



# Customizing Superelevation Rule Files

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Bentley Civil Product Management





# Defining Superelevation

# Superelevation Workflow

## Create



Create the Superelevation Section(s)

- From Alignment
- From Corridor

## Define



Define Superelevation Lane(s)

- Manually
- By Template

## Calculate



Calculate Superelevation

- Transitions and cross slopes

## Associate

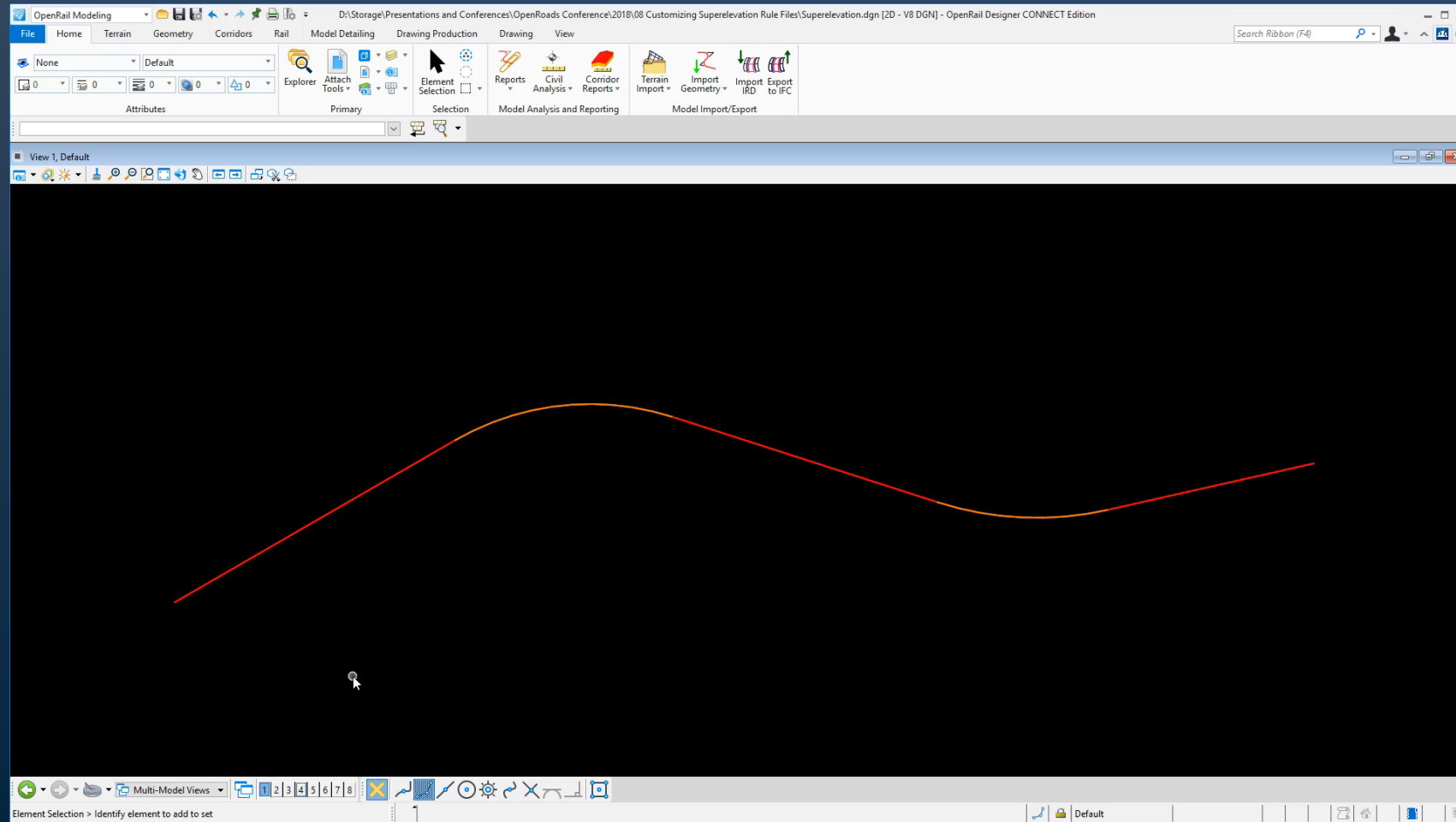


Associate to a corridor

- Uses Superelevation Flag in Template
- Creates Point Controls

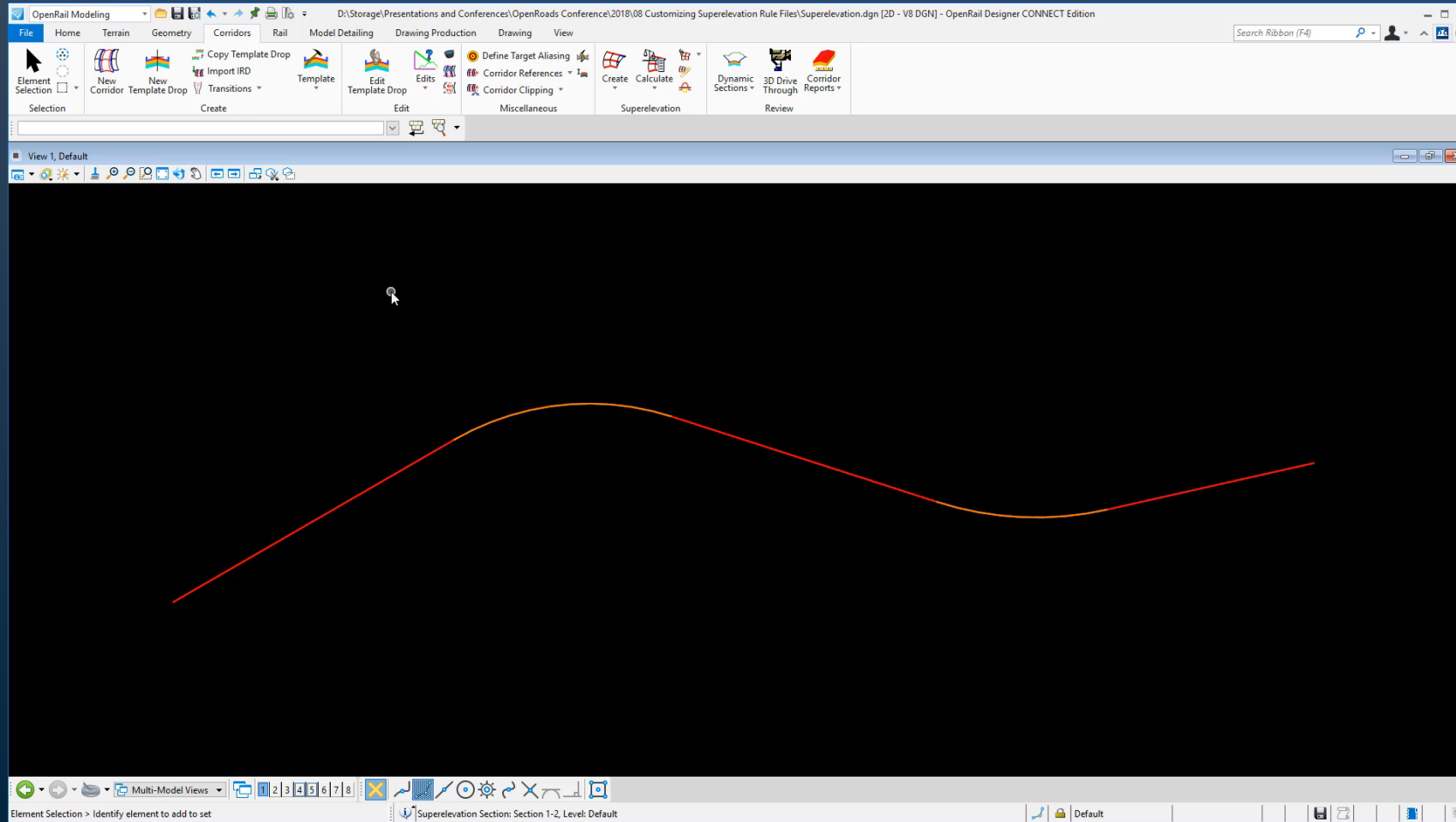
# Create Superelevation from Alignment

## - Manual Lane Definition



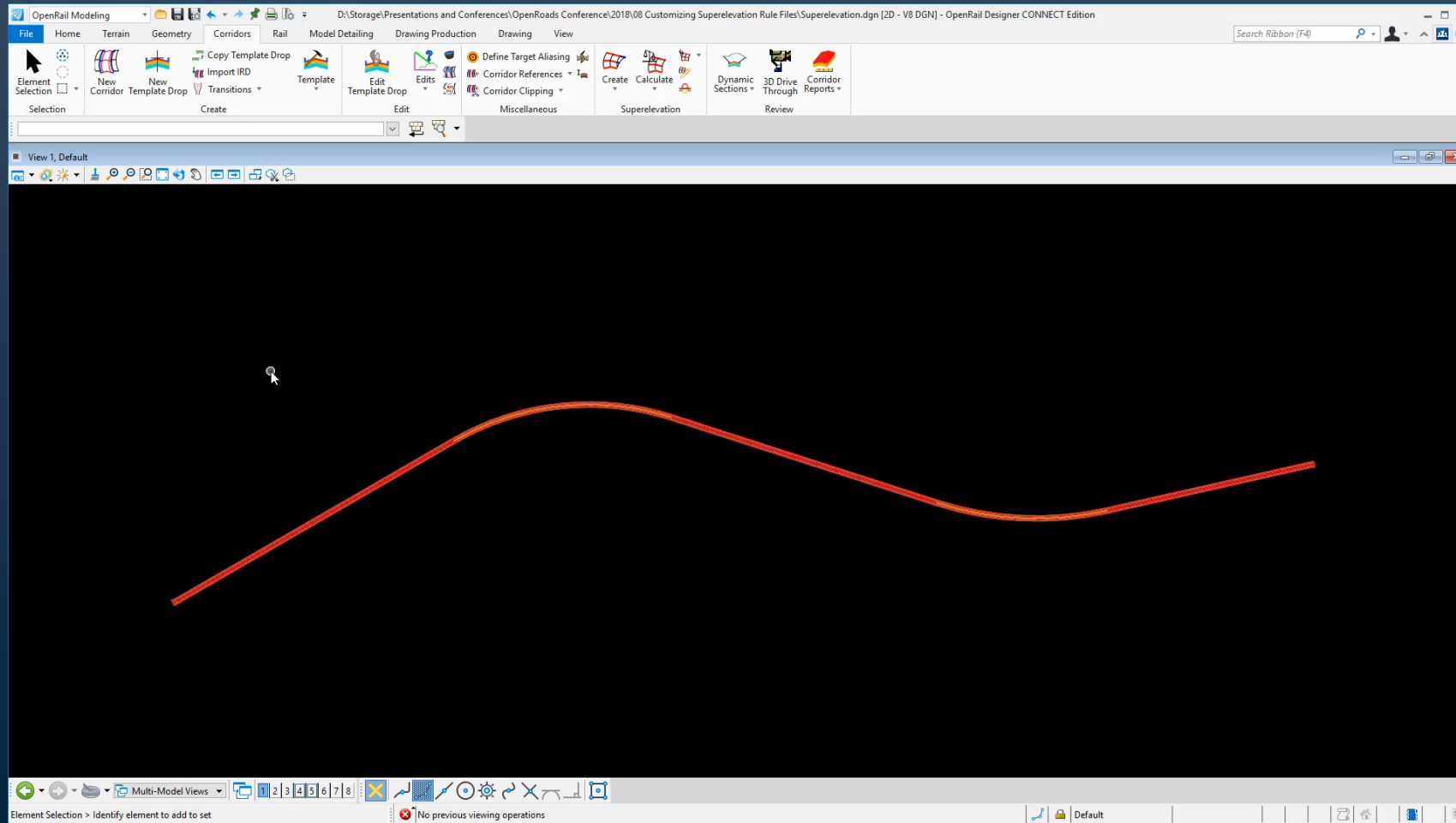
# Create Superelevation from Alignment

## - Template Based Lane Definition



# Create Superelevation from Corridor

BEST  
PRACTICE





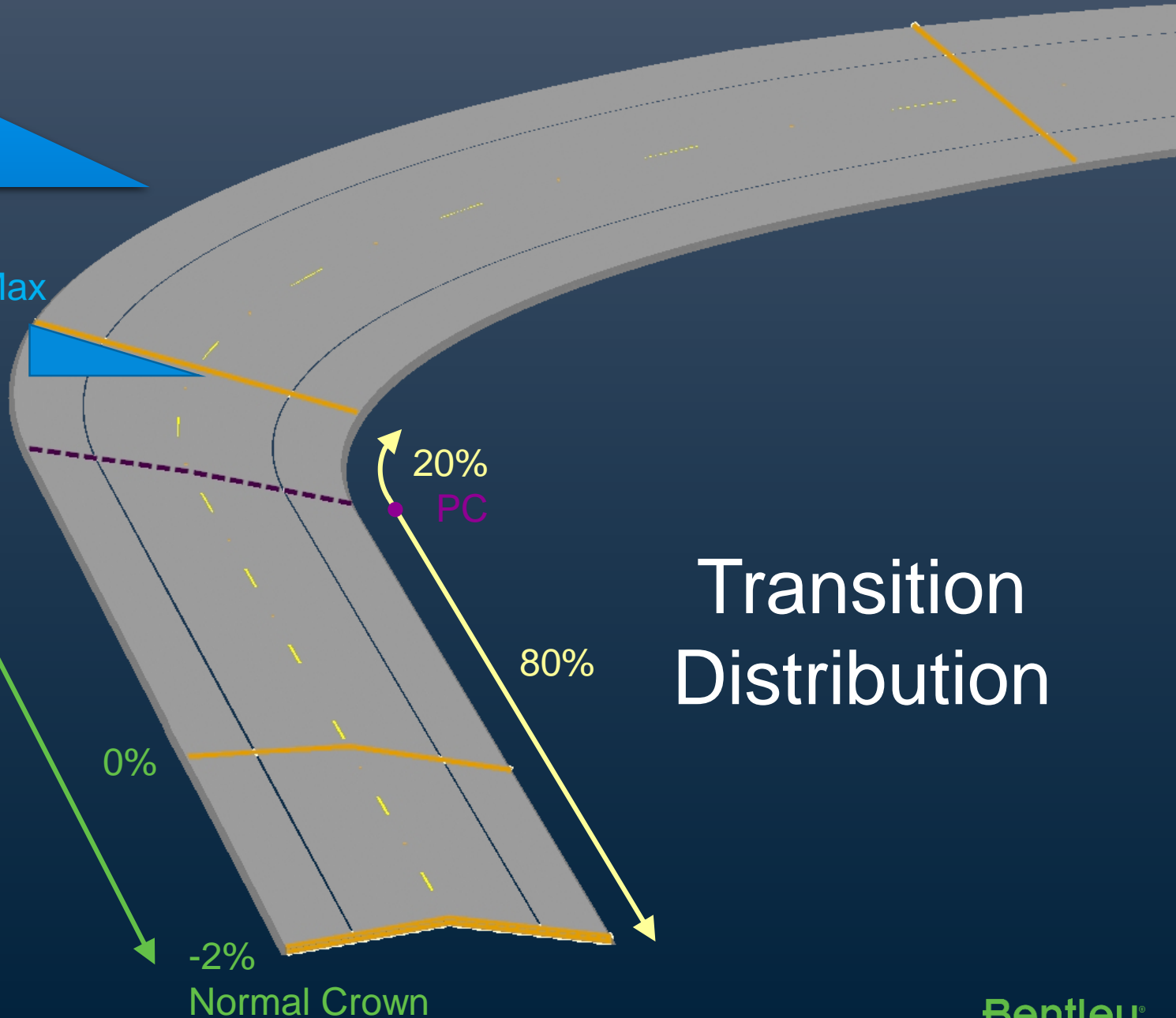
# Understanding the XML Rule File

Maximum  
Superelevation  
Rate



Transition  
Distance

e Max



Transition  
Distribution

0%

20%  
PC

80%

-2%

Normal Crown



# How the XML Rule File is Processed



THE MAX E RATE IS  
CALCULATED FROM  
TABLE OR EQUATION



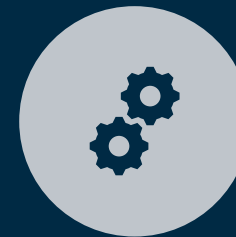
