ACE Structural Engineering Applications LLC
ACE FrameWorks Utilities
Flexible Handrail Layout Documentation

Mar 15, 2013

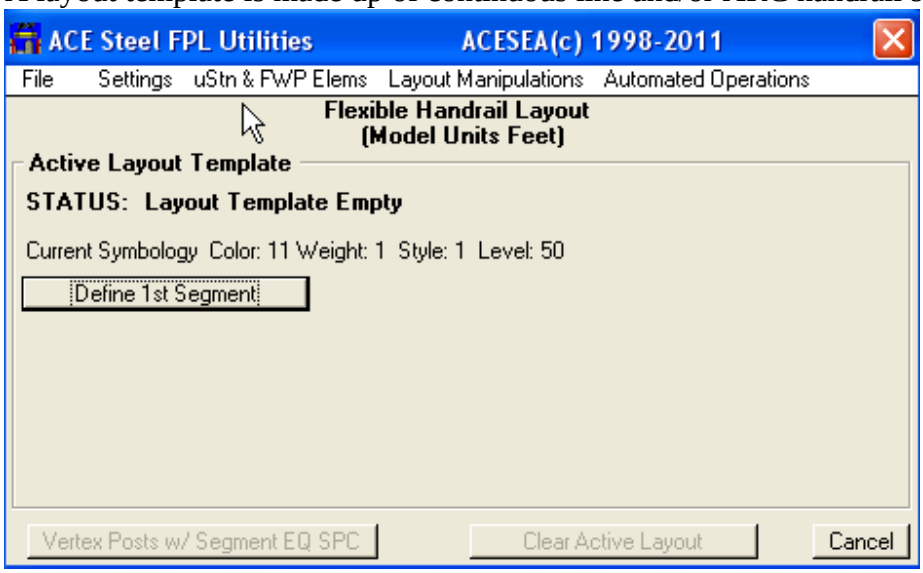
Flexible Handrail Layout (ACE_FHL.MA)

(Versions - FWP 3.1.x.x/3.2.x.x rel 2.0.8 & FWP 7.0.x.x rel 7.0.8 & FWP 7.1/7.2/7.3 rel 6.0.8 & FWP 8.0.x.x rel 8.0.8 & FWP 9.0.x.x rel 9.0.8 & FWP 10.0.x.x rel 10.0.8 & FWP 11.0.x.x rel 11.0.8 & FWP 12.0.x.x rel 12.0.8)

The Flexible Handrail Layout application facilitates the placement of continuous line and/or arc segments of handrail. The application places handrail FrameWorks elements into the FWP model file with a two-step process. First, a layout template is generated and optionally manipulated until acceptable layout template is obtained. The initial Layout Template can be read from uStn and FWP elements, read from special binary files, interactively created from intersecting beams/lines/grids or it can be defined interactively. When complete, the accepted layout template is processed using the desired set of Layout Template Processing Rules to create an active handrail layout. The active handrail layout can be generated using any one of the three sets of Layout Processing Rules available, each with various configurable options. The handrail layout may then be further manipulated if desired. Handrail layout manipulation allows precise placement of handrail components. Another feature this application allows is concept of entries. One entry opening per segment defined interactively. When complete, the handrail layout FrameWorks elements (post, rail, toe plate, and interference envelope) may be placed into the FWP model. An option exists to place dumb graphics into model to represent handrail for drawings. The application can process two types of special uStn design file elements (Smart ACELineString & Smart ACEComplexString) and two types external ACE binary files in an automated mode. Layout Template operations and Handrail layout operations are discussed in the subsequent paragraphs.

Layout Template

A layout template is made up of continuous line and/or ARC handrail segments. In reality, the layout template is the Cardinal Point (CP) line of the handrail rail projected to the HR base (non-offset) elevation. The handrail segments may be flat or sloped. The handrail layout template may be open or closed. The dialog box at the left is the startup dialog box. The layout template can be completely defined interactively, or it may be initiated from specific MicroStation or FWP elements (uStn FWP Elems pull-down menu), or read from two ACE binary files (File pull-down menu). To interactively, press the "Define 1st Segment" button. This will allow a linear segment to be defined by several methods: key in data points, uStn Point locator and FWP members. Subsequently additional segments may be added until the layout template is complete. The dialog boxes for segment definition are shown in the Interactive Section.



An interactively defined layout template can only contain linear segments. Layout templates with arcs can be created by 1) reading a smart or ordinary ACEComplexString uStn element ; 2) reading a FWP ARC; 3) reading a ALT file w/ ARCs; or 4) reading a AHL file with ARCs.

Reading uStn and/or FWP elements is a very effective way to create Layout Templates rapidly. The process of reading design file elements is illustrated in the Design File Elements section.

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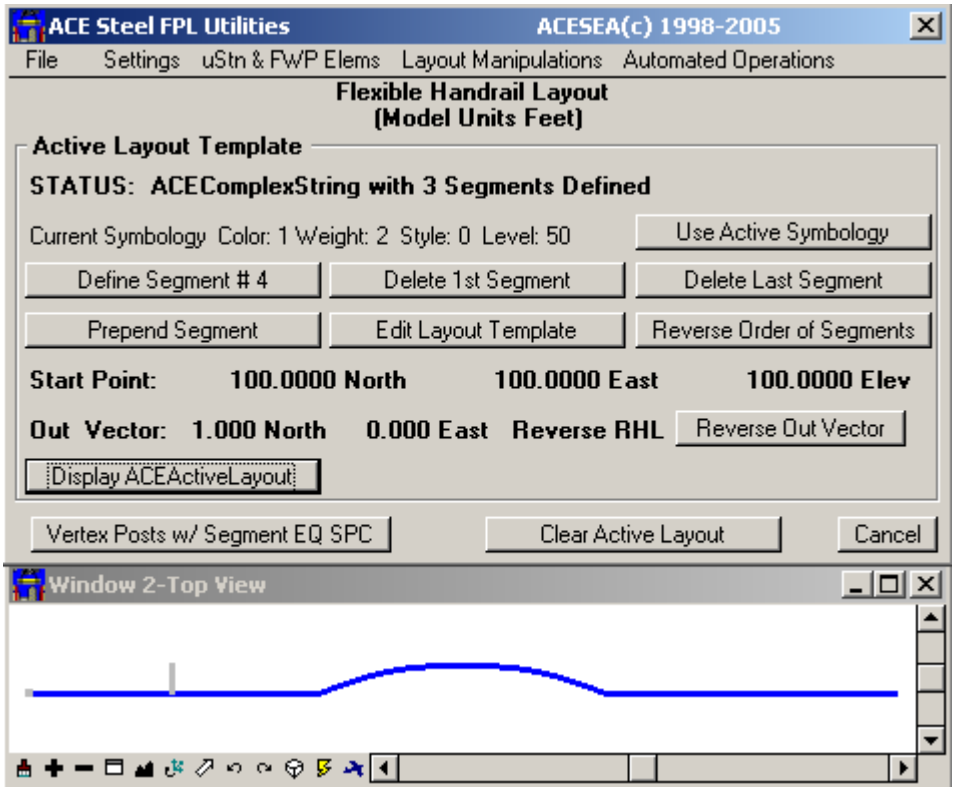
Layout Template (con'd)

The dialog box below illustrates the results of reading an ACEComplexString (see first example in Design File Elements section). Reading uStn elements or FWP elements is a very effective way to start or fully define an active layout template. The active handrail layout template may be continuously manipulated until the desired layout template is achieved. Manipulations include, adding segments (postpend or prepend), deleting segments (first or last), editing layout template, reversing segment order, translating or rotating template. Once the desired layout template is achieved, the layout template may be processed to produce a handrail layout. Additionally, the layout template may be: 1) saved as either Smart ACELineString (or Smart ACEComplexString if ARCs present) into the design file; and/or 2) saved as a ACELayoutTemplate external binary file. The layout template can be displayed at any time by pressing the "Display ACEActiveLayout" button. The figure beneath the dialog box shows the display of the ACEComplexString which was just read. Notice that the ACEComplexString is displayed with the current symbology (color 25, weight 2, style 0). Notice also that the out vector is illustrated by a small highlighted line extending from the center of the first segment. Note that the start of the ACEComplexString has a highlighted active point (left most position for this case). The first segment and it's direction (important for closed layout templates) can be determined by the location of the highlighted start point and the out vector. For Layout Templates read from Smart ACEStrings, ALT & AHL files, the Out Vector is defined. For Layout Templates read from ordinary uStn elements, FWP elements and interactive definition, the Out Vector is initially computed using the following rule. A vectore is drawn from start point to the end of the first segment. This vector is crossed with a vertical Z vector creating the horizontal Out Vector. This is essentially a arbitrary yet consistent method to define the Out Vector. The Out Vector may be reversed at any time by pressing the "Reverse Out Vector" button. The Out Vector can be thought of as a vector, which would point the direction of the long leg of an rail angle profile. The toe plate, if one is placed, will be on the start side of the Out Vector (opposite side of which the Out Vector points). For Handrail Layouts where the post & rail is pipe section (symmetric) placed by post center and without toe plate, the Out Vector is irrelevant.



The symbology is initially defined in the definitions file and can be edited with the Edit/View ACELayoutTemplate Symbology in the Settings pull-down menu. If the symbology is modified, the "Use Current Symbology" button must be pressed to change the symbology for an active layout template.

To generate a Handrail Layout, press the button at the lower left labeled "Vertex Posts w/ Segment EQ SPC" on the above dialog box. This button will always show which Layout Template Processing Method is active and thus utilized to generate the Handrail Layout. The resulting Handrail Layout Manipulations dialog box is shown on the next page.

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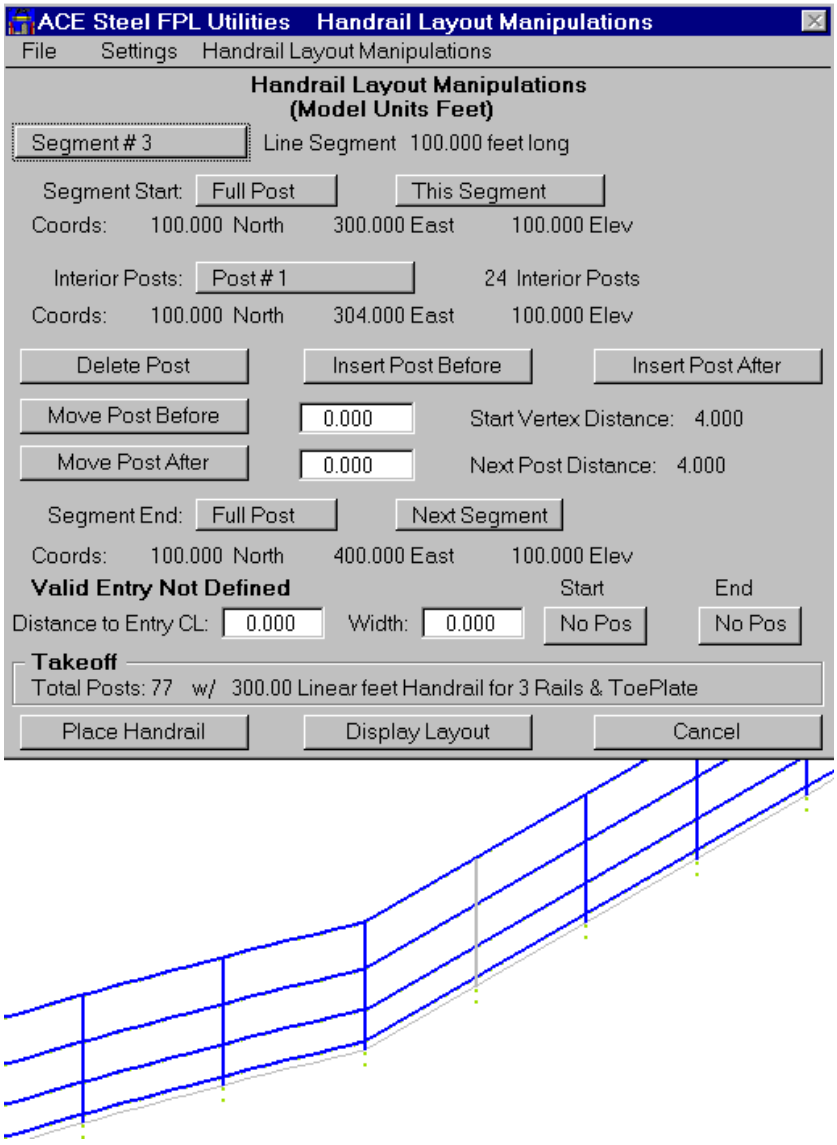
Handrail Layout

Once a layout template accepted, the active Layout Template Processing Method (Rule) is used to process the template and generate a Handrail Layout. Three Layout Template Processing Methods (Rules) are available and each has configurable options. Once the handrail layout is generated it can be interactively manipulated. Some of the manipulation capabilities can be seen in the dialog box below. The vertex and interior posts can be manipulated by first selecting which segment to view/edit using the option button at the top left of the dialog box. At both the start and the end of the segment, the vertex post may be full post, partial post or no post. The orientation of the post may be associated with this segment, the vertex or the neighboring segment for the end in question. Interior posts may be deleted, added or moved.



A useful and unique capability is the ability to define one entry per handrail segment (Interactively only). If an entry is defined, posts or partial posts at either end of the entry may be defined. If an entry is defined, any interior posts in the entry region will not be placed (Note: Even though they will not be placed, posts in entry region will be highlighted when selected with the Interior Posts option button).

The pull-down menus also provide manipulation capabilities. The handrail layout may be translated or rotated if desired (Handrail Layout Manipulations pull-down menu). The Handrail Parameters may be changed at any time using the Edit/View HR Parameters on the Settings pull-down menu.

As can be seen in the figure above, the handrail layout is displayable from the Handrail Layout Manipulations dialog box. This is a very helpful feature for editing a handrail layout. When the Handrail Layout dialog box is displayed, the current selected post is highlighted. In the figure above, this would be the 1st post on the third segment.

The dialog box shown at the left illustrates the handrail layout display capability. The display graphics setting is defined in the definition file. The settings can be viewed/edited in the Settings menu on the Layout Template pull-down menu. Notice that the 1st interior post for the second segment is highlighted. The display graphics is temporary graphics that will go away on screen redraws etc. The "Display Layout" button can be pressed at any time to redisplay the handrail layout.

Once the handrail layout is satisfactory, it can be: 1) placed into the FrameWorks model as FrameWorks members or 2) saved as an ACEHandrailLayout external binary file (File pull-down menu).

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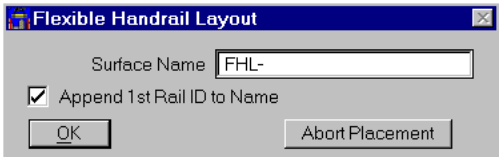
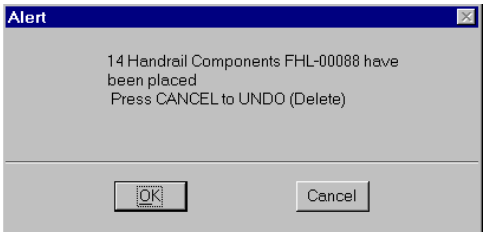
Handrail Layout (con'd)

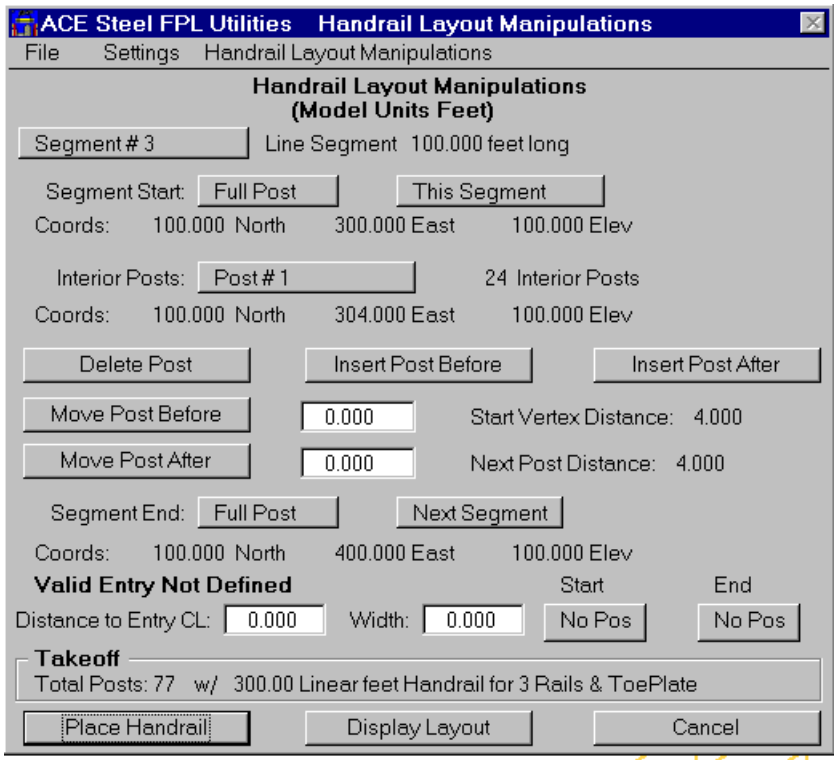
To place the Handrail Layout, press the "Place Handrail" button. If dynamic naming is active (originally set in definition file and viewable/editable through the Settings pull-down menu), the dialog box (left) will appear. The name prefix may be specified and the 1st rail ID may be optionally appended (toggle option) to the name. Placement may be stopped with the "Abort Placement" button. To continue w/ placement, press "OK".



If OK is pressed, the FWP elements are placed and the following "immediate undo" dialog box appears. To accept the Handrail Layout placement, press "OK". To undo (FWP delete elements), press the "Cancel" button. If "OK" is pressed, the Handrail Layout Manipulations dialog box reappears as it was prior to placement.

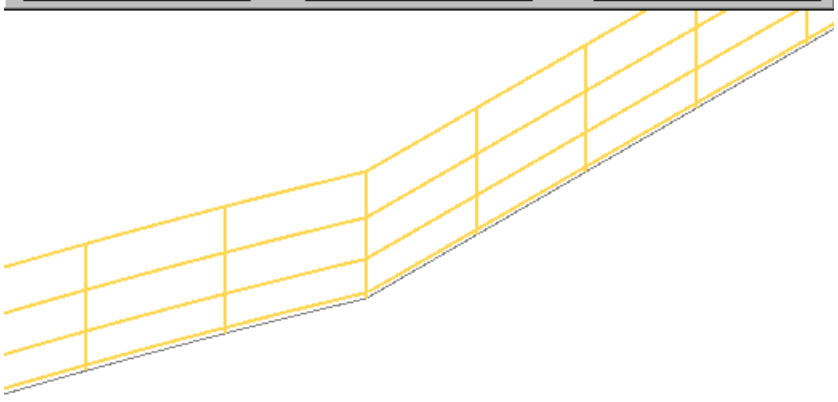


After placement, the Handrail Layout Manipulations dialog box remains unchanged. The Handrail Layout may be further manipulated or saved as an AHL file. This feature is extremely useful in a structure where the handrail is identical for two or more floors. The Handrail Layout Manipulations pull-down translate and/or rotate can be utilized to move the Handrail Layout to the desired location.



If the cancel button is pressed, the Layout Template dialog box will appear. The Layout Template remains active. The active Layout Template may be modified, the Layout Template Processing Method may be modified and the Handrail Layout regenerated, the ALT file may be saved, a Smart ACEString may be placed in the design file or the active layout may be cleared.

The figure below the dialog box shows a zoomed in area after Handrail Layout placement.



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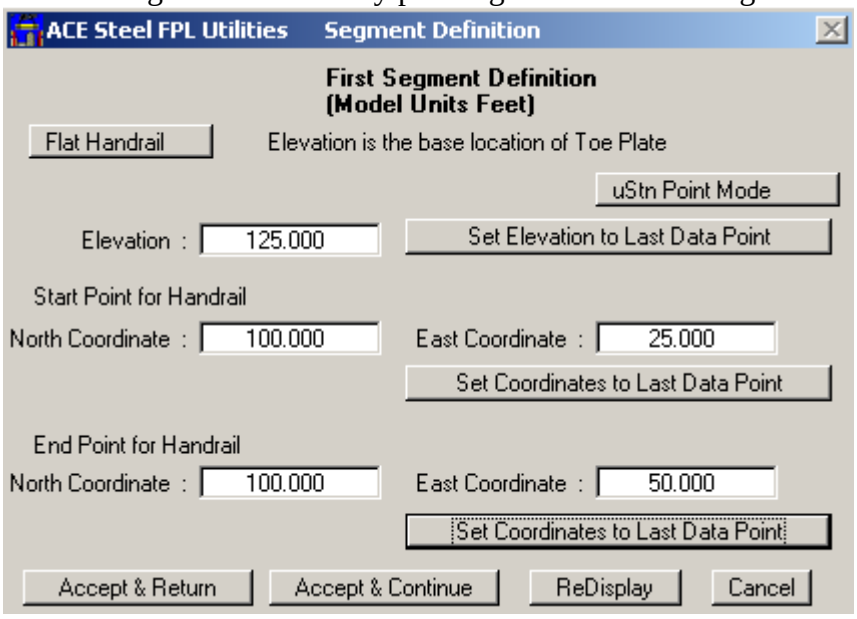
Interactive Creation of Layout Template

As previously stated, the layout template may be generated with interactive commands. This section illustrates a simple layout template creation (two segments). Note that all segments are linear when only interactive commands are utilized (i.e. uStn & FWP elements not read and ALT & AHL files not read).

Defining the 1st Segment

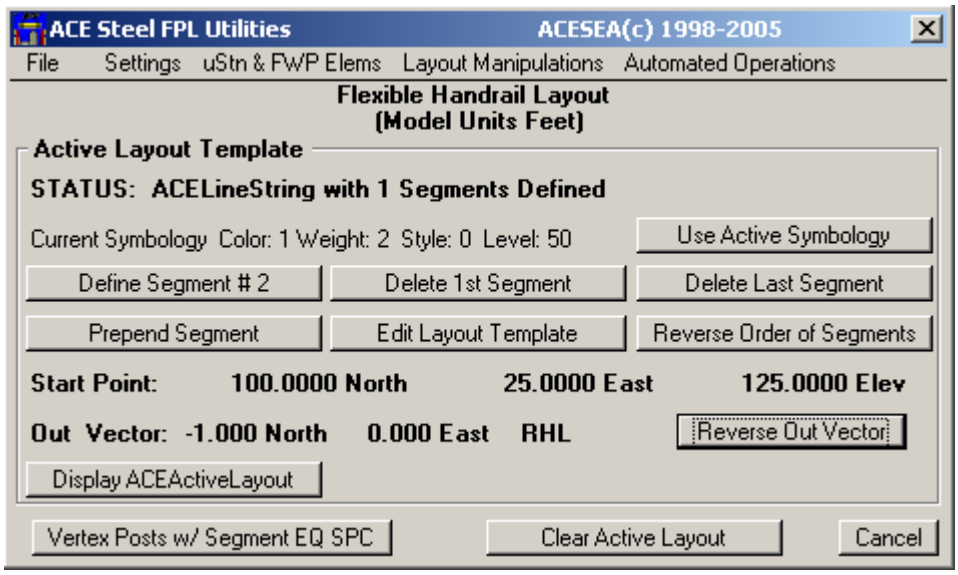
The first segment is started by pressing the "Define 1st Segment" button. The following dialog box appears when this button is pressed. The segment can be defined as flat (as in this case) or sloped. The coordinates for the two segment ends can be keyed in or they can be defined using either "Last Data Point" commands (uStn Point Mode) and/or "Member Point Locator (ACE FWP Point Mode). The "Last Data Point" allows the last datapoint to be utilized and the "Member Point Locator" allows a point on a FrameWorks member (any CP anywhere along the member) to be utilized. See the section Point Select Mode – "uStn Point Mode" or "ACE FWP Point Mode" for more information.



After appropriate data has been input, press either "Accept & Return" or "Accept & Continue". If "Accept & Continue" is pressed, the first segment is processed and the dialog box changes to accept the next segment. If "Accept & Return" is pressed the Layout Template dialog box reappears as.

