The Power of Constraints in Template Creation

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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

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Constraint Types

- Single Parent
  - Horizontal, Vertical, Slope
- Two Parent
  - Horizontal Min, Horizontal Max, Vertical Min, Vertical Max
  - Vector-Offset
  - Angle-Distance
- Project to Surface
- Project to Design
- Style

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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.

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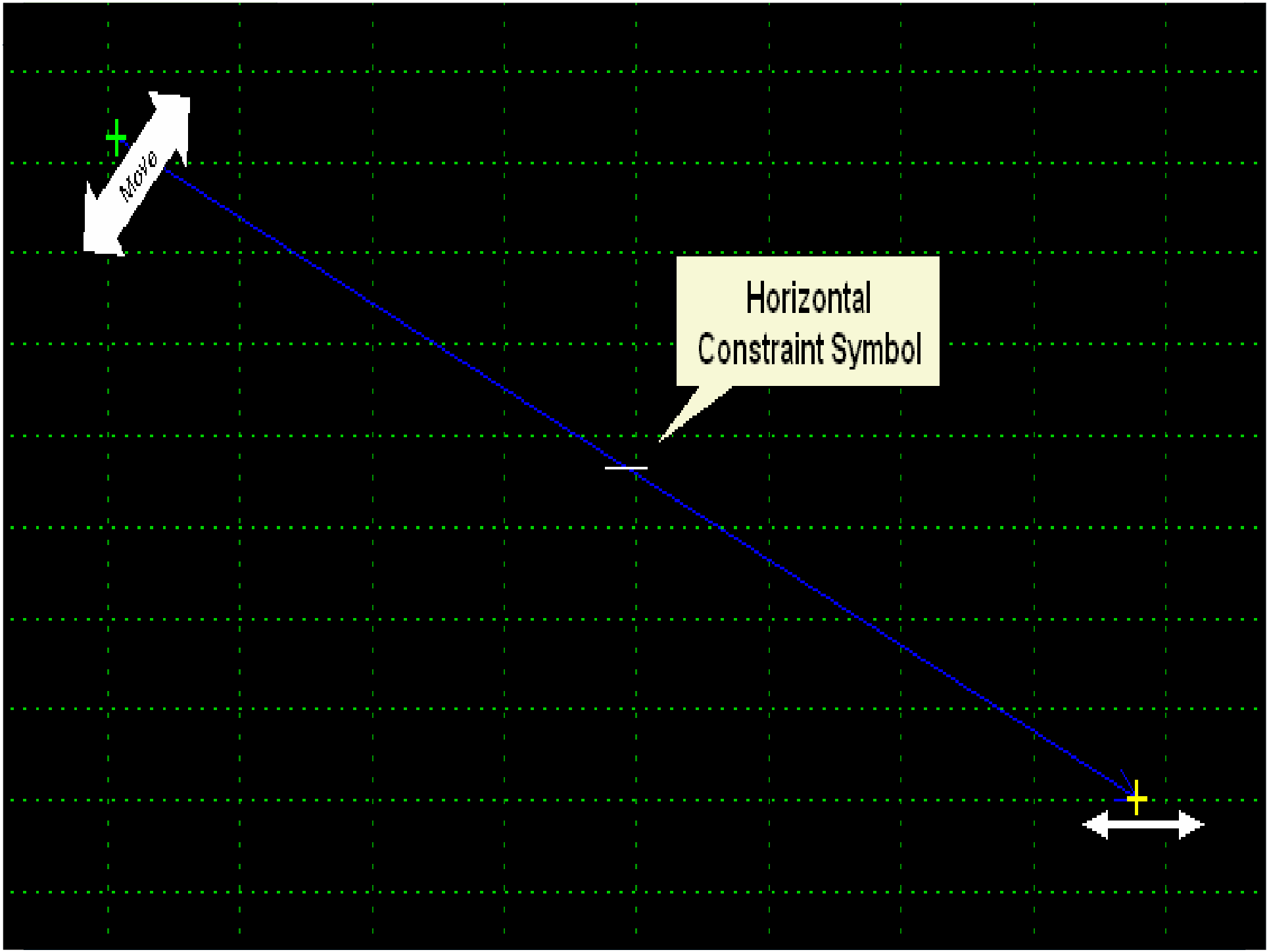
Move
Horizontal
Constraint Symbol

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.

