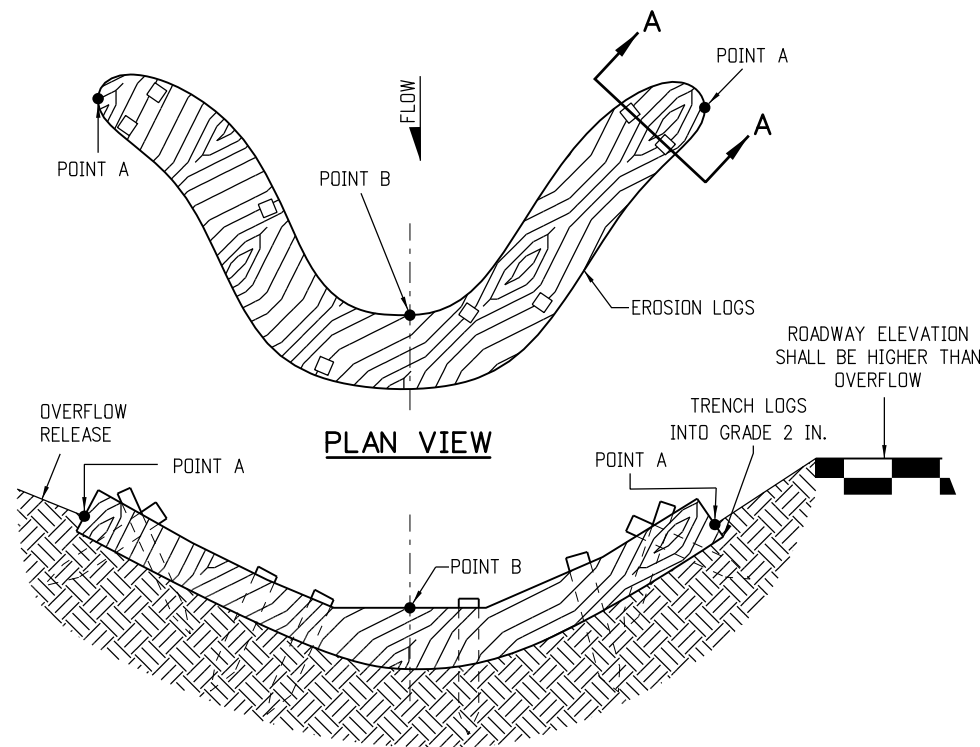
NOTE: THE PAY ITEM NUMBER FOR STORM DRAIN INLET PROTECTION (TYPE III) (EACH) IS 208-00056.

STORM DRAIN INLET PROTECTION TYPES

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	<h1>TEMPORARY EROSION CONTROL</h1>	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments			M-208-1	
Designer Initials: JBK	(R-X)					Standard Sheet No. 5 of 11	
Last Modification Date: 07/31/19	(R-X)						
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)			Project Sheet Number:			

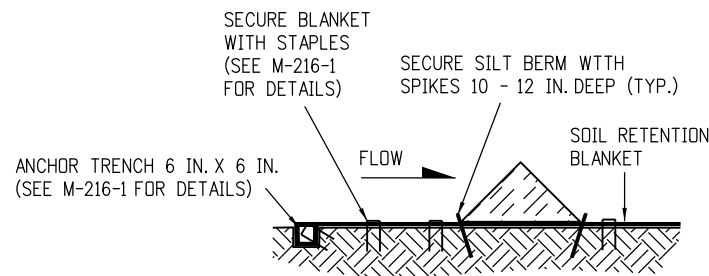
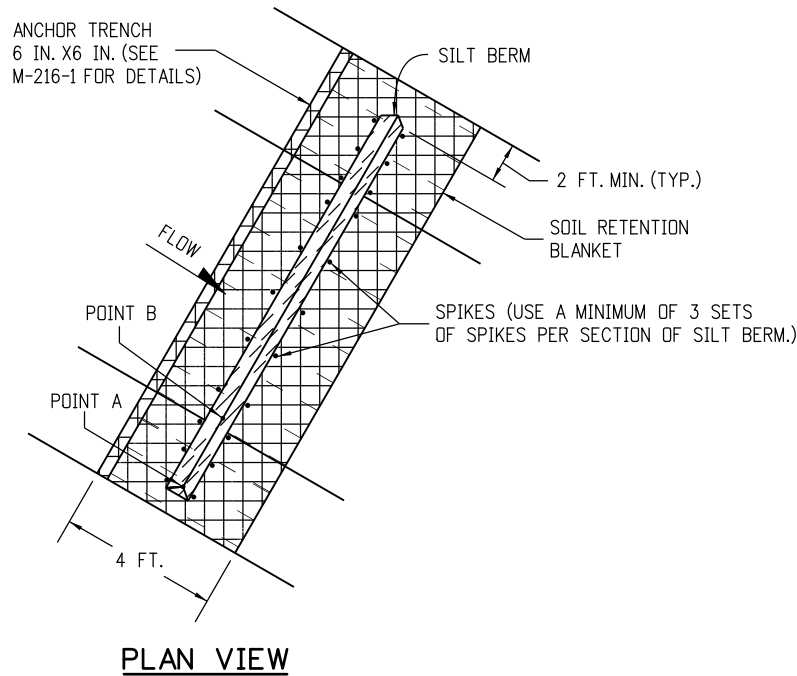
Issued by the Project Development Branch: July 31, 2019

JBK

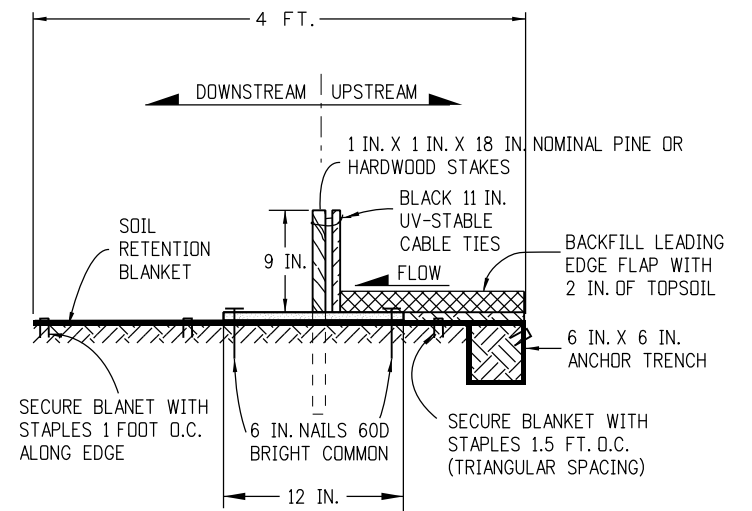


- NOTES:
1. EROSION LOGS SHALL BE EMBEDDED 2 INCHES INTO THE SOIL.
 2. EROSION LOGS SHALL BE TIGHTLY ABUTTED WITH NO GAPS.
 3. V-SHAPED TEMPORARY DITCHES SHALL NOT BE USED. DITCHES SHALL BE GRADED IN A PARABOLIC OR TRAPEZOIDAL SHAPE.

EROSION LOG INSTALLATION

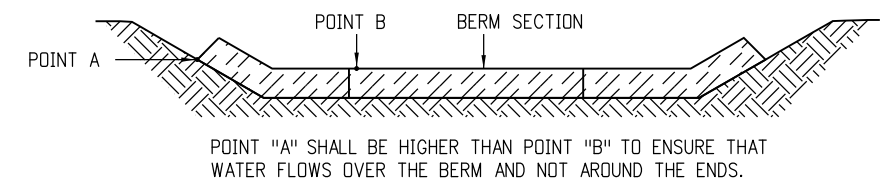


SILT BERM (1) SECTION VIEW



- NOTES:
1. MINIMUM 4 NAILS PER SEGMENT (UPSTREAM).
 2. MINIMUM 2 NAILS PER SEGMENT (DOWNSTREAM).
 3. MINIMUM 2 WOOD STAKES PER SEGMENT.

SILT BERM (2) SECTION VIEW

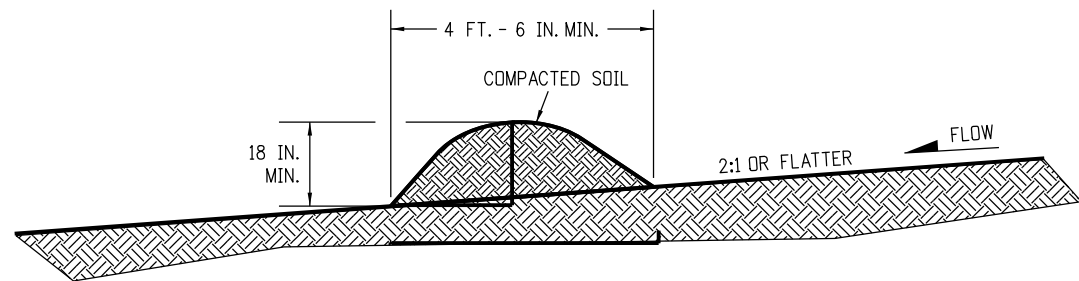


- NOTES
1. ANCHOR SOIL RETENTION BLANKET INTO TRENCH WITH 8 INCHES MIN. STAPLES PLACED AT 1 FOOT INTERVALS ALONG EDGE.
 2. FILL AND COMPACT TRENCH.
 3. SECTIONS OF THE SILT BERM SHALL BE OVERLAPPED WITH NO GAPS.
 4. FOR SLOPE AND CHANNEL SPACING SEE THE "SECTION VIEW ALONG DITCH FLOWLINE" DETAIL ON SHEET 11 OF 11.
 5. SOIL RETENTION BLANKET SHALL ALWAYS BE REQUIRED.
 6. THE PAY ITEM NUMBER FOR SILT BERM (LF) IS 208-00004.

SILT BERM INSTALLATION

DRAINAGE DITCH APPLICATIONS

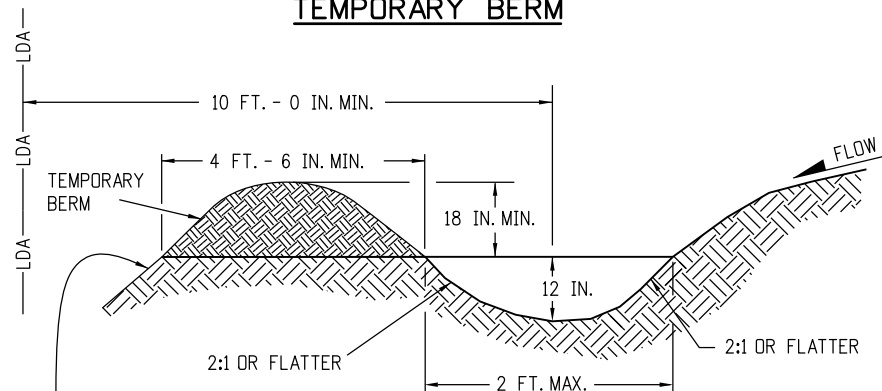
Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments:			M-208-1	
Designer Initials: JBK	(R-X)					Standard Sheet No. 6 of 11	
Last Modification Date: 07/31/19	(R-X)					Project Sheet Number:	
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		(R-X)		Project Development Branch	Issued by the Project Development Branch: July 31, 2019		



NOTES:

1. BERMS SHALL HAVE A HEIGHT OF 18 INCHES, SIDE SLOPES OF 2:1 OR FLATTER AND A MINIMUM BASE WIDTH OF 4 FT. -6 IN.
2. BERMS SHALL BE USED TO INTERCEPT AND DIVERT DRAINAGE TO A DESIGNATED OUTLET.
3. BERMS SHALL NOT BE USED WHERE DRAINAGE AREA EXCEEDS 10 ACRES.
4. BERMS SHALL BE CONSTRUCTED OUT OF ACCEPTABLE MATERIAL THAT CAN BE COMPACTED AND RECEIVE AT A MINIMUM HEAVY EQUIPMENT WHEEL ROLLED COMPACTION.
5. TEMPORARY BERMS SHALL BE CONSTRUCTED OUT OF EMBANKMENT (SUBSOIL) AND IN NO CIRCUMSTANCE CONSTRUCTED OUT OF SALVAGED TOPSOIL.
6. THE PAY ITEM NUMBER FOR TEMPORARY BERM (LF) IS 208-00300.

TEMPORARY BERM

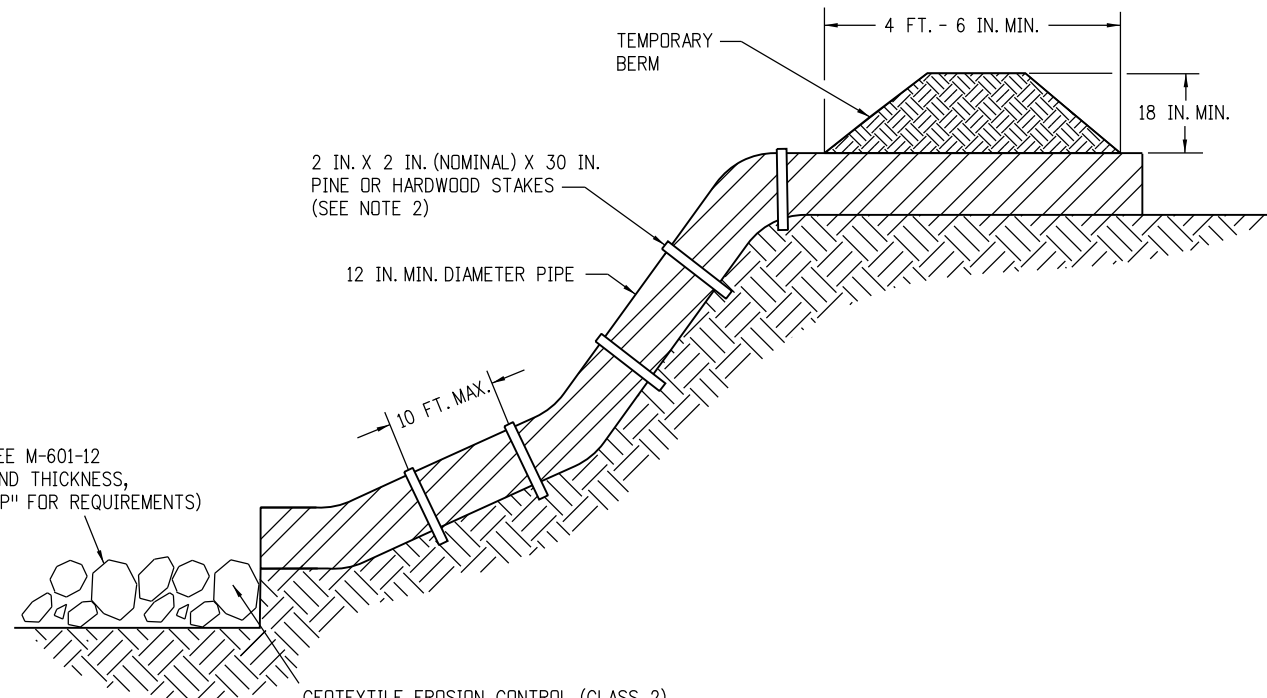


FOR BERMS TALLER THAN 2 FT.,
INSTALL TOE OF SLOPE CONTROL MEASURES.
SEE SHEET 3 OF 11 FOR DETAILS.

NOTES:

1. TEMPORARY DIVERSION DITCHES SHALL BE CONSTRUCTED ACROSS THE SLOPE TO INTERCEPT RUNOFF AND DIRECT IT TO A STABLE OUTLET OR SEDIMENT TRAP.
2. USE THE TEMPORARY DIVERSION DITCH IMMEDIATELY ABOVE A NEW CUT, FILL SLOPE, OR AROUND THE PERIMETER OF A DISTURBED AREA.
3. THE GRADIENT ALONG THE FLOW PATH SHALL HAVE A POSITIVE GRADE TO ASSURE DRAINAGE, BUT SHALL NOT BE SO STEEP AS TO RESULT IN EROSION DUE TO HIGH VELOCITY.
4. THE DIVERSION FLOWLINE SHALL ALWAYS BE LOCATED A MINIMUM 10 FEET FROM THE OUTSIDE LIMITS OF DISTURBED AREA BOUNDARY.
5. THE PAY ITEM NUMBER FOR TEMPORARY DIVERSION (LF) IS 208-00301.

TEMPORARY DIVERSION



* RIPRAP OUTLET PROTECTION (SEE M-601-12 FOR MIN. HORIZONTAL LAYOUT AND THICKNESS, AND SPECIFICATION 506 "RIPRAP" FOR REQUIREMENTS)

* RIPRAP SIZE $D_{50} = 6$ IN. OR AS SHOWN ON THE PLANS.

GEOTEXTILE EROSION CONTROL (CLASS 2) SHALL ALWAYS BE REQUIRED

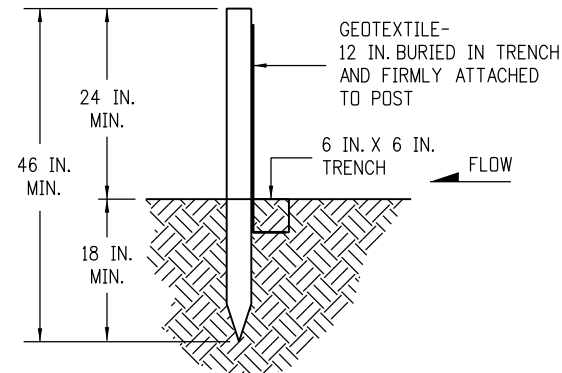
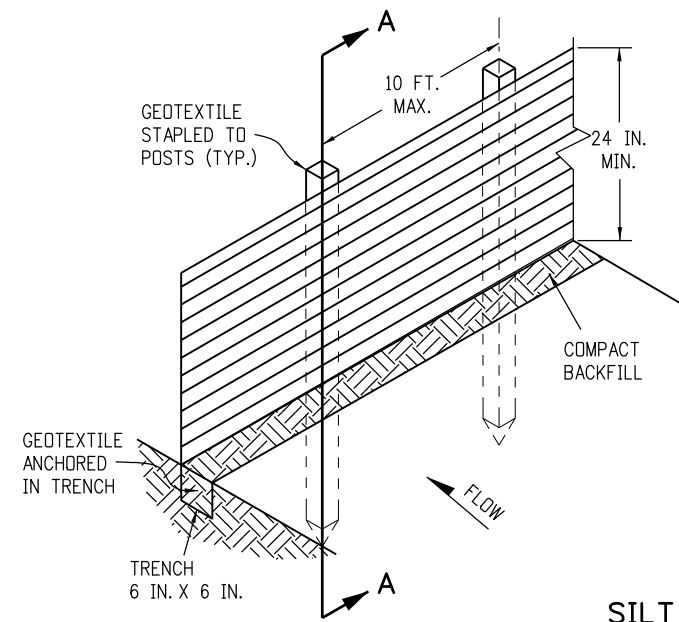
NOTES:

1. ANCHOR SIZE VARIES ACCORDING TO PIPE SIZE
2. TO SECURE THE PIPE, DRIVE STAKES INTO GROUND, THEN TIE A 12 GAUGE WIRE BETWEEN THEM ABOVE AND ACROSS THE PIPE'S WIDTH.
3. THE OUTLET SHALL BE ALIGNED WITH THE FLOW DIRECTION OF THE EXISTING GRADE. PERPENDICULAR DISCHARGE TO A CHANNEL SHALL NOT BE ACCEPTABLE.
4. THE GRADE AROUND THE INLET TO THE PIPE SHALL BE COMPACTED.
5. THE PAY ITEM NUMBER FOR TEMPORARY SLOPE DRAINS (LF) IS 208-00060.

TEMPORARY SLOPE DRAINS

GRADING APPLICATIONS

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments:			M-208-1	
Designer Initials: JBK	(R-X)					Standard Sheet No. 7 of 11	
Last Modification Date: 07/31/19	(R-X)						
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)			Project Development Branch	JBK	Issued by the Project Development Branch: July 31, 2019	
						Project Sheet Number:	

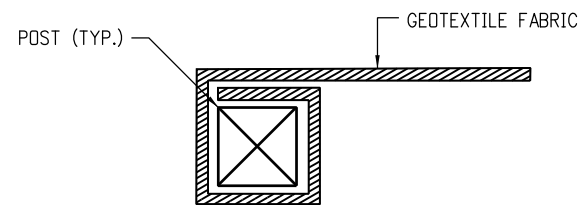


SECTION A-A

SILT FENCE

NOTES:

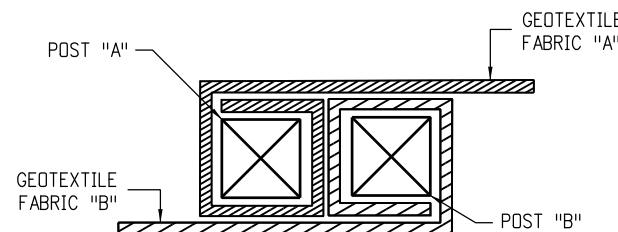
1. GEOTEXTILE SHALL BE ATTACHED TO WOOD POSTS WITH THREE OR MORE STAPLES PER POST. STAPLES SHALL BE HEAVY DUTY WIRE AND AT LEAST 1 INCH LONG.
2. WOOD POST SHALL BE 1 IN. X 1 IN. NOMINAL.
3. THE PAY ITEM NUMBER FOR SILT FENCE (LF) IS 208-00020.
4. THE SILT FENCE SHALL BE PLACED ON THE CONTOUR (AT THE SAME ELEVATION ±6 IN.). THE ENDS SHALL BE FLARED UP SLOPE (MINIMUM ELEVATION GAIN OF 18 IN.).



END SECTION DETAIL (PLAN VIEW)

NOTE:

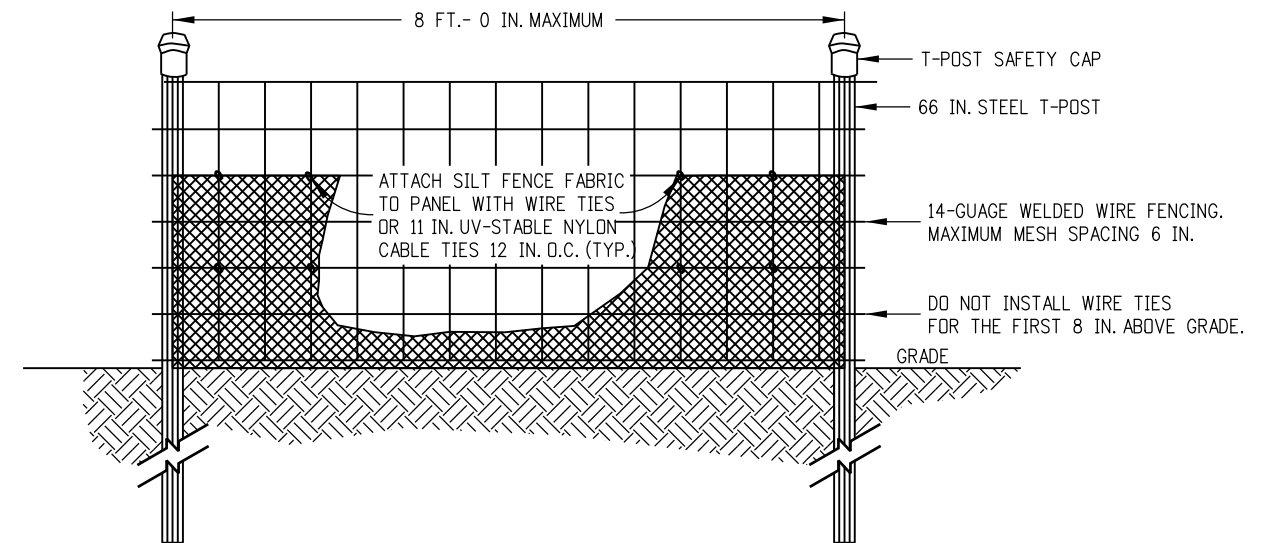
1. THE END OF THE SILT FENCE FABRIC SHALL BE WRAPPED APPROX. 6 INCHES AROUND A WOODEN POST ONE FULL TURN, THEN SECURED ALONG THE POST WITH 6 HEAVY DUTY WIRE STAPLES AT LEAST 1 INCH LONG.



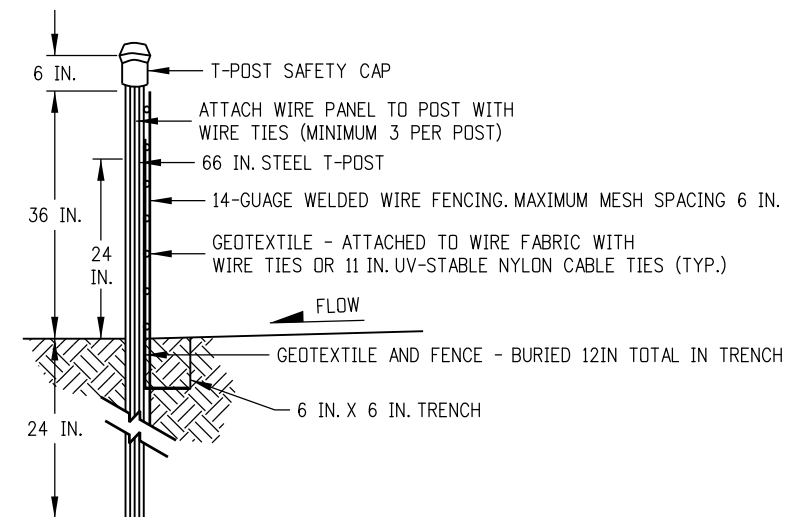
JOINING SECTION DETAIL (PLAN VIEW)

NOTES:

1. THE ENDS OF THE SILT FENCE FABRIC SHALL BE JOINED TOGETHER BY WRAPPING APPROX. 6 INCHES OF EACH END AROUND A WOODEN POST ONE FULL TURN, THEN SECURED ALONG THE POST WITH 6 HEAVY DUTY WIRE STAPLES AT LEAST 1 INCH LONG.
2. POSTS SHALL BE TIGHTLY ABUTTED WITH NO GAPS TO PREVENT POTENTIAL FLOW-THROUGH OF SEDIMENT AT JOINT.



ELEVATION VIEW



SIDE VIEW

NOTES:

1. THE ENDS OF THE SILT FENCE FABRIC SHALL BE JOINED TOGETHER BY WRAPPING APPROX. 6 INCHES OF EACH END AROUND A STEEL T-POST, THEN SECURED ALONG THE POST WITH WIRE TIES (MINIMUM 3 PER POST).
2. POSTS SHALL BE TIGHTLY ABUTTED WITH NO GAPS TO PREVENT POTENTIAL FLOW-THROUGH OF SEDIMENT AT JOINT.
3. SILT FENCES SHALL NOT BE USED FOR CHECK DAMS.
4. THE PAY ITEM NUMBER FOR SILT FENCE (REINFORCED) (LF) IS 208-00021.

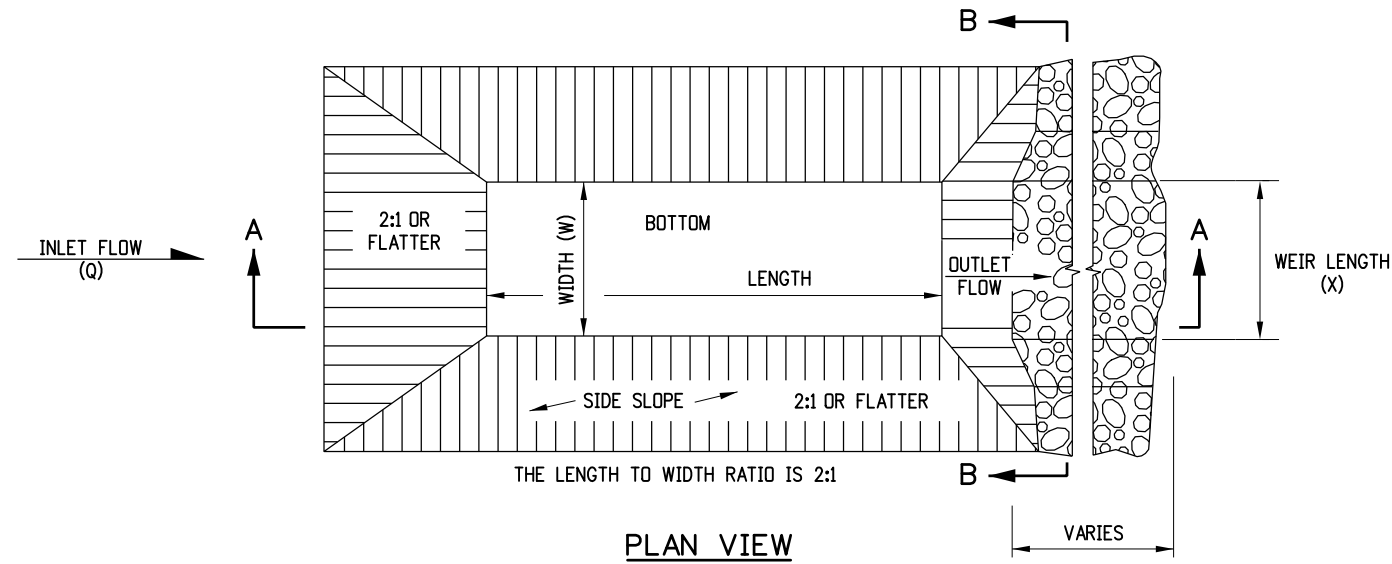
SILT FENCE (REINFORCED)

SILT FENCE APPLICATIONS

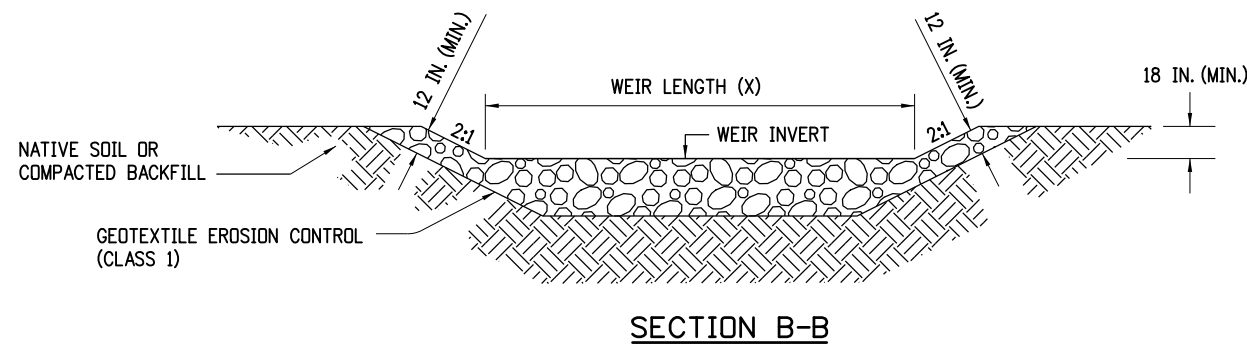
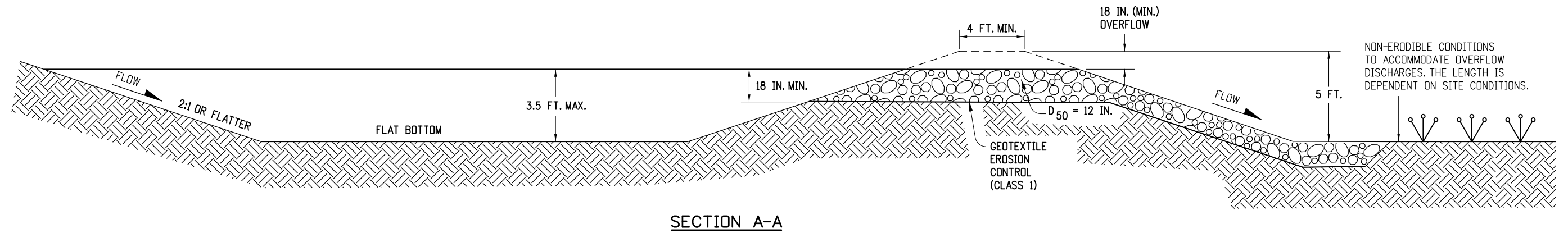
Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments			M-208-1	
Designer Initials: JBK	(R-X)					Standard Sheet No. 8 of 11	
Last Modification Date: 07/31/19	(R-X)						
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)			Project Sheet Number:			

Issued by the Project Development Branch: July 31, 2019

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- NOTES**
1. THE MAXIMUM DRAINAGE AREA IS 5 ACRES.
 2. THE MAXIMUM STRUCTURE LIFE IS 2 YEARS.
 3. THE STORAGE AREA IS 1800 CUBIC FEET PER ACRE.
 4. THE MAXIMUM EMBANKMENT HEIGHT SHALL BE 5 FT. MEASURED ON THE DOWNSTREAM SIDE.
 5. THE LENGTH/WIDTH RATIO MAY BE ADJUSTED TO MEET SITE CONDITIONS WHEN APPROVED BY THE ENGINEER.
 6. WIDTH (W) OF SEDIMENT TRAP IS APPROXIMATELY EQUAL TO THE WEIR LENGTH (X).
 7. SEDIMENT TRAP DESIGN SHALL BE APPROVED BY THE ENGINEER.
 8. THE DOWN GRADE FROM WEIR SHALL BE STABLE AND NON-ERODIBLE.
 9. THE PAY ITEM NUMBER FOR SEDIMENT TRAP (LF) IS 208-00033.

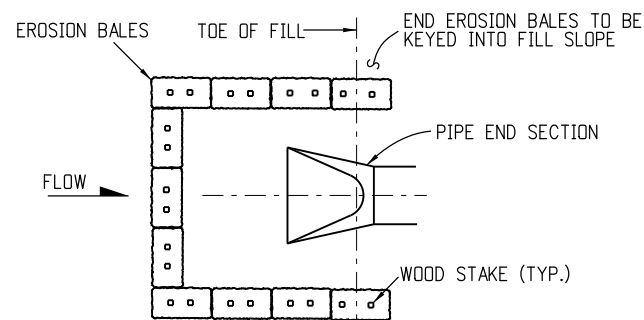
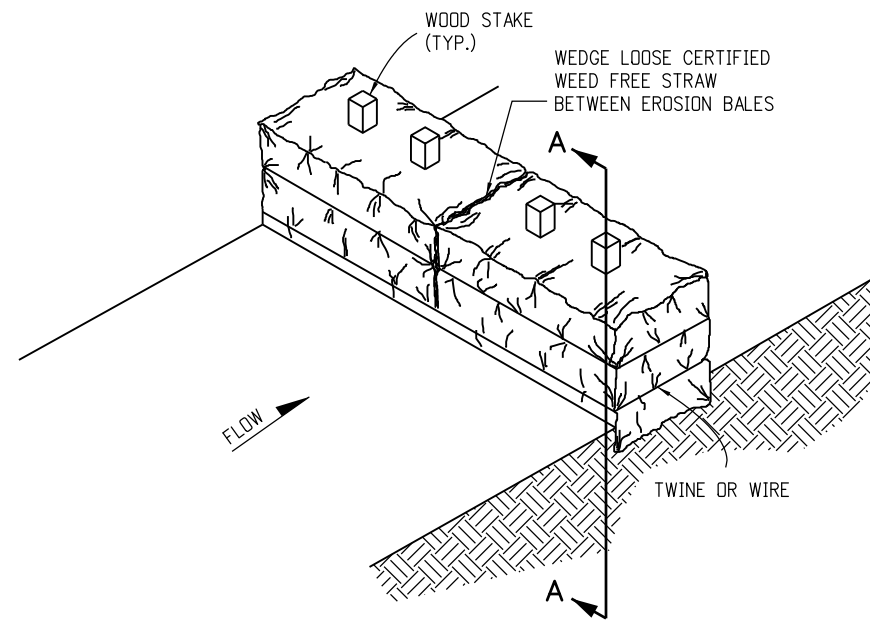
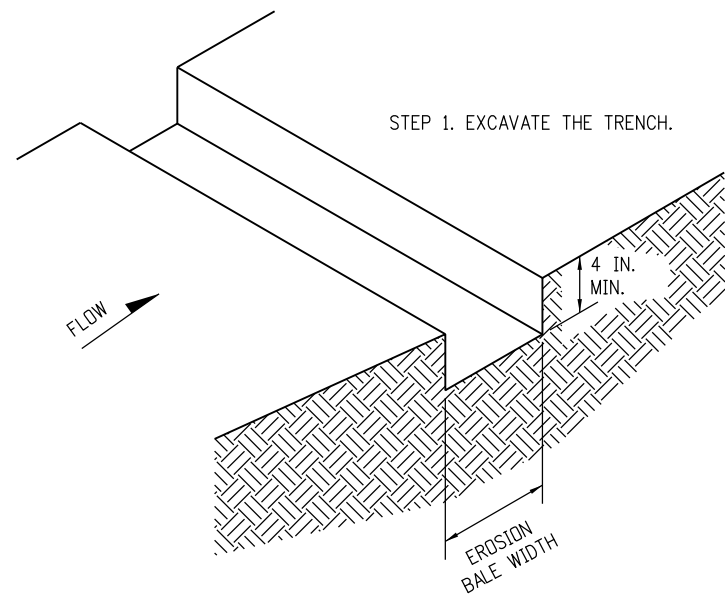


DRAINAGE AREA (ACRES)	WEIR LENGTH (FEET)
1	4
2	6
3	8
4	10
5	12

WEIR LENGTH TABLE

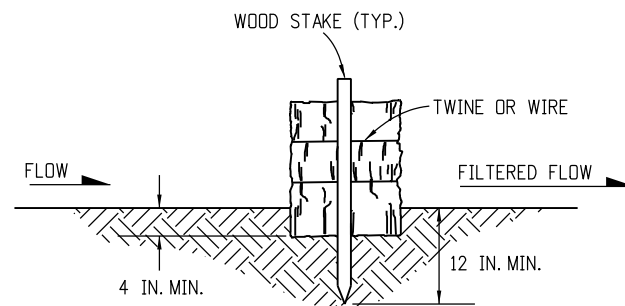
SEDIMENT TRAP

Computer File Information		Sheet Revisions		Colorado Department of Transportation		TEMPORARY EROSION CONTROL		STANDARD PLAN NO.	
Creation Date: 07/31/19		Date: _____		2829 West Howard Place				M-208-1	
Designer Initials: JBK		Comments: _____		CDOT HQ, 3rd Floor		Standard Sheet No. 9 of 11		Project Sheet Number: _____	
Last Modification Date: 07/31/19		_____		Denver, CO 80204					
Detailer Initials: LTA		_____		Phone: 303-757-9021 FAX: 303-757-9868		Issued by the Project Development Branch: July 31, 2019			
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		_____		Project Development Branch					
				JBK					



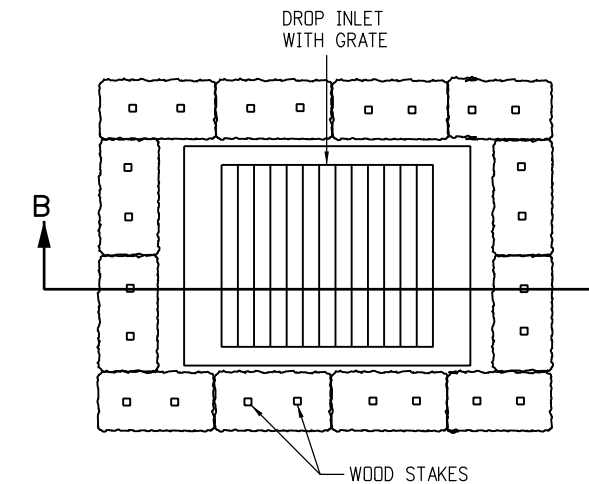
PLAN VIEW

EROSION BALES CULVERT INLET PROTECTION

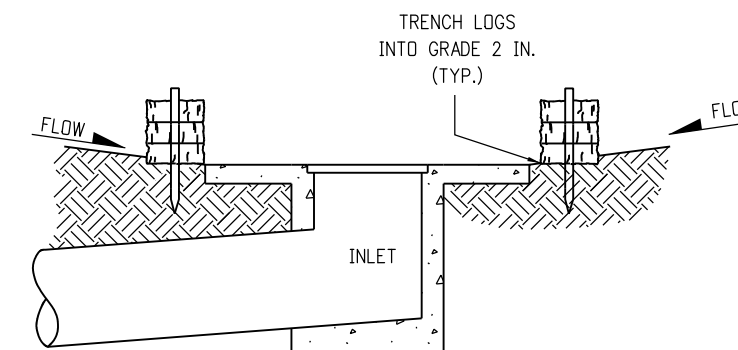


SECTION A-A

EROSION BALES TRENCHING AND STAKING



PLAN VIEW



SECTION B-B

NOTE: LOCATE EROSION BALES AT THE OUTSIDE EDGE OF THE CONCRETE APRON.

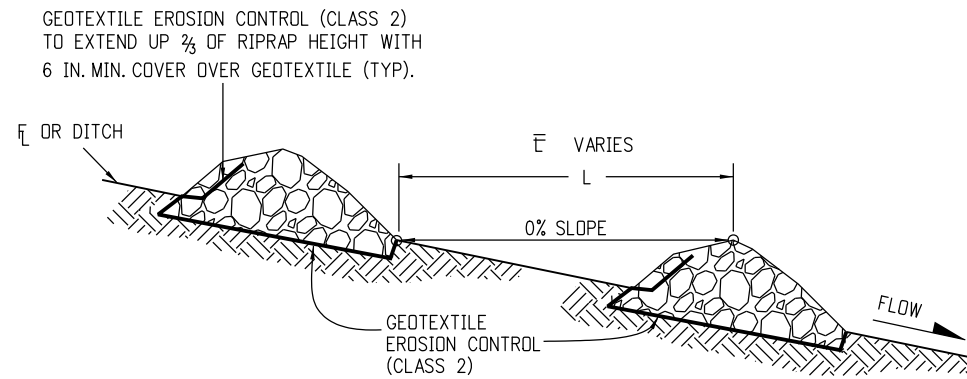
EROSION LOG FILTER AT DROP INLET

NOTES

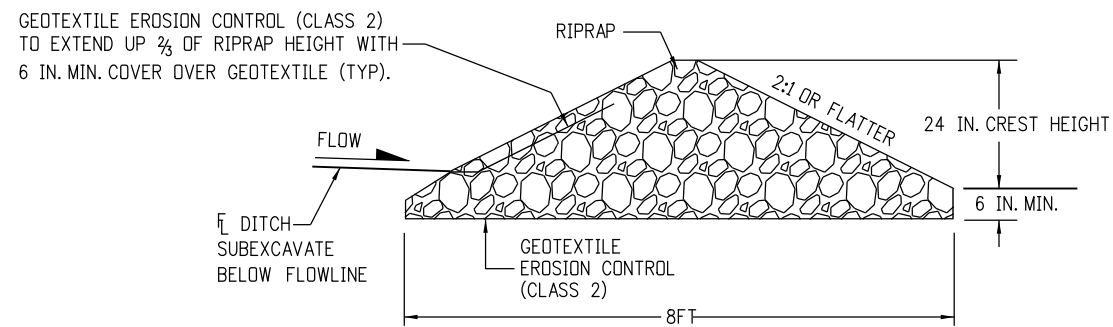
1. STAKES SHALL BE WOOD AND SHALL BE 2 IN. X 2 IN. X 30 IN. NOMINAL.
2. EROSION BALES SHALL BE 18 IN. X 18 IN. X 36 IN.
3. EROSION BALES SHALL BE ENTRENCHED 4 IN. MINIMUM INTO THE SOIL, TIGHTLY ABUTTED WITH NO GAPS, STAKED, AND BACKFILLED AROUND THE ENTIRE OUTSIDE PERIMETER.
4. EROSION BALES CANNOT BE USED FOR CHECK DAMS.
5. EROSION BALE FILTER SHALL BE LOWER THAN BERM ELEVATION OR USED IN A SUMP CONDITION.
6. THE PAY ITEM NUMBER FOR EROSION BALES (WEED FREE) (EA) IS 208-00011.

EROSION BALES APPLICATIONS

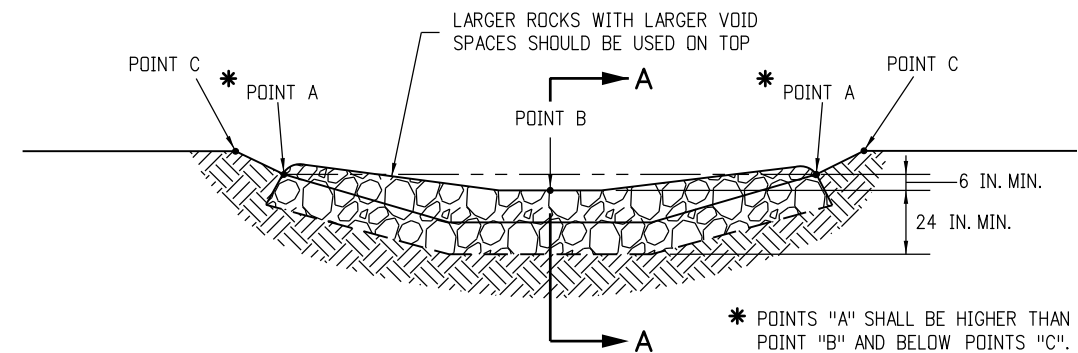
Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments			M-208-1	
Designer Initials: JBK		(R-X)				Standard Sheet No. 10 of 11	
Last Modification Date: 07/31/19		(R-X)					
Detailer Initials: LTA		(R-X)					
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		(R-X)		Project Sheet Number:			



SECTION VIEW ALONG DITCH FLOWLINE



SECTION A-A



TYPICAL SECTION VIEW

NOTES:

1. RIPRAP SIZE D_{50} = 6IN OR AS SHOWN ON THE PLANS.
2. THE GEOTEXTILE EROSION CONTROL SHALL BE CLASS 2 AND CONFORM TO THE REQUIREMENTS OF SUBSECTION 712.08.
3. THE ENDS OF RIPRAP CHECK DAM SHALL BE A MINIMUM OF 6 IN. HIGHER THAN CENTER OF CHECK DAM.
4. FOR USE AS TEMPORARY CHECK DAMS ONLY AND NOT FOR PERMANENT INSTALLATIONS.
5. THE PAY ITEM NUMBER FOR ROCK CHECK DAM (EA) IS 208-00041.

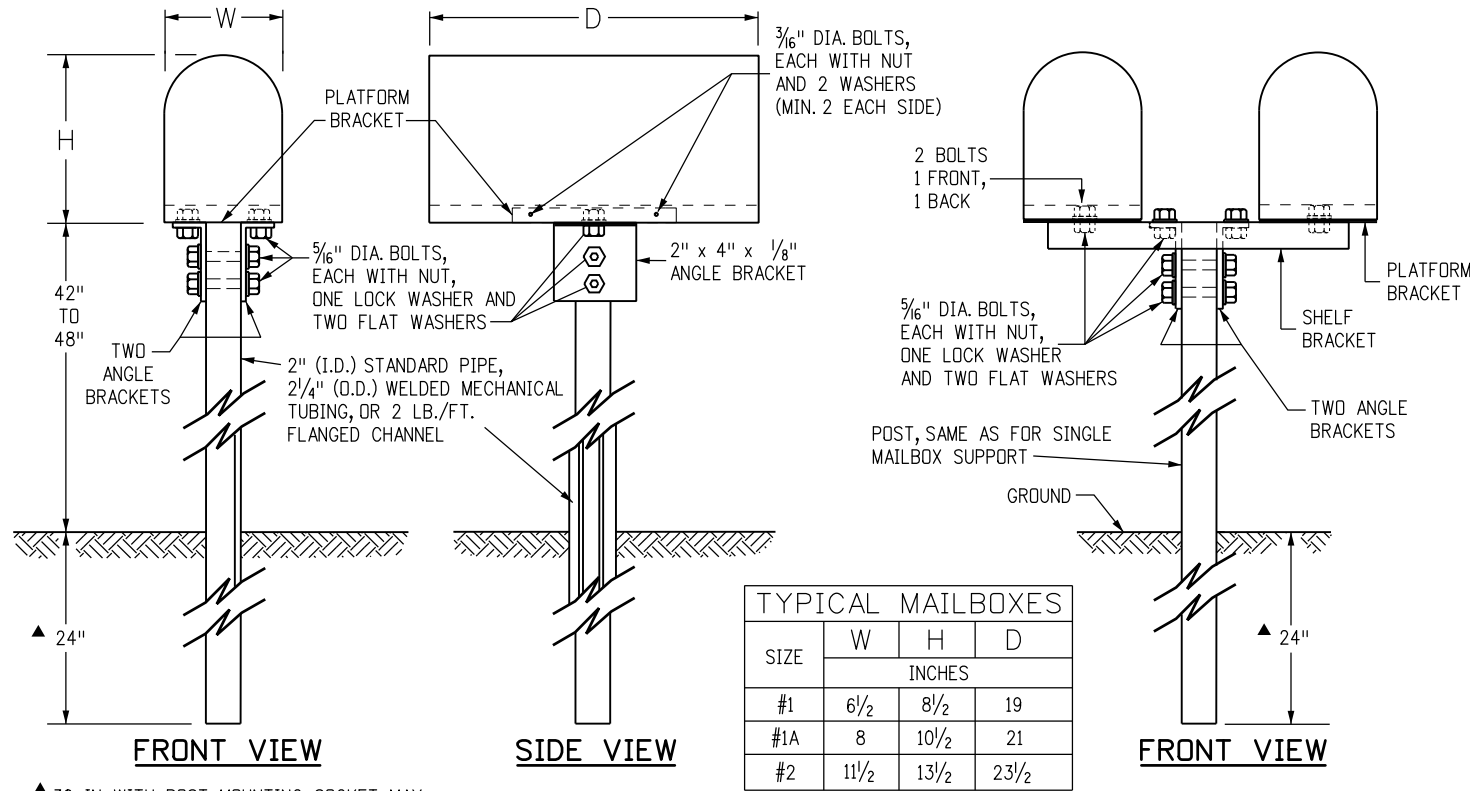
NOTE: ALL MATERIALS AND LABOR TO COMPLETE THE ROCK CHECK DAM SHALL BE INCLUDED IN THE COST OF WORK.

ROCK CHECK DAM

Computer File Information		Sheet Revisions		Colorado Department of Transportation  2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch JBK	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.	
Creation Date: 07/31/19	(R-X)	Date:	Comments:			M-208-1	
Designer Initials: JBK	(R-X)					Standard Sheet No. 11 of 11	
Last Modification Date: 07/31/19	(R-X)					Project Sheet Number:	
Detailer Initials: LTA	(R-X)					Issued by the Project Development Branch: July 31, 2019	
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)						

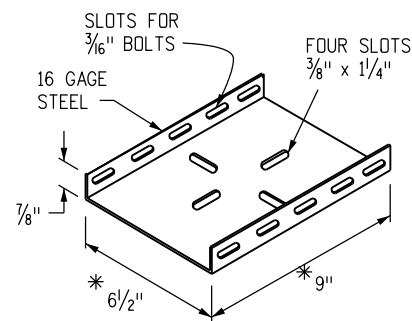
GENERAL NOTES

1. WHEN A MAILBOX TURNOUT IS REQUIRED, THE NECESSARY PAY QUANTITIES WILL BE SHOWN ON THE PLANS.
2. A SINGLE MAILBOX SHALL BE RESET AT THE FINAL DESIGNATED LOCATION ON A NEW TYPE 1 SUPPORT. TWO MAILBOXES RESET AT THE SAME LOCATION SHALL BE RESET ON ONE DOUBLE (TYPE 2) SUPPORT OR ON TWO SINGLE (TYPE 1) SUPPORTS AS DESIGNATED. THREE, FOUR, OR FIVE MAILBOXES SHALL BE RESET ON A MULTIPLE (TYPE 3) SUPPORT. AN EXISTING MAILBOX THAT IS MOUNTED ON A CANTILEVER SUPPORT SHALL BE RESET ON A CANTILEVER (TYPE 4) SUPPORT. ALL WORK AND MATERIALS SHALL BE INCLUDED IN THE UNIT BID PRICE FOR "RESET MAILBOX STRUCTURE (TYPE _)".
3. WHEN THE ENGINEER DETERMINES THAT THE EXISTING MAILBOX CAN NOT BE REUSED, A NEW METAL MAILBOX OF SIMILAR SIZE SHALL BE SUPPLIED AND ERECTED BY THE CONTRACTOR. A NEW PLASTIC MAILBOX CONFORMING TO POSTAL SERVICE SPECIFICATIONS MAY BE USED AS AN ALTERNATIVE WHEN APPROVED BY THE ENGINEER. AN EXISTING MAILBOX LARGER THAN A SIZE NO. 2 SHALL BE REPLACED WITH A NEW SIZE NO. 2 MAILBOX. THE COST OF SUPPLYING THE NEW MAILBOX WILL BE PAID FOR IN ACCORDANCE WITH SUBSECTION 109.04(b). EXCEPTION: A CUSTOM BUILT, RURAL-TYPE MAILBOX MAY BE RESET IF THE MAILBOX OWNER OBTAINS PRIOR WRITTEN APPROVAL FROM THE POSTMASTER.
4. THE ADDRESS INFORMATION THAT APPEARED ON THE ORIGINAL MAILBOX SHALL BE PLACED ON THE APPROACH SIDE OF THE REPLACEMENT MAILBOX. SIZE AND STYLE OF LETTERING AND MATERIALS ARE SUBJECT TO THE ENGINEER'S APPROVAL.
5. POSTS, BRACKETS, AND ALL MOUNTING HARDWARE SHALL BE GALVANIZED IN CONFORMANCE WITH AASHTO M 232 AND M 111, EXCEPT THE WELDED MECHANICAL TUBING COATING SHALL BE G-90 OR EQUIVALENT CONFORMING TO ASTM A 525. A 2 IN. OUTSIDE DIAMETER, 14 GAGE WELDED MECHANICAL TUBING SHALL CONFORM TO THE REQUIREMENTS OF ASTM A 513.
6. EXACT DIMENSIONS OF ANGLES, PLATFORM AND SHELF BRACKETS, BOLT HOLES, SLOTS AND MULTIPLE MAILBOX SUPPORT COMPONENTS MAY VARY FROM THOSE SHOWN OR IMPLIED HEREIN SO THAT ALL COMPONENTS WILL FIT TOGETHER PROPERLY.
7. PLASTIC NEWSPAPER RECEPTACLES MAY BE REMOUNTED BELOW THE MAILBOX ON THE SUPPORT. PLASTIC NEWSPAPER RECEPTACLES SHALL BE MOUNTED IN THEIR INTENDED ORIENTATION USING A GALVANIZED U-BOLT AND HARDWARE OR OTHER MOUNTING SYSTEM APPROVED BY THE ENGINEER. ASSOCIATED COSTS WILL NOT BE PAID FOR SEPARATELY BUT WILL BE INCLUDED IN THE WORK.
8. ON ROADS WITH CURB AND GUTTER, THE MAILBOX SUPPORT SHALL BE LOCATED IN THE GROUND SO THE FRONT OF THE MAILBOX SHALL BE 8 IN. TO 12 IN. BACK FROM THE CURB FACE. THE HEIGHT SHALL BE 42 IN. TO 48 IN. MEASURED FROM THE GUTTER FLOW LINE TO THE BOTTOM OF THE MAILBOX.
9. ON ROADS WITH SIDEWALK ATTACHED TO CURB AND GUTTER, THE MAILBOX SUPPORT SHALL BE LOCATED IN THE GROUND BEHIND THE SIDEWALK. THE FRONT OF THE MAILBOX SHALL BE IN LINE WITH OR SLIGHTLY BEHIND THE EDGE OF THE SIDEWALK. THE MOUNTING HEIGHT SHALL BE 42 IN. TO 48 IN. ABOVE THE SIDEWALK.
10. THE GROUND SURROUNDING THE MAILBOX SUPPORTS SHALL BE FIRM, UNDISTURBED GROUND, OR WELL COMPACTED REGRADED SOIL. THE SUPPORTS ARE NORMALLY DRIVEN, BUT THEY MAY BE PLACED IN A DUG HOLE WITH WELL COMPACTED BACKFILL.
11. PROPRIETARY MAILBOX SUPPORT SYSTEMS LISTED ON THE CDDT APPROVED PRODUCTS LIST WILL BE ACCEPTED AS EQUIVALENT ALTERNATIVES.



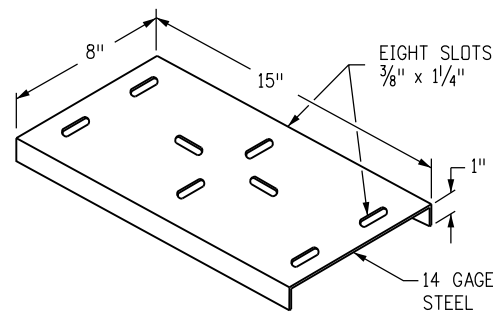
▲ 30 IN. WITH POST MOUNTING SOCKET MAY BE USED, SEE DETAIL ON SHEET 2 OF 2.

SINGLE (TYPE 1) AND DOUBLE (TYPE 2) MAILBOX SUPPORTS

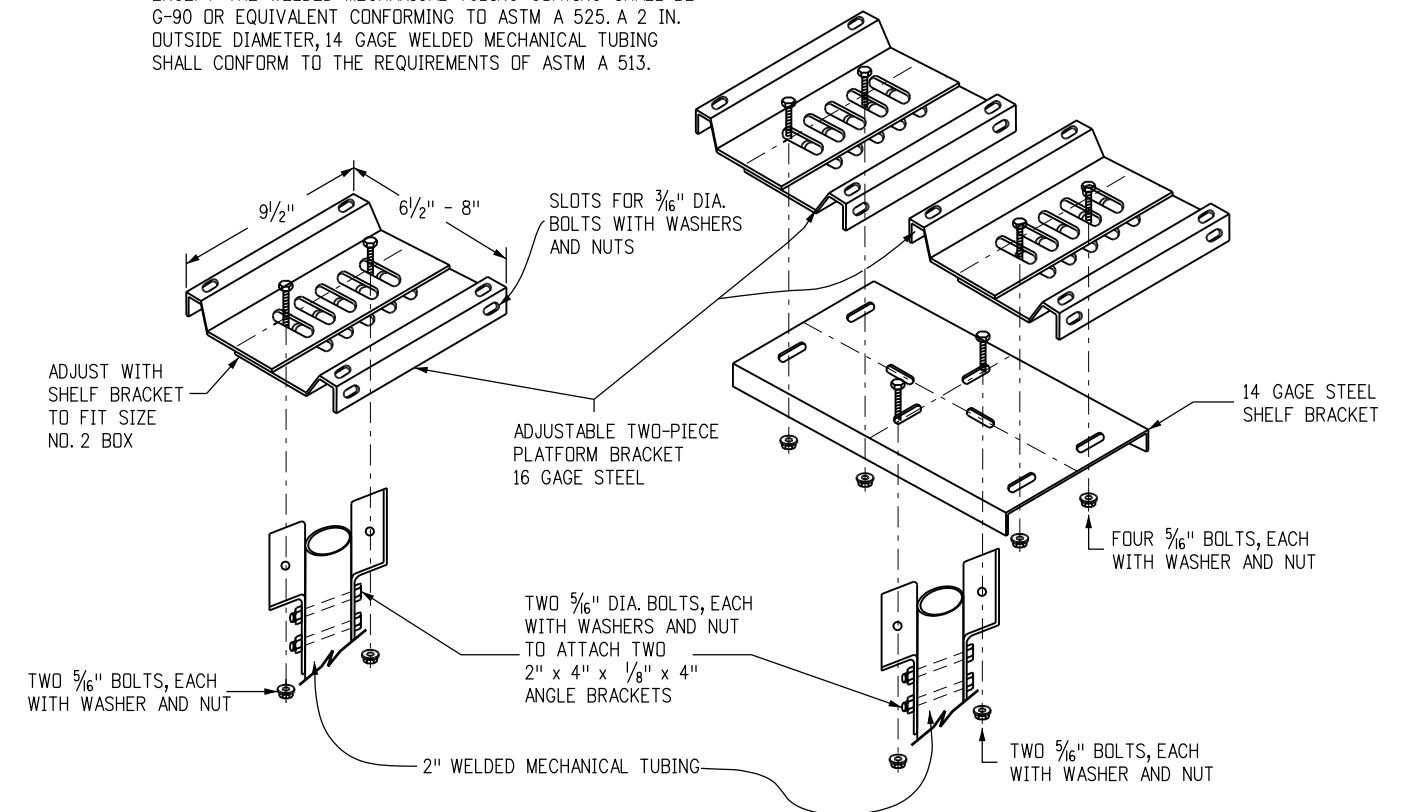


* DIMENSIONS VARY TO FIT SIZE OF MAILBOX USED

PLATFORM BRACKET



SHELF BRACKET



SINGLE AND DOUBLE MAILBOX SUPPORTS ALTERNATIVE

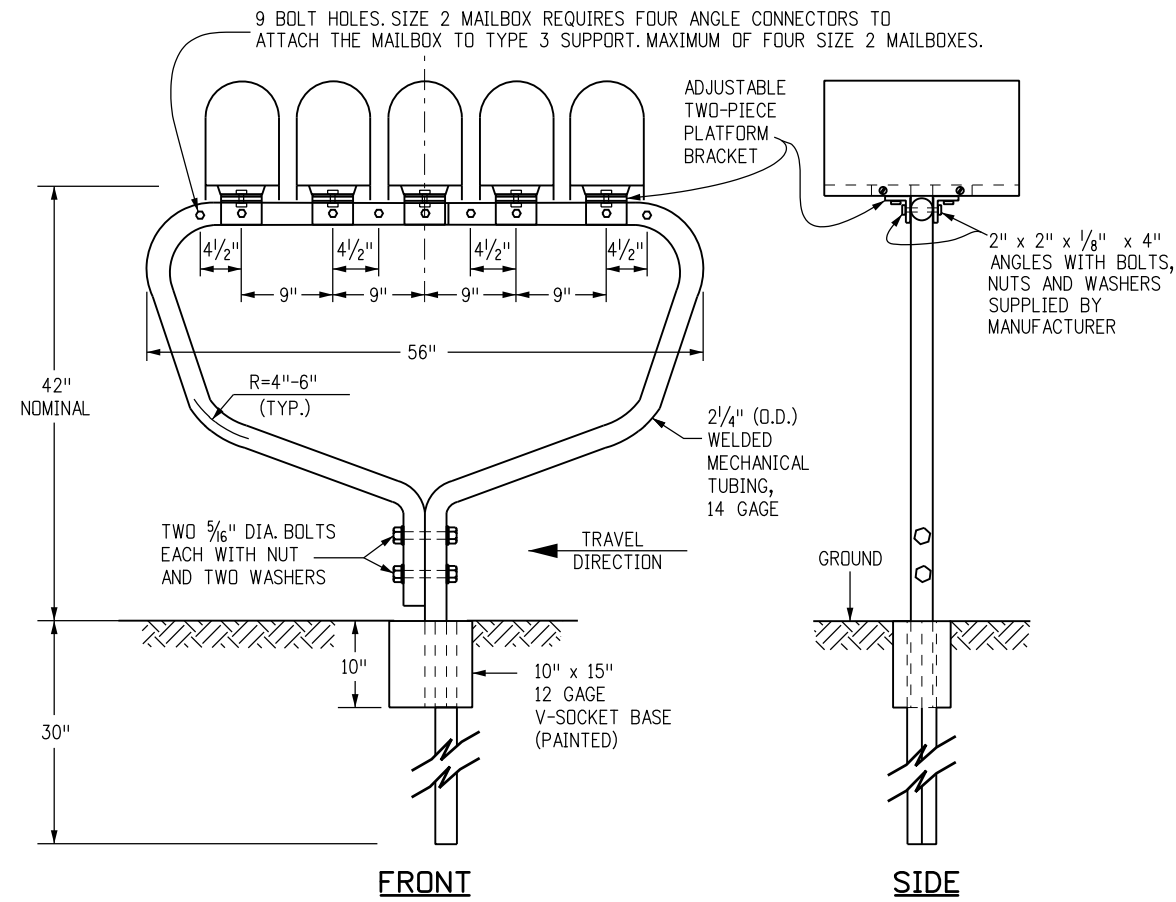
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Creation Date: 07/31/19	
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

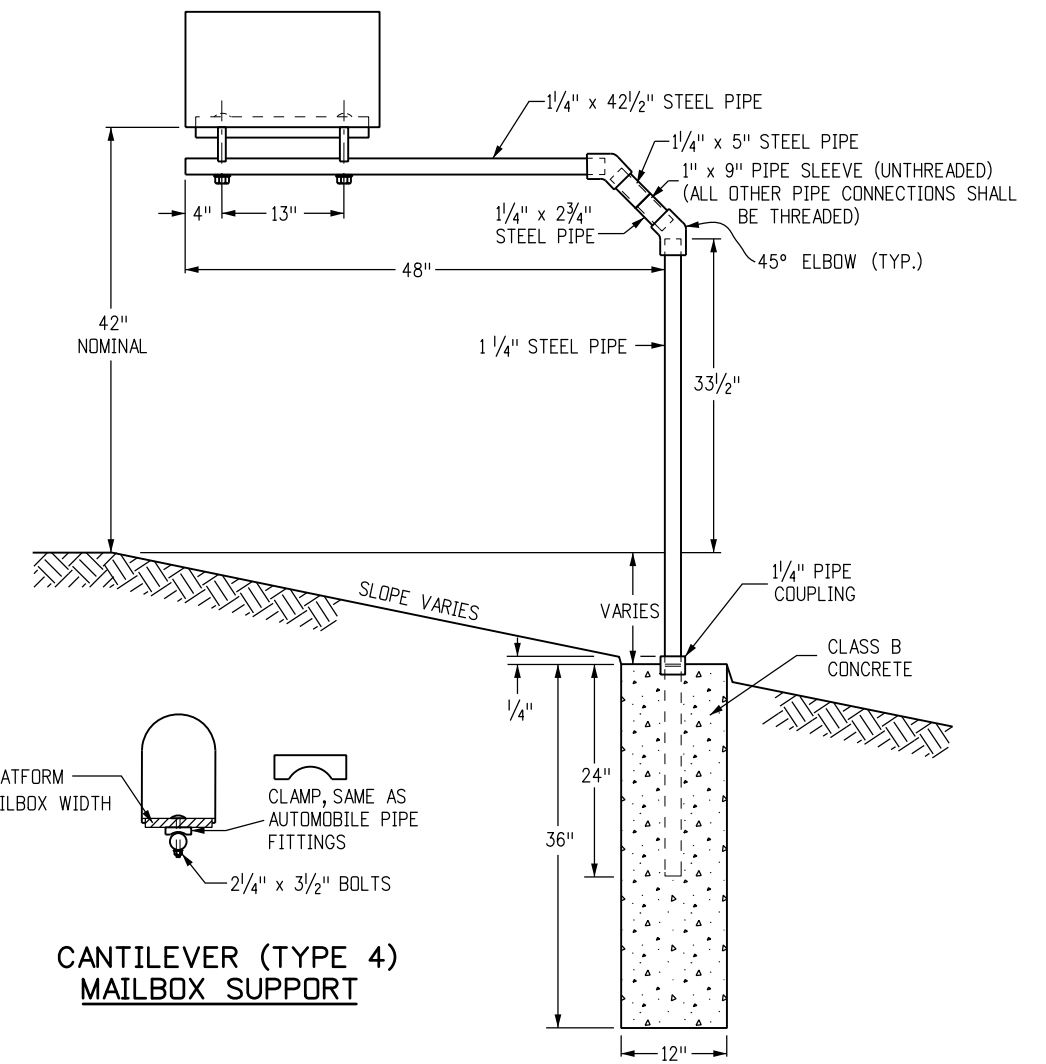
Colorado Department of Transportation
 2829 West Howard Place
 CDDT HQ, 3rd Floor
 Denver, CO 80204
 Phone: 303-757-9021 FAX: 303-757-9868
 Project Development Branch JBK

MAILBOX SUPPORTS
 Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-210-1
 Standard Sheet No. 1 of 2
 Project Sheet Number:

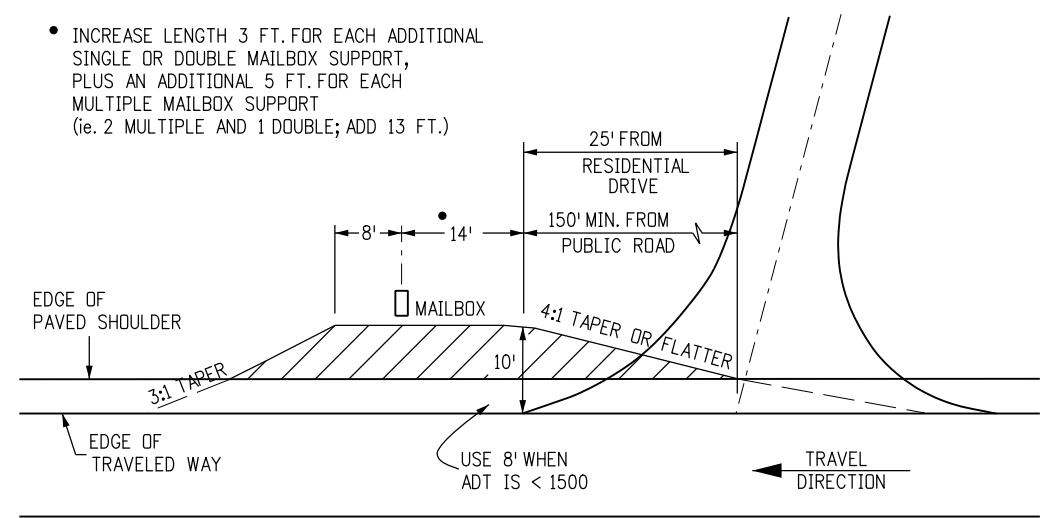


**MULTIPLE (TYPE 3) MAILBOX SUPPORT
FOR 3, 4, OR 5 MAILBOXES OR APPROVED EQUAL**
FIVE SIZE 1 MAILBOXES SHOWN

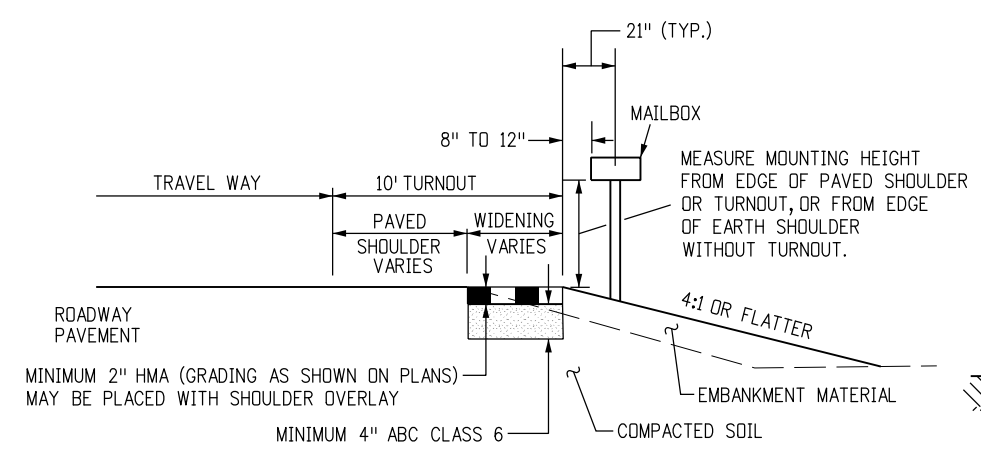


**CANTILEVER (TYPE 4)
MAILBOX SUPPORT**

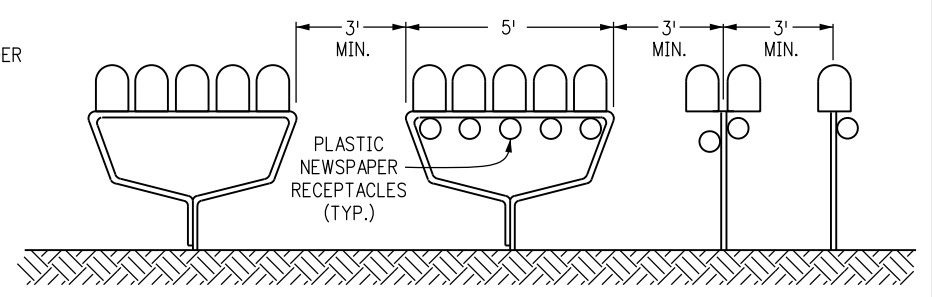
- INCREASE LENGTH 3 FT. FOR EACH ADDITIONAL SINGLE OR DOUBLE MAILBOX SUPPORT, PLUS AN ADDITIONAL 5 FT. FOR EACH MULTIPLE MAILBOX SUPPORT (ie. 2 MULTIPLE AND 1 DOUBLE; ADD 13 FT.)



