The Complete Reference Guide

RhinoCAM-ART 2025

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MecSoft Corpotation

Table of Contents

Quick Start

ART Module 2025

Prefer Printed Documentation? Check Here!

What's New | Quick Start Play List

Quick Start Guides for each RhinoCAM module are available in both PDF and Video format. Refer to the following information to access these guides:

How to Access the Quick Start Guide Documents

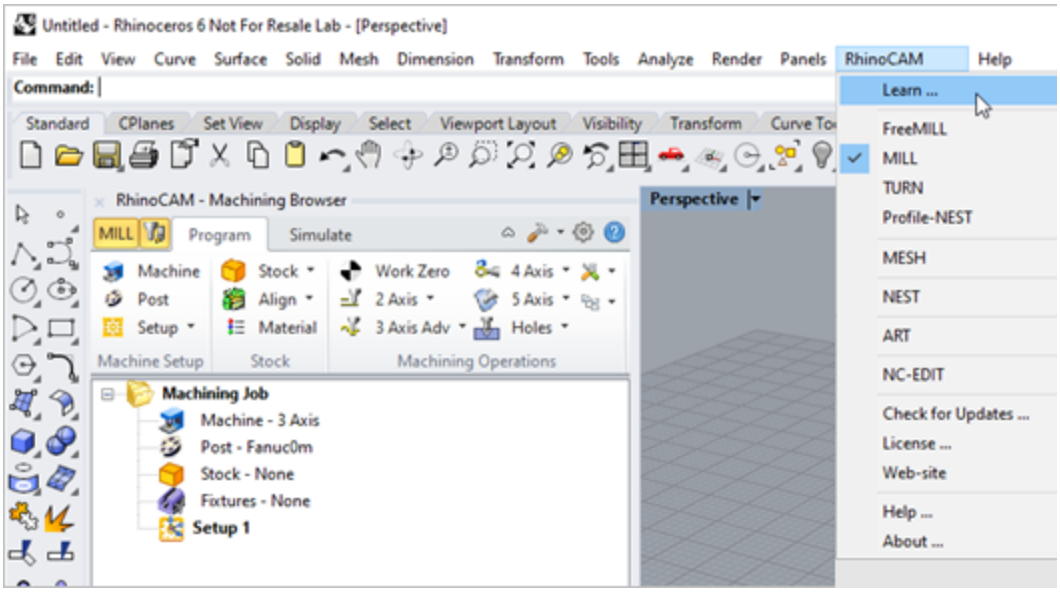
To help you quickly get started in working with each module, select one of the Help buttons located on the RhinoCAM Learning Resources dialog.

You will find:

- Quick Start Guides
- What's New documents
- Online Help links

The Quick Start Guides will help you step through an example tutorial which will illustrate how to use the module. To access the Learning Resources dialog:

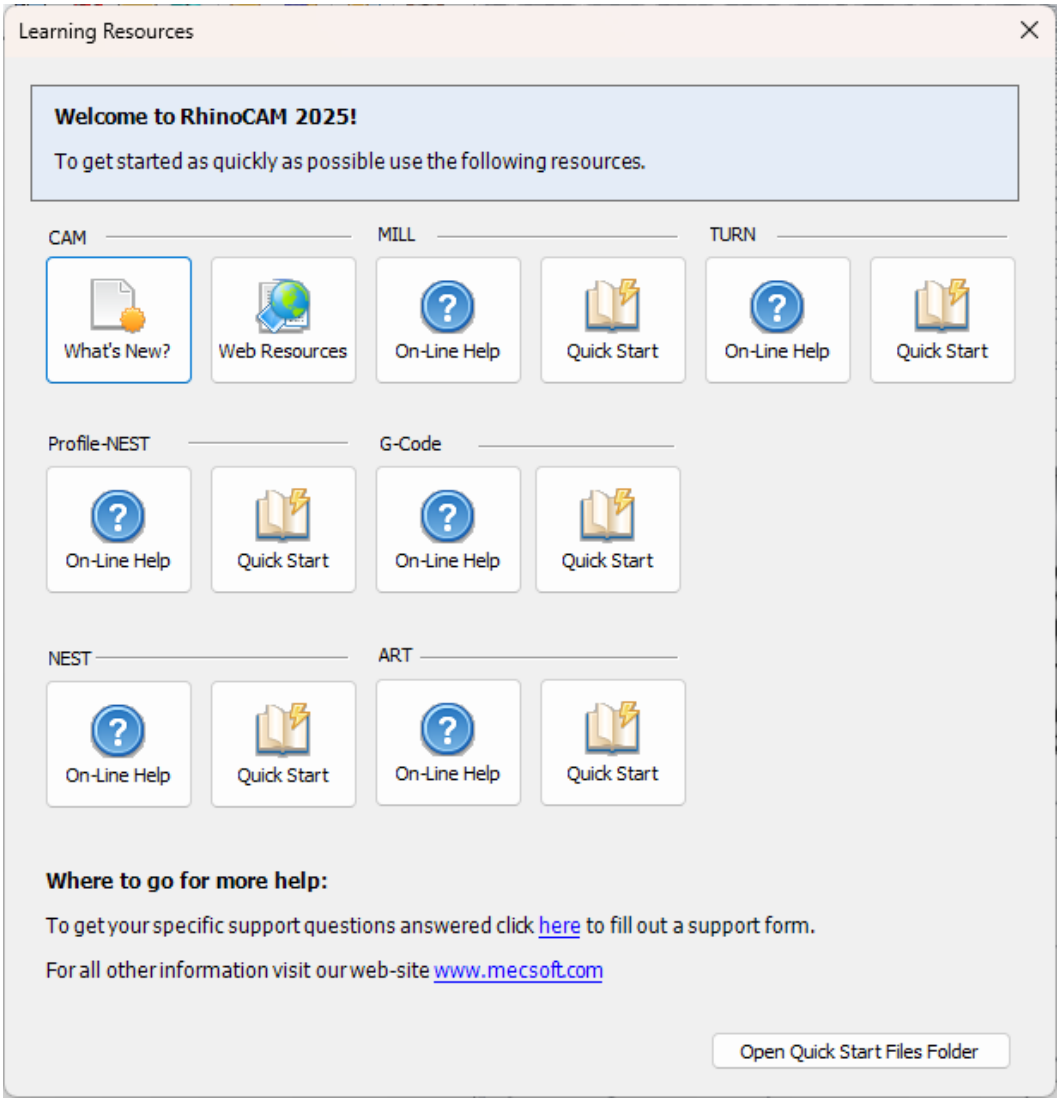
1. From the Rhino Main Menu, drop down the Main menu and select Learn ...



To access the Learning Resources dilog in RhinoCAM

2. Select a document from the Learning Resources dialog to get started using the module of your choice.

You can also select the Open Quick Start Files Folder button located at the bottom of the dialog to open the Quick Start folder where the source files (start and completed versions) are located.



Learning Resources Dialog

Related Topics

Find More Resources

Resource Guide

Download this PDF Guide for a list of the available RhinoCAM Resources.

2025 RhinoCAM Resource Guide

The 2025 RhinoCAM Resource Guide!

18 Pages

Lists PDF downloads and Online resources including Quick Start Guides, Reference Guides, Exercise Guides, Tutorials and More.

Prefer Printed Documentation? Check Here!

What's New | Quick Start Play List

Welcome

RhinoCAM® MecSoft

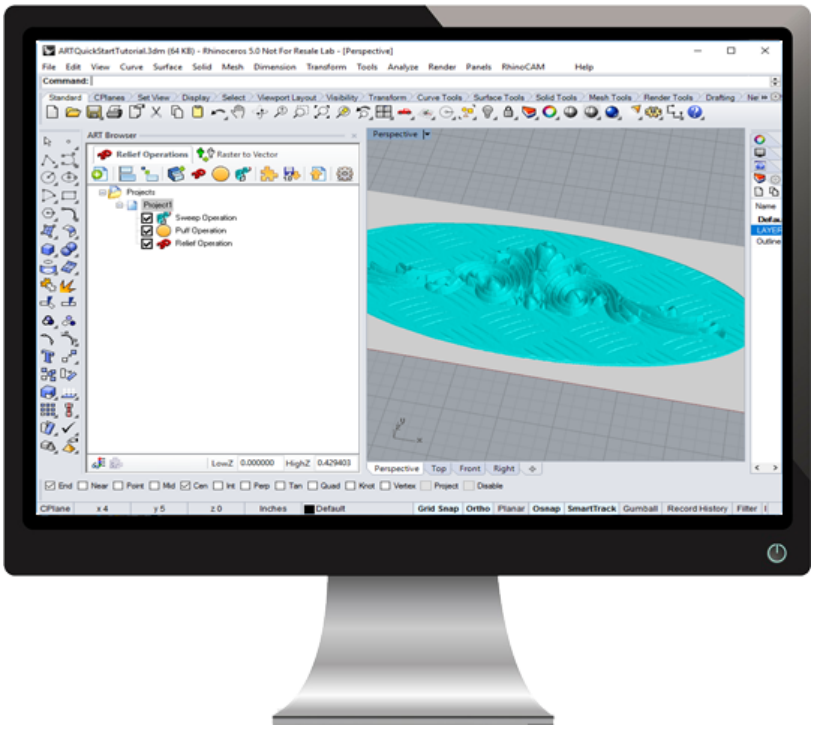
ART Module 2025

Prefer Printed Documentation? Check Here!

What's New | Quick Start Play List

Welcome to the on-line help system for the RhinoCAM module included with your MecSoft CAM software. This online help system provides comprehensive help topics as well as context sensitive help to dialogs that will help you become productive with the RhinoCAM module.

For purposes of brevity, RhinoCAM will be referred to as ART in all subsequent references. Also, Rhino refers to both Rhinoceros 6 or Rhino 7.



Related Topics

Overview of ART

Features of ART

Understanding ART

3.1 Overview of ART

ART is a module that runs inside of the RhinoCAM product. This module is fully integrated inside of Rhinoceros 6 (or Rhino 7) and compliments the CAD functionality of Rhinoceroswith additional artistic modeling capabilities. ART's capabilities enable you to produce 3D models as well as wireframe geometry from picture files. The created geometry can then be exported to Rhinoceros for use in other downstream applications such as RhinoCAM.

Related Topics

The RhinoCAM Module

3.2 Features of ART

The ART module is used to convert artwork into geometry suitable for machining or any other downstream applications such as 3D printing. It augments the traditional modeling capabilities of Rhinoceros and allows you to utilize bitmap files to construct geometry. The list below summarizes the features found in ART.

Relief Operations

Relief operations are used to create 3D shapes. The different functions that a user can utilize are:

- Convert Native Geometry
  Convert CAD data to ART geometry
- Create 3D Relief
  Convert bitmap files to 3D geometry based on gray-scale
- Create Puffed Volume
  Create puffed shapes using wireframe geometry as boundaries
- Create Swept Volume
  Performing sweeping operations of cross sectional shape functions along a curve to create 3D geometry

Raster to Vector

This operation can be used to convert picture or bitmap files (Raster) into wireframe (Vector), by tracing the boundary edges between differently colored regions in the picture file.

Shape Library

You can save created ART geometry to shapes that can be reused in other projects.

Export to CAD

Once 3D or wireframe geometry is created in ART, they can be exported to Rhinoceros for use in downstream applications. There are various settings that can be used to control the way the geometry is created in Rhinoceros.

File Formats Supported

Bitmap Files (*.bmp*), JPEG, JPG Files (*.jpg, .jpeg*) and GIF Files (*.gif*)

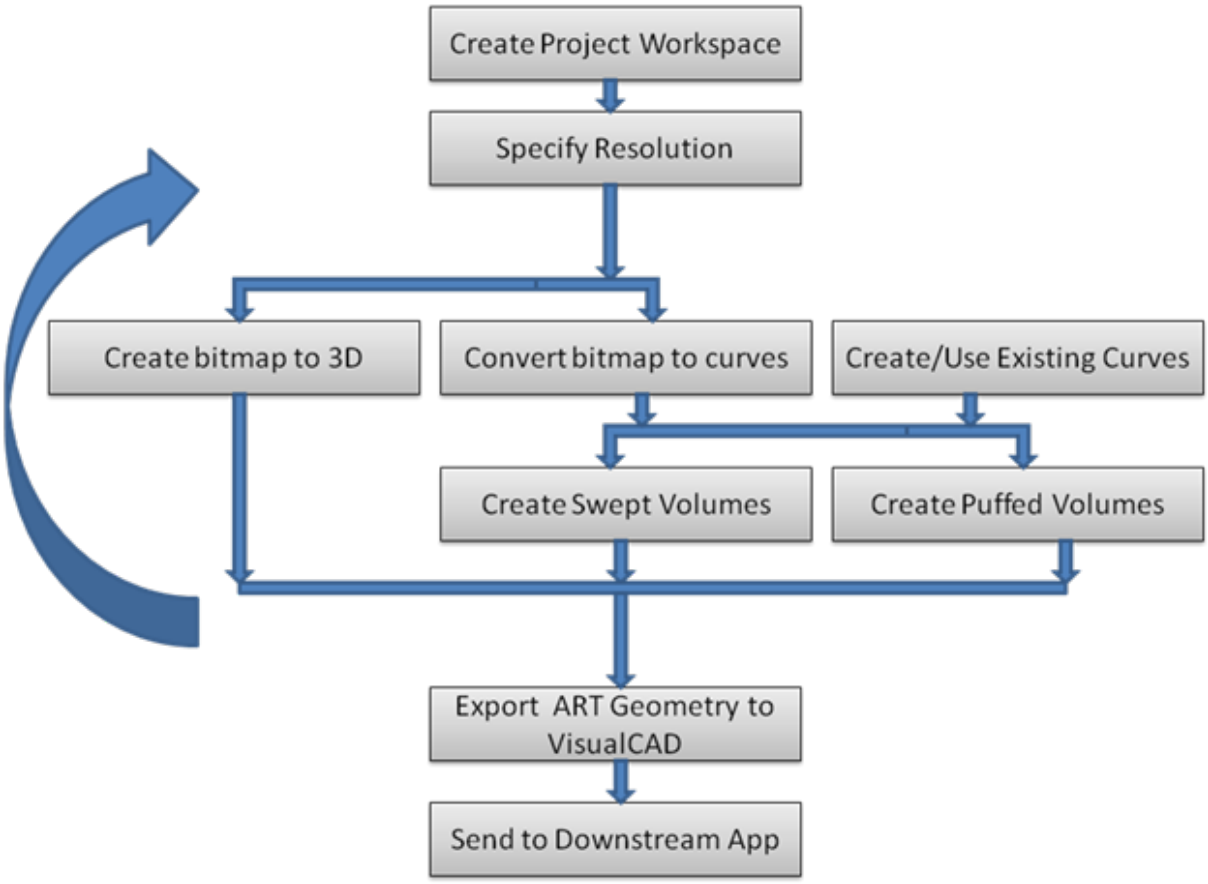
Related Topics

The RhinoCAM Module

3.3 Understanding ART

The ART module is used to convert artwork into geometry suitable for machining or 3D printing. To accomplish this, you utilize modeling techniques unique to the ART module that are found within the "Relief Operations" tabbed browser window or the "Raster to Vector" tabbed browser window. These modeling operations augment the traditional modeling methods available in Rhinoceros.

The created geometry will be displayed on the graphics screen by the ART module for easy visualization and modification if necessary. At any point during the geometry creation, the ART geometry can be exported to Rhinoceros. This geometry can then be used in any downstream applications to create the physical part. The standard work flow of ART module mimics this process and can be represented by the flow chart shown below.



Understanding ART

Related Topics

The RhinoCAM Module

3.4 Typical Scenario

Modeling in ART starts with defining a project workspace. The project workspace specifies the extents of the finally created model. Various operations such as Creating 3D Relief from a bitmap image (.bmp, .jpg, and .gif), Image to Curve geometry conversion, Sweep Volume Generation, Puffed Volume Generation can be specified within this workspace. These operations, once created, will be displayed in the ART browser in a tree structure. The project workspace model represents the state of the model after each and every operation's geometry has been combined into one final shape. The combination is defined using rules (called Operation Type in each of the operation dialogs) that can be selected when creating the operation.

Selecting any of the operation icons in the tree display in the ART Browser will display the corresponding shape on the

graphics screen. Selecting the project icon in the browser will display the shape of the entire project, obtained by combining all of the individual operations that make up the project.

By using a combination of the ART tools, and a variety of bitmaps and operations, different shapes can be created. If any operation is not to your expectation, it can be edited to modify any of the parameters used to create the shape. Operations can also be deleted easily by simply deleting the operation icon in the tree display. After a satisfactory model is generated, the entire project can be exported to Rhinoceros as 3D mesh geometry. This mesh is now ready to be used for machining using software such as RhinoCAM's milling module.

Related Topics

The RhinoCAM Module

3.5 Work-flow

Once the part is loaded, the typical work flow is reflected in the layout of the tabs of the ART Browser window. The work flow is designed to allow you to work from either the Relief Operation tab or Raster to Vector tab. As each tab is accessed, a toolbar with functions specific to the tab chosen will be displayed just below the tab. The functions in each of the toolbars corresponding to each tab are also best accessed in order from left to right.

Thus you typically would start with either the Relief Operations tab or the Raster to Vector tab and access each of the buttons, optionally, in the toolbar that appears when either of these tabs is selected in sequence from left to right. Once the setup functions are completed, you will then proceed to the Relief Operations to commence programming the part. Once relief operations or raster to vector operations are completed you can export the meshes or curves to CAD.

Step 1: Relief Operations tab or Raster to Vector tab

- Create project, create curves, load shape library, import ART 1.0 file or modify preferences
- Create Relief Operations, align native geometry, move selections to origin or convert native geometry

Step 2: Export Models to CAD

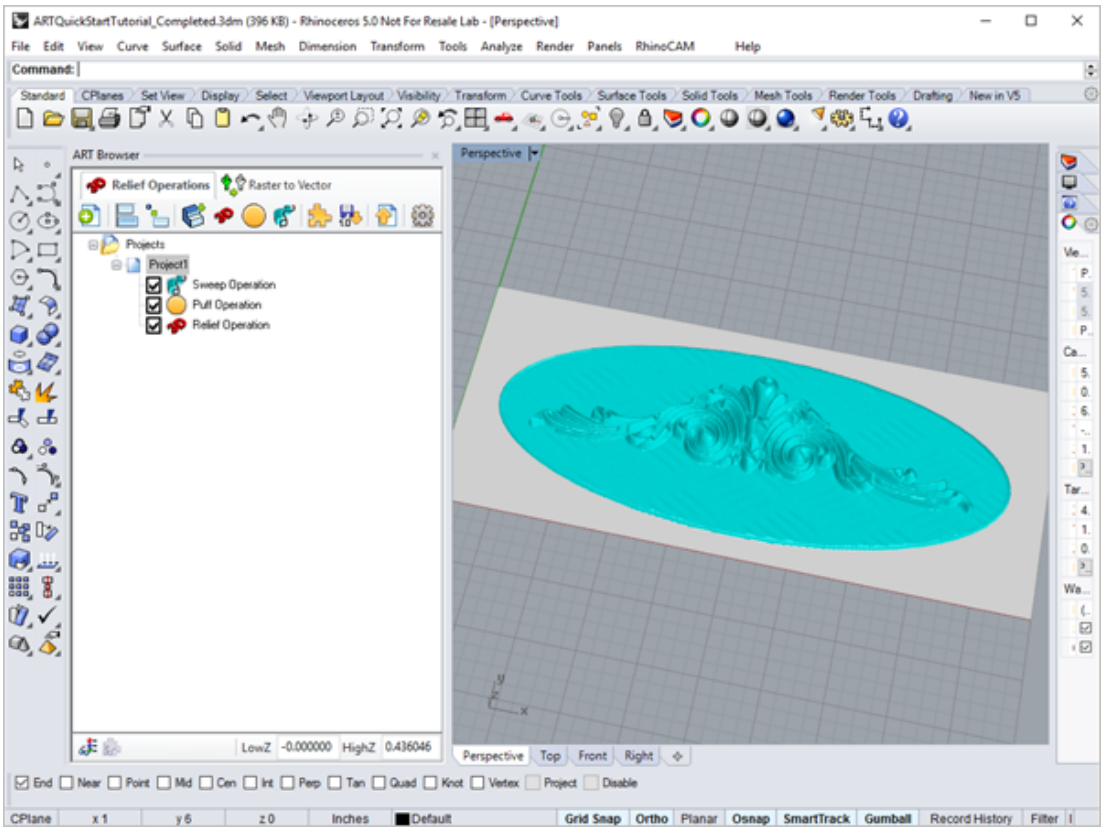
- Export relief operations meshes to CAD
- Export vector operations curves to CAD

Related Topics

User Interface

The ART interface adheres to the Windows standard for user interface design and integrated into the Rhinoceros screen seamlessly. A screen shot of ART running inside of Rhinoceros is shown below:

ART User Interface



Related Topics

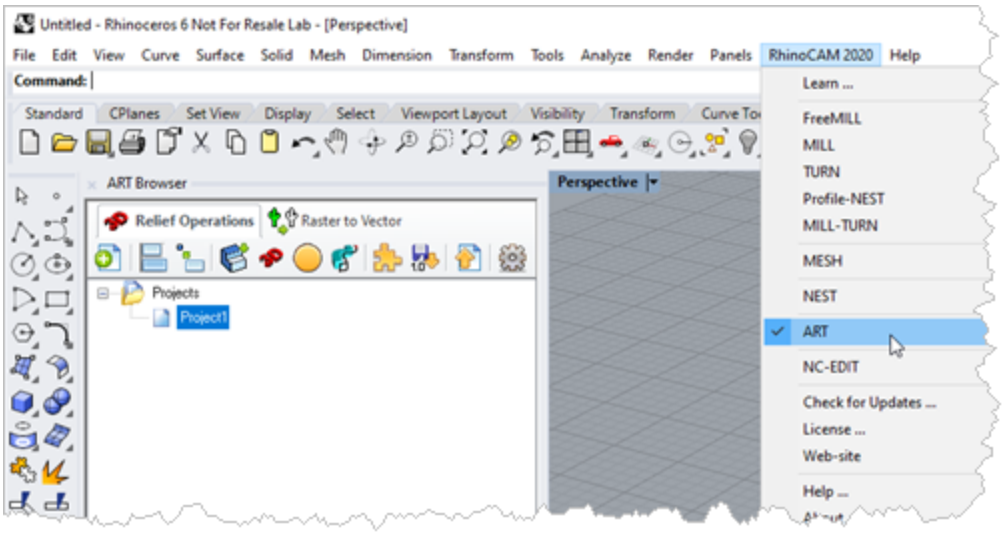
ART Menu Bar Item

ART Browser

ART Online Help

4.1 ART Menu Bar Item

When RhinoCAM is loaded it will add a menu bar item, titled RhinoCAM 2023 to the main Rhino menu bar. Selecting this menu bar item will display a drop down menu as shown below. Select ART to display the ART Browser.



