

## APPENDIX G

### WIDENING

Widening is used to modify the shape of the roadway templates. Widening is generally used for pavement width transitions, ramp areas, and fill widening. The designer may want to modify a template segment width and/or elevation to accommodate passing lanes, guardrail, parking, etc. This can be done in one of five ways:

- Define a new template
- Specify widening to change the width of the template segments
- Define plan view or 3D MicroStation or IGrds geometry elements; then assign these to specific ridge lines within the template (geometric template modification)
- Specify a widening of the last template segment by a horizontal distance on a fill sideslope (see Appendix J)
- Request automatic pavement widening on sharp horizontal curves

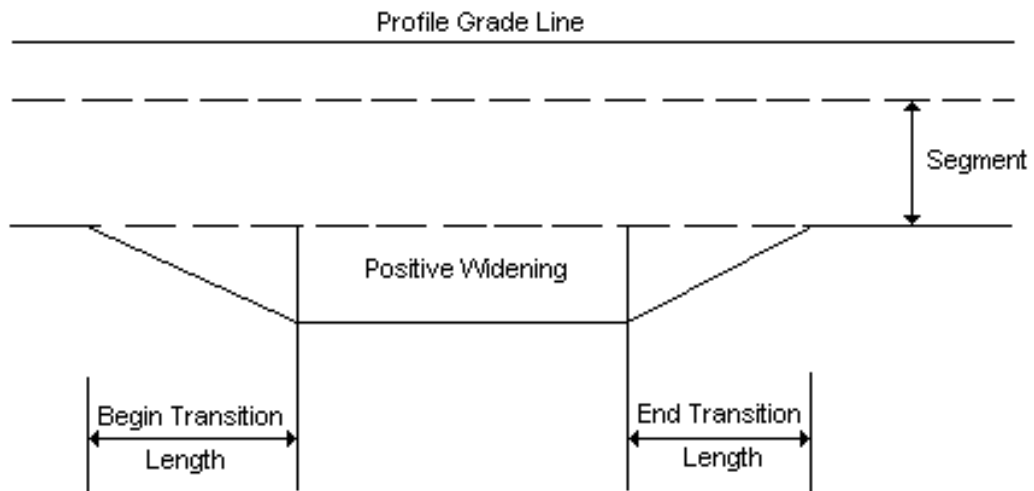
The IGrds widening process, geometric template modification, and automatic pavement widening are discussed in the remainder of this Appendix.

### WIDENING PROCESS

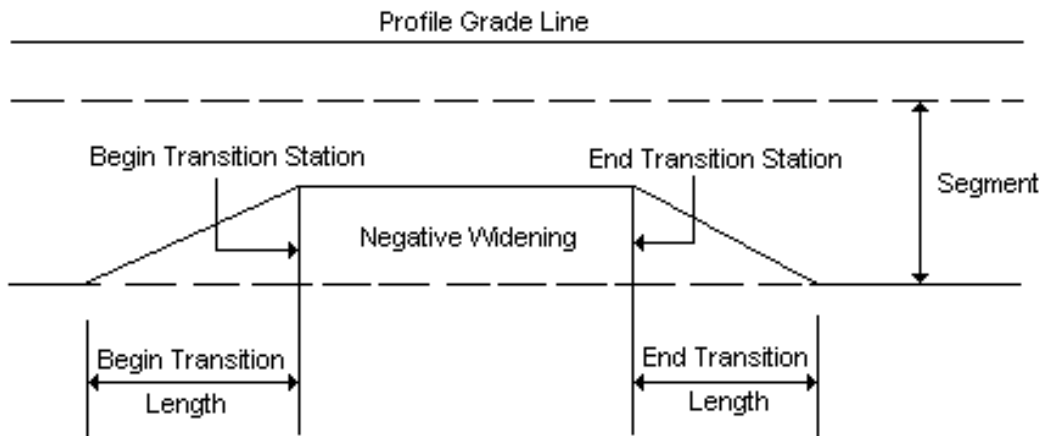
The widening process provides for altering any two segments (i.e., widening 1 and widening 2) at any station for a given design roadway.

Widening data serves to define modifications to roadway surface shapes by altering the width of template segments. It provides for either widening or narrowing (negative widening) of a template segment, and for transition to and from the widened shape. Widening always takes place on the edge of the segment which is farthest from the profile grade point.

Some discretion should be used by the designer when using widening. For example, if turnouts and curve widening are conflicting with each other, it may be wise to put the turnout in the templates.