MAILBOX TURNOUT



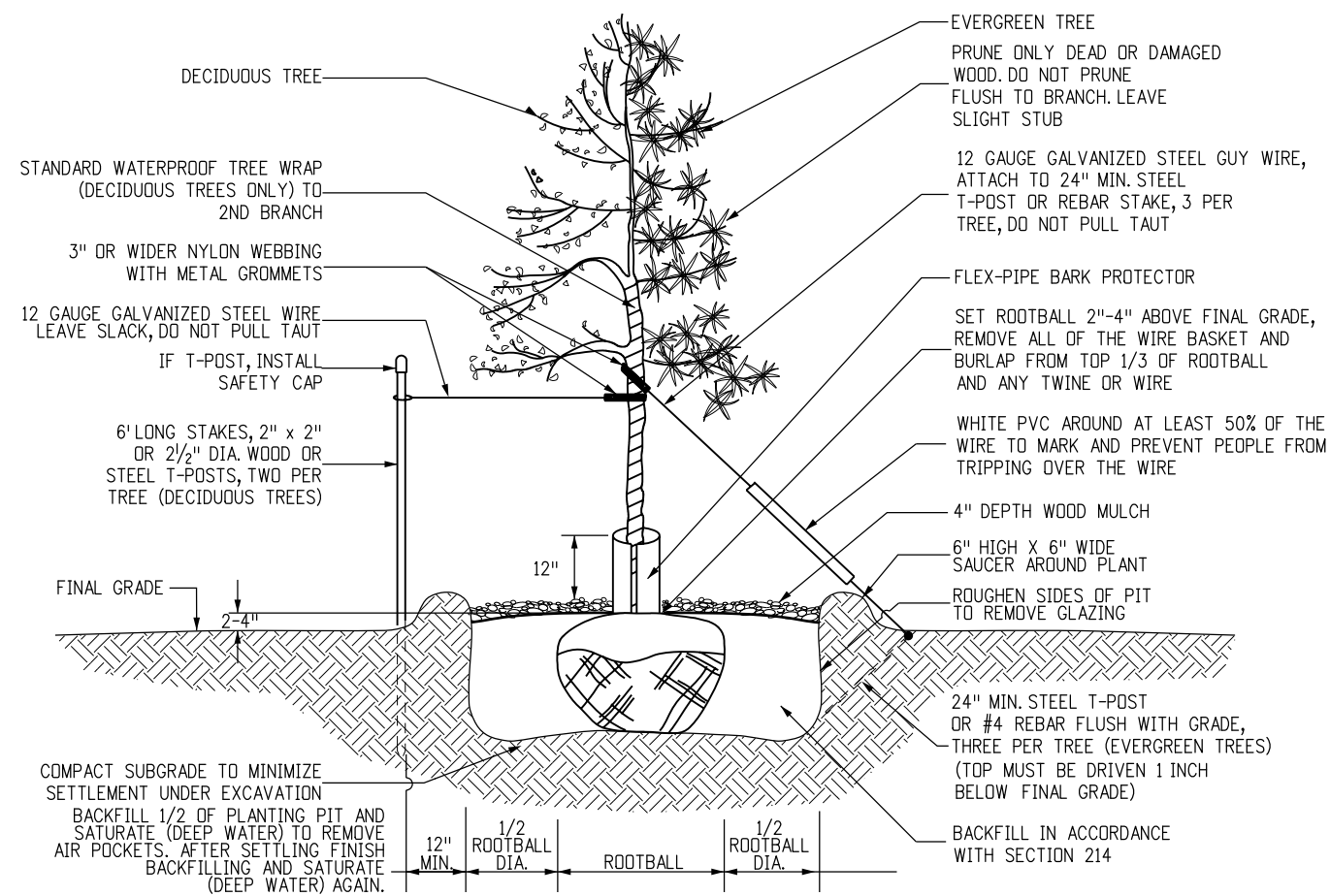
TURNOUT TYPICAL SECTION



SUPPORT SPACING

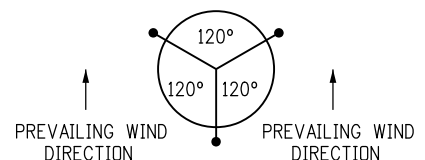
NOTE: SEE SHEET 1, GENERAL NOTE 7, FOR MOUNTING PLASTIC NEWSPAPER RECEPTACLES.

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	<h1>MAILBOX SUPPORTS</h1>	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments:			M-210-1	
Designer Initials: JBK	(R-X)					Standard Sheet No. 2 of 2	
Last Modification Date: 07/31/19	(R-X)					Project Sheet Number:	
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		(R-X)		Issued by the Project Development Branch: July 31, 2019			



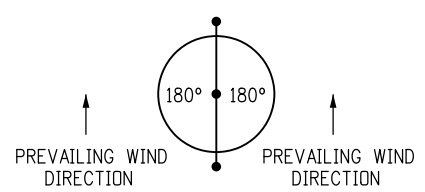
DECIDUOUS AND EVERGREEN BALLED AND BURLAPPED TREE PLANTING AND GUYING DETAIL

(GUY AND STAKE DECIDUOUS TREES 2" AND LARGER CALIPER AND EVERGREEN TREES OVER 4' HEIGHT.)
NOT TO SCALE

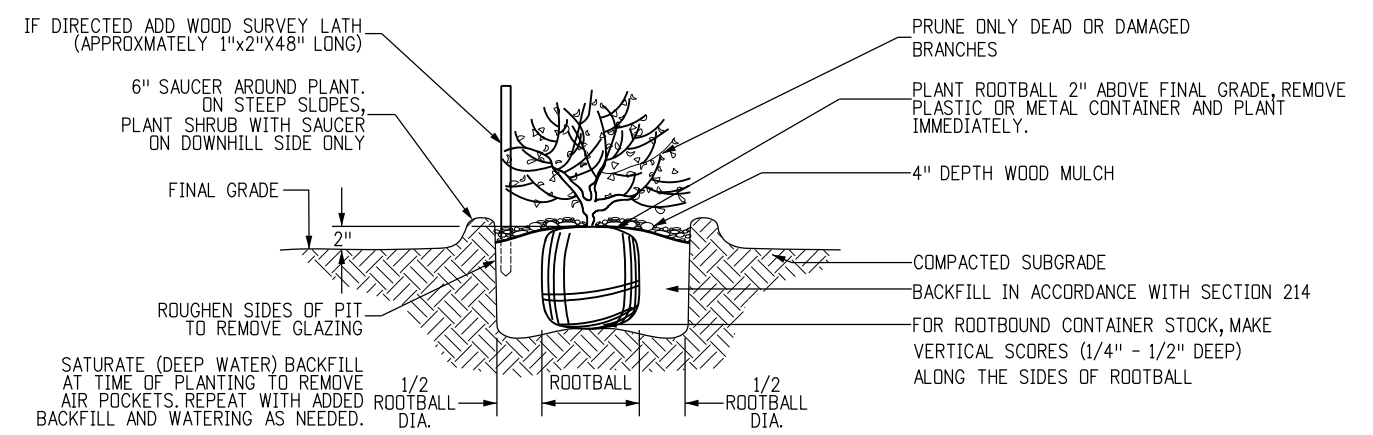


NOTE: FOR TREES ON 4:1 OR STEEPER SLOPES, PLACE TWO GUYS UPSLOPE AND ONE DOWN SLOPE. OTHERWISE, PLACE FOR PREVAILING WIND.

GUYING PATTERN FOR EVERGREEN TREE BALLED AND BURLAPPED TREE PLANTINGS

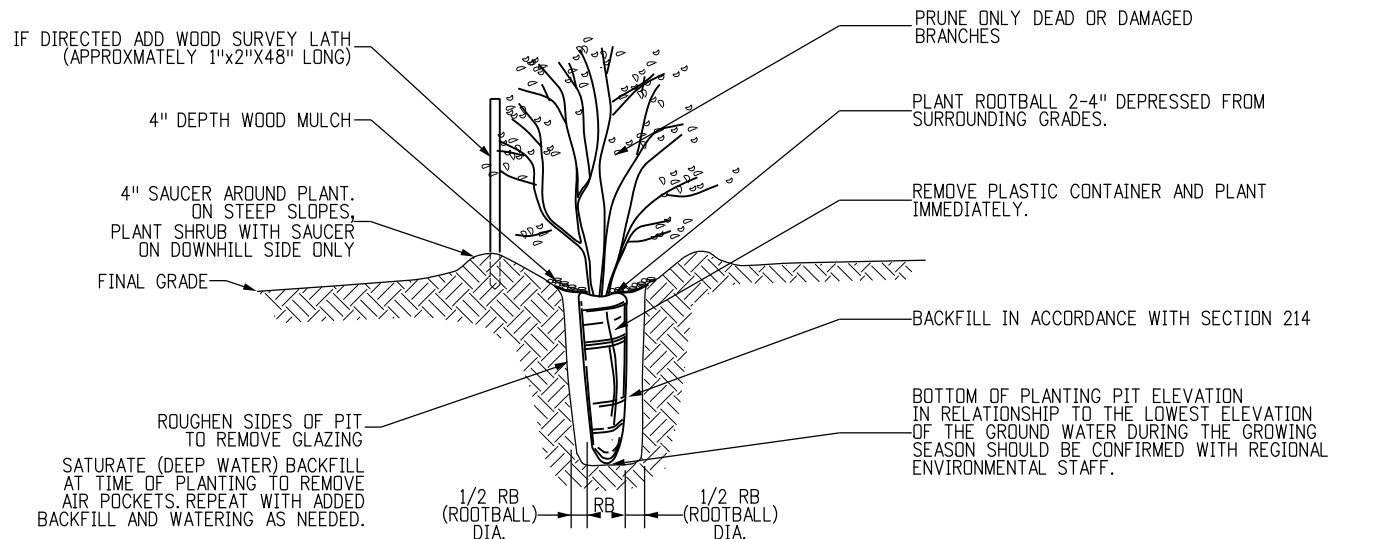


GUYING PATTERN FOR DECIDUOUS TREE BALLED AND BURLAPPED TREE PLANTINGS



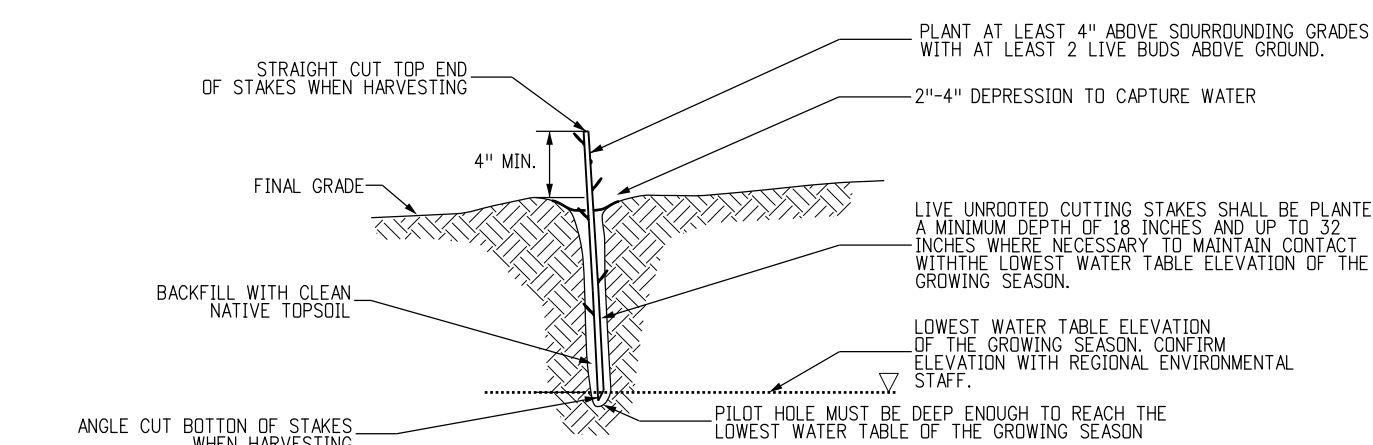
STANDARD NURSERY STOCK CONTAINERS (#5, #10 AND #20) PLANTING DETAIL

NOT TO SCALE



DEEP ROOTED UPLAND NURSERY CONTAINERS (DRC #10, #40, #60 AND #180) PLANTING DETAIL

NOT TO SCALE



UNROOTED CUTTING STAKES PLANTING DETAIL

NOT TO SCALE

Computer File Information	
Creation Date: 07/31/19	
Designer Initials: MP	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

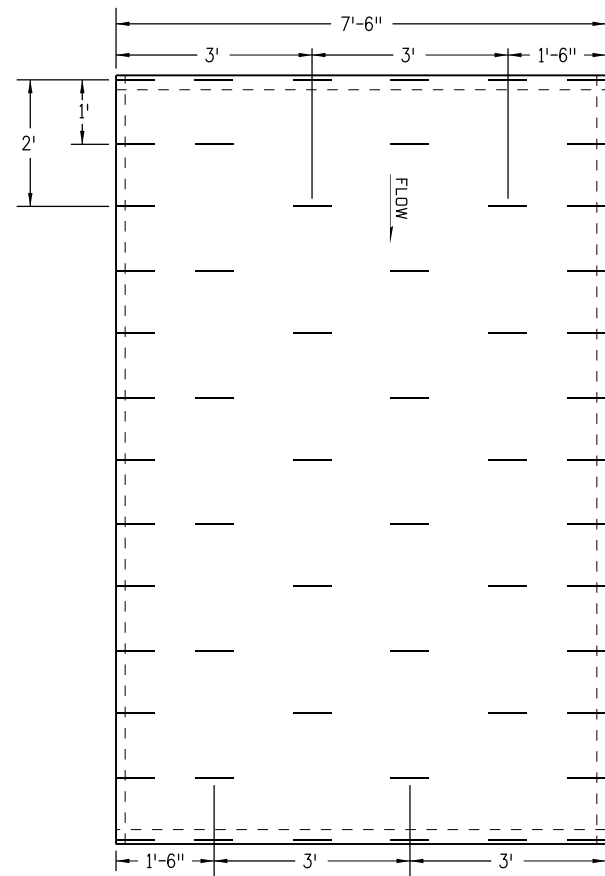
Colorado Department of Transportation
2829 West Howard Place
CDOT HQ,
Denver, CO 80204
Phone: 303-757-9542

Project Development Branch **JBK**

NURSERY STOCK DETAILS

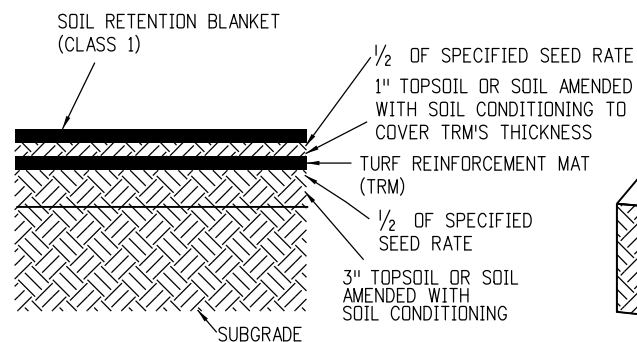
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-214-1
Standard Sheet No. 1 of 1
Project Sheet Number:



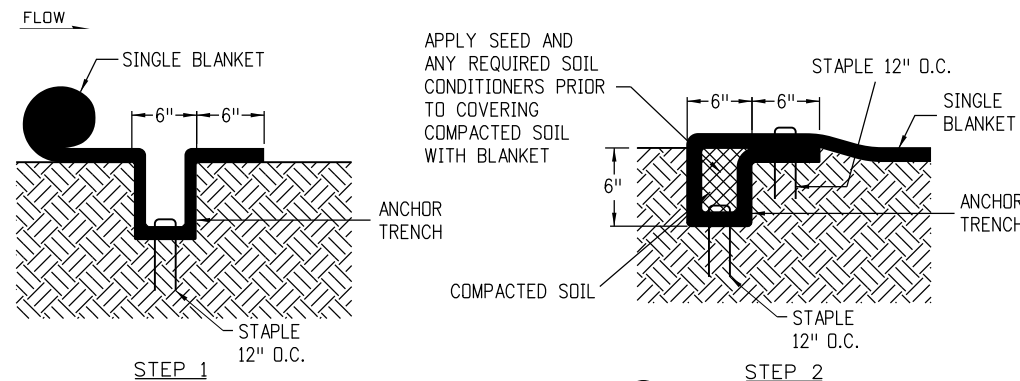
TYPICAL STAPLE PATTERN FOR CHANNEL APPLICATION

SEE SUBSECTION 216.05.



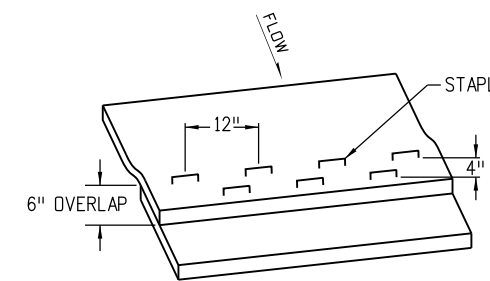
SOIL FILLED TRM APPLICATION

1. PLACE 3" TOPSOIL OR SOIL AMENDED WITH SOIL CONDITIONING.
2. APPLY HALF OF THE SPECIFIED SEED AT THE BROADCAST RATE AND RAKE IT INTO THE SOIL.
3. INSTALL TRM.
4. PLACE 1" TOPSOIL OR SOIL AMENDED WITH SOIL CONDITIONING INTO THE MATRIX TO COVER THE PRODUCT'S THICKNESS.
5. APPLY THE REMAINING HALF OF THE SPECIFIED SEED AT THE BROADCAST RATE AND RAKE IT INTO THE SOIL.
6. INSTALL SOIL RETENTION BLANKET (CLASS 1).



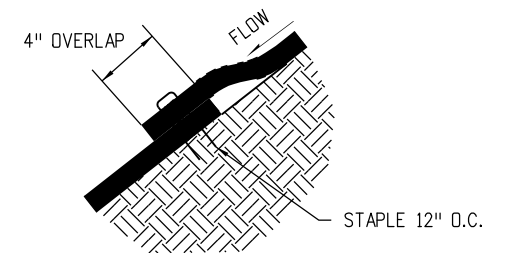
ANCHOR TRENCH (A)

TO BE USED AT THE BEGINNING AND END OF THE CHANNEL ACROSS IT'S ENTIRE WIDTH.



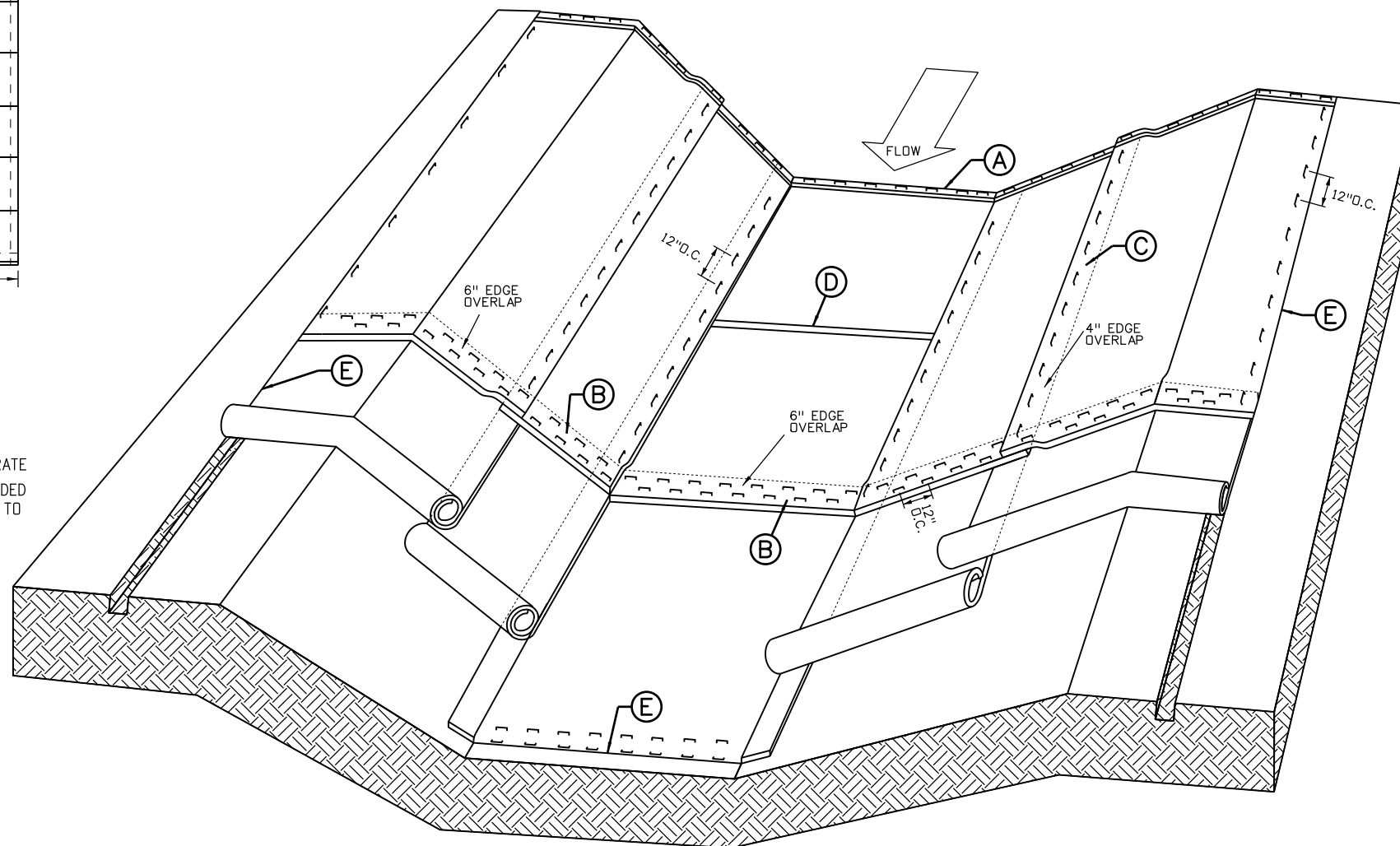
CONSECUTIVE ROLL OVERLAP (B)

TO BE USED WHEREVER ONE ROLL OF BLANKET ENDS AND ANOTHER BEGINS WITH UPSTREAM BLANKET PLACED ON TOP OF THE BLANKET ON THE DOWNSTREAM SIDE.



SIDE SEAM OVERLAP (C)

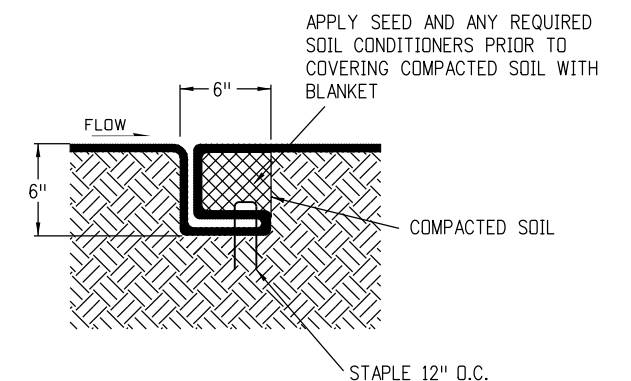
TO BE USED FOR OVERLAP WHEN 2 WIDTHS OF BLANKET ARE APPLIED SIDE BY SIDE WITH THE UPHILL BLANKET PLACED ON TOP OF THE BLANKET ON THE DOWNHILL SIDE.



SOIL RETENTION BLANKETS/TURF REINFORCEMENT MATS (TRM)

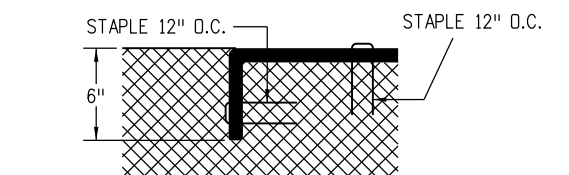
CHANNEL APPLICATION

IN ACCORDANCE WITH SECTION 216.



CHANNEL CHECK SLOT (D)

TO BE USED AT 30' INTERVALS IN CHANNEL FLOWLINE.



TERMINATION OF CHANNEL (E)

GENERAL NOTES

1. Z SHAPED FOLD TO BE USED ON SLOPE EVERY 35 FEET MAXIMUM.
2. STAPLE CHECK LOCATIONS SHOULD BE AT LEAST 15 FEET FROM THE BOTTOM OF SLOPE.

Computer File Information

Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions

Date:	Comments

Colorado Department of Transportation
 2829 West Howard Place
 CDDT HQ, 3rd Floor
 Denver, CO 80204
 Phone: 303-757-9021 FAX: 303-757-9868
 Project Development Branch JBK

SOIL RETENTION COVERING

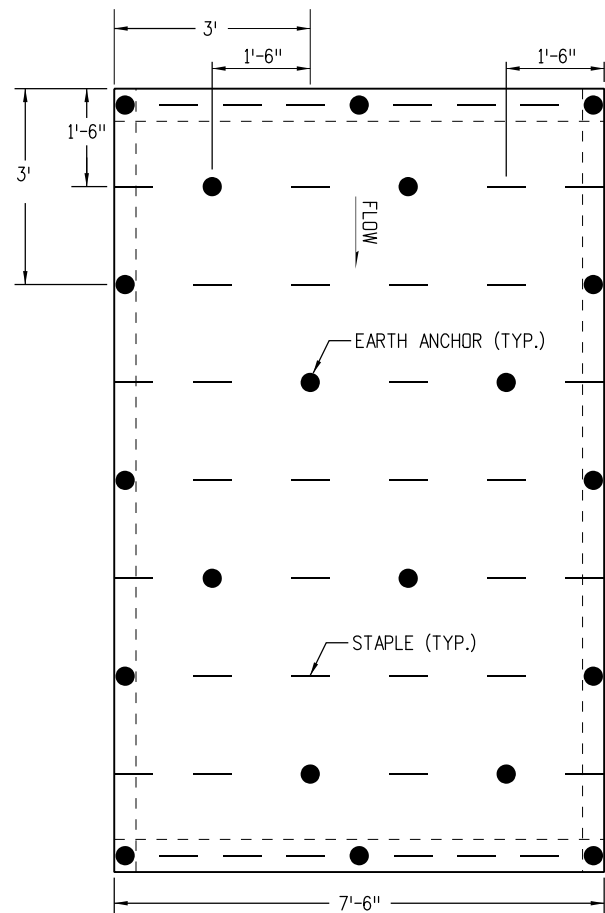
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-216-1

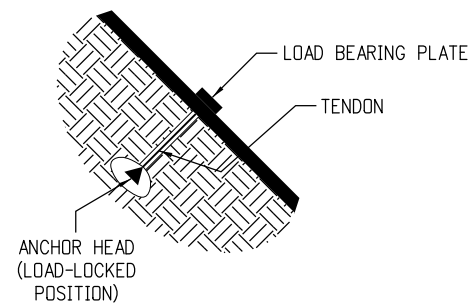
Standard Sheet No. 1 of 2

Project Sheet Number:



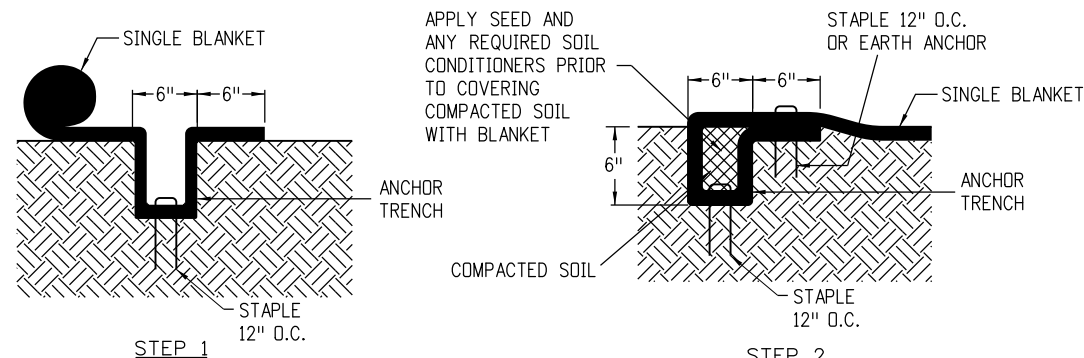
TYPICAL STAPLE OR EARTH ANCHOR PATTERN FOR SLOPE APPLICATION

IF EARTH ANCHORS ARE NOT SPECIFIED ON THE PLANS, ONLY STAPLES SHALL BE USED. SEE SUBSECTION 216.04



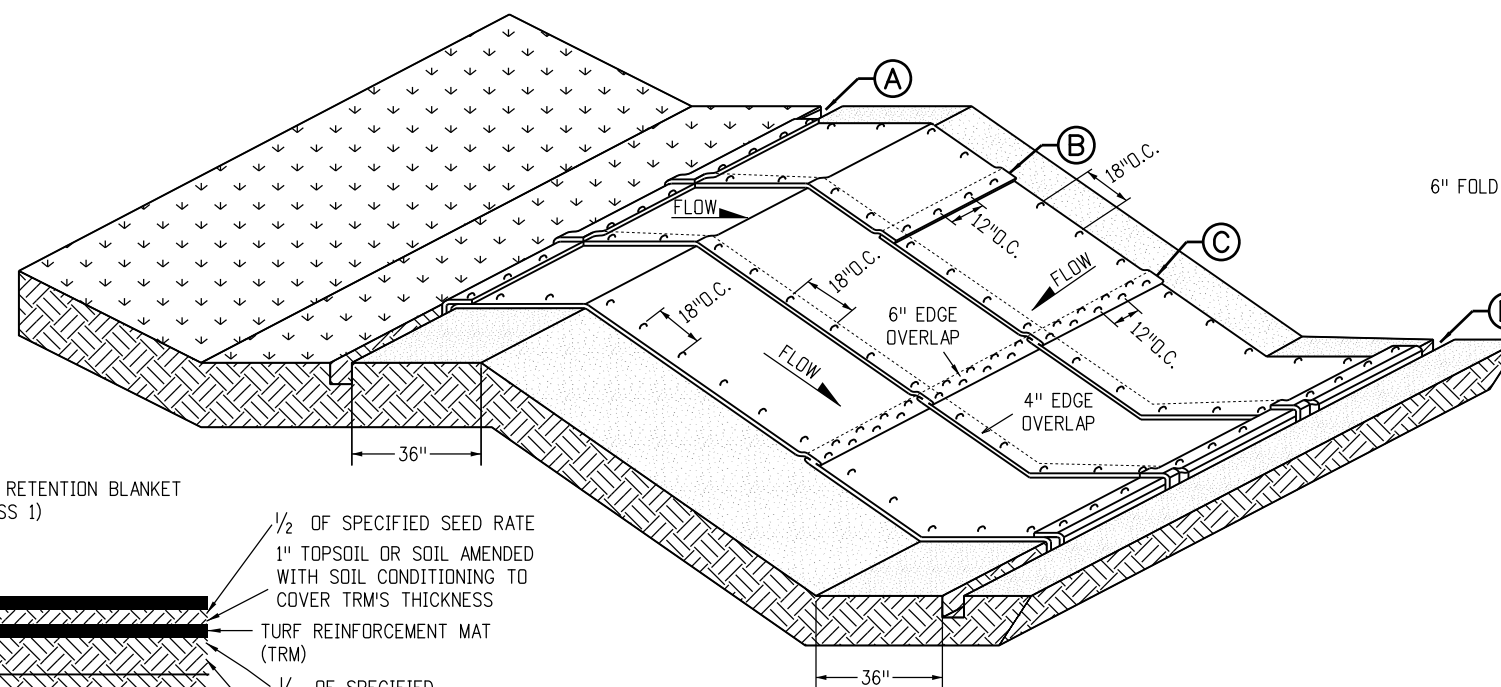
EARTH ANCHOR

- NOTES:
1. EARTH ANCHORS WILL BE USED INSTEAD OF STAPLES WHEN SPECIFIED IN THE PLANS.
 2. EARTH ANCHORS SHALL BE PAID FOR SEPERATLY AS SPECIFIED IN SECTION 216.



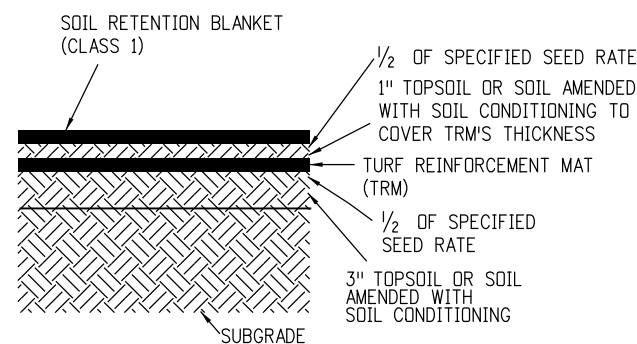
ANCHOR TRENCH (A)

TO BE USED AT THE UPSLOPE AND DOWNSLOPE ENDS OF BLANKET ACROSS THE ENTIRE WIDTH OF SLOPE UNLESS SLOPE RUNS INTO RECEIVING WATER. (SEE DOWNSLOPE END STAPLE CHECK).



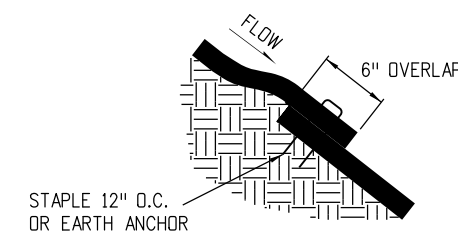
SOIL RETENTION BLANKETS/TURF REINFORCEMENT MATS (TRM) SLOPE APPLICATION

IN ACCORDANCE WITH SECTION 216.



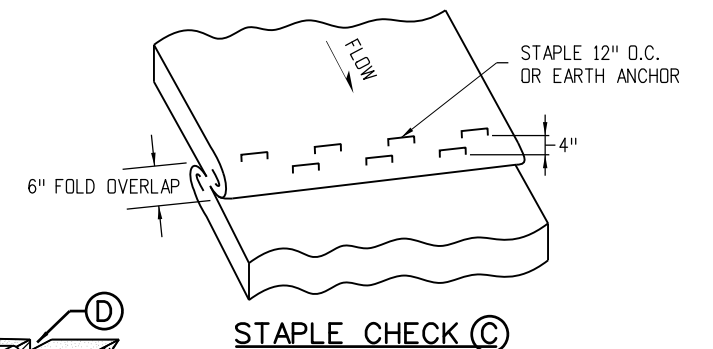
SOIL FILLED TRM APPLICATION

1. PLACE 3" TOPSOIL OR SOIL AMENDED WITH SOIL CONDITIONING.
2. APPLY HALF OF THE SPECIFIED SEED AT THE BROADCAST RATE AND RAKE IT INTO THE SOIL.
3. INSTALL TRM.
4. PLACE 1" TOPSOIL OR SOIL AMENDED WITH SOIL CONDITIONING INTO THE MATRIX TO COVER THE PRODUCT'S THICKNESS.
5. APPLY THE REMAINING HALF OF THE SPECIFIED SEED AT THE BROADCAST RATE AND RAKE IT INTO THE SOIL.
6. INSTALL SOIL RETENTION BLANKET (CLASS 1).

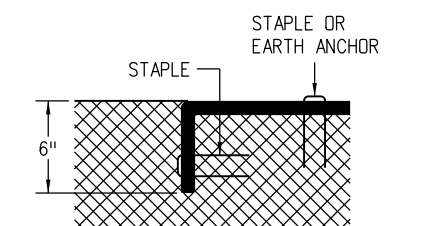


CONSECUTIVE ROLL OVERLAP (B)

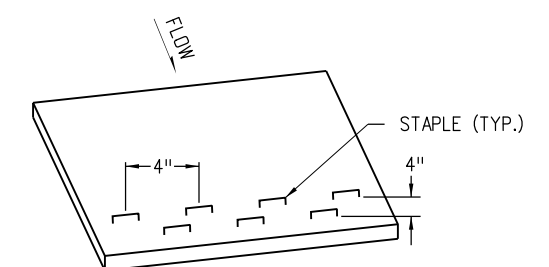
TO BE USED WHEREVER ONE ROLL OF BLANKET ENDS AND ANOTHER BEGINS WITH THE UPHILL BLANKET PLACED ON TOP OF THE BLANKET ON THE DOWNHILL SIDE.



STAPLE CHECK (C)



TERMINATION OF CHANNEL (D)



DOWNSLOPE END STAPLE CHECK

TO BE USED WHEN SLOPE RUNS INTO A RECEIVING WATER AND CANNOT BE EXTENDED 3 FEET BEYOND SLOPE.

Computer File Information

Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions

Date:	Comments

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 2829 West Howard Place
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 Phone: 303-757-9021 FAX: 303-757-9868
 Project Development Branch JBK

SOIL RETENTION COVERING

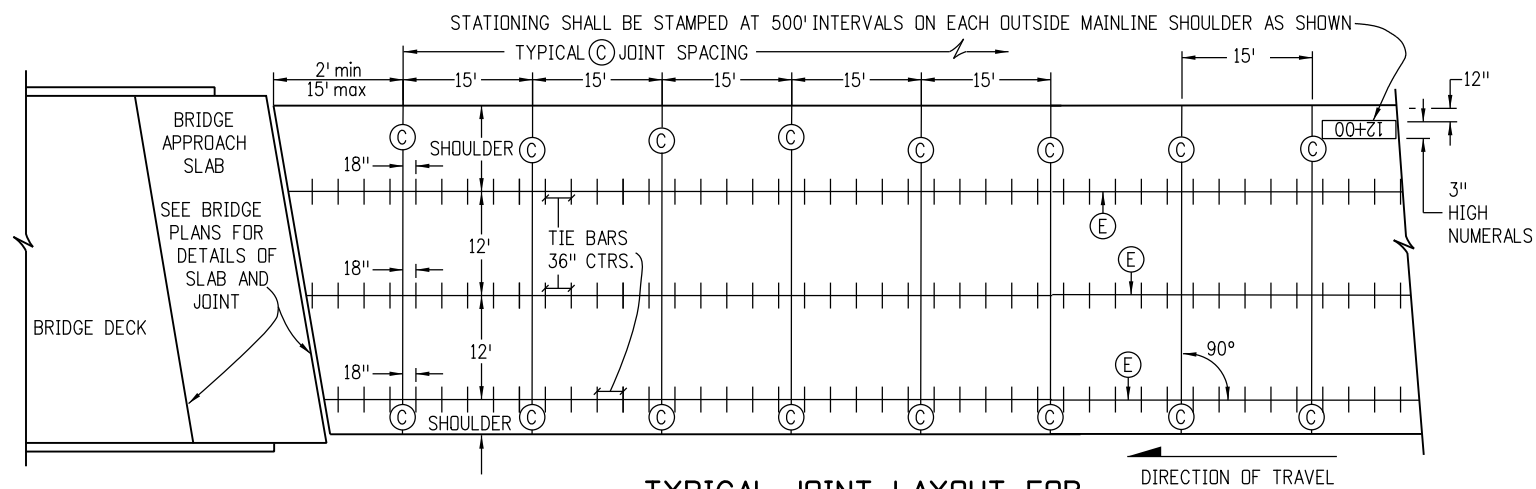
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-216-1

Standard Sheet No. 2 of 2

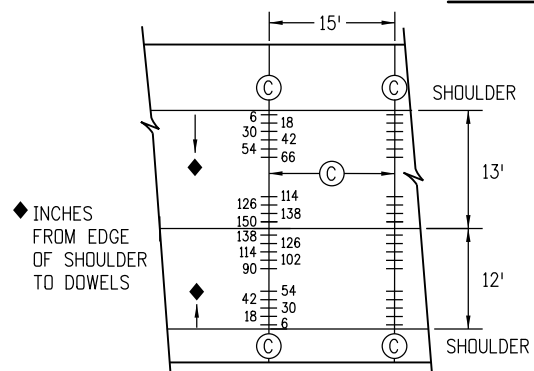
Project Sheet Number:



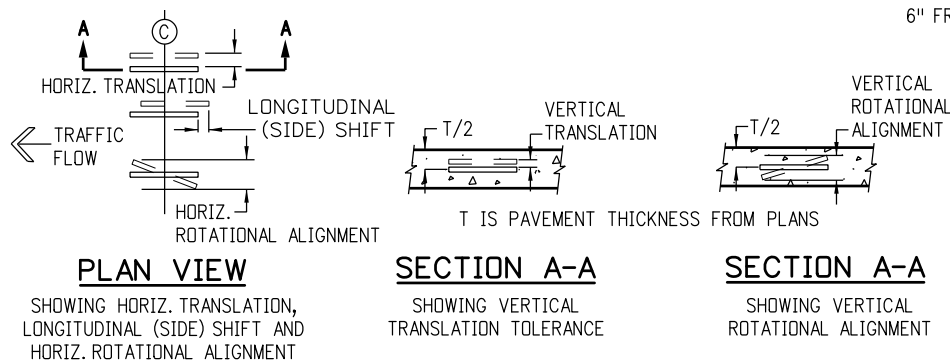
TYPICAL JOINT LAYOUT FOR CONCRETE ROADWAY WITH CONCRETE SHOULDERS

GENERAL NOTES

1. THIS STANDARD PLAN DOES NOT APPLY TO THIN CONCRETE OVERLAYS (WHITETOPPING).
2. TRANSVERSE CONSTRUCTION JOINTS SHALL BE LOCATED AT A (C) JOINT.
3. THIS JOINT LAYOUT SHALL BE USED AS A STANDARD OF THE JOINT LAYOUT FOR THE PROJECT. IF THE CONTRACTOR PROPOSES VARIATIONS FROM THIS STANDARD OR THE PROJECT HAS UNUSUAL OR IRREGULAR CONDITIONS NOT COVERED HEREIN, THE CONTRACTOR SHALL PREPARE A PAVEMENT JOINT LAYOUT FOR APPROVAL BY THE ENGINEER. SLABS 13 FT. IN WIDTH SHALL BE CONSTRUCTED ONLY WHERE DESIGNATED ON THE PLANS.
4. ON MULTILANE DIVIDED HIGHWAYS, THE MULTILANE DIRECTIONAL PAVEMENT AND BOTH SHOULDERS SHALL BE PLACED WITH (E) LONGITUDINAL SAWED CONTRACTION JOINTS.
5. ON MULTILANE DIVIDED HIGHWAYS SEPARATED BY A CONCRETE BARRIER, A (D) JOINT SHALL BE CONSTRUCTED AT ONE OF THE BARRIER FACES.
6. (D) JOINTS SHALL BE CONSTRUCTED BETWEEN THE TWO OPPOSING DIRECTIONS OF TRAVEL ON A MULTILANE UNDIVIDED HIGHWAY WHEN ALL OF THE FOLLOWING APPLY:
 - A. PAVEMENT IS CONTINUOUS ACROSS BOTH DIRECTIONS OF TRAVEL.
 - B. THERE IS NO MEDIAN BARRIER.
 - C. THE WIDTH OF THE PAVEMENT IN ONE DIRECTION IS GREATER THAN 80 FEET.
7. ON VARIABLE WIDTH SLABS, THE 2 FT. OR 4 FT. END OF SLAB WIDTH DIMENSION MAY VARY ± 6 INCHES.
8. (L) JOINTS ARE TO BE USED WHEN A TRAFFIC LANE IS ADDED SEPARATELY, OR FOR TAPERS, OR FOR SPEED CHANGE LANES. ALTERNATIVE LONGITUDINAL JOINT LOCATIONS AT SPEED CHANGE LANES MAY BE USED IF APPROVED.
9. WHERE (C) JOINTS ARE SHOWN IN THE SHOULDER, THE DOWEL BARS WILL BE PLACED ON 12" CENTERS STARTING 6" FROM THE ROADWAY (E) JOINT.



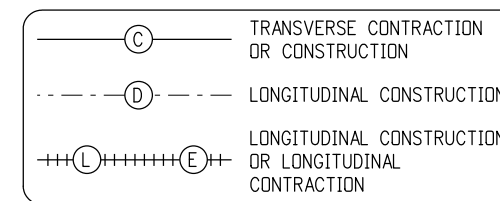
DOWEL BAR DETAIL FOR (C) JOINT WITH 13 FT. AND 12 FT. WIDE SLABS



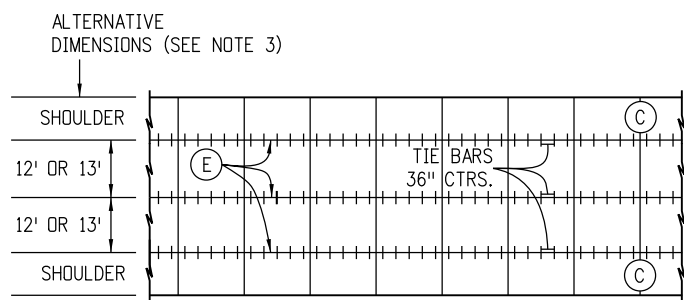
DETAILS ILLUSTRATING DOWEL PLACEMENT TOLERANCES
SEE SUBSECTION 412.13(b)2 FOR ALLOWED TOLERANCE VALUES.

JOINT LEGEND

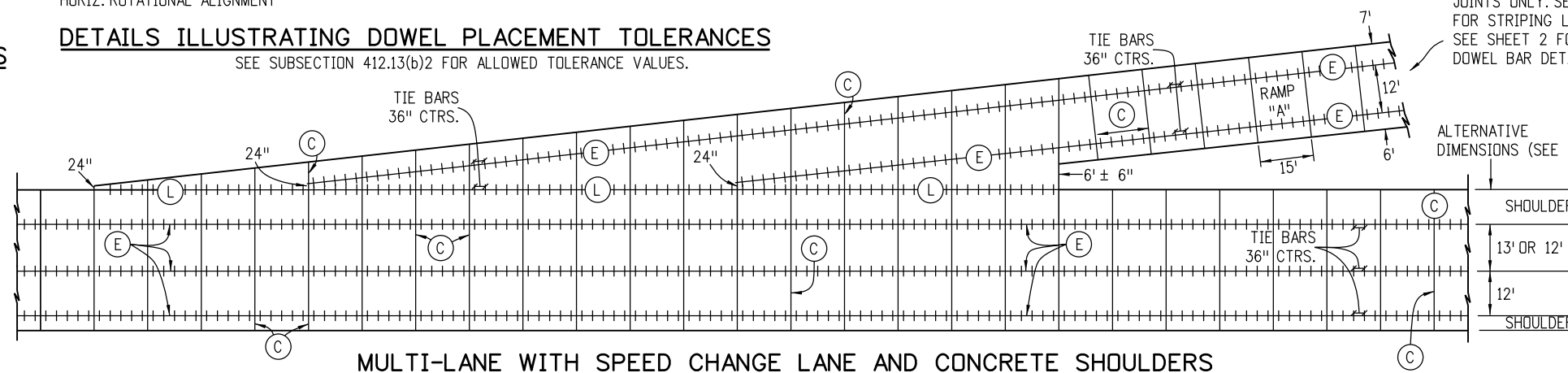
(SEE SHEET 5 FOR JOINT DETAILS)



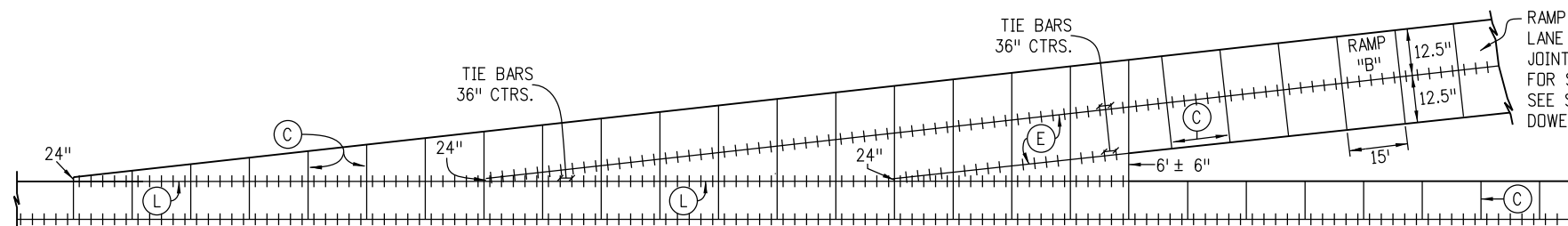
RAMP AND SPEED CHANGE LANE DIMENSIONING FOR JOINTS ONLY. SEE PLANS FOR STRIPING LOCATIONS. SEE SHEET 2 FOR RAMP DOWEL BAR DETAILS.



RURAL TWO-LANE



MULTI-LANE WITH SPEED CHANGE LANE AND CONCRETE SHOULDERS



OPTIONAL LONGITUDINAL JOINT IN CENTER FOR SINGLE LANE SPEED CHANGE LANE

Computer File Information

Creation Date: 07/31/19
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Sheet Revisions

Date:	Comments
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(R-X)	
(R-X)	

Colorado Department of Transportation
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Project Development Branch JBK

CONCRETE PAVEMENT JOINTS

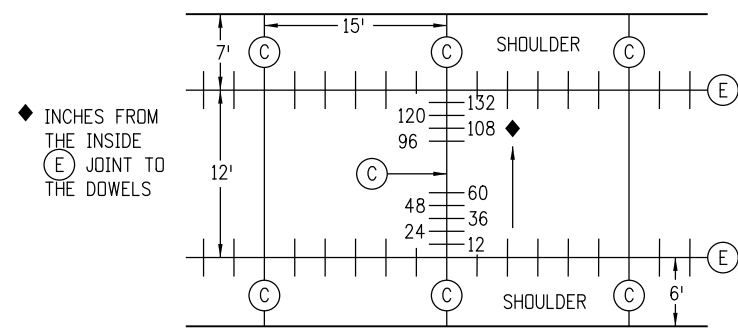
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

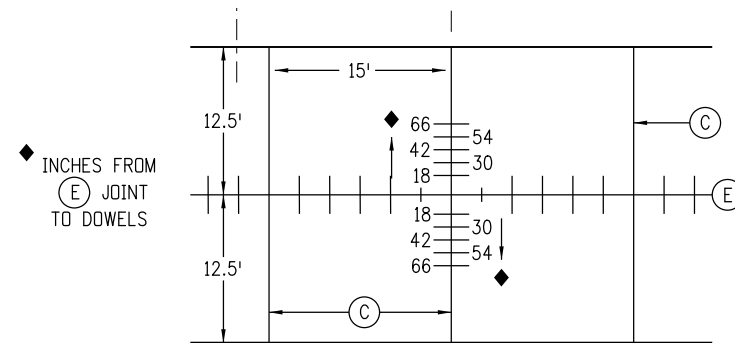
M-412-1

Standard Sheet No. 1 of 5

Project Sheet Number:



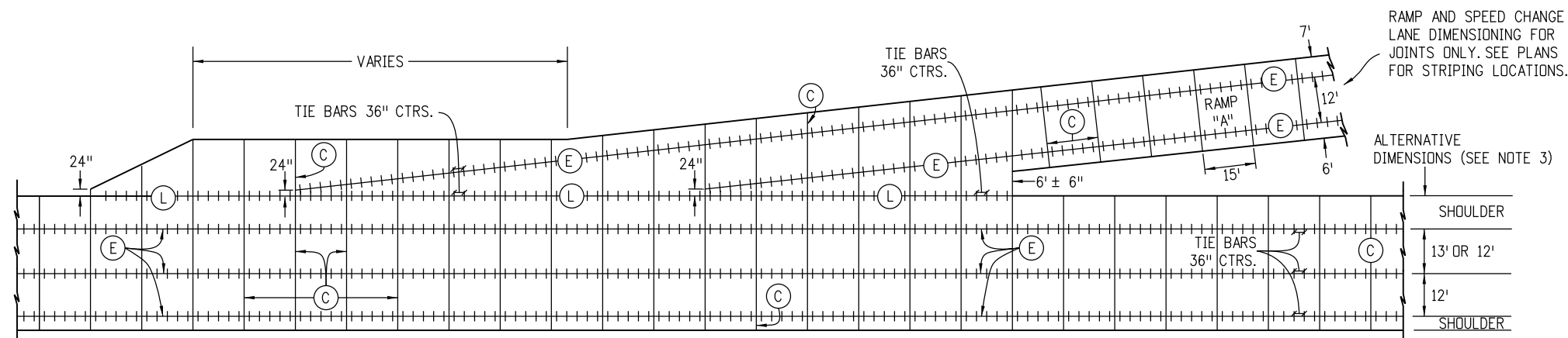
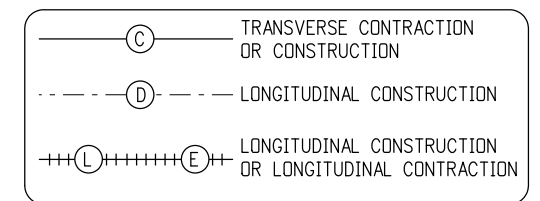
RAMP "A" DOWEL BAR DETAIL FOR C JOINT WITH A 12 FT. LANE



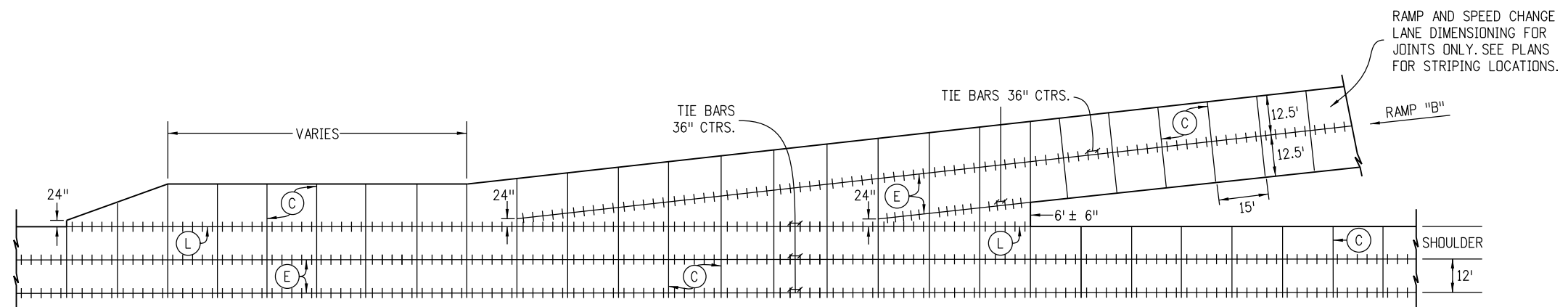
RAMP "B" DOWEL BAR DETAIL FOR C JOINT WITH CENTER LONGITUDINAL SPLIT LANE

JOINT LEGEND

(SEE SHEET 5 FOR JOINT DETAILS)



MULTI-LANE WITH ACCELERATION AND DECELERATION LANES AND CONCRETE SHOULDERS



OPTIONAL LONGITUDINAL JOINT IN CENTER FOR SINGLE LANE ACCELERATION AND DECELERATION LANE

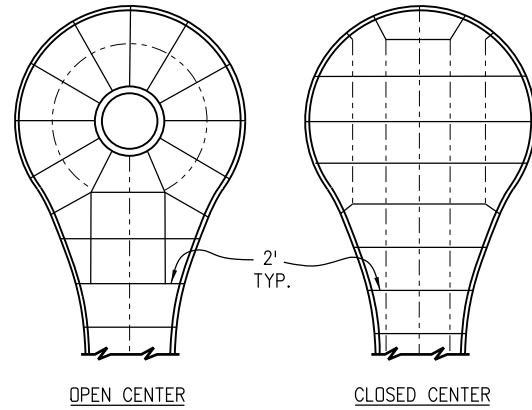
Computer File Information	
Creation Date: 07/31/19	
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
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Sheet Revisions	
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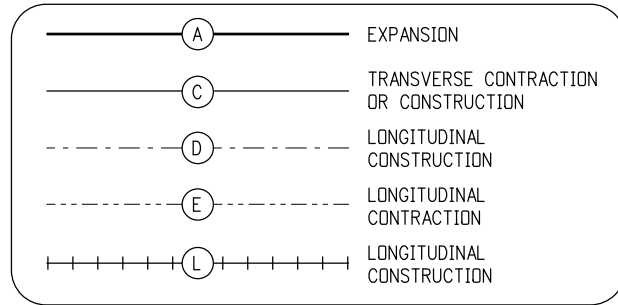
CONCRETE PAVEMENT JOINTS
 Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-412-1
 Standard Sheet No. 2 of 5
 Project Sheet Number:



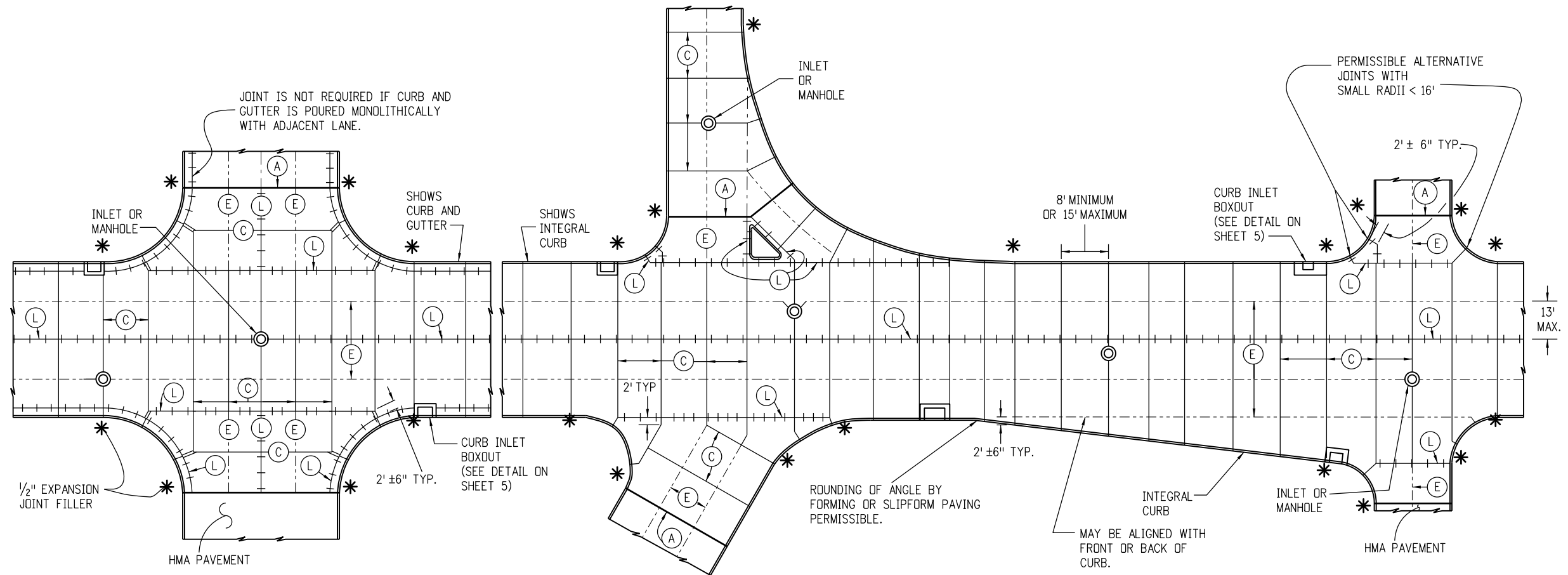
CUL-DE-SAC

JOINT LEGEND
(SEE SHEET 5 FOR JOINT DETAILS)



NOTES

1. LONGITUDINAL JOINTS SHALL BE PLACED ADJACENT TO LANE MARKINGS WHEN POSSIBLE, AND HAVE A MAXIMUM SPACING OF 13 FT. (15 FT. IS PERMITTED WITH MONOLITHIC CURB AND GUTTER).
2. CONSTRUCT TRANSVERSE JOINTS PERPENDICULAR TO THE CENTERLINE OF PAVEMENT AND EXTEND THROUGH THE CURB OR CURB AND GUTTER.
- * 3. PLACE 1/2 IN. MIN. EXPANSION JOINT FILLER IN TOP 6 IN. OF CURB JOINT AT INTERSECTION RETURN RADIUS POINTS.
4. THE CONTRACTOR SHALL, UNLESS OTHERWISE SHOWN ON THE PLANS, SELECT AND USE A BOND BREAKER AT INLETS, MANHOLES AND SIMILAR SIZE STRUCTURES. SMALLER STRUCTURES SUCH AS VALVE AND MONUMENT BOXES SHALL NOT REQUIRE A BOND BREAKER.
5. WHERE A LONGITUDINAL JOINT PASSES LESS THAN 1 FT. FROM A CAST-IN-PAVEMENT MANHOLE OR SIMILAR SIZE STRUCTURE, A TYPICAL 2 FT. RADIAL JOINT, AS SHOWN IN THE DETAILS, SHALL BE USED.
6. TRANSVERSE JOINTS SHALL EITHER INTERSECT THE CENTER OF CIRCULAR MANHOLES AND INLETS OR BE AT LEAST 4 FT. AWAY FROM THE EDGE OF CIRCULAR MANHOLES. SEE CURB INLET BOXOUT DETAIL ON SHEET 5.
7. TRANSVERSE CONSTRUCTION JOINTS SHALL BE LOCATED AT A (C) JOINT.
6. THE ENGINEERS SHALL HAVE AN OPTION TO USE INDIVIDUAL DOWELS IN THE (C) JOINT ON SHORT RUN (2' ± 6") TO CURB RADIUS RETURNS.

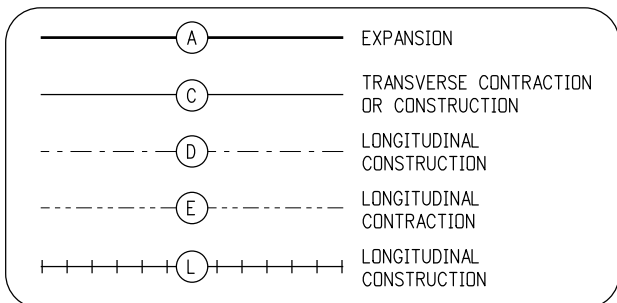


TYPICAL CURBED PAVEMENT JOINT LAYOUT

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	<h1>CONCRETE PAVEMENT JOINTS</h1>	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments:			M-412-1	
Designer Initials: JBK		(R-X)				Standard Sheet No. 3 of 5	
Last Modification Date: 07/31/19		(R-X)					
Detailer Initials: LTA		(R-X)					
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		(R-X)		Project Sheet Number:			
				JBK	Issued by the Project Development Branch: July 31, 2019		

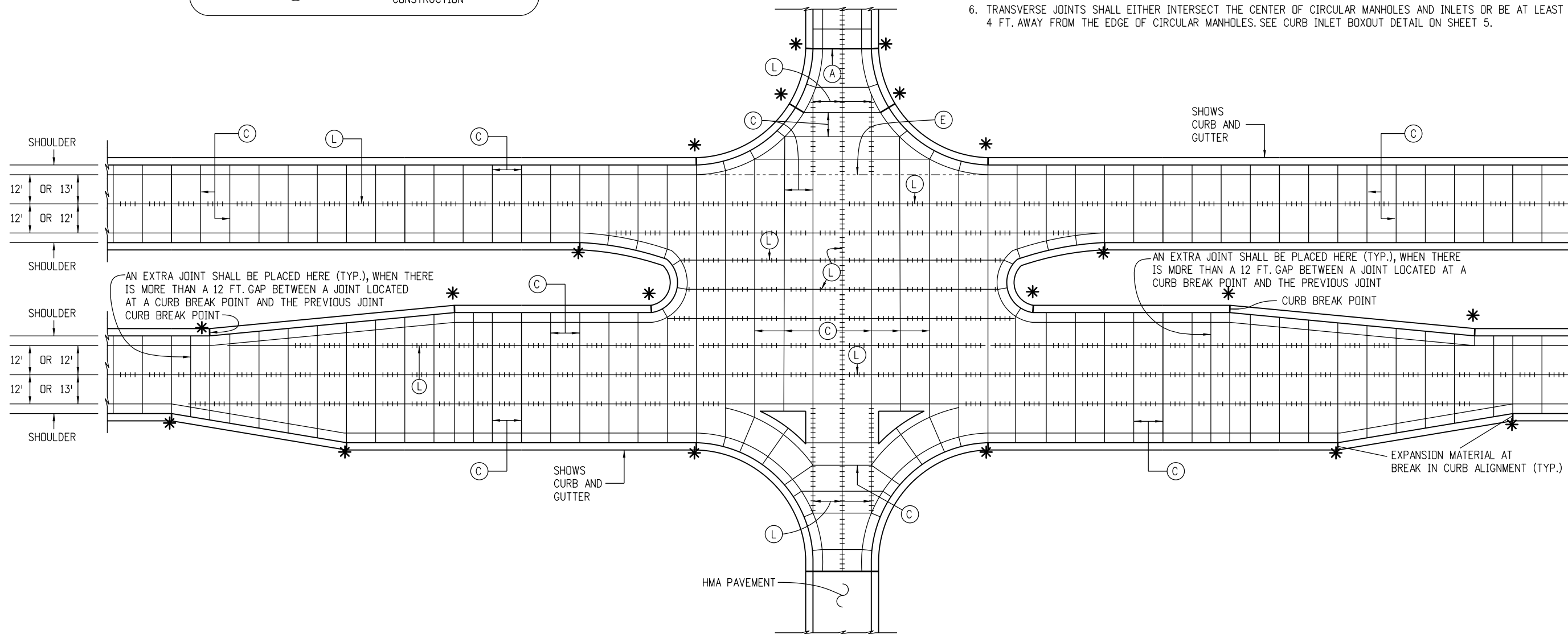
JOINT LEGEND

(SEE SHEET 5 FOR JOINT DETAILS)



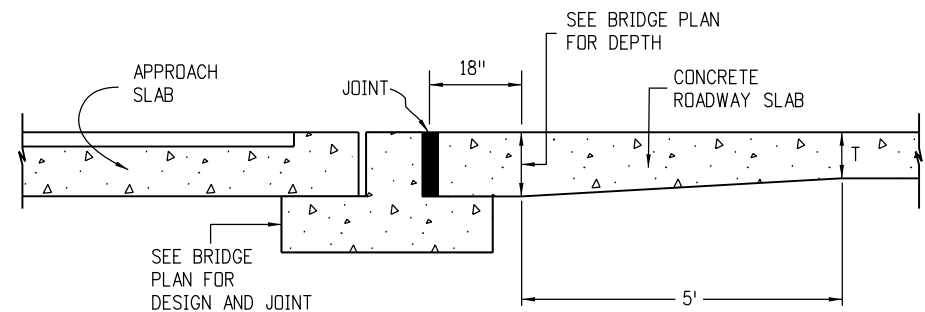
NOTES

- LONGITUDINAL JOINTS SHALL BE PLACED ADJACENT TO LANE MARKINGS WHEN POSSIBLE, AND HAVE A MAXIMUM SPACING OF 13 FT. (15 FT. IS PERMITTED WITH MONOLITHIC CURB AND GUTTER).
- CONSTRUCT TRANSVERSE JOINTS PERPENDICULAR TO THE CENTERLINE OF PAVEMENT AND EXTEND THROUGH THE CURB OR CURB AND GUTTER.
- PLACE 1/2 IN. MIN. EXPANSION JOINT FILLER IN TOP 6 IN. OF CURB JOINT AT INTERSECTION RETURN RADIUS POINTS.
- THE CONTRACTOR SHALL, UNLESS OTHERWISE SHOWN ON THE PLANS, SELECT AND USE A BOND BREAKER AT INLETS, MANHOLES AND SIMILAR SIZE STRUCTURES. SMALLER STRUCTURES SUCH AS VALVE AND MONUMENT BOXES DO NOT REQUIRE A BOND BREAKER.
- WHERE A LONGITUDINAL JOINT WOULD PASS LESS THAN 1 FT. FROM A CAST-IN-PAVEMENT MANHOLE OR SIMILAR SIZE STRUCTURE, A TYPICAL 2 FT. RADIAL JOINT, AS SHOWN IN THE DETAILS, SHALL BE USED.
- TRANSVERSE JOINTS SHALL EITHER INTERSECT THE CENTER OF CIRCULAR MANHOLES AND INLETS OR BE AT LEAST 4 FT. AWAY FROM THE EDGE OF CIRCULAR MANHOLES. SEE CURB INLET BOXOUT DETAIL ON SHEET 5.

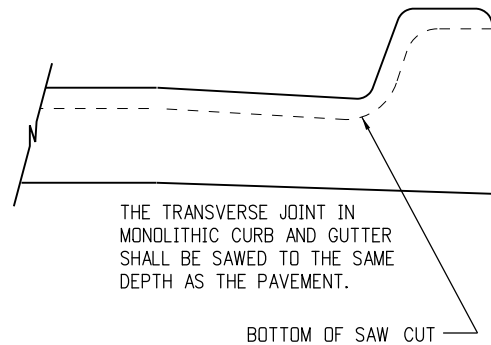


MULTI-LANE INTERSECTION WITH SPEED CHANGE LANE AND CONCRETE SHOULDERS

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	<h1>CONCRETE PAVEMENT JOINTS</h1>	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments:			M-412-1	
Designer Initials: JBK	(R-X)					Standard Sheet No. 4 of 5	
Last Modification Date: 07/31/19	(R-X)						
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)			Project Development Branch	JBK	Issued by the Project Development Branch: July 31, 2019	Project Sheet Number:



BRIDGE APPROACH



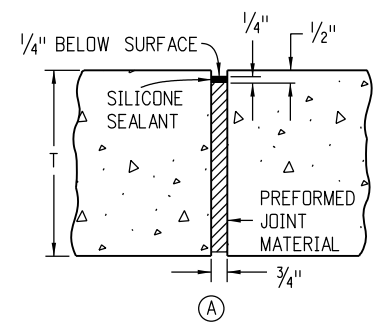
NOTE

1. PAVEMENT THICKNESS (T), SHALL BE AS SHOWN ON THE PLANS.

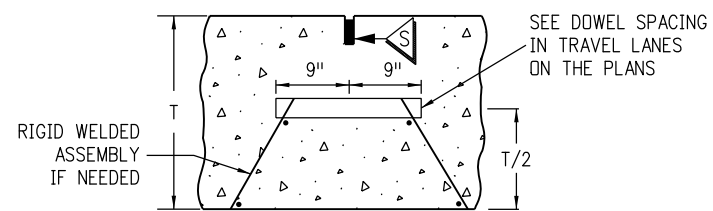
PAVEMENT THICKNESS (T)	DOWEL BAR DIAMETER
7 IN. ≤ T < 8 IN.	1 IN.
8 IN. ≤ T ≤ 10 IN.	1.25 IN.
10 IN. < T ≤ 15 IN.	1.50 IN.

REINFORCING SIZE TABLE

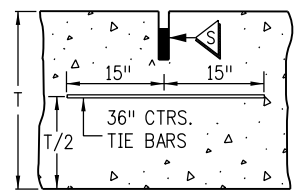
TIE BAR SIZE IS NO. 5 WHEN PAVEMENT IS PLACED ON UNBOUND BASES.
TIE BAR IS NO. 6 WHEN PAVEMENT IS PLACED ON LIME TREATED SOIL, ASPHALT OR CEMENT TREATED, MILLED ASPHALT, OR RECYCLED ASPHALT BASES.



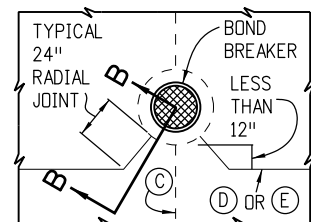
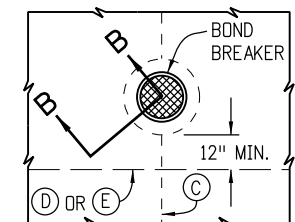
EXPANSION JOINT



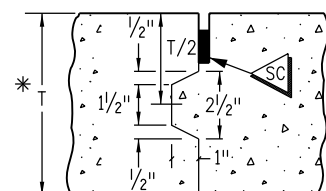
DOWELED TRANSVERSE CONSTRUCTION OR CONTRACTION JOINT
(TRANSVERSE WEAKENED PLANE JOINT)



LONGITUDINAL CONTRACTION JOINT
(LONGITUDINAL WEAKENED PLANE JOINT)

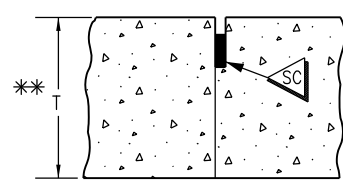


INLET OR MANHOLE CAST IN PAVEMENT



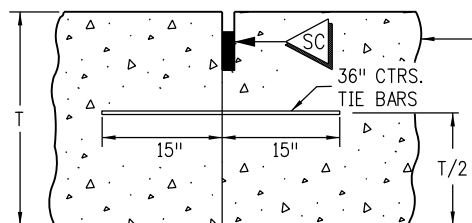
LONGITUDINAL CONSTRUCTION JOINT

* USE ONLY IF T ≥ 8 IN. FORM ONLY FEMALE KEYWAY



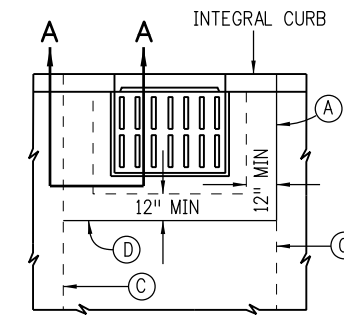
LONGITUDINAL CONSTRUCTION JOINT

** USE ONLY IF T < 8 IN.



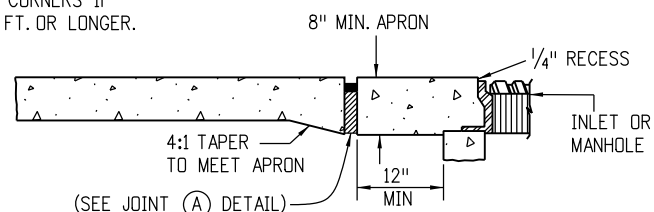
LONGITUDINAL CONSTRUCTION JOINT

A KEYWAY IS ALLOWED TO FACILITATE USE OF BENT TIE BARS OR APPROVED TWO PIECE CONNECTORS

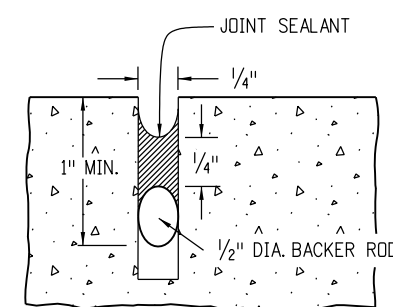


CURB INLET BOXOUT

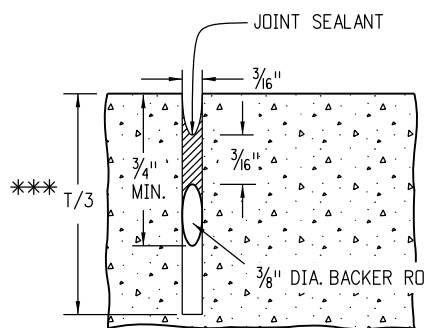
INSTALL TRANSVERSE JOINT AT BOTH BOXOUT CORNERS IF BOXOUT IS 8 FT. OR LONGER.



SECTION A-A

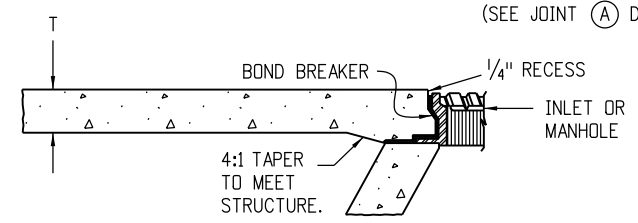


SEAL AT CONSTRUCTION JOINT



SAWED JOINT

*** USE T/4 WHEN T < 8 IN.



SECTION B-B

BOND BREAKER SHALL BE COMPOSED OF PLASTIC SHEET, BUILDING PAPER OR OTHER APPROVED MATERIAL THAT PREVENTS BONDING.

