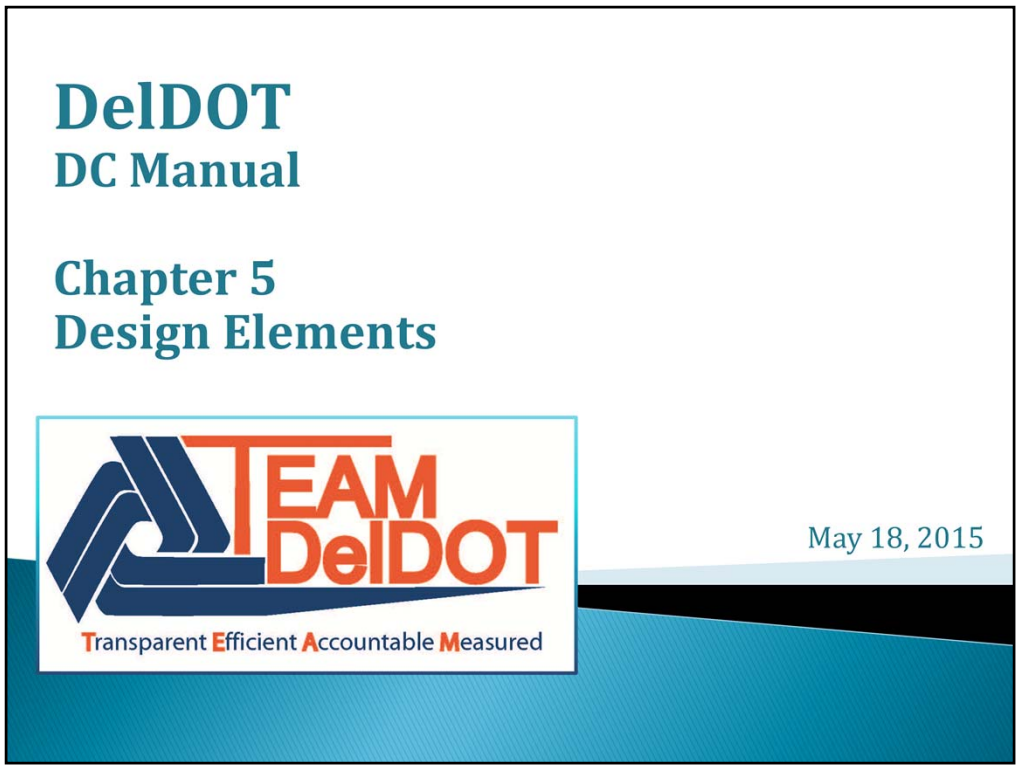


Chapter 5 is really the meats and bones of what many of you will use to complete your designs and produce the construction plans. We recognized when we began making revisions that this Chapter told you what was required but lacked guidance how to meet the requirements so much more guidance has been added to this Chapter to reduce the amount of guess work required. We reviewed manuals from several other DOTs to cherry pick the best of the best and incorporate it into our manual. We hope that this will enable you to do your job easier and help reduce the number of review comments.

Chapter 5

- **Intersection Design**
  - Subdivision Street Curb Radii

Intersecting Subdivision Street Types		Corner Radii (@ edge of pavement)
Type I	Type I	15 feet
Type I	Type II	20 feet
Type II	Type II	25 feet
Type II	Type III	25 feet
Type III	Type III	Set to meet design vehicle

Figure 5.1.3-a

The reduced radii lessens impervious areas and helps to lower speeds in subdivision, making them safer. Some have asked about larger vehicles making turns at intersections and encroachment is expected by the larger vehicles are in subdivisions.

Chapter 5

- **Intersection Design**
  - Vertical Alignment Guidelines

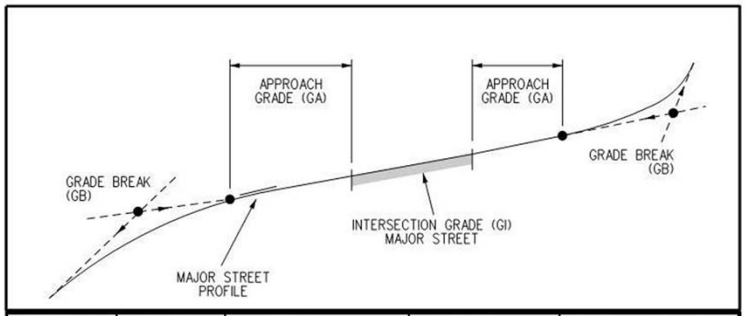


Figure 5.1.3-c

Subdivision Street Type	Design Speed (mph)	Maximum Intersection Grade (GI, %)	Maximum Grade Break (GB, %)	Minimum Length of Approach Grade (GA, ft)
I	25	5	4	40
II	30	5	3	60
III	35	5	2	60

Provide minimum lengths on each side of intersection roadway before introducing vertical curves

Chapter 5

- **Intersection Design**
  - Intersection Cross Slope Transition
  - Maintaining Major Street Crown Through Intersection
  - Adjust Minor Street Grade
  - Transition minor subdivision street to match profile of intersecting major subdivision street
  - See example, pg 5-4

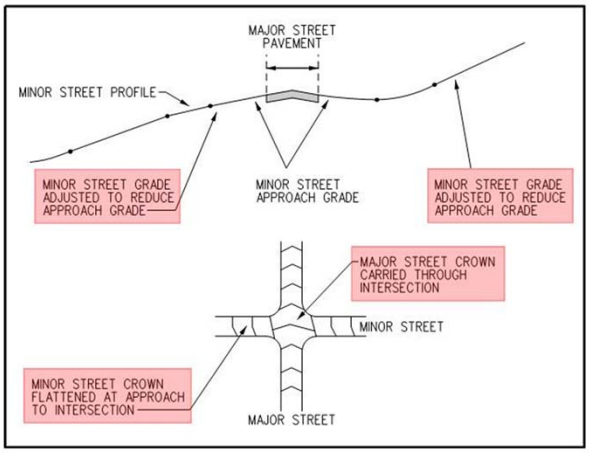
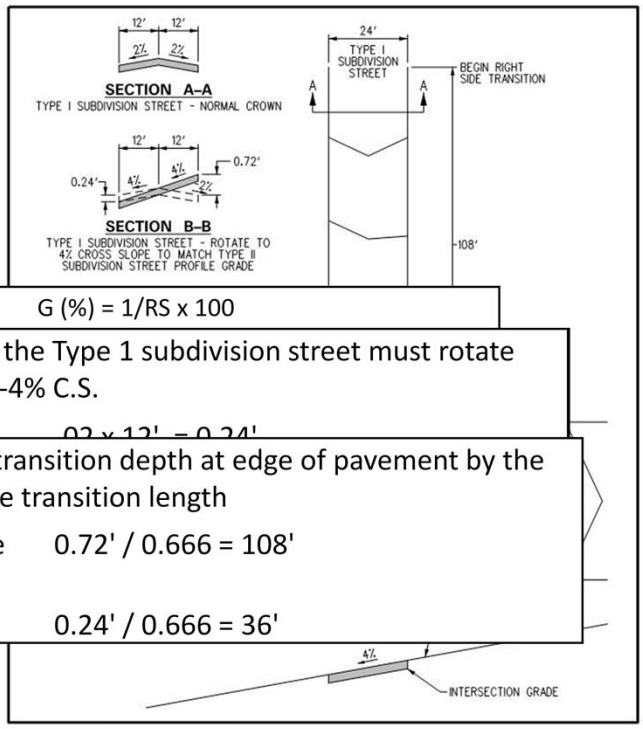


Figure 5.1.3-b

Chapter 5

- **Intersection Design**
  - Intersection C



Gradient	G (%) = 1/RS x 100

Left outside edge of the Type 1 subdivision street must rotate from a -2% C.S. to a -4% C.S.

.02 x 12' = 0.24'

Therefore, divide transition depth at edge of pavement by the gradient to find the transition length

Right outside edge	0.72' / 0.666 = 108'
Left outside edge	0.24' / 0.666 = 36'

Fi

Chapter 5

- **Parking Provisions**
  - Subdivision Street Parking Provisions
  - Parking not permitted on turnarounds and cul-de-sacs

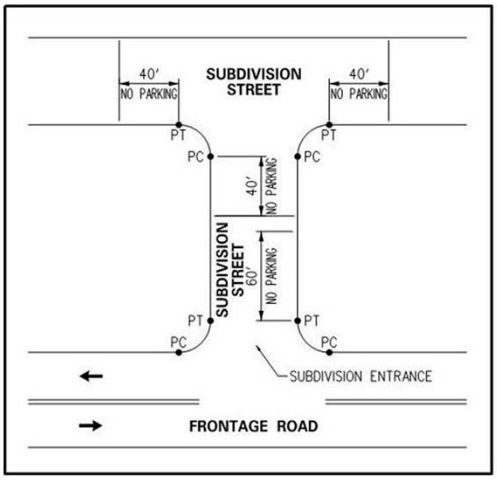
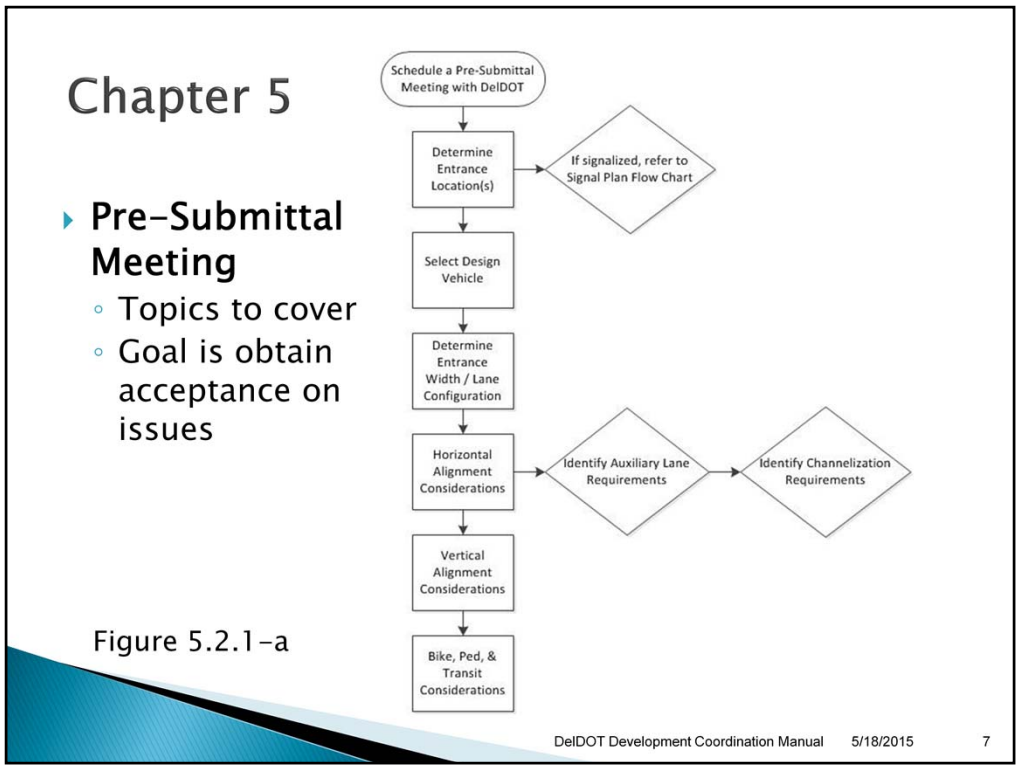


Figure 5.1.4-a

No driveways or parking bays shall be located in subdivisions within 40 feet from the edge of the radius return for the connecting street. This distance shall increase to 60 feet at the entrance to the subdivision.

