



The Power of Template Constraints

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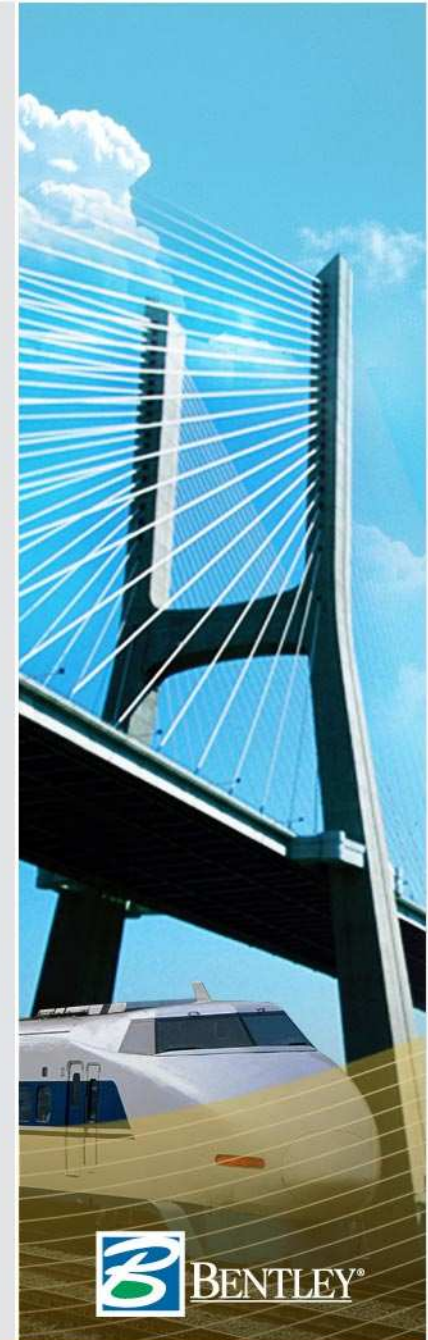
This presentation will cover:

- Constraint types
- Best approaches for constraint application
- Systematic approach to applying constraints to a complex component
- Parametric constraints
- Interaction between constraints and external controls



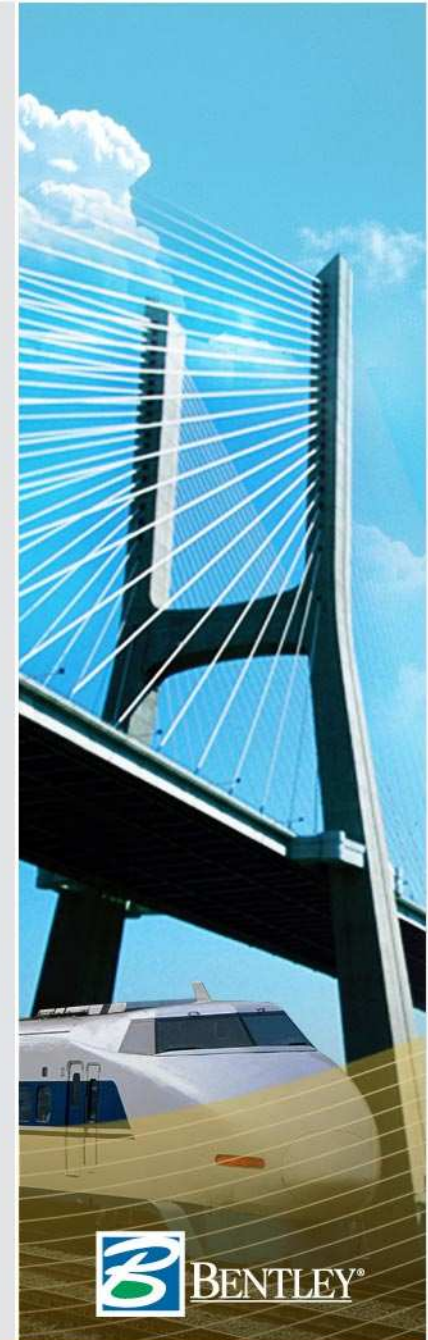
Constraint Types

- Single Parent
 - Horizontal, Vertical, Slope
- Two Parent
 - Horizontal Min, Horizontal Max, Vertical Min, Vertical Max
 - Vector-Offset
 - Angle-Distance (new for 8.9)!
- Project to Surface
- Project to Design
- Style