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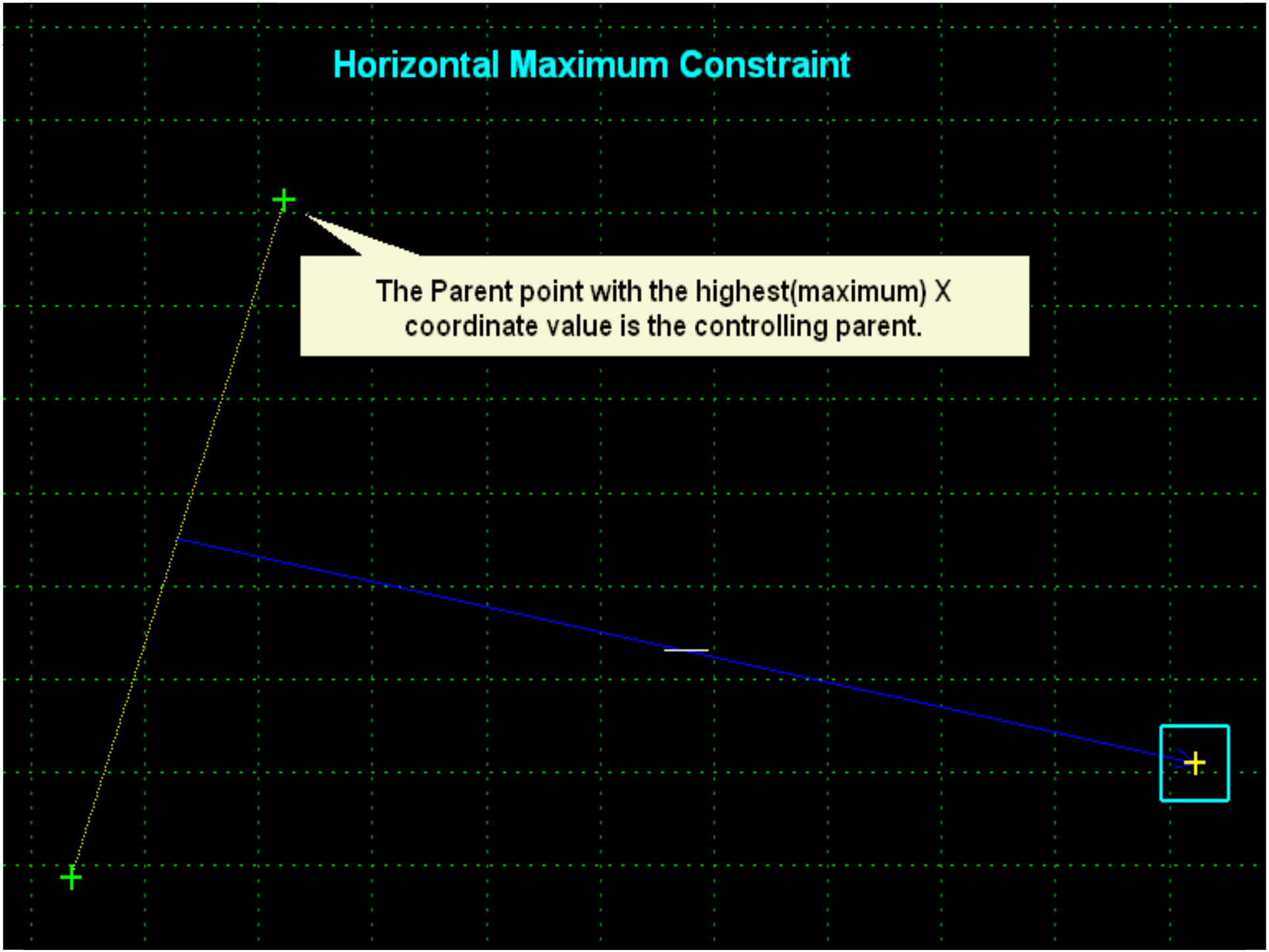
Horizontal Maximum Constraint
The Parent point with the highest(maximum) X coordinate value is the controlling parent.

