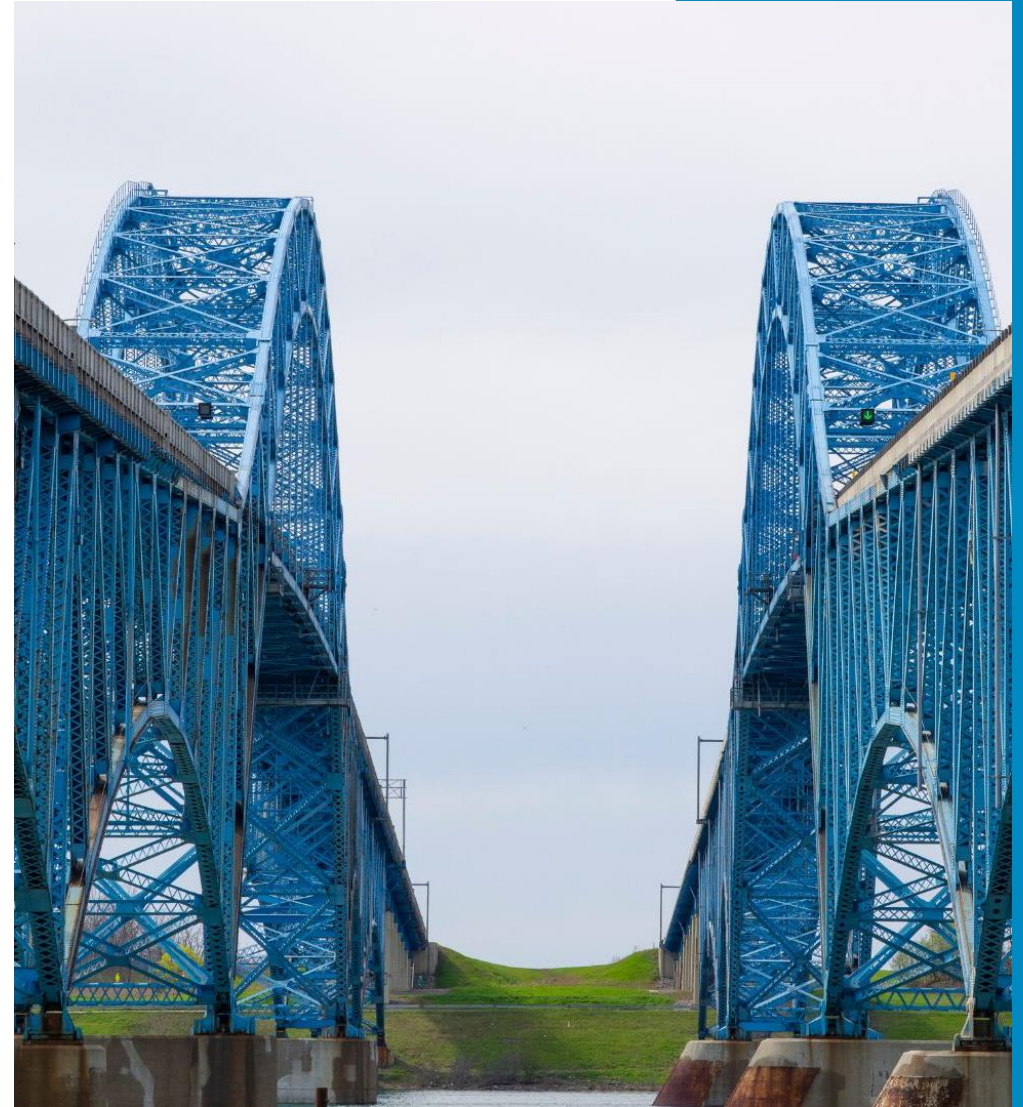

Update to AASHTOWare BrDR for Soil/Structure Interaction

Jennifer Hart, P.E., Indiana DOT

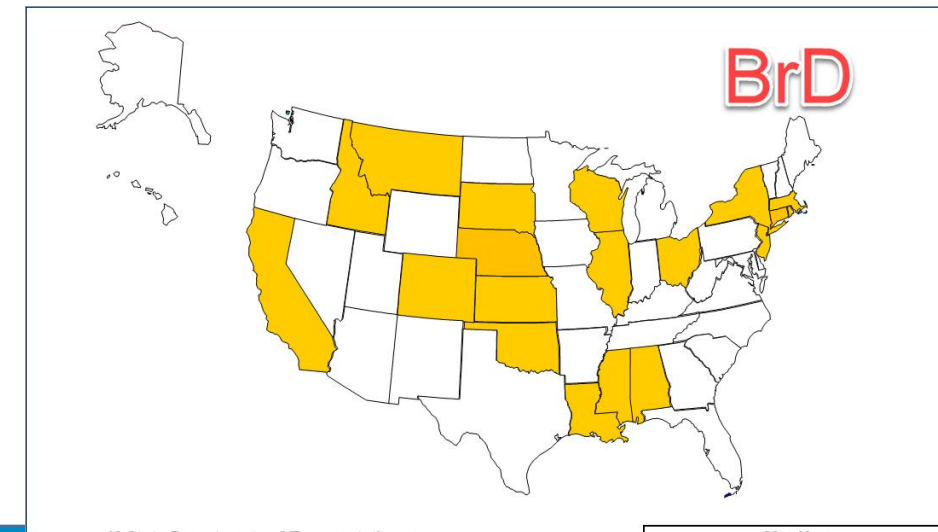
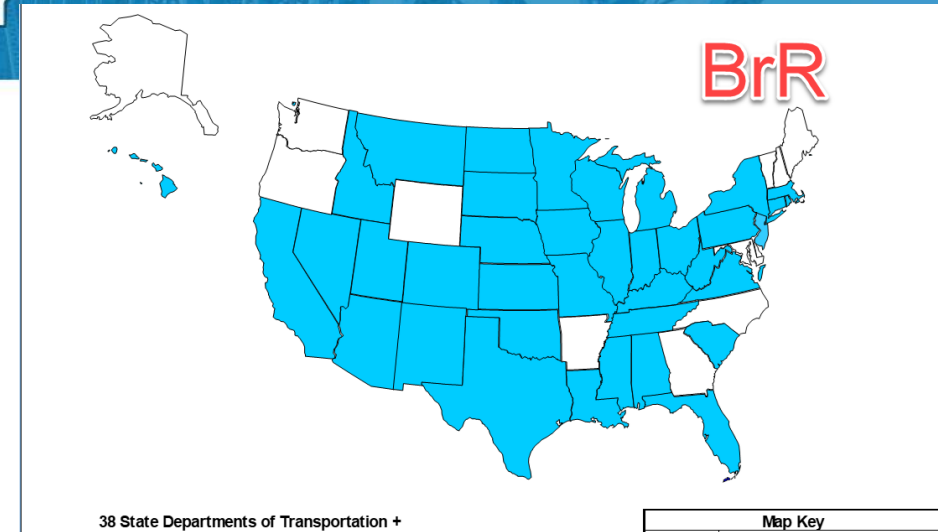
Mark Mlynarski, P.E., ProMiles

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BrDR licensees

- BrR 40+ State DOT's and agencies
- BrD 20 State DOT's and agencies
- 27 unlimited licenses
- 700+ other licenses
- 100,000+ bridge models entered into BrDR
- RADBUG (Rating and Design Bridge User Group)