In order to restrict parking in areas within a subdivision street that can accommodate overflow on-street parking, the DelDOT Traffic Section must receive a petition signed by 75% of the owners indicating their support for "Stopping, Standing, and Parking Restriction."



The flow chart shown here lists the topics to cover at the pre-submittal meeting.

It will be more productive to provide as much of this in advance of the meeting so it may be reviewed by staff

Getting acceptance on this topics early will result in much less design changes

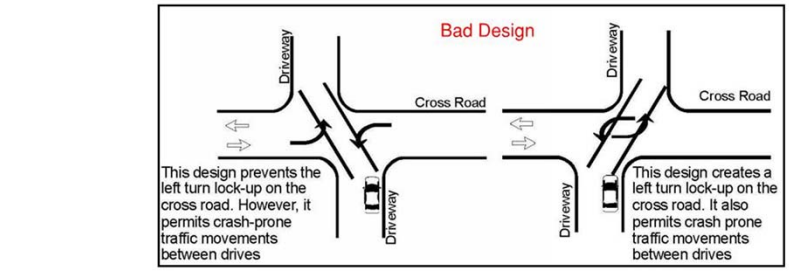
Chapter 5

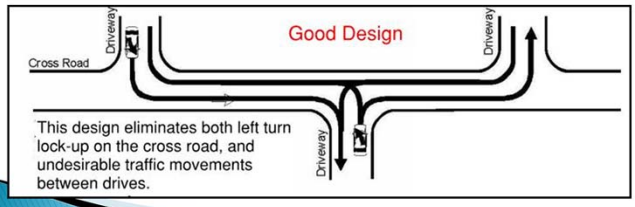
- **Entrance Location**
  - Provide sufficient spacing
  - Reduce conflict points
  - Avoid 'jog maneuvers'

Figure 5.2.2-a, 5.2.2-b, 5.2.2-c

Posted Speed (mph)	Desirable Offset Distance Between Access Points on Opposite Sides of the Roadway (feet)
25	255
30	325
35	425
40	525
45	630
50	750

Entrance Location Cont.





Chapter 5

- **Design Vehicles**
  - Recommended based on proposed use

Proposed Development Use	Design Vehicle*
Residential Subdivision	SU-30, WB-50**
Bank	SU-30
Gas Station	WB-40, WB-50, or WB-62
Big Box Store (e.g. Walmart, Lowes, Best Buy)	WB-67
Restaurant (e.g. Applebee's, Chili's, Ruby Tuesday)	WB-62
Fast Food	WB-40, WB-50, or WB-62
Mid-size Retail/Grocery (e.g. Dollar Store, Giant, Safeway)	WB-62
Small Retail	SU-30, WB-40, or WB-50
Pharmacy	WB-62
Car Wash	SU-30
School	SU-30, WB-62**
Intersections of State Maintained Roadways	WB-62

** – Encroachment may be permitted but not on curb or islands

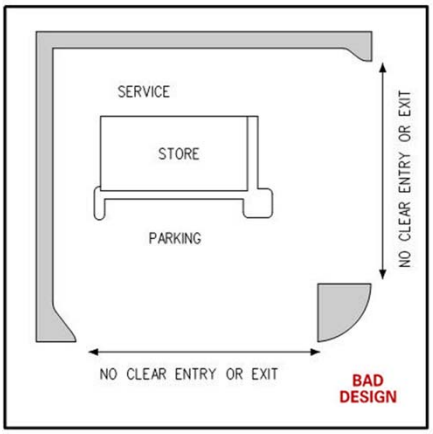
Figure 5.2.3-a

It's extremely important to identify early and gain acceptance by DelDOT prior to design and submitting plans for review.

We don't want to see an entrance we feel should be designed a WB-62 to be designed by you for a SU-30 because of the time and effort required to redesign the entrance.

Chapter 5

- **Entrance Widths**
  - Provide clear points of access
  - Dependent on number of lanes needed



Figures 5.2.4-a, 5.2.4-b

Entrance Widths Continued

Entrance Type	Pavement Width
Subdivision Type I, II, and III Streets (One-way)	16 feet
	18 feet (without curb and gutter)
Subdivision Type I Street (Two-way)	24 feet
Subdivision Type II and III Streets (Two-way)	32 feet
Industrial Street (Two-way)	32 feet
Commercial Access (One-way)	18 feet
Commercial Access (Two-way)	24 – 32 feet

Chapter 5

- **Intersection Corner Design**
- **Turning Movements**
  - Lane Encroachment by D.V. is not permitted
    - On curbed channelizing islands
    - Outer curb line
    - Beyond the edge of pavement (when curb isn't present)
  - Lane Encroachment by D.V. may be permitted
    - On approach and/or departure legs in certain cases

Section 5.2.5

Chapter 5

- **Lane Encroachment**
  - Condition A
  - No encroachment
  - Most desirable option

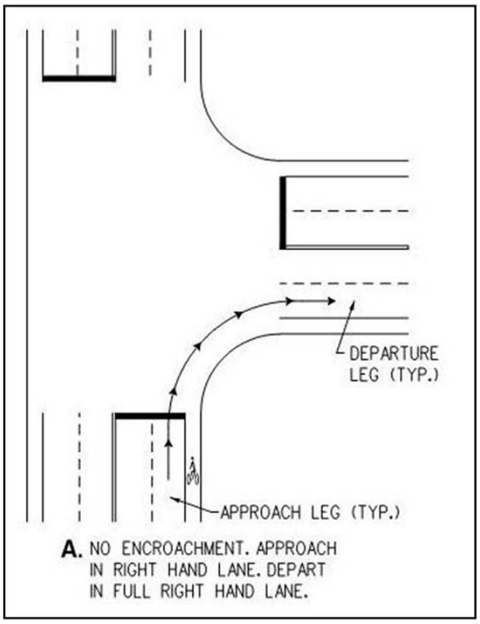


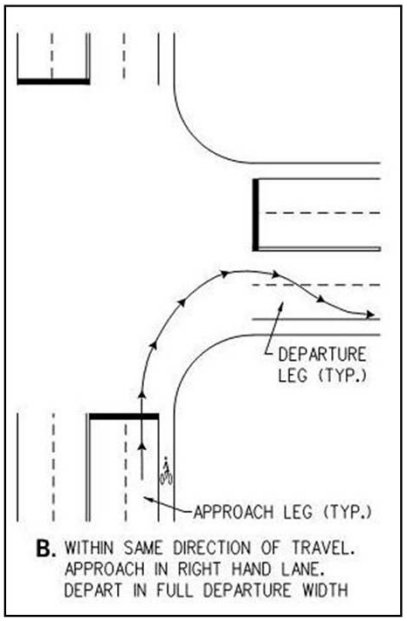
Figure 5.2.5-a

D.V. performs turning movement in designated approach and departure lanes

Chapter 5

- **Lane Encroachment**
  - Condition B
  - Signalized intersections
  - Multi-lane roadway
  - Encroachment in near travel lane

Figure 5.2.5-a

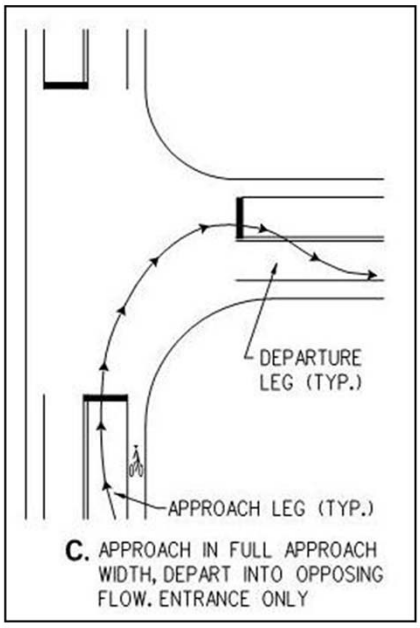


D.V. performs turning movement in designated approach lane but uses both lanes on departure leg at signals when a gap is provided during the red phase

Chapter 5

- **Lane Encroachment**
  - Condition C
  - Encroachment on exit lane at entrance
  - Acceptable when D.V. movements are expected during off-peak times (i.e. night deliveries)

Figure 5.2.5-a

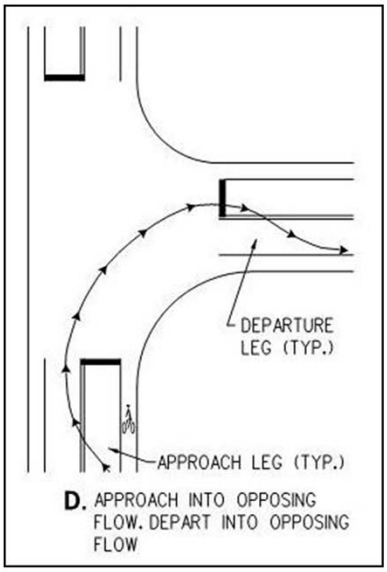


D.V. performs turning movement in designated approach lane but encroaches on exit lane on departure leg