Related Topics

ART User Interface

ART Online Help

4.2 ART Browser

When the ART module is loaded from the RhinoCAM menu, the ART browser window will be displayed. If you are using the default factory settings, this browser window will be docked to the left hand side of the Rhinoceros product as shown above.

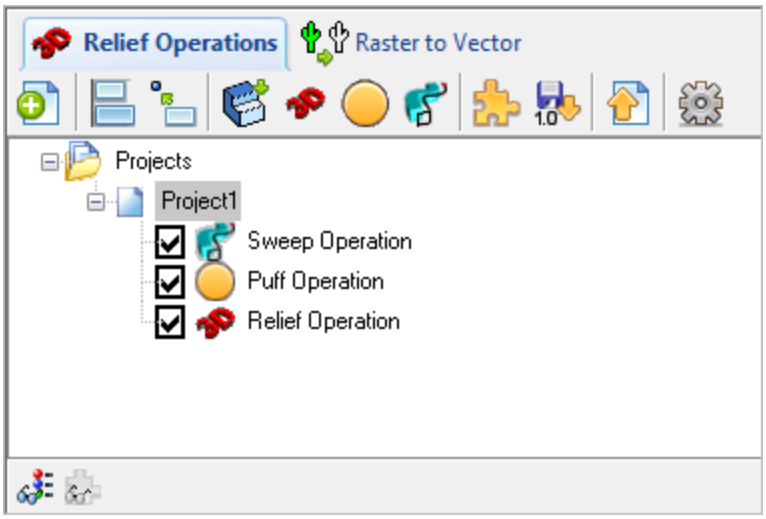
This browser consists of a tabbed toolbar located on top which has two tabs. These tabs are:

1. Relief Operations (ROps) tab
2. Raster to Vector tab

The Relief Operations tab is used for 3D geometry using various operations such as creating reliefs, sweep and puff operations. In the Raster to Vector tab, raster images can be converted in to a vector (Curves).

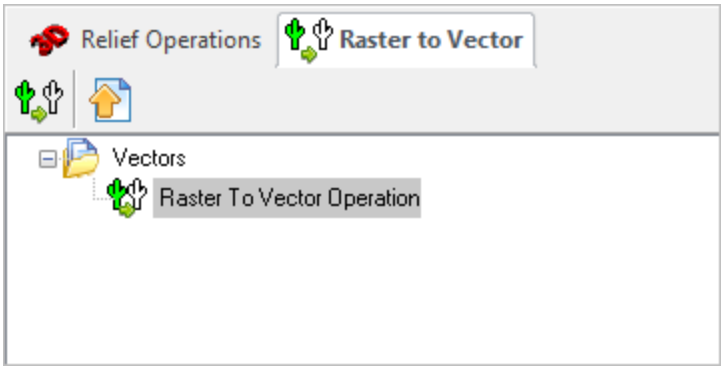
Relief Operations (ROps)

ART allows you to create multiple relief operations in a part file. This feature is the one that allows you to create the entire sequence of relief operations that are necessary to create the part model. This set of operations can additionally be archived to a disk file and retrieved at a later time with no loss of information. The Browser shown below allows you to manage this list of relief operations.



Raster to Vector

Selecting the Raster to Vector tab in the ART Browser shows 2 functions that provide the functionality to create curves from images and export the curves to CAD.



Related Topics

ART User Interface

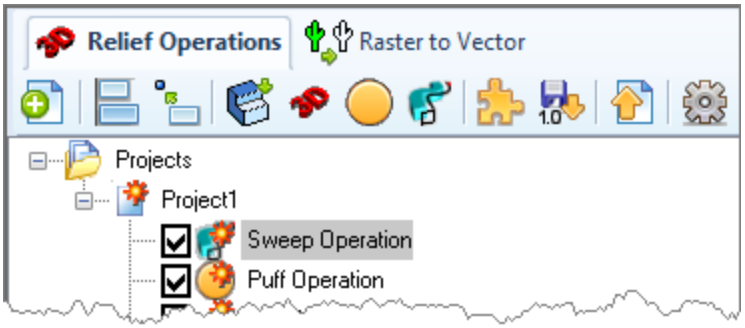
Relief Operations tab

Raster to Vector tab

Docking the ART Browser

ART Online Help

4.2.1 Relief Operations tab



Project Setup

This option brings up the dialog that allows you to setup a project workspace in the XY plane.

Align Native Geometry

This option allows you to align native CAD geometry to the project.

Move to Origin

This option allows you to move the objects or geometry to a specified origin within the project.

Convert Native Geometry

This option allows you to convert native CAD geometry to a relief in the project.

Create 3D Relief from Image

This option brings up the file open dialog which allows you to select the image files such as gif, bmp and jpg. After a file has been selected, the 3D Relief creation dialog pops up and you can now change the parameters in the dialog to create relief.

Create Puffed Volume

This option brings up the puffed volume creation dialog. This dialog allows you to select two sets of curves (border curves and detail curves) and generates a puffed volume inside the enclosed curve.

Create Sweep Volume

This option allows you to sweep a cross-section curve along the selected rail curve to generate a swept volume. You can create curves of various cross sections such as straight lines, arcs (concave or convex) and ellipses (concave or convex).

Load Shape Library

This brings up the open dialog which allows you to select shapes (.slb files) that have been previously saved to Shape Library.

Import ART 1.0 File

Selecting this button imports operations from the RhinoART 1.0 plug in to the ART Browser for part file that is currently loaded.

Export Meshes to CAM

This button allows you to export the ART geometry (meshes) to Rhinoceros. Thus, a mesh can be easily saved in Rhinoceros and further used in any downstream applications native to Rhinoceros.

Preferences

This button allows you to set preferences such as File Load Options, Display Options, Mesh Export Options, and Closed Mesh Options.

Material Texture Visibility

Toggle material texture visibility on and off. When on, the material texture will display on the part.

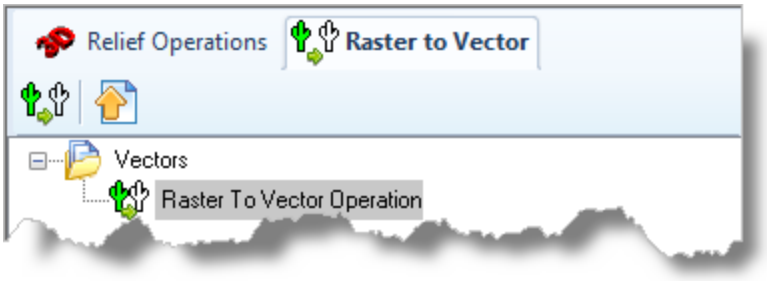
Load Shape Library Visibility

Toggle the display of the Shape Library. When toggled on, the Shape Library will display below the ART Browser.

Related Topics

ART Browser

4.2.2 Raster to Vector tab



Raster to Vector tab

Create Curves from Raster Image


This brings up the file open dialog which allows you to select an image to convert to RhinoCAM Curves.

Export as Curves to CAD


This button allows you to export the ART geometry (curves) to the MILL module. Thus, a mesh can be easily saved using the MILL module, and further machined using any CAM software such as RhinoCAM.

Related Topics

ART Browser

4.2.3 Docking the ART Browser

The ART Browser is a dockable window. This means this window can be docked in any position in Rhinoceros. This section describes the procedure to be used to dock this window.

Select RhinoCAM 2023 from the menu bar and click ART. This displays the ART Browser and by default is docked to the left half of the application window next to the view bar.

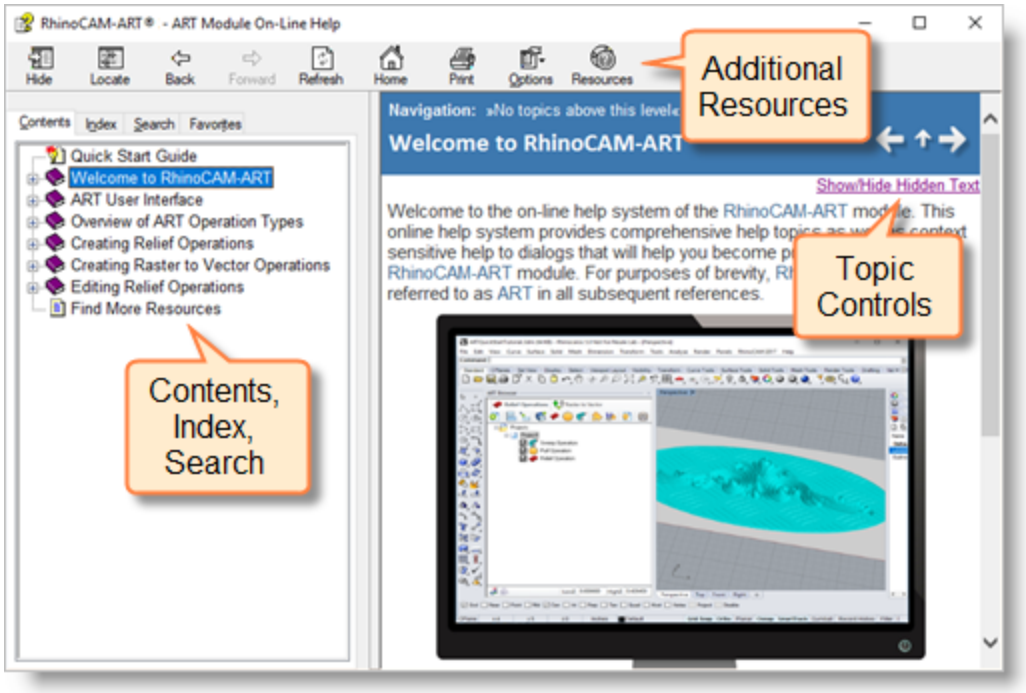
Selecting the title bar and holding the left mouse button down and dragging the browser window will display a widget that allows you to dock the browser to desired location.

Related Topics

ART Browser

4.3 ART Online Help

Select the Help button from any ART dialog to display the Online Help system.



RhinoCAM-ART Online Help

Related Topics

ART User Interface

Relief Operations tab

Raster to Vector tab

Docking the ART Browser

Overview of Operation Types

There are two major classes of operations that can be created in ART module. ART operations are used to convert artwork into geometry for machining. ART operations can be categorized as Relief Operations and Raster to Vector operations.

Relief Operations

Create 3D Relief, Create Puffed Volume, Create Swept Volume

Raster to Vector

Create Curves from image

These categories, and the available operations, within them are described in the sections to follow.

ART allows you to choose from a variety of 3D relief, puffed volume, sweep volume and vector operations to satisfy various artwork converting conditions and requirements. A list of the available types with a short description for each type is given below. Selecting either the 3D Relief Operations tab or Raster to Vector tab in the ART Browser can be used to access the ART operations. The relief operations under the 3D Relief Operations tab that can be used are Create 3D Relief, Create Puffed Volume, and Create Swept Volume. Create curves from image can be selected under the Raster to Vector tab.

Related Topics

Create 3D Relief

Create Puffed Volume

Sweep Volume Generation

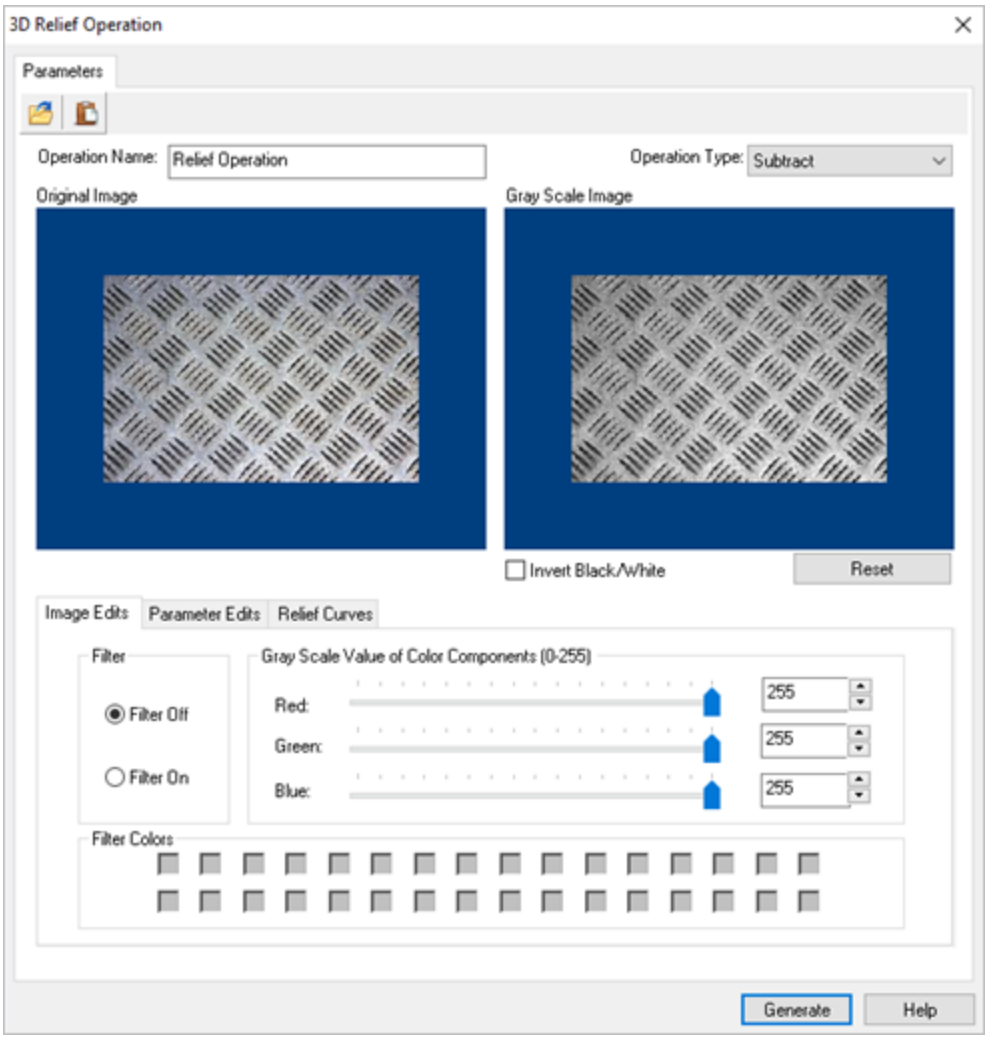
Create Curves from Image

5.1 Create 3D Relief

This part is required for converting the Raster images to gray scale image, which in turn will be converted into the 3D model based on the gray scale values of each pixel in the raster image.

On selecting the Image file, the Create Relief Operation dialog appears as shown below. As seen in the dialog below, you can see the original image and the preview image at the same time.

Dialog Box: 3D Relief Operation



Dialog Box: 3D Relief Operation

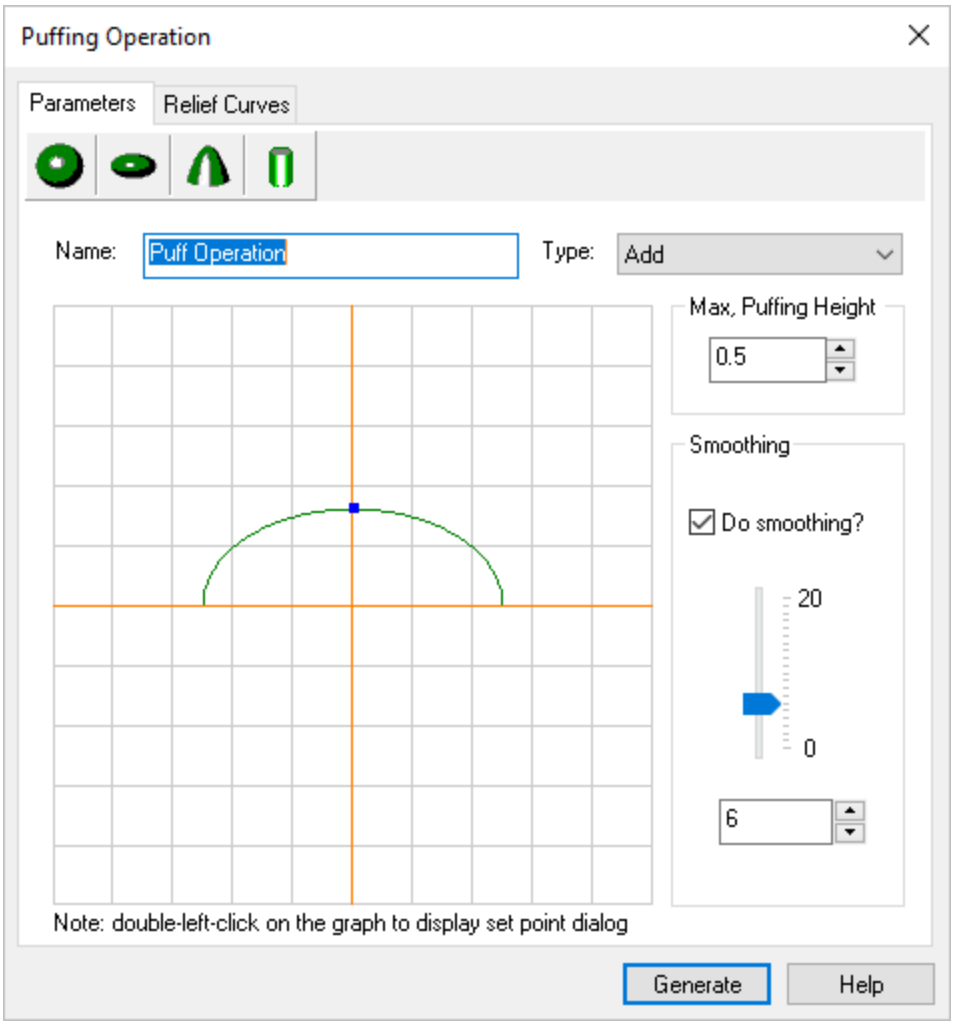
Related Topics

Overview of ART Operation Types

5.2 Create Puffed Volume

This operation is used to puff up the interior of a closed curve. This dialog can be invoked by pressing the icon from the toolbar of the ART Browser. The dialog is shown in the picture below:

Dialog Box: Puffing Operation



Dialog Box: Puffing Operation

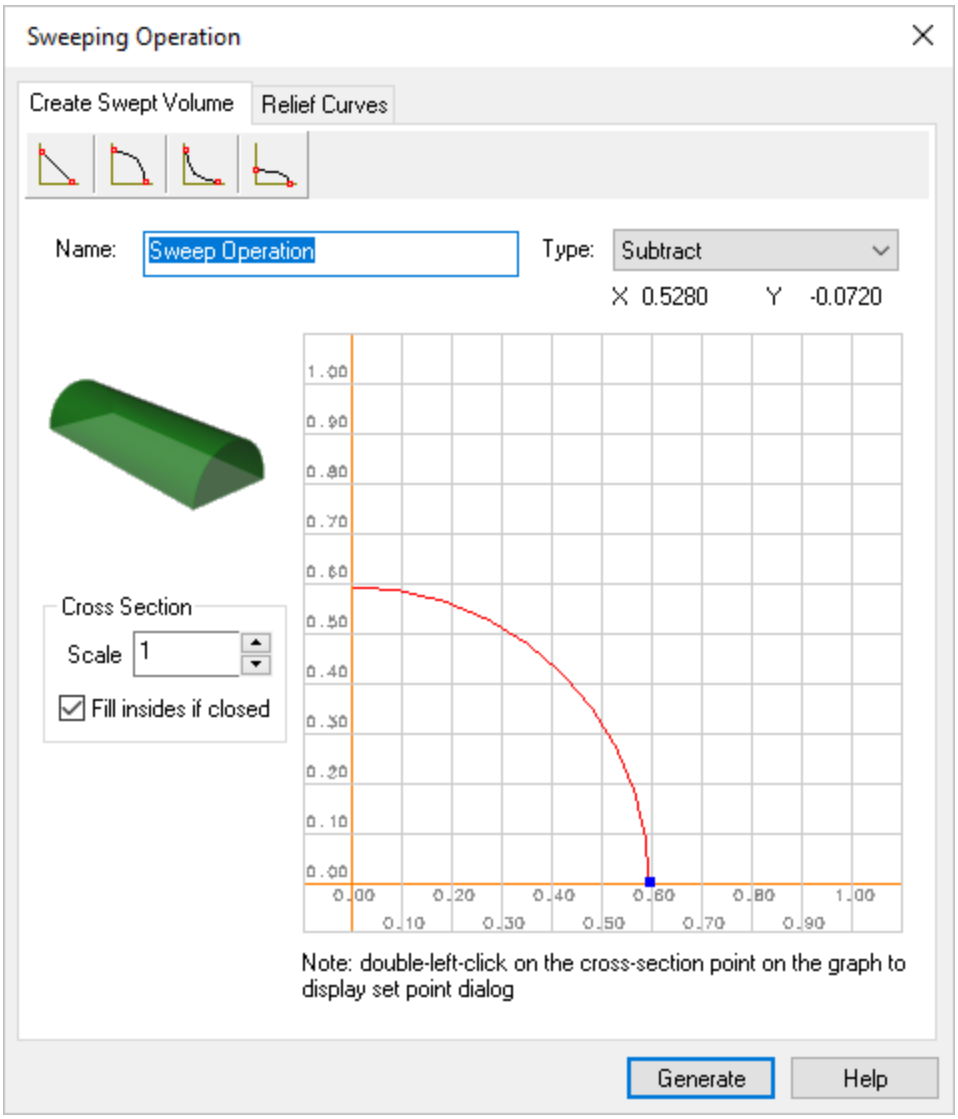
Related Topics

Overview of ART Operation Types

5.3 Sweep Volume Generation

This method is used for generating a volume along a curve by specifying a type of cross-section. This dialog can be invoked by pressing icon in the Art Browser toolbar under Relief Operations tab.

