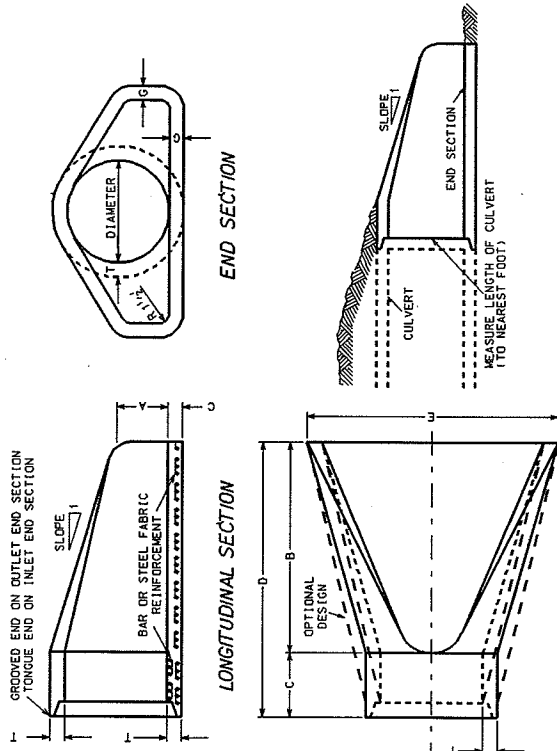


REINFORCED CONCRETE APRON ENDWALLS



DIA	APPROX. SECTION	T	A	B	C	D	E	G	APPROX. SLOPE
12"	530	2"	4"	24"	48 1/2"	72 1/2"	24"	2"	3 TO 1
15"	740	2 1/2"	6"	27"	46"	73"	30"	2 1/2"	3 TO 1
18"	990	2 1/2"	9"	36"	46"	73"	36"	2 1/2"	3 TO 1
21"	1280	2 1/2"	9"	36"	37 1/2"	73 1/2"	42"	2 1/2"	3 TO 1
24"	1520	3"	9 1/2"	43 1/2"	30"	73 1/2"	48"	3"	3 TO 1
27"	1930	3 1/2"	10 1/2"	49 1/2"	24"	73 1/2"	54"	3 1/2"	3 TO 1
30"	2190	3 1/2"	12"	54"	19 1/2"	73 1/2"	60"	3 1/2"	3 TO 1
36"	4100	4"	15"	63"	34 1/2"	97 1/2"	72"	4"	3 TO 1
42"	5380	4 1/2"	21"	63"	35"	98"	78"	4 1/2"	3 TO 1
48"	6550	5"	24"	72"	26"	98"	84"	5"	3 TO 1
54"	8040	5 1/2"	27"	65"	33 1/2"	95"	90"	5 1/2"	2 TO 1
60"	8730	6"	30"	78"	39"	99"	96"	6"	2 TO 1
66"	10630	6 1/2"	34"	78"	41"	99"	102"	6 1/2"	2 TO 1
72"	12520	7"	37"	84"	41"	99"	108"	7"	2 TO 1
78"	14430	7 1/2"	40"	90"	41"	99"	114"	7 1/2"	2 TO 1
84"	18160	8"	36"	90"	21"	111 1/2"	120"	8"	1 1/2 TO 1

NOTE: MINIMUM/MAXIMUM

GENERAL NOTES:

DETAILS OF CONSTRUCTION, MATERIALS, AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.

VARIATIONS OF THE DIMENSIONS AND DESIGNS SHOWN BEFORE WILL BE PERMITTED PROVIDING ENGINEER IS OBTAINED.

CONCRETE ENDWALLS MAY NOT BE USED WITH GALVANIZED STEEL OR ALUMINUM CULVERT PIPE OR VICE VERSA.

GALVANIZED STEEL OR ALUMINUM ENDWALLS SHALL NORMALLY BE INSTALLED ON CULVERT PIPE OF THE SAME METAL. THE USE OF GALVANIZED STEEL OR ALUMINUM PIPES IS PERMITTED, PROVIDED THAT THE METAL THICKNESS OF THE ENDWALL SHALL BE AT LEAST 1/8" GREATER THAN THE THICKNESS OF THE PIPE. APPROXIMATELY 1/4" THICK OR GREATER, SUCH MATERIAL WOULD BE AN ASPHALT IMPREGNATED FABRIC, A SHEET PLASTIC, A RUBBER GASKET OR OTHER NONBIODEGRADABLE MATERIAL OF SUBSTANTIAL STRENGTH.

WHEN TWO OR MORE PIPE ARCHES WITH APRON ENDWALLS ARE TO BE LAID ADJACENT TO EACH OTHER, THEY SHALL BE SEPARATED BY THE FOLLOWING AMOUNT:

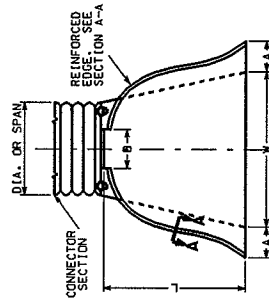
PIPES: TOTAL WIDTH OF APRON ENDWALL LESS THE DIAMETER OF PIPE PLUS 6 INCHES.

PIPE ARCHES: TOTAL WIDTH OF APRON ENDWALL LESS THE SPAN DIMENSION OF THE PIPE ARCH PLUS 6 INCHES.

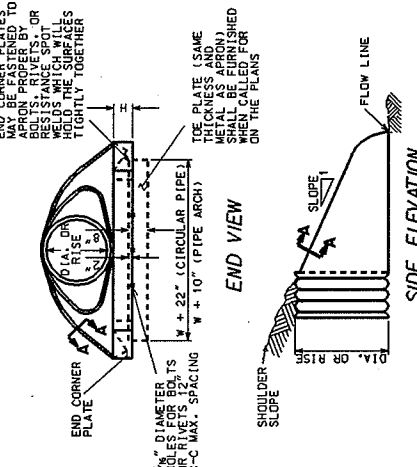
METAL APRON ENDWALLS FOR PIPE ARCHES

PIPE-ARCH SPAN RISE	DIMENSIONS				APPROX. SLOPE
	A	B	H	L	
17"	13"	0.064	7"	19"	2 1/2 TO 1
21"	15"	0.064	7"	23"	2 1/2 TO 1
24"	18"	0.064	8"	26"	2 1/2 TO 1
28"	20"	0.064	9"	28"	2 1/2 TO 1
35"	24"	0.079	10"	32"	2 1/2 TO 1
42"	29"	0.079	12"	39"	2 1/2 TO 1
49"	33"	0.109	13"	46"	2 1/2 TO 1
57"	38"	0.109	18"	53"	2 1/2 TO 1
64"	43"	0.109	18"	63"	2 1/2 TO 1
71"	47"	0.109	18"	70"	2 1/2 TO 1
77"	52"	0.109	18"	77"	2 TO 1
83"	57"	0.109	18"	83"	2 TO 1