Layout Template (Primary) Dialog Box After 1st Segment

The dialog box now indicates that there is an active layout template with one segment. As can be seen, many new buttons have appeared. A second segment may now be added to the end or the start of the first segment (making the first segment the second). Other options include: deleting first or last segment, reversing the Out Vector, changing symbology, displaying ACEActiveLayout, clearing active layout or generating handrail layout using the "String EQ SPC" Layout Template Processing Method. In addition several pull-down menu option are also active such as save ACELayoutTemplate File (ALT), write Smart ACEString into design file and Layout Manipulation options translate or rotate. To continue defining segments press either "Define Segment #2" or "Prepend Segment". For this example, a 2nd sloped segment will be defined at the end of the first. This could have been done faster & easier with the "Accept & Continue" option in the previous dialog box.



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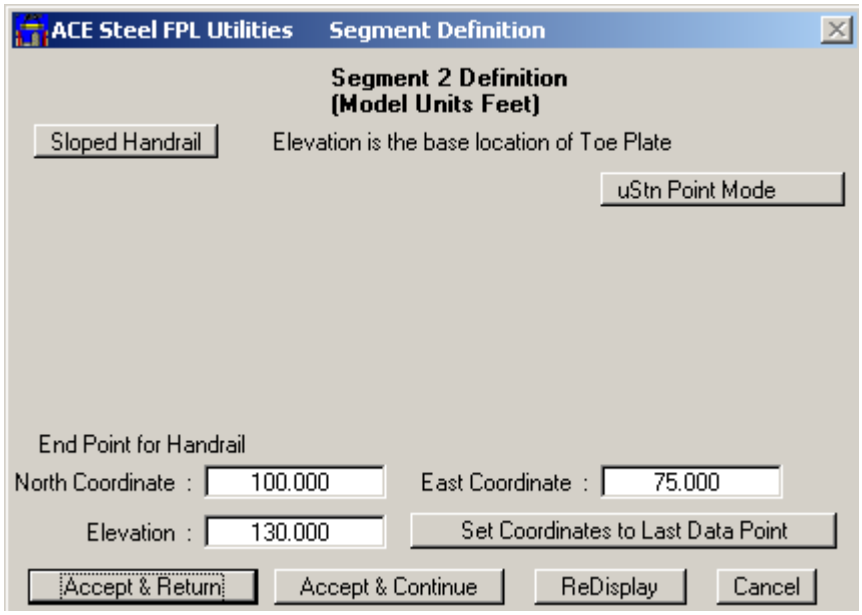
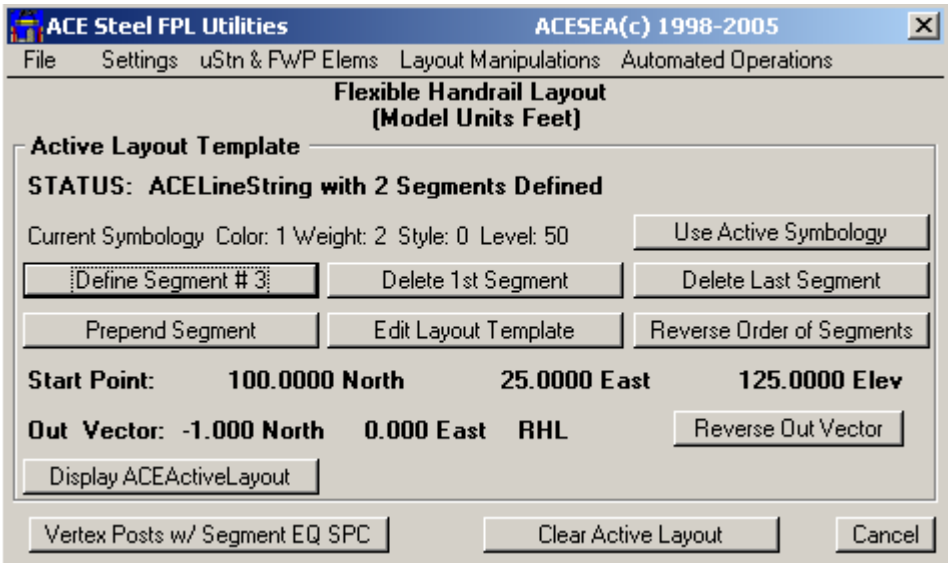
Defining the Second Segment

The next segment is defined by pressing the "Define Segment #2" button. As with the 1st segment, the second segment can be flat or sloped. Only one point is of course required to define the 2nd segment. If the 2nd segment is flat, only a North and East coordinate need be supplied. If the segment is sloped as in our case, an elevation is also required. As with the 1st segment definition, the coordinates may be keyed in, defined with "Last Data Point" or defined with "Member Point Locator". Press "Accept & Return", "Accept & Continue" or "Cancel". Since this is the last segment desired, press the "Accept & Return" button. When the button is pushed, the Layout Template (primary) dialog box reappears as follows.



Layout Template (Primary) Dialog Box After 2nd Segment

The dialog box now indicates that there is an active layout template with two segments. One important feature is the "Reverse Order of Segments" button. Pressing this button will reverse the order of the segments. This will adjust the display value for the Start Point and the Out Vector. The Out Direction is still the same but the vector for the first segment will change if the orientation of the new 1st segment has changed. The Out Vector can of course be toggled at any time from the Layout Template (primary) dialog box. The pull-down menu capabilities remain the same way they were when the first segment was defined. Additional segments can be added or numerous manipulations may be performed. When the layout template is satisfactory, the Handrail Layout can be generated using the active Layout Template Processing Method. The Layout Template Processing method may be changed or modified from the Settings pull-down menu. Notice that the "String EQ SPC" (method 2) is currently active.



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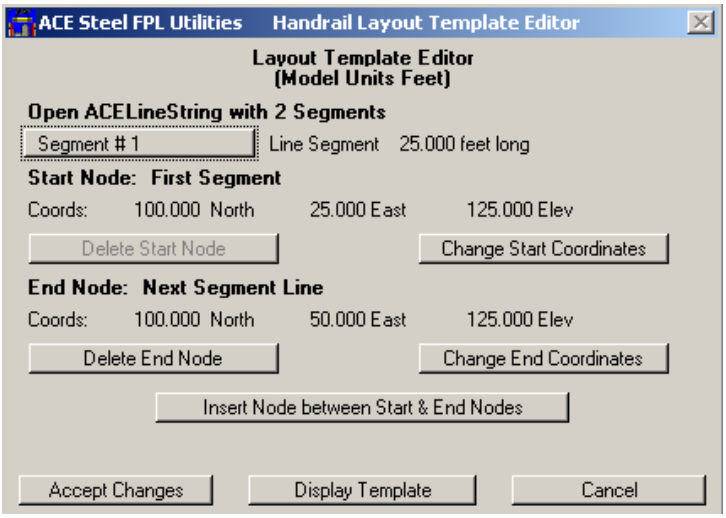
Editing the Layout Template

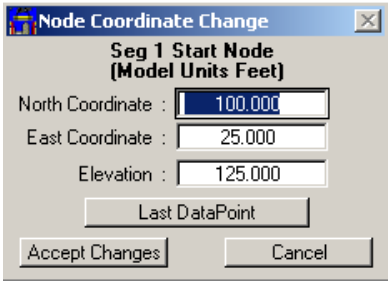
At any time the layout template can be edited with the "Edit Layout Template" capability. This button appears once the first segment of a layout template is defined. The layout template editor has the following capabilities:

1. Split a linear segment (produces two equal length linear segments)
2. Split a arc segment (produces two equal length arc segments)
3. Change coordinates for a linear segment not bordered by a arc segment
4. Delete a node for a linear segment bordered by a linear segment
5. Shrink/Expand (all edges) of a closed flat line string (non complex string) template (not this case)

For the previous example, pressing the "Edit Layout Template" produces the following dialog box. This example has two linear (line) segments. The segment option button allows the segment of interest to be selected (segment 1 is selected). The following editing options are available: The end node could be deleted making a one segment layout template. The start or end coordinates of segment 1 (also segment 2) could be changed. Finally a node can be inserted between the start and end node of the first segment. This can be very valuable if more than one entry is desired on a long segment. If the "Change Start Coordinates" is pressed the following dialog box appears.



Change Coordinates

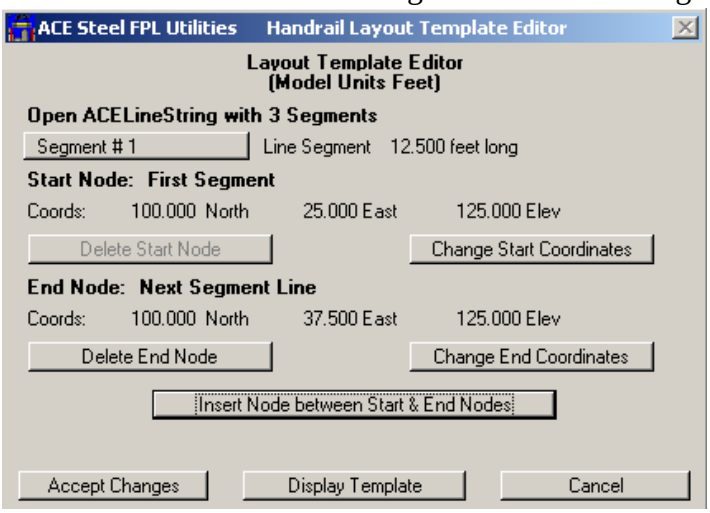


The new coordinates can be keyed in or the Last DataPoint method can be utilized to define a new node coordinate.

If the "Insert Node between Start & End Nodes" button is pressed, a node is pressed at the centerpoint of the first segment and there would then be three segments. Pressing this button would result in the following.

Inserting Node between Start & End Nodes

As noted there are now three segments as the first segment was split into 2 segments. If a different split node location is desired, the node coordinates can be edited. For pure linear (line) segment ACELineStrings, the editor is a very powerful tool as the ACELineString can be totally edited. When arc segments are involved, ACEComplexStrings, the tool is somewhat limited but still can be very useful. Arc segments can be equally split and linear segments may be split and edited. Any two consecutive linear segments may be edited, split or combined.



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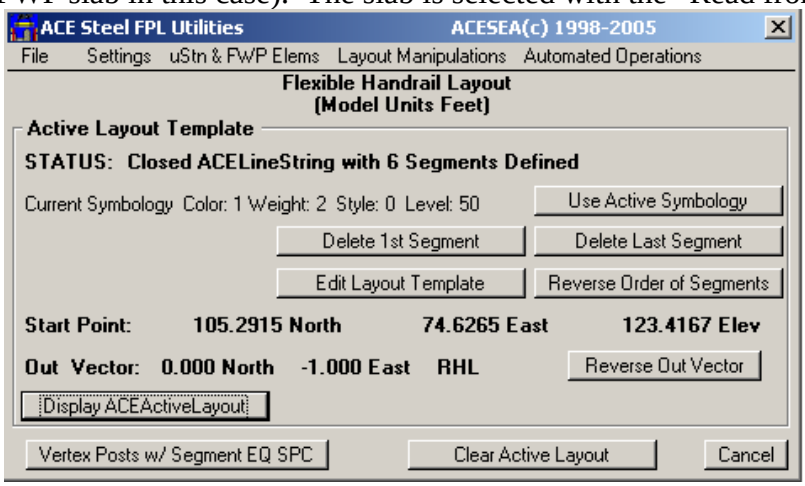
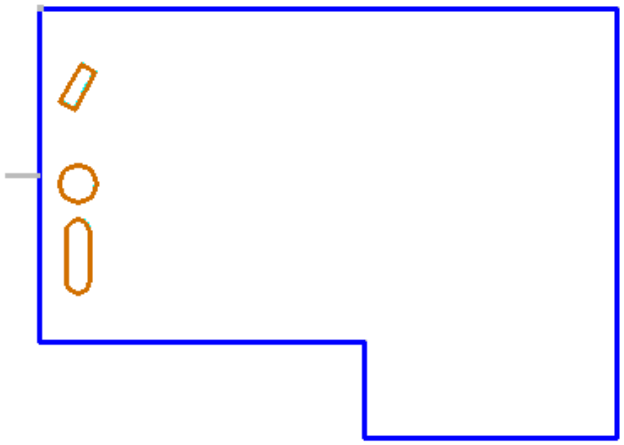
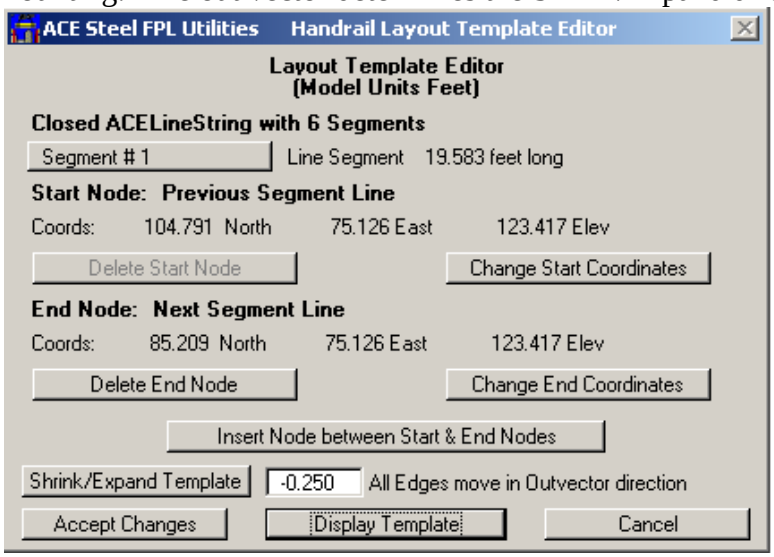
Editing the Layout Template (con'd)

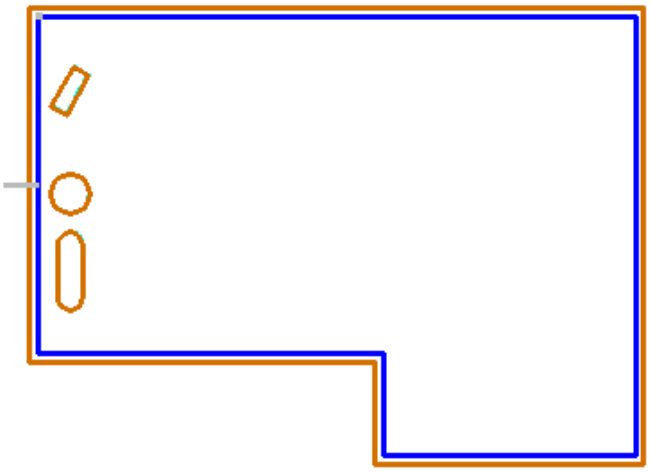
This "Edit Layout Template" example illustrates the Shrink/Expand capability for a closed flat line string (a FWP slab in this case). The slab is selected with the "Read from FWP Slab" as shown below.



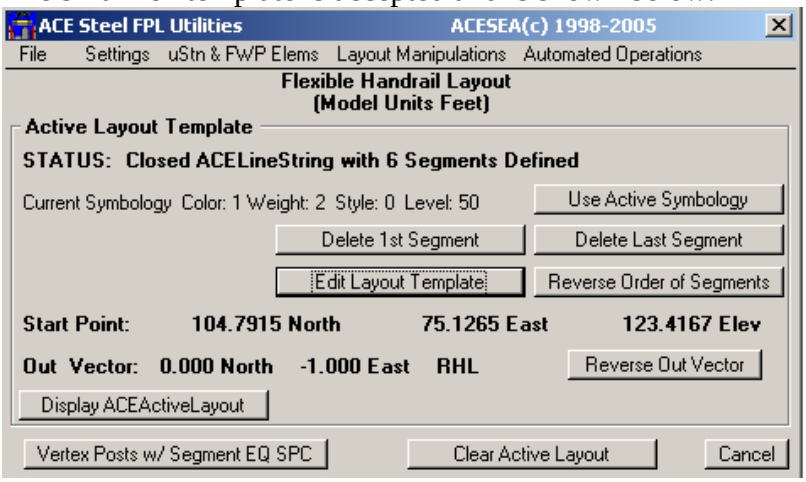


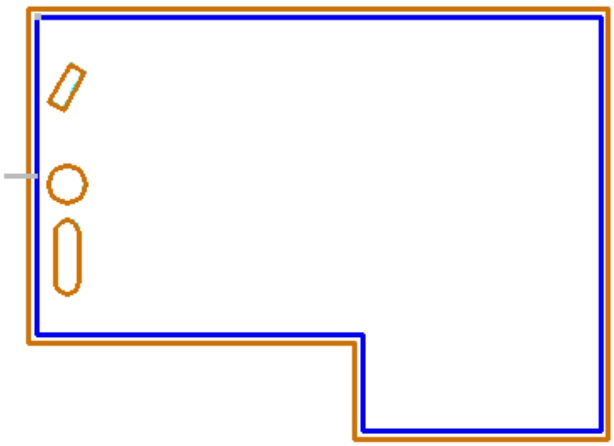
The "Edit Layout Template" is activated and the template is shrunk by 3 inches on all edges to allow handrail top mounting. The out vector determines the Shrink/Expand direction (in this case a negative value shrinks).





The shrunken template is accepted and is shown below.





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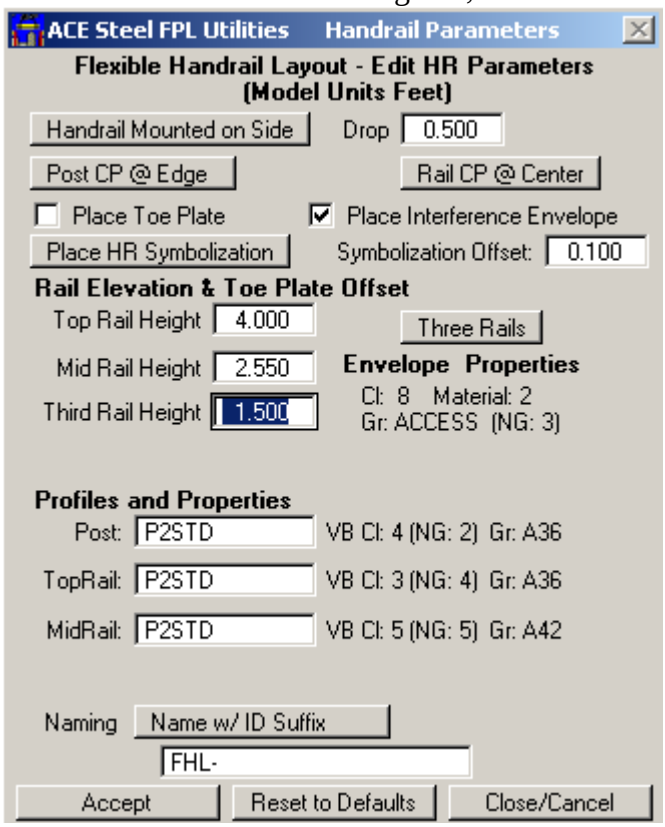
Handrail Parameters

The Handrail Parameters dialog box, which is activated from any of the Settings pull-down menus (Layout Template, Handrail Layout Manipultaions & Automated Operations dialog boxes), is shown below. The utility has internal defaults for toe plate and handrail section sizes, types, classes and grades. Handrail dimensions: top rail height, mid rail height, third rail height and rail & post CP's also have internal default values. In addition all input parameters shown in the dialog box shown left have default values. The defaults may be overridden with user definable defaults by using a definition file. Definition files are discussed in detail later in this document.



As can be seen the following items can be changed with the Handrail Parameters dialog box: handrail position top of side, post CP location, rail CP location, toe plate option, interference envelope option, HR dumb graphics symbology option including offset, number of rails and corresponding heights, toe plate vertical offset, profiles for post, toprail, midrails and toe plate. Finally the naming method and prefix may be specified.

The following items may be specified only in the definitions file: post, toprail, midrail and toe plate class, named group, grade and type. The envelope class, material, grade and named group may also only be specified in the definitions file.

To abort changes, press the Close/Cancel button. Pressing the Accept button will cause the displayed values to become the active values. The values specified in the definition file can be restored by pressing the Reset to Defaults button.

Handrail Dumb Graphics Placement & Symbology

If the option button is set to "Place HR Symbolization", uStn lines and arcs (dumb graphics) representing the handrail layout will be placed into the uStn design file using the Handrail (Dumb) Graphics Symbology. Editing & viewing of the Handrail (Dumb) Graphics Symbology is discussed on the next page. The Symbology Offset (see above dialog box) value specifies a horizontal offset for the placement of the dumb graphics. A line or arc is placed for each segment corresponding to segment type. For a linear segment, each endpoint of the line is offset by the Symbology Offset value. The offset direction for the line is the Out Vector. For a arc segment, each endpoint and the midpoint of the arc is offset by the Symbology Offset value. For each point, the offset direction for the arc point is a radial vector, which makes a positive projection on the Out Vector. The elevation of the line or arc matches the corresponding Layout Template segment.

Interference Envelope

If requested, an interference envelope is placed that will appropriately cover, with a solid vertical wall, all the handrail members. If the members have fireproofing, the fireproofing thickness will be utilized in determining the interference envelope.

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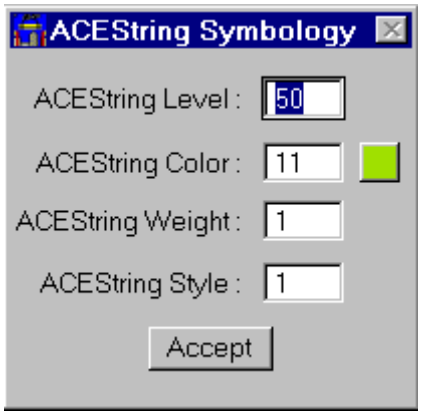
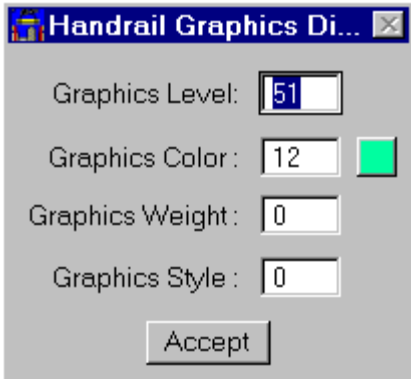
Edit/View ACELayoutTemplate Symbology

The active layout template (also termed ACEString) symbology is initially defined in the definitions file. This symbology controls the following: the display graphics for the Layout Template, the display graphics for the Handrail Layout, the symbology settings for saved ACELineString and ACEComplexString design file elements, and the saved ACELayoutTemplate symbology settings in ALT & AHL files. This dialog box, which can be activated from the Layout Template dialog box, allows the active ACEString symbology to be changed. The active ACELayoutTemplate symbology is utilized for new layouts (note that Layout Templates read from ALT or AHL files will carry the symbology that was in effect when the file was saved). The current ACELayoutTemplate symbology can be changed to the active ACELayoutTemplate symbology by pressing the "Use Active Symbology" button on the Layout Template dialog box.



Edit/View Handrail (Dumb) Graphics Symbology

The handrail graphics symbology is initially defined in the definitions file. This symbology controls the dumb graphics that are optionally placed in the design file to represent the handrail layout when the handrail layout is placed as FrameWorks elements into the model. Note that the HR Parameters dialog box contains two items that relate to this. First, the placement of dumb graphics may be turned on or off with an option button. If the placement of dumb graphics is on, a horizontal offset for the graphics may be specified. If a value other than 0 is specified, the dumb graphics will be offset in the out vector direction the specified amount. The graphics will be placed with the level, color, weight and style specified in this dialog box.



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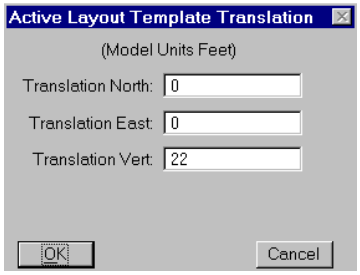
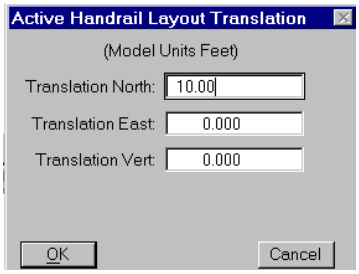
Translating Layout Templates & Handrail Layouts

Both Layout Template and Handrail Layouts may be translated. Layout Templates may be translated by using the Translate Active Layout option from the Layout Manipulations pull-down menu on the Layout Template dialog box. Handrail Layouts (includes the corresponding Layouts Template) may be translated by using the Translate Handrail Layout option from the Handrail Layout Manipulations pull-down menu on the Handrail Layout Manipulations dialog box.