Dialog Box: Sweeping Operation



Dialog Box: Sweeping Operation

Related Topics

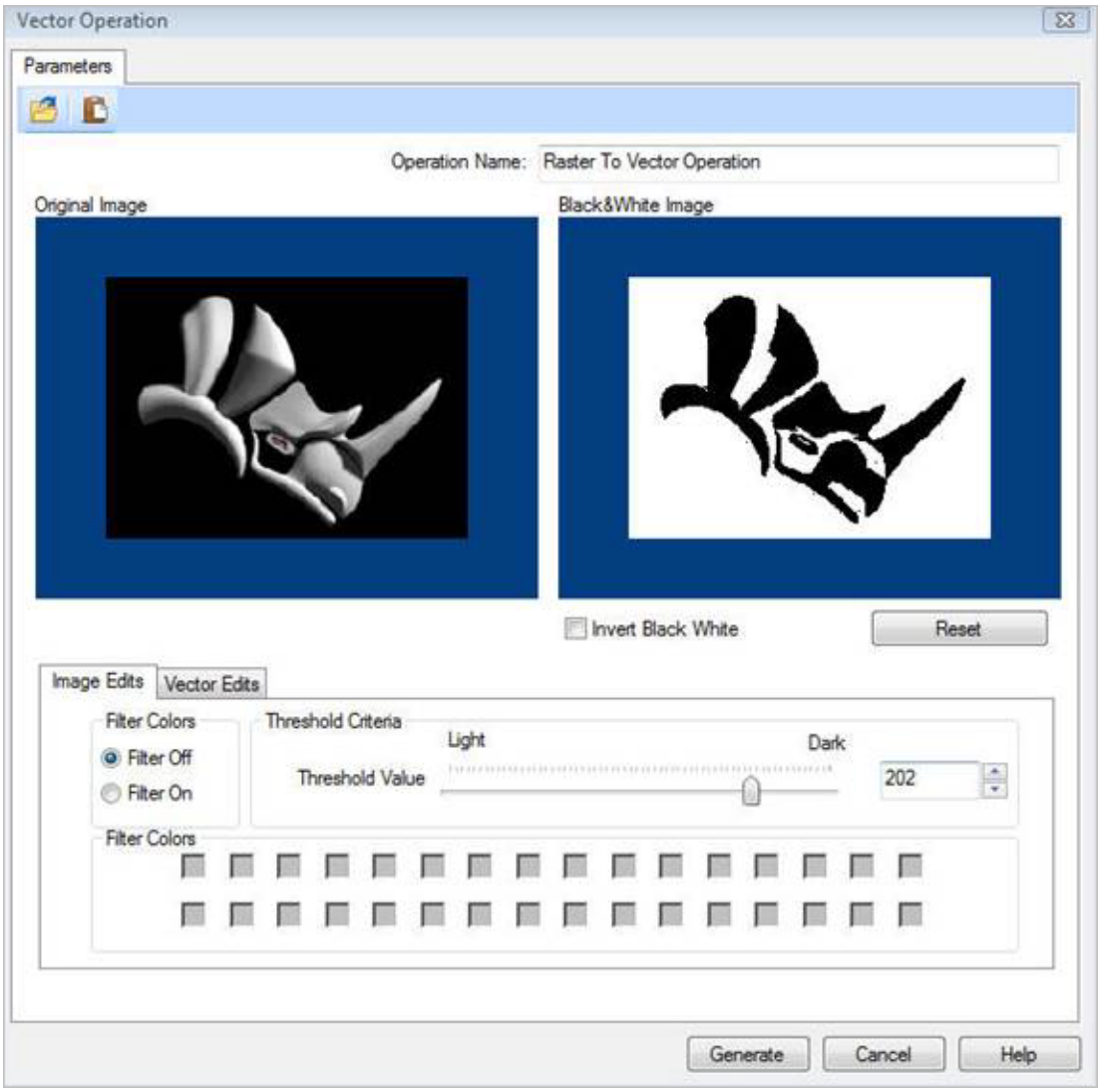
Overview of ART Operation Types

5.4 Create Curves from Image

This method is mainly used to convert and image outline into curves, so that they can be used in the next operation. The first step is to convert the image into black and white image based on the threshold value you defined.

This property page will allow you to load, convert the image to black/white image and preview a color image to a gray scale bitmap. Also, it allows you to view the converted image into a vector and to make changes in the image options to review the vector geometry. The dialog for this implementation will be very similar to the dialog for Raster to 3D Relief. The operation can be undone if you want to reject the obtained geometry.

Dialog Box: Vector Operation



Dialog Box: Vector Operation

Related Topics

Overview of ART Operation Types

Creating Relief Operations

Related Topics

Project Setup

Align Native Geometry Inside Project Setup

Move to Origin

Convert Native Geometry

Create 3D Relief from Image

Create Puffed Volume

Create Sweep Volume

Operation Types

Load Shape Library

Import ART 1.0 File

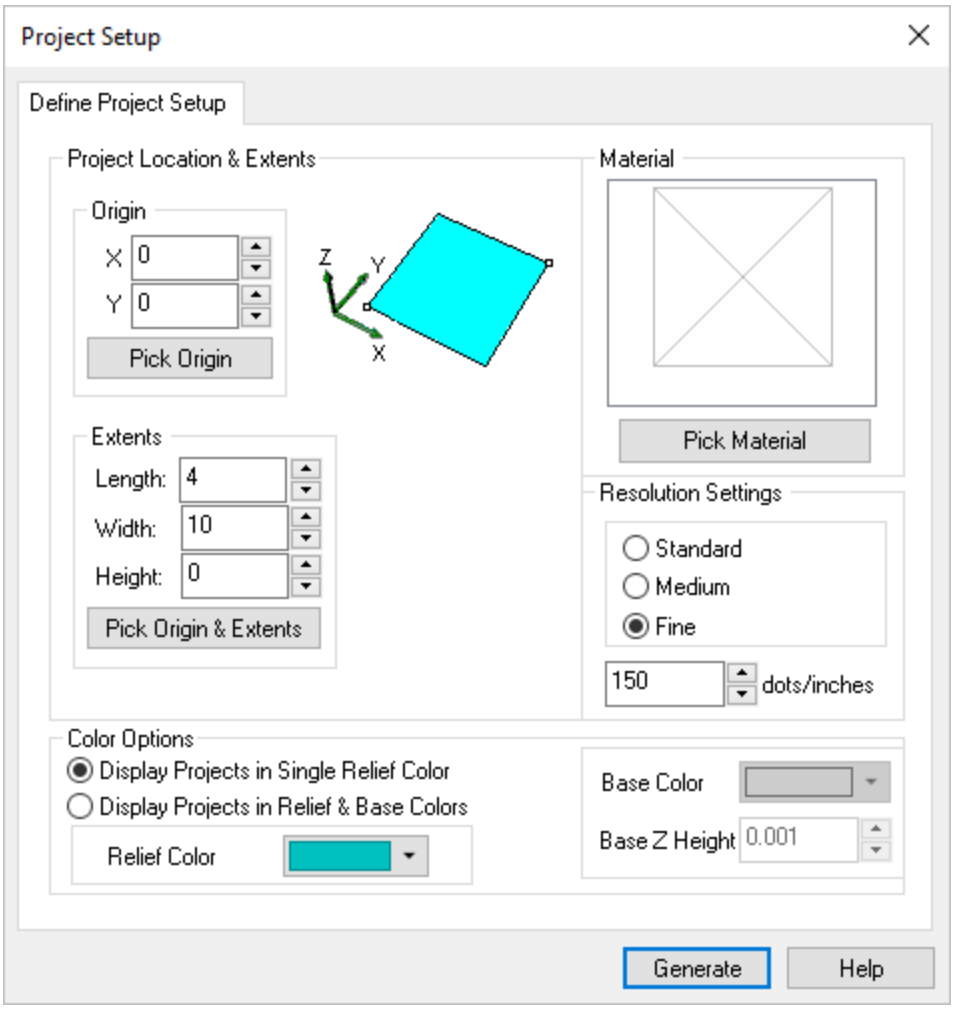
Export Meshes to CAD

Preferences

6.1 Project Setup

This is the first step required before any relief operation is created. The project setup dialog defines the workspace extents that you will be using. Any further operations which appear outside the workspace setup will be ignored.

Dialog Box: Project Setup



Dialog Box: Project Setup

Project Location & Extents / Origin

You can select the Pick Origin button and the dialog box momentarily disappears to allow you to graphically pick the origin point of the project. Or the numerical value can be entered as well as using the up/down arrows.

Extents

You can select the Pick Origin & Extents button and the dialog box momentarily disappears to allow you to graphically pick the origin and the extents (workspace area) of the project.

Resolution Settings

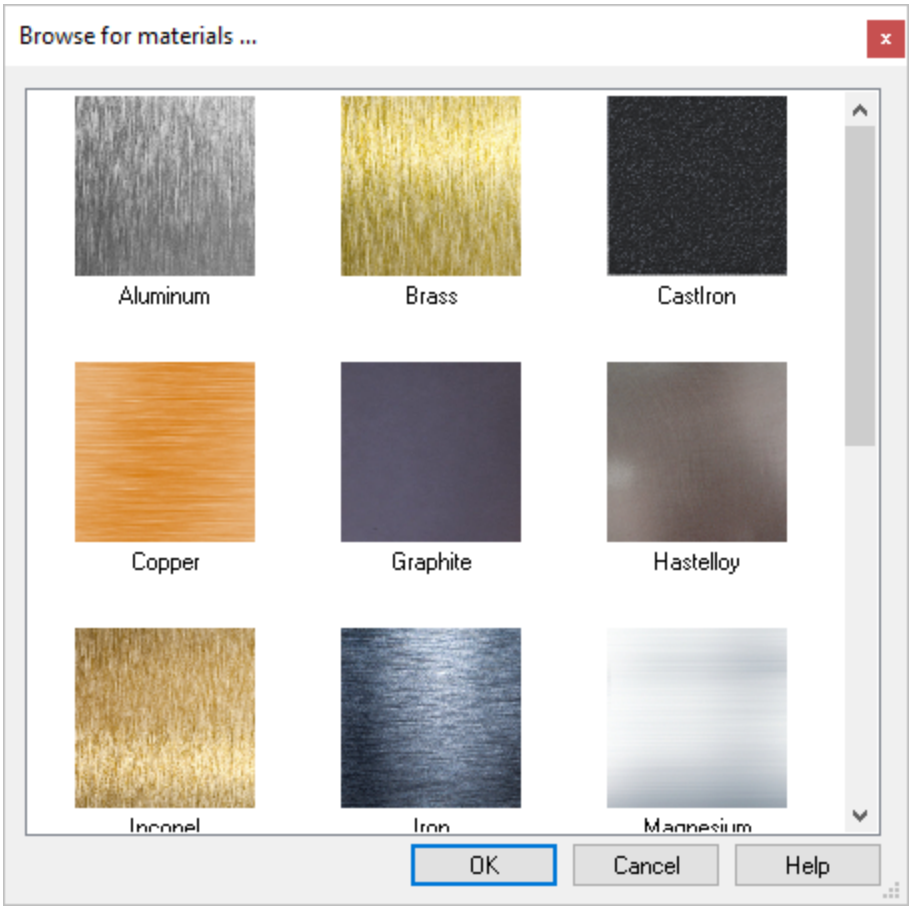
The resolution defines the accuracy used to generate the actual model. The higher the resolution, the better the quality of the output mesh generated. However, increasing the resolution also reduces the relief generation time and above all affects the display.

You can use the radio buttons to select Standard, Medium, or Fine. You can also enter the numerical value desired or use the up/down arrows to specify resolution. Standard range is 0-99, Medium range is 100-149, Fine range is 150 and above. Depending on the values entered, the radio button will toggle automatically to the appropriate resolution designation.

Pick Material

You can select the Pick Material button to specify the material texture desired for the project. With the Material Texture Visibility enabled, the material texture will be displayed on the project and operations. When the Pick Material button is selected, the below dialog box will appear.

Dialog Box: Browse for materials ...



Dialog Box: Browse for materials ...

Color Options

Display Projects in Single Relief or Relief & Base Colors

Here you can select from two color options for your project. Single Relief Color displays the entire project in one Color. You can then select the Relief Color using the color selector. Relief & Base Color displays the project in two colors. Use the Relief Color selector and then also use the Base Color selector. You can also define the Base Z Height of your Project.

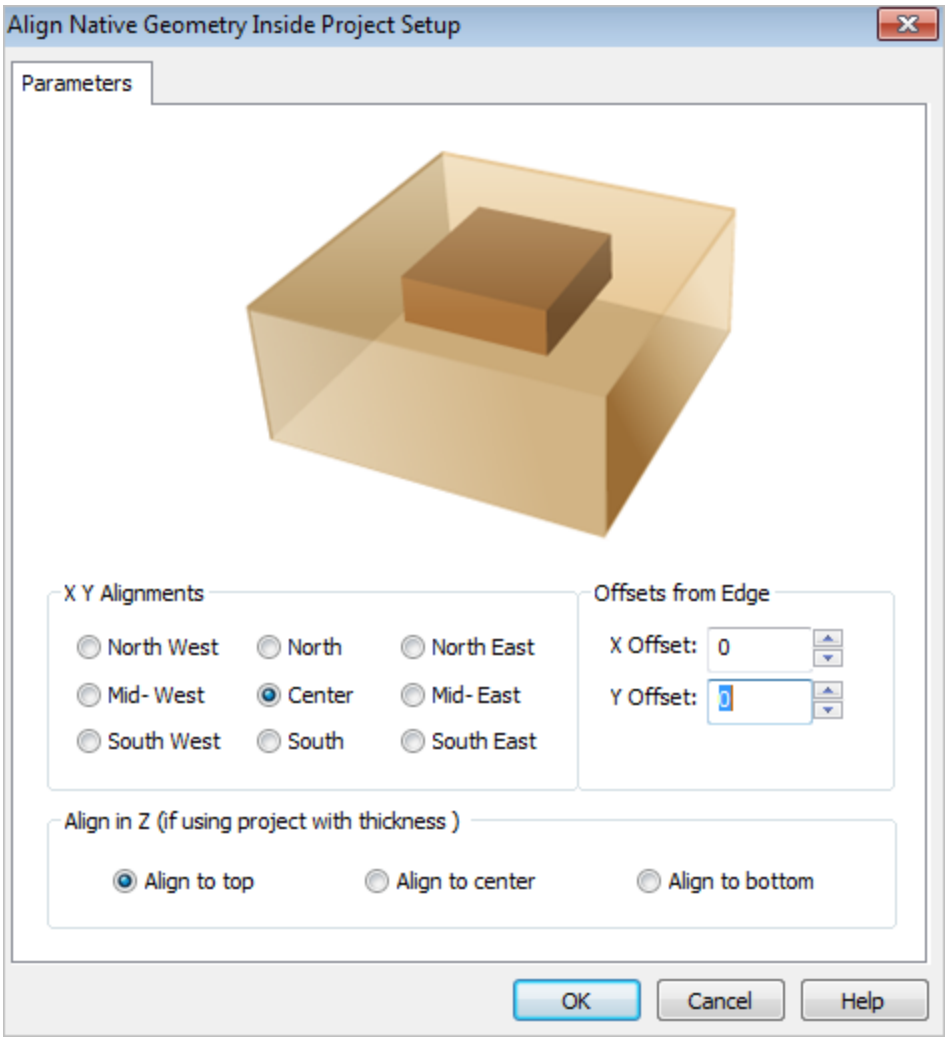
Related Topics

Creating Relief Operations

6.2 Align Native Geometry Inside Project Setup

This command allows you to align native CAD geometry to the project. You can align the CAD in the X, Y or Z coordinate of the project workspace. You also has the option to offset the CAD from the edge of the project workspace.

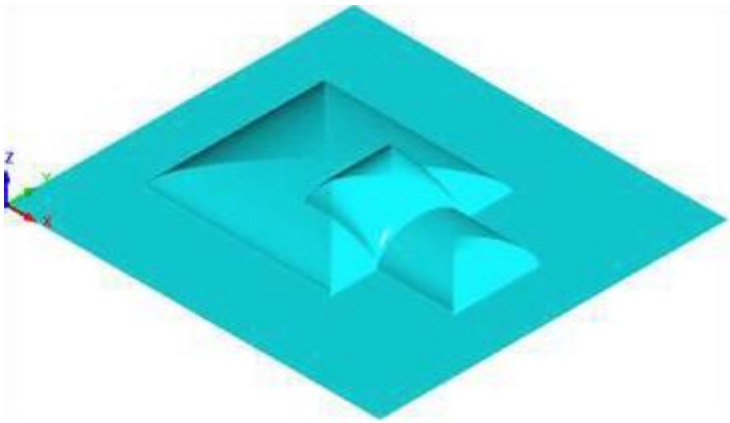
Dialog Box: Align Native Geometry Inside Project Setup



Dialog Box: Align Native Geometry Inside Project Setup

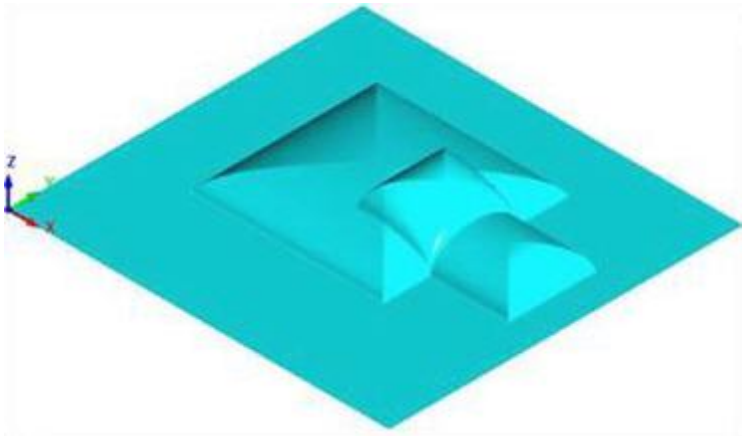
X Y Alignments

You can determine where to place the geometry in the X Y coordinates within the project workspace by selecting the desired X Y alignment coordinate radio button. In the example below, the X Y alignment that is selected is Center and notice the relief shapes are centered about the rectangular project.



Offsets from Edge

You can enter a numerical value or use the up/down arrows to specify an offset amount for either the X or Y or both. The example below shows an offset of X .250 and Y .250 from Center of project.



Align in Z (if using project with thickness)

You has the option to align the geometry within the project workspace in Z if using project with thickness. You can select the radio button for Align to top, Align to center, or Align to bottom. Align to top will move the geometry such that the top of the geometry and the top of the project workspace are flush with each other. Alight to bottom will do the same to align the bottoms of the two geometries. Align to center will position the geometry such that its middle Z value and the middle Z value of the project workspace are the same.

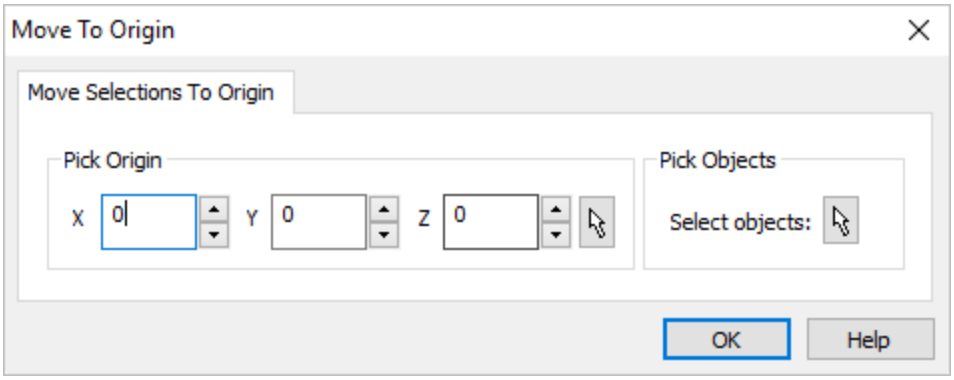
Related Topics

Creating Relief Operations

6.3 Move to Origin

This command allows you to move the objects or geometry to a specified origin within the project. You can select a new origin to move to and select the object(s) to be moved to the new origin.

Dialog Box: Move to Origin



Dialog Box: Move to Origin

Pick Origin

You can select the Pick Origin arrow and the dialog box momentarily disappears to allow you to graphically pick the move to origin point of the project. Or the numerical value can be entered as well as using the up/down arrows.

Pick Objects

By selecting the Select Objects arrow, the dialog momentarily disappears and allows you to designate the curves to be moved to origin.