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Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions

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Project Development Branch **JBK**

CONCRETE PAVEMENT JOINTS

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

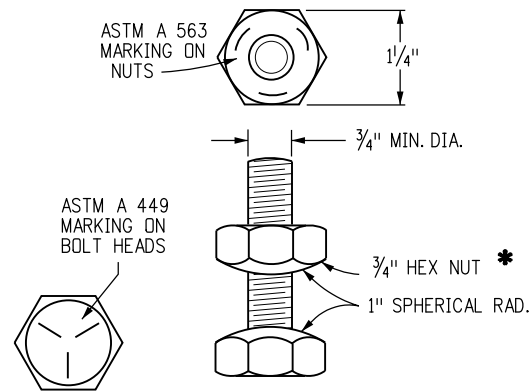
M-412-1

Standard Sheet No. 5 of 5

Project Sheet Number:

PIPE DIA.	MIN. COVER	MAX. HEIGHT OF COVER H (FT.)						
		WALL THICKNESS (IN.)						
IN.		0.109	0.138	0.168	0.188	0.218	0.249	0.280
60	12	47	68	90	100	100	100	100
66	12	43	62	81	93	100	100	100
72	12	39	57	75	86	95	100	100
76	12	36	52	69	79	86	95	100
84	12	34	49	64	73	88	97	100
90	12	31	45	60	68	82	97	100
96	12	29	43	56	64	77	91	100
102	18	28	40	52	60	73	86	94
108	18	26	38	50	57	69	81	88
114	18	25	36	47	54	65	77	84
120	18	23	34	45	51	62	73	80
126	18	22	32	42	49	59	69	76
132	18	21	31	40	46	56	66	72
138	18	20	29	39	44	54	63	69
144	18	19	28	37	43	51	61	66
150	24	19	27	36	41	49	58	64
156	24	18	26	34	39	47	56	61
162	24	17	25	33	38	46	54	59
168	24	17	24	32	36	44	52	57
174	24	16	23	31	35	42	50	55
180	24	15	22	30	34	41	48	53
186	24	15	22	29	33	40	47	51
192	24		21	28	32	38	45	50
198	30		20	27	31	37	44	48
204	30		19	26	30	36	43	47
210	30			25	29	35	41	45
216	30			25	28	34	40	44
222	30			24	27	33	39	43
228	30			23	27	32	38	42
234	30			23	26	31	37	41
240	30			25	31	36	40	

TABLE I - 6 IN. x 2 IN. CORRUGATIONS ROUND STEEL PIPE



PIPE BOLT AND NUT

*INSTALL CULVERT NUTS AS SHOWN. DO NOT INVERT.

NOTES:

- NUTS MADE IN CONFORMANCE WITH ASTM A 194, GRADE 2 OR GRADE 2H, AND MARKED WITH THE GRADE SYMBOL ARE ACCEPTABLE EQUIVALENTS FOR ASTM A 563, GRADE C NUTS.
- BOLTS SHALL BE PLACED LOOSE TO ALIGN PLATES, THEN TIGHTENED TO MAINTAIN STRUCTURE SHAPE.

PIPE SIZE SPAN x RISE	MIN. COVER	MIN. WALL THICKNESS	CORNER RADII	MAX. H
6- 1 x 4- 7	12	0.109	18	15
6- 4 x 4- 9	12	0.109	18	15
6- 9 x 4-11	12	0.109	18	14
7- 0 x 5- 1	12	0.109	18	14
7- 3 x 5- 3	12	0.109	18	13
7- 8 x 5- 5	12	0.109	18	13
7-11 x 5- 7	12	0.109	18	12
8- 2 x 5- 9	18	0.109	18	12
8- 7 x 5-11	18	0.109	18	11
8-10 x 6- 1	18	0.109	18	11
9- 4 x 6- 3	18	0.109	18	10
9- 6 x 6- 5	18	0.109	18	10
9- 9 x 6- 7	18	0.109	18	10
10- 3 x 6- 9	18	0.109	18	9
10- 8 x 6-11	18	0.109	18	9
10-11 x 7- 1	18	0.109	18	9
11- 5 x 7- 3	18	0.109	18	8
11- 7 x 7- 5	18	0.109	18	7
11-10 x 7- 7	18	0.109	18	7
12- 4 x 7- 9	30	0.109	18	6
12- 6 x 7-11	30	0.109	18	6
12- 8 x 8- 1	30	0.109	18	6
12-10 x 8- 4	30	0.109	18	6
13- 3 x 9- 4	30	0.109	31	13
13- 6 x 9- 6	30	0.109	31	12
14- 0 x 9- 8	30	0.109	31	12
14- 2 x 9-10	30	0.109	31	12
14- 5 x 10- 0	30	0.109	31	11
14-11 x 10- 2	30	0.109	31	11
15- 4 x 10- 4	30	0.109	31	11
15- 7 x 10- 6	30	0.109	31	11
15-10 x 10- 8	30	0.109	31	10
16- 3 x 10-10	30	0.138	31	10
16- 6 x 11- 0	30	0.138	31	10
17- 0 x 11- 2	30	0.138	31	10
17- 2 x 11- 4	30	0.138	31	10
17- 5 x 11- 6	30	0.138	31	9
17-11 x 11- 8	30	0.138	31	9
18- 1 x 11-10	30	0.168	31	9
18- 7 x 12- 0	30	0.168	31	9
18- 9 x 12- 2	30	0.168	31	9
19- 3 x 12- 4	30	0.168	31	8
19- 6 x 12- 6	30	0.168	31	8
19- 8 x 12- 8	30	0.168	31	7
19-11 x 12-10	30	0.168	31	7
20- 5 x 13- 0	36	0.188	31	7
20- 7 x 13- 2	36	0.188	31	6

TABLE II - 6 IN. x 2 IN. CORRUGATIONS STEEL PIPE-ARCH

☑ - PIPE-ARCH IS INTENDED FOR USE WHERE MINIMUM COVER REQUIREMENTS FOR ROUND PIPE CANNOT BE MET. USE ROUND PIPE WHEN H EXCEEDS 15 FT.

PIPE SIZE SPAN x RISE	MIN. COVER	MIN. WALL THICKNESS	CORNER RADII	MAX. H
6- 2 x 5- 0	21	0.100	27	15
6- 7 x 4-11	21	0.100	27	15
6- 7 x 5- 8	21	0.100	32	15
6-11 x 5- 9	21	0.100	32	15
7- 3 x 5-11	21	0.100	32	15
7- 9 x 6- 0	24	0.100	32	15
8- 1 x 6- 1	24	0.100	32	15
8- 5 x 6- 3	24	0.100	32	15
8-10 x 6- 4	27	0.100	32	15
9- 3 x 6- 5	27	0.100	32	15
9- 7 x 6- 6	27	0.100	32	15
9-11 x 6- 8	27	0.100	32	15
10- 3 x 6- 9	27	0.100	32	15
10- 9 x 6-10	30	0.100	32	14
11- 1 x 7- 0	30	0.100	32	14
11- 5 x 7- 1	30	0.100	32	14
11- 9 x 7- 2	33	0.100	32	13
12- 3 x 7- 3	33	0.100	32	13
12- 7 x 7- 5	33	0.100	32	12
12-11 x 7- 6	33	0.100	32	12
13- 1 x 8- 2	33	0.100	32	12
13- 1 x 8- 4	33	0.100	32	12
13-11 x 8- 5	30	0.125	32	13
14- 0 x 8- 7	33	0.125	32	13
13-11 x 9- 5	30	0.125	32	13
14- 3 x 9- 7	33	0.125	32	12
14- 8 x 9- 8	33	0.125	32	12
14-11 x 9-10	33	0.125	32	12
15- 4 x 10- 0	33	0.125	32	12
15- 7 x 10- 2	30	0.150	32	11
16- 1 x 10- 4	33	0.150	32	11
16- 4 x 10- 6	33	0.150	32	11
16- 9 x 10- 8	33	0.150	32	11
17- 0 x 10-10	33	0.150	32	10
17- 3 x 11- 0	30	0.175	32	10
17- 9 x 11- 2	30	0.175	32	10
18- 0 x 11- 4	33	0.175	32	10
18- 5 x 11- 6	33	0.175	32	10
18- 8 x 11- 8	33	0.175	32	9
19- 2 x 11- 9	30	0.200	32	9
19- 5 x 11-11	30	0.200	32	9
19-10 x 12- 1	33	0.200	32	9
20- 1 x 12- 3	33	0.200	32	9
20- 1 x 12- 6	33	0.200	32	9
20-10 x 12- 7	30	0.225	32	8
21- 1 x 12- 9	33	0.225	32	8
21- 6 x 12-11	33	0.225	32	8

TABLE III - 9 IN. x 2 1/2 IN. CORRUGATIONS ALUMINUM PIPE-ARCH

H - HEIGHT OF COVER LIMIT. MAXIMUM HEIGHT OF FILL OVER THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT: HMA OR PCCP. FILL HEIGHTS GREATER THAN MAXIMUM ALLOWED IN THE FILL HEIGHT TABLE REQUIRE SPECIAL DESIGN.

PIPE DIA.	MIN. COVER	MAX. HEIGHT OF COVER H (FT.)						
		WALL THICKNESS (IN.)						
IN.		0.100	0.125	0.150	0.175	0.200	0.225	0.250
60	15	31	45	60	70	81	92	100
66	18	28	41	54	64	74	84	94
72	21	25	37	50	58	67	77	86
78	21	23	35	46	54	62	71	79
84	21	22	32	42	50	58	66	73
90	24	20	30	40	47	54	61	68
96	24	19	28	37	44	50	57	64
102	24	18	26	35	41	47	54	60
108	27	17	25	33	39	45	51	57
114	27	16	23	31	37	42	48	54
120	27	15	22	30	35	40	46	51
126	30	14	21	28	33	38	44	49
132	30	14	20	27	32	37	42	46
138	30	13	19	26	30	35	40	44
144	33	12	18	25	29	33	38	42
150	30		18	24	28	32	36	40
156	30		17	23	27	31	35	38
162	30			22	26	30	34	37
168	30			21	25	29	32	35
174	30			20	24	28	31	34
180	27				23	27	30	33
186	27				22	26	29	31
192	27					25	28	30
198	27					24	27	29
204	27					23	26	28
210	27						25	27
216	27							26
222	27							25
228	27							25

TABLE IV - 9 IN. x 2 1/2 IN. CORRUGATIONS ROUND ALUMINUM PIPE

GENERAL NOTES

- PIPE OR PIPE-ARCH WITH ENDS CUT TO FIT A SLOPE AND REPAIRED IN ACCORDANCE WITH SUBSECTION 707.09, SHALL BE REINFORCED AS SHOWN ON THE PLANS.
- WHERE MULTIPLE PIPES ARE USED, THEY SHALL BE SPACED SO THAT ADJACENT SIDES OF THE PIPE SHALL BE AT LEAST ONE-HALF DIAMETER OR ONE-HALF SPAN APART TO PERMIT CAREFUL TAMPING OF THE BACKFILL MATERIAL, EXCEPT THAT THE CLEAR DISTANCE BETWEEN ADJACENT SIDES SHALL NOT BE MORE THAN 3 FT.
- MINIMUM COVER FOR STRUCTURAL PLATE PIPE OR PIPE ARCH IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT: HMA OR PCCP. DURING CONSTRUCTION, ADEQUATE COVER SHALL BE PROVIDED TO PROTECT THE STRUCTURE FROM DAMAGE. THE COVER DURING CONSTRUCTION SHALL BE AT LEAST 1 FT.

∇ - PIPE ARCH WITH EQUAL PERIPHERY AND WITH SPAN AND RISE DIMENSIONS APPROXIMATELY EQUAL TO THOSE SPECIFIED ON THE PLANS WILL BE PERMITTED.

PIPE OR PIPE-ARCH CONFORMING TO SECTION 603 SHALL NOT BE SUBSTITUTED FOR STRUCTURAL PLATE PIPE OR PIPE-ARCH. PIPE-ARCH DESIGN IS BASED ON CORNER BEARING PRESSURE ON THE SOIL OF 2 TONS PER SQUARE FT.

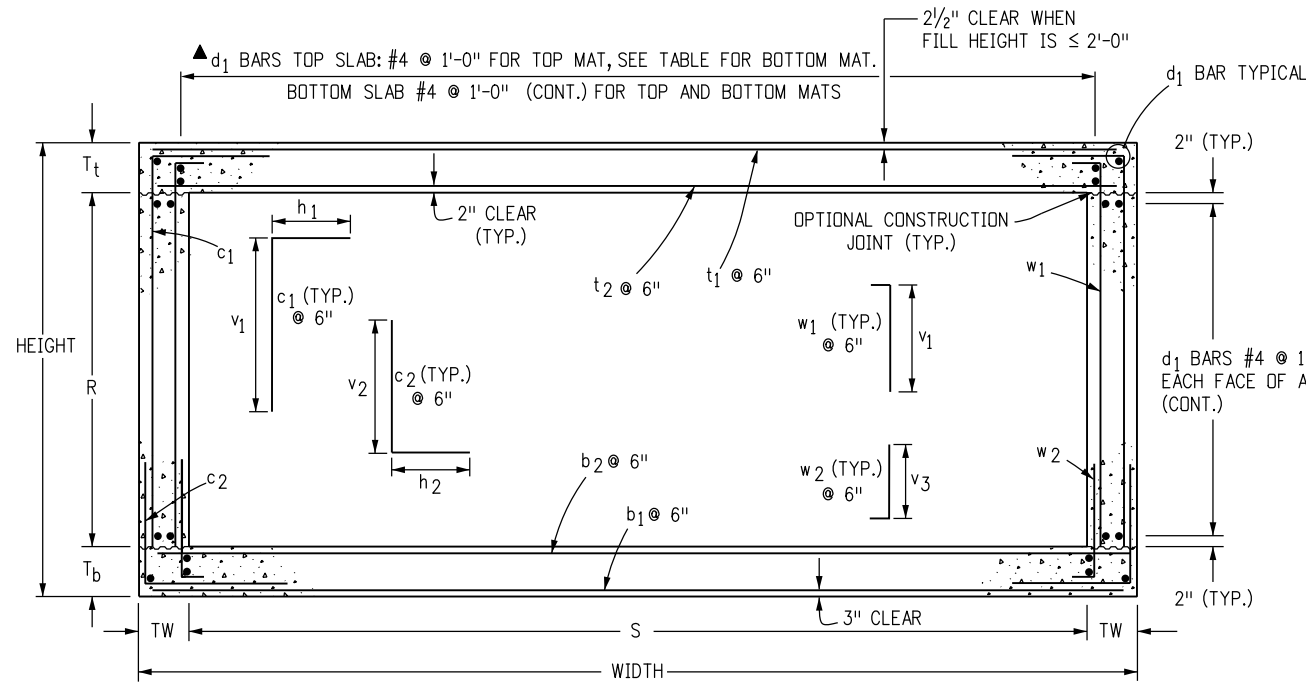
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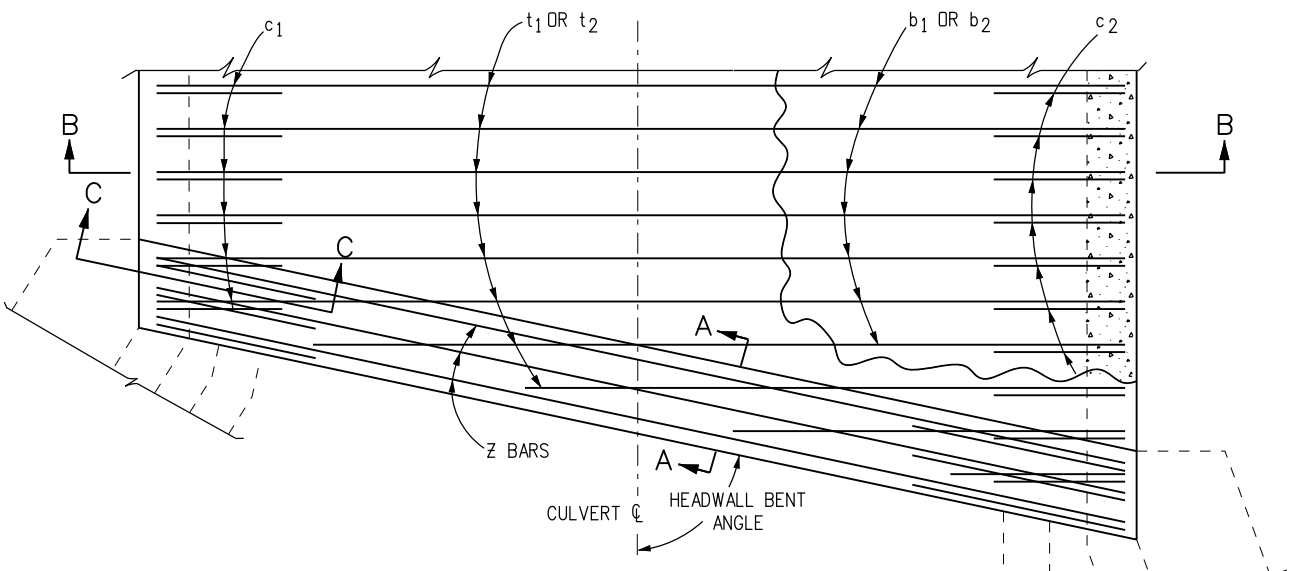
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Project Development Branch **JBK**

**STRUCTURAL PLATE
 PIPE H-20 LOADING**
 Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-510-1
Standard Sheet No. 1 of 1
 Project Sheet Number: _____

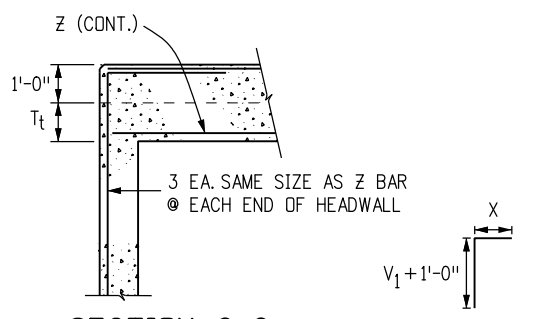


SECTION B-B

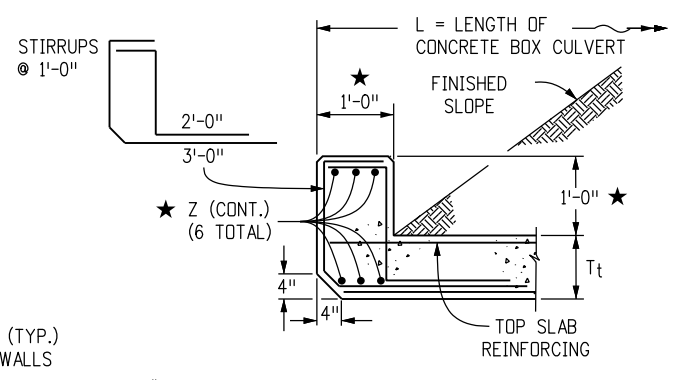


REINFORCING PLAN

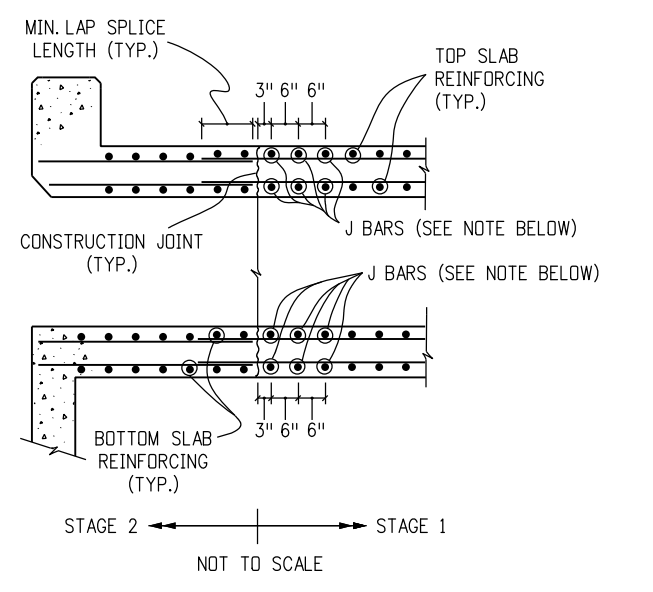
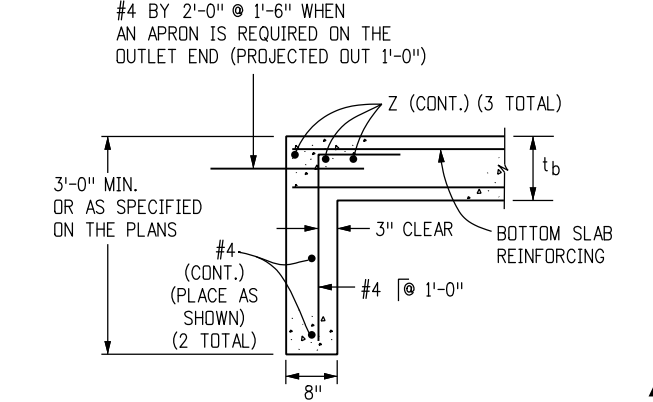
BAR SIZE (#)	EPOXY X (FT.-IN.)	BLACK X (FT.-IN.)
4	2-4	1-11
5	2-10	2-4
6	3-5	2-10
7	4-1	3-3
8	5-3	4-3
9	6-8	5-5



**SECTION C-C
HEADWALL CORNER REINFORCING DETAIL**



SECTION A-A



CONSTRUCTION JOINT DETAIL FOR STAGED CONSTRUCTION

NOTE: THIS DETAIL IS FOR CONSTRUCTION JOINTS INSTALLED PERPENDICULAR TO THE C OF THE BOX ONLY. THE CONTRACTOR CAN DESIGN AND INSTALL J BARS AT HIS EXPENSE TO SUPPORT TEMPORARY LIVE LOADS DURING STAGE 1 CONSTRUCTION. J BARS SHALL BE THE SAME SIZE AS THE TOP AND BOTTOM SLAB REINFORCING WHEN THERE ARE NO TEMPORARY LIVE LOADS TO SUPPORT.

GENERAL NOTES

1. ALL CONCRETE SHALL BE CLASS D (BOX CULVERT).
2. ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE FRESH CONCRETE IS PLACED.
3. ALL CONSTRUCTION JOINTS NOT SHOWN ON THE PLANS SHALL BE CONSTRUCTED ONLY IF APPROVED BY THE ENGINEER.
4. THE CONTRACTOR SHALL MAINTAIN THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION.
5. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH STANDARD PLAN M-206-1.
6. ANY CULVERT SPAN 20 FT. OR GREATER, A FOUNDATION INVESTIGATION AND REPORT ARE REQUIRED.
7. BACKFILL SHALL NOT BEGIN UNTIL TOP SLAB HAS REACHED DESIGN STRENGTH, f'c.
8. SPLICE QUANTITIES FOR LONGITUDINAL AND TRANSVERSE BARS ARE NOT INCLUDED.
9. REINFORCING STEEL SHALL BE GRADE 60.
10. THE MINIMUM LAP SPLICE LENGTH FOR EPOXY COATED REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-3"	1'-7"	2'-5"	2'-10"	3'-8"	4'-8"	5'-11"	7'-3"

THE MINIMUM LAP SPLICE LENGTH FOR BLACK REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-1"	1'-4"	1'-7"	1'-11"	2'-6"	3'-1"	3'-11"	4'-10"

- THE ABOVE SPLICE LENGTHS ARE FOR CLASS B SPLICES.
11. ALL DIMENSIONS ARE PERPENDICULAR TO THE CENTERLINE OF THE BOX.
 12. WINGWALLS SHALL BE TIED TO CONCRETE BOX CULVERT IN ACCORDANCE WITH STANDARD PLAN M-601-20.
 13. ALL TRANSVERSE REINFORCING SHALL BE NORMAL TO THE CENTERLINE OF THE BOX.
 14. THE FILL HEIGHT IS THE DISTANCE MEASURED FROM THE TOP OF THE TOP SLAB TO THE TOP OF PAVEMENT.
 15. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4".
 16. FOR FILL HEIGHTS LESS THAN 2 FT. A WATERPROOFING MEMBRANE SHALL BE PROVIDED FOR THE TOP OF THE TOP SLAB AND 18 INCHES DOWN FROM THE TOP OF THE EXTERIOR WALLS.
 17. FOR FILL HEIGHTS LESS THAN 2 FT, THE d1 BARS FOR THE BOTTOM MAT OF THE TOP SLAB SHALL BE AS FOLLOWS:

S	6	8	10	12, 14, 16, 18, 20
BAR SIZE:	#5	#6	#6	#5
SPACING	1'-0"	1'-0"	0'-6"	0'-6"

DESIGN DATA: 7TH EDITION, 2014, OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
 RATING DATA: 2ND EDITION, 2011, OF THE AASHTO MANUAL FOR BRIDGE EVALUATION

f_y = 60,000 psi,
 f'c = 4,500 psi,
LOADING DATA:
 LIVE LOAD = AASHTO LRFD, HL-93 TRUCK, HL-93 TANDEM, COLORADO PERMIT TRUCK, AND NRL
 DEAD LOAD CASE 1: VERTICAL EARTH LOAD = 120 LBS./CU. FT.
 HORIZONTAL EARTH LOAD = 30 LBS./CU. FT.
 DEAD LOAD CASE 2: VERTICAL EARTH LOAD = 120 LBS./CU. FT.
 HORIZONTAL EARTH LOAD = 60 LBS./CU. FT.
 THRUST IS NOT CONSIDERED IN THIS STANDARD, I.E. THRUST = 0.
 WEARING SURFACE - 12 INCHES THICK CONCRETE PAVEMENT.
 DEAD LOAD - TYPE 7 BARRIER.
 EXTREME HEADWATER TO DEPTH RATIO IS IN ACCORDANCE WITH THE CDDT DRAINAGE MANUAL.
 EXTREME HEADWATER TO DEPTH RATIO WAS INCLUDED IN THE DESIGN BUT EXCLUDED FROM THE RATINGS AS PER THE AASHTO MANUAL FOR BRIDGE EVALUATION.
 LIVE LOAD SURCHARGE ON EXTERIOR WALLS = 2 FT. OF EARTH

- ★ IF HEADWALL MOUNT GUARDRAIL IS USED (SEE STANDARD PLAN M-606-1, SHEET 19, AND THE INFORMATION BELOW):
- ALL REINFORCING STEEL SHALL BE ACCORDING TO THIS BOX CULVERT PLAN.
 - ANY SPECIAL DESIGN FOR STIRRUPS WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
 - HEADWALL DIMENSION AND CONCRETE QUANTITY SHALL BE ACCORDING TO STANDARD PLAN M-606-1, SHEET 19.
 - POST ANCHORS SHALL BE PROVIDED ACCORDING TO STANDARD PLAN M-606-1, SHEET 19.
 - POST ANCHORS AND CONCRETE FOR HEADWALL MOUNT OF GUARDRAIL WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
 - POST ANCHORS WHEN REQUIRED AND ENCASED IN HEADWALL CONCRETE, SHALL CONFORM TO ASTM A 36 OR AASHTO M 169 STEEL.
18. SEE M-603-3 FOR PRECAST CONCRETE BOX CULVERT DETAILS.

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Sheet Revisions

Date:	Comments

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**SINGLE CONCRETE BOX
 CULVERT (CAST-IN-PLACE)**
 Issued by the Project Development Branch: July 31, 2019

**STANDARD PLAN NO.
 M-601-1
 Standard Sheet No. 1 of 2**
 Project Sheet Number:

SINGLE CONCRETE BOX CULVERT DIMENSIONS, QUANTITIES & RATING FACTORS (EXCLUDING HEADWALL & TOEWALL QUANTITIES)

BOX SIZE				FILL HEIGHT ALLOWED	SLAB & WALL THICKNESS (INCHES)			BAR SIZES						d1▲	DIMENSIONS					QUANTITIES			RATING FACTORS			
S	R	HT.	WIDTH		FT-IN	Tt	Tb	TW	t1* & b1	t2	b2	w1* & w2	c1*		c2	NO.	h1	h2	v1	v2	v3	CONCRETE CY/LF	REBAR STL LBS/LF	WATERPROOFING SY/LF	HL-93 INVENTORY	HL-93 OPERATING
6	7	8-8	7-8	< 2	10	10	10	4	6	6	4	5	5	64	3-5	4-4	7-7	3-1	1-11	0.905	215	1.185	1.23	1.59	2.03	2.09
		8-4.5	7-8	2 TO 8	8.5	8	10	4	5	5	4	5	5	64	3-10	4-4	7-6	2-11	1-9	0.823	199	1.67	1.67	2.17	2.51	2.58
		8-5	7-8	8 TO 15	8.5	8.5	10	4	5	5	4	5	5	64	3-8	2-4	7-6	3-0	1-9	0.834	190	◆	◆	◆	◆	◆
		8-5	7-8	15 TO 20	8.5	8.5	10	4	5	5	4	5	5	64	3-8	2-4	7-6	3-0	1-9	0.834	190	◆	◆	◆	◆	◆

HEADWALL AND TOEWALL QUANTITIES

HEADWALL BENT ANGLE	90° TO 75°			74° TO 60°			59° TO 45°			
	CLEAR SPAN (S)	Z	STIRRUPS	REBAR QUANT.	Z	STIRRUPS	REBAR QUANT.	Z	STIRRUPS	REBAR QUANT.
	#	#	LBS/LF	#	#	LBS/LF	#	#	LBS/LF	
6	4	4	22.8	4	4	22.2	6	4	34.6	
8	4	4	23.0	5	4	28.8	7	4	44.0	
10	5	4	28.5	6	4	35.1	9	4*	68.7	
12	6	4	35.3	6	4	34.4	9	5*	71.7	
14	6	4	34.2	7	4	41.5	★	★	★	
16	6	4	33.1	8	5	54.0	★	★	★	
18	7	4	39.5	9	5	63.3	★	★	★	
20	7	4	39.3	★	★	★	★	★	★	

CONCRETE QUANTITY = 0.086 CY/LF

NOTES

- 1. SIX INCH SPACING AT EACH END OF THE SPAN FOR A DISTANCE OF 1/4 OF THE SPAN LENGTH; 12 INCH SPACING ELSEWHERE.
2. QUANTITIES ARE GIVEN FOR ONE HEADWALL AND ONE TOEWALL AND ARE BASED ON PER LINEAR FOOT OF HEADWALL. STEEL QUANTITIES INCLUDE ALL REINFORCING. QUANTITIES SHALL BE PAID FOR AS SHOWN ON THE PLANS.
- ★ 3. SKEWED HEADWALLS ARE NOT RECOMMENDED FOR THESE SPANS. A SPECIAL DESIGN IS REQUIRED.
4. FOR HEADWALL AND TOEWALL DETAILS SEE M-601-1, SHEET 1 OF 2.
5. WHEN THE FILL HEIGHTS ARE LESS THAN OR EQUAL TO 2 FT, ALL REINFORCING BARS IN THE HEADWALL, ALL REINFORCING BARS DESIGNATED BY AN ASTERISK (*), AND THE d1 BARS IN THE TOP MAT OF THE TOP SLAB SHALL BE EPOXY COATED.
6. REINFORCING QUANTITIES INCLUDE BOTH EPOXY-COATED AND UNCOATED BARS.
7. WHEN A (RISE) R OF LESS THAN 6 FT IS REQUIRED, USE THE BAR SIZES AND THE SLAB AND WALL THICKNESSES FOR THE 6 FT RISE (IF AVAILABLE ON THE TABLE).
- ▲ 8. FOR SIZE AND SPACING OF THE BOTTOM MAT BARS IN THE TOP SLAB SEE TABLE ON M-601-1, SHEET 1 OF 2. ALL OTHER d1 BARS ARE #4's AT 1'-0" SPACING. THE NUMBER OF BARS REQUIRED IS LISTED ON THIS SHEET AND INCLUDES BOTH #4 BARS AND THOSE FROM THE TABLE.
- ◆ 9. LIVE LOAD IS NEGLECTED AS PER AASHTO LRFD SECTION 3.6.1.2.6. FOR THESE STRUCTURES REFER TO THE CDDT RATING MANUAL.
10. FOR ALL NEW CULVERT DESIGNS, A RATING IS REQUIRED. THE RATING SUMMARY SHEET SHOULD BE PRINTED FROM THE CDDT EXTERNAL WEBSITE AND SUBMITTED TO THE BRIDGE RATING UNIT OR INCLUDED AS PART OF A LARGER DESIGN PACKAGE. FOR ADDITIONAL INFORMATION, SEE THE CDDT RATING MANUAL.

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Project Development Branch JBK

SINGLE CONCRETE BOX CULVERT (CAST-IN-PLACE)

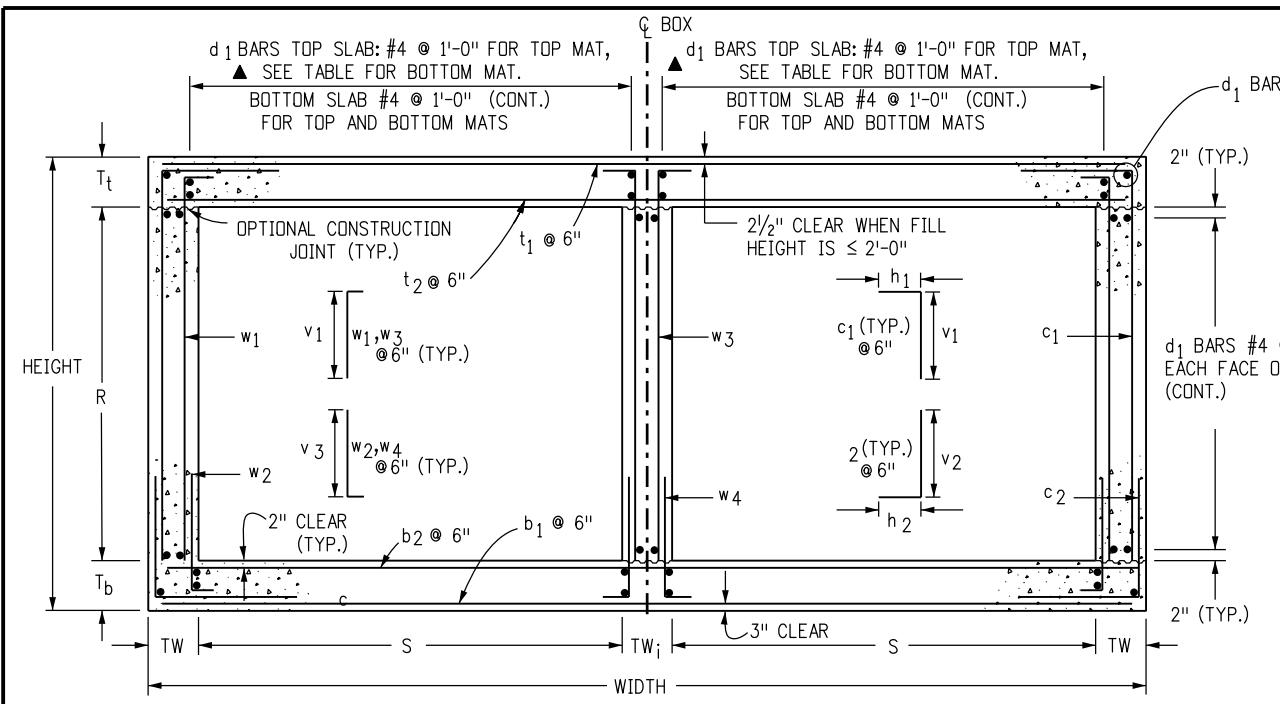
Issued by the Project Development Branch: July 31, 2019

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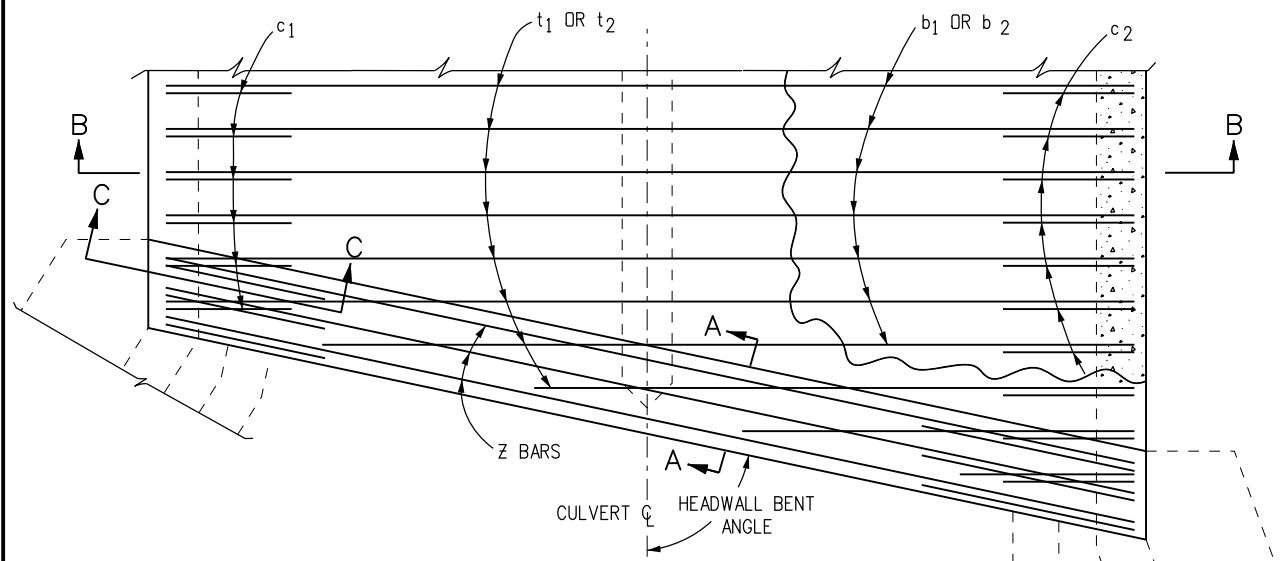
M-601-1

Standard Sheet No. 2 of 2

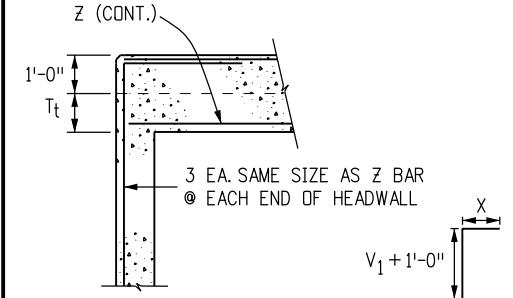
Project Sheet Number:



SECTION B-B

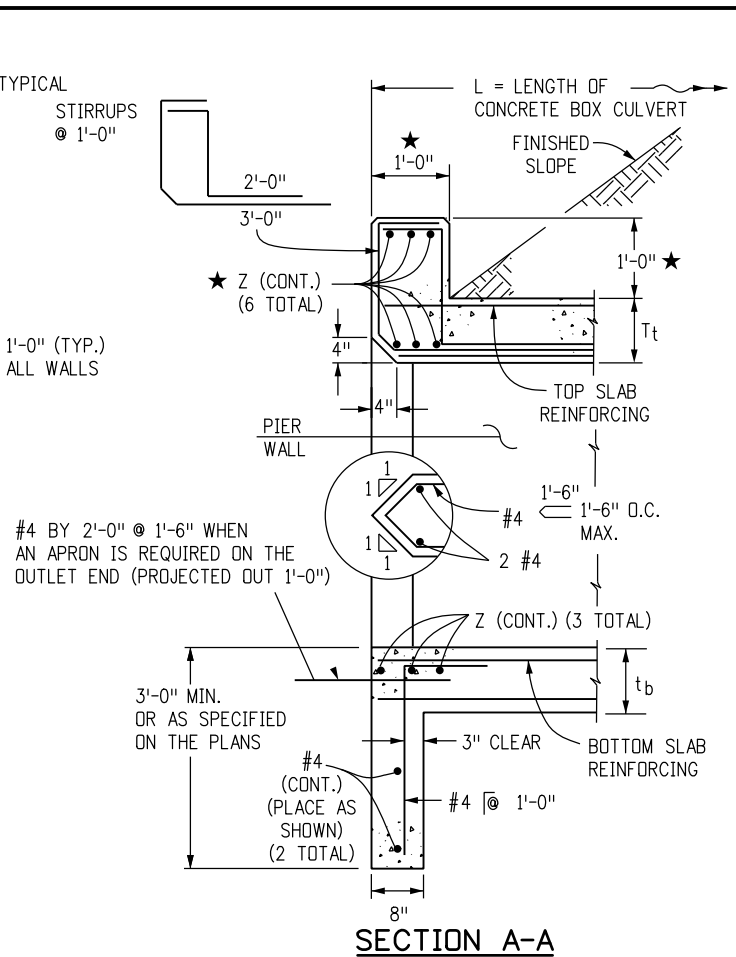


REINFORCING PLAN

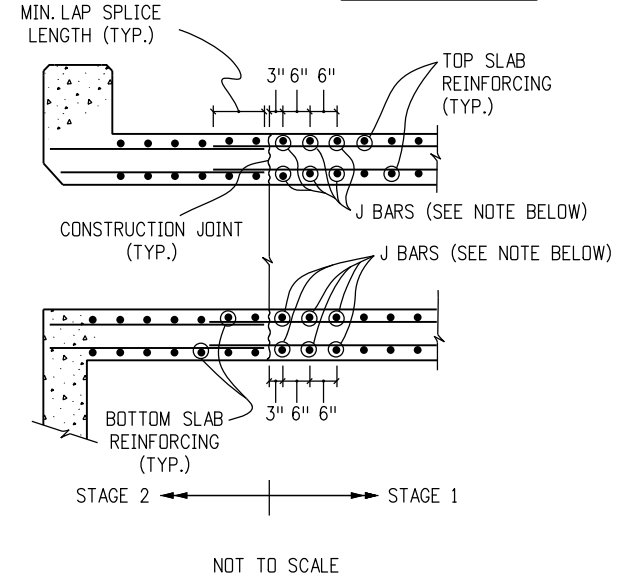


**SECTION C-C
HEADWALL CORNER REINFORCING DETAIL**

BAR SIZE (#)	EPOXY X (FT.-IN.)	BLACK X (FT.-IN.)
4	2-4	1-11
5	2-10	2-4
6	3-5	2-10
7	4-1	3-3
8	5-3	4-3
9	6-8	5-5



SECTION A-A



CONSTRUCTION JOINT DETAIL FOR STAGED CONSTRUCTION
NOTE: THIS DETAIL IS FOR CONSTRUCTION JOINTS INSTALLED PERPENDICULAR TO THE C OF THE BOX ONLY. THE CONTRACTOR CAN DESIGN AND INSTALL J BARS AT HIS EXPENSE TO SUPPORT TEMPORARY LIVE LOADS DURING STAGE 1 CONSTRUCTION. J BARS SHALL BE THE SAME SIZE AS THE TOP AND BOTTOM SLAB REINFORCING WHEN THERE ARE NO TEMPORARY LIVE LOADS TO SUPPORT.

GENERAL NOTES

1. ALL CONCRETE SHALL BE CLASS D (BOX CULVERT).
2. ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE FRESH CONCRETE IS PLACED.
3. ALL CONSTRUCTION JOINTS NOT SHOWN ON THE PLANS SHALL BE CONSTRUCTED ONLY IF APPROVED BY THE ENGINEER.
4. THE CONTRACTOR SHALL MAINTAIN THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION.
5. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH STANDARD PLAN M-206-1.
6. FOR ANY CULVERT SPAN 20 FT. OR GREATER, A FOUNDATION INVESTIGATION AND REPORT ARE REQUIRED.
7. BACKFILL SHALL NOT BEGIN UNTIL TOP SLAB HAS REACHED DESIGN STRENGTH, f_c .
8. SPLICE QUANTITIES FOR LONGITUDINAL AND TRANSVERSE BARS ARE NOT INCLUDED.
9. REINFORCING STEEL SHALL BE GRADE 60.
10. THE MINIMUM LAP SPLICE LENGTH FOR EPOXY COATED REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-3"	1'-7"	2'-5"	2'-10"	3'-8"	4'-8"	5'-11"	7'-3"

THE MINIMUM LAP SPLICE LENGTH FOR BLACK REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-1"	1'-4"	1'-7"	1'-11"	2'-6"	3'-1"	3'-11"	4'-10"

THE ABOVE SPLICE LENGTHS ARE FOR CLASS B SPLICES.

11. ALL DIMENSIONS ARE PERPENDICULAR TO THE CENTERLINE OF THE BOX.
12. WINGWALLS SHALL BE TIED TO CONCRETE BOX CULVERT IN ACCORDANCE WITH STANDARD PLAN M-601-20.
13. ALL TRANSVERSE REINFORCING SHALL BE NORMAL TO THE CENTERLINE OF THE BOX.
14. THE FILL HEIGHT IS THE DISTANCE MEASURED FROM THE TOP OF THE TOP SLAB TO THE TOP OF PAVEMENT.
15. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED $\frac{3}{4}$ ".
16. FOR FILL HEIGHTS LESS THAN 2 FT, A WATERPROOFING MEMBRANE SHALL BE PROVIDED FOR THE TOP OF THE TOP SLAB AND 18" DOWN ALONG THE TOPS OF THE EXTERIOR WALLS.
- ▲ 17. FOR FILL HEIGHTS LESS THAN 2 FT, THE d_1 BARS FOR THE BOTTOM MAT OF THE TOP SLAB SHALL BE AS FOLLOWS:

S	6, 8	10, 12, 16	14, 18	20
BAR SIZE:	#4	#5	#6	#7
SPACING	0'-6"	1'-0"	1'-2"	1'-2"

DESIGN DATA: 7TH EDITION, 2014, OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
RATING DATA: 2ND EDITION, 2011, OF THE AASHTO MANUAL FOR BRIDGE EVALUATION

LOADING DATA:
 $f_y = 60,000$ psi,
 $f_c = 4,500$ psi,
LIVE LOAD = AASHTO LRFD, HL-93 TRUCK, HL-93 TANDEM, COLORADO PERMIT TRUCK AND NRL
DEAD LOAD CASE 1: VERTICAL EARTH LOAD = 120 LBS./CU. FT.
HORIZONTAL EARTH LOAD = 30 LBS./CU. FT.
DEAD LOAD CASE 2: VERTICAL EARTH LOAD = 120 LBS./CU. FT.
HORIZONTAL EARTH LOAD = 60 LBS./CU. FT.
WEARING SURFACE - 12 IN. THICK CONCRETE PAVEMENT.
DEAD LOAD - TYPE 7 BARRIER.
THRUST IS NOT CONSIDERED IN THIS STANDARD, I.E. THRUST = 0.
EXTREME HEADWATER TO DEPTH RATIO IS IN ACCORDANCE WITH THE CDDT DRAINAGE MANUAL.
EXTREME HEADWATER TO DEPTH RATIO WAS INCLUDED IN THE CULVERT DESIGNS BUT EXCLUDED FROM THE RATINGS AS PER THE AASHTO MANUAL FOR BRIDGE EVALUATION.
LIVE LOAD SURCHARGE ON EXTERIOR WALLS = 2 FT. OF EARTH

- ★ IF HEADWALL MOUNT GUARDRAIL IS USED (SEE STANDARD PLAN M-606-1, SHEET 19) AND THE NOTES BELOW:
 - ALL REINFORCING STEEL SHALL BE ACCORDING TO THIS BOX CULVERT PLAN.
 - ANY SPECIAL DESIGN FOR STIRRUPS WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
 - HEADWALL DIMENSION AND CONCRETE QUANTITY SHALL BE ACCORDING TO STANDARD PLAN M-606-1, SHEET 19.
 - POST ANCHORS SHALL BE PROVIDED ACCORDING TO STANDARD PLAN M-606-1, SHEET 19.
 - POST ANCHORS AND CONCRETE FOR HEADWALL MOUNT OF GUARDRAIL WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
 - POST ANCHORS WHEN REQUIRED AND ENCASED IN HEADWALL CONCRETE, SHALL CONFORM TO ASTM A 36 OR AASHTO M 169 STEEL.
- 18. SEE M-603-3 FOR PRECAST CONCRETE BOX CULVERT DETAILS.

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Detailer Initials: LTA
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Sheet Revisions

Date:	Comments
(R-X)	
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(R-X)	

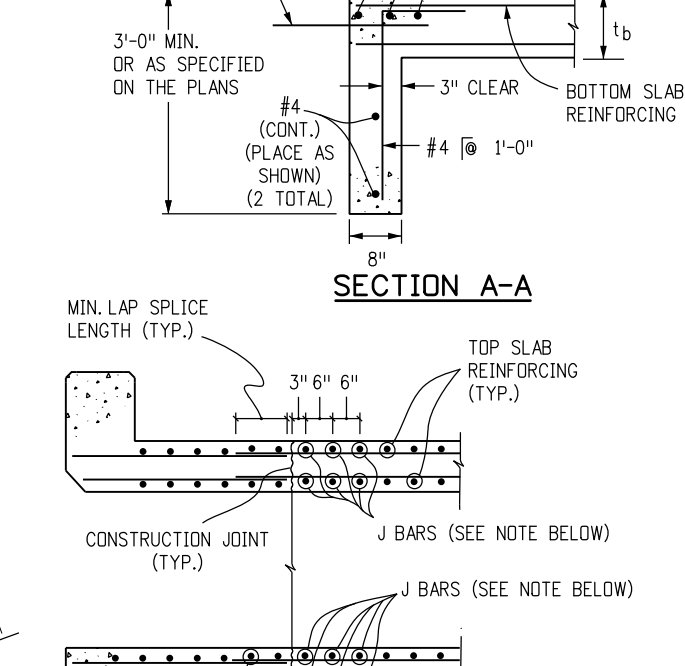
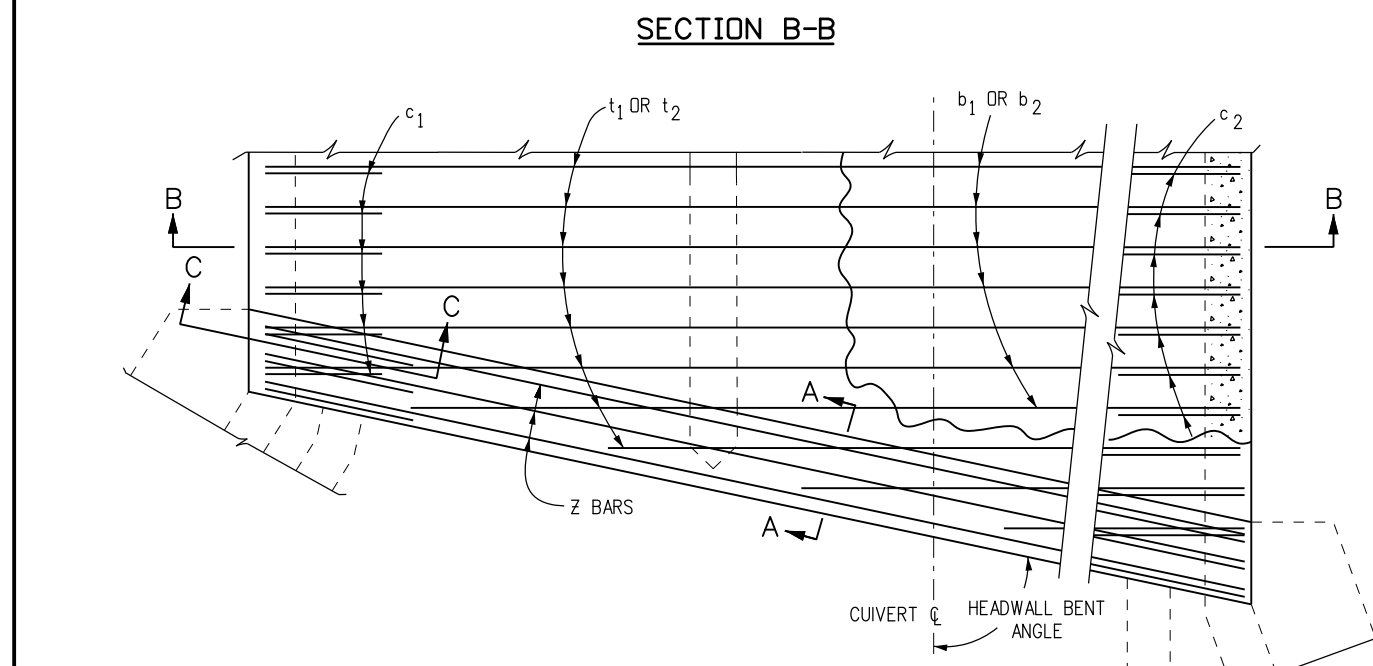
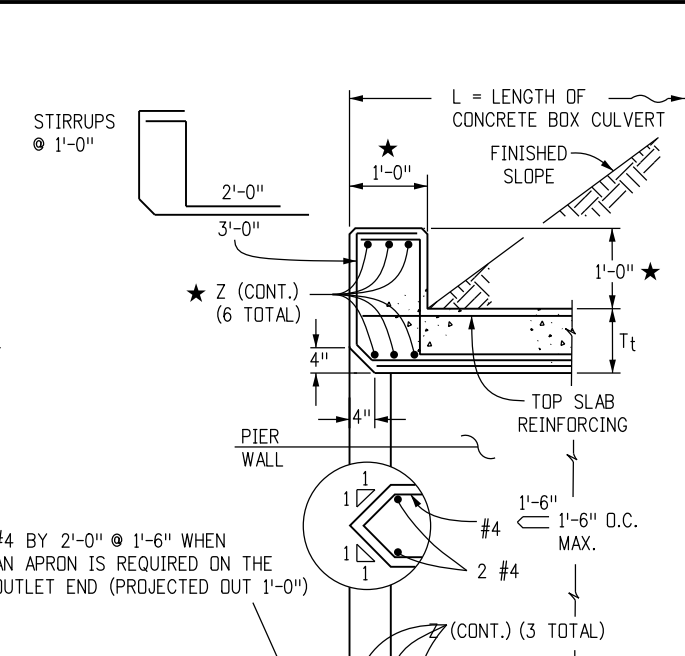
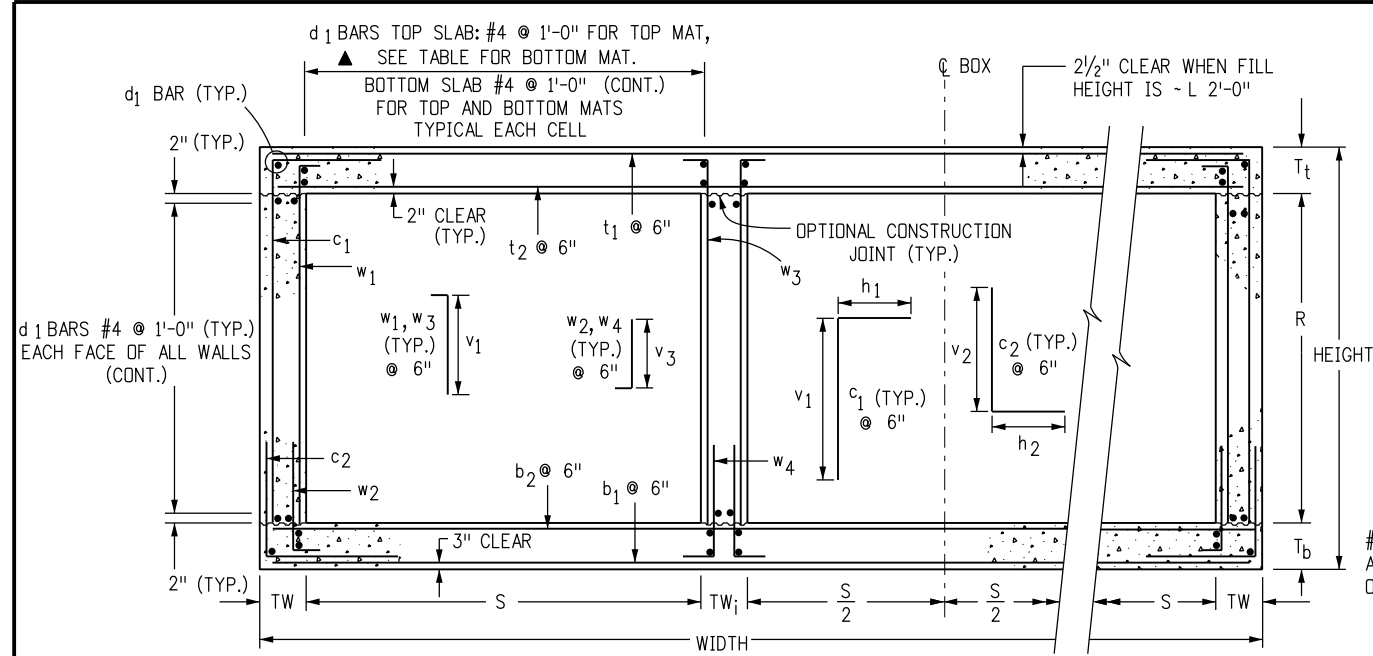
Colorado Department of Transportation
2829 West Howard Place
CDDT HQ, 3rd Floor
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Project Development Branch **JBK**

**DOUBLE CONCRETE BOX
CULVERT (CAST-IN-PLACE)**
Issued by the Project Development Branch: July 31, 2019

**STANDARD PLAN NO.
M-601-2**
Standard Sheet No. 1 of 2
Project Sheet Number:

DOUBLE CONCRETE BOX CULVERT DIMENSIONS, QUANTITIES & RATING FACTORS (EXCLUDING HEADWALL & TOEWALL QUANTITIES)

BOX SIZE				FILL HEIGHT ALLOWED	SLAB & WALL THICKNESS (INCHES)		BAR SIZES						DIMENSIONS					QUANTITIES			RATING FACTORS									
S	R	HT.	WIDTH		T ₁	T ₂	TW	TW ₁	t ₁ *	t ₂	b ₁	b ₂	w ₁ *	w ₂	w ₃ *	w ₄	c ₁ *	c ₂	d ₁ *	h ₁	h ₂	v ₁	v ₂	v ₃	CONCRETE	REBAR STL	MEMBRANE	HL-93 INVENTORY	HL-93 OPERATING	COLORADO PERMIT
FT	FT	FT-IN	FT-IN	FT-FT				#	#	#	#	#	#	#	#	#	#	NO.	FT-IN	FT-IN	FT-IN	FT-IN	FT-IN	CY/LF	LBS/LF	CY/LF				
6	8	7-9	14-6	< 2	11	10	10	5	6	5	6	4	4	5	5	114	3-5	2-4	6-8	3-1	1-11	1.495	338	1.944	1.27	1.65	2.09	2.05		
		7-7.5	14-6	2 TO 10	10	9.5	10	5	5	5	5	4	4	4	5	5	102	2-6	2-4	6-8	3-1	1-11	1.428	300	1.944	1.81	2.35	2.90	2.82	
		7-7.5	14-6	10 TO 12.8	10	9.5	10	4	4	4	4	4	4	4	5	5	102	2-6	2-4	6-8	3-1	1-11	1.428	258	1.944	4.53	5.88	6.42	7.36	
		7-8	14-6	12.8 TO 20	10	10	10	4	4	4	4	4	4	4	5	5	102	2-6	2-4	6-8	3-1	1-11	1.451	258	1.944	4.53	5.88	6.42	7.36	
		9-9	14-6	< 2	11	10	10	5	6	5	6	4	4	4	5	5	126	3-5	2-4	8-8	3-1	1-11	1.681	365	1.944	1.28	1.66	2.10	2.05	
		9-7.5	14-6	2 TO 10	10	9.5	10	5	5	5	5	4	4	4	5	5	114	2-6	2-4	8-8	3-1	1-11	1.613	327	1.944	1.82	2.36	2.85	2.77	
		9-7.5	14-6	10 TO 12.8	10	9.5	10	4	4	4	4	4	4	4	5	5	114	2-6	2-4	8-8	3-1	1-11	1.613	285	1.944	4.66	6.04	6.82	5.08	
		9-8	14-6	12.8 TO 20	10	10	10	4	5	5	5	4	4	4	5	5	114	2-6	2-4	8-8	3-1	1-11	1.636	317	1.944	4.66	6.04	6.82	5.08	
		11-9	14-6	< 2	11	10	10	5	6	5	6	4	4	4	5	5	138	3-5	2-4	10-8	3-1	1-11	1.866	392	1.944	1.28	1.67	1.00	2.06	
		11-7.5	14-6	2 TO 10	10	9.5	10	5	5	5	5	4	4	4	5	5	126	2-6	2-4	10-8	3-1	1-11	1.799	354	1.944	1.83	2.38	1.00	2.78	
11-7.5	14-6	10 TO 12.8	10	9.5	10	4	4	4	4	4	4	4	5	5	126	2-6	2-4	10-8	3-1	1-11	1.799	312	1.944	2.22	2.88	2.79	1.96			
11-8.5	14-10.5	12.8 TO 20	10	10.5	11.5	4	5	4	5	4	4	4	5	5	126	2-6	2-4	10-8	3-2	2-0	2.006	336	1.944	4.66	6.04	6.82	5.08			
8	8	7-10.5	18-6	< 2	12.5	10	10	5	6	5	6	4	4	5	5	134	3-5	2-4	6-10	3-1	1-11	1.840	394	2.389	1.20	1.56	1.76	1.65		
		7-8	18-6	2 TO 10	10	10	10	5	5	5	5	4	4	4	5	5	118	2-6	2-4	6-8	3-1	1-11	1.698	344	2.389	1.47	1.90	2.19	2.15	
		7-10	18-6	10 TO 15	10	12	10	5	4	5	5	4	4	4	5	5	118	2-6	2-4	6-8	3-3	2-1	1.812	332	2.389	2.89	3.74	4.00	4.38	
		7-11	18-9	15 TO 16.8	10.5	12.5	11	5	4	5	5	4	4	4	5	5	118	2-6	2-5	6-8	3-4	2-2	1.942	335	2.389	3.37	4.37	4.60	4.86	
		7-11	18-9	16.8 TO 20	10.5	12.5	11	5	4	5	5	4	4	4	5	5	118	2-6	2-4	6-8	3-4	2-2	1.942	335	2.389	3.37	4.37	4.60	4.86	
		9-10.5	18-6	< 2	12.5	10	10	5	6	5	6	4	4	4	5	5	146	3-5	2-4	8-10	3-1	1-11	2.025	421	2.389	1.21	1.57	1.71	1.61	
		9-8	18-6	2 TO 10	10	10	10	5	5	5	5	4	4	4	5	5	130	2-6	2-4	8-8	3-1	1-11	1.883	371	2.389	1.46	1.89	2.18	2.13	
		9-10	18-6	10 TO 15	10	12	10	5	4	5	5	4	4	4	5	5	130	2-6	2-4	8-8	3-3	2-1	1.997	359	2.389	2.96	3.83	4.10	4.37	
		9-11	18-9	15 TO 16.8	10.5	12.5	11	5	4	5	5	4	4	4	5	5	130	2-6	2-5	8-8	3-4	2-2	2.146	362	2.389	3.44	4.46	4.70	4.96	
		9-11	18-9	16.8 TO 20	10.5	12.5	11	5	4	5	5	4	4	4	5	5	130	2-6	2-5	8-8	3-4	2-2	2.146	362	2.389	3.44	4.46	4.70	4.96	
10	8	8-0.5	22-6	< 2	13.5	11	10	5	6	5	6	4	4	5	5	134	3-5	2-4	6-11	3-2	2-0	2.257	444	2.833	1.15	1.49	1.65	1.49		
		8-1.5	22-6	2 TO 5	13	12.5	10	5	6	5	6	4	4	4	5	5	134	2-6	2-4	6-11	3-4	2-2	2.326	434	2.833	1.52	1.98	1.82	1.84	
		8-2	22-6	5 TO 10	13	13	10	5	4	6	6	4	4	4	5	5	134	2-6	2-4	6-11	3-5	2-2	2.361	417	2.833	1.77	2.29	2.65	3.77	
		8-2.5	22-9	10 TO 15	13	13.5	11	6	5	6	6	5	5	5	5	5	134	2-6	2-5	6-11	3-5	2-7	2.472	495	2.833	3.57	4.63	4.62	5.05	
		8-5.5	23-0	15 TO 20	14	15.5	12	6	5	6	6	5	5	5	5	5	134	2-6	2-6	7-0	3-7	2-9	2.761	501	2.833	3.36	4.36	4.38	4.52	
		10-1	22-6	< 2	14	11	10	5	6	5	6	4	4	4	5	5	146	3-5	2-5	8-11	3-2	2-0	2.477	472	2.833	1.22	1.58	1.60	1.44	
		10-1.5	22-6	2 TO 5	13	12.5	10	5	6	5	6	4	4	4	5	5	146	2-6	2-4	8-11	3-4	2-2	2.512	461	2.833	1.52	1.97	1.79	1.79	
		10-3	22-6	5 TO 10	13	14	10	5	4	5	6	4	4	4	5	5	146	2-6	2-4	8-11	3-5	2-3	2.616	425	2.833	1.74	2.25	2.61	3.53	
		10-3	22-9	10 TO 15	13	14	11	6	5	6	5	5	5	5	5	5	146	2-6	2-5	8-11	3-5	2-7	2.711	508	2.833	3.95	5.12	5.26	5.69	
		10-5.5	23-0	15 TO 20	14	15.5	12	6	5	6	6	5	5	5	5	5	146	2-6	2-6	9-0	3-7	2-9	2.983	588	2.833	3.46	4.48	4.51	4.64	
10	10	12-2	22-6	< 2	14	12	10	5	6	5	6	4	4	5	5	158	3-5	2-5	10-11	3-3	2-1	2.731	499	2.833	1.24	1.60	1.79	1.61		
		12-2	22-6	2 TO 5	13	13	10	5	6	5	6	4	4	4	5	5	158	2-6	2-4	10-11	3-4	2-2	2.731	488	2.833	1.64	2.12	1.89	1.88	
		12-3	22-6	5 TO 10	13	14	10	5	4	5	6	4	4	4	5	5	158	2-6	2-4	10-11	3-5	2-3	2.801	452	2.833	1.72	2.23	2.58	2.74	
		12-5.5	22-9	10 TO 15	14	15.5	11	5	6	6	4	5	5	5	5	5	158	2-6	2-5	11-0	3-7	2-9	3.090	527	2.833	2.42	3.14	3.18	2.25	
		12-5.5	23-0	15 TO 20	14	15.5	12	6	5	6	6	5	5	5	5	5	158	2-6	2-5	11-0	3-7	2-9	3.205	567	2.833	2.11	2.73	2.64	1.86	
		8-3.5	26-6	< 2	14.5	13	10	5	6	5	6	4	4	4	5	5	150	3-5	2-5	7-0	3-4	2-2	2.805	500	3.278	1.16	1.51	1.51	1.59	
		8-5	26-6	2 TO 5	14	15	10	5	6	6	6	4	4	4	5	5	150	2-6	2-4	7-0	3-6	2-4	2.927	512	3.278	1.22	1.59	1.43	1.54	
		8-5.5	26-6	5 TO 10	14	15.5	10	6	5	6	6	4	4	4	5	5	150	2-6	2-4	7-0	3-6	2-5	2.968	488	3.278	2.10	2.72	3.13	3.89	
		8-6.5	26-9	10 TO 15	15	15.5	11	6	6	7	6	5	5	5	5	5	150	3-3	2-5	7-1	3-7	2-9	3.129	610	3.278	1.86	2.42	2.36	2.53	
		10-4	26-6	< 2	14.5	13.5	10	5	6	5	6	4	4	4	5	5	162	3-5	2-5	9-0	3-5	2-3	3.031	528	3.278	1.16	1.51	1.56	1.59	
10-5.5	26-6	2 TO 5	14	15.5	10	5	6	5	6	4	4	4	5	5	162	2-6	2-4	9-0	3-7	2-5	3.154	515	3.278	1.22	1.58	1.43	1.51			
10-7.5	26-6	5 TO 10	16	15.5	10	5	6	6	6	4	4	4	5	5	162	3-3	2-4	9-2	3-7	2-5	3.317	544	3.278	1.70	2.21	2.16	2.39			
10-7.5	26-9	10 TO 15	16	15.5	11	6	6	7	6	5	5	5	5	5	162	3-3	2-5	9-2	3-7	2-9	3.416	644	3.278	2.83	3.67	3.54	3.80			
12-5	26-6	< 2	15	14	10	5	6	5	6	4	4	4	5	5	174	3-9														



GENERAL NOTES

1. ALL CONCRETE SHALL BE CLASS D (BOX CULVERT).
2. ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE FRESH CONCRETE IS PLACED.
3. ALL CONSTRUCTION JOINTS NOT SHOWN ON THE PLANS SHALL BE CONSTRUCTED ONLY IF APPROVED BY THE ENGINEER.
4. THE CONTRACTOR SHALL MAINTAIN THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION.
5. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH STANDARD PLAN M-206-1.
6. FOR ANY CULVERT SPAN 20 FT. OR GREATER, A FOUNDATION INVESTIGATION AND REPORT ARE REQUIRED.
7. BACKFILL SHALL NOT BEGIN UNTIL TOP SLAB HAS REACHED DESIGN STRENGTH, f_c .
8. SPLICE QUANTITIES FOR LONGITUDINAL AND TRANSVERSE BARS ARE NOT INCLUDED.
9. REINFORCING STEEL SHALL BE GRADE 60.
10. THE MINIMUM LAP SPLICE LENGTH FOR EPOXY COATED REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-3"	1'-7"	2'-5"	2'-10"	3'-8"	4'-8"	5'-11"	7'-3"

THE MINIMUM LAP SPLICE LENGTH FOR BLACK REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-1"	1'-4"	1'-7"	1'-11"	2'-6"	3'-1"	3'-11"	4'-10"

- THE ABOVE SPLICE LENGTHS ARE FOR CLASS B SPLICES.
11. ALL DIMENSIONS ARE PERPENDICULAR TO THE CENTERLINE OF THE BOX.
 12. WINGWALLS SHALL BE TIED TO CONCRETE BOX CULVERT IN ACCORDANCE WITH STANDARD PLAN M-601-20.
 13. ALL TRANSVERSE REINFORCING SHALL BE NORMAL TO THE CENTERLINE OF THE BOX.
 14. THE FILL HEIGHT IS THE DISTANCE MEASURED FROM THE TOP OF THE TOP SLAB TO THE TOP OF PAVEMENT.
 15. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED $\frac{3}{4}$ IN.
 16. FOR FILL HEIGHTS LESS THAN 2 FT, A WATERPROOFING MEMBRANE SHALL BE PROVIDED FOR THE TOP OF THE TOP SLAB AND 18" DOWN ALONG THE TOPS OF THE EXTERIOR WALLS.
 17. FOR FILL HEIGHTS LESS THAN 2 FT. THE d_1 BARS FOR THE BOTTOM MAT OF THE TOP SLAB SHALL BE AS FOLLOWS:

S	8, 9, 10	14, 16, 18	20
BAR SIZE:	#5	#6	#7
SPACING:	1'-0"	1'-0"	1'-0"

DESIGN DATA: 7TH EDITION, 2014, OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
 RATING DATA: 2ND EDITION, 2011, OF THE AASHTO MANUAL FOR BRIDGE EVALUATION

LOADING DATA: $f_y = 60,000$ psi., $f'_c = 4,500$ psi.,
 LIVE LOAD = AASHTO LRFD, HL-93 TRUCK, HL-93 TANDEM, COLORADO PERMIT TRUCK AND NRL
 DEAD LOAD CASE 1: VERTICAL EARTH LOAD = 120 LBS./CU. FT. HORIZONTAL EARTH LOAD = 30 LBS./CU. FT.
 DEAD LOAD CASE 2: VERTICAL EARTH LOAD = 120 LBS./CU. FT. HORIZONTAL EARTH LOAD = 60 LBS./CU. FT.
 WEARING SURFACE - 12 IN. THICK CONCRETE PAVEMENT.
 DEAD LOAD - TYPE 7 BARRIER.
 THRUST IS NOT CONSIDERED IN THIS STANDARD, I.E. THRUST = 0.
 EXTREME HEADWATER TO DEPTH RATIO IS IN ACCORDANCE WITH THE CDDT DRAINAGE MANUAL.
 EXTREME HEADWATER TO DEPTH RATIO WAS INCLUDED IN THE CULVERT DESIGNS BUT EXCLUDED FROM THE RATINGS AS PER THE AASHTO MANUAL FOR BRIDGE EVALUATION.
 LIVE LOAD SURCHARGE ON EXTERIOR WALLS = 2 FT. OF EARTH

- ★ IF HEADWALL MOUNT GUARDRAIL IS USED (SEE STANDARD PLAN M-606-1, SHEET 19 AND NOTES BELOW):
- ALL REINFORCING STEEL SHALL BE ACCORDING TO THIS BOX CULVERT PLAN.
 - ANY SPECIAL DESIGN FOR STIRRUPS WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
 - HEADWALL DIMENSION AND CONCRETE QUANTITY SHALL BE ACCORDING TO STANDARD PLAN M-606-1, SHEET 19.
 - POST ANCHORS SHALL BE PROVIDED ACCORDING TO STANDARD PLAN M-606-1, SHEET 19.
 - POST ANCHORS AND CONCRETE FOR HEADWALL MOUNT OF GUARDRAIL WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
 - POST ANCHORS WHEN REQUIRED AND ENCASED IN HEADWALL CONCRETE, SHALL CONFORM TO ASTM A 36 OR AASHTO M 169 STEEL.
18. SEE M-603-3 FOR PRECAST CONCRETE BOX CULVERT DETAILS.

CONSTRUCTION JOINT DETAIL FOR STAGED CONSTRUCTION
 NOTE: THIS DETAIL IS FOR CONSTRUCTION JOINTS INSTALLED PERPENDICULAR TO THE c OF THE BOX ONLY. THE CONTRACTOR CAN DESIGN AND INSTALL J BARS AT HIS EXPENSE TO SUPPORT TEMPORARY LIVE LOADS DURING STAGE 1 CONSTRUCTION. J BARS SHALL BE THE SAME SIZE AS THE TOP AND BOTTOM SLAB REINFORCING WHEN THERE ARE NO TEMPORARY LIVE LOADS TO SUPPORT.