NOTE: ALL SPLICES TO BE LAP RIVETED OR BOLTED



CONNECTION DETAILS

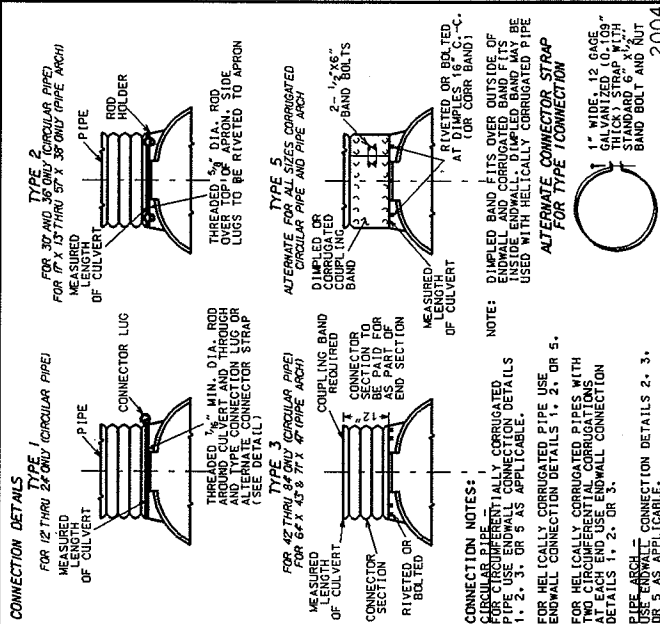


NOTE: ALL SPLICES TO BE LAP RIVETED OR BOLTED

METAL OR ALUMINUM APRON ENDWALLS FOR CIRCULAR PIPES

DIA	MIN. METAL THICKNESS		DIMENSIONS				APPROX. SLOPE
	A	B	H	L	W		
12"	0.064	0.060	6"	6"	21"	24"	2 1/2 TO 1
15"	0.064	0.060	7"	8"	26"	30"	2 1/2 TO 1
18"	0.064	0.060	8"	10"	31"	36"	2 1/2 TO 1
21"	0.064	0.060	9"	12"	36"	42"	2 1/2 TO 1
24"	0.064	0.075	10"	13"	41"	48"	2 1/2 TO 1
30"	0.079	0.075	12"	16"	51"	60"	2 1/2 TO 1
36"	0.079	0.105	14"	19"	60"	72"	2 1/2 TO 1
42"	0.109	0.105	16"	22"	69"	84"	2 1/2 TO 1
48"	0.109	0.105	18"	27"	78"	90"	2 1/2 TO 1
54"	0.109	0.105	18"	30"	84"	102"	2 TO 1
60"	0.109	N/A	18"	33"	87"	114"	1 1/2 TO 1
66"	0.109	N/A	18"	36"	90"	120"	1 1/2 TO 1
72"	0.109	N/A	18"	39"	93"	126"	1 1/2 TO 1
78"	0.109	N/A	18"	42"	96"	132"	1 1/2 TO 1
84"	0.109	N/A	18"	45"	99"	138"	1 1/2 TO 1

NOTE: ALL SPLICES TO BE LAP RIVETED OR BOLTED

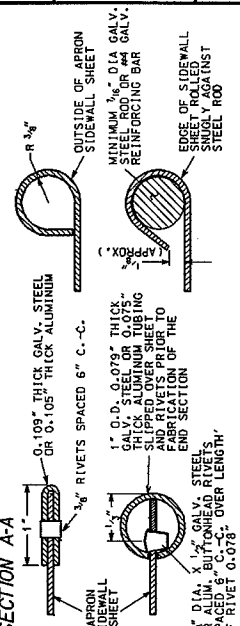


NOTE: ALL SPLICES TO BE LAP RIVETED OR BOLTED

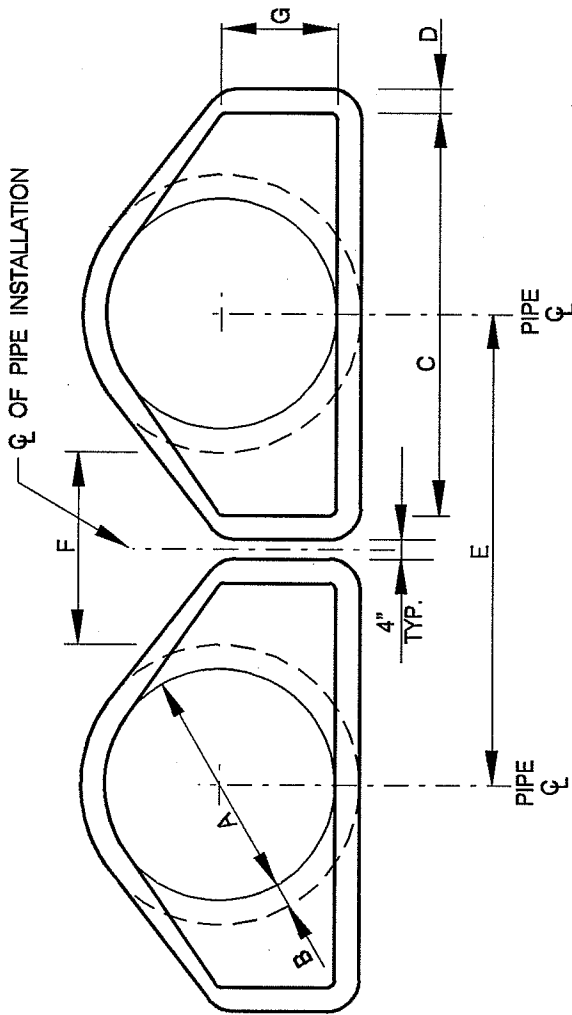
CITY OF MADISON
ENGINEERING DIVISION

APRON ENDWALLS FOR PIPES AND PIPE ARCHES

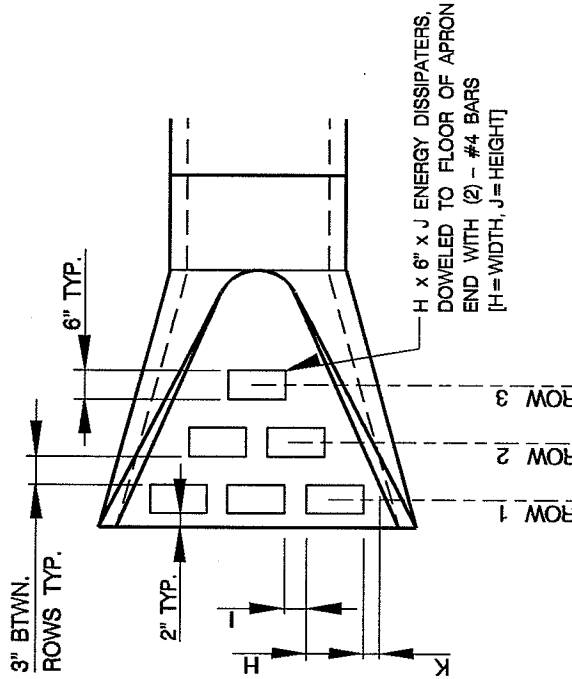
STANDARD DETAIL DRAWING 5.4.1



ENERGY DISSIPATERS TO BE INSTALLED ONLY WHEN DIRECTED BY THE DESIGN ENGINEER



FRONT VIEW NOT TO SCALE



TOP VIEW NOT TO SCALE

H x 6" x J ENERGY DISSIPATERS,
DOWELED TO FLOOR OF APRON
END WITH (2) - #4 BARS
(H=WIDTH, J=HEIGHT)

DIM.	PIPE DIAMETERS, RCP, CLASS III															
	12"	15"	18"	21"	24"	27"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"
A	2"	2-1/4"	3"	3-1/4"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"
B	2"	2-1/4"	3"	3-1/4"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"
C	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"	108"	114"
D	2"	2-1/4"	3"	3-1/4"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"
E	32"	38-1/2"	45"	51-1/2"	58"	64-1/2"	71"	78"	84"	91"	98"	104"	110"	117"	124"	131"
F	18"	19"	22"	25"	28"	31"	34"	40"	40"	40"	39"	38"	38"	38"	38"	37"
G	4"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"
H	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"
I	6"	10"	5"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"	6"
J	3"	3"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"
K	3"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"	4"
ROW 1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	8	8
ROW 2	0	0	2	2	3	3	4	4	5	5	6	6	7	7	7	7
ROW 3	0	0	0	0	2	2	3	3	4	4	5	5	6	6	6	6

BLG TCK YS

NOTE: DIMENSIONS 'K' & 'H' ARE FIXED. DIMENSION 'I' IS APPROXIMATE. ACTUAL 'I' DIMENSION SHALL BE THE RESULT OF EVENLY SPACED BLOCKS WITHIN THE REMAINDER OF OPEN SPACE FOR THE ROW.