Two Parent Constraint Types

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

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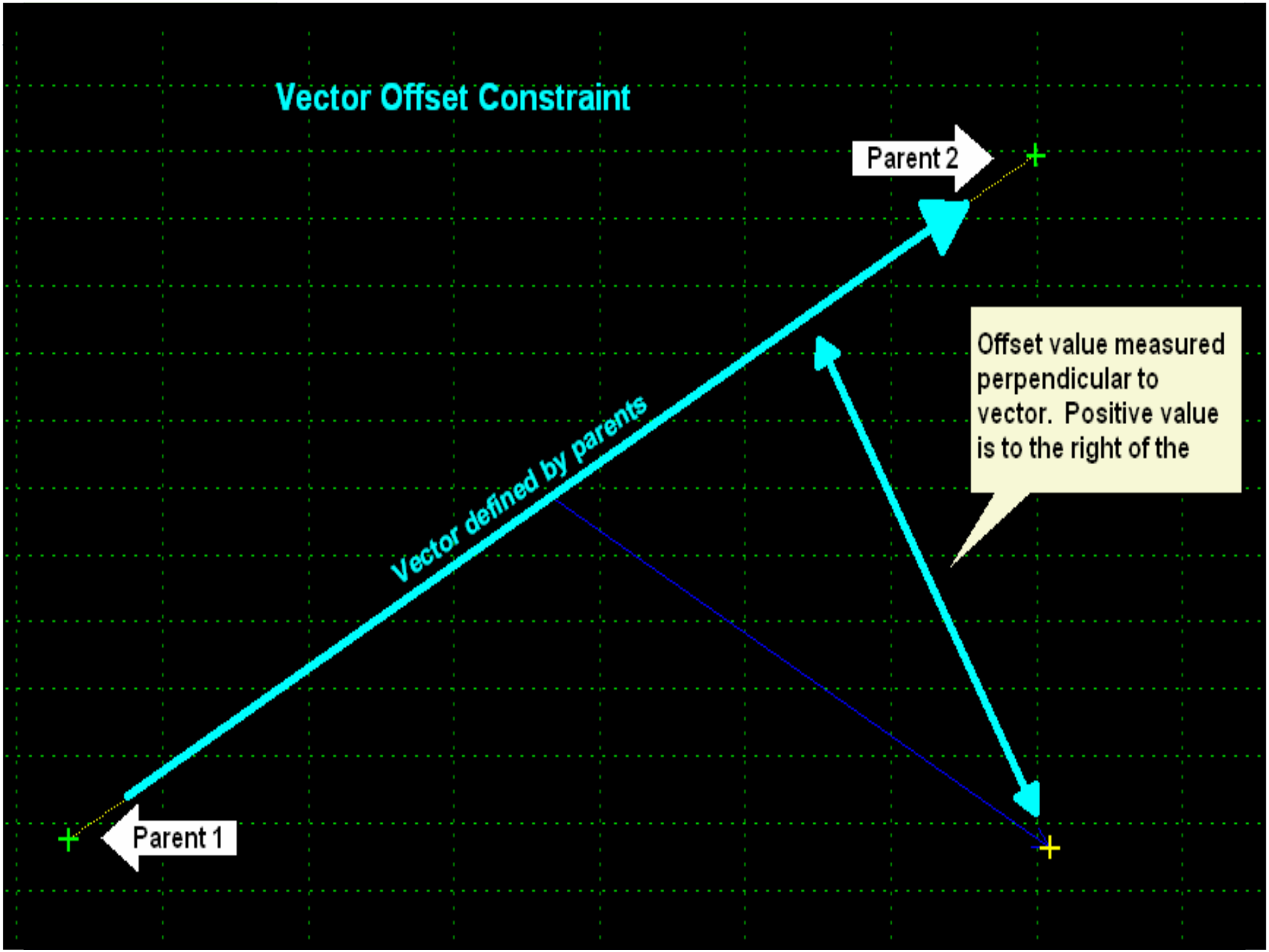
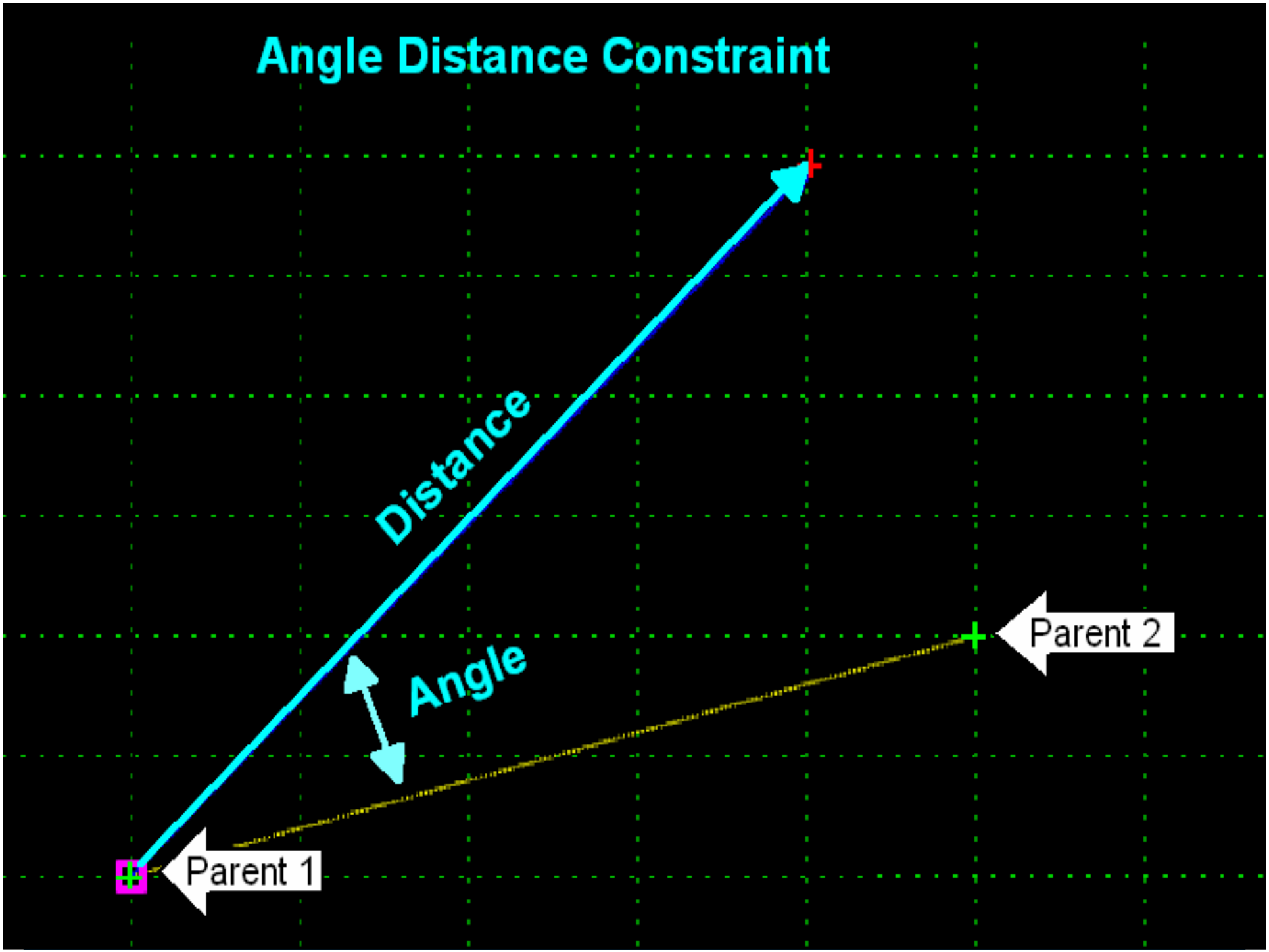

Vector Offset Constraint
Parent 2
Offset value measured perpendicular to vector. Positive value is to the right of the
Vector defined by parents
Parent 1

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
Distance
Angle
Parent 2
Parent 1

Projection Constraints

- Requires another constraint to determine projection direction.
- Project to Surface constraint projects to an existing surface.
  - Athens Honors this with Target Aliasing
- Project to Design constraint projects to the nearest end condition component of the template.

