13. Superelevation

In this exercise we will be setting up superelevation control shapes for our project. Most roadways have a constant offset from the centerline to where the finished grade is applied. A crown roadway where the finished grade runs right with the centerline like we have in the urban section at the end of our project uses a tie offset of **0**. The depressed 48' median section at the beginning of our project applies the finished grade at the inside edges of pavement and so the tie offset is **-24** for the left and **24** for the right.

In some areas the tie offset may not be a constant value but instead changes from cross section to cross section. That is the situation where we transition from the 4 lane depressed median section (24' tie offset) to the urban crown section (0' tie offset). For stations 316+75 to 327+75 we will store special transition chains to use as GEOPAK profile grade lines or PGLs. These chains will reflect the transition of the inside edges of pavement from 24' out down to 0' where the urban section with turn lane starts.

NOTES:

PGL transition chains **are not** needed for transitioning pavement widths. Your pavement lines are read by the cross section criteria files and automatically handle all pavement width changes.

Superelevation shapes **do not** have to cover the full pavement width. On side roads where the pavement width starts at one width then widens out as it approaches the intersection with the mainline you should never make the shapes wider than the narrowest width. During cross section processing as the pavement lines widen out the criteria will automatically take the cross slope specified by the superelevation shape and project it to the current width of the pavement lines.

I.) Storing Transition Chains for PGLs

a) Left PGL Chain

1) **Open** the MicroStation file

C:\Projects\Roane\SR95PoplarCr\ROSR95SEShapes.dgn

Access Project Manager.

2) Select the icon Coordinate Geometry button from the Project Manager workflow dialog.

- **3) Set** visualization option to **Disable Visualization**. Storing a transition chain generates numerous points which we do not need to be displayed.
- 4) If **Redefine** is clicked on, **click it off** to prevent accidental overwriting of data already stored in the coordinate geometry GPK database.
- 5) Click on the **Store Transition Chain** icon.



The Store Transition Chain tool will allow you to build a list of station ranges and offsets based upon a Reference Chain and connect the ranges into one chain.

- 6) **Complete** the Transition Chain information as shown below:
- 7) To build the transition table, in the lower portion of the dialog, enter the SR95 station to begin the transition chain at, 316+75 and the distance from the reference chain (SR95) to the inner left edge of pavement, -24. Press the Add icon to include in the list box (it is the top left icon to the right of the station/offset list).

📕 Store Transition	Chain	- • •
File		
Begin Po	ime: LTPGL bint: DLT1 ion: 0+00	
	2.00000	
Station/Region	Offset	
316+75.00	-24	(☐) ↑ × ↓ ⊡ ≵↓
316+75.00	-24	***
Store		Draw

8) Continue to build the transition list for the left PGL chain as shown below by entering the SR95 station where the median ending nose radius begins, 327+75 and the distance from the reference chain (SR95) to the inner left edge of pavement, -6.
 Press the Add icon to include in the list box.

Exercise 13

📕 Store Transition C	hain	- • •
File		
Reference Chair Transition Chain	n: SR95	
Chain Name	e: LTPGL	
Begin Poin	t: DLT1	
Begin Station	n: 0+00	
Taper Increment 💌	2.000000	
Station/Region	Offset	
316+75.00	-24	(□)↑
327+75.00	-6	∀ ↓
327+75.00	-6	+++
Store		Draw

- 9) Finish the transition list for the left PGL chain by entering the SR95 station where the urban section begins (328+25) and the distance from the reference chain (SR95) is
 0. Press the Add icon to include in the list box.
- **10) Press** the **Store** button to compute the transition chain.
- **11)** The required points are located along the alignment, sub-chains are formed as needed and the transition chain is stored.

Review the chain **LTPGL** within the coordinate geometry dialog output list box.