Computer File Information

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Last Modification Date: 07/31/19
Detailer Initials: LTA
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Sheet Revisions

Date:	Comments
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(R-X)	
(R-X)	

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 Project Development Branch JBK

TRIPLE CONCRETE BOX CULVERT (CAST-IN-PLACE)
 Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO. M-601-3
 Standard Sheet No. 1 of 2
 Project Sheet Number:

TRIPLE CONCRETE BOX CULVERT DIMENSIONS, QUANTITIES & RATING FACTORS (EXCLUDING HEADWALL & TOEWALL QUANTITIES)

BOX SIZE				FILL HEIGHT ALLOWED FT-FT	SLAB & WALL THICKNESS (INCHES)			BAR SIZES						DIMENSIONS					QUANTITIES			RATING FACTORS							
S	R	HT.	WIDTH		T ₁	T ₂	T ₃	t ₁ *	t ₂	b ₁	b ₂	w ₁ *	w ₂	w ₃ *	w ₄	c ₁ *	c ₂	d ₁ ▲	h ₁	h ₂	v ₁	v ₂	v ₃	CONCRETE CY/LF	REBAR STL LBS/LF	WATERPROOFING SY/LF	HL-93 INVENTORY	HL-93 OPERATING	COLORADO PERMIT
7-10.5	27-4	< 2	10	10	10	10	5	6	5	6	4	4	5	5	5	5	168	3-5	2-4	6-10	2-4	1-11	2,639	531	3,370	1.21	1.57	1.82	1.69
7-9.5	27-4	2 TO 8	10.5	11	10	10	4	5	4	5	4	4	5	5	5	168	2-6	2-4	6-8	3-2	2-0	2,555	429		1.47	1.90	2.07	1.83	
8-0	27-4	8 TO 12	11	13	10	10	4	5	4	5	4	4	5	5	5	168	2-6	2-4	6-9	3-4	2-2	2,765	432		3.38	4.39	4.80	5.22	
8-0	27-4	12 TO 16	11	13	10	10	5	4	4	4	5	5	5	5	5	168	2-6	2-4	6-9	3-4	2-2	2,765	462		6.80	8.81	9.35	8.63	
8-0	27-4	16 TO 20	11	13	10	10	5	4	4	4	5	5	5	5	5	168	2-4	2-4	6-9	3-5	2-2	2,765	482		1.69	2.19	2.20	2.27	
8-3.5	27-4	20 TO 25.9	13	14.5	10	10	5	5	5	5	5	5	5	5	5	168	2-6	2-4	6-11	2-4	2-3	3,061	523		6.80	8.82	8.50	5.95	
8-4.5	27-10	26 TO 30	13.5	15	11.5	10	5	6	5	6	5	5	5	5	5	168	3-3	2-6	6-11	3-6	2-4	3,300	587		◆	◆	◆	◆	
9-10.5	27-4	< 2	12.5	10	10	10	5	6	5	6	4	4	5	5	5	184	3-5	2-4	8-10	3-1	1-11	2,886	566	3,370	1.21	1.57	1.82	1.65	
9-9.5	27-4	2 TO 8	10.5	11	10	10	4	5	4	5	4	4	5	5	5	175	2-6	2-4	8-8	3-2	2-0	2,801	461		1.46	1.89	2.00	1.82	
10-0	27-4	8 TO 12	11	13	10	10	4	5	4	5	4	4	5	5	5	184	2-6	2-4	8-9	3-4	2-2	3,012	464		3.45	4.47	4.89	5.12	
10-0	27-4	12 TO 16	11	13	10	10	5	4	4	5	4	4	5	5	5	184	2-6	2-4	8-9	2-4	2-2	3,012	460		2.53	3.27	3.47	3.73	
10-4	27-4	16 TO 20	13.5	14.5	10	10	5	4	4	5	4	4	5	5	5	184	3-3	2-4	8-11	3-5	2-2	3,350	490		3.07	3.98	3.84	2.72	
10-4	27-6	20 TO 25.9	13.5	14.5	10.5	10	5	6	5	6	6	6	5	5	5	184	3-3	2-4	8-11	3-6	2-3	3,414	675		1.78	2.32	2.23	1.56	
10-4.5	27-10	26 TO 30	13.5	15	11.5	10	5	5	5	5	5	5	5	5	5	184	3-3	2-6	8-11	3-6	2-4	3,584	578		◆	◆	◆	◆	

HEADWALL AND TOEWALL QUANTITIES

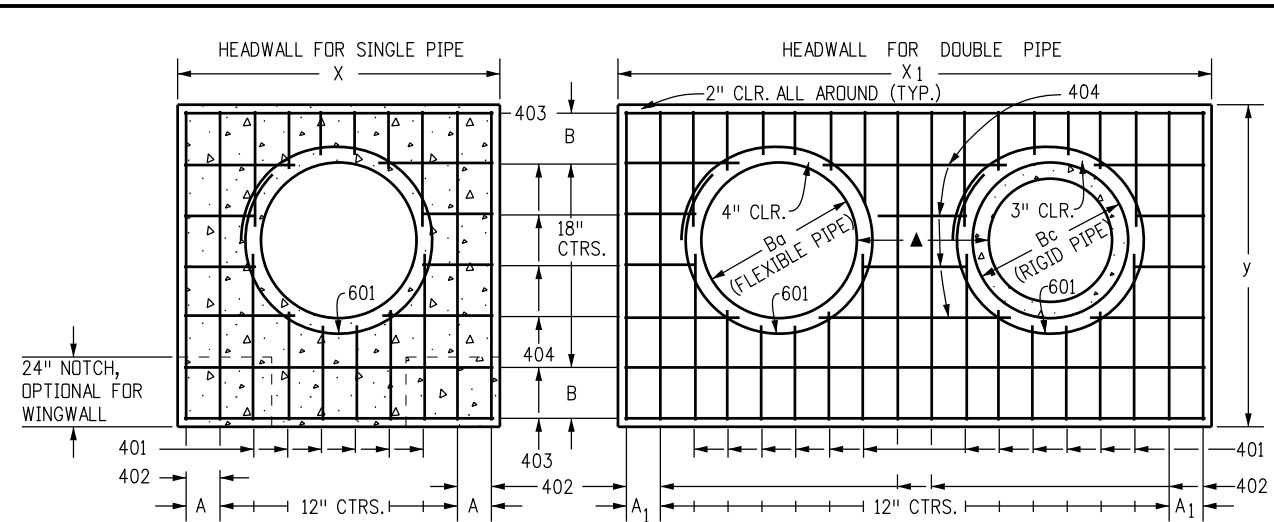
HEADWALL BENT ANGLE	90° TO 75°			74° TO 60°			59° TO 45°			
	CLEAR SPAN (S)	Z	STIRRUPS	REBAR QUANT.	Z	STIRRUPS	REBAR QUANT.	Z	STIRRUPS	REBAR QUANT.
	#	#	LBS/LF	#	#	LBS/LF	#	#	LBS/LF	
8	4	4	19.2	5	4	23.5	7	4	34.4	
10	5	4	23.9	6	4	28.7	9	4	54.0	
12	6	4	28.7	6	4	28.2	9	5	59.2	
14	6	4	27.9	7	4	33.5	★	★	★	
16	6	4	27.5	8	5	44.1	★	★	★	
18	7	4	33.0	9	5	51.8	★	★	★	
20	7	4	32.8	★	★	★	★	★	★	

CONCRETE QUANTITY = 0.086 CY/LF

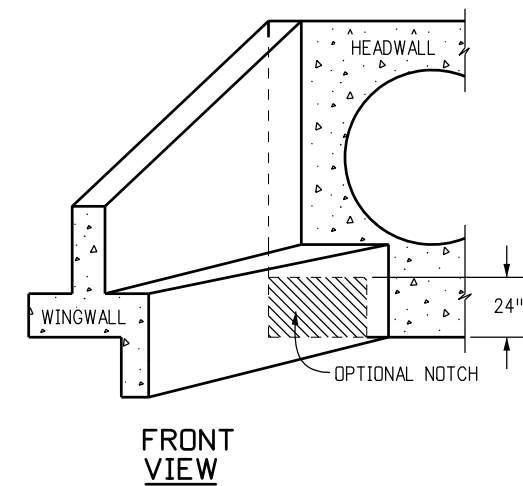
NOTES

- SIX INCH SPACING AT EACH END OF THE SPAN FOR A DISTANCE OF 1/4 OF THE SPAN LENGTH; 12 INCH SPACING ELSEWHERE.
- QUANTITIES ARE GIVEN FOR ONE HEADWALL AND ONE TOEWALL AND ARE BASED ON PER LINEAR FOOT OF HEADWALL. STEEL QUANTITIES INCLUDE ALL REINFORCING. QUANTITIES SHALL BE PAID FOR AS SHOWN ON THE PLANS.
- ★ SKewed HEADWALLS ARE NOT RECOMMENDED FOR THESE SPANS. A SPECIAL DESIGN IS REQUIRED.
- FOR HEADWALL AND TOEWALL DETAILS SEE M-601-3, SHEET 1 OF 2.
- WHEN THE FILL HEIGHTS ARE LESS THAN OR EQUAL TO 2 FT, ALL REINFORCING BARS IN THE HEADWALL, ALL REINFORCING BARS DESIGNATED BY AN ASTERISK (*), AND THE d₁ BARS IN THE TOP MAT OF THE TOP SLAB SHALL BE EPOXY COATED.
- REINFORCING QUANTITIES INCLUDE BOTH EPOXY-COATED AND UNCOATED BARS.
- WHEN A (RISE) R OF LESS THAN 6 FT IS REQUIRED, USE THE BAR SIZES AND THE SLAB AND WALL THICKNESSES FOR THE 6 FT RISE (IF AVAILABLE ON THE TABLE).
- ▲ FOR SIZE AND SPACING OF THE BOTTOM MAT BARS IN THE TOP SLAB SEE TABLE ON M-601-3, SHEET 1 OF 2. ALL OTHER d₁ BARS ARE #4's AT 1'-0" SPACING. THE NUMBER OF BARS REQUIRED IS LISTED ON THIS SHEET AND INCLUDES BOTH #4 BARS AND THOSE FROM THE TABLE.
- ◆ LIVE LOAD IS NEGLECTED AS PER AASHTO LRFD SECTION 3.6.1.2.6. FOR THESE STRUCTURES REFER TO THE CDDT RATING MANUAL.
- FOR ALL NEW CULVERT DESIGNS, A RATING IS REQUIRED. THE RATING SUMMARY SHEET SHOULD BE PRINTED FROM THE CDDT EXTERNAL WEBSITE AND SUBMITTED TO THE BRIDGE RATING UNIT OR INCLUDED AS PART OF A LARGER DESIGN PACKAGE. FOR ADDITIONAL INFORMATION, SEE THE CDDT RATING MANUAL.

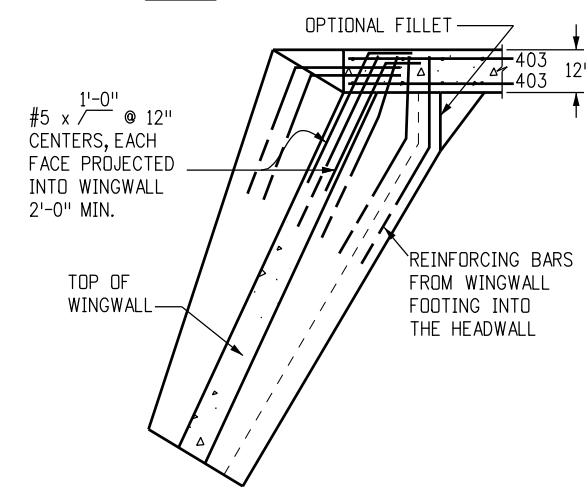
Computer File Information Creation Date: 07/31/19 Designer Initials: JBE Last Modification Date: 07/31/19 Detailer Initials: LTA CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		Sheet Revisions Date: _____ Comments: _____ (R-X) (R-X) (R-X) (R-X)		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch JBK		TRIPLE CONCRETE BOX CULVERT (CAST-IN-PLACE) Issued by the Project Development Branch: July 31, 2019		STANDARD PLAN NO. M-601-3 Standard Sheet No. 2 of 2 Project Sheet Number:	
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TYPICAL BAR LAYOUT FOR CONCRETE HEADWALLS

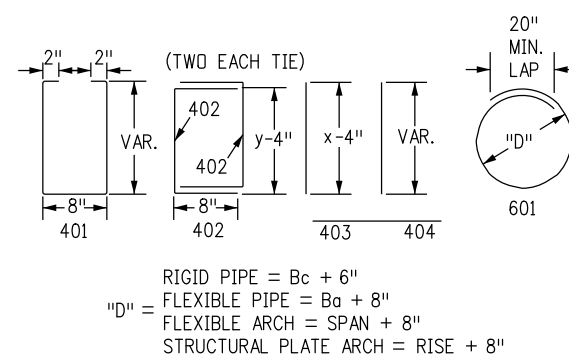


FRONT VIEW



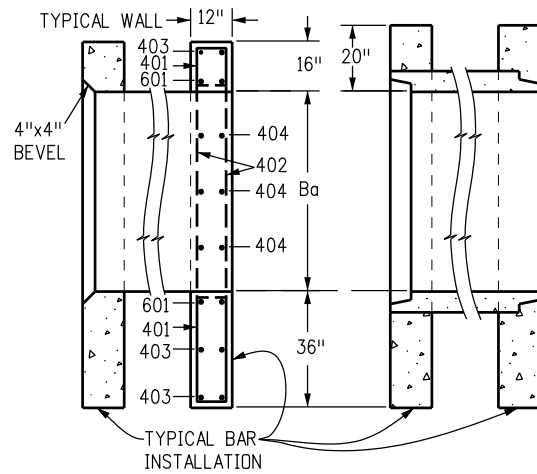
TOP VIEW

WINGWALL CONNECTION



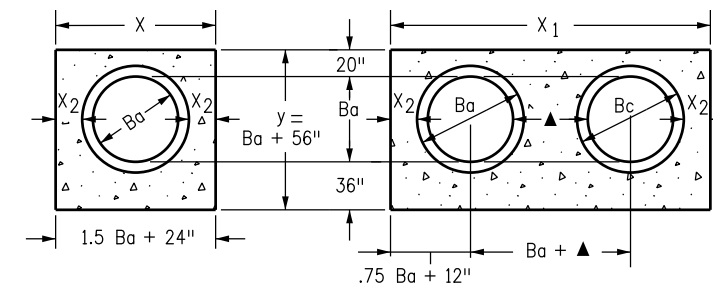
"D" = RIGID PIPE = $B_c + 6"$
 FLEXIBLE PIPE = $B_a + 8"$
 FLEXIBLE ARCH = $SPAN + 8"$
 STRUCTURAL PLATE ARCH = $RISE + 8"$

BAR BENDING



INLET ENDS OF FLEXIBLE PIPE

OUTLET ENDS OF RIGID PIPE

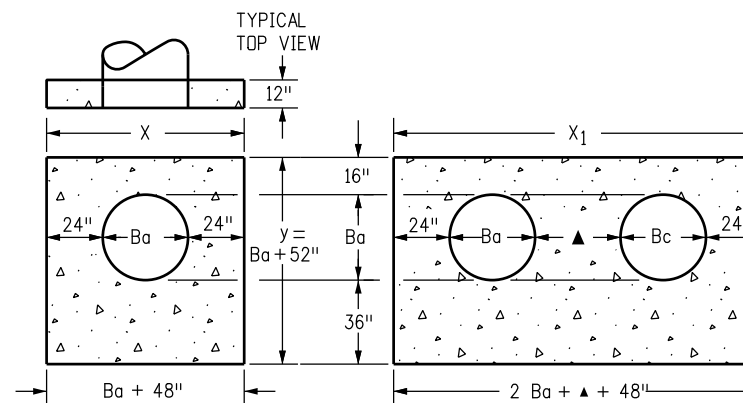


DIMENSIONS

Ba IN.	Bc IN.	X FT.-IN.	A IN.	X ₁ FT.-IN.	A ₁ IN.	y FT.-IN.	B IN.	X ₂ IN.	CONCRETE		STEEL	
									SGL CU. YD.	DBL CU. YD.	SGL LBS.	DBL LBS.
54	65	8-9	8 1/2	15-6	7	9-2	17	20	2.12	3.55	209	364
60	72	9-6	7	17-0	10	9-8	11	21	2.35	3.99	236	414
66	79	10-3	11 1/2	18-6	7	10-2	14	22	2.60	4.44	249	453
72	86	11-0	10	20-0	10	10-8	17	23	2.85	4.91	270	476
78	93	11-9	8 1/2	21-3	11	11-2	11	24	3.11	5.29	306	527
84	100	12-6	7	22-6	7	11-8	14	25	3.38	5.68	333	572
90	107	13-3	11 1/2	23-9	8 1/2	12-2	17	26	3.66	6.08	335	593
96	114	14-0	10	25-0	10	12-8	11	27	3.94	6.48	379	649
102	121	14-9	8 1/2	26-3	11 1/2	13-2	14	28	4.24	6.89	400	664
108	128	15-6	7	27-6	7	13-8	17	29	4.54	7.30	424	707

QUANTITIES

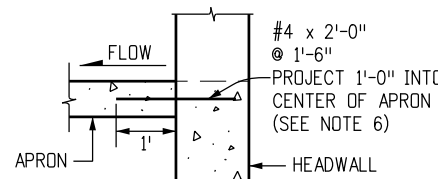
HEADWALL FOR RIGID ROUND PIPE



DIMENSIONS

Ba IN.	X FT.-IN.	A IN.	X ₁ FT.-IN.	A ₁ IN.	y FT.-IN.	B IN.	CONCRETE		STEEL	
							SGL CU. YD.	DBL CU. YD.	SGL LBS.	DBL LBS.
54	8-6	7	15-3	11 1/2	8-10	15	2.19	3.81	211	358
60	9-0	10	16-6	7	9-4	18	2.38	4.25	217	396
66	9-6	7	17-9	8 1/2	9-10	12	2.58	4.70	252	454
72	10-0	10	19-0	10	10-4	15	2.78	5.17	255	472
78	10-6	7	20-0	10	10-10	18	2.98	5.56	276	499
84	11-0	10	21-0	10	11-4	12	3.19	5.95	297	553
90	11-6	7	22-0	10	11-10	15	3.40	6.36	317	517
96	12-0	10	23-0	10	12-4	18	3.62	6.79	321	597
102	12-6	7	24-0	10	12-10	12	3.84	7.21	364	663
108	13-0	10	25-0	10	13-4	15	4.06	7.63	362	678

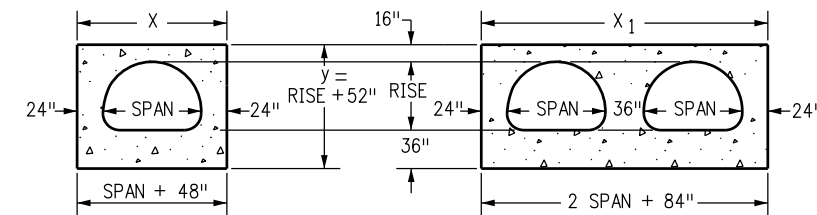
HEADWALL FOR FLEXIBLE ROUND PIPE



WHEN APRON IS REQUIRED

GENERAL NOTES

1. CONCRETE SHALL BE CLASS B.
 2. HEADWALL SHALL BE PERPENDICULAR TO THE PIPE C UNLESS OTHERWISE SHOWN ON THE PLANS. TABULATED DIMENSIONS AND QUANTITIES MUST BE ADJUSTED FOR SKEWED INSTALLATIONS.
 3. FOR WINGWALL DETAILS, SEE STANDARD PLAN M-601-20.
 4. VOLUME OCCUPIED BY PIPE HAS BEEN DEDUCTED FROM STEEL AND CONCRETE QUANTITIES.
 5. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4 IN.
 6. ALL REINFORCING BARS SHALL HAVE A 2 IN. MINIMUM CLEARANCE.
- ▲ WHEN TWO OR MORE PIPES ARE LAID SIDE BY SIDE, THEY SHALL BE PLACED SO THAT THE ADJACENT PIPES WILL BE 1/2 INSIDE DIAMETER APART, OR 1/2 INSIDE SPAN APART, OR 3 FT. APART (INCLUDING WALL THICKNESS), WHICHEVER IS LESS.
- ADD 0.89 x (X OR X₁) (LB.) WHEN APRON IS REQUIRED.



DIMENSIONS

EQUIV. Ba IN.	SPAN IN.	RISE IN.	X FT.-IN.	A IN.	X ₁ FT.-IN.	A ₁ IN.	y FT.-IN.	B IN.	CONCRETE		STEEL	
									SGL CU. YD.	DBL CU. YD.	SGL LBS.	DBL LBS.
72	81	59	10-9	8 1/2	20-6	7	9-3	17 1/2	2.72	5.10	250	467
78	87	63	11-3	11 1/2	21-6	7	9-7	10 1/2	2.85	5.34	275	531
84	95	67	11-9	8 1/2	22-10	9	9-11	12 1/2	3.08	5.79	290	547
90	103	71	12-7	7 1/2	24-2	11	10-3	15	3.30	6.21	321	591
96	112	75	13-4	12	25-8	8	10-7	16 1/2	3.52	6.65	314	606
102	117	79	13-9	8 1/2	26-6	7	10-11	9 1/2	3.63	6.86	356	672
108	128	83	14-8	8	28-4	12	11-3	11 1/2	3.96	7.51	376	699

HEADWALL FOR FLEXIBLE PIPE ARCH

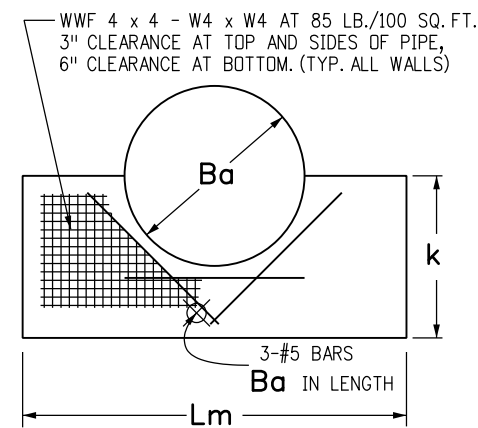
DIMENSIONS

EQUIV. Ba IN.	SPAN FT.-IN.	RISE FT.-IN.	X FT.-IN.	A IN.	X ₁ FT.-IN.	A ₁ IN.	y FT.-IN.	B IN.	CONCRETE		STEEL	
									SGL CU. YD.	DBL CU. YD.	SGL LBS.	DBL LBS.
66	6-1	4-7	10-1	10 1/2	19-2	11	8-11	15 1/2	2.52	4.70	232	424
75	7-0	5-1	11-0	10	21-0	10	9-5	9 1/2	2.80	5.25	282	509
84	7-11	5-7	11-11	9 1/2	22-10	9	9-11	12 1/2	3.08	5.79	291	540
93	8-10	6-1	12-10	9	24-8	8	10-5	15 1/2	3.36	6.33	309	622
102	9-9	6-7	13-9	8 1/2	26-6	7	10-11	9 1/2	3.63	6.86	379	673
111	10-11	7-1	14-11	9 1/2	28-10	9	11-5	12 1/2	4.05	7.67	377	711
120	11-10	7-7	15-10	9	30-8	8	11-11	15 1/2	4.36	8.28	395	731
132	12-10	8-4	16-10	9	32-8	8	12-8	11	4.75	9.03	441	839
141	14-1	8-9	18-1	10 1/2	35-2	11	13-1	13 1/2	5.17	9.86	448	931
150	15-4	9-3	19-4	12	37-8	8	13-7	16 1/2	5.69	10.88	490	953
159	15-10	9-10	19-10	9	38-8	8	14-2	11	5.89	11.25	534	1019

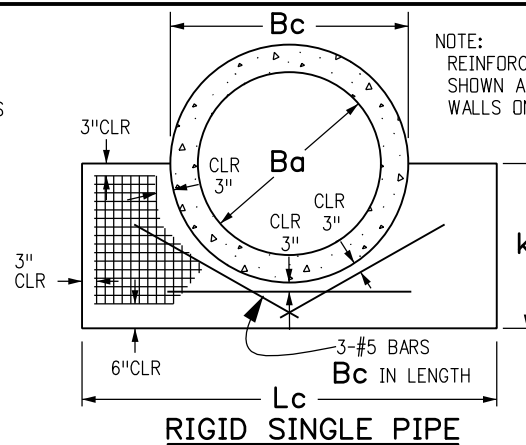
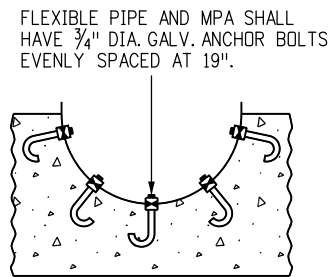
HEADWALL FOR STRUCTURAL PLATE ARCH

SKEW ANGLE A°	90	85	80	75	70	65	60	55	50	45	40	35	30
	FACTOR (cosecA°)												
	1.000	1.004	1.015	1.035	1.064	1.103	1.155	1.221	1.305	1.414	1.556	1.743	2.000

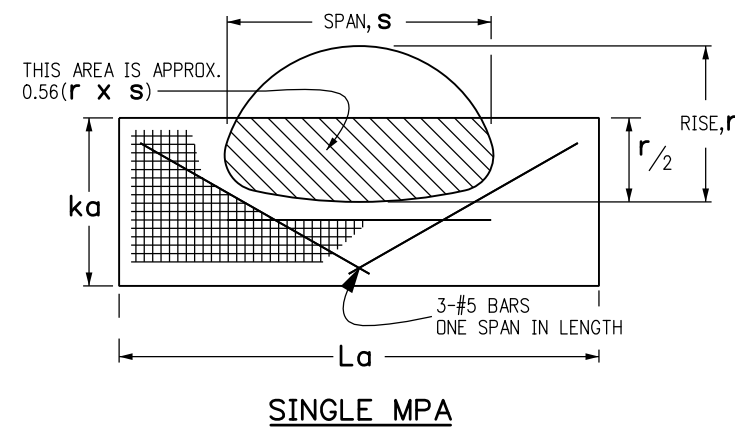
SKEW FACTOR TABLE



FLEXIBLE SINGLE PIPE

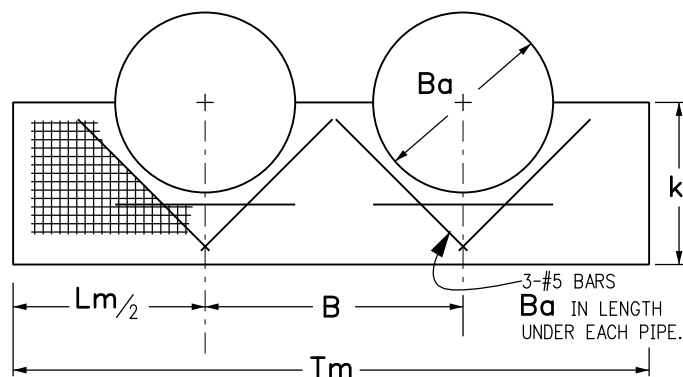


RIGID SINGLE PIPE

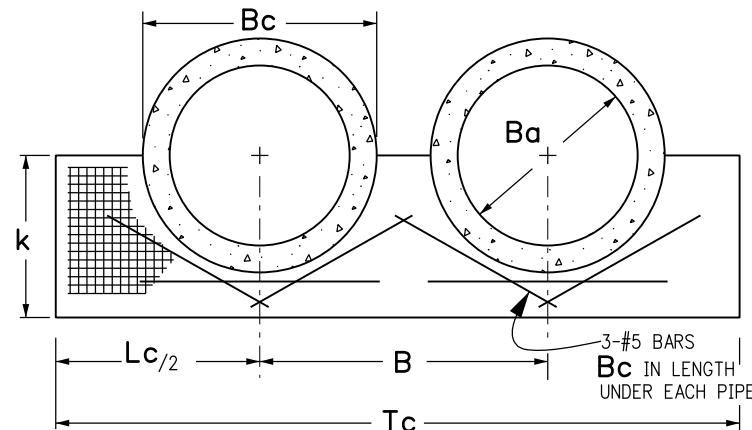


SINGLE MPA

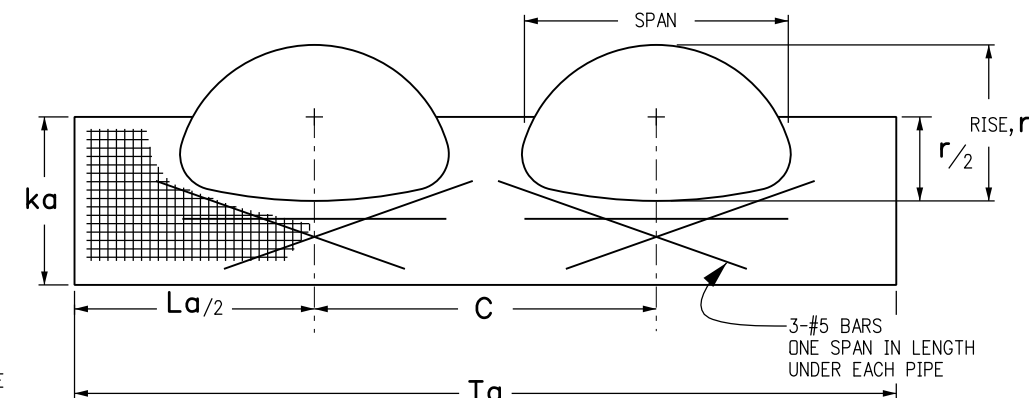
- GENERAL NOTES**
1. CONCRETE SHALL BE CLASS B.
 2. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4 IN.
 3. IF A PRECAST HEADWALL IS USED, A PERMANENT EPOXY BOND, APPROVED BY THE ENGINEER, SHALL BE USED BETWEEN PIPE AND HEADWALL.
 4. HEADWALL SHALL BE PERPENDICULAR TO THE CULVERT CENTERLINE UNLESS OTHERWISE SPECIFIED. TABULATED DIMENSIONS AND QUANTITIES SHALL BE ADJUSTED FOR SKEWED INSTALLATIONS.
 5. HEADWALL ANCHOR BOLTS SHALL CONFORM TO AASHTO M 167 AND SHALL BE INCLUDED IN THE COST OF PIPE.
 6. HEADWALL ANCHOR BOLTS SHALL BE USED ONLY WITH FLEXIBLE PIPE, BOTH ROUND AND ARCH.



FLEXIBLE DOUBLE PIPE



RIGID DOUBLE PIPE

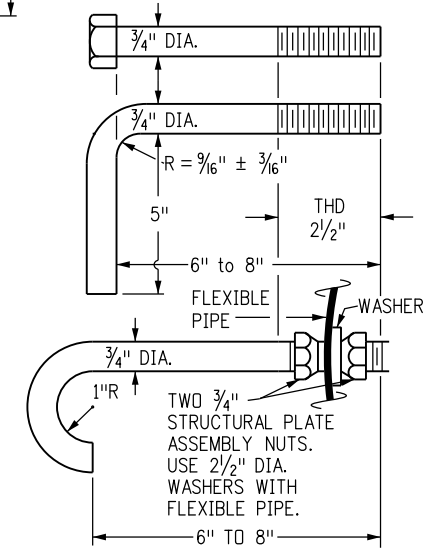
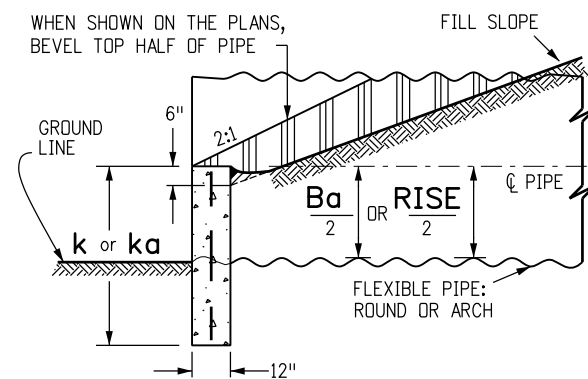


DOUBLE MPA

RANGE OF EQUIV. DIAMS.	RANGE OF SPANS s	RANGE OF RISES r	ka	La	C	Ta	SINGLE		DOUBLE	
							CONCRETE	STEEL	CONCRETE	STEEL
							CU. YDS.	LBS.	CU. YDS.	LBS.
IN.										
36-42	39-47	30-36	36	94	71	165	0.72	26.2	1.22	49.8
42-48	48-59	31-41	41	118	89	207	1.04	36.5	1.77	68.7
54-60	60-71	40-51	51	142	107	249	1.53	52.2	2.61	97.2
60-75	72-83	44-69	69	166	119	285	2.49	78.3	4.14	142.0
72-81	84-95	63-72	72	190	131	321	2.93	93.1	4.76	166.5
84-90	96-107	69-76	76	214	143	357	3.42	110.1	5.45	194.6

NOTE: EACH LINE OF THE PIPE ARCH TABLE DESCRIBES A SINGLE HEADWALL THAT WILL ACCOMMODATE SEVERAL SIZES OF PIPE-ARCH. THE CONCRETE QUANTITIES IN THIS TABLE ARE BASED ON DEDUCTION OF CONCRETE FROM THE HEADWALL OF THE MEDIAN SIZE PIPE IN THE RANGE OF EQUIVALENT DIAMETERS SHOWN.

ADJUST L, B, T, C, #5 BAR LENGTH AND QUANTITIES WHEN SKEW IS < 90°



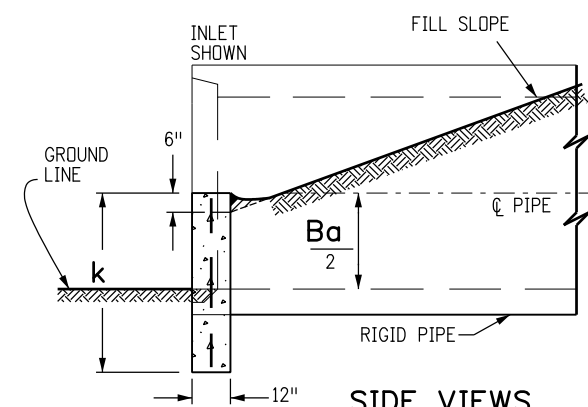
TYPICAL GALVANIZED ANCHOR BOLTS

HEADWALL FOR METAL PIPE ARCH (MPA)

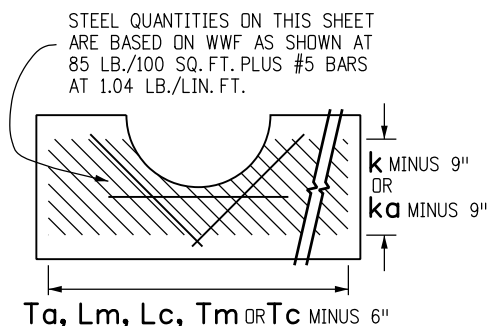
NOM. DIA. Ba	RCP O.D. Bc	k	Lm	Lc	B	Tm	Tc	FLEXIBLE PIPE				RIGID PIPE			
								SINGLE		DOUBLE		SINGLE		DOUBLE	
								CONCRETE	STEEL	CONCRETE	STEEL	CONCRETE	STEEL	CONCRETE	STEEL
IN.															
36	44	36	81	99	56	137	155	0.62	21.3	1.01	39.6	0.72	26.3	1.04	46.2
42	51	42	94	114	63	157	177	0.84	28.1	1.34	51.3	0.97	34.3	1.39	59.8
48	58	48	108	130	72	180	202	1.10	36.0	1.76	64.4	1.27	43.6	1.81	75.3
54	65	54	121	146	81	202	227	1.39	44.6	2.22	80.1	1.60	54.1	2.30	92.5
60	72	60	134	161	90	224	251	1.70	54.1	2.73	96.8	1.96	65.7	2.83	111.2
66	79	66	148	177	99	247	276	2.07	64.9	3.31	115.4	2.37	78.1	3.42	131.9
72	86	72	161	193	108	269	301	2.46	76.4	3.93	135.2	2.83	91.9	4.08	154.4
78	93	78	175	208	114	289	322	2.90	89.1	4.57	155.8	3.30	106.5	4.71	177.1
84	100	84	188	224	120	308	344	3.35	102.4	5.23	177.4	3.83	122.5	5.41	201.6
90	107	90	202	240	126	328	366	3.86	117.1	5.96	200.8	4.40	139.7	6.16	227.8
96	114	96	215	255	132	347	387	4.38	132.3	6.71	225.1	4.98	157.5	6.93	254.9

HEADWALL FOR ROUND PIPE

SKEW°	FACTOR
90	1.000
85	1.004
80	1.015
75	1.035
70	1.064
65	1.103
60	1.155
55	1.221
50	1.305
45	1.414
40	1.556
35	1.743
30	2.000



SIDE VIEWS



Computer File Information

Creation Date: 07/31/19
Designer Initials: JBK
Last Modification Date: 07/31/19
Detailer Initials: LTA
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English

Sheet Revisions

Date:	Comments
(R-X)	
(R-X)	
(R-X)	
(R-X)	

Colorado Department of Transportation

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TYPE "S" SADDLE HEADWALLS FOR PIPE

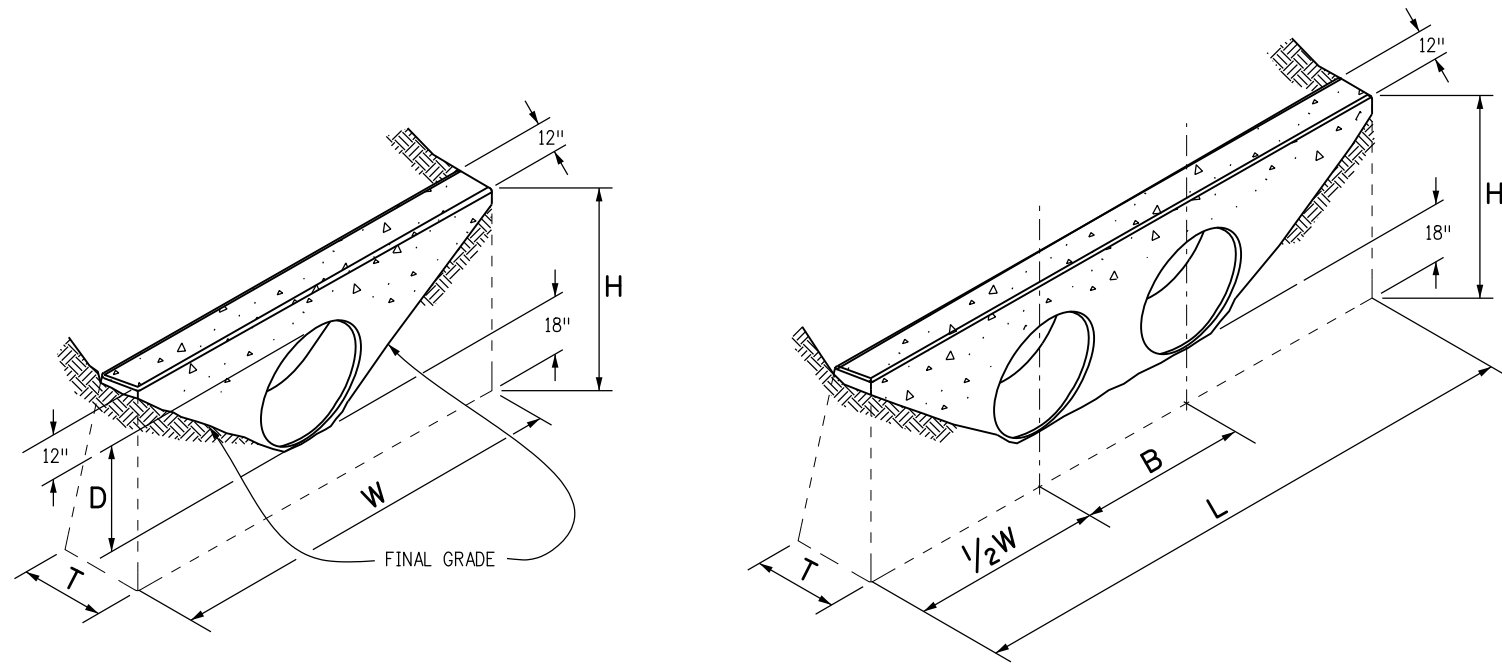
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-601-11

Standard Sheet No. 1 of 1

Project Sheet Number:



SINGLE PIPE

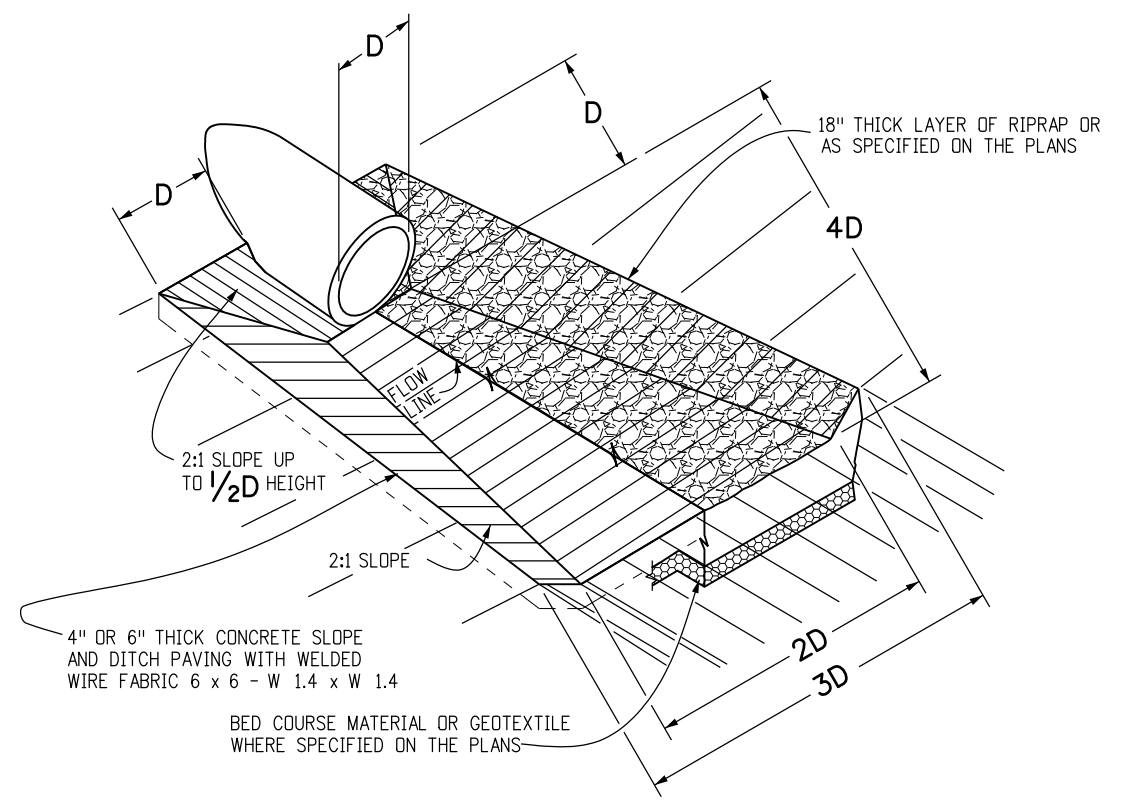
DOUBLE PIPE

CONCRETE HEADWALL INSTALLATIONS

SEE STANDARD PLAN M-601-10 FOR REINFORCING DETAILS.

GENERAL NOTES

1. FOR SIZE AND LOCATION OF PIPES, SEE THE PLANS.
2. ALL CONCRETE SHALL BE CLASS B.
3. FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED IN ACCORDANCE WITH SUBSECTION 601.09(b).
4. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED $\frac{3}{4}$ IN.
5. HEADWALL SHALL HAVE REINFORCING STEEL INSTALLED IN A PATTERN SIMILAR TO STANDARD PLAN M-601-10.
6. THE COST OF REINFORCING STEEL SHALL BE INCLUDED IN THE WORK UNLESS THE STEEL QUANTITIES ARE LISTED IN THE PLANS AND ARE PAID FOR SEPARATELY.



PIPE OUTLET PAVING

MAY BE USED WITH MULTIPLE PIPES.

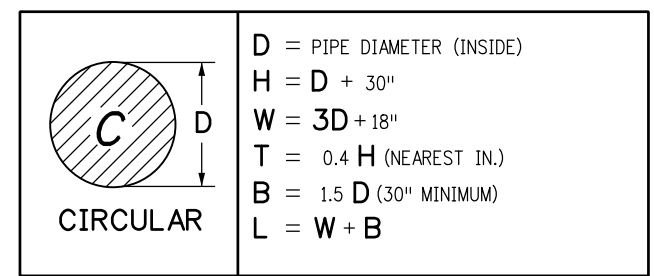
PIPE		PIPE DIAMETER (AND EQUIVALENT DIAMETER) (IN.)											
		18		24		30		36		42		48	
TYPE	MATERIAL	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE	SINGLE	DOUBLE
CIRCULAR	RIGID	1.0	1.3	1.5	2.0	2.0	2.7	2.8	3.6	3.6	4.6	4.6	6.0
	FLEXIBLE	1.1	1.4	1.6	2.1	2.2	3.0	3.0	4.0	3.9	5.3	5.0	6.8
ELLIPTICAL	RIGID	23 x 14		30 x 19		38 x 24		45 x 29		53 x 34		60 x 38	
		0.9	1.2	1.3	1.6	1.7	2.2	2.3	2.9	2.9	3.7	3.5	4.4
ARCH	METAL	22 x 13		29 x 18		36 x 22		43 x 27		50 x 31		58 x 36	
		0.9	1.3	1.4	1.9	1.8	2.4	2.4	3.4	3.2	4.4	3.4	5.0

CONCRETE QUANTITIES FOR ONE CONCRETE HEADWALL (CUBIC YARDS)

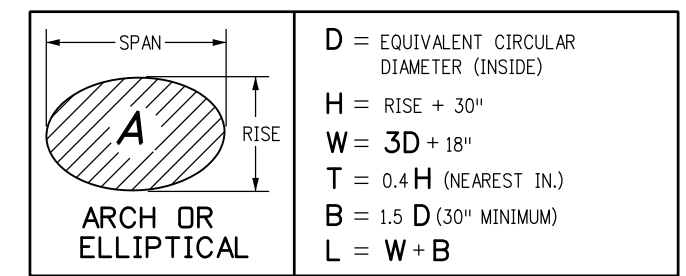
THICKNESS	MATERIAL	PIPE DIAMETER (IN.)					
		18	24	30	36	42	48
4"	CONCRETE	0.4	0.8	1.2			
6"	CONCRETE				2.6	3.6	4.7
18"	RIPRAP	2.0	3.5	5.4	7.8	10.7	13.9

PIPE OUTLET PAVING (CUBIC YARDS)

NOTE: VOLUME OCCUPIED BY PIPE HAS BEEN DEDUCTED.



CIRCULAR TYPE OF PIPE HEADWALL DIMENSIONS



ARCH OR ELLIPTICAL TYPE OF PIPE HEADWALL DIMENSIONS

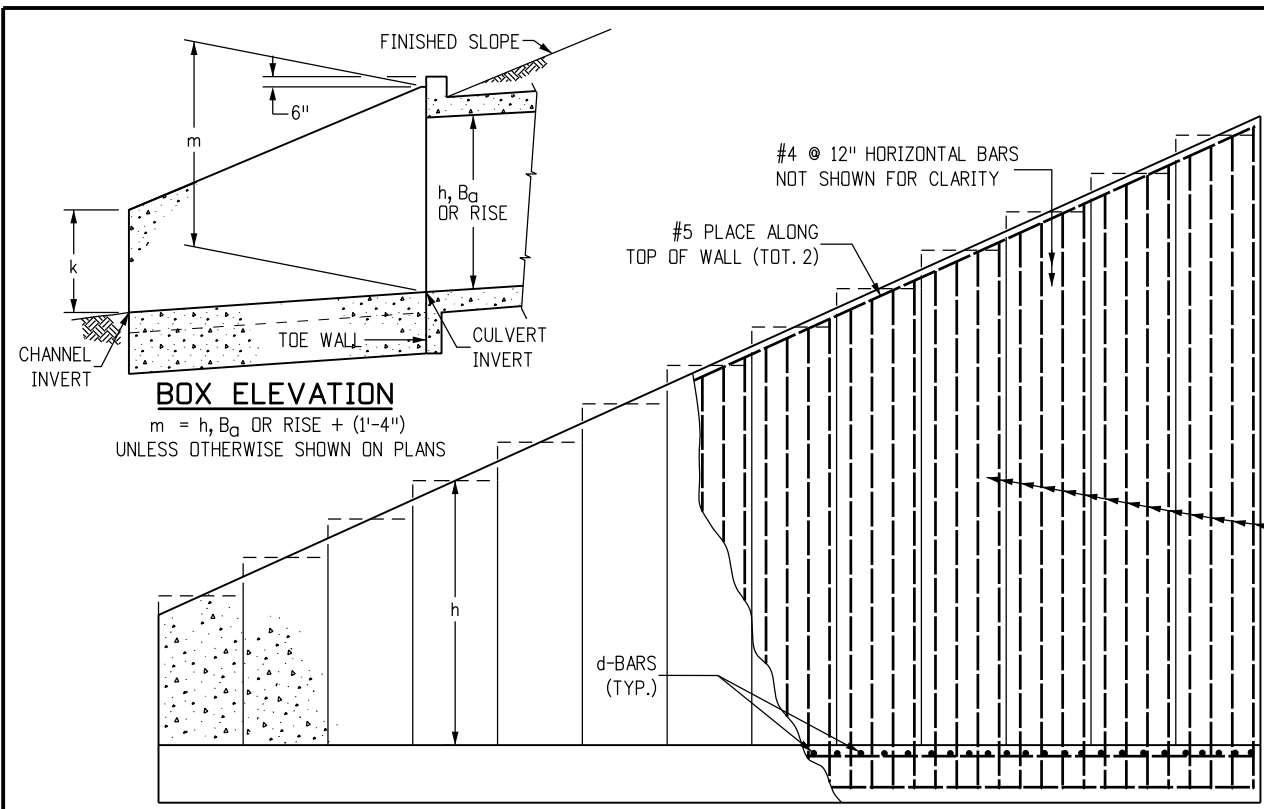
Computer File Information	
Creation Date: 07/31/19	
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

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**HEADWALLS AND
 PIPE OUTLET PAVING**
 Issued by the Project Development Branch: July 31, 2019

**STANDARD PLAN NO.
 M-601-12**
 Standard Sheet No. 1 of 1
 Project Sheet Number:



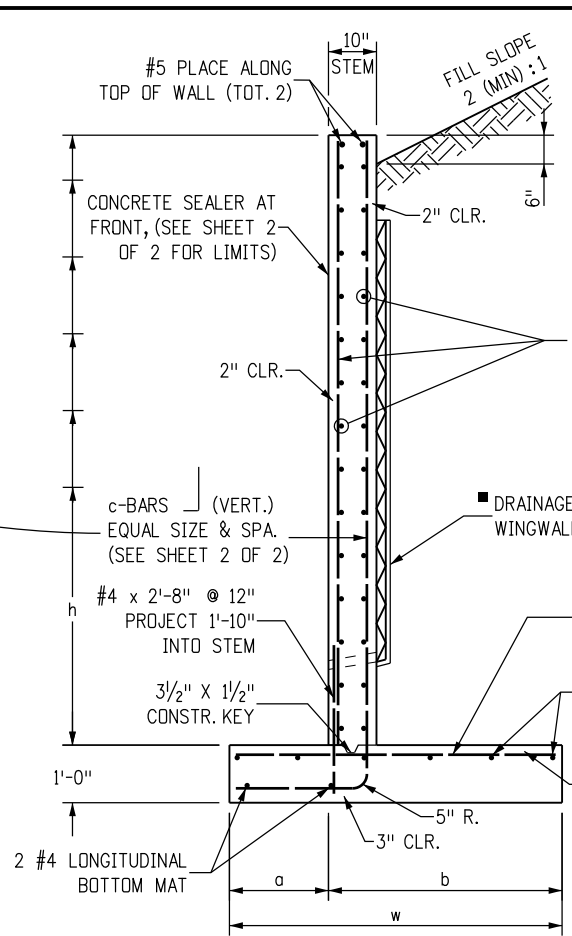
BOX ELEVATION

$m = h, B_a \text{ OR RISE} + (1'-4")$
UNLESS OTHERWISE SHOWN ON PLANS

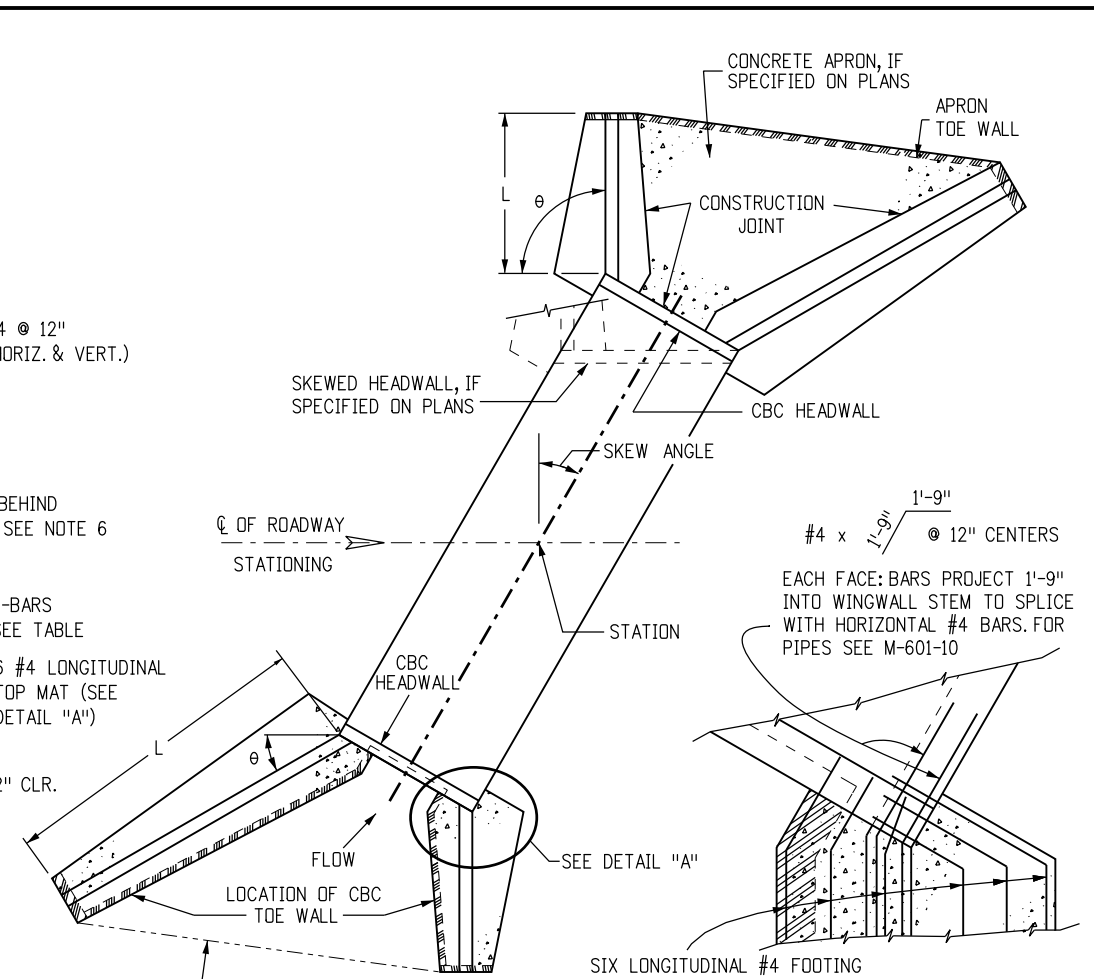
h =	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'
a =	1'-0"	1'-2"	1'-4"	1'-6"	1'-8"	1'-10"	2'-0"	2'-2"	2'-4"	2'-6"	2'-8"	2'-10"	3'-0"
b =	1'-8"	2'-0"	2'-4"	2'-8"	3'-0"	3'-4"	3'-8"	4'-0"	4'-4"	4'-8"	5'-0"	5'-4"	5'-8"
w =	2'-8"	3'-2"	3'-8"	4'-2"	4'-8"	5'-2"	5'-8"	6'-2"	6'-8"	7'-2"	7'-8"	8'-2"	8'-8"
d-BARS	#4 @ 9"	#4 @ 9"	#4 @ 9"	#4 @ 9"	#4 @ 9"	#4 @ 9"	#5 @ 11"	#5 @ 10"	#5 @ 10"	#5 @ 8"	#6 @ 8"	#7 @ 9"	#7 @ 7"
* CONC. CY/LF	0.161	0.210	0.259	0.309	0.358	0.407	0.457	0.506	0.556	0.605	0.654	0.704	0.753

* DOES NOT INCLUDE TOE WALL QUANTITIES SEE SHEET 2 OF 2 FOR REINFORCING STEEL QUANTITY

■ REQUIRED DRAINAGE BEHIND WINGWALLS SEE NOTE 6



TYPICAL SECTION



TYPICAL CULVERT LAYOUT

DESIGN DATA:

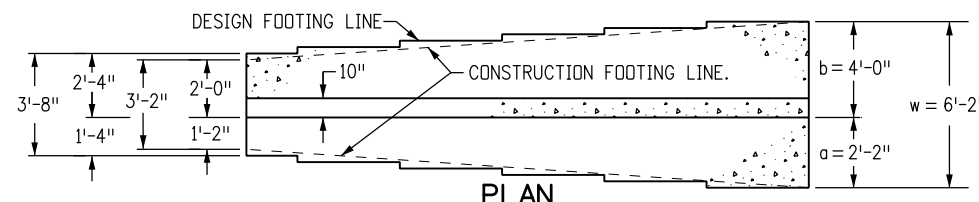
AASHTO LRFD EIGHTH EDITION, 2017
DESIGN METHOD: LOAD AND RESISTANCE FACTOR DESIGN, YIELD LINE METHOD

REINFORCED CONCRETE:
CONCRETE CLASS D (BOX CULVERT): $f'_c = 4,500 \text{ PSI}$
REINFORCING STEEL: $f_y = 60,000 \text{ PSI}$

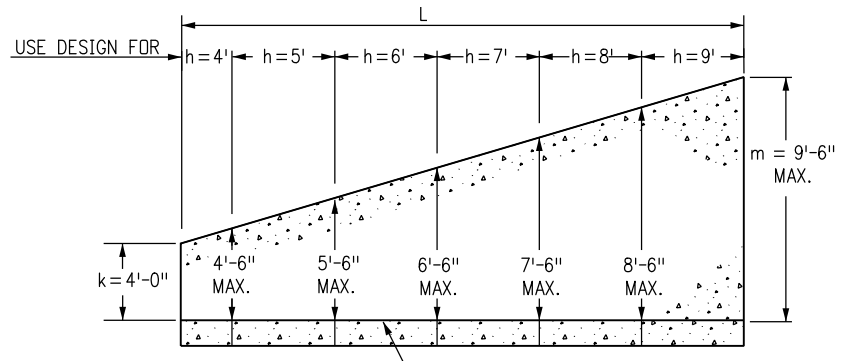
LOADING:
AT-REST EARTH (FLUID) PRESSURE FOR CONCRETE STEM DESIGN = 55 PCF FOR 2 (MIN.):1 SLOPED BACKFILL
ACTIVE EARTH (FLUID) PRESSURE FOR CONCRETE FOOTING DESIGN = 40 PCF FOR 2 (MIN.):1 SLOPED BACKFILL
LIVE LOAD SURCHARGE = 2'
MINIMUM RESISTANCE FOR SOIL BEARING = 5.5 KSF
SOIL BEARING RESISTANCE FACTOR = 0.45

GENERAL NOTES:

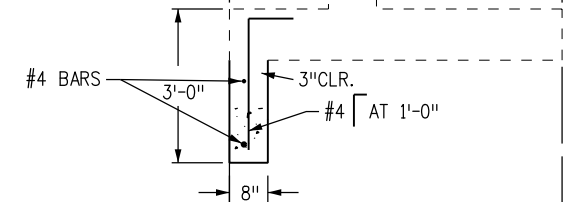
- ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED $\frac{3}{4}$ IN.
- WINGWALL FOOTING AND FLOOR OF BOX CULVERT SHALL BE PLACED MONOLITHICALLY.
- DIMENSIONS "h", "k", "L", "m" AND ANGLE "θ" FOR WINGWALL SHALL BE AS SHOWN ON THE PLANS.
- MINIMUM CLASS B LAP SPLICE LENGTH FOR BLACK REINFORCING BARS:
BAR SIZE: #4 #5 #6 #7
SPLICE LENGTH: 1'-6" 1'-11" 2'-3" 2'-7"
- DESIGN DOES NOT CONSIDER ANY SCOUR EFFECTS.
- WINGWALL DRAIN SHALL BE REQUIRED IF "h" ≥ 12.0 FT., SEE SHEET 2 OF 2 FOR DETAILS.



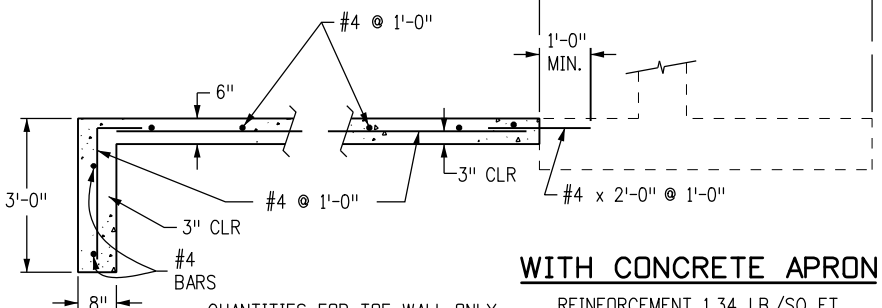
PLAN



ELEVATION DESIGN EXAMPLE



WITH TOE WALL



WITH CONCRETE APRON

QUANTITIES FOR TOE WALL ONLY
CONCRETE 0.049 CU. YD./LIN. FT.
REINFORCEMENT 5.1 LB./LIN. FT.

REINFORCEMENT 1.34 LB./SQ. FT.

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Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions

Date:	Comments:

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WINGWALLS FOR PIPE OR BOX CULVERTS

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-601-20

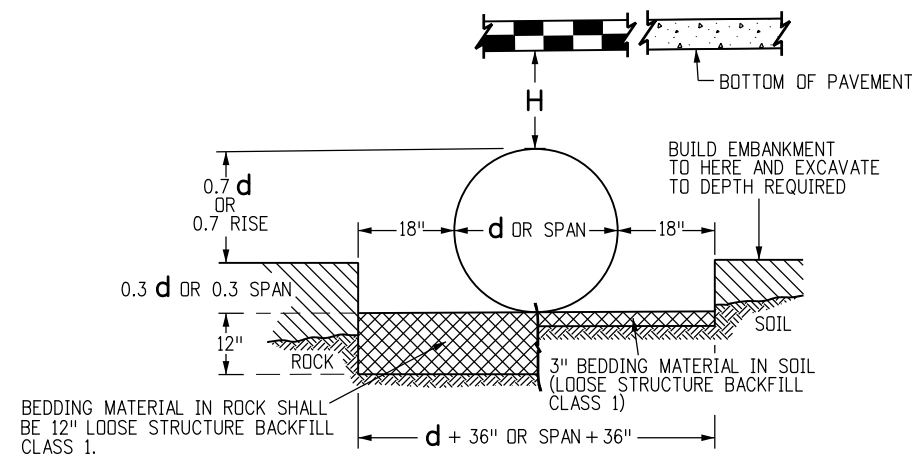
Standard Sheet No. 1 of 2

Project Sheet Number:

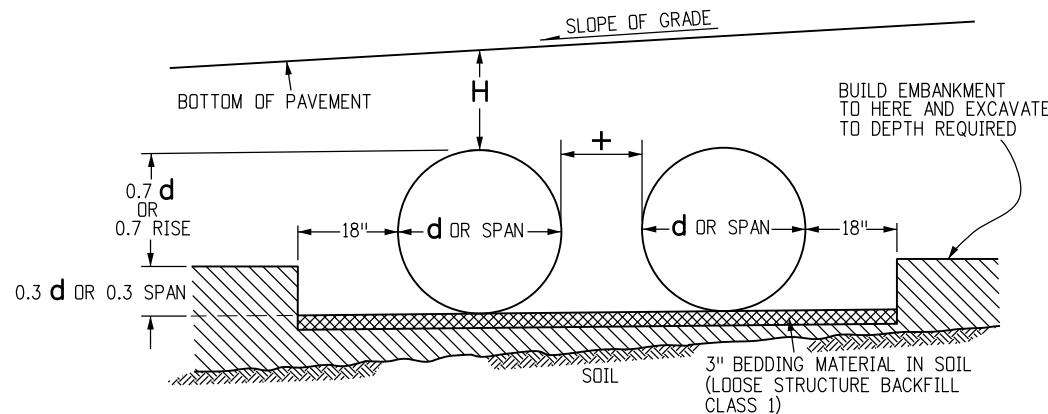
c-BARS AND REINFORCING STEEL QUANTITY (EXCLUDE TOE WALL)

* REINFORCING STEEL QUANTITY INCLUDES STEM AND FOOTING QUANTITIES, BUT DOES NOT INCLUDE TOE WALL QUANTITIES.

