



ACE Structural Engineering Applications LLC

ACE FrameWorks Utilities

Handrail Documentation

Mar 15, 2013

Handrail (ACE_HR.MA)

(Current Releases - FWP 3.1.x.x/3.2.x.x rel 2.1.1 & FWP 7.0.x.x rel 7.1.1 & FWP 7.1/7.2/7.3 rel 6.1.1 & FWP 8.0.x.x rel 8.1.1 & FWP 9.0.x.x rel 9.1.1 & FWP 10.0.x.x rel 10.1.1 & FWP 11.0.x.x rel 11.1.1 & FWP 12.0.x.x rel 12.1.1)

This handrail application facilitates the placement of straight runs of handrail. The handrail profiles can be pipe and/or angle handrail and may be oriented to the left or right (side on which the toe plate resides - best illustrated in figures later shown in this document). A handrail run consists of handrail posts, top rail, optional mid rail, optional third rail, optional toe plate and in certain cases optional partial closing posts. The handrail can be mounted on the top or side, can be placed by several cardinal point options (see later section on cardinal points), and can be flat or sloped. An option is given to place a handrail interference envelope (a FrameWorks solid).

ACE Steel FPL Utilities ACESEA(c) 1998-2011

Straight Pipe Handrail
(All Units Feet)

Handrail Mounted on Top Edge/Center

Start Post w/ Defined Spacing Toe Plate on Right

Post Spacing: 4.000 Maximum Post Spacing = 4.75 ☒ Close Overhangs

☒ Toe Plate ☐ Place Interference Envelope ACE FWP Point Mode

Flat Handrail Elevation is the base location of Toe Plate

Elevation: 0.000 Set Elevation via Member Point Locator

Start Point for Handrail

North Coordinate: 0.000 East Coordinate: 0.000

Set Coordinates via Member Point Locator

End Point for Handrail

North Coordinate: 0.000 East Coordinate: 20.000

Set Coordinates via Member Point Locator

HR Post: P2STD Toeplate: P2STD

HR Toprail: P2STD Midrail: P1 1/2STD

Place Handrail Handrail Info Cancel

Numerous layout definition techniques (six total) are provided to define the handrail layout, which allows great flexibility in placing virtually any handrail configuration. The handrail run is placed by handrail start point and a handrail end point. Both the start and end point correspond to the beginning and end of the handrail run, which may optionally have start and/or end posts. The elevation point is the base of the toe plate (non-offset value at start & end locations), which in cases where the handrail is mounted on top is coincident with the base of the full post (if one exists at start and end locations). The start and end points are illustrated in the figures in this document. The various handrail layout definition options are listed in the ensuing sections. This utility features two unique datapoint input techniques: the uStn Point Mode, "Last Data Point", and the ACE FWP Point Mode, "ACE FWP Point Selector" (see page 10 - Point Select Mode). After handrail coordinate data is established, the handrail can then be placed with the Place Handrail button.

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 maximum post spacing also have internal default values. In addition all input parameters shown in the dialog box shown above have default values. The defaults can and should be overridden with user definable defaults by using a definition file. Handrail profiles (hrp, hrr, hrm & toepl) can be based on handrail run length if the Variable Handrail Capability is activated (see next page) in the definition file. Definition files are discussed in detail later in this document.

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Variable Handrail Capability (Handrail Profiles Based on Property Specification Case - PSC) (Optional Capability)

The Variable Handrail Capability can be activated by specifying a valid PSC command in the definition file. A PSC command points to a PSC file, which contains cases defining a set of profiles for a specific length condition. The details of the PSC file are included at the end of the document following section on definition files. If a valid PSC file with at least one case (maximum 10) is defined in the definition file, the start-up dialog box will look as follows:

The screenshot shows the 'ACE Steel FPL Utilities' dialog box with the title 'ACESEA(c) 1998-2004'. The main section is titled 'Straight Pipe Handrail (All Units Feet)'. It includes several options and input fields: a checked 'Use Variable HR' checkbox, a 'Variable Handrail Details' button, a 'Handrail Mounted on Top' button, an 'Edge/Center' button, a 'Start Post w/ Defined Spacing' button, a 'Toe Plate on Right' button, a 'Post Spacing' input field set to 4.000, a 'Maximum Post Spacing = 4.75' label, a checked 'Close Overhangs' checkbox, a checked 'Toe Plate' checkbox, an unchecked 'Place Interference Envelope' checkbox, an 'ACE FWP Point Mode' button, a 'Flat Handrail' button, and a text label 'Elevation is the base location of Toe Plate'. Below these are an 'Elevation' input field set to 18.000 and a 'Set Elevation via Member Point Locator' button. The 'Start Point for Handrail' section has 'North Coordinate' and 'East Coordinate' input fields both set to 20.000, with a 'Set Coordinates via Member Point Locator' button. The 'End Point for Handrail' section has 'North Coordinate' and 'East Coordinate' input fields both set to 20.000, also with a 'Set Coordinates via Member Point Locator' button. At the bottom, it says 'HR Profiles: Variable Profiles - see Variable Handrail Details' and has four buttons: 'Place Handrail', 'Handrail Info', 'Compute Profiles', and 'Cancel'.