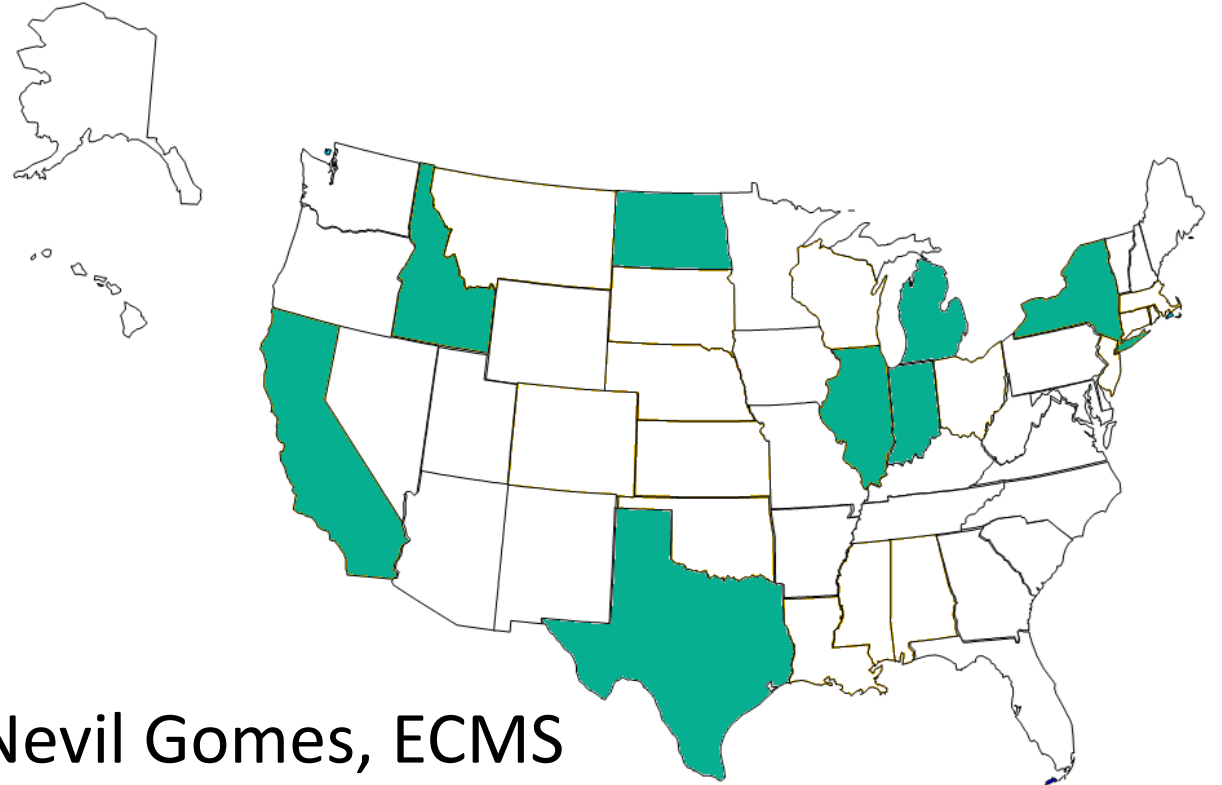
BrR RADBUG voting

AASHTOWare Bridge Rating (BrR) – 28 state agencies returned the ballot with 113 unique enhancements.

Rank	Points	Key	Summary
1	3247.1	BSSD-3824	Create a CANDE-like modeling/engine for BrDR <i>The BrDR 7.7 development will start tackling this enhancement by implementing non-linear finite element formulation of soil-culvert interaction. The development of the user interface, modeling capabilities, and specification checking are currently under planning.</i>
2	2484.3	BSSD-3618	Allow adding Girder(s) to either Left or Right side of Girder System model
3	2060.8	BSSD-3503	Add steel curved girder functionality to the load rating tool for both LFD and LRFR
4	2016.0	BSSD-1692	Steel girder strengthening: Cover plates and Post-Tensioning

Culvert TAG participants – 8 DOTs, 2 consultants

- Jennifer Hart, Indiana, Chair
- Mike Johnson, Idaho, Vice-Chair
- Mark Mlynarski, ProMiles
- Biniam Aregawi, Texas DOT
- Ruben Boehler, Illinois DOT
- Ratan Huda, New York DOT
- Matt Luger, North Dakota DOT
- Don Tempinson, Michigan DOT
- Richard Tsang, CalTrans
- Nevil Gomes, ECMS
- Damian Silverstrim, AI Engineers



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Current and future development status

Mark Mlynarski, P.E., ProMiles

Early stages–Phase I – Version 7.7 (Fall, 2025)