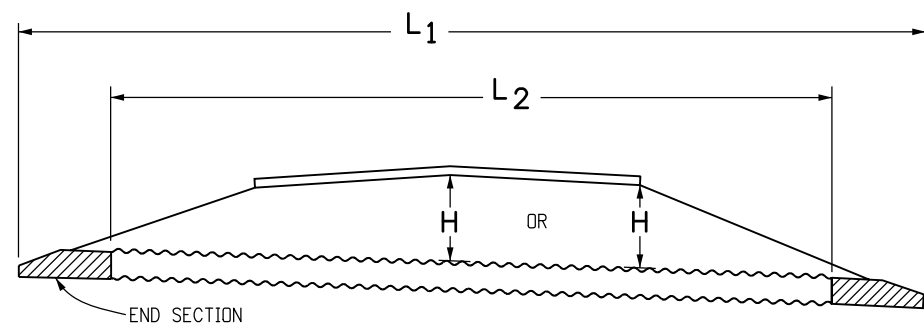
L (MULTIPLE OF m)		≤ (1.0 x m)		≤ (1.25 x m)		≤ (1.5 x m)		≤ (1.75 x m)		≤ (2.0 x m)		≤ (2.25 x m)		≤ (2.5 x m)		≤ (2.75 x m)		≤ (3.0 x m)		≤ (3.25 x m)		≤ (3.5 x m)	
m (FT)	k (FT)	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.	c-BARS	* REINF. LB./L.F.
14	4	#4 @ 10"	53.60	#5 @ 10"	57.95	#5 @ 10"	57.10	#5 @ 8"	60.22	#5 @ 7"	62.43	#5 @ 7"	62.09	#5 @ 6"	65.38	#5 @ 6"	65.15	#6 @ 8"	67.10	#6 @ 8"	66.94	#6 @ 7"	70.66
	5	#4 @ 10"	55.86	#5 @ 10"	60.46	#5 @ 10"	59.60	#5 @ 8"	62.89	#5 @ 7"	65.23	#5 @ 7"	64.88	#5 @ 6"	68.34	#5 @ 6"	68.11	#6 @ 8"	70.17	#6 @ 8"	70.00	#6 @ 7"	73.90
	6	#5 @ 10"	64.43	#6 @ 10"	70.60	#6 @ 10"	69.69	#6 @ 8"	74.93	#6 @ 8"	74.45	#6 @ 7"	78.30	#6 @ 6"	83.64	#6 @ 6"	83.40	#6 @ 6"	83.22	#6 @ 6"	83.05	#7 @ 7"	89.64
	7	#5 @ 10"	67.29	#6 @ 10"	73.76	#6 @ 10"	72.83	#6 @ 8"	78.32	#6 @ 8"	77.84	#6 @ 7"	81.87	#6 @ 6"	87.45	#6 @ 6"	87.21	#6 @ 6"	87.02	#6 @ 6"	86.86	#7 @ 7"	93.73
	8	#5 @ 8"	74.71	#6 @ 8"	83.46	#6 @ 7"	87.09	#6 @ 6"	92.54	#7 @ 7"	99.47	#7 @ 7"	99.08	#7 @ 6"	107.11	#7 @ 6"	106.86	#7 @ 6"	106.66	#7 @ 6"	106.49	#7 @ 6"	106.35
9	#5 @ 8"	78.10	#6 @ 8"	87.23	#6 @ 7"	91.03	#6 @ 6"	96.72	#7 @ 7"	103.93	#7 @ 7"	103.54	#7 @ 6"	111.90	#7 @ 6"	111.65	#7 @ 6"	111.45	#7 @ 6"	111.28	#7 @ 6"	111.13	
13	4	#4 @ 10"	50.51	#4 @ 10"	49.25	#5 @ 10"	53.71	#5 @ 10"	53.09	#5 @ 10"	52.36	#5 @ 9"	53.85	#5 @ 8"	55.54	#5 @ 7"	57.85	#5 @ 7"	57.67	#5 @ 7"	57.51	#6 @ 9"	59.93
	5	#4 @ 10"	52.66	#4 @ 10"	51.37	#5 @ 10"	56.09	#5 @ 10"	55.46	#5 @ 10"	54.99	#5 @ 9"	56.29	#5 @ 8"	58.08	#5 @ 7"	60.51	#5 @ 7"	60.33	#5 @ 7"	60.17	#6 @ 9"	62.72
	6	#4 @ 10"	54.92	#5 @ 10"	59.48	#5 @ 9"	60.31	#6 @ 9"	67.56	#6 @ 9"	67.08	#6 @ 9"	66.70	#6 @ 8"	69.53	#6 @ 8"	69.28	#6 @ 7"	73.12	#6 @ 7"	72.95	#6 @ 7"	72.81
	7	#4 @ 10"	57.36	#5 @ 10"	62.16	#5 @ 9"	63.05	#6 @ 9"	70.66	#6 @ 9"	70.16	#6 @ 9"	69.78	#6 @ 8"	72.75	#6 @ 8"	72.50	#6 @ 7"	76.52	#6 @ 7"	76.35	#6 @ 7"	76.20
	8	#5 @ 10"	66.39	#6 @ 10"	72.82	#6 @ 8"	77.97	#6 @ 7"	81.68	#6 @ 7"	81.19	#6 @ 6"	86.67	#6 @ 6"	86.37	#7 @ 7"	93.18	#7 @ 7"	92.97	#7 @ 7"	92.80	#7 @ 7"	92.64
9	#5 @ 10"	69.37	#6 @ 10"	76.10	#6 @ 8"	81.49	#6 @ 7"	85.37	#6 @ 7"	84.87	#6 @ 6"	90.59	#6 @ 6"	90.29	#7 @ 7"	97.39	#7 @ 7"	97.18	#7 @ 7"	97.00	#7 @ 7"	96.85	
12	2	#4 @ 10"	43.91	#4 @ 10"	42.65	#4 @ 10"	41.82	#4 @ 10"	41.22	#4 @ 10"	40.78	#4 @ 9"	41.29	#5 @ 10"	44.61	#5 @ 10"	44.37	#5 @ 10"	44.18	#5 @ 10"	44.01	#5 @ 10"	43.87
	3	#4 @ 10"	45.82	#4 @ 10"	44.55	#4 @ 10"	43.71	#4 @ 10"	43.11	#4 @ 10"	42.66	#4 @ 9"	43.22	#5 @ 10"	46.75	#5 @ 10"	46.51	#5 @ 10"	46.32	#5 @ 10"	46.15	#5 @ 10"	46.01
	4	#4 @ 10"	47.80	#4 @ 10"	46.51	#4 @ 10"	45.65	#5 @ 10"	50.06	#5 @ 10"	49.59	#5 @ 10"	49.23	#5 @ 10"	48.94	#5 @ 10"	48.69	#5 @ 9"	50.00	#5 @ 8"	51.72	#5 @ 8"	51.57
	5	#4 @ 10"	49.84	#4 @ 10"	48.53	#4 @ 10"	47.66	#5 @ 10"	52.33	#5 @ 10"	51.85	#5 @ 10"	51.48	#5 @ 10"	51.19	#5 @ 10"	50.94	#5 @ 9"	52.33	#5 @ 8"	54.14	#5 @ 8"	54.00
	6	#4 @ 10"	51.99	#4 @ 10"	50.65	#5 @ 10"	55.34	#5 @ 8"	58.41	#5 @ 8"	57.93	#6 @ 10"	60.60	#6 @ 10"	60.29	#6 @ 9"	62.42	#6 @ 9"	62.22	#6 @ 9"	62.04	#6 @ 8"	64.89
	7	#4 @ 10"	54.30	#5 @ 10"	58.80	#5 @ 10"	57.87	#5 @ 8"	61.10	#5 @ 8"	60.61	#6 @ 10"	63.43	#6 @ 10"	63.11	#6 @ 9"	65.35	#6 @ 9"	65.15	#6 @ 9"	64.97	#6 @ 8"	67.96
	8	#5 @ 10"	62.91	#5 @ 10"	61.45	#5 @ 7"	67.46	#5 @ 6"	70.68	#5 @ 6"	70.20	#6 @ 7"	76.44	#6 @ 7"	76.13	#6 @ 7"	75.87	#6 @ 6"	81.30	#6 @ 6"	81.12	#6 @ 6"	80.98
	9	#5 @ 10"	65.64	#5 @ 10"	64.15	#5 @ 7"	70.44	#5 @ 6"	73.82	#5 @ 6"	73.33	#6 @ 7"	79.86	#6 @ 7"	79.54	#6 @ 7"	79.28	#6 @ 6"	84.95	#6 @ 6"	84.77	#6 @ 6"	84.62
	11	2	#4 @ 10"	41.70	#4 @ 10"	40.42	#4 @ 10"	39.57	#4 @ 10"	38.96	#4 @ 10"	38.50	#4 @ 10"	38.15	#4 @ 10"	37.87	#4 @ 10"	37.63	#4 @ 9"	38.25	#5 @ 10"	41.46	#5 @ 10"
3		#4 @ 10"	43.57	#4 @ 10"	42.27	#4 @ 10"	41.40	#4 @ 10"	40.79	#4 @ 10"	40.33	#4 @ 10"	39.97	#4 @ 10"	39.69	#4 @ 10"	39.45	#4 @ 9"	40.12	#5 @ 10"	43.54	#5 @ 10"	43.39
4		#4 @ 10"	45.48	#4 @ 10"	44.16	#4 @ 10"	43.28	#4 @ 10"	42.66	#4 @ 9"	43.09	#5 @ 10"	46.57	#5 @ 10"	46.27	#5 @ 10"	46.02	#5 @ 10"	45.82	#5 @ 10"	45.65	#5 @ 10"	45.50
5		#4 @ 10"	47.46	#4 @ 10"	46.10	#4 @ 10"	45.21	#4 @ 10"	44.58	#4 @ 9"	45.06	#5 @ 10"	48.74	#5 @ 10"	48.44	#5 @ 10"	48.19	#5 @ 10"	47.99	#5 @ 10"	47.81	#5 @ 10"	47.67
6		#4 @ 10"	49.52	#4 @ 10"	48.14	#4 @ 9"	48.23	#5 @ 10"	51.88	#5 @ 10"	51.38	#5 @ 9"	52.57	#5 @ 9"	52.27	#5 @ 8"	53.99	#5 @ 8"	53.79	#5 @ 7"	56.16	#5 @ 7"	56.01
7		#4 @ 10"	51.73	#4 @ 10"	50.31	#4 @ 9"	50.43	#5 @ 10"	54.29	#5 @ 10"	53.78	#5 @ 9"	55.04	#5 @ 9"	54.73	#5 @ 8"	56.55	#5 @ 8"	56.35	#5 @ 7"	58.84	#5 @ 7"	58.70
8		#4 @ 10"	54.00	#5 @ 10"	58.44	#5 @ 10"	57.45	#5 @ 8"	60.64	#5 @ 7"	62.92	#5 @ 6"	66.25	#5 @ 6"	65.94	#5 @ 6"	65.69	#6 @ 8"	67.76	#6 @ 8"	67.57	#6 @ 7"	71.45
9		#4 @ 10"	56.20	#5 @ 10"	60.87	#5 @ 10"	59.85	#5 @ 8"	63.21	#5 @ 7"	65.60	#5 @ 6"	69.09	#5 @ 6"	68.78	#5 @ 6"	68.52	#6 @ 8"	70.69	#6 @ 8"	70.51	#6 @ 7"	74.57
10		2	#4 @ 10"	39.84	#4 @ 10"	38.53	#4 @ 10"	37.65	#4 @ 10"	37.03	#4 @ 10"	36.57	#4 @ 10"	36.20	#4 @ 10"	35.91	#4 @ 10"	35.67	#4 @ 10"	35.48	#4 @ 9"	36.07	#4 @ 9"
	3	#4 @ 10"	41.68	#4 @ 10"	40.35	#4 @ 10"	39.47	#4 @ 10"	38.84	#4 @ 10"	38.36	#4 @ 10"	38.00	#4 @ 10"	37.71	#4 @ 10"	37.46	#4 @ 10"	37.27	#4 @ 9"	37.91	#4 @ 9"	37.76
	4	#4 @ 10"	43.58	#4 @ 10"	42.22	#4 @ 10"	41.31	#4 @ 10"	40.67	#4 @ 10"	40.19	#4 @ 10"	39.82	#4 @ 10"	39.53	#4 @ 10"	39.28	#4 @ 10"	39.08	#4 @ 9"	39.77	#4 @ 9"	39.63
	5	#4 @ 10"	45.53	#4 @ 10"	44.14	#4 @ 10"	43.21	#4 @ 10"	42.56	#4 @ 10"	42.07	#5 @ 10"	46.44	#5 @ 10"	46.13	#5 @ 10"	45.87	#5 @ 10"	45.67	#5 @ 10"	45.49	#5 @ 10"	45.34
	6	#4 @ 10"	47.58	#4 @ 10"	46.14	#4 @ 10"	45.20	#4 @ 10"	44.53	#4 @ 10"	44.03	#5 @ 10"	48.67	#5 @ 10"	48.35	#5 @ 10"	48.08	#5 @ 10"	47.88	#5 @ 10"	47.69	#5 @ 10"	47.54
	7	#4 @ 10"	49.79	#4 @ 10"	48.31	#4 @ 10"	47.34	#5 @ 10"	51.97	#5 @ 10"	51.45	#5 @ 10"	51.04	#5 @ 9"	52.29	#5 @ 9"	52.03	#5 @ 8"	53.79	#5 @ 8"	53.61	#5 @ 7"	56.00
	8	#4 @ 10"	52.06	#4 @ 10"	50.54	#4 @ 10"	49.54	#5 @ 10"	54.43	#5 @ 10"	53.89	#5 @ 10"	53.47	#5 @ 9"	54.80	#5 @ 9"	54.53	#5 @ 8"	56.39	#5 @ 8"	56.20	#5 @ 7"	58.72
	9	#4 @ 10"	54.43	#4 @ 10"	52.85	#4 @ 10"	51.77	#5 @ 10"	55.47	#5 @ 10"	54.85	#5 @ 10"	54.33	#5 @ 9"	55.66	#5 @ 9"	55.36	#5 @ 8"	57.05	#5 @ 8"	56.83	#5 @ 7"	59.16
9	2	#4 @ 10"	38.01	#4 @ 10"	36.75	#4 @ 10"	35.85	#4 @ 10"	35.21	#4 @ 10"	34.73	#4 @ 10"	34.36	#4 @ 10"	34.06	#4 @ 10"	33.81	#4 @ 10"	33.61	#4 @ 10"	33.44	#4 @ 10"	33.30
	3	#4 @ 10"	39.93	#4 @ 10"	38.56	#4 @ 10"	37.64	#4 @ 10"	36.99	#4 @ 10"	36.51	#4 @ 10"	36.13	#4 @ 10"	35.83	#4 @ 10"	35.58	#4 @ 10"	35.38	#4 @ 10"	35.21	#4 @ 10"	35.06
	4	#4 @ 10"	41.81	#4 @ 10"	40.40	#4 @ 10"	39.47	#4 @ 10"	38.81	#4 @ 10"	38.31	#4 @ 10"	37.93	#4 @ 10"	37.63	#4 @ 10"	37.37	#4 @ 10"	37.17	#4 @ 10"	36.99	#4 @ 10"	36.84
	5	#4 @ 10"	43.75	#4 @ 10"	42.30	#4 @ 10"	41.35	#4 @ 10"	40.67	#4 @ 10"	40.17	#4 @ 10"	39.78	#4 @ 10"	39.47	#4 @ 10"	39.20	#4 @ 9"	39.86	#5 @ 10"	43.28	#5 @ 10"	43.12
	6	#4 @ 10"	45.79	#4 @ 10"	44.30	#4 @ 10"	43.31	#4 @ 10"	42.62	#4 @ 10"	42.10	#4 @ 10"	41.71	#4 @ 10"	41.39	#4 @ 10"	41.12	#4 @ 9"	41.82	#5 @ 10"	45.46	#5 @ 10"	45.30
	7	#4 @ 10"	48.04	#4 @ 10"	46.50	#4 @ 10"	45.49	#4 @ 10"	44.77	#5 @ 10"	49.29	#5 @ 10"	48.86	#5 @ 10"	48.53	#5 @ 10"	48.24	#5 @ 10"	48.03	#5 @ 10"	47.84	#5 @ 10"	47.67
	8	#4 @ 10"	50.43	#4 @ 10"	48.84	#4 @ 10"	47.80	#4 @ 10"	47.06	#5 @ 10"	51.83	#5 @ 10"	51.40	#5 @ 10"	51.05	#5 @ 10"	50.77	#5 @ 10"	50.54	#5 @ 10"	50.35	#5 @ 10"	50.18
8	2	#4 @ 10"	36.41	#4 @ 10"	35.01	#4 @ 10"	34.08	#4 @ 10"	33.42	#4 @ 10"	32.92	#4 @ 10"	32.54	#4 @ 10"	32.23	#4 @ 10"	31.97	#4 @ 10"	31.77	#4 @ 10"	31.59	#4 @ 10"	31.44
	3	#4 @ 10"	38.23	#4 @ 10"	36.80	#4 @ 10"	35.85	#4 @ 10"	35.18	#4 @ 10"	34.67	#4 @ 10"	34.28	#4 @ 10"	33.97	#4 @ 10"	33.70	#4 @ 10"	33.50	#4 @ 10"	33.32	#4 @ 10"	33.17
	4	#4 @ 10"	40.09	#4 @ 10"	38.61	#4 @ 10"	37.64	#4 @ 10"	36.95	#4 @ 10"	36.44	#4 @ 10"	36.04	#4 @ 10"	35.72	#4 @ 10"	35.45	#4 @ 10"	35.25	#4 @ 10"	35.07	#4 @ 10"	34.91
	5	#4 @ 10"	41.99	#4 @ 10"	40.47	#4 @ 10"	39.47	#4 @ 10"	38.76	#4 @ 10"	38.24	#4 @ 10"	37.83	#4 @ 10"	37.50	#4 @ 10"	37.23	#4 @ 10"	37.02	#4 @ 10"	36.84	#4 @ 10"	36.68
	6	#4 @ 10"	43.97	#4 @ 10"	42.40	#4 @ 10"	41.36	#4 @ 10"	40.64	#4 @ 10"	40.10	#4 @ 10"	39.68	#4 @ 10"	39.35	#4 @ 10"	39.07	#4 @ 9"	43.33	#5 @ 10"	43.13	#5 @ 10"	42.96
	7	#4 @ 10"	46.19	#4 @ 10"	44.56	#4 @ 10"	43.49	#4 @ 10"	42.74	#4 @ 10"	42.18	#4 @ 10"	41.75	#4 @ 10"	41.41	#4 @ 10"	41.13	#4 @ 9"	45.65	#5 @ 10"	45.45	#5 @ 10"	45.28
	8	#4 @ 10"	48.64	#4 @ 10"	46.91	#4 @ 10"	45.70	#4 @ 10"	44.81	#5 @ 10"	49.51	#5 @ 10"	49.03	#5 @ 10"	48.53	#5 @ 10"	48.03	#5 @ 10"	47.52	#5 @ 10"	47.00	#5 @ 10"	46.48
7	2	#4 @ 10"	34.90	#4 @ 10"	33.44	#4 @ 10"	32.47	#4 @ 10"	31.78	#4 @ 10"	31.27	#4 @ 10"	30.86	#4 @ 10"	30.54	#4 @ 10"	30.27	#4 @ 10"	30.06	#4 @ 10"	29.88	#4 @ 10"	29.72
	3	#4 @ 10"	36.73	#4 @ 10"	35.23	#4 @ 10"	34.23	#4 @ 10"	33.53														



INSTALLATION OF METAL PIPE

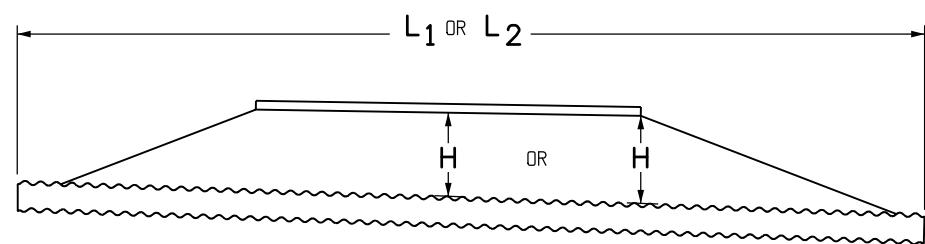


INSTALLATION OF MULTIPLE METAL PIPES



METAL PIPE WITH END SECTIONS

NOTE: USE THE H THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

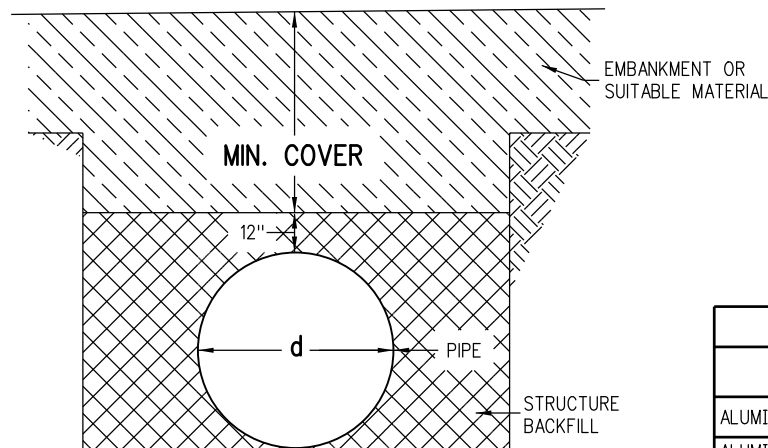


METAL PIPE WITHOUT END SECTIONS

NOTE: USE THE H THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

PIPE SPAN (IN.)	MINIMUM COVER (IN.) FOR INDICATED AXLE LOADS, kips			
	18.0 - 50.0	50.0 - 75.0	75.0 - 110.0	110.0 - 150.0
12.0 - 42.0	24	30	36	36
48.0 - 72.0	36	36	42	48
78.0 - 120.0	36	42	48	48
126.0 - 144.0	42	48	54	54

MINIMUM COVER FOR CONSTRUCTION LOADS



CONSTRUCTION MINIMUM COVER FOR PIPE

CONVERSION OF NOMINAL GAGE TO THICKNESS					
GAGE NO.	16	14	12	10	8
ALUMINUM THICKNESS - IN.	0.060	0.075	0.105	0.135	0.164
ALUMINIZED OR GALVANIZED STEEL THICKNESS - IN.	0.064	0.079	0.109	0.138	0.168

ALLOWED WALL THICKNESS

GENERAL NOTES

- STEEL PIPES SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M36. ALUMINUM PIPES SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M196. ALUMINIZED STEEL SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M274.
- MINIMUM COVER SHALL BE PROVIDED DURING CONSTRUCTION TO PROTECT THE STRUCTURE FROM DAMAGE.
- PIPE SHALL BE PLACED WITH LONGITUDINAL SEAMS AT THE SIDES OR QUARTER POINTS BUT NOT ALONG TOP OF VERTICAL AXIS.
- STRUCTURAL PLATE PIPES OF EQUAL OR GREATER DIAMETER THAT CONFORM TO SECTION 510 MAY BE SUBSTITUTED FOR THE PIPES ON THESE SHEETS AT THE CONTRACTOR'S EXPENSE.
- WHEN A PIPE IS TO BE EXTENDED, THE SAME PIPE MATERIAL AND SIZE AS IN THE ORIGINAL INSTALLATION SHALL BE USED.
- EXTENSIONS FOR CMP ARCH PIPE SHALL MATCH THE CORRUGATIONS, AND THE SPAN AND RISE DIMENSIONS OF THE PIPE TO BE EXTENDED.
- WHEN INSTALLING A GUARDRAIL OR A SIGN POST DIRECTLY ABOVE A PIPE, THE BOTTOM OF THE POST MUST BE AT LEAST 1 FOOT ABOVE THE TOP OF THE PIPE. THE HOLE FOR THE POST SHALL BE DRILLED INTO THE SOIL.
- PIPE ARCH WITH EQUAL PERIPHERY AND WITH SPAN AND RISE DIMENSIONS APPROXIMATELY EQUAL TO THOSE SPECIFIED ON THE PLANS WILL BE PERMITTED.
- PIPE ARCH IS INTENDED FOR USE WHERE MINIMUM COVER REQUIREMENTS FOR ROUND PIPE CANNOT BE MET. WHEN COVER EXCEEDS 11 FT. USE ROUND PIPE.
- PIPE COVER GREATER THAN 90 FT. SHALL REQUIRE AN INVESTIGATION OF THE FOUNDATION MATERIAL.

LEGEND

H = THE MAXIMUM ALLOWABLE HEIGHTS OF FILL OVER THE TOP OF THE PIPE, EXCLUDING PAVEMENT THICKNESS, ARE SHOWN IN THE TABLES OF THIS STANDARD.

THE MINIMUM COVER SHALL BE AS SHOWN ON THESE TABLES OR CONFORM TO AASHTO REQUIREMENTS, WHICHEVER IS GREATER.

THE MINIMUM COVER FOR PIPE IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT: HMA OR PCCP.

THE MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE SUBGRADE FOR CONSTRUCTION LOADS.

L₁ = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 624.

L₂ = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 603.

+ = THE MINIMUM SPACING BETWEEN THE OUTSIDE WALLS OF MULTIPLE PIPES OR END SECTIONS IS 18" OR 1/2 d, WHICHEVER IS GREATER, BUT NOT TO EXCEED 36".

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 Last Modification Date: 07/31/19
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(R-X)	

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 Project Development Branch JBK

METAL PIPE

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-603-1

Standard Sheet No. 1 of 4

Project Sheet Number:

THESE TABLES ARE APPLICABLE FOR THE FOLLOWING LIST OF CORRUGATED STEEL PIPE:

1. GALVANIZED CORRUGATED STEEL PIPE (CSP)
2. ALUMINIZED CORRUGATED STEEL PIPE TYPE 2 (ALT2 CSP)
3. BITUMINOUS COATED CORRUGATED STEEL PIPE (BIT. CO. CSP)
4. ARAMID FIBER BONDED CORRUGATED STEEL PIPE (A.F. BO. CSP)
5. PRECOATED CORRUGATED STEEL PIPE (PCSP- BOTH SIDES)

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE				
		H MAXIMUM OF COVER (FT.)				
		16	14	12	10	8
12	24	207	259			
15	24	165	207			
18	24	138	172	242		
21	24	118	148	207		
24	24	103	129	181		
30	24	82	103	145		
36	24	68	86	120	155	
42	24	58	73	103	133	163
48	36	51	64	90	103	142
54	36		57	80	93	126
60	36			72	84	114
66	36				77	103
72	36					94
78	36					84
84	36					72

2-2/3" X 1/2" CORRUGATIONS CORRUGATED STEEL PIPE

SPAN X RISE (IN. X IN.)	ROUND EQUIVALENT (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	H MAXIMUM COVER (FT.)
17 X 13	15	24	16	13
21 X 15	18	24	16	12
24 X 18	21	24	16	13
28 X 20	24	24	16	12
35 X 24	30	24	16	12
42 X 29	36	24	16	12
49 X 33	42	24	14	12
57 X 38	48	36	12	12
64 X 43	54	36	12	12
71 X 47	60	36	10	12
77 X 52	66	36	8	12
83 X 57	72	36	8	12

2-2/3" X 1/2" CORRUGATIONS * CORRUGATED STEEL PIPE ARCH

* CORNER BEARING PRESSURE OF 2 TONS PER SQ. FT.

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	
		H MAXIMUM OF COVER (FT.)	
		16	14
6	24	408	509
8	24	306	382
10	24	244	305

1-1/2" X 1/4" CORRUGATIONS CORRUGATED STEEL PIPE

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE				
		H MAXIMUM OF COVER (FT.)				
		16	14	12	10	8
48	36	59	74	104	134	164
54	36	52	65	92	119	146
60	36	47	59	83	107	131
66	36	42	53	75	97	119
72	36	39	49	69	89	109
78	36		45	63	82	101
84	36		42	59	76	93
90	36			55	71	87
96	36			51	66	81
102	36			48	62	77
108	36				59	72
114	36				56	68
120	36				53	65
126	42					62

3" X 1" CORRUGATIONS CORRUGATED STEEL PIPE

SPAN X RISE (IN. X IN.)	ROUND EQUIVALENT (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	H MAXIMUM COVER (FT.)
53 X 41	48	36	14	12
60 X 46	54	36	14	20
66 X 51	60	36	14	20
73 X 55	66	36	14	20
81 X 59	72	36	14	17
87 X 63	78	36	14	16
95 X 67	84	36	14	16
103 X 71	90	36	12	16
112 X 75	96	36	12	16
117 X 79	102	36	12	16

3" X 1" CORRUGATIONS * CORRUGATED STEEL PIPE ARCH

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 	<h1>METAL PIPE</h1>	STANDARD PLAN NO.
Creation Date: 07/31/19	Designer Initials: JBK	Date:	Comments:			M-603-1
Last Modification Date: 07/31/19	Detailer Initials: LTA			Project Development Branch	Issued by the Project Development Branch: July 31, 2019	Standard Sheet No. 2 of 4
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English				JBK		Project Sheet Number:

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE				
		H MAXIMUM OF COVER (FT.)				
		16	14	12	10	8
54	36	46	58	82	106	129
60	36		52	74	95	116
66	36		47	66	86	106
72	36			61	79	97
78	36			56	73	89
84	36			53	68	83
90	36				63	77
96	36				59	72
102	36				55	68
108	36					64

**5" X 1" CORRUGATIONS
CORRUGATED STEEL PIPE**

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE			
		H MAXIMUM OF COVER (FT.)			
		16	14	12	10
18	24	90	126		
21	24	77	108	181	
24	24	67	95	158	
30	24	54	75	126	
36	24	45	63	105	
42	24	38	54	90	
48	36	33	47	78	114
54	36	29	41	70	101
60	36		37	63	91
66	36		34	57	83
72	36			52	76
78	36			48	70
84	36			44	65
90	36				60
96	36				56
102	36				50

**3/4" X 3/4 7-1/2" CORRUGATIONS
CORRUGATED STEEL PIPE**

THESE TABLES ARE APPLICABLE FOR THE FOLLOWING LIST OF CORRUGATED STEEL PIPE:

1. GALVANIZED CORRUGATED STEEL PIPE (CSP)
2. ALUMINIZED CORRUGATED STEEL PIPE TYPE 2 (ALT2 CSP)
3. BITUMINOUS COATED CORRUGATED STEEL PIPE (BIT. CO. CSP)
4. ARAMID FIBER BONDED CORRUGATED STEEL PIPE (A.F. BO. CSP)
5. PRECOATED CORRUGATED STEEL PIPE (PCSP- BOTH SIDES)

SPAN X RISE (IN. X IN.)	ROUND EQUIVALENT (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	H MAXIMUM COVER (FT.)
81 X 59	72	36	12	17
87 X 63	78	36	12	16
95 X 67	84	36	12	16

**5" X 1" CORRUGATIONS
CORRUGATED STEEL PIPE ARCH ***

* CORNER BEARING PRESSURE OF 2 TONS PER SQ. FT.

SPAN X RISE (IN. X IN.)	ROUND EQUIVALENT (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	H MAXIMUM COVER (FT.)
20 X 16	18	24	16	16
23 X 19	21	24	16	15
27 X 21	24	24	16	13
33 X 26	30	24	16	13
40 X 31	36	24	16	14
46 X 36	42	24	12	13
53 X 41	48	36	12	13
60 X 46	54	36	12	20
66 X 51	60	36	12	20

**3/4" X 3/4 7-1/2" CORRUGATIONS
CORRUGATED STEEL PIPE ARCH ***

THESE TABLES ARE APPLICABLE FOR THE FOLLOWING LIST OF CORRUGATED STEEL PIPE:
 1. GALVANIZED CORRUGATED STEEL PIPE (CSP)
 2. ALUMINIZED CORRUGATED STEEL PIPE TYPE 2 (ALT2 CSP)
 3. BITUMINOUS COATED CORRUGATED STEEL PIPE (BIT. CO. CSP)
 4. ARAMID FIBER BONDED CORRUGATED STEEL PIPE (A.F. BO. CSP)
 5. PRECOATED CORRUGATED STEEL PIPE (PCSP- BOTH SIDES)

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	
		H MAXIMUM OF COVER (FT.)	
		16	
6	24	247	
8	24	185	
10	24	148	

1-1/2" X 1/4" CORRUGATIONS
CORRUGATED ALUMINUM PIPE

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE			
		H MAXIMUM OF COVER (FT.)			
		16	14	12	10
18	24	43	61		
21	24	38	52	84	
24	24	33	45	73	
30	24	26	36	58	
36	24	21	30	49	69
42	24		25	41	59
48	36			36	51
54	36			32	46
60	36			29	41
66	36				37
72	36				34

3/4" X 3/4" 7-1/2" CORRUGATIONS
CORRUGATED ALUMINUM PIPE

SPAN X RISE (IN. X IN.)	ROUND EQUIVALENT (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE			
			H MAXIMUM OF COVER (FT.)			
			16	14	12	10
20 X 16	18	24	16			
23 X 19	21	24	15			
27 X 21	24	24	13	13		
33 X 26	30	24	13	13	13	
40 X 31	36	24		13	13	
46 X 36	42	24			13	13
53 X 41	48	36			13	13
60 X 46	54	36			20	20
66 X 51	60	36				20

3/4" X 3/4" 7-1/2" CORRUGATIONS
CORRUGATED ALUMINUM PIPE ARCH *

DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE				
		H MAXIMUM OF COVER (FT.)				
		16	14	12	10	8
12	24	125	157			
15	24	100	125			
18	24	83	104			
21	24	71	89			
24	24	62	78	109		
27	24		69	97		
30	24		62	87		
36	24		51	73	94	
42	24			62	80	
48	36			54	70	85
54	36			48	62	76
60	36				52	64
66	36					52
72	36					43

2-2/3" X 1/2" CORRUGATIONS
CORRUGATED ALUMINUM PIPE

SPAN X RISE (IN. X IN.)	ROUND EQUIVALENT (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	H MAXIMUM COVER (FT.)
17 X 13	15	24	16	13
21 X 15	18	24	16	12
24 X 18	21	24	16	13
28 X 20	24	24	16	12
35 X 24	30	24	16	12
42 X 29	36	24	16	12
49 X 33	42	24	14	12
57 X 38	48	36	12	12
64 X 43	54	36	12	12
71 X 47	60	36	10	12

2-2/3" X 1/2" CORRUGATIONS
CORRUGATED ALUMINUM PIPE ARCH *

* CORNER BEARING PRESSURE OF 2 TONS PER SQ. FT.

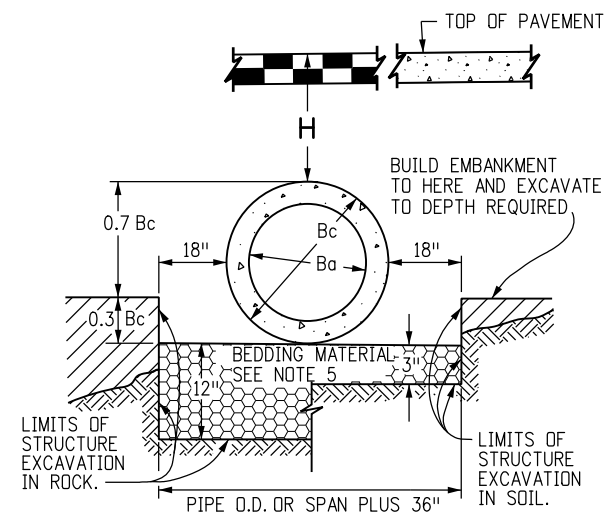
DIAMETER (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE				
		H MAXIMUM OF COVER (FT.)				
		16	14	12	10	8
30	24	57	72	101	135	159
36	24	47	60	84	112	132
42	24	40	51	72	96	113
48	36	35	44	62	84	99
54	36	31	39	55	74	88
60	36	28	35	50	67	79
66	36	25	32	45	61	72
72	36	23	29	41	56	66
78	36		27	38	51	61
84	36			35	48	56
90	36			33	44	52
96	36			31	41	49
102	36				39	46
108	36				37	43
114	36					39
120	36					36

3" X 1" CORRUGATIONS
CORRUGATED ALUMINUM PIPE

SPAN X RISE (IN. X IN.)	ROUND EQUIVALENT (IN.)	H MINIMUM COVER (IN.)	PIPE GAGE	H MAXIMUM COVER (FT.)
60 X 46	54	36	14	20
66 X 51	60	36	14	20
73 X 55	66	36	14	20
81 X 59	72	36	12	16
87 X 63	78	36	12	16
95 X 67	84	36	12	16
103 X 71	90	36	10	16
112 X 75	96	36	8	16

3" X 1" CORRUGATIONS
CORRUGATED ALUMINUM PIPE ARCH *

Computer File Information		Sheet Revisions		Colorado Department of Transportation		METAL PIPE	STANDARD PLAN NO.
Creation Date: 07/31/19		Date:	Comments	2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868			M-603-1
Designer Initials: JBK	(R-X)			Project Development Branch			Standard Sheet No. 4 of 4
Last Modification Date: 07/31/19	(R-X)			JBK		Issued by the Project Development Branch: July 31, 2019	Project Sheet Number:
Detailer Initials: LTA	(R-X)						
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)						



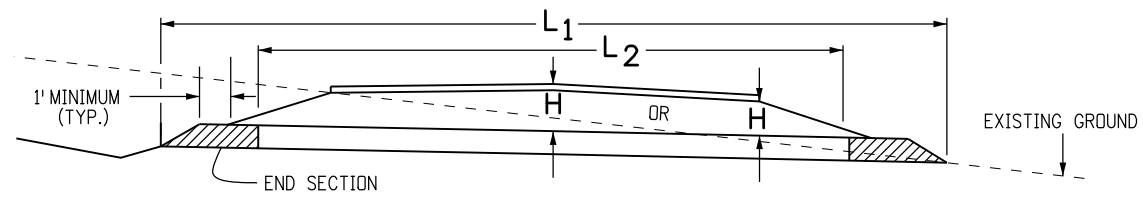
NOTE: Bc IS THE OUTSIDE DIMENSION FOR DIAMETER, SPAN OR RISE.

PIPE INSTALLATION
(WITH 0.7 PROJECTION RATIO)

CIRCULAR (CIR)			VERTICAL ELLIPTICAL (VE)				HORIZONTAL ELLIPTICAL (HE)			
PIPE SIZE = Ba (INSIDE DIA)	WALL THICKNESS	0.3 Bc (OUTSIDE DIA)	SPAN	RISE	WALL THICKNESS	0.3 OUTSIDE RISE	SPAN	RISE	WALL THICKNESS	0.3 OUTSIDE RISE
IN.		FT.	IN.				IN.			
			FT.				FT.			
12	2	0.40					23	14	2-3/4	0.49
15	2-1/4	0.49								
18	2-1/2	0.58								
21	2-3/4	0.66					30	19	3-1/4	0.66
24	3	0.75					34	22	3-1/2	0.73
27	3-1/4	0.84								
30	3-1/2	0.92					38	24	3-3/4	0.79
33	3-3/4	1.01								
36	4	1.10	29	45	4-1/2	1.35	45	29	4-1/2	0.95
42	4-1/2	1.28	34	53	5	1.58	53	34	5	1.10
48	5	1.45	38	60	5-1/2	1.78	60	38	5-1/2	1.23
54	5-1/2	1.62	43	68	6	2.00	68	43	6	1.38
60	6	1.80	48	76	6-1/2	2.23	76	48	6-1/2	1.53
66	6-1/2	1.97	53	83	7	2.43	83	53	7	1.68
72	7	2.15	58	91	7-1/2	2.65	91	58	7-1/2	1.83
78	7-1/2	2.32	63	98	8	2.85	98	63	8	1.98
84	8	2.50	68	106	8-1/2	3.08	106	68	8-1/2	2.13
90	8-1/2	2.68	72	113	9	3.28	113	72	9	2.25
96	9	2.85	77	121	9-1/2	3.50	121	77	9-1/2	2.40
102	9-1/2	3.02	82	128	9-3/4	3.69	128	82	9-3/4	2.54
108	10	3.20	87	136	10	3.90	136	87	10	2.68

△ ALSO EQUIVALENT ROUND DIMENSION FOR ELLIPTICAL PIPE.

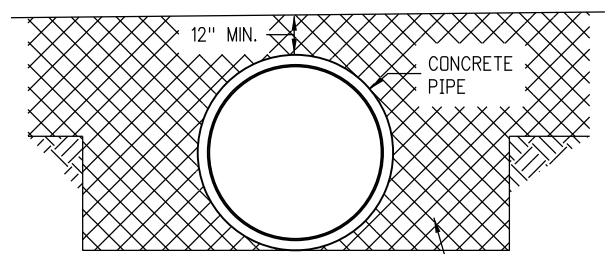
DIMENSIONS FOR REINFORCED CONCRETE PIPE
(FOR INFORMATION ONLY)



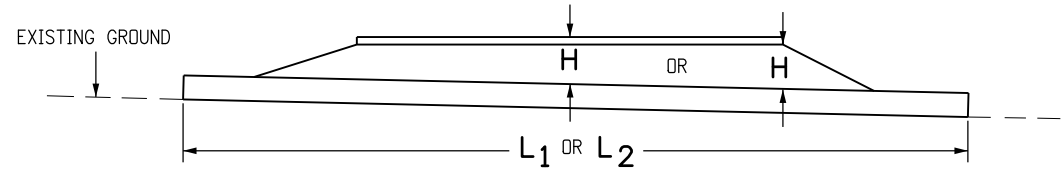
CONCRETE PIPE WITH END SECTIONS

NOTE: USE THE H THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

- H = HEIGHT OF FILL OVER TOP OF PIPE, INCLUDING PAVEMENT THICKNESS.
- L1 = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 624.
- L2 = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 603.



CONSTRUCTION
MINIMUM COVER FOR RIGID PIPE



CONCRETE PIPE WITHOUT END SECTIONS

NOTE: USE THE H THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

GENERAL NOTES

REINFORCED CONCRETE PIPE

- FILL HEIGHTS GREATER THAN MAXIMUM ALLOWED IN THE HEIGHTS OF FILL TABLE ON THIS SHEET REQUIRE SPECIAL DESIGN OF STRUCTURE.
- PIPE DESIGN IS BASED ON SAFETY FACTOR OF 1.33 ON ULTIMATE STRENGTH.
- THE HEIGHTS OF FILL OVER TOP OF PIPE ARE BASED ON UNIT WEIGHT OF SOIL AT 135 LBS. PER CUBIC FT.
- PIPE CLASS IS DETERMINED FROM 0.01 IN. CRACK D-LOAD.
- BEDDING IS CLASS B (MODIFIED) (FROM CONCRETE PIPE DESIGN MANUAL-AMERICAN CONCRETE PIPE ASSOCIATION) WITH SETTLEMENT RATIO R = 0.0_{sd} (YIELDING BED). BEDDING MATERIAL FOR RIGID PIPE IN SOIL SHALL BE 3 IN. LOOSE THICKNESS STRUCTURE BACKFILL CLASS 2. BEDDING MATERIAL FOR RIGID PIPE IN ROCK SHALL BE 12 IN. LOOSE THICKNESS STRUCTURE BACKFILL CLASS 1.
- CHANGES IN DESIGN FACTORS REQUIRE COMPENSATING CHANGES IN PIPE DESIGN.
- MINIMUM WALL THICKNESS DIMENSIONS ARE BASED ON AASHTO M 170 (WALL B) FOR CIRCULAR PIPE, AND AASHTO M 207 FOR ELLIPTICAL PIPE.
- SPACING FOR MULTIPLE PIPE INSTALLATIONS SHALL CONFORM TO THE DETAILS SHOWN ON STANDARD PLAN M-206-1.
- WHEN A PIPE IS TO BE EXTENDED, THE SAME PIPE MATERIAL AND SIZE AS IN THE ORIGINAL PIPE INSTALLATION SHALL BE USED.

NONREINFORCED CONCRETE PIPE

- AT THE OPTION OF THE CONTRACTOR, NONREINFORCED CONCRETE PIPE CONFORMING TO AASHTO M 86 MAY BE USED IN LIEU OF REINFORCED CONCRETE PIPE FOR ALL SIZES 36 INCHES IN DIAMETER AND SMALLER. THE NONREINFORCED CONCRETE PIPE SHALL MEET THE SAME D-LOAD TO PRODUCE THE ULTIMATE LOAD UNDER THE THREE-EDGE BEARING METHOD AS SPECIFIED FOR REINFORCED CONCRETE PIPE IN CONFORMANCE WITH AASHTO M 170. THE CONTRACTOR SHALL PROVIDE WRITTEN CERTIFICATION OF CONFORMANCE. THE WALL THICKNESS OF THE NONREINFORCED PIPE MAY BE INCREASED AS REQUIRED TO MEET D-LOAD REQUIREMENT.
- ALL REQUIREMENTS FOR REINFORCED CONCRETE PIPE, EXCEPT THOSE REFERRING TO REINFORCEMENT, SHALL APPLY TO NONREINFORCED CONCRETE PIPE.

TYPE OF PIPE	HEIGHT OF FILL OVER TOP OF PIPE, H (FEET)				
	CLASS OF PIPE (0.01 IN. CRACK D-LOAD)				
	CLASS CIR II CLASS VE II 1000 D	CLASS CIR III CLASS VE III 1350 D	CLASS CIR IV CLASS VE IV 2000 D	CLASS CIR V CLASS VE V 3000 D	CLASS VE VI 4000 D
CIRCULAR (CIR)	1 TO 18	1 TO 25	± 25 TO 37	± 37 TO 45	
VERTICAL ELLIPTICAL (VE)	1 TO 18	1 TO 25	± 25 TO 37	± 37 TO 45	± 45 TO 62
HORIZONTAL ELLIPTICAL (HE)	1 TO 18	1 TO 25	± 25 TO 37		

ALLOWABLE RANGE OF HEIGHTS FOR FILL
OVER REINFORCED CONCRETE PIPE

(ALL SIZES)

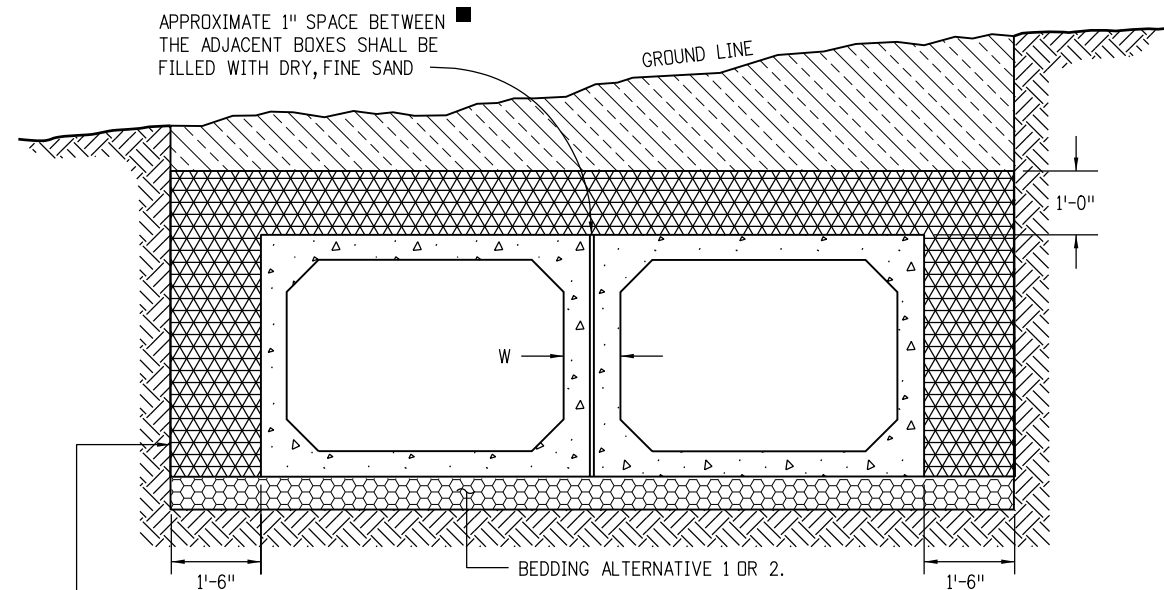
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Creation Date: 07/31/19	(R-X)
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Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

Colorado Department of Transportation
2829 West Howard Place
CDOT HQ, 3rd Floor
Denver, CO 80204
Phone: 303-757-9021 FAX: 303-757-9868
Project Development Branch **JBK**

REINFORCED CONCRETE PIPE
Issued by the Project Development Branch: July 31, 2019

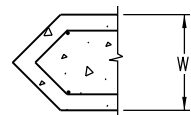
STANDARD PLAN NO.
M-603-2
Standard Sheet No. 1 of 1
Project Sheet Number:



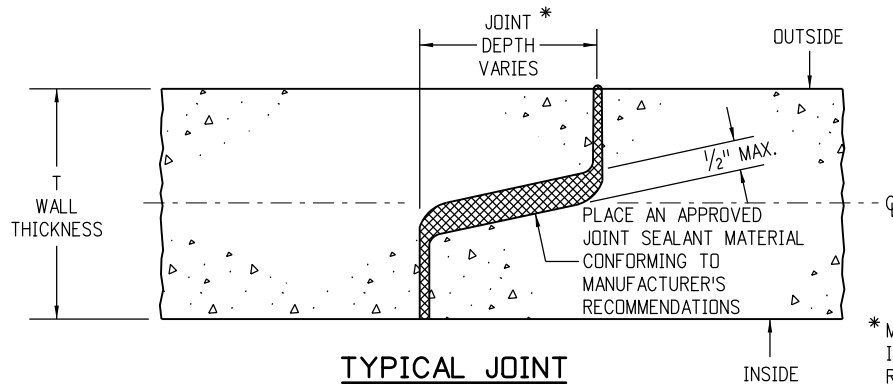
EXCAVATION & BACKFILL WILL BE MEASURED AND PAID FOR TO THIS LINE IN ACCORDANCE WITH SECTION 206.

EXCAVATION & BACKFILL
(DOUBLE PARALLEL PRECAST BOX CULVERT INSTALLATION SHOWN)

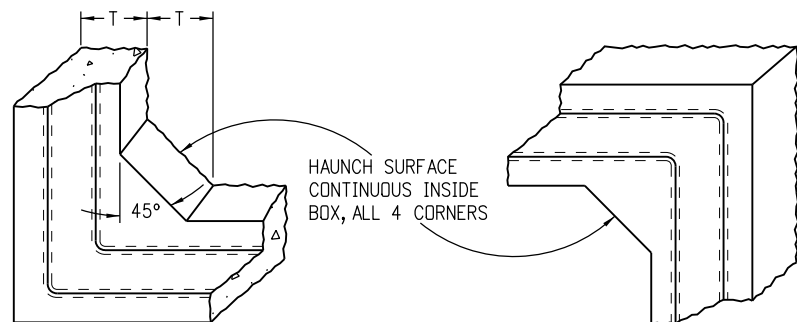
■ GROUT OR FOAM SEALANT SHALL BE USED WHEN SPECIFIED ON THE PLANS.



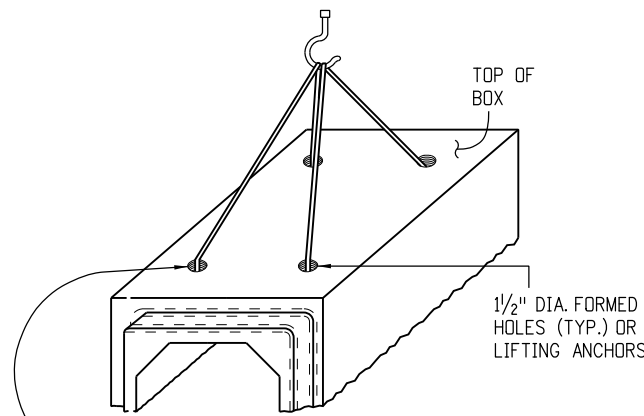
NOSE ANGLE DETAIL
SEE STANDARD PLANS M-601-2, AND 3 TYPICAL AT ADJACENT BOXES DRILL AND GROUT REINFORCING BARS (TYP.)



TYPICAL JOINT

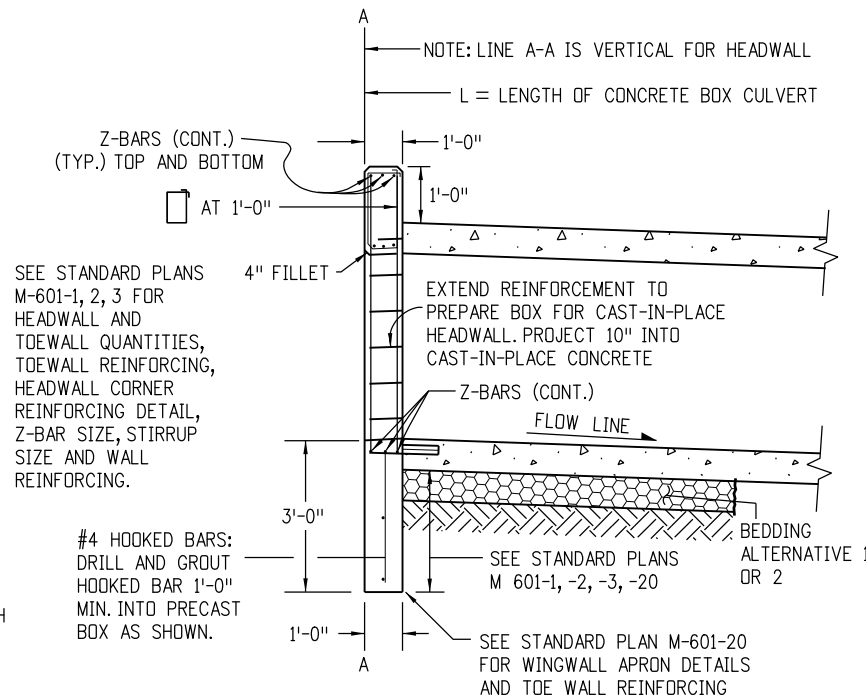


CORNERS

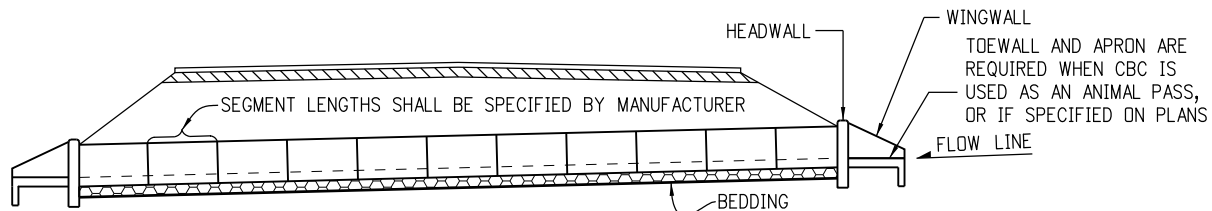


LIFTING

LIFTING HOLES (LOCATED BY MFR.) SHALL BE FILLED WITH GROUT BEFORE BACKFILLING IS STARTED, (2 HOLES PLACED DIAGONALLY MAY SUFFICE FOR SMALLER BOX SIZES). LIFTING ANCHOR RECESSES MAY NOT BE FILLED.



CULVERT END (WITH HEADWALL)



TYPICAL CULVERT INSTALLATION

GENERAL NOTES

1. PRECAST CONCRETE BOX CULVERT SHALL CONFORM TO THE REQUIREMENTS OF THE FOLLOWING SPECIFICATIONS:

ITEM OR CONDITION	MIN. COVER	AASHTO	EQUIV. ASTM
2 FT. OR MORE COVER	2 FT.	M 259, TABLE 2	C 1433, TABLE 2
LESS THAN 2 FT. COVER	0 FT.	M 273, TABLE 2	C 1433, TABLE 2
PREFORMED JOINT MATERIAL	—	M 198, 6.1 OR 6.2	C 990, 6.1 OR 6.2
SPAN 20 FT. OR MORE	0 FT.	—	C 1577

THE SPECIFICATIONS LISTED ABOVE SHOW REINFORCING PLACEMENT, EARTH COVER AND OTHER DETAILS NEEDED TO MANUFACTURE THE BOX CULVERTS.

THE DESIGN FOR A PRECAST CONCRETE BOX WITH A SPAN LARGER THEN 12 FT. SHALL BE PROVIDED BY THE MANUFACTURER.

2. THE CONTRACTOR SHALL SUBMIT TWO SETS OF WORKING DRAWINGS TO THE ENGINEER FOR INFORMATION ONLY, PRIOR TO FABRICATION.

3. BEDDING ALTERNATIVE 1 OR 2 IS REQUIRED:

BEDDING ALTERNATIVE IS AT THE CONTRACTOR'S OPTION. BEDDING AND EXCAVATION FOR BEDDING WILL NOT BE MEASURED AND PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THE WORK.

BEDDING ALTERNATIVE 1 CONSISTS OF 6 IN. OF AGGREGATE BASE COURSE (CLASS 6) COMPACTED TO NOT LESS THAN 95% MAXIMUM DENSITY DETERMINED IN CONFORMANCE WITH AASHTO T 180.

BEDDING ALTERNATIVE 2 CONSISTS OF AN 3 IN. THICK, MINIMUM, LEAN CONCRETE BASE. CEMENT CONTENT = 250 LBS./CU. YD.

AGGREGATE GRADATION FOR ALTERNATIVE 2 BEDDING:

PASSING 2 IN. SIEVE	—	100%
PASSING NO. 4 SIEVE	—	20% TO 70%
PASSING NO. 200 SIEVE	—	5% TO 15%

4. CBC JOINTS USING RUBBER GASKETS SHALL MEET ASTM C1677.

5. CLASS 1 DRAINAGE GEOTEXTILE SHALL BE COMPLETELY WRAPPED AROUND ALL CBC JOINTS WHICH DO NOT HAVE RUBBER GASKETS. THE GEOTEXTILE SHALL EXTEND A MINIMUM OF 1 FT. ON EACH SIDE OF JOINTS AND SHALL OVERLAP AND BE SECURELY ATTACHED FOR AT LEAST 1 FT. AT ITS ENDS. THE WRAP SHALL BE A SMOOTH FIT (NOT LOOSE OR STRETCHED) JUST PRIOR TO BACKFILL. THE GEOTEXTILE MATERIAL SHALL MEET THE APPLICABLE REQUIREMENTS OF SECTION 420. COST FOR GEOTEXTILE WILL NOT BE MEASURED AND PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THE WORK.

6. FOR ANY CULVERT SPAN 20 FT. OR GREATER, A FOUNDATION INVESTIGATION AND REPORT ARE REQUIRED. A LOAD-AND-RESISTANCE FACTOR DESIGN (LRFD) IS REQUIRED USING ASTM C 1577.

7. THE CONTRACTOR HAS THE OPTION OF PROVIDING A CBC WHICH MEETS ASTM C 1577 FOR SPANS LESS THAN 20 FT.

8. SEE M-601-1, 2, AND 3 FOR CAST-IN-PLACE CONCRETE BOX CULVERT DETAILS.

LEGEND

	STRUCTURE EXCAVATION LIMITS
	STRUCTURE BACKFILL, (CLASS 1)
	EMBANKMENT MATERIAL
	EARTH
	BEDDING
	CONCRETE

Computer File Information

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Colorado Department of Transportation
2829 West Howard Place
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Project Development Branch JBK

PRECAST CONCRETE BOX CULVERT

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-603-3

Standard Sheet No. 1 of 1

Project Sheet Number:

LEGEND

H = MAXIMUM ALLOWABLE HEIGHT OF COVER OVER THE TOP OF THE PIPE, EXCLUDING PAVEMENT THICKNESS.

FILL HEIGHTS AND DESIGN ASSUMPTIONS ARE BASED ON AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 4TH EDITION, SECTION 12, FOR 900 PSI LONG TERM STRENGTH OF HDPE, AND AASHTO T180 MINIMUM RELATIVE COMPACTION OF 95% OR 90%.

FILL HEIGHTS ARE BASED ON AASHTO M294 FOR POLYETHYLENE AND AASHTO M330 FOR POLYPROPYLENE, TYPE S PIPES WITH OUTER, CORRUGATED WALLS AND SMOOTH INNER LINEARS.

FILL HEIGHTS, FOR INSTALLATION WITH HIGH WATER TABLE, REQUIRE A SPECIAL DESIGN. THE MAXIMUM HEIGHT IN HIGHWATER LOCATIONS SHOULD BE 15 FEET OR BASED ON AASHTO LRFD DESIGN SPECIFICATIONS.

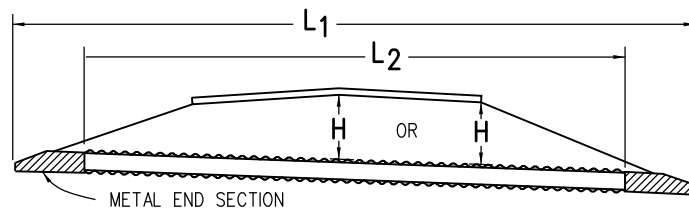
THE MINIMUM COVER SHALL BE AS SHOWN ON THESE TABLES OR CONFORM TO AASHTO REQUIREMENTS, WHICHEVER IS GREATER. THE MINIMUM COVER FOR PIPE IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT: HMA OR PCCP.

THE MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE SUBGRADE DURING CONSTRUCTION. THE MINIMUM COVER IS BASED ON DUAL AXLE LOADS UP TO 50,000 POUNDS.

L₁ = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 624.

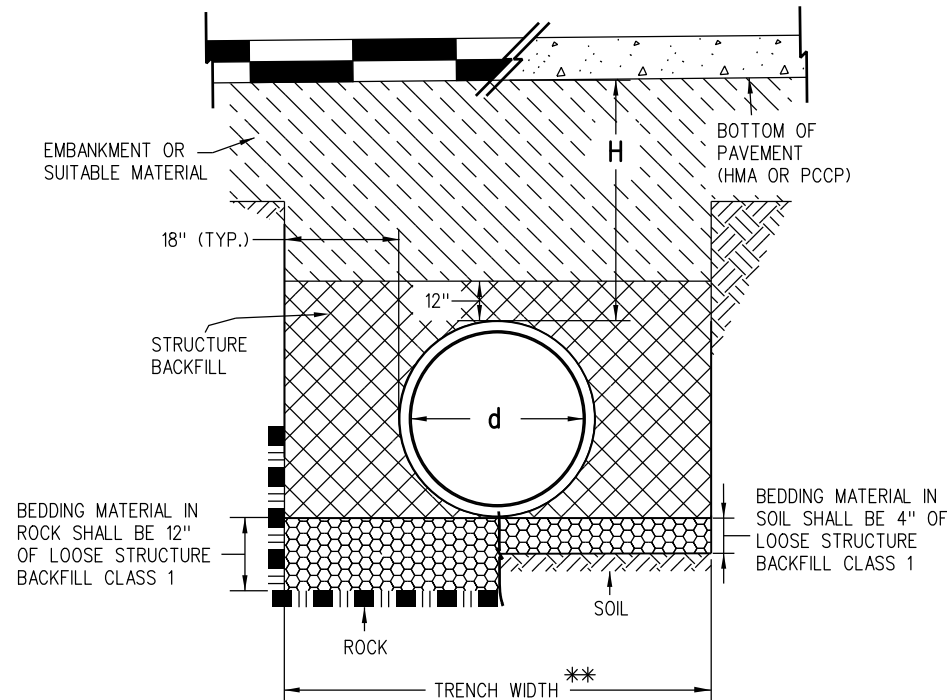
L₂ = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 603.

+ = THE MINIMUM SPACING BETWEEN THE OUTSIDE WALLS OF MULTIPLE PIPES OR END SECTIONS IS 18" OR 1/2(d), WHICHEVER IS GREATER.

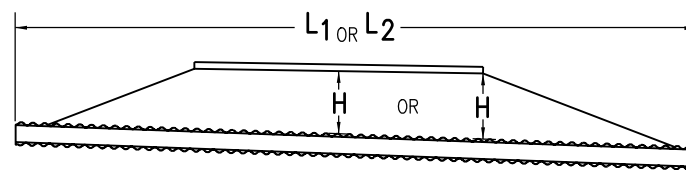


NOTE: USE THE **H** THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

PIPE WITH END SECTIONS

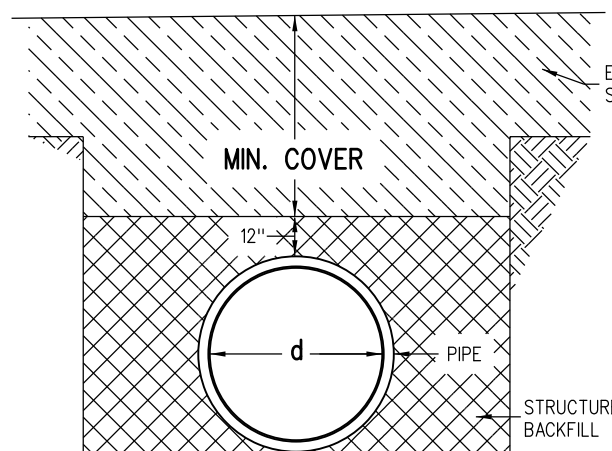


INSTALLATION OF PIPE



NOTE: USE THE **H** THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

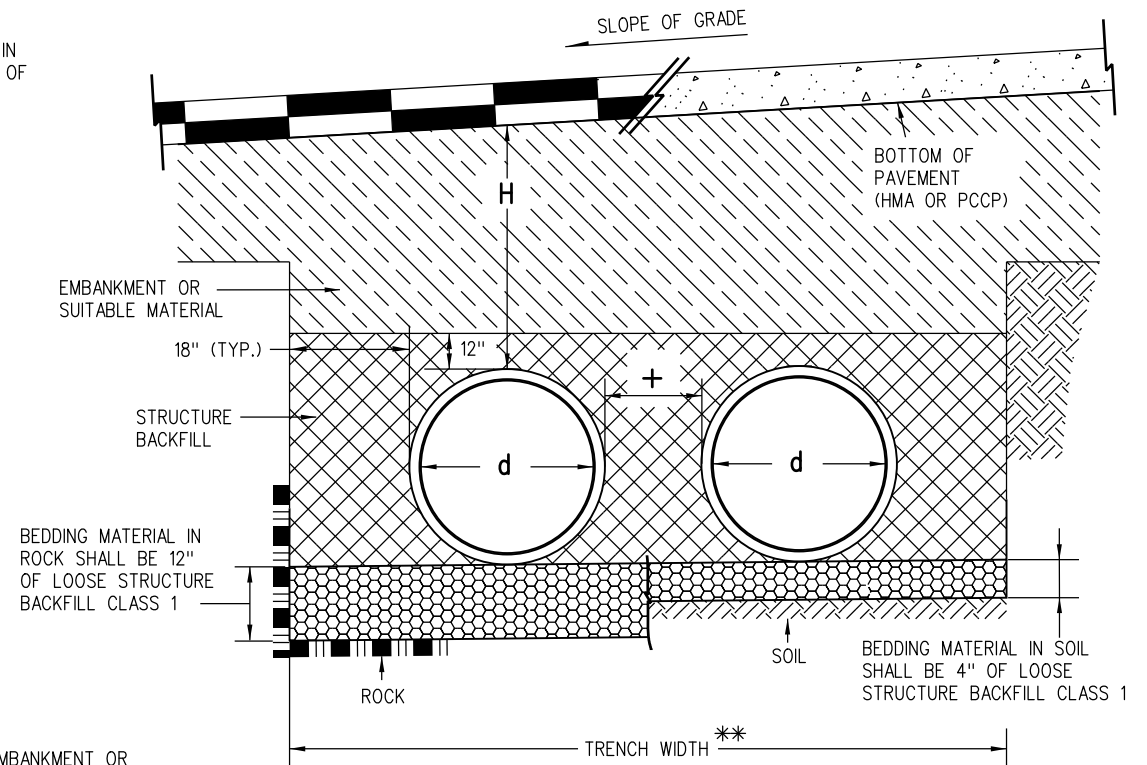
PIPE WITHOUT END SECTIONS



CONSTRUCTION MINIMUM COVER FOR PIPE

GENERAL NOTES

1. ALL PIPES SHALL MEET THE REQUIREMENTS OF AASHTO M294 FOR POLYETHYLENE AND AASHTO M330 FOR POLYPROPYLENE, TYPE S FOR HIGH DENSITY CORRUGATED POLYETHYLENE PIPE (HDPE) AND POLYPROPYLENE PIPE (PP) RESPECTIVELY, WITH SMOOTH INNER SURFACE.
2. WHEN A PIPE IS TO BE EXTENDED, THE SAME PIPE MATERIAL AND SIZE AS IN THE ORIGINAL INSTALLATION SHALL BE USED.
3. MINIMUM COVER SHALL BE PROVIDED DURING CONSTRUCTION TO PROTECT THE PIPE FROM DAMAGE.
4. WHEN INSTALLING A GUARDRAIL OR A SIGN POST DIRECTLY ABOVE A PIPE, THE POST'S BOTTOM MUST BE AT LEAST 1 FOOT ABOVE THE TOP OF THE PIPE. THE HOLE FOR THE POST SHALL BE DRILLED INTO THE SOIL.
5. STRUCTURE BACKFILL MATERIAL SHALL BE CLASS 1.
6. FOR PIPES 24 INCHES OR LESS IN DIAMETER, H MIN. MAY BE REDUCED TO ONE FOOT FOR LOW VOLUME APPROACH ROADS NOT ON STATE HIGHWAYS.



INSTALLATION OF MULTIPLE PIPES

** TRENCH WIDTH ASSUMES STABLE IN-SITU SIDE WALL

PIPE DIAMETER, d (IN.)	H MINIMUM HEIGHT OF COVER (FT.)		H MAXIMUM HEIGHT OF COVER (FT.)			
	95% COMPACTION	90% COMPACTION	95% COMPACTION	90% COMPACTION	95% COMPACTION	90% COMPACTION
12	2	2	27	25	19	17
15	2	2	29	27	20	20
18	2	2	24	23	17	17
24	2	2	21	20	15	14
30	2	2	18	23	12	17
36	2	2	20	20	13	14
42	2	2	19	18	13	13
48	3	2	17	20	12	13
60	3	2.5	20	21	13	14

NOTE: THE VALUES FOR POLYPROPYLENE PIPES (AASHTO M330) ARE SHOWN IN ITALICS.

MINIMUM AND MAXIMUM COVER

NOMINAL PIPE DIAMETER (IN.)	MINIMUM COVER (IN.) FOR INDICATED AXLE LOADS (KIPS)			
	18.0-50.0	50.0-75.0	75.0-110.0	110.0-150.0
24 - 36	24.0	30.0	36.0	36.0
42 - 48	36.0	36.0	42.0	48.0
54 - 60	36.0	36.0	42.0	48.0

AASHTO MINIMUM COVER FOR CONSTRUCTION LOADS

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(R-X)	
(R-X)	
(R-X)	

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Project Development Branch

JBK

CORRUGATED
 POLYETHYLENE PIPE (AASHTO M294)
 AND
 POLYPROPYLENE PIPE (AASHTO M330)

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-603-4

Standard Sheet No. 1 of 1

Project Sheet Number:

LEGEND

H = MAXIMUM ALLOWABLE HEIGHT OF COVER OVER THE TOP OF THE PIPE, EXCLUDING PAVEMENT THICKNESS.

FILL HEIGHTS ARE BASED ON AASHTO M304 POLYVINYL CHLORIDE (PVC) PIPE WITH OUTER, RIBBED WALL AND SMOOTH INNER WALL, AND ON AASHTO T180 MINIMUM RELATIVE COMPACTION OF 95% OR 90%.

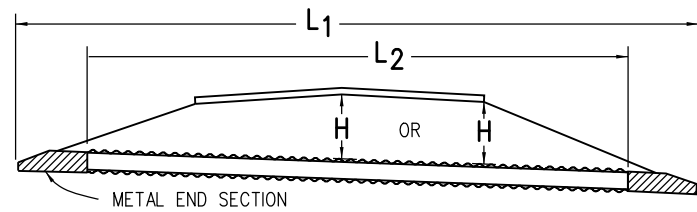
FILL HEIGHTS, FOR INSTALLATION WITH HIGH WATER TABLE, REQUIRE A SPECIAL DESIGN. THE MAXIMUM HEIGHT IN HIGHWATER LOCATIONS SHOULD BE 15 FEET OR BASED ON AASHTO LRFD DESIGN SPECIFICATIONS.

THE MINIMUM COVER SHALL BE AS SHOWN ON THESE TABLES OR CONFORM TO AASHTO REQUIREMENTS, WHICHEVER IS GREATER. THE MINIMUM COVER FOR PIPE IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT: HMA OR PCCP.

THE MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE SUBGRADE DURING CONSTRUCTION. THE MINIMUM COVER IS BASED ON DUAL AXLE LOADS UP TO 50,000 POUNDS.

L₁ = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 624.

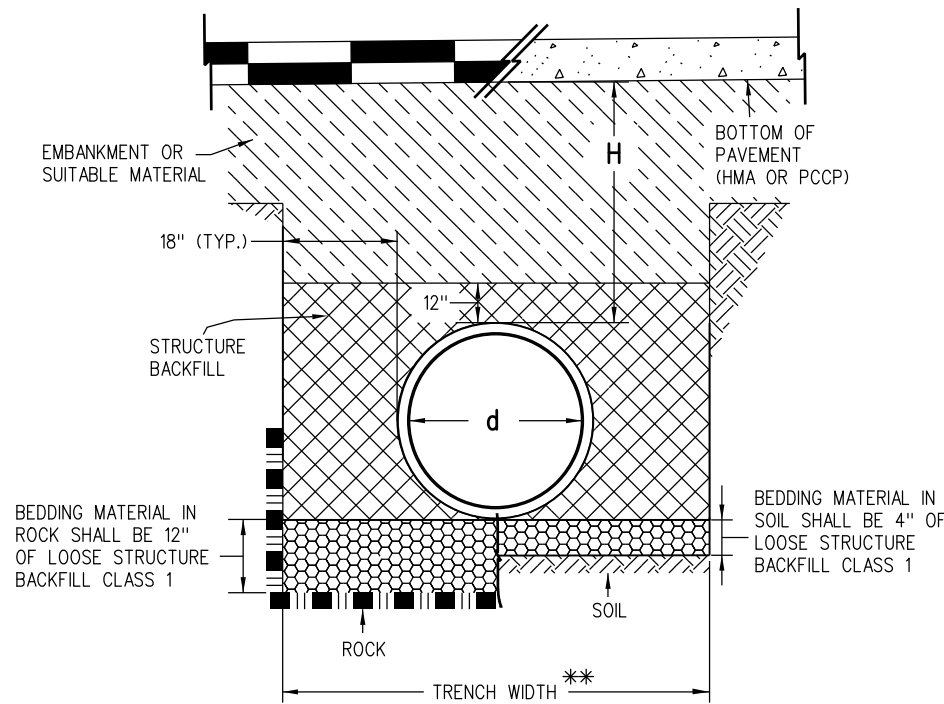
L₂ = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 603.



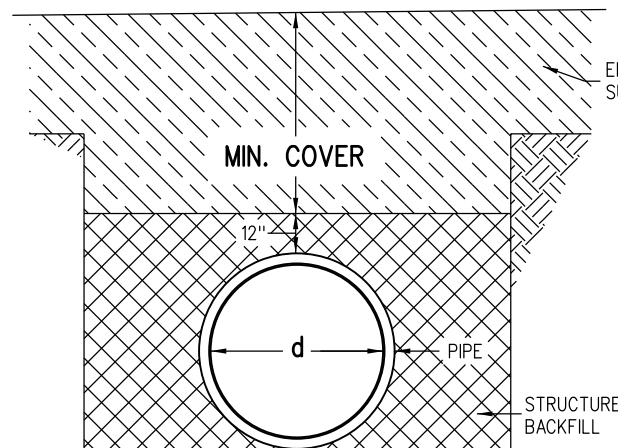
PIPE WITH END SECTIONS

PIPE DIAMETER, d (IN.)	H MINIMUM HEIGHT OF COVER (FT.)	H MAXIMUM HEIGHT OF COVER (FT.)	
		95% COMPACTION	90% COMPACTION
12	2	65	55
15	2	59	51
18	2	63	53
21	2	58	49
24	2	58	49
30	2	56	47
36	2	56	47

MINIMUM AND MAXIMUM COVER



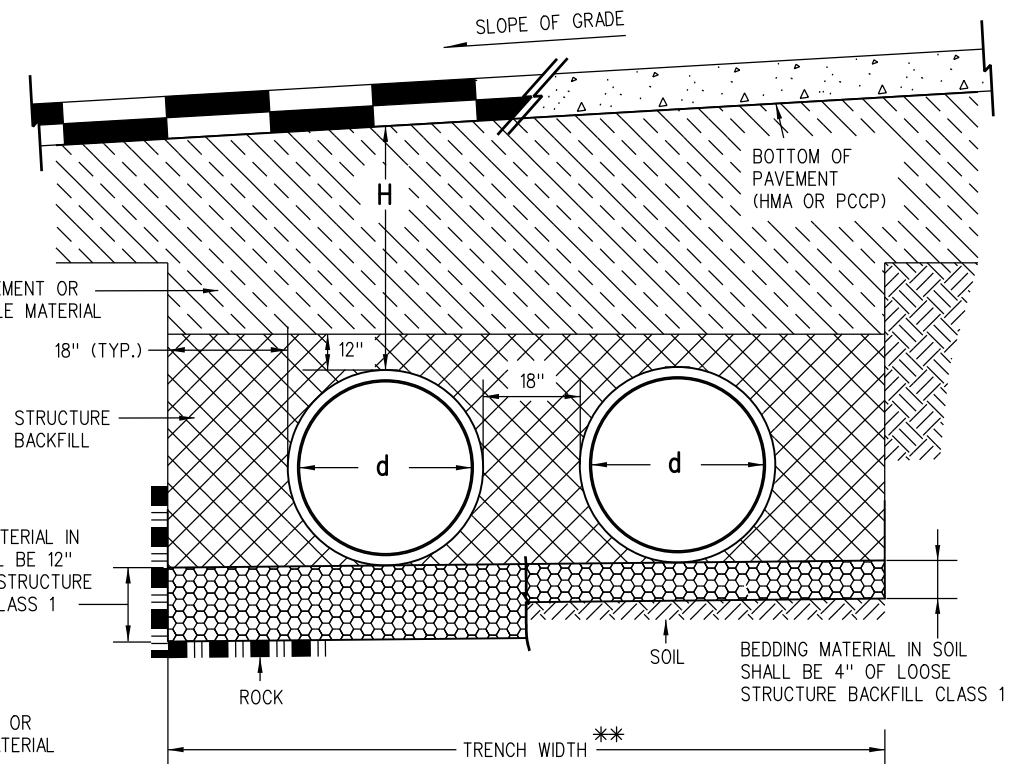
INSTALLATION OF PIPE



CONSTRUCTION MINIMUM COVER FOR PIPE

GENERAL NOTES

1. ALL PIPES SHALL MEET THE REQUIREMENTS OF AASHTO M304 FOR POLYVINYL CHLORIDE (PVC) PROFILE WALL DRAIN PIPE WITH 46 PSI WALL STIFFNESS PER ASTM F949.
2. FOR PIPES WITH DIAMETERS OF 15 INCHES OR LESS, SOLID WALL PVC PIPES MEETING AASHTO M278 MAY BE USED.
3. WHEN A PIPE IS TO BE EXTENDED, THE SAME PIPE MATERIAL AND SIZE AS IN THE ORIGINAL INSTALLATION SHALL BE USED.
4. MINIMUM COVER SHALL BE PROVIDED DURING CONSTRUCTION TO PROTECT THE PIPE FROM DAMAGE.
5. WHEN INSTALLING A GUARDRAIL OR A SIGN POST DIRECTLY ABOVE A PIPE, THE POST'S BOTTOM MUST BE AT LEAST 1 FOOT ABOVE THE TOP OF THE PIPE. THE HOLE FOR THE POST SHALL BE DRILLED INTO THE SOIL.
6. STRUCTURE BACKFILL MATERIAL SHALL BE CLASS 1.
7. FOR PIPES 24 INCHES OR LESS IN DIAMETER, H MIN. MAY BE REDUCED TO ONE FOOT FOR LOW VOLUME APPROACH ROADS NOT ON STATE HIGHWAYS.



INSTALLATION OF MULTIPLE PIPES

** TRENCH WIDTH ASSUMES STABLE IN-SITU SIDE WALL

NOMINAL PIPE DIAMETER (IN.)	MINIMUM COVER (IN.) FOR INDICATED AXLE LOADS (KIPS)			
	18.0-50.0	50.0-75.0	75.0-110.0	110.0-150.0
24 - 36	24.0	30.0	36.0	36.0

AASHTO MINIMUM COVER FOR CONSTRUCTION LOADS

Computer File Information

Creation Date: 07/31/19
 Designer Initials: JBK
 Last Modification Date: 07/31/19
 Detailer Initials: LTA
 CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English

Sheet Revisions

Date:	Comments
(R-X)	
(R-X)	
(R-X)	
(R-X)	

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 Project Development Branch **JBK**

POLYVINYL CHLORIDE (PVC) PIPE (AASHTO M304)

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

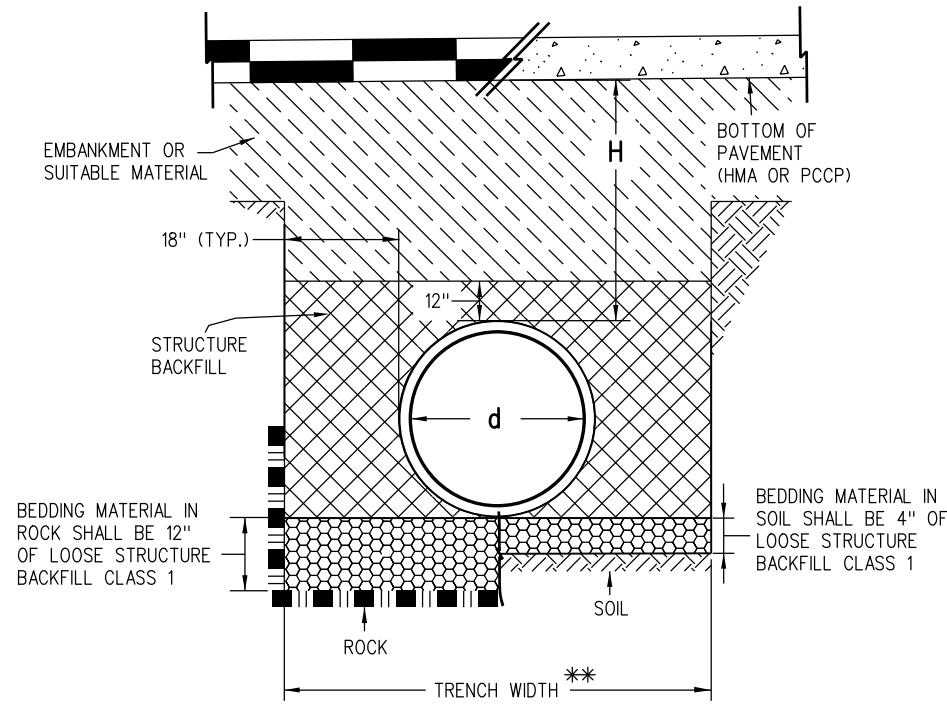
M-603-5

Standard Sheet No. 1 of 1

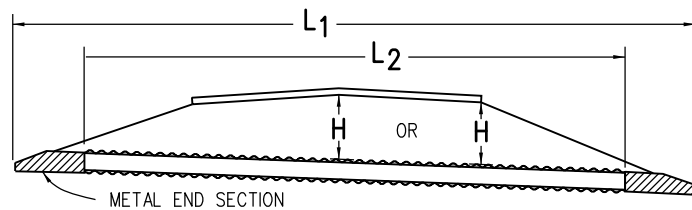
Project Sheet Number:

LEGEND

- H** = MAXIMUM ALLOWABLE HEIGHT OF COVER OVER THE TOP OF THE PIPE, EXCLUDING PAVEMENT THICKNESS.
- FILL HEIGHTS AND DESIGN ASSUMPTIONS ARE BASED ON AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 7TH EDITION, SECTION 12.7.
- FILL HEIGHTS ARE BASED ON AASHTO MP 20, TYPE S PIPES WITH RIBBED REINFORCED STEEL WALLS.
- FILL HEIGHTS FOR INSTALLATION WITH HIGH WATER TABLE REQUIRE A SPECIAL DESIGN.
- THE MINIMUM COVER SHALL BE AS SHOWN ON THESE TABLES OR CONFORM TO AASHTO REQUIREMENTS, WHICHEVER IS GREATER. THE MINIMUM COVER FOR PIPE IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT: HMA OR PCCP.
- THE MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE SUBGRADE DURING CONSTRUCTION. THE MINIMUM COVER IS BASED ON DUAL AXLE LOADS UP TO 50,000 POUNDS.
- L₁** = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 624.
- L₂** = LENGTH OF PIPE TO BE MEASURED WHEN PLACED IN ACCORDANCE WITH SECTION 603.
- +** = THE MINIMUM SPACING BETWEEN THE OUTSIDE WALLS OF MULTIPLE PIPES OR END SECTIONS IS 18" OR d/2, WHICHEVER IS GREATER.