The dialog box includes the “Use Variable HR” toggle, the “Variable Handrail Details” and the “Compute Profiles” command. The variable handrail capability can be toggled off at any time with the “Use Variable HR” toggle.

Compute Profiles

If the “Compute Profiles” button is pressed, the PSC cases are studied. If a case is found where the current length meets the case’s length condition, that case’s profiles will be utilized. If a satisfying case is not found, the profiles specified in the definition file will be utilized. This button allows the determination of profiles which will be utilized for handrail placement prior to actual placement.

The screenshot shows a dialog box titled 'Variable Handrail - Selected PSC Case: Medium Run'. It contains the following text: 'Condition: where: Horizontal Length LT 18.000', 'For Length= 15.000 & Horizontal Length= 15.000 - Profiles are:', 'Post: L2X2X1/4', 'ToePlate: TOEPL', 'TopRail: L2X2X1/4', and 'MidRails L2X2X1/4'. At the bottom is an 'OK' button.

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Variable Handrail Capability (con'd)

Variable Handrail Details

Variable Handrail Information Units : feet

VARIABLE HR DETAILS

HR Toprail: P2STD	Class: 3 (NG: 4)
Grade: A36	Type: VBRACE
HR Midrail: L2x2x1/4	Class: 5 (NG: 5)
Grade: A42	Type: VBRACE
HR Post: P2STD	Class: 4 (NG: 2)
Grade: A36	Type: VBRACE
ToePlate: TOEPL	Class: 2 (NG: 1)
Grade: A36	Type: VBRACE

Close CASE: ▸ Default Handrail Profiles from Definition File
Small Run
Medium Run
Long Run
Very Long Stair

The following dialog box appears when the “Variable Handrail Details” button is pressed.

The cases contained in the PSC file can be viewed through this dialog box using the CASE option button at the bottom of the dialog box. The default case (profiles & properties specified in the definition file) can also be viewed. Cases are examined from the 1st to the last. The first case, which satisfies the length condition, determines the handrail component properties.

ACE Steel FPL Utilities ACESEA(c) 1998-2004

Straight Pipe Handrail (All Units Feet)

☐ Use Variable HR Variable Handrail Details

Handrail Mounted on Top Edge/Center

Start Post w/ Defined Spacing Toe Plate on Right

Post Spacing: 4.000 Maximum Post Spacing = 4.75 ☒ Close Overhangs

☒ Toe Plate ☐ Place Interference Envelope ACE FWP Point Mode

Flat Handrail Elevation is the base location of Toe Plate

Elevation: 18.000 Set Elevation via Member Point Locator

Start Point for Handrail

North Coordinate: 20.000 East Coordinate: 35.000
Set Coordinates via Member Point Locator

End Point for Handrail

North Coordinate: 20.000 East Coordinate: 20.000
Set Coordinates via Member Point Locator

Post P2STD Toprail P2STD Midrail P1 1/2STD Toepl TOEPL

Place Handrail Handrail Info Cancel

When the variable stair capability is toggled off, the default profiles are displayed on the bottom of the dialog box as shown left. The “Compute Profiles” button disappears. If the “Place Stair” button is pressed the displayed profiles are those that will be utilized for stair placement.

The Variable Handrail Capability can be toggled on at any time.

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Handrail (continued)

The Detailed Handrail Info button yields the following information for the default case where profile editing is turned off:

The screenshot shows a Windows-style dialog box titled "ACE Steel FPL Utilities" with a subtitle "ACESEA(c) 1998-2004". The main heading is "Pipe Handrail Information". The content is organized into four sections, each with two columns of text. The first section is for the Handrail Rail (P2STD, Class: 3, NG: 4, Grade: A36, Type: VBRACE, Top Rail Height: 4.75). The second is for the Handrail MidRail(s) (P1 1/2STD, Class: 5, NG: 5, Grade: A42, Type: VBRACE, Mid Rail Height: 2.25, Third Rail Height: 1.25). The third is for the HR Post Section (P2STD, Class: 4, NG: 2, Grade: A36, Type: VBRACE, HR Post Maximum Spacing: 4.75). The fourth is for the Toe Plate Section (TOEPL, Class: 2, NG: 1, Grade: A36, Type: VBRACE, Toe Plate Vertical Offset: 0.200). Below these sections, it says "ENV: Class: 8 (NG: 3) Grade: ACCESS Material: 2" and "Dynamic naming Active (Default Name - HR-)". At the bottom are two buttons: "ACCEPT" and "Close".

