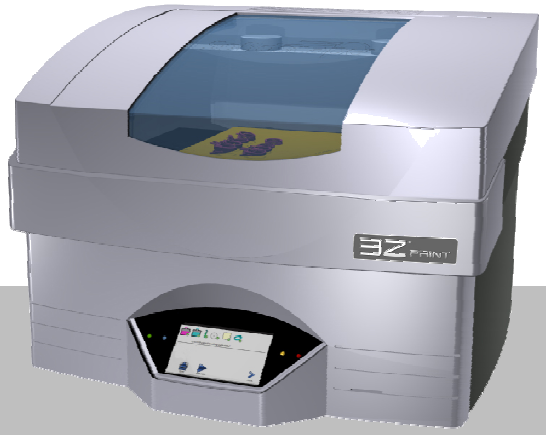
3Zworks



User Manual

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Table of Contents

List of Figures

Overview

Program Functions

Each of the 3 installed programs has a unique purpose and function.

3ZWorks is the primary program that transforms an input file to software data format that the 3Z printer uses to grow a model.

3ZAnalyzer is a program that presents a visual representation of the model building process. This allows the operator to analyze all aspects of the model creation in a layer by layer format prior to growing the model.

3ZOrganizer is an automated program that will automatically retrieve model files from a specific location and process them in a pre determined manner.

The typical file processing is shown in **Figure 1: File Processing**

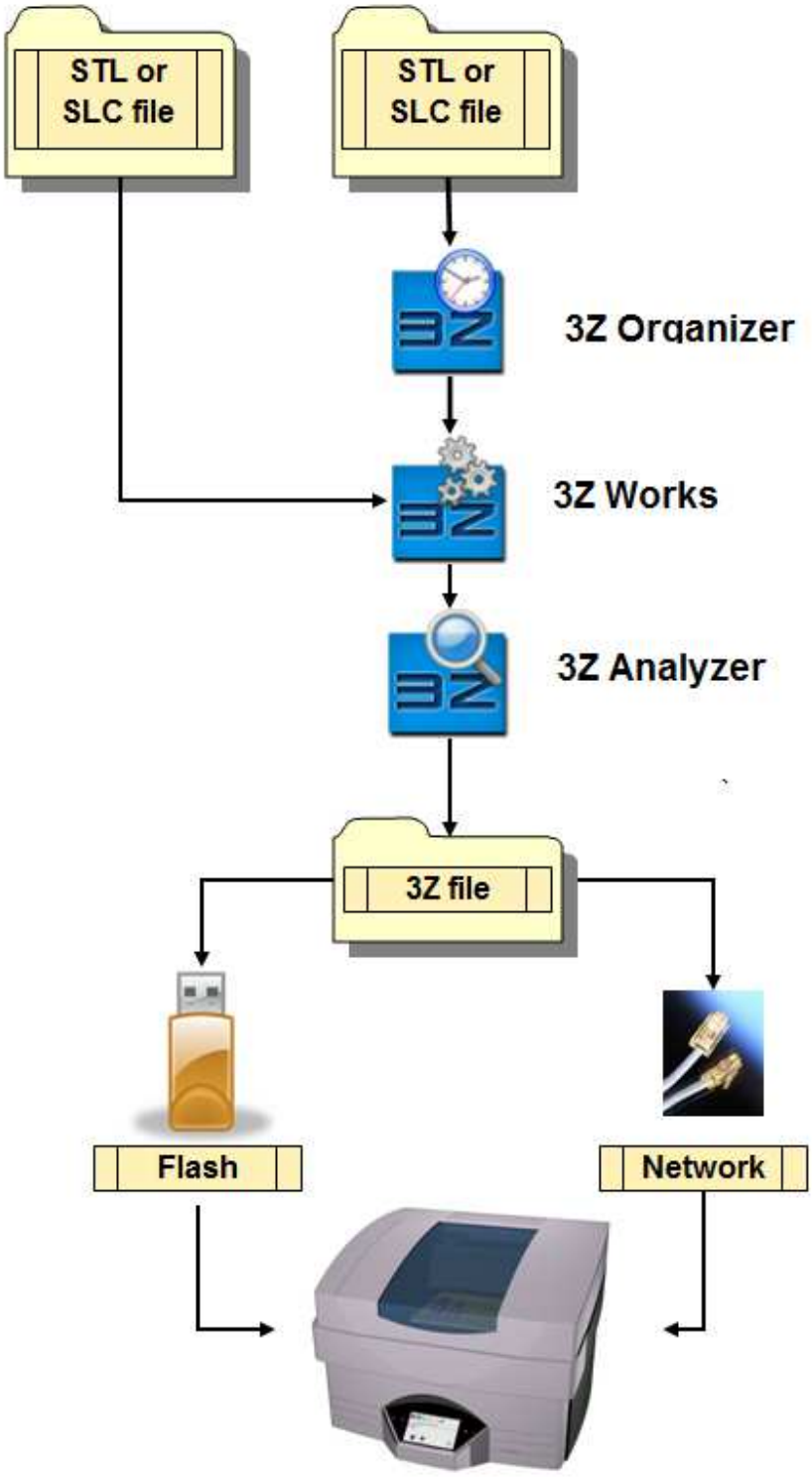

Figure 1: File Processing

System Requirements

3ZWorks requires the following software and hardware:

- Microsoft Windows XP or Vista or Windows 7.
- A minimum of 1 GB of RAM.

Solidscape recommends at least a P4 class processor, 10GB free disk space, and a screen resolution of 800 x 600 with 256 colors. Greater performance, memory, and disk space would be needed for more complex model geometries.

Software Installation

Before installing a new version of 3Z software, any previously installed versions should be uninstalled. See Removing 3ZWorks on page 13 for details. Once the software is installed, do not move or rename any of the files or directories.

To install the 3Z software from the 3Z software installation flash drive, insert the installation flash drive in the USB port of your computer. The installation program may run automatically. You can also double–click on the file.

<USB drive>\CDMenu.exe to start the 

program. Follow the setup instructions on the screen to install all the 3Z Software and the Configuration Database files.

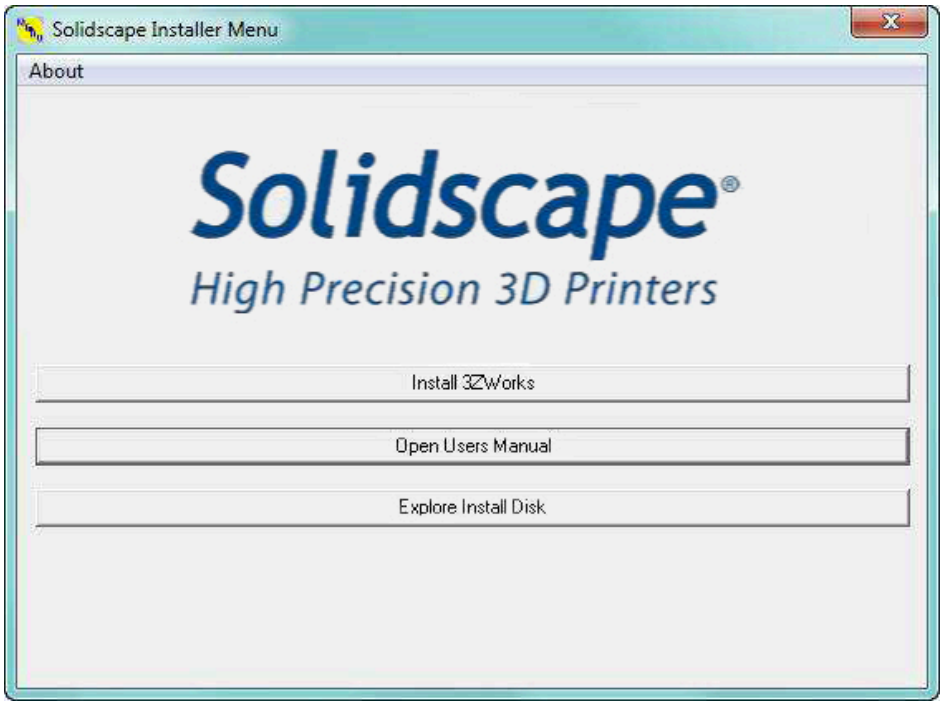

Figure 2: 3Z Software Installation Menu

The Configuration Database that is on the installation flash drive may not be the most recent version available. First consult the README.TXT file on the drive, if present. Then check the Solidscape web site at romanoff.com under Resource Center > Product Related > Solidscape Related Documents, to see if a later version of the Configuration Database is available. If necessary, download and install the Configuration Database after installing 3Z Software.