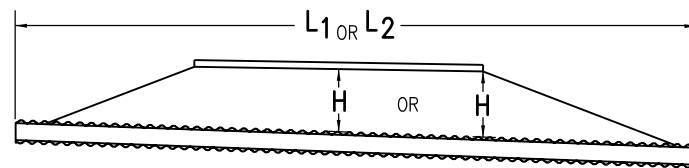


INSTALLATION OF PIPE



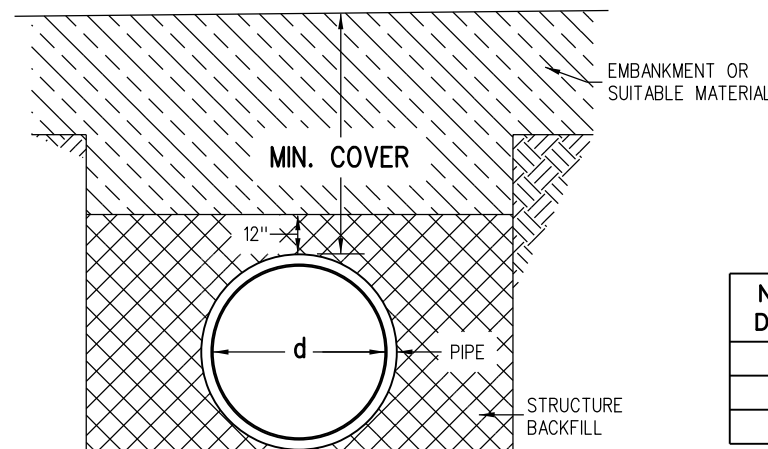
NOTE: USE THE H THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

PIPE WITH END SECTIONS



NOTE: USE THE H THAT IS GREATER FOR MAXIMUM ALLOWABLE FILL HEIGHT.

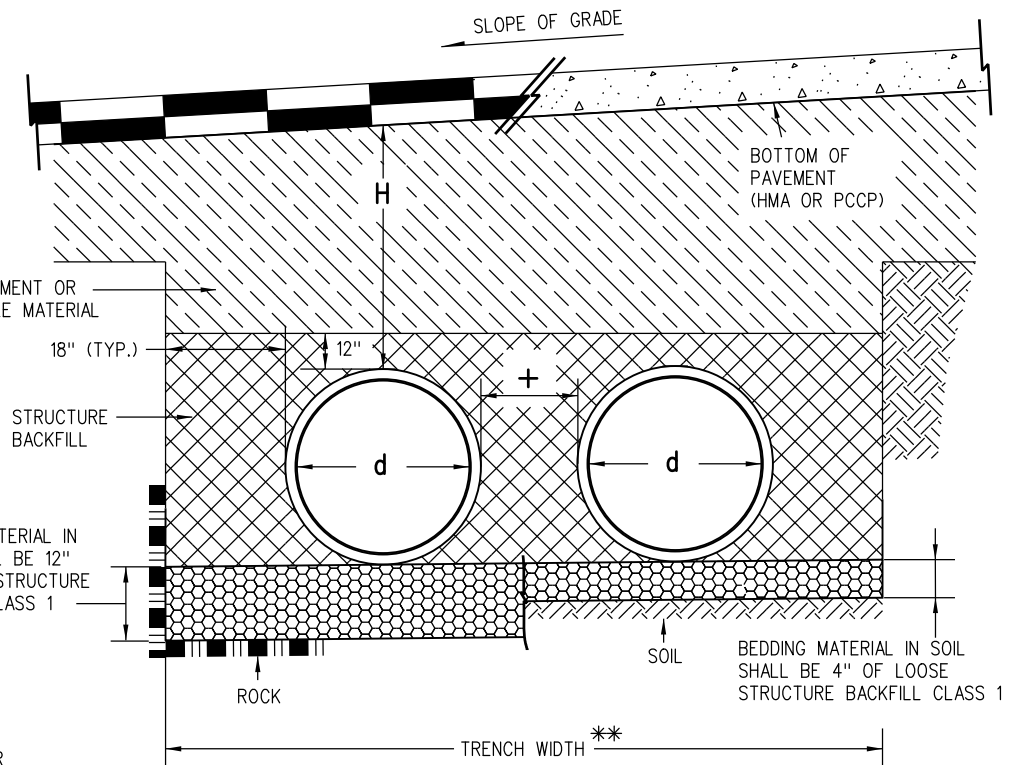
PIPE WITHOUT END SECTIONS



CONSTRUCTION MINIMUM COVER FOR PIPE

GENERAL NOTES

1. ALL PIPES SHALL MEET THE REQUIREMENTS OF AASHTO MP 20 FOR STEEL REINFORCED, POLYETHYLENE, TYPE S RIBBED PIPE WITH SMOOTH INNER SURFACE. INSTALLATION SHALL CONFORM TO AASHTO LRFD BRIDGE CONSTRUCTION SPECIFICATIONS, 3RD EDITION, SECTION 26.
2. WHEN A PIPE IS TO BE EXTENDED, THE SAME PIPE MATERIAL AND SIZE AS IN THE ORIGINAL INSTALLATION SHALL BE USED.
3. MINIMUM COVER SHALL BE PROVIDED DURING CONSTRUCTION TO PROTECT THE PIPE FROM DAMAGE.
4. WHEN INSTALLING A GUARDRAIL OR A SIGN POST DIRECTLY ABOVE A PIPE, THE POST'S BOTTOM MUST BE AT LEAST 1 FOOT ABOVE THE TOP OF THE PIPE. THE HOLE FOR THE POST SHALL BE DRILLED INTO THE SOIL.
5. STRUCTURE BACKFILL MATERIAL SHALL BE CLASS 1.



INSTALLATION OF MULTIPLE PIPES

** TRENCH WIDTH ASSUMES STABLE IN-SITU SIDE WALL

PIPE DIAMETER, d (IN.)	H MINIMUM HEIGHT OF COVER (FT.)	H MAXIMUM HEIGHT* OF COVER (FT.)
30	2	50
36	2	50
42	2	50
48	2	30
54	2	30
60	2.5	30

* A MANUFACTURER'S CERTIFICATION OF MAXIMUM ALLOWABLE FILL HEIGHT IS REQUIRED PRIOR TO INSTALLATION.

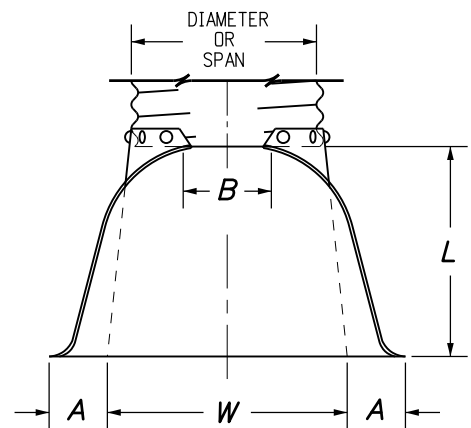
MINIMUM AND MAXIMUM COVER

NOMINAL PIPE DIAMETER (IN.)	MINIMUM COVER (IN.) FOR INDICATED AXLE LOADS (KIPS)			
	18.0-50.0	50.0-75.0	75.0-110.0	110.0-150.0
30 - 36	24.0	30.0	36.0	36.0
42 - 48	36.0	36.0	42.0	48.0
54 - 60	36.0	36.0	42.0	48.0

AASHTO MINIMUM COVER FOR CONSTRUCTION LOADS

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	STEEL REINFORCED POLYETHYLENE RIBBED PIPE (AASHTO MP 20)	STANDARD PLAN NO.
Creation Date: 07/31/19		Date:	Comments			M-603-6
Designer Initials: JBK	(R-X)					Standard Sheet No. 1 of 1
Last Modification Date: 07/31/19	(R-X)					
Detailer Initials: LTA	(R-X)					
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)			JBK	Issued by the Project Development Branch: July 31, 2019	Project Sheet Number:

PIPE DIA.	THICKNESS	DIMENSIONS					
		A	B	H	L	W	T
IN.							
12	0.064	6	6	6	21	24	34
18	0.064	8	10	6	31	36	46
21	0.064	9	12	6	36	42	52
24	0.064	10	13	6	41	48	58
30	0.079	12	16	8	51	60	70
36	0.079	14	19	9	60	72	94
42	0.109	16	22	11	69	84	106
48	0.109	18	27	12	78	90	112
54	0.109	18	30	12	84	102	124
60	0.109	18	33	12	87	114	136
66	0.109	18	36	12	87	120	142
72	0.109	18	39	12	87	126	148
78	0.109	18	42	12	87	132	154
84	0.109	18	45	12	87	138	160



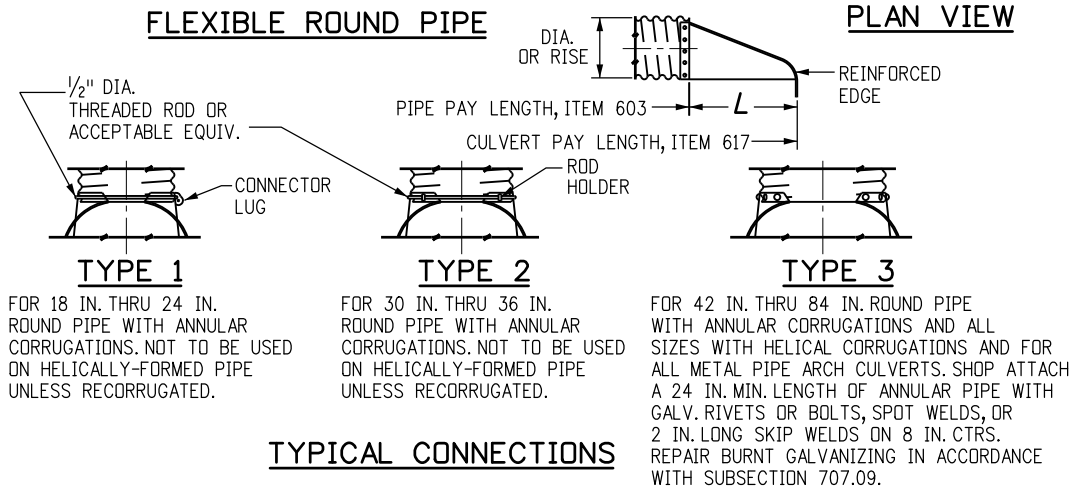
PIPE ARCH	THICKNESS	DIMENSIONS					
		A	B	H	L	W	T
IN.							
21 x 15	0.064	7	10	6	23	36	46
24 x 18	0.064	8	12	6	28	42	52
28 x 20	0.064	9	14	6	32	48	58
35 x 24	0.079	10	16	6	39	60	70
42 x 29	0.079	12	18	8	46	75	85
49 x 33	0.109	13	21	9	53	85	103
57 x 38	0.109	18	26	12	63	90	108
64 x 43	0.109	18	30	12	70	102	120
71 x 47	0.109	18	33	12	77	114	132

FLEXIBLE PIPE ARCH

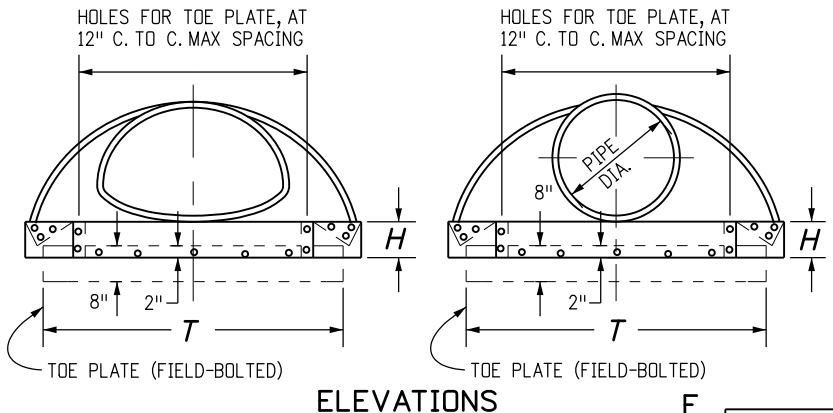
GENERAL NOTES

1. DIMENSIONS OF END SECTIONS MAY VARY SLIGHTLY FROM THOSE SHOWN ON THE TABLES DUE TO DIFFERENT MANUFACTURERS' CONFIGURATIONS.
2. CONCRETE END SECTIONS SHALL BE FURNISHED WITH TONGUE OR GROOVE AS REQUIRED.
3. DESIGN LENGTH OF PIPE OR SIDE DRAIN IS BASED ON LENGTH OF END SECTION SHOWN IN TABLE. ANY ADDITIONAL PIPE REQUIRED TO PROVIDE THE DESIGN LENGTH SHALL BE FURNISHED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE PROJECT.
4. THE INSIDE CONFIGURATION AND THE JOINT OF CONCRETE END SECTION AND PIPE SHALL MATCH.
5. END SECTIONS FOR CMP ARCH PIPE SHALL MATCH THE DIMENSIONS OF THE PIPE SHOWN ON THE PLANS.
6. GALVANIZED TOE PLATE AS SHOWN IS REQUIRED ON END SECTIONS FOR CORRUGATED STEEL PIPE AND SHALL BE THE SAME THICKNESS AS END SECTIONS. TOE PLATE SHALL BE FIELD-BOLTED TO END SECTION WITH $\frac{3}{8}$ " GALVANIZED BOLTS, NUTS AND WASHERS.
7. GALVANIZED STEEL SHALL CONFORM TO AASHTO M 111, M 218 OR M 232.
8. CONCRETE PIPE JOINT FASTENERS, WHERE SHOWN ON PLANS, SHALL BE INSTALLED SO THAT A MINIMUM OF 15 LINEAR FEET OF THE OUTLET END OF THE PIPE ARE MECHANICALLY LOCKED TOGETHER. END SECTION LENGTHS WHEN USED, SHALL BE INCLUDED IN THE 15 LF REQUIREMENT.
9. CONNECTIONS OF METAL END SECTIONS TO PLASTIC PIPE SHALL BE APPROVED BY THE ENGINEER. PLASTIC END SECTIONS SHALL NOT BE USED.
10. THE END SECTION STYLE, EITHER REGULAR OR SAFETY, SHALL BE AS SHOWN ON THE PLANS.
11. AT THE OPTION OF THE CONTRACTOR AND APPROVAL OF THE CDDT PROJECT ENGINEER, REINFORCED CONCRETE END SECTIONS MAY BE MADE WITH SYNTHETIC FIBERS INSTEAD OF STEEL FOR PIPES 36 INCHES IN DIAMETER AND SMALLER, AND CONFORM TO AASHTO M 86 AND SUBSECTION 601.03.

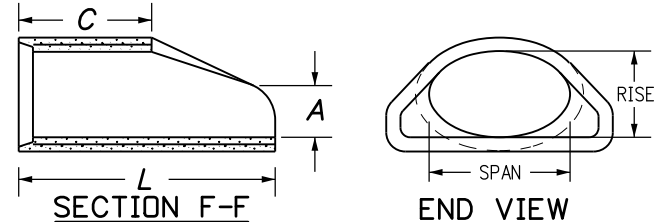
FLEXIBLE ROUND PIPE



PLAN VIEW



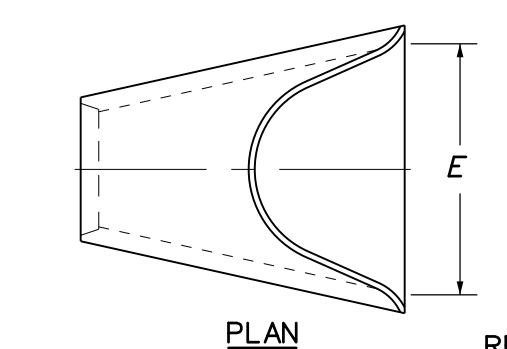
ELEVATIONS



EQUIVALENT CIRCULAR DIA.	DIMENSIONS					
	NOMINAL SPAN x RISE	A	C	L	E	
		IN.				
24	30	19	9	33	72	48
30	38	24	10	18	72	60
36	45	29	12	24	84	72
42	53	34	16	36	96	78
48	60	38	21	36	96	84
54	68	43	26	36	96	90
60	76	48	30	36	96	96

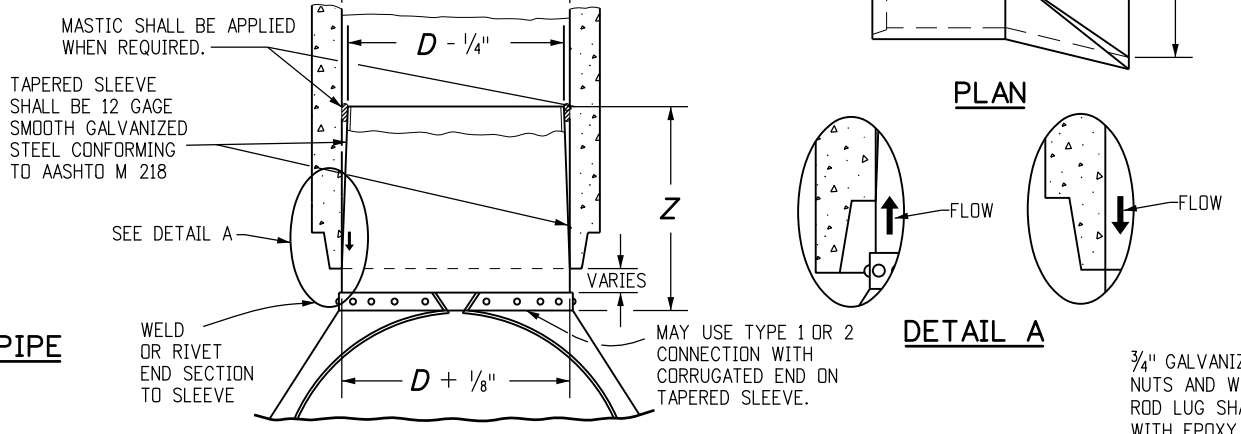
END SECTION FOR REINFORCED CONCRETE ELLIPTICAL PIPE

END SECTION AND CONNECTION DETAILS FOR ROUND AND ARCH METAL PIPES



PIPE I.D.	DIMENSIONS				
	A	C	L	E	
IN.					
18	10	48	78	36	
24	10	48	78	48	
30	14	36	96	60	
36	18	36	96	72	
42	24	36	96	78	
48	28	24	96	84	
54	30	36	96	90	
60	36	36	96	96	
72	34	20	96	108	

REINFORCED CONCRETE CIRCULAR PIPE



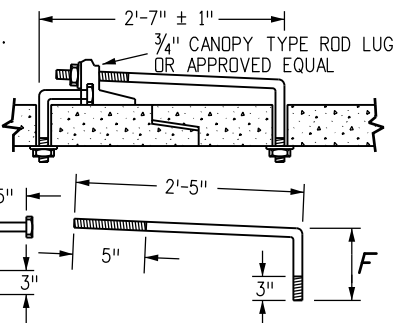
D	Z (MIN.)
IN.	
18 - 24	12
30 AND 36	16
42 AND LARGER	24

STEEL END SECTION FOR CONCRETE CIRCULAR PIPE

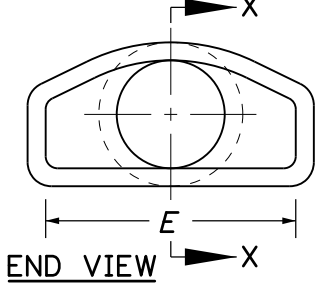
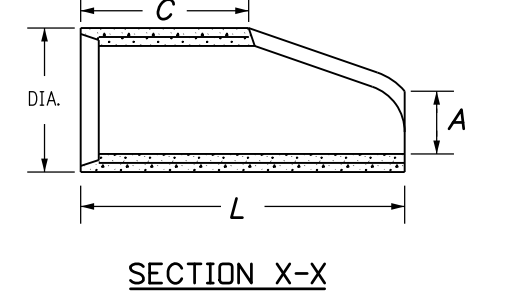
(ALTERNATIVE FOR CONCRETE END SECTION)

PIPE DIAMETER	F
IN.	
18 - 30	5
36 - 42	6
48 - 60	7
72 - 84	9

$\frac{3}{4}$ " GALVANIZED ANCHOR BOLTS, NUTS AND WASHERS, MILD STEEL, ASTM A 307. ROD LUG SHALL BE GALVANIZED OR COATED WITH EPOXY PAINT OR APPROVED EQUAL.



CONCRETE JOINT FASTENER (TWO PER JOINT)



SECTION X-X

END VIEW

END SECTION FOR REINFORCED CONCRETE CIRCULAR PIPE

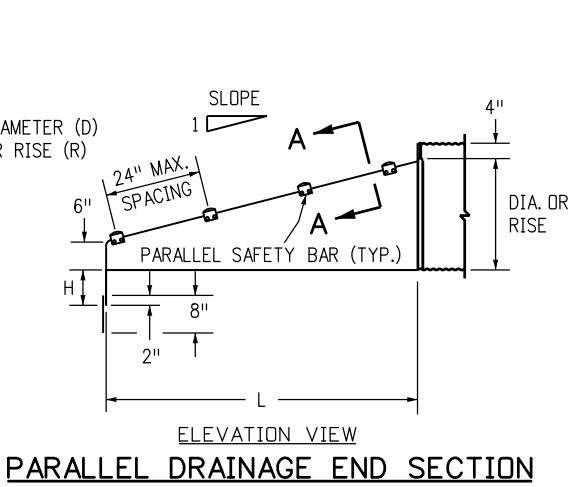
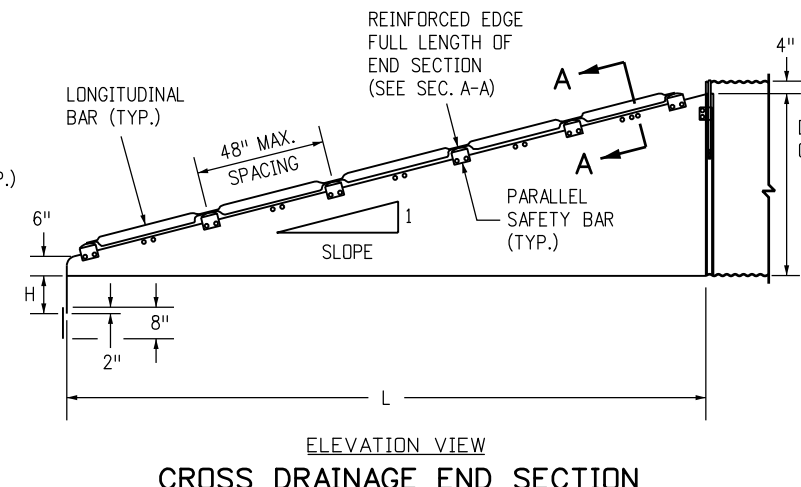
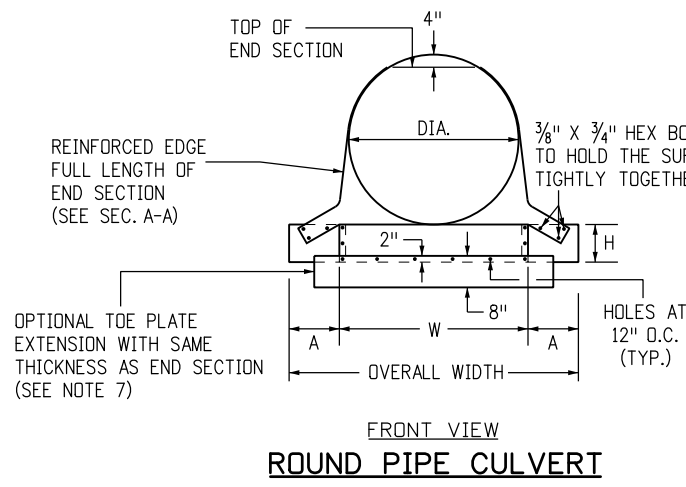
Computer File Information	
Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

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 Project Development Branch JBK

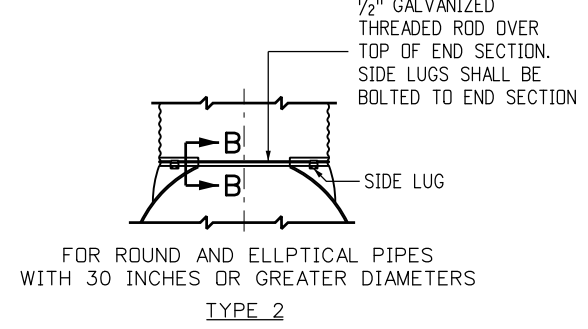
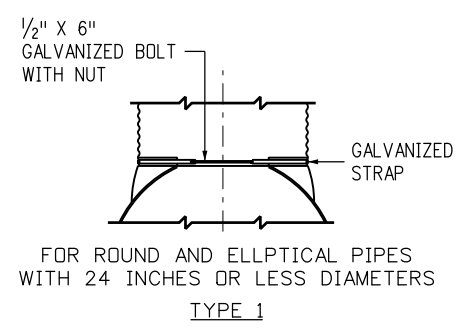
CONCRETE AND METAL END SECTIONS
 Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-603-10
 Standard Sheet No. 1 of 1
 Project Sheet Number:



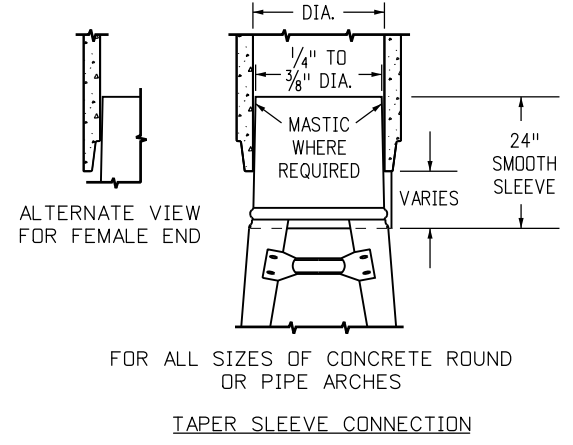
GENERAL NOTES

1. USE END SECTIONS ON 1V:4H TO 1V:6H SLOPES ONLY. USE TOE PLATE EXTENSION WHERE SHOWN ON THE PLANS.
2. FABRICATE SAFETY AND LONGITUDINAL BARS FROM STEEL PIPE CONFORMING TO ASTM A53 SCHEDULE 40 SPECIFICATIONS. GALVANIZE BARS HOT DIPPED AFTER FABRICATION.
3. A LONGITUDINAL BAR IS REQUIRED FOR CROSS DRAINAGE END SECTIONS WHEN THE SPAN IS GREATER THAN 30 INCHES. USE ADDITIONAL LONGITUDINAL BARS IF SPACING EXCEEDS 30 INCHES ON LARGER END SECTIONS.
4. SAFETY AND LONGITUDINAL BARS ARE NOT REQUIRED ON 30 INCHES AND SMALLER CROSS DRAINAGE END SECTIONS.
5. SAFETY BARS ARE NOT REQUIRED ON 18 INCHES AND SMALLER PARALLEL DRAINAGE END SECTIONS.
6. WHEN REQUIRED, TOE PLATE EXTENSIONS SHALL BE THE SAME GAGE AS END SECTIONS. DIMENSIONS SHALL BE OVERALL WIDTH LESS 6 INCHES BY 8 INCHES HIGH.



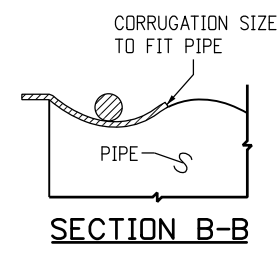
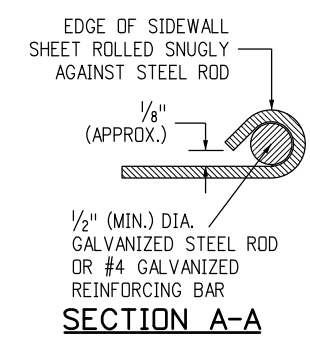
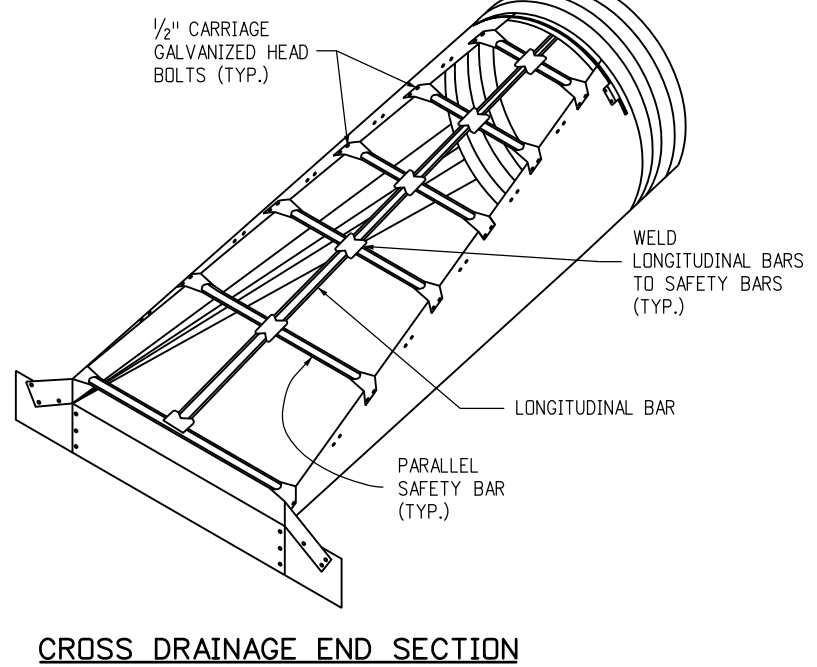
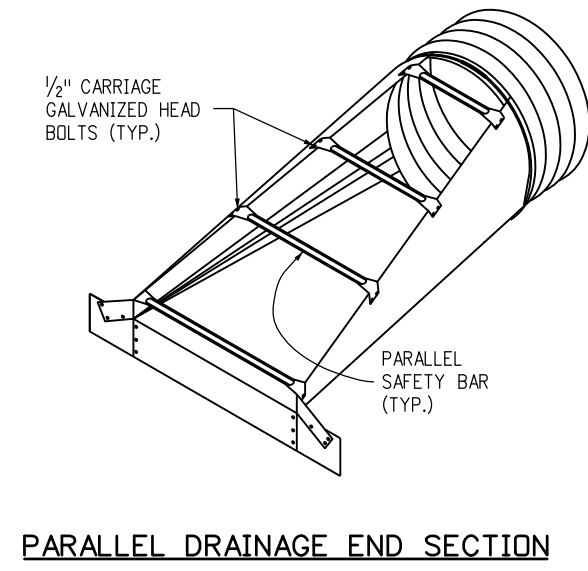
CONNECTOR DETAILS

NOTE: SIZES THRU 24" ATTACH TO PIPE WITH TYPE 1 STRAPS. ALL OTHER SIZES ATTACH WITH TYPE 2 RODS AND LUGS.



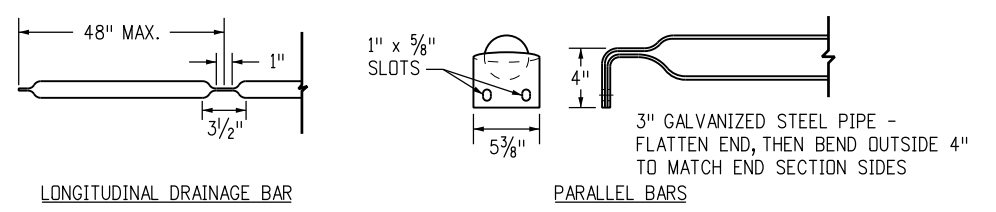
METAL END SECTIONS FOR ROUND PIPE CULVERT

PIPE DIA. SIZE (INCHES)	METAL THICK MIN. (INCH/GAGE)	DIMENSIONS IN INCHES					
		A	H	W	OVERALL WIDTH	L	
						Slope = 4	Slope = 6
18	0.064/16	8	6	24	40	32	47
24	0.064/16	8	6	30	46	55	83
30	0.109/12	12	9	36	60	79	118
36	0.109/12	12	9	42	66	102	154
42	0.109/12	16	12	48	80	126	189
48	0.109/12	16	12	54	86	150	224
54	0.109/12	16	12	60	92	173	260
60	0.109/12	16	12	66	98	197	295



METAL END SECTIONS FOR PIPE ARCH CULVERT

PIPE SIZE (INCHES)			METAL THICK MIN. (INCH/GAGE)	DIMENSIONS (INCHES)					
EQUIV. DIA.	SPAN	RISE		A	H	W	OVERALL WIDTH	L	
								Slope = 4	Slope = 6
18	21	15	0.064/16	8	6	27	43	20	30
24	28	20	0.064/16	8	6	33	49	40	60
30	35	24	0.109/12	12	9	40	64	55	83
36	41	29	0.109/12	12	9	47	71	75	112
42	48	32	0.109/12	16	12	54	86	90	136
48	56	37	0.109/12	16	12	62	94	110	165
54	63	42	0.109/12	16	12	69	101	130	195
60	70	46	0.109/12	16	12	76	107	146	218
72	82	56	0.109/12	16	12	88	120	185	278



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Last Modification Date: 07/31/19
Detailer Initials: LTA
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English

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Date:	Comments
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(R-X)	
(R-X)	

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Project Development Branch **JBK**

TRAVERSABLE END SECTIONS AND SAFETY GRATES

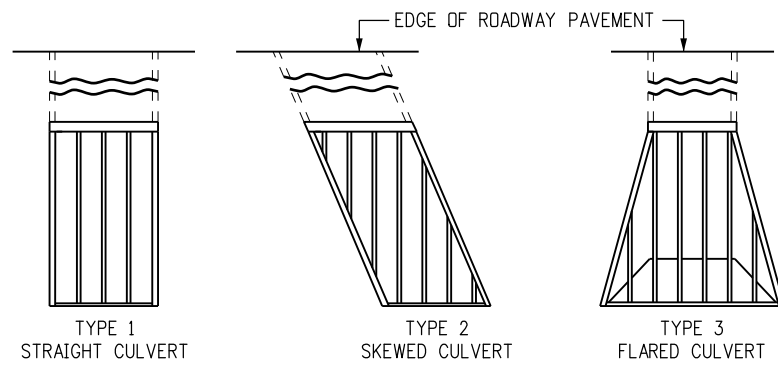
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-603-12

Standard Sheet No. 1 of 3

Project Sheet Number:



TYPE 1
STRAIGHT CULVERT

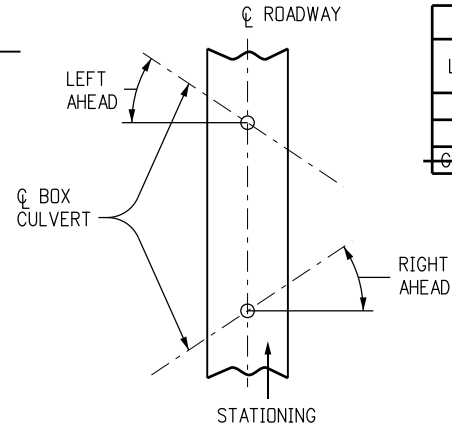
TYPE 2
SKEWED CULVERT

TYPE 3
FLARED CULVERT

TYPE 4
FLARED-SKEWED CULVERT

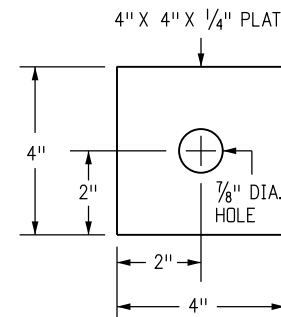
INSTALLATION TYPES

GRATE BARS SHALL BE PERPENDICULAR TO DIRECTION OF TRAFFIC FLOW.

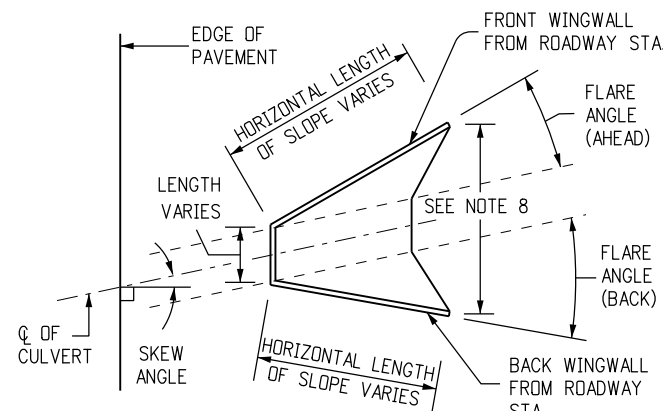


SKEW ANGLE DETERMINATION

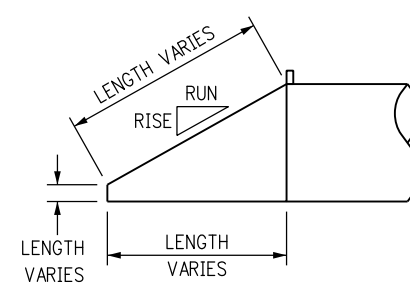
GRATE & CROSS BAR SIZE REQUIREMENTS		
LENGTH OF SPAN	NOMINAL PIPE SIZE (SEE NOTE 7)	O.D. SIZE
LESS THAN 12'	3.0"	3.0"
12' - 16'	3.5"	3.5"
GREATER THAN 16'	4.0"	4.0"



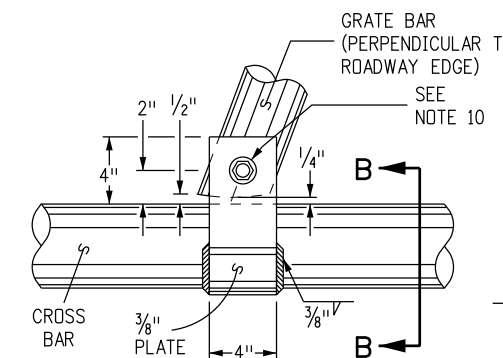
SHIM DETAIL



TOP VIEW

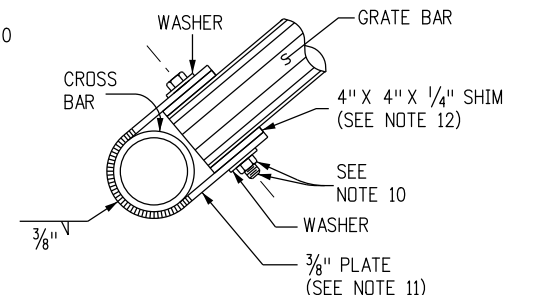


SIDE VIEW

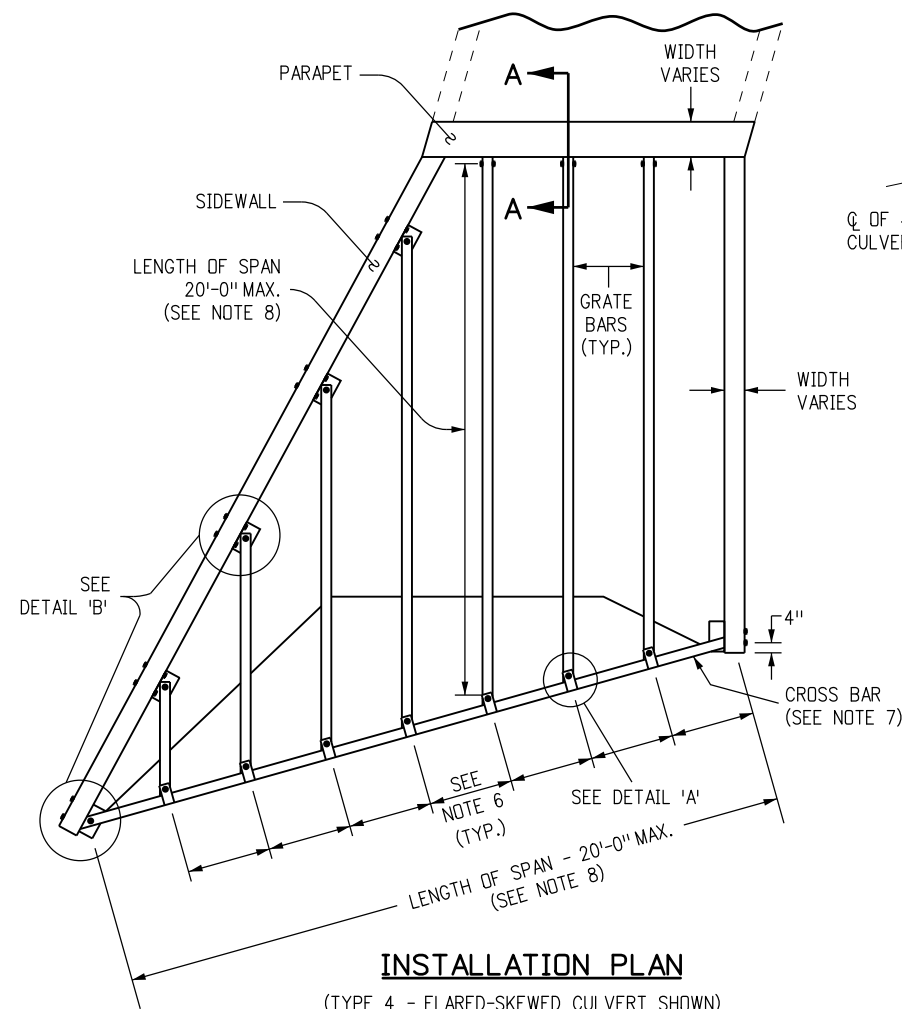


DETAIL "A"

TOP VIEW

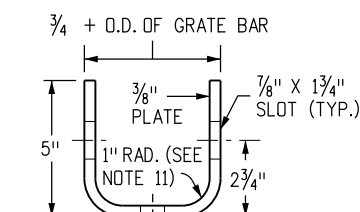


SECTION B-B



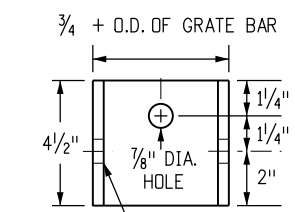
INSTALLATION PLAN

(TYPE 4 - FLARED-SKEWED CULVERT SHOWN)



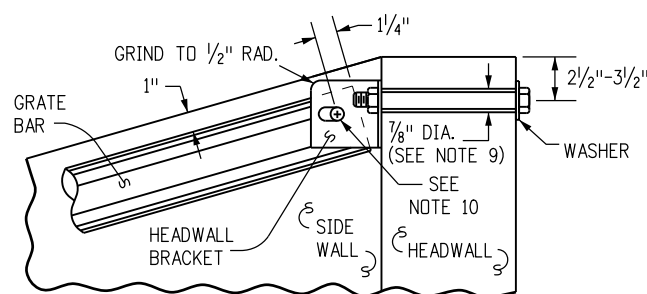
HEADWALL BRACKET

TOP VIEW

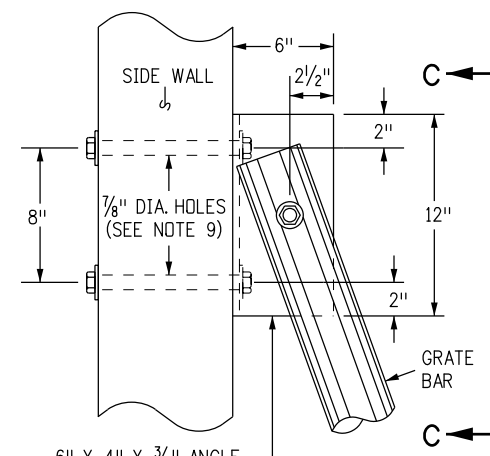


HEADWALL BRACKET

FRONT VIEW

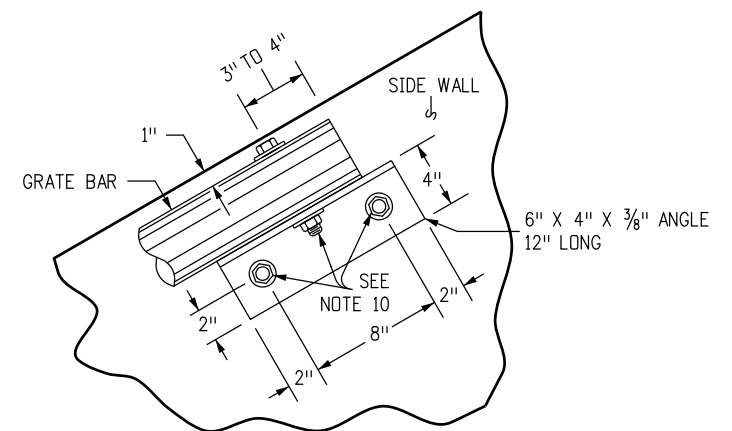


SECTION A-A



DETAIL "B"

TOP VIEW



SECTION C-C

- NOTES**
- SHOP DRAWINGS SHALL BE SUBMITTED PER 105.02
 - HARDWARE SUCH AS BOLTS, WASHERS, AND LOCK NUTS SHALL BE HOT-DIPPED GALVANIZED PER ASTM A123
 - INTENDED FOR USE ON TERRAIN XX SLOPES WITH A CLEAR RUNOUT FOR ERRANT VEHICLES. GUARDRAIL IS THE PREFERRED OPTION ON STEEPER TERRAIN OR WITH HIGHER TRAFFIC VOLUMES
 - MINIMUM SCHEDULE 40 PIPE SHALL BE USED. GALVANIZE ALL PIPES, FITTINGS AND HARDWARE AFTER ALL CUTTING, WELDING, DRILLING, AND FABRICATION.
 - BOTH ENDS OF CULVERT SHALL BE TREATED TO PREVENT DEBRIS FROM ENTERING
 - EQUALLY SPACED 24 INCHES MIN. TO 30 INCHES MAX. FROM EDGE OF SIDEWALL TO CENTER OF BRACKET, OR FROM CENTER TO CENTER OF BRACKET.
 - THE CROSS BAR DIAMETER SHALL BE EQUAL TO OR GREATER THAN THE GRATE BAR DIAMETER.
 - IF MORE THAN 20 FEET THAN A MIDSPAN SUPPORT SHALL BE REQUIRED. SEE SHEETS 3 AND 4.
 - DRILL HOLES USING EQUIPMENT DESIGNED TO CUT THROUGH CONCRETE AND REINFORCING STEEL.
 - A 3/4 INCH BOLT, LOCK NUT AND WASHERS. ALL HOLES ARE TO BE 7/8 INCH IN DIAMETER.
 - BEND PLATES OR STRIPS WITHOUT CRACKING MATERIAL.
 - SHIM THICKNESS EQUALS THE DIFFERENCE IN DIAMETERS OF THE GRATE BAR AND CROSS BAR.

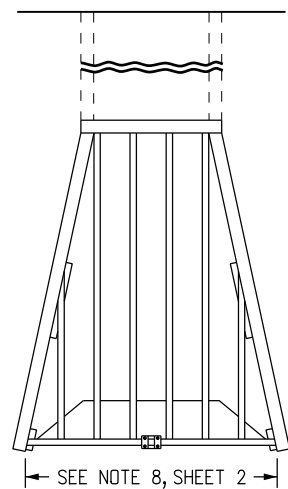
Computer File Information	
Creation Date: 07/31/19	
Designer Initials: JJP	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

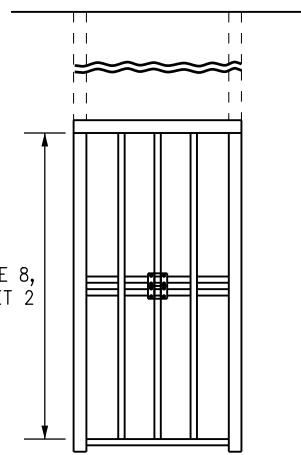
Colorado Department of Transportation
 2829 West Howard Place
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 Denver, CO 80204
 Phone: 303-757-9021 FAX: 303-757-9868
 Project Development Branch JBK

**TRAVERSABLE END SECTIONS
AND SAFETY GRATES**
 Issued by the Project Development Branch: July 31, 2019

**STANDARD PLAN NO.
M-603-12**
Standard Sheet No. 2 of 3
 Project Sheet Number:



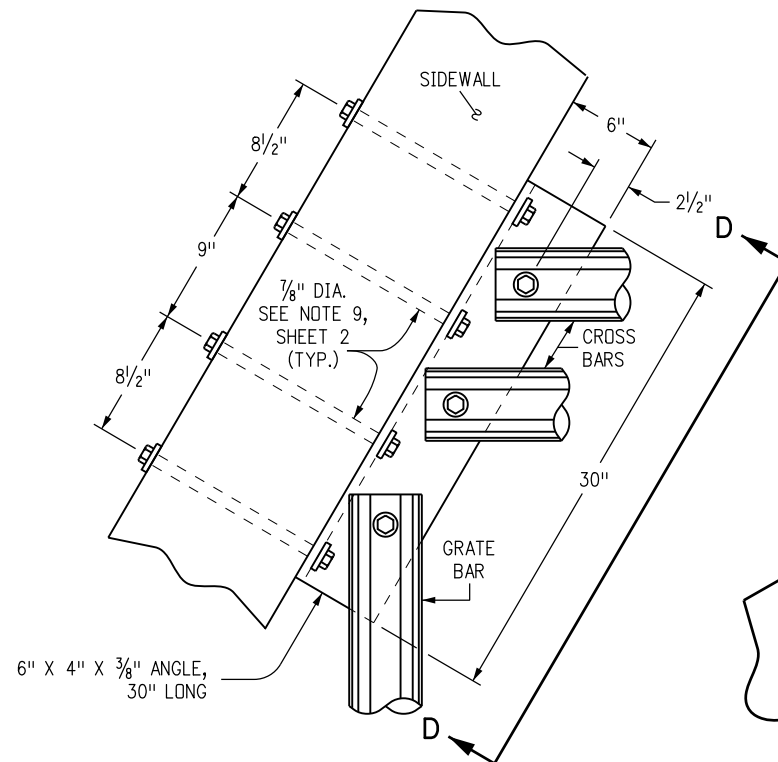
CASE 1



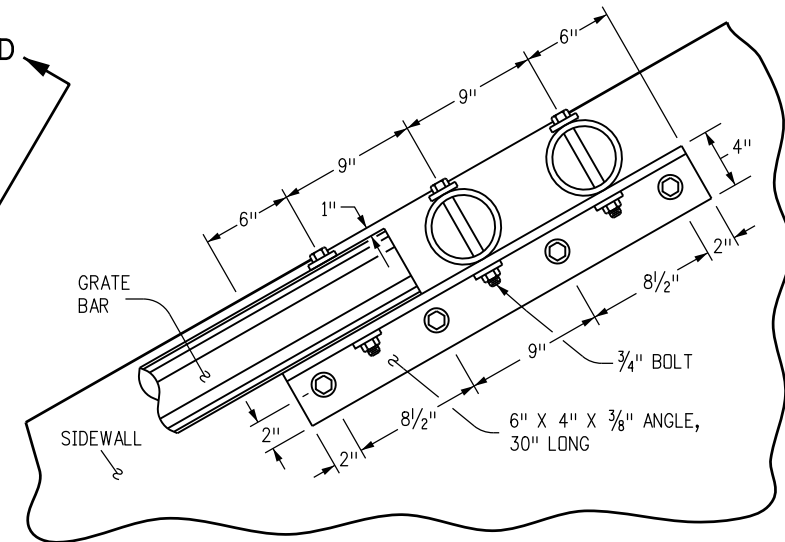
CASE 2

SEE NOTE 8, SHEET 2

SEE NOTE 8, SHEET 2



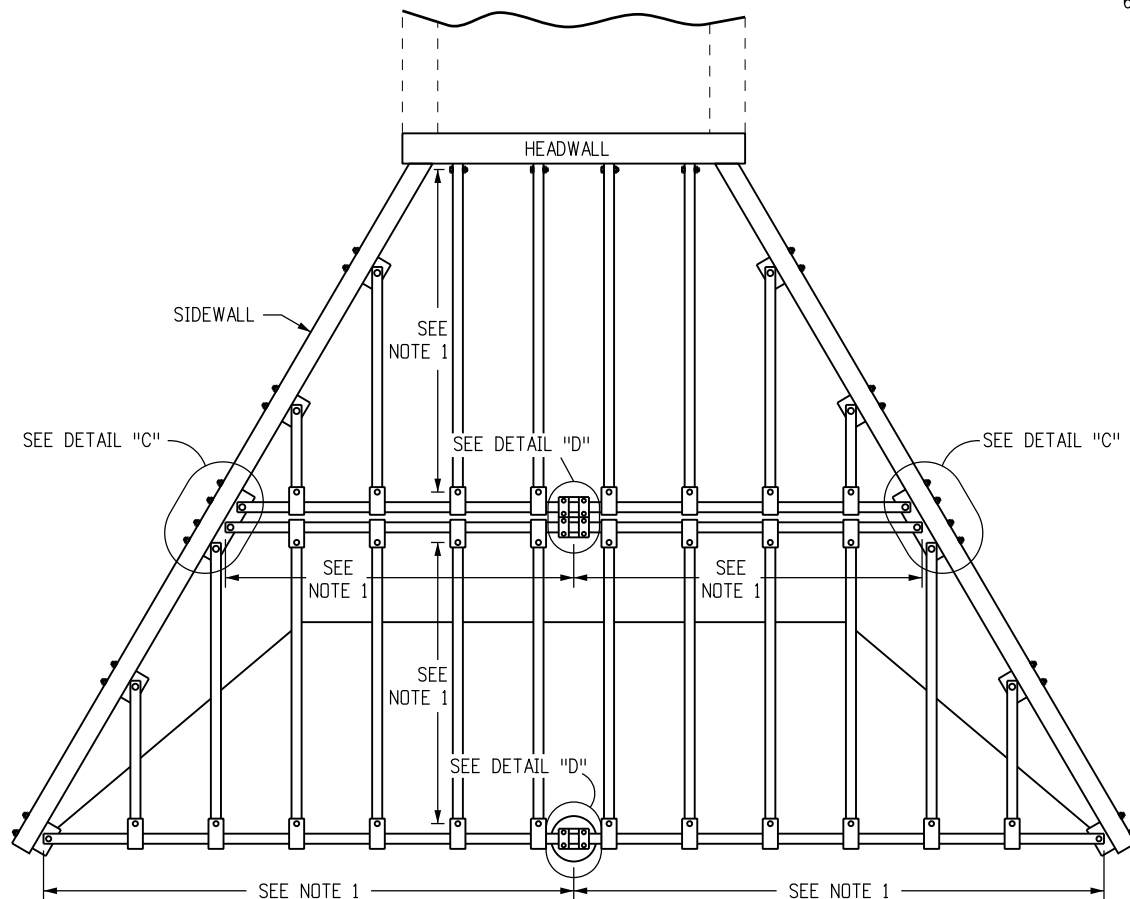
DETAIL "C"



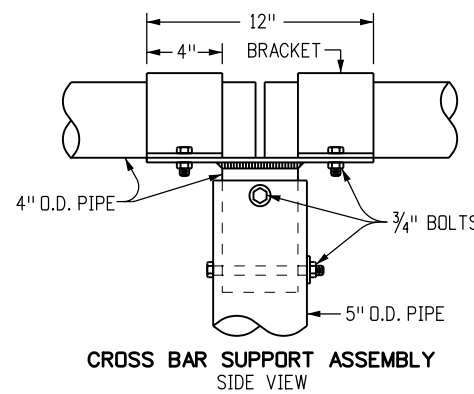
SECTION D-D

NOTES

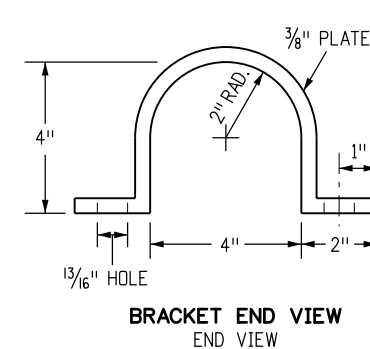
1. LENGTH OF SPAN (20 FEET MAXIMUM).
2. ALL ANCHOR BOLTS SHALL BE GROUTED IN PLACE WITH A NONSHRINK OR EPOXY GROUT WHICH SHALL COMPLETELY FILL THE HOLES.



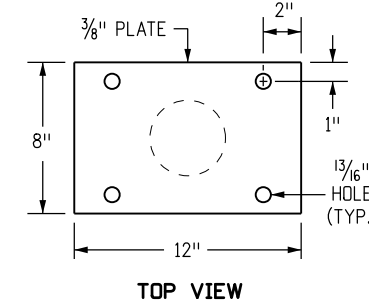
INSTALLATION PLAN WITH MIDSPAN SUPPORT



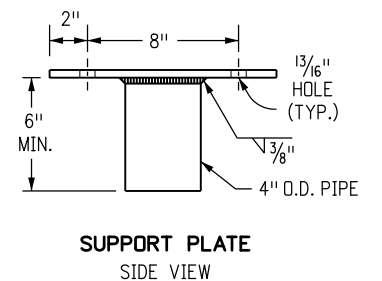
CROSS BAR SUPPORT ASSEMBLY SIDE VIEW



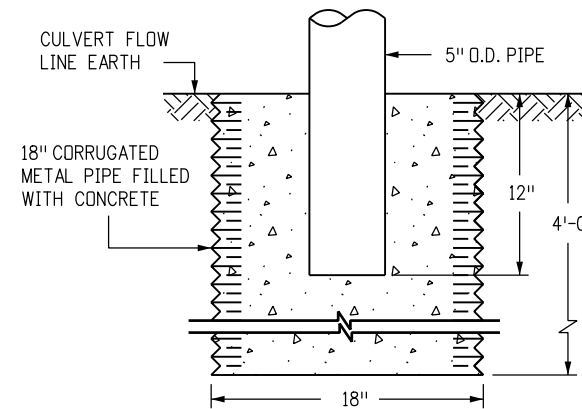
BRACKET END VIEW END VIEW



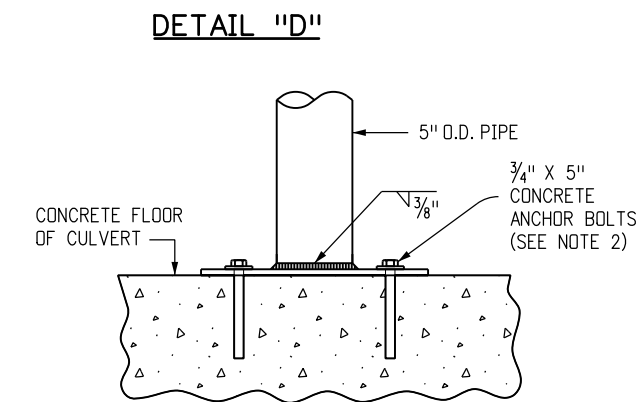
TOP VIEW



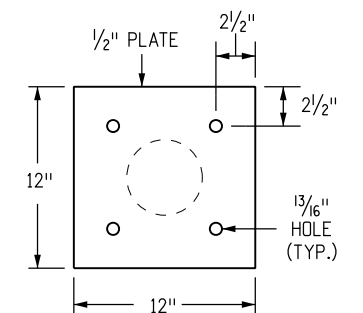
SUPPORT PLATE SIDE VIEW



BOTTOM SUPPORT ON EARTH



BOTTOM SUPPORT ON CULVERT FLOOR



BOTTOM SUPPORT PLATE

Computer File Information

Creation Date: 07/31/19	(R-X)
Designer Initials: JJP	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
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Sheet Revisions

Date:	Comments

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TRAVERSABLE END SECTIONS AND SAFETY GRATES

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-603-12

Standard Sheet No. 3 of 3

Project Sheet Number:

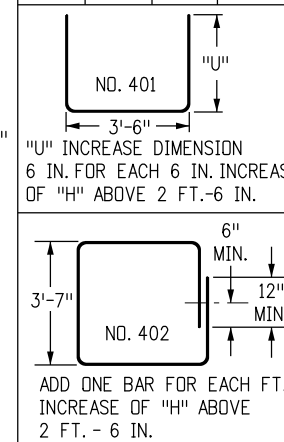
QUANTITIES FOR ONE INLET

H	CONCRETE (CU. YDS.)	STEEL (LBS.)	NO. STEPS REQ'D.
2'-6"	1.0	76	0
3'-0"	1.1	81	0
3'-6"	1.2	97	0
4'-0"	1.3	102	1
4'-6"	1.5	117	2
5'-0"	1.6	123	2
5'-6"	1.7	138	2
6'-0"	1.9	143	3
6'-6"	2.0	159	3
7'-0"	2.1	164	3
7'-6"	2.2	180	4
8'-0"	2.4	185	4
8'-6"	2.5	200	4
9'-0"	2.6	206	5
9'-6"	2.8	221	5
10'-0"	2.9	236	6
11'-6"	3.3	252	6

▼ PIPE INSIDE DIAMETER SHALL BE 30 IN. OR LESS. CONCRETE AND STEEL QUANTITIES ARE FOR ONE ENTIRE INLET BEFORE DEDUCTION FOR VOLUME OCCUPIED BY PIPE. WEIGHT OF STEEL INCLUDES A RING FOR THE MAXIMUM PIPE DIAMETER.

BAR LIST FOR H = 2 FT.-6 IN. AND BENDING DIAGRAM

MARK	NO. REQ'D.	HEIGHT	LENGTH
401	2	2'-2 1/2"	8'-0"
401	6	2'-7"	8'-8"
402	4	"U"	15'-4"

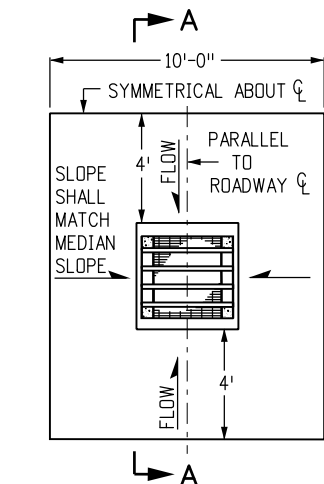


402 BARS SHALL BE EQUALLY SPACED FROM EACH OTHER.

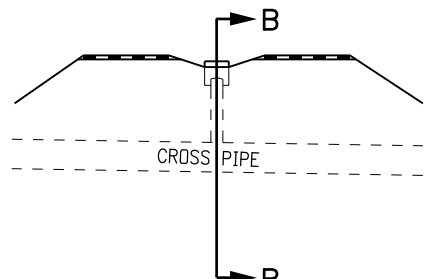
STEEL GRATE QUANTITIES

NO. PIECES	DESCRIPTION	LENGTH	LBS PER FT.	WEIGHT (LBS.)
4	S4 x 7.7 BEAM	41"	7.90	106
2	3 1/2" x 1/4" FLAT	26 5/8"	2.98	13
2	3" x 1/4" FLAT	26 5/8"	2.55	12

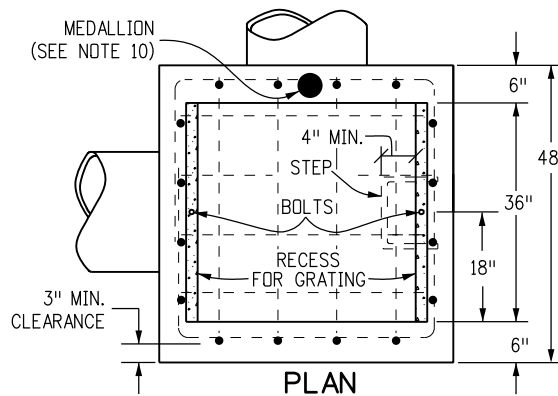
TOTAL LBS. - 131



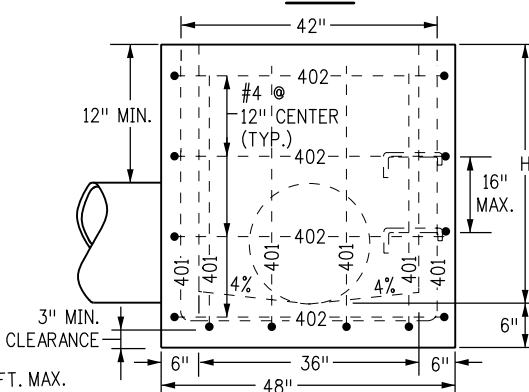
INLET WITH DITCH PAVING



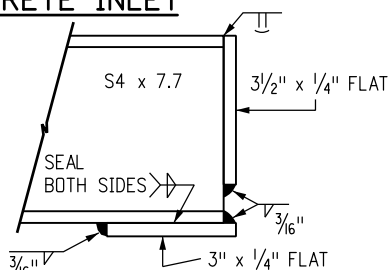
SECTION VIEW



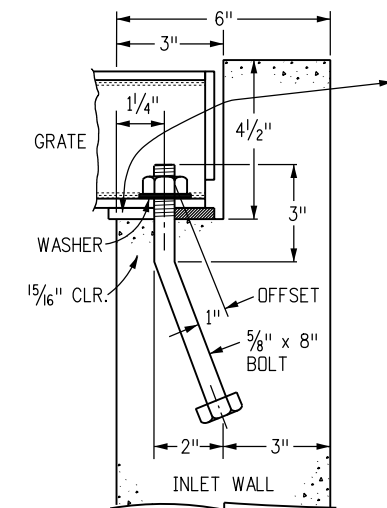
PLAN



ELEVATION CONCRETE INLET

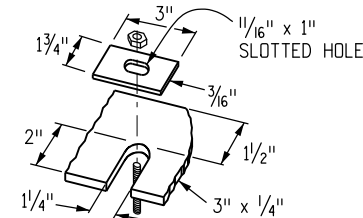


SECTION D-D



GRATE INSTALLATION DETAIL

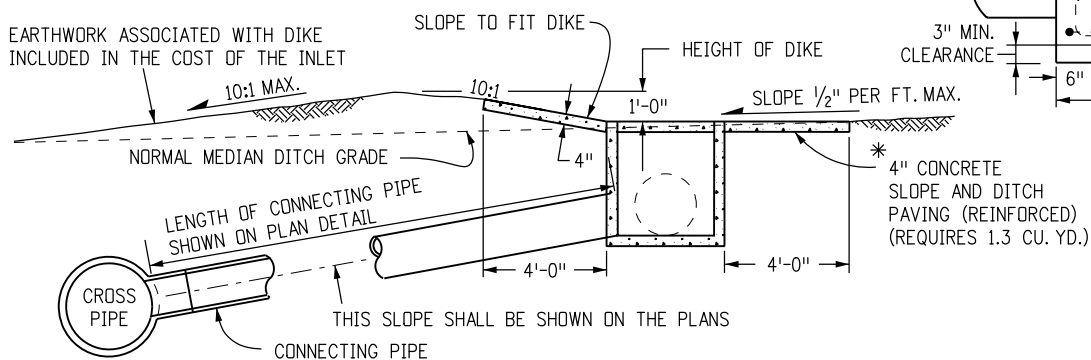
SLOT DETAIL



ALTERNATE SLOT AND HOLD DOWN PLATE DETAIL

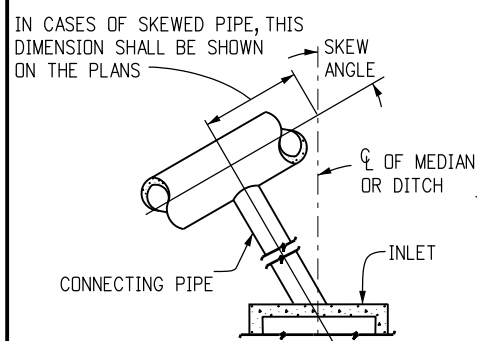
GENERAL NOTES

- INLET TYPE C IS NOT HS-20 RATED AND SHALL NOT BE PLACED IN PAVED ROADWAYS. THIS INLET SHALL BE USED ONLY OUTSIDE PAVED ROADWAYS.
- CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
- REINFORCING BARS SHALL BE GRADE 60, EPOXY COATED, AND DEFORMED #4, AND SHALL HAVE A MIN. 2 INCH CLEARANCE. CUT OR BEND AROUND PIPES AS REQUIRED.
- CONCRETE SLOPE AND DITCH PAVING SHALL BE IN ACCORDANCE WITH SECTION 507. REINFORCEMENT FOR CONCRETE SLOPE PAVING SHALL BE 6 X 6 - W1.4 X W1.4 OR 6 X 6 - W2.1 X W2.1.
- STRUCTURAL STEEL FOR GRATES AND GRATE INSTALLATION HARDWARE SHALL BE GALVANIZED, AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.
- THE STANDARD INLET GRATES SHALL BE USED ON ALL TYPE C INLETS UNLESS CLOSE MESH INLET GRATES ARE SPECIFIED ON THE PLANS.
- CLOSE MESH GRATES ARE RECOMMENDED WHERE FOOT TRAFFIC OR BICYCLE ROUTES ARE IN CLOSE PROXIMITY TO GRATE. THIS GRATE IS NOT ADA COMPLIANT OR BICYCLE FRIENDLY AND SHALL NOT BE PLACED DIRECTLY IN SIDEWALKS, CROSSWALKS OR BIKE PATHS.
- STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET - 6 INCHES AND SHALL CONFORM TO AASHTO M 199.
- SEE STANDARD PLAN M-604-11, FOR REINFORCEMENT AROUND THE PIPE OPENING.
- ALL INLETS SHALL HAVE A 4 INCH DIA. METAL MEDALLION WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE ON IT. THE MEDALLION SHALL HAVE A FISH SYMBOL WITH A BLUE BACKGROUND. IT SHALL BE FIRMLY ATTACHED TO THE TOP OF THE INLET WITH A PERMANENT FASTENER.

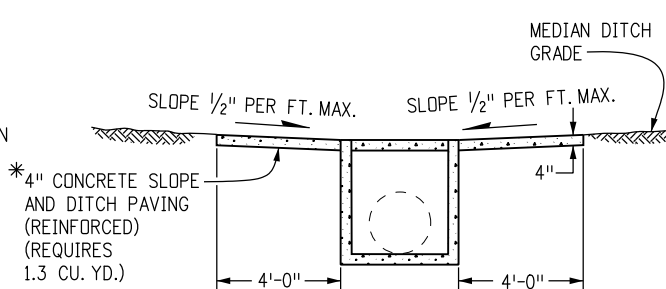


SECTION A-A INLET ON GRADE (FLOW FROM ONE DIRECTION)

SECTION B-B INLET CONNECTED TO A CROSS PIPE

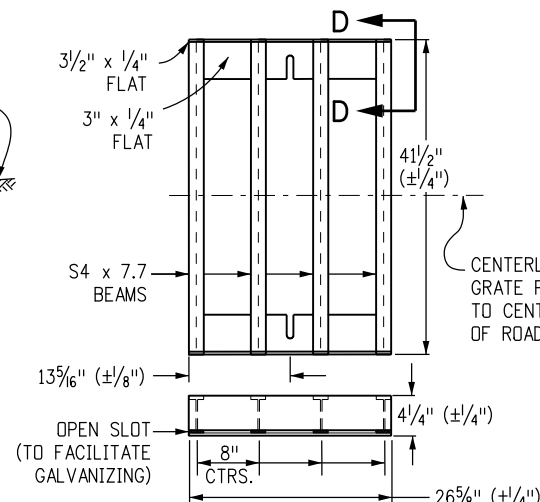


INLET CONNECTED TO A SKEWED CROSS PIPE

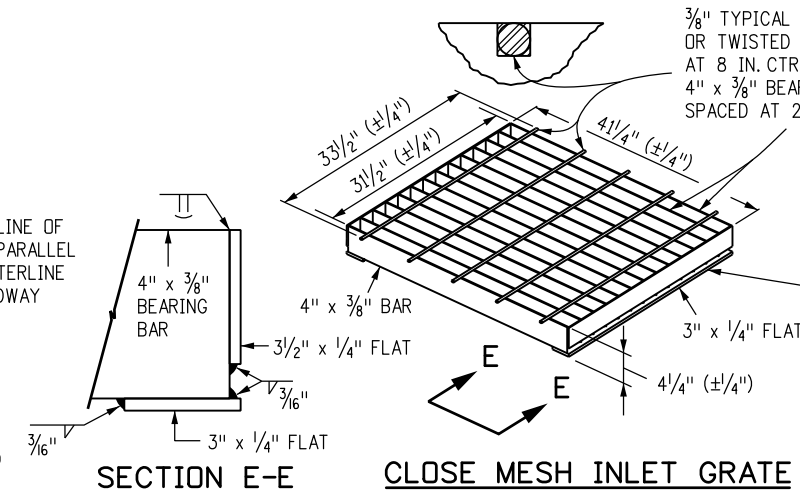


SECTION A-A INLET AT BOTTOM OF VERTICAL CURVE (FLOW FROM TWO DIRECTIONS)

*CONCRETE SLOPE AND DITCH PAVING WILL BE REQUIRED WHEN SHOWN ON THE PLANS.