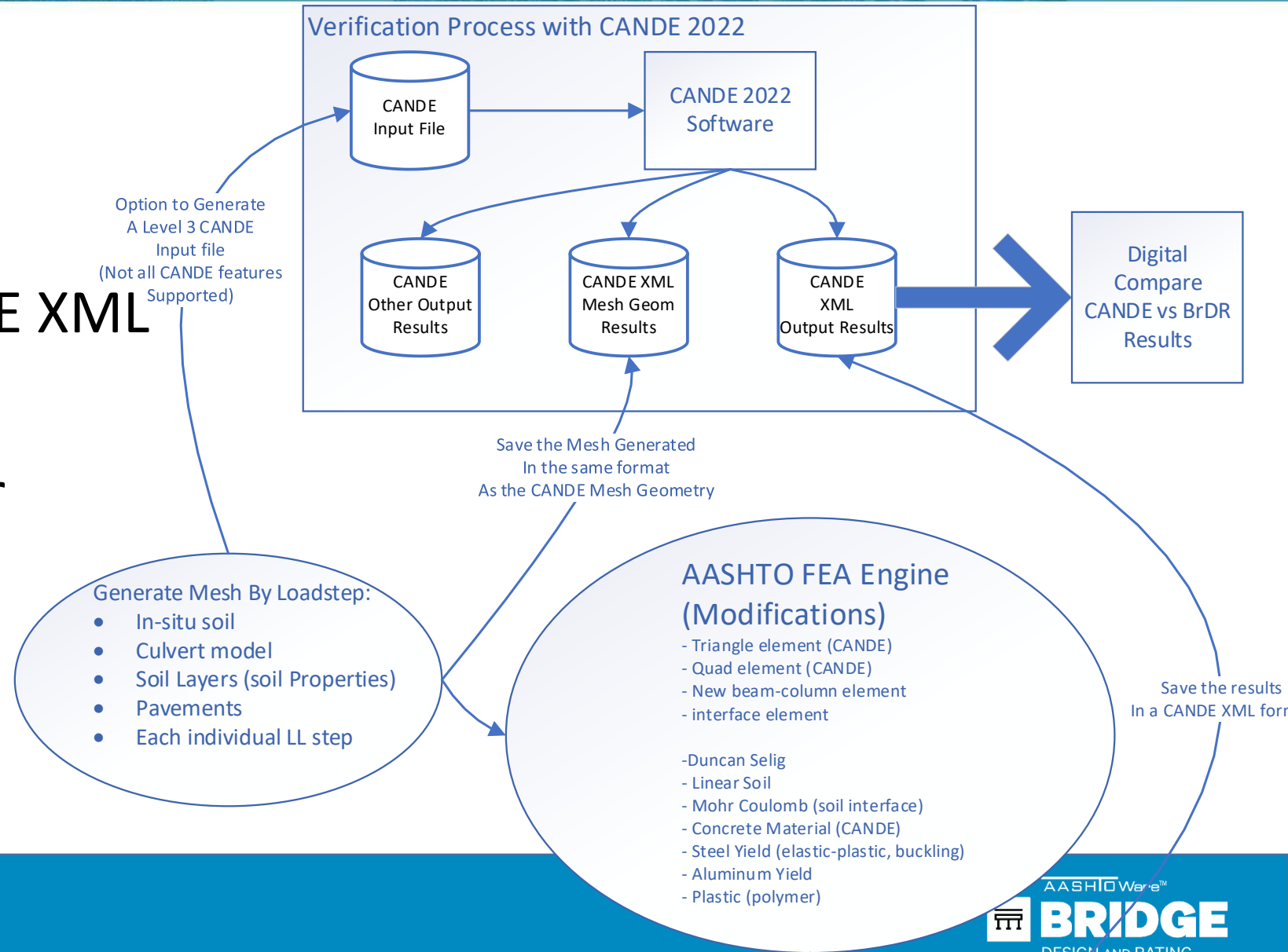
- Developing Elements similar to CANDE
- Using modern programming techniques and practices
 - (**NOT** integrating the existing CANDE into BrDR – just the techniques)
- Creating the analysis engine to run Level 3 models