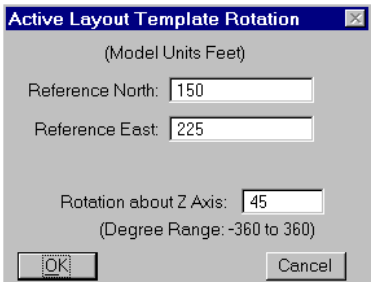
If the Layout Template menu is utilized, the following dialog box is used for translations. For this example, a elevation translation of 22 feet has been specified. Obviously, the Handrail Layout that is later generated from the layout template will also be translated.



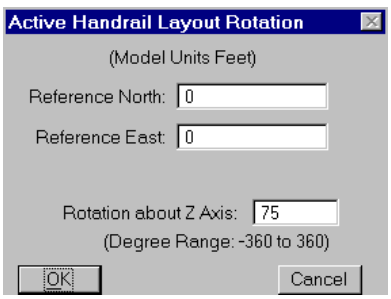
If the Handrail Layout Manipulations menu is utilized, the following dialog box is used for translations. For this example, a North translation of 10 feet has been specified. Translating the Handrail Layout will of course translate the associated layout template.

Rotating Layout Templates & Handrail Layouts

Both Layout Template and Handrail Layouts may be rotated. Layout Templates may be rotated by using the Rotate Active Layout option from the Layout Manipulations pull-down menu on the Layout Template dialog box. Handrail Layouts (includes the corresponding Layouts Template) may be rotated by using the Rotate Handrail Layout option from the Handrail Layout Manipulations pull-down menu on the Handrail Layout Manipulations dialog box.



If the Layout Template menu is utilized, the following dialog box is used for rotation. For this example, a rotation of 45 degrees about reference point North 150 & East 225 has been specified. Obviously, the Handrail Layout that is later generated from the layout template will also be rotated to match the layout template.



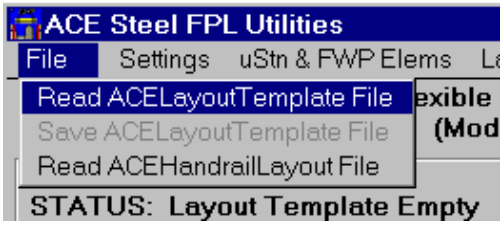
If the Handrail Layout Manipulations menu is utilized, the following dialog box is used for rotation. For this example, a rotation of 75 degrees about reference point North 0 & East 0 has been specified. Rotating the Handrail Layout will of course rotate the associated layout template.

ACE FWP Flexible Handrail Layout Documentation

Primary (Layout Template) Dialog Box Pulldown Menus

The dialog box features the following 5 pull-down menus: File, Settings, uStn & FWP Elems, Layout Manipulations and Automated Operations. Each of the pulldown menus and the associated options are discussed below.

File Menu



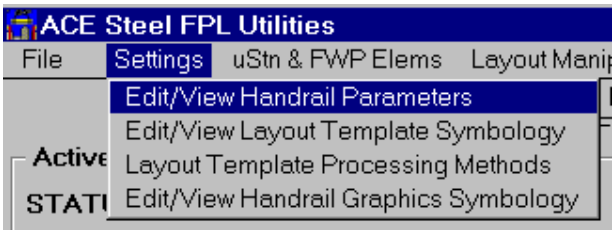
The file pull-down has three options. The three options are: Read ACELayoutTemplate File, Save ACE ACELayoutTemplate File and Read ACEHandrailLayout File. Both the ACE ACELayoutTemplate file and the ACEHandrailLayout file are binary files. The files are discussed in detail in the later section "External Binary Files".

Read ACELayoutTemplate File: An ACELayoutTemplate binary file may be read as the initial layout if a layout template is not currently active. If a layout is active, it can be cleared and then an ACELayoutTemplate can then be read. The option is dimmed when an active layout template exists. Once a ACELayoutTemplate file is read, a active layout template is established. The layout template may be manipulated as desired.

Save ACELayoutTemplate File: An ACELayoutTemplate binary file may be saved provided an active layout template exists. The option is dimmed when an active layout template does not exist.

Read ACEHandrailLayout File: An ACEHandrailLayout binary file may be read as both the initial layout and handrail layout, if a layout template is not currently active. If a layout is active, it can be cleared and then an ACEHandrailLayout file can then be read. The option is dimmed when an active layout template exists. Once an ACEHandrailLayout file is read, a active layout template & handrail layout is established. The handrail layout dialog box appears and the handrail layout may be further manipulated as desired.

Settings Menu



The settings pull-down has four options. The four options are: Edit/View Handrail Parameters, Edit/View ACELayoutTemplate Symbology, Layout Template Processing Methods and Handrail Graphics Symbology.

Edit/View Handrail Parameters: The handrail parameters consist of all the handrail settings (editable & non-editable) defined in the definition file. Items include: rail, post & toe plate properties; interference envelope settings, toe plate option, CP settings, post position, etc. The handrail parameters are shown in greater detail in the Handrail Parameters section. Note that handrail parameters may also be accessed through the handrail layout dialog box and the automated operations dialog box.

Edit/View ACELayoutTemplate Symbology: The symbology for display of both the layout template and the handrail layout may be edited/viewed with this settings dialog box. The symbology is initially defined in the definition file. Any new layout templates will receive the default symbology. The symbology may be changed at any time. The symbology is saved in both ACELayoutTemplate & ACEHandrailLayout files.

ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)

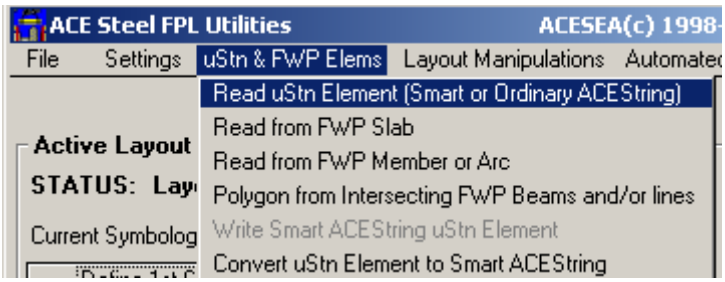
Settings Menu (con'd)

Layout Template Processing Methods: There are three available Layout Template Processing Methods. This dialog box allows both configuration and selection of template processing method. The Layout Template Processings Methods are initially defined in the definition file. The Layout Template Processings Methods are discussed in greater detail in the Layout Template Processings Methods section. Note that Layout Template Processing Methods may also be accessed through the automated operations dialog box.

Handrail Graphics Symbology: The symbology for placement of dumb graphics to depict handrail may be edited/viewed with this settings dialog box. The symbology is initially defined in the definition file. The symbology may be changed at any time. The symbology is saved in ACEHandrailLayout files.

uStn & FWP Elems Menu

The uStn & FWP Elems pull-down has five options. The five options are: Read uStn Element, Read FWP Slab, Read FWP Member or Arc, Write Smart ACEString uStn Element and Convert uStn Elements to Smart ACEString.



Read uStn Element: Allows a MicroStation element to be read as the initial layout template. The option is dimmed when an active layout template exists. The MicroStation element may be ordinary or smart.

Read from FWP Slab: Allows a FWP solid element to be read as the initial layout template. The option is dimmed when an active layout template exists.

Read from FWP Member or Arc: Allows a FWP member or arc element to be read as the initial layout template. The option is dimmed when an active layout template exists.

Polygon from Intersecting FWP Beams and/or Lines: Allows for the creation of an open or closed polygon using the intersection of FWP members, grids or lines. This capability is illustrated in the following pages. The option is dimmed when an active layout template exists.

Write Smart ACEString uStn Element: Allows the active layout template to be saved into the design file as a Smart ACEString. The option is available only when an active layout template exists.

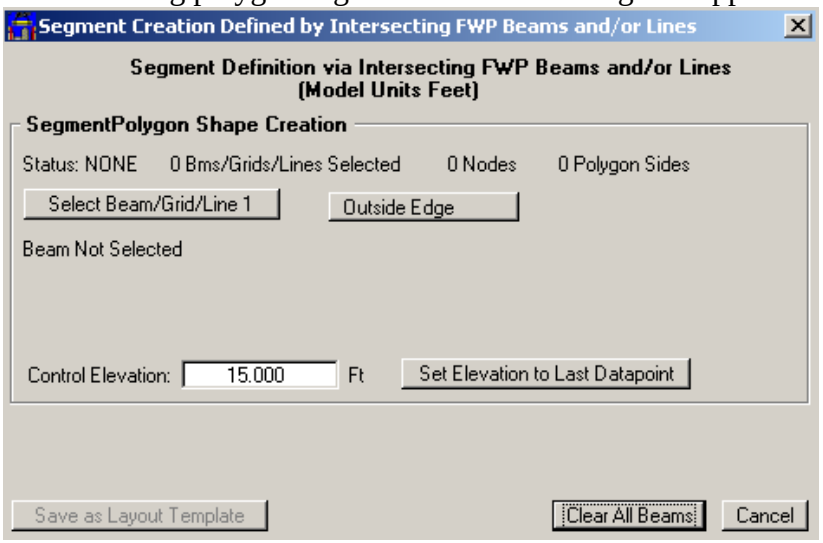
Convert uStn Element to Smart ACEString uStn Element: Allows a conforming MicroStation linestring (type 4) or a MicroStation chain (type 12) to be read and saved back into design file as a Smart ACEString. Note that a Smart ACEString contains out vector information and may be utilized for automated processing.

ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)

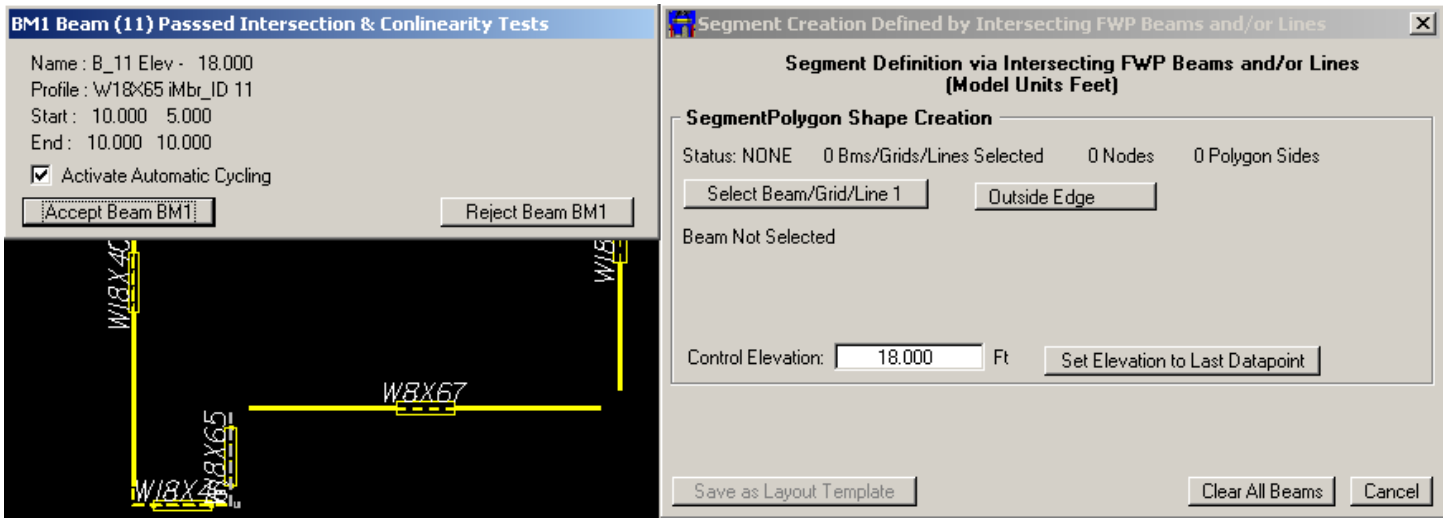
Polygon from Intersecting FWP Beams and/or Lines (uStn & FWP Elems Menu)

The following polygon segment definition dialog box appears when this command is activated:



The process of creating a polygon template is initiated by selecting the starting element (beam/grid/line). As previously mentioned the successive elements must project an intersection to the previous element. (For the intersection computation, all elements are projected to the control elevation – i.e. only X & Y coordinates are used in intersection calculation). The element selection progression may be either clockwise or counterclockwise. The detailed element checks are discussed in the next section. The easiest way to start the element selection process is to start by pressing the "Select Beam/Grid/Line 1" button. Select a element (beam/grid/line) and the accept/reject dialog box pops up as shown below.

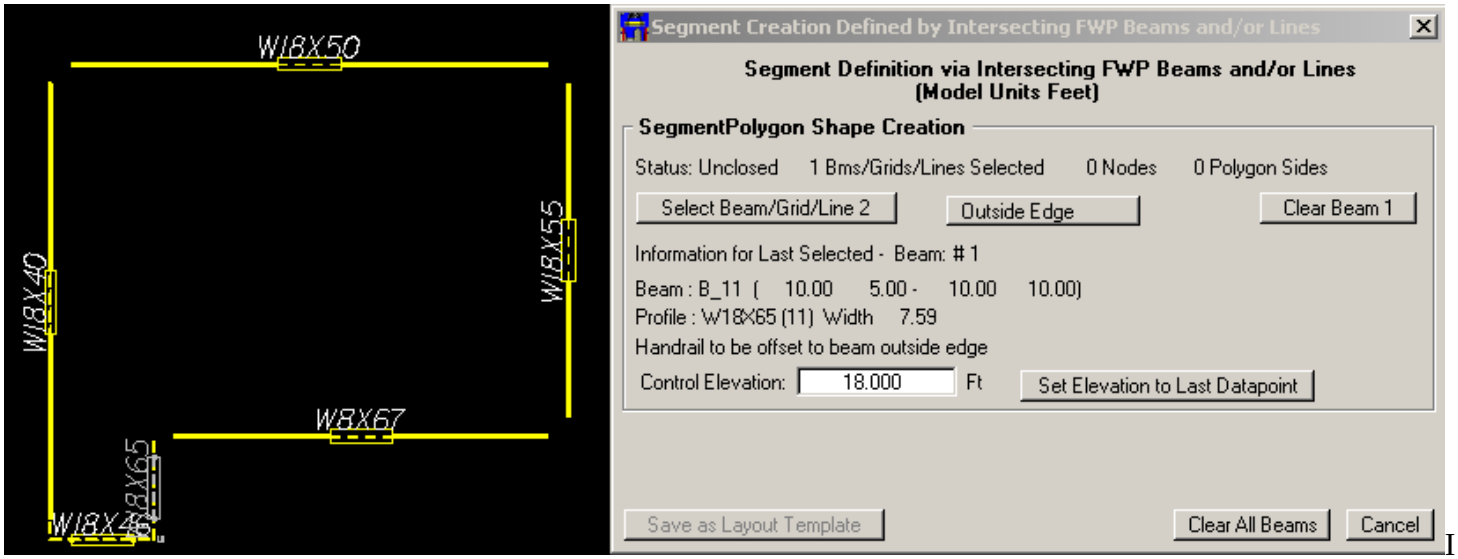
The "Automatic Cycling" is active by default and may be toggled off. With automatic cycling on, the application will expect the selection of elements to continue in progression until the final element is selected with the close polygon toggle option on or until an open polygon is accepted. For this example an open polygon will be created as it is more subtle than creating a closed polygon. The southern end of the "L" shaped polygon will be left open. The first beam selected will be the short W18x65. The selection will then progress in a counter clockwise operation. The handrail will be placed to the outside of the beams (mounted to the side of the beam). After the beam is selected the accept/reject dialog box & polygon dialog box looks as follows:



Note that the W18x65 is highlighted. If Bm1 is accepted, the polygon dialog box will look as shown on next page.

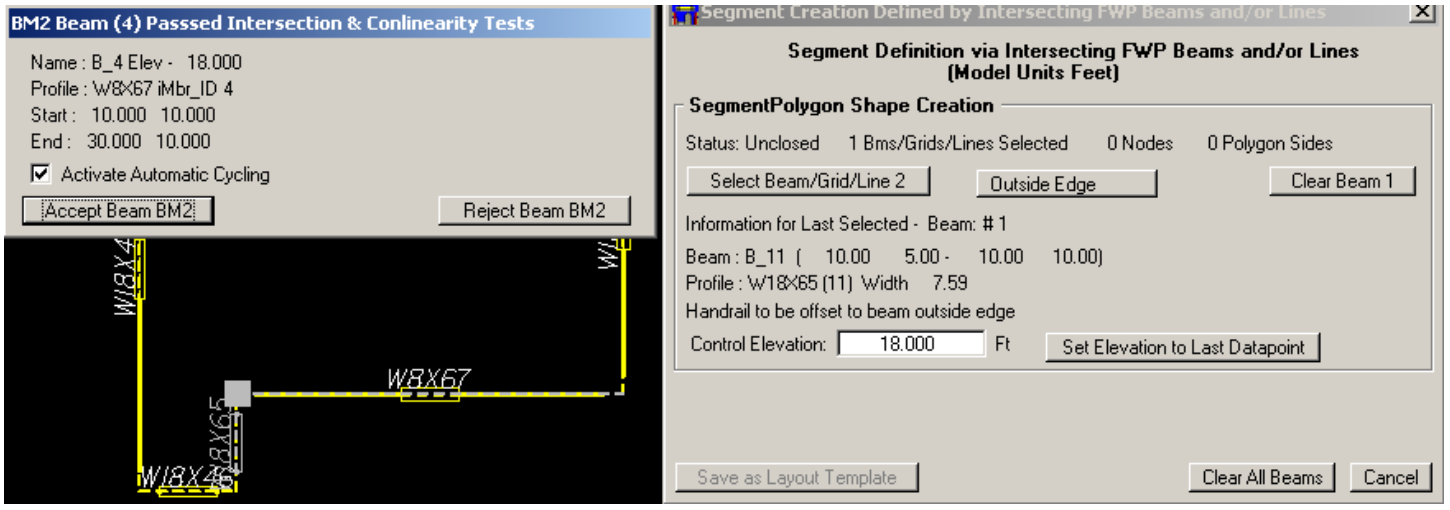
ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)
Polygon from Intersecting FWP Beams and/or Lines (uStn & FWP Elems Menu) (con'd)



In the figure above, the first element (in this case a W18x65) has been selected and the application is ready for the second element. The first element defines the control elevation but does not define any nodes or sides. Notice that a Button "Clear Beam 1" is now present. If desired the last beam selected can be cleared by pressing this button. In fact all elements selected can be cleared by continuously pressing this button until they are no longer any elements selected. This is effectively removing an element at a time from the back. All elements can be cleared at any time by pressing the "Clear all Beams" button. The edge handling (outside, inside, center or defined) may be selected before the element is selected or may be altered for any element after the polygon is accepted (closed or open).

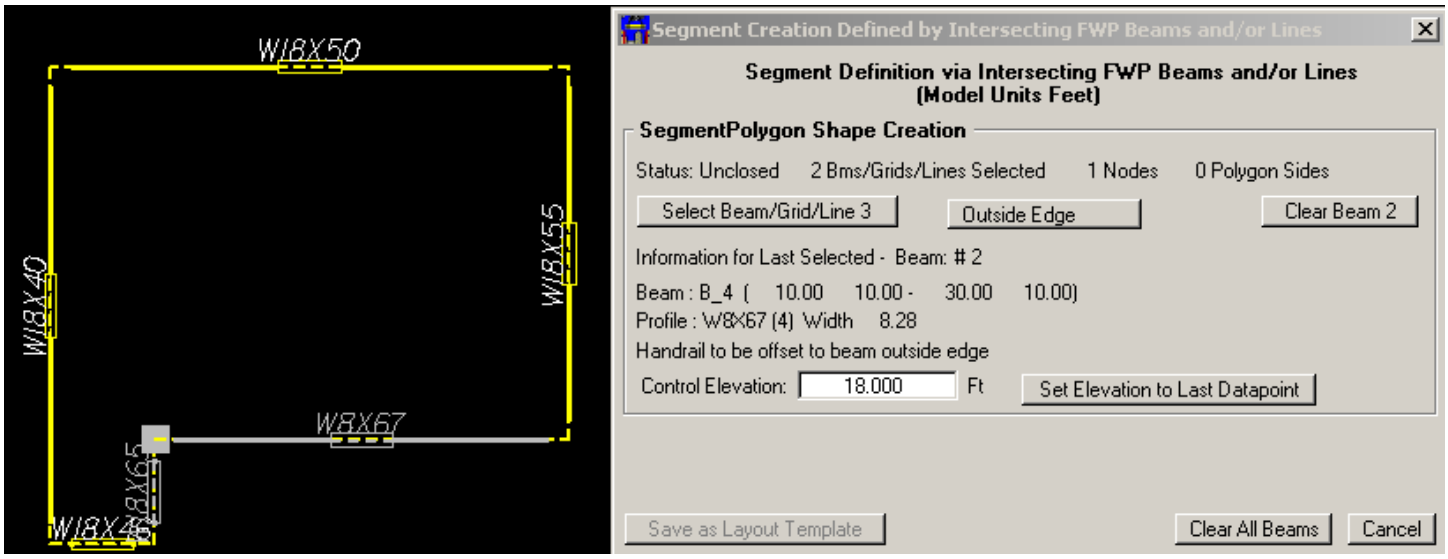
Next, the second beam the W18x67 is then selected. The accept dialog box, polygon dialog box & the view looks as follows:



Note that the W18x67 is highlighted. Also note that intersection of Bm1 & Bm2 now has an active point. When Bm2 is accepted, the polygon dialog box & FWP look as shown on the next page.

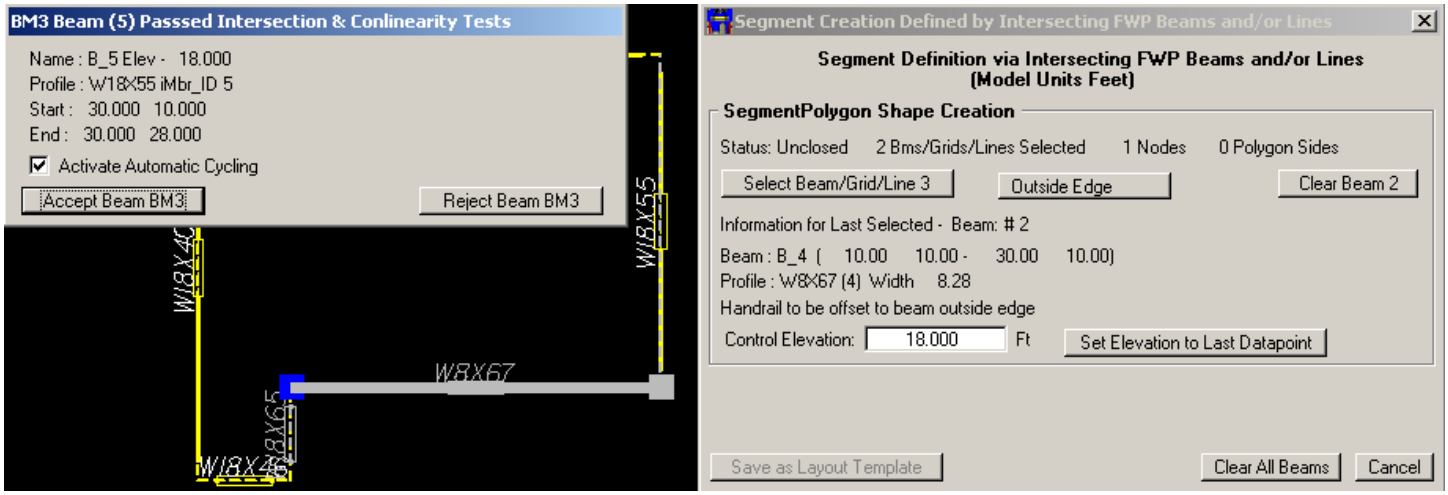
ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)
Polygon from Intersecting FWP Beams and/or Lines (uStn & FWP Elems Menu)



In the figure above, the second element (in this case a W18x67) has been accepted and the application is ready for the third element. Notice that a Button "Clear Beam 2" is now present. If desired the last selection can be "undone". This can be repeated as necessary. The Clear All Beams option is also present.