STANDARD INLET GRATE



SECTION E-E

CLOSE MESH INLET GRATE

SLOT DETAIL IN 3 1/2" x 1/4" FLATS SAME AS IN STANDARD INLET GRATE

Computer File Information

Creation Date: 07/31/19
Designer Initials: JBK
Last Modification Date: 07/31/19
Detailer Initials: LTA
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English

Sheet Revisions

Date:	Comments
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(R-X)	
(R-X)	
(R-X)	

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Denver, CO 80204
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Project Development Branch

JBK

INLET, TYPE C

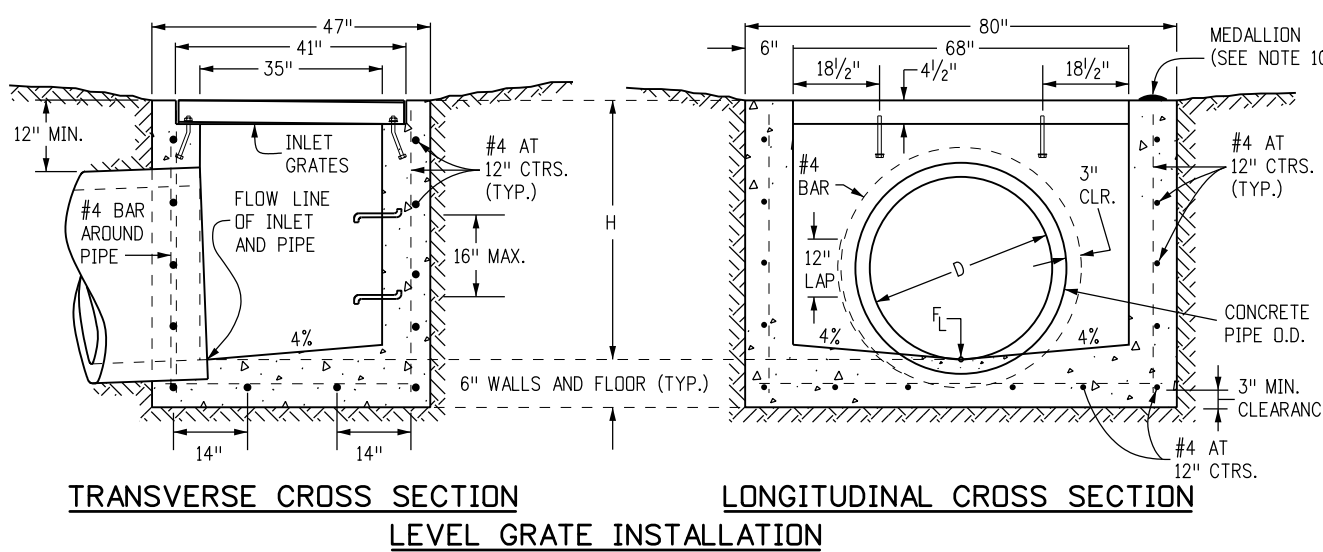
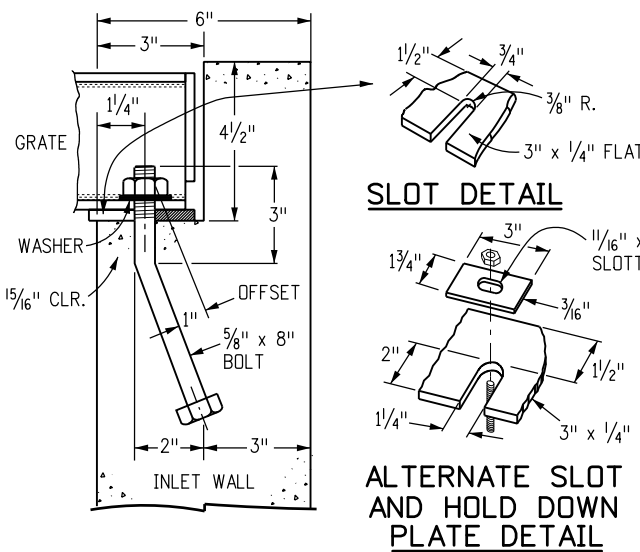
Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

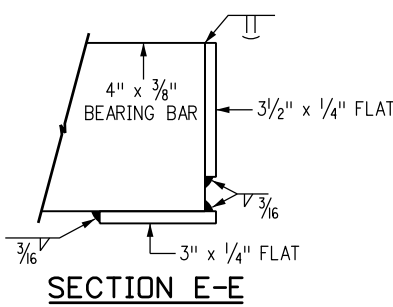
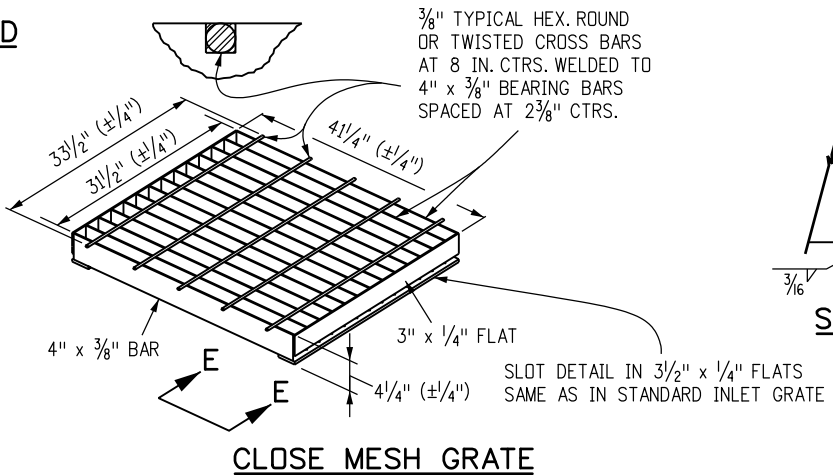
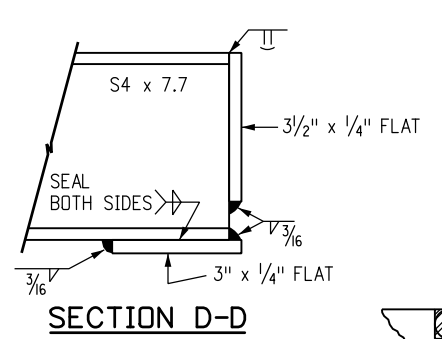
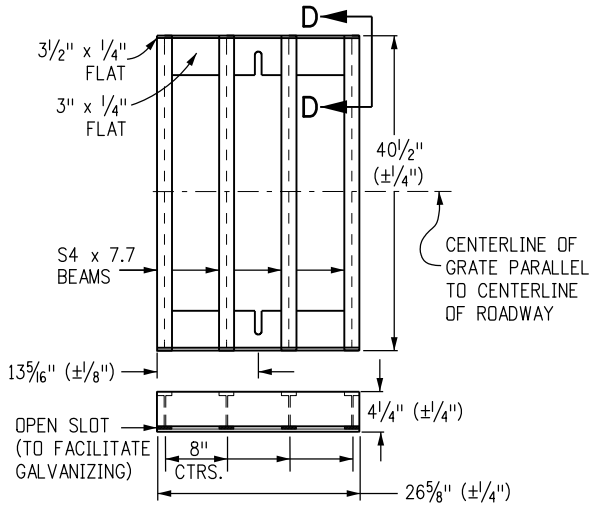
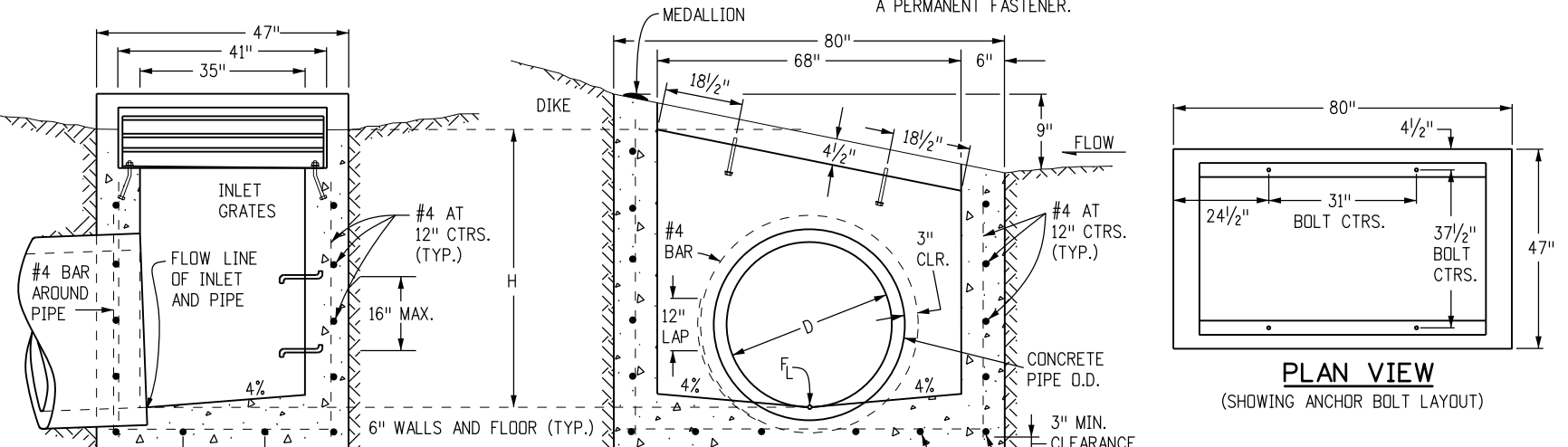
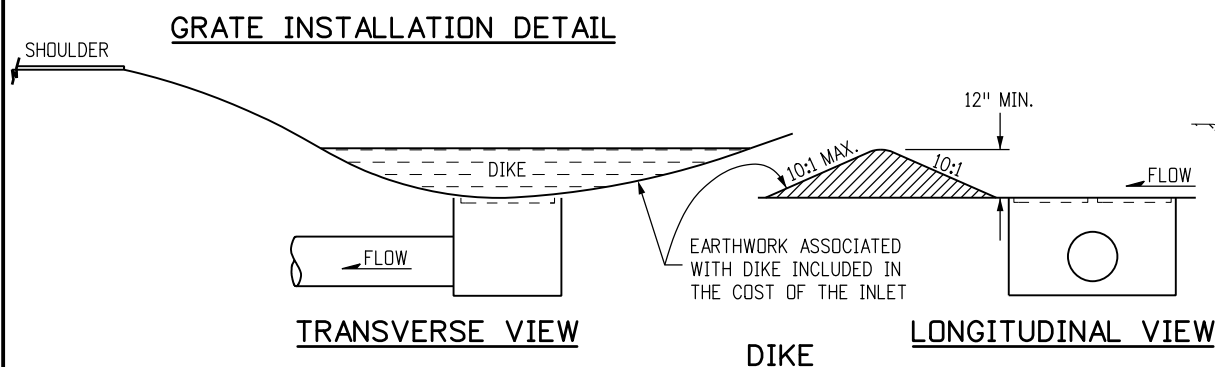
M-604-10

Standard Sheet No. 1 of 1

Project Sheet Number:



- GENERAL NOTES**
1. INLET TYPE D IS NOT HS-20 RATED AND SHALL NOT BE PLACED IN PAVED ROADWAYS. THIS INLET SHALL BE USED ONLY OUTSIDE PAVED ROADWAYS.
 2. CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
 3. SEE PLANS FOR SIZE AND LOCATION OF PIPE.
 4. STRUCTURAL STEEL FOR GRATES AND GRATE INSTALLATION HARDWARE SHALL BE GALVANIZED AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.
 5. STANDARD INLET GRATES SHALL BE USED ON ALL TYPE D INLETS UNLESS CLOSE MESH GRATES ARE SPECIFIED ON THE PLANS.
 6. CLOSE MESH GRATES ARE RECOMMENDED WHERE FOOT TRAFFIC OR BICYCLE ROUTES ARE IN CLOSE PROXIMITY TO GRATE. THIS GRATE IS NOT ADA COMPLIANT OR BICYCLE FRIENDLY AND SHALL NOT BE PLACED DIRECTLY IN SIDEWALKS, CROSSWALKS OR BIKE PATHS.
 7. STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET-6 INCHES AND SHALL CONFORM WITH AASHTO M 199.
 8. REINFORCING BARS SHALL BE GRADE 60, EPOXY COATED, AND DEFORMED #4, AND SHALL HAVE A 2 INCH MIN. CLEARANCE. CUT OR BEND BARS AROUND PIPE AS REQUIRED.
 9. ALL INLETS SHALL HAVE A 4 INCH DIA. METAL MEDALLION WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE ON IT. THE MEDALLION SHALL HAVE A FISH SYMBOL WITH A BLUE BACKGROUND. IT SHALL BE FIRMLY ATTACHED TO THE INLET'S SURFACE WITH A PERMANENT FASTENER.



OUTLET PIPE INSIDE DIA. FT. - "D"	MIN. "H" FT.
1.5	3.0
2.0	3.5
2.5	4.0
3.0	4.5
3.5	5.0

"H" FT.	CONCRETE CU. YDS.	STEEL LBS.	CIRCULAR PIPE RANGE INSIDE DIA., IN. - "D"
3.0	1.5	127	18
3.5	1.7	149	18-24
4.0	1.9	157	18-30
4.5	2.0	179	18-36
5.0	2.2	187	18-42
5.5	2.4	208	18-42
6.0	2.6	215	18-42
6.5	2.8	236	18-42
7.0	2.9	243	18-42
7.5	3.1	264	18-42
8.0	3.3	271	18-42
8.5	3.5	292	18-42
9.0	3.6	299	18-42
9.5	3.8	320	18-42
10.0	4.0	327	18-42

CONCRETE AND STEEL QUANTITIES ARE FOR ONE ENTIRE INLET BEFORE DEDUCTION FOR VOLUME OCCUPIED BY PIPE. WEIGHT OF STEEL INCLUDES A RING FOR THE MAXIMUM PIPE DIAMETER.

TWO STEEL GRATE PER INLET QUANTITIES

NO. PIECES	DESCRIPTION	LENGTH	LBS PER FT.	WEIGHT (LBS.)
8	S4 x 7.7 BEAM	40"	7.70	206
4	3 1/2" x 1/4" FLAT	26 5/8"	2.98	26
4	3" x 1/4" FLAT	26 5/8"	2.55	24

TOTAL LBS. - 256

QUANTITIES FOR ONE INLET

Computer File Information

Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions

Date:	Comments

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 Denver, CO 80204
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Project Development Branch **JBK**

INLET, TYPE D

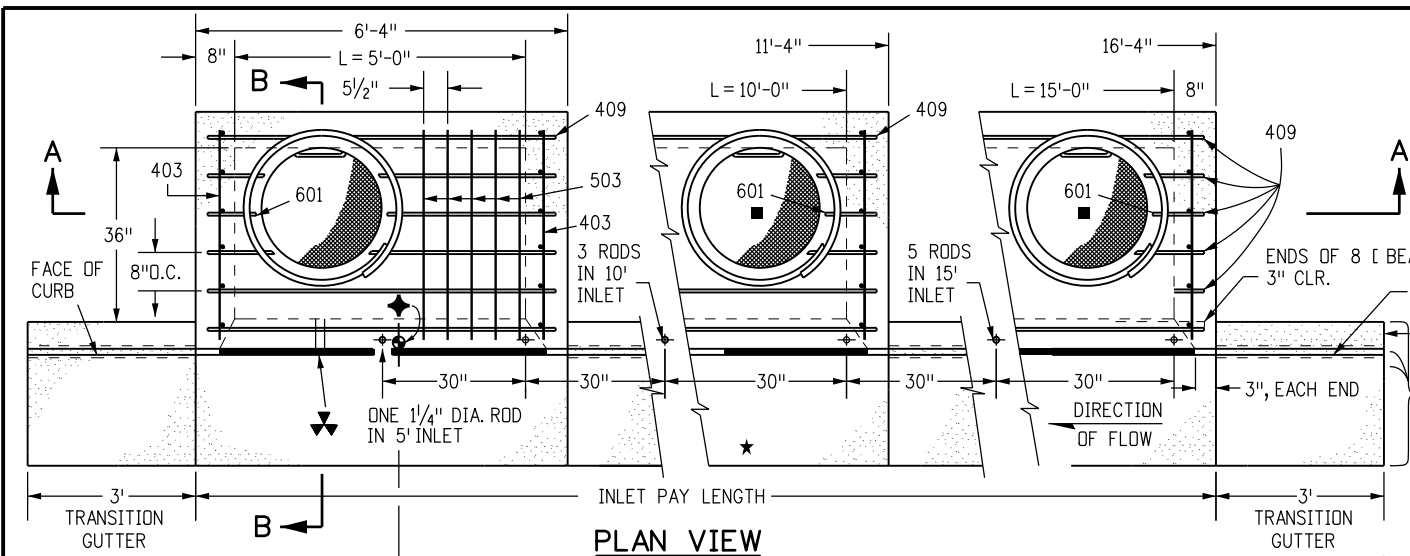
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STANDARD PLAN NO.

M-604-11

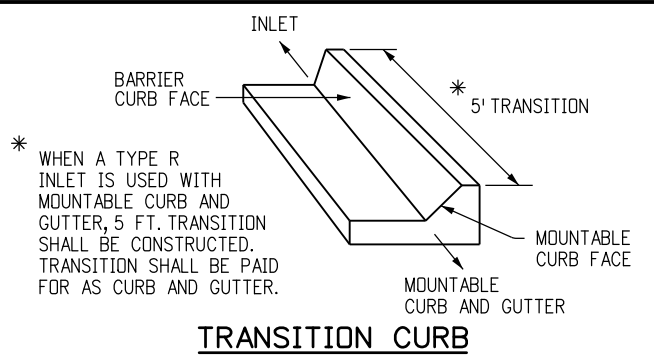
Standard Sheet No. 1 of 1

Project Sheet Number:



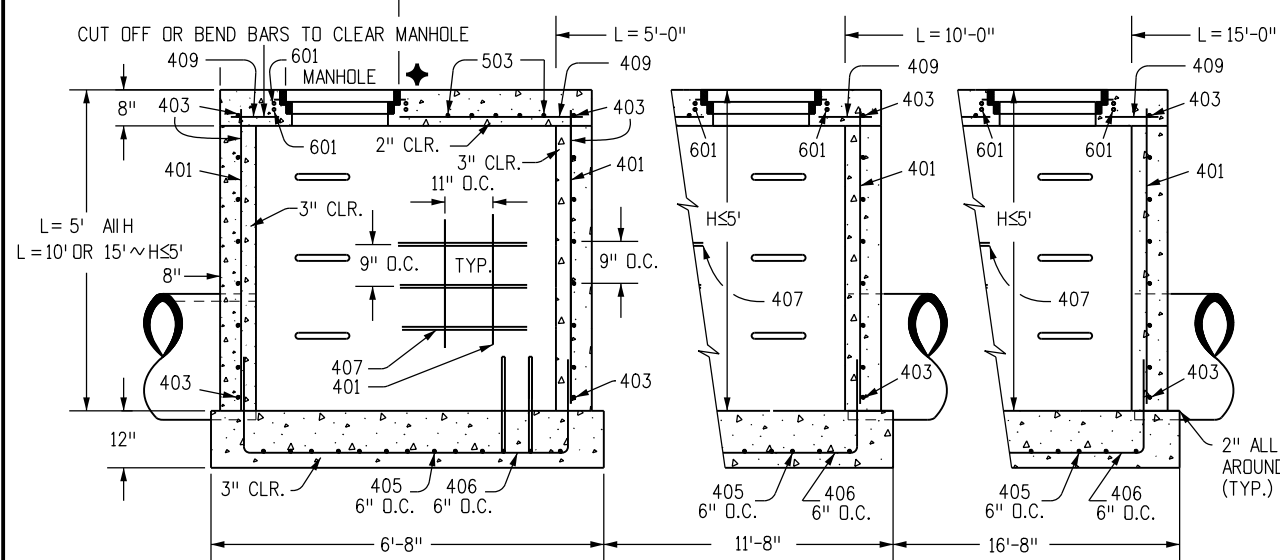
PLAN VIEW

- ★ FOR LENGTH (L) 10 FT. OR MORE, PROVIDE MAINTENANCE ACCESS AT BOTH ENDS WITH AN ADDITIONAL MANHOLE RING AND COVER. CUT REINFORCEMENT BAR ACCORDINGLY.
- ◆ STATION POINT AT MIDPOINT OF INLET ALONG FLOWLINE

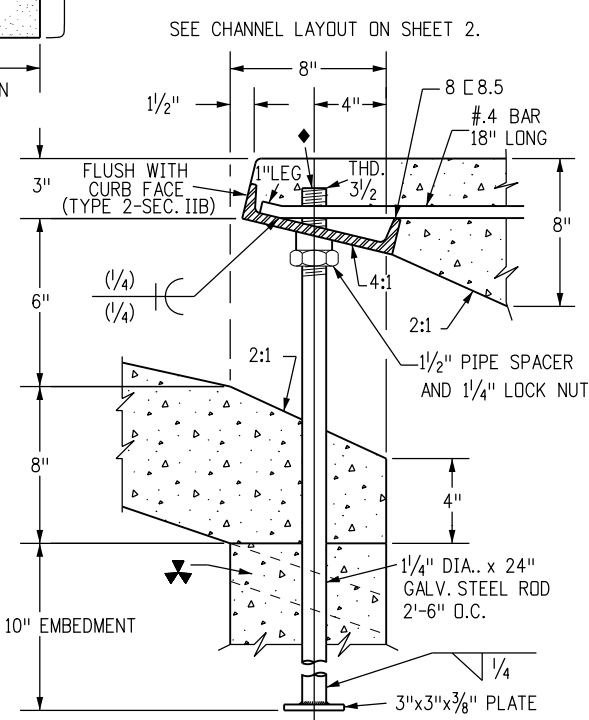


TRANSITION CURB

▲ - FOR A 1'-0" PAN SLOPE 2" PER FT.

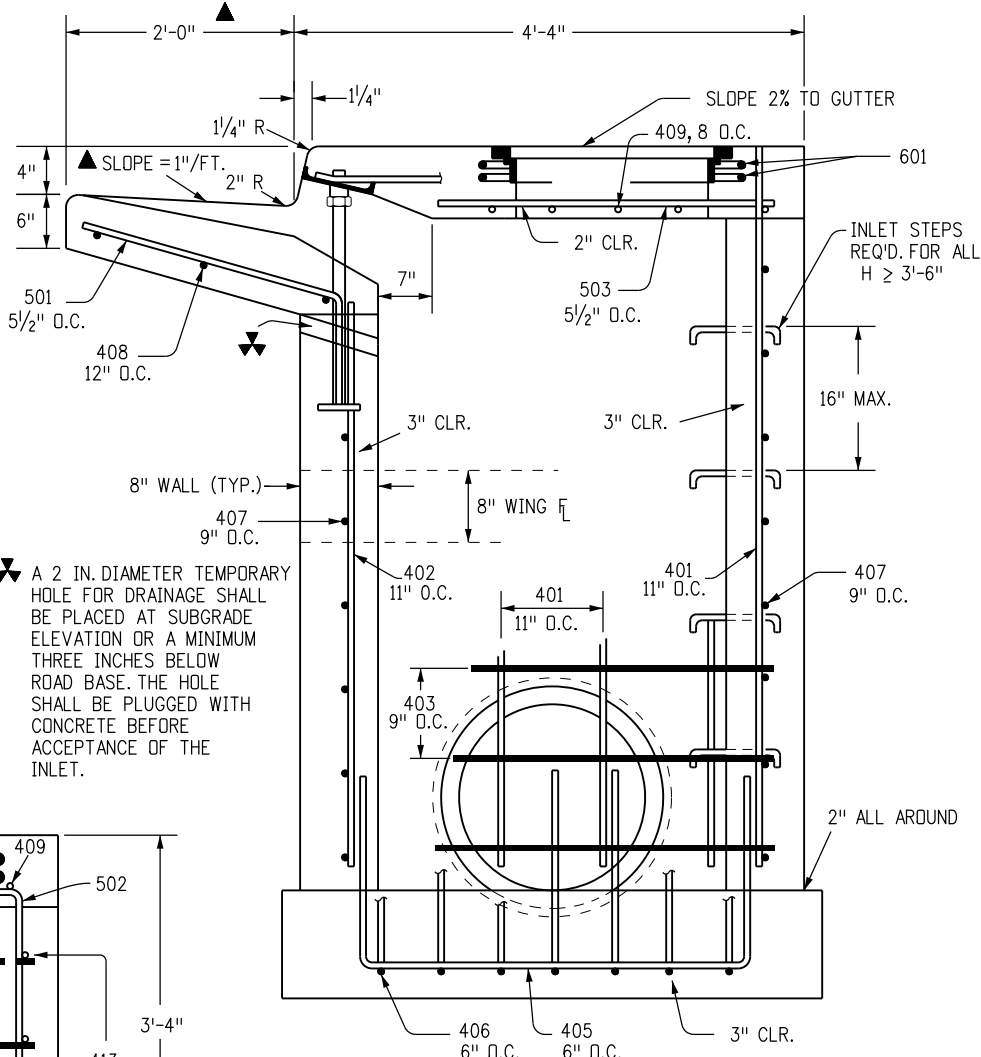


SECTION A-A REGULAR INLET



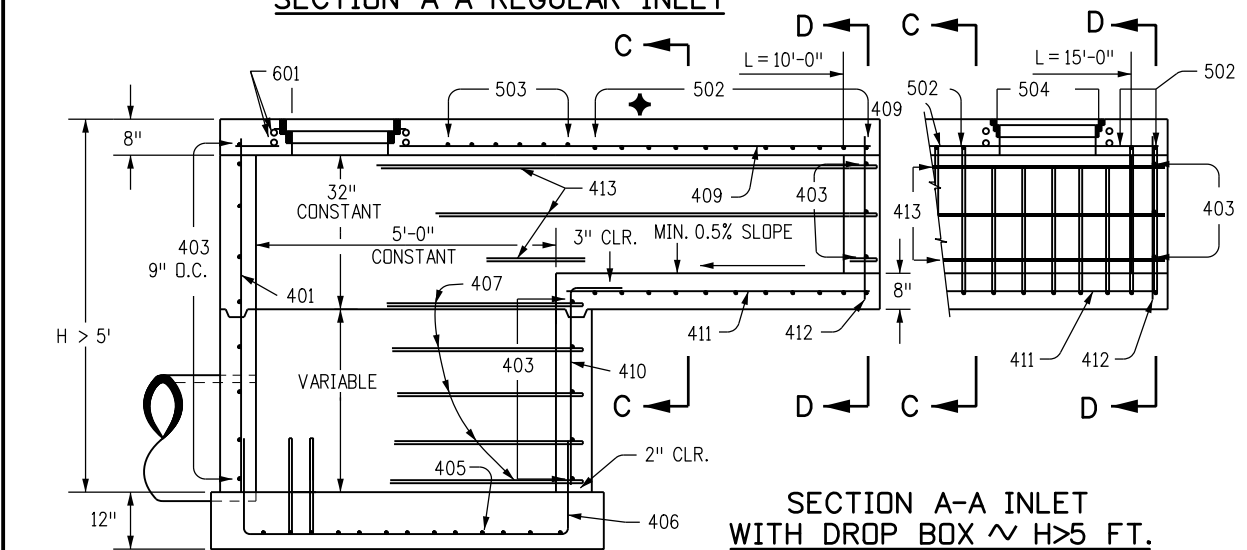
CURB FACE ASSEMBLY

◆ PLACE ENTIRE ASSEMBLY BEFORE POURING CONCRETE.

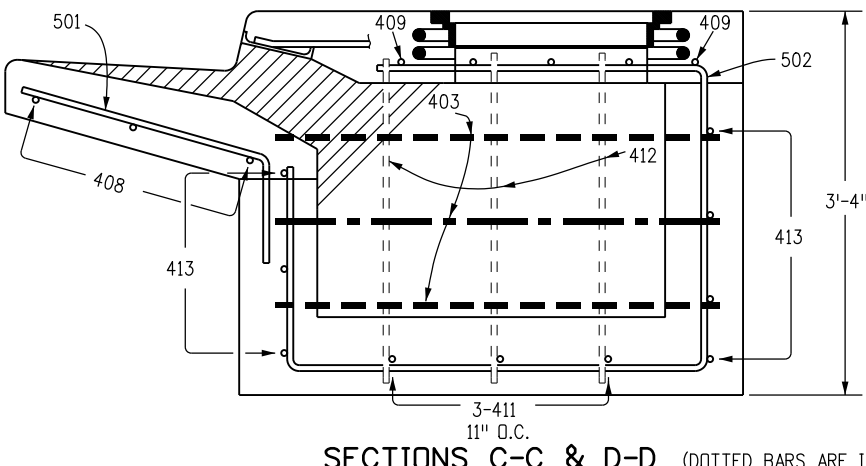


SECTION B-B END VIEW

NOTE: MANHOLE RING AND COVER, STATION POINT AND OUTFLOW PIPE SHALL BE LOCATED AT THE SAME END OF THE INLET.



SECTION A-A INLET WITH DROP BOX ~ H > 5 FT.



SECTIONS C-C & D-D (DOTTED BARS ARE IN SECTION D-D)

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Designer Initials: JBK	
Last Modification Date: 07/31/19	
Detailer Initials: LTA	
CAD Ver.: MicroStation V8	Scale: Not to Scale Units: English

Sheet Revisions	
Date:	Comments
(R-X)	
(R-X)	
(R-X)	
(R-X)	

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CURB INLET TYPE R

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-604-12
Standard Sheet No. 1 of 2
Project Sheet Number:

MARK	BAR # OR SIZE	O.C. SPACING	TYPE	ALL INLETS		INLETS: H ≤ 5 FT.				INLETS: H > 5 FT.			
				L = 5 FT.		L = 10 FT.		L = 15 FT.		L = 10 FT.		L = 15 FT.	
				NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH
401	4	11"	II	15	*	21	*	26	*	11	*	11	*
402	4	11"	II	7	*	13	*	18	*	7	*	7	*
403	4	9"	II	*	4'-0"	*	4'-0"	*	4'-0"	*	4'-0"	*	4'-0"
405	4	6"	VI	11	6'-10"	21	6'-10"	31	6'-10"	11	6'-10"	11	6'-10"
406	4	6"	VIII	7	8'-10"	7	13'-10"	7	18'-10"	7	8'-10"	7	8'-10"
407	4	9"	II	*	5'-10"	*	10'-10"	*	15'-10"	*	5'-10"	*	5'-10"
408	4	12"	II	3	6'-10"	3	11'-10"	3	16'-0"	3	11'-10"	3	16'-0"
409	4	8"	II	6	5'-10"	6	10'-10"	6	15'-10"	6	10'-10"	6	15'-10"
410	4	11"	VII							3		3	*
411	4	11"	II							3	5'-2"	3	10'-2"
412	4	11"	II							3	2'-9"	3	2'-9"
413	4	9"	II							7	10'-10"	7	15'-10"
501	5	5 1/2"	IV	11	3'-4"	22	3'-4"	33	3'-4"	22	3'-4"	33	3'-4"
502	5	5 1/2"	III							11	11'-5"	17	11'-5"
503	5	5 1/2"	II	5	3'-6"	16	3'-6"	27	3'-6"	6	3'-6"	6	3'-6"
504	5	5 1/2"	IX									5	8'-4"
601	6	2 1/2"	V	2	8'-10"	2	8'-10"	2	8'-10"	2	8'-10"	4	8'-10"
8E.5				1	5'-10"	1	10'-10"	1	15'-10"	1	10'-10"	1	15'-10"
				2 BARS, 1 RODS		4 BARS, 3 RODS		8 BARS, 5 RODS		4 BARS, 3 RODS		8 BARS, 5 RODS	

* VARIABLE REFER TO TABLE TWO.

■ INCLUDE #4, 18 IN. BARS (SEE CHANNEL LAYOUT).

REGULAR INLETS

DROP BOX INLETS

TABLE ONE ~ BAR LIST FOR CURB INLETS, TYPE "R"

"H"	LENGTH			NO. REQ'D.		NO. REQ'D.		L = 5 FT.		L = 10 FT.		L = 15 FT.	
	401	402	410	REGULAR		DROP BOX		CONC. CU. YDS.	STEEL LBS.	CONC. CU. YDS.	STEEL LBS.	CONC. CU. YDS.	STEEL LBS.
				403	407	403	407						
3'-0"	2'-8"	1'-8"		10	7			3.2	285	5.3	497	7.4	706
3'-6"	3'-2"	2'-2"		10	7			3.4	305	5.7	528	7.9	747
4'-0"	3'-8"	2'-8"		12	9			3.7	326	6.0	559	8.4	786
4'-6"	4'-2"	3'-2"		12	9			3.9	334	6.4	571	8.8	803
5'-0"	4'-8"	3'-8"		14	11			4.1	354	6.7	602	9.3	844
5'-6"	5'-2"	4'-2"	3'-5"	16	13	15	6	4.4	375	6.0	607	7.4	850
6'-0"	5'-8"	4'-8"	3'-11"	16	13	16	6	4.6	382	6.2	616	7.6	860
6'-6"	6'-2"	5'-2"	4'-5"	18	15	18	8	4.8	402	6.4	637	7.8	880
7'-0"	6'-8"	5'-8"	4'-11"	20	17	19	10	5.0	423	6.6	654	8.0	897
7'-6"	7'-2"	6'-2"	5'-5"	20	17	20	10	5.3	430	6.9	664	8.3	907
8'-0"	7'-8"	6'-8"	5'-11"	22	19	22	12	5.5	451	7.1	684	8.5	927
8'-6"	8'-2"	7'-2"	6'-5"	24	21	23	14	5.7	471	7.3	702	8.7	944
9'-0"	8'-8"	7'-8"	6'-11"	24	21	24	14	6.0	479	7.6	711	9.0	954
9'-6"	9'-2"	8'-2"	7'-5"	26	23	26	16	6.2	499	7.8	732	9.2	974
10'-0"	9'-8"	8'-8"	7'-11"	28	25	27	18	6.4	520	8.0	749	9.4	992
10'-6"	10'-2"	9'-2"	8'-5"	28	25	28	18	6.7	527	8.3	759	9.7	1001
11'-0"	10'-8"	9'-8"	8'-11"	30	27	30	20	6.9	547	8.5	779	9.9	1022

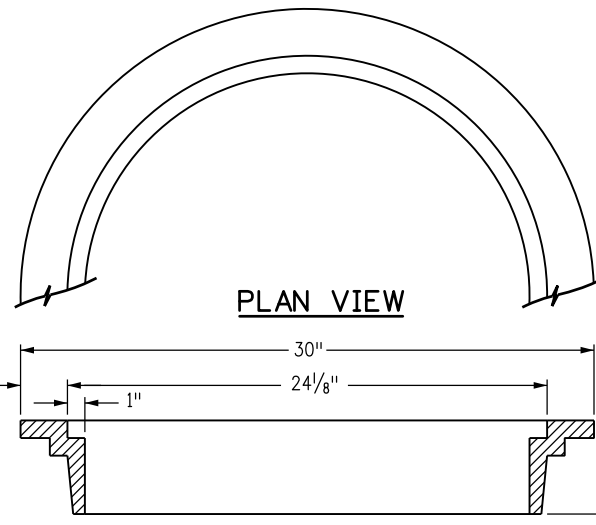
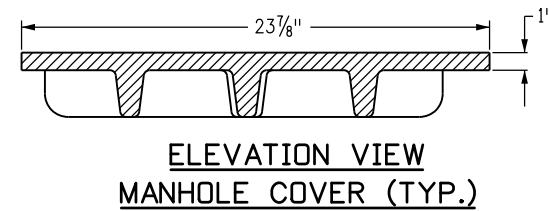
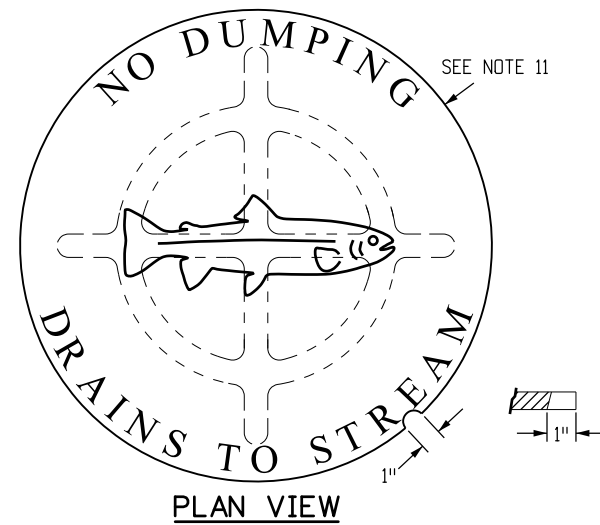
NOTES: FOR L=5 FT., L=10 FT., AND L=15 FT.

REGULAR INLETS: TOTAL QUANTITIES NEEDED ARE OUTSIDE THE HEAVY BLACK LINE.

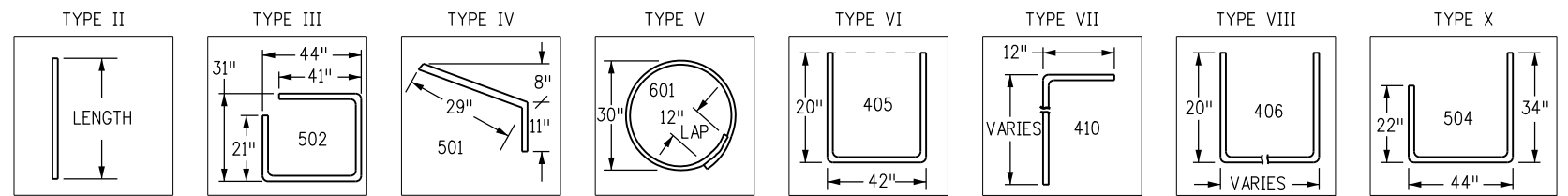
DROP BOX INLETS: TOTAL QUANTITIES NEEDED ARE INSIDE THE HEAVY BLACK LINE.

STEEL WEIGHTS DO NOT INCLUDE STRUCTURAL STEEL CHANNEL.

TABLE TWO ~ BARS AND QUANTITIES VARIABLE WITH "H"

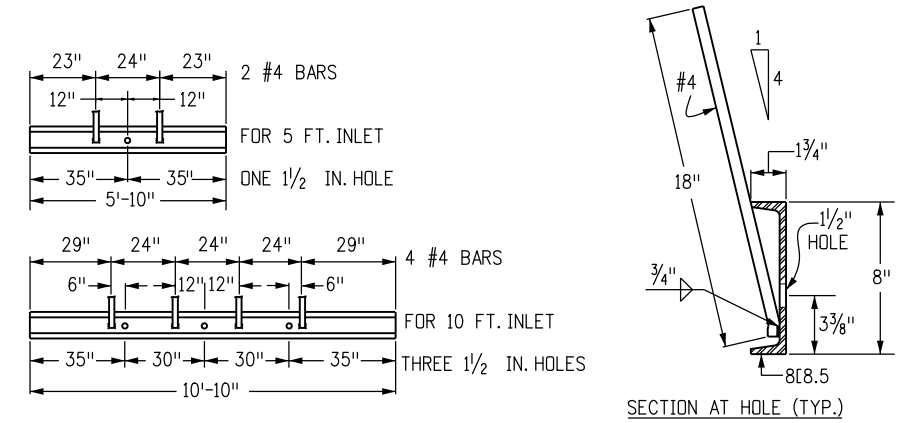


WEIGHTS: COVER = 125 LBS.
+ RING = 135 LBS.
TOTAL = 260 LBS.



BAR BENDING DIAGRAMS ~ (DIMENSIONS ARE OUT-TO-OUT OF BAR)

- ### GENERAL NOTES
- CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
 - CONCRETE WALLS SHALL BE FORMED ON BOTH SIDES AND SHALL BE 8 INCHES THICK.
 - INLET STEPS SHALL BE IN CONFORMANCE WITH AASHTO M 199.
 - CURB FACE ASSEMBLY SHALL BE GALVANIZED AFTER WELDING.
 - EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4 OF AN INCH. CURB AND GUTTER CORNERS SHALL BE FINISHED TO MATCH THE EXISTING CURB AND GUTTER BEYOND THE TRANSITION GUTTER.
 - REINFORCING BARS SHALL BE DEFORMED AND SHALL HAVE A 2 INCH MINIMUM CLEARANCE. ALL REINFORCING BARS SHALL BE GRADE 60 AND EPOXY COATED.
 - DIMENSIONS AND WEIGHTS OF TYPICAL MANHOLE RING AND COVER ARE NOMINAL.
 - MATERIAL FOR MANHOLE RINGS AND COVERS SHALL BE GRAY OR DUCTILE CAST IRON IN ACCORDANCE WITH SUBSECTION 712.06.
 - SINCE PIPE ENTRIES INTO THE INLET ARE VARIABLE, THE DIMENSIONS SHOWN ARE TYPICAL. ACTUAL DIMENSIONS AND QUANTITIES FOR CONCRETE AND REINFORCEMENT SHALL BE AS REQUIRED IN THE WORK. QUANTITIES INCLUDE VOLUMES OCCUPIED BY PIPES.
 - STRUCTURAL STEEL SHALL BE GALVANIZED AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.
 - ALL MANHOLE COVERS SHALL BE CAST WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE AND A FISH SYMBOL. THE SURFACE OF THE MANHOLE COVER SHALL HAVE A NON-SLIP PATTERN.



CHANNEL LAYOUT DETAILS
SEE CURB FACE ASSEMBLY ON SHEET 1.

Computer File Information	
Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

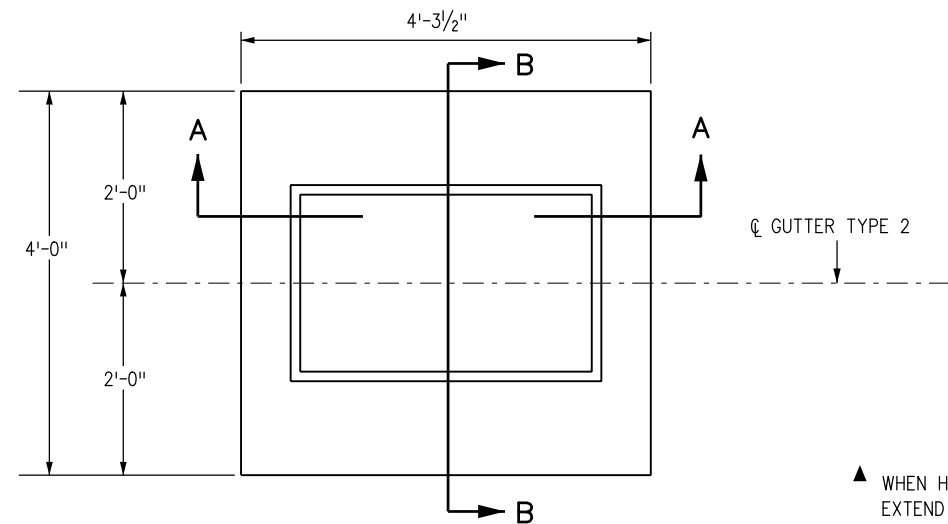
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Project Development Branch JBK

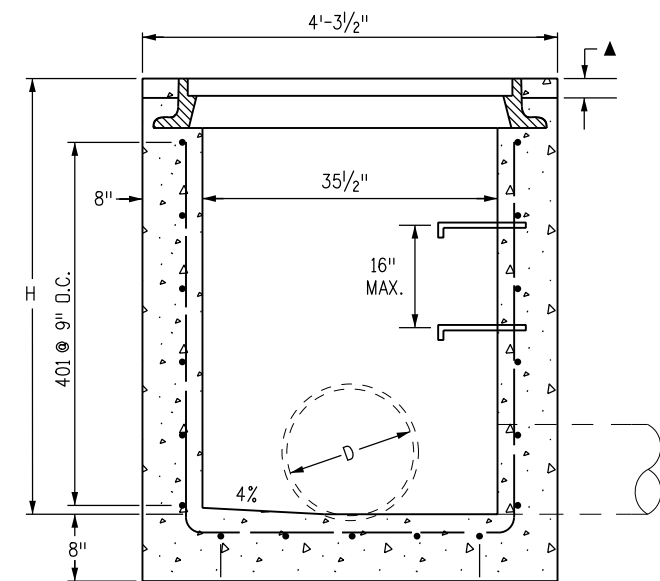
CURB INLET TYPE R

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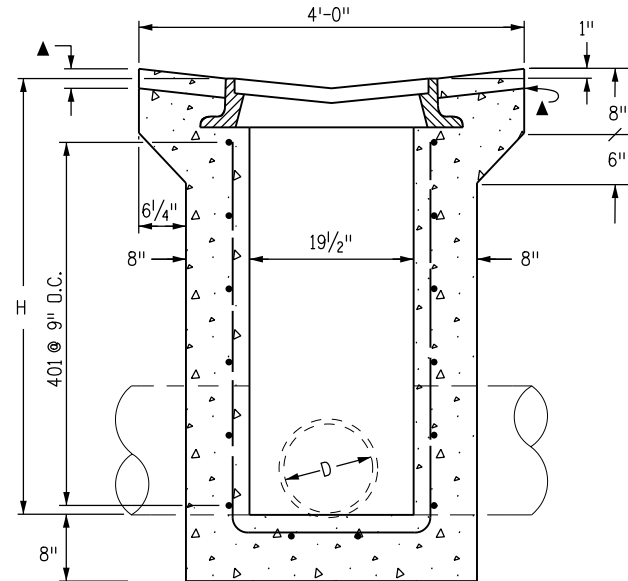
STANDARD PLAN NO.
M-604-12
Standard Sheet No. 2 of 2
Project Sheet Number:



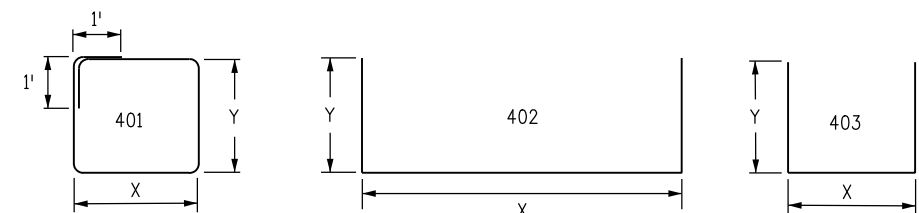
PLAN VIEW
TYPE 13 INLET FOR GUTTER TYPE 2



SECTION A-A
D MAX = 30 IN. FOR H > 4 FT.

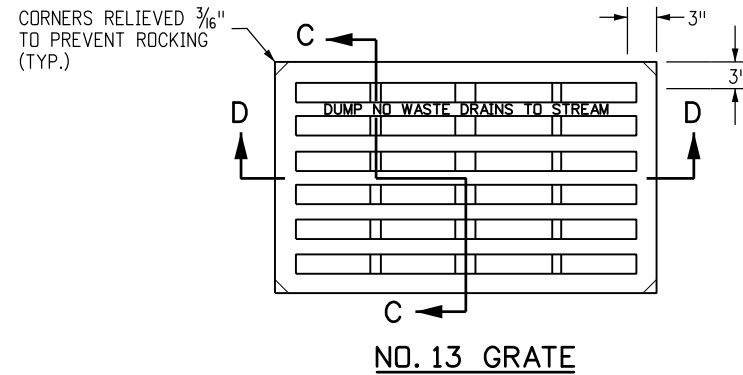


SECTION B-B
D MAX = 18 IN. FOR ALL H

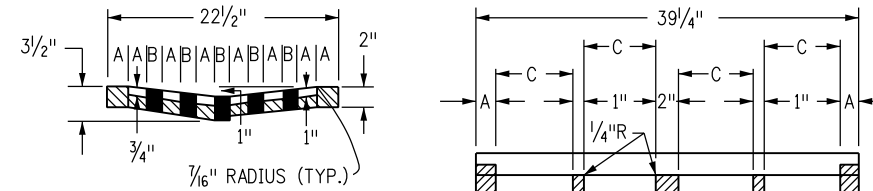


BENDING DIAGRAMS

ALL DIMENSIONS ARE OUT-TO-OUT OF BAR.



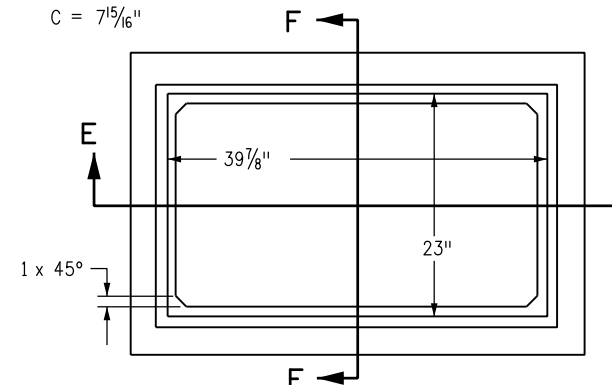
NO. 13 GRATE



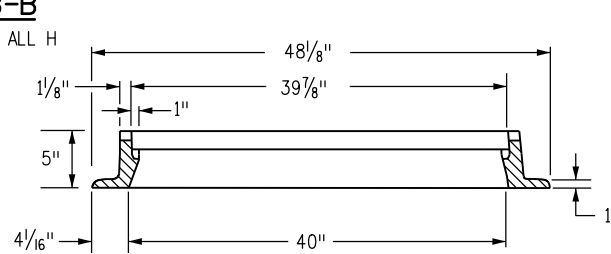
SECTION C-C

SECTION D-D

A = 1 3/4"
B = 1 1/16"
C = 7 15/16"

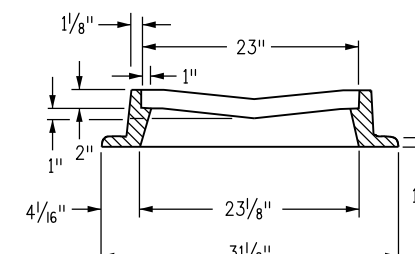


NO. 13 GRATING & FRAMES



SECTION E-E

APPROXIMATE WEIGHT = 590 LBS.



SECTION F-F

GENERAL NOTES

1. CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
2. CAST-IN-PLACE CONCRETE WALLS SHALL BE FORMED ON BOTH SIDES.
3. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4 OF AN INCH.
4. REINFORCING BARS SHALL BE DEFORMED #4 AND SHALL HAVE A 2 INCH MINIMUM CLEARANCE. ALL REINFORCING BARS SHALL BE GRADE 60 AND EPOXY COATED.
5. STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET-6 INCHES AND SHALL CONFORM TO AASHTO M 199.
6. ALL GRATES AND FRAMES SHALL BE GRAY OR DUCTILE CAST IRON IN ACCORDANCE WITH SUBSECTION 712.06. GRATES AND FRAMES SHALL BE DESIGNED TO WITHSTAND HS 20 LOADING.
7. STATION POINT IS AT THE CENTER OF THE INLET.
8. GRATE SHALL HAVE "DUMP NO WASTE DRAINS TO STREAM" MESSAGE CAST ON SURFACE.

H	CONCRETE	REINFORCING STEEL	NO. OF 401 BARS REQ'D.	MAXIMUM PIPE I.D.	
	CU. YDS.	Ø LB.		SEC. A-A	SEC. B-B
3'-0"	1.3	72	4	18	18
3'-6"	1.5	76	4	24	18
4'-0"	1.6	90	5	30	18
4'-6"	1.8	104	6	30	18
5'-0"	1.9	109	6	30	18
5'-6"	2.1	122	7	30	18
6'-0"	2.2	136	8	30	18
6'-6"	2.4	141	8	30	18
7'-0"	2.5	154	9	30	18
7'-6"	2.7	168	10	30	18
8'-0"	2.8	173	10	30	18
8'-6"	3.0	187	11	30	18
9'-0"	3.1	200	12	30	18
9'-6"	3.3	205	12	30	18
10'-0"	3.4	219	13	30	18

Ø INCLUDES 1% FOR OVERRUN.
NOTE: CONCRETE QUANTITIES INCLUDE VOLUME OCCUPIED BY PIPE.

QUANTITIES FOR ONE INLET

MARK	NO. REQ'D.	DIMENSIONS		LENGTH
		X	Y	
401	4	3'-6"	2'-2"	13'-4"
402	2	3'-4 1/2"	* 2'-6 1/2"	8'-5 1/2"
403	5	2'-1/2"	* 2'-7"	7'-2 1/2"

* ADD 6 IN. TO THIS DIMENSION FOR EACH 6 IN. INCREASE OF "H" OVER 3 FT.-0 IN.

BAR LIST FOR H = 3 FT.-0 IN.

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Designer Initials: JBK
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CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English

Sheet Revisions

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(R-X)	
(R-X)	
(R-X)	
(R-X)	

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Project Development Branch **JBK**

CONCRETE INLET
TYPE 13

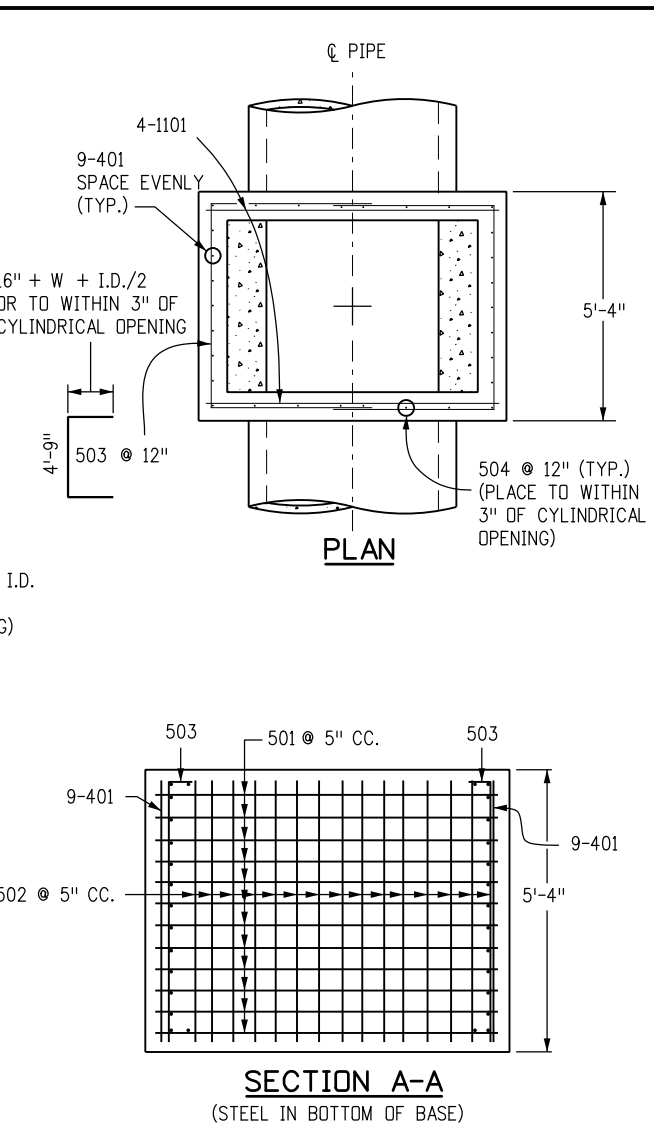
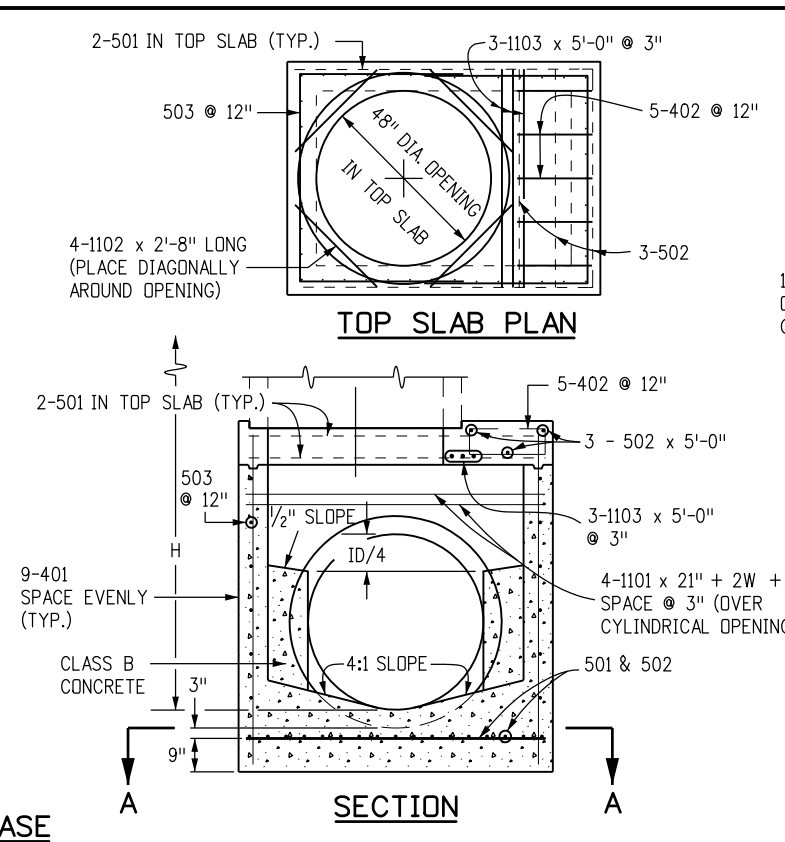
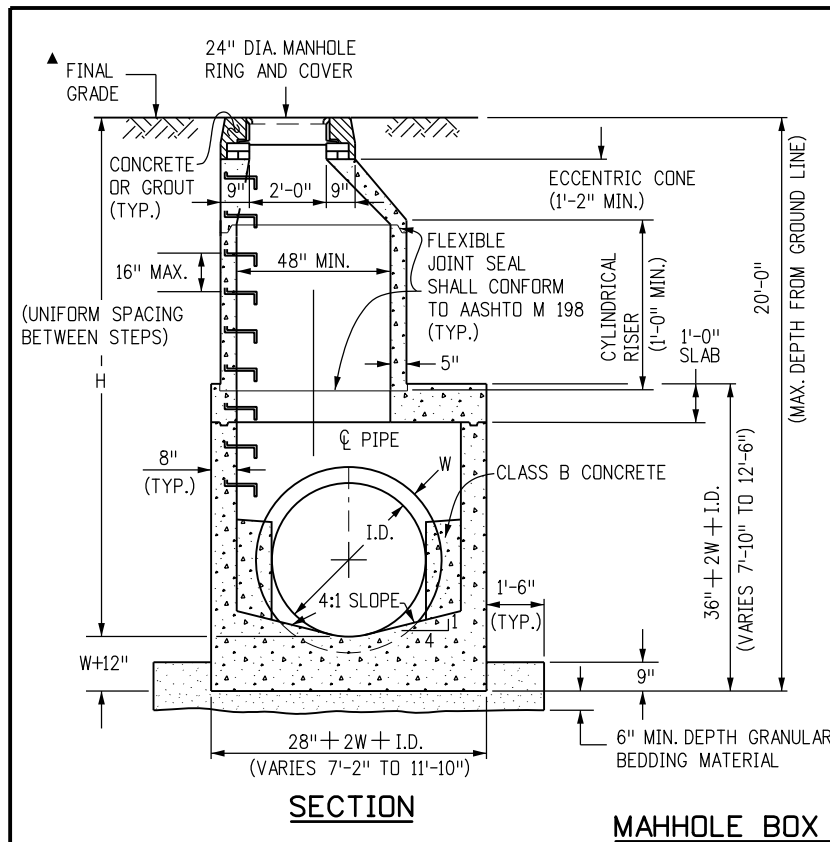
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STANDARD PLAN NO.

M-604-13

Standard Sheet No. 1 of 1

Project Sheet Number:

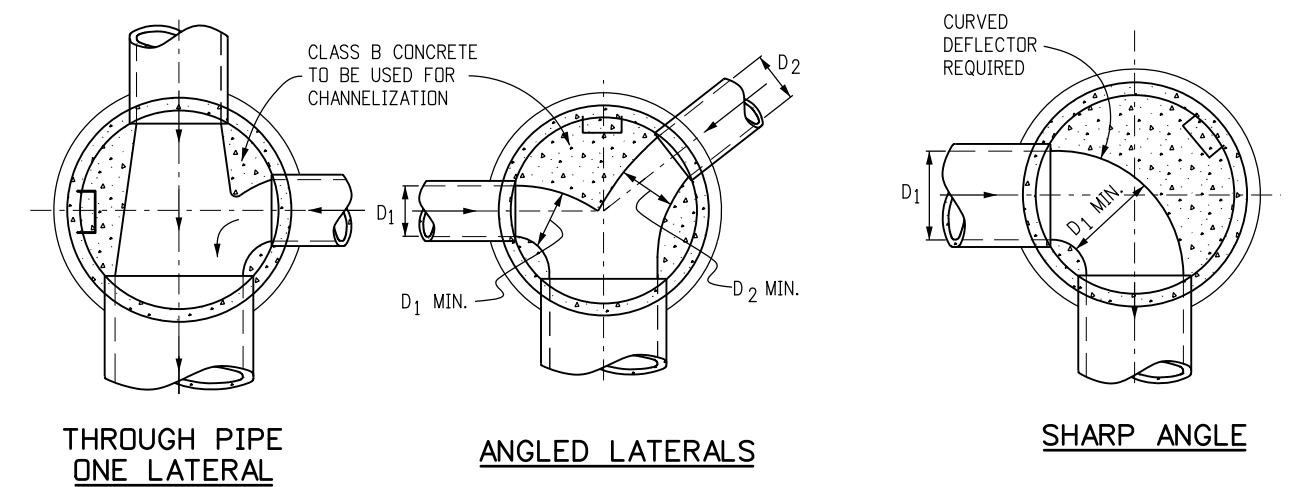


- ### GENERAL NOTES
1. SINCE ALL PIPE ENTRIES INTO THE BASE ARE VARIABLE, THE DIMENSIONS SHOWN ARE TYPICAL. ACTUAL DIMENSIONS AND QUANTITIES FOR CONCRETE AND REINFORCEMENT SHALL BE AS REQUIRED IN THE WORK.
 2. THE PRECAST FLAT TOP MAY BE USED ON ANY MANHOLE. THE ECCENTRIC CONE MAY BE USED WHEN THE MANHOLE "H" HEIGHT IS AT LEAST 8 FT.
 3. THE MANHOLE RING FRAME SHALL BE SET IN A BED OF GROUT. THE FRAME SHALL BE SURROUNDED WITH A CEMENT GROUT IN UNPAVED AREA, OR A CONCRETE COLLAR IN PAVED AREA. SEE DETAILS ON SHEETS 2 AND 3.
 4. DESIGN OF BOX BASE IS BASED ON STRAIGHT RUNS OF PIPE OR CHANGE IN DIRECTION OF LESS THAN 45°. SPECIAL DESIGN IS REQUIRED FOR 45° OR GREATER.
 5. PRECAST MANHOLES AND REINFORCEMENT SHALL CONFORM TO AASHTO M 199 (ASTM C 478).
 6. CAST-IN-PLACE MANHOLES SHALL BE CLASS B CONCRETE.
 7. STEPS SHALL BE REQUIRED WHEN THE MANHOLE DEPTH EXCEEDS 3 FT.-6 IN. AND SHALL CONFORM TO AASHTO M 199.
 8. ALL REINFORCING STEEL SHALL BE GRADE 60 AND EPOXY COATED. VERTICAL STEEL SHALL BE PLACED AT CENTERLINE OF WALL. ALL BARS SHALL HAVE A 2 IN. MINIMUM CLEARANCE.
 9. ALL PIPE ENTRIES INTO THE BASE OF MANHOLE SHALL BE CONNECTED BY OPEN CHANNELIZATION ADJUSTED FOR PIPE SIZE, SHAPE, SLOPE, AND DIRECTION OF FLOW. DETAILS SHOWN ARE TYPICAL FOR INSTALLATIONS WITH ALL INVERTS OF SAME RELATIVE ELEVATION. FOR EXCESSIVE ELEVATION DIFFERENCE BETWEEN INVERTS, SPECIAL BASE/CHANNEL DETAILS WILL BE SHOWN ON THE PLANS.
 10. FLOW CHANNELS AND INVERTS SHALL BE FORMED BY SHAPING WITH CLASS B CONCRETE OR APPROVED GROUT.
 11. STUB-OUTS SHALL EXTEND 2 FT. MINIMUM BEYOND OUTSIDE WALL SURFACE OF MANHOLE AND BE SATISFACTORILY PLUGGED.
 12. THE SLOPE OF THE MANHOLE COVER SHALL MATCH THE ROADWAY PROFILE AND CROSS SLOPE.
- ▲ WHEN FINAL GRADE IS PAVEMENT SURFACE, RECESS MANHOLE RING AND COVER 1/4" MIN. TO 1/2" MAX.

MARK	SIZE	TYPE	WT. #/FT.	BARS	I.D.						FORMULAS
					54"	60"	66"	72"	84"	96"	
401	4	I	0.668	{ NO. REQ'D. LENGTH WEIGHT * 18 8'-1" 97.2 18 8'-8" 104.2 18 9'-3" 111.2 18 9'-10" 118.2 18 11'-0" 132.3 18 12'-2" 146.3	18 8'-1" 97.2	18 8'-8" 104.2	18 9'-3" 111.2	18 9'-10" 118.2	18 11'-0" 132.3	18 12'-2" 146.3	401 BAR LENGTH = 32" + 2W + I.D.
402	4	III	0.668	{ NO. REQ'D. LENGTH WEIGHT * 5 5'-5" 18.1 5 6'-0" 20.0 5 6'-7" 22.0 5 7'-2" 23.9 5 8'-4" 27.8 5 9'-6" 31.7	5 5'-5" 18.1	5 6'-0" 20.0	5 6'-7" 22.0	5 7'-2" 23.9	5 8'-4" 27.8	5 9'-6" 31.7	402 BAR LENGTH = I.D. + 2W
501	5	I	1.043	{ NO. REQ'D. LENGTH WEIGHT * 17 7'-5" 131.5 17 8'-0" 141.8 17 8'-7" 152.2 17 9'-2" 162.5 17 10'-4" 183.2 17 11'-6" 203.9	17 7'-5" 131.5	17 8'-0" 141.8	17 8'-7" 152.2	17 9'-2" 162.5	17 10'-4" 183.2	17 11'-6" 203.9	501 BAR LENGTH = 24" + I.D. + 2W
502	5	I	1.043	{ NO. REQ'D. LENGTH WEIGHT * 22 5'-0" 114.7 23 5'-0" 119.9 25 5'-0" 130.4 26 5'-0" 135.6 29 5'-0" 151.2 32 5'-0" 166.9	22 5'-0" 114.7	23 5'-0" 119.9	25 5'-0" 130.4	26 5'-0" 135.6	29 5'-0" 151.2	32 5'-0" 166.9	502 NUMBER BARS REQ'D. = 3 + (24+I.D.+2W+1) / 5"
503	5	II	1.043	{ NO. REQ'D. LENGTH WEIGHT * 16 12'-10" 214.2 16 13'-5" 223.9 18 14'-0" 262.8 18 14'-7" 273.8 20 15'-9" 328.5 24 16'-11" 423.5	16 12'-10" 214.2	16 13'-5" 223.9	18 14'-0" 262.8	18 14'-7" 273.8	20 15'-9" 328.5	24 16'-11" 423.5	503 NUMBER BARS REQ'D. = 2 * (13+I.D.+2W+1) / 12" @ 12" BAR LENGTH = 4'-9"+2(16+W+I.D./2)
504	5	I	1.043	{ NO. REQ'D. LENGTH WEIGHT * 12 8'-1" 101.2 14 8'-8" 126.6 14 9'-3" 135.1 16 9'-10" 164.1 18 11'-0" 206.5 20 12'-2" 253.8	12 8'-1" 101.2	14 8'-8" 126.6	14 9'-3" 135.1	16 9'-10" 164.1	18 11'-0" 206.5	20 12'-2" 253.8	504 NUMBER BARS REQ'D. = 2 * (2W+I.D.-4) / 12" @ 12" BAR LENGTH = 32"+2W+I.D.
1101	11	I	5.313	{ NO. REQ'D. LENGTH WEIGHT * 4 7'-2" 152.3 4 7'-9" 164.7 4 8'-4" 177.1 4 8'-11" 189.5 4 10'-1" 214.3 4 11'-3" 239.1	4 7'-2" 152.3	4 7'-9" 164.7	4 8'-4" 177.1	4 8'-11" 189.5	4 10'-1" 214.3	4 11'-3" 239.1	1101 BAR LENGTH = 21" + I.D. + 2W
1102	11	I	5.313	{ NO. REQ'D. LENGTH WEIGHT * 4 2'-8" 56.7 4 2'-8" 56.7 4 2'-8" 56.7 4 2'-8" 56.7 4 2'-8" 56.7 4 2'-8" 56.7	4 2'-8" 56.7	4 2'-8" 56.7	4 2'-8" 56.7	4 2'-8" 56.7	4 2'-8" 56.7	4 2'-8" 56.7	BENDING TYPE I STRAIGHT
1103	11	I	5.313	{ NO. REQ'D. LENGTH WEIGHT * 3 5'-0" 79.7 3 5'-0" 79.7 3 5'-0" 79.7 3 5'-0" 79.7 3 5'-0" 79.7 3 5'-0" 79.7	3 5'-0" 79.7	3 5'-0" 79.7	3 5'-0" 79.7	3 5'-0" 79.7	3 5'-0" 79.7	3 5'-0" 79.7	TYPE II 4'-9" / 16"+W+I.D./2
* REINFORCING STEEL TOTAL					965.6	1,037.5	1,127.2	1,204.0	1,380.2	1,601.6	
CONCRETE - CUBIC YARDS - TOTAL					6.0	6.6	7.3	8.0	9.5	11.1	

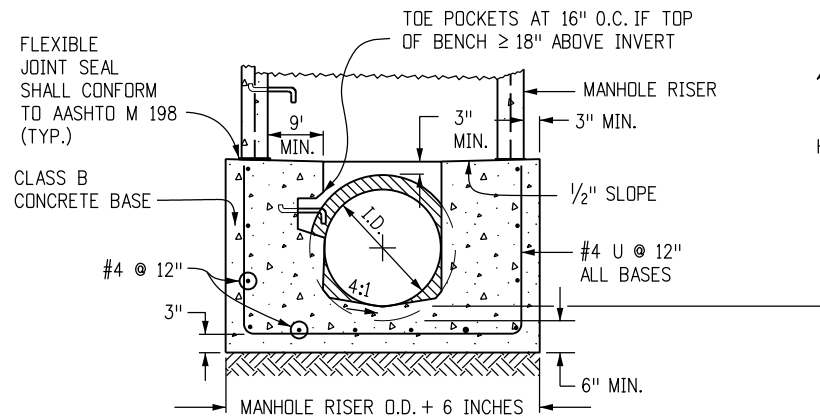
NOTE: QUANTITIES ARE BASED ON SAME SIZE PIPE ENTRANCE TO AND EXIT FROM, BASE AND A 4 FT. MANHOLE ENTRANCE INTO TOP SLAB OF BASE.

QUANTITIES FOR CONCRETE MANHOLE BOX BASE

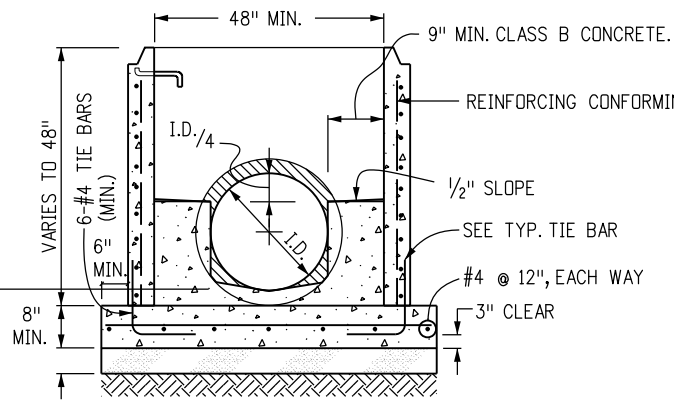


TYPICAL CHANNELIZATION DETAILS

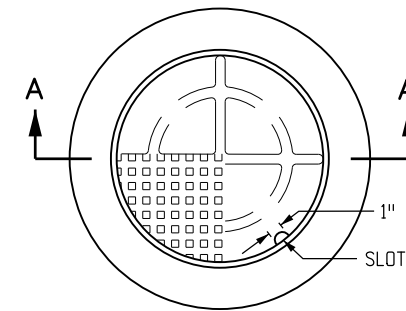
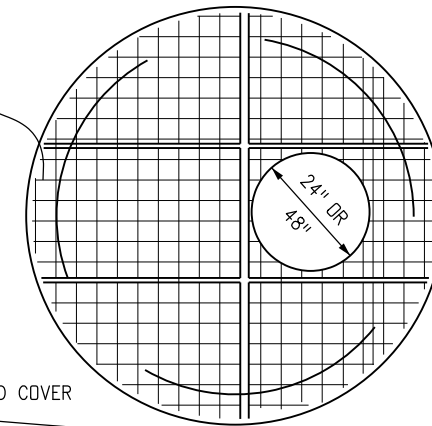
Computer File Information Creation Date: 07/31/19 Designer Initials: JBK Last Modification Date: 07/31/19 Detailer Initials: LTA CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		Sheet Revisions Date: _____ Comments: _____ (R-X) (R-X) (R-X) (R-X)		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch		MANHOLES Issued by the Project Development Branch: July 31, 2019		STANDARD PLAN NO. M-604-20 Standard Sheet No. 1 of 3 Project Sheet Number: _____	
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SECTION B-B

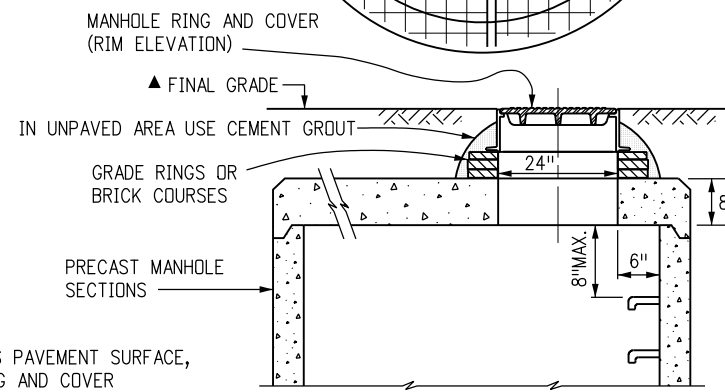


SECTION D-D



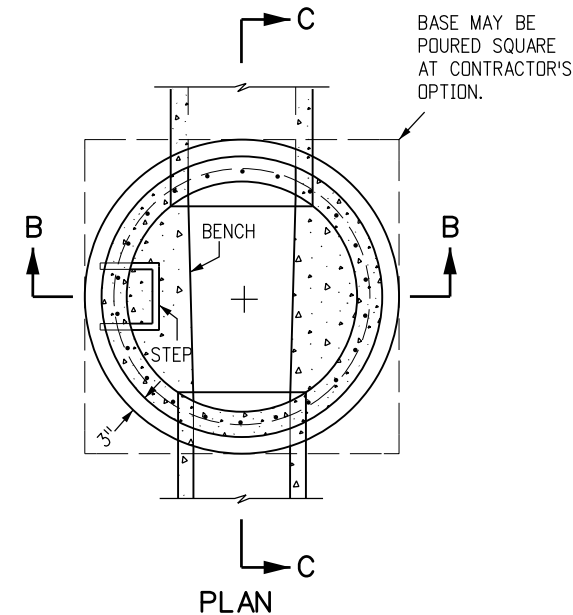
TOTAL WEIGHT: APPROXIMATELY 400 LBS.
SHALL BE GRAY OR DUCTILE CAST
IRON IN ACCORDANCE WITH
SUBSECTION 712.06.