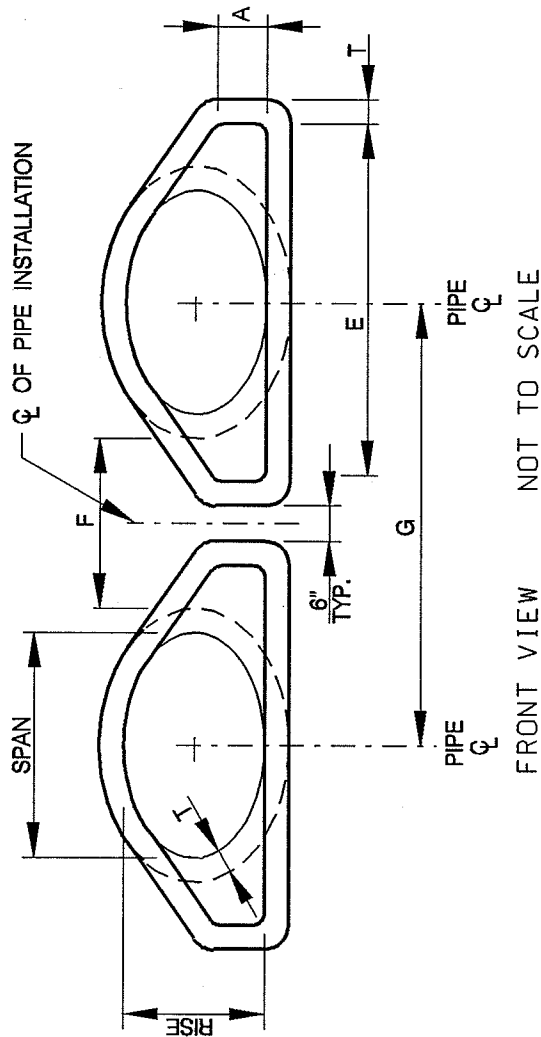
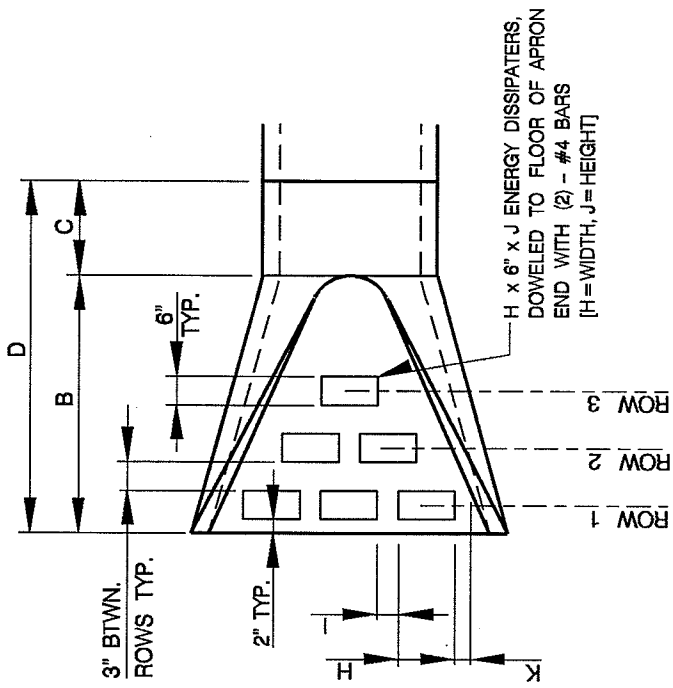
2004

CITY OF MADISON
ENGINEERING DIVISION

MULTIPLE RCP AE

STANDARD DETAIL DRAWING 5.4.2

ENERGY DISSIPATORS TO BE INSTALLED ONLY WHEN DIRECTED BY THE DESIGN ENGINEER



TOP VIEW NOT TO SCALE

FRONT VIEW NOT TO SCALE

NOTE: DIMENSIONS 'K' & 'H' ARE FIXED. DIMENSION 'I' IS APPROXIMATE. ACTUAL 'I' DIMENSION SHALL BE THE RESULT OF EVENLY SPACED BLOCKS WITHIN THE REMAINDER OF OPEN SPACE FOR THE ROW.

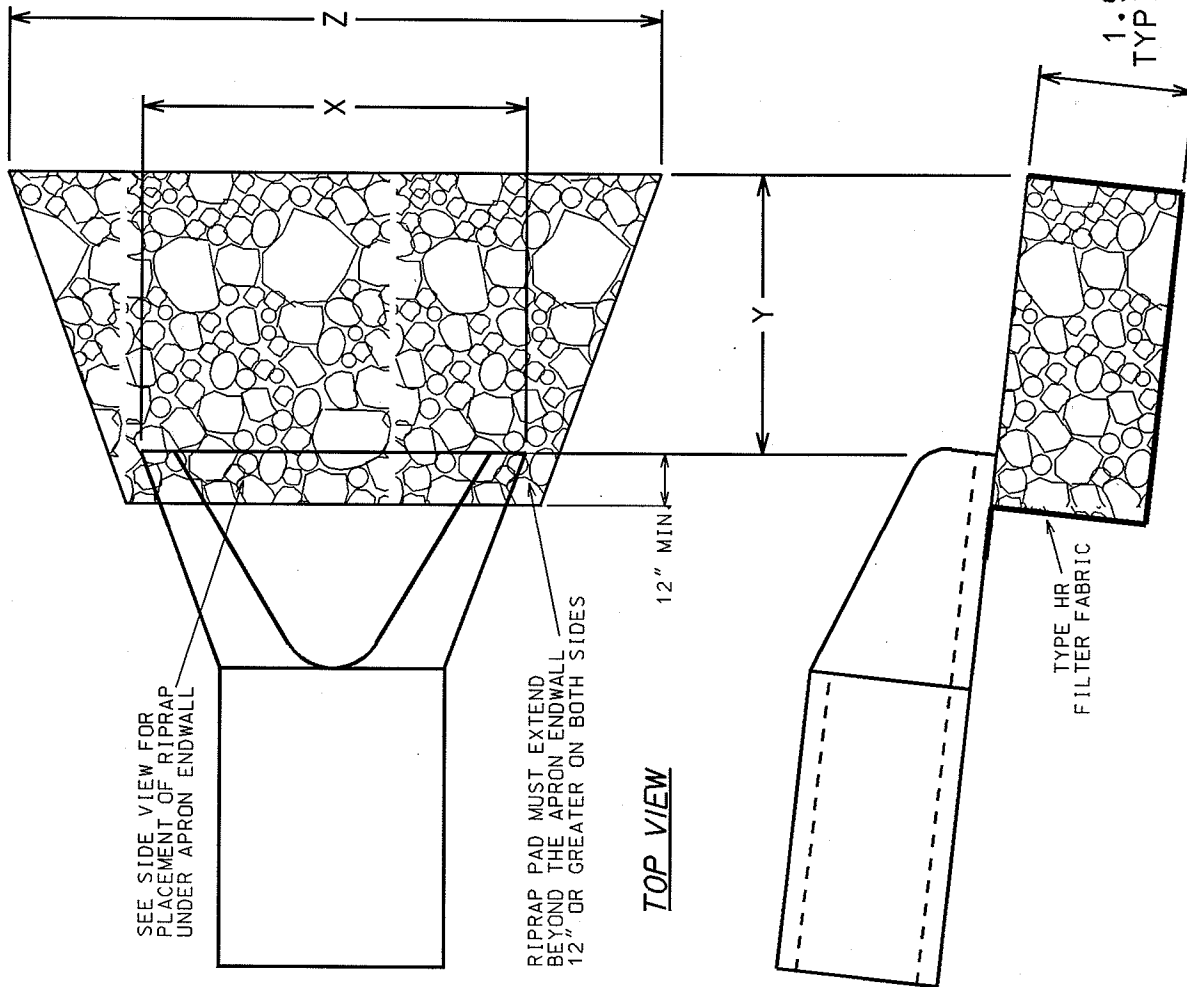
PIPE DIAMETERS, HERCP, CLASS III																
EQUIVALENT ROUND DIA.	RISE x SPAN DIMENSIONS	QTY. OF BLOCKS														
		A	B	C	D	E	F	G	H	I	J	K	T			
18"	14 x 23	9.00"	3'-4"	2'-8"	6'-0"	3'-0"	1'-7"	3'-11 1/2"	6"	5"	4"	4"	2 3/4"	ROW 1 3	ROW 2 2	ROW 3 0
24"	19 x 30	8.50"	3'-0"	4'-0"	7'-0"	4'-0"	2'-0"	5'-0 1/2"	6"	5 1/3"	4"	4"	3 1/4"	4	3	2
30"	24 x 38	9.50"	4'-6"	2'-6"	7'-0"	5'-0"	2'-4"	6'-1 1/2"	6"	8"	4"	6"	3 3/4"	4	3	2
36"	29 x 45	11.25"	5'-0"	2'-0"	7'-0"	6'-0"	2'-9"	7'-3"	6"	8 1/2"	6"	4"	4 1/2"	5	4	3
42"	34 x 53	14.00"	5'-0"	2'-0"	7'-0"	6'-3"	2'-4"	7'-7"	6"	8 1/4"	6"	6"	5"	5	4	3
48"	38 x 60	18.00"	5'-0"	2'-0"	7'-0"	6'-10"	2'-4"	8'-3"	6"	7 1/2"	6"	4 1/4"	5 1/2"	6	5	4
54"	43 x 68	32.00"	5'-0"	3'-5"	8'-5"	7'-5"	2'-8"	9'-4"	6"	8"	6"	6 1/2"	6"	6	5	4
60"	48 x 76	36.00"	5'-0"	3'-5"	8'-5"	7'-11"	2'-1"	9'-6"	6"	9"	6"	7"	6 1/2"	6	5	4
72"	58 x 91	36.00"	5'-5"	2'-8"	8'-1"	8'-11"	1'-10"	10'-8"	6"	9 1/2"	6"	4"	7 1/2"	7	6	5