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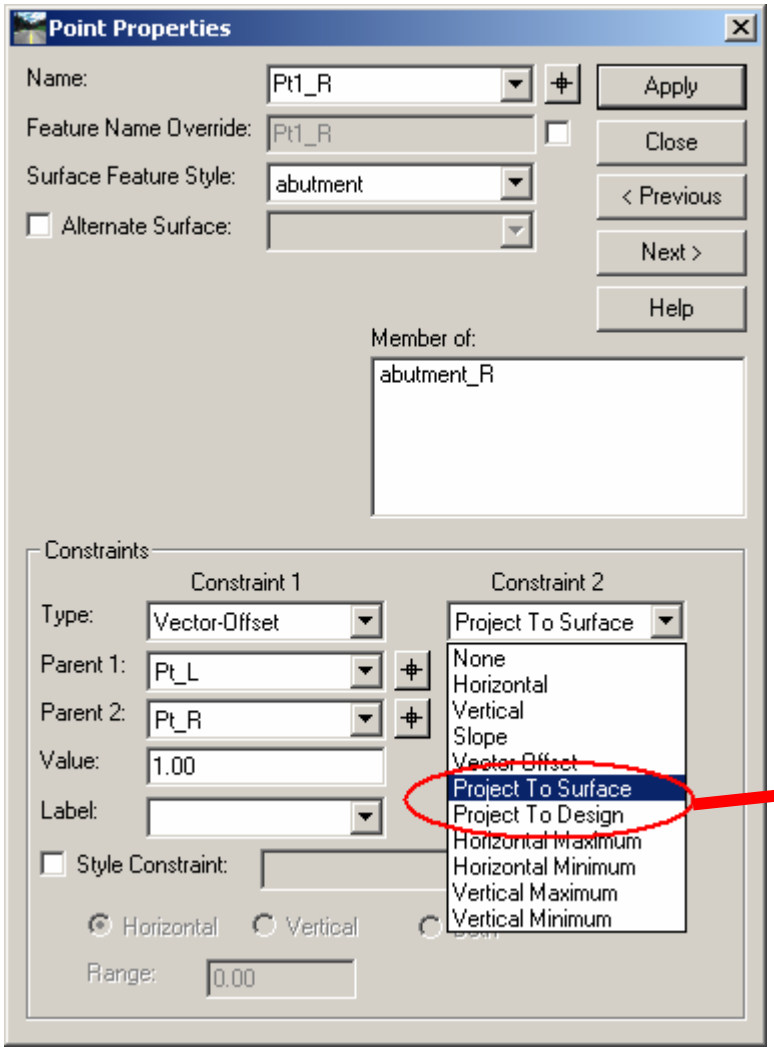
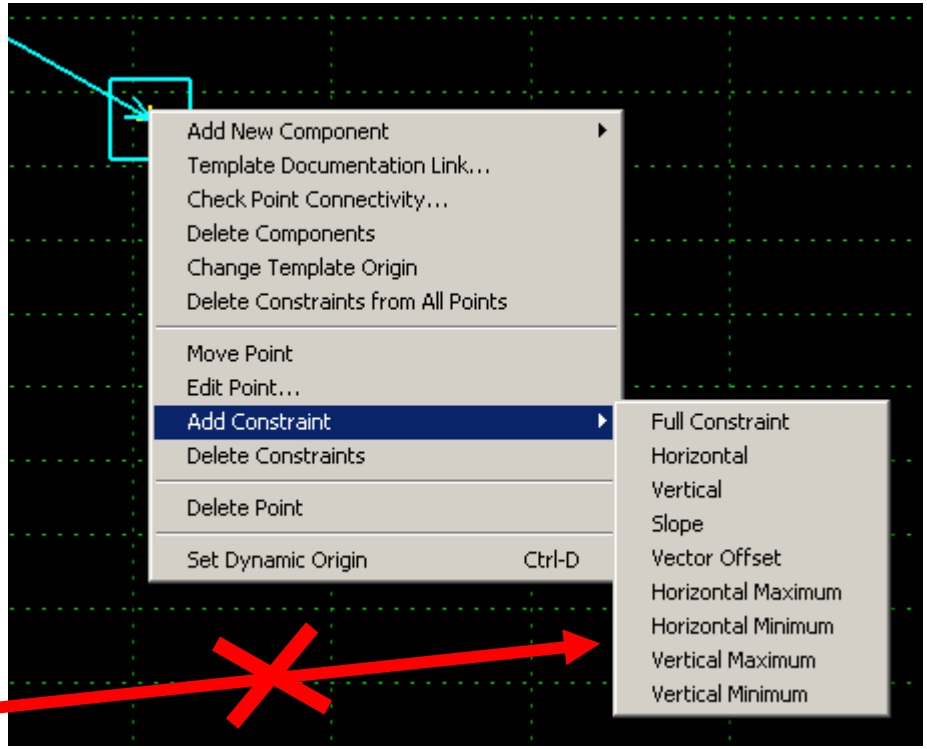

Point Properties
Name:
Pt1_R
Feature Name Override:
Pt1_R
Surface Feature Style:
abutment
Alternate Surface:
Apply
Close
< Previous
Next >
Help
Member of:
abutment_R
Constraints
Constraint 1
Constraint 2
Type:
Vector-Offset
Project To Surface
Parent 1:
Pt_L
Parent 2:
Pt_R
Value:
1.00
Label:
Style Constraint:
Horizontal
Vertical
Range:
0.00
None
Horizontal
Vertical
Slope
Vector Offset
Project To Surface
Project To Design
Horizontal Maximum
Horizontal Minimum
Vertical Maximum
Vertical Minimum


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

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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.