File Edit	Element	View Tool	s										
	Disable Visi		and the second second		10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					·	**	* % , %	°0
GO Keyin:	DLT24 DLT	25 DLT26 DL	T27 DLT2	8 DLT29 (DLT30 DL	T31 DLT3	2 DLT33 D	LT34 DLT	35 DLT36	DLT37 D	LT38 DLT	39 DLT40	DLT41
Doint DL	T342 store	d.											
<+ 3	43 STORE	CHAIN LT	PGL DLT	DLT2	DLT3 DLT	T4 DLT5	DLT6 DI	LT7 DLT	B DLT9 I	DLT10 DI	LT11 DL1	12 DLT	3 DLT
LT17 DLT	18 DLT19 D	LT20 DLT2	1 DLT22	DLT23	DLT24 DI	LT25 DL	26 DLT	27 DLT2	B DLT29	DLT30 I	DLT31 DI	LT32 DL1	133 DL
	T38 DLT39								SS				1000
DLT57 D	LT58 DLT59	DLT60 DL	T61 DLT	52 DLT6	3 DLT64	DLT65	DLT66 DI	LT67 DL	TES DLT	59 DLT7	DLT71	DLT72	DLT73
5 DLT77	DLT78 DLT7	9 DLT80 D	LTS1 DL1	CS2 DLT	83 DLT8	4 DLT85	DLT86 I	DLT87 DI	LTSS DLT	C89 DLT	90 DLT91	DLT92	DLT93
6 DLT97	DLT98 DLT	99 DLT100	DLT101	DLT102	DLT103	DLT104	DLT105	DLT106	DLT107	DLT108	DLT109	DLT110	DLT11
OLT114 D	LT115 DLT1	16 DLT117	DLT118	DLT119	DLT120	DLT121	DLT122	DLT123	DLT124	DLT125	DLT126	DLT127	DLT12
DLT131 D	LT132 DLT1	33 DLT134	DLT135	DLT136	DLT137	DLT138	DLT139	DLT140	DLT141	DLT142	DLT143	DLT144	DLT14
DLT148 D	LT149 DLT1	50 DLT151	DLT152	DLT153	DLT154	DLT155	DLT156	DLT157	DLT158	DLT159	DLT160	DLT161	DLT16
DLT165 D	LT166 DLT1	67 DLT168	DLT169	DLT170	DLT171	DLT172	DLT173	DLT174	DLT175	DLT176	DLT177	DLT178	DLT17
DLT182 D	LT183 DLT1	84 DLT185	DLT186	DLT187	DLT188	DLT189	DLT190	DLT191	DLT192	DLT193	DLT194	DLT195	DLT19
DLT199 D	LT200 DLT2	01 DLT202	DLT203	DLT204	DLT205	DLT206	DLT207	DLT208	DLT209	DLT210	DLT211	DLT212	DLT21
	LT217 DLT2					100 B 200 A 20		100000000000000000000000000000000000000					1000
DLT233 D	LT234 DLT2	35 DLT236	DLT237	DLT238	DLT239	DLT240	DLT241	DLT242	DLT243	DLT244	DLT245	DLT246	DLT24
DLT250 D	LT251 DLT2	52 DLT253	DLT254	DLT255	DLT256	DLT257	DLT258	DLT259	DLT260	DLT261	DLT262	DLT263	DLT26
	LT268 DLT2				10000								
10010000	LT285 DLT2	A 10 10 10 10 10 10 10	1000	100 B S 640					1000	1000	10-10-10-10-10-10-10-10-10-10-10-10-10-1		1000
	LT302 DLT3						1000000						
DLT318 D	LT319 DLT3	20 DLT321	DLT322	DLT323	DLT324	DLT325	DLT326	DLT327	DLT328	DLT329	DLT330	DLT331	DLT33
DLT335 D	LT336 DLT3	37 DLT338	DLT339	DLT340	DLT341	DLT342	STA 0+0	00					
	PGL stored												

NOTE:

The Taper Increment value used in transition chains can directly affect how Geopak tools that use superelevation shapes react. The response time can be slowed down considerably as more points are defined in these chains. The 2' value used in this exercise works well for this roadway set up which has only 1 transition area. On projects where multiple transition areas are required then a higher value such as 5' should be used.

The Store Chain command has a limit for the number of characters it can include in single command. The Store Transition Chain command takes this into account, builds sub-chains when needed and then combines them into the final chain.

b) Right PGL Chain

- 1) In the Store Transition Chain dialog update the Transition Chain information as shown below:
- 2) Since the transition is the same on the right side except for the offsets which are positive, you can edit the existing information in the list box as shown below for the chain **RTPGL**.