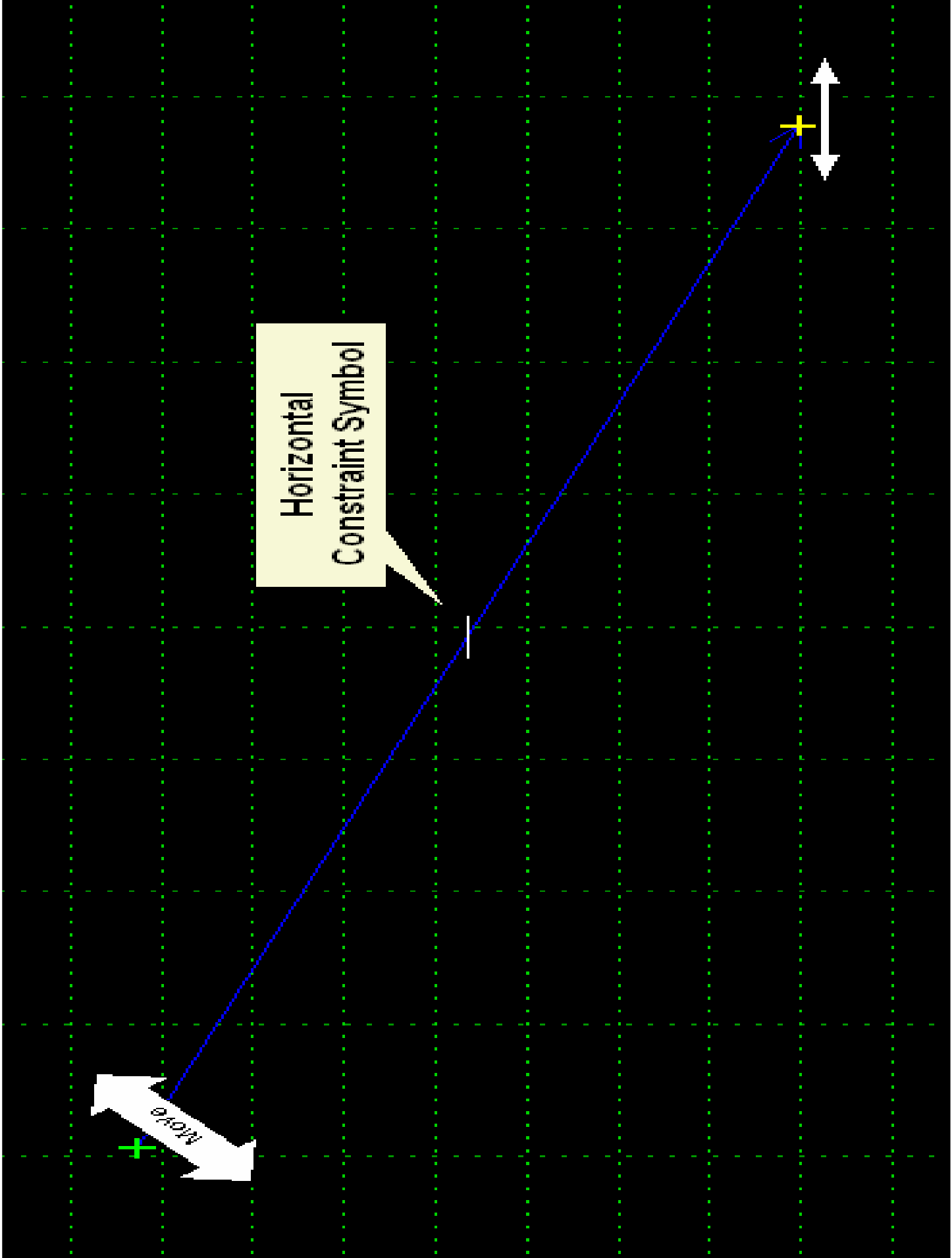
Single Parent Constraint Types

- Location of point is determined by constraining the point to its parent by the distance or slope specified in the constraint.





Horizontal
Constraint
Symbol



Two Parent Constraint Types

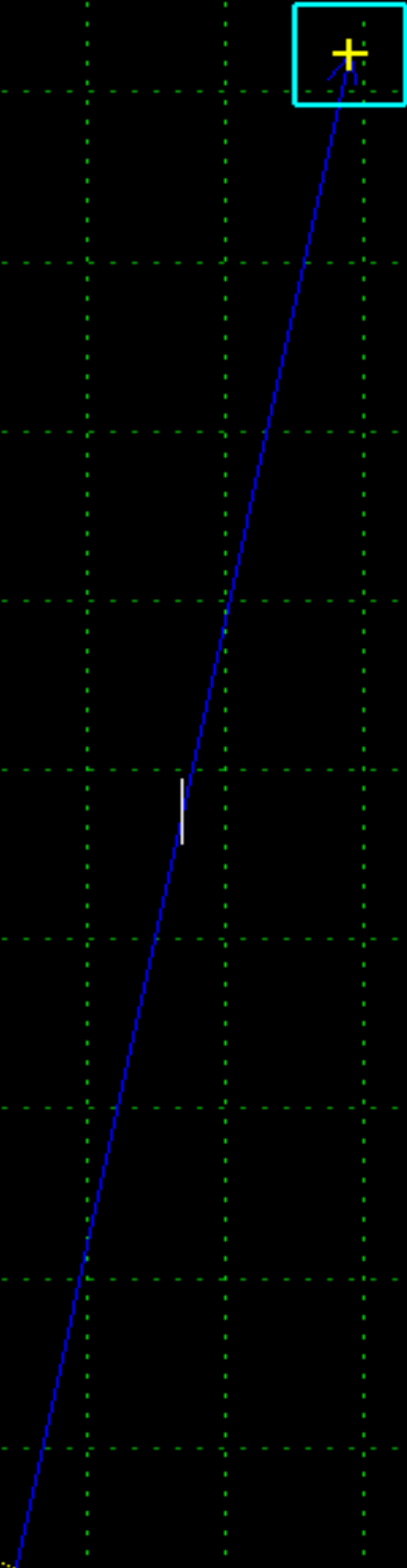
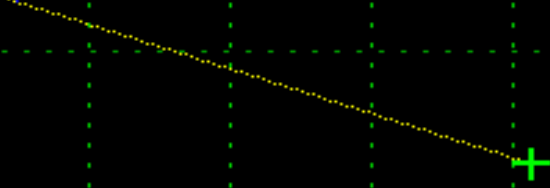
- Max/Min constraints
 - Takes the parent with the lowest coordinate value (Min) or highest coordinate value (Max) and applies a single parent constraint from that controlling parent.