All documentation is in Adobe® Acrobat ® format. If your system does not include the Adobe Acrobat Reader, you need to install it to view and print the documentation included on the flash drive.

Using 3ZWorks

This section introduces the 3ZWorks program and describes instructions for preparing a model for the Solidscape family of machines.

Overview

3ZWorks by Solidscape®, Inc. is a Windows based program to generate files for their pattern making and tool making machines. 3ZWorks has many convenient features that make the preparation of files for the Solidscape printers easy and efficient.

With 3ZWorks you can:

- Import models in either facet or slice format.
- Position parts on the machine build platform.
- Select configurations to specify build parameters such as slice thickness.
- Slice and fill models to produce binary data files for the Solidscape machines.
- Monitor machines as your parts are building.

3ZWorks comes with a database of extensively tested build configurations that optimize performance of the machines.

Starting 3ZWorks

To run the 3ZWorks program, select Programs → Solidscape 3ZWorks → 3ZWorks from the Start button.

Exiting 3ZWorks

Click on Exit in the File menu to exit 3ZWorks.

Removing 3ZWorks

Use the following steps to uninstall the 3ZWorks software:

1. Click Start, Settings, and then the Control Panel icon.
   The Control Panel window displays.
2. Double click the Add/Remove Programs icon or Program and Features for Windows 7.

Build Process Overview

To build a model on the Solidscape machines, first use the 3ZWorks program to create a binary data file. This file contains all the data describing how to build the model. It defines each drawn vector for each layer of the model for both the build and support materials.

3ZWorks builds the binary file from a facet or slice file created by a CAD system. Binary files can have what ever name the user chooses, but must have a file extension that matches the machine type they intend to build it on. The machine requires a binary file to build the model.

Following are the basic steps for preparing to build models:

1. Load models into 3ZWorks.
2. Position the models on the build platform for the best build. Different factors to consider include the position of critical surfaces or features, the position of part and part features relative to the cutter, and the amount of support required. See Positioning Models on page 15 for details.
3. Use the 3ZWorks Wizard or the Printer Interface to help select build parameters and automatically generate a binary build file. See 3ZWorks Wizard on page 31 for more information. Alternatively, select a configuration based on slice thickness, feature sizes, general model shape, and the build time. Generate a binary file, using the Slice and Fill operation. See Selecting a Configuration on page 16 and on page 42 for more details.
4. Use 3ZAnalyzer to check the filled model for irregularities.
5. Move the binary file to the machine for building.

Basic Usage

This section discusses the basic steps for using 3ZWorks.

Importing Model Files

Model files for 3ZWorks are designed using a CAD or other modeling program, or from scanning a physical part. Models are converted to either a facet or slice file format in the CAD or modeling program before being imported into 3ZWorks. The most popular file format is STL, which is a standard for the rapid prototyping industry and is supported by almost all CAD vendors. 3ZWorks supports both ASCII and binary STL formats, as well as DXF and Alias OBJ facet files. For further information on these file formats see File Formats on page 84. Slice files can also be used for building parts. Although slice files are not as flexible as facet files because the part orientation and slice thickness cannot be changed, the file size can often be smaller than for an STL file. In addition, some CAD systems produce more reliable slice files than STL files. 3ZWorks supports the SLC slice format as well as HPGL and the 3ZWorks proprietary SLF format. Processing slice files is similar to STL files, however the following restrictions apply:

- Slice files can only be rotated about the Z-axis, so that the slices stay parallel to the build platform. They can also be scaled in the X and Y direction, but not in the Z direction which would change the slice thickness.
- When choosing a configuration, the slice thickness of the configuration must match the slice thickness in the slice file.
- When building multiple slice files, all must have the same slice thickness. If the slice files have multiple slice ranges, all the ranges must match
- Slice ranges can be used with slice files only if the file already contains multiple slice thicknesses. 3ZWorks will automatically set the slice ranges for these types of files.
- When generating slice files with a program other than 3ZWorks, do not specify any line width or tool width compensation. 3ZWorks assumes that the vectors in a slice file define the actual part boundary and automatically compensates for the width of the line drawn by the machines.
- Geometric volume estimates are not available for slice files.

Multiple facet or slice files can be loaded into 3ZWorks, to build several parts at the same time. The overall build time is less for a build containing multiple parts than if each part is built separately. Parts of a multi-piece model, such as the top and bottom of a mold, can match each other better if they are in the same build.

Positioning Models

Once a model is loaded, it needs to be positioned on the machine's build plate. Models can be moved and rotated in any direction in 3ZWorks. The position and orientation of the model affect the build time as well as the quality of the finished part.

The basic rule for positioning models in 3ZWorks is to have the longest length parallel to the cutter and centered in that direction (the Y-axis), and to have the shortest length in the Z-axis. This minimizes both the distance the cutter travels and the number of layers required to build the model, both of which help decrease the build time. When building several models, the taller parts should be positioned closest to the cutter, and the shortest parts further away. This minimizes the cut length for the upper layers, also decreasing the build time.

The following are other factors to consider when positioning the model on the build plate:

- Support structures
  - Position the model to minimize the amount of support material, to optimize build time and to simplify dewaxing. Support material is generated under all model overhangs and around the outside of the part.
  - When dewaxing a part, the heated support material expands faster than the build material and can therefore crack, break or fracture the model. Avoid orientations where there will be large solid blocks of support material inside the part, especially inside relatively thin walls.
  - If possible, models with large areas of support should be positioned so that an area of build material is between the support area and the cutter, as the model is being built. This helps prevent gumming the cutter with support material.
- Flat surfaces
  - Flat surfaces will have the best surface finish when positioned to face upwards, so they are cut smooth by the cutter.
  - Large flat surfaces which face downward might cause the part to "curl" or warp if they are positioned parallel to the build plate. The recommended position for this type of model is a five-degree angle. If the bottom surface is flat, eliminating the platform layer can also help, if a smooth bottom surface is not required.
- Thin walls
  - Vertical thin walls cut better when positioned perpendicular to the cutter.

  - Cylindrical models with very thin walls build best when positioned with the axis of the cylinder parallel to the Z-axis, although this can take more time in some cases

- Critical surfaces
  - Upward facing surfaces are generally better than downward facing surfaces.
  - For vertical surfaces, the best detail is on the surface facing the cutter.
  - Very fine features can be better defined if built in the Z-axis using the smallest layer thickness.

Selecting a Configuration

3ZWorks comes with a selection of build configurations that optimize the performance of the machines. Each configuration is a set of build parameters that has been extensively tested by Solidscape in order to build the best part for the particular slice thickness and model type in specific materials. The configuration selection determines the build speed and surface quality of the model. Different configurations are provided for various model types and various material types. Multiple configurations can be used in a model, using the Slice Ranges feature, to increase the build speed in sections without a lot of detail, but still take advantage of smaller slice thicknesses in sections with fine detail.