Station/Region	Offset
316+75	24
327+75	6
328+25	0

You can edit an existing item in the list box by highlighting the desired station and offset, modifying the value in the fields at the bottom of the dialog and then pressing the **'Edit'** icon (bottom left icon to the right of the station/offset list) as shown below:

📕 Store Transition O	hain		
File			
Reference Chain Transition Chain Chain Nam Begin Poir Begin Station Taper Increment	e RTPGL DRT1 n: 0+00		
Station/Region	Offset		
316+75.00	24		친 🛧
327+75.00	6		X+
328+25.00	0		₽
327+75.00	6	+++	
Store		Draw	

- 3) **Press** the **Store** button to compute the transition chain.
- 4) **Exit** the Store Transition Chain dialog. Also, **exit** COGO and **save** your session in a subject name of your choosing.

II.) Automated Superelevation

Since our project has multiple pavement configurations, we'll have to process the automated superelevation process for each configuration.

Configuration 1: 4 Lane Divided (287+00 – 316+75)
Configuration 2: 4 Lane Divided with Median Transitioning (316+75 – 327+75)
Configuration 3: 5 Lane Undivided (327+75 – 347+50)

1) **Open** the MicroStation file (if not already open).

C:\Projects\Roane\SR95PoplarCr\ROSR95SEShapes.dgn

Access Project Manager.

2) Select the Calculate Superelevation button from the Project Manager workflow dialog.

III.) 4 Lane Divided (287+00 – 316+75)

1) **Create** a new run called **SR95a** to represent the computations for the first configuration and **press OK**.

Select Run		
<u>R</u> un		
Name	Time	
SR95a	09/16/2016 09:10:04	
Untitled	09/16/2016 09:09:37	
Description		
mainline 4 lane de	pressed median	
	OK Cancel	

Once the Automated Superelevation dialog has been invoked, the following dialog will be displayed:

📕 Automated Superelevation - SR	95a 🗖 🗖 💌
<u>F</u> ile	
	Station Range
Job 101 Q	Chain: SR95 🔹 🛵
Design Speed: 60	Begin: 287+00.00 ++++
Transition ID: Linear	End: 316+75.00 ++++
Preference File: tennessee	Facility: Divided 🔹
e Selection: 8% e max 💌	L Selection: 4 Lane
Left	Right
Profile: SR95 -	
Tie: Offset	Offset: 0.0000
% Slope Offset Off	set Dependent
	$ \mathbf{X} $
	4
	₩.
Create Input File: 5lanesupers.inp	<u>م</u>
Generate Superelev	vation Transitions

2) For the upper portion of the dialog, complete as follows:

Job:	101 (Working Alignment should set automatically)
Chain:	SR95 (Working Alignment should set automatically)
Begin Station :	287+00
End Station:	316+75
Design Speed:	60
Preference File:	tennessee
E Selection:	8% e max
Facility:	Divided
L Selection:	4 Lane

For the lower portion of the dialog, we will build the Left and Right side of the Roadway.

a) Left & Right Roadway (4 Lane Divided)

3) Set the profile from which the shapes should be computed to SR95 for the Left.Click on the Right tab to set it there as well.

	Left		Right	
Profile:	SR95 👻			
Tie:	Profile	Offset:	0.0000	
	<select></select>			7
% Slop	SR95	fset	Dependent	
	SR95GRN			1

4) Click on the Quick Entry icon near the bottom on the right. Fill in the roadway data as shown and click OK.

4	4
Quick Entry	
Facility:	Divided -
Median Width:	48.0000
Lane Widths:	12.0000
Total Number of Lanes:	4
Nominal Percent Slope	-2.0000
OK	Cancel

5) All lanes are set up for the left and right sides of the roadway.

The inside lane is identified as **Dependent** which indicates that its elevation control comes directly from the profile SR95. If this is not clicked on as is the case with the outside lane it indicates that it is **Independent** and gets its elevation control from the adjoining shape rather than the profile.

		Left		Right	
<- 24' ->	Profile SR95				
K-36'	Tie: Offse	et 🔻	Offset:	-24.0000	
48'	% Slope	Offset	Offset	Dependent	
	-2.0000	-24.0000	-36.0000	2	
	-2.0000	-36.0000	-48.0000	<u>.</u>	$ \times $
4 LANE DIVIDED STA 287+00 - STA 316+75					₩ # √

- 6) **Enter** the Input Filename, **4lanesupers.inp**, at the bottom of the dialog to store the computed superelevation transition commands for this station range.
- 7) **Press** the **Generate Superelevation Transitions** button to initiate the calculation of the transitions for the Left and Right roadway within the defined station range. The input file is created and opened automatically in the GEOPAK Text Editor.