2003

CITY OF MADISON
ENGINEERING DIVISION

MULTIPLE HERCP AE

STANDARD DETAIL DRAWING 5.4.3



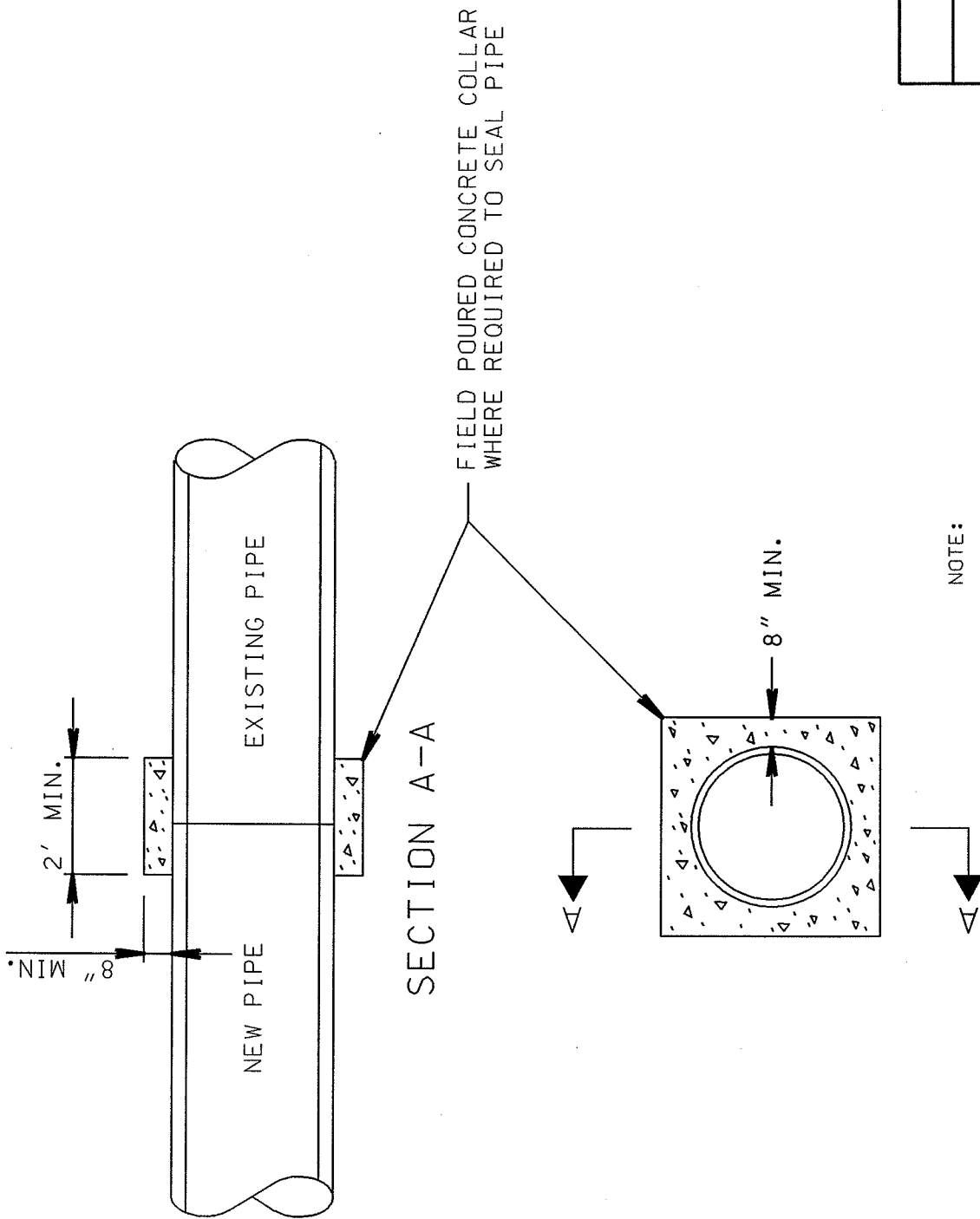
DIA (in)	X (in)	Y (in)	Z (in)	APPROX. WEIGHT (tons)
12	24	48	48	1.78
15	30	60	60	2.64
18	36	60	60	2.78
21	42	72	72	3.83
24	48	72	72	4.00
27	54	72	81	4.42
30	60	84	90	5.64
36	72	96	108	7.56
42	78	96	120	8.22
48	84	108	120	9.50
54	90	108	150	11.00
60	96	108	162	11.75
66	102	132	174	15.28
72	108	132	186	16.19

- NOTES:
- 1) CITY OF MADISON STANDARD SPECIFICATIONS SHALL APPLY TO ALL INSTALLATIONS.
 - 2) PIPES 36" AND GREATER SHALL HAVE JOINT TIES PER STANDARD DETAIL DRAWING 5.4.6 & SECTION 504.2 (i).
 - 3) PIPES 36" OR GREATER SHALL HAVE 50% OF THE RIPRAP PAD PLACED WITH A SLURRY GROUT MIX ON AN UNEVEN RIPRAP SURFACE. SLURRY GROUT SHALL BE TYPE B SLURRY PER SECTION 300 OF THE STANDARD SPECIFICATIONS.
 - 4) TWIN APRON INSTALLATIONS SHALL BE GOVERNED BY THE OUTSIDE DIMENSIONS OF A SINGLE PIPE.

2004

CITY OF MADISON ENGINEERING DIVISION
RIPRAP AT APRON END WALLS
STANDARD DETAIL DRAWING 5.4.4

NOT TO SCALE



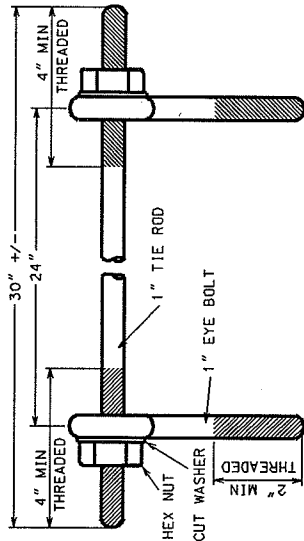
NOTE:
 IF REQUESTED BY THE CONSTRUCTION
 ENGINEER, FIBER REINFORCED
 CONCRETE SHALL BE PROVIDED

2004

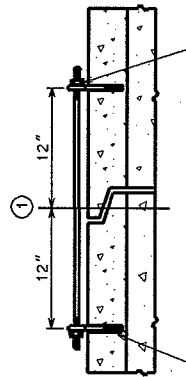
CITY OF MADISON ENGINEERING DIVISION
CONCRETE COLLAR
STANDARD DETAIL DRAWING 5.4.5

ALTERNATE 1

EYE BOLT AND TIE ROD ASSEMBLY
(JOINT TIES FOR 72" DIA AND OVER CONCRETE PIPE)



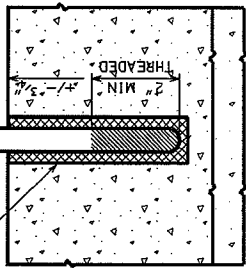
EYE BOLTS AND TIE ROD



② INSERT, CAST-IN-PLACE DURING FABRICATION FOR 1 1/2" DIA. EYE BOLT

WELDED EYE BOLT OR APPROVED EQUAL

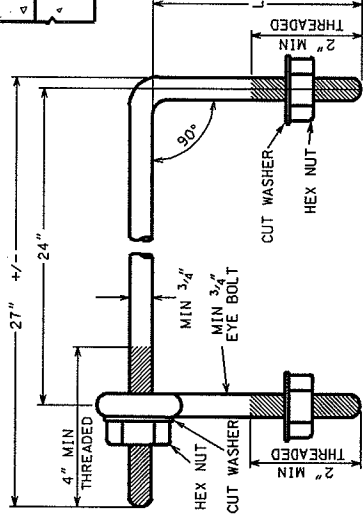
ROTATE 90° FOR NORMAL POSITION



(CAST-IN-PLACE THREADED INSERT) LONGITUDINAL SECTIONS

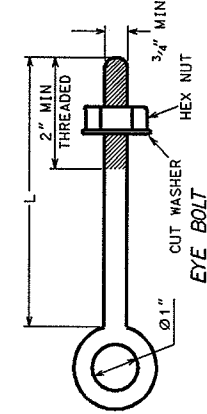
ALTERNATE 2

EYE BOLT AND TIE ROD ASSEMBLY
(JOINT TIES FOR 18" TO 66" DIA CONCRETE PIPE)



