RANDOM OBSERVATIONS

- Curb Selection
- Grate Selection
- Channeling Clayton
- Monuments

WHAT IS THIS?

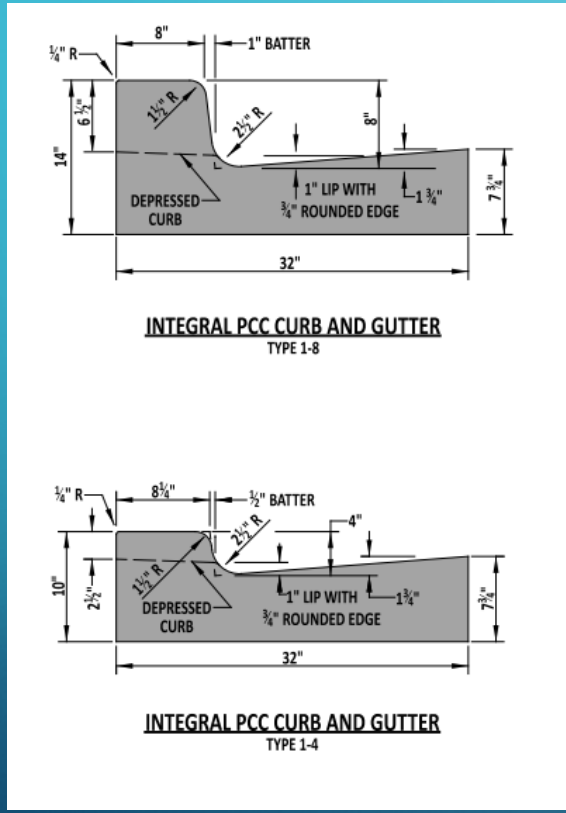
1. Lake Johnny?
2. Lake Jenny?
3. Lake Wright?

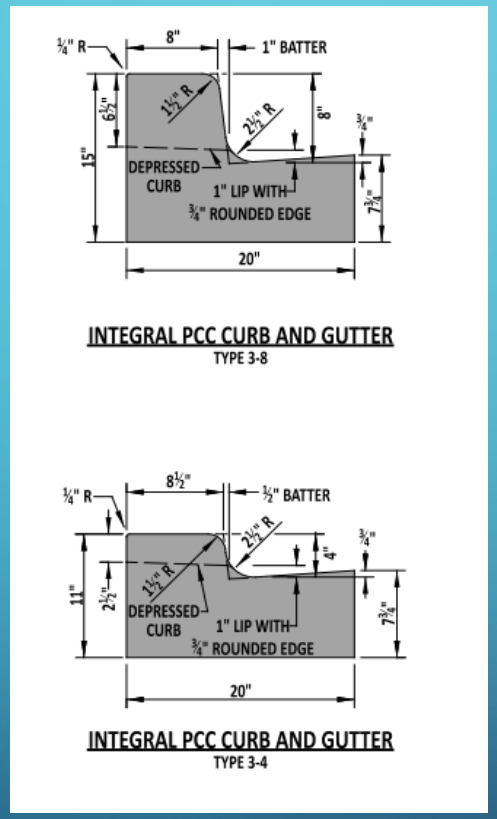
CURB SELECTION

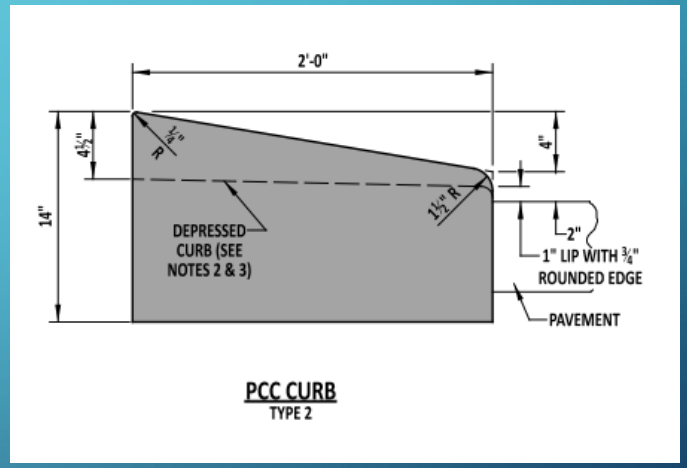
Considerations

- Design Speed/Posted Speed
- Access Control
- Entrance Delineation
- Hydraulics
- Available RW/Bike lane
- Life Cycle Cost

CURB SELECTION







2021 SCD

CURB SELECTION

RDM 10.4.2

- On urban highways, mountable curb should be used for design speeds 50 mph [80 km/h] and above.
- Barrier (vertical) curb may be used with design speeds of 45 mph [70 km/h] or less

CURB SELECTION

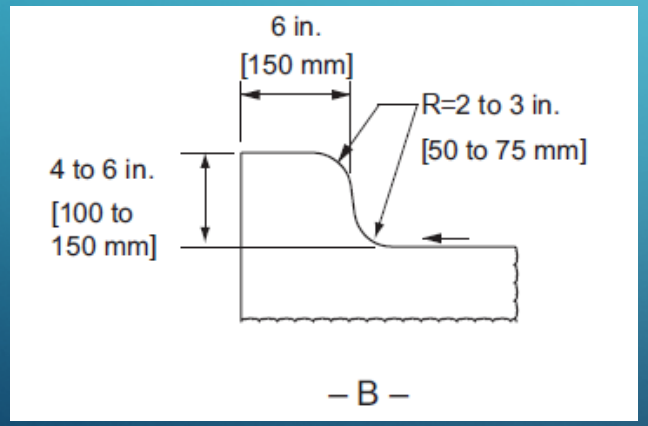
RDG 3.4.1

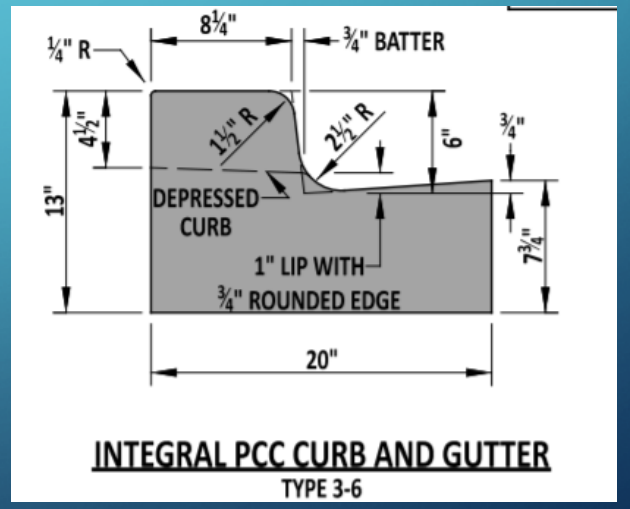
- Vertical curbs are those having a vertical or nearly vertical traffic face 150 mm [6 in.] or higher. They are intended to discourage motorists from deliberately leaving the roadway. Sloping curbs are those having a sloping traffic face 150mm [6 in.] or less in height.
- Sloping curbs, especially those with heights of 100 mm [4 in.] or less, can be readily traversed by a motorist when necessary.
- Curbs higher than 100 mm [4 in.], whether sloping or vertical, may drag the underside of some vehicles.