Review the computations within the Text Editor dialog.

K Text Editor: 4lanesupers.inp		
<u>File</u> dit <u>C</u> riteria		
D 🖆 🖬 👗 🛍 💼 🗠 🗠 🐲		
/* Superelevation Settings and Parameters:		
Project Name: C:\Projects\Roane\SR95PoplarCr\SR95.prj		
User: C:\Projects\Roane\SR95PoplarCr\projdbs\Joe Run Name: SR95a		
Unit System is english.		=
Created input file "4lanesupers.inp".		-
Created activity log file "4lanesupers.log".		
Created on Fri, Sep 16, 2016 at 09:21.		
Using Preference File "tennessee"		
Using e Selection of "8% e max". Using Length Selection of "4 Lane"		
Using Design Speed of 60.000000.		
·····,····		
*/		
auto shape job number = 101		
auto shape set		
shape cluster baseline = SR95		
shape cluster profile = SR95		
shape cluster tie = -24.0000 dependent shape		
chain / offset		
SR95 -24.00000		
SR95 -36.000000		
filler line station / slope		
287+00.000000 -2.0000		
309+35.289172 -2.0000 210100 205345		
310+99.795345 -6.1000 /* Spiral DC104B, Curve DC104 */		•
	Line: 1	Col: 1
,	,	,

NOTES:

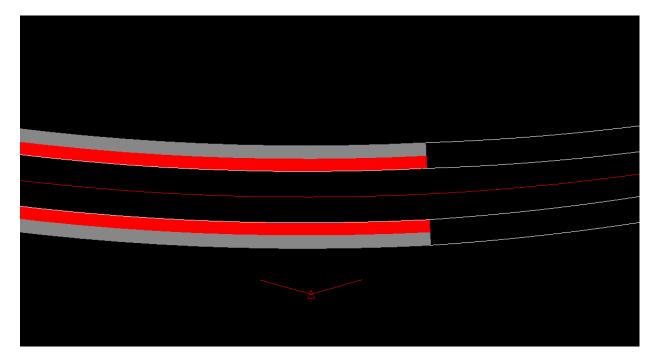
Transition stations and rates should always be reviewed for errors, etc.

Notice at the top of this input file that at the same time the input file was generated, a special report "log" file with the same name was generated. If problems occur with transitions, that log file should be reviewed for information on the rates and transition lengths which were applied.

If needed these transitions can be edited or if needed additional cross slope transitions can be added such as when transitioning to existing cross slopes at final roadway tie-ins which are at the beginning and end of the project. 8) To build the superelevation shapes into the graphics file, press the Autoshape
 Builder icon within the Text Editor dialog.



This will automatically draw the shapes into your design file.



9) Close the Text Editor dialog as well as the Automated Superelevation dialog. When prompted to Save Superelevation settings, **press Yes**.

IV.) 4 Lane Divided with Median Transitioning (316+75 – 327+75)

Next, we will create a new Run to calculate and build the shapes for Configuration 2 which is the transition from a 4 lane depressed median to a 5 lane curb and gutter.

- 1) Select the Calculate Superelevation button from the Project Manager workflow dialog.
- 2) Create a new run called SR95b to represent the computations for the second configuration and press OK.
- 3) For the upper portion of the dialog, complete as follows:

Job:	101 (Working Alignment should set automatically)
Chain:	SR95 (Working Alignment should set automatically)
Begin Station:	316+75
End Station:	328+25
Design Speed:	60
Preference File:	tennessee
E Selection:	8% e max
Facility:	Divided
L Selection:	4 Lane

For the lower portion of the- dialog, we will build the Left and Right side of the Roadway.

a) Left Roadway (Transition Area)

4) Set the profile from which the shapes should be computed to SR95.

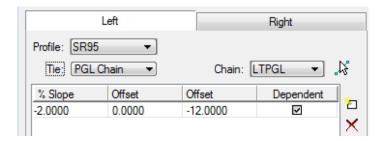


- 5) Set the Tie option to PGL Chain. The PGL Chain should be set to LTPGL for the left transition chain.
- 6) Since our tie offset to the centerline is not constant in the transition area, we will have to use the manual method instead of Quick Entry to set up our lanes.