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Best approaches for constraint application

- Typical road component
  - Up and then to the middle

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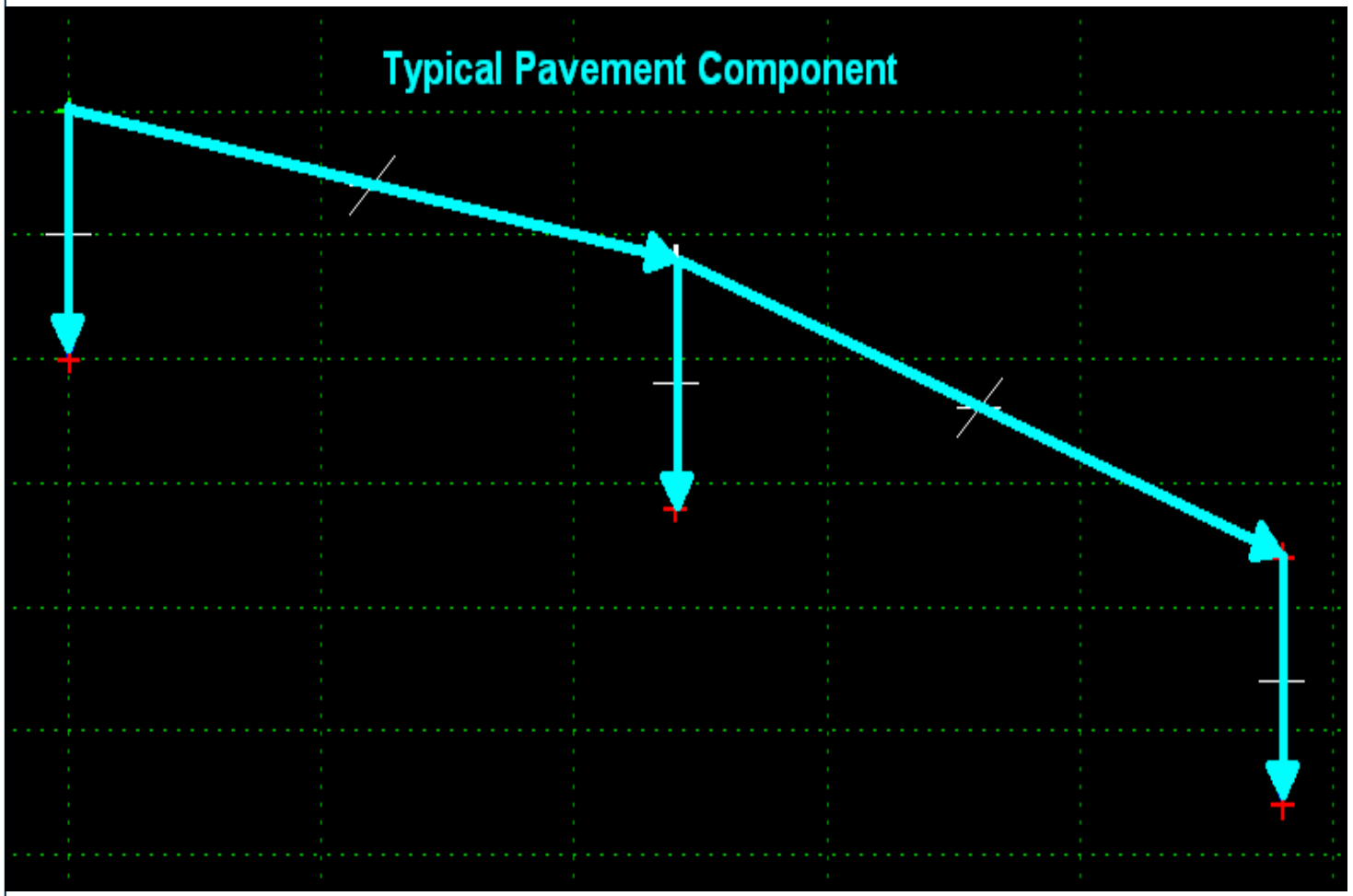
Typical Pavement Component