Chapter 5

- **Lane Encroachment**
  - Condition D
  - Encroachment into opposing flow on both legs

Figure 5.2.5-a

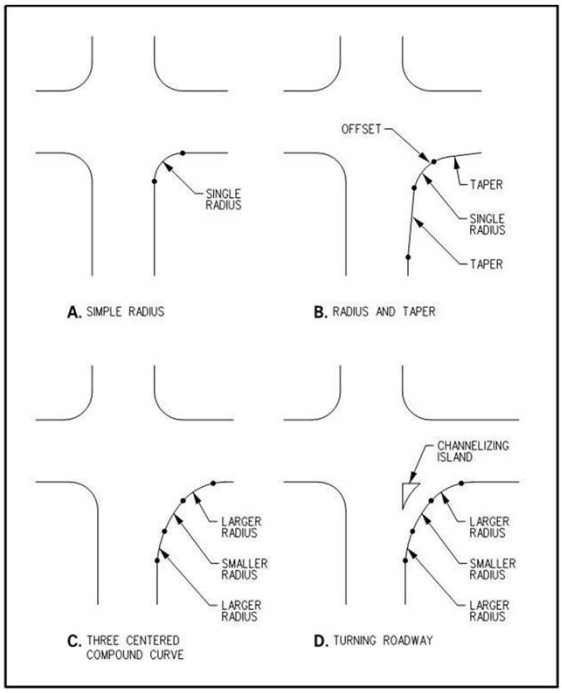


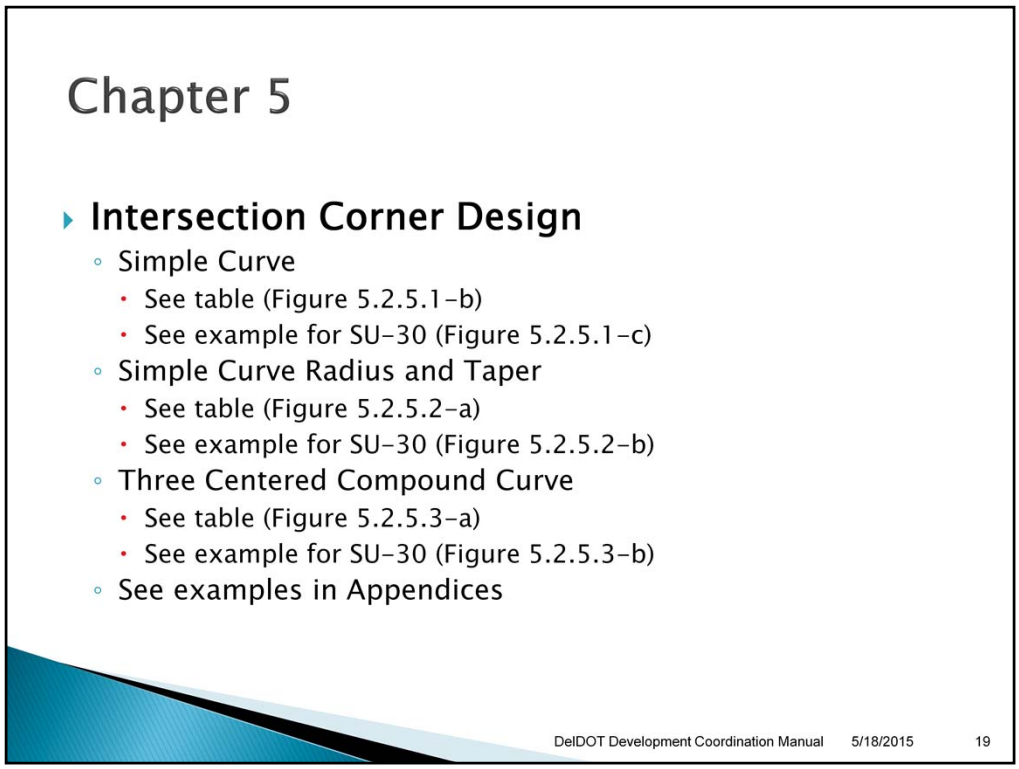
D.V. performs turning movement encroaching on exit lanes on approach and departure legs

Chapter 5

- **Intersection Corner Design**
  - Simple Curve
  - Radius and Taper
  - Three Centered Compound Curve
    - Most efficient option
  - Turning Roadway

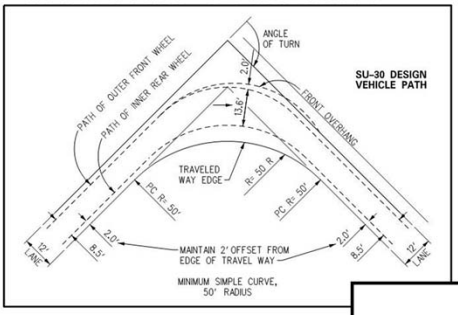
Figure 5.2.5-b

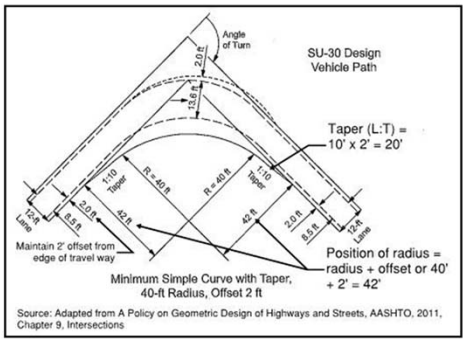


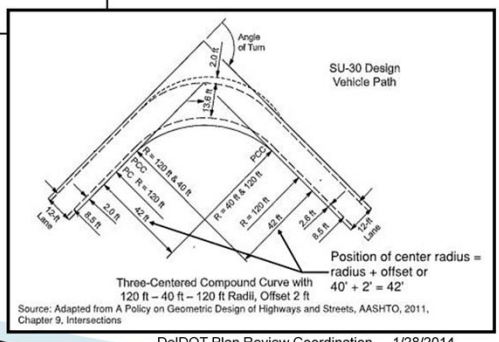


Listed here are the options and associated figures and exhibits to assist you with designs. The simple curve and radius and 3 centered compound curve design options will save you real estate at corners and reduce impervious area.

Intersection Corner Design



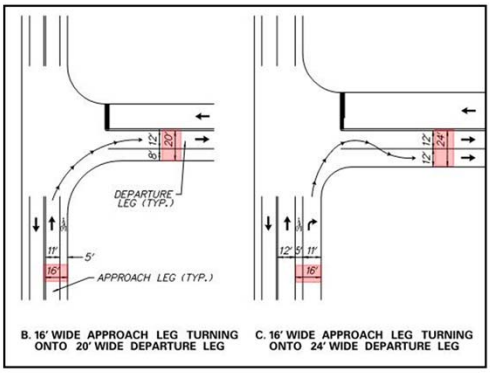




Chapter 5

- **Intersection Corner Design**
  - Using Effective Pavement
    - Effective width is typically greater than 11' or 12' travel lane
    - Increased width on approach and departure legs = smaller curve radius
    - Turning movement diagrams will define intersection geometry
      - **Perform early in design!!**

Figure 5.2.5.1-a



Don't wait to perform turning movement diagrams until just before submitting plans for review. This step should be done early in design before the drainage design is started.

Chapter 5

- **Turning Roadway**
  - See table (Figure 5.2.5.4-d)
  - See examples for
    - Passenger car/ occasional SU-30 (Figure 5.2.5.4-e)
    - SU-30 / occasional WB-62 (Figure 5.2.5.4-f)
    - WB-62 (Figure 5.2.5.4-g)

Chapter 5

- **Turning Roadway**
  - Channelizing Islands
    - Mountable curb – P.C.C. curb, Type 2 preferred
    - Corners of islands – flush on approaches per std. specs for snow plowing operations
    - Refer to
      - DGM 1-22 (http://www.deldot.gov/information/business/drc/highway.shtml)
      - Section 7.3.3. of Road Design Manual (http://www.deldot.gov/information/pubs_forms/manuals/road_design/pdf/revisions062811/07_Intersections.pdf?100411)
      - Curb Ramp, Type 5 – Std Detail C-5 (http://www.deldot.gov/information/pubs_forms/const_details/2013/pdf/SD_c02-3.pdf?031114)
      - AASHTO Green Book

Chapter 5

- **Turning Roadway**
  - Channelizing Islands without Pedestrian Facilities

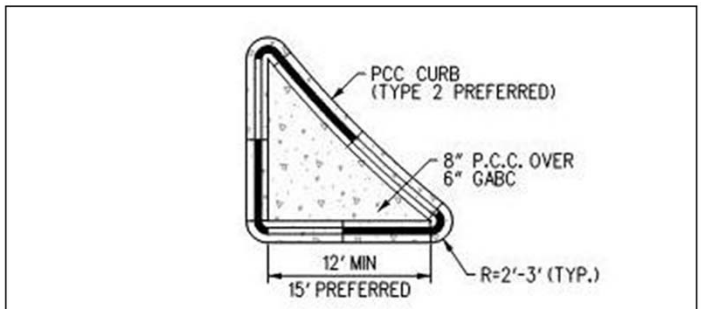


Figure
5.2.5.5-a

LOCATION	MINIMUM ISLAND SIZE (ft^2)	PREFERRED ISLAND SIZE (ft^2)
URBAN	50	100
RURAL	75	100

Notice different sizes for rural and urban areas.

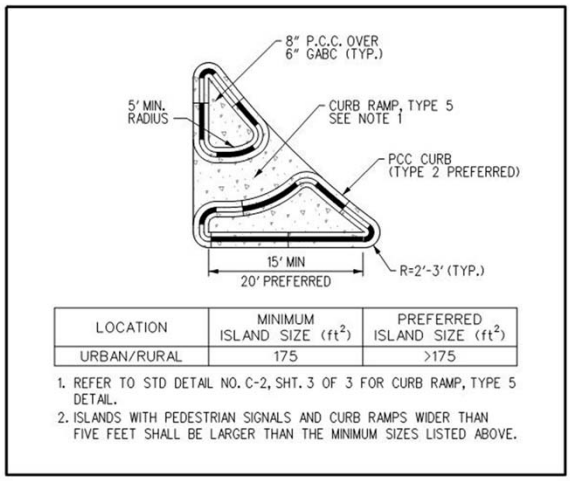
Try to meet or exceed the preferred size. If you provide the minimum it looks like it is feasible to increase the size, we're going to ask you to make it larger or prove that it can't be done.