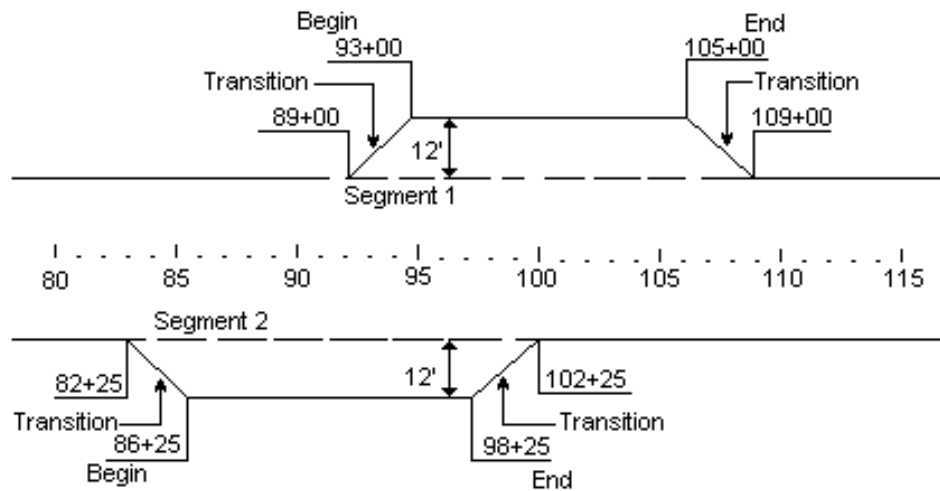


Widening introduced by  
Beginning Transition  
Stays in Effect Until  
Next Widening Data

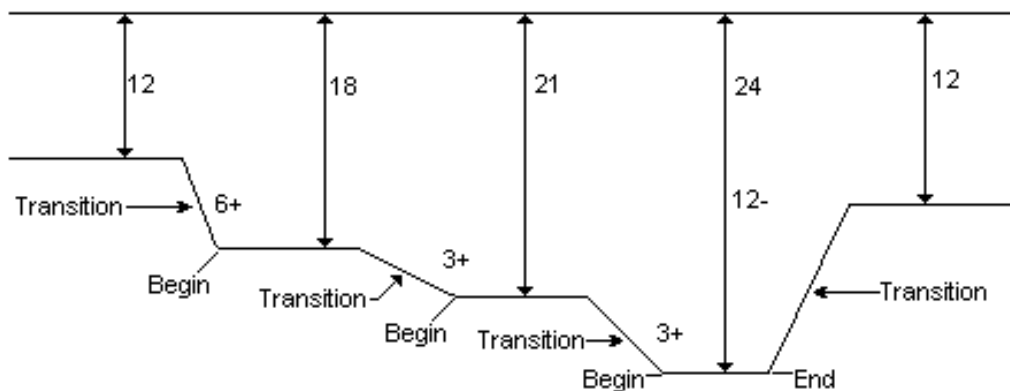


Note that widening specified by the beginning transition stays in effect until the next widening data. Beginning and ending widening can be of different values. This allows the designer to accumulate or take a portion of widening off. Particular attention must be given to cases where the number of template segments changes within a widening.

An example of widening is shown below.



Accumulated widening is accomplished by having two beginning transitions with one ending transition.



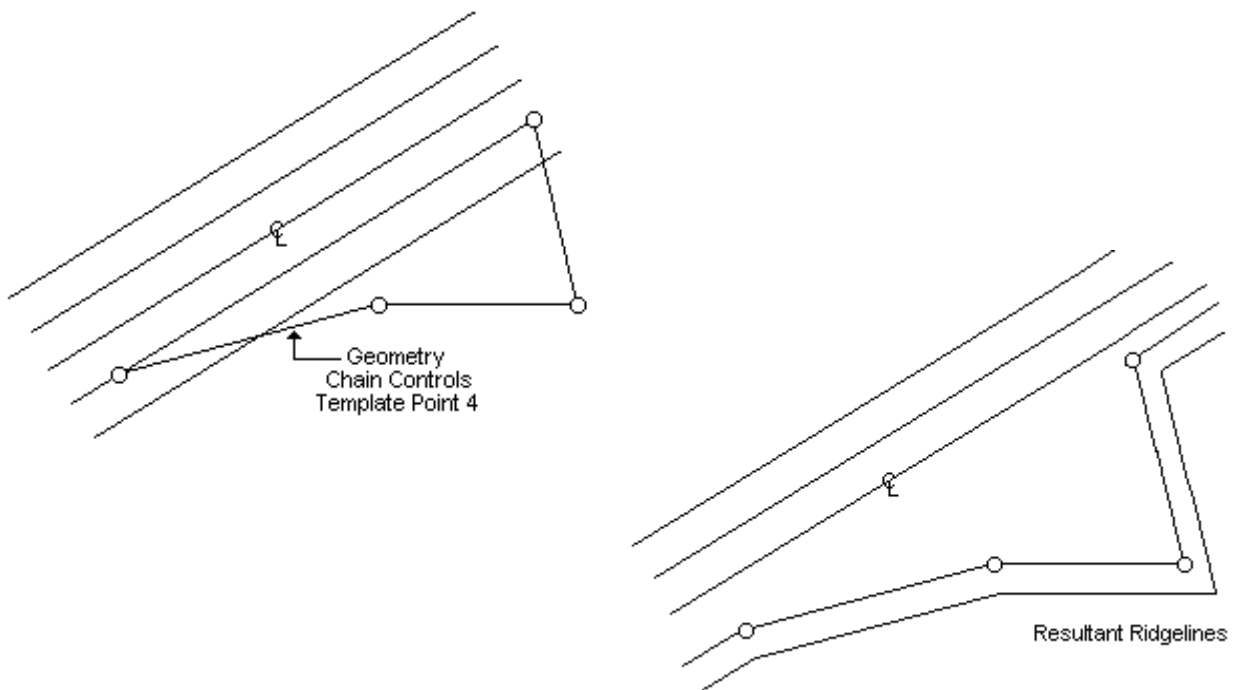
IGrds stores the widening data for future use and produces a widening design data listing.