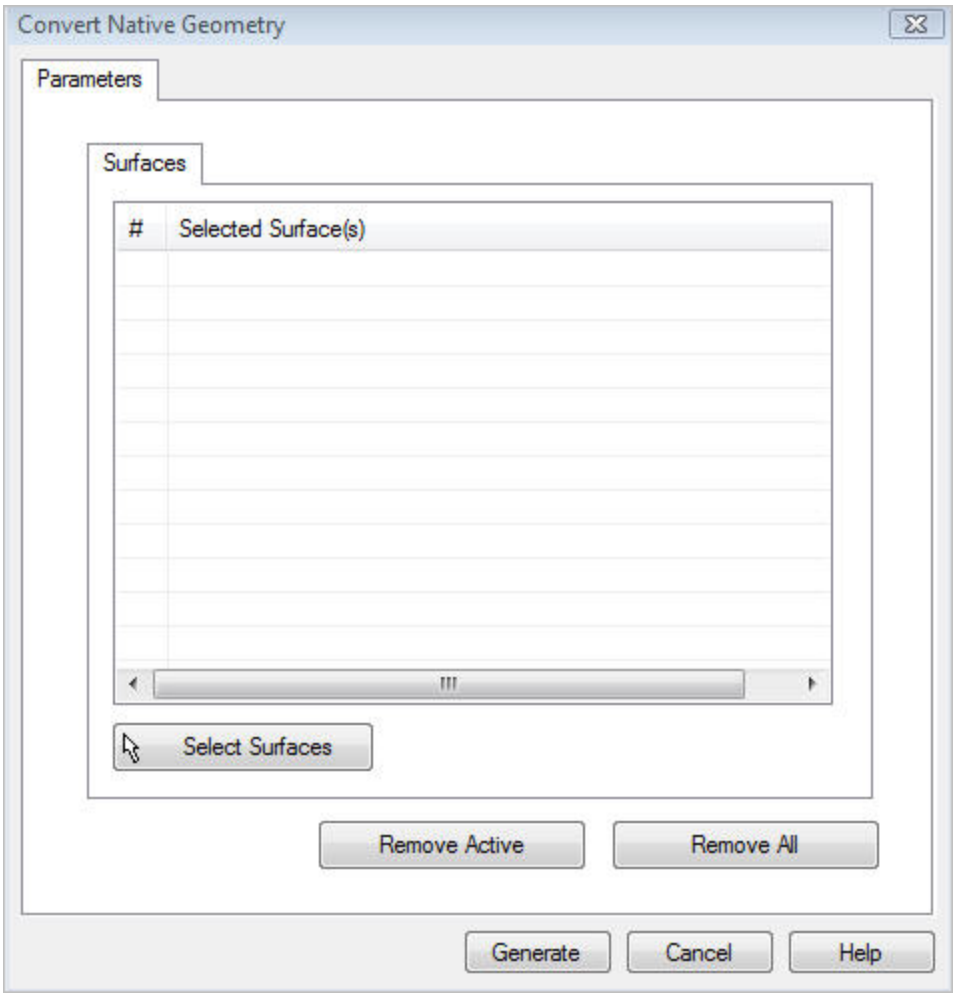
Related Topics

Creating Relief Operations

6.4 Convert Native Geometry

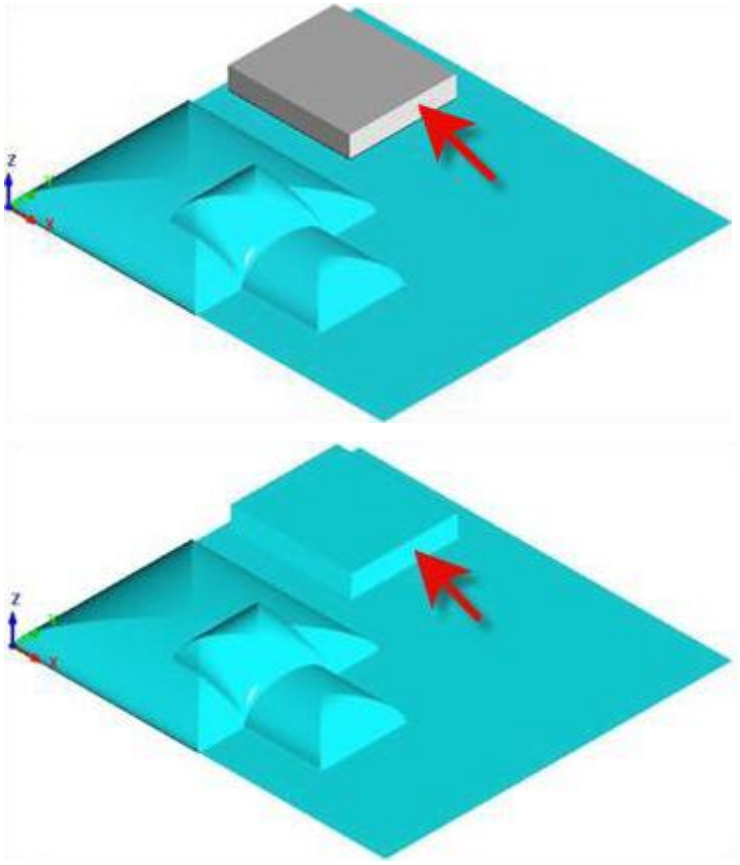
This command allows you to convert native CAD geometry to a relief in the project. You can select a surface or mesh for conversion within the project workspace. This option converts the CAD geometry suitable for 3D reliefs.

Dialog Box: Move to Origin



Select Surfaces

You can select a solid, surface or mesh for conversion by selecting the Select Surfaces button. Upon selecting the Select Surfaces button, the dialog will momentarily disappear and allow you to select a surface or mesh for conversion. Selected items which appear in the Selected Surfaces list can be easily removed by either using the Remove Active button to delete single items or use the Remove All button which removes all items from the list. Below is an example of native geometry converted. The box that consists of CAD surfaces is shown in gray.



The converted native geometry is now part of the project geometry

Related Topics

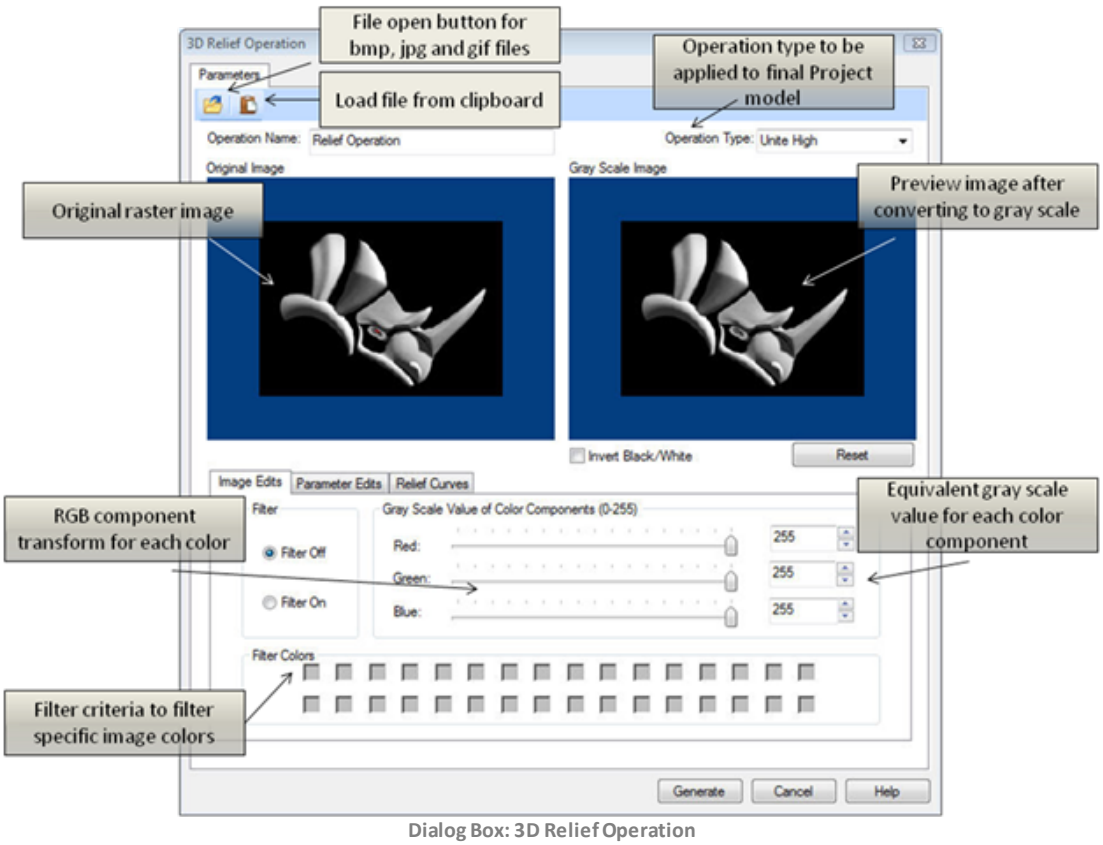
Creating Relief Operations

6.5 Create 3D Relief from Image

This part is required for converting the Raster images to gray scale image, which in turn will be converted into the 3D model based on the gray scale values of each pixel in the raster image.

On selecting the Image file, the Create Relief dialog appears as shown below. As seen in the dialog below, you can see the original image and the preview image at the same time.

Dialog Box: 3D Relief Operation



Dialog Box: 3D Relief Operation

Operation Name

Allows you to change the name if so desired by typing the new name.

Operation Type

Refer to Operation Type

Invert Black/White

The invert color option is provided for you to be able to invert the gray scale. The gray scale inversion is required in case the model needs to be created as a relief depth instead of relief height.

Reset Button

The reset button is provided for you to be able to reset the changes that have been done before such as inverting the image, or changing the Gray scale value color components.

Filter Off

This option turns off the filter for colors thus not filtering any colors.

Filter On

This option turns on the filter for colors thus allowing you to filter out specified colors.

Gray Scale Value of Color Components (0-255)

You can convert the image into a gray-scale image by adjusting the red, blue and green components on the dialog bar. By adjusting the slider bar in the dialog bar, you can adjust the weight of color component to be converted into gray scale. The slider bar indicates the approximate value of the component, and its equivalent value in gray scale is shown in the text box in front of the slider bar. The slider bar determines the weights of the color components for conversion to gray-scale.

Filter Colors

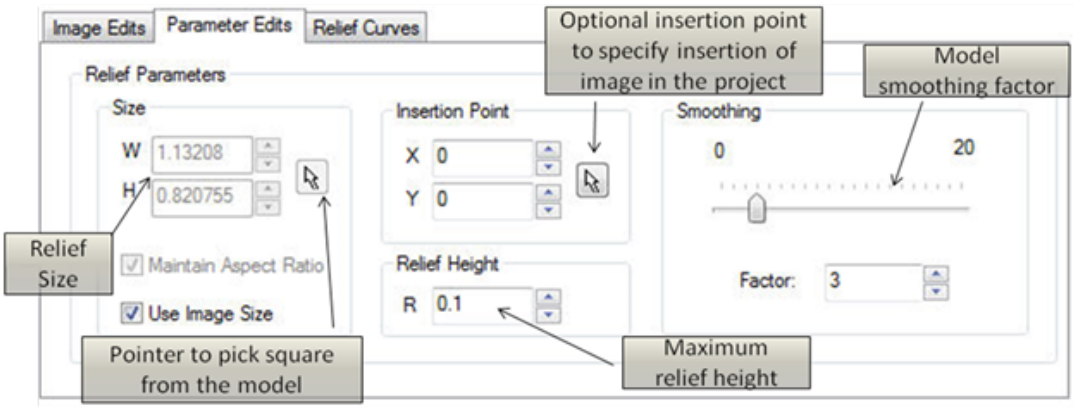
This option allows you to filter specific image colors.

Generate

You can update any changes that were made by clicking the Generate button.

Parameter Edits tab

The dialog below allows you to edit the parameters available within the Parameter Edits tab.



Dialog Box: 3D Relief Operation, Parameter Edits tab

Size

The width (W) and height (H) of the relief size can be specified by entering numerical values, using the up/down arrows or by using the pointer to pick the area from the model.

Maintain Aspect Ratio

If Use Image Size is unchecked this will enable this function allowing you to either maintain the aspect ratio (i.e. scale factor) if checked or if it is unchecked it will not honor the aspect ratio. The aspect ratio refers to the width/height ratio of the image. The pick button allows user to pick two points such that the aspect ratio of the image remains same, and the image does not get distorted in the mapping process. On pressing the pick button, the dialog box gets minimized allowing you to select two points. You can cancel the pick operation by right clicking on the mouse.

Use Image Size

If this option is checked, this will honor the original image size. It will use the original image size and place it within the project workspace.

Insertion Point

You can specify the insertion point of the image by either entering numerical values, using the up/down arrows or by using the pointer to pick the insertion point within the project.

Relief Height

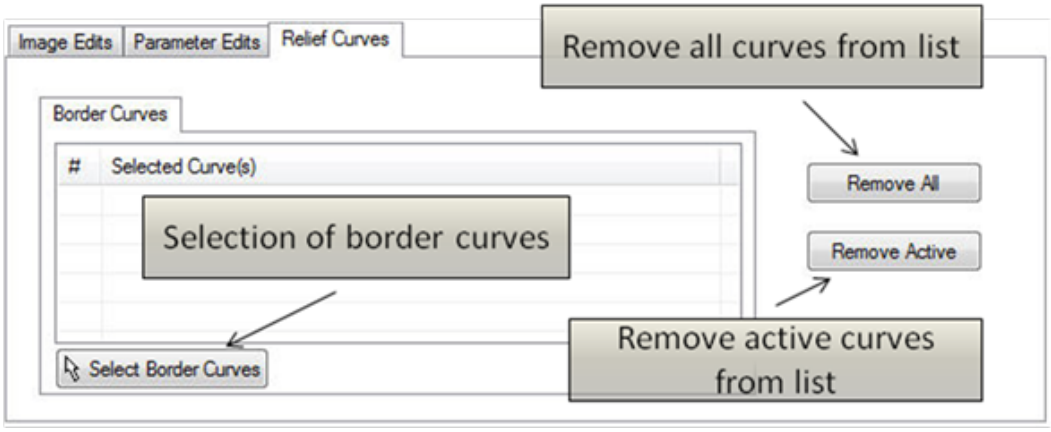
You can specify the relief height by entering numerical values or using the up/down arrows.

Smoothing

This allows you to specify the smoothness of the model. You can specify the value between 0-20 by using the slider bar, entering numerical values or using the up/down arrows.

Relief Curves tab

The dialog below allows you to edit the parameters available within the Relief Curves tab.



Dialog Box: 3D Relief Operation, Parameter Edits tab

Select Border Curves

The borders can be selected by choosing the Border Curves tab under the Relief Curves tab using the Select Border Curves button on the dialog. The dialog will be minimized and you can now pick the curves.

Remove All

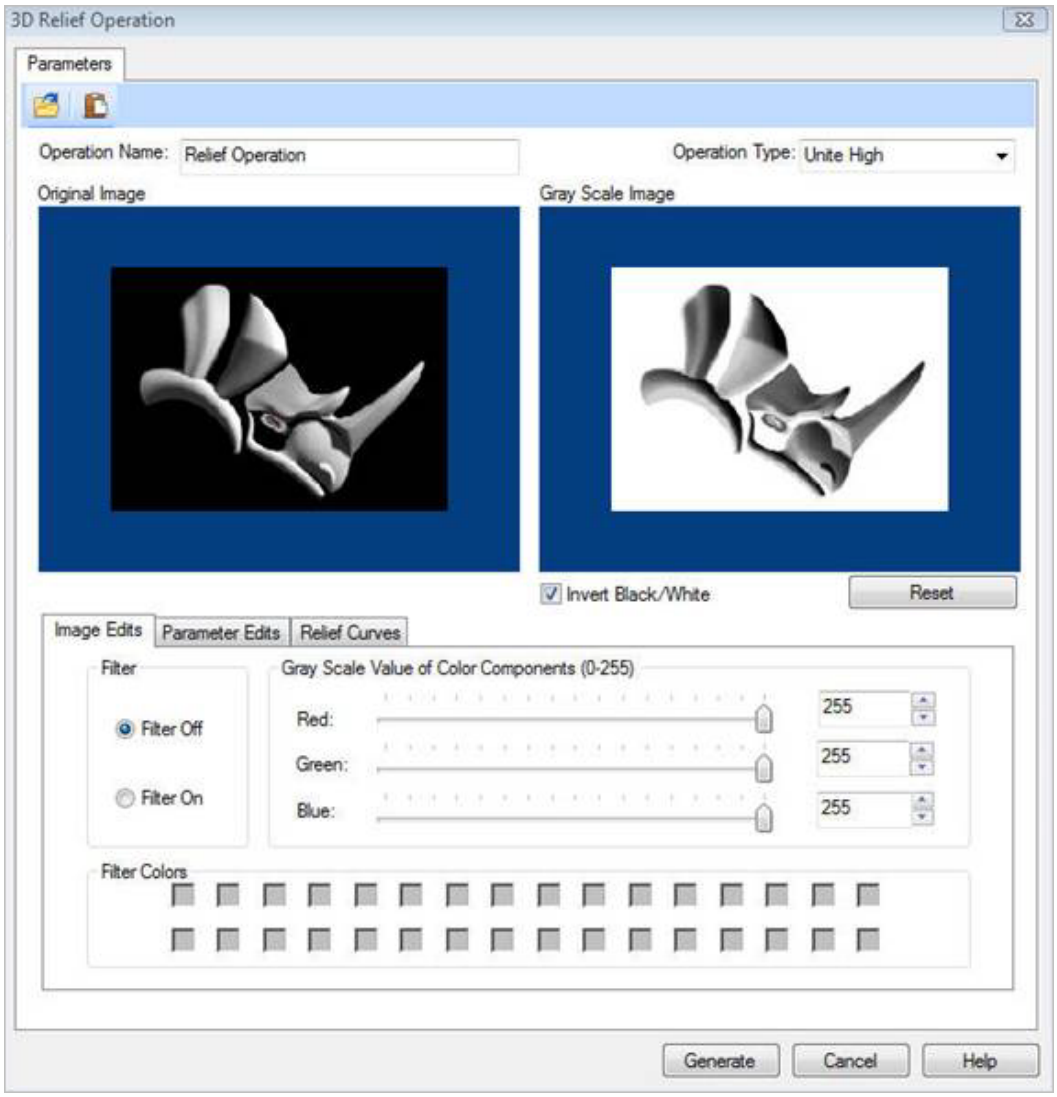
This option allows you to remove all the curves from the Selected Curve(s) list.

Remove Active

This option allows you to remove the specified/highlighted curve from the Selected Curve(s) list.

Strategy 1:

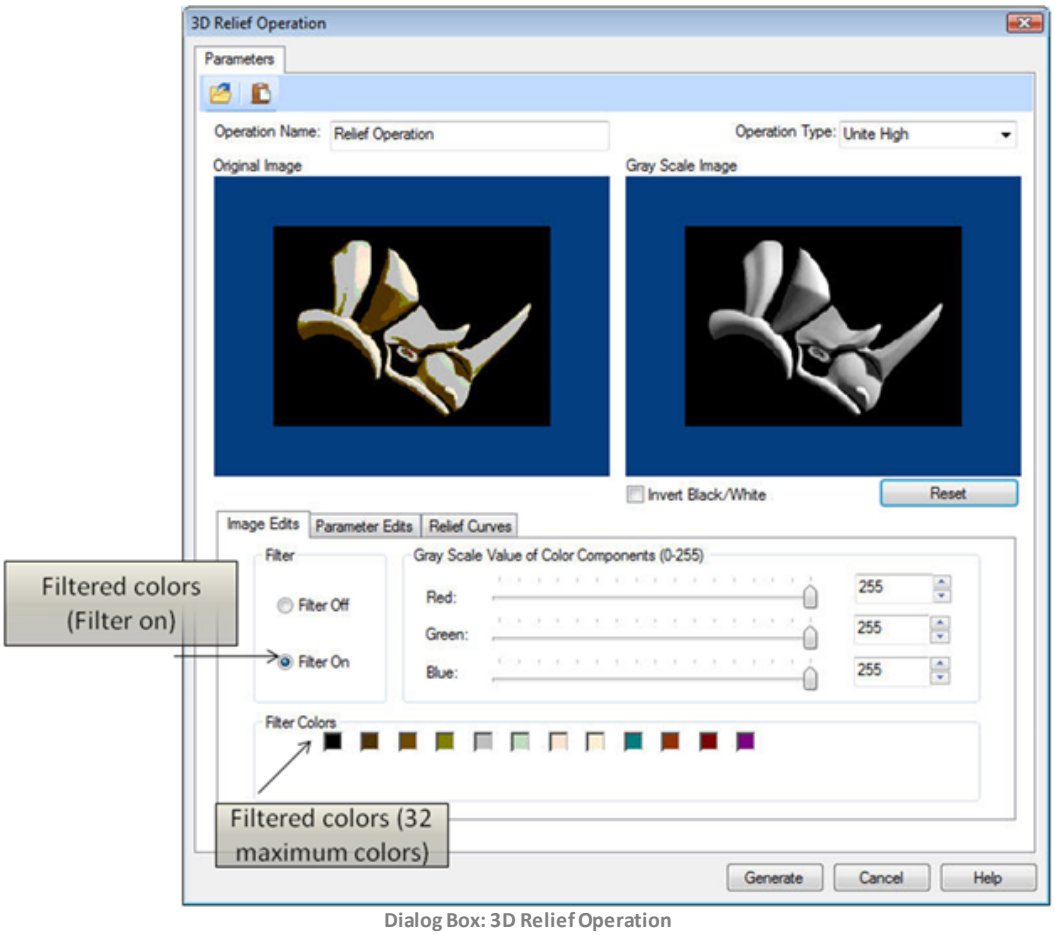
The figure below shows the dialog with the inverted image, after the check box for inverting the image is applied.



Dialog Box: 3D Relief Operation

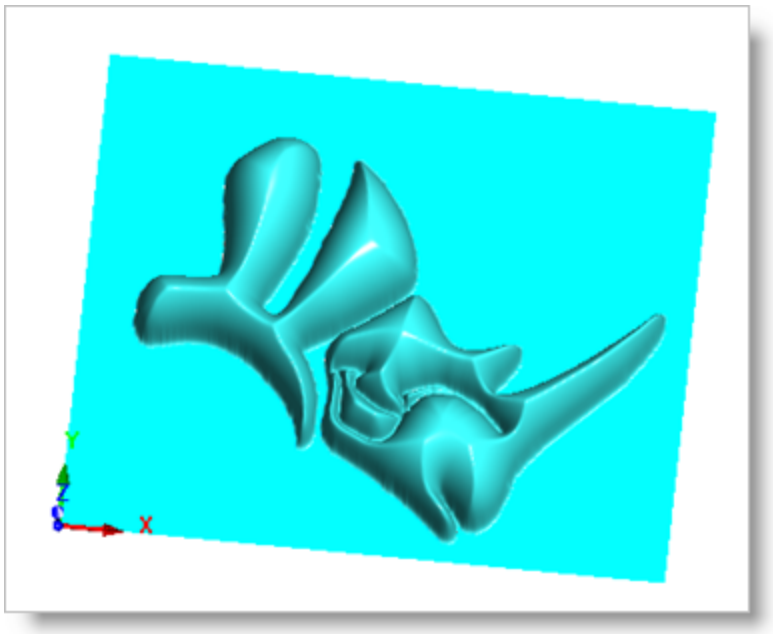
Strategy 2:

The second strategy of creating a relief by filtering a certain color can be used to create a relief from a reduced set of colors. By selecting the Filter Colors option, the Original Image is converted into a 32 Color Image. The check boxes also get populated based on the number of the colors the image has reduced to. By clicking the check boxes, we can either select or deselect a color to be a part of the final relief. This method can be very useful to filter out some colors from the Image and create relief of only a certain part of the image.