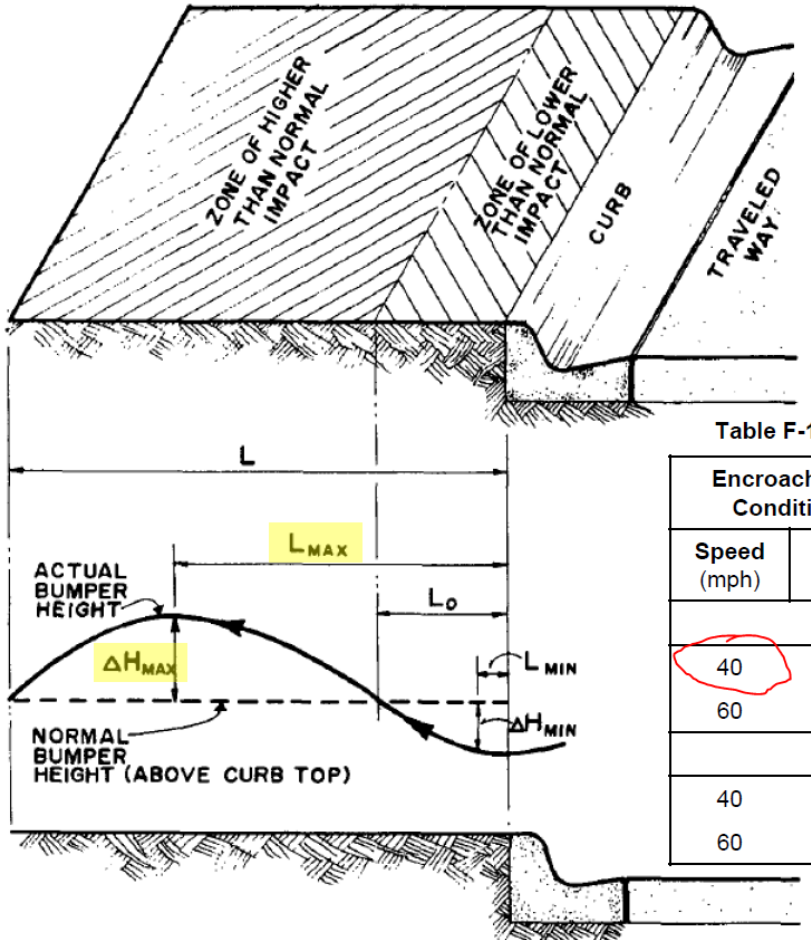
CURB SELECTION

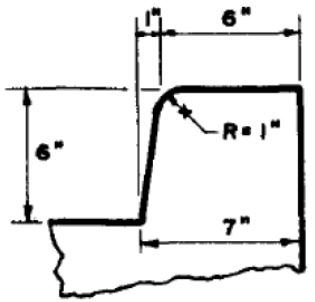
GB-7 4.7.1

- Sloping curbs with 6” heights may be considered for use on high-speed urban/suburban facilities where there is need a need for delineation
- Sloping curbs with heights up to 4” may be considered for use on high-speed facilities where needed for drainage or restricted right-of-way









6" TYPE A

Table F-11 Excerpt: Bumper Trajectory Data – 6-inch Type A Curb

Encroachment Conditions		ΔH_{MIN} (in)	L_{MIN} (ft)	L_O (ft)	ΔH_{MAX} (in)	L_{MAX} (ft)	L (ft)
Speed (mph)	Angle (deg)						
Full Size Car							
40	10	6.0	1.0	1.9	5.5	3.3	5.1
60	10	6.2	1.2	2.5	7.5	4.4	5.7
Compact Car							
40	10	6.1	1.0	1.4	8.6	2.1	2.9
60	10	6.2	1.2	1.8	10.0	3.6	5.2

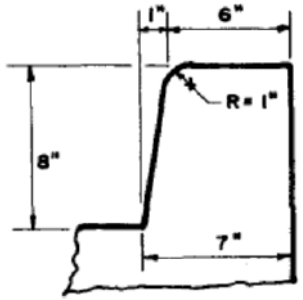
1977 AASHTO *Guide for Selecting, Locating and Designing Traffic Barriers*

Table F-10. Bumper Trajectory Data—8-Inch Type A Curb—Full Size Car

ENCROACHMENT CONDITIONS		$\Delta H_{min}^{(b)}$ (IN.)	$L_{min}^{(b)}$ (FT.)	$L_o^{(b)}$ (FT.)	$\Delta H_{max}^{(b)}$ (IN.)	$L_{max}^{(b)}$ (FT.)	$L^{(b)}$ (FT.)
SPEED(MPH)	ANGLE(DEG)[a]						
40	10	VEHICLE REDIRECTED UPON IMPACT WITH CURB					
40	15	9.0	1.0	1.7	8.0	2.5	3.3
60	10	VEHICLE REDIRECTED UPON IMPACT WITH CURB					
60	15	9.0	1.0	2.4	25.0	6.6	9.5

[a] ANGLE BETWEEN VEHICLE HEADING AND TANGENT TO TRAVELED WAY
[b] SEE FIGURE F-14

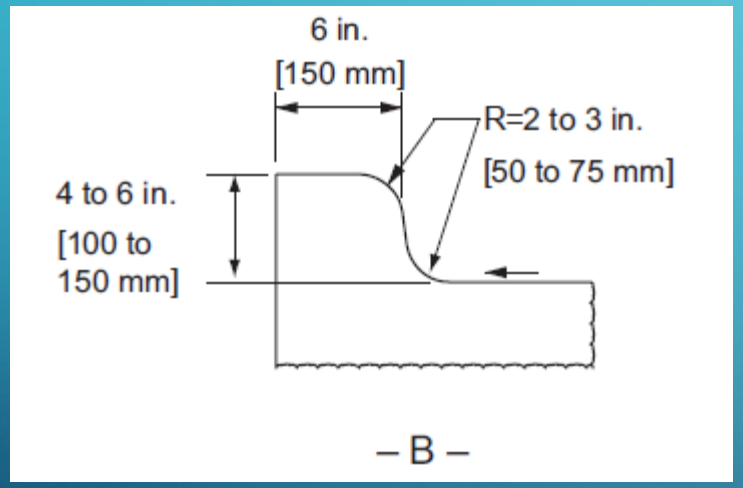
1 ft. = 0.3048 m
1 in. = 0.0254 m



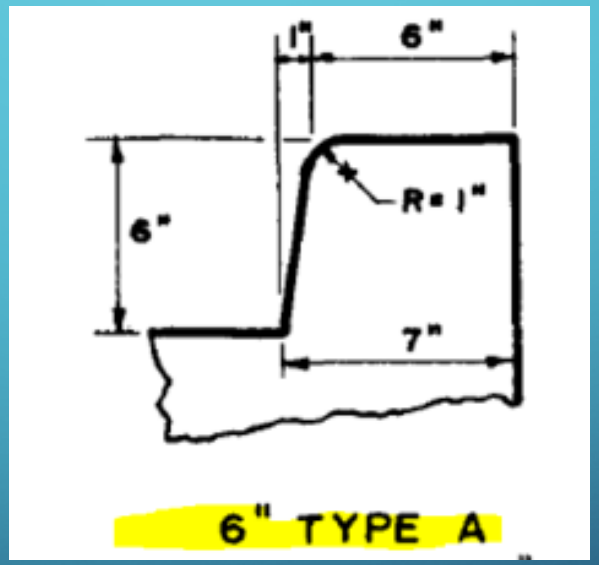
CURB SELECTION

Table F-11 Excerpt: Bumper Trajectory Data – 6-inch Type A Curb

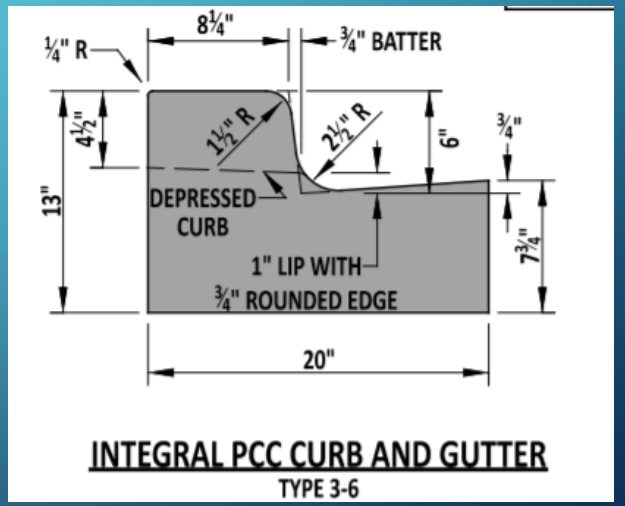
Encroachment Conditions		ΔH_{MIN} (in)	L_{MIN} (ft)	L_O (ft)	ΔH_{MAX} (in)	L_{MAX} (ft)	L (ft)
Speed (mph)	Angle (deg)						
Full Size Car							
40	10	6.0	1.0	1.9	5.5	3.3	5.1
60	10	6.2	1.2	2.5	7.5	4.4	5.7
Compact Car							
40	10	6.1	1.0	1.4	8.6	2.1	2.9
60	10	6.2	1.2	1.8	10.0	3.6	5.2



GB 7 Sloping Curb?