## GEOMETRIC TEMPLATE MODIFICATION

Geometric template modification provides the means for defining elevation and/or lateral shifts in template ridge lines over a specified station range, based upon the location of MicroStation or IGrds geometry line, arc or chain elements defined along the roadway. If a MicroStation element is selected, it is automatically converted to an IGrds geometry element. Any, or all, template points at a given station, except the centerline point, can be modified. There are three options for geometric template modification described below.

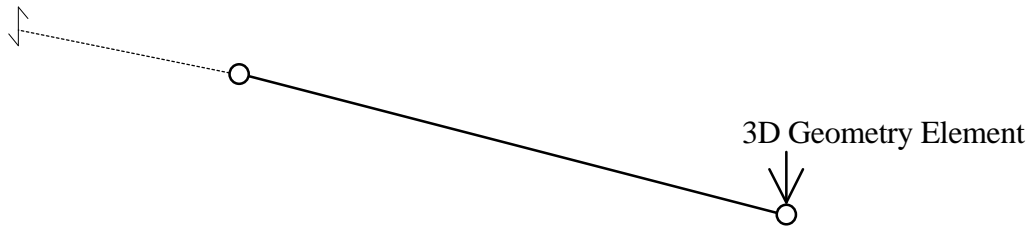
### Horizontal Control Only

The Horizontal Control Only (H Only) option is the simplest method for geometric template modification and means that the selected template point is only horizontally controlled by the selected geometry element over the station range specified. Either 2D or 3D geometry elements can be used for this option. The example below illustrates a typical use of the H Only option.



## Horizontal and Vertical Control

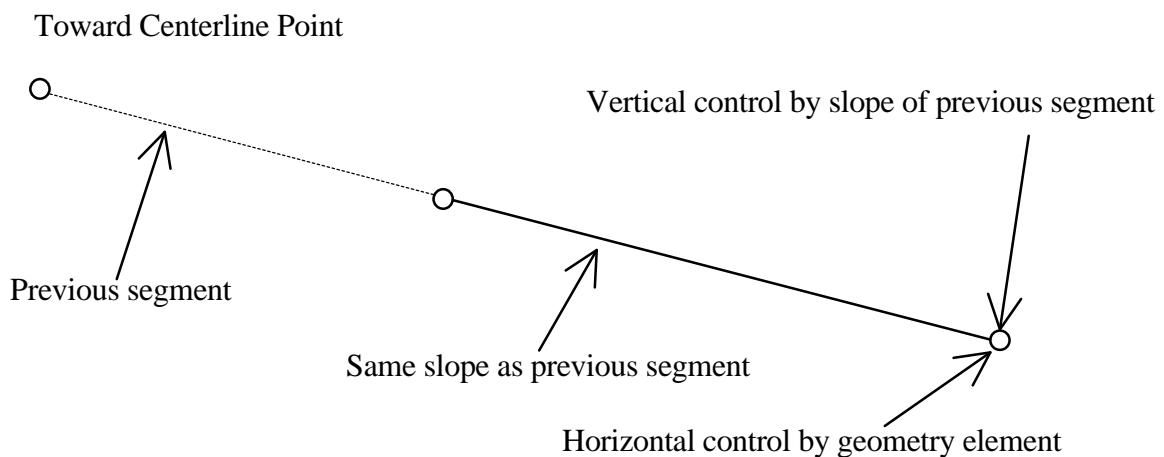
The Horizontal and Vertical Control (H & V) option implies that the selected template point is both horizontally and vertically controlled by the selected geometry element over the station range specified. However, in superelevation conditions, the vertical control can be overridden by superelevation, depending on the segment option. 3D geometry elements can be used with this option. The cross section view sketch below illustrates how the H & V option functions.