Note the minimum tangent length and provide radii on corners.

In addition, note the pavement section of 8" PCC over 6" GABC.

Chapter 5

- **Turning Roadway**
  - Channelizing Islands with Pedestrian Facilities
  - See Std Detail C-5 for more guidance

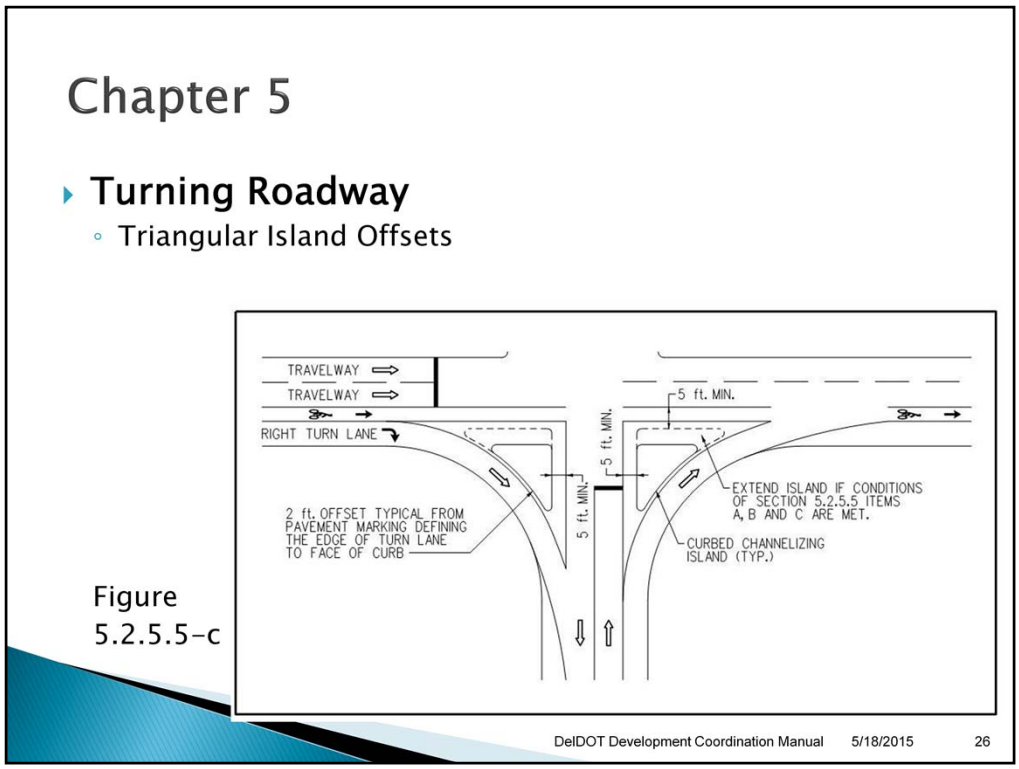


LOCATION	MINIMUM ISLAND SIZE (ft^2)	PREFERRED ISLAND SIZE (ft^2)
URBAN/RURAL	175	>175

1. REFER TO STD DETAIL NO. C-2, SHT. 3 OF 3 FOR CURB RAMP, TYPE 5 DETAIL.
2. ISLANDS WITH PEDESTRIAN SIGNALS AND CURB RAMPS WIDER THAN FIVE FEET SHALL BE LARGER THAN THE MINIMUM SIZES LISTED ABOVE.

Figure 5.2.5.5-b

The increased area requirements for the type 5 curb ramp and possible ped signal.



As stated in the AASHTO Green Book, "islands used for channelization should not interfere with or obstruct bicycle lanes at intersections

This figure was added to the DC manual and taken from DGM 1-22.

The corners of the island shall be flush with the pavement as per the *Standard Specifications* for snow plowing operations.

The corners of islands which are not offset the full width of the shoulder adjacent to the roadway shall be delineated with flexible delineators

Chapter 5

- **Turning Roadway**
  - Sample RIRO Entrance for SU-30 D.V.

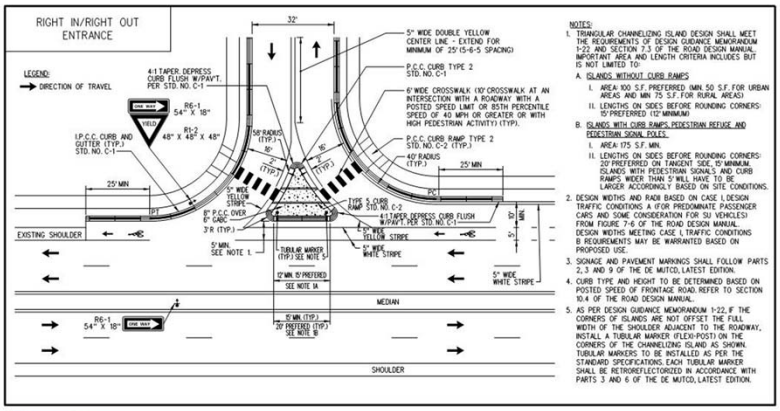


Figure 5.2.5.4-b

The geometry shown here is not a one size fits all. It's dependent on sight conditions and is only meant to serve as guidance on what to include and what may possibly work for the specified D.V.

For example, if the frontage road doesn't have a bike lane to utilize as effective width, then the entry geometry most likely won't work b/c the additional 5' of effective width provided by the bike lane allows for a slightly smaller radius.

Turning movement diagrams are still required even you match the geometry shown in the examples.

Chapter 5

- **Turning Roadway**
  - Sample RIRO Entrance for WB-40 D.V.

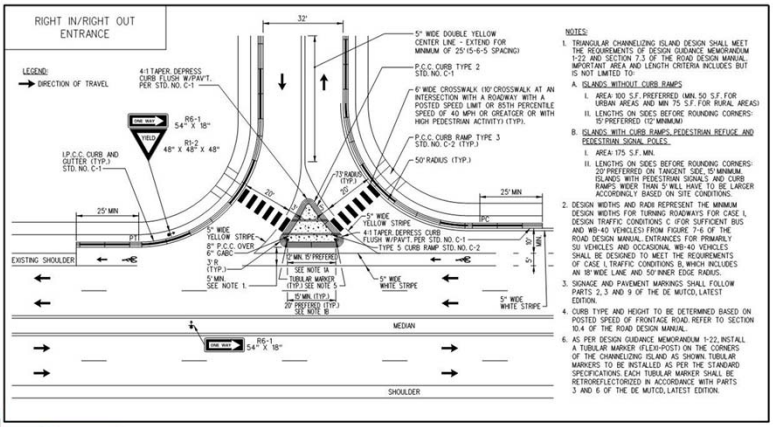


Figure 5.2.5.4-c

Chapter 5

- **Turning Movement Diagrams**
  - Maintain 2’ offset from EOP on tangents and throughout most of turn (9” minimum from face of curb or EOP)
  - Use min. 10 mph speed with turning software
  - Submit for review

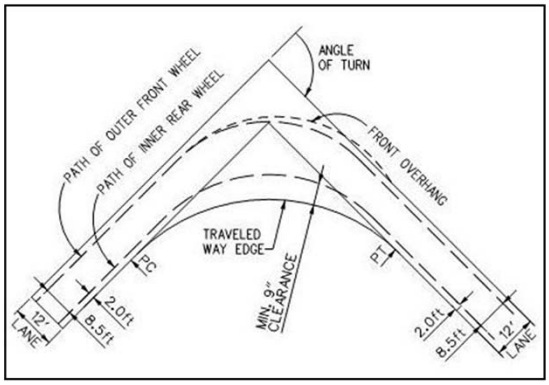


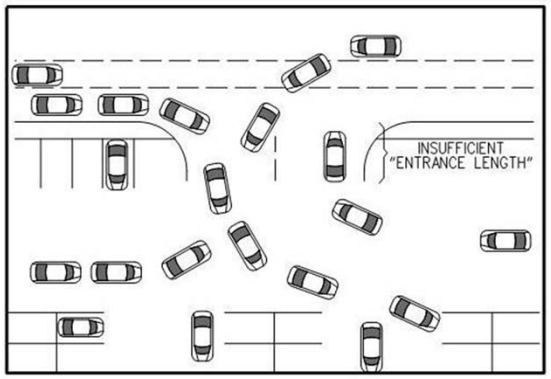
Figure 5.2.5.6-a

Per AASHTO

Chapter 5

- **Entrance Length**
  - Provide sufficient stacking for both incoming and outgoing vehicles

Land Use	Entrance Length
"Big Box" centers with four or more total lanes at the entrance.	300 feet
Regional Shopping Centers over 150,000 s.f.	250 feet
Community Shopping Centers between 100,000 sf and 150,000 s.f.	150 feet
Small Strip Shopping Center	50 feet
Small Commercial Developments	50 feet



Figures 5.2.6-a, 5.2.6-b

Avoid this chaotic situation when you begin laying out your sites as this create confusion and an unsafe condition for motorists entering and exiting the site.

Take this into account early in design

Recommend providing the entrance lengths shown here which are based on different uses.

Chapter 5

- **Drive-Thru Queue**
  - Avoid queuing onto lanes of adjacent roadway
  - Provide sufficient length to allow queuing within site

Use	Expected Maximum Number of Queued Vehicles	Queue Distance Required
Fast-food restaurant	9	225 feet
Bank	7	175 feet
Car Wash	2	50 feet
Pharmacy	4	100 feet



Figure 5.2.6-c

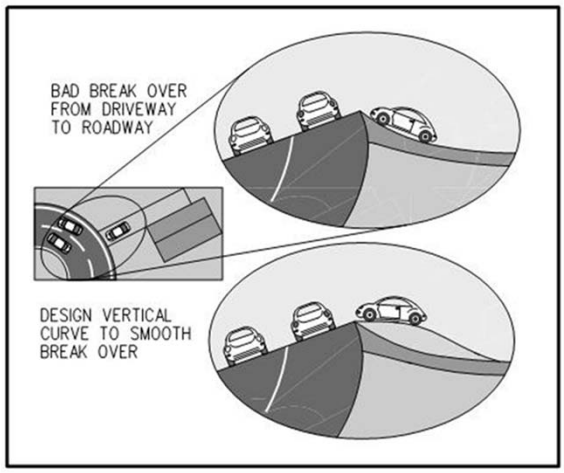
DelDOT Development Coordination Manual 5/18/2015 31

We've all seen this situation while driving at lunchtime or weekends. Again, we want to clear vehicles from the travel lanes and avoid unsafe conditions. This also affects level of service on the roadways too.