Dialog Box: 3D Relief Operation

The Final model obtained will look as shown in the figure below:



Strategy 2 Final Model

Related Topics

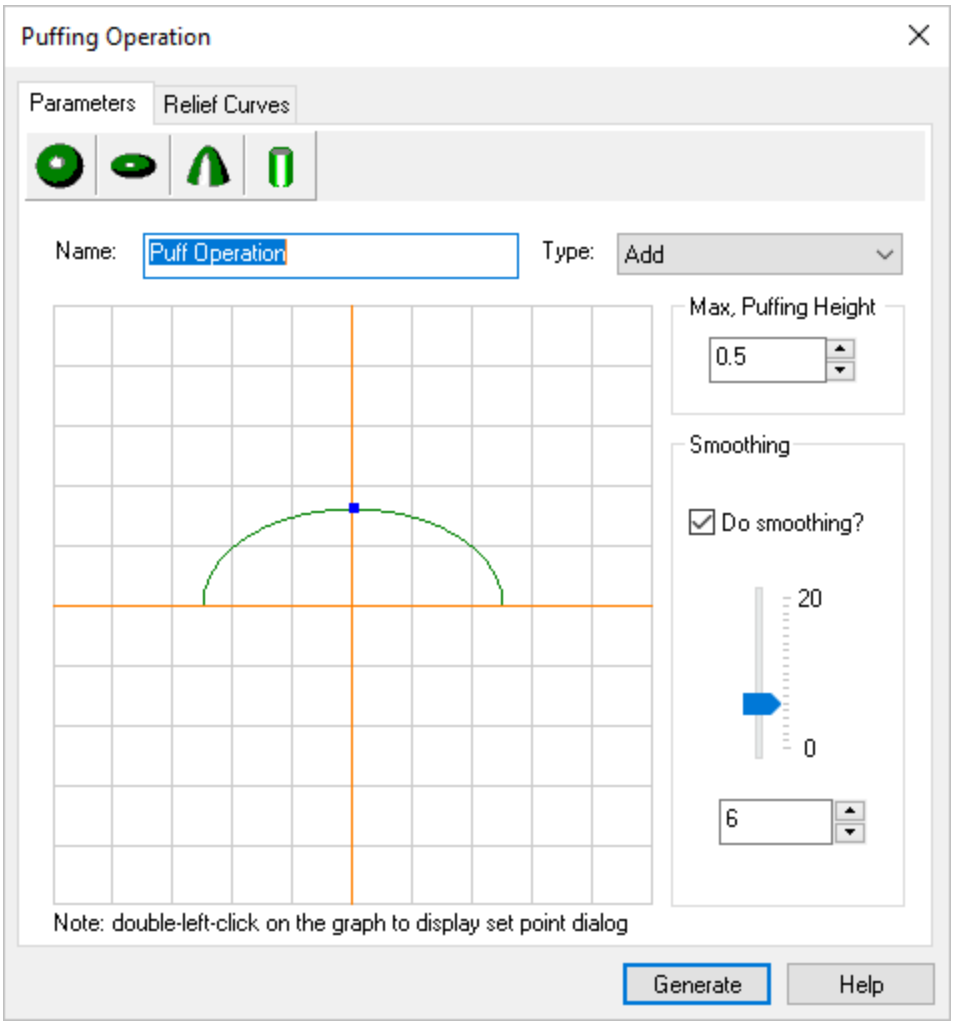
Creating Relief Operations

6.6 Create Puffed Volume

This operation is used to puff up the interior of a closed curve. This dialog can be invoked by pressing the icon button in the toolbar of the ART Browser. The dialog is shown in the picture below.

The puff shapes can be defined by 4 different functions. Each of these functions can be selected in the toolbar shown in the dialog above. Selecting a function will display the graph corresponding to this function and some additional controls to affect the shape of this function. Each of these functions is described below:

Dialog Box: Puffing Operation, Parameters tab



Dialog Box: Puffing Operation, Parameters tab

Spherical Puffing

The puffed up volume will be spherical mapped to create sphere like puffed interior. This option is by default.

Ellipsoidal Puffing

The puffed up volume will be spherical mapped to create sphere like puffed interior.

Paraboloid Puffing

The puffed up volume will be spherical mapped to create sphere like puffed interior.

Extrude Curves

 The extrude curves will extrude curves along the Z axis to the specified puff height.

Name

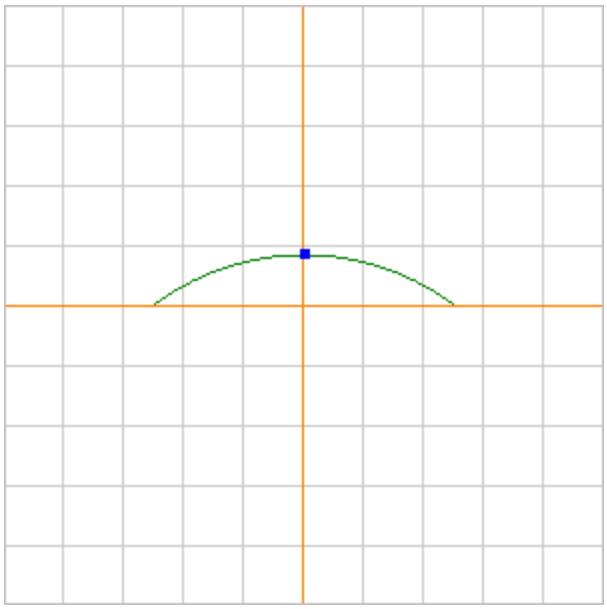
By default the puffing operation name is set to "Puff Operation". This name can be changed for customization purposes if so desired by typing in a new name.

Max. Puffing Height

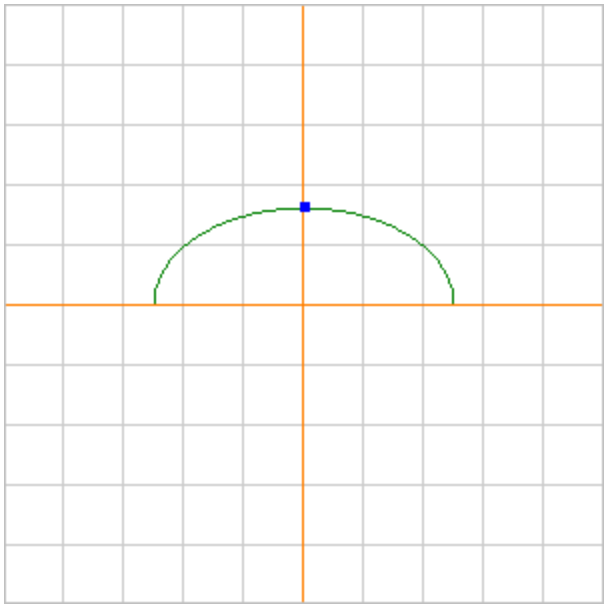
Enter a numerical value or use the up/down arrows to specify the puffing height.

Smoothing

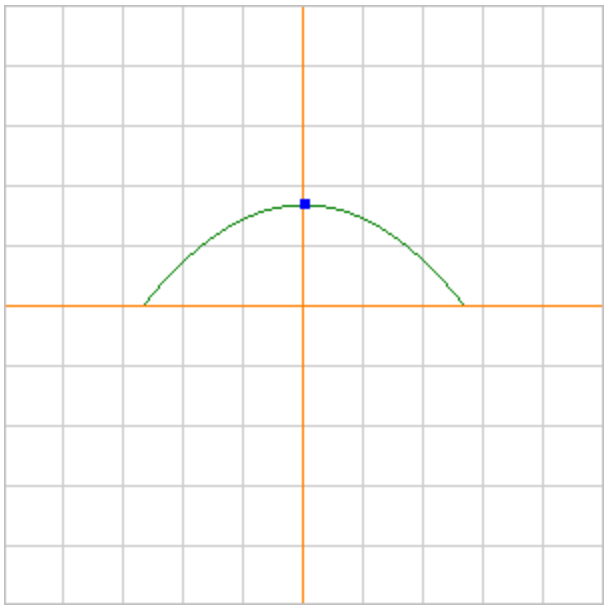
The shape graphs for each of these functions are shown below:



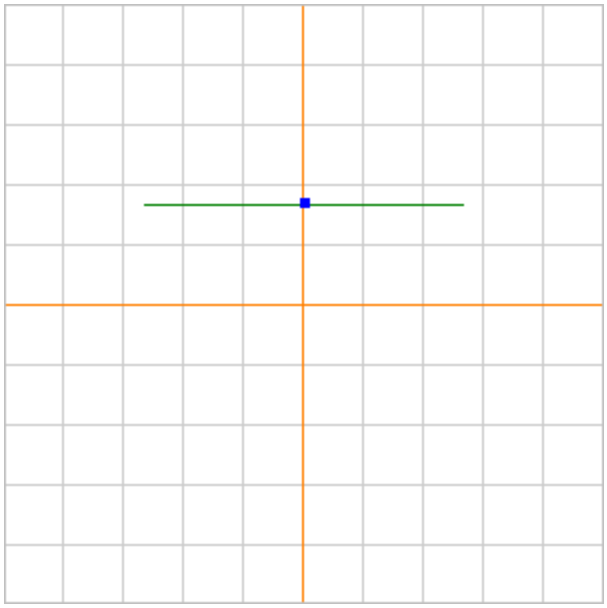
Spherical Puffing



Ellipsoidal Puffing



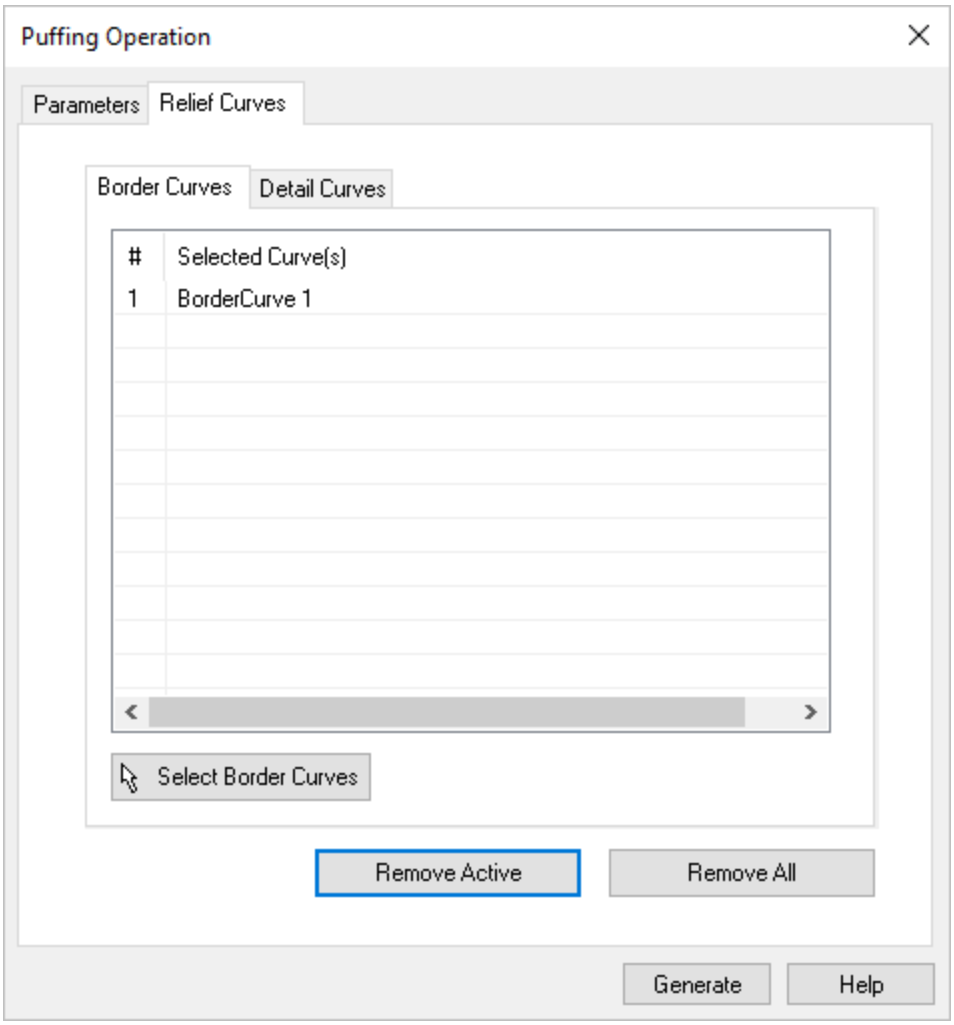
Paraboloid



Extrude Curves

Dialog Box: Puffing Operation, Relief Curves, Border Curves tab

The puffing operation requires curves to be selected. There are two types of curves that can be specified for puffing. They are as follows:



Dialog Box: Puffing Operation, Relief Curves tab

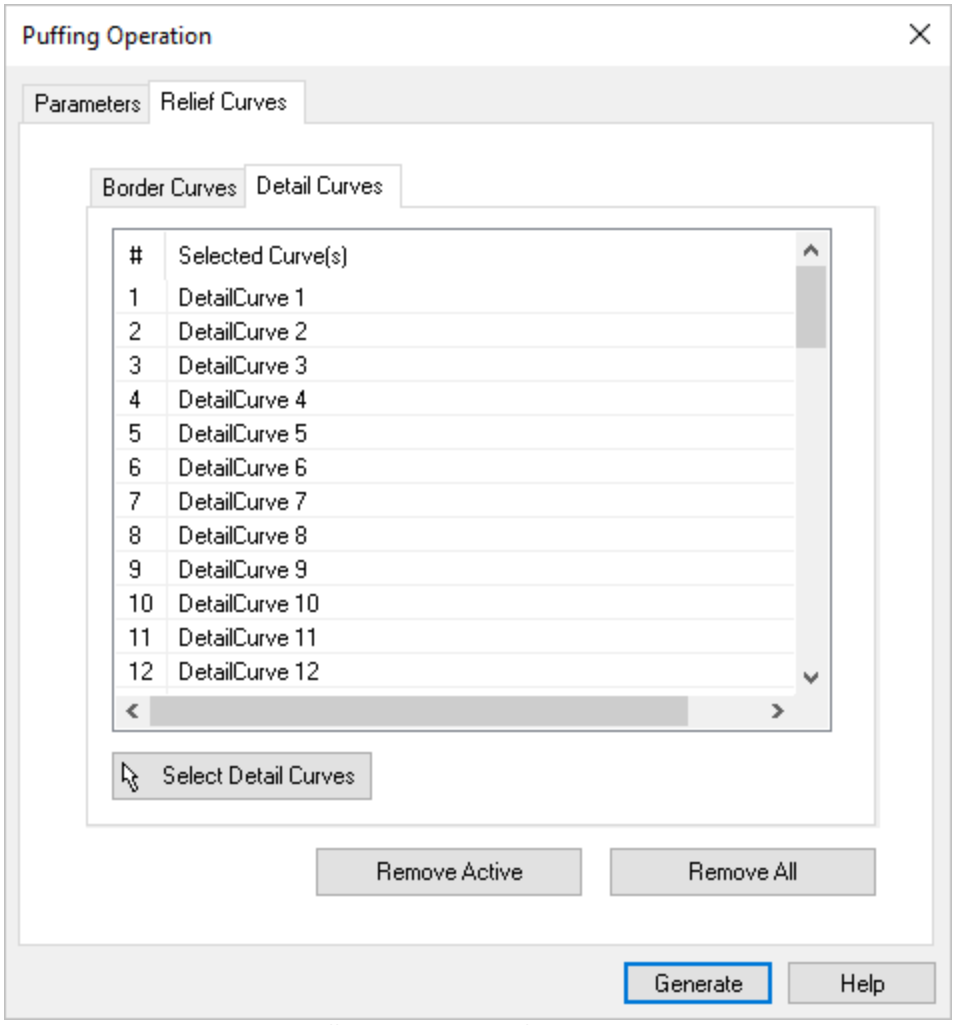
Border Curves

These curves are used to determine the borders and they must be closed. The region in the interior of these borders will be puffed. These borders can be selected by choosing the Border Curves tab under the Relief Curves tab using the Select Border Curves button on the dialog. The dialog will be minimized and you can now pick the curves. After the required curves are picked, you can invoke the dialog again by Right clicking the mouse button. After selection of border curves they can be removed by either selecting the Remove Active button or the Remove All button. Click on Generate button after desired selections appear in Selected Curve(s) list.

Detail Curves

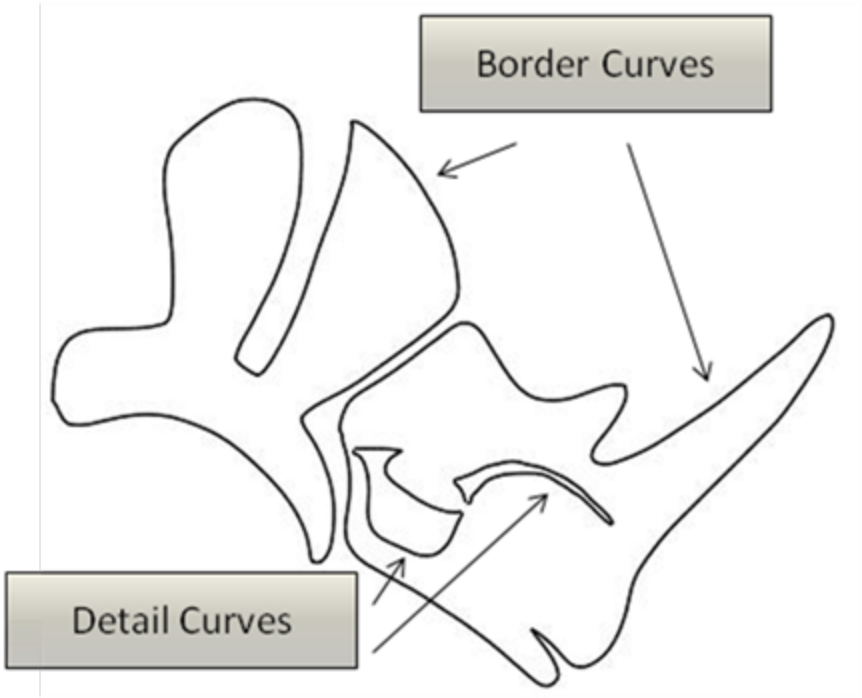
These curves are Optional and need not be specified for puffing. Detail curves can be open curves. You can specify these curves by selecting the Detail Curves tab under the Relief Curves tab and using the Select Detail Curves button in the dialog. After selection of border curves they can be removed by either selecting the Remove

Active button or the Remove All button. Click on Generate button after desired selections appear in Selected Curve(s) list.

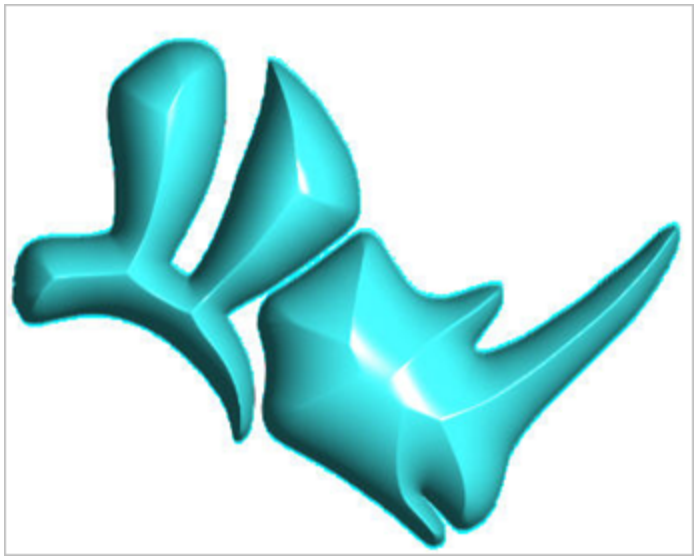


Dialog Box: Puffing Operation, Relief Curves, Detail Curves tab

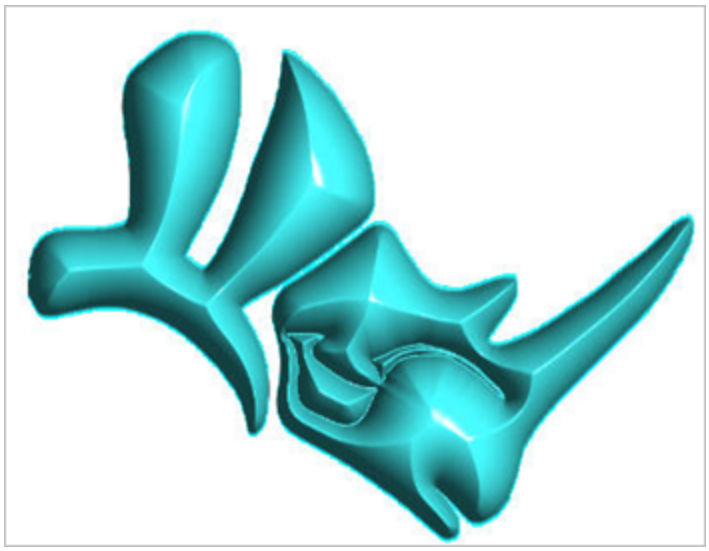
An example of how detail curves affect the shape of a puff operation is illustrated below:



Border curves and detail curves that are selected in the example



Puff volume obtained without any detail curves selected

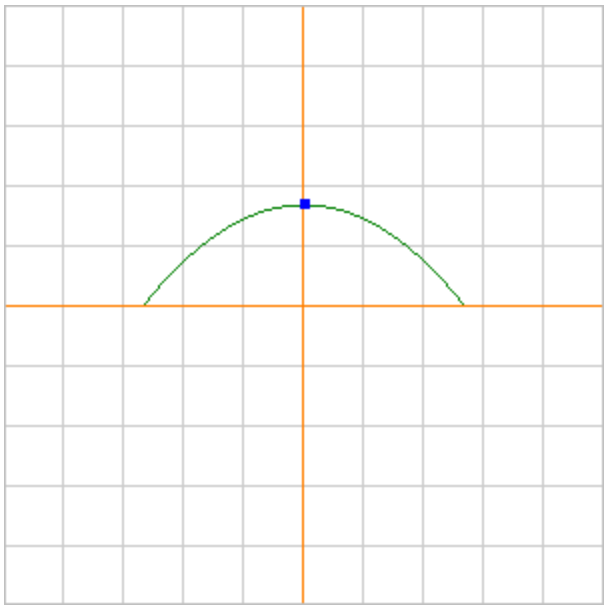


Puff volume obtained with the shown detail curves selected

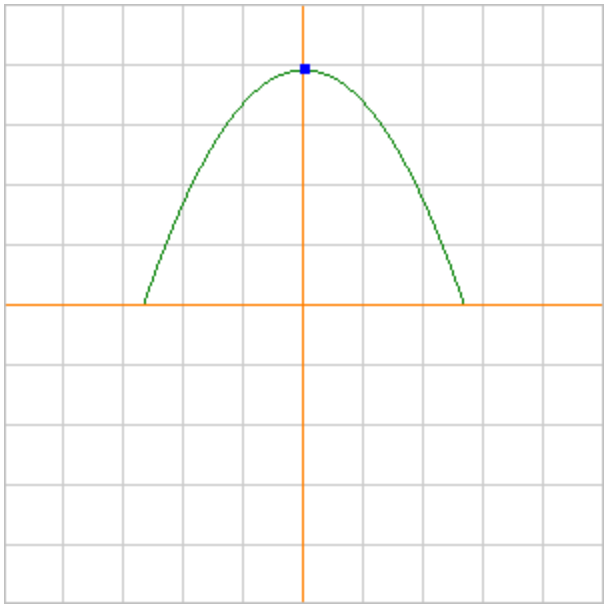
The Graph

For each of the type of puffing specified above, the puffing shape function can be influenced for each of the operations. This can be achieved by clicking and dragging the blue marker on the graph using the mouse. This will change the shape of the puff function, and will influence the output puffed volume.