Horizontal Maximum Constraint



The Parent point with the highest(maximum) X coordinate value is the controlling parent.



Two Parent Constraint Types

- Vector-Offset constraint
 - The two parent points define the vector, and the offset is measured perpendicular from that vector.



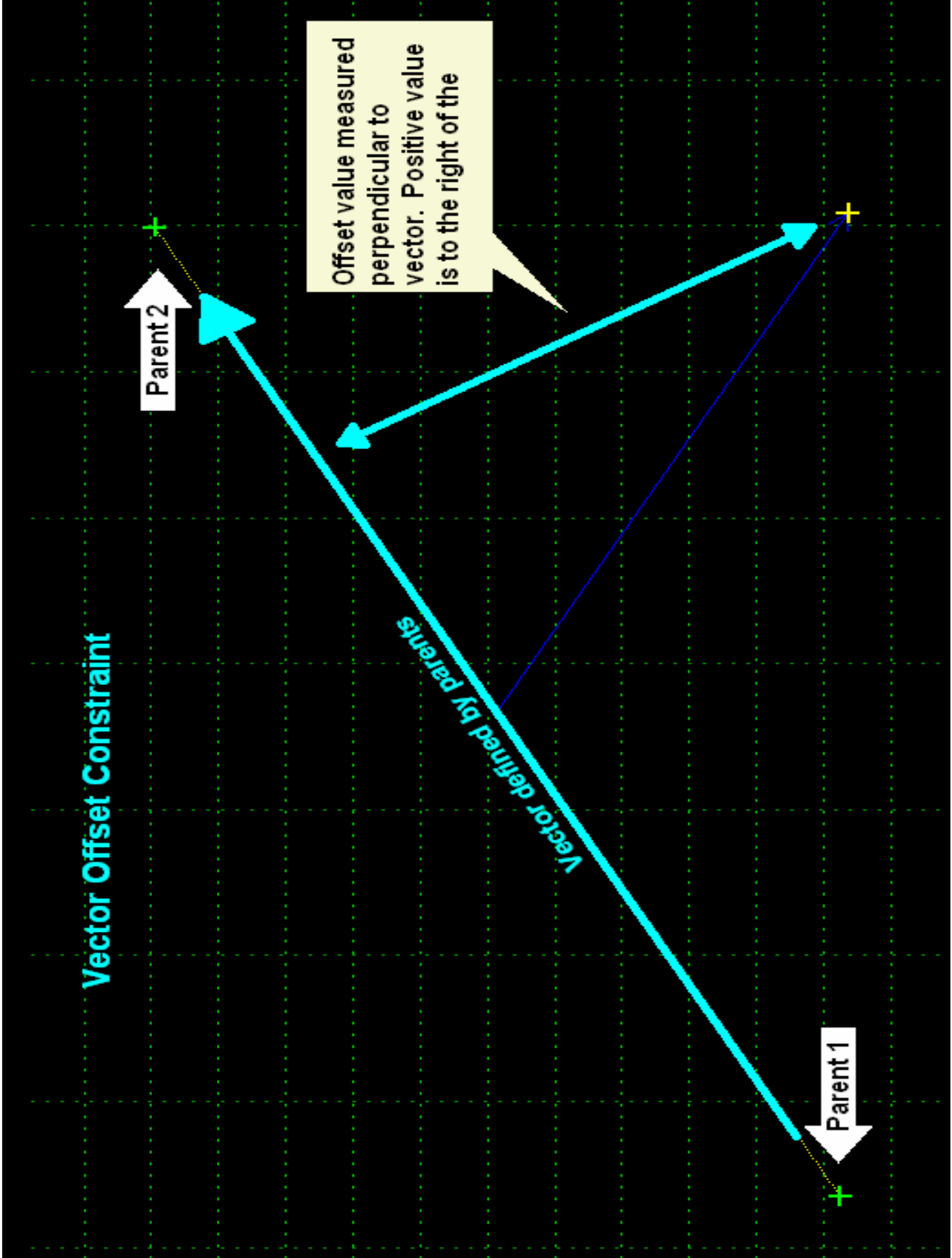
Vector Offset Constraint

Parent 2

Parent 1

Offset value measured perpendicular to vector. Positive value is to the right of the