Chapter 5

- **Vertical Alignment at Entrance**
  - Affects
    - Speed differentials with adjacent roadway
    - Visibility/Sight Distance
  - Introduce vertical curve at intersection with adjacent roadway
  - Max grades
    - Commercial – 8%
      Residential – 10%
  - Consider Ped Crossings

Figure 5.2.8-a



Chapter 5

- **Vertical Alignment at Entrance**
  - Rural and Urban (for Pedestrian Crossings) Turnout Profiles

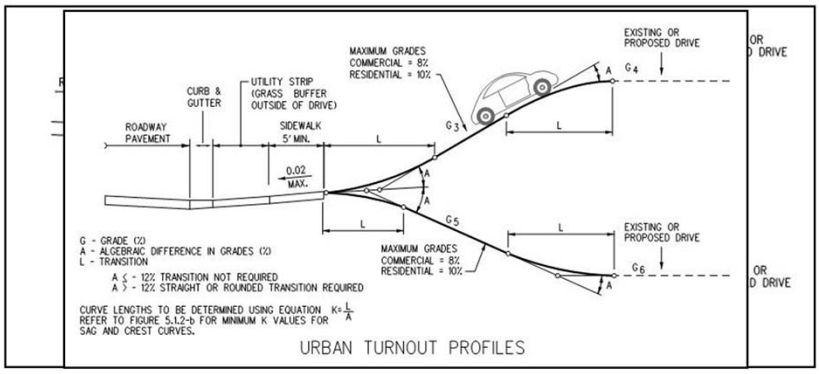


Figure 5.2.8-b

Chapter 5

- **Auxiliary Lanes**
  - Right-Turn Lane
  - Bypass Lane
    - Not permitted on major collector roadways or higher with projected 10-year ADT > 2,000
    - Not permitted when an existing entrance or street is located within limits of proposed bypass lane
    - Use center left-turn lane when conditions above exist
  - Left-Turn Lane
  - Complete Auxiliary Lane worksheet
    - Submit for pre-submittal meeting

Section 5.2.9

Chapter 5

- **Auxiliary Lane Worksheet –**
- **Committed Development ADT**
  - Proposed Site ADT is typically not inputted in Committed Development

Name of Project	XX	Date of Submittal	MM/DD/YYYY
Maintenance Road No. (i.e. K234A)	(County)XXX	Road Name	XX
Signalized / Unsignalized	Unsignalized		
Total Number of Through Lanes (* Does Not Include Turn Lanes)	2 lanes	Roadway Functional Classification	Local
Number of intersection legs	3	Calculation for (specify leg)	Proposed Entrance 1
Posted Speed Limit	30	Design Speed	35
Roadway ADT (From DelDOT Traffic Manual)	2000	Projected 10yr ADT	2320
Committed Development ADT (Add Additional Trips to Roadway)	0		
Traffic Pattern Group	6	K Factor	10.28
		D Factor	60.77

Section 5.2.9

Chapter 5

- **Auxiliary Lane Worksheet –**
- **Committed Development ADT**
  - Proposed Site ADT is typically not inputted in Committed Development
    - Only when multiples entrances are proposed on same frontage road
    - See Appendix for example
  - Input ADT of nearby unbuilt proposed or approved projects

Roadway ADT (From DelDOT Traffic Manual)	2000	Projected 10yr ADT	2320
Committed Development ADT (Add Additional Trips to Roadway)	0		

Section 5.2.9

Chapter 5

- **Auxiliary Lane Worksheet –**
- **Site ADT**
  - Input entrance turning movements in lower portion of worksheet

Left Turn Information		Right Turn Information	
Left Turn ADT	101 - 200	Right Turn ADT	Over 400
Left Turn VPH (0 - 400)	20		
Left Turn Approach Grade *(-9% - 9%)	0.0%	Right Turn Approach Grade *(-9% - 9%)	0.0%
Heavy Vehicle %	30	Entrance Radius	R>50'
10 Yr Opposing Vol. (COUNT based)	0	< With DelDOT's concurrence, this cell may be used to override the automatically calculated 10-year opposing volume. This alternative 10 year opposing volume may be obtained from a TIS / TOA or shall otherwise be reviewed and approved by DelDOT Development Coordination Staff.	
10 Yr Opposing Volume (Calculated)	145	Right Turn Length (ft.)	110
10 Yr Opposing Volume (Calculated Vol.)	145		
Left Turn Length (ft.)	LTL Not Required		
Bypass Lane Taper	50		
Bypass Lane Storage	160		

Section 5.2.9

Chapter 5

- **Auxiliary Lanes**
  - Typical Entrance Diagram with Bypass lane

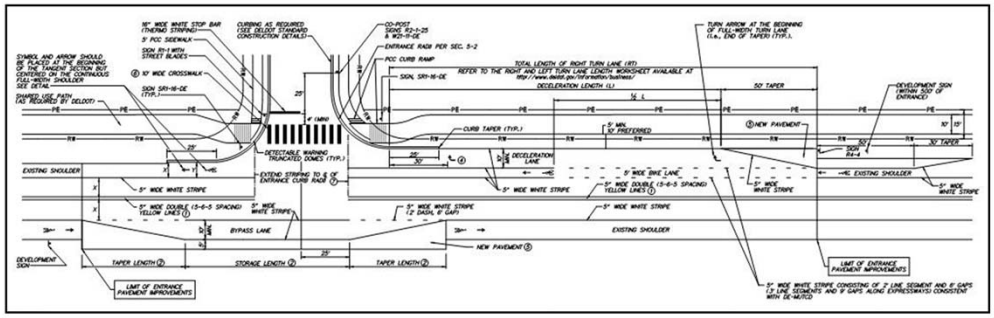


Figure 5.2.9.2-b

Chapter 5

- **Auxiliary Lanes**
  - Typical Entrance Diagram with Left-Turn lane

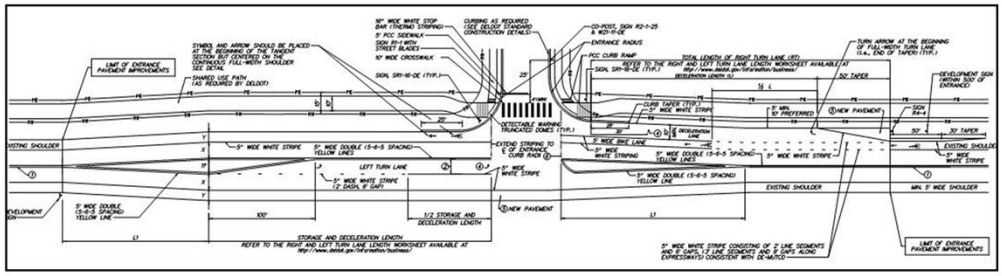


Figure 5.2.9.3-b

Chapter 5

- **Auxiliary Lanes**
  - Crossovers
    - Opening controlled by median width and control radius of D.V.
    - Urban Areas –1,000’ to 1,500’ spacing
    - Rural Areas – 2,000’ to 3,000’ spacing
    - Turning movement diagrams required for left and U-turn movements
    - Widening opposing shoulder may be required to permit U-turn movements

Section 5.2.9.4

Chapter 5

- **Auxiliary Lanes**
  - Crossovers for WB-40 D.V. – Median Width ≥ 4’ to ≤ 18’

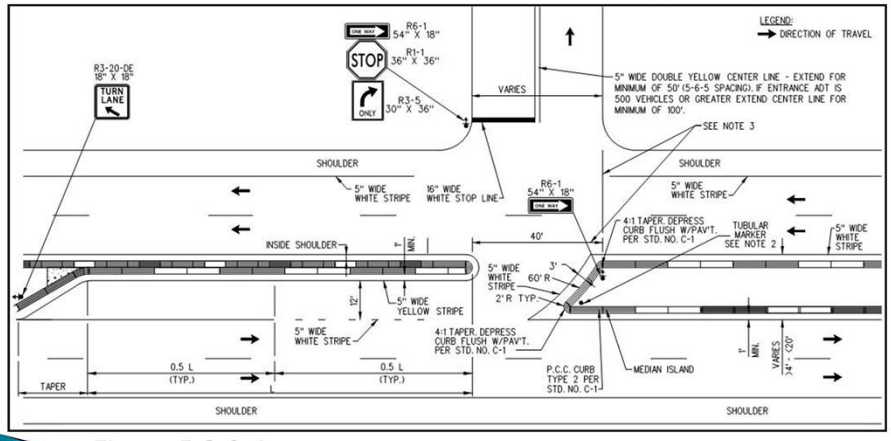


Figure 5.2.9.4-a

Figures are provided for guidance. Site conditions may alter the layout shown here. Signing, striping, curb limits are very helpful to help reduce comments on designs.