Bumper Trajectory Study



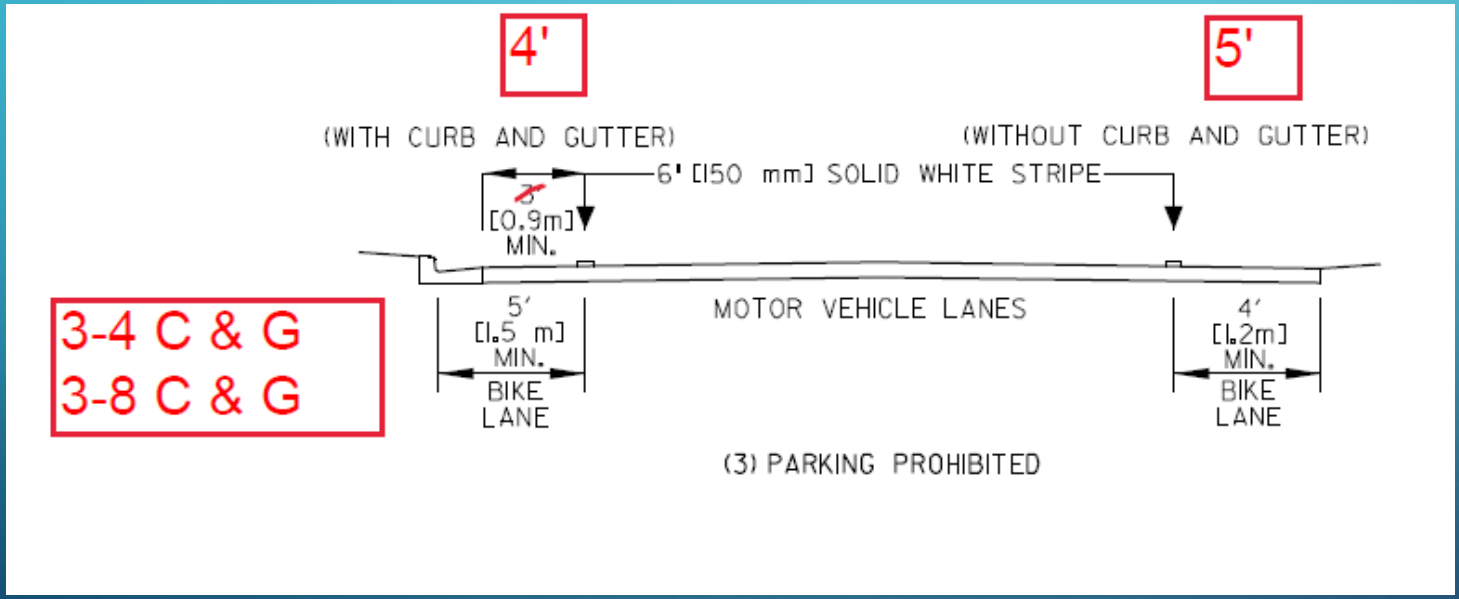
DelDOT SCD

CURB SELECTION

Curb and Gutter 1-8 vs 3-8 3year price comaprison (large projects)												
2015 (16) Spec Book												
C & G 1-8	701018						C & G 3-8	701023				
Qauntity	Award Price	2nd Bid	3rd Bid	Estimate	Rep bid		Qauntity	Award Price	2nd Bid	3rd Bid	Estimate	Rep bid
690	$ 31.00	$ 31.00	$ 32.00	$ 32.00	$ 31.50		756	$ 33.32	$ 45.00	$ 42.00	$ 31.00	$ 37.66
2765	$ 28.00	$ 20.78	$ 52.50	$ 38.00	$ 33.00		653	$ 35.50	$ 36.00	$ 30.00	$ 47.23	$ 35.75
560	$ 27.50	$ 33.50	$ 31.50	$ 25.00	$ 29.50		1724	$ 32.00	$ 31.00	$ 24.00	$ 34.00	$ 31.50
745	$ 38.00	$ 36.15	$ 58.50	$ 33.00	$ 37.08		400	$ 38.75	$ 46.20		$ 45.00	$ 45.00
6715	$ 33.50	$ 31.00	$ 38.00	$ 29.25	$ 32.25		440	$ 40.00	$ 39.10	$ 46.00	$ 35.00	$ 39.55
1050	$ 48.00	$ 60.00	$ 74.70	$ 45.00	$ 54.00		1805	$ 34.00	$ 32.00	$ 56.50	$ 35.00	$ 34.50
1415	$ 35.00	$ 40.00	$ 55.00	$ 30.58	$ 37.50							
3630	$ 32.00	$ 15.00	$ 60.00	$ 30.58	$ 31.29							
1031	$ 21.50	$ 41.50	$ 27.20	$ 32.00	$ 29.60							
Averages							Averages					
2067	$ 32.72	$ 34.33	$ 47.71	$ 32.82	$ 35.08		642	$ 35.60	$ 38.22	$ 33.08	$ 37.87	$ 37.33

CURB SELECTION & BIKE LANES

RDM Figure 10-6

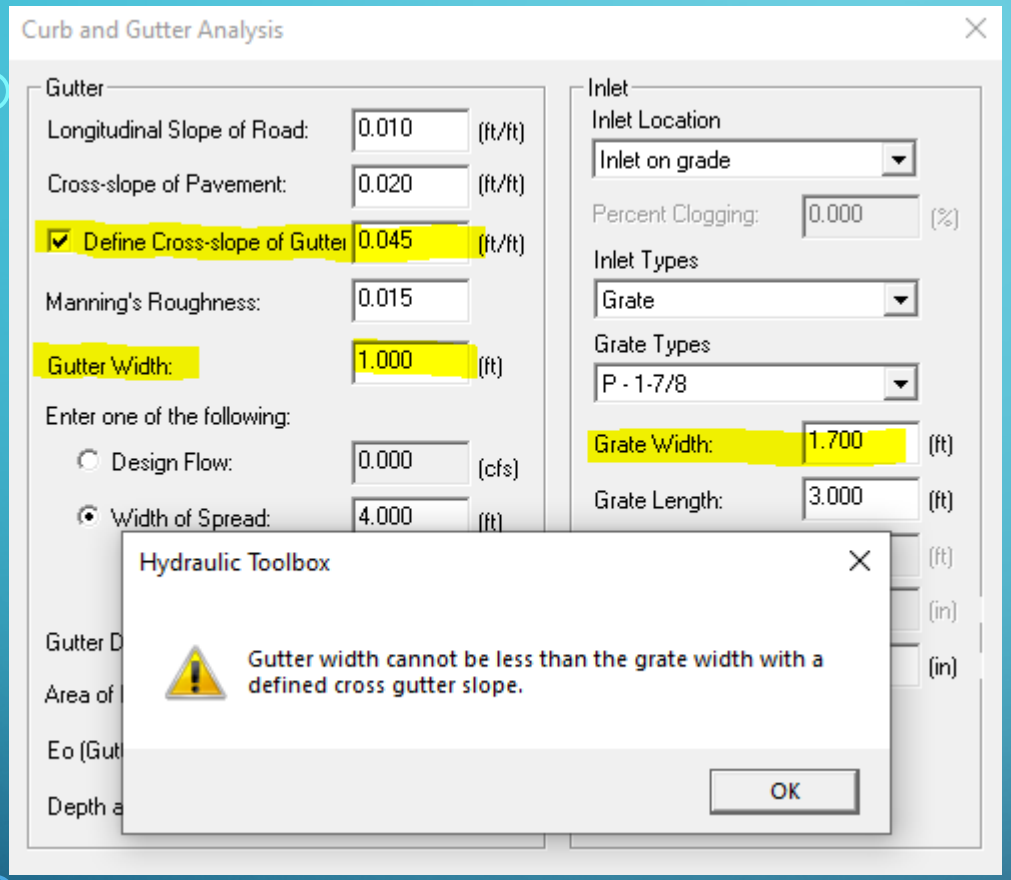


WHAT IS THIS?

1. DelDOT Bioretention Cell?
2. Million Trees Project?
3. A Cry for Help?
4. Someone has too much free time on their hands?

If found, please call John Garcia regardless of county.