Vector defined by parents

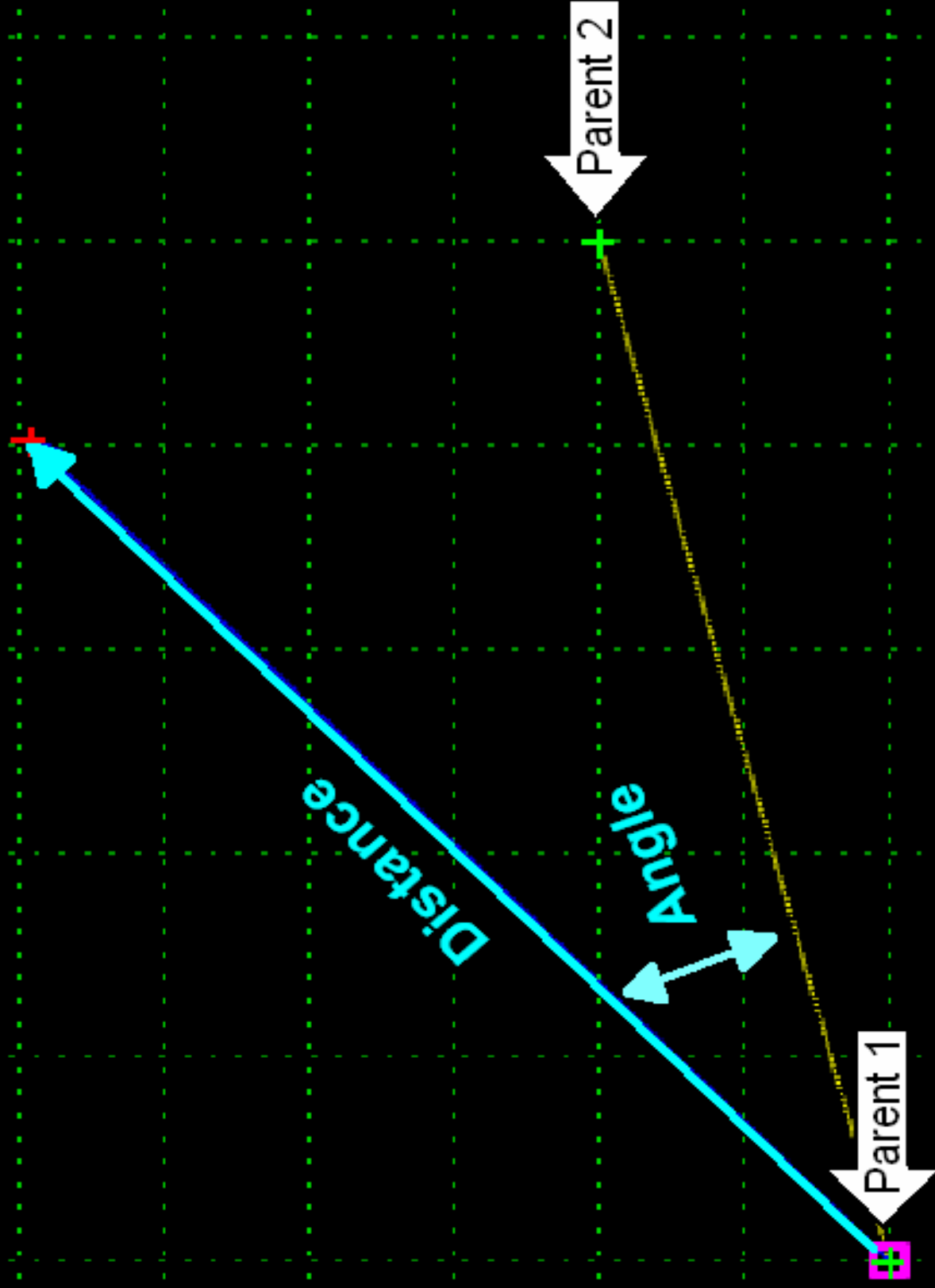


Two Parent Constraint Types

- Angle-Distance constraint
 - The two parent points define a baseline direction. The angle is relative to the baseline, and the distance is along the vector define by the angle. This constraint allows for rigid body rotation of the vector, and the offset is measured perpendicular from that vector.
 - An angle distance constraint fully constrains a point.

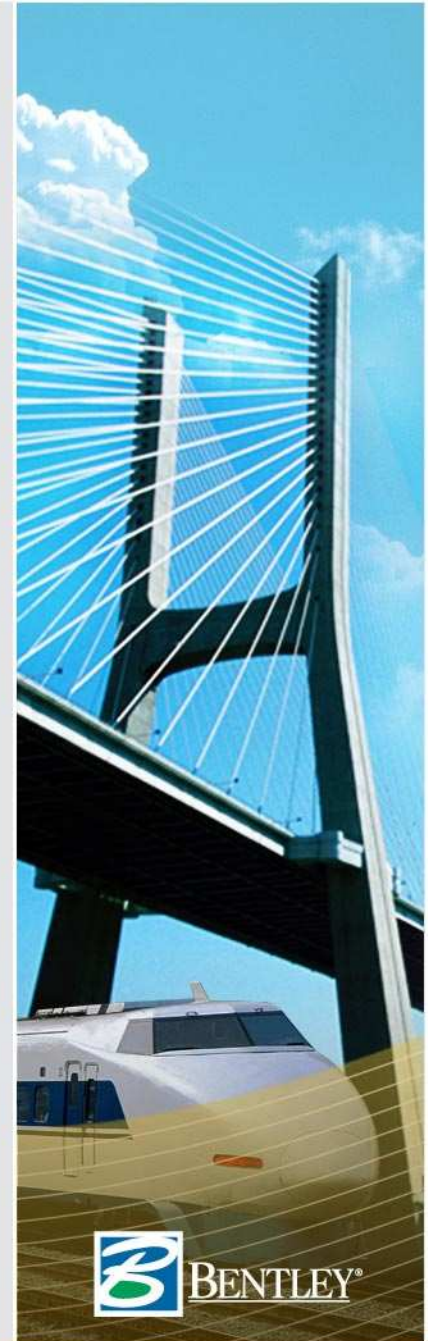


Angle Distance Constraint



Projection Constraints

- Requires another constraint to determine projection direction.
- Project to Surface constraint projects to an existing surface.
- Project to Design constraint projects to the nearest end condition component of the template.