This for example, by clicking and dragging the blue marker on the paraboloid puffing will give us the result as shown in the figure below:



Paraboloid



Paraboloid

Name

By default the puffing operation name is set to "Puff Operation". This name can be changed for customization purposes if so desired by typing in a new name.

Operation Type

Refer to Operation Type

Max. Puffing Height

Enter a numerical value or use the up/down arrows to specify the puffing height.

Smoothing

Smoothing is used to remove any unevenness in the final puffed volume. This is optional input that is ON by default. The smoothing weight can be increased to obtain smoother results for the finally puffed volume. Smoothing values can be adjusted from 0-20 using either the slider bar or entering a numerical value.

Related Topics

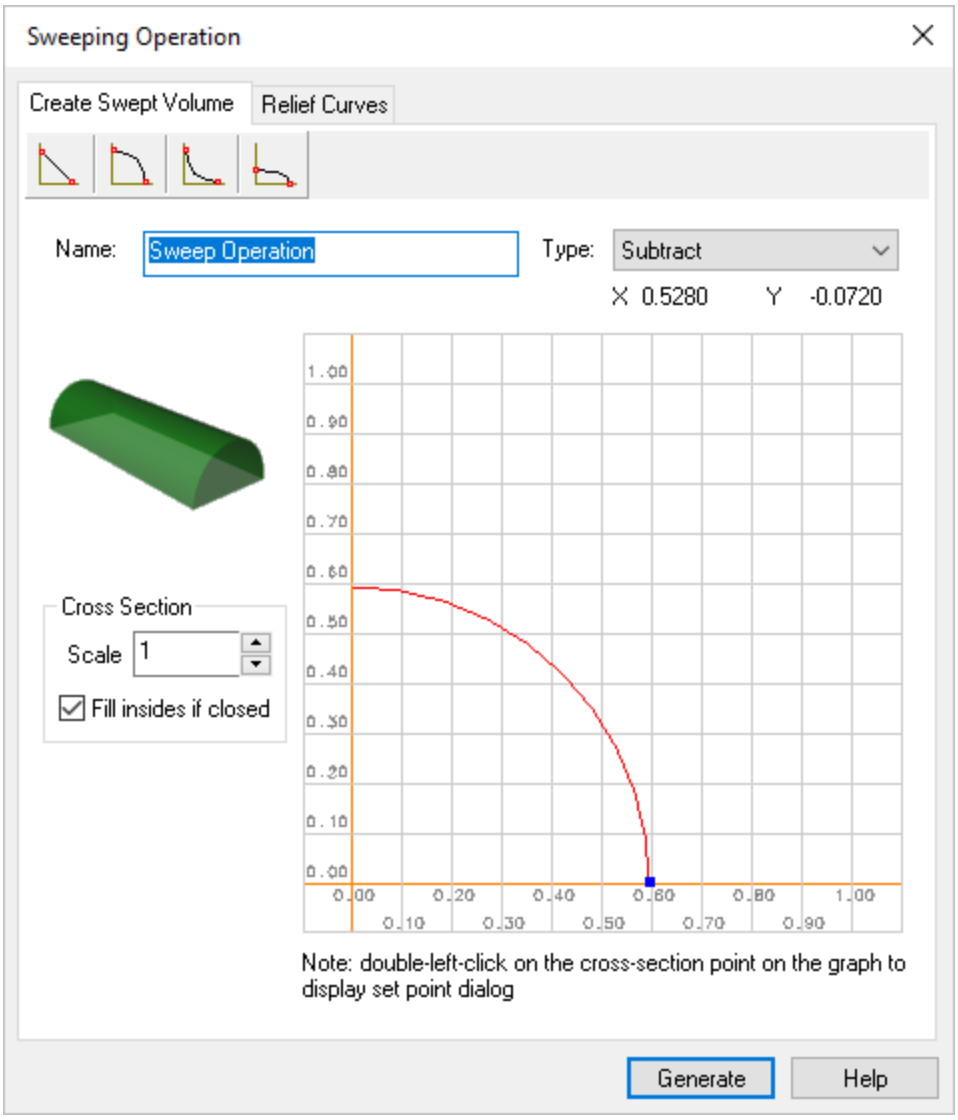
Creating Relief Operations

6.7 Create Sweep Volume

 This method is used for generating a volume along a curve by specifying a type of cross-section. The Dialog for this operation is shown in the figure below. This dialog can be invoked by pressing icon button in the Art Browser toolbar under Relief Operations tab.

The cross-section that can be specified is as follows.

Dialog Box: Sweeping Operation, Create Swept Volume tab



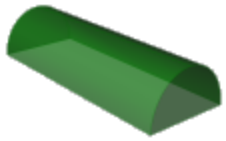
Dialog Box: Sweeping Operation, Create Swepted Volume tab

Linear Cross-section

This type outputs a triangular cross-section along the curve you have picked. This sweep generated is shown in the figure below.

Convex Arc

This type outputs a convex cross-section along the curve you have picked. This sweep generated is shown in the figure below.



Concave Arc

This type outputs a concave arc cross-section along the curve you have picked. This sweep generated is shown in the figure below.

Convex Ellipse

This type outputs a concave elliptical cross-section along the curve you have picked. This sweep generated is shown in the figure below.

Name

By default the sweeping operation name is set to "Sweep Operation". This name can be changed for customization purposes if so desired by typing in a new name.

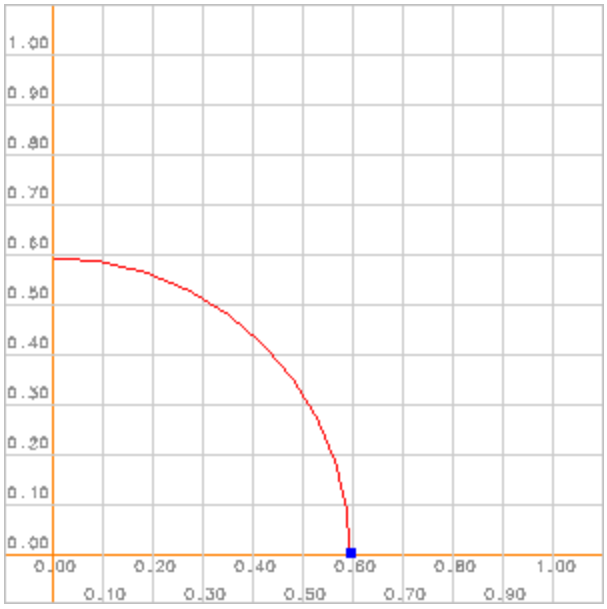
Type

Refer to Operation Type

Graph

The Graph shown in the dialog can be used to modify the parameters of the cross-sections. This can be achieved by simply dragging the blue marker in the dialog with mouse. The co-ordinate system in the top right of the dialog shows the current

location of the mouse in the window. Thus, by simply dragging the mouse over the dialog, The parameters can be changed. This is illustrated in the figure below.



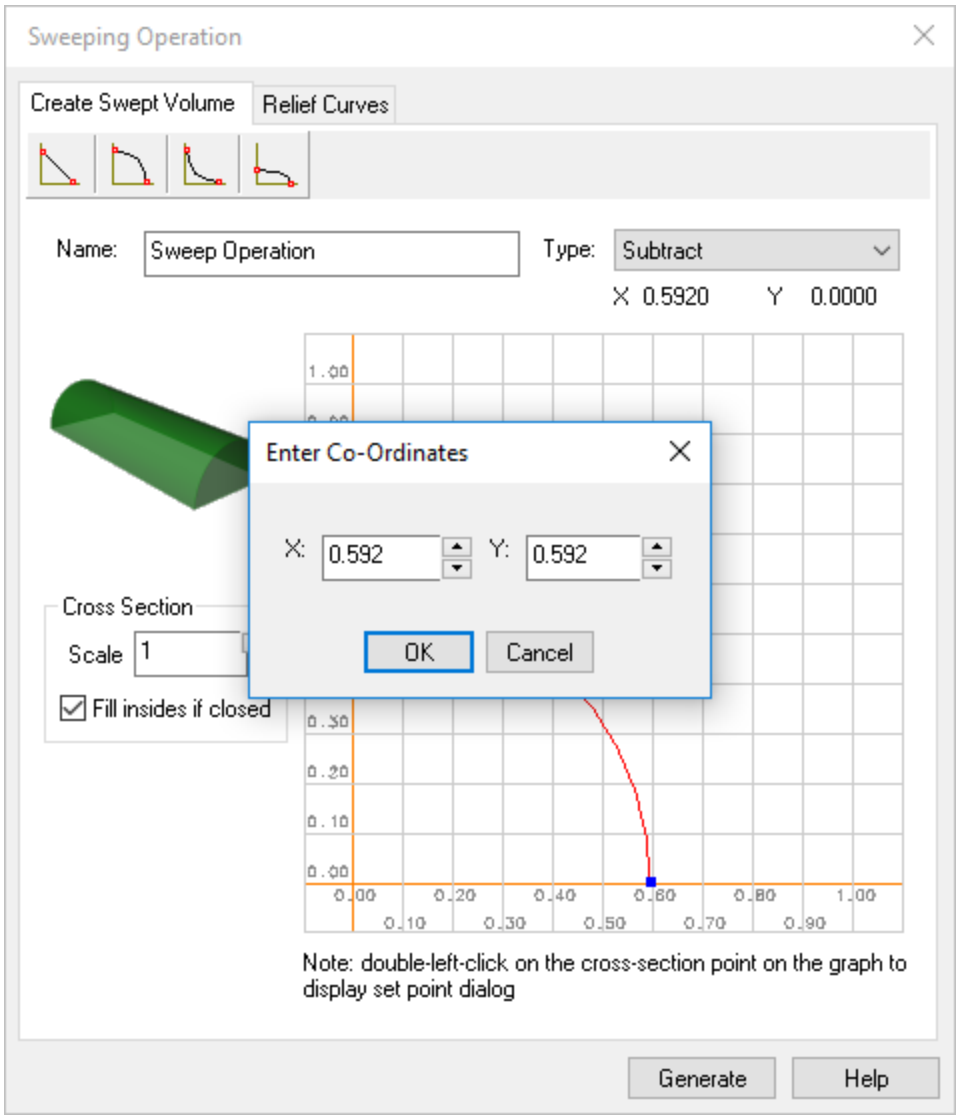
Create Swept Volume Graph

By clicking on the blue control points and dragging the mouse over the screen, the properties of the cross-section can be changed.

Scale

The scale of the graph can also be changed to suit your requirement. This can be achieved using the scale edit box present in the window. The default value of the scale is set to 0.1. By using the up and down arrow keys, the scale of the graph can be changed and will be reflected in the output graph.

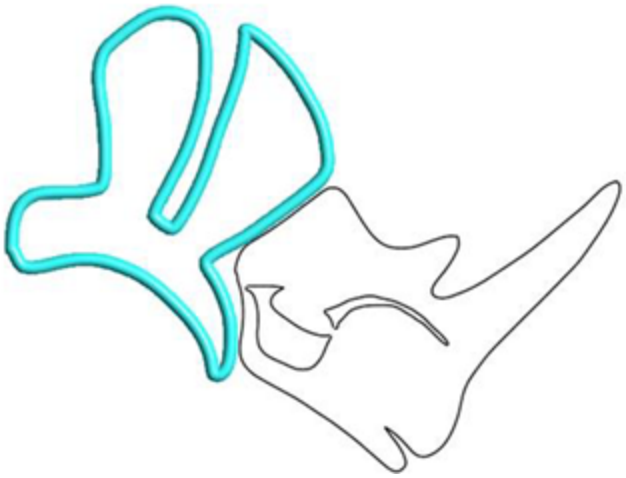
Specifying exact co-ordinates for the cross section, can be achieved by double clicking the mouse over the marker dot. This will bring up another dialog specifying the current position of the marker. This can now be modified and the changes will be reflected in the output.



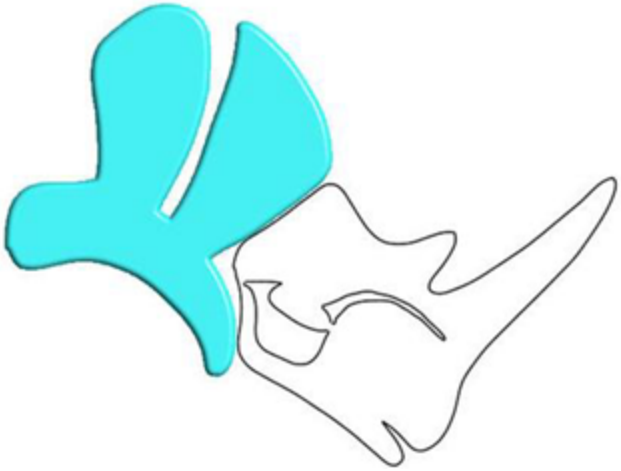
Dialog Box: Sweeping Operation, Enter Co-Ordinates

Fill Insides if Closed

This option is provided to user, if it is needed to close the interior of a specified closed curve. The sweep operation will be carried out as normal. However, if the curve is closed and you have specified this option, the interior of the curve will be raised to the maximum height of the cross-section.



Volume Swept without "Fill Inside if Closed" option



Volume Swept with "Fill Inside if Closed" option

Related Topics

Creating Relief Operations

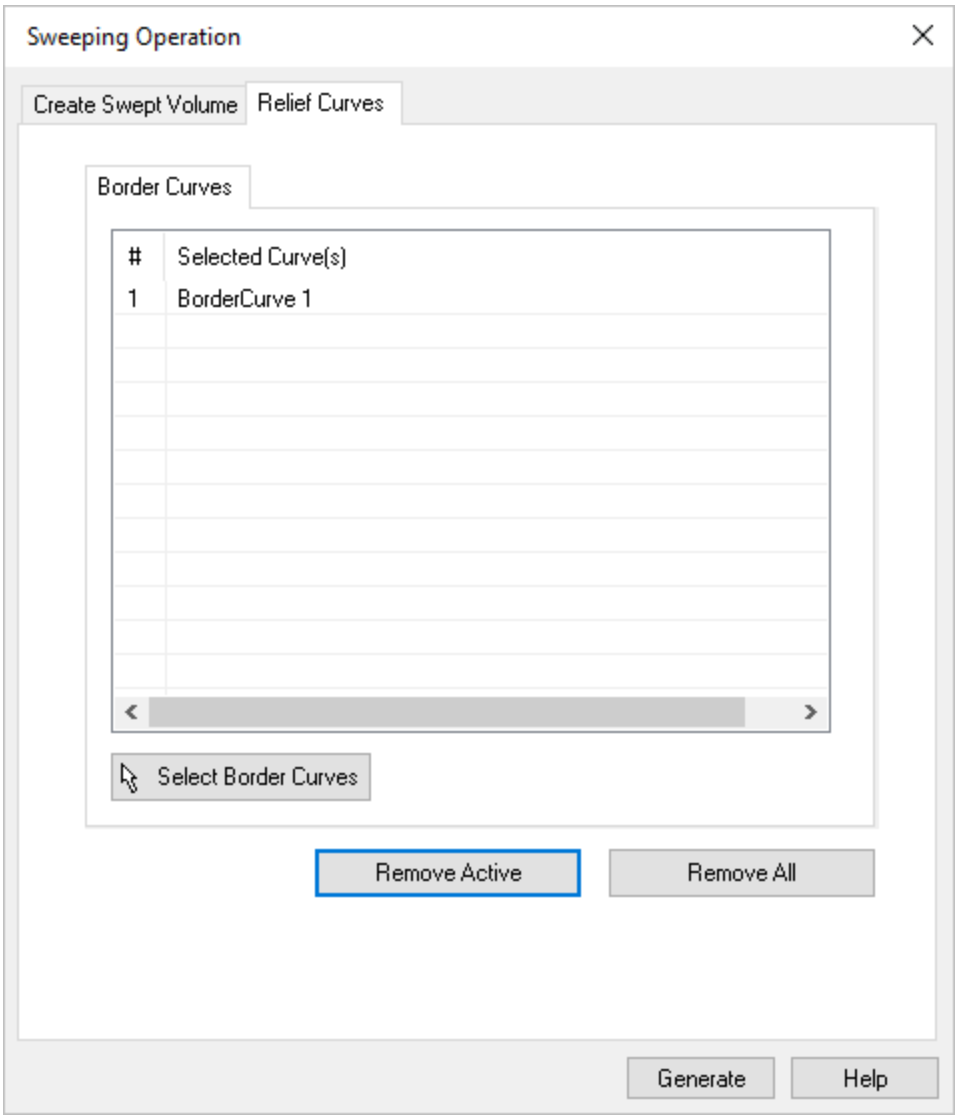
Relief Curves

6.7.1 Relief Curves

These curves are used to determine the borders and they must be closed. The region in the interior of these borders will be swept. These borders can be selected by choosing the Border Curves tab under the Relief Curves tab using the Select Border Curves button on the dialog as seen in the figure below.

The dialog will be minimized and you can now pick the curves. After the required curves are picked, you can invoke the dialog again by Right clicking the mouse button. After selection of border curves they can be removed by either selecting the Remove Active button or the Remove All button. Click on Generate button after desired selections appear in Selected Curve(s) list.

Dialog Box: Sweeping Operation, Relief Curves tab



Dialog Box: Sweeping Operation, Relief Curves tab

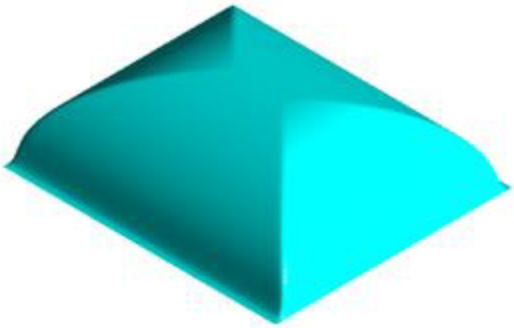
Related Topics

Create Sweep Volume

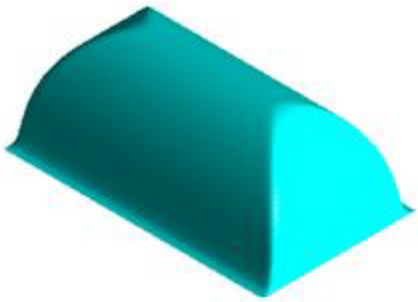
6.8 Operation Types

You can combine reliefs using Boolean operation types with 3D Relief, Puff and Swept volumes and shape libraries. As each relief operation is created in the Operation the operation tree, these operation shapes will be combined with the existing project workspace shape using the selected Boolean operation. These operation types are explained below with the help of examples. The

examples below show how 2 shape primitives can produce different shapes depending on the Boolean operations chosen.



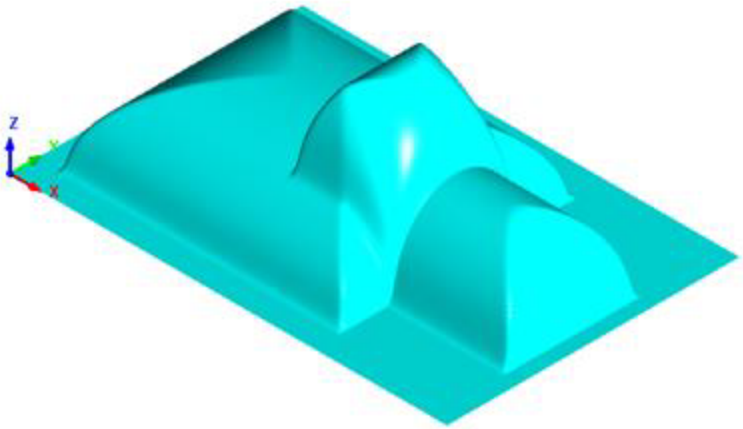
Operation Types, Primitive A



Operation Types, Primitive B

The ADD Operation

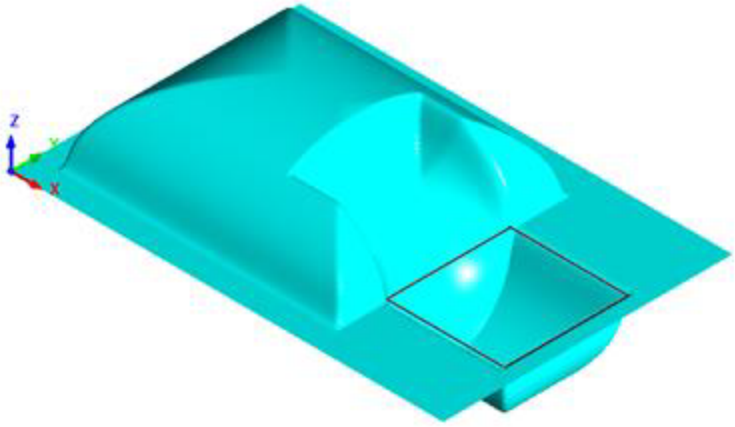
This operation adds the generated shape, along the Z axis, to the existing Project Workspace as shown below.