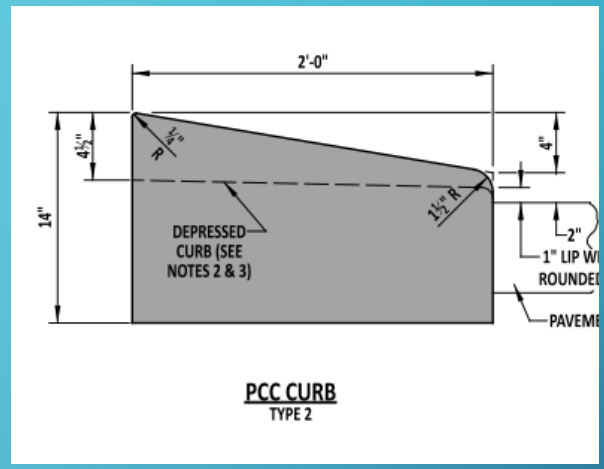
CURB SELECTION & DRAINAGE



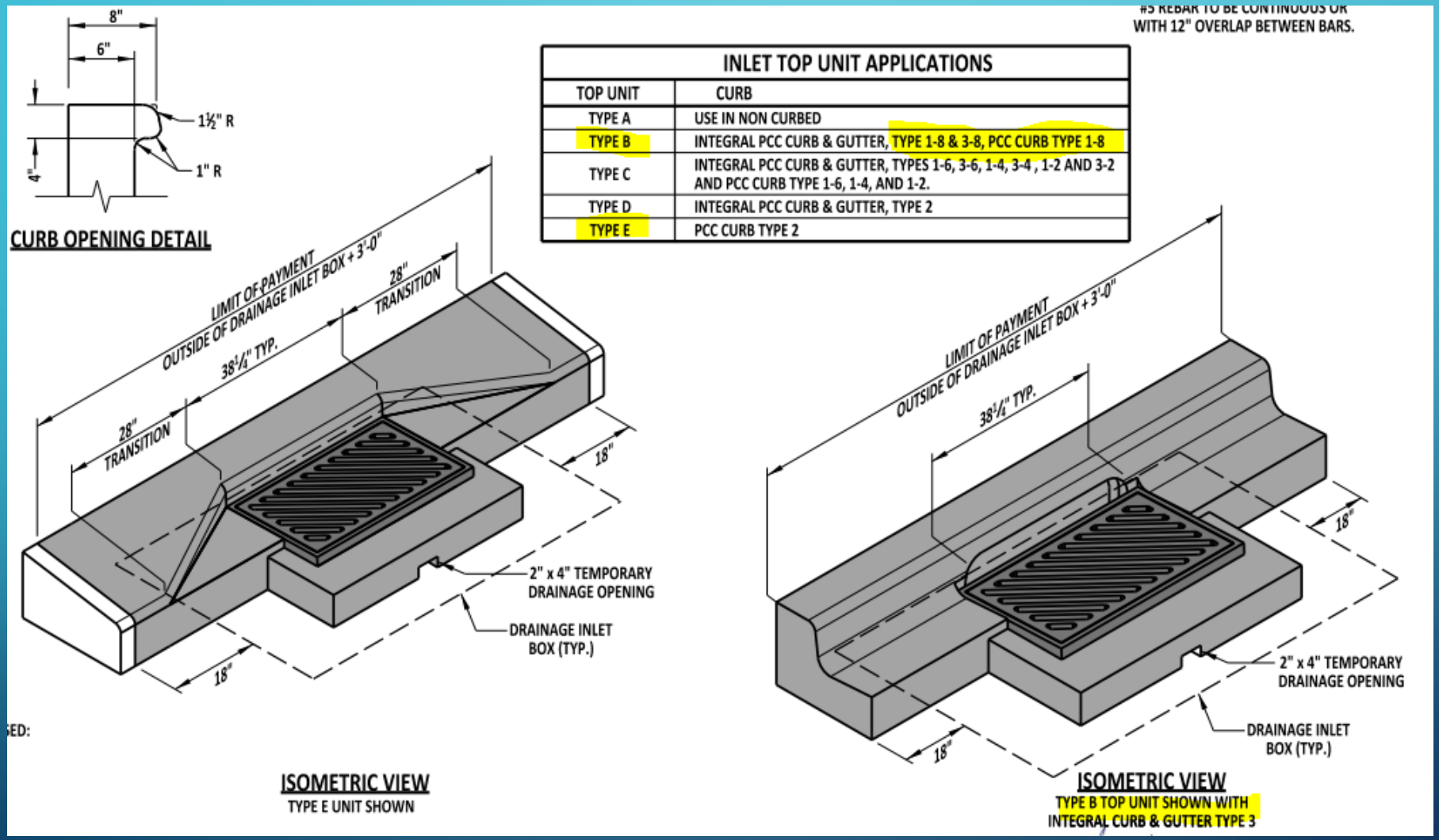
FHWA Hydraulic Toolbox

CURB SELECTION & DRAINAGE

- PCC Curb Type 2
- Inlet Top Unit Type E



2021 SCD


#5 REBAR TO BE CONTINUOUS OR
WITH 12" OVERLAP BETWEEN BARS.
8"
6"
1½" R
1" R
4"
CURB OPENING DETAIL
INLET TOP UNIT APPLICATIONS
TOP UNIT | CURB
TYPE A | USE IN NON CURBED
TYPE B | INTEGRAL PCC CURB & GUTTER, TYPE 1-8 & 3-8, PCC CURB TYPE 1-8
TYPE C | INTEGRAL PCC CURB & GUTTER, TYPES 1-6, 3-6, 1-4, 3-4 , 1-2 AND 3-2 AND PCC CURB TYPE 1-6, 1-4, AND 1-2.
TYPE D | INTEGRAL PCC CURB & GUTTER, TYPE 2
TYPE E | PCC CURB TYPE 2
LIMIT OF PAYMENT
OUTSIDE OF DRAINAGE INLET BOX + 3'-0"
28" TRANSITION
38¼" TYP.
28" TRANSITION
18"
2" x 4" TEMPORARY DRAINAGE OPENING
DRAINAGE INLET BOX (TYP.)
18"
ISOMETRIC VIEW
TYPE E UNIT SHOWN
LIMIT OF PAYMENT
OUTSIDE OF DRAINAGE INLET BOX + 3'-0"
38¼" TYP.
18"
2" x 4" TEMPORARY DRAINAGE OPENING
DRAINAGE INLET BOX (TYP.)
18"
ISOMETRIC VIEW
TYPE B TOP UNIT SHOWN WITH INTEGRAL CURB & GUTTER TYPE 3