**SECTION A-A
MANHOLE RING AND COVER**

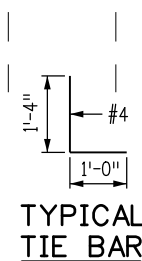


FLAT TOP SECTION DETAIL

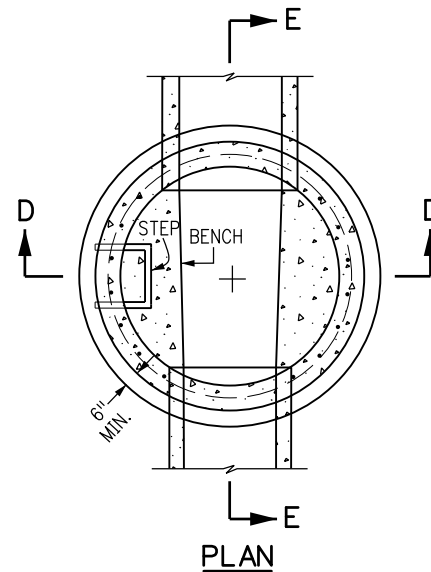
▲ WHEN FINAL GRADE IS PAVEMENT SURFACE,
RECESS MANHOLE RING AND COVER
1/4" MIN. TO 1/2" MAX.



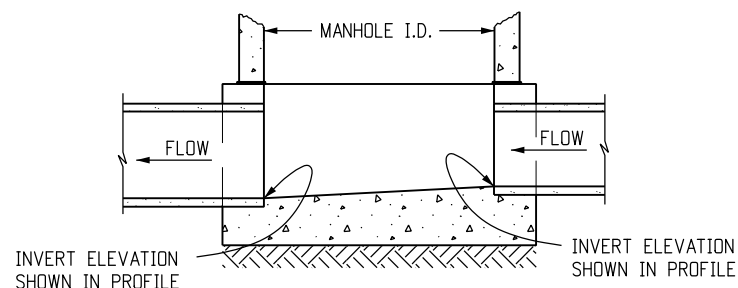
PLAN



**TYPICAL
TIE BAR**

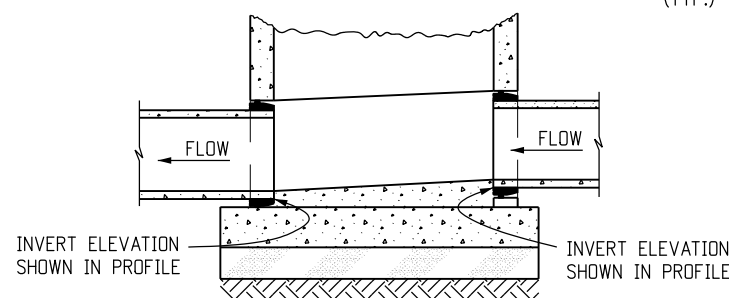


PLAN



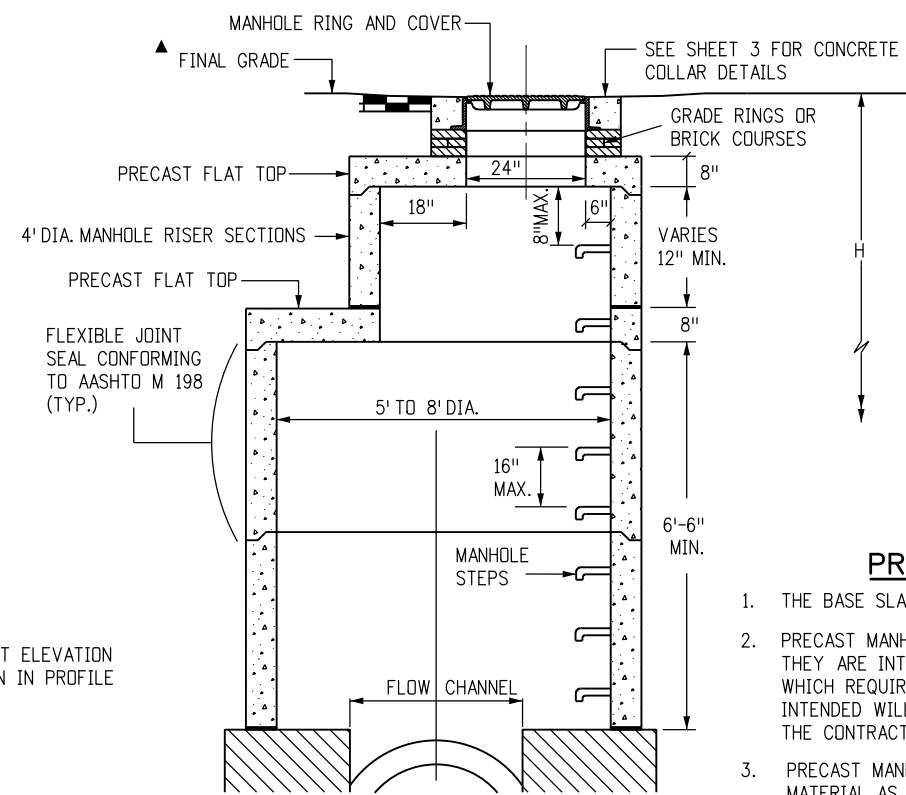
SECTION C-C

CAST-IN-PLACE SLAB BASE



SECTION E-E

PRECAST SLAB BASE



MANHOLE RISER DETAIL

LEGEND

- SUITABLE SUBGRADE
- GRANULAR BEDDING MATERIAL
- CONCRETE

PRECAST MANHOLE BASES NOTES:

1. THE BASE SLAB SHALL BE POURED MONOLITHICALLY WITH BOTTOM RISER SECTION.
2. PRECAST MANHOLE BASES SHALL FIT THE CONDITIONS AND LOCATIONS FOR WHICH THEY ARE INTENDED WITHOUT ANY FIELD MODIFICATIONS. ANY MANHOLE BASE WHICH REQUIRES FIELD CUTTING OR MODIFICATION IN ORDER TO FIT THE LOCATIONS INTENDED WILL BE REJECTED BY THE ENGINEER AND REMOVED AND REPLACED BY THE CONTRACTOR AT NO COST TO THE DEPARTMENT.
3. PRECAST MANHOLE BASES SHALL BE BEDDED ON AN APPROVED GRANULAR BEDDING MATERIAL AS SHOWN ABOVE.

Computer File Information

Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
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Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions

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Project Development Branch **JBK**

MANHOLES

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.

M-604-20

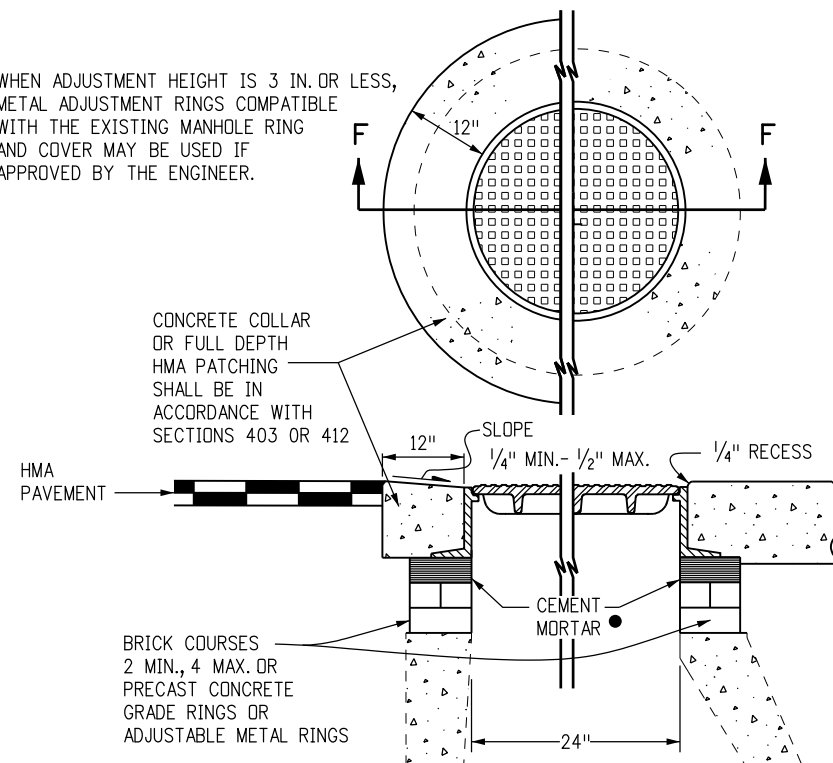
Standard Sheet No. 2 of 3

Project Sheet Number:

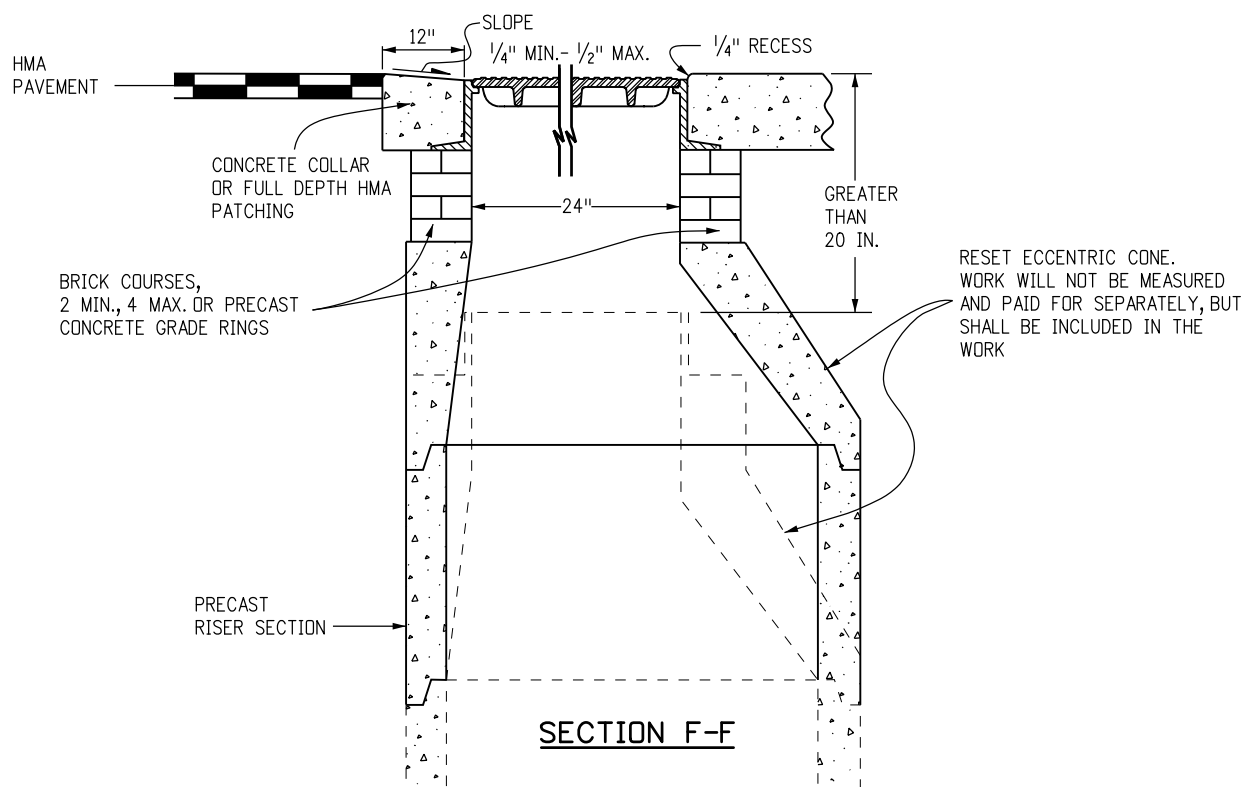
T-BASE MANHOLES NOTES

1. THE T-BASE SECTION SHALL BE SHOP-FABRICATED FOR DELIVERY TO THE CONSTRUCTION SITE AS A COMPLETE UNIT.
2. THESE DETAILS SHOW ONLY THE CONCEPTUAL AND STANDARD DIMENSIONAL REQUIREMENTS FOR TYPE T-BASE MANHOLES. THE CONTRACTOR SHALL FURNISH DETAILED SHOP DRAWINGS FOR APPROVAL PRIOR TO FABRICATION. THE DETAILS SHOWN HEREIN APPLY ONLY TO 48 IN. AND GREATER DIAMETER PIPES.
3. EXCEPT FOR CLASS OF PIPE, SPECIFICATIONS FOR THE MANHOLE SHALL BE THE SAME AS THOSE REQUIRED FOR THE ADJOINING PIPE.
4. THE T-BASE SECTION SHALL MAINTAIN ITS INTERNAL SHAPE AND FLOW AREA. GROUTING OR FILLING SHALL BE APPLIED SO AS TO NOT DISTURB THE NORMAL FLOW OR REDUCE THE AREA.

WHEN ADJUSTMENT HEIGHT IS 3 IN. OR LESS, METAL ADJUSTMENT RINGS COMPATIBLE WITH THE EXISTING MANHOLE RING AND COVER MAY BE USED IF APPROVED BY THE ENGINEER.

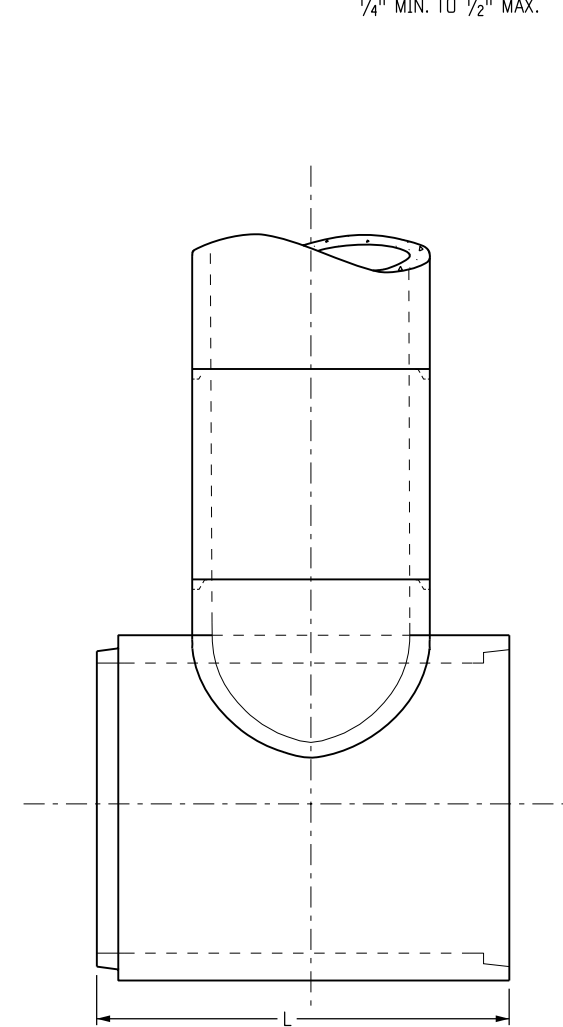


**SECTION F-F
ADJUST MANHOLE 20 IN. OR LESS**

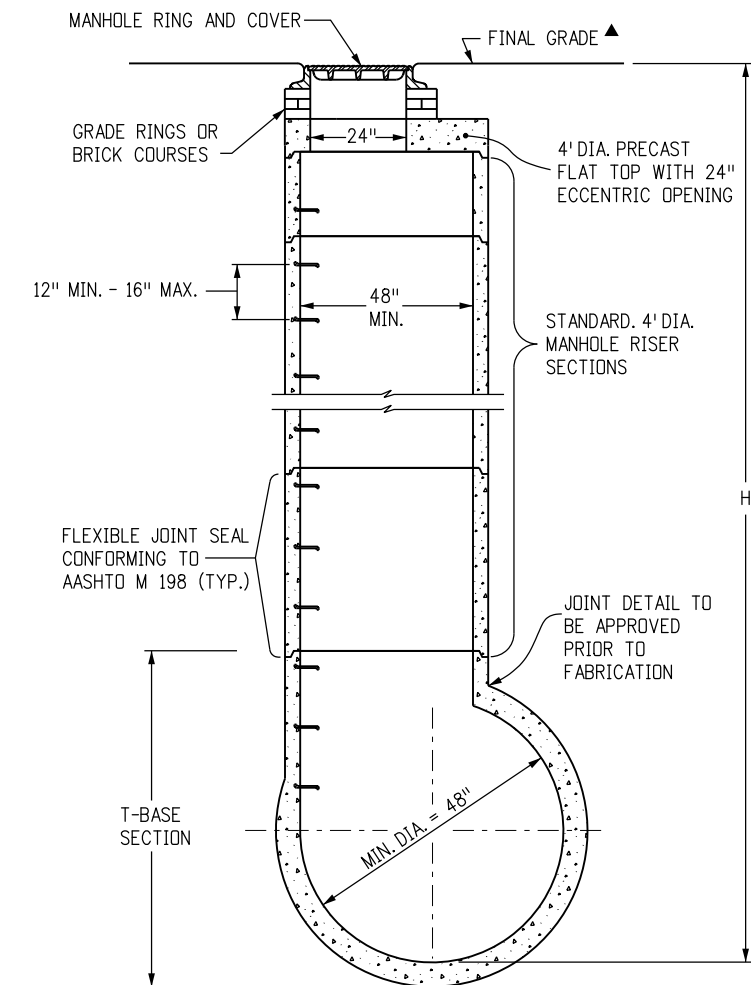


**SECTION F-F
MODIFY MANHOLE GREATER THAN 20 IN.**

▲ WHEN FINAL GRADE IS PAVEMENT SURFACE, RECESS MANHOLE RING AND COVER 1/4" MIN. TO 1/2" MAX.



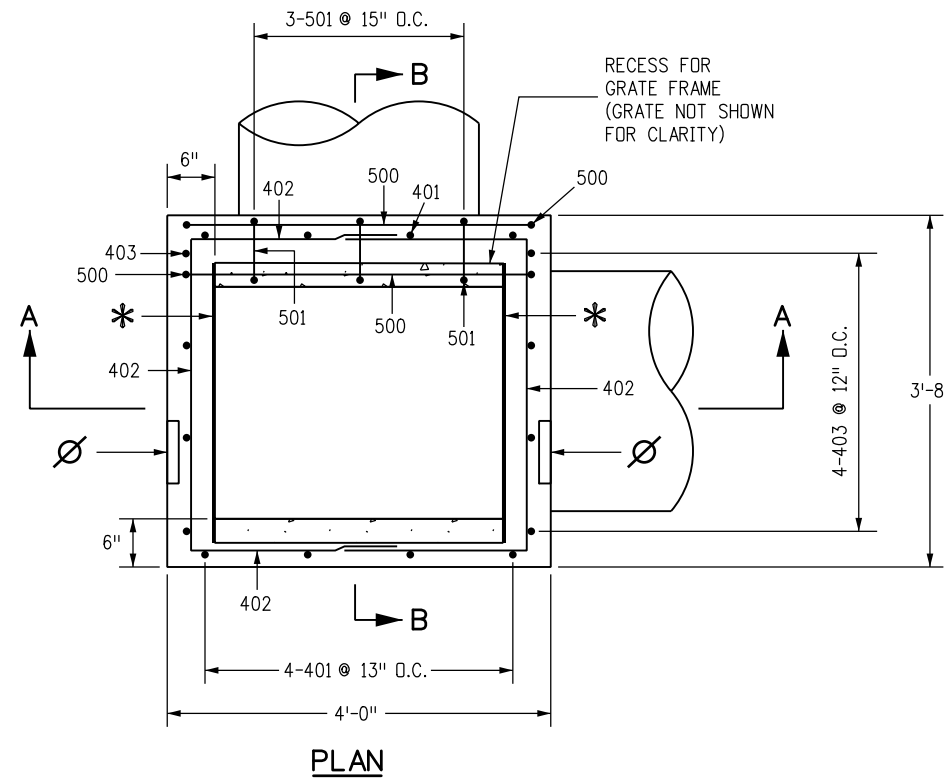
**CIRCULAR RIGID PIPE
(LONGITUDINAL SECTION)**



**CIRCULAR RIGID PIPE
(TRANSVERSE SECTION)**

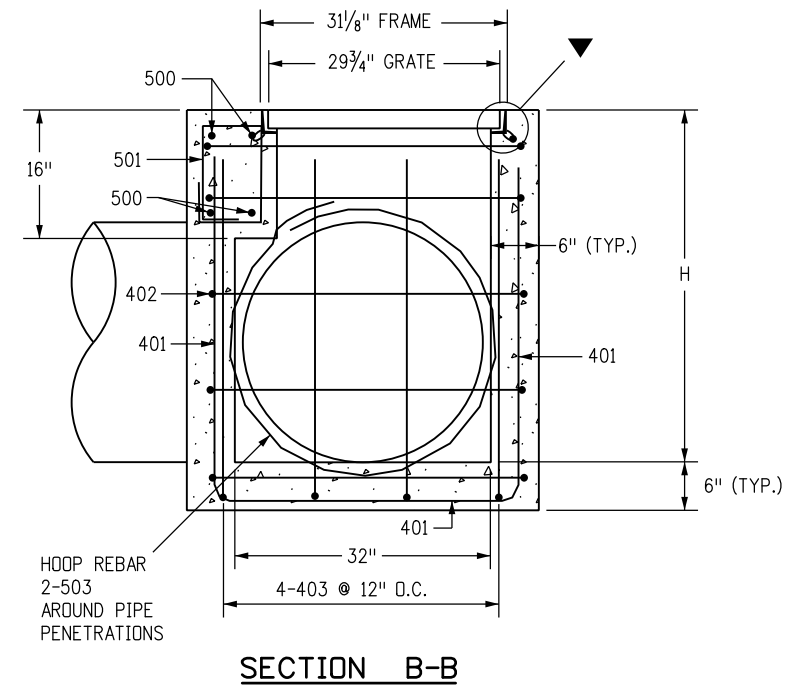
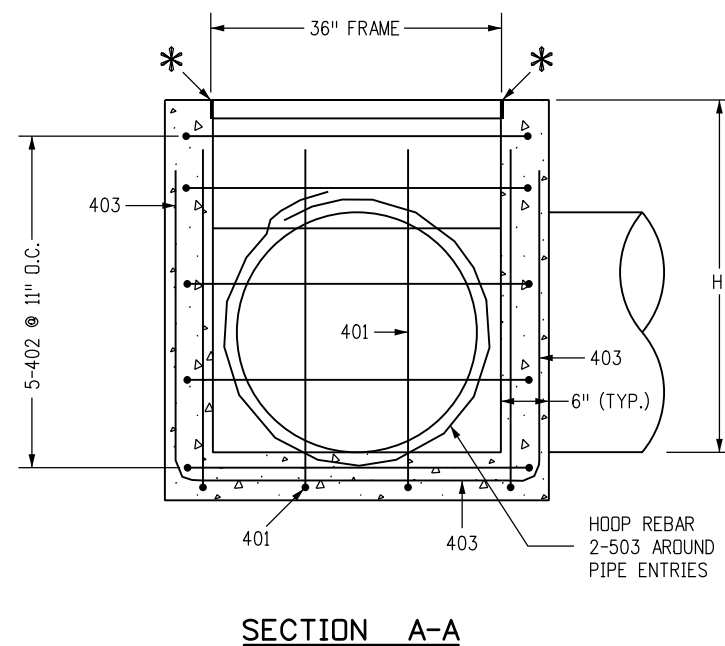
MANHOLE T-BASE

Computer File Information		Sheet Revisions		Colorado Department of Transportation		MANHOLES	STANDARD PLAN NO.	
Creation Date: 07/31/19	(R-X)	Date:	Comments:	 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868	Project Development Branch JBK		M-604-20	
Designer Initials: JBK	(R-X)						Issued by the Project Development Branch: July 31, 2019	Standard Sheet No. 3 of 3
Last Modification Date: 07/31/19	(R-X)							Project Sheet Number:
Detailer Initials: LTA	(R-X)							
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)							



GENERAL NOTES

- FOR THE 32 INCH AND 36 INCH INSIDE INLET DIMENSIONS, THE ALLOWABLE PIPE I.D. IS 30 INCHES OR LESS. FOR THE 72 INCH INSIDE INLET DIMENSION, THE ALLOWABLE PIPE I.D. IS "H" MINUS 18 INCHES, OR LESS, UP TO A MAXIMUM OF 66 INCHES FOR "H" OF 7 FEET OR MORE.
- ALL CONCRETE SHALL BE CLASS B.
- INLET MAY BE CAST-IN-PLACE OR PRECAST.
- REINFORCING BARS SHALL BE #4 UNLESS SHOWN OTHERWISE.
- ALL REINFORCING BARS SHALL BE GRADE 60 AND EPOXY COATED. REINFORCING BARS SHALL HAVE A MINIMUM CLEARANCE OF 2 IN.
- ALL EDGE DISTANCES NOT MARKED "CLEAR" ARE TO THE CENTERLINE OF THE BAR.
- CUT OR BEND REINFORCING BARS AROUND PIPES AS REQUIRED.
- STEPS SHALL BE REQUIRED WHEN THE INLET DEPTH "H" IS EQUAL TO OR GREATER THAN 4 FT. AND SHALL CONFORM TO AASHTO M 199.
- THE INVERT OF THE BOX SHALL BE SLOPED TO DRAIN.
- THE CONTRACTOR SHALL STAMP FLOW ARROWS INTO THE TOP SURFACE OF THE INLET BOX SIDEWALLS TO INDICATE THE DIRECTION OF RUNOFF. THE STAMPED ARROWS SHALL BE 6 IN. LONG, 1 IN. HIGH, AND 3/8 IN. DEEP. FOR INLETS IN SUMP CONDITIONS, THE STAMPED FLOW ARROWS SHALL INDICATE THE PREDOMINATE DIRECTION OF RUNOFF FLOW.
- A 4 IN. DIA. STAINLESS STEEL MEDALLION WITH "NO DUMPING DRAINS TO STREAM" OR SIMILAR MESSAGE SHALL BE FIRMLY ATTACHED TO TOP OF THE INLET SURFACE WITH A PERMANENT FASTENER. THE MEDALLION WILL HAVE A FISH SYMBOL AND BLUE COLOR BACKGROUND. ALTERNATIVELY, THIS MESSAGE MAY BE CAST WITH 1 IN. HEIGHT LETTERS INTO THE TOP OF THE INLET'S CONCRETE SURFACE OR SURROUNDING CONCRETE APRON. THE NO DUMPING MESSAGE SHALL BE ELIMINATED FOR INLETS LOCATED WITHIN THE SHOULDER OF CONTROLLED ACCESS FREEWAYS WHEN SPECIFIED IN THE PLANS.



LEGEND

- ▼ GRATE TO BE INSTALLED DURING CONSTRUCTION OF THE BOX WITH THE VANE GRATE BOLTED IN PLACE TO THE FRAME.
- * TO FACILITATE REMOVAL OF THE GRATE, PLACE PLYWOOD 3 IN. x 1/4 IN. x 31-3/8 IN. ALONG EDGE OF THE GRATE AS SHOWN.
- ∅ FLOW ARROW STAMP IN DIRECTION OF FLOW (TYP.). FLOW →

Computer File Information

Creation Date: 07/31/19
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 Last Modification Date: 07/31/19
 Detailer Initials: LTA
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Sheet Revisions

Date:	Comments
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(R-X)	
(R-X)	
(R-X)	

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 Project Development Branch JBK

VANE GRATE INLET

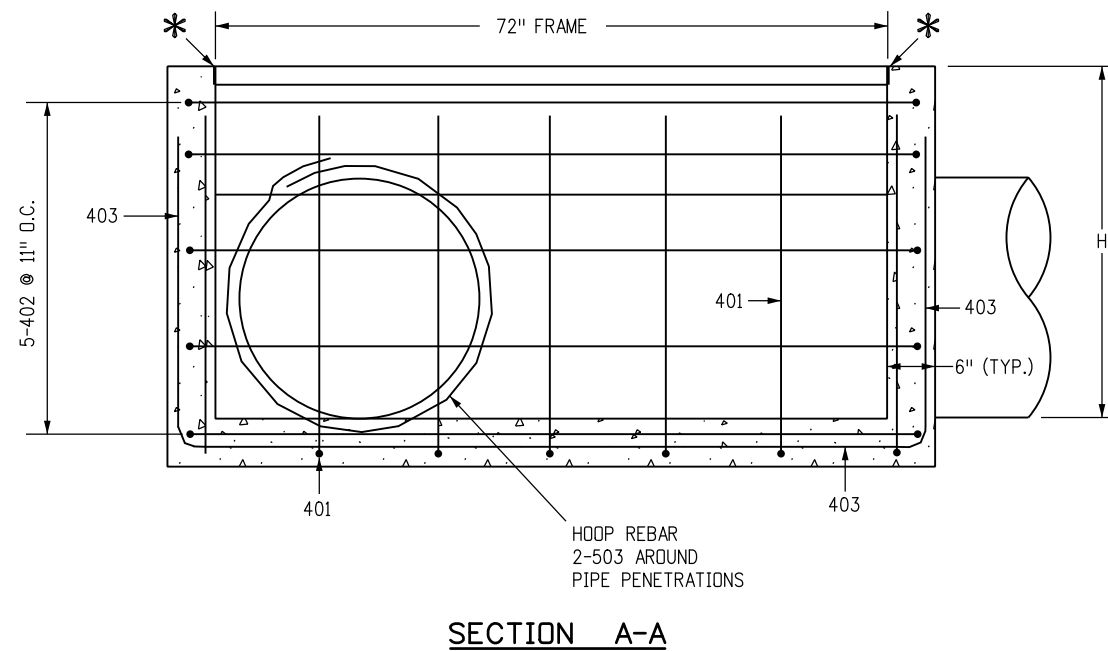
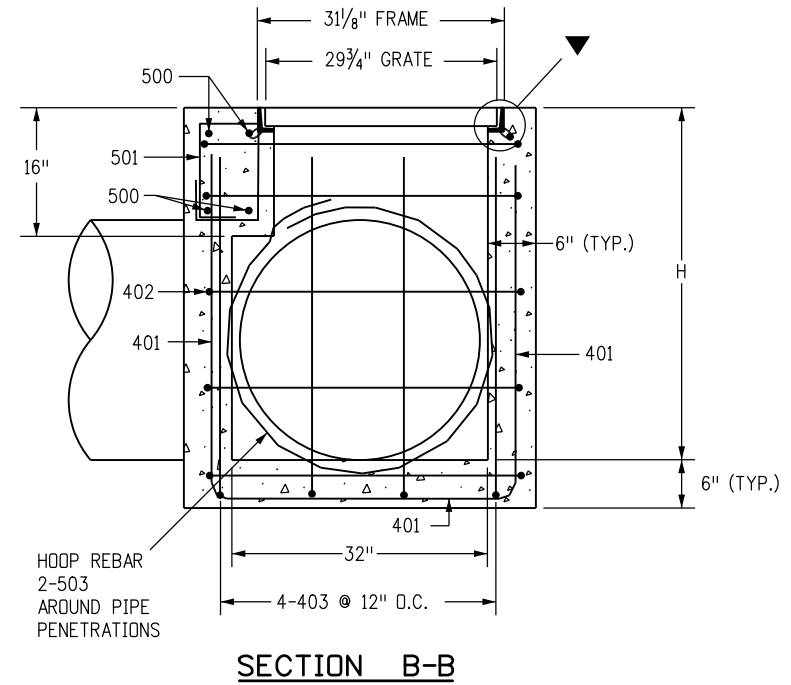
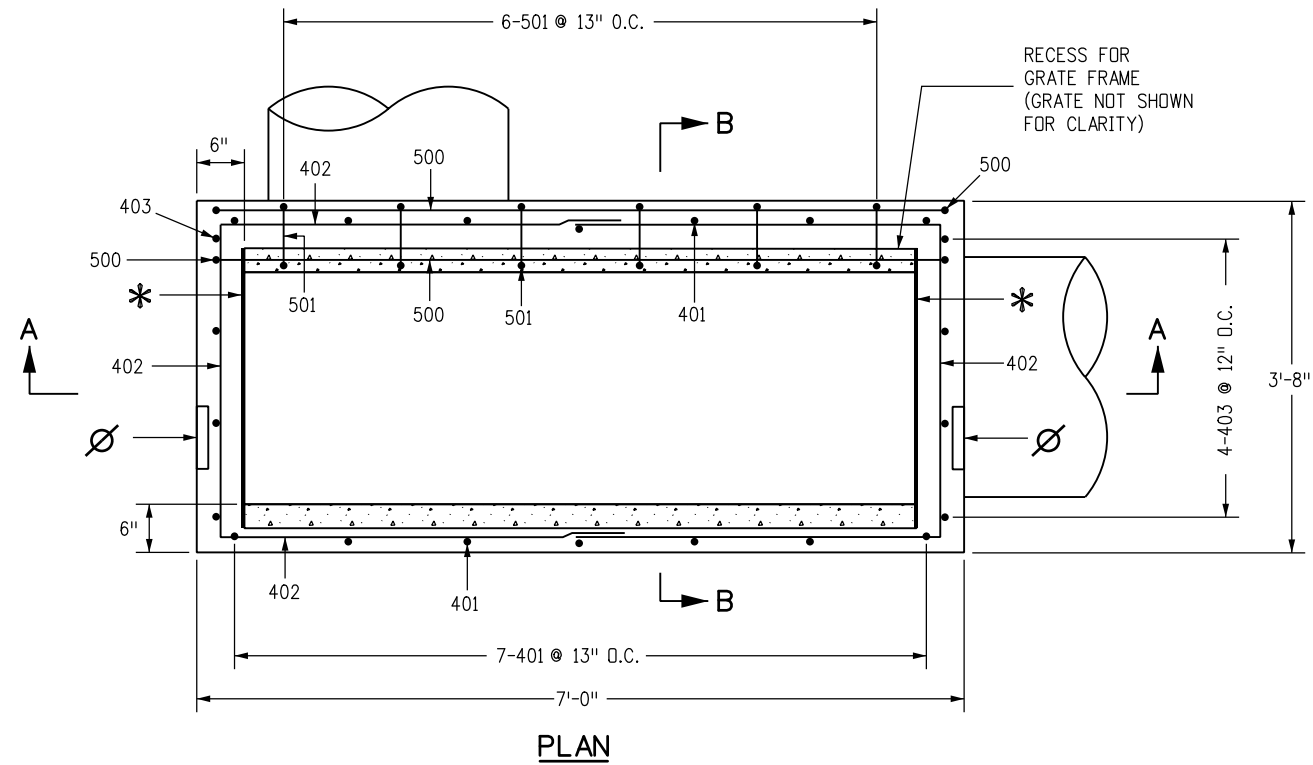
Issued by the Project Development Branch: July 31, 2019

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M-604-25

Standard Sheet No. 1 of 5

Project Sheet Number:



LEGEND

- ▼ GRATE TO BE INSTALLED DURING CONSTRUCTION OF THE BOX WITH THE VANE GRATE BOLTED IN PLACE TO THE FRAME.
- * TO FACILITATE REMOVAL OF THE GRATE, PLACE PLYWOOD 3 IN. x 1/4 IN. x 31-3/8 IN. ALONG EDGE OF THE GRATE AS SHOWN.
- ∅ FLOW ARROW STAMP IN DIRECTION OF FLOW (TYP.).

Computer File Information	
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Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

Colorado Department of Transportation

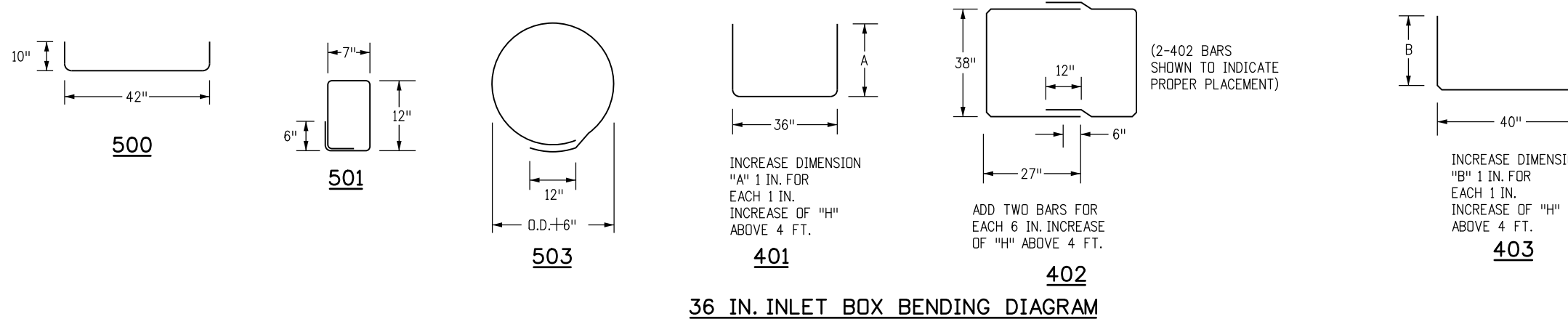
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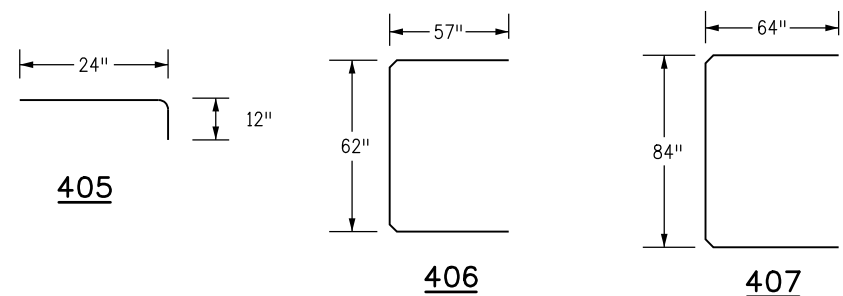
**VANE GRATE
INLET**

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-604-25
Standard Sheet No. 2 of 5
Project Sheet Number:



36 IN. INLET BOX BENDING DIAGRAM



INLET APRON BENDING DIAGRAM FOR 36 IN. INLET

MARK	NO. REQ'D	LENGTH (EACH)
405	9	3'-0"
406	1	14'-8"
407	1	17'-8"

BAR LIST FOR CONCRETE APRON
(FOR INFORMATION ONLY)

MARK	NO. REQ'D	HEIGHT "A"	HEIGHT "B"	LENGTH (EACH)
500	4			5'-2"
501	3			4'-2"
503	4			10'-5"
401	4	3'-10"		10'-8"
402	10			7'-8"
403	4		4'-0"	11'-4"

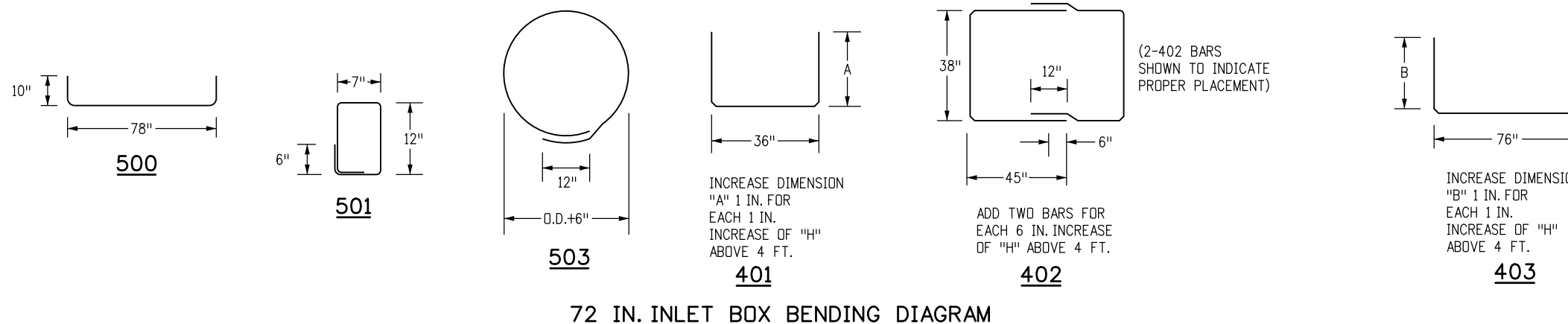
BAR LIST FOR H = 4'-0" 36 IN. INLET

QUANTITIES FOR ONE 36 IN. INLET

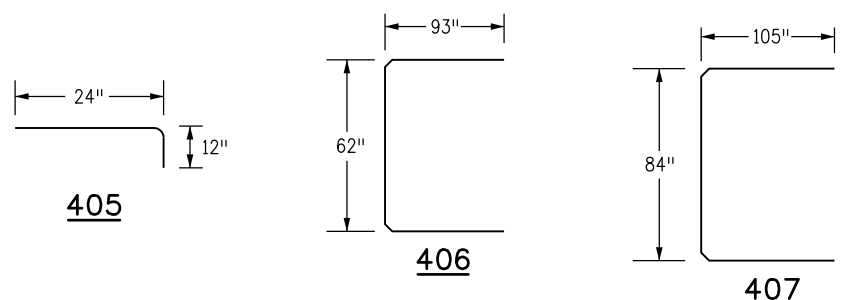
H	NUMBER OF STEPS REQUIRED	CONC. CU. YD.	STEEL LBS.
4'-0"	1	1.3	180
4'-6"	2	1.5	186
5'-0"	2	1.6	201
5'-6"	2	1.7	207
6'-0"	3	1.8	222
6'-6"	3	1.9	227
7'-0"	3	2.1	243
7'-6"	4	2.2	248
8'-0"	4	2.3	263
8'-6"	4	2.4	269
9'-0"	5	2.5	285
9'-6"	5	2.7	289
10'-0"	5	2.8	306
10'-6"	6	2.9	310
11'-0"	6	3.0	326
11'-6"	6	3.1	331

NOTES

1. CONCRETE QUANTITY INCLUDES VOLUME OCCUPIED BY PIPES.
2. REINFORCING STEEL QUANTITY ASSUMES TWO 503 HOOPS FOR EACH 24 IN. PIPE.
3. BARS NUMBERED IN 400 SERIES INDICATES #4 SIZE BAR. BARS NUMBERED IN 500 SERIES INDICATES #5 SIZE BAR.
4. ALL REINFORCING BARS SHALL BE GRADE 40 AND EPOXY COATED.



72 IN. INLET BOX BENDING DIAGRAM



INLET APRON BENDING DIAGRAM FOR 72 IN. INLET

MARK	NO. REQ'D	LENGTH (EACH)
405	13	3'-0"
406	1	20'-8"
407	1	24'-6"

BAR LIST FOR CONCRETE APRON
(FOR INFORMATION ONLY)

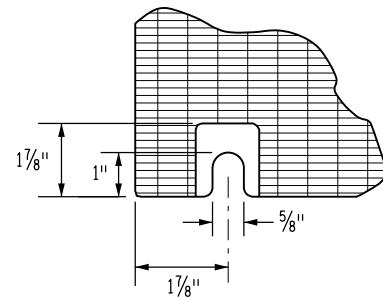
MARK	NO. REQ'D	HEIGHT "A"	HEIGHT "B"	LENGTH (EACH)
500	4			8'-2"
501	6			4'-2"
503	4			10'-5"
401	7	3'-10"		10'-8"
402	10			10'-8"
403	4		4'-0"	14'-4"

BAR LIST FOR H = 4'-0" 72 IN. INLET

QUANTITIES FOR ONE 72 IN. INLET

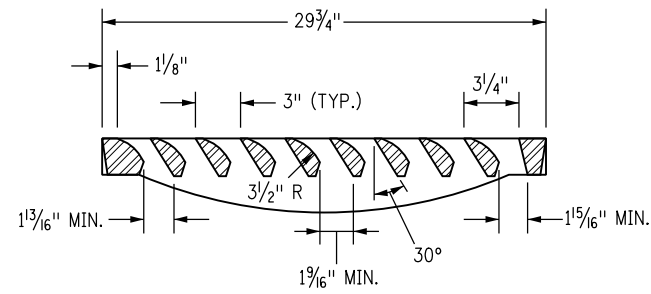
H	NUMBER OF STEPS REQUIRED	CONC. CU. YD.	STEEL LBS.
4'-0"	1	2.1	253
4'-6"	2	2.3	260
5'-0"	2	2.4	282
5'-6"	2	2.6	289
6'-0"	3	2.8	310
6'-6"	3	3.0	318
7'-0"	3	3.2	339
7'-6"	4	3.3	346
8'-0"	4	3.5	369
8'-6"	4	3.7	376
9'-0"	5	3.9	397
9'-6"	5	4.1	405
10'-0"	5	4.2	426
10'-6"	6	4.4	433
11'-0"	6	4.6	455
11'-6"	6	4.8	462

Computer File Information		Sheet Revisions		Colorado Department of Transportation 2829 West Howard Place CDDT HQ, 3rd Floor Denver, CO 80204 Phone: 303-757-9021 FAX: 303-757-9868 Project Development Branch	<h1>VANE GRATE INLET</h1>	STANDARD PLAN NO.	
Creation Date: 07/31/19		Date:	Comments:			M-604-25	
Designer Initials: JBK		(R-X)				Standard Sheet No. 3 of 5	
Last Modification Date: 07/31/19		(R-X)					
Detailer Initials: LTA		(R-X)					
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English		(R-X)		Project Sheet Number:			

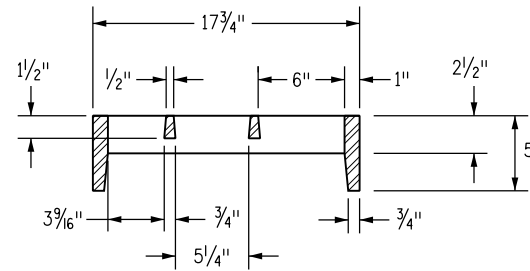


DETAIL A

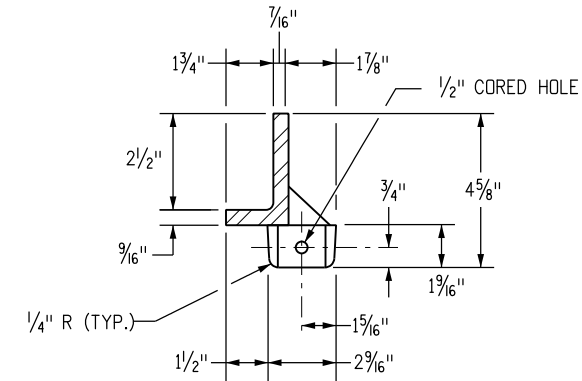
BOLT SLOT AT CORNER (TYP.)



SECTION A-A



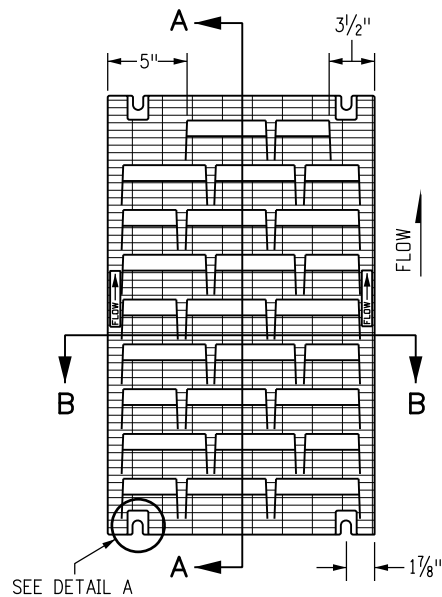
SECTION B-B



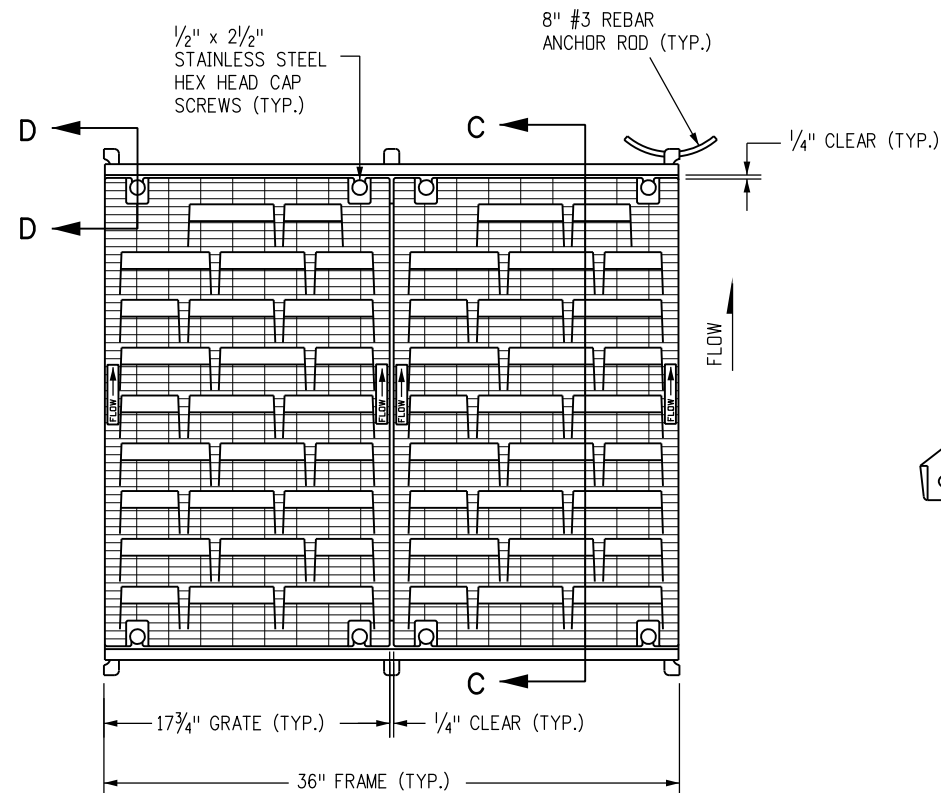
DETAIL B

NOTES

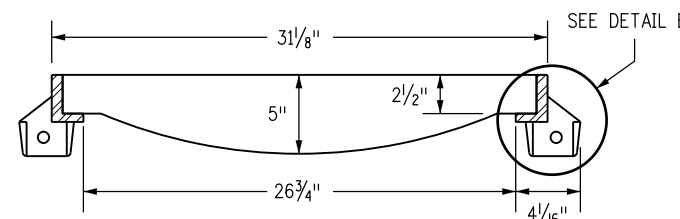
1. FREE OPEN AREA: 190 SQ. IN./GRATE.
2. MATERIAL: CAST GRAY IRON ASTM A-48 CLASS 35B.
3. FINISH: NO PAINT.
4. WEIGHT: GRATE 170 LBS. EACH; FRAME 29 LBS. EACH.
5. ALL REINFORCING BARS SHALL BE EPOXY COATED.



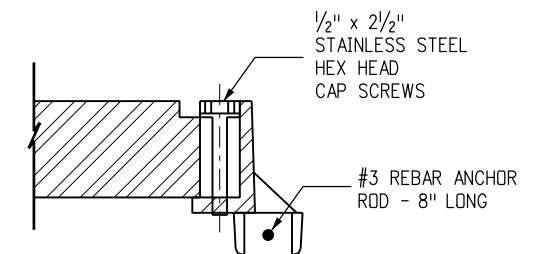
GRATE PLAN



MULTIPLE GRATE WITH FRAME PLAN



SECTION C-C



SECTION D-D

Computer File Information

Creation Date: 07/31/19
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Last Modification Date: 07/31/19
Detailer Initials: LTA
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English

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**VANE GRATE
INLET**

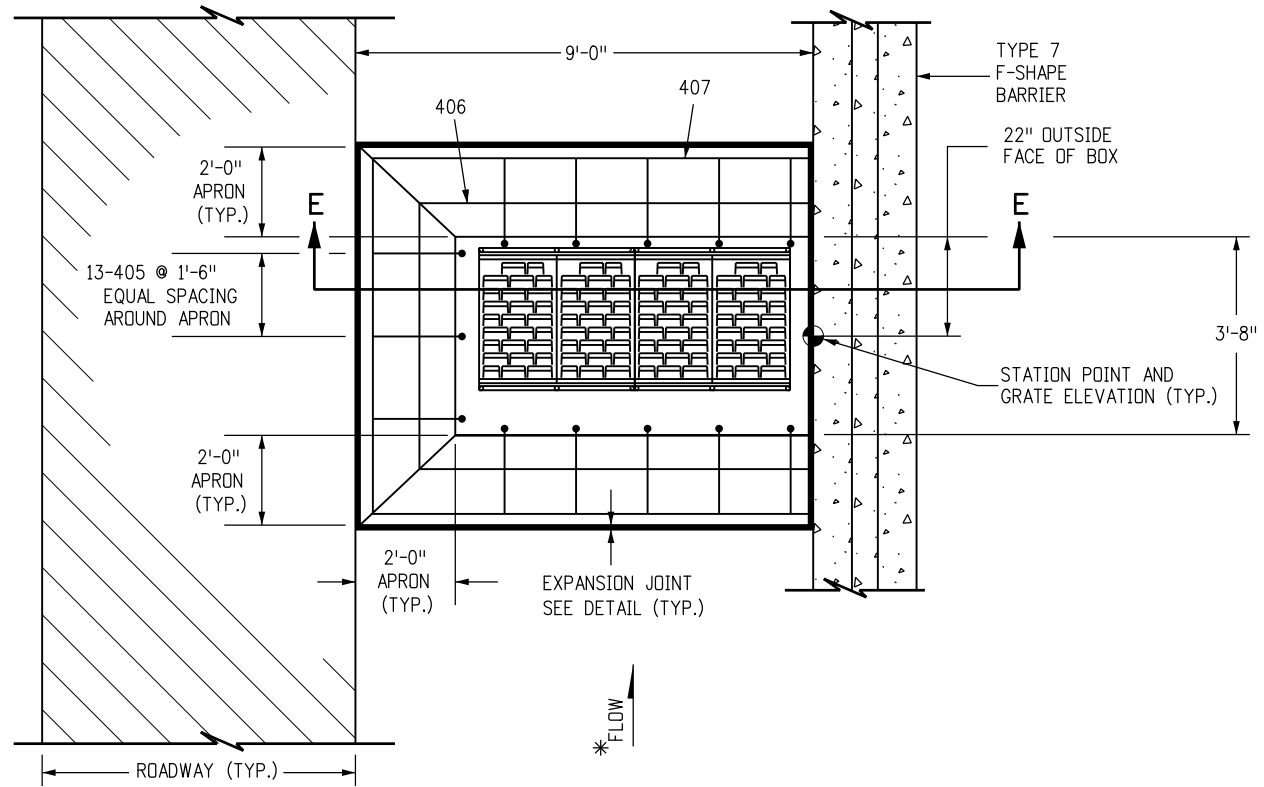
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STANDARD PLAN NO.

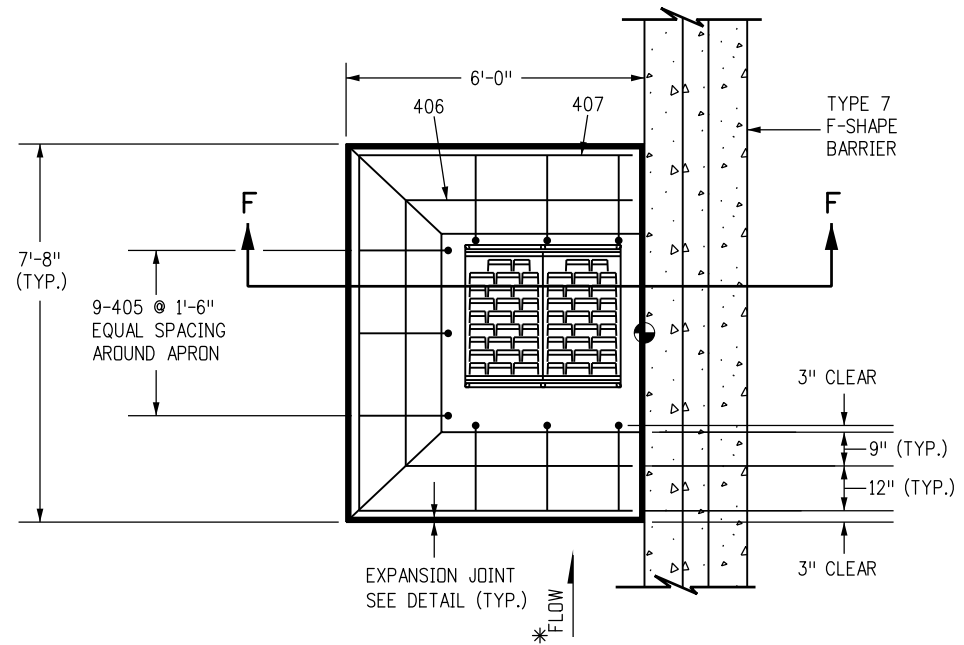
M-604-25

Standard Sheet No. 4 of 5

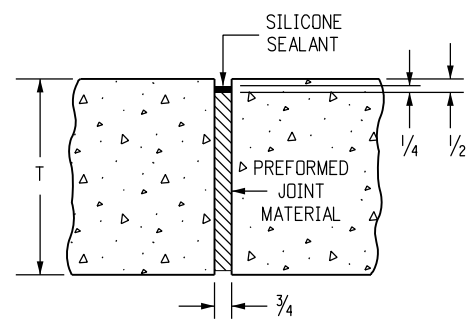
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CONCRETE APRON FOR 72 IN. INLET



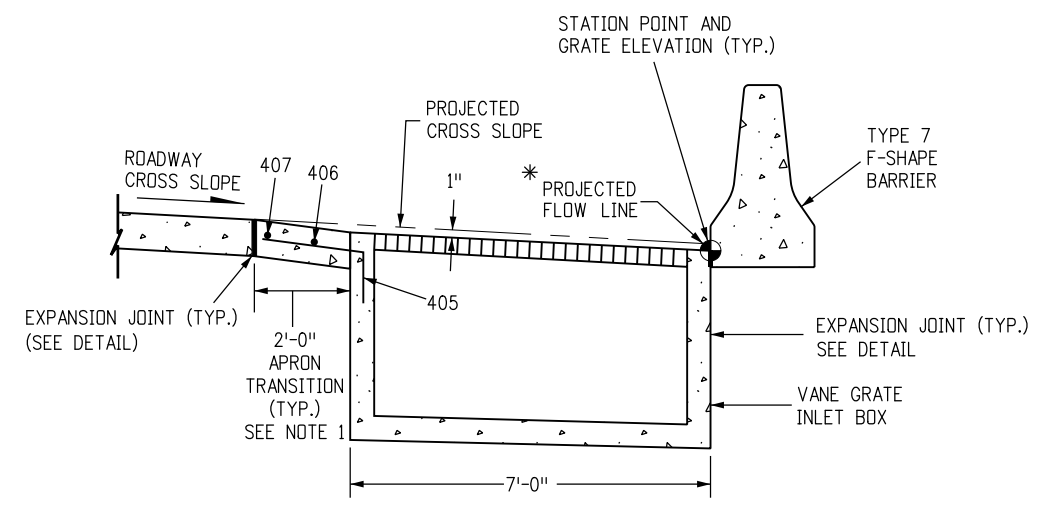
CONCRETE APRON FOR 36 IN. INLET



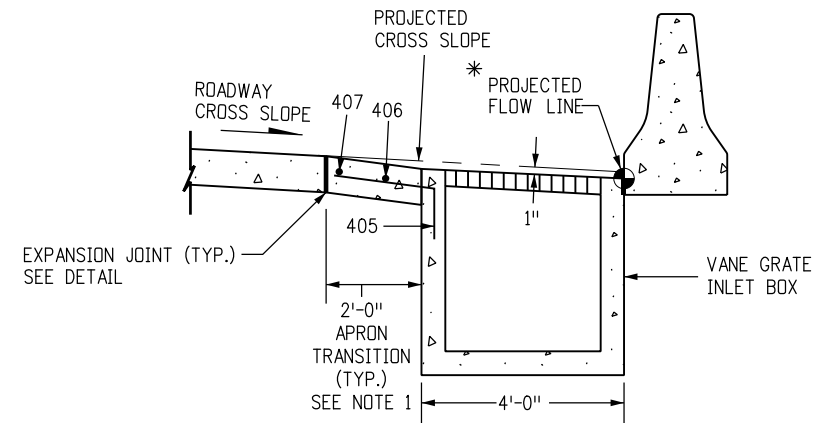
EXPANSION JOINT (TYP.)

NOTES

1. A 2 FT. CONCRETE TRANSITION APRON SHALL BE CONSTRUCTED AS SHOWN AND SHALL BE KEYED INTO THE INLET.
 2. CONCRETE APRON SHALL BE THE SAME THICKNESS AND TYPE AS THE SURROUNDING CONCRETE.
 3. THE COST OF THE CONCRETE APRON SHALL BE INCLUDED THE COST OF THE INLET.
- * IF THE INLET IS OFFSET FROM THE BARRIER, SLOPE THE APRON ADJACENT TO THE BARRIER TO DIRECT FLOW TOWARD THE GRATE.



SECTION E-E



SECTION F-F

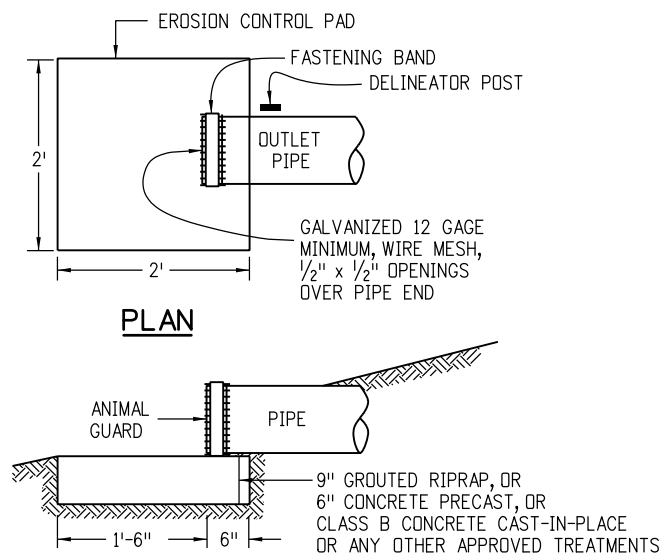
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Creation Date: 07/31/19	
Designer Initials: JBK	(R-X)
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Date:	Comments

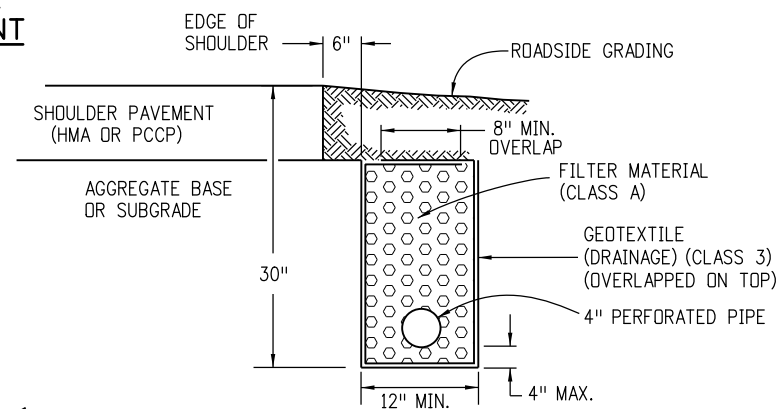
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 Project Development Branch **JBK**

VANE GRATE INLET
 Issued by the Project Development Branch: July 31, 2019

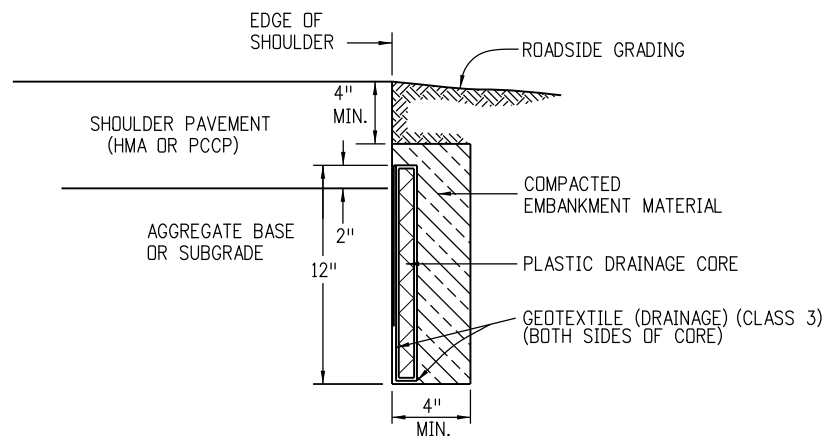
STANDARD PLAN NO.
M-604-25
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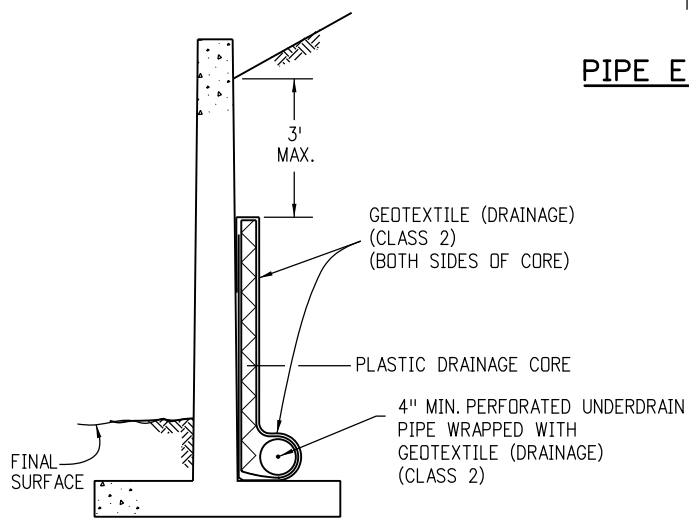
OUTLET PIPE END TREATMENT



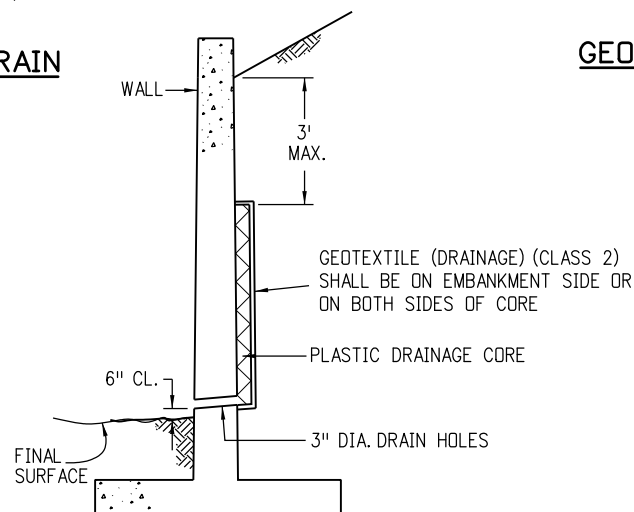
PIPE EDGE DRAIN



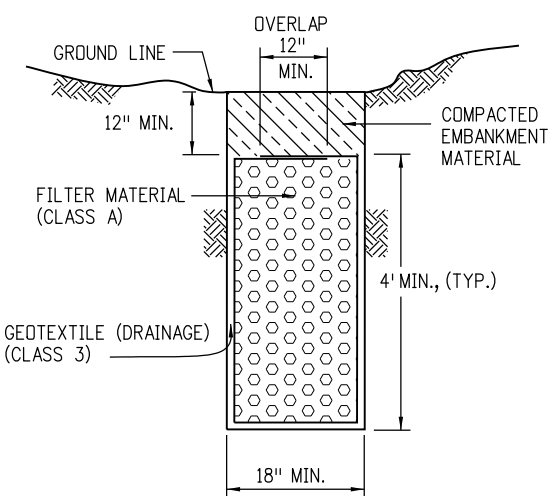
GEOCOMPOSITE EDGE DRAIN



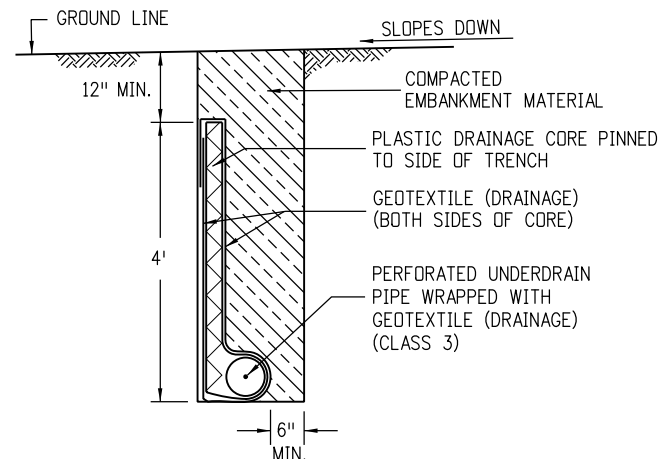
GEOCOMPOSITE DRAIN WITH PIPE



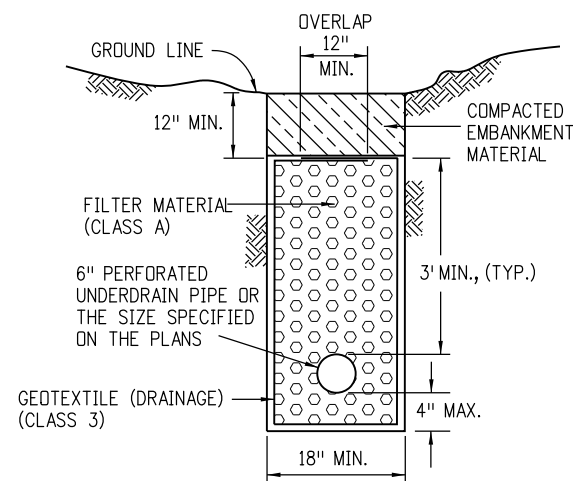
GEOCOMPOSITE DRAIN WITHOUT PIPE



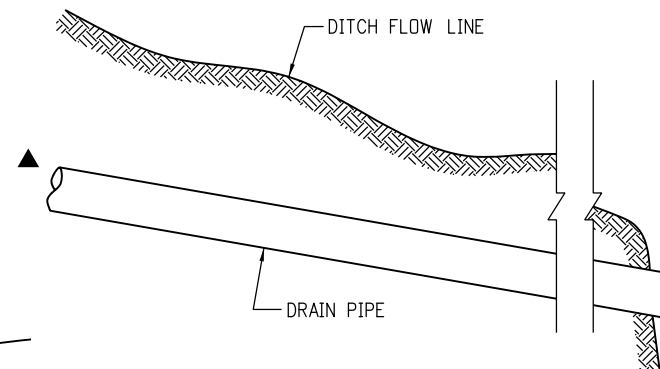
FRENCH DRAIN



GEOCOMPOSITE UNDERDRAIN



PIPE UNDERDRAIN



UNDERDRAIN PIPE

FLOWLINE OF PIPE SHALL FOLLOW ESTABLISHED GRADE AND NOT NATURAL SLOPE OF GROUND LINE.

▲ THE SLOPE OF PERFORATED UNDERDRAIN PIPES AND NON-PERFORATED UNDERDRAIN PIPES SHALL BE UNIFORM.

GENERAL NOTES

1. THE LOCATION AND GRADE OF SUBSURFACE DRAINS AND OUTLET PIPES WILL BE AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER.
2. SPACING FOR THE EDGE DRAINS ARE TO BE SPACED AT MAXIMUM 600 FT. INTERVALS OR AS SHOWN ON THE PLANS. GEOCOMPOSITE OUTLET CONNECTIONS SHALL CONFORM TO MANUFACTURER'S RECOMMENDATIONS.
3. WHERE THE UNDERDRAIN PIPE OUTLETS ONTO A SLOPE OR DITCH, THE OUTLET PIPE END SHALL BE MARKED WITH A DELINEATOR POST, AND HAVE AN ANIMAL GUARD AND AN EROSION CONTROL PAD.
4. THE GEOCOMPOSITE SHALL BE SECURED TO THE WALL OR TO THE TRENCH SIDE TO PREVENT MOVEMENT DURING BACKFILLING.
5. DRAIN HOLES IN RETAINING WALL SHALL BE SPACED AT 10 FT. INTERVALS OR AS SHOWN ON THE PLANS.
6. STRUCTURE EXCAVATION AND BACKFILL LIMITS FOR RETAINING WALLS ARE SHOWN ON STANDARD PLAN M-206-1. ALL EXTRA EXCAVATION AND BACKFILL WORK NECESSARY TO COMPLETE RETAINING WALL, AGGREGATE, AND GEOCOMPOSITE DRAINS IS INCLUDED IN THE DRAIN WORK.
7. FILTER MATERIAL SHALL BE TAMPED WITH A LIGHT VIBRATORY TAMPER PRIOR TO OVERLAPPING THE GEOTEXTILE FABRIC.
8. THE EDGE DRAIN TRENCH SHALL BE CONSTRUCTED AFTER PLACEMENT OF THE AGGREGATE BASE AND SUBBASE.

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SUBSURFACE DRAINS

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M-605-1

Standard Sheet No. 1 of 1

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