Operation Types, ADD

The SUBTRACT Operation

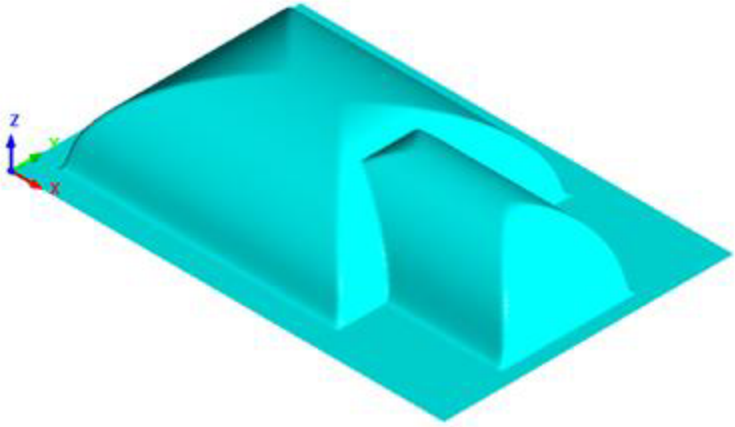
This operation subtracts, along the Z axis, the generated shape to the existing Project Workspace as shown below.



Operation Types, SUBTRACT

The UNITE HIGH Operation

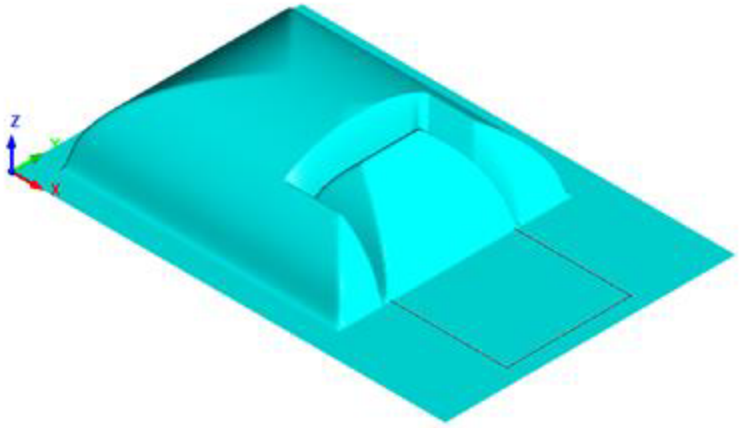
This operation selects in the Z axis, the *maximum* value of either of the two primitives to create the resultant shape.



Operation Types, UNITE HIGH

The UNITE LOW Operation

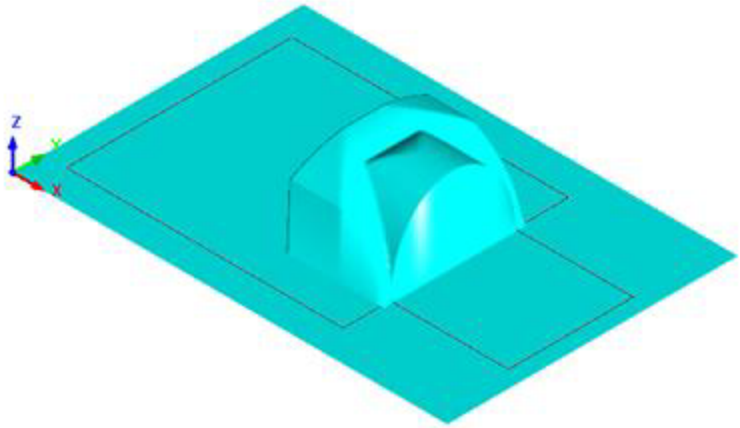
This operation selects in the Z axis, the *minimum* value of either of the two primitives to create the resultant shape.



Operation Types, UNITE LOW

The INTERSECT HIGH Operation

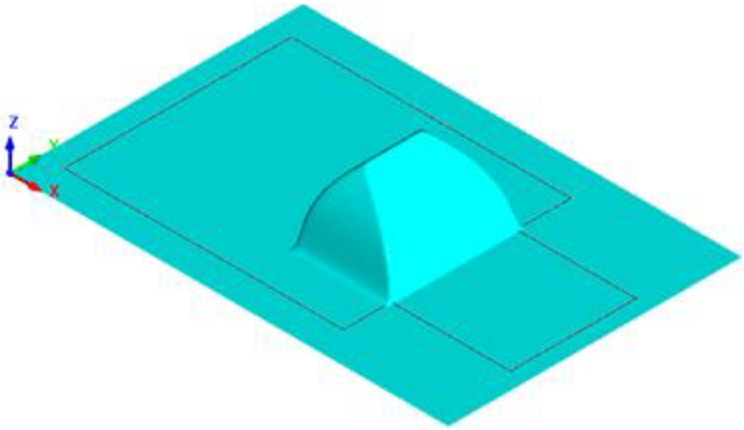
This operation selects only the volume that is common to both shapes and then selects the *maximum* value along the Z axis in this intersected volume.



Operation Types,INTERSECT HIGH

The INTERSECT LOW Operation

This operation selects only the volume that is common to both shapes and then selects the *minimum* value along the Z axis in this intersected volume.



Operation Types, INTERSECT LOW

Related Topics

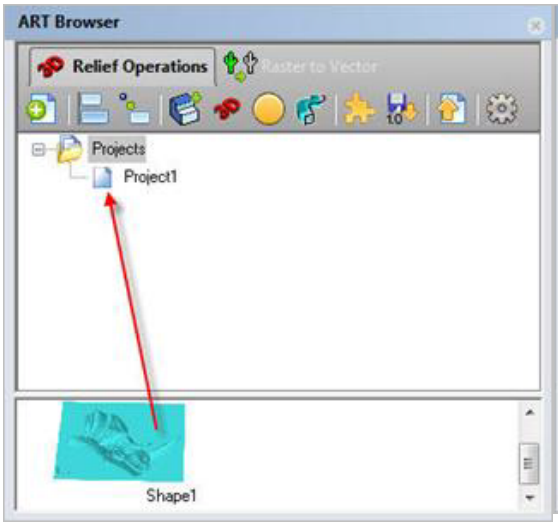
Creating Relief Operations

6.9 Load Shape Library

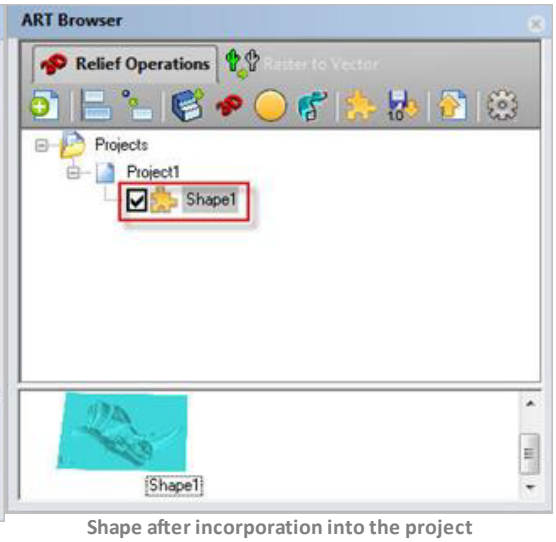
Selecting the Load Shape Library icon brings up the Open dialog which allows you to select shapes (*.slb* files) that have been previously saved to a Shape Library. To load the shape, simply select the desired shape (*.slb* file) and click Open button.

You will then be able to view the shape within the ART Browser after it has been selected from the Open dialog and clicking Open button.

Drag & Drop Shape Files to the ART Browser



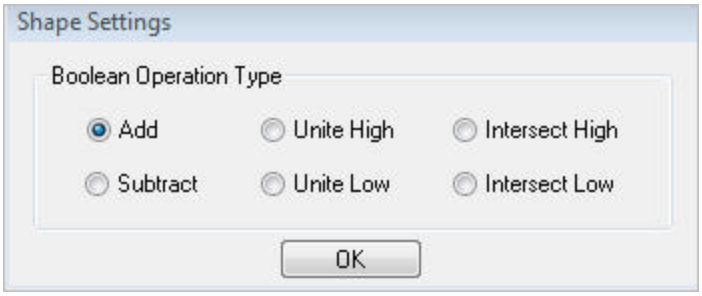
Shape being dragged to the project



Shape after incorporation into the project

Dialog Box: Shape Settings

There must be a project already created before dragging and dropping the shape to the Projects tree. To add the shape to the Projects tree, drag and drop the shape to the preferred project as shown in the image below.



Dialog Box: Shape Settings

Once the shape is dragged to the project tree, the dialog shown box will appear to allow you to select the Boolean operation type to use to incorporate the shape into the project.

You can select the desired radio button depending on the type of Boolean they wish to use.

Related Topics

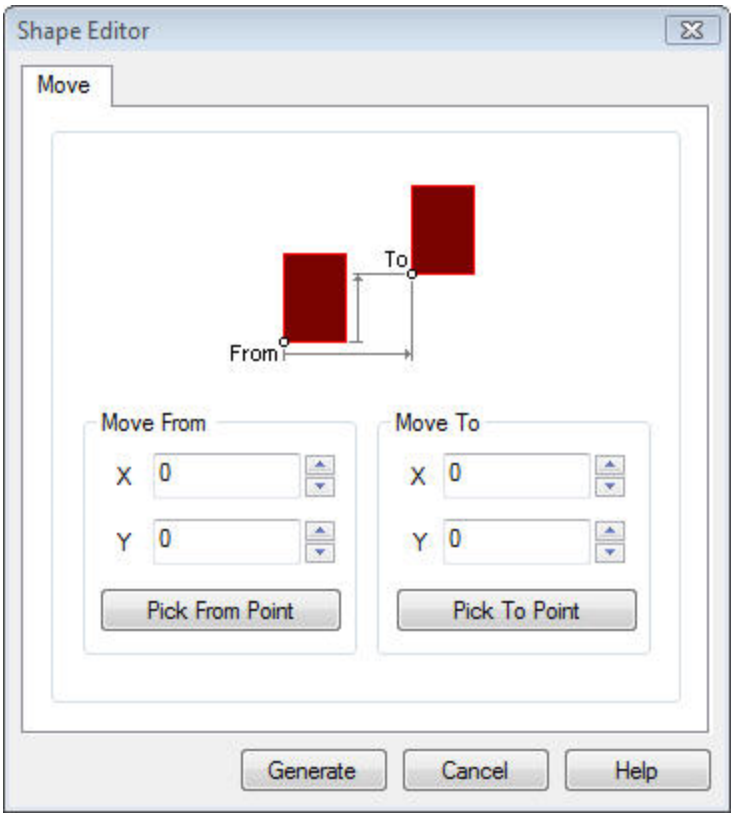
Creating Relief Operations

Shape Editor

6.9.1 Shape Editor

To use Shape Editor to move the shape, right click on the shape name in the project tree and select Edit from the list. This will bring up the Shape Editor dialog box as shown below.

Dialog Box: Shape Editor



Dialog Box: Shape Editor

Pick From Point

Upon selection of this button the dialog box will disappear and allow you to pick the point they wish to move from. You can also enter the numerical value by typing them in or use the up/down arrows to specify the Pick From Point.

Pick to Point

Upon selection of this button the dialog box will disappear and allow you to pick the point they wish to move to. You can also enter the numerical value by typing them in or use the up/down arrows to specify the Pick To Point.

Generate

Click on Generate button to update any changes that were made.

Related Topics

Load Shape Library

6.10 Import ART 1.0 File

The Import ART 1.0 file icon imports RhinoART 1.0 plug-in data to the ART Browser for the part file that is currently loaded. You can then edit and generate the operation in the ART Browser.

Related Topics

Creating Relief Operations

6.11 Export Meshes to CAD

Selecting the Export Meshes to CAD icon allows you to export the ART geometry (meshes) to MILL module. Thus, a mesh can be easily saved using MILL module, and further machined within the MILL module.

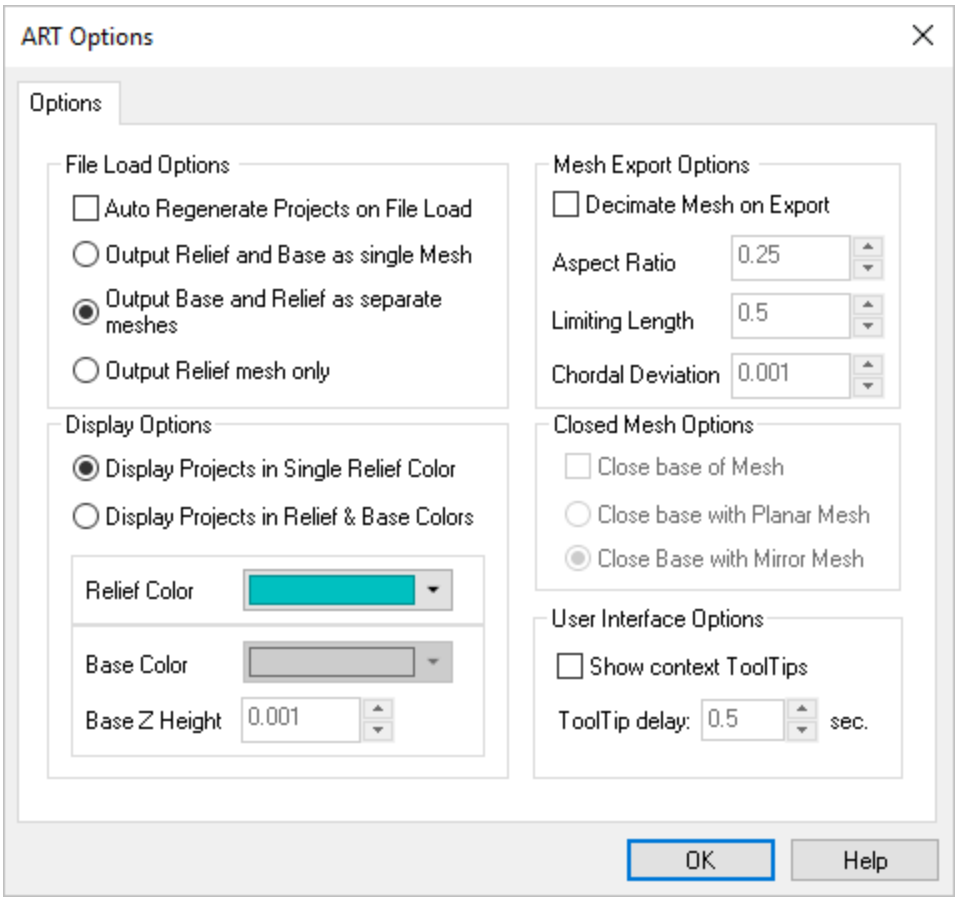
Related Topics

Creating Relief Operations

6.12 ART Options

This button allows you to set preferences such as File Load Options, Display Options, Mesh Export Options, and Closed Mesh Options.

Dialog Box: ART Options



Dialog Box: ART Options

File Load Options

- Auto Regenerate Projects
  on File Load will automatically regenerate files with operations upon being loaded if box is checked.
- Output Relief and Base as single mesh
  will output 3D reliefs and base as a single mesh within project if box is checked. This option combines the relief and base meshes into one single mesh upon export to CAD.

Display Options

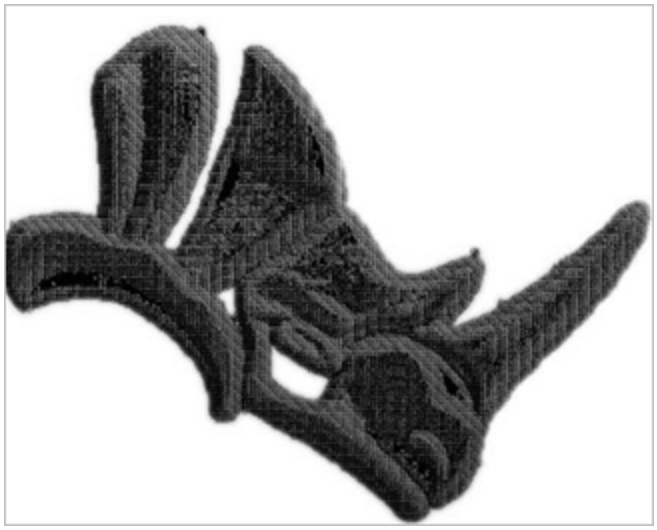
- Display Projects in Single Relief Color
  will display the entire project using a single color if this radio button is selected.
- Display Projects in Relief & Base Colors
  will display the relief and base in separate colors if so desired. Once the selection of this radio button is made, it enables the drop down menu for Base Color.

- Relief Color
  drop down menu is for selecting the color to be used for the reliefs.
- Base Color
  drop down menu is for selecting the color to be used for the base of the project.
- Base Z Height
  determines the height of the project from the zero point of the Z axis coordinate. The desired Z height can be specified by either entering a numerical value or using the up/down arrows.

Mesh Export Options

- Decimate Mesh on Export
  This option can be used if you wish to simplify the model by reducing the mesh count. This can be done by checking the Decimate Mesh on Export box and adjusting the Aspect Ratio, Limiting Length, and Chordal Deviation. The greater the value the more it will try to reduce the mesh count. If the values are set too high, this will distort the geometry.

Examples



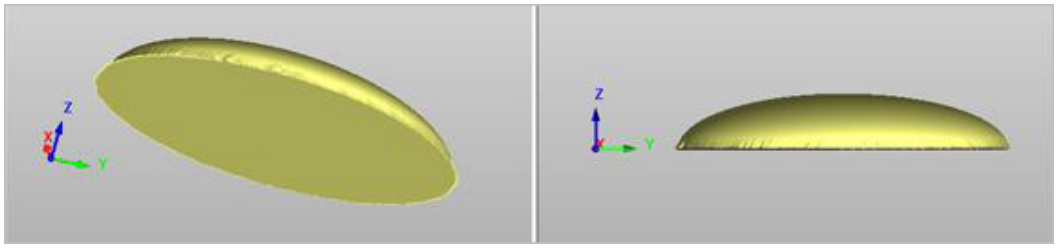
Example: Decimate Mesh on Export is unchecked

- Aspect Ratio
  This defines the ration of the width to the length of the triangles on the mesh.
- Limiting Length
  This is the maximum length for the chord segment.

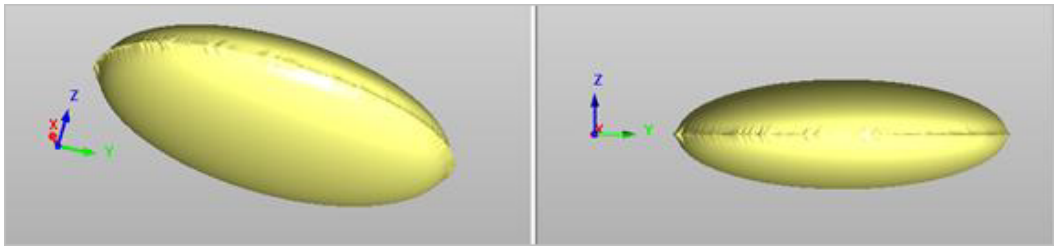
- Chordal Deviation
  This is a maximum permitted distance from a facet face to the original mesh geometry.

Closed Mesh Options

This option allows the exported mesh to be closed or not. If the Close base of Mesh option is chosen, you can close the mesh by either a planar mesh or a mirror mesh. The effects of selecting each of these options on a simple puff shape are shown below:



Closed mesh with a planar mesh selected

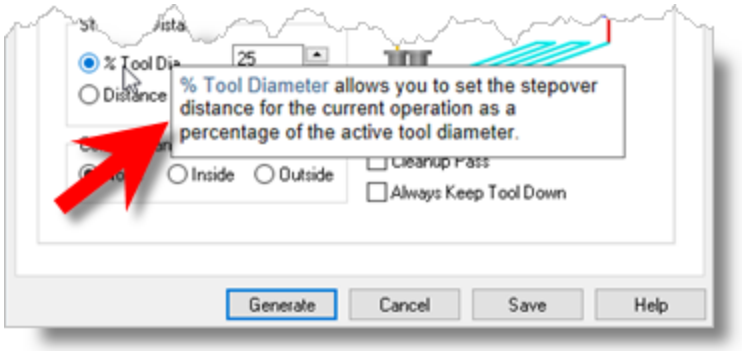


Closed mesh with a mirror mesh selected

User Interface Options

Show context ToolTips

Check this box to display Context ToolTips when the mouse moves over a parameter in a dialog. A definition of the parameter will pop-up automatically. **Note** that Context ToolTips may not be available for ALL dialogs. You can also set the ToolTip Delay in seconds. This is the amount of time it takes to display the Context ToolTip when the mouse activate it.



Related Topics

Creating Relief Operations

Creating Raster to Vector Operations

This section describes the second area of functionality that is featured in the ART module. This is the ability of ART to create curve geometry (lines and arcs, sometimes called vectors) from bitmap picture files. This functionality can be accessed by selected the Raster to Vector tab in the ART Browser window.

Related Topics

Create Curves from Image

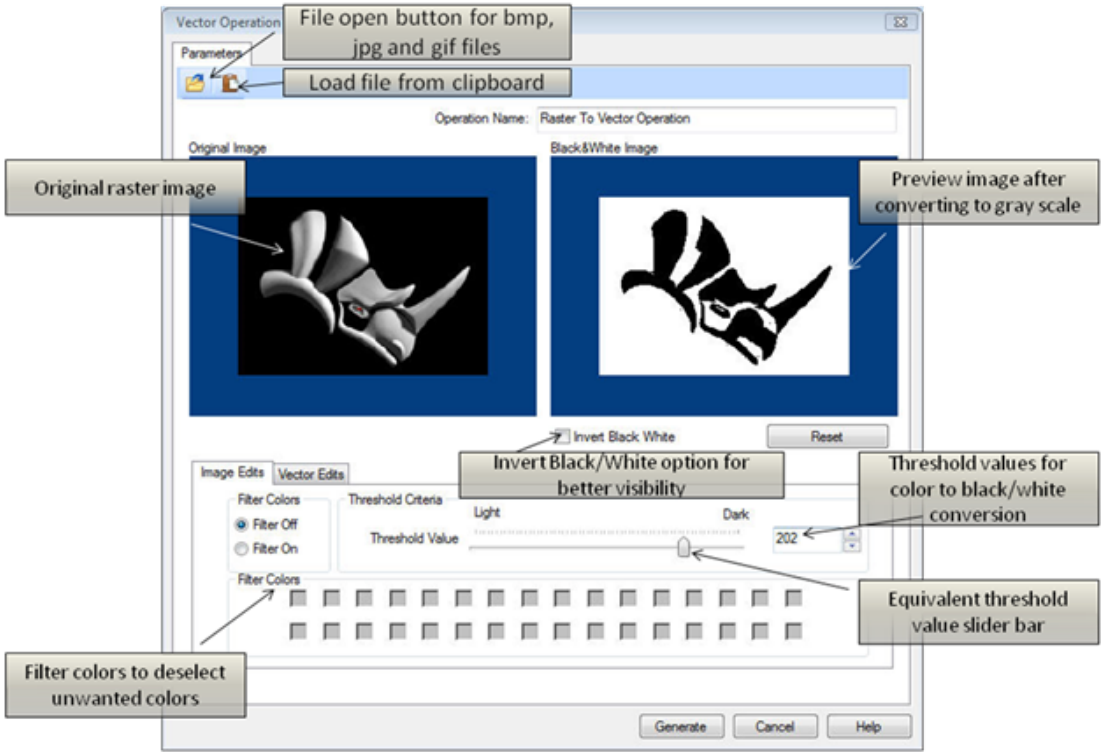
7.1 Create Curves from Image

This method is mainly used to convert and image outline into curves, so that they can be used in the next operation. The first step is to convert the image into black and white image based on the threshold value you have defined.