For your convenience, Solidscape has provided the 3ZWorks Wizard to guide you through selecting a configuration and setting other build parameters. See 3ZWorks Wizard on page 31 for more information on using the Wizard. Configurations can also be selected directly using the Slice and Fill dialog.

The following are the configuration selection variables:

- Machine type. Configurations are available for each machine type, optimized for the characteristics of the machine. Choose a configuration that matches your machine type and material. Configurations for one machine type cannot be used on another.
- Configuration Style. Configurations are labeled depending on their design. Default configurations are suitable for the widest range of parts, and are the best all-around choice. Solid configurations can be used when stronger parts are needed for post-processing. Rounded Surfaces are designed for parts with shallow rounded bottom surfaces. Fast configurations can be used to decrease build times, but part quality may suffer.
- Slice thickness
  - Thicker slices build faster. However, quality might be sacrificed depending on the model.

- Thinner slices produce smoother surfaces. However, the build time is increased. The thinnest layers produce minimal stair stepping on curved surfaces.
- Thicker slices can be used for vertical walls, since there will be no stair stepping.
- Small features might require thin slices. Allow at least six slices to build a small feature See **Figure 3: Model Stair stepping.**

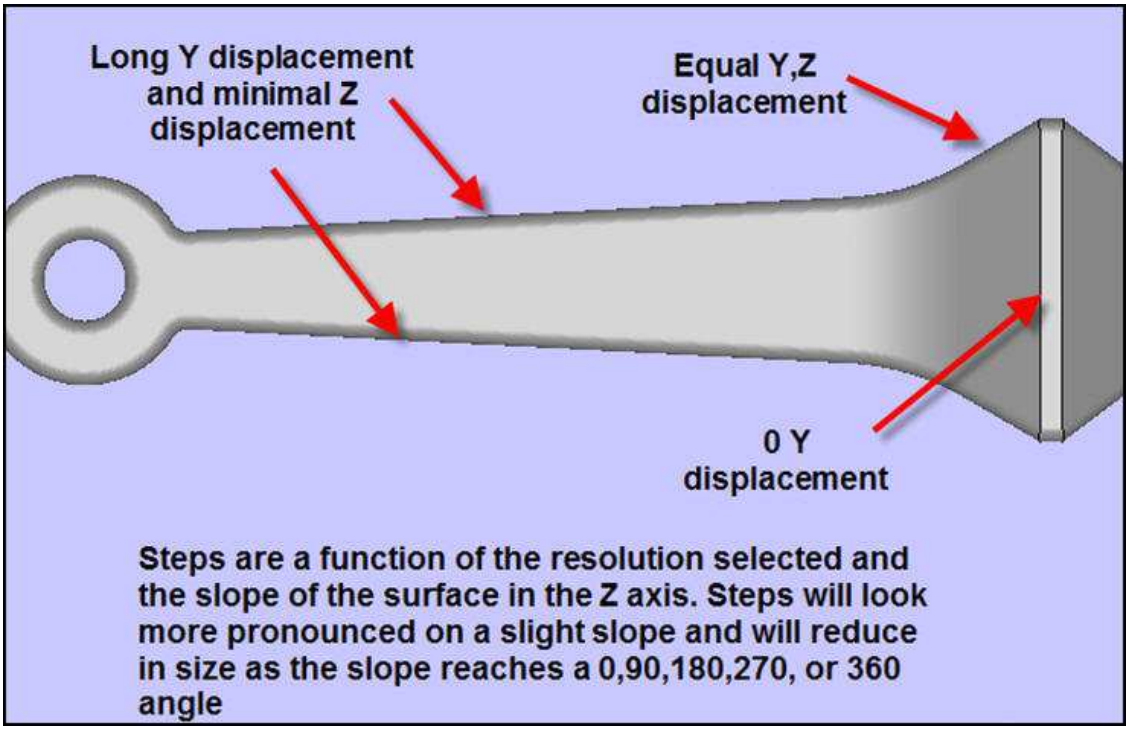

Figure 3: Model Stair stepping

Slicing and Filling

The slicing and filling operations generate the binary data file for the Solidscape machines. Models are built up slice by slice on the machine, so slicing the facet file is the first step in this process. This step is not necessary when using slice files. Next, a pass is made through the slices to automatically generate the support areas. Finally, the lines to build the slices are generated in the fill step. This includes calculating the perimeter lines for both the build material and the support, and filling the part interior and support areas with grid lines. When the operation is finished, a build time estimate is displayed.

After creating the build file, examine it with 3ZAnalyzer. If there are no problems, copy the file to the printer via network or USB to be built.

Examining the File with 3ZAnalyzer

Running 3ZAnalyzer and looking at the model before it is sent to the printer is an important step in the build process. The following lists the reasons for looking at the file in 3ZAnalyzer:

- Ensures the sliced model is good and will build properly
- Shows what is expected in the build
- Shows things that might hinder a good build or cause a re-slice using a different configuration

3ZWorks Buttons and Commands

This section describes all the 3ZWorks screens, buttons and commands. These commands can be accessed through the pull-down menus or by using the buttons on the 3ZWorks screen as shown in **Figure 4: 3ZWorks Screen with TestDisk.stl Displayed**.

File Commands

The File commands are located in the File menu and in the Main Toolbar. These commands are used to load and append model files, and to save files.

Loading Models

Open Model opens a browse window to select a model file. This can be either a facet or a slice file. Multiple files can be selected in the browse window, and all the models will be loaded onto the build plate. Files can also be loaded by using the Open option in the File menu, selecting the name of a recently opened file from the File menu, by dragging and dropping a file into the 3ZWorks application window, or by double-clicking on an STL or SLC file.

The model is displayed in 3ZWorks at the location where it was designed in the CAD system. If the Automatically move model to platform origin when load file option in the Options dialog is selected, all parts will automatically be placed at the platform origin, at the lower left corner of the build plate. The Status Bar at the bottom of the screen shows the total number of facets or slices that were read into memory, as well as the number of parts.

When files are loaded they are assumed to be in the current units. If the model is too small or too large, the units are probably incorrect. Reset the units as described in Setting Units of Models on page 23, and reload the model. Or, use

the Inch to MM or MM to Inch commands to convert the model to the current units.

Figure 4 shows the 3ZWorks screen with `TestDisk.stl` displayed. This file is installed with the 3Z software files and is located in the **Sample Models** directory.