Handrail Rail : P2STD	Class: 3 (NG: 4)
Grade : A36	Type : VBRACE
Top Rail Height : 4.75	
Handrail MidRail(s) : P1 1/2STD	Class: 5 (NG: 5)
Grade : A42	Type : VBRACE
Mid Rail Height : 2.25	Third Rail Height : 1.25
HR Post Section : P2STD	Class: 4 (NG: 2)
Grade : A36	Type : VBRACE
HR Post Maximum Spacing : 4.75	
Toe Plate Section : TOEPL	Class: 2 (NG: 1)
Grade : A36	Type : VBRACE
Toe Plate Vertical Offset : 0.200	

ENV: Class: 8 (NG: 3) Grade: ACCESS Material: 2

Dynamic naming Active (Default Name - HR-)

ACCEPT Close

If profile editing feature is turned on, the dialog box would appear as follows:

This screenshot is similar to the previous one, but the input fields for the rail sections are now active. The "TopRail:" field contains "P2STD", "MidRail:" contains "P1 1/2STD", "Post:" contains "P2STD", and "Toe Plate:" contains "TOEPL". The other information, including grades, types, heights, spacing, and environment settings, remains the same. The "ACCEPT" and "Close" buttons are still at the bottom.

TopRail: P2STD	Class: 3 (NG: 4)
Grade : A36	Type : VBRACE
Top Rail Height : 4.75	
MidRail: P1 1/2STD	Class: 5 (NG: 5)
Grade : A42	Type : VBRACE
Mid Rail Height : 2.25	Third Rail Height : 1.25
Post: P2STD	Class: 4 (NG: 2)
Grade : A36	Type : VBRACE
HR Post Maximum Spacing : 4.75	
Toe Plate: TOEPL	Class: 2 (NG: 1)
Grade : A36	Type : VBRACE
Toe Plate Vertical Offset : 0.200	

ENV: Class: 8 (NG: 3) Grade: ACCESS Material: 2

Dynamic naming Active (Default Name - HR-)

ACCEPT Close

If variable handrail capability is active, the keyin boxes shown above are disabled.

ACE FWP Handrail Documentation

Handrail (continued)

Handrail Variables and Options

The Handrail application, ACE_HR.MA, has been designed to allow great flexibility (i.e. many options) in the placement of handrail runs. This FrameWorks Plus FPL application is limited to a single handrail run but allows the following interactive changes:

- Handrail layout definition
- Toggle for partial post placement at overhangs
- Handrail orientation (left or right)
- Handrail position (mounted on top or side) (Drop distance for side mounted)
- Handrail placement cardinal point (4 options - reference cardinal point section)
- Handrail run slope (flat or sloped)
- Toggle to place toe plate
- Toggle for Interference Envelope
- Option for point selection technique (“last datapoint” or ACE FWP point select)
- Handrail Profiles (optional)
- Variable Handrail Capability Toggle if PSC specified in definition file (optional)

Note: The above options may be locked if so desired (see definition file).

The following parameters may be defined in the definitions file (note that all interactive definition variables may also be defined in the definitions file). Items shown in bold may only be defined in definitions file:

- **Toe plate grade, class & type**
- **HR post section, grade, class & type**
- **HR rail section, grade, class & type**
- **HR Post maximum spacing**
- **HR top rail height**
- **HR mid rail height**
- **HR third rail height**
- **Toe Plate vertical offset**
- **Envelope grade, class & material**
- **PSC file (Variable Handrail Capability) (optional)**
- **Handrail Profile Editing (optional)**
- Handrail start overhang at startup
- Handrail end overhang at startup
- Handrail post spacing at startup
- Handrail drop distance at startup
- Handrail orientation at startup (**w/ lock option**)
- Handrail CP definition at startup (**w/ lock option**)
- Handrail slope mode at startup (**w/ lock option**)
- Handrail position at startup (**w/ lock option**)
- Method of handrail layout at startup (**w/ lock option**)
- Toggle for place partial posts at overhangs (**w/ lock option**)
- Toggle for place toe plate at startup (**w/ lock option**)
- Toggle for interference envelope at startup (**w/ lock option**)
- Point select technique at startup

Many of the above listed options are shown graphically in the following illustrations. Subsequently a sample definitions file is shown with expanded explanation.

ACE FWP Handrail Documentation

Handrail Run Geometry

The handrail run 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 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 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 run 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.

Handrail Orientation

Handrail orientation may be left or right. Handrail orientation can be best understood if viewed as follows: looking from the start location to the end location the following is true.

LEFT ORIENTATION

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
3. EDGE/anything cardinal point option would put cardinal point on the left for both post & rail

RIGHT ORIENTATION

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
3. EDGE/anything cardinal point option would put cardinal point on the right for both post & rail

LIMITATIONS ON SECTION PROFILES

This application has been design for equal leg angle handrail and pipe handrail.