The third beam a W18x55 (Eastern most beam) is next selected, the accept dialog box, the polygon dialog box & FWP view look as follows:

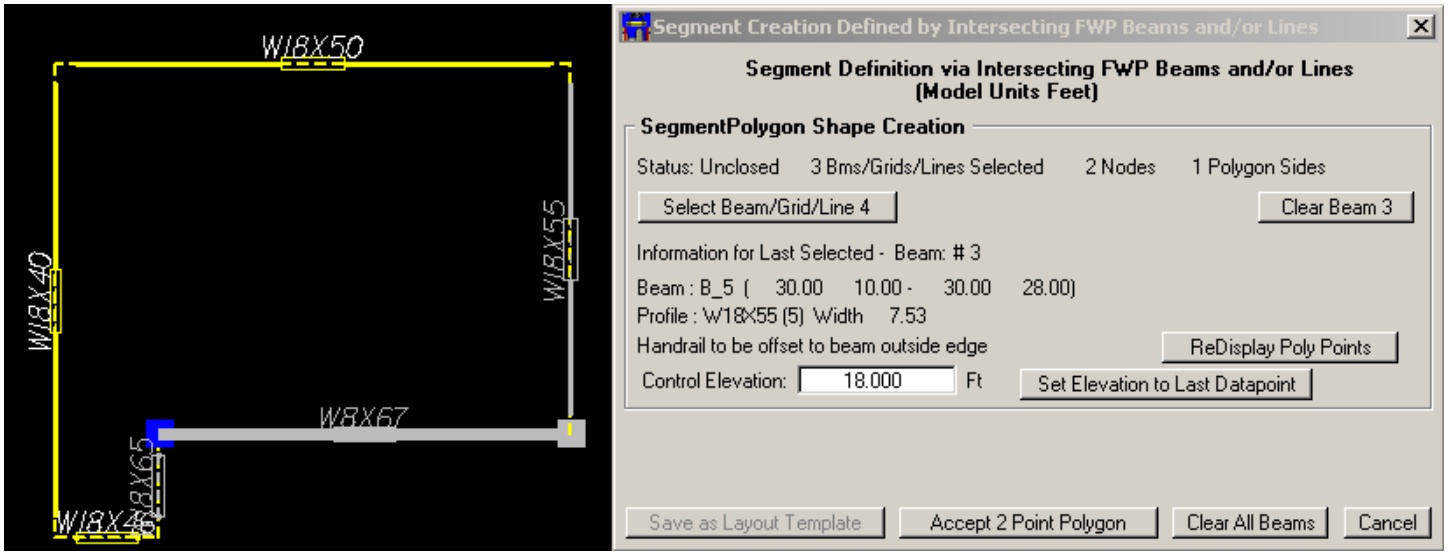


Notice that the W18x55 is now highlighted. Also note that the intersection between Bm2 & Bm3 has a highlighted active point. Also note that the previous intersection of Bm1 & Bm2 is now a blue active point.

When Bm3 is accepted, the polygon dialog box & FWP look as shown on the next page.

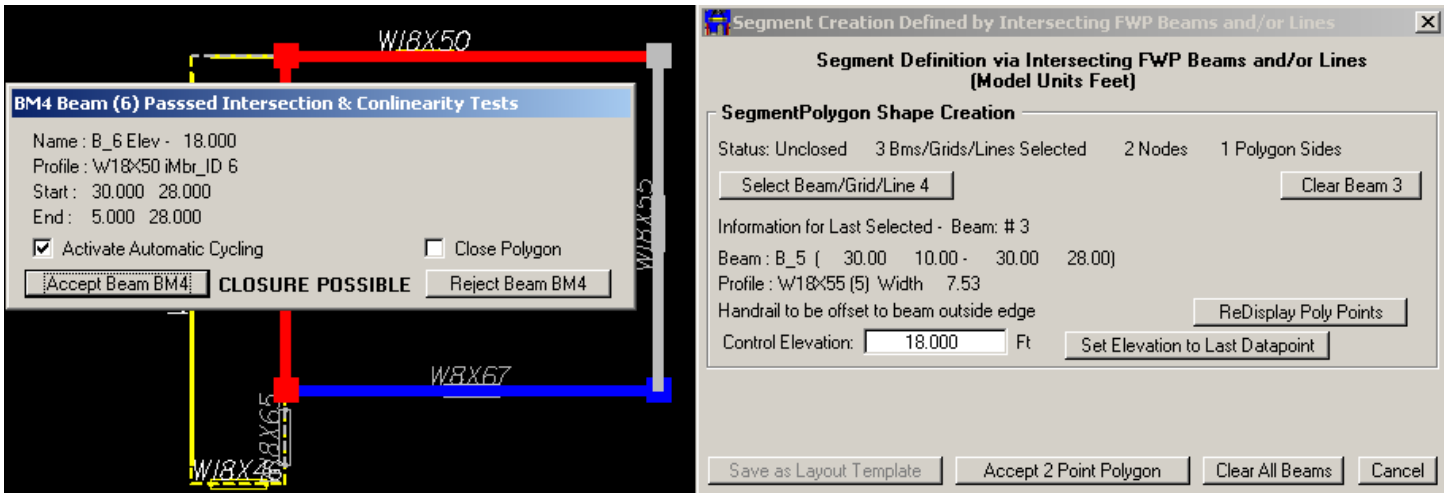
ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)
Polygon from Intersecting FWP Beams and/or Lines (uStn & FWP Elems Menu) (con'd)



In the figure above, the third beam (in this case a W18x55) has been accepted and the application is ready for the fourth beam. Notice that a Button "Clear Beam 3" is now present. If desired the last selection can be "undone". This can be repeated as necessary. The Clear All Beams option is also present.

The fourth beam a W18x50 (Northern most beam) is next selected, the accept dialog box, the polygon dialog box & FWP view look as follows:

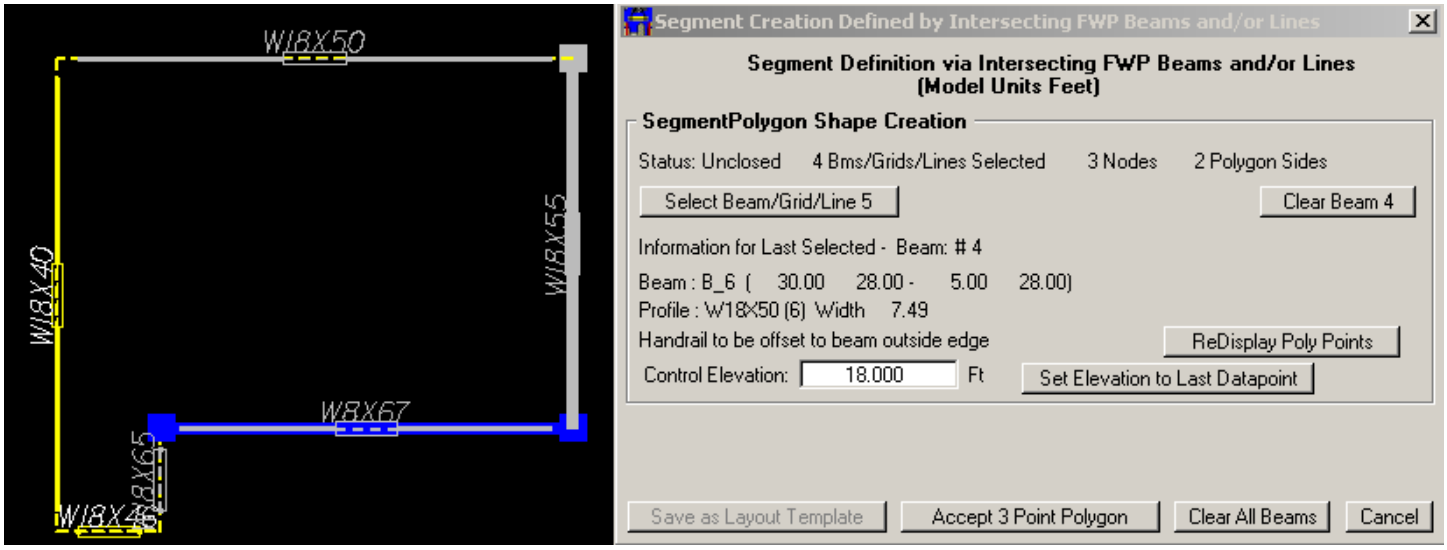


Notice that the W18x50 is now highlighted in red as is a line passing though the first beam. If a closed polygon as shown above is desired, the close polygon toggle should be turned on and Bm4 accepted. This is not what is desired so this Bm 4 is accepted without the close polygon toggle. Also note that the intersection between Bm4 & Bm4 has a highlighted active point. Also note that the previous intersection of Bm2 & Bm3 is now a blue active point. Also note the two red active points indicating possible closure.

When Bm4 is accepted, the polygon dialog box & FWP look as shown on the next page.

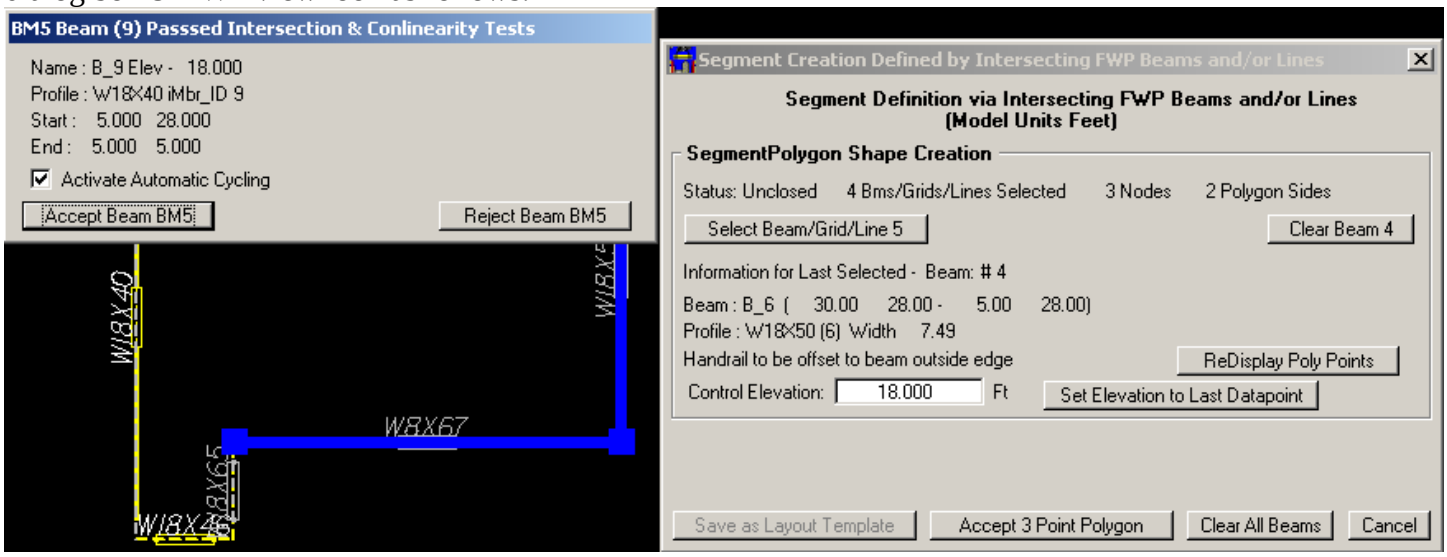
ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)
Polygon from Intersecting FWP Beams and/or Lines (uStn & FWP Elems Menu) (con'd)



In the figure above, the fourth beam (in this case a W18x50) has been accepted and the application is ready for the fourth beam. Notice that a Button "Clear Beam 4" is now present. If desired the last selection can be "undone". This can be repeated as necessary. The Clear All Beams option is also present.

The fifth and final beam a W18x40 (Western most beam) is next selected, the accept dialog box, the polygon dialog box & FWP view look as follows:



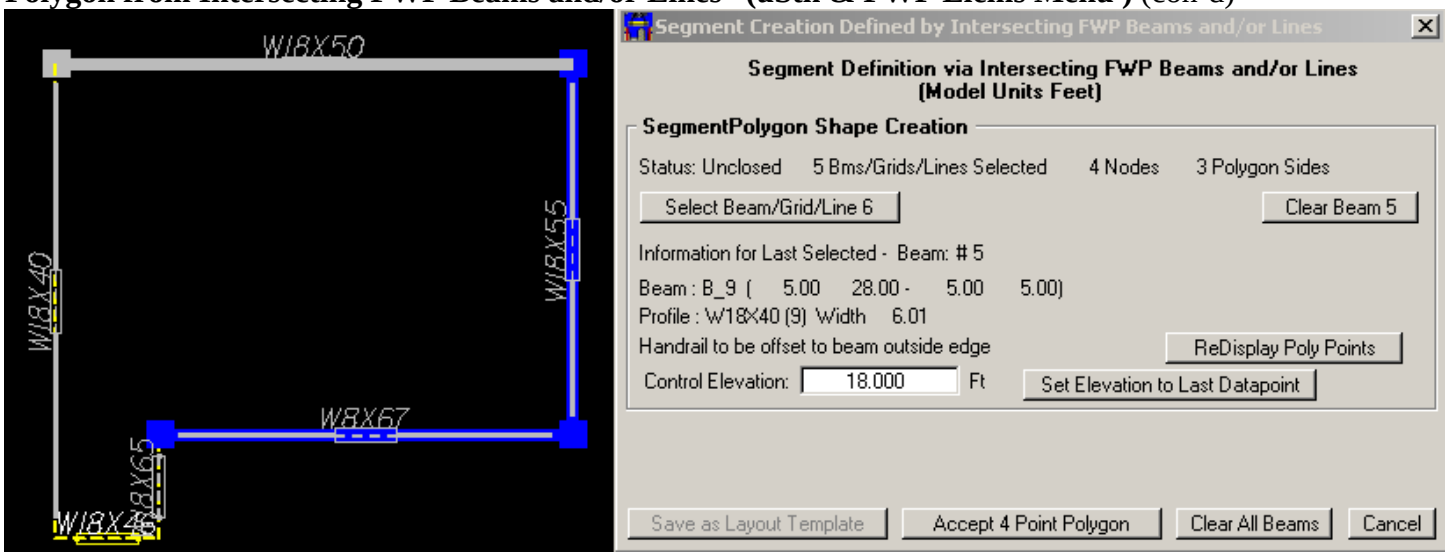
Notice that the W18x40 is now highlighted. Also note that the intersection between Bm4 & Bm5 has a highlighted active point. Also note that the previous intersections of Bm1 & Bm2, Bm2 & Bm3, Bm3 & Bm4 are all now a blue active points. Also note the two red active points indicating possible closure.

When Bm5 is accepted, the polygon dialog box & FWP look as shown on the next page.

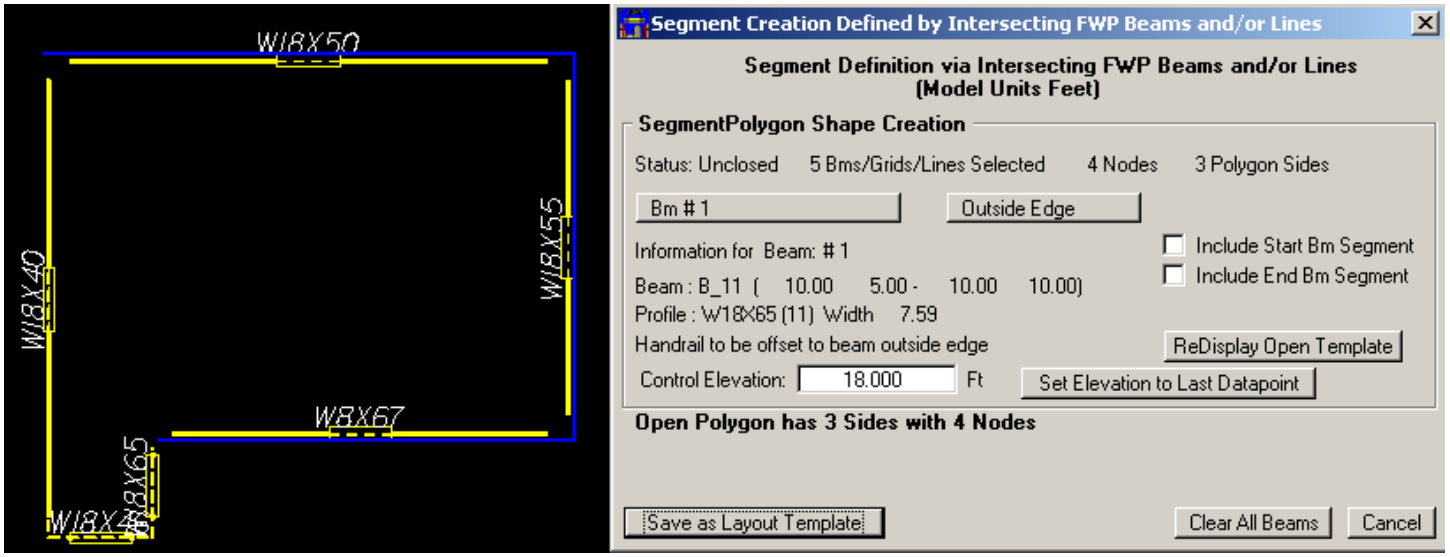
ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)

Polygon from Intersecting FWP Beams and/or Lines (uStn & FWP Elems Menu) (con'd)



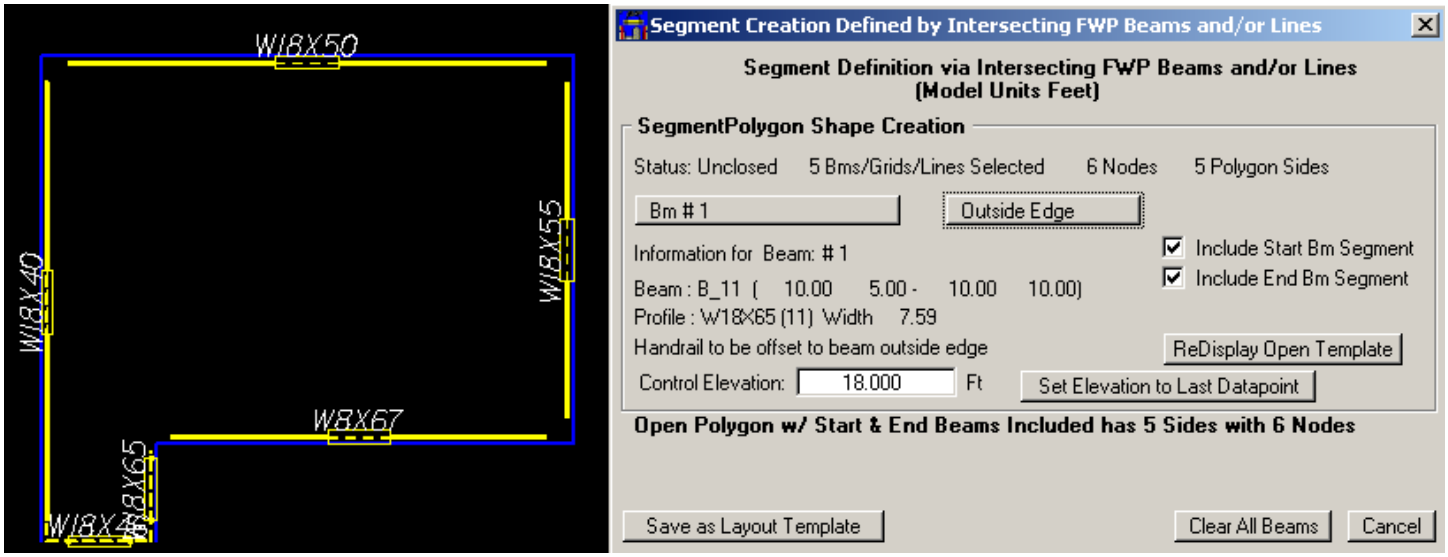
All of the desired beams have been selected and accepted. To proceed, press the "Accept 4 Point Polygon" button. This will take the dialog box to the stage where the end of the polygon may be treated and the extents of the polygon may be manipulated.



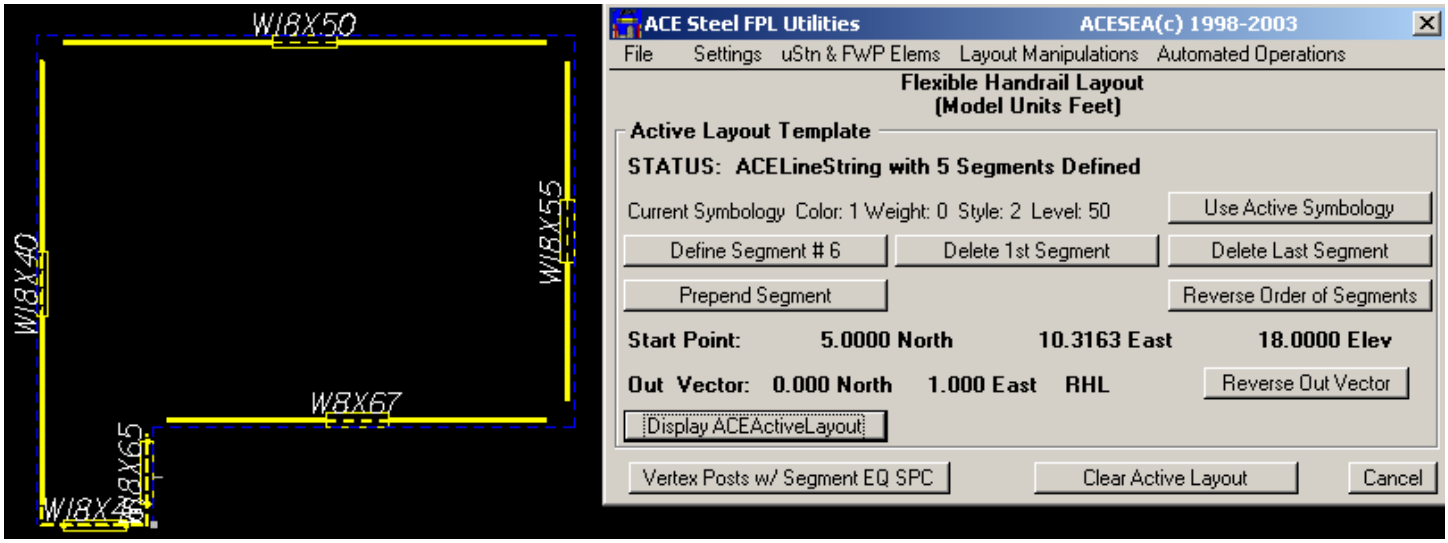
The option to include the start and end beam is now presented with toggles. For this case we wish to have both the start beam segment and the end beam segment utilized thereby making a 5 sided polygon. To do this the two options are toggled on. When the toggles are turned on the polygon dialog box and FWP view are as follows:

ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)
Polygon from Intersecting FWP Beams and/or Lines (uStn & FWP Elems Menu) (con'd)



The extents of the polygon can also be adjusted (outside, center, inside, or defined). For this case outside has been selected for all 5 beams. The template is displayable so that it can be verified. When satisfied with the template press the "Save as Layout Template" button. The primary dialog box will appear as shown below and the layout template can be displayed as shown.



A starting (may be final as in this case) layout template has been successfully defined. This template may now be further edited or processed for handrail. All operation on a template are the same whether template interactively defined, polygon defined, or read from uStn or FWP elements, uStn element smart or ordinary ACEstrings (linestrings or complex chains), saved layout template files or saved handrail layout files.