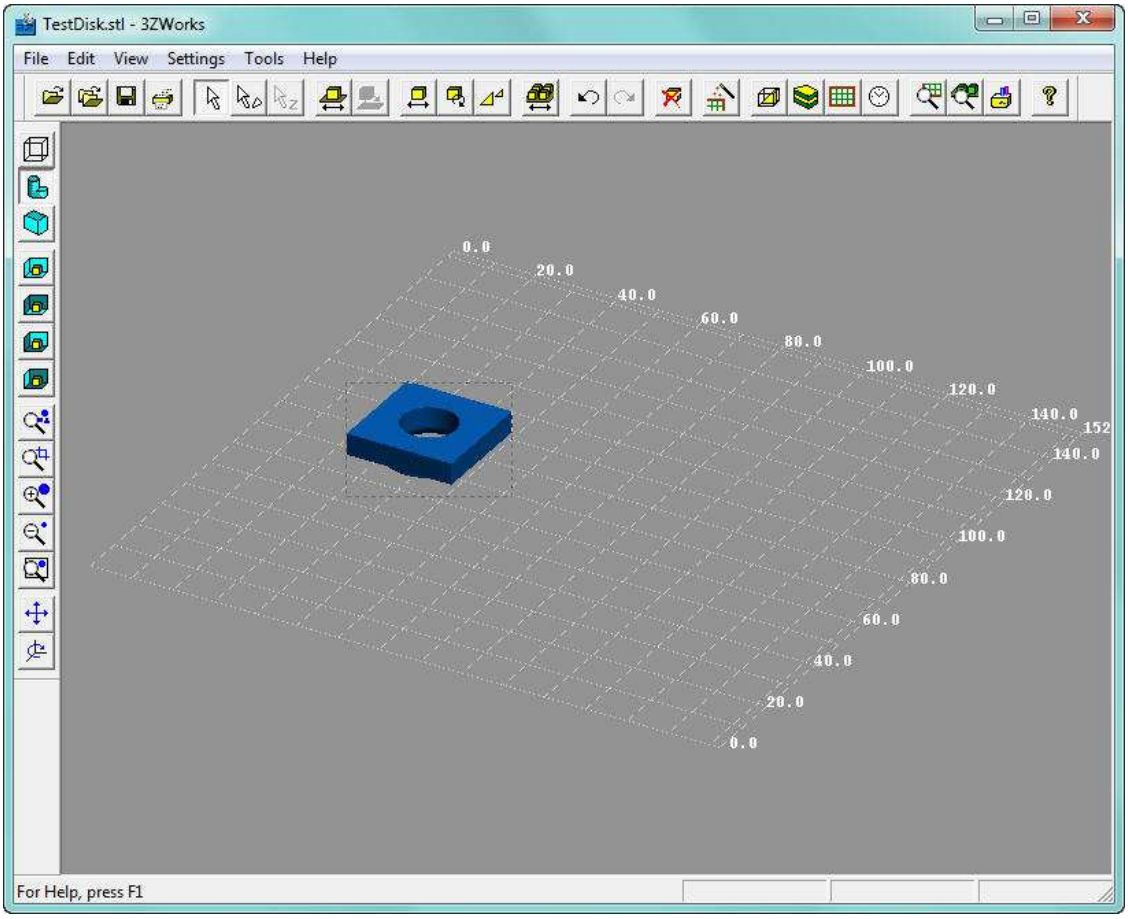

Figure 4: 3ZWorks Screen with TestDisk.stl Displayed

Appending Models

Append Model is used to load more than one model into 3ZWorks. In many cases, especially when building small parts, it is desirable to include multiple models in one build. Use this command if you are building several different models at once.

As models are added, 3ZWorks displays them in different colors. The first model is teal, the second is aqua, the third is green, and so forth. When all the models

are appended, they will need re-positioning. To select a model, click on it with the mouse. A thin dashed line is drawn around the active model. Multiple parts can be selected by holding down the Ctrl key while clicking. To select all parts, hit `Ctrl-A` or pick Select All in the Edit menu. Use the edit commands to position the selected models, or the Auto Arrange command to automatically position all the models. See **Figure 5: 2 models loaded on the build plate.**

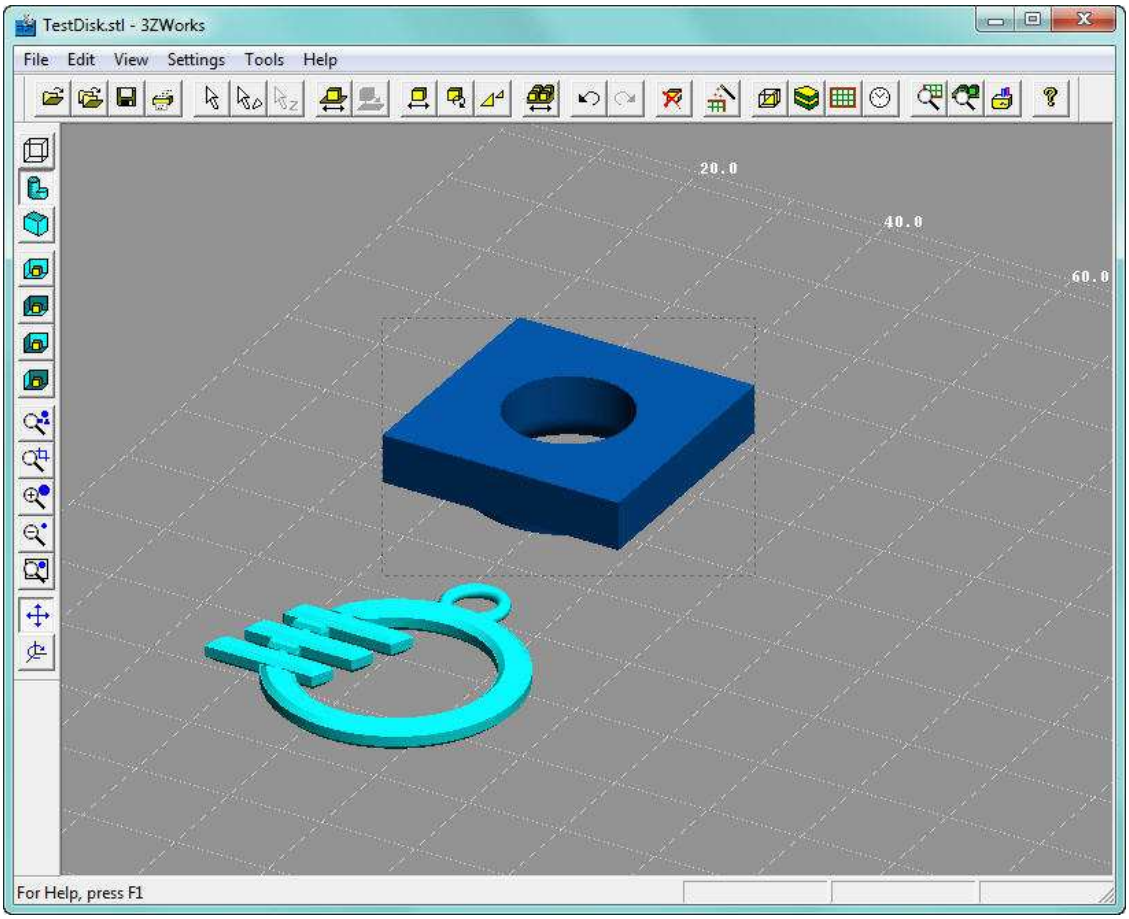

Figure 5: 2 models loaded on the build plate

Saving Model Files

Save As is used to save a facet or slice file. Models can be written in binary STL format, DXF format or 3ZWorks SLF slice format. All models currently loaded will be written to the file, in their current positions. Once several models have been combined into one file, they are treated as one object and cannot be moved and rotated individually.

Use this function to save models after they have been positioned for building. You can also save slices produced from facet files after the slicing and filling operation. This can save time if you want to slice and fill a model more than once, for example, to try out two different configurations.

Adjusting the Display

Setting the Display Mode

The display mode buttons, located in the View Toolbar, control what type of image is displayed. They are useful for files with many facets because they can speed up screen redrawing. The display mode can also be set in the View menu.

 The Wireframe button changes the display to a wireframe view, displaying the facet edges or slice edges.

 The Shaded button changes the display to a fully shaded view for facet files. It displays the slice edges for a slice file. The shaded view reveals the most detail about how a model looks and how it should be positioned. This is the default mode.

 The Bounding Box button changes the display to a bounding box view. When the model is in bounding box mode the details are hidden and the screen redraws more rapidly.

Setting the View Angle

Setting the view angle moves the viewpoint around the build platform so you can see the model from different directions. 3ZWorks provides standard views such as isometric and top views.

When changing view angles keep the following in mind:

- When changing the view angle interactively, hiding the detail on the model using Bounding Box mode speeds up repainting of the screen.
- The view of the model is the only thing being changed; the model is not being rotated relative to the build platform.

The following standard views are available in the View Toolbar. Additional views are available in the View menu.

 Iso View changes to an isometric view, looking towards the left rear corner of the build platform. This is the default view.

Top View changes to a top view, looking down on the build platform.

Front View changes to a front view of the build platform, from the front of the machine.