Equal Leg Angle Handrail

If either the handrail post or the handrail rail is an angle section, the other must also be an angle section. If the angle legs are not equal in length, the resulting handrail will be less than desirable.

Pipe Handrail and Possible Variations

While the application is designed for both handrail rail & post to be pipe (also solid round, square tube or solid square) sections, it is possible to use a solid bar (or rectangular tube) as a post. When a rectangular section is used as a post, it is important to understand that the depth of the post runs parallel to the handrail run and the width is normal to it. In all likelihood, the section properties will have to be created for such situations as in most instances it is desired that the width be greater than the depth. Thus the handrail post properties would typically be opposite of a toe plate where the height is greater than the width. Hence if a rectangular structural is utilized, the properties will have to be recreated in a user library to attain desired results. If a rectangular post is utilized, the rail will be centered with the post with the CENTER/CENTER and CENTER/EDGE options only.

ACE FWP Handrail Documentation

Cardinal Point Options

Four cardinal point options are available and are very important to understand. The actual location of handrail run components are defined by the cardinal point option selected in conjunction with 1) the start and end points and 2) the handrail orientation. 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. Right Orientation refers to toe plate on right side & left orientation refers to toe plate on left side.

Option 1 - EDGE/CENTER (Post & Rail outside edge on the handrail run line)

Right Orientation for Post

Cardinal point for the post will be 4. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point. The post should be visualized by standing beneath it and looking up. Same for both angle and pipe handrail.

Right Orientation for 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 4. Reflect is off and rotation is 0 degrees The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will actually be higher than the rail height by the depth of the angle or pipe.

Right Orientation for 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.

Left Orientation for Post

Pipe - Cardinal point for the post will be 6. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

Angle - Cardinal point for the post will be 4. Reflect is on and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

The post should be visualized by standing beneath it and looking up.

Left Orientation for 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 4. Reflect is on and rotation is 0 degrees The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will actually be higher than the rail height by the depth of the angle or pipe.

Left Orientation for 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.

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Cardinal Point Options (continued)

Option 2 - EDGE/EDGE (Post & Rail outside edge on the handrail run line)

Right Orientation for Post

Cardinal point for the post will be 1. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point. The post should be visualized by standing beneath it and looking up. Same for both angle and pipe handrail.

Right Orientation for 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 0 degrees. The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will match the rail height.

Right Orientation for Toe Plate

Toe plate is placed at an offset equal to negative 1/2 depth of angle or pipe 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.

Left Orientation for Post

Pipe - Cardinal point for the post will be 3. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

Angle - Cardinal point for the post will be 1. Reflect is on and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

The post should be visualized by standing beneath it and looking up.

Left Orientation for 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 on and rotation is 0 degrees. The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will match the rail height.

Left Orientation for 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 Handrail Documentation

Cardinal Point Options (continued)

Option 3 - CENTER/CENTER (Post & Rail centerlines on the handrail run line)

Right Orientation for Post

Cardinal point for the post will be 5. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point. The post should be visualized by standing beneath it and looking up. Same for both angle and pipe handrail.

Right Orientation for 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 0 degrees. The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will actually be higher than the rail height by the depth of the angle or pipe.

Right Orientation for Toe Plate

Toe plate is placed at an offset equal to negative 1/2 depth of angle or pipe 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.

Left Orientation for Post

Pipe - Cardinal point for the post will be 5. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

Angle - Cardinal point for the post will be 5. Reflect is on and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

The post should be visualized by standing beneath it and looking up.

Left Orientation for 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 0 degrees. The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will actually be higher than the rail height by the depth of the angle or pipe.

Left Orientation for 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 Handrail Documentation

Cardinal Point Options (continued)

Option 4 - CENTER/EDGE (Post & Rail centerlines on the handrail run line)

Right Orientation for Post

Cardinal point for the post will be 2. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point. The post should be visualized by standing beneath it and looking up. Same for both angle and pipe handrail.

Right Orientation for 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 0 degrees. The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will match the rail height.

Right Orientation for 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.

Left Orientation for Post

Pipe - Cardinal point for the post will be 2. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

Angle - Cardinal point for the post will be 2. Reflect is on and rotation is 0 degrees. The OV vector is defined by a line from the start point to the end point.

The post should be visualized by standing beneath it and looking up. Same for both angle and pipe handrail.

Left Orientation for 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.