NOTE: TWO EYE BOLTS MAY BE USED WITH A 30" LONG THREADED ROD IN LIEU OF THE 90° BENT TIE ROD

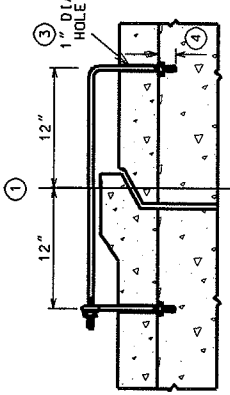
EYE BOLT AND TIE ROD



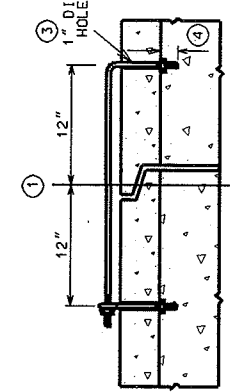
EYE BOLT

EYE BOLT DIMENSION TABLE

PIPE SIZE	TONGUE & GROOVE PIPE	L = LENGTH
18" TO 24"	4 1/2"	6 1/4"
30"	5"	7"
36"	5 1/2"	7"
42"	6"	7"
48"	6 1/2"	7"
60"	7 1/2"	7"
66"	8"	7"



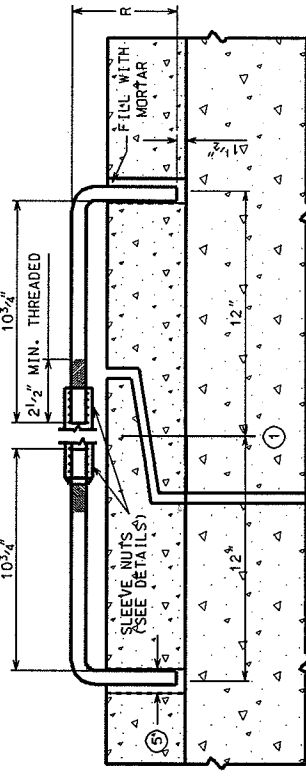
(MODIFIED BELL PIPE) LONGITUDINAL SECTION



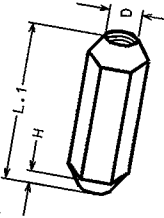
(TONGUE AND GROOVE PIPE) LONGITUDINAL SECTION

ALTERNATE 3

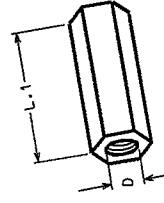
ADJUSTABLE TIE ROD
(JOINT TIES FOR 12" TO 108" DIA CONCRETE PIPE)



LONGITUDINAL SECTION



TAPERED



PLAIN

RIGHT AND LEFT THREADS SLEEVE NUTS

PIPE DIAMETER	TIE ROD DIAMETER	D	L-1	H	R
12" TO 30"	1 1/2"	1 1/2"	5"	1 1/2"	1 3/4"
36" TO 84"	3 1/4"	3 1/4"	5"	1 1/2"	5"
90" TO 104"	1"	1"	7"	1 1/8"	7 1/2"

ADJUSTABLE TIE ROD TABLE

GENERAL NOTES:

- CONCRETE CULVERT PIPE SHALL BE TIED TOGETHER IN THE MANNER ILLUSTRATED BY THIS DETAIL AND PER STANDARD SPEC. 502.7 (D) AS LOCATION DESIGNATED ON THE PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL EXISTING UTILITIES AND SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL OTHER UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL UTILITIES.
- THE INSIDE OF THE THREADED INSERTS SHALL BE CLEAN TO ALLOW THE INSERTION OF THREADED EYE BOLTS.
- HOLES SHALL BE CAST-IN-PLACE OR DRILLED FROM THE INSIDE OF THE CULVERT PIPE, OR REINFORCED CONCRETE PIPE CATTLE PASS.
- BOLT PROJECTION INSIDE OF PIPE SHALL NOT EXCEED 2".
- ROD DIAMETER = 1 INCH

GENERAL NOTES:

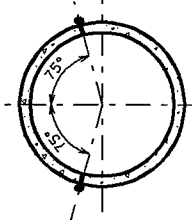
- Ø OF TONGUE AND GROOVE OR BELL AND SPIGOT JOINTS
- THE INSIDE OF THE THREADED INSERTS SHALL BE CLEAN TO ALLOW THE INSERTION OF THREADED EYE BOLTS.
- HOLES SHALL BE CAST-IN-PLACE OR DRILLED FROM THE INSIDE OF THE CULVERT PIPE, OR REINFORCED CONCRETE PIPE CATTLE PASS.
- BOLT PROJECTION INSIDE OF PIPE SHALL NOT EXCEED 2".
- ROD DIAMETER = 1 INCH

2004

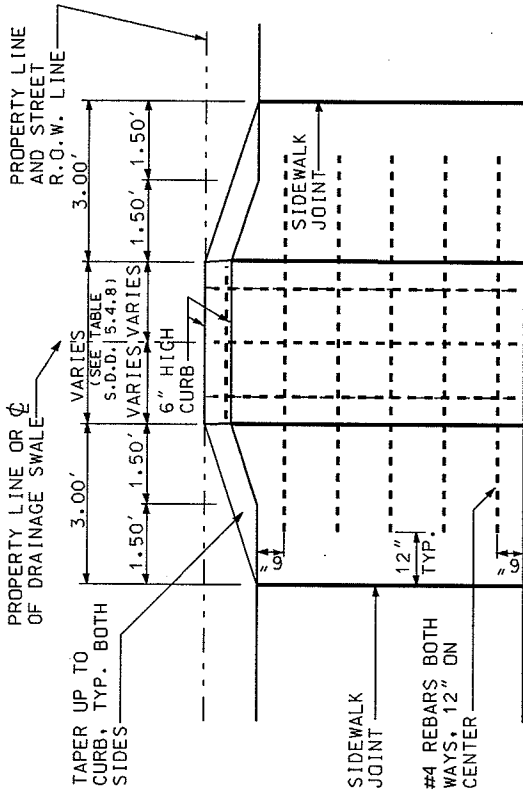
CITY OF MADISON
ENGINEERING DIVISION

CONCRETE PIPE JOINT TIES

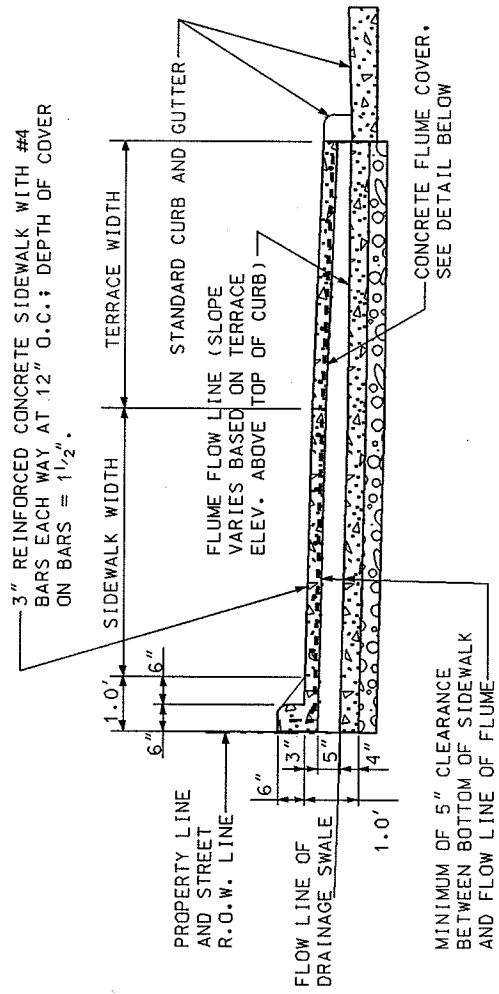
TRANSVERSE SECTION



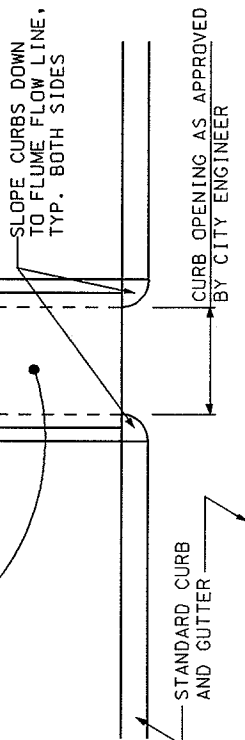
STANDARD DETAIL DRAWING 5.4.6



**DRAINAGE FLUME
LONGITUDINAL SECTION**



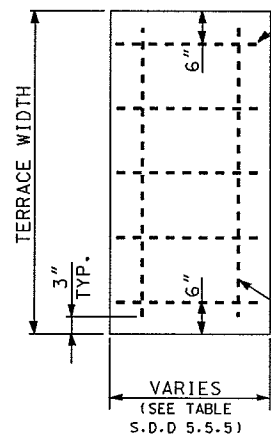
TERRACE CONCRETE FLUME COVER;
SEE PLAN DETAIL BELOW AND CROSS
SECTION VIEW IN S.D.D. 5.4.8