Right View changes to a view of the build platform from the right side.

Zoom

The five zoom buttons, located in the View Toolbar, vary the view to see the model at different levels of magnification.

Zoom Extents adjusts the view so the model fills the screen. Use this function when the model is off the screen or partially on the screen. The F9 key can also be used for zoom extents.

Zoom Window zooms into a sub-area of the model. Click the left mouse key and drag the cursor across two diagonal points on the drawing area of the screen. Release the mouse key after reaching the second diagonal point. The screen refreshes with an enlargement of the area selected in the center of the screen.

Zoom In and Zoom Out adjust the zoom factor in and out. Use Zoom Extents to view the entire model.

Zoom Platform adjusts the view so that the machine platform fills the screen. This view is useful when positioning multiple parts on the build plate. The F10 key can also be used for zoom platform.

Pan

Pan moves the viewpoint up and down or from right to left so that different parts of the model are displayed. Click on this button, and then click on the view. Holding the left mouse button down, drag the view to the desired position.

Rotate View

Rotate View rotates the view interactively as the mouse is dragged back and forth and up and down. Click on this button, and then click on the view. Holding the left mouse button down, drag the mouse to view different parts of the model.

Displaying Toolbars

The display of the Main Toolbar, the View Toolbar and the Status Bar can be toggled on and off using the options in the View menu. Toolbars may also be

moved to another side of the 3ZWorks window by selecting them along an edge and dragging them to the desired position.

Settings

The Settings pull-down menu is used to set various program options.

Setting Units of Models

The model units are set in the Settings pull-down menu. Select the system of units to match the units of the STL or slice file, before reading in the model. The units are also used for displaying numeric values in the dialog boxes, such as the slice thickness.

If a model was read in using the wrong units, use the Inch to MM or MM to Inch command to scale the model appropriately.

Setting the Machine Type

The machine type specifies the machine where the model builds. Select the entry in the Settings pull-down menu that matches the type of machine where the model will be built. Once a machine type is selected, only the corresponding configurations for that machine type will be displayed at slice time.

Options Settings

Select Options in the Settings menu to display the Options dialog, as shown in **Figure 6: Options Dialog.**

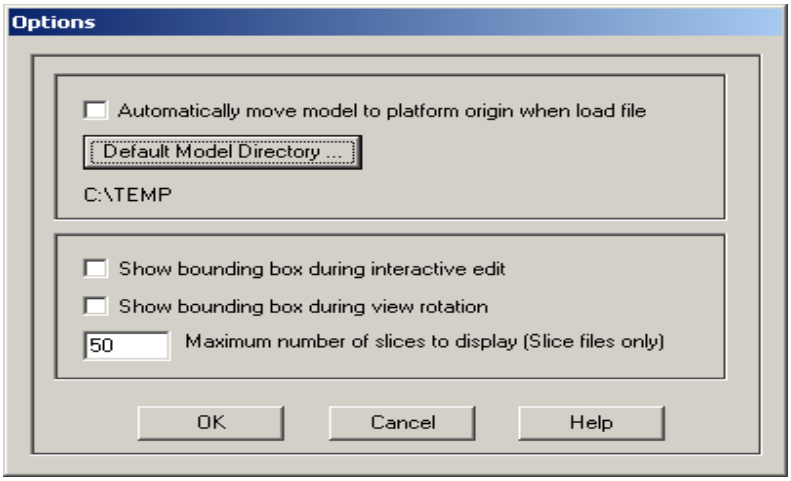

Figure 6: Options Dialog

When Automatically move model to platform origin when load file is checked, all models will automatically be moved to the platform origin (front left corner) when they are loaded into 3ZWorks. If it is not selected, models will be loaded at the position where they were created in the CAD program. This option is useful for locating parts that are in an unknown location.

The Default Model Directory sets the default location to use when loading model files, and for writing build files. Click the Default Model Directory button and select the directory to use.

Show bounding box during interactive edit specifies whether to display the model bounding box or the model geometry during the interactive Move command, to increase the display speed. If checked, the model bounding box is also displayed during slice range Z plane selection. See Slice Ranges on page 38 for more information on Z planes.

Show bounding box during view rotation specifies whether to display the model bounding box or the model geometry during the interactive Rotate View command, to increase the display speed.

The number of slices that are displayed for slice files can be adjusted by using the Maximum number of slices to display field. Setting the number lower speeds up screen redrawing, while setting the number higher shows more detail of the model.

Allow Boolean Processing specifies whether independent shells within an STL file (or a group of STL files) will be joined as they are sliced or if they will be treated independently. This option allows a user to bypass the union solids operation (joining) in their native CAD system and allow 3ZWorks to perform that operation as it slices.

The check boxes provide some control over how the independent pieces will be processed.

Unions - Enables the joining of two objects into one.

Self Unions - Rejoins the ends of an object that overlaps itself, creating an inside and an outside object.

Insertions - Since double solids equate to voids, this function removes a solid object found to be inside another solid.

Multiple - Sorts the inside versus outside contours of two overlapping objects with multiple intersections.

Single point - Ignores intersections of objects that touch, but do not overlap.

Small Feature - This function removes very small features whose inside versus outside may be incorrectly detected.

Same Vector - Breaks a vector with multiple intersections into smaller vectors with one intersection each.

Wraps - Wraps may occur when very similar shapes are nested together and touch an odd number of times. This causes two objects to be misinterpreted as one.

Overlaps - Overlaps occur when multiple copies of an object exist in the same space. This can happen if an object is copied and pasted, then not moved to a new location. This function removes duplicate objects.

The Boolean function does have limitations. Currently, shells that were created via "mirroring" of solids do not join robustly due to their exact symmetry. Other problems may occur in models with very similar contours, single point intersections, and self overlapping complex shapes that create internal voids.

Edit Commands

The Edit pull-down menu contains commands to position models on the build platform, to convert between units and to repair normal vectors in STL files.

Selection Modes

 Select is the default mode in 3ZWorks. Click on this button and then on a part to select it for an edit operation. To select multiple parts, hold down the Ctrl key while clicking on each part. To select all parts, use the Select All option in the Edit menu, or hit Ctrl-A. Editing commands affect all selected parts.

 Select Facet is used with the Rotate to Platform operation. Click on this button, and then on one of the facets in a part. The facet is highlighted. Selecting a facet also selects that part.

 Select Z Plane is used to select and edit Z planes for defining slice ranges, either in the 3ZWorks Wizard or the Slice Ranges dialog. Click on a slice plane in the display to select it. Then click again and drag the plane up or down to the desired position.

Moving Models

When a model is loaded, it might be off of the build platform. Use the Move and Rotate options to position the model on the build platform. In addition, the Automatically move model to platform origin when load file option in the Options dialog can be used to automatically move parts to the platform origin when the are loaded.

Move moves a model interactively in the X and Y directions, on the build plate. Click on this button and drag the cursor to move the active part, or multiple parts. Parts will move on the build platform, but not in the Z direction. For best results, use the Top view with this command.

Move XYZ moves a model on the build platform. Specify the move distance in the dialog box that displays. If the default is used, the model moves to the platform origin (0,0,0). Use this position when building multiple copies of the same model, as specified in the Build Model dialog.

The Auto Center option is located at the bottom of the dialog box. Check this option to move the model to the left edge of the platform, centered in the Y-direction. This is the recommended position for building most models.

Figure 7 shows the **Move Object dialog** box as it appears with pre-calculated distances that move the model to the origin of the platform. Override any of the X, Y, or Z distances as required. When clicking OK, the software adds the Delta X, Delta Y, and Delta Z distance to every vertex of the facet file or every point in the slice file, thus moving the model relative to the model's current position.

Note:

The Solidscape printers cannot build a model if any of the coordinates are negative, or if they are too far beyond the platform maximum dimensions.