ACE FWP Flexible Handrail Layout Documentation

Primary (Layout) Dialog Box Pulldown Menus (con'd)

Layout Manipulations Menu

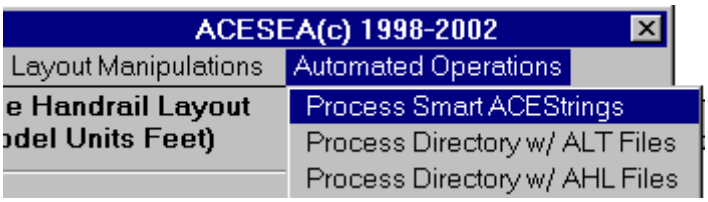
The layout manipulation pull-down has two options. The first option allows for the translation of the entire Layout Template. The second option allows for the rotation of the entire Layout Template about the Z axis relative to a specified coordinate.

Translate Active Layout Template: This option allows the entire Layout Template to be translated a specific amount in the x, y & z coordinates (North/South, East/West & Elevation).

Rotate Active Layout Template: This option allows the entire Layout Template to be rotated about the Z-axis. The rotation is relative to a specified coordinate.

Automated Operations

The Automated Operations pull-down has three options. The three options are: Process Smart ACEStrings, Process Directory w/ ALT Files and Process Directory w/ AHL Files.



Process Smart ACEStrings: Allows automated processing of Smart ACEString elements in the design file. This option will activate a dialog box, which allows a processing filter to be specified before the automated operation is executed. Automated operation utilizes the currently active Layout Template Processing Method. The option is dimmed when an active layout template exists.

Process Directory w/ ALT Files: Allows automated processing of ALT Files (binary ACELayoutTemplate files) in a selected directory. This option will activate a dialog box, which allows a processing filter to be specified before the automated operation is executed. Automated operation utilizes the currently active Layout Template Processing Method. The option is dimmed when an active layout template exists.

Process Directory w/ AHL Files: Allows automated processing of AHL Files (binary ACEHandrailLayout files) in a selected directory. This option will activate a dialog box, which allows a processing filter to be specified before the automated operation is executed. The option is dimmed when an active layout template exists.

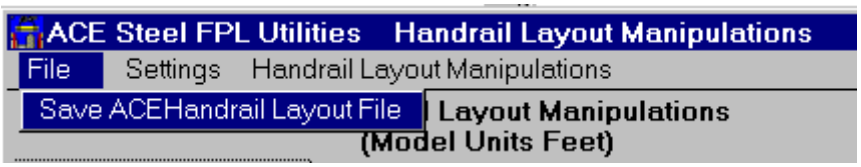
ACE FWP Flexible Handrail Layout Documentation

Handrail Layout Dialog Box Pull-down Menus

The dialog box features the following 3 pull-down menus: File, Settings, Handrail Layout Manipulations. Each of the pull-down menus and the associated options are discussed below.

File Menu

The file pull-down has only one option, Save ACEHandrailLayout File (AHL file). Whenever the Handrail Layout Manipulations dialog box is active, the handrail layout may be saved as an AHL file.



Save ACEHandrailLayout File: The AHL file is a complete handrail layout configuration (including Layout Template). A saved AHL file can be read interactively or processed in automated mode. An AHL file can only be read interactively from the Layout Template (primary) dialog box when there is no active layout template.

Settings Menu

The settings pull-down has two options. The first option is the same Edit/View Handrail Parameters that can also be found in the settings pull-down menu of the Layout Template (primary) dialog box and the Automated Operations dialog box.

Edit/View Handrail Parameters: The handrail parameters consist of all the handrail settings (editable & non-editable) defined in the definition file. Items include: rail, post & toe plate properties; interference envelope settings, toe plate option, CP settings, post position, etc. The handrail parameters are shown in greater detail in the Handrail Parameters section. Note that handrail parameters may also be accessed through the layout template (primary) dialog box and the automated operations dialog box.

Handrail Graphics Symbology: The symbology for placement of dumb graphics to depict handrail may be edited/viewed with this settings dialog box. The symbology is initially defined in the definition file. The symbology may be changed at any time. The symbology is saved in ACEHandrailLayout files.

Handrail Layout Manipulations Menu

The layout manipulation pull-down has two options. The first option allows for the translation of the entire Handrail Layout. The second option allows for the rotation of the entire Handrail Layout.

Translate Handrail Layout: This option allows the entire Handrail Layout (obviously includes the layout template) to be translated a specific amount in the x, y & z coordinates (North/South, East/West & Elevation).

ACE FWP Flexible Handrail Layout Documentation

Handrail Layout Dialog Box Pull-down Menus (con'd)

Handrail Layout Manipulations Menu (con'd)

Rotate Handrail Layout: This option allows the entire Handrail Layout (obviously includes the layout template) to be rotated about the Z-axis. The rotation is relative to a specified coordinate.

Set Exterior Posts to Vertex: This option allows the exterior posts for all segments to be set to vertex OV orientation (first & last posts are not changed for open layouts). A vertex setting is computed as the average OV for the segment proceeding (previous) and following (next) the exterior post.

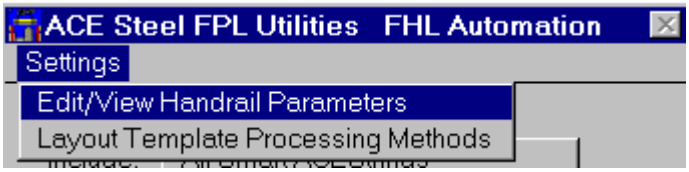
Set Exterior Posts to Prev Segment: This option allows the exterior posts for all segments to be set to the OV for the previous segment (first post is not changed for open layouts).

Set Exterior Posts to Next Segment: This option allows the exterior posts for all segments to be set to the OV for the next segment (last post is not changed for open layouts).

Note that the OV for an arc segment is parallel to a line drawn from the arc center to the exterior post. The OV for a linear segment is perpendicular to the segment. For both cases, the positive direction is determined by the OUT vector.

Automated Operations Dialog Box Pull-down Menus

This dialog box features the following one pull-down menu: Settings.



Edit/View Handrail Parameters: The handrail parameters consist of all the handrail settings (editable & non-editable) defined in the definition file. Items include: rail, post & toe plate properties; interference envelope settings, toe plate option, CP settings, post position, etc. The handrail parameters are shown in greater detail in the Handrail Parameters section. Note that handrail parameters may also be accessed through the layout template (primary) dialog box and the automated operations dialog box.

Layout Template Processing Methods: There are three available Layout Template Processing Methods. This dialog box allows both configuration and selection of template processing method. The Layout Template Processing Methods are initially defined in the definition file. The Layout Template Processing Methods are discussed in greater detail in the Layout Template Processing Methods section. Note that Layout Template Processing Methods may also be accessed through the Layout Template dialog box.

ACE FWP Flexible Handrail Layout Documentation

External Binary Files

The Flexible Handrail Layout applications sports two binary file formats for saving and recalling handrail layout information. The two formats are as follows:

ACELayoutTemplate File (ALT file)

This file contains information for an ACELineString or a ACEComplexString (see above MicroStation Design File Elements as Layout Template). The binary file contains all the information to construct the appropriate element and the following additional information: name, date created, creator, and OUT direction. At any time, an active handrail layout template can be saved as an ACELayoutTemplate file. The ACELayoutTemplate file can be read at a later time. The new active handrail layout template may then be processed. At that point, the handrail layout may then be placed into a FrameWorks model as FrameWorks components or it may be manipulated (see Interactive Capabilities) or it may be saved as an ALT or AHL file. At any time, an active handrail layout may be saved as a ACELineString (ACEComplexString if ARCs are present) directly into the design file. ACELayoutTemplate files all have an .ALT extension.

The initial search location of ALT files can be controlled with the following environment variable. **ACE_FHL_ALT**. If this variable is not set, the default location is C:\ but can of course be changed with the open and/or save dialog boxes. To search for ALT files in the D:\mydir directory, set variable as follows:

ACE_FHL_ALT=D:\mydir

ACEHandrailLayout File (AHL file)

This file contains all the information necessary to place a handrail layout into a FrameWorks model (includes: active layout template, active handrail parameters, detailed Post locations and detailed entry information). At any time, an active handrail layout can be saved as a ACEHandrailLayout file. The ACEHandrailLayout file can be read at a later time. If an active handrail layout exists when an ACEHandrailLayout file is read, it will be deleted and replaced by the contents in the AHL file. The new active handrail layout may then be placed into a FrameWorks model as FrameWorks components or it may be manipulated (see Interactive Capabilities) or it may be saved as a ALT or AHL file. ACEHandrailLayout files all have an .AHL extension.

The initial search location of AHL files can be controlled with the following environment variable. **ACE_FHL_AHL**. If this variable is not set, the default location is C:\ but can of course be changed with the open and/or save dialog boxes. To search for AHL files in the D:\mydir directory, set variable as follows:

ACE_FHL_AHL=D:\mydir

ACE FWP Flexible Handrail Layout Documentation

Design File Elements as Layout Template

Three uStn elements and three FWP elements may be used as templates for handrail layouts. Two of the uStn elements (type 4 & type 12) can be "smart". Smart elements contain a 100 UOR line at the beginning representing out vector for line string start. The six elements may be used to start the definition of a handrail layout. The two "smart" elements may also be used for automated handrail placement.

MicroStation (uStn) LineString (Type 4) Smart or Ordinary

A MicroStation linestring may be utilized as a template for a handrail layout if 1) there are 51 vertices or less and 2) if there are no vertical elements. The linestring may be open or closed. An element conforming to those limitations is termed an ACELineString. ACELineString's may be smart or ordinary. An ordinary ACELineString does not contain an OUT direction definition.

MicroStation (uStn) Shape (Type 6) (ordinary only – may be converted to Smart LineString)

A MicroStation shape may be utilized as a template for a handrail layout if 1) there are 51 vertices or less and 2) if there are no vertical elements. Shapes are by their very nature closed. An element conforming to those limitations is termed an ACELineString. Note that an ACELineString does not contain an OUT direction definition, thus when identified, both the start of the ACELineString and the OUT direction are identified. An option is switch to change either.

MicroStation (uStn) Complex Chain Element (Type 12) Smart or Ordinary

A special type MicroStation complex chain element may be utilized as a template for a handrail layout if 1) the complex element is continuous and all elements are lines or FrameWorks conforming ARC's, 2) there are 50 components or less and 3) if there are no vertical elements. The chain element may be open or closed. An element conforming to those limitations is termed an ACEComplexString. Note that a ACEComplexString does not contain a OUT direction definition, thus when identified, both the start of the ACEComplexString and the OUT direction are identified. An option is given to switch either.

MicroStation (uStn) Arc Element (Type 16) Ordinary

A MicroStation arc element may be utilized as a template for a handrail layout if the arc does not lie in a vertical plane. Arc elements are by their very nature open. An element conforming to those limitations is termed an ACEComplexString (albeit a simple one). Note that a ACEComplexString does not contain a OUT direction definition, thus when identified, both the start of the ACEComplexString and the OUT direction are identified. An option is given to switch either. If the arc is a 360 degree arc, the arc will be subdivided into two 180 degree arcs.

Frameworks Slabs (ordinary only – may be converted to Smart ACEComplexString)

A Frameworks Slab may be utilized as a template for a handrail layout if 1) there are 50 lines and/or arcs or less and 2) if there are no vertical elements. Note that a Frameworks Slabs does not contain a OUT direction definition, thus when identified, both the start of the Frameworks Slabs and the OUT direction are identified. An option is given to switch either.

Frameworks Member (ordinary only – may be converted to Smart ACELineString)

A Frameworks Member (linear Beam, Column, Vbrace or Hbrace) may be utilized as a template for a handrail layout. This produces a single straight segment as the active layout template segment.

Frameworks Arc (ordinary only – may be converted to Smart ARCComplexString)

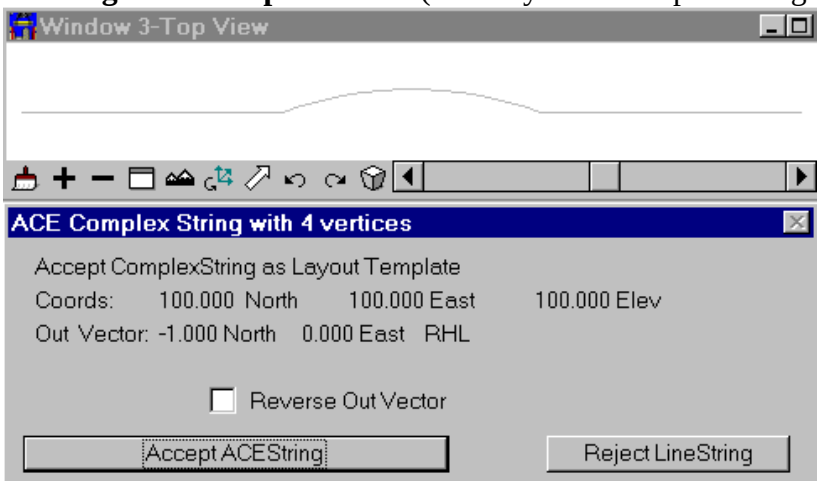
A Frameworks Arc (Arc Beam, Column, Vbrace or Hbrace) may be utilized as a template for a handrail layout. This produces a single arc segment as the active layout template segment unless, the arc is a 360 degree arc. For a 360 degree arc element, the active layout template will be two segments, each segment being a 180 degree arc, forming a closed template.

ACE FWP Flexible Handrail Layout Documentation

Reading Design File Elements as Layout Template

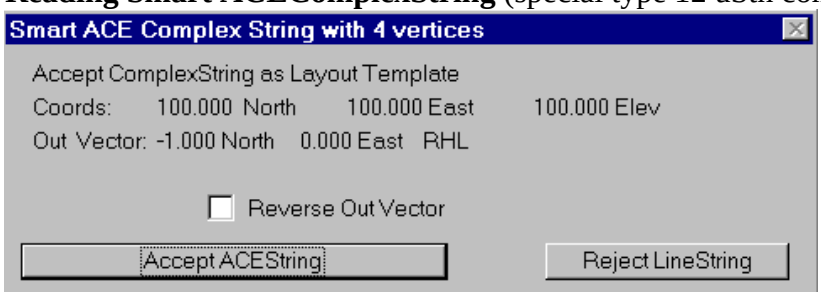
Reading various uStn elements for Layout Templates is illustrated below.

Reading uStn Complex Chain (ordinary ACEComplexString type 12 uStn element)



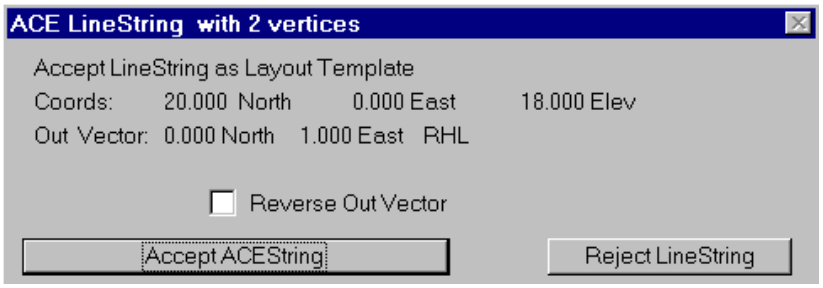
A uStn type 12 complex chain can be read as a layout template if it contains connected line & arcs. The command "Read uStn Element (Smart or Ordinary)" from the "uStn & FWP Elems" pull-down menu is first initiated. A prompt to select the element is issued. When a conforming ACEString element is found, the element is highlighted. When the element is accepted, a dialog box as shown on the left appears. The ACEString can be accepted or rejected. The Out Vector can optionally be reversed. This particular ACEString was the one used for the initial dialog box illustrations.

Reading Smart ACEComplexString (special type 12 uStn complex chain element)



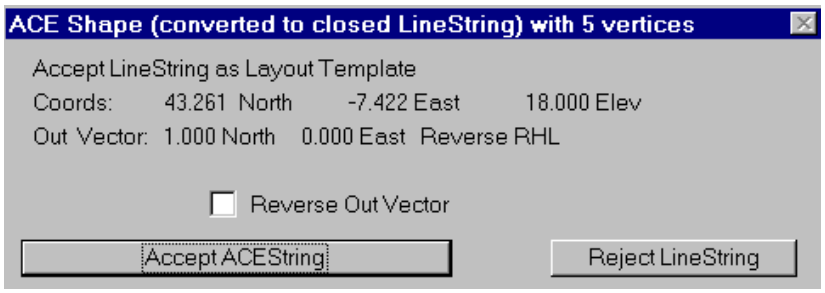
The only difference between a Smart ACEComplexString and a ordinary ACEComplexString is that the Out Vector is already defined. Even though it is defined, it can still be reversed if desired. The rest of the operation is the same as that described above.

Reading uStn LineString (ordinary ACELineString type 4 uStn element)



A uStn type 4 linestring can be read as a layout template. The command "Read uStn Element …" from the "uStn & FWP Elems" pull-down menu is first initiated. The rest of the operation is the same as that described above.

Reading uStn Shape (type 6 uStn element)



A uStn type 6 shape can be read as a closed Layout Template. The start of the closed ACELineString is the vertex closest to the point used to identify the shape. The command "Read uStn Element…"from the "uStn & FWP Elems" pull-down menu is first initiated. The rest of the operation is the same as that described above.

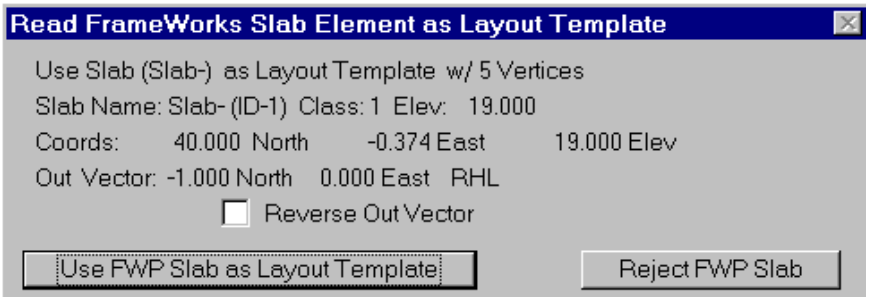
ACE FWP Flexible Handrail Layout Documentation

Reading Design File Elements as Layout Template (con'd)

Reading of FWP Slab & Arc elements for Layout Templates is illustrated below. The reading of a FWP Member is not illustrated, as it is very similar to the reading of a FWP Arc.

Reading FWP Slab (FWP element)

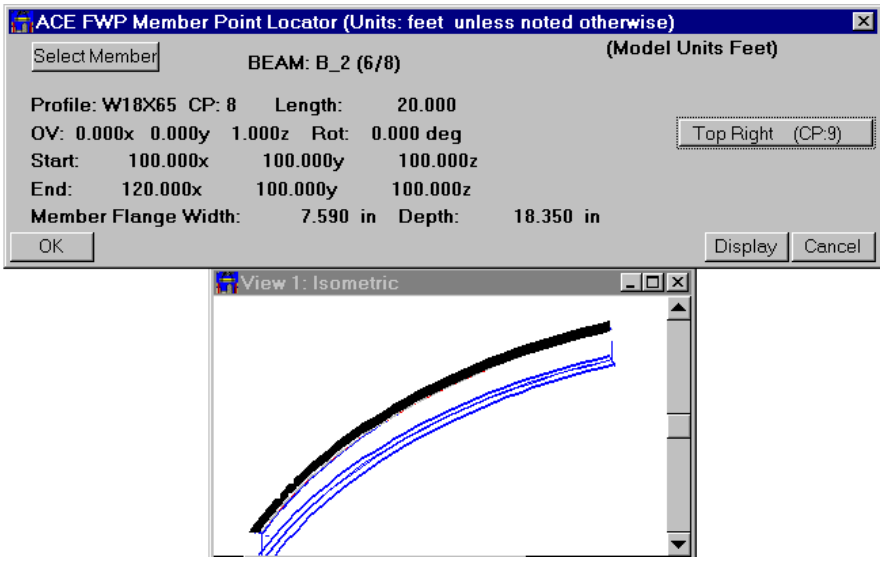
A FWP slab can be read as a closed Layout Template. The command "Read from FWP Slab" from the "uStn & FWP Elems" pull-down menu is first initiated. A prompt to select the slab is issued. When a slab is selected, the slab is highlighted. When the slab is accepted, a dialog box as shown on the left appears. The ACEString can be accepted or rejected. The Out Vector can optionally be reversed. The start of the closed ACEString is the vertex closest to the point used to identify the slab. The read slab can be an especially useful capability if the company and/or project standard promotes the use of handrail side mounted against slabs.



Reading FWP Arc (FWP element)

A FrameWorks Arc or member (linear) element may be read as the 1st segment. This segment may be any cardinal point (1 through 9) for the element. If "OK" is pressed the selected CP of the member becomes the first active Layout Template segment. The active Layout Template can be manipulated as shown earlier. Reading a FWP element simply defines the 1st segment (obviously this can be the only segment if so desired).

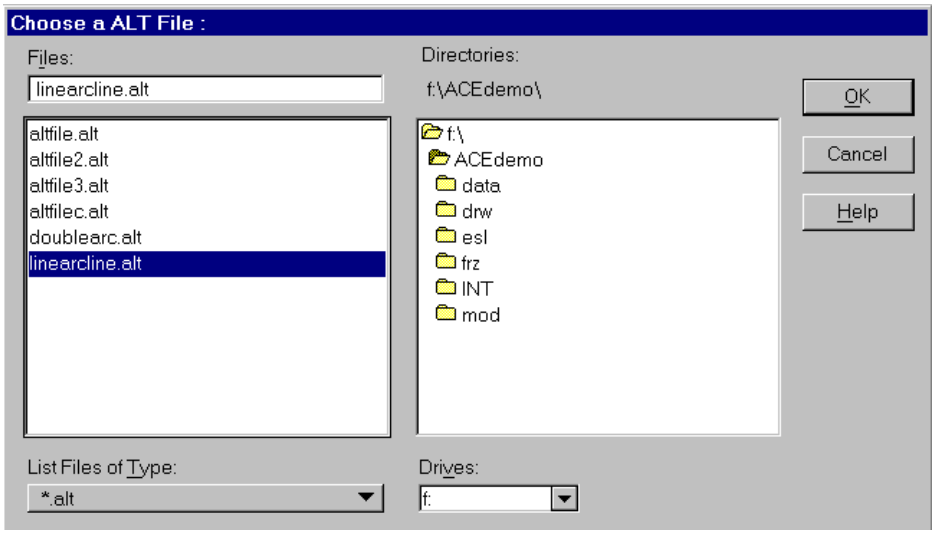
The dialog box and figure at the left illustrates reading a FWP Arc element. Reading a linear member is very similar and thus is not illustrated.



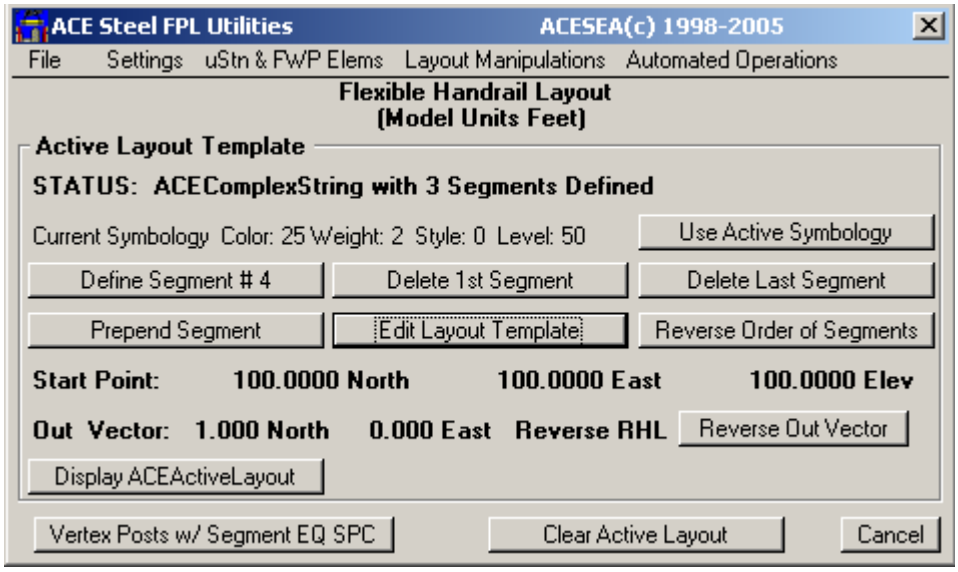
ACE FWP Flexible Handrail Layout Documentation

Reading Binary ACELayoutTemplate File as Layout Template

An ACELayoutTemplate (ALT) file can be read as an Active Layout Template. Reading an ALT file is initiated by selecting the option “Read ACELayoutTemplate File” on the “File” pull-down menu. This results in the dialog box shown at the left. An ALT file can be read as a layout template only when there is no active layout template. If an active Layout Template exists, it can optionally be saved as an ALT file and then cleared. The desired ALT file can then be read to create a new active Layout Template. Select linearcline.alt & press OK.