**DRAINAGE FLUME
PLAN VIEW**

NOTES:

1. A MINIMUM OF 2 SIDEWALK SECTIONS SHALL BE REMOVED AND REPLACED, UNLESS OTHERWISE DIRECTED BY THE CITY ENGINEER.
2. ALTERNATE ALIGNMENTS OF TERRACE PORTION OF FLUME SHALL BE ALLOWED WITH THE PRIOR APPROVAL OF THE CITY ENGINEER.
3. ALL REINFORCING BARS SHALL BE EPOXY COATED.
4. SIDEWALK AND SIDEWALK CURBING TO BE POURED MONOLITHIC.



CONCRETE FLUME COVER SHALL BE 3" THICK WITH #4 TRANSVERSE REBARS AT 8" O.C. MIN. TO 12" O.C. MAX. SPACING, AND 1" BOTTOM CLEARANCE. SEE DETAIL ON S.D.D. 5.4.8

#4 LONGITUDINAL BARS, SEE TABLE ON S.D.D. 5.4.8 FOR NUMBER OF BARS AND SPACING

**TERRACE CONCRETE FLUME COVER
PLAN VIEW**

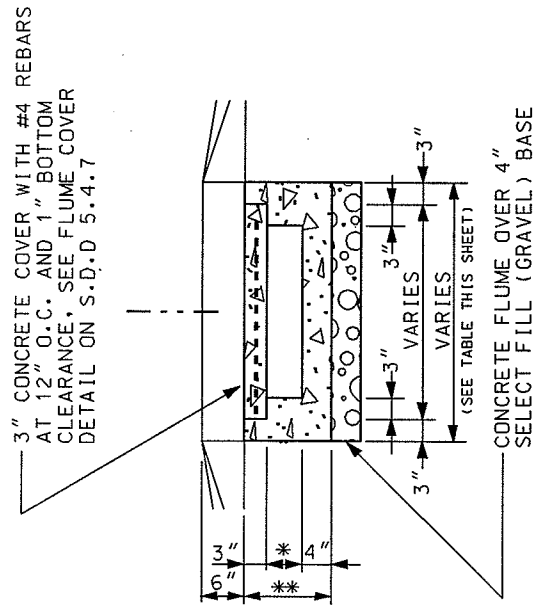
2004

CITY OF MADISON
ENGINEERING DIVISION

**DRAINAGE FLUME
DETAIL**

PLATE 1 OF 2

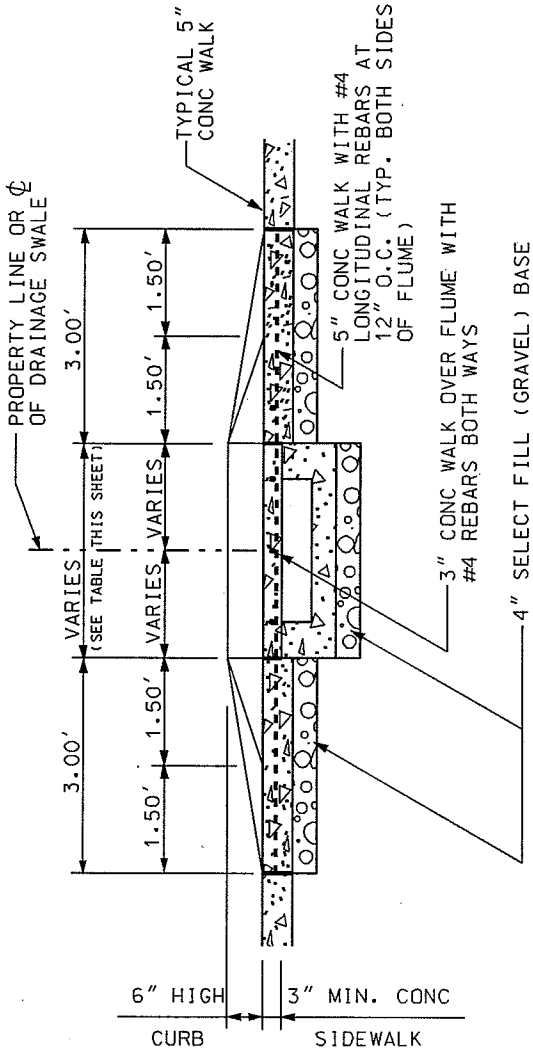
STANDARD DETAIL DRAWING 5.4.7



* DIMENSION VARIES, 5" AT SIDEWALK TO 3" AT CURB.

** DIMENSION VARIES, 12" AT SIDEWALK TO 10" AT CURB.

DRAINAGE FLUME AT TERRACE CROSS SECTION



DRAINAGE FLUME AT SIDEWALK CROSS SECTION

ON GRADE IMPERVIOUS AREA IN SQUARE FEET

OUTLET FLUME SIZE	COVER WIDTH	NO. OF LONG. REBARS	CLEAR FROM EDGE	CENTER SPACING	EQUIV. PIPE DIAM.	GRADE PER FOOT OF PIPE & FLUME			
						1/16"	1/8"	1/4"	1/2"
12"x3"	18"	2	3"	12"	4"	1.625	7,470	3,740	4,720
18"x3"	24"	2	6"	12"	6"	5,200	7,470	10,400	14,600
24"x3"	30"	3	3"	12"	8"	11,650	16,250	22,750	32,600
30"x3"	36"	3	6"	12"	10"	22,100	30,850	44,250	63,000
36"x3"	42"	4	3"	12"	12"	34,150	52,300	71,500	102,200

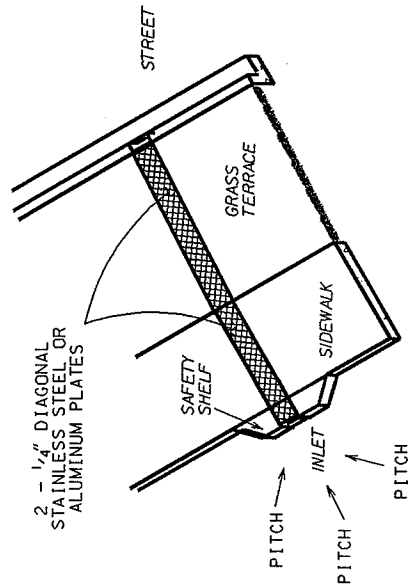
NOTE: INCREASE ROOF AREAS BY 25% PRIOR TO USING CHART

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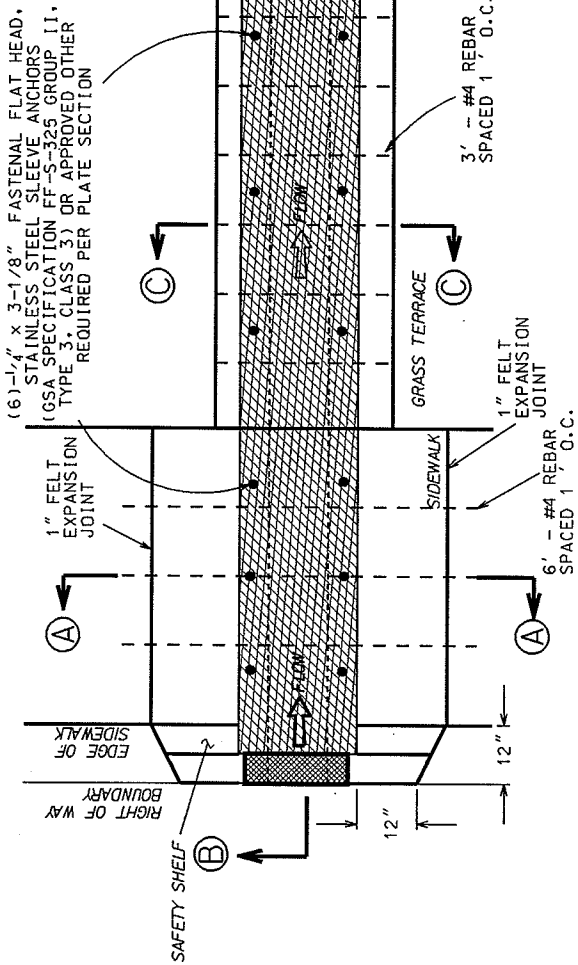
CITY OF MADISON
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DRAINAGE FLUME DETAIL