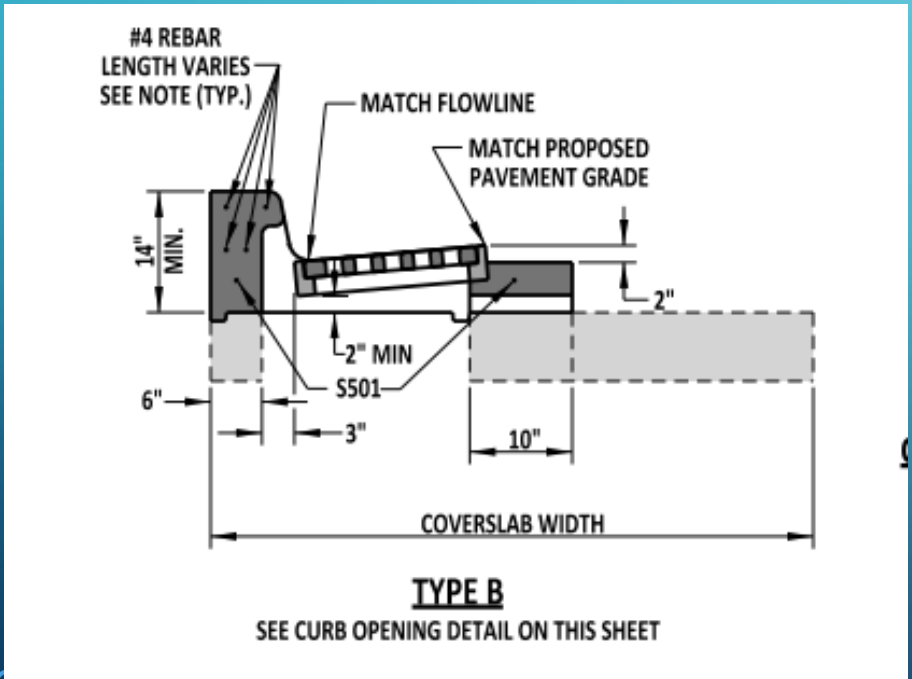
2021 SCD

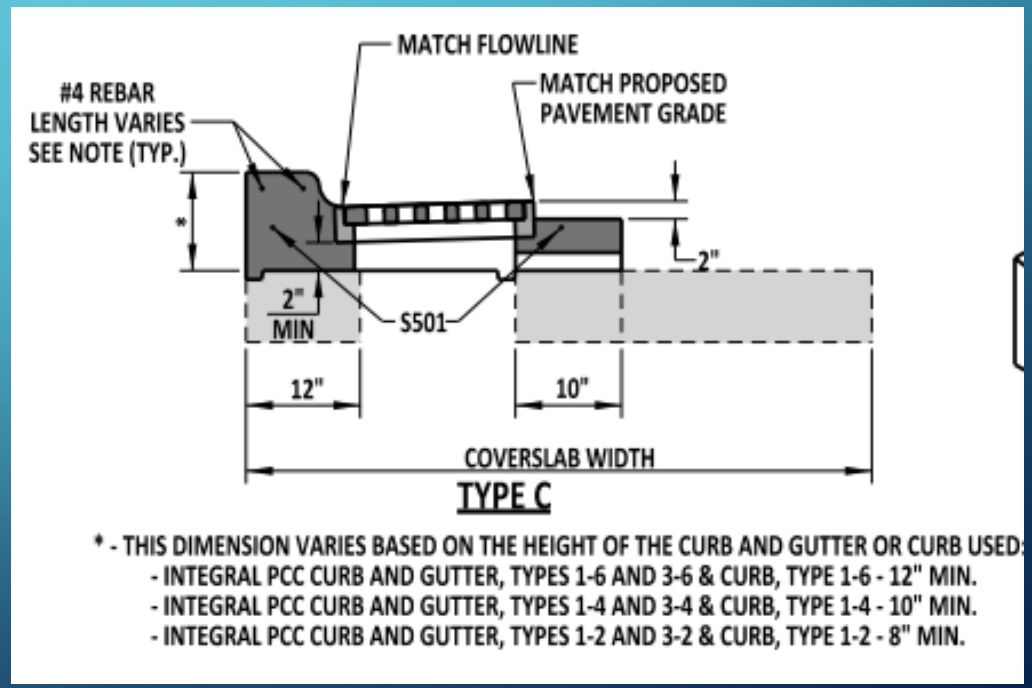
CURB SELECTION & DRAINAGE

RDM Figure 6-3

Inlet clogging factor of safety

- 1.5 with curb and 2.0 without curb
- 1.0 for curb opening inlet



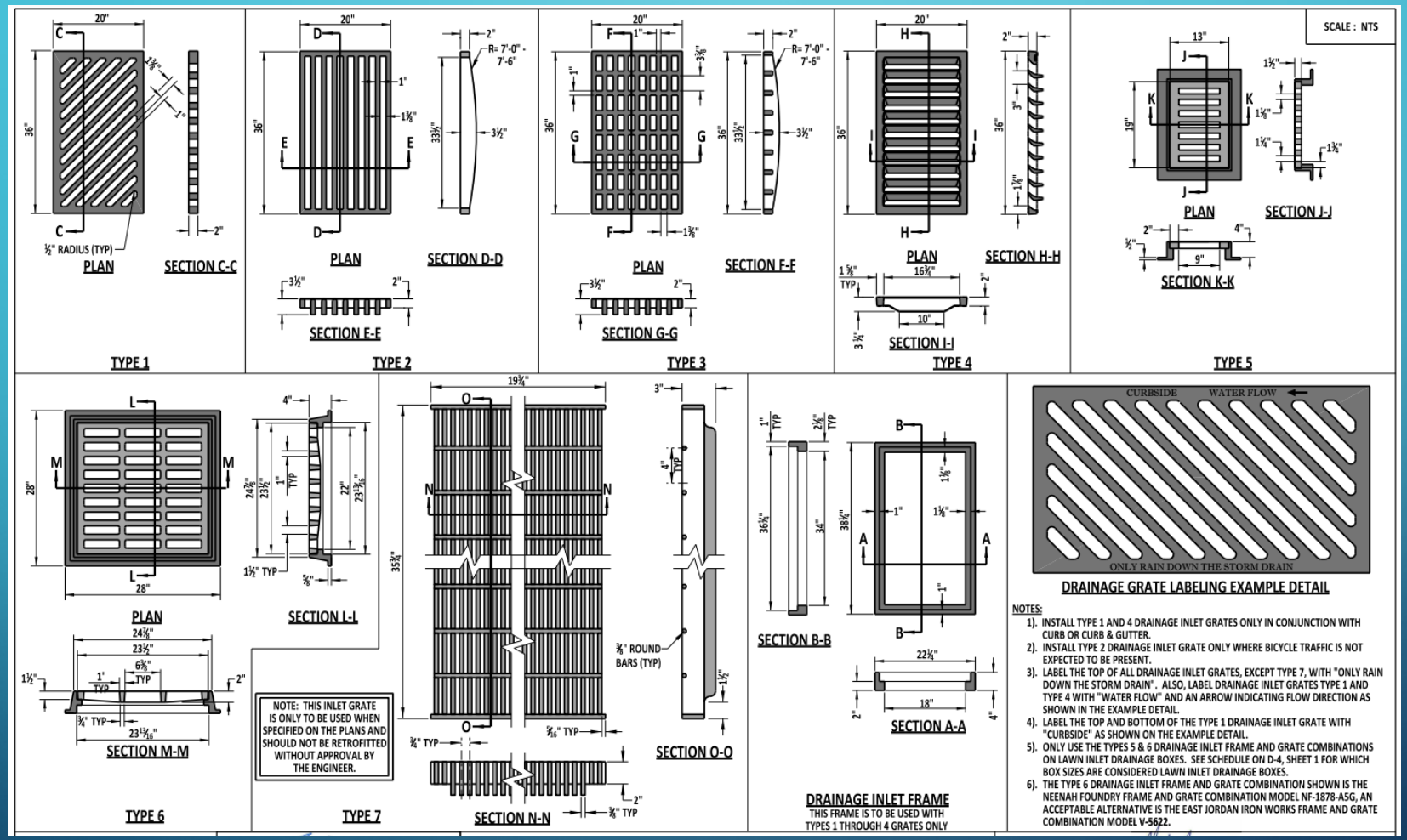


GRATE SELECTION & DRAINAGE

Considerations:

- Hydraulics
- Bike Safe
- Debris Handling
- Pedestrians

GRATE SELECTION & DRAINAGE



2021 SCD

GRATE SELECTION & DRAINAGE

6.8.2.6.2 INLET GRATES

The types of inlet grates used on projects are shown in DelDOT's *Standard Construction Details*. All the grates are 20 in by 36 in. A description of the grates follows.

Type 1 grate has an opening area of 320 in^2, approximately 44% of the total area. The rounded bars intercept flow more efficiently. It is used adjacent to curb with or without integral gutter where bicycle traffic can be anticipated.

Type 2 grate has an opening area of 370 in^2, approximately 51% of the total area. This grate is used adjacent to a curb in controlled access highways or in median swales where bicycle traffic is restricted.

Type 3 grate has an opening area of 295 in^2, approximately 41% of the total area. This type of grate is used in open parking areas, median swales, and along roadsides where bicycle traffic can be expected. These grates are intended to intercept the surface runoff in sump conditions and shall not be used beside curbs.

Type 4 vane grate has an opening area of 215 in^2, approximately 30% of the total area. This type of grate has a higher hydraulic capacity and lower weight than the other types. It may be used where bicycle traffic can be expected. It is not recommended for use in sump locations.