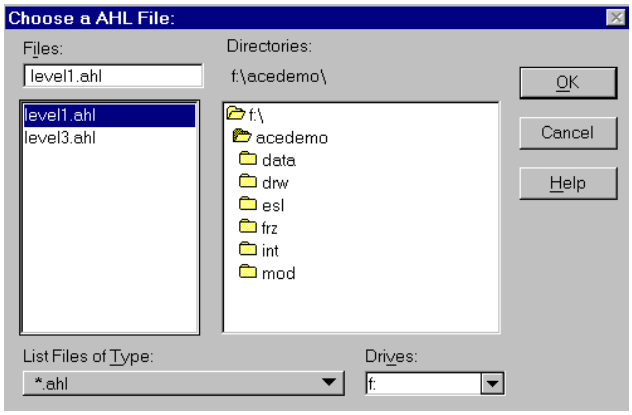
When the “OK” button is pressed, the Layout Template dialog box appears populated with data from the ACELayoutTemplate file. If Layout Template modifications are desired, they can now be made. Once a satisfactory Layout Template is established, a Handrail Layout may be generated. Generate a Handrail Layout by processing the Layout Template with the currently active Layout Template Processing Method (for this example “Vertex Posts w/ Segment EQ SPC). The active Layout Template Processing Method may be changed or modified if so desired.



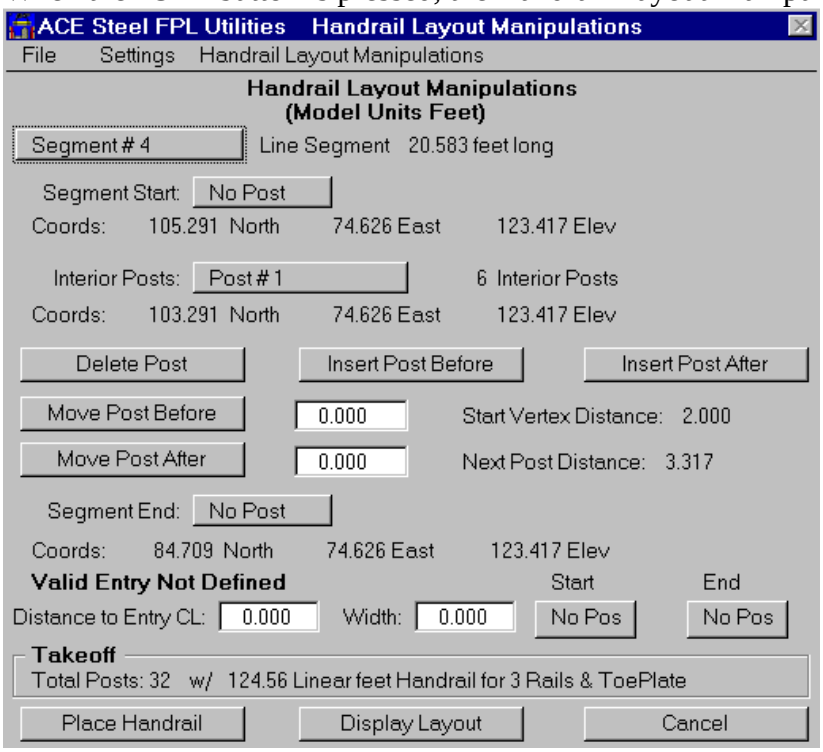
ACE FWP Flexible Handrail Layout Documentation

Reading Binary ACEHandrail Layout File

An ACEHandrail Layout (AHL) file can be read as a complete Handrail Layout configuration. Reading an AHL file is initiated by selecting the option "Read ACEHandrailLayout File" on the "File" pull-down menu. This results in the dialog box shown at the left. An AHL file can only be read from the Layout Template dialog box and only when there is no active Layout Template. If an active Layout Template exists, it can optionally be saved as an ALT file and then cleared. The desired AHL file can then be read to create a complete Handrail Layout.



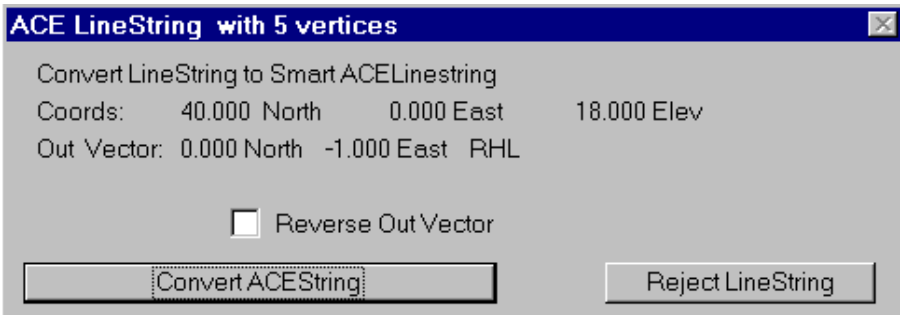
When the "OK" button is pressed, the Handrail Layout Manipulations dialog box appears populated with data form the ACEHandrailLayout File. An AHL file contains both Layout Template data and Handrail Layout data. When an AHL file is read, the active Handrail Parameters become those contained in the AHL file.



ACE FWP Flexible Handrail Layout Documentation

Converting uStn Design File Elements to Smart ACEString uStn Design File Elements

A conforming uStn linestring (type 4) may be converted to a Smart ACELineString. Similarly a conforming uStn complex chain (type 12) may be converted to a Smart ACEComplexString. The only difference between an ordinary conforming uStn element and a Smart ACEString is that the Out Vector is known by the Smart ACEString. Smart ACEStrings in the design file may be processed in an automated fashion (see Automated Capabilities). To convert ordinary uStn elements to Smart ACEStrings, the "Convert uStn Element to Smart ACEString" option on the "uStn & FWP Elems" pull-down menu. When the command is activated, select the desired uStn element and the following dialog box appears.



Notice that an option exists to "Reverse Out Vector". Toggle this on if the Out Vector shown is incorrect. If the wrong element was selected, press "Reject LineString" and the Layout Template dialog box will reappear with no action. If the correct element was identified, press "Convert ACEString" to convert the element. When an element is converted, the following occurs. The identified element is deleted from the design file. Subsequently a Smart ACEString (ACELineString if all segments are linear or a ACEComplexString if any segment is an Arc) is written to the design file. The smart element will be written as a type 4 or type 12 element with a linear vector (100 UOIRs long) to represent the OUT Vector. The element that is written will have the current default symbology (level, color, weight & style). This can of course be very important so be sure to set the symbology to the desired settings. The symbology can be set with the "Edit/View ACEString Symbology" on the "Settings" pull-down menu.

The "Convert uStn Element to Smart ACEString" command is always available even when an active Layout Template exists. Whether an active Layout Template exists or not the symbology is controlled as stated above and will note necessarily be the symbology for the active Layout Template.

ACE FWP Flexible Handrail Layout Documentation

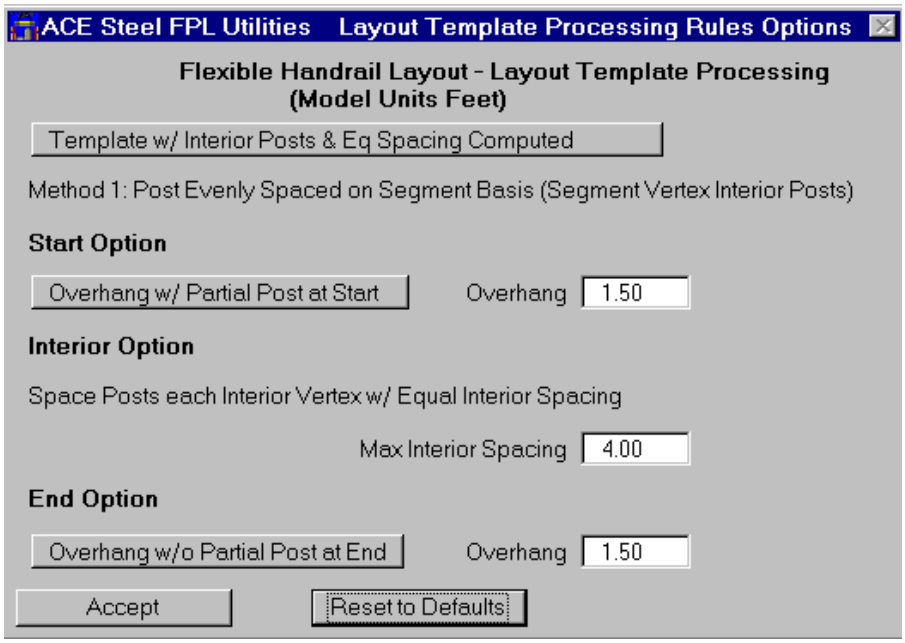
Layout Template Processing Methods (Rules)

The layout template is in reality a connected set of lines and/or arcs. The layout template may be processed with three available methods (rules). The three methods allow significantly different processing techniques for the layout template. The active Layout Template Processing Method and the variables for each method is specified in the definitions file. The active method is the method that is displayed when the Layout Template Processing Method dialog box is activated. Note that the active method is also shown in the title of the "process button" at the lower left of the Layout Template (primary) dialog box. Each method has several options.

Method 1 (Template w/ Interior Posts & Eq Spacing Computed)
This method will place a post at each interior vertex. The first segment first post can be specified at the start vertex or a start overhang distance can be specified. Similarly, the last segment last post can be specified at the end vertex or a end overhang distance can be specified (see closed layout notes below). Each segment's interior posts will be spaced so as not to exceed the Interior Option Maximum Interior Spacing Value.

- **Start Option (1st vertex of Layout Template)**
  1. Post at Start
  2. Partial Post w/ Overhang at start – Overhang value is specified
  3. Overhang w/o partial post at start – Overhang value specified
- **Interior Option (Option for each interior segment)**
  Place post at each interior vertex (node)
  Maximum Interior (segment) Spacing Value is specified
- **End Option (last vertex of Layout Template)**
  1. Post at End ***(for non-closed layouts)***
  2. Partial Post w/ Overhang at end – Overhang value is specified
  3. Overhang w/o partial post at end – Overhang value specified

  Note that for a closed layout, if the post at start is specified there will be an end post. If an overhang is specified for the start & a post is specified at the end for a closed layout, the start overhang condition is used for the end.



Note: If this method is active, the "process button" will state **Vertex Posts w/ Segment EQ SPC.**

ACE FWP Flexible Handrail Layout Documentation

Layout Template Processing Methods (Rules) (con'd)

Method 1 (Template w/ Interior Posts & Eq Spacing Computed) (con'd)

Layout Template Method 1 allows specification of both a start offset & an end offset. If an overhand is specified that is close to or exceeds the segment length special rules have been developed to hopefully produce better post population results. The same basis rule is utilized at both the start & end.

Case where the Overhang exceeds the First (or Last) Segment Length
In this situation a post is not placed on the interior of the first segment.

Case where the Overhang exceeds the First (or Last) Segment Length minus 1/3 Max Interior Spacing
In this situation a single interior post is placed at the center of the first (or last) segment.

ACE FWP Flexible Handrail Layout Documentation

Layout Template Processing Methods (con'd)

Method 2 (Template w/o Interior Posts & Eq Spacing Specified)

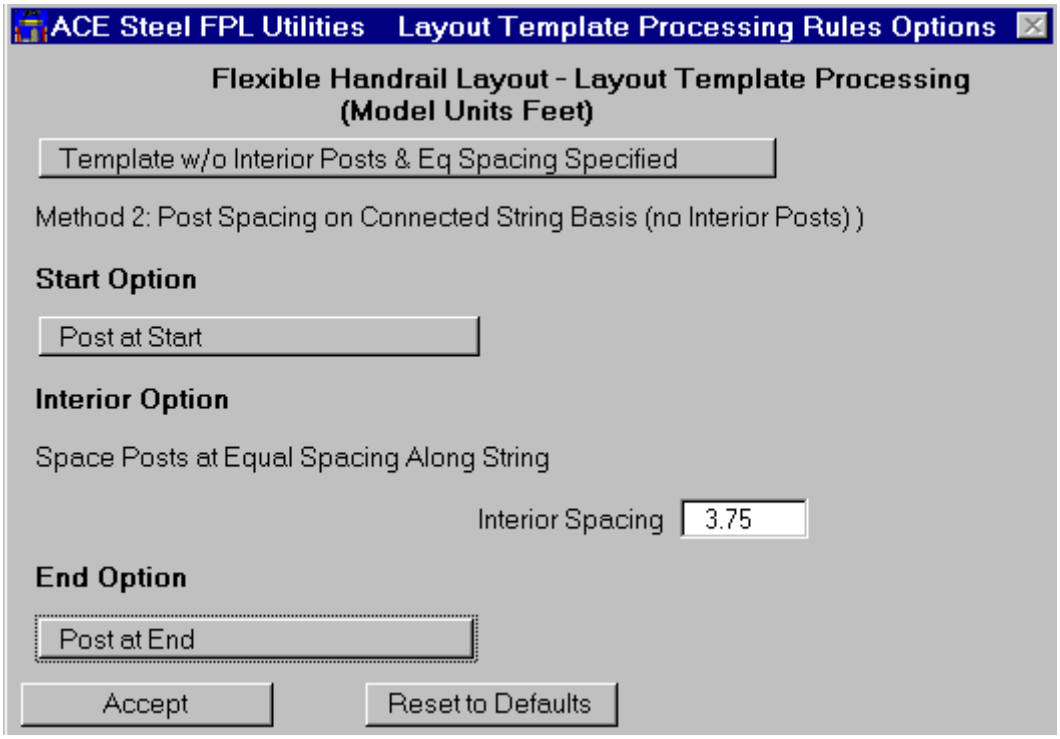
This is the only method that truly allows the layout template to be processed as a continuous collection of lines and arcs. The first segment first post can be specified at the start vertex or a start overhang distance can be specified. Interior posts are then spaced equally (using Interior Spacing Value) from the first post along the layout template. A partial post may be placed at the start vertex. A post or partial post may be placed at the end vertex for non-closed layouts (see closed layout notes below).

Start Option (1st vertex of Layout Template)

1. Post at Start
2. Overhang w/ Partial Post at start – Overhang value is specified
3. Overhang w/o Partial Post at start – Overhang value is specified

- **Interior Option (post spacing for all but 1st & last posts)**
  Space Posts Equally along Layout Template
  Interior Spacing Value is used as actual spacing
- **End Option**
  1. Post at End
  2. Overhang w/ Partial Post at end – Overhang value is computed
  3. Overhang w/o partial post at end – Overhang value is computed

  Note that for a closed layout, if the post at start is specified there will be a end post. If an overhang is specified for the start & a post is specified at the end for a closed layout, end post is handled as follows. End overhang is computed and if overhang equals Interior Spacing Value, a post is placed at the end.



Note: If this method is active, the "process button" will state **String EQ SPC**.

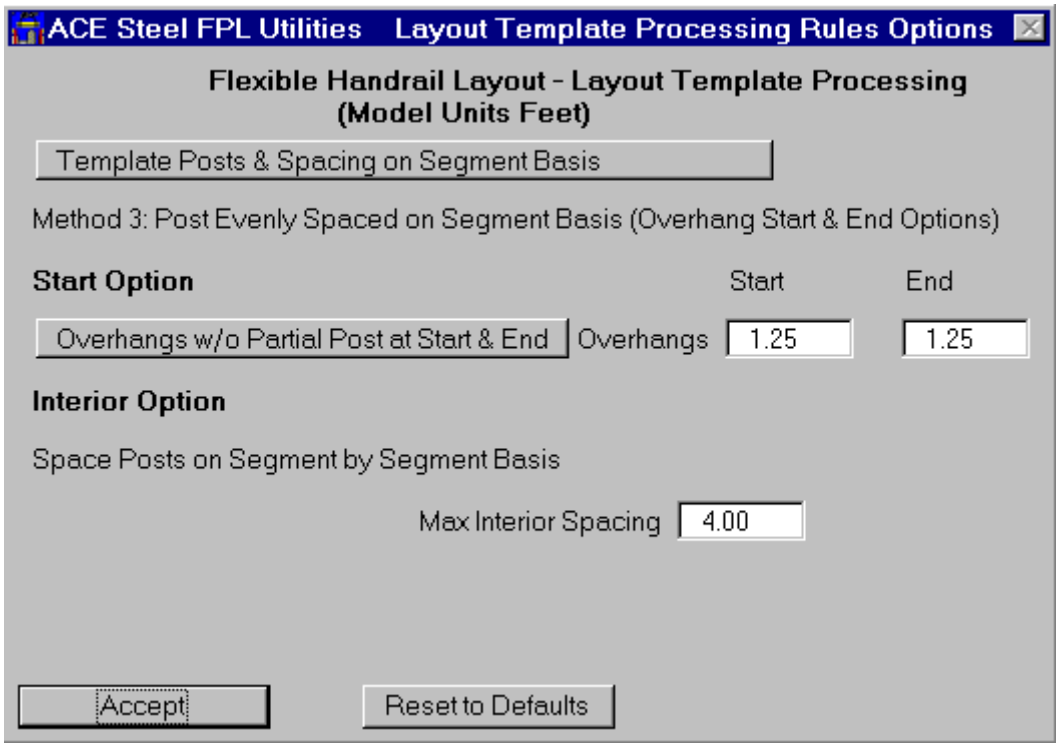
ACE FWP Flexible Handrail Layout Documentation

Layout Template Processing Methods (con'd)

Method 3 (Template Posts & Spacing on Segment Basis)

This method allows the post spacing to be handled on a segment by segment basis. For each segment, the vertexes are handled by the vertex options. A post may be placed at the start and end vertex or overhang values can be specified for both. Template vertices without posts can be populated with partial posts. Interior posts are then placed equally so that the post spacing does not exceed the Maximum Interior (segment) Spacing Value.

- **Vertex Options**
  1. Post at Start and End of each segment
  2. Partial Post w/ Overhang at start & end – Overhang values are specified for start & end
  3. Overhang w/o partial post at start & end – Overhang values are specified for start & end
- **Interior Option**
  Maximum Interior (segment) Spacing Value is specified



Note: If this method is active, the "process button" on the Layout Template dialog box will state **Segment EQ SPC**.

Layout Template Method 3 allows specification of both a start offset & an end offset for each segment. The following rules are utilized for post placement..

Case where the Sum of Overhangs does not exceed the Segment Length minus 1/3 Max Interior Spacing
Both interior posts placed as specified.

Case where the Overhang exceeds the Segment Length minus 1/3 Max Interior Spacing

- **IF Start Overhang is less than Segment Length minus 1/3 Max Interior Spacing**
  In this situation a single interior post is placed at the start location.
- **ELSE IF End Overhang is less than Segment Length minus 1/3 Max Interior Spacing**
  In this situation a single interior post is placed at the end location.
- **ELSE**
  In this situation a single interior post is placed at the center of the segment.

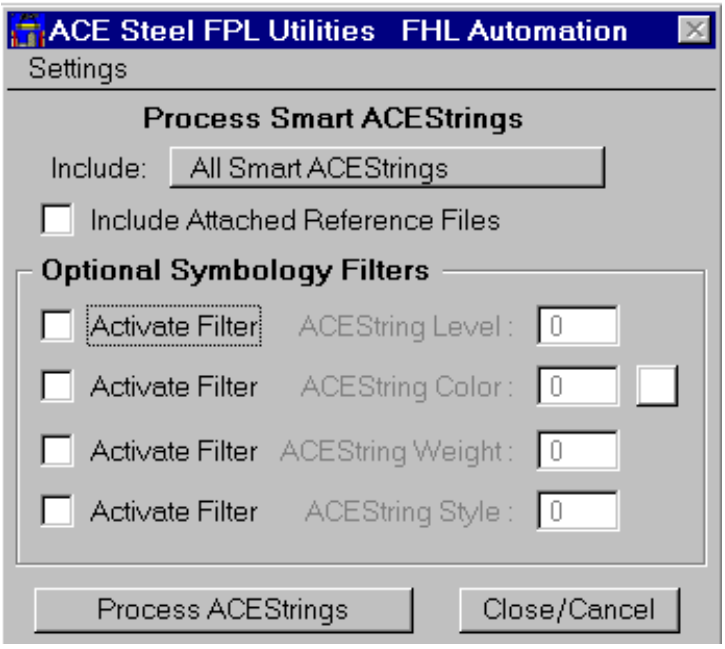
ACE FWP Flexible Handrail Layout Documentation

Automated Operations

The Automated Operations pull-down has three options: Process Smart ACEStrings, Process Directory w/ ALT Files and Process Directory w/ AHL Files. Each option is illustrated below.

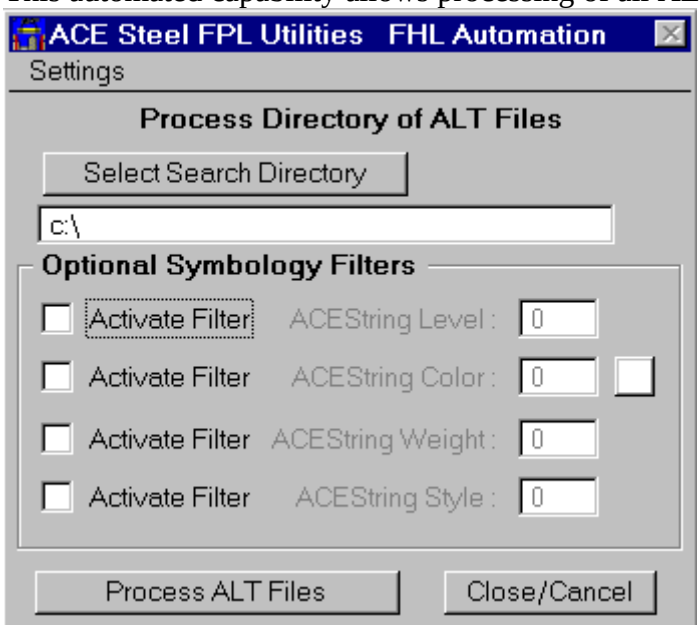
Process Smart ACEStrings

This automated capability allows processing of all Smart ACEStrings in the current model and optionally those in attached reference files (toggle option). The option button provides the following three processing options: 1) All Smart ACEStrings; 2) Only Smart ACELineStrings and 3) Only Smart ACEComplexStrings. In addition, symbology filters may be utilized for processing. The symbology filter include Level, Color, Weight and/or Style. Toggle on the "Activate Filter" to activate a filter and then enter the value to match for inclusion. Any or all symbology filters may be active. The settings pull-down menu allows modification of Handrail Parameters and/or Layout Template Processing Methods prior to automated execution. To kick-off the automated process, press the "Process ACEStrings" button.