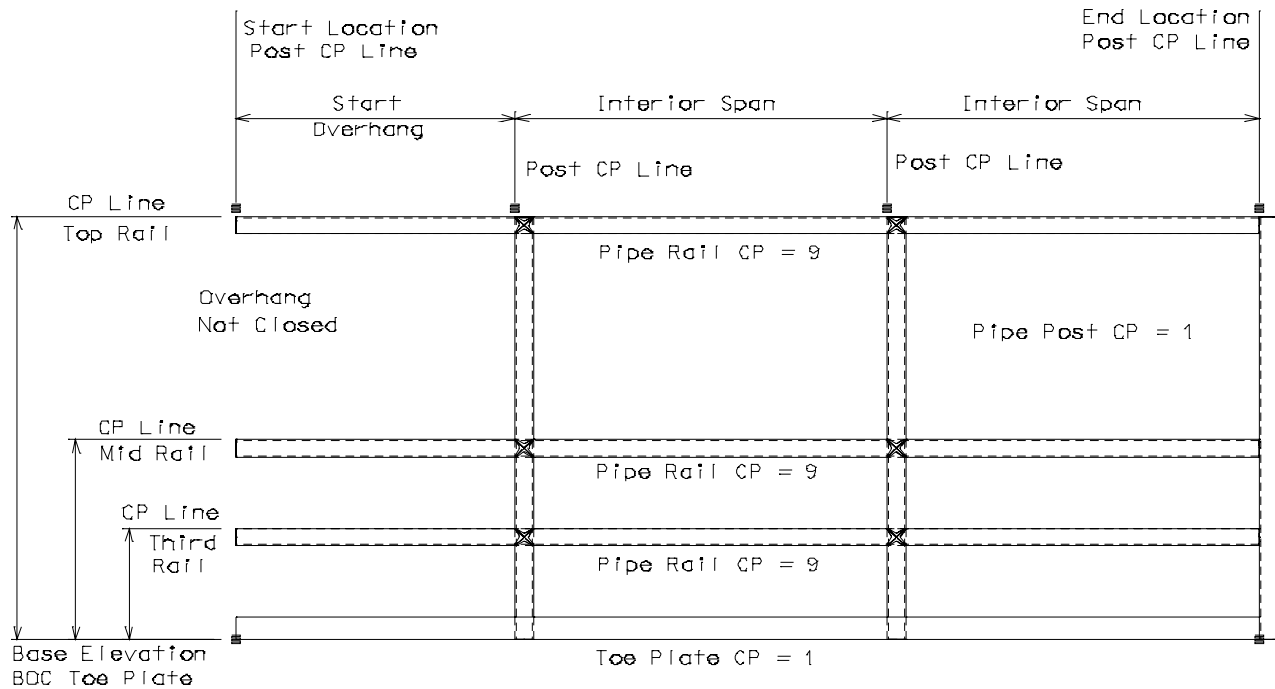
Angle - Cardinal point for the rail will be 2. Reflect is on and rotation is 0 degrees. The OV vector is defined by a line parallel to the global negative Z axis.

Note: For both angle & pipe - The rail should be visualized by standing at start location and looking toward the end. Also the TOS for the handrail will match the rail height.

Left Orientation for Toe Plate

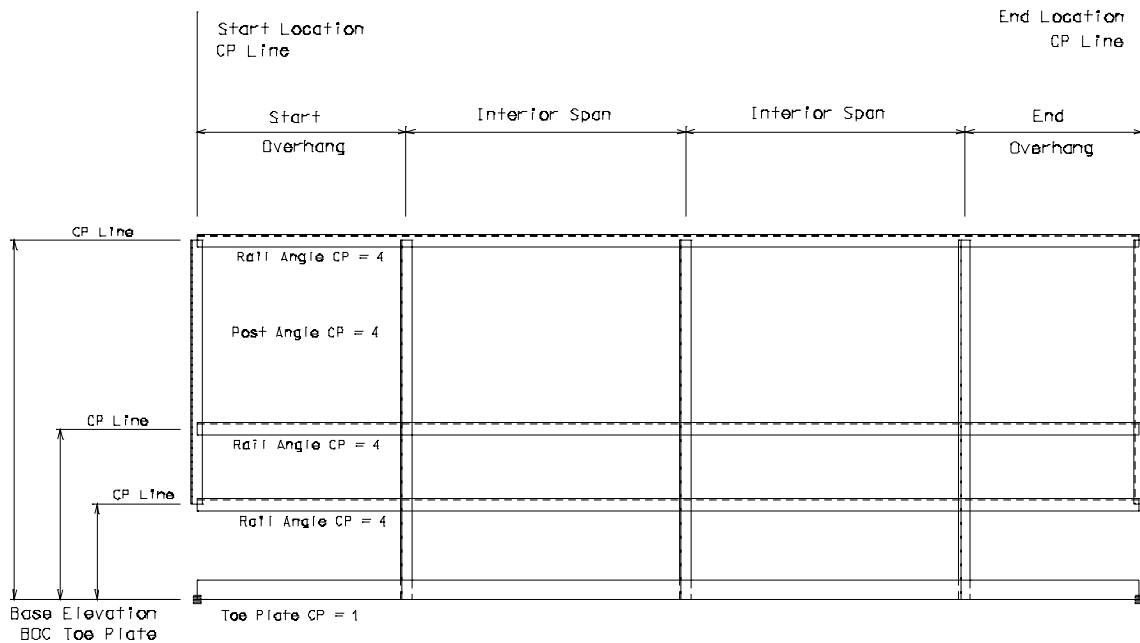
Toe plate is placed at start and end points with cardinal point 3. Reflect is off and rotation is 0 degrees. The OV vector is defined by a line parallel to the global positive Z axis.