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

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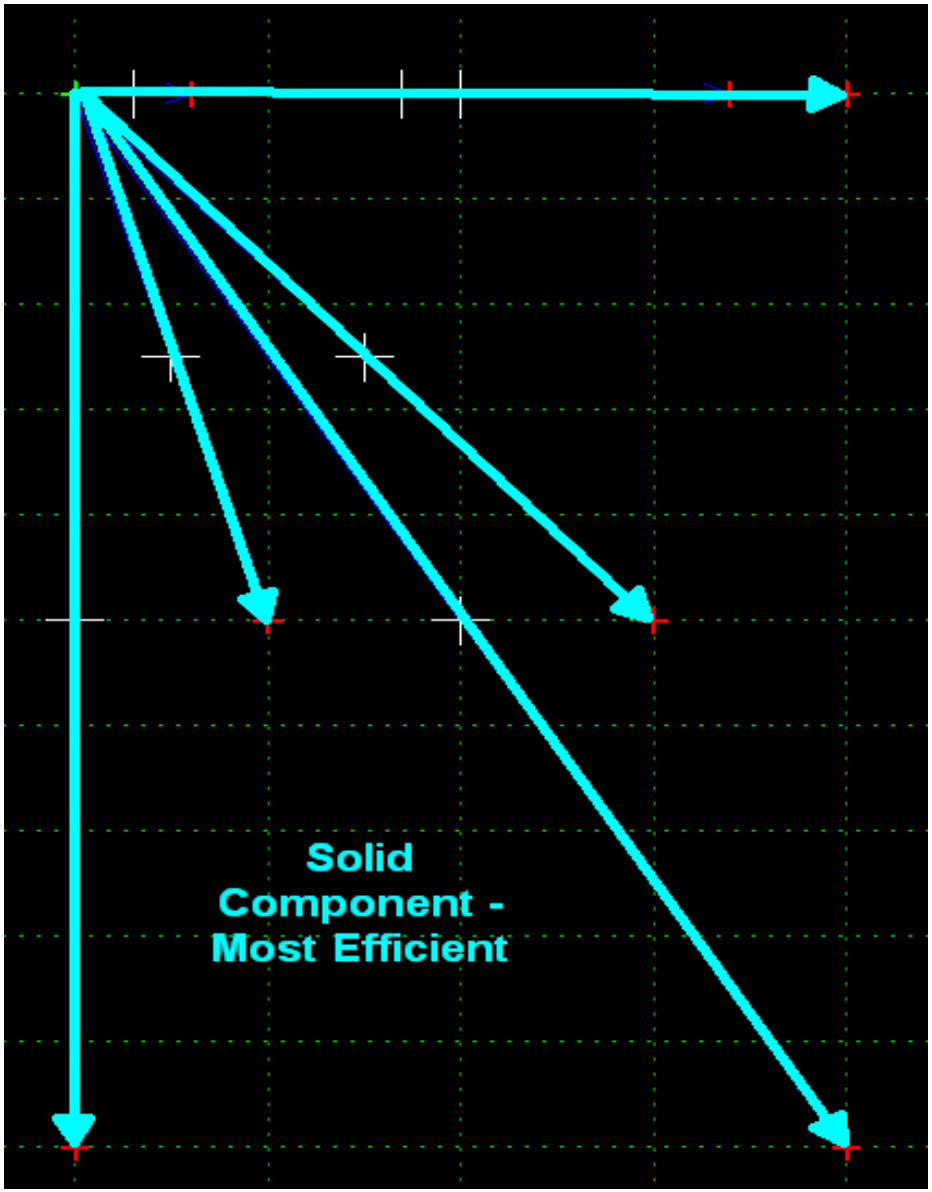
Solid
Component -
Most Efficient

Complex Component Example

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

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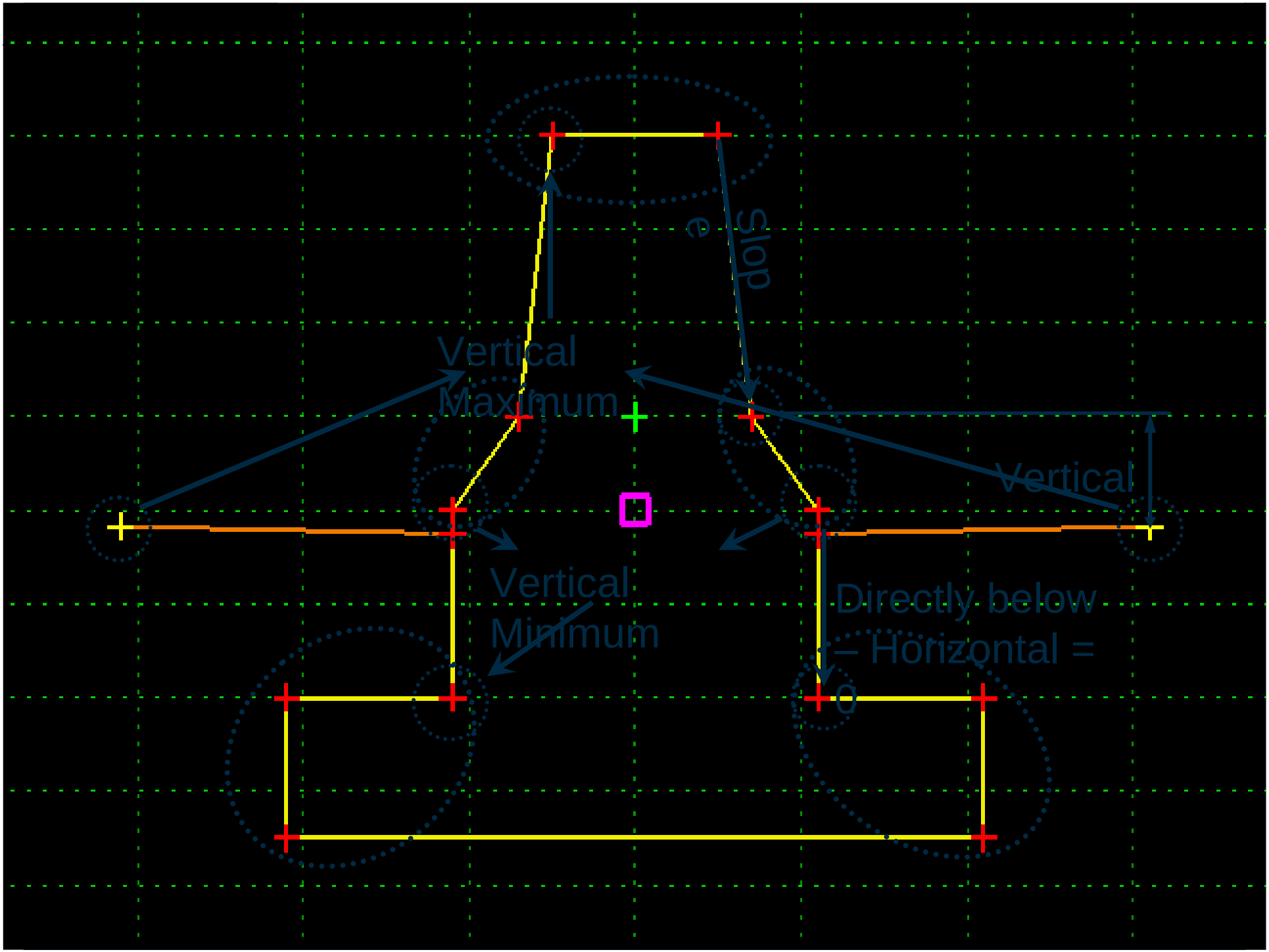
Slope
Vertical
Maximum
Vertical
Vertical
Minimum
Directly below
– Horizontal =
0