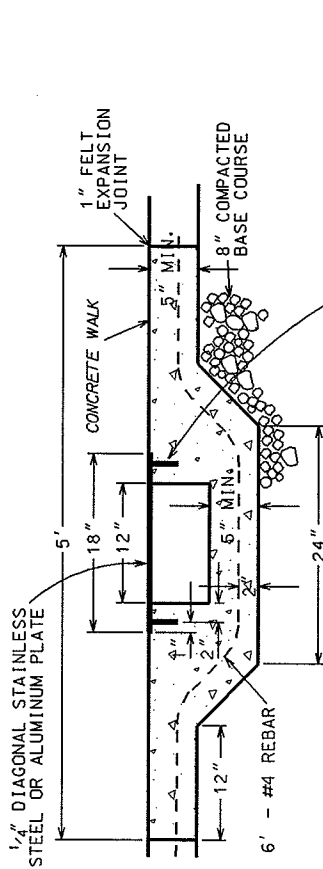
STANDARD DETAIL DRAWING 5.4.8
PLATE 2 OF 2



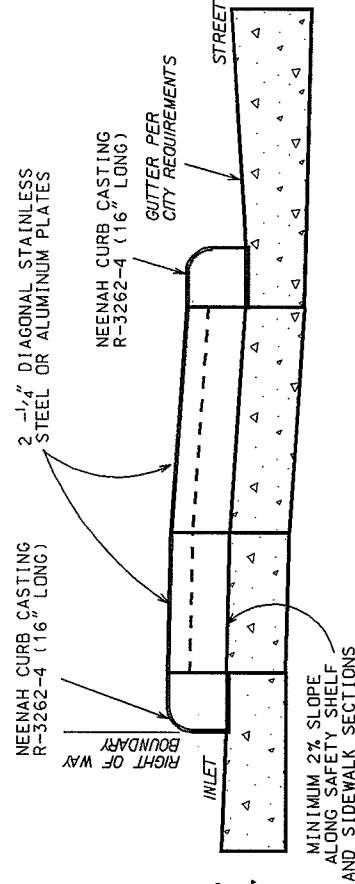
ISOMETRIC VIEW



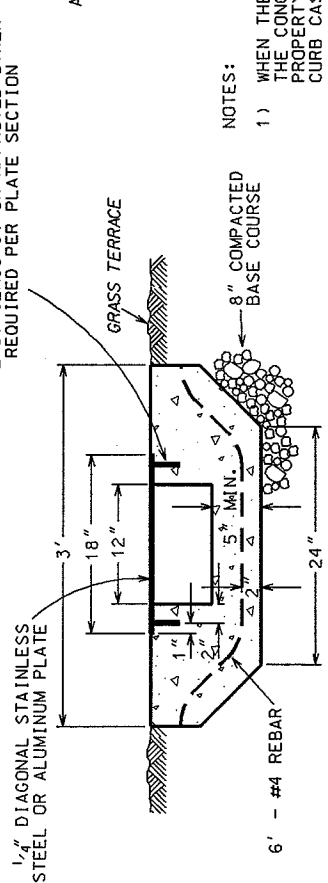
PLAN VIEW



SECTION A-A



SECTION B-B



SECTION C-C

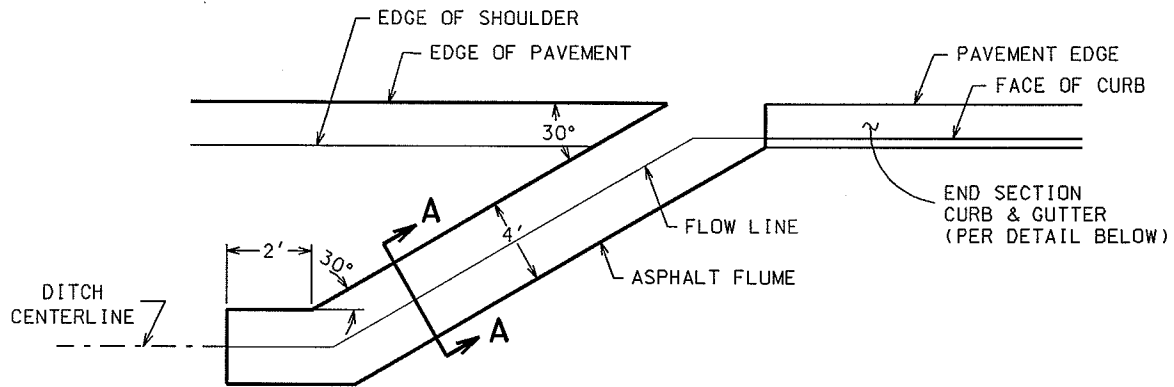
- NOTES:**
- 1) WHEN THE SIDEWALK IS ABUTTING A GRASSED PROPERTY, THE CONCRETE FLAG AND NEEHAH CASTING ON THE PROPERTY SIDE SHALL BE OMITTED. ONLY ONE NEEHAH CURB CASTING IS REQUIRED FOR THE STREET OUTLET.
 - 2) WHEN THE SIDEWALK IS ABUTTING A PAVED PROPERTY, THE CONCRETE FLAG SHALL EXTEND 1' BEYOND THE RIGHT OF WAY BOUNDARY.

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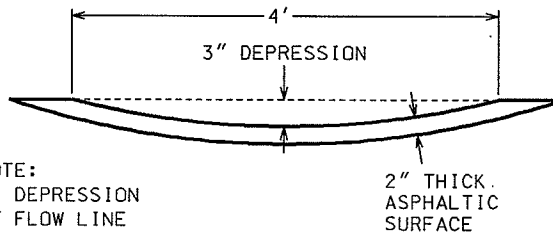
CITY OF MADISON
ENGINEERING DIVISION