TRANSITION LENGTH  
IS CALCULATED  
FROM TABLE OR  
EQUATION



*OPTIONAL - RUNTIME  
VARIABLES  
EVALUATED*



CALCULATIONS  
ADJUSTED IF  
NECESSARY



*OPTIONAL - CUSTOM  
KEY STATION  
ADJUSTMENTS  
PROCESSED*



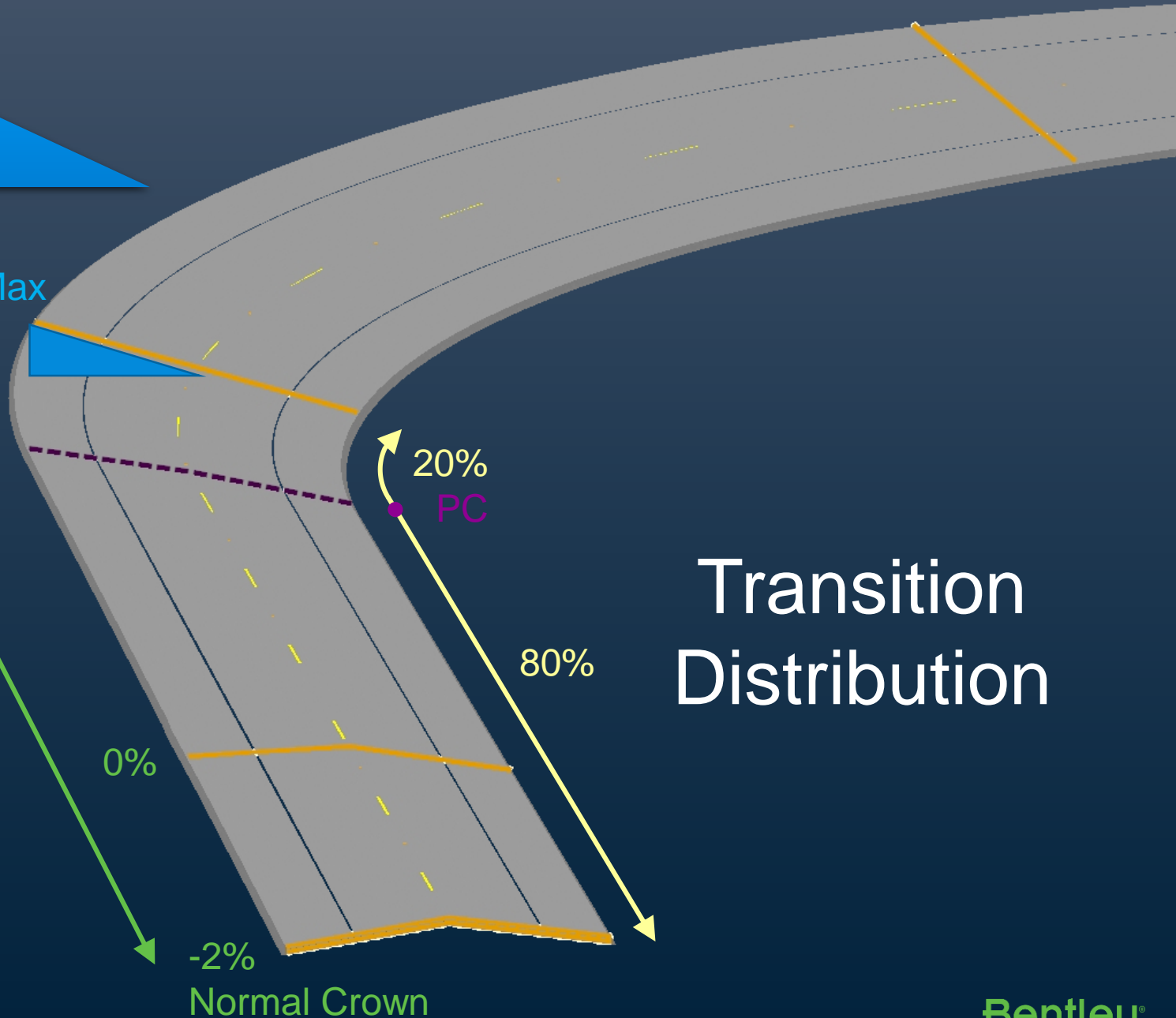
CURVE OVERLAP  
ADJUSTMENTS  
PROCESSED

# Maximum Superelevation Rate



Transition  
Distance

e Max



Transition  
Distribution

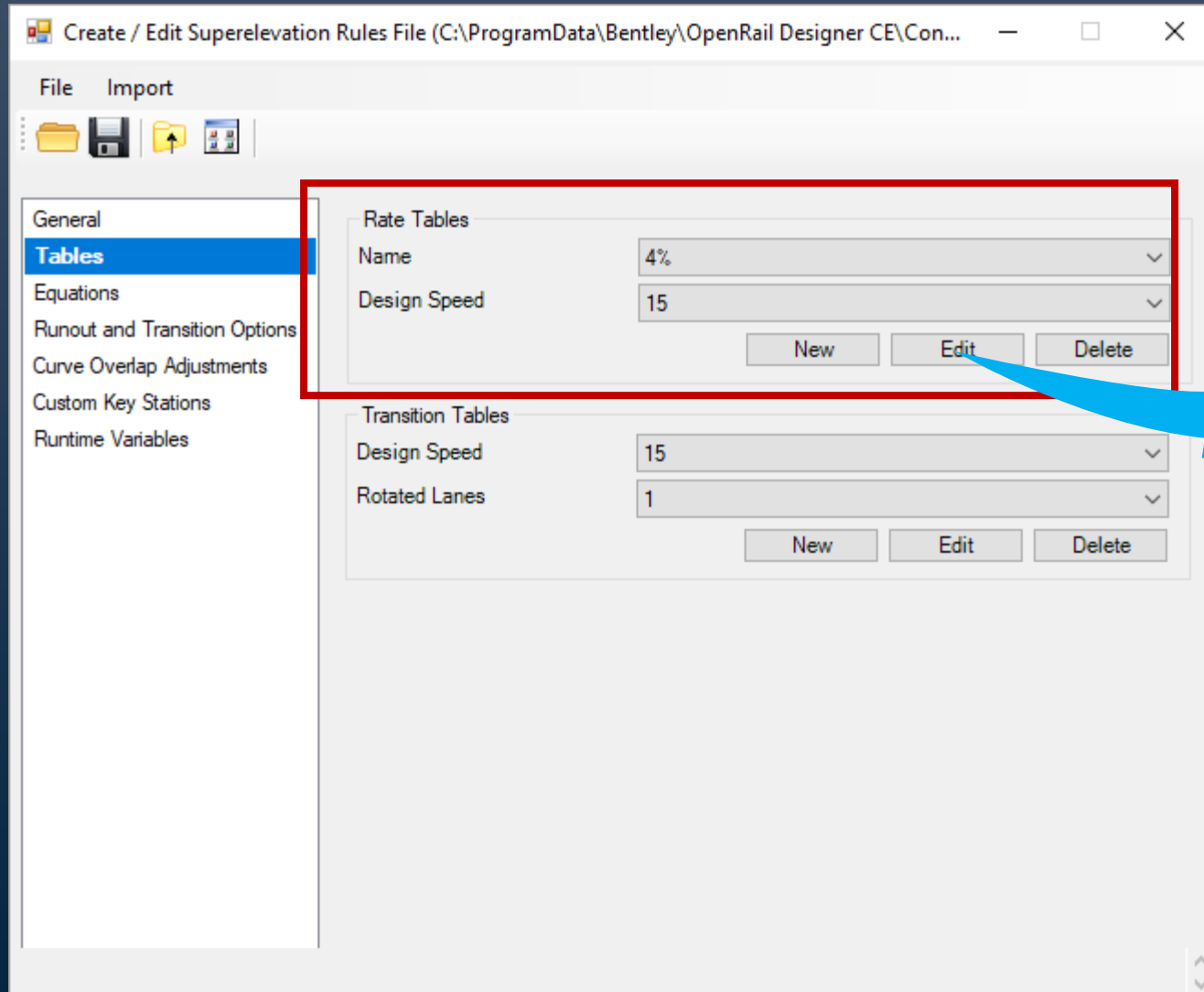
0%

20%  
PC

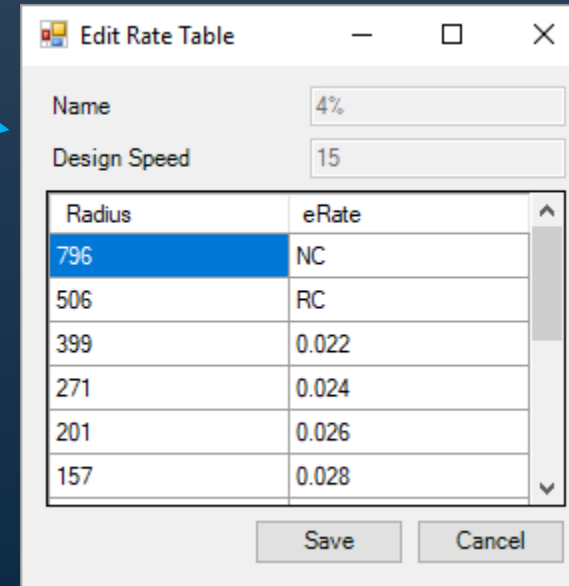
80%

-2%  
Normal Crown

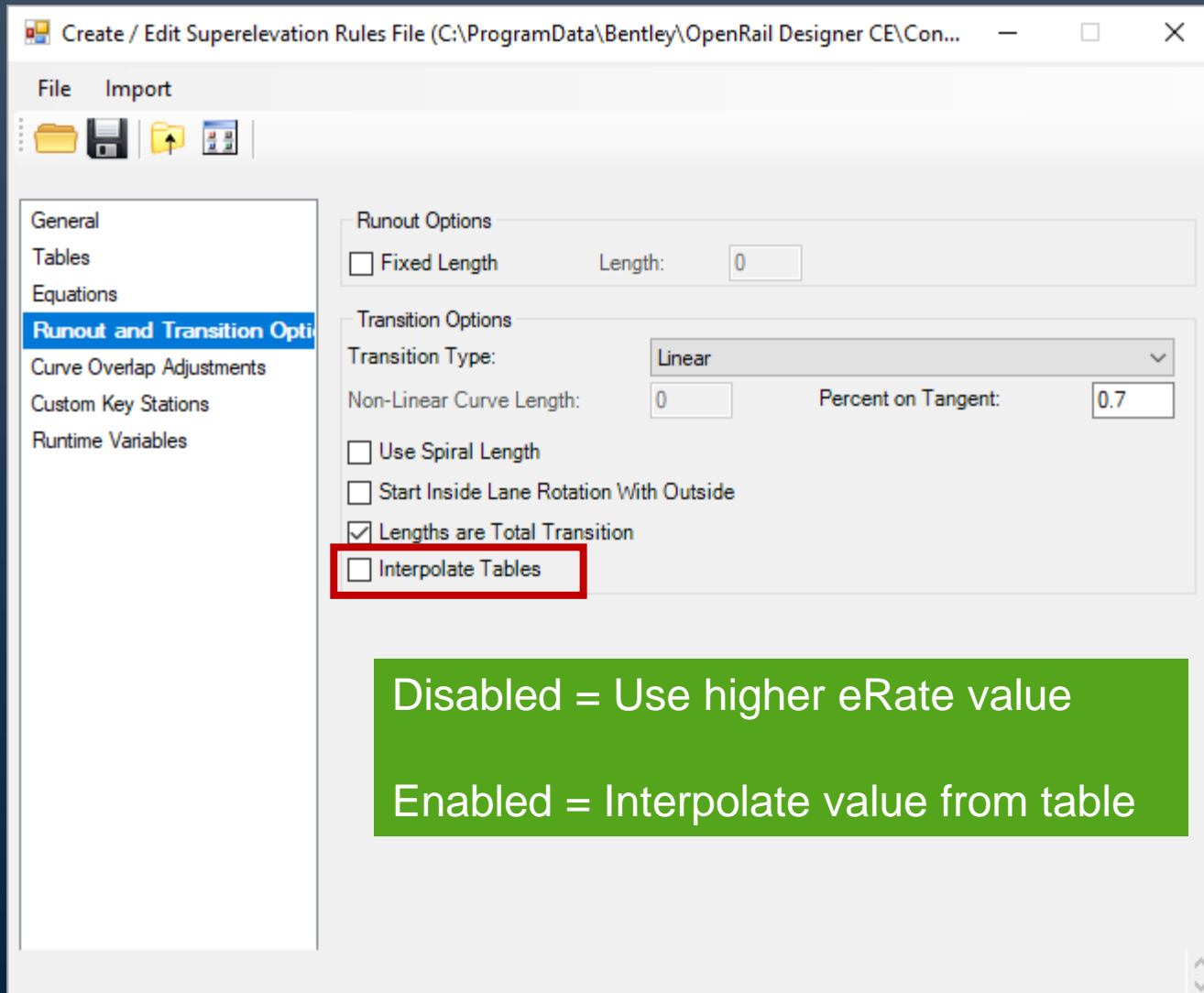
# Maximum Superelevation Rate – Defined by Table



- Define Radius and eRate
- Separate table for each combination
- Table name must end in eMax (4%)

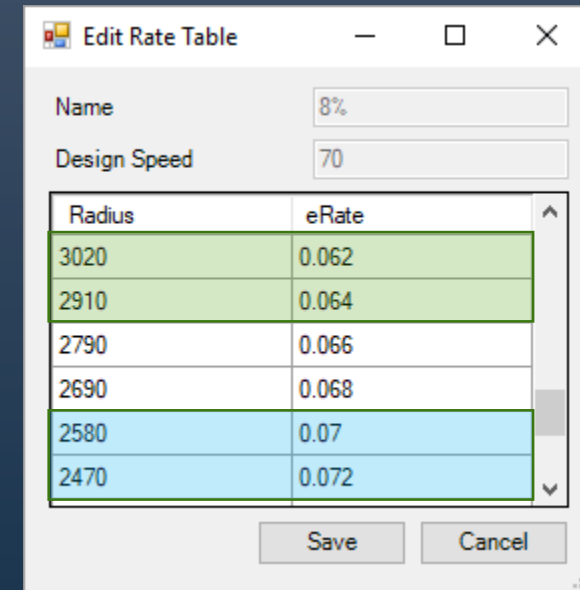


# Maximum Superelevation Rate – Defined by Table



Disabled = Use higher eRate value

Enabled = Interpolate value from table



Radius	Interpolate DISABLED	Interpolate ENABLED
3000	6.40%	6.24%
2500	7.20%	7.15%

# Maximum Superelevation Rate – Defined by Equation

Equation Editor

Rate Equation

Name: AASHTO Method 5

Equation: eRate

Show Variables and Operators

Equation Variables

Variable	Equation	Description	Interpolation Table