Early stages–Phase I – Version 7.7 (Fall, 2025)

- Validation with CANDE
 - Tools for comparing the results of existing CANDE models
- Engine included in version 7.7 of the BrDR software
 - Will NOT be available to users (no user interface)
 - User Interface will be provided in later versions (Phase II)

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- Validation Process
- Use new engine with SSI elements
- Produce output in CANDE XML format
- Digital (or graphical) comparison of results for various models



Phase II – Version 7.8 (Fall, 2026 - Tentative)

- Model windows for RC Box culverts/CMPs
- Model the RC Box with SSI and produce results (analysis and spec checking)
- Produce Simple CMP pipe models (Single span)
- LL Analysis
- Graphical output

RC Box - Make use of existing models

RC Box Culvert Thickness

Cell	Top slab thickness (in)	Bottom thckn (in)
> 1	12.50	
2	12.50	

Wall	Thickness (in)
> 1	12.00
2	12.00
3	12.00

RC Box Culvert Geometry

Number of cells: Bottom slab present

Cell height: ft Horiz. construction joint height: in

Cell	Width (ft)
> 1	12.000
2	12.000

Haunches

Top haunch width: in

Top haunch depth: in

Bottom haunch width: in

Bottom haunch depth: in

RC Box Culvert Reinforcement

Top slab - top bars | Top slab - bot bars | Bot slab - top bars | Bot slab - bot bars | Corner | Wall | Dowel

Note: Bars will always be placed in the orientation shown

Set	Bar mark	Clear cover (in)	Bar spacing (in)	Measured from	Wall number	Centered	Start distance (ft)	Straight length (ft)	Fully developed start	Fully developed end
> 1	B714	2.00	14.00	CL Wall	2	<input checked="" type="checkbox"/>	4.50	9.00	<input type="checkbox"/>	<input type="checkbox"/>
2	B715	2.00	14.00	CL Wall	2	<input checked="" type="checkbox"/>	2.42	4.83	<input type="checkbox"/>	<input type="checkbox"/>

New Duplicate Delete

Reinforcement wizard...

OK Apply Cancel

Additional information required for soil and load steps

In-situ/bedding soil input

Depth below bedding

Number of element Rows

In situ soil

Trench left distance

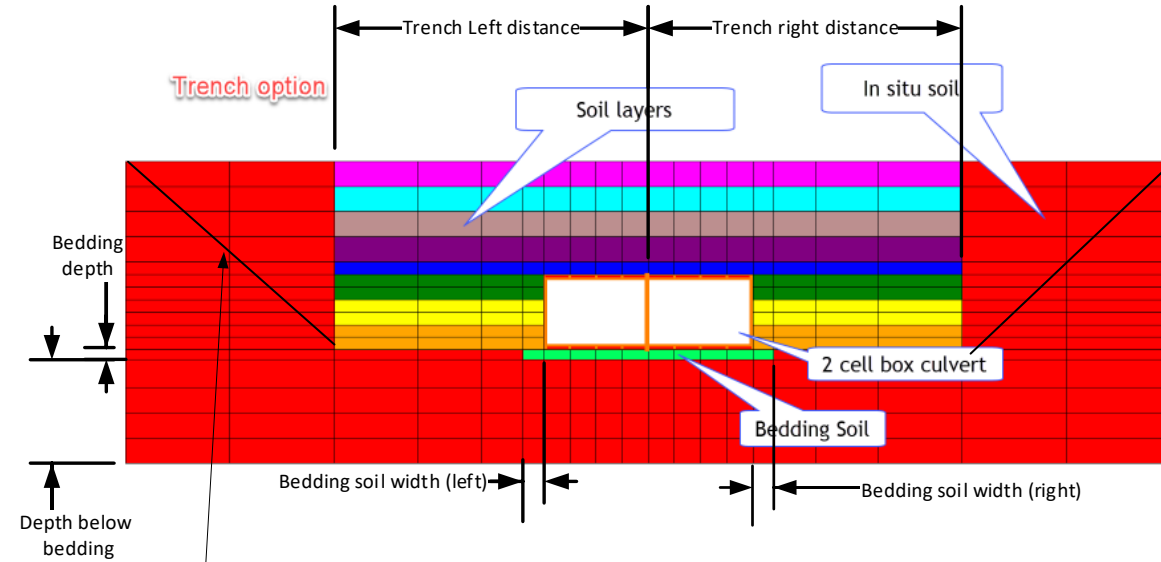
Trench right distance

Bedding depth

Bedding soil width (left)