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

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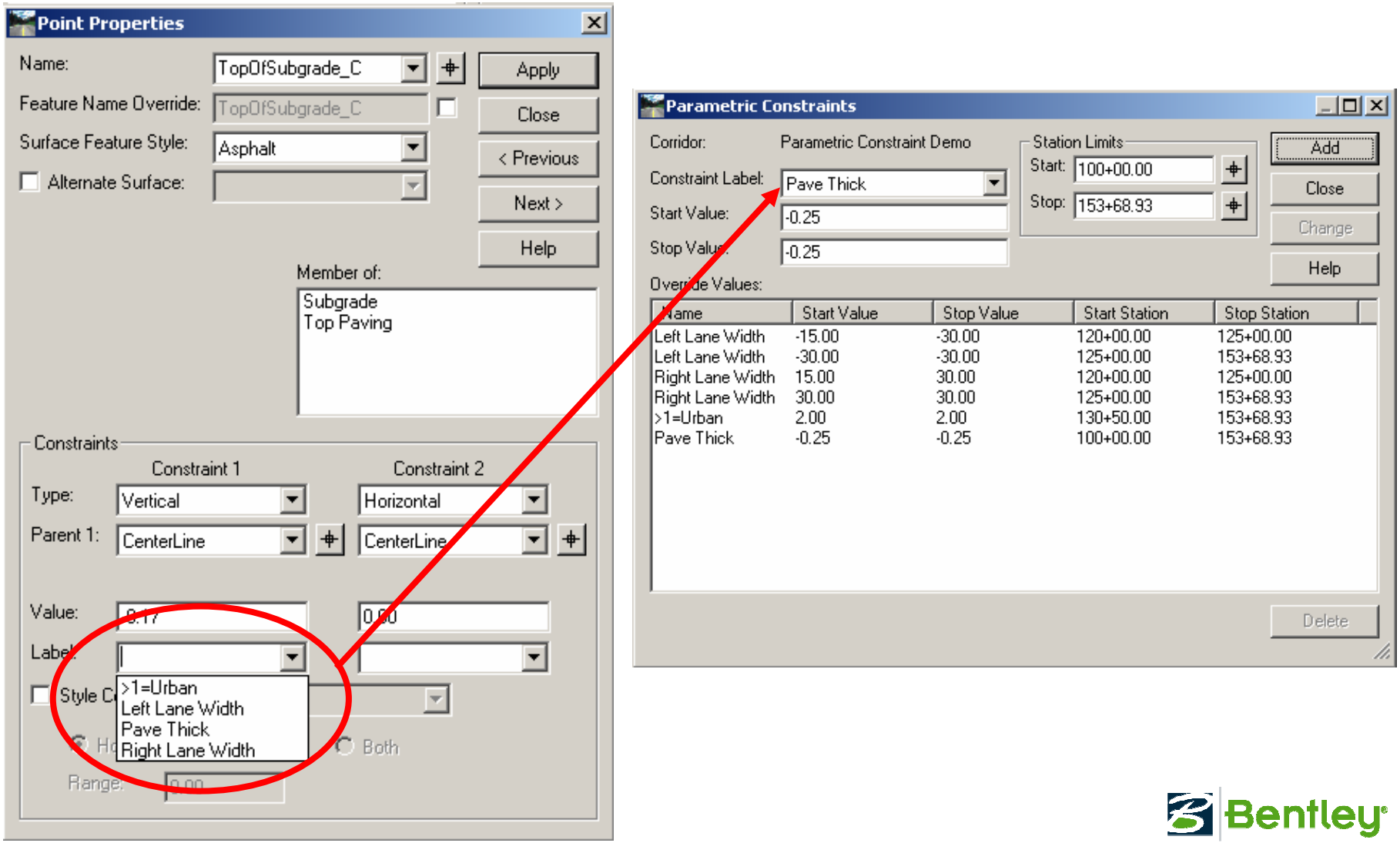
Point Properties
Name:
TopOfSubgrade_C
Feature Name Override:
TopOfSubgrade_C
Surface Feature Style:
Asphalt
Alternate Surface:
Apply
Close
< Previous
Next >
Help
Member of:
Subgrade
Top Paving
Constraints
Constraint 1
Constraint 2
Type:
Vertical
Horizontal
Parent 1:
CenterLine
CenterLine
Value:
Label:
>1=Urban
Left Lane Width
Pave Thick
Right Lane Width
Both
Range:
Parametric Constraints
Corridor:
Parametric Constraint Demo
Constraint Label:
Pave Thick
Start Value:
-0.25
Stop Value:
-0.25
Override Values:
Station Limits
Start:
100+00.00
Stop:
153+68.93
Add
Close
Change
Help
Delete
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

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Interaction between constraints and external controls

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

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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

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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.