RDM

GRATE SELECTION & DRAINAGE

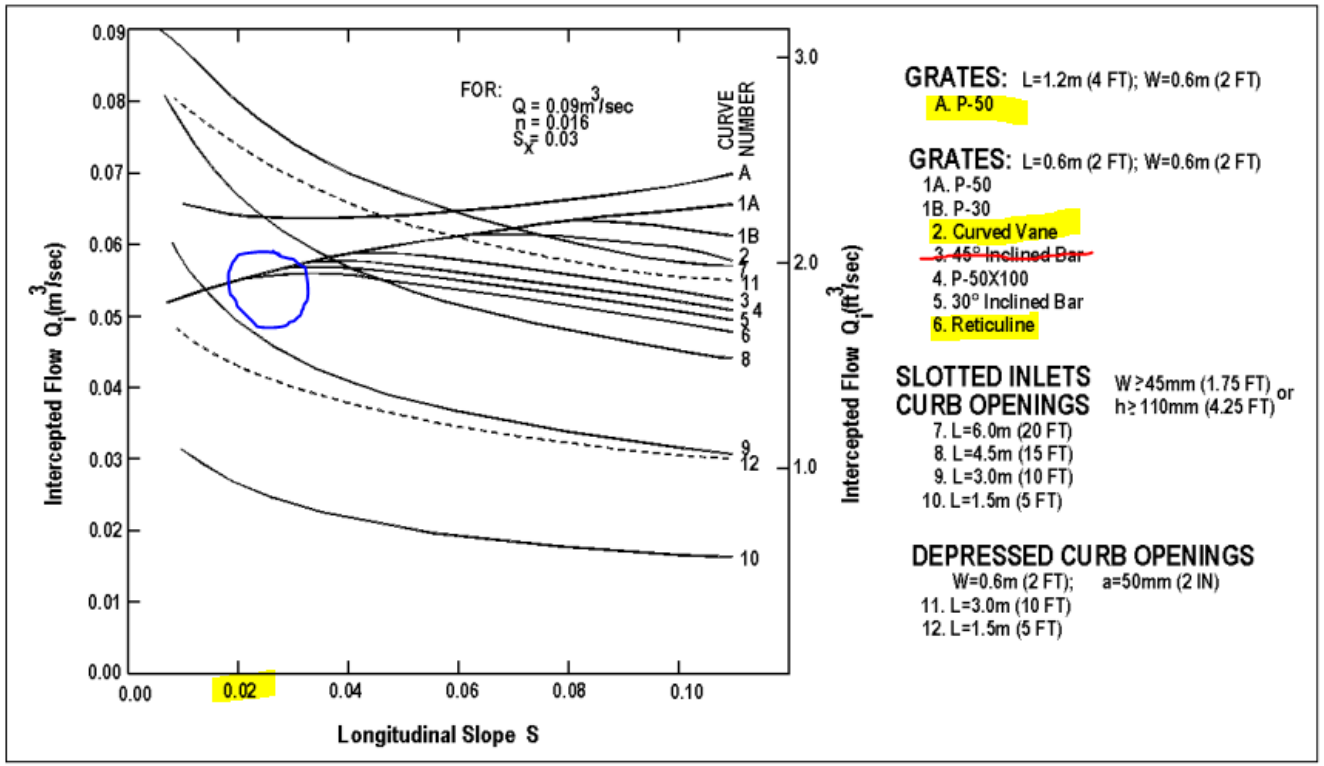


Figure 4-11. Comparison of inlet interception capacity, slope variable.

HEC-22

CURB SELECTION & DRAINAGE

Correct Use of Type 3 Grate

Poor use of Type 3 Grate

GRATE SELECTION & DRAINAGE

DRAINAGE INLET GRATES ADJACENT TO THE CURB OR EDGE PAVING, WITHIN THE PROJECT LIMITS, WHICH ARE NOT TYPE 1 OR TYPE 4, SHALL BE REPLACED WITH TYPE 1. INLET GRATES WITHIN THE PAVING, NOT ADJACENT TO THE CURB OR EDGE OF PAVING SHALL BE REPLACED WITH TYPE 3. THE ACTUAL LOCATIONS, THE NEED FOR ANY GRATE MODIFICATIONS OR FOR NEW FRAMES SHALL BE DETERMINED BY THE ENGINEER.

2020 Approved Project Notes

CURB SELECTION & DRAINAGE

GRATE SELECTION & DRAINAGE

Ideal locations for Type 2 Grates

GRATE SELECTION & DRAINAGE

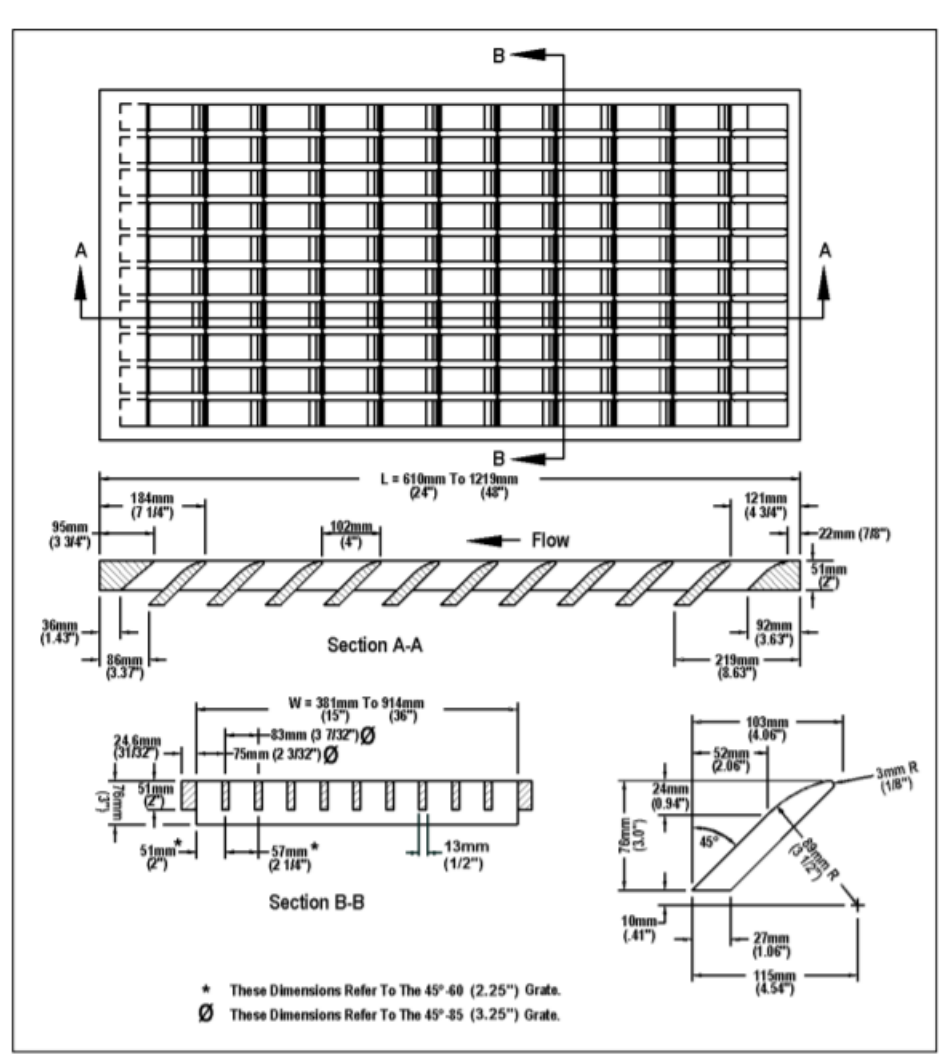
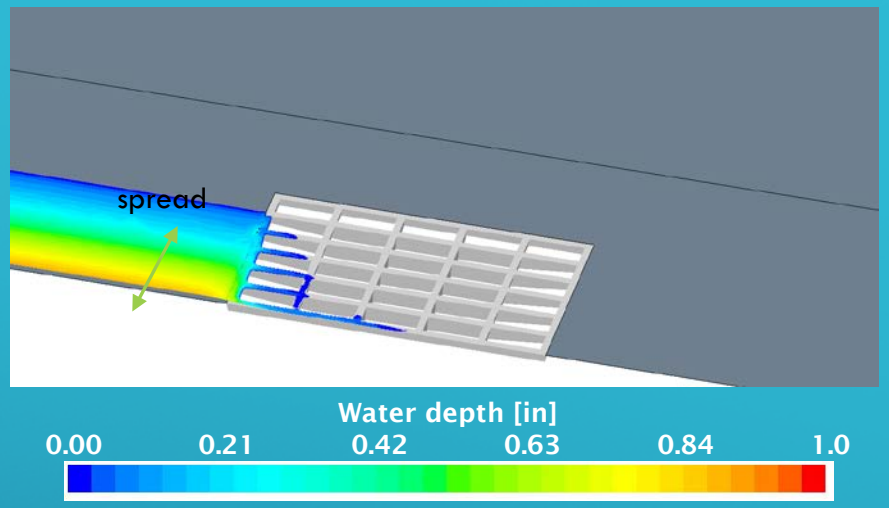


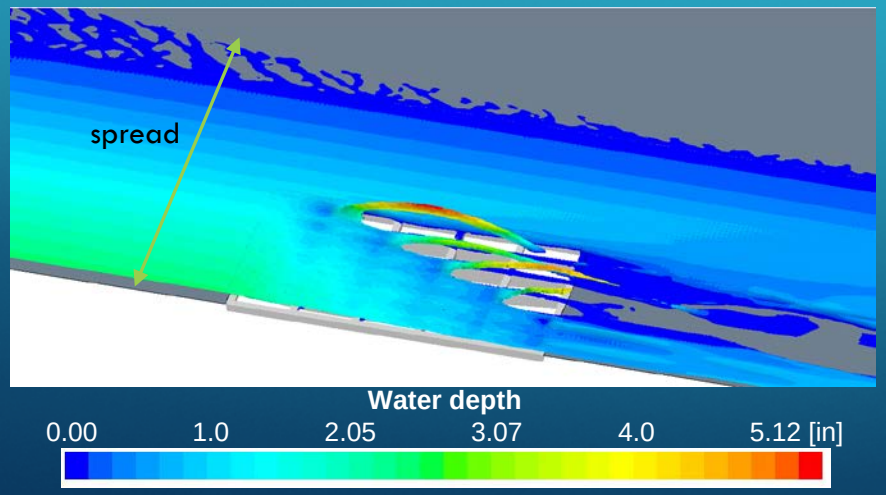
Figure 4-8. 45°- 60 (2.25") and 45°- 85 (3.25") tilt-bar grates.