Chapter 5

- **Auxiliary Lanes**
  - Crossovers for WB-62 D.V. – Median Width $\geq$ 4' to $\leq$ 18'

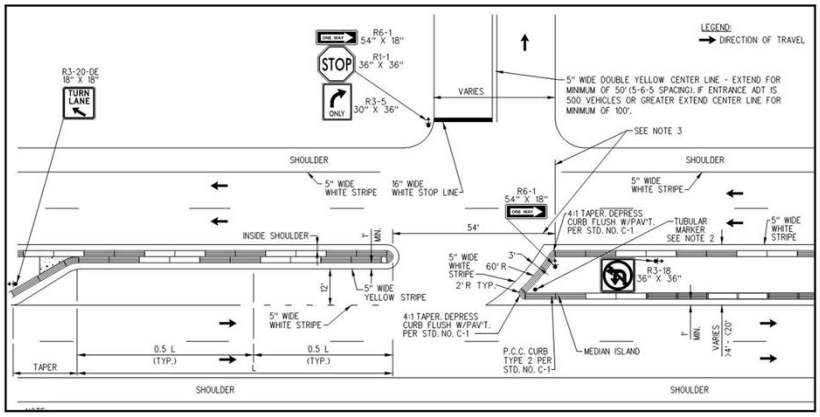


Figure 5.2.9.4-b

Chapter 5

- **Auxiliary Lanes**
  - Crossovers for WB-40 D.V. – Median Width $\geq$ 18’

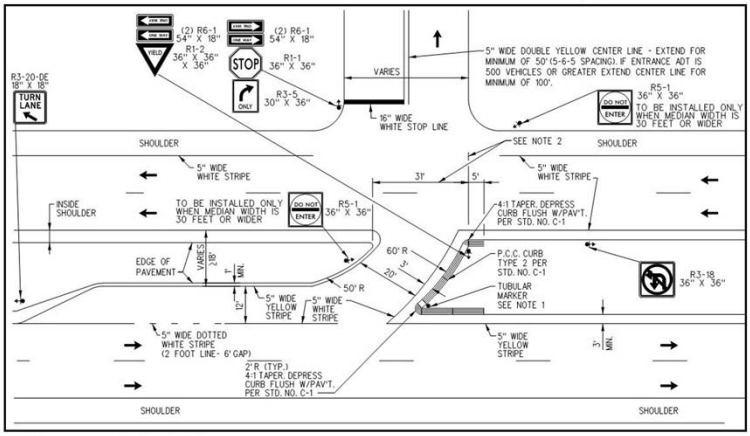


Figure 5.2.9.4-c

Chapter 5

- **Auxiliary Lanes**
  - Crossovers for WB-62 D.V. - Median Width $\geq$ 18'

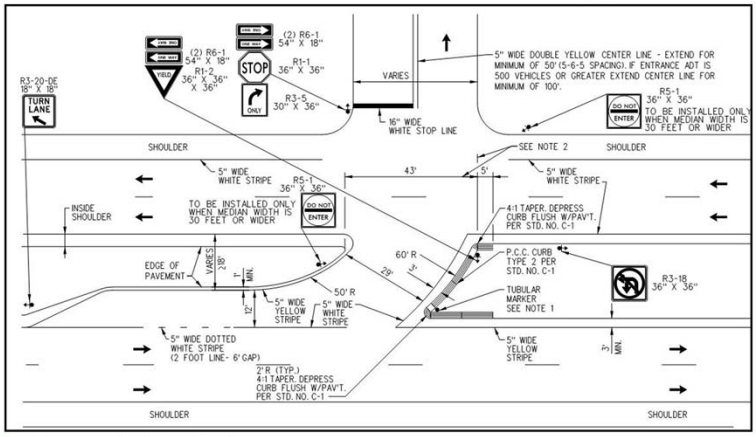


Figure 5.2.9.4-d

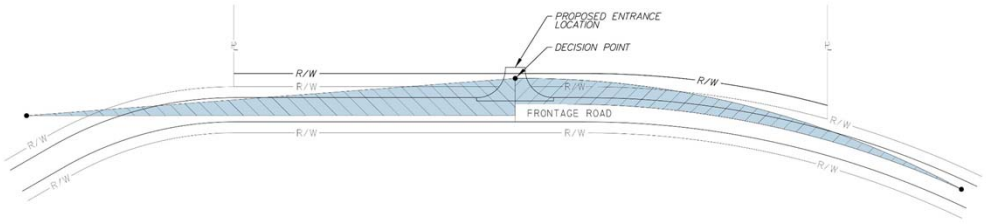
Chapter 5

- **Sight Distance**
  - Provide clear line of sight for vehicles exiting entrance
  - Decision Point – 18' from edge of through travel lane
    - Minor Sub. Plans – 14.5' from edge of through travel lane
  - Sight Easement should be established if sight triangle is outside ROW
  - Sight triangle shall be free of plantings or signs at entrances
  - Complete and submit Intersection Sight Distance worksheet

Figure 5.4

Chapter 5

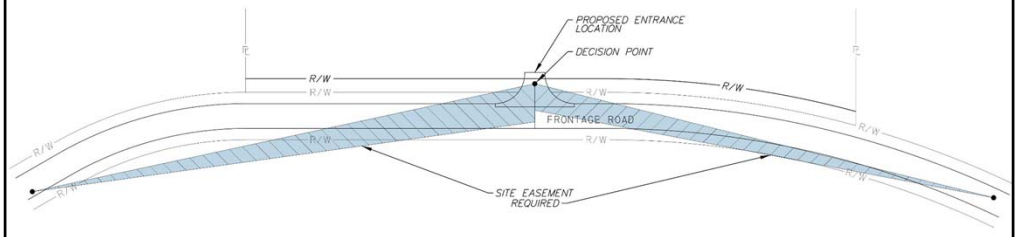
- **Intersection Sight Triangles**
  - Bad example
    - Sight triangle end point remains on the roadway in center of approaching travel lane
    - Sight triangles don't bend along a curve



Section 5.4

Chapter 5

- **Intersection Sight Triangles**
  - Good Example
    - Sight Easement required for portion located outside ROW

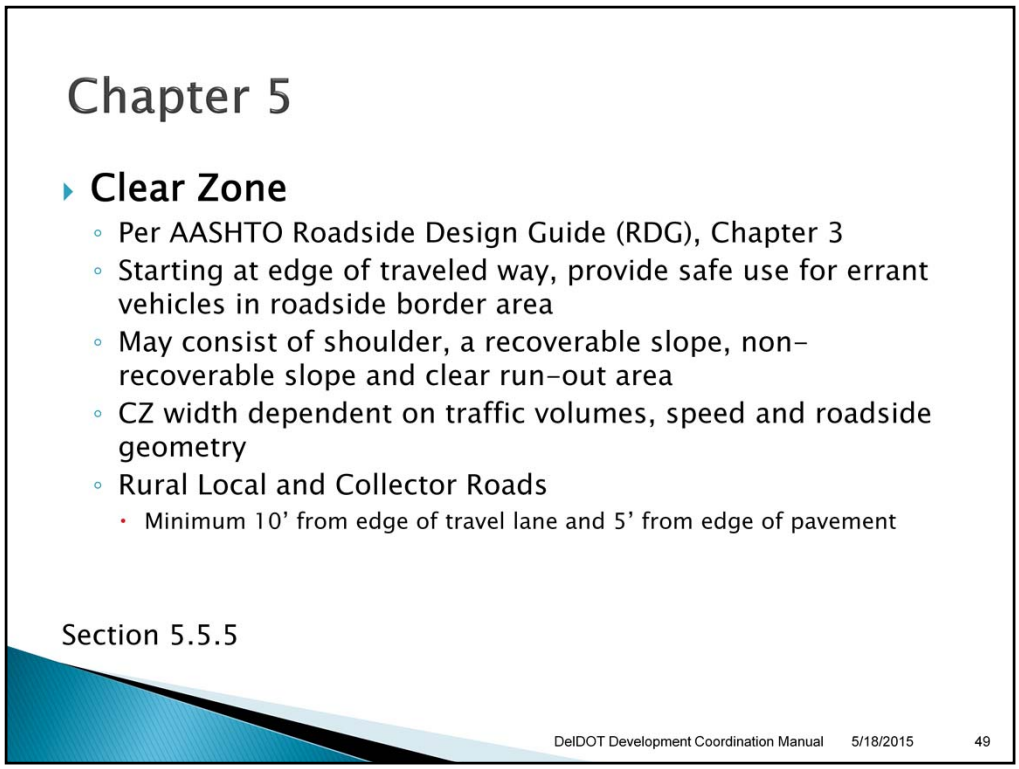


Section 5.4

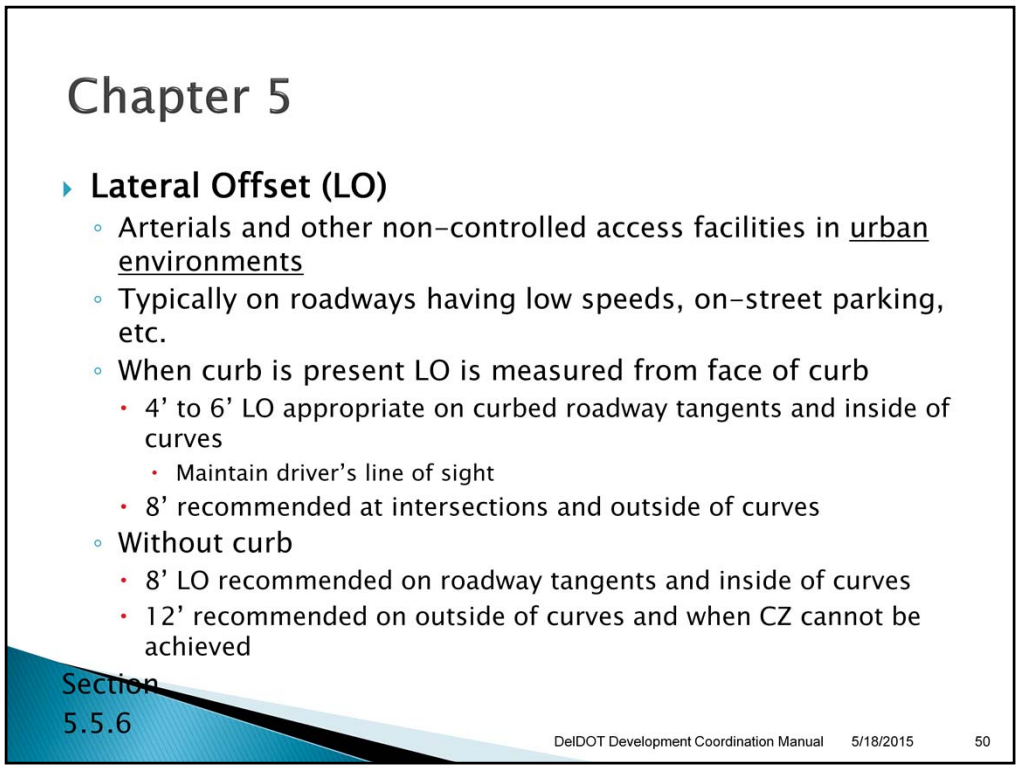
Chapter 5

- **Typical Section**
  - Typical Sections are not the same as Cross Sections
  - Represent a typical section of a roadway over a station range to define:
    - Existing and proposed pavement section
    - Travel lane, shoulder, sidewalk, SUP widths and cross slopes
    - Swale geometry (width, depth, side slopes)
    - Existing and proposed ROW, PE, TCE widths
    - Medians
    - Curb types, underdrain, topsoil, seed, mulch, soil retention blanket mulch (SRBM)

Section 5.5



Because of challenges acquiring ROW and/or easements beyond site frontages, the guidance on rural local and collector roadways may be used:



Lateral offset is the new buzzword to describe what used to be called horizontal clearance.