Bedding soil width (right)

Bedding Soil



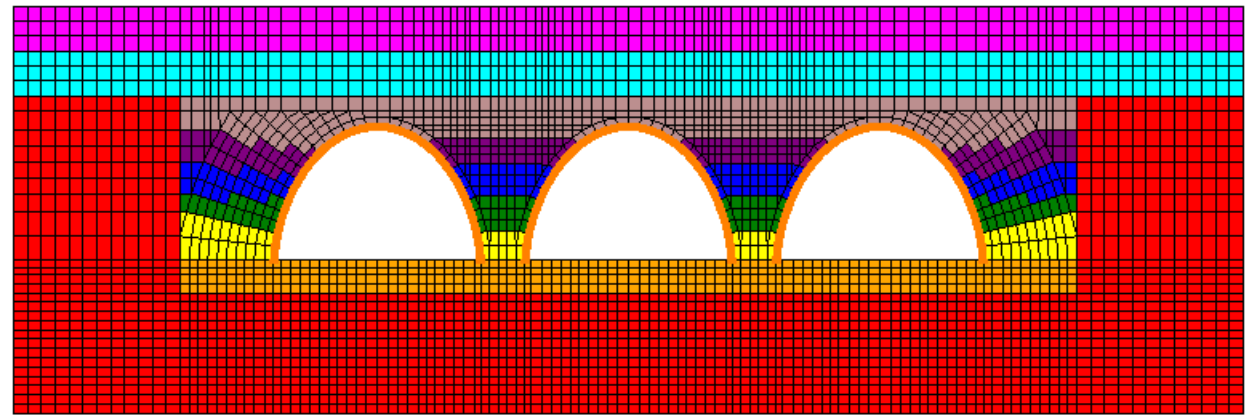
Optional slope line for trench. Will always be present. Elements will be on either side of this line. In-situ if square trench and soil layers if sloped.

Soil Level Input

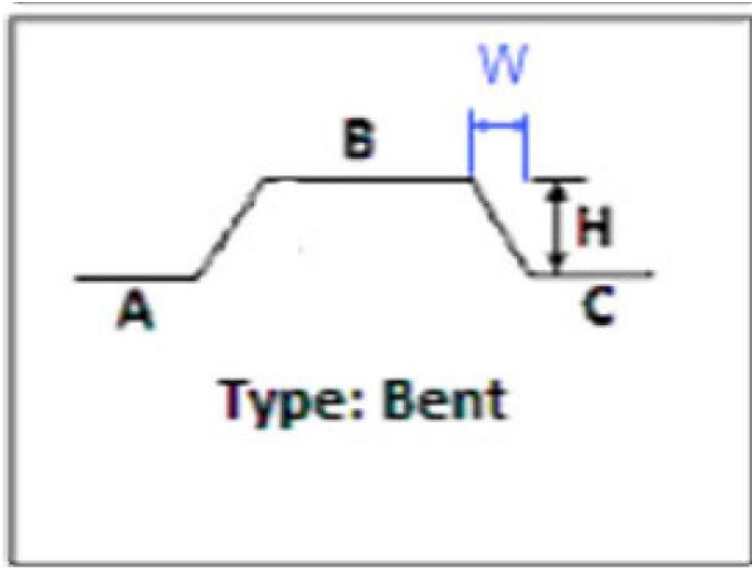
Layer #	Soil Type	Layer depth (ft)	Number Rows		
	<input type="text" value="Choose soil from drop down"/>				

Phase III – Version 7.9 (Fall, 2027 - Tentative)

- Produce models for more complicated structures
- Multiple pipes
- Multiple materials
- Consider methods for improving the LL analysis



Other culvert items? Bent Bar Reinforcement



Bar Mark Definition

Name:

Bar types:

- A
Type: Straight
- B
Type: Hook
- Corner
- C Bar
- Bent
- WWR

Material: Grade 60

Bar size: 3

Bar type: Bent

Dimension

A: ft

B: ft

C: ft

H: ft

W: ft.