Process Directory of ALT Files

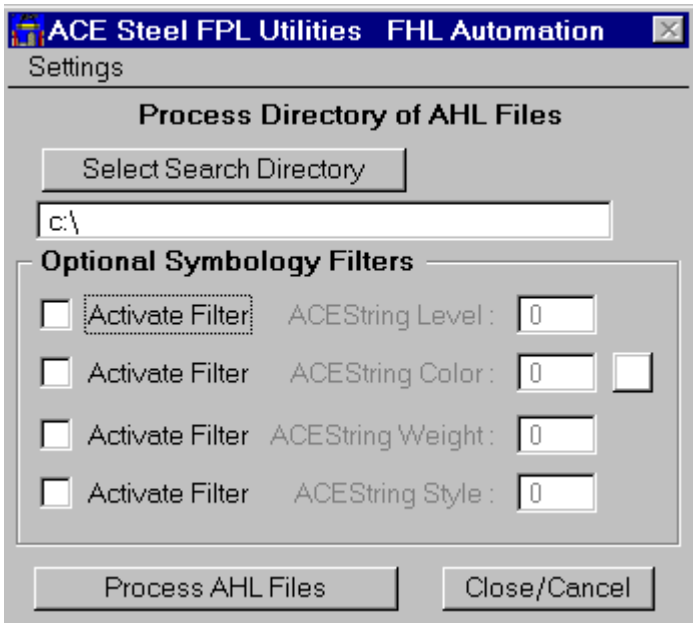
This automated capability allows processing of all ALT file in the specified directory. The directory location may be keyed in or may be located with the "Select Search Directory" button. Similar to the ACEString automated capability, symbology filters may be utilized for processing. The symbology filter include Level, Color, Weight and/or Style. Toggle on the "Activate Filter" to activate a filter and then enter the value to match for inclusion. Any or all symbology filters may be active. The settings pull-down menu allows modification of Handrail Parameters and/or Layout Template Processing Methods prior to automated execution. To kick-off the automated process, press the "Process ALT Files" button.



ACE FWP Flexible Handrail Layout Documentation

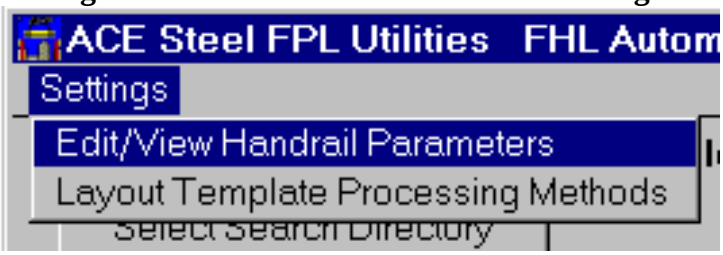
Automated Operations (con'd)

Process Directory of AHL Files



This automated capability allows processing of all AHL files in the specified directory. The directory location may be keyed in or may be located with the "Select Search Directory" button. Similar to the ACEString & ALT file automated capabilities, symbology filters may be utilized for processing. The symbology filter include Level, Color, Weight and/or Style. Toggle on the "Activate Filter" to activate a filter and then enter the value to match for inclusion. Any or all symbology filters may be active. The settings pull-down menu allows modification of Handrail Parameters and/or Layout Template Processing Methods prior to automated execution. To kick-off the automated process, press the "Process AHL Files" button.

Settings Pull-Down Menu on Automated Dialog Box



Automated processing utilizes both the currently active Handrail Parameters and Layout Template Processing Methods. Both can be edited and/or reviewed with the "Settings" pull-down menu.

ACE FWP Flexible Handrail Layout Documentation

Handrail Segment Geometry

Each handrail segment begins at a start location and terminates at a end location. If top mounted handrail is being placed, the start & end locations are both the base elevation of the toe plate (provided toe plate offset is 0) and the base elevation of the handrail post. If side mounted handrail is being placed, the start & end locations are the base elevation of the non-offset toe plate and is "drop" distance above the base of the handrail post. These start and end points are the two reference or work points that define the handrail segment orientation (presence or lack of overhangs has no effect on this concept). In understanding the cardinal point discussion below it is important to understand that: 1) posts are always placed from low elevation to high and are always parallel to the global Z axis; 2) rails (top, mid & third) are placed from the start location to the end location. The only exception to this is when an entry is defined for the segment. If an entry is defined, the handrail rail and the toe plate are discontinued (broken) at the entry.

The post should be visualized by standing beneath it and looking up. For linear segments, the rail & toe plate should be visualized by standing at start location and looking toward the end. For Arc segments, the rail & toe plate should always be visualized by standing at start location and looking along a vector normal to radial line.

Handrail Orientation

Handrail may be RHL orientation or Reverse RHL. In other handrail, the terms left and right orientation were utilized. This application utilizes the terms RHL and Reverse RHL. They are in essence the same, however the RHL mathematical definition is easy to apply to both linear and arc handrail. Handrail orientation can be best understood if viewed as follows: looking from the segment start location to the segment end location the following is true.

RHL Orientation (termed LEFT ORIENTATION for Handrail application)

1. The toe plate would be on the left side (typically platform is on the left)
2. Angle handrail post and rail flanges would point to the right (matches Out Vector)
3. Post Edge (rail top/center) cardinal point options puts cardinal point on the left for both post & rail

Reverse RHL Orientation (termed RIGHT ORIENTATION for Handrail application)

1. The toe plate would be on the right side (typically platform is on the right)
2. Angle handrail post and rail flanges would point to the left (matches Out Vector)
3. Post Edge (rail top/center) cardinal point option puts cardinal point on the right for both post & rail

RHL Mathematical Definition

The application utilizes the following mathematical method to determine the RHL Out Vector for each segment. A vector from the segment start to the segment end is created. This vector is crossed with a vertical Z vector. The resulting vector is the segment RHL vector. All segments for the Layout Template have either RHL or Reverse RHL orientation.

DIFFERENCES Between this Application & the other Handrail Application

For the other handrail application, when a non-symmetric section is used as a post, the depth of the post runs parallel to the handrail segment and the width is normal to it. This orientation required different section property definition if the same shape was used as toe plate and post. The Flexible Handrail Layout (this application) utilized the Out Vector for linear segments and a radial line with positive projection on the Out Vector for the OV of the post for arc segments. As a result, the depth of the post runs normal to the handrail segment for linear segments and the depth is parallel to a radial line for arc segments.

This application will handle mixed shapes for rails and posts. For instance, the posts could be angle profiles, the top rail could be a rectangular tube and the 2^{nd} & 3^{rd} rails could be solid flat bars.

ACE FWP Flexible Handrail Layout Documentation

Cardinal Point Options

There are two Post and tw0 rail CP options (4 combinations) which are very important. The actual location of handrail segment components are defined by the cardinal point option selected in conjunction with: 1) the segment start and end points; 2) the handrail orientation (RHL or Reverse RHL); and 3) segment type (linear or Arc). Of course the layout parameters and rails heights and spacing also play a significant yet easy to understand role. The cardinal point is a bit trickier and thus extra documentation is being provided.

Option 1 – Post Edge & Rail Center (Post & Rail outside edge on the handrail segment line)

Reverse RHL Orientation

Posts (Interior & Exterior)

Pipe & Angle - Cardinal point for the post will be 2. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

Rail

Pipe - Cardinal point for the rail will be 6. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

Angle - Cardinal point for the rail will be 2. Reflect is off and rotation is -90 degrees. The OV vector is defined by a line parallel to the global negative Z axis.

Toe Plate

Toe plate is placed at start and end points with cardinal point 1. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

RHL Orientation

Post

Pipe & Angle - Cardinal point for the post will be 2. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

Rail

Pipe - Cardinal point for the rail will be 4. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

Angle - Cardinal point for the rail will be 2. Reflect is on and rotation is -90 degrees The OV vector is defined by a line parallel to the global negative Z axis.

Toe Plate

Toe plate is placed at start and end points with cardinal point 3. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

ACE FWP Flexible Handrail Layout Documentation

Cardinal Point Options (continued)

Option 2 – Post Edge & Rail Top (Post & Rail outside edge on the handrail run line)

Reverse RHL Orientation

Posts (Interior & Exterior)

Pipe & Angle - Cardinal point for the post will be 2. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

Rail

Pipe - Cardinal point for the rail will be 9. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.
Angle - Cardinal point for the rail will be 1. Reflect is off and rotation is -90 degrees The OV vector is defined by a line parallel to the global positive Z axis.

Toe Plate

Toe plate is placed at start and end points with cardinal point 1. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

RHL Orientation

Post

Pipe & Angle - Cardinal point for the post will be 2. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

Rail

Pipe - Cardinal point for the rail will be 7. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.
Angle - Cardinal point for the rail will be 1. Reflect is off and rotation is -90 degrees The OV vector is defined by a line parallel to the global positive Z axis.

Toe Plate

Toe plate is placed at start and end points with cardinal point 3. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

ACE FWP Flexible Handrail Layout Documentation

Cardinal Point Options (continued)

Option 3 – Post Center & Rail Center (Post & Rail centerlines on the handrail segment line)

Reverse RHL Orientation

Post

Pipe & Angle - Cardinal point for the post will be 5. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

Rail

Pipe - Cardinal point for the rail will be 5. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.
Angle - Cardinal point for the rail will be 5. Reflect is on and rotation is -90 degrees The OV vector is defined by a line parallel to the global positive Z axis.

Toe Plate

Toe plate is placed at an offset equal to negative 1/2 depth of post profile (angle, pipe, tube, bar) from start and end points with cardinal point 1. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

RHL Orientation

Post

Pipe & Angle - Cardinal point for the post will be 5. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

Rail

Pipe - Cardinal point for the rail will be 5. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.
Angle - Cardinal point for the rail will be 5. Reflect is off and rotation is 90 degrees The OV vector is defined by a line parallel to the global positive Z axis.

Toe Plate

Toe plate is placed at an offset equal to positive 1/2 depth of angle or pipe from start and end points with cardinal point 3. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

ACE FWP Flexible Handrail Layout Documentation

Cardinal Point Options (continued)

Option 4 – Post Center & Rail Top (Post & Rail centerlines on the handrail segment line)

Reverse RHL Orientation

Post

Pipe & Angle - Cardinal point for the post will be 5. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

Rail

Pipe - Cardinal point for the rail will be 8. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.
Angle - Cardinal point for the rail will be 4. Reflect is on and rotation is -90 degrees The OV vector is defined by a line parallel to the global positive Z axis.

Toe Plate

Toe plate is placed at start and end points with cardinal point 1. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

RHL Orientation

Post

Pipe & Angle - Cardinal point for the post will be 5. Reflect is off and rotation is 0 degrees. For linear segments, the OV vector is identical to the Out Vector. For Arc segments, the OV vector is on the line from the Arc center to the post making a positive projection on the Out Vector. Note that exterior posts may be associated with a neighboring segment or the vertex. When an exterior post which neighbors two linear segments is associated with the vertex, the OV line is the average of the Out Vectors for the segments on each side – all other settings remain the same. When an exterior post which neighbors Arc segment(s) is associated with the vertex, the OV line is the average of the Out Vectors for the linear segment and the vertex radial line for the Arc segment – all other settings remain the same.

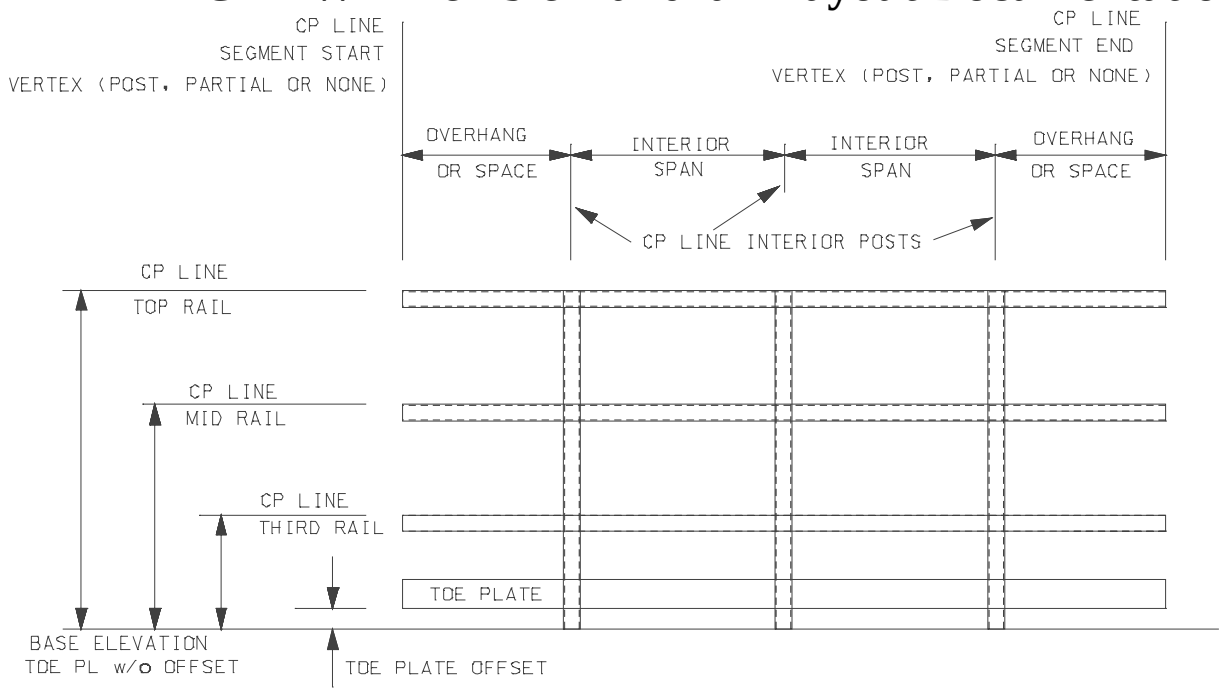
Rail

Pipe - Cardinal point for the rail will be 8. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.
Angle - Cardinal point for the rail will be 2. Reflect is off and rotation is 90 degrees The OV vector is defined by a line parallel to the global positive Z axis.

Toe Plate

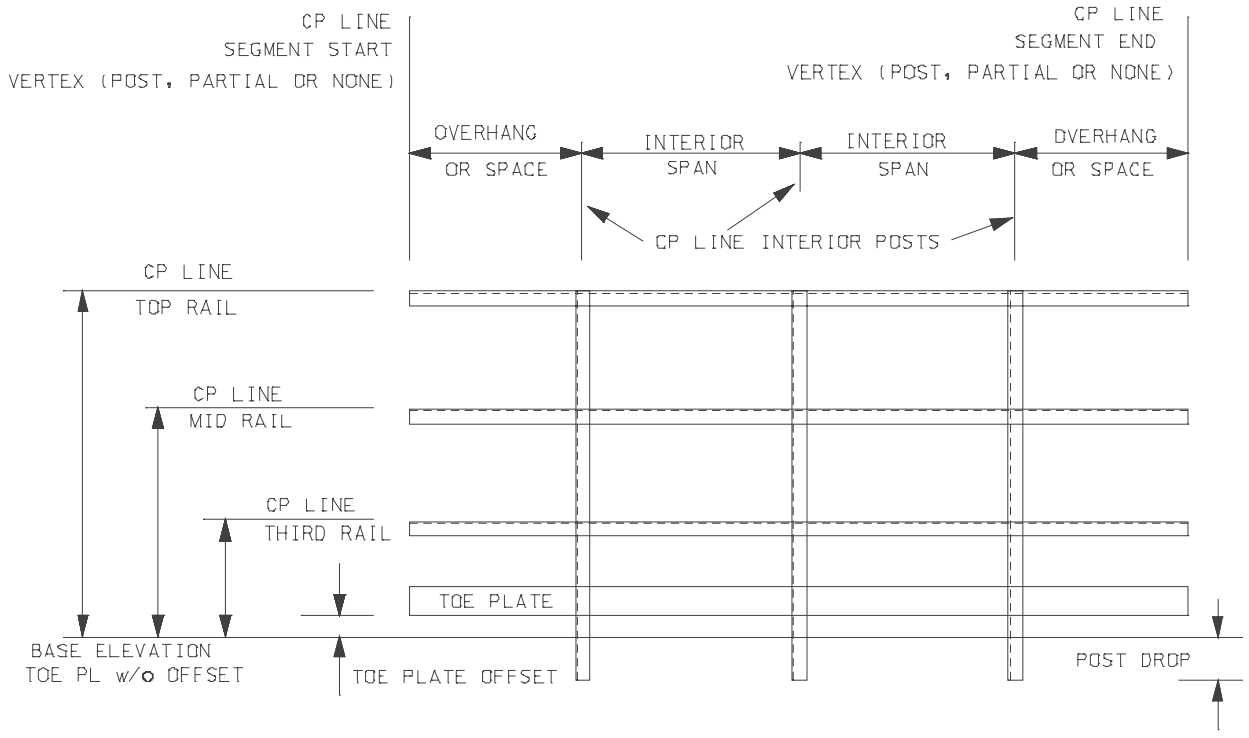
Toe plate is placed at start and end points with cardinal point 3. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

ACE FWP Flexible Handrail Layout Documentation



Pipe Handrail

(Position on Top, CP's: Post Center - Rail Top)



Angle Handrail

(Position on Side, CP's: Post Edge - Rail Top)

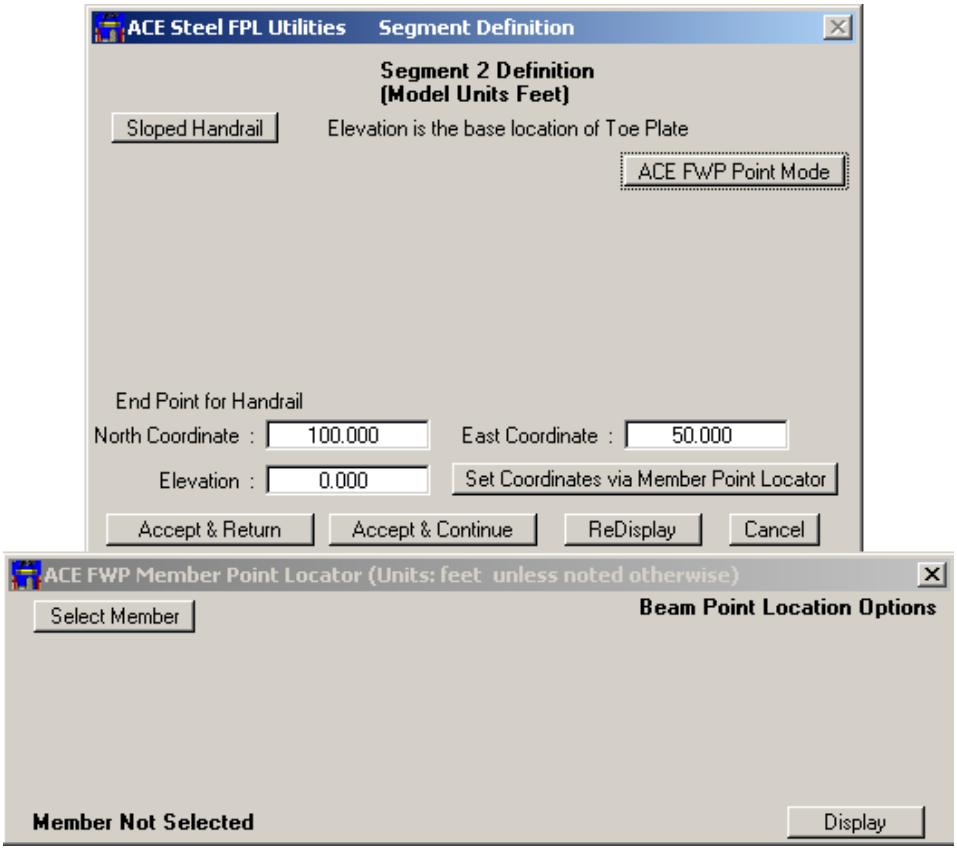
ACE FWP Flexible Handrail Layout Documentation

Point Select Mode Option Button – "uStn Point Mode" or "ACE FWP Point Mode"

The point mode option button has two settings; namely: uStn Point Mode and ACE FWP Point Mode. These modes are available for the interactive segment definition dialog boxes. When the uStn Point Mode is active, the button near point data is labeled "Last Data Point". When the "Last Data Point" button is pressed, the coordinates for the data in question is set to MicroStation's last data point. For 1st segment definition, there is either two (sloped case) or three (flat case) "Last Data Point" buttons. For subsequent segment definition, there is one "Last Data Point" button. The last data point is simply the last MicroStation datapoint that was entered. The ACE FWP Point Mode has similarity to the uStn point mode but uses points along a FWP member not uStn data points. The uStn point mode was illustrated in previous examples. The ACE FWP Point Mode capability is illustrated below.

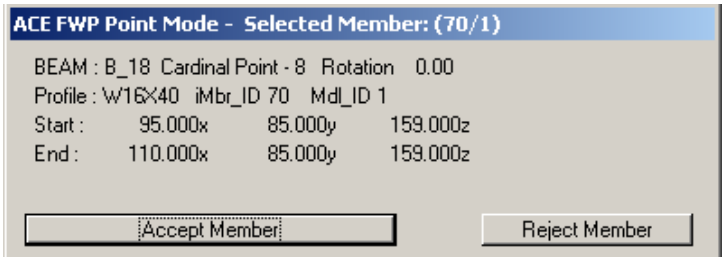
ACE FWP Member Point Locator Mode

The ACE FWP Point Mode sets the point select buttons to use the ACE FWP member point locator. In this mode, a point may be selected using points on a FrameWorks member. When the option button on the segment definition dialog box is set to "ACE FWP Point Mode", the following dialog box activates as shown below.



ACE FWP Member Point Locator Dialog Box after ACE FWP Point Mode Option Selected

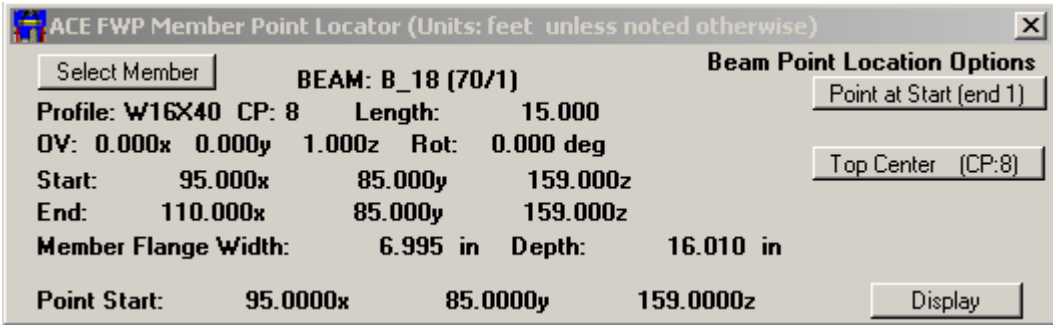
When the Select Member button is pressed & a FrameWorks Member is identified, the following dialog box appears. (Note that the button near coordinates is now labeled "Set Coordinates via Member Point Locator")



Member Accept/Reject Dialog

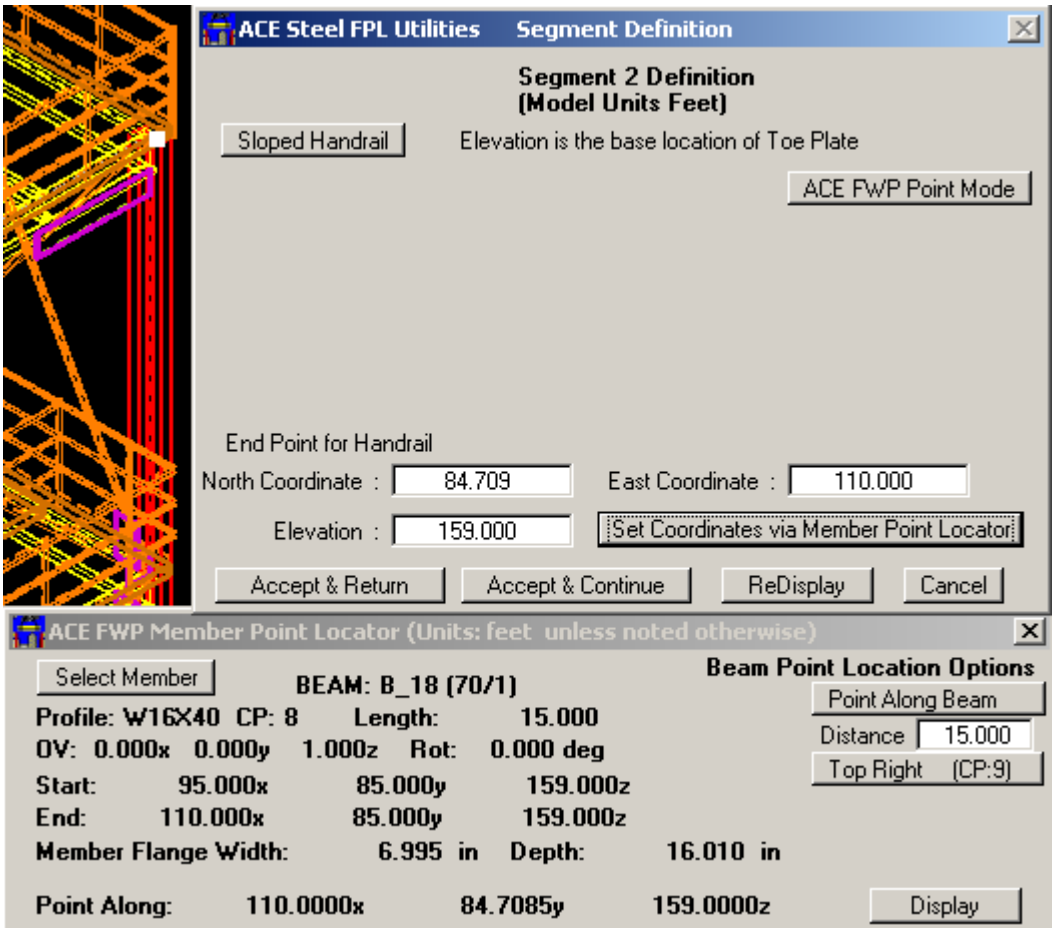
ACE FWP Flexible Handrail Layout Documentation

If the accept Member button is pressed, the following dialog box appears.