Point Properties

Name: Pt1_R

Feature Name Override: Pt1_R

Surface Feature Style: abutment

Alternate Surface:

Member of:
abutment_R

Constraints

Constraint 1	Constraint 2
Type: Vector-Offset	Project To Surface
Parent 1: Pt_L	None
Parent 2: Pt_R	Horizontal
Value: 1.00	Vertical
Label:	Slope
	Vector-Offset
	Project To Surface
	Project To Design
	Horizontal Maximum
	Horizontal Minimum
	Vertical Maximum
	Vertical Minimum

Style Constraint: Horizontal Vertical

Range: 0.00

Apply Close < Previous Next > Help

Add New Component

Template Documentation Link...

Check Point Connectivity...

Delete Components

Change Template Origin

Delete Constraints from All Points

Move Point

Edit Point...

Add Constraint

Delete Constraints

Delete Point

Set Dynamic Origin

Ctrl-D

Full Constraint

Horizontal

Vertical

Slope

Vector Offset

Horizontal Maximum

Horizontal Minimum

Vertical Maximum

Vertical Minimum



Partially Constrained Points

- Points that only have one point are said to be partially constrained.
- Behavior is dependent on the type of constraint applied.
- To avoid unpredictable results, it is best to fully constrain a point whenever possible.

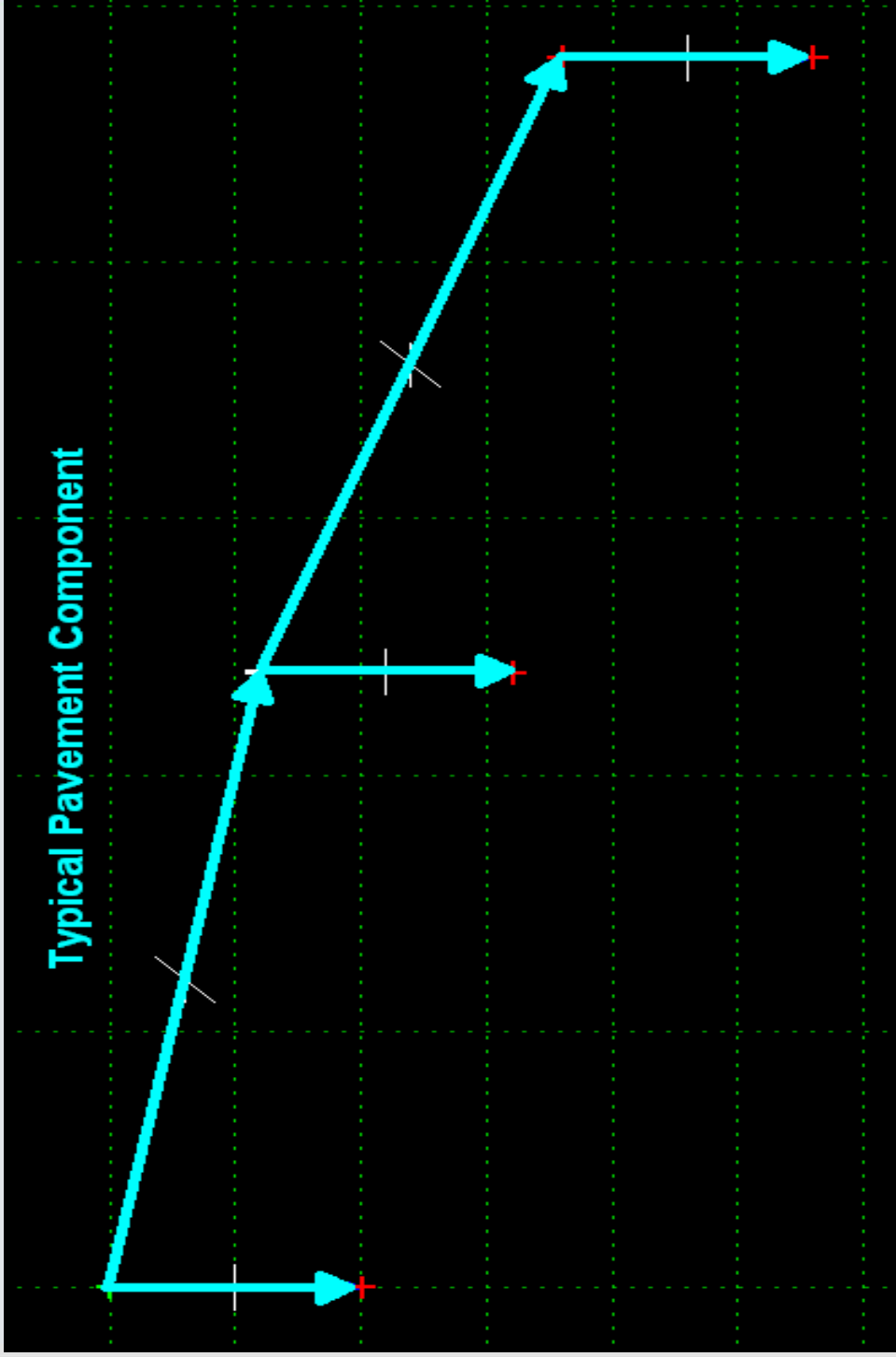


Best approaches for constraint application

- Typical road component
 - Up and then to the middle



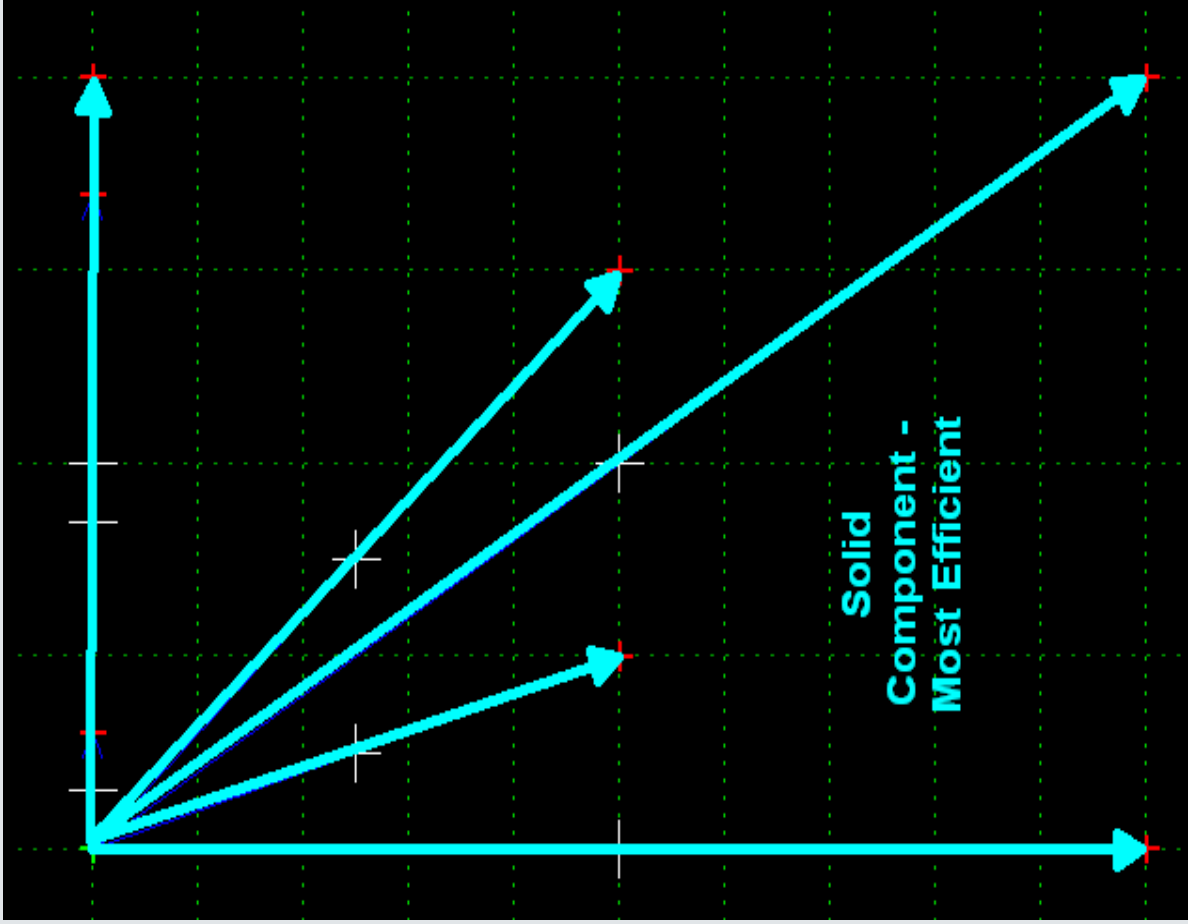
Typical Pavement Component



Best approaches for constraint application

- Solid object
 - All constrained to the first point
 - Depends on how it is to be used
 - » Parametric constraints
 - » External controls