eRate	if(R < MinRadius ? M...	Calculated Cross Slo...	Create/Edit
MaxERate	0.08		Create/Edit
R	ABS(Radius)	Absolute Radius	Create/Edit
MinRadius	Speed*Speed/(15*(...	Minimum Radius   A...	Create/Edit

New Edit Import Delete

Name: eRate

Equation: if(R < MinRadius ? MaxERate : if(R >= NCRadius ? InitialCrossSlope : (EFD - F))

Description: Calculated Cross Slope Value | AASHTO Equation 3-20

Set Allowable Design Speeds

Minimum Speed: 15 Maximum Speed: 80 Increment: 5

Apply Cancel

- Mathematical Equations
- Logic Equations
- Lookup Tables

File Home Terrain Geometry Corridors Rail Model Detailing Drawing Production Drawing View

Search Ribbon (F4)

Element Selection Selection

New Corridor New Template Drop

Copy Template Drop Import IRD Transitions Create

Template Edit Edit Edit

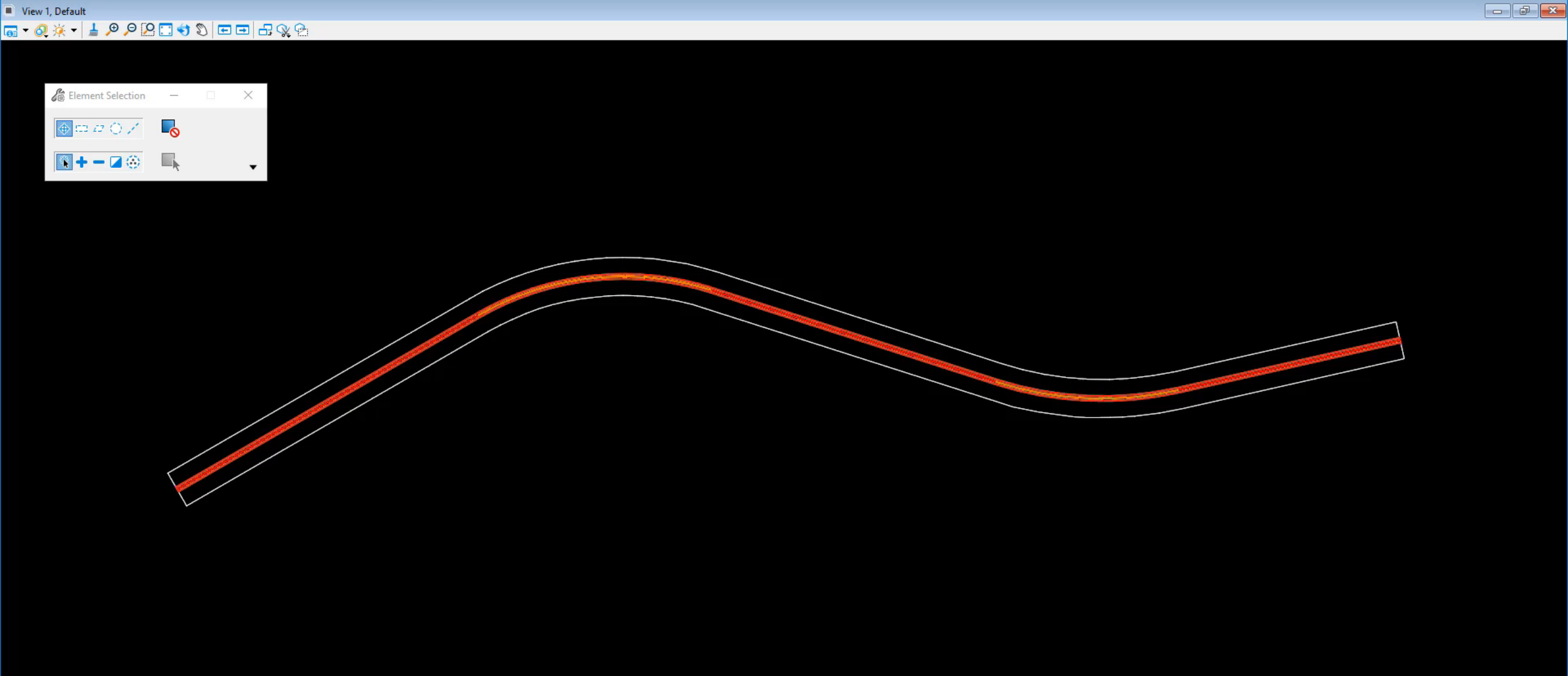
Define Target Aliasing Corridor References Corridor Clipping Miscellaneous

Create Calculate Superelevation

Dynamic Sections 3D Drive Through Review

Corridor Reports

View 1, Default



Element Selection

Selection tools: pan, zoom, rotate, move, delete, copy, paste, undo, redo, viewports, and other navigation tools.

Navigation and tool icons: back, forward, home, search, and various drawing tools.