Click on the **New Lane** icon to the right, near the bottom of the Automated Superelevation dialog. The settings for normal cross slope and lane width are remembered from our previous run.



Since we are using a PGL chain the offsets for the super shape are from the PGL chain not the roadway chain as it was in the previous set up so the values of **0** and **-12** are correct and do not need editing.



We are in a transition here so we will only set up the 1 lane. When we re-run our cross sections, the criteria files will take the cross slope and project them to the edge of pavement to maintain the correct pavement widths.

🔑 Automated Superelevation - SR95b 📃 🖃 💌				
<u>F</u> ile				
		Station	Range	
Job: 1	101 Q	Chain:	SR95 -	\$4 .
Design Speed:	60	Begin:	316+75.00	*•*
Transition ID: [Linear	End:	328+25.00	*•*
Preference File: t	ennessee	- F	acility: Divided	•
e Selection: 8	8% e max 🔹	L Sel	ection: 4 Lane	-
Le	ft		Right	
Profile: SR95	•			
Tie: PGL Cha	ain 🔻	Chain:	LTPGL -	"]\$
% Slope	Offset	Offset	Dependent	
-2.0000	0.0000	-12.0000	V	
				×
				4
				F /
Create Input Fil	e:			۹
Generate Superelevation Transitions				

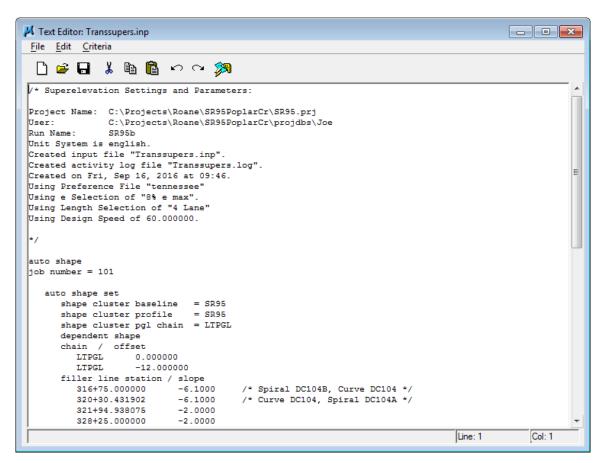
b) Right Roadway Transition Area

7) Repeat steps 5 & 6 for the Right tab (Right roadway) using the PGL chain RTPGL.

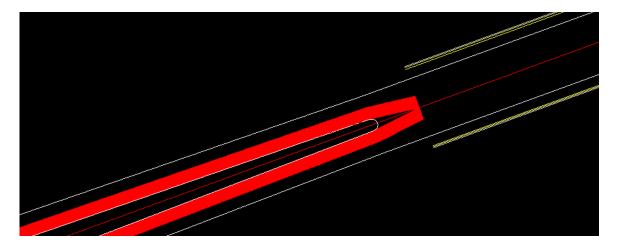
📕 Automated Superelevation - SR95b 📃 🔳 💌					
<u>F</u> ile					
			Station Ra	ange	
Job:	<u>101</u> 오		Chain: S	R95 🔻	J .K
Design Speed:	60		Begin: 3	16+75.00	***
Transition ID:	Linear	-	End: 3	28+25.00	* ••
Preference File:	tennessee	-	Fac	ility: Divided	•
e Selection:	8% e max	•	L Select	tion: 4 Lane	-
	Left			Right	
Profile: SR95	•				
Tie: PGLC	hain 🔻		Chain: [F	RTPGL 🔻	"Ъ
% Slope	Offset	Off	set	Dependent	
-2.0000	0.0000	12	.0000	2	
$ \mathbf{X} $					
4					
F					
Create Input File:					
Generate Superelevation Transitions					

- 8) Enter the Input Filename, **Transsupers.inp**, to store the computed transitions for this station range.
- 9) **Press** the **Generate Superelevation Transitions** button to initiate the calculation of the transitions for the Left and Right roadway within the defined station range.

Review the computations within the Text Editor dialog.



10) Click the Autoshape Builder icon to build these shapes into the graphics file.



11) Close the Text Editor dialog as well as the Automated Superelevation dialog. When prompted to Save Superelevation settings, **press Yes**.

V.) 5 Lane Undivided (328+25 – 347+50)

Next, we will create a new Run to calculate and build the shapes for Configuration 3 which is a 5-lane curb and gutter section.