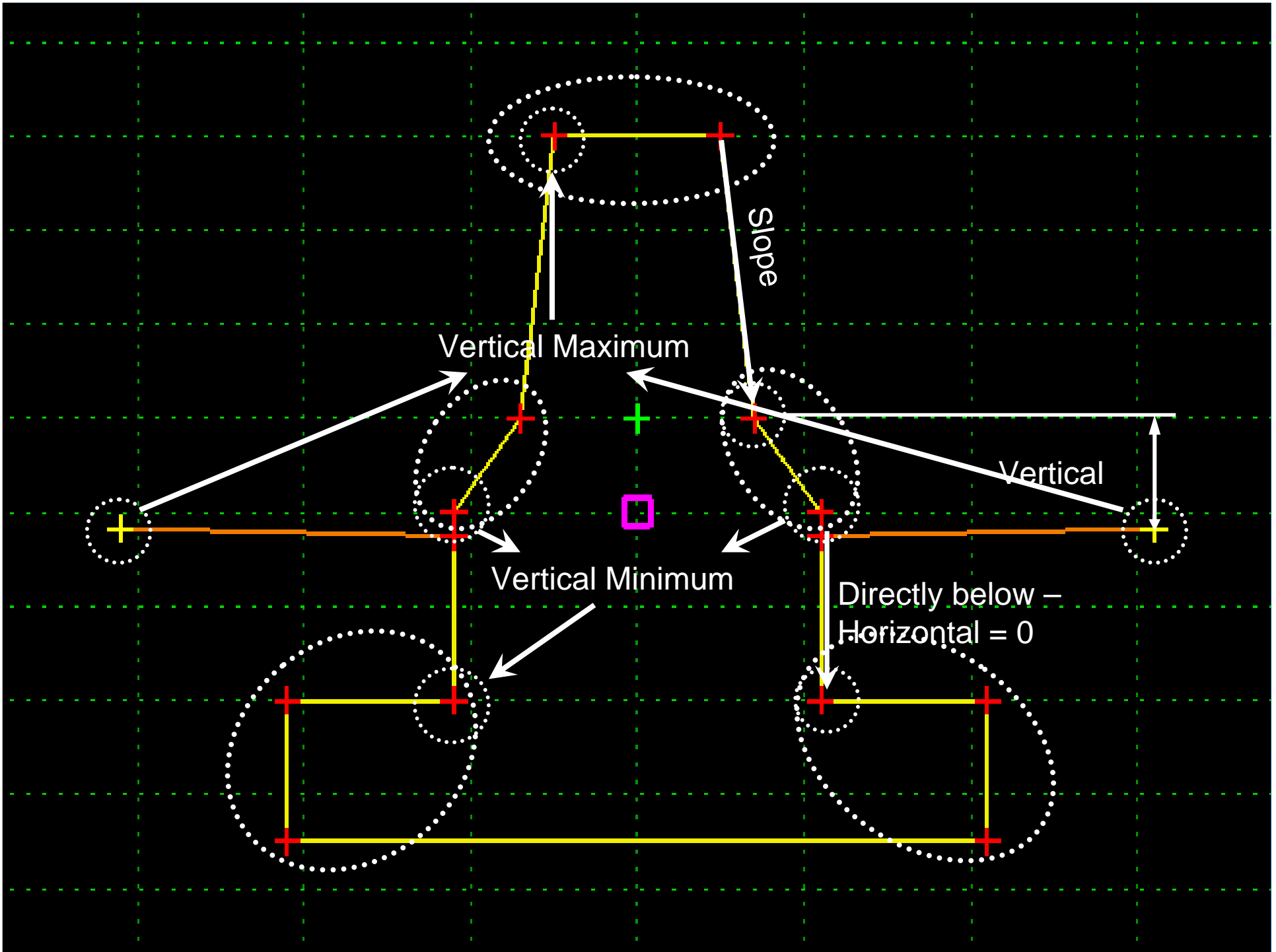




Complex Component Example

- Steps
 1. Determine points that move together and constrain them as rigid bodies
 2. Determine variable relationships and constrain them appropriately.





Parametric constraints

- What are parametric constraints?
 - Standard constraints with a parametric label
 - Can be changed along a corridor
- What are some applications?
 - As transitions for road widening
 - As switches for template changes
 - To change pavement thickness



Point Properties

Name: TopOfSubgrade_C

Feature Name Override: TopOfSubgrade_C

Surface Feature Style: Asphalt

Alternate Surface:

Member of:
Subgrade
Top Paving

Constraints

	Constraint 1	Constraint 2
Type:	Vertical	Horizontal
Parent 1:	CenterLine	CenterLine
Value:	0.17	0.00
Label:		
Style C:	>1=Urban Left Lane Width Pave Thick Right Lane Width	Both
Range:	0.00	0.00

Buttons: Apply, Close, < Previous, Next >, Help

Parametric Constraints

Corridor: Parametric Constraint Demo

Station Limits
Start: 100+00.00
Stop: 153+68.93

Constraint Label: Pave Thick

Start Value: -0.25

Stop Value: -0.25

Override Values:

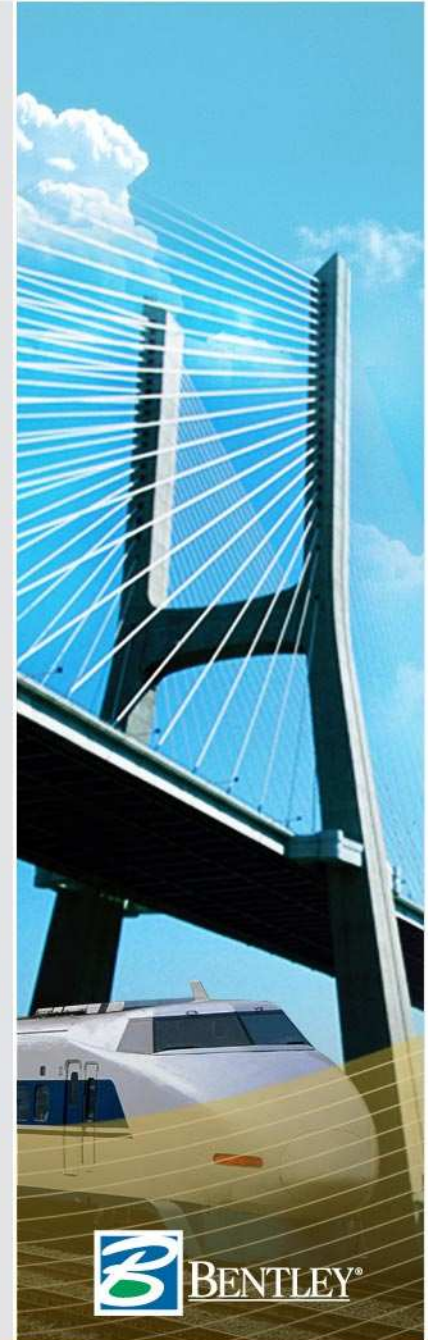
Name	Start Value	Stop Value	Start Station	Stop Station
Left Lane Width	-15.00	-30.00	120+00.00	125+00.00
Left Lane Width	-30.00	-30.00	125+00.00	153+68.93
Right Lane Width	15.00	30.00	120+00.00	125+00.00
Right Lane Width	30.00	30.00	125+00.00	153+68.93
>1=Urban	2.00	2.00	130+50.00	153+68.93
Pave Thick	-0.25	-0.25	100+00.00	153+68.93

Buttons: Add, Close, Change, Help, Delete



Interaction between constraints and external controls

- How are point coordinates determined?
- When an external control is applied, what happens to the point constraints?