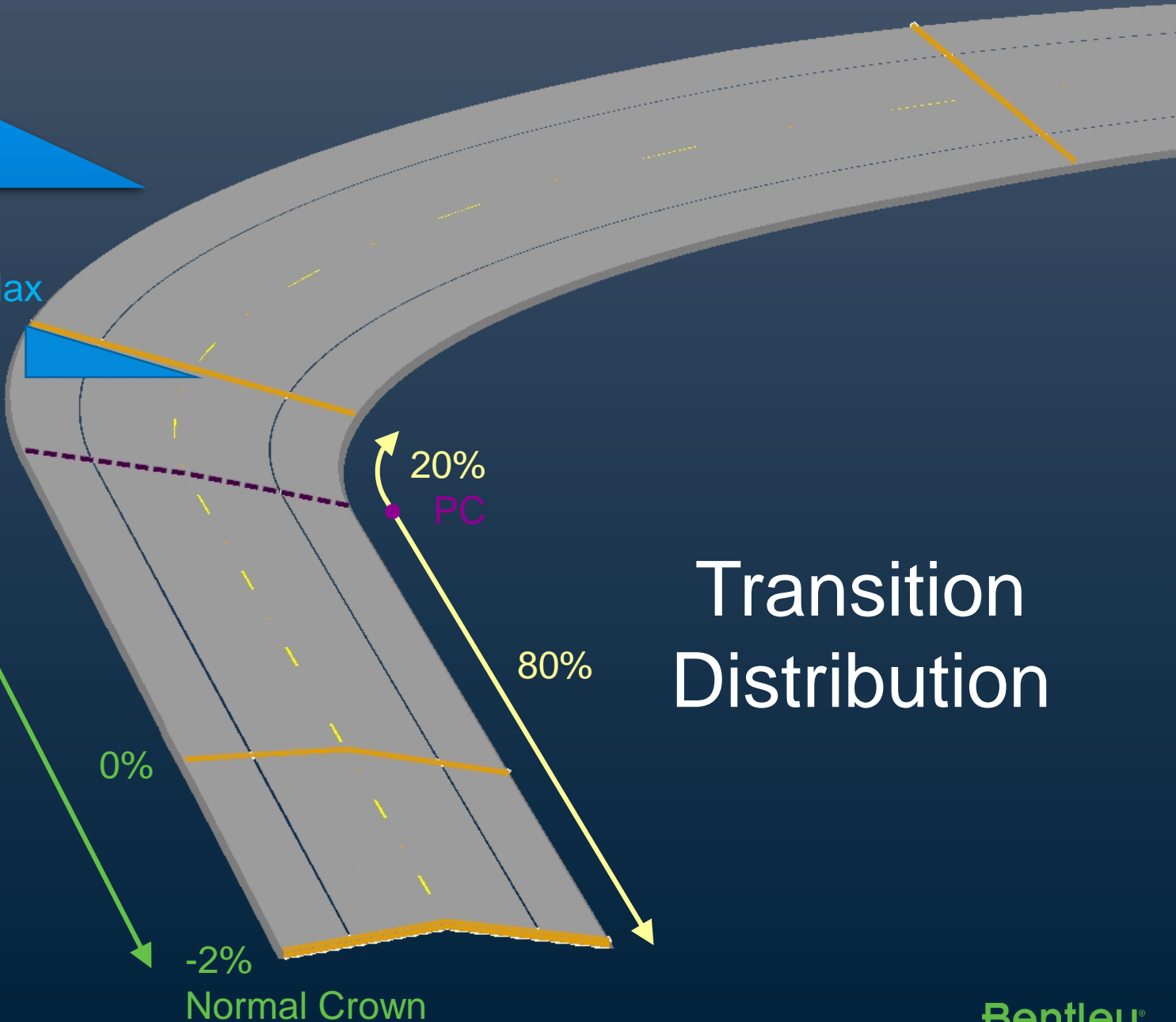
Maximum  
Superelevation  
Rate



Transition  
Distance

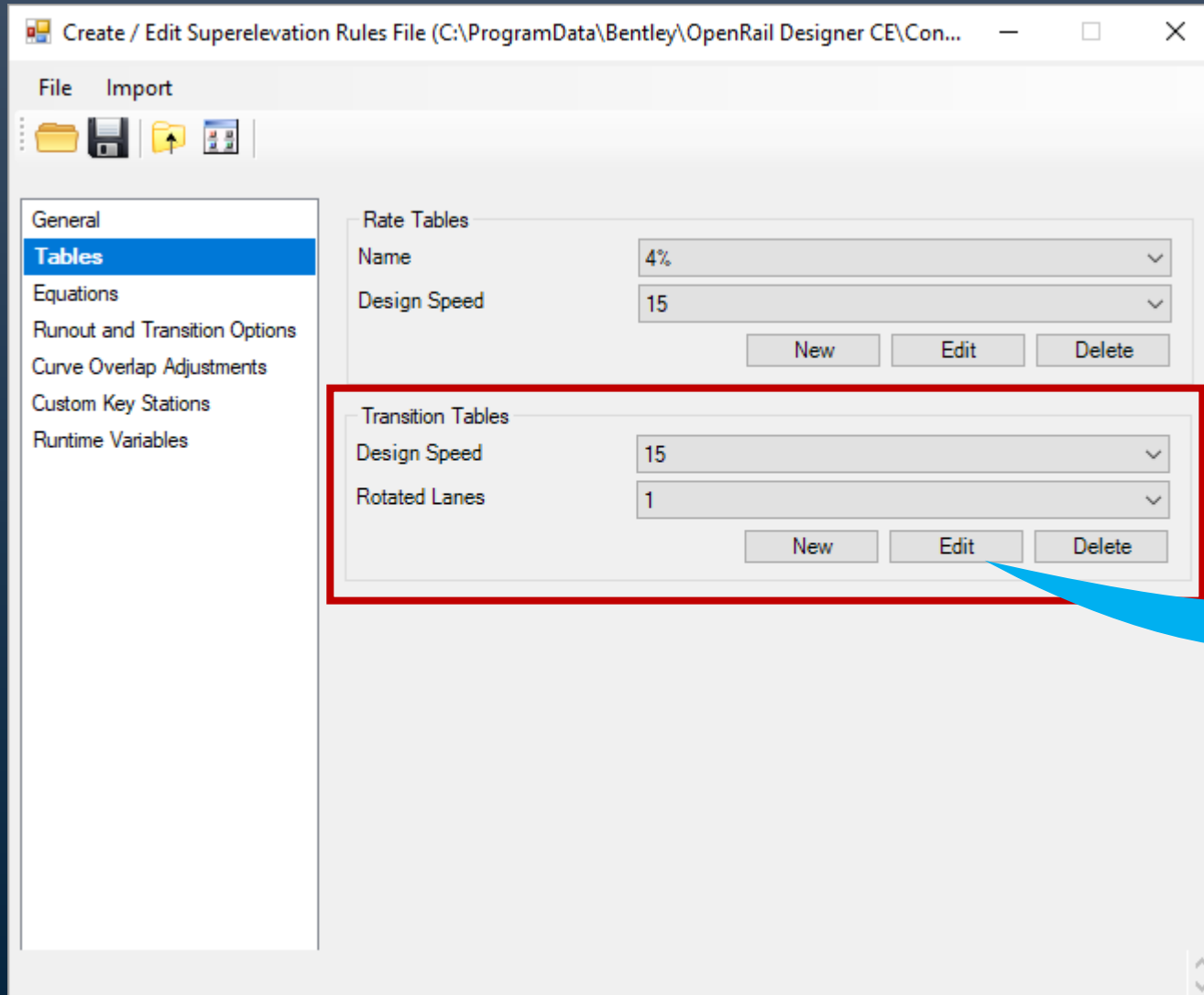


e Max

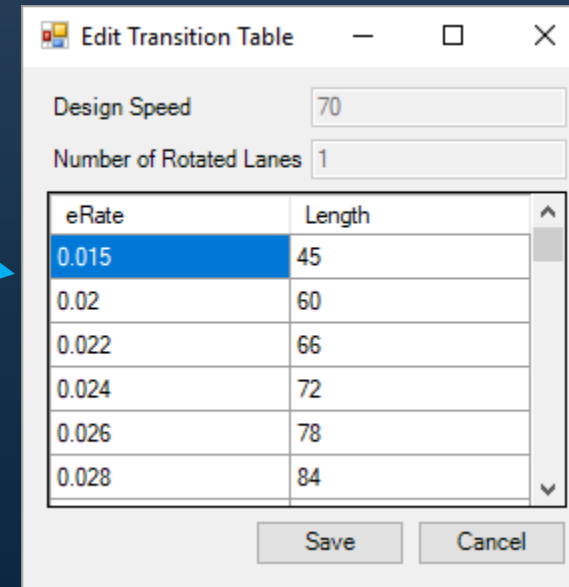


Transition  
Distribution

# Superelevation Transition – Defined by Table



- Define Speed & Number of Rotated Lanes
- Separate table for each combination
- Interpolation works the same as Rates





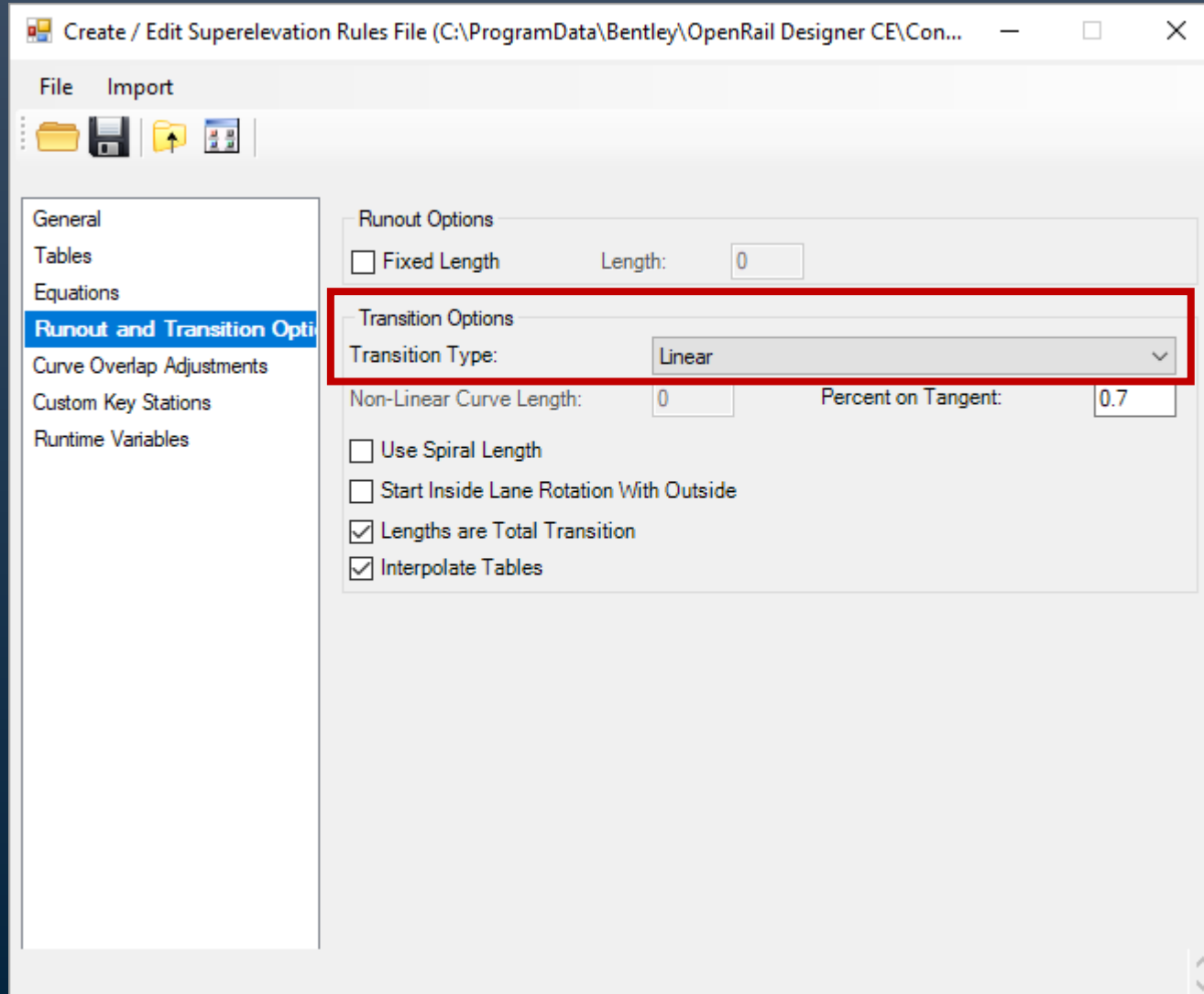
# Superelevation Transition – Defined by Equation

The screenshot shows the 'Equation Editor' dialog box. The 'Transition Equation' section has 'Name: AASHTO' and 'Equation: TransitionLength'. Below this is a 'Show Variables and Operators' button. The 'Equation Variables' section contains a table with three rows: 'TransitionLength', 'bw', and 'gradient'. The 'TransitionLength' row is highlighted in blue. Below the table are 'New', 'Edit', 'Import', and 'Delete' buttons. At the bottom of the dialog are 'Apply' and 'Cancel' buttons.

Variable	Equation	Description	Interpolation Table
TransitionLength	100*(WidthLane*NRot...	Calculated Transition ...	Create/Edit
bw	(NRotatedLanes+1)/(...	Adjustment Factor for ...	Create/Edit
gradient		Delta G (%)   AASHT...	Create/Edit

- Mathematical Equations
- Logic Equations
- Lookup Tables

# Superelevation Transition Types



- Parabolic
- Linear
- Reverse Parabolic
- Reverse Biquadratic
- Reverse Cubic
- Reverse Parabolic Nonsymmetrical
- Reverse Parabolic Symmetrical

File Home Terrain Geometry Corridors Rail Model Detailing Drawing Production Drawing View

Search Ribbon (F4)

Element Selection, New Corridor, New Template Drop, Copy Template Drop, Import IRD, Transitions, Create, Template, Edit Template Drop, Edits, Define Target Aliasing, Corridor References, Corridor Clipping, Create, Calculate, Dynamic Sections, 3D Drive Through, Corridor Reports

View 1, Default

Navigation icons: pan, zoom, rotate, etc.

Create / Edit Superelevation Rules File (C:\ProgramData\Bentley\OpenRail Designer CE\Con...)

File Import

General Tables Equations Runout and Transition Options Curve Overlap Adjustments Custom Key Stations Runtime Variables

Rate Tables

Name	10%
Design Speed	70

New Edit Delete

Transition Tables

Design Speed	15
Rotated Lanes	1

New Edit Delete

Navigation icons: back, forward, home, etc.