ACE FWP Member Point Locator Dialog Box w/ Member Located

The dialog box initially comes up with the start of the member selected (unless the member was selected by snapping to the end of the member) and at the true cardinal point of the member. The Beam Point Location Options has two option buttons. The first controls point location along the member. The point may be at the start, end or at a defined location from the start. The second option button controls the location in the plane normal to the member. This is handled by the cardinal point of the member. Cardinal points from 1 to 9 my be selected or an offset CP line value may be specified. The point is displayed as a highlighted point and may be redisplayed at any time with the ReDisplay button.



For this example, two adjustments have been made. First, the Point Along Member option was selected and 15 foot was entered into the keyin box. Second, a CP of 9 was selected. Pressing "Set Coordinates via Member Point Locator" on the Segment Definition dialog box will cause the point shown at bottom of the dialog box to be used for the point in question (elevation, North & South coordinates or all three for sloped handrail cases). This tool makes it easy to reference any CP location along the member. And previously mentioned, offset points can also be specified. Offset points are computed from the actual CP of the member in question. The ACE FWP Member Point Locator dialog box will remain active as long as the Segment Definition dialog box is active and the "ACE FWP Point Mode" option is set. Dismissing the Segment Definition Dialog box or changing the point mode will dismiss the ACE FWP Member Point Locator dialog box.

Naming Options (continued)

For a given handrail run, all components are given the same name by concatenating the FWP ID to a prefix. The default prefix is FHL, however a different prefix may be specified in the definition file. Other naming options include: dynamic naming at placement time; a constant specified name for all stairs; or FrameWorks normal naming for individual components (autoname). Dynamic naming allows the name to be selected (or remain the last name selected) at placement time with or without appending the FWP ID to the name. The naming option may be changed at runtime by editing the Handrail Parameters vis one of the "Settings" pull-down menus (Layout Template dialog box, Handrail Layout Manipultaions dialog box and the Automated Operations dialog boxes).

Definitions File

Due to the dissimilar nature of the variables in the steel utilities, each steel utility has a separate definition (DEF) file. While each file is distinctly different, each file is similar in the basic method of definition. Each definition file may optionally be controlled with either of two environment variables. Thus a project specific definition file for each project may be easily specified. The environment variables may be specified in numerous ways (similar to any MicroStation variable), however the utilization of a project.pcf is highly recommended. Environment variable definition is discussed in detail in the installation notes provided with the ACE FrameWorks utilities. The default name and location for the definition file for this utility are: C:\ACE_FHL.DEF. A directory for the definition file may be specified with the environment variable ACE_DEF_PATH (will look in specified path for file ACE_FHL.DEF). A complete name and location of a definition file may be also specified with the environment variable ACE_FHL_DEF. The first valid definition file found is utilized. The search for a definition file happens in the following order or priority:

1. If the variable ACE_FHL_DEF is specified, the named file at this location will be used if found.
2. If the variable ACE_DEF_PATH is specified and ACE_FHL.DEF is found in this directory, it is used.
3. If there is a c:\ace_fhl.def file it is utilized.
4. If none of the above, internal program defaults are utilized – a warning message will be displayed. ***(if environment variables in 1 and/or 2 above are specified and corresponding DEF file is not found, a warning is displayed)***

A sample default file is provided in the next section of this document. Following the sample, the commands for the definition file are outlined in detail.

Due to the complex nature of the variables, the steel definition files allow the specification of units (either Metric (meters or mm) or English (feet or inch)). Thus a given default file may be utilized in either a Metric or English project. The units may be changed throughout the definition file. If units are not specified, it is assumed that the definition file units match the units of the model (feet/inch-English & meters/mm-Metric). If units are defined and they do not match the model, the variables after the units command are converted to match the model units.

ACE FWP Flexible Handrail Layout Documentation

Sample Definitions File

Typical Definition File:

```
UNI ENG
TOE   TOEPL       2       A36    VB
HRR   P2STD       3       A36    VB
HRM   P2STD       5       A42    VB
HRP   P2STD       4       A36    VB
HRS     4.00       2.55  1.25   0.25   0.5     2  2  2
NGP   2     4     1     3      5
ENV     8  ACCESS       2
SYM   1     0.10   51         12    0     0
STR   50    11    1     1
GEN   2     1     2     1
NAM SPE HR-
LT1   2     2.25  4.124 1     2.5
LT2   1     2.15  4.224 1
LT3   3     2.35  2.53    4.024
```

Command Definition

- **Valid Primary Keyword Commands: (UNI, GEN, TOE, HRR, HRP, HRM, HRS, NGP, ENV, SYM, STR, LT1, LT2, LT3, NAME)**
- **Each record must begin with a valid primary keyword or it is ignored**
- **All records that start with a blank are considered comments**
- **The commands/keywords (records) may be placed in any order however the order is significant**
- **All values for a given command must be defined in order shown above. If default values are acceptable, only the changed values must be given. However all values up to that point must be defined whether changed or not.**
- **The components of a given command (record) must all be present and in the order shown**
- **The units command is special and my be repeated and located as required. While commands may be in any order, it should be obvious that the location of the units command is extremely important.**
- **By default application looks for C:\ACE_FHL.DEF definition file**
- **Definition file path may be defined with environment variable ACE__DEF_PATH**
- **ACE_DEF_PATH=d:\mydir**
  (the DEF file ACE_FHL.DEF will be looked for in the directory d:\mydir)
- **Definition file may be defined with environment variable ACE_FHL_DEF**
- **ACE_FHL_DEF = d:\mydir\mydef_file** ***(highest priority definition)***
  (the DEF file mydef_file will be looked for in the directory d:\mydir)
- **NOTE: Components shown in bold may only be specified in the definitions file**

UNIT Command - Units Command (optional command)

UNIT {UNITTYPE} {UNIT}

where :

{UNITTYPE} May be ENGlish or METric

{UNIT} May be FEEt or INCh for ENGlish (feet is default) or METer or MM for METric (meter is default)

If units is not specified it is assumed that the units match the current model units.

Units may be changed at any time but be aware that the properties (in attached library) for the member specified must match the current model units.

ACE FWP Flexible Handrail Layout Documentation

Flexible Handrail Layout Definition File (continued)

TOE Command - Toe Plate Command defines toe plate parameters

TOE toe_section toe_class toe_grade toe_type

where :

toe_section : Tread section (default value - Std_Tread)
Section profile name may be enclosed in quotes
If name includes spaces, quotes must be utilized (i.e. “P1 1/2STD”)

toe_class **:** Tread class valid options 0 - 9 (default value - 6)

toe_grade **:** Tread grade any valid FrameWorks grade (default value - A36)

toe_type **:** FrameWorks member type - valid options : VB, HB, BE,CO (default VB)

HRR Command - Handrail Rail Command defines rail

HRR hrr_section hrr_class hrr_grade hrr_type

where

hrr_section : Section size for handrail rail (Pipe or Angle) (default value - P2STD)
Section profile name may be enclosed in quotes
If name includes spaces, quotes must be utilized (i.e. “P1 1/2STD”)

hrr_class : The class for the handrail rail (0 =< class < 10) (default value - 6)

hrr_grade : The grade for the handrail rail (i.e. A36 etc) (default value - A36)

hrr_type : The type for the handrail rail (BE,CO,VB,HB) (default VB)

HRM Command - Handrail Midrail Command defines midrail(s)
(OPTIONAL COMMAND IF NOT PRESENT - HRR USED FOR ALL RAILS)

HRM hrm_section hrm_class hrm_grade hrm_type

where

hrm_section : Section size for handrail midrail (Pipe or Angle) (default P2STD)
Section profile name may be enclosed in quotes
If name includes spaces, quotes must be utilized (i.e. “P1 1/2STD”)

hrm_class : The class for the handrail midrail (0 =< class < 10) (default 7)

hrm_grade : The grade for the handrail midrail (i.e. A36 etc) (default A36)

hrm_type : The type for the handrail midrail (BE,CO,VB,HB) (default VB)

HRP Command - Handrail Post Command defines post

HRP hrp_section hrp_class hrp_grade hrp_type

where

hrp_section : Section size for handrail post (Pipe or Angle) (default value - P2STD)
Section profile name may be enclosed in quotes
If name includes spaces, quotes must be utilized (i.e. “P1 1/2STD”)

hrp_class : The class for the handrail post (0 =< class < 10) (default value - 6)

hrp_grade : The grade for the handrail post (i.e. A36 etc) (default value - A36)

hrp_type : The type for the handrail post (BE,CO,VB,HB) (default VB)

Flexible Handrail Layout Definition File (continued)

HRS Command - Handrail standards Command defines handrail standards

HRS hr_height_top hr_height_mid hr_height_mid2 toepl_offset post_extension hrp_cp hrr_cp hrp_pos hrp_edgeCPopt hrp_centerCPopt

where

hr_height_top	: Vertical distance from Wp line to top rail (default 3.0 ft)
hr_height_mid	: Vertical distance from Wp line to mid rail (default 1.5 ft)
hr_height_mid2	: Vertical distance from Wp line to third rail (default 1.5 ft)
toepl_offset	: Vertical offset for toe plate (default 0.0)
post_extension	: Default startup - post extension value (default 0.5 ft)
hrp_cp	: HRP cardinal point (default - 1) 1 - Center 2 - Edge
hrr_cp	: HR rail cardinal point (default - 1) 1 - Top 2 - Center
hrp_pos	: HR post on Top or on Side (default - 1) 1 - Top 2 - Side
hrp_edgeCPopt	: Actual CP of Post for edge placement CP of 2 is the default 0 w/ hrp_cp = 2 will yield a post CP of 2 1 w/ hrp_cp = 2 will yield a post CP of 1 2 w/ hrp_cp = 2 will yield a post CP of 2 3 w/ hrp_cp = 2 will yield a post CP of 3
hrp_centerCPopt	: Actual CP of Post for center placement CP of 5 is the default 0 w/ hrp_cp = 1 will yield a post CP of 5 4 w/ hrp_cp = 1 will yield a post CP of 4 5 w/ hrp_cp = 1 will yield a post CP of 5 6 w/ hrp_cp = 1 will yield a post CP of 6

GEN Command - General Command defines misc handrail options

GEN layout_template_active toe_plate interference_opt point_select

where

layout_template_active : Default option for Layout Template Processing (default 1)
- 1 – Layout Template Processing Method 1
- 2 - Layout Template Processing Method 2
- 3 - Layout Template Processing Method 3

toe_plate : Place toe plate or do not place toe plate (default - 2)
- 1 – Do Not Place Toe Plate
- 2 – Place Toe Plate

interference_opt : Default option for interference envelope (default 1)
- 1 - No interference envelope
- 2 - Interference Envelope

point_select : Point selection mode
- 1 - "Last Datapoint" Technique (Default)
- 2 - ACE FWP Member Point Select Technique

SYM Command - Symbology Command defines graphic handrail dumb symbology

SYM 2Dsym_opt fOffset iLevel iColor iWeight iStyle

where

2Dsym_opt : Default option for placing HR symbology as dumb graphics into file (default 1)
- 1 - No symbology placed
- 2 – Symbology Placed

fOffset : Horizontal Offset for Display Graphics (default 0.0)
iLevel : Graphics Level (default - 60) (valid range 1 to 62)
iColor : Graphics Color (default - 1) (valid range 0 to 254)
iWeight : Graphics Weight (default - 1) (valid range 0 to 31)
iStyle : Graphics Style (default - 0) (valid range 0 to 7)

ACE FWP Flexible Handrail Layout Documentation

Flexible Handrail Layout Definition File (continued)

LT1 Command - Layout Template Processing Method (Rules) 1 options

LT1 start_opt start_overhang max_post_spacing end_opt end_overhang

where

start_opt : Active option for start options for this method (default 1)
- 1 – Post at Start
- 2 – Overhang with Partial Post at Start
- 3 – Overhang without Partial Post at Start

start_overhang : Distance for the start overhang (default 2 FT)

max_post_spacing : Maximum for post spacing (default 4 FT)

end_opt : Active option for end options for this method (default 1)
- 1 – Post at End
- 2 – Overhang with Partial Post at End
- 3 – Overhang without Partial Post at End

end_overhang : Distance for the end overhang (default 2 FT)

LT2 Command - Layout Template Processing Method (Rules) 2 options

LT2 start_opt start_overhang post_spacing end_opt

where

start_opt : Active option for start options for this method (default 1)
- 1 – Post at Start
- 2 – Overhang with Partial Post at Start
- 3 – Overhang without Partial Post at Start

start_overhang : Distance for the start overhang (default 2 FT)

post_spacing : Distance for post spacing (default 4 FT)

end_opt : Active option for end options for this method (default 1)
- 1 – Post at End
- 2 – Overhang with Partial Post at End
- 3 – Overhang without Partial Post at End

LT3 Command - Layout Template Processing Method (Rules) 3 options

LT3 startend_opt start_overhang end_overhang max_post_spacing

where

startend_opt : Active option for start & endoptions for this method (default 1)
- 1 – Post at Start & End
- 2 – Overhang with Partial Post at Start & End
- 3 – Overhang without Partial Post at Start & End

start_overhang : Distance for the start overhang (default 2 FT)

end_overhang : Distance for the start overhang (default 2 FT)

max_post_spacing : Maximum for post spacing (default 4 FT)

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Flexible Handrail Layout Definition File (continued)

STR Command - String Symbology Command defines template/handrail symbology

STR iLevel iColor iWeight iStyle

where

iLevel	:	Active layout template (string) Level (default - 60) (valid range 1 to 62)
iColor	:	Active layout template (string) Color (default - 1) (valid range 0 to 254)
iWeight	:	Active layout template (string) Weight (default - 1) (valid range 0 to 31)
iStyle	:	Active layout template (string) Style (default - 0) (valid range 0 to 7)

ENV Command - Envelope Command defines interference envelope parameters

ENV envclass envgrade envmaterial

where :

envclass	:	The class for the interference envelope (Default = 9) (0 =< class < 10)
envgrade	:	The grade for the interference envelope (Default: Access)
envmaterial	:	The material type for the interference envelope (Default 2 (usually Aluminum)

NGP Command - Named Group Command defines namedgroups

NGP iNGP_hrp iNGP_hrr iNGP_toe iNGP_env iNGP_hrm

where

iNGP_hrp	**:**	Named group for handrail post (default -1 which is none)
iNGP_hrr	**:**	Named group for handrail rail (default -1 which is none)
iNGP_toe	**:**	Named group for handrail toe plate (default -1 which is none)
iNGP_env	**:**	Named group for handrail solid envelope (default -1 which is none)
iNGP_hrm	**:**	Named group for handrail midrail(s) (default -1 which is none)

NOTE: Namedgroups are defined globally for a project. The iNGP_xxx value is an integer value that corresponds to the index of the global namedgroups. The first namedgroup is 0, the next is 1 and so on up to a maximum integer value of the number of namedgroups minus one. If a name group does not exist for the integer value specified, the member type in question will simply not be placed in a named group. A value of –1 specifies that the member type in question is not to be put in a namedgroup. In FWP namedgroups are specified by an alpha name so be careful when selecting integers. **SOLID NAMEDGROUPS ARE FUNCTIONAL with FWP version 7.0.0.17 and later**

NAME Command - Name Command defines method of naming components

NAME {NAME_OPTION} name_prefix

where

{NAME_OPTION} : Keyword - must be AUT or SPE or DYN or CON

SPEcified : Use the supplied name and append the member ID for first rail placed
Thus each handrail run will have a different name
However all components of a given platform will have same name
(This is the default option with the name "HR")

DYNamic : At placement time will display last name used with following options
1) option to supply a new name
2) option to request that member ID for first rail placed be appended
Thus each handrail run will have a different name
However all components of a given handrail will have same name
3) option to abort placement

AUTo : FrameWorks assigns names by type and sequence number
(name_prefix not required or utilized)

CONstant : Use this name for all handrail placed for all components

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ACEComplexString

An ACEComplexString is either a smart or ordinary uStn complex chain element (Type 12) definition with from 1 to 50 continuous lines and ARCs. A uStn arc (type 16) may also be read (obviously open & not "Smart"). Smart ACEComplexStrings start with a straight element 100 UORS long which is the OUT vector for the complex string. The complex string may be open or closed. An open complex string does not have the same start and end vertices whereas the start and end vertices are identical for a closed complex string. An ACEComplexString may be read from a design file or it may be read from an external ACELayoutTemplate (ALT) data file.

A Smart ACEComplexString also contains the OUT direction but does not contain the additional data information in an ACELayoutTemplate file.

An ACELayoutTemplate (ALT) external data file contains the OUT direction & additional information for the layout template whereas a design file ordinary ACEComplexString does not.

When an ACEComplexString read from design file or an ACELayoutTemplate file is imported, it can be processed into a ACEHandrailLayout using Layout Template Processing Rules. An ACEHandrailLayout can be saved as a Smart ACEComplexString (or Smart ACELineString if ARC's DO NOT exist) in the design file or to an external ACELayoutTemplate.

ACEHandrailLayout (AHL format)

An ACEHandrailLayout is a complete defined handrail configuration. An ACEHandrailLayout is a collection of segments (50 maximum). An ACEHandrailLayout can be generated a layout template and applying Layout Template Processing Rules. A active ACEHandrailLayout can be manipulated in many ways (i.e. such as changing ACEHandrailLayout Parameters, location (translate and/or rotate), individual post locations. At any time, an ACEHandrailLayout may be placed as FrameWorks elements into a FrameWorks model. At any time, the layout template for the active handrail layout may be saved as a Smart ACELineString (or Smart ACEComplexString) to the design file or to a external data file. At any time, an ACEHandrailLayout may be saved as an ACEHandrailLayout to a external data file. There can be only one active ACEHandrailLayout at a time. Once started a ACEHandrailLayout remains active until it is cleared (deleted).

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ACELineString

An ACELineString is either a smart or ordinary uStn line string element with from 2 to 51 vertices or a uStn shape element with up to 51 vertices. (i.e. 1 to 50 line segments) Smart ACELineStrings start with a straight element 100 UORS long which is the OUT vector for the complex string.

uStn Line String (Type 4): This element may be smart or ordinary**.** The line string may be open or closed. Normally uStn will generate a shape (type 6) when a closed line string is placed in a design file. However, a closed line string (type 4) may be generated if an open line string is placed and then later manipulated to be closed. An open line string does not have the same start and end vertices whereas the start and end vertices are identical for a closed line string.

uStn Shape (Type 6): This closed element may only be ordinary When a uStn shape is interactively read from the design file, the start location is not the first vertex of the shape but rather the first vertex closest to the datapoint used to select the shape. In automated batch modes, the shape first vertex is the ACELineString first vertex. The application reads, stores and saves (if saved) the shape as a closed line string.

A Smart ACELineString also contains the OUT direction but does not contain the additional data information in an ACELayoutTemplate file.

An ACELayoutTemplate (ALT) external data file contains the OUT direction & additional information for the layout template whereas a design file ordinary ACELineString does not.

When an ACELineString read from design file or an ACELayoutTemplate file is imported, it can be processed into a ACEHandrailLayout using Layout Template Processing Rules. An ACEHandrailLayout can be saved as a Smart ACELineString in the design file or to an external ACELayoutTemplate.

ACELayoutTemplate File (ALT format)

An ACELayoutTemplate (ALT) file is a binary file that contains either ACELineString or ACEComplexString data. The binary string file contains information that a design file ACELineString & ACE ComplexString does not. The additional information is the OUT direction, creation date, creator name and layout template name.

ACEString & Smart ACEString

An ACEString is either an ACELineString or an ACEComplexString. An ACEString may be saved into the design file as a Smart ACEString element. This element contains the OUT vector. Note that an ACELayoutTemplate (ALT) file contains ACEString data (including symbology), OUT vector and additional information.

Automated Batch Mode

Binary ACELayoutTemplate & ACEHandrailLayout files may be processed in an automated batch mode. In addition, smart ACELineStrings and/or smart ACEComplexStrings may be processed using a automated batch mode. In the automated batch mode operation, as each qualifying ACELayoutTemplate file, ACEHandrailLayout file, smart ACELineString and/or smart ACEComplexString is located and processed. This will continue until all qualifying items have been processed.

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Layout Template

A layout template is a set of continuous (connected) straight lines and/or ARCs . This connected set of lines and arcs actually represents the cardinal point line of the handrail rail projected to the base of the handrail. The base of the handrail is the location where the base of the toeplate (not considering the optional toeplate vertical offset). The active layout template may be saved as a Smart ACEString in the design file or as a ACELayoutTemplate (ALT) binary external file.

Layout Template Processing Methods

Layout template processing methods are sets of rules used to populate layout templates with interior and exterior posts. There are three methods available and each method has several configuration options (see section "Layout Template Processing Methods (Rules)").

OUT Direction

The OUT Direction is the out side of the handrail. The toe plate (if it exists) is always located on the opposite side (inside). For angle handrail, the angle will point to the OUT Direction. If posts are placed by edge, both the posts and the rails will be placed with CP's on the in side. Another way to define the OUT direction would be as follows: handrail is typically protecting a area, the OUT Direction is the area adjacent to the protected area.

For a layout template, the OUT vector is initially assumed to following the following convention. First, a vector is established going from the first layout template segment start to the segment end. This vector is crossed with a vertical (Z-axis) vector and the resulting vector is the initial OUT vector. This can also be determined with the following right hand rule. Point right index finger from first segment start to end. Point the 2nd finger toward the vertical axis (Z-axis). The thumb points toward the OUT vector.

If the posts are placed by center, the handrail is a symmetric shape, there is no toe plate, and dumb graphics are not drawn or offset, the OUT Direction is irrelevant.

Segments

A layout template is made up of continuous straight lines and/or ARCs. An layout template may be made up of from 1 to 50 segments. A line segment has the following properties: start & end coordinates. A arc segment has the following properties: start, end and point on arc coordinates.

A handrail layout is a layout template which has been processed. Processing involves populating each layout template segment with interior and exterior posts.

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LOG FILES

All applications can write log files if the environment variable ACE_DUMP is set to 1. There have been reports that some sites lock the C root drive and under certain conditions a locked C drive can cause a system fault 5.

All applications have been modified to warn of a locked drive/file and then gracefully exit. All applications now look for the environment variable ACE_LOG_PATH. If it is found, that is the directory where the log files will be placed. If the directory is locked or non-existent or if file is locked a warning will be given and the C drive will be tried. If it is locked or the file is locked a warning will be given and application will gracefully exit.

Usage of the variable ACE_LOG_PATH to control log file locations is similar to ACE_DEF_PATH to control DEF files. However there is one very important difference: ACE_LOG_PATH should NEVER point to a network drive (this is highly recommended for ACE_DEF_PATH). Everyone writes to the same named log file and if they are on a network drive there will be bad consequences. ALWAYS point ACE_LOG_PATH to a local drive (perhaps a temp off C root).