HEC-22

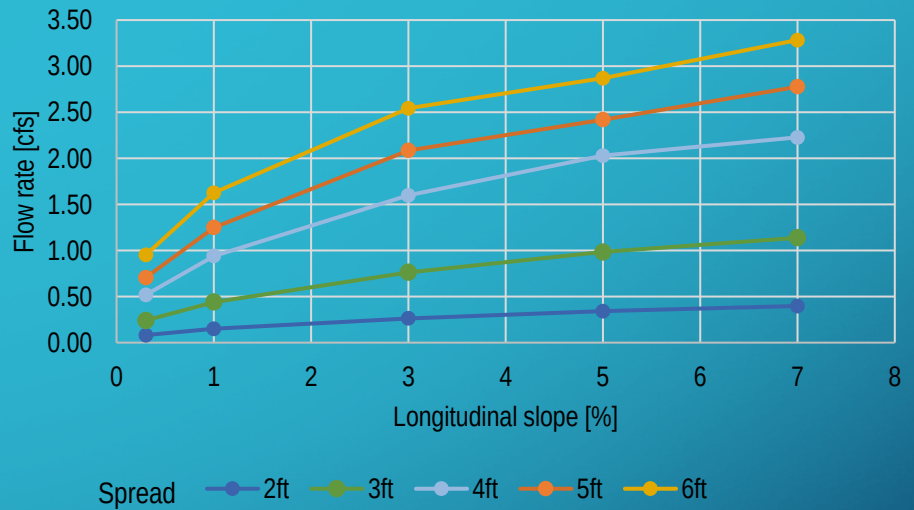
FLOW PATTERNS FOR VARYING CONDITIONS



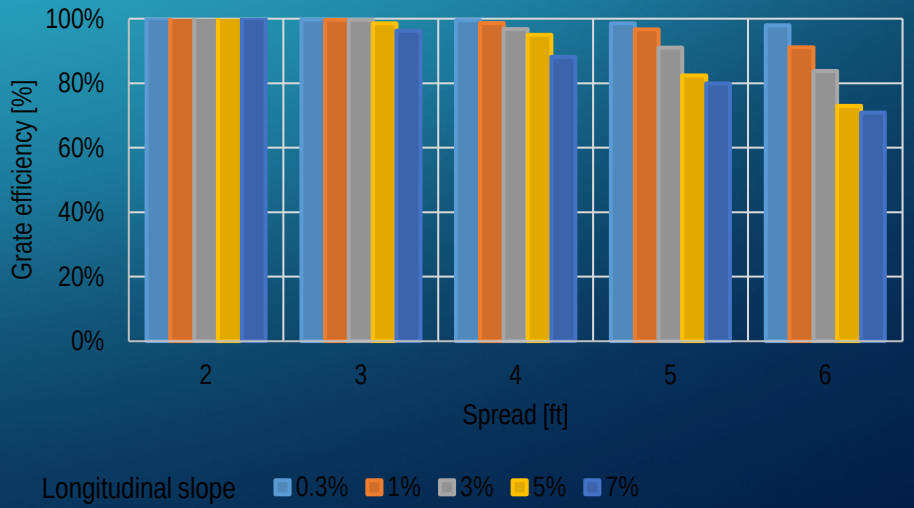
No bypass flow



Bypass flow without overtopping of the grate

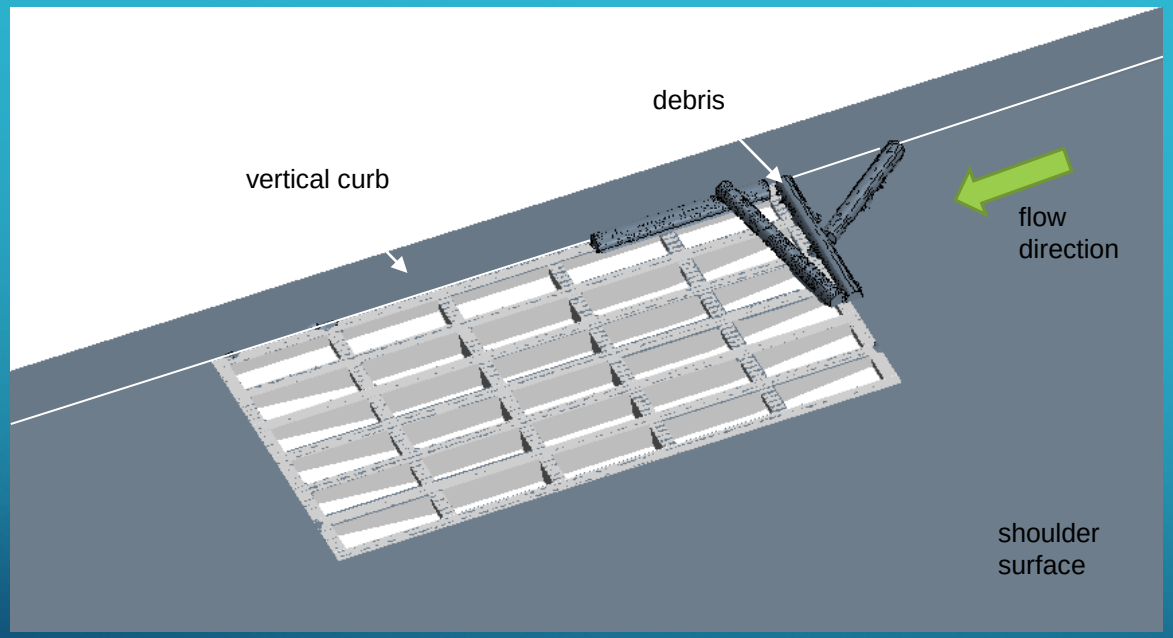


Flow rate through the grate vs. longitudinal slope for a road with a 4-foot shoulder



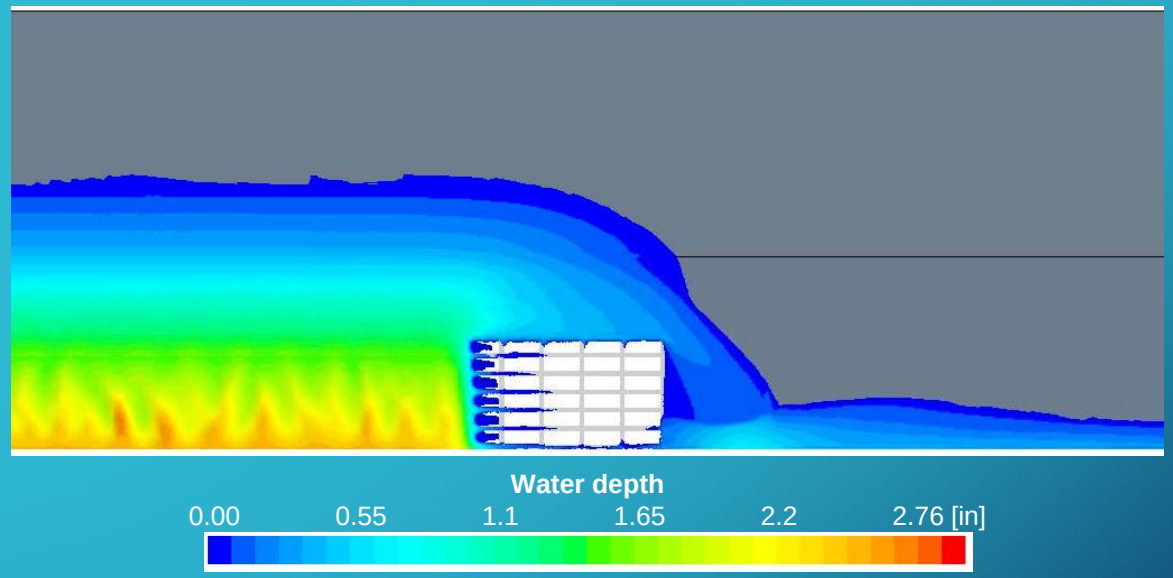
Efficiency of the grate for a roadway with a 4-foot shoulder