LO width shall be free of vertical obstructions. This means utility poles. Vertical clearances for commercial signs should be at least 16' to provide clearance for tractor trailers.

Chapter 5

- **Lateral Offset (LO)**

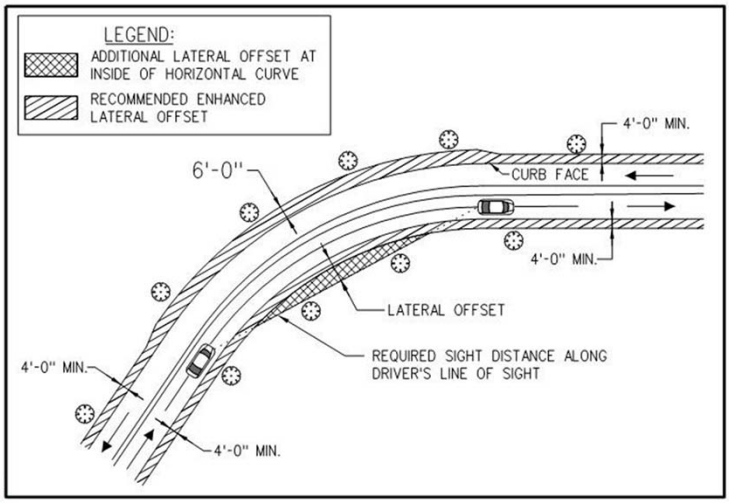
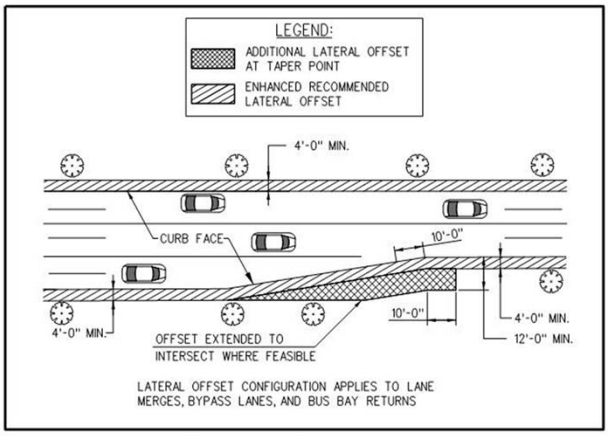


Figure 5.5.6-a

Chapter 5

- **Lateral Offset (LO)**
  - Merge Points
  - 12’ recommended in vicinity of taper point

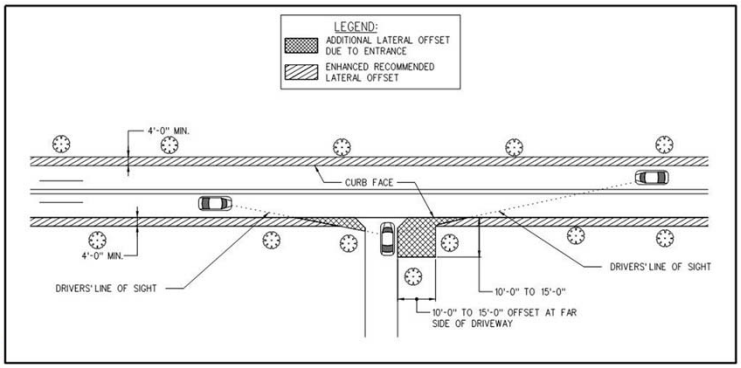
Figure 5.5.6-b

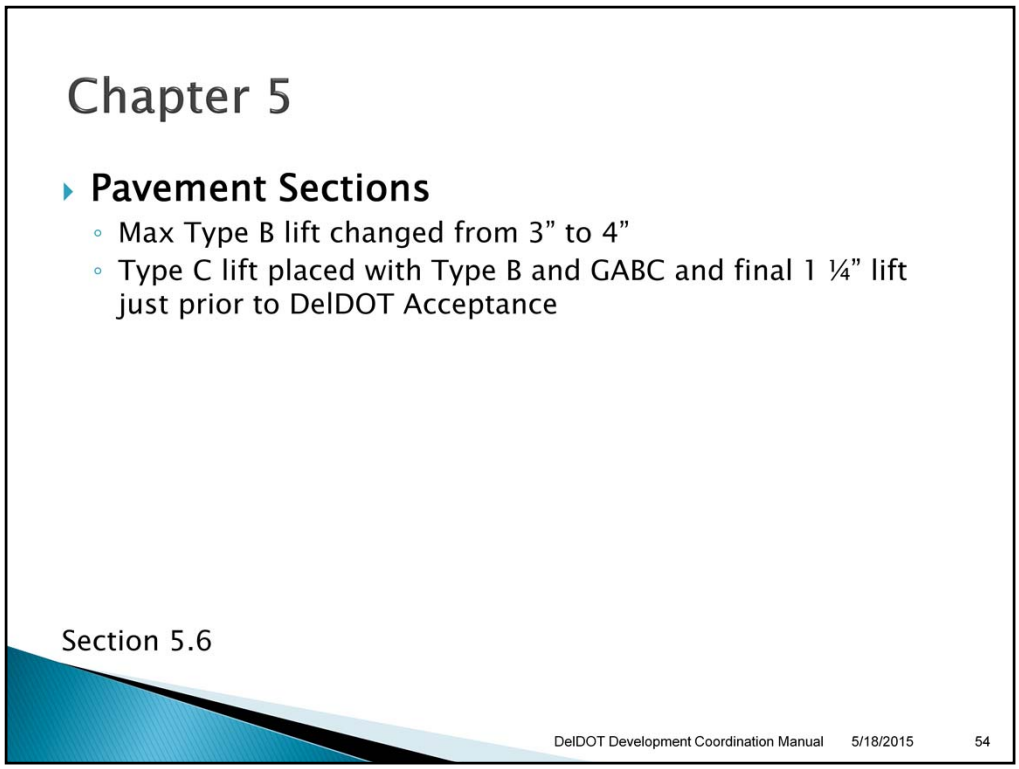


Chapter 5

- **Lateral Offset (LO)**
  - Entrances
  - 10’ to 15’ recommended beyond driveway
  - Reduce potential for a fixed-object collision in this high crash location

Figure 5.5.6-c





Coordinated with DCA to revise Type C lift

Chapter 5

Pavement Sections

- Max Type B lift changed from 3" to 4"
- Type C lift placed with Type B and GABC and final 1 ¼" lift just prior to DelDOT Acceptance

Section 5.6

Figure 5.6.1-a Pavement Design Chart for Internal Subdivision Streets

ADT	Required Structural Number - Overall (prior to 1 ¼" Type C asphalt pavement overlay)	Asphalt Pavement Section
1- 500	2.98 (2.48)	1 ¼" Type C 1 ½" Type C 2 ¼" Type B 7" GABC
501 - 1000	3.12 (2.62)	1 ¼" Type C 1 ½" Type C 2 ¼" Type B 8" GABC
1001 - 2000	3.42 (2.92)	1 ¼" Type C 1 ½" Type C 3" Type B 8" GABC
2001 - 3000	3.82 (3.32)	1 ¼" Type C 1 ½" Type C 4" Type B 8" GABC
3001 - 5000	4.02 (3.52)	1 ¼" Type C 2" Type C 4" Type B 8" GABC
> 5000	Submit data to DelDOT for Pavement design	

Coordinated with DCA to revise Type C lift

Chapter 5

- **Pavement Sections**
  - Lane Widening/Restoration Detail
  - Full travel lane mill and overlay when encroachment of 1' or more onto a travel lane

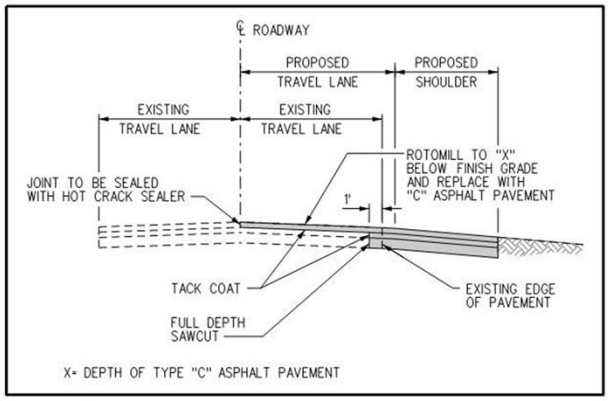
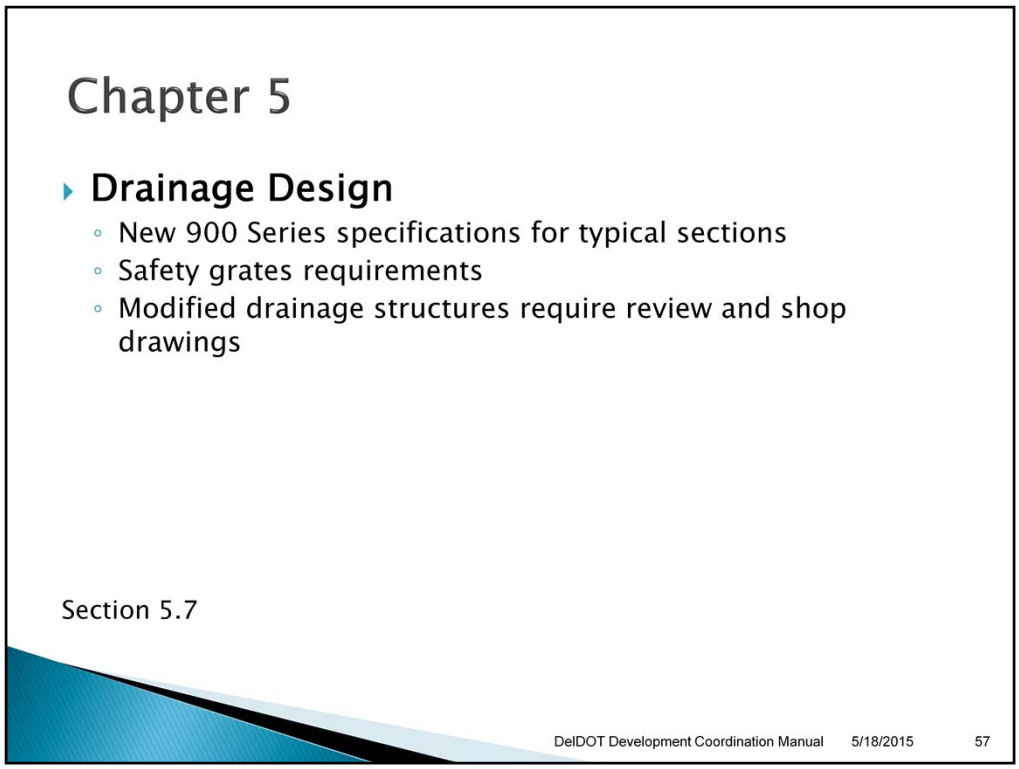


Figure 5.6.4-b

DelDOT Development Coordination Manual 5/18/2015 56

This change was made to be consistent with the Utility Design manual.