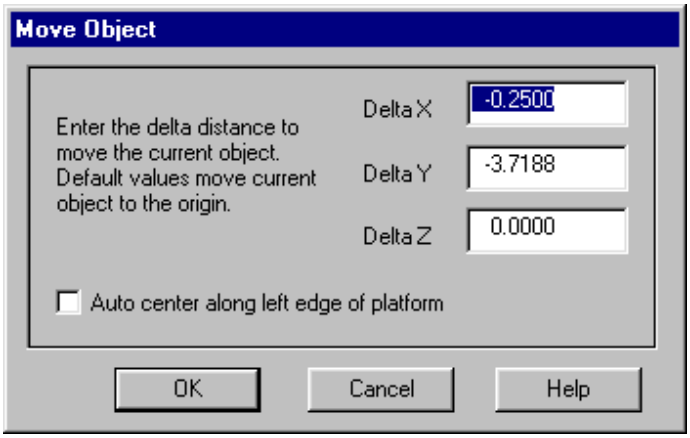

Figure 7: Move Object Dialog Box

Rotating Models

Rotate to Platform rotates the model so that the selected facet is facing downwards on the platform. Use Select Facet to first select the facet, which enables the Rotate to Platform button. Then click on Rotate to Platform and the model will be rotated into position. In some cases, the rotation may result in part of the model lying below the platform. If so, then the model is automatically moved up so that the lowest point is on the platform and the selected facet is parallel to the build plate.

Rotate XYZ rotates the model in space relative to the build platform. Click on the Rotate XYX button and the Rotate Object dialog box displays. The rotation angles are in degrees, counter-clockwise positive. Figure 8 shows the Rotate Object dialog box.

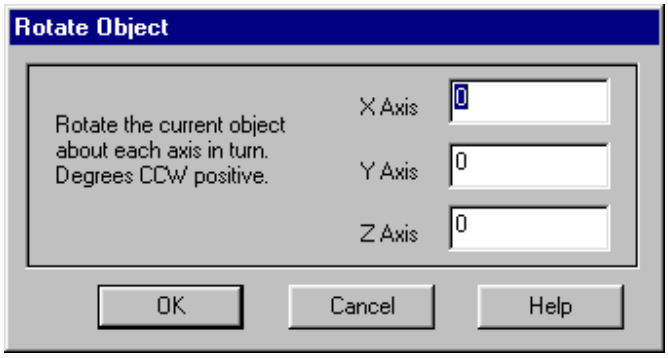

Figure 8: Rotate Object Dialog Box

The rotation direction follows the right hand rule: Point the right-hand thumb in the positive direction of the axis and the fingers curl in the positive rotation direction.

Note the following about the rotation angles:

- The angles are relative to the current position of the model. If a model is rotated by 30 degrees, then to rotate the model back again enter -30 degrees (or use the Undo command).
- The model is rotated about the center of its bounding box, parallel to the X-, Y-, or Z-axis. It is recommended that the model be rotated about one axis at a time.
- Slice files can only be rotated about the Z-axis, so that the slices remain parallel to the build platform.

Scaling Models

- Scale XYZ scales the model to allow for shrinkage factors or to build scale models.

When clicking on the Scale XYZ button, the Scale Object dialog box displays. Figure 9 shows the Scale Object dialog box. Scale Factors are the multipliers by which the model is scaled. For example, if a half-scale model is desired, set the factors to .5. If the Same scale factor in all dimensions checkbox is selected, all the scale factors will be set to the same value automatically. This is the default setting.

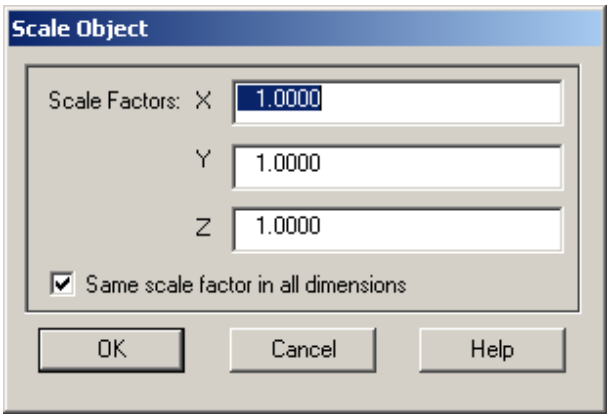

Figure 9: Scale Object Dialog Box

Slice files can only be scaled in X and Y, so that the slice thickness does not change. To scale slice files from one unit of measurement to another, use the Inch to MM and MM to Inch commands.

Auto Arrange

 Auto Arrange arranges multiple parts on the build platform. Parts are arranged in rows and columns so that the tallest parts are closest to the cutter, each column is centered in the Y direction, and parts are spaced uniformly. Parts are not rotated, so they should be oriented before using Auto Arrange. See **Figure 10: Auto Arrange Dialog Box**.

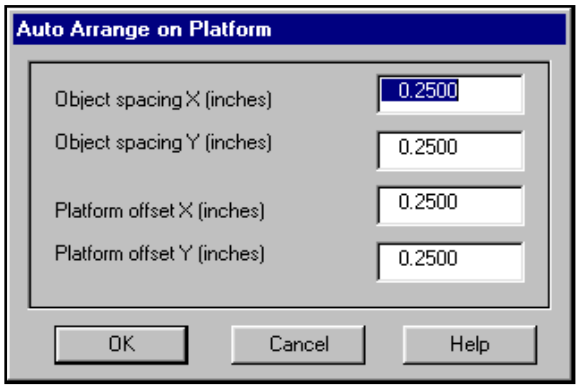

Figure 10: Auto Arrange Dialog Box

Object spacing specifies the distance between objects in the X direction and the Y direction. Platform offset specifies the width of the margin to leave between the outside of the parts and the edges of the build area. Offsets do not include any support perimeters or extra support cells.

Offsets are calculated between the rectangular bounding boxes of each part, so the actual distance can be larger than specified, depending on the shape and orientation of the models. Note that while the Auto Arrange command attempts to find a good arrangement, you may want to adjust the positions to optimize the build speed. In some situations, The Auto Arrange operation may not be able to find a solution and displays an error message.

Undo

Undo reverses the previous edit operation, returning the model to its size and position before the operation was performed. All Edit operations can be undone except Compute Normals. To undo the Compute Normals operation, delete the part and load the file again. Only one operation can be undone. The Undo button is disabled when there is no operation to undo.

Redo

Redo reverses the previous undo operation, restoring the previous edit operation. Only one operation can be redone. The Redo button is disabled when there is no operation to redo.

Deleting Models

Delete deletes the selected model from the build platform. A deleted model can be restored with the Undo command.

Converting Units of Models

The Inch to MM and MM to Inch commands located in the Edit menu change the units of a model after it has been loaded. For example, if the model was designed in inches and was loaded with the units set to millimeters, use the Inch to MM command to convert the inch model to the current millimeter units. If the model was designed in millimeters and the units are inches, select MM to Inch from the Edit menu.

Repairing Normal Vectors

STL files are composed of triangular facets and normal vectors. Normal vectors are vectors that are perpendicular to the surface of the facet, pointing towards the outside of the part and away from the solid build material. In some cases, the normals in an STL or other facet file are incorrect or corrupted. This can cause the part to fill incorrectly. Recalculating the normals can fix these problems in some cases.

Files with bad normal vectors usually exhibit some of the following behavior:

- When displaying the model in shaded mode, nothing displays. When the display is toggled to wireframe mode, the model is visible and appears correct. In this case, the normal vectors are all set to zero.
- When shading the model, it appears that the back surfaces are sticking through the front surfaces. In this case, some or all of the normals are probably reversed.
- When shading the model, there appear to be some holes or missing surfaces. In wireframe mode the surfaces appear normal. In this case, some surfaces are positioned the wrong way and have their normals reversed.