The template point being defined is controlled both horizontally and vertically by the 3D geometry element.

## Horizontal and Vertical Slope Control

The Horizontal and Vertical Slope Control (H & VS) option implies that the selected template point is controlled horizontally by the selected geometry element over the station range specified, but the vertical control of the template point is controlled by the cross slope of the previous segment toward the centerline point. However, in superelevation conditions, the vertical control can be overridden by superelevation, depending on the segment option. See the sketch below. Either 2D or 3D geometry elements can be used for this option.



Note: Since geometric template modification can be used as an alternate means to accomplish template widening, do not combine its use with widening data over the same range.

## AUTOMATIC PAVEMENT WIDENING ON SHARP HORIZONTAL CURVES

Pavements on curves are sometimes widened to make operating conditions on curves comparable to those on tangents. On modern facilities with wide lanes (12 ft. or 3.6m) and high type alignments, the need for widening has lessened, but there are still conditions, which require widening, especially with the suggested design vehicles within the 2001 Green Book. If automatic widening is desired, the user can request this by selecting the automatic widening option when the alignment is being created or updated. The standard AASHTO methodology is used based on a designated design vehicle and lateral clearances from the AASHTO Green Book(s).

The design parameters for the design vehicle(s) are maintained in the Design Criteria Table (ha.tbl). Within the 1990/1994 partition the default design vehicle for automatic widening calculations is the SU (single unit) vehicle. Within the 2001, partition dimensional characteristics for all design vehicles (metric and imperial) are stored. These are displayed within the Design Criteria dialog box and the user can select the appropriate design vehicle. AASHTO recommends the WB-50 (WB-15, metric) design vehicle for automatic widening calculations. Within both partitions, other data used include the number of lanes, line width, design speed, and the radius of the arc being processed.

Complete discussions of automatic widening are found in the various Green Books editions. For the 1990 edition, see pages 213-219. For the 1994 edition, see pages 212-219. For the 2001 edition, see pages 206-220. The formulae and definitions discussed below are derived from these documents. The 2001 edition allows for multiple wheel bases in the off tracking formula and is used for both standards (1990/1994 and 2001).

### Tabular Data

#### 1990/1994 Standards

Su Design Vehicle	Imperial	Metric
u = Overall Width	8.5 ft	2.60 m
L = Wheel Base	20.0 ft	6.10 m
A = Front Overhang	4.0 ft	1.20 m
f = Metric/Imperial Factor	1.0	0.105

#### 2001 Standards

WB-50 (WB-15) Design Vehicle	Imperial	Metric
U = Overall Width	8.5 ft.	2.6 m
L <sub>1</sub> = Tractor Wheelbase	14.6 ft.	4.5 m
L <sub>2</sub> = Trailer Wheelbase	35.4 ft.	10.8 m
A = Front Overhang	3.0 ft.	0.9 m
f = Metric/Imperial Factor	1.0	0.1

#### Both Standards

Lateral Clearance	Imperial Units				
Lane Width (Imperial)	8'	9'	10'	11'	12'
Lateral Clearance (C)	1'	1.5'	2'	2.5'	3'

#### Both Standards

Lateral Clearance	Metric Units				
Lane Width (Metric)	2.4m	2.7m	3.0m	3.3m	3.6m
Lateral Clearance (C)	.30m	.45m	0.60m	0.75m	0.90m

Other Definitions

- N = Number of lanes from pivot point to edge of travel way  
 LW = Lane width (from design criteria table)  
 $W_{N2}$  = Normal total width for two lane tangent sections  
       = LW x 2  
 R = Curve radius for PI being processed  
 V = Design Velocity for PI being processed

Formulae

U = Track width  

$$= u + R - \sqrt{R^2 - \sum L_i^2}$$

F<sub>A</sub> = Front Overhang  

$$= \sqrt{R^2 + A(2L_1 + A)} - R$$

Z = Extra Width  

$$= \frac{fV}{\sqrt{R}}$$

W<sub>c2</sub> = Total width for two lane pavements  

$$= 2(U+C)+F_A+Z$$

W<sub>2L</sub> = Total pavement widening for two lane pavements  

$$= W_{c2} - W_{N2}$$

then; round W<sub>2L</sub> upward to specified number of decimal places stored within the design criteria table.

W<sub>L</sub> = Single lane widening, used in transitions length calculations.  

$$= \frac{W_{2L}}{2}$$

W<sub>T</sub> = Pavement widening to be stored as widening data (i.e., widenings 3 and 4) that is used within IGrds design calculations. This value is actually one-half of the total pavement widening.  

$$= W_L \times N$$

Then; if the total pavement widening (W<sub>T</sub> x 2) is less than the minimum total widening (2.0 ft or 0.6m); W<sub>T</sub> = 0 and W<sub>L</sub> = 0.

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