How are point coordinates determined?

- Order of processing (from highest to lowest)
 1. External control
 2. Style constraint
 3. Point constraint
 4. Location as drawn



What happens when an external control is applied?

- If the control is both horizontal and vertical then all constraints are deleted because the control fully defines the point location.
- If the control is only horizontal or only vertical, then one constraint will be deleted.
- Which constraint is deleted?
 - The constraint deleted is the one that most closely matches the external control.
 - If there is ambiguity about which constraint is most like the control, then the second constraint is deleted.



Style Constraint

- Similar to a Point Control.
- Overrides Horizontal and/or Vertical constraints on a point.
- Applied when:
 1. A feature or horizontal alignment is found in the active surface or geometry project that has the specified style.
 2. The feature or alignment with the matching style intersects the cross section within the horizontal distance specified.

Point Properties

Name:

Feature Name Override:

Surface Feature Style:

Alternate Surface:

Member of:

- L_Top Paving
- LO_Curb_R
- Top Paving

Constraints

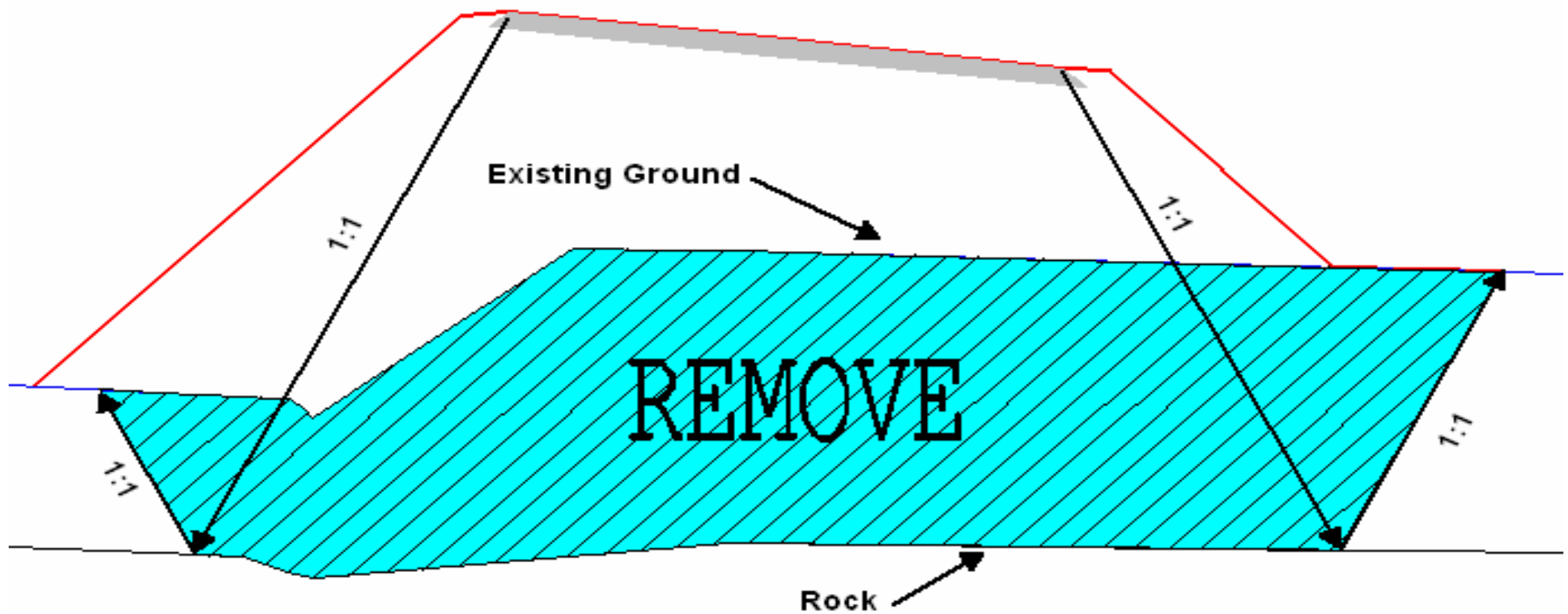
	Constraint 1	Constraint 2
Type:	<input type="text" value="Horizontal"/>	<input type="text" value="Slope"/>
Parent 1:	<input type="text" value="Centerline"/> <input type="button" value="Apply"/>	<input type="text" value="Centerline"/> <input type="button" value="Apply"/>
		<input type="checkbox"/> Rollover Values...
Value:	<input type="text" value="-29.50"/>	<input type="text" value="2.000%"/>
Label:	<input type="text"/>	<input type="text"/>
<input checked="" type="checkbox"/> Style Constraint:	<input type="text" value="EOP"/>	
	<input checked="" type="radio"/> Horizontal <input type="radio"/> Vertical <input type="radio"/> Both	
Range:	<input type="text" value="-50.00"/>	

Project to Surface / Project to Design constraints

- The “Project to Surface” and “Project to Design” are special constraints.
- They need one other constraint on the point to determine the projection vector.
- The only place they can be applied is in the Point Properties dialog.



Project to Surface Test Case



Summary

- Normal constraints can be used to create templates that solve complex problems
- Parametric constraints and style constraints can be used to modify the behavior of templates in a roadway design file.
- The combination of constraints, along with display rules, can be used to significantly reduce the number of templates required to design a road.



Questions ?