Default

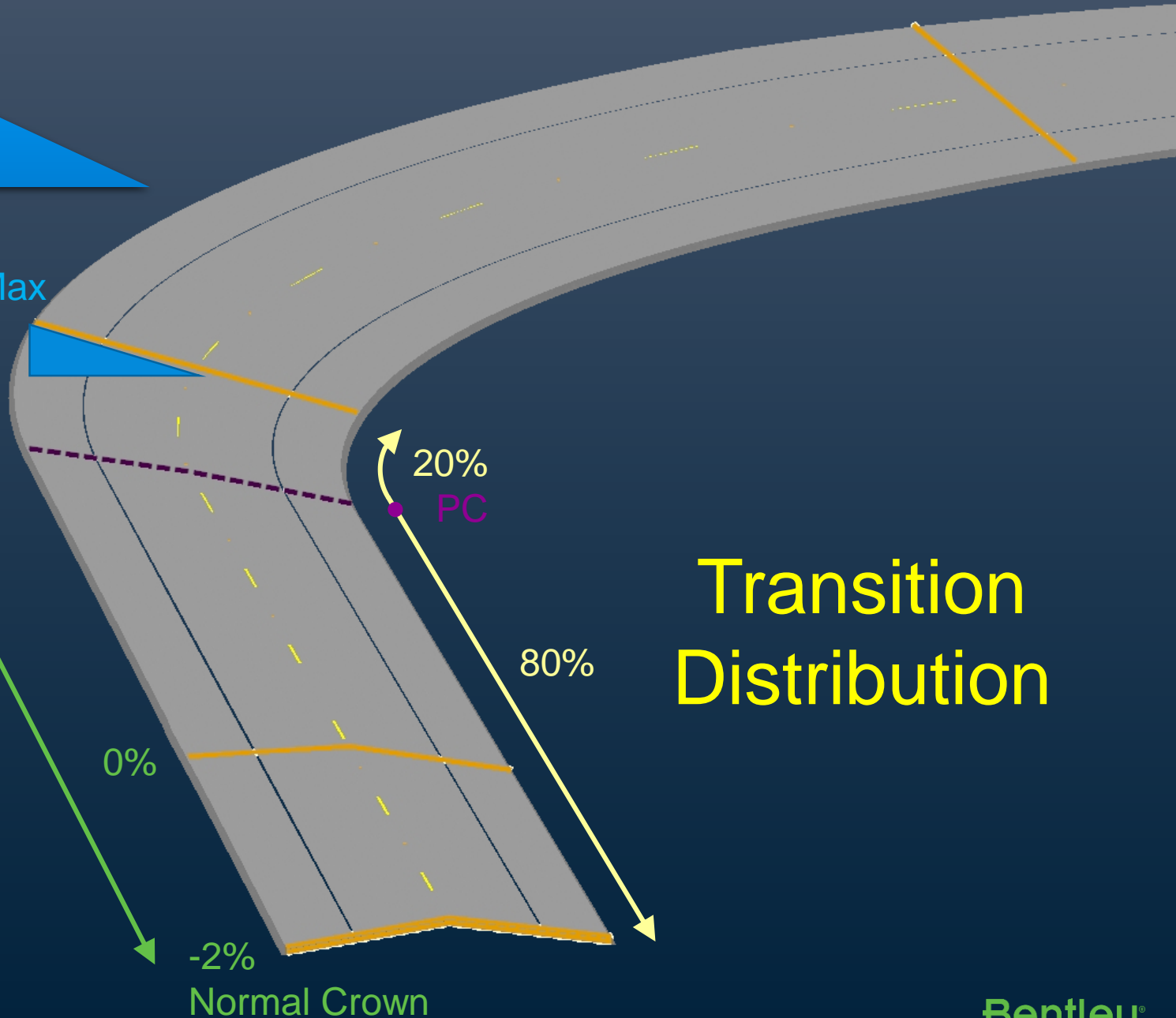
Default

Maximum  
Superelevation  
Rate



Transition  
Distance

e Max



Transition  
Distribution

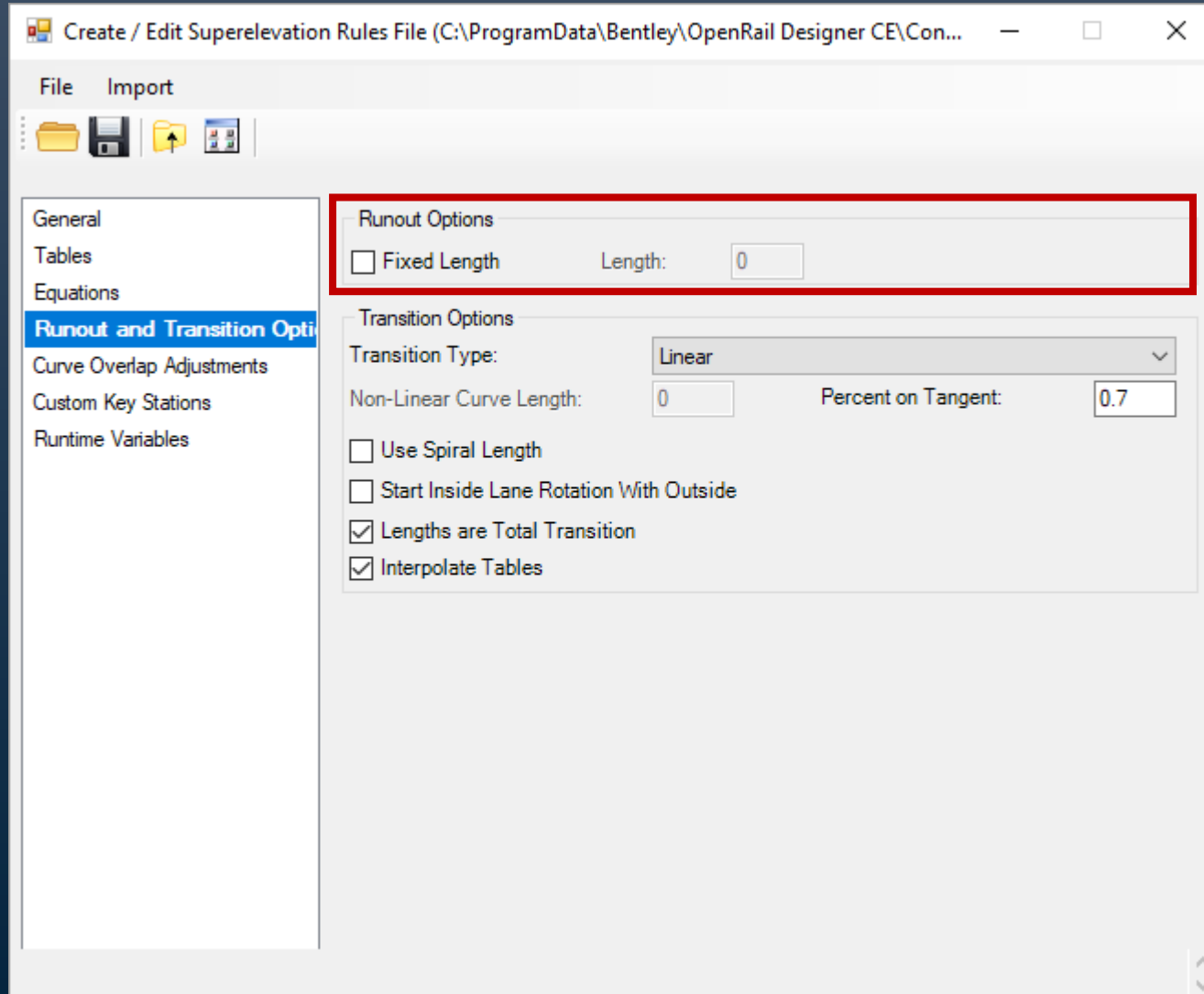
0%

20%  
PC

80%

-2%  
Normal Crown

# Runout and Transition Options



## Fixed Length

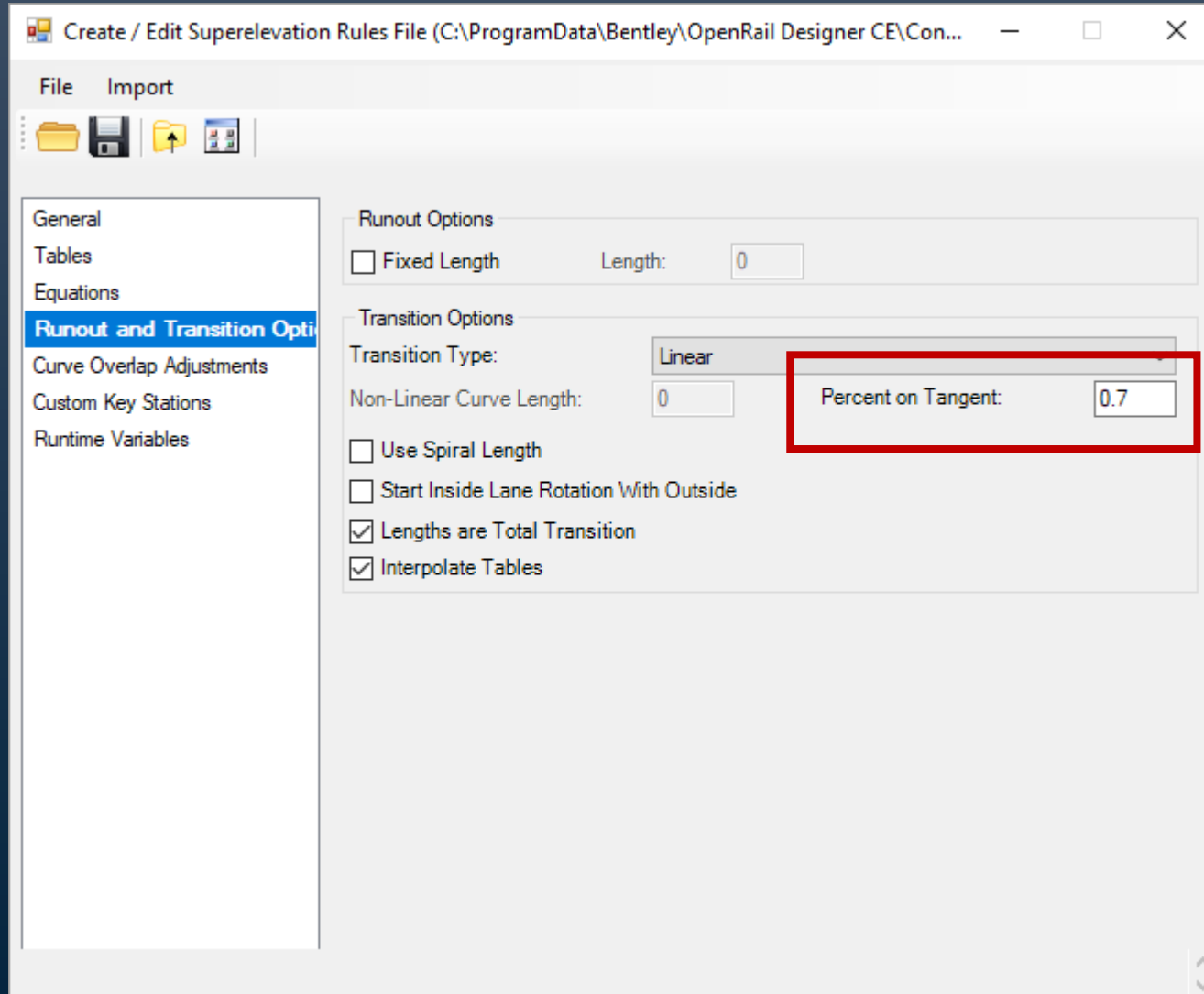
**ENABLED**

Use Defined Length Value

**DISABLED**

Project Relative Gradient to Compute Length

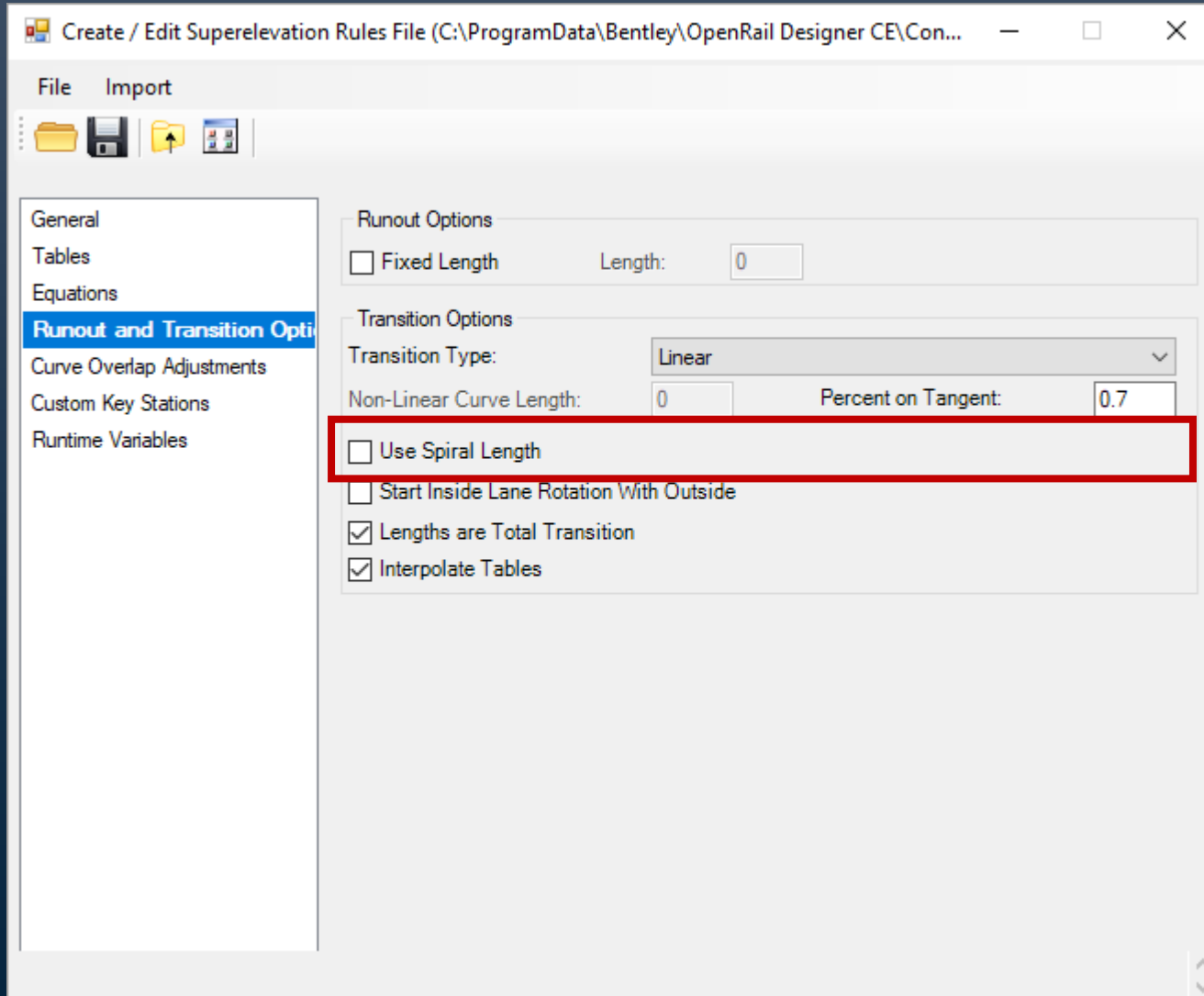
# Runout and Transition Options



## Fixed Length

Defines percentage of transition on tangent.