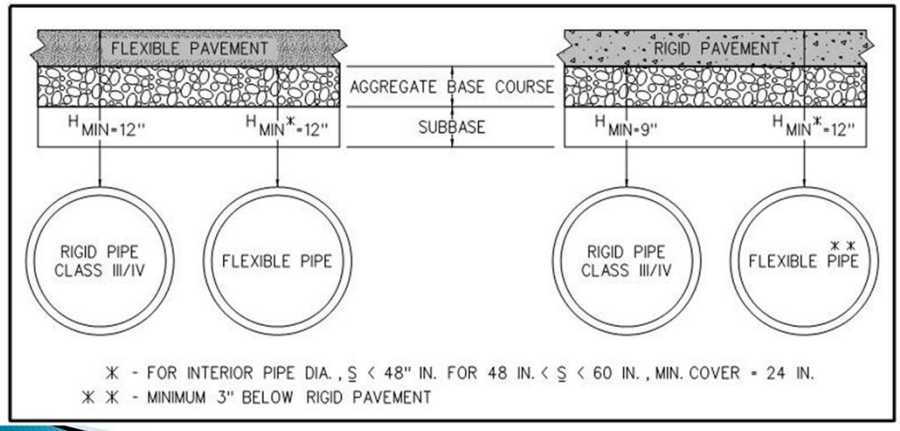
I'm sure you've all driven and seen where the longitudinal joint is deteriorated at entrances where widening occurred because the joint falls in the wheelpath. This change will help to seal the joint and stop water intrusion which in conjunction with the vehicles driving across it, really begins to damage the pavement and require maintenance in a short amount of time in many cases.



The 900 pay items are still not available on DelDOT's website!

Chapter 5

- **Drainage Design**
  - Pipe Cover



Section 5.7.2.5-a

Discuss Hmin requirements based on pipe material type, pavement material and pipe size

Chapter 5

- **Drainage Design**
  - Pipe Cover

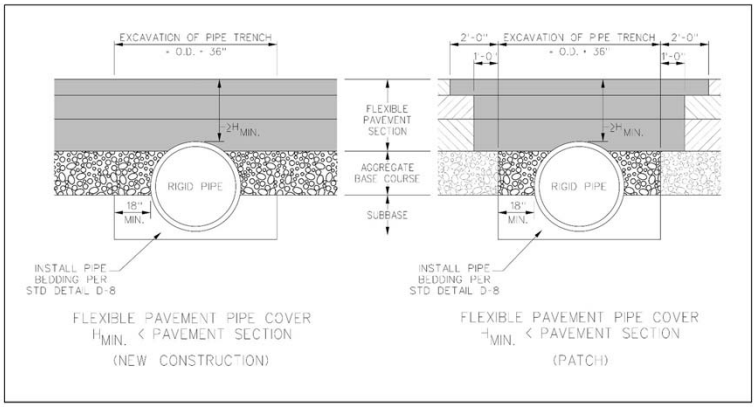


Figure 5.7.2.5-b

Discuss when Hmin is met but pipe is located in asphalt on thick full depth asphalt pavement sections, it is permitted.

Chapter 5

- **Drainage Design**
  - Pipe Easements

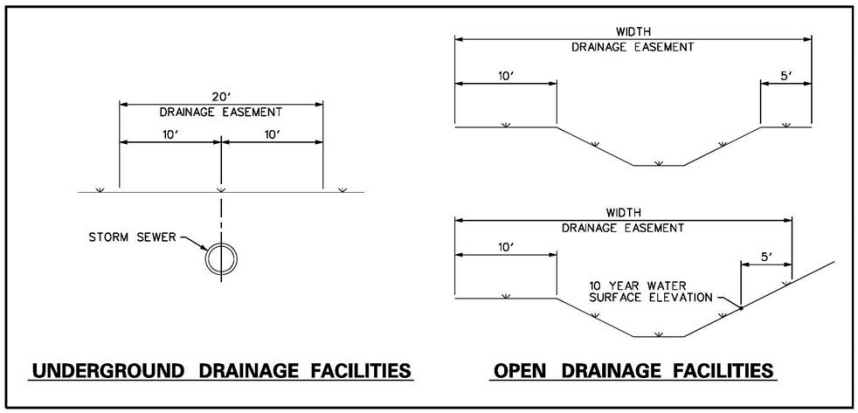


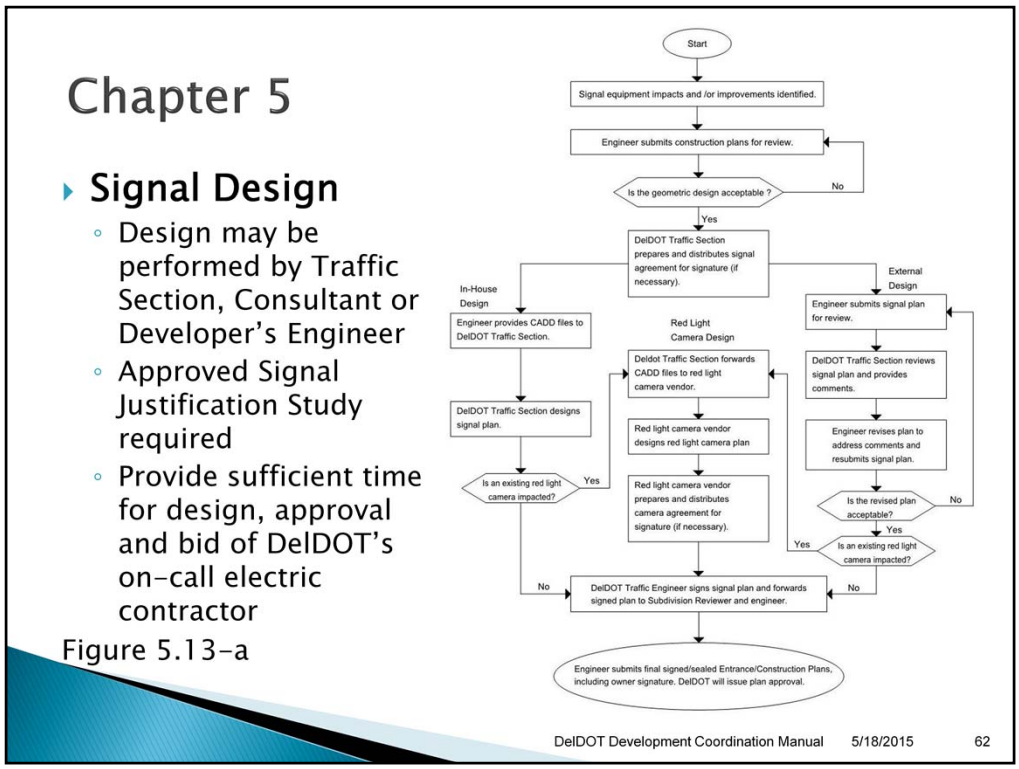
Figure 5.7.2.6-a

Discuss 20' easement on closed drainage, 10' on each side of the pipe. Open drainage requires 10' from top of swale on one side for access and 5' from top of swale on the other side side

Chapter 5

- **Stormwater Management**
  - June 30th deadline to review and approve BMPS for compliance under old DSSR regulations
  - Pre-application meeting – DelDOT will attend as needed for larger projects or projects with known drainage issues
  - Letter of No Objection to State ROW email or letter will be sent to applicant once
    - DelDOT and Regulatory Agency are in concurrence
    - No increase in discharge to State ROW occurs
  - Separate SWM report required with GIS shape file for BPM's treating DelDOT runoff

Section 5.8



This flow chart helps to walk you through the steps to complete the design or a signal including red light camera and if designed by the Traffic Section, Consultant or the Developer's engineer.

Whether its' recommended by a TIS or not, the Traffic Section requires a signal justification study to be done.

I just learned last week that geotech analysis is required for signal pole foundations and shall be performed by DelDOT's on-call drilling contractor so once again, determine the pole locations and get this request in asap.

Chapter 5

- **Utility Design**
  - Keys to Success
    - Place design ticket with Miss Utility of DE (800-282-8555)
    - Obtain as-built plans from utility companies
    - Perform Subsurface Utility Engineering (SUE)
    - Coordinate with utility companies about conflicts/relocations
    - Perform test holes during design!
    - Identify ROW/PE needs early in design
  - Utility relocation plans required for review

Section 5.14

Chapter 5

- **Lighting Design**
  - Lighting may be required for an entrance or O.I.
  - Roundabouts require lighting
  - Keys to Success
    - Design will be performed in accordance with DelDOT *Lighting Design Guidelines*
    - DelDOT Traffic Section will perform lighting design and electrical analysis
    - Provide electronic files to DelDOT once geometric, drainage, SWM, and utility designs are developed
    - Provide sufficient time for design, approval and bid of DelDOT's on-call electric contractor
  - Developer shall contribute towards lighting design and construction costs

Section 5.15

Chapter 5

- Questions?