The Compute Normals and Flip Normals commands, located in the Edit menu, can be used to repair facet normals.

Note:

Incorrect facet normals can affect the way a file is sliced and filled. They can also indicate that other data in the file is incorrect. If the vectors are still incorrect or the model does not fill correctly after using these commands, use the CAD program to make the corrections and regenerate the STL file.

Compute Normals recalculates facet unit normal vectors based on the order of the facet coordinates. The vertices of the facets are ordered so that their outer unit normals follow the right hand rule. This command will recalculate the normal vector for each facet, based on this ordering.

Flip Normals reverses all normals in the model. In some STL files the facets are numbered backwards, while in other situations the facets are pointing in the reverse direction. In these cases, computing normals gives a reversed normal. The Flip Normals command rectifies these situations.

3ZWorks Wizard

The 3ZWorks Wizard is the easiest way to prepare a build file for a Solidscape machine. It guides you through choosing a configuration, setting slice ranges and other options, and generating a build file. Answer the questions on each page about the type of models you are building, and other requirements you may have. Press Next when you are done with a page. You may go back at any time and change an answer by pressing Back. If you are unsure about an option, use the default selection, or press Help to display help on any page.

Some advanced options are not available through the Wizard. For these, use the Slice Ranges and Fill dialogs.

Click on the 3ZWorks Wizard icon to display the first page of the Wizard, as shown in **Figure 11: 3ZWorks** Wizard. Make sure all your models are loaded and positioned on the build plate before using the Wizard. If they are, hit Next to continue. If not, hit Cancel to exit the Wizard.

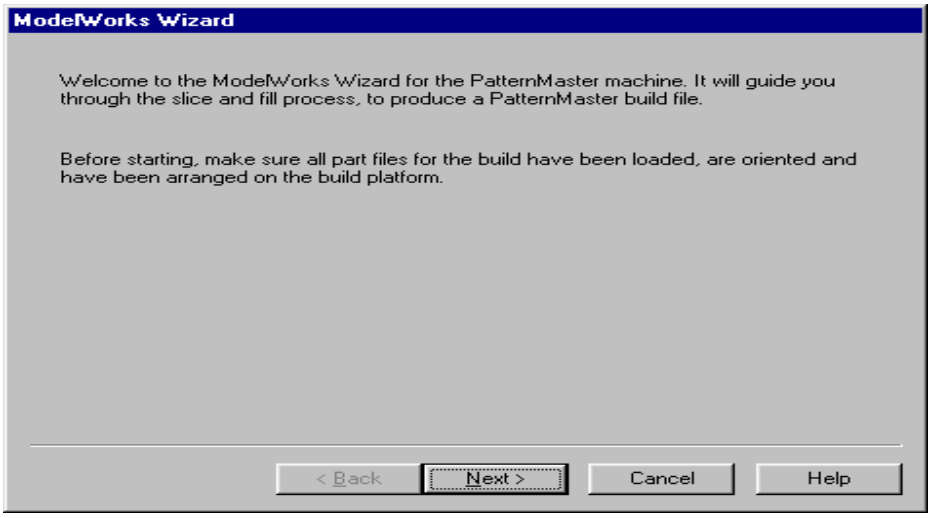

Figure 11: 3ZWorks Wizard

The next page is for setting slice ranges, as shown in **Figure 12: Wizard - Slice Ranges Page**. Slice ranges can decrease the build time for some parts, by using coarser build parameters in areas that don't have a lot of detail or where surface finish is not important. If your part is uniformly detailed, or if you are unsure whether to use slice ranges, choose No. If your part divides naturally into different vertical areas, choose Yes and enter the number of sections. Click Next when you are finished.

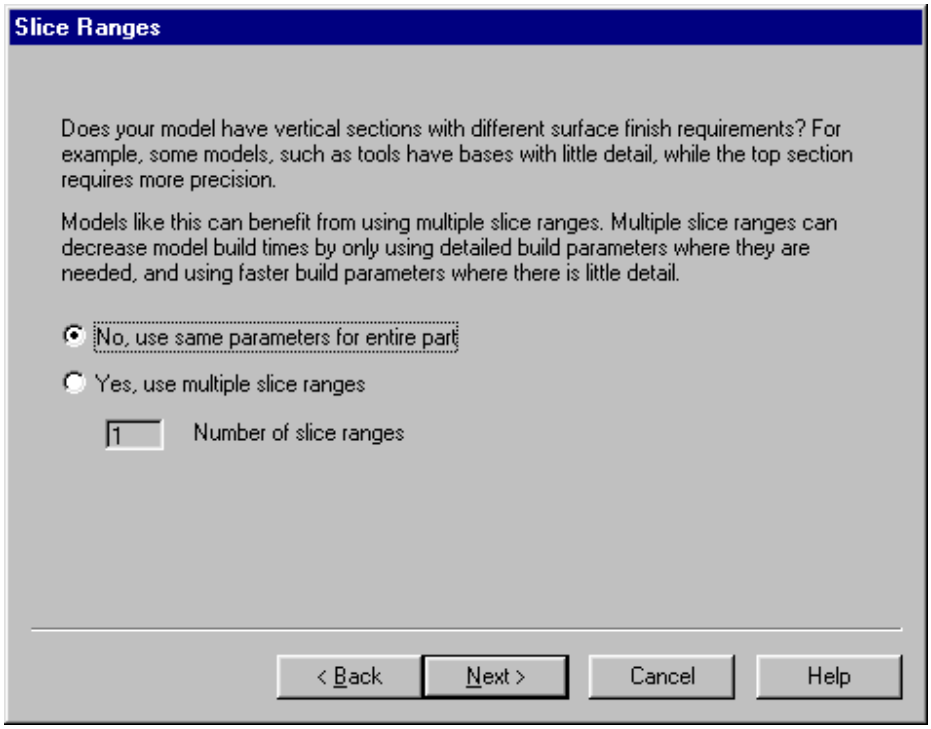

Figure 12: Wizard - Slice Ranges Page

If you entered Yes, the Slice Range Boundaries page displays, as shown in **Figure 13: Wizard - Slice Range Boundaries Page**. Otherwise, the Surface Finish page is next.

Slice ranges are numbered from the bottom of the part to the top, in the order in which they are built. The start of the first range is always the bottom of the part, and the end of the last range is the top of the part. For other ranges, both top and bottom can be changed and the adjoining ranges will be updated automatically.

Set the start and stop Z heights for the indicated slice range. Either enter the Z value if you know it, or use the view to drag the slice plane display to the correct location on the part. To use the view, move the Wizard window to the side, if necessary, and click on the border of the Z plane. Then click again to drag the plane up or down. The view can be changed, for example to a side view or a wireframe display to make it easier to see the part features. After changing the view, you may need to reset the cursor by hitting the Select Z Plane icon, as described in Selection Modes on page 25. If you have a complex part and the display refresh is too slow, set the Show bounding box during interactive edit option in the Options dialog to display the part bounding box while the plane is being dragged.