- 1) Select the Calculate Superelevation button from the Project Manager workflow dialog.
- 2) Create a new run called SR95c to represent the computations for the third configuration and press OK.
- **3)** For the upper portion of the dialog:

Job:	101 (Working Alignment should set automatically)		
Chain:	SR95 (Working Alignment should set automatically)		
Begin Station :	328+25		
End Station:	347+50		
Design Speed:	50		
Preference File:	tennessee		
E Selection:	4% e max		
Facility:	Undivided		
L Selection:	4 Lane		

4) For the lower portion of the dialog, we will define as follows:

Profile:	SR95
Tie:	Offset
Offset:	0.0

5) Since the tie offset is constant here, we will use the **Quick Entry** method again to populate the shape list box.

Click on the Quick Entry icon on the Automated Superelevation dialog box.

6) **Complete** the dialog as shown for the 5 Lane section

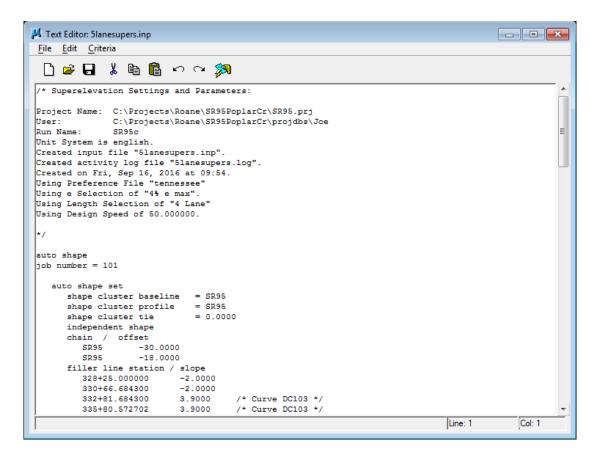
Quick Entry	
Facility:	Undivided 🔹
Median Width:	0.0000
Lane Widths:	12.0000
Total Number of Lanes:	5
Nominal Percent Slope	-2.0000
ОК	Cancel

7) **Press OK** and review that the Left and Right Tabs have been completed to cover the entire pavement left and right of the centerline and profile.

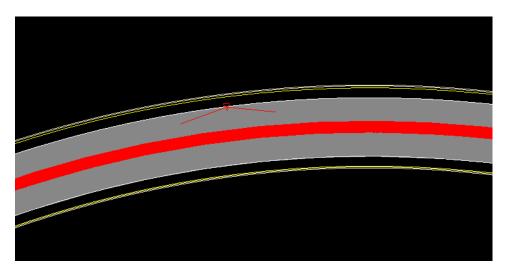
		Superelevation	- SR95c		×
>6'	<u>F</u> ile		Station R		N
>6~	Job Design Speed Transition ID	: 50	Chain: S Begin: 3 End: 3	28+25.00	\$ \$
-18' -> -18'>	Preference File	: tennessee	▼ Fac	cility: Undivided	•
	Profile: SR9	Left		Right	
< 30' >< 30' >	Tie: Offse		Offset:		1
	% Slope -2.0000 -2.0000	Offset -0.0000 -6.0000	Offset -6.0000 -18.0000	Dependent	*= ×
I F F I K F I	-2.0000	-18.0000	-30.0000		₩ H
5 LANE UNDIVIDED	Create Inpu	t File: 5lanesupe	rs.inp		<u>ू</u>
STA 328+25 - STA 347+50		Generate Supe	erelevation Transi	itions	

- 8) Enter the Input Filename, **5lanesupers.inp**, to store the computed transitions for this station range.
- 9) **Press** the **Generate Superelevation Transitions** button to initiate the calculation of the transitions for the Left and Right roadway within the defined station range.

Review the computations within the Text Editor dialog.

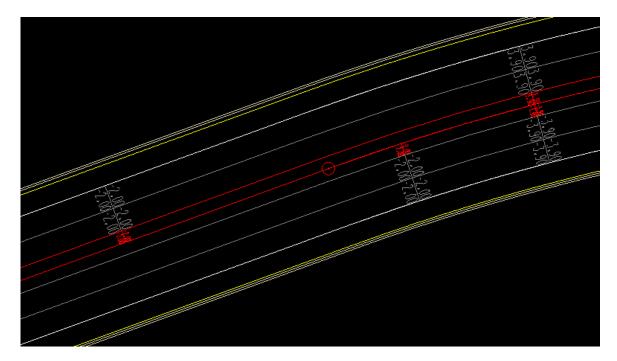


10) Click the Autoshape Builder icon to build these shapes into the graphics file.