# Runout and Transition Options



## Use Spiral Length

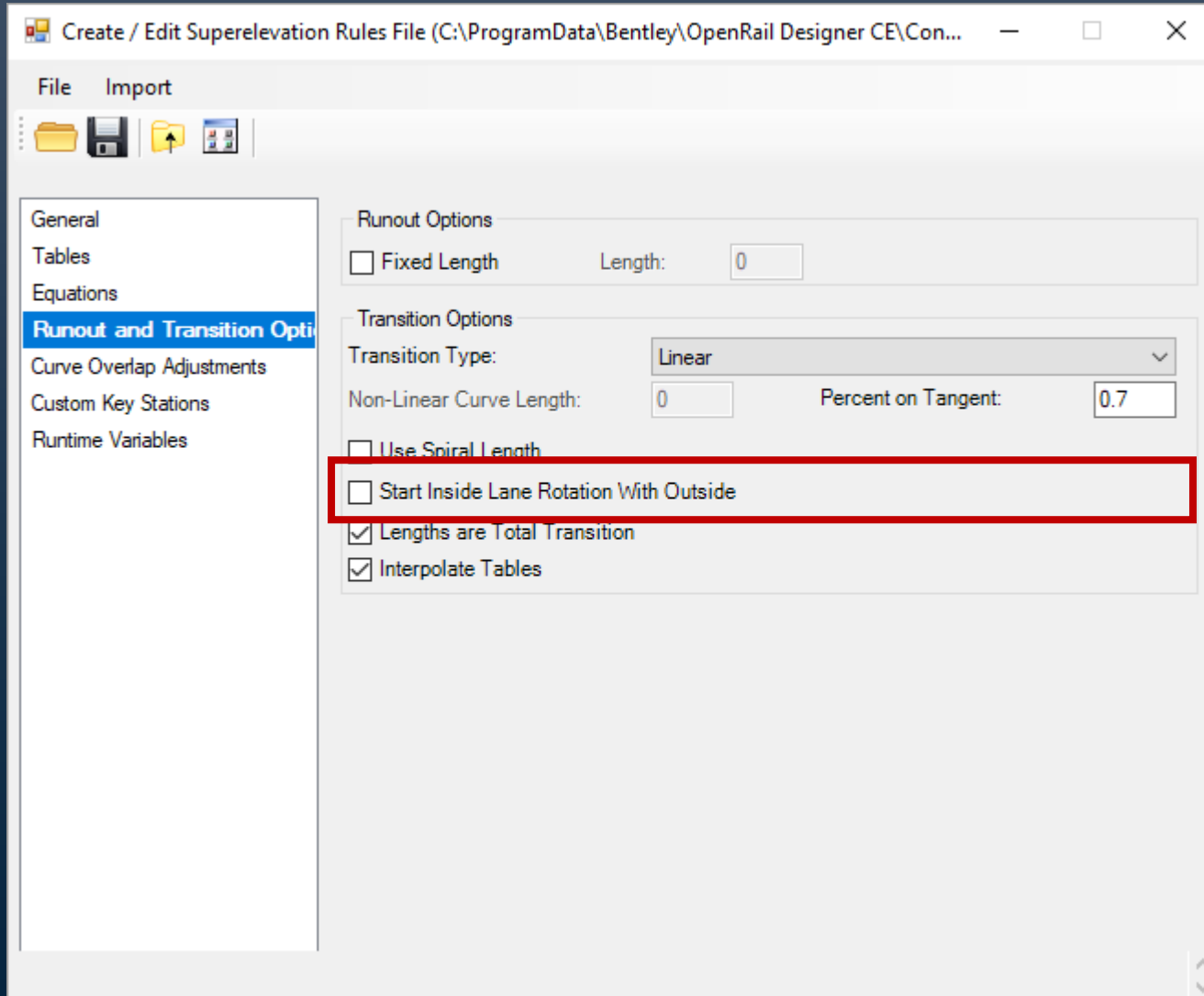
### ENABLED

If a spiral curve exists,  
Transition length = spiral length  
Else  
Transition length is calculated

### DISABLED

Transition length is calculated

# Runout and Transition Options



## Start Inside Lane Rotation with Outside

### ENABLED

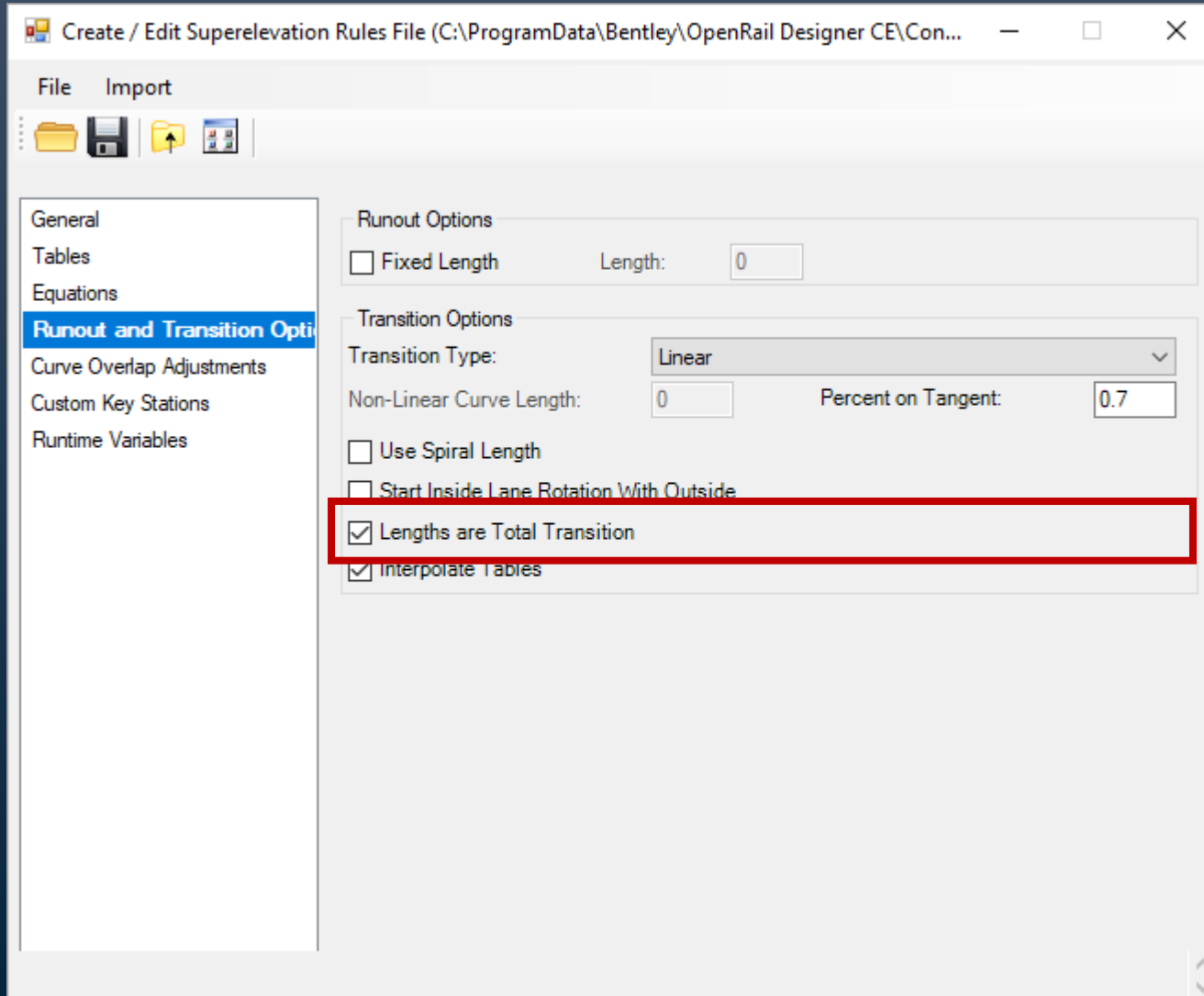
The inside lanes will start rotating (early start) at the same location that the outer lane starts rotating.  
Inside and outside lanes are not planer.

### DISABLED

The inside lanes will start rotating where the outer lane reaches reverse crown.  
Inside and outside lanes rotate planer.



# Runout and Transition Options



## Lengths are Total Transition

### ENABLED

Transition length = Runoff + Runout  
= normal crown to full super

### DISABLED

Transition length = Runoff  
= zero slope to full super

# But what if I need to...

- Use different rates for different types of roads
- Use different transitions for different types of roads
- Adjust transitions based on the number of lanes
- Distribute transition in a different way
- Compute stations along the transition



# Introducing Runtime Variables

Prompt User when calculating superelevation

Maintain standards – but with flexibility

Custom variables to use in eMax and Transition Length equations

Internal variables to override Runout and Transition Options

# Runtime Variable Example 1

- Override Runout and Transition Options
  - Transition Type
  - Percent on Tangent

Create / Edit Runtime Variable

Name: Transition Type

Description: Select the Transition Type

Override: None

Type: String

Default Value: Linear

Selection Options: Linear, Parabolic

Buttons: New, Delete, Clear, Save, Cancel, Import CSV

Variable	Type	Description
Transition Type	String	Select the Transition Type
Percent on Tangent	Decimal	

File Home Terrain Geometry Corridors Rail Model Detailing Drawing Production Drawing View

Search Ribbon (F4)

Element Selection Selection

New Corridor New Template Drop

Copy Template Drop Import IRD Transitions

Template Edit Edit Edit

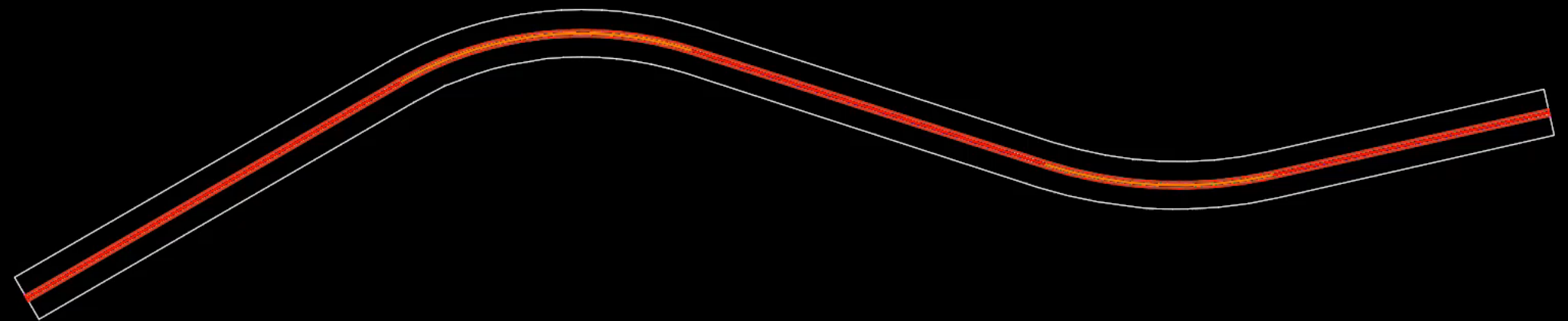
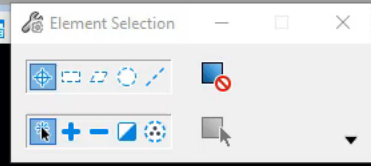
Define Target Aliasing Corridor References Corridor Clipping