INFLUENCE OF DEBRIS

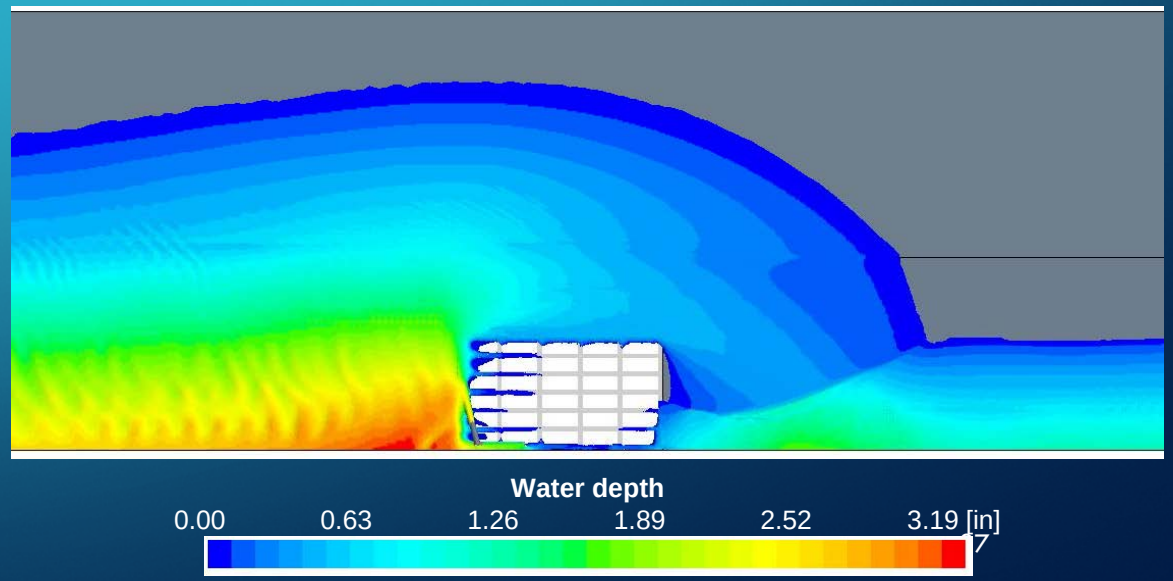


Model of stacked debris at the inlet

Efficiency drop of 15 %



Flow pattern in the vicinity of the inlet grate without obstruction



Flow pattern in the vicinity of the inlet grate with obstruction

GRATE SELECTION & DRAINAGE

GRATE SELECTION & DRAINAGE

Table 4-5. Average Debris Handling Efficiencies of Grates Tested.

Rank	Grate	Longitudinal Slope	
		0.005	0.04
1	Curved Vane	46	61
2	30°- 85 Tilt Bar	44	55
3	45°- 85 Tilt Bar	43	48
4	P – 50	32	32
5	P - 50xl00	18	28
6	45°- 60 Tilt Bar	16	23
7	Reticuline	12	16
8	P – 30	9	20

HEC-22

GRATE SELECTION & DRAINAGE

Good use of Type 3-8 C&G

West Dover Connector

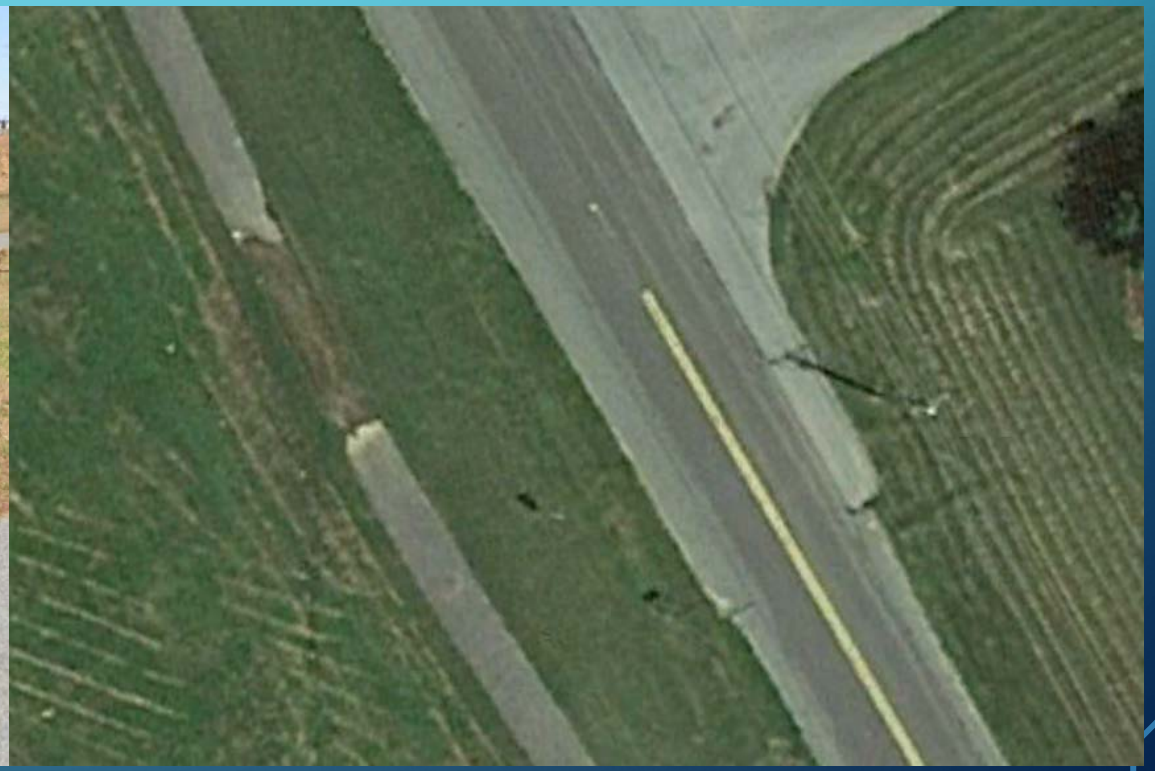
CHANNELING CLAYTON

PAS 4.5.3.1.4 Drainage Considerations

The pedestrian access route is to be designed to prevent the accumulation of water (and debris)*. Drainage collection features should be located on the upstream side of all street level pedestrian connections. Depending upon the scope of the work, consideration can be given to adding additional drainage collection features, modifying the configuration of the street level pedestrian connection, or adjusting the location of the crossing.

*Recommended edit

CHANNELING CLAYTON



CHANNELING CLAYTON

CHANNELING CLAYTON

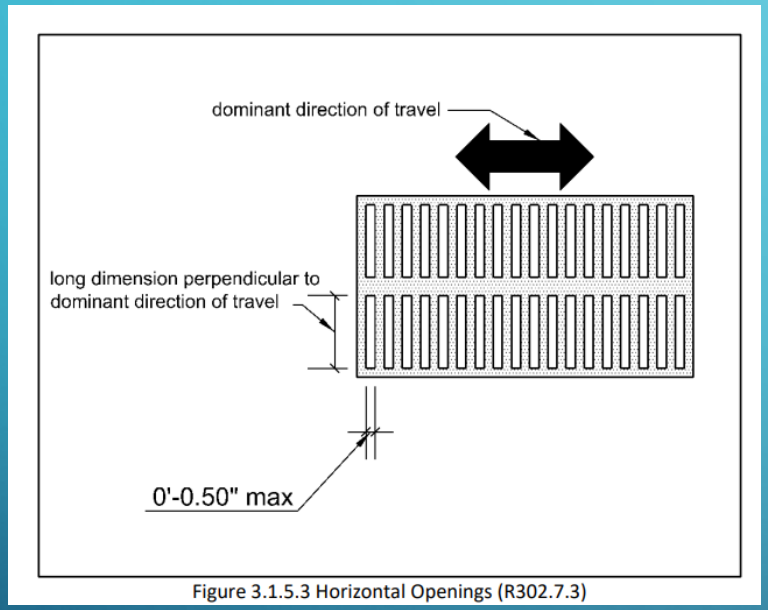


Figure 3.1.5.3 Horizontal Openings (R302.7.3)

PAS

MONUMENTS

Design Meeting

Right-of-way monuments should be placed to provide a permanent reference for reestablishing the centerline and right-of-way line. Right-of-way monuments The Department’s policy is to place concrete monuments on curve P.C. and P.T. points and to place capped rebar at jogs in the right-of-way.

WHAT IS THIS?

1. Greatest Super Bowl Play Ever?
2. Greatest Super Bowl Play Ever!
3. Greatest Super Bowl Play Ever!!