Add field for width of bent section (only show this when "Bent" is selected in the Bar Type dropdown)

Update graphic

OK Apply Cancel

Other culvert items?

Bent Bar Reinforcement

RC Box Culvert Top slab – bot bars window

This part of schematic currently shows a straight bar. Update to show bent bar as shown here.

Top Slab Bottom Bars

The screenshot displays the 'RC Box Culvert Reinforcement' software window. The 'Top slab - bot bars' tab is active, showing a schematic of a culvert cross-section with reinforcement bars. The bars are shown as straight lines, but a callout indicates they should be bent. The schematic includes labels for 'Straight Length', 'Start Distance', 'Clear Cover (Typ.)', 'Left Face Wall', 'Right Face Wall', 'CL Culvert', and 'CL Cell'. Below the schematic is a table with the following data:

Set	Bar mark	Clear cover (in)	Bar spacing (in)	Measured from	Cell/Wall number	Centered	Start distance (ft)	Straight length (ft)	Fully developed start	Fully developed end
1	B408			CL Culvert		<input checked="" type="checkbox"/>	1.00	2.00	<input type="checkbox"/>	<input type="checkbox"/>

A callout points to the 'Bar mark' dropdown menu in the table, stating: 'Enable bent bars to be selected from the dropdown'.

Other culvert items? Bent Bar Reinforcement

Bottom Slab Top Bars

RC Box Culvert Bot slab – top bars window

This part of schematic currently shows a straight bar. Update to show bent bar as shown here. Add callout for clear cover to this part of bar.

The screenshot shows the 'RC Box Culvert Reinforcement' window with tabs for 'Top slab - top bars', 'Top slab - bot bars', 'Bot slab - top bars', 'Bot slab - bot bars', 'Corner', 'Wall', and 'Dowel'. The 'Bot slab - top bars' tab is active. A note states: 'Note: Bars will always be placed in the orientation shown'. The schematic shows a cross-section of a culvert with 'Left Face Wall', 'Right Face Wall', 'CL Culvert', and 'CL Cell'. Reinforcement bars are shown with 'Straight Length' and 'Start Distance' dimensions. A bent bar is highlighted with a blue box. A table below the schematic lists bar properties:

Set	Bar mark	Clear cover (in)	Bar spacing (in)	Measured from	Cell/Wall number	Centered	Start distance (ft)	Straight length (ft)	Fully developed start	Fully developed end
1	B506	2.00	13.00	CL Cell	2	<input checked="" type="checkbox"/>	4.08	8.17	<input type="checkbox"/>	<input type="checkbox"/>

Enable bent bars to be selected from the dropdown

Other culvert items Bent Bar Reinforcement

Wall bars

RC Box Culvert Wall Bars window

This part of schematic currently shows a straight bar. Update to show bent bar as shown here. Add callout for Clear Cover to this section of the bar