Create Calculate

Dynamic Sections 3D Drive Through Corridor Reports

Miscellaneous Superelevation Review

Element Selection

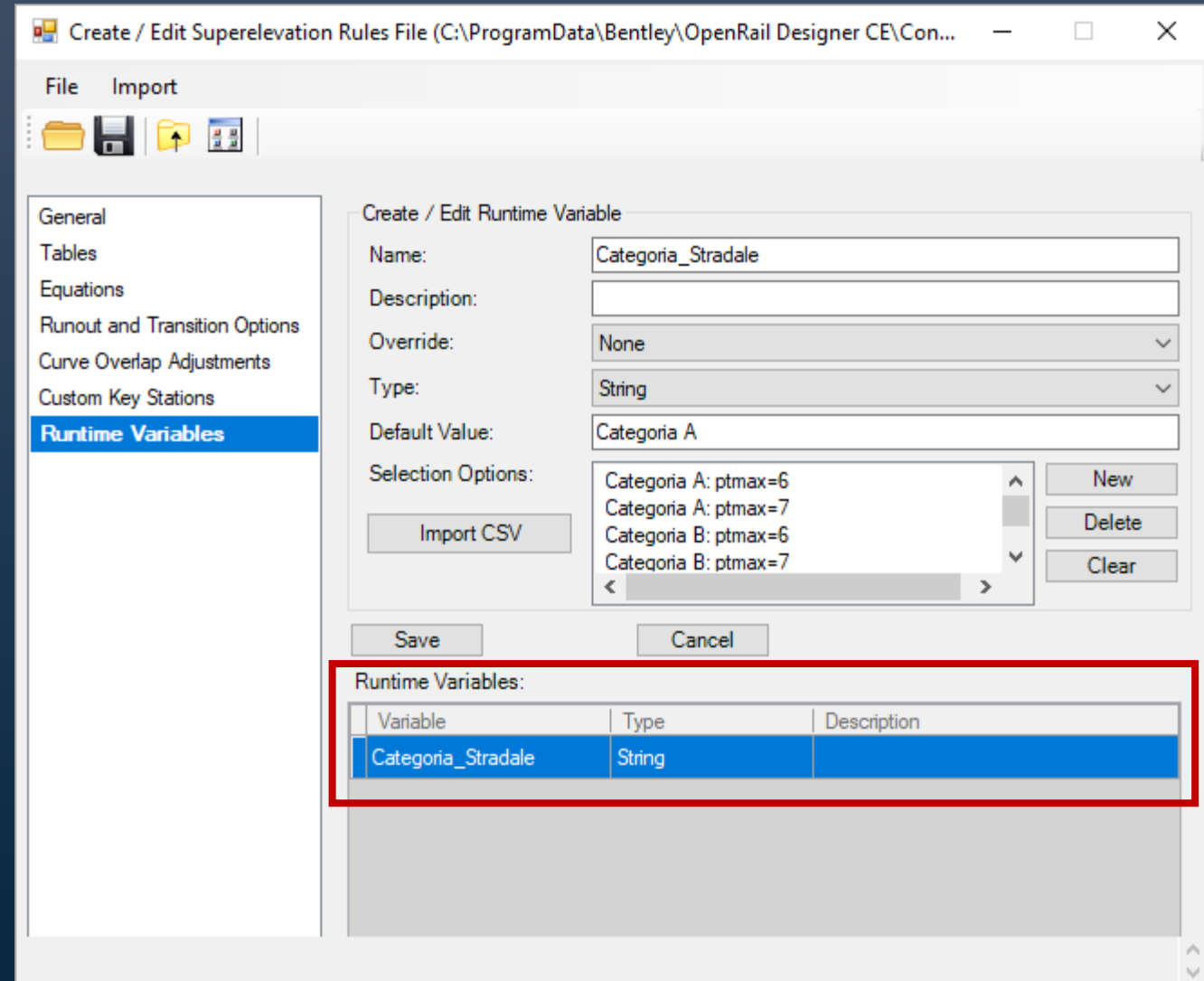


Navigation and tool icons: back, forward, home, pan, zoom, and other standard CAD controls.

# Runtime Variable

## Example 2

- Custom Road Categories
- Used in custom equations to Calculate eMax and Transition Length



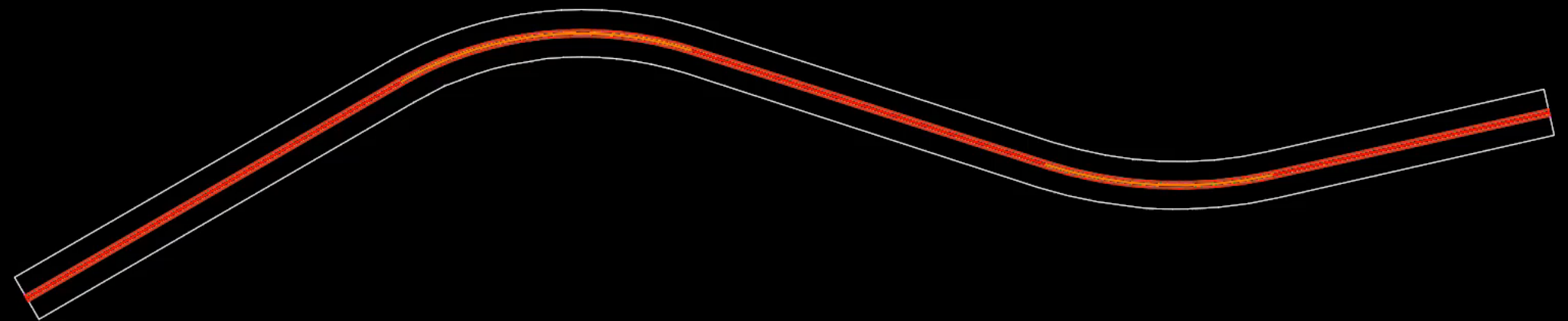
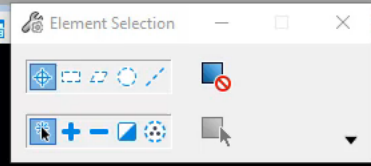
File Home Terrain Geometry Corridors Rail Model Detailing Drawing Production Drawing View

Search Ribbon (F4)

Element Selection New Corridor New Template Drop Copy Template Drop Import IRD Transitions Template Edit Template Drop Edits Define Target Aliasing Corridor References Corridor Clipping Create Calculate Dynamic Sections 3D Drive Through Corridor Reports

Selection Create Edit Miscellaneous Superelevation Review

Element Selection



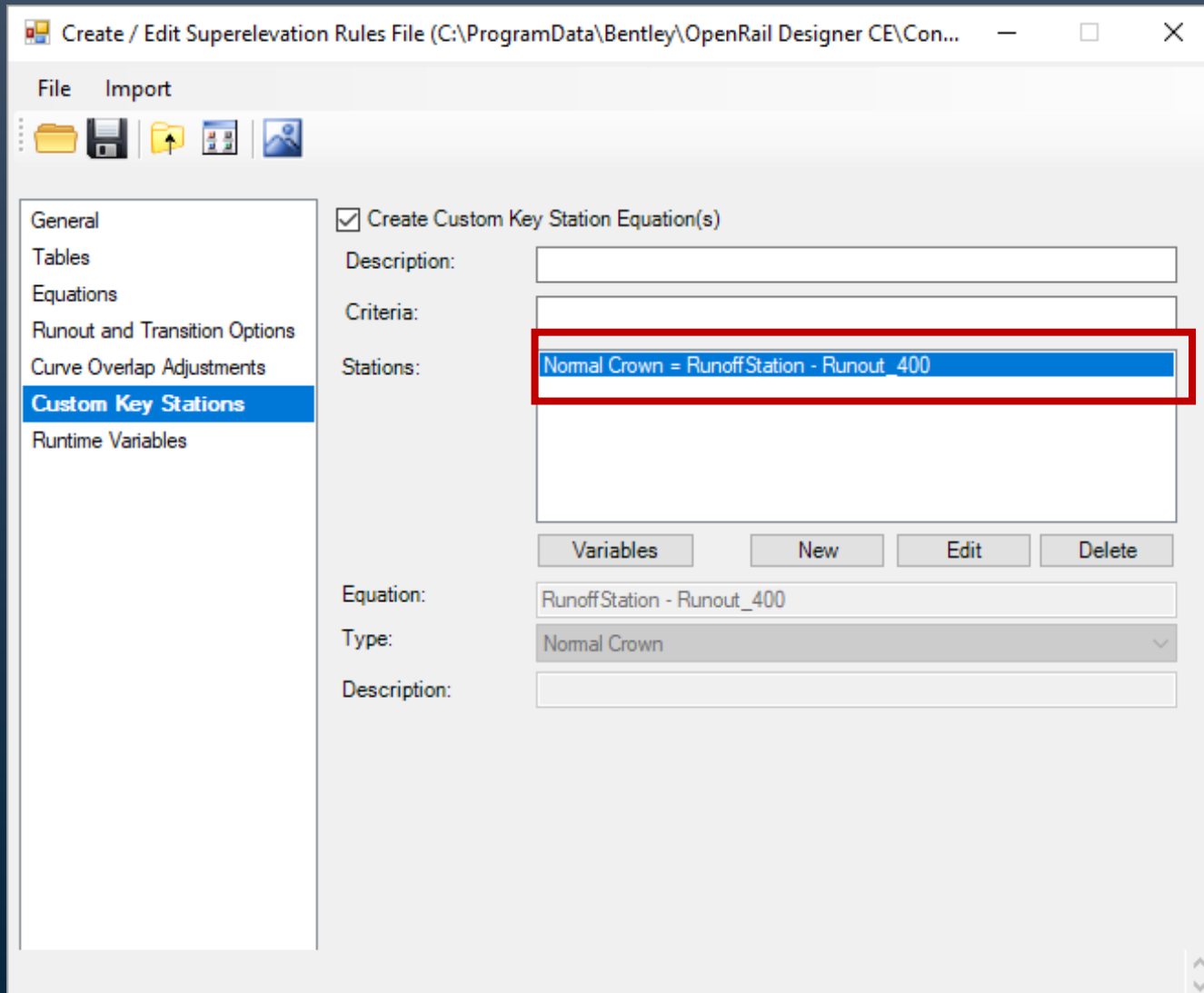
# Custom Key Stations

- Define Additional Transition Stations
- Override Calculated Transition Stations



# Custom Key Stations Example

1



- Runout length at 1:400
- Calculate Runout Length
- Calculate new Runout (Normal Crown) Station

# Custom Key Stations Example

2

- Fixed length runout
- Runout length varies by speed
- Define lookup table
  - Speed : Runout Length
- Calculate new Runout (Normal Crown) Station

The screenshot displays the Equation Editor software interface. The main window is titled "Equation Editor" and contains a "Variable Editor" section. The "Variable Editor" section has a "Show Variables and Operators" button and a table of variables. The table has four columns: "Variable", "Equation", "Description", and "Interpolation Table". The first row is highlighted in blue and contains the following data:

Variable	Equation	Description	Interpolation Table
IRunout		Fixed Length Runout ...	Create/Edit

Below the table are buttons for "New", "Edit", "Import", and "Delete".

Overlaid on the main window is a "Create Interpolated Variable" dialog box. The dialog has the following fields and options:

- Name:** IRunout
- Equation:** (empty)
- Description:** (empty)
- Variable Name:** IRunout
- Variable Description:** Fixed Length Runout based on Speed
- Interpolation Table:**
  - Input Variable Name:** Speed
  - Interpolation Type:** Lower Bound
  - Table Description:** (empty)
  - Import CSV** button
  - Variables** checkbox (unchecked)

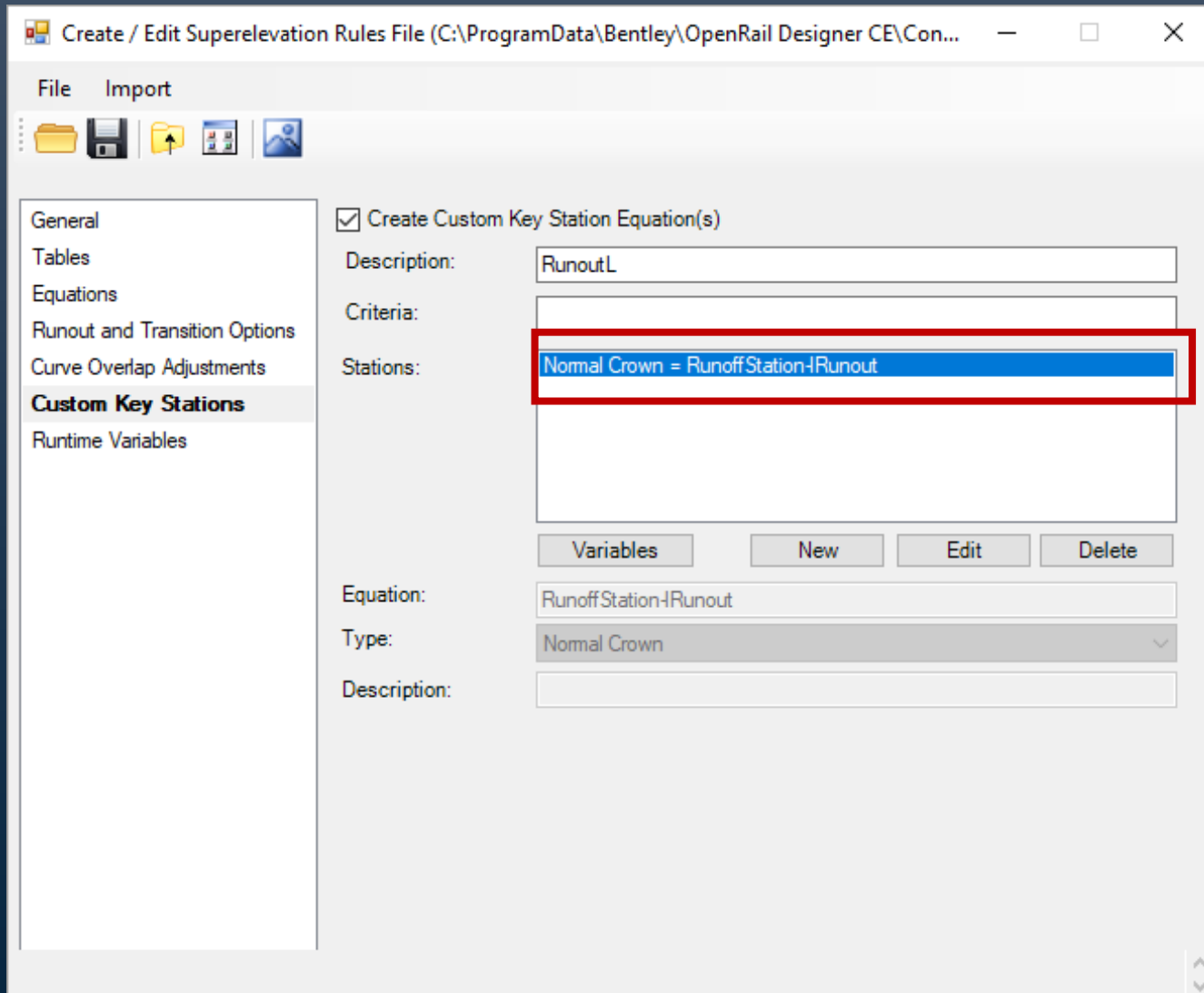
The "Interpolation Table" section contains a table with the following data:

Input	Output
30	36
35	39
40	41
45	44

At the bottom of the dialog are "Save" and "Cancel" buttons.