ACE FWP Handrail Documentation



Pipe Handrail

(Position on Top, Cardinal Point Edge/Edge, Right Orientation)



Angle Handrail

(Position on Top, Cardinal Point Edge/Center, Right Orientation)

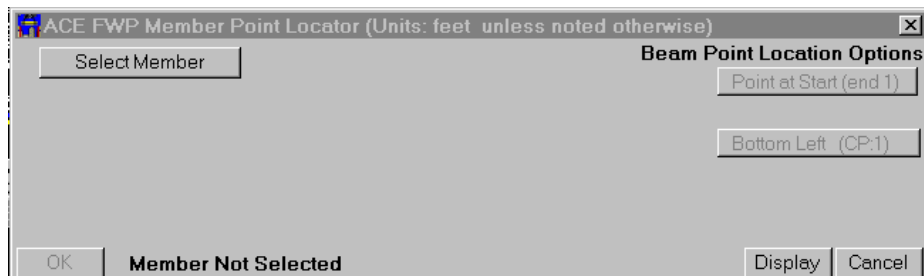
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Point Select Mode

There are two point select modes: uStn Point Mode and ACE FWP Point Mode. The uStn Point Mode sets the two (sloped case) or three (flat case) point select buttons to use the “Last Data Point”. The last data point is simply the last MicroStation datapoint that was entered. The ACE FWP Point Mode sets the point select buttons to use the ACE FWP member point locator.

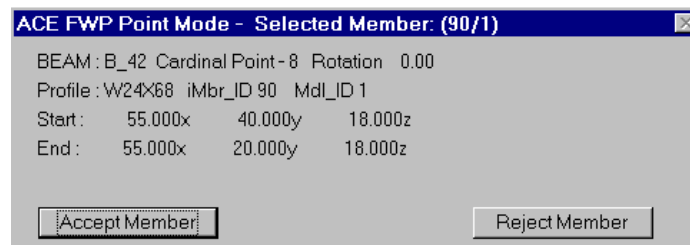
ACE FWP Member Point Locator Mode

In this mode, a point may be selected using points on a FrameWorks member. When a Set ... via Member Point Locator button is pressed the following dialog box appears.



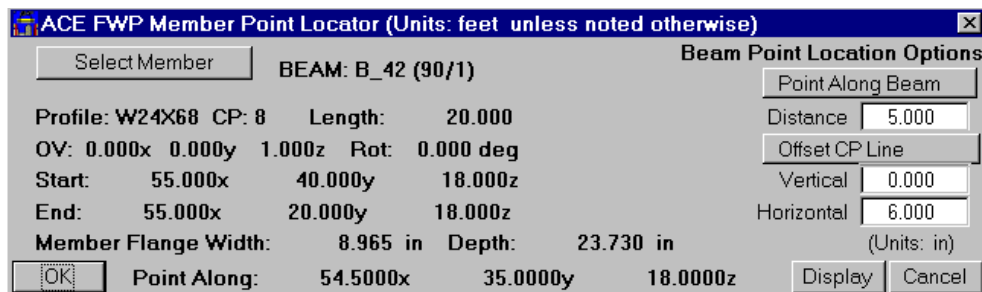
ACE FWP Member Point Locator Dialog Box

When the Select Member button is pressed and a FrameWorks Member is identified, the following dialog box appears.



Member Accept/Reject Dialog

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 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. In the above situation, two adjustments have been made. First, the Point Along Member option was selected and 5 foot was entered into the keyin box. Second, the Offset CP Line option was selected and a horizontal offset of 6 inches was entered into the keyin box. Pressing Display will highlight the point. Pressing OK 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 as shown above, offset points can also be specified. Offset points are computed from the actual CP of the member in question.

ACE FWP Handrail Documentation

Naming Options

For a given handrail run, all components are given the same name by concatenating the FWP ID to a prefix. The default prefix is HR, 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.

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_HR.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_HR.DEF). A complete name and location of a definition file may be also specified with the environment variable ACE_HR_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_HR_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_HR.DEF is found in this directory, it is used.
3. If there is a c:\ace_hr.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 later sections of this document. Toward the end of this document, the commands for the definition file are outlined in detail.

The steel definition files allow the specification of units (Metric (meters or mm) or English (ft or in)). 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/in-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.