RC Box Culvert Reinforcement

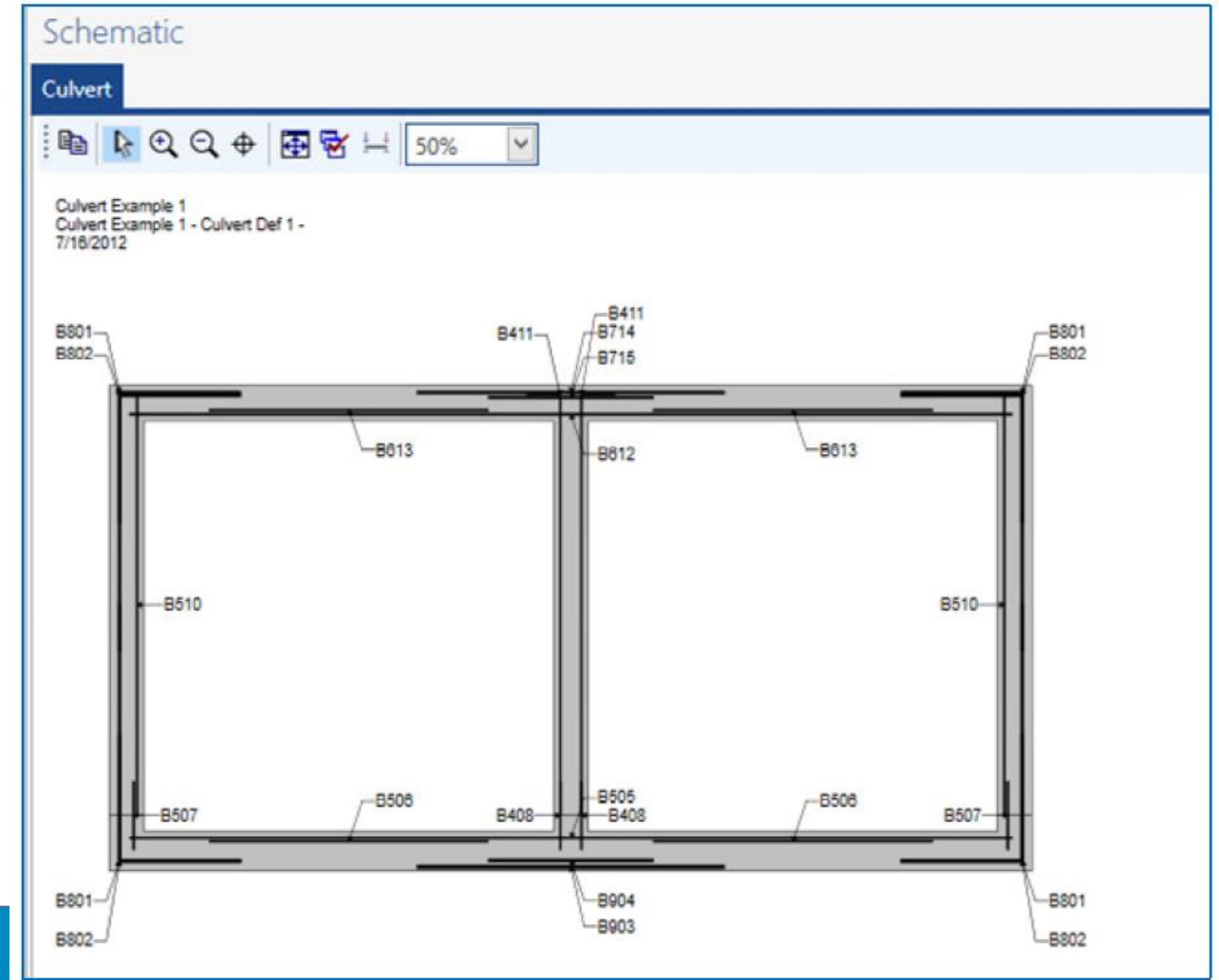
Top slab - top bars | Top slab - bot bars | Bot slab - top bars | Bot slab - bot bars | Corner | Wall | Dowel

Set	Bar mark	Clear cover (in)	Bar spacing (in)	Location	Wall number	Measured from	Centered	Start distance (ft)	Straight length (ft)	Fully developed start	Fully developed end
> 1	B510	2.00	11.00	Left	3	Horiz Const Joint	<input type="checkbox"/>	0.00	12.33	<input type="checkbox"/>	<input type="checkbox"/>
2	B510	2.00	11.00	Right	1	Horiz Const Joint	<input type="checkbox"/>	0.00	12.33	<input type="checkbox"/>	<input type="checkbox"/>

Enable bent bars to be selected from the dropdown

Other culvert items? Bent Bar Reinforcement

**Schematic –
currently bent
bars are shown as
straight**



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Questions?