# Custom Key Stations Example

2

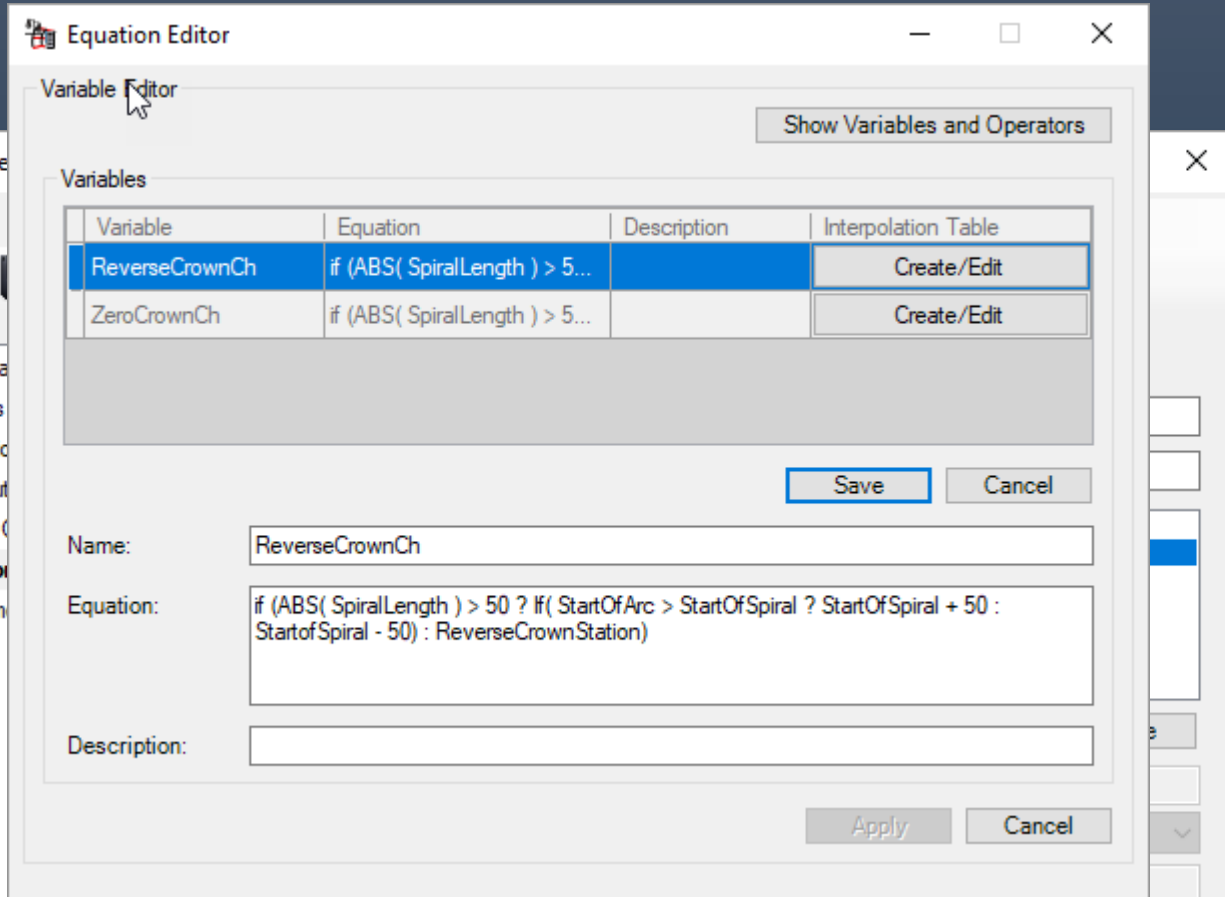


- Fixed length runout
- Runout length varies by speed
- Define lookup table
  - Speed : Runout Length
- Calculate new Runout (Normal Crown) Station

# Custom Key Stations Example

3

- Reverse Crown Location
  - if Spiral > 50 at Spiral
  - else at Calculated Station
- Zero Crown Location
  - if Spiral > 50 at Spiral +25
  - else at Calculated Station



Adjust transitions when tangent distance is short.

Curve  
Overlap  
Adjustments

	CURVE CURVE	REVERSE CURVE
Slide	X	X
Shorten	X	X
Reverse Crown	X	
Planar	X	X
Custom Equation	X	X



# Importing SUP and SEP Files

# Importing SUP Files

- Import tool is an assistant
- What Imports
  - Rate Tables
  - Transition Length Tables
- What does not Import
  - Settings in XIN file



# Importing SEP Files

- Import tool is an assistant
- What Imports
  - Rate Tables
  - Transition Length Tables
  - Relative Gradient Tables
- What does not Import
  - Equations
  - Most Other Settings





# Search for the section named **Edit Superelevation Rule File**


## Product Help

OpenRail Designer CONNECT Edition

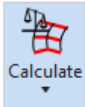
Content

- > Corridor Modeling Overview
  - Selection
- > Corridor Creation
- > Corridor Edit
- > Corridor Misc.
- ▼ Superelevation
  - > Superelevation Overview
  - > Create
  - ▼ Calculate
    - Calculate Superelevation
    - Edit Superelevation Rule File**
    - Import Superelevation
    - Assign to Corridor
  - > Edit
  - Superelevation Report
  - Open Superelevation View
- > Review
- > Rail
- > Model Detailing
- > Drawing Production
  - Software Compatibility
- > Survey
  - MicroStation
  - Descartes
  - Subsurface Utilities
  - Geotechnical
- > Readme

### Edit Superelevation Rule File

 Edits an existing superelevation rule file. When a rules file is opened with this tool it validates the file against the schema.

You can access this tool from the following:

-  Calculate
  - Calculate Superelevation
  - Edit Superelevation Rule File**
  - Import Superelevation
  - Assign To Corridor

- Ribbon: **Corridors > Superelevation > Calculate** split button

#### Superelevation Rule File

The superelevation calculator uses an XML-formatted rules file to calculate various aspects of superelevation. This file is used to calculate Max E rate for each curve of an alignment and the transition lengths needed to rotate the road bed from normal crown cross slopes to full superelevation cross slope (Max E).

The sections that follow describe:

- How the Superelevation Rules File is Applied During Calculation of Superelevation
- How the Edit Superelevation Rules File Command Works
- Writing Equations in the Rules File
- Example Equations

#### How the Superelevation Rules File is Applied During Calculation of Superelevation

The Max E Rate is calculated by one of two possible methods, a Rate Table or a Rate Equation.

If RateTable is used, then the Design Speed is populated by looking at which rate tables exist in the Rule File.

If a user selects a RateEquation, then the Design Speed selection is populated with the Speed elements that are in the Speeds collection under the equation. Speeds don't have to be simple numerical values. For example, a Rule file can be defined with speeds of "60 Urban", "Loop Ramp", or "All Speeds". Alphanumeric "speed" names can be useful when the Rate Equation determines the actual speed from another source such as a User Variable.

Transition calculations are also computed by one of two possible methods, a Transition Table or a Transition Equation.

# OpenRoads Designer Superelevation Rule File Guide

BENTLEY

CIVIL ENGINEERING

## OpenRoads Designer Superelevation Rule File Guide

Document Revision #1

1

## Contents

OpenRoads Designer Rule File .....	4
Importing SUP Files into OpenRoads Designer .....	4
Importing SEP Files into OpenRoads Designer.....	4
SEP Variable Mapping to OpenRoads Designer Settings .....	9
E Rate .....	9
Runoff.....	9
Tangent Runout .....	10
Adjustment Factors.....	11
Distribution .....	11
Rotation .....	12
Reverse Curves.....	12
Compound Curves.....	14
Short Curves.....	15

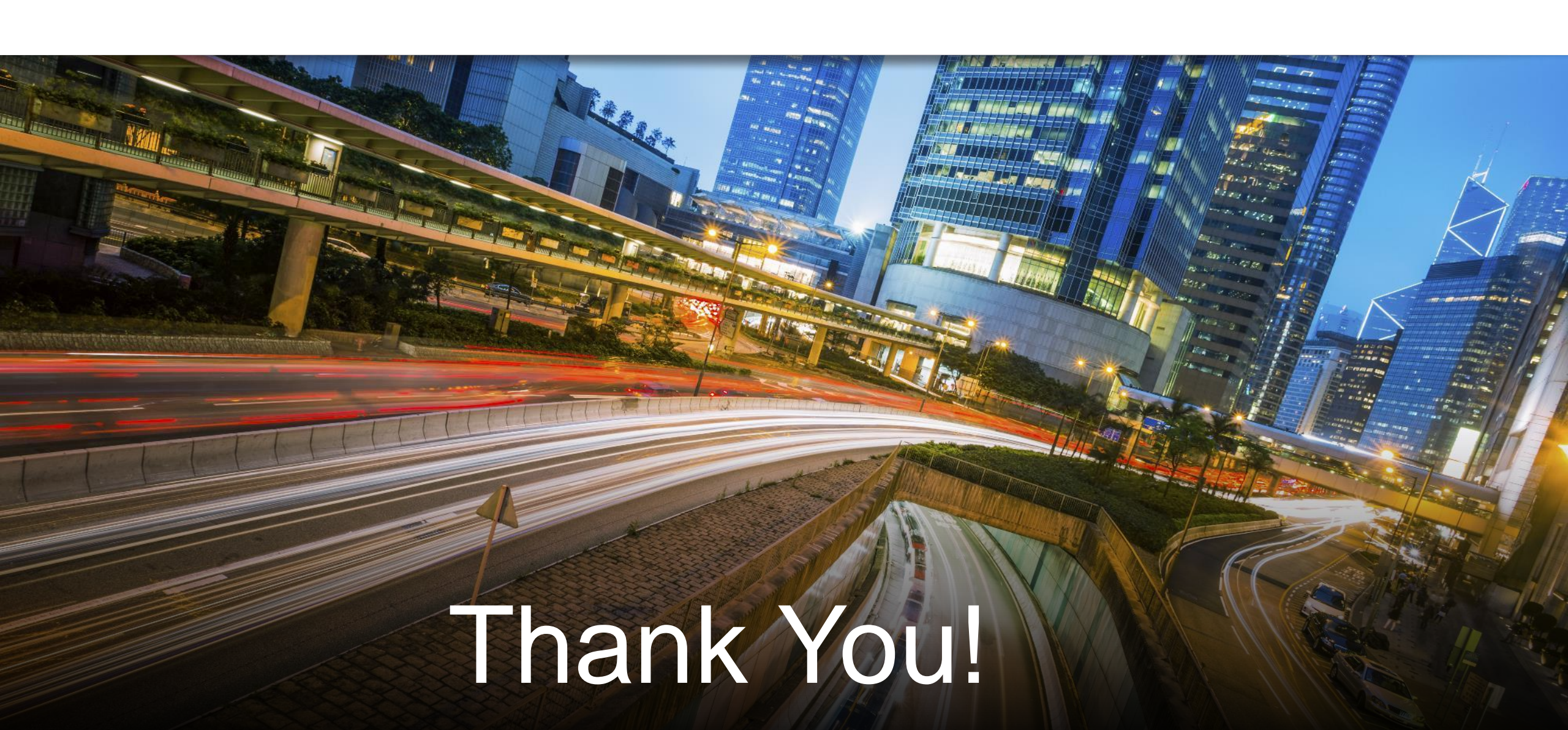
## SEP Variable Mapping to OpenRoads Designer Settings

### E Rate

eMethod	E_RADIUS_TABLE	Tables defined by the eTableName variable are imported into the XML rule file. Rates can be "NC", "RC", or a % as in "4%"
	AASHTO Method 5	Equation is already defined in the XML rule file.
	EQUATION	Equations are not automatically imported into the XML rule file. They must be defined manually using <b>Equations &gt; Rate Equations &gt; New</b> . The existing equation is defined by the eEquation variable in the SEP file.
eSpeedInterpolation	The XML rule file only supports a single True/False switch for Table calculations. This is defined by the <b>Runout and Transition Options &gt; Interpolate Tables</b> option. When enabled, all tables are interpolated, when disabled, eRate and Transition lengths will be the higher value. Additional interpolation methods can be achieved if necessary using Custom Key Station equations.	
radiusInterpolation	See eSpeedInterpolation.	
eRoundingIncrement	Defined by the <b>General &gt; Cross Slope Rounding</b> value in the XML rule file.	

### Runoff

RunoffSpiralOption	LS_RUNOFF_ONLY	Enable <b>Runout and Transition Options &gt; Use Spiral Length</b> .
	LS_RUNOFF_AND_RUNOUT	Enable <b>Runout and Transition Options &gt; Use Spiral Length</b> and <b>Runout and Transition Options &gt; Lengths are Total Transition</b> . See undividedDistributeOver for additional details.
runoffLengthMethod	RUNOFF_EQUATION	Define with <b>Equations &gt; Rate Equations &gt; New</b> . The existing equation is defined by the runoffLengthEquation variable. Equations are not automatically imported into the XML rule file. They must be defined manually.
	RUNOFF_E_TABLE	Tables defined by the lengthTableName variable should automatically imported into the XML rule file.



Thank You!