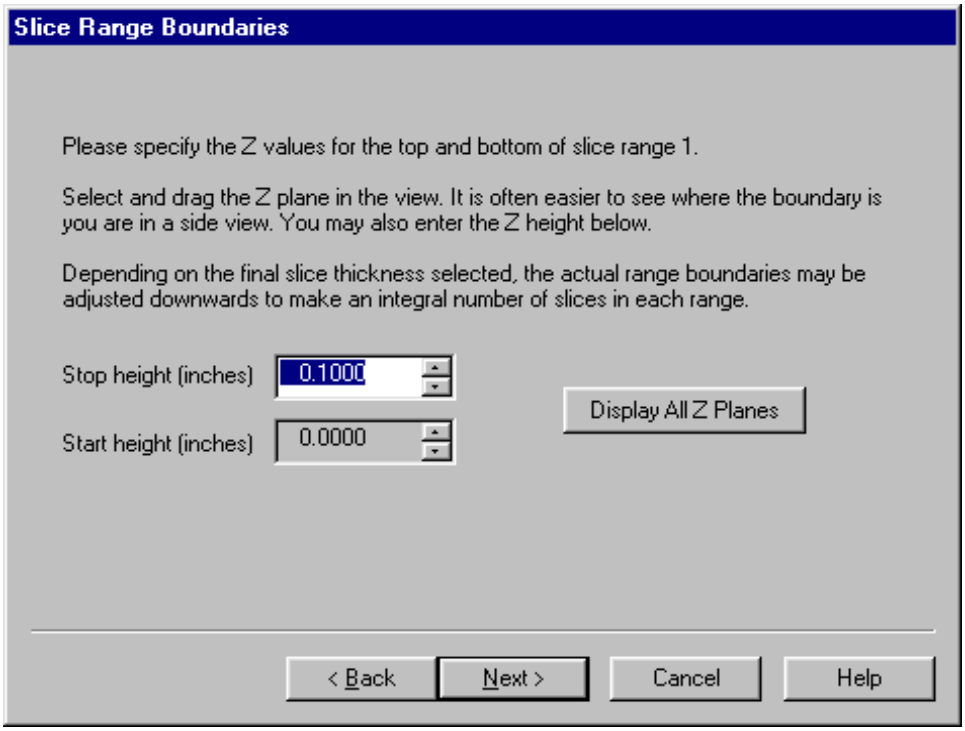

Figure 13: Wizard - Slice Range Boundaries Page

The Display All Z Planes button can be used to show all the current slice range boundary planes.

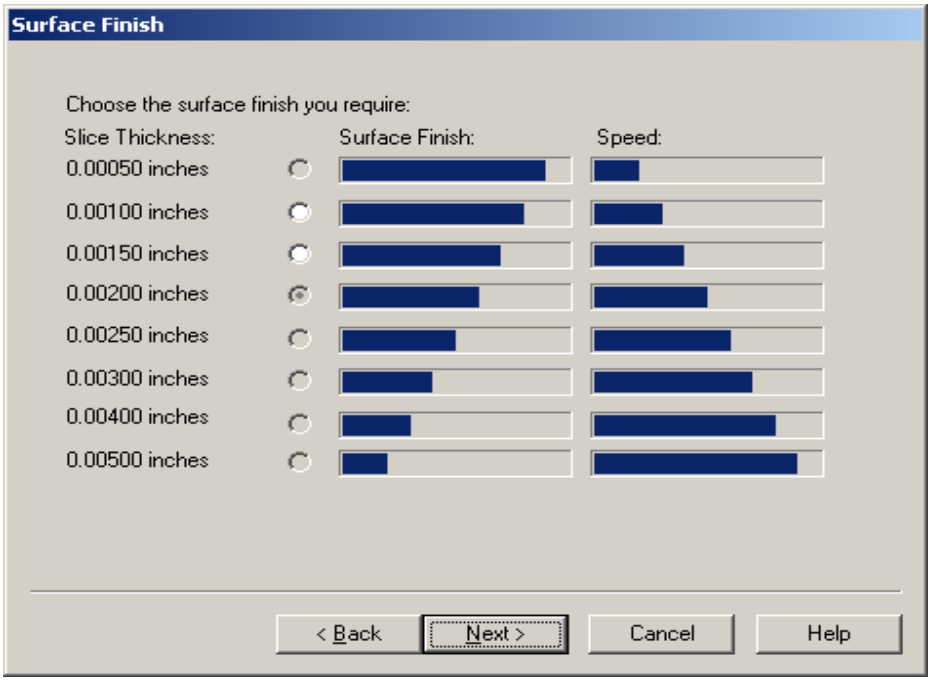

Figure 14: Wizard - Surface Finish Page

Press Next when you are finished with setting the Z values. The Wizard will guide you through parameter settings for this slice range, then return to the Slice Range Boundaries page for each range.

The Surface Finish page is shown in

Figure 14: Wizard - Surface Finish Page

Select the surface finish you require. This determines the slice thickness used, which is the major factor in determining the build time. If you are unsure what surface finish to use, choose the default, which produces a very good part. With experience, you may decide that you need a better surface finish, or you may find that you do not need this level of detail and can decrease the build time by using a thicker slice.

If you are using slice ranges, the slice range is listed at the top of the page. The surface finish will apply to that slice range only.

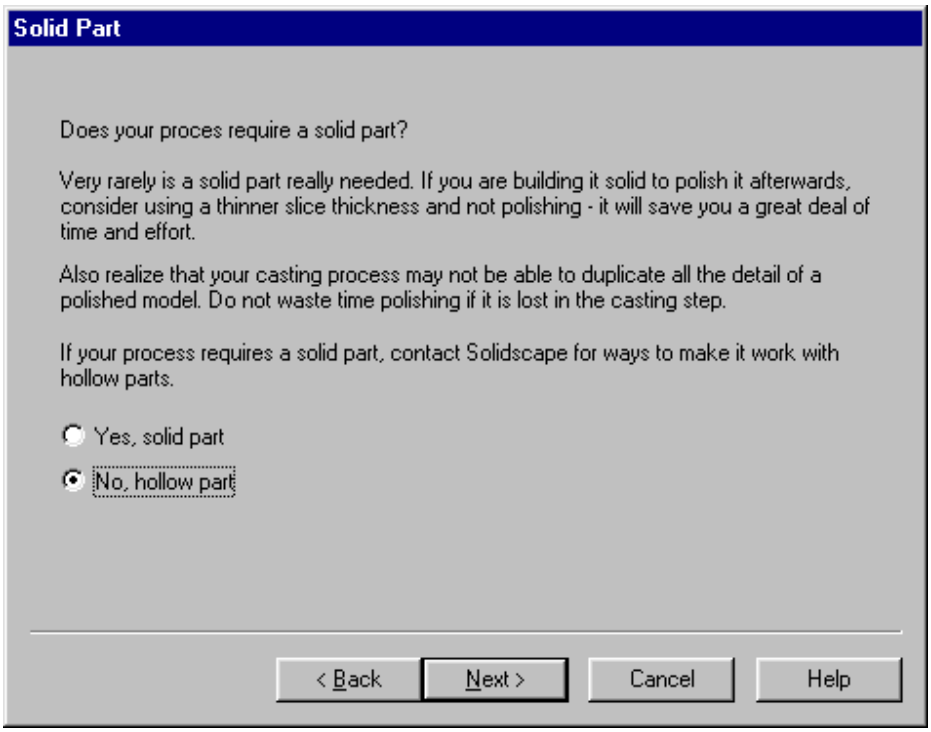

Figure 15: Wizard - Solid Part Page

Depending on the surface finish you selected, you may have the option of building a solid part, as shown in **Figure 15: Wizard - Solid Part Page**. Most Solidscape parts are built with a hollow grid in the interior. Solid parts take longer to build, but depending on the casting process you use with the final part, you may get better results with a solid part. Solid parts can also be easier to polish. If you are using slice ranges, the slice range is listed at the top of the page. This option applies to that slice range only.

Depending on the surface finish you selected, you may have the option of selecting a faster build as shown in **Figure 16: Wizard - Speed Page**. Although the build speed is reduced, the quality of the model may suffer. Do not choose the faster build speed if the surface finish is important. In addition, do not use the faster build speed if your part has any large overhangs (greater than one inch squared or four centimeters squared). The support deposited under the overhangs may not have enough time to cool, causing the cutter to become coated with support material.

If you are using slice ranges, the slice range is listed at the top of the page. This option applies to that slice range only.