The black and white picture is converted to a collection of lines and arcs, representing its outline. There is a possibility to adjust further the smoothness of the contours, if desired.

This property page will allow you to load, convert the image to black/white image and preview a color image to a gray scale bitmap. Also, it allows you to view the converted image into a vector and to make changes in the image options to review the vector geometry. The dialog for this implementation will be very similar to the dialog for Raster to 3D Relief. The operation will can be undone if you want to reject the obtained geometry.

Dialog Box: Vector Operation



Dialog Box: Vector Operation

Operation Name

Allows you to change the name if so desired by typing the new name.

Invert Black/White

The invert color option is provided for you to be able to invert the gray scale. The gray scale inversion is required in case the model needs to be created as a relief depth instead of relief height.

Reset Button

The reset button is provided for you to be able to reset the changes that have been done before such as inverting the image, or changing the Gray scale value color components.

Filter Off

Turns off the filter for colors thus not filtering any colors.

Filter On

Turns on the filter for colors thus allowing you to filter out specified colors.

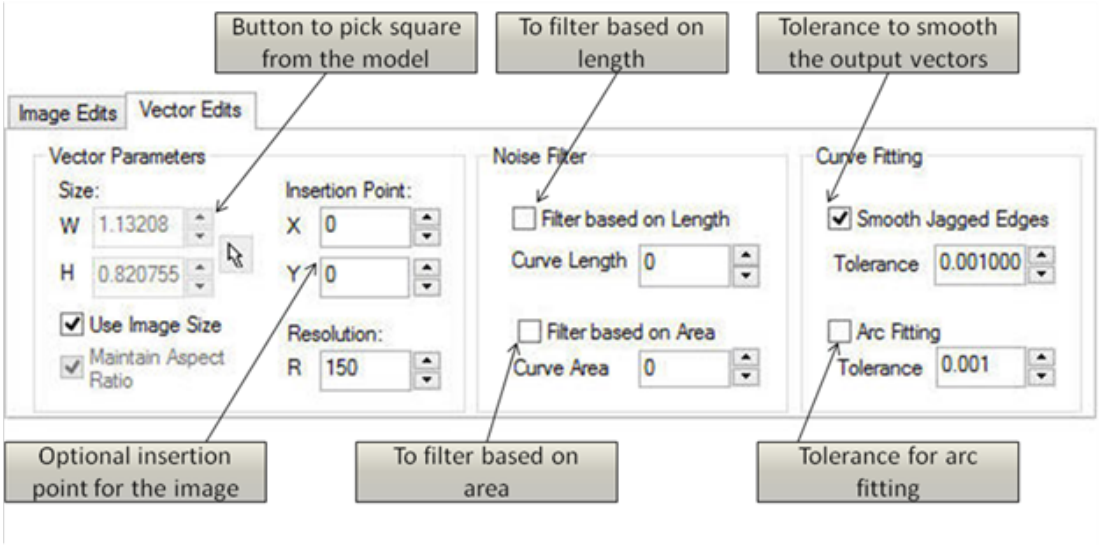
Threshold Criteria

The Threshold slider filters out pixels with gray-scale values smaller than the threshold. The left-hand preview box shows the original image with its gray tones. The right preview box shows the image that will result from the selected Black/White conversion method. You can specify the value by using the slider bar, entering numerical values or using the up/down arrows.

Filter Colors

This strategy is used for converting the image in to a 32 colors image. You can select a specific part of the image by filtering out the colors from the image. Filtering can be obtained by checking the colored check boxes. If a specific color in the check box is checked, then it will not be used in the raster to vector conversion. The Threshold Slider Bar will NOT work in this mode and is disabled during this operation.

Dialog Box: ART Options, Vector Edits tab



Dialog Box: Vector Operation, Vector Edits tab

Size

The width (W) and height (H) of the relief size can be specified by entering numerical values, using the up/down arrows or by using the pointer to pick the area from the model.

Use Image Size

If this option is checked, this will honor the original image size. It will use the original image size and place it within the project workspace.

Maintain Aspect Ratio

If Use Image Size is unchecked this will enable this function allowing you to either maintain the aspect ratio(i.e. scale factor) if checked or if it is unchecked it will not

honor the aspect ratio. The aspect ratio refers to the width/height ratio of the image. The pick button allows user to pick two points such that the aspect ratio of the image remains same, and the image does not get distorted in the mapping process. On pressing the pick button, the dialog box gets minimized until you have picked two points. You can cancel the pick operation by right clicking on the mouse.

Insertion Point

You can specify the insertion point of the image by either entering numerical values, using the up/down arrows or by using the pointer to pick the insertion point within the project.

Resolution

The resolution defines the accuracy used to generate the actual model. The higher the resolution, the better the quality of the output mesh generated. However, increasing the resolution also reduces the relief generation time and above all affects the display.

Filter based on Length

Filters all closed/unclosed curves whose length is smaller than or equal to the specified length.

Filter based on Area

Filters all closed curves whose area is smaller than or equal to the specified area.

Smooth Jagged Edges

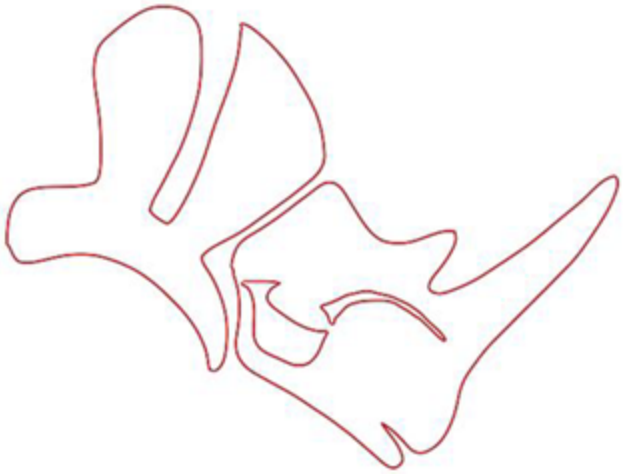
This option will smooth the jagged edges of the curve during the raster to vector conversion based on the specified tolerance.

Arc Fitting

Fits arcs to the curves created during the raster to vector conversion based on the specified tolerance.

Generated Vector

The output of the generated vector looks as shown in the figure below. For better output, the resolution may be needed to be specified again in the project settings tab. The obtained Curve cannot be selected immediately and needs to be exported to Rhinoceros Curve by pressing export button while the curve is visible. This curve can now be used as an input for generating sweep operation as well as puffing up the interior of the curves as explained in the next two sections.



Generated Vector

Dialog Box: ART Options, Vector Edits tab

Creating Raster to Vector Operations

Editing Relief Operations

Once a relief operation has been created it can be edited in a couple of ways. Changes can be made to any of the objects that make up the operation such as the image, smoothness, picked curve list and other relief parameters. This type of editing is called associative editing. This is because the edits made to the operation are saved with the operation and upon regeneration the changes would be effected.

Related Topics

Editing Operations Associatively

Regenerating Relief Operation

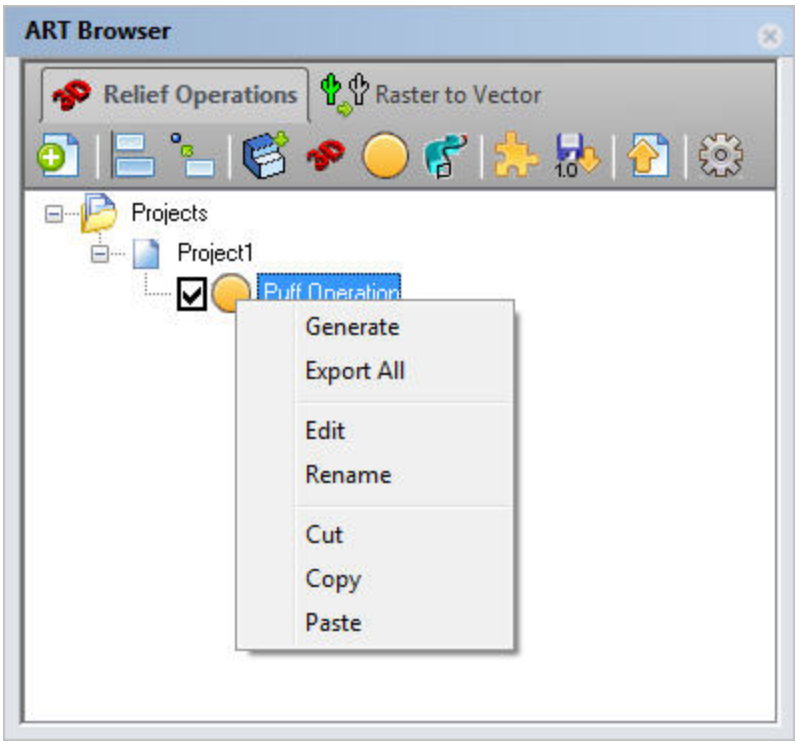
Archiving Relief Operations

8.1 Editing Operations Associatively

Relief Operations can be edited by using the Browser. Each relief operation is represented by an icon in the browser. Double clicking on any of these icons gives you an opportunity to edit the object. The same dialog that was used in the creation of the object being edited would be invoked and editing is exactly similar to creation. For example, double clicking on the 3D Relief icon would bring up the 3D Relief dialog, upon which you can substitute the current image with another or edit the parameters of the current operation.

The following menu will pop up on right clicking the mouse button over the project or operation on the tree structure.

ART Browser - Right-click Operations



RhinoCAM - ART Browser

Generate

This option will generate the operation that is selected. To generate all operations, select the Project, right click and select Generate All.

Export All

This option exports the meshes or curves to CAD of the selected operation.

Edit

Selecting this option opens the operations dialog box for editing the selected operation.

Rename

This option allows you to rename the operation that is selected.

Copy/Cut/Paste

- Cut
  This option allows you to cut/remove the operation that is selected.
- Copy
  This option allows you to copy the operation that is selected.

- Paste
  This option allows you to paste an operation (an operation that has been either copied or cut).

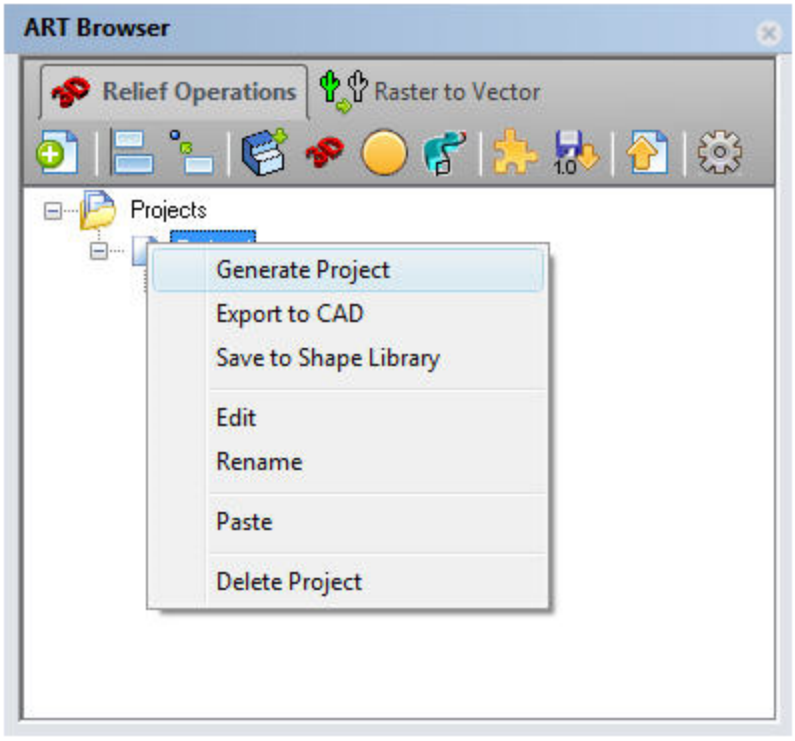
Related Topics

Editing Relief Operations

8.2 Regenerating Relief Operation

After all the operations are created you can now regenerate all the operations under a single Project by clicking on the Project icon in the Browser tree. The following menu will pop up on right clicking the mouse button over the project setup icon on the tree structure.

ART Browser - Right-click, Generate Projects



ART Browser - Right-click, Generate Project

Generate Project

This option will generate the selected project.

Export to CAD

This option exports the entire selected project to CAD.

Save to Shape Library

This option saves the relief operation shape(s) to the Shape Library.

Edit

Selecting this option opens the project dialog box for editing the selected project.

Rename

This option allows you to rename the project that is selected.

Paste

This option allows you to paste a project (a project that has been either copied or cut).

Delete Project

This option will allow you to delete the selected project

Related Topics

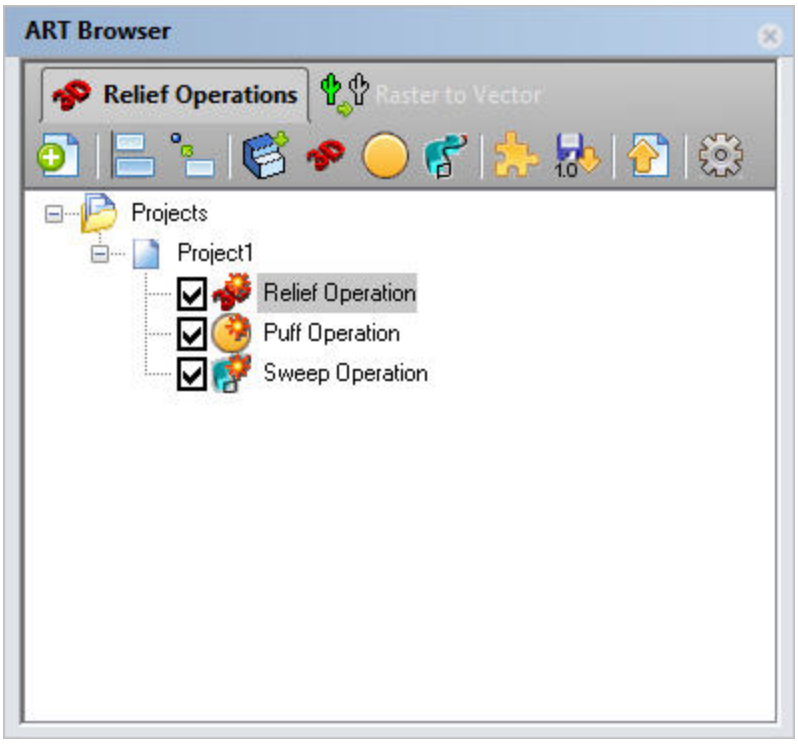
Editing Relief Operations

8.3 Archiving Relief Operations

Once relief operations are created they can be archived along with the *.3dm* RhinoCAM part file. This can be accomplished by simply saving the part file. When the part file is retrieved, all archived operations will be loaded along with the part file.

After loading the *3dm* file, the operations need to be regenerated explicitly for the relief operations to show up. If the operations are not generated, the images in the tree will appear red as shown in the figure below. Once you select Project and right clicks, the drop down menu will appear. You need to select "Generate Project" to regenerate a project. Once the operations are regenerated, the icons will appear normal (without the red color).

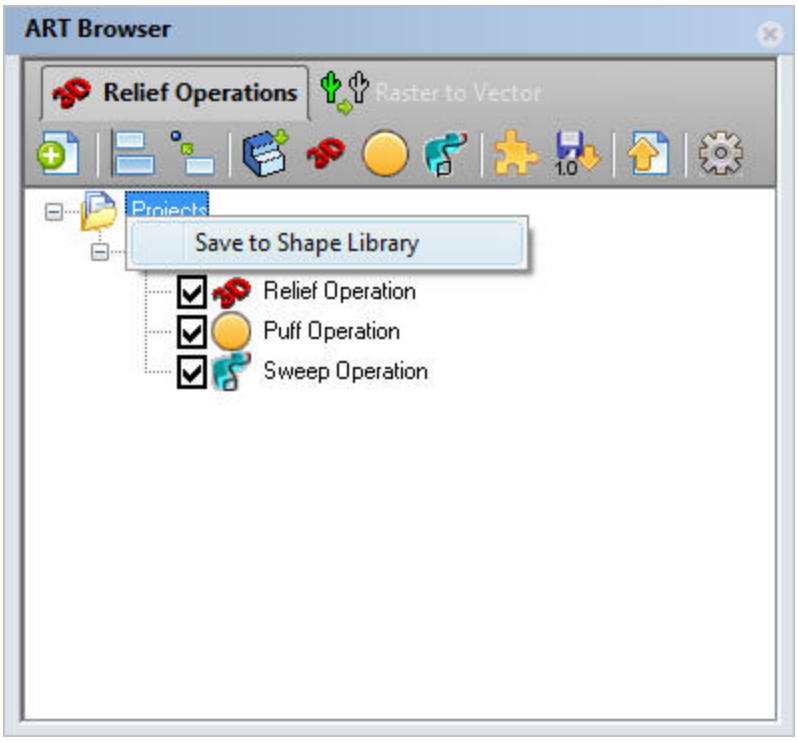
ART Browser, showing Ungenerated Operations



ART Browser, showing Ungenerated Operations

ART Browser, Save to Shape Library

Right clicking on Projects allows you to Save to Shape Library. Using this option saves all the relief operation shapes under all projects to Shape Library.



ART Browser, Projects, Save to Shape Library

Related Topics

Editing Relief Operations

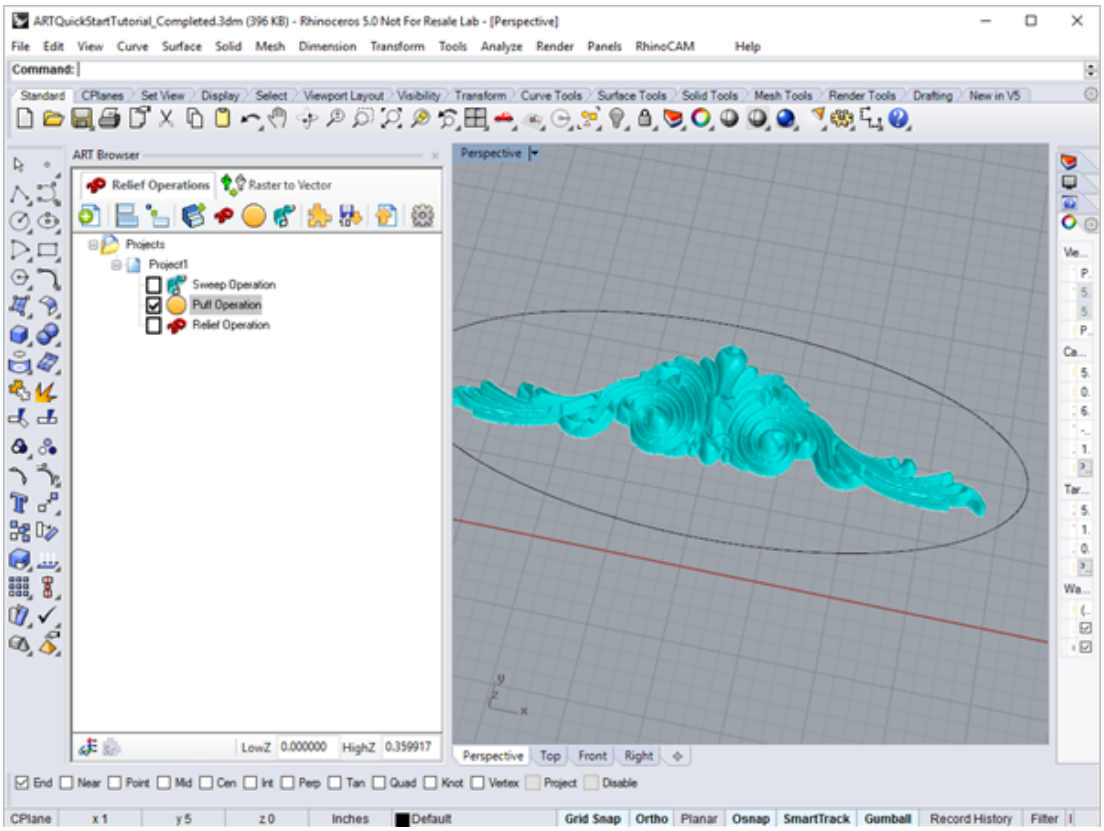
Operation Suppression

8.3.1 Operation Suppression

The check marked ☑ operations in the Project1 tree shown in the example below are visible in the graphics window. All unchecked ☐ operations are visually suppressed from the graphics window.

ART Browser, Operation Suppression

To suppress an operation simply uncheck the box which precedes the operation as shown in the example below. The Sweep Operation relief is unchecked therefore the relief is not visible in the viewport (only the curve geometry is visible).



ART Browser, Operation Suppression

To Suppress an Operation, un-Check it

To suppress an operation simply uncheck ☐ the box which precedes the operation in the Project tree. In the example shown above, the Sweep and the Relief operations are suppressed (i.e., they are unchecked in the Project tree and are not displayed in the graphics window.

Related Topics

Archiving Relief Operations

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