If **Fill** is turned off under View Attributes, you can see where super shapes/transitions begin and end as well as the superelevation rates which the shapes will apply.

Exercise 13



11) **Close** the Text Editor dialog as well as the automated superelevation dialog. When prompted to Save Superelevation settings, **press Yes**.

a) Notes on Replacing Superelevation Shapes

If **any** change is made to the chain on which superelevation shapes are based, **you must re-create the shapes**.

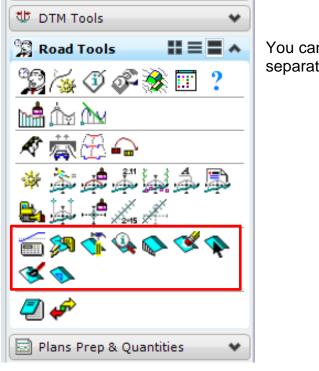
It is often necessary to adjust the proposed profile. If this is done and the name of the profile is changed you **must** update the superelevation shapes. There are tools you can use to do this but due to the number of shapes usually encountered this method is problematic at best. It is highly recommended that you avoid changing the **profile name if at all possible.** You can save the current profile under a different name that can be saved back to the original name if you decide to throw out the profile change. If you do change the profile name then just re-create the shapes rather than trying to edit them.

For these and other reasons it may be necessary to delete superelevation shapes for a roadway and re-create them. When you do this, **always compress** the MicroStation DGN file afterwards so that GEOPAK cannot read deleted invalid superelevation shape graphics.

VI.) Shape Manager Tools

Several tools are available to get information from or to check superelevation shapes. The following sections describe some of the more useful of these. Review our graphical superelevation shapes with the following tools before we re-run our proposed cross sections.

The **Superelevation Shape Manager tools** are available in the **Road Tools** task group when running Civil Workflows or you can invoke the tool box from the MicroStation menu bar drop down option **Applications** \rightarrow **GEOPAK** \rightarrow **Road** \rightarrow **Cross Sections** \rightarrow **Superelevation Shape Manager Tools**.



You can right click within the tasks to open it as a separate tool box as well.



a) Autoshape Builder

The Autoshape builder tool icon you may recognize from running super shape input files earlier. When you build input files with the Automated Superelevation dialog this icon is added to the GEOPAK Editor so that you can run the input file from there.



What you can do with the icon from this location is run an input file for super shapes without going through the Automated Superelevation dialog. You can take an input file generated earlier, open it up and make some changes to transitions or whatever and then use this tool to build the shapes.

The **Display Only** option allows you to test run the input file without actually writing the superelevation shape graphics to the file.

The **Override Input File Level Symbology** option allows you to supersede the definitions specified for the shape's level, color, weight and style in the input file. Double click on the symbology preview boxes to open up Set Feature dialogs to set these alternate values.

📕 Superelevation Autoshape Buil 💼 💷 📧		
Autoshape Input File: SR95PoplarCr\5lanesupers.inp Q		
Display Only		
Superelevation Shape Level Symbology		
Override Input File Level Symbology		
Dependent Shape:		
Independent Shape:		
Draw Superelevation Shapes		

This can truly be helpful in areas where special conditions require extensive non-standard superelevation transition settings which may end up being adjusted multiple times to come up with a design that will work.

VII.) Working Alignment - Define Shapes

We are completing the Plan View of the Working Alignment Definition in Project Manager.

- 1) From the Workflow dialog of Project Manager, **press** the **Define** button.
- 2) Highlight the Plan View → Shapes option and populate the Shapes Design file as shown below:

📕 Working Alignment Definition: SR95		
Plan View Pattem Shapes Profile View Location Cross Section View Existing Ground Proposed Finish Grade DTM Cancel	All In DGN Design File: R95SEShapes.dgn	Q

NOTE:

If you place super shapes for multiple roadways in the same DGN file it will be necessary to set up **By Search Criteria** for this setting instead of All in DGN. We recommend using different levels to separate them. This allows for easy isolation of the graphics in the event that one set may need to be replaced.

3) **Press** the **OK** button to save the updates and close the dialog.