Sample Definitions File

Typical Definition File:

UNIts	ENGLISH	FEET								
STD	1	2	2	2	1	2	1	2	1	
TOE	FLATBR1	2		A-36		VB				
HRR	"P1 1/2STD"	3		A-36		VB				
HRM	"P1 1/2STD"	2		A-36		VB				
HRP	P2STD	4		A-36		VB				
HRS	2.75	1.75	1.00	3.75		2.0	1.5	4.0	1.25	0.0
NGP	2	4	1	-1	3					
ENV	8 ACCESS	2								
NAME	DYNamic	S200_								

ACE FWP Handrail Documentation

Definitions File - Command Definition

- **Valid Primary Keyword Commands:** (UNI, STD, TOE, HRR, HRP, HRS, NGP, ENV, 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 may 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_HR.DEF definition file
- Definition file path may be defined with environment variable ACE_DEF_PATH
- ACE_DEF_PATH=d:\mydir\
(the DEF file ACE_HR.DEF will be looked for in the directory d:\mydir)
- Definition file may be defined with environment variable ACE_HR_DEF
- ACE_HR_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.

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)

ACE FWP Handrail Documentation

Handrail Definition File (continued)

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)

HRS Command - Handrail standards Command defines handrail standards

HRS *hr_height_top hr_height_mid hr_height_mid2 max_hr_space start_overhang end_overhang
post_spacing post_extension toepl_offset*

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)
- max_hr_space** : Maximum horizontal spacing for HR posts (default 4.0 ft)
- start_overhang** : Default startup value for start overhang (default 2.0 ft)
- end_overhang** : Default startup value for end overhang (default 2.0 ft)
- post_spacing** : Default startup value for post spacing (default 2.0 ft)
- post_extension** : Default startup - post extension value (default 0.5 ft)
- toepl_offset** : Vertical offset for toe plate (default 0.0)

ACE FWP Handrail Documentation

Handrail Definition File (continued)

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
SPE cified	: 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")
DYN amic	: 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
AUT o	: FrameWorks assigns names by type and sequence number (name_prefix not required or utilized)
CON stant	: Use this name for all handrail placed for all components

PSC Command - Property Specification Case Command defines PSC file

(optional command to define variable handrail profile specification file)

PSC sPSCfile

where

sPSCfile	: Name of PSC (Property Specification Case) file Name includes file path, name and extension Environment variables may be utilized (i.e. PSC \$(WKSP_ACE)mypscfile.psc)
----------	--

Optional Command :

Note 1: If command not present, definition file is used for component properties (handrail profiles may be interactively defined if hr_edit_profile is defined as 1 on STD command)

Note 2: If command is present, PSC file is studied for valid case. If valid case is found, the component properties for the valid case is utilized. (the PSC file may be "turned off" interactively)

ACE FWP Handrail Documentation

PSC Files

A file termed a “Property Specification Case file” can be utilized to specify properties for Handrail application. A Property Specification Case file has a “PSC” file extension. This file can be utilized to specify handrail post, top-rail, mid-rail, & toe-plate properties for Handrail application (including profile, class, grade, type & named group) as a function of length. For the Handrail application, length is the distance from the start point to the end point. The length may be total length or horizontal projected length.

This file conditionally defines a set of cases, which are essentially conditions with a corresponding set of member properties for Handrail. When a Handrail run is being processed, the cases are studied starting with the first case and proceeding downward through the file. The first case that applies will dictate the properties used for the corresponding application. If none of the cases are valid, the properties specified in the definition file, ACE_HR.DEF, are utilized.

The case structure is initiated with a CASE statement that specifies a length condition. The CASE statement is followed by property definitions (valid property keywords). The CASE is terminated with the ENDCase command. A typical CASE statement would look as follows:

```
CASE “Sample Case 1”      LEN LT  10.0
HRR “P1 1/2STD”    3    A36 VB   3
HRM “P1 1/2STD”    6    A42 VB   3
HRP “P1 1/2STD”    4    A36 VB   3
TOE TOEPL          4    A36 VB   3
ENDC
```

Note that if a property is not specified, the value specified in the definition file is utilized. The PSC feature is be toggled off interactively. If toggled off, the properties specified in the definition file will be utilized. In this case (PSC feature is be toggled off), the stringer and/or tread may be optionally keyed-in.

CASE statements are studied from the first to the last. The first case to be TRUE is utilized for FWP member placement. Thus the order of case statements is very important. There can be from 1 to 10 case statements in a PSC file

A sample PSC files for the Stairs application is shown at the end of this document.

ACE FWP Handrail Documentation

Property Specification Case File Format

(PSC File - Command Definition)

- Has Only Three Valid Primary Keyword Commands: (CASE, UNIT & ENDC)
- Valid Property Keyword Commands: (HRR, HRP, HRM & TOE)
- NOTE: HRR, HRP, HRM & TOE commands all specify named group
- A minimum of 1 CAS command is required, a maximum of 10 CAS commands are permitted
- All records that start with a blank (or incomplete) are considered comments
- The components of a given command (record) must all be present and in the order shown
- The full path & name location of the PSC file is specified in the ACE_HR definition file
- The Property Specification Case file must have a .PSC extension
- 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 units command is special and may 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.