SIDEWALK FLUME

STANDARD DETAIL DRAWING 5.4.9



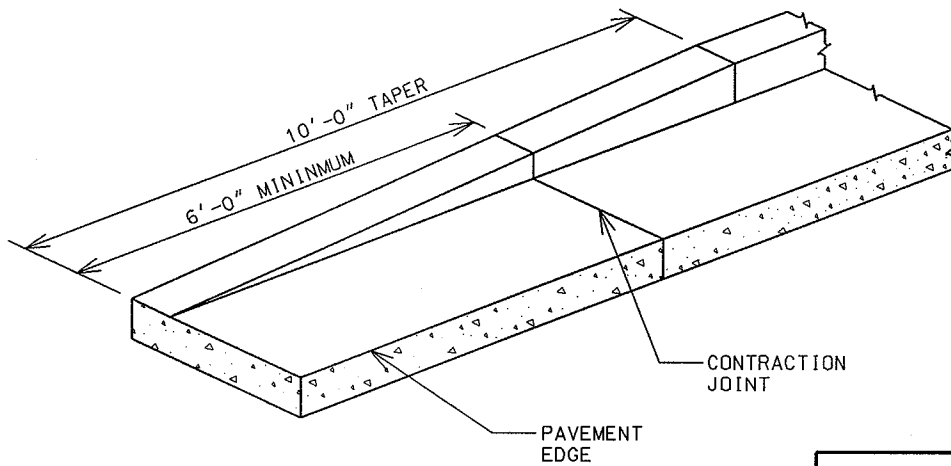
ASPHALT FLUME DETAIL
TOP VIEW



NOTE:
3" DEPRESSION
AT FLOW LINE

2" THICK
ASPHALTIC
SURFACE

ASPHALT FLUME
SECTION A-A



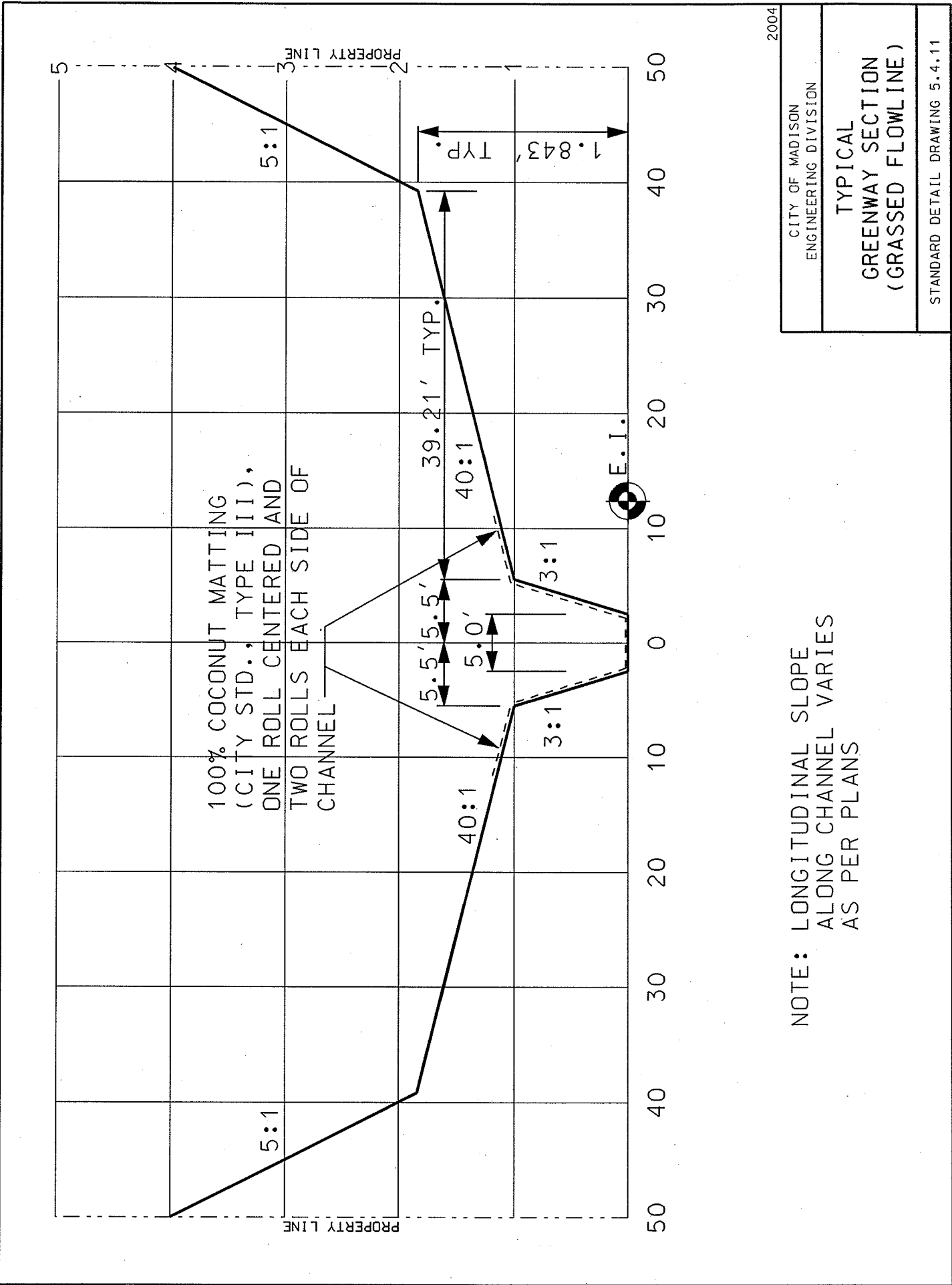
END SECTION CURB AND GUTTER

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CURB TO DITCH
TRANSITION
ASPHALT FLUME

STANDARD DETAIL DRAWING 5.4.10



100% COCONUT MATTING
(CITY STD., TYPE III),
ONE ROLL CENTERED AND
TWO ROLLS EACH SIDE OF
CHANNEL

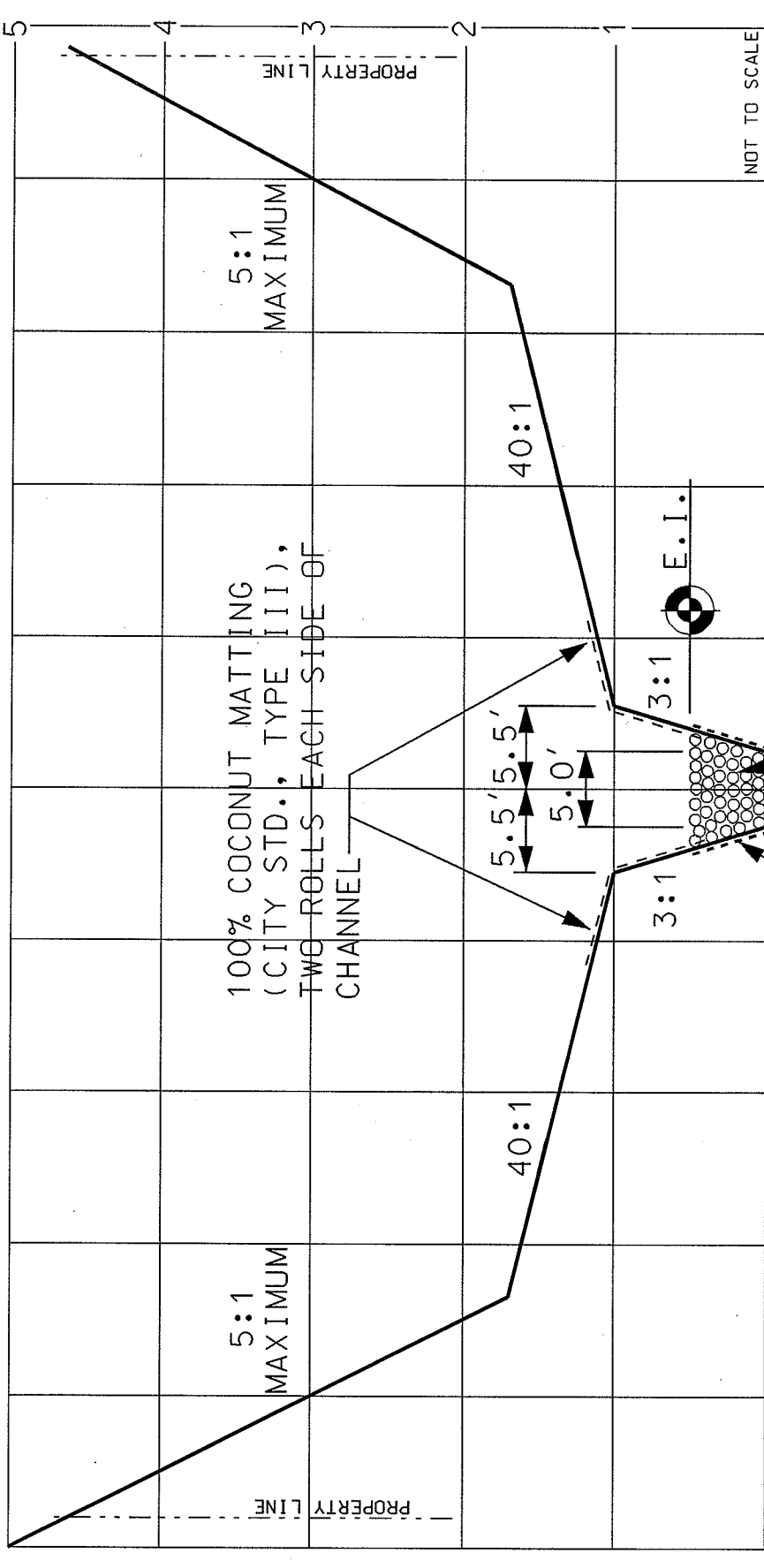
NOTE: LONGITUDINAL SLOPE
ALONG CHANNEL VARIES
AS PER PLANS

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CITY OF MADISON
ENGINEERING DIVISION

TYPICAL
GREENWAY SECTION
(GRASSED FLOWLINE)

STANDARD DETAIL DRAWING 5.4.11



50 40 30 20 10 0 10 20 30 40 50

'R' FABRIC TO MEET D.O.T. SPECIFICATIONS

CLEAR STONE, 3"-5" SMALLEST DIMENSION LARGEST DIMENSION SHALL NOT EXCEED 3x IT'S SMALLEST DIMENSION

NOTE: LONGITUDINAL SLOPE ALONG CHANNEL VARIES AS PER PLANS.

2004
 CITY OF MADISON
 ENGINEERING DIVISION
 TYPICAL
 GREENWAY SECTION
 (STABILIZED FLOWLINE)
 STANDARD DETAIL DRAWING 5.4.12