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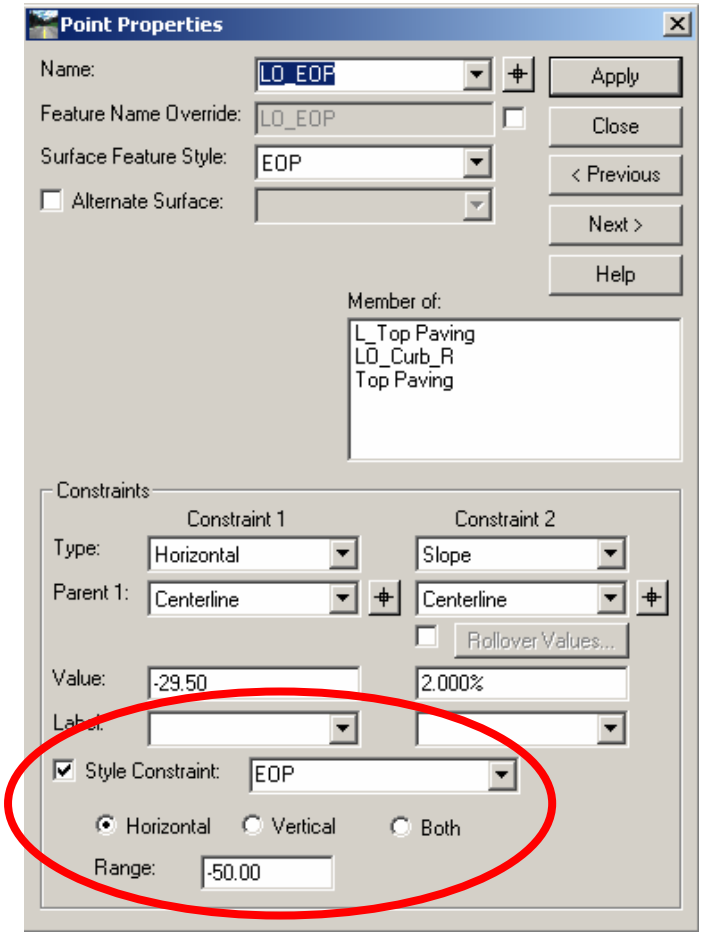
Style Constraint

- 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.



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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.

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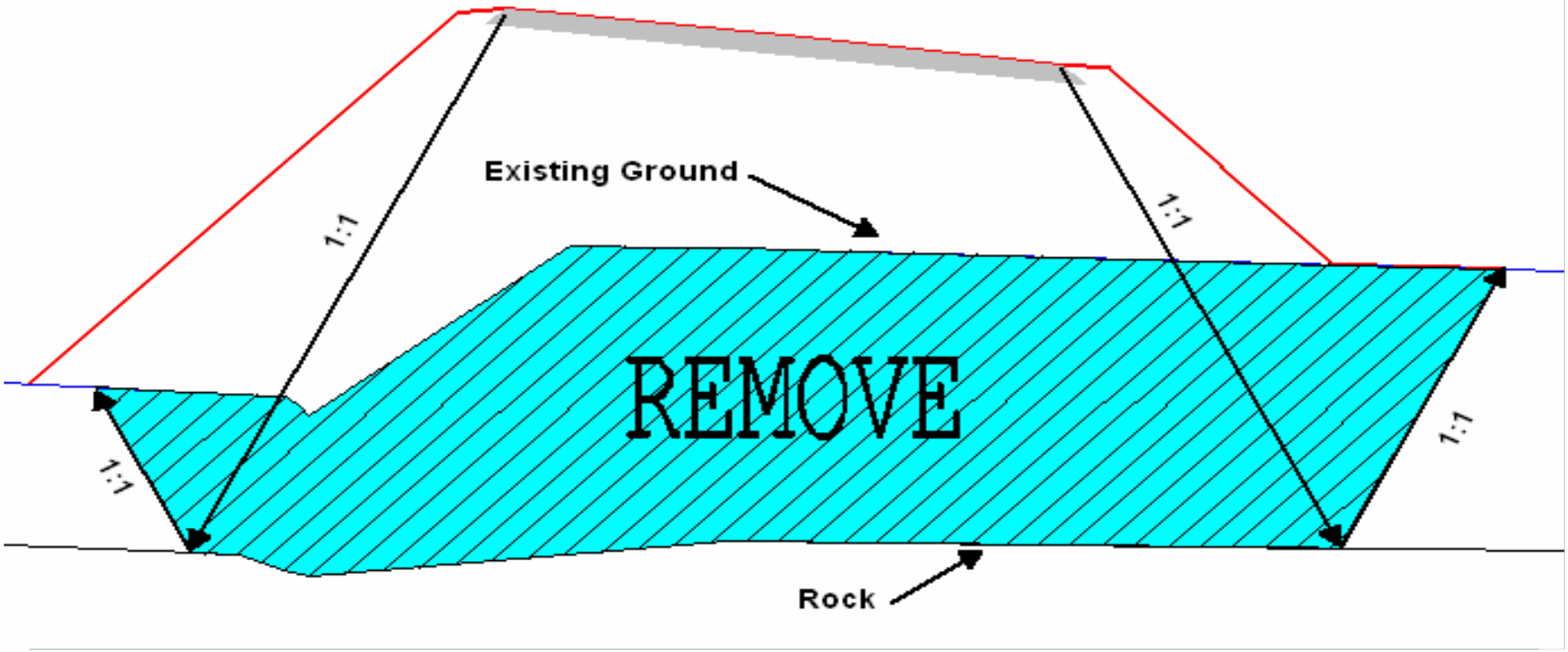
Project to Surface Test Case



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.

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Questions ?

- Hands on experience with point constraints:
- WS26 – Exploring Template Points and Constraints (InRoads/GEOPAK)
  - When - Wednesday 1:00 – 3:00

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Thank You

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