CASE Command - Case Command Structure

CASE *“sCaseName”* {Condition Statement}

where :

sCaseName: Reference name for case up to 32 characters in quotes (spaces/ blanks are allowed)
{Condition Statement} The condition may only be LEN for length

{Condition Statement} explanation
where:

LENGTH Conditions		(total length-LEN or horizontal length-HLE)	
LEN	EQ	fValue	
LEN	LE	fValue	
LEN	LT	fValue	
LEN	GT	fValue	
LEN	GE	fValue	
LEN	BE	fValueLow	fValueHigh
HLE	EQ	fValue	
HLE	LE	fValue	
HLE	LT	fValue	
HLE	GT	fValue	
HLE	GE	fValue	
HLE	BE	fValueLow	fValueHigh

Where:

fValue	Floating point value
fValueLow	Starting (lower) floating point value
fValueHigh	Ending (higher) floating point value
LEN	Length is total length between work points
HLE	Length is projected horizontal length between work points

When a CASE command is processed, the applicable property specifications that follow (HRR, HRP, HRM & TOE) will be attributed to that case until a ENDCase command is encountered.

ACE FWP Handrail Documentation

PRIMARY KEYWORD COMMANDS

UNIT Command - Units Command (optional command)

UNIT {UNITTYPE} {UNIT}

where :

{UNITTYPE} May be ENGLISH or METRIC

If UNIT is not specified, the units are assumed to match the current model units.

{UNIT}

Must be FEET or INCH for ENGLISH (default feet) or

must be METER or MM for METRIC (default meters).

If {UNIT} is not specified, it is assumed that the units are feet for English & meters for metric models.

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.

ENDC Command - End Case Command Structure

ENDC

The property keyword commands must be sandwiched between the CASE and the ENDC primary commands. Property keyword statements which are not between CASE and ENDC commands are ignored. The UNIT command may be given at any time.

ACE FWP Handrail Documentation

PROPERTY KEYWORD COMMANDS (must be between CASE and ENDC primary commands)

HRP Command - Handrail Post Command defines post

HRP *hrp_section hrp_class hrp_grade hrp_type hrp_ngp*

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)
- hrp_ngp** : Named group for stair handrail post (default -1 which is none)

HRR Command - Handrail Rail Command defines rail

HRR *hrr_section hrr_class hrr_grade hrr_type hrr_ngp*

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)
- hrr_ngp** : Named group for stair handrail rail (default -1 which is none)

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 hrm_ngp*

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)
- hrm_ngp** : Named group for stair handrail mid-rail (default -1 which is none)

PROPERTY KEYWORD COMMANDS (con'd)

TOE toe_section toe_class toe_grade toe_type toe_ngp

NOTE: Namedgroups are defined globally for a project. The xxx_ngp 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**

ACE FWP Handrail Documentation

Sample PSC File for Stairs Application

Typical PSC File w/ name *anything*.PSC (no spaces/blanks):

```
UNIT  ENG  FEEt
UNITS FEET
CASE  "Small Run"      HLEN  LE      10
HRR   "P1 1/2STD"      5     A36  VB    1
HRM   "P1 1/2STD"      5     A42  VB    1
HRP   "P1 1/2STD"      5     A36  VB    1
TOE   TOEPL            5     A36  VB    1
ENDC
CASE  "Medium Run"     HLEN  LT      18.0
HRR   L2X2X1/4         4     A36  HB    3
HRM   L2X2X1/4         4     A36  HB    3
HRP   L2X2X1/4         4     A36  HB    3
TOE   TOEPL            4     A36  VB    3
ENDC
CASE  "Long Run"       HLEN  LT      25.0
HRR   P2STD            3     A36  VB    4
HRM   "P1 1/2STD"      3     A42  VB    4
HRP   P2STD            3     A36  VB    4
TOE   TOEPL            3     A36  VB    4
ENDC
CASE  "Very Long Stair" HLEN  GE      25.0
HRR   P2STD            2     A42  VB    5
HRM   P2STD            2     A42  VB    5
HRP   P2STD            2     A42  VB    5
TOE   TOEPL            2     A42  VB    5
ENDC
```

The Handrail application would for each handrail run placed, start with the first case looking for a fulfilled condition. The four cases above are carefully ordered and cover the entire range on possibilities. If a case condition matches, the specified component properties are utilized. If the case condition fails, the next case condition is investigated. If all case conditions fail (which can not happen for the cases shown above), the default Handrail properties specified in the Handrail definition file (ACE_HR.DEF) would be utilized.

ACE FWP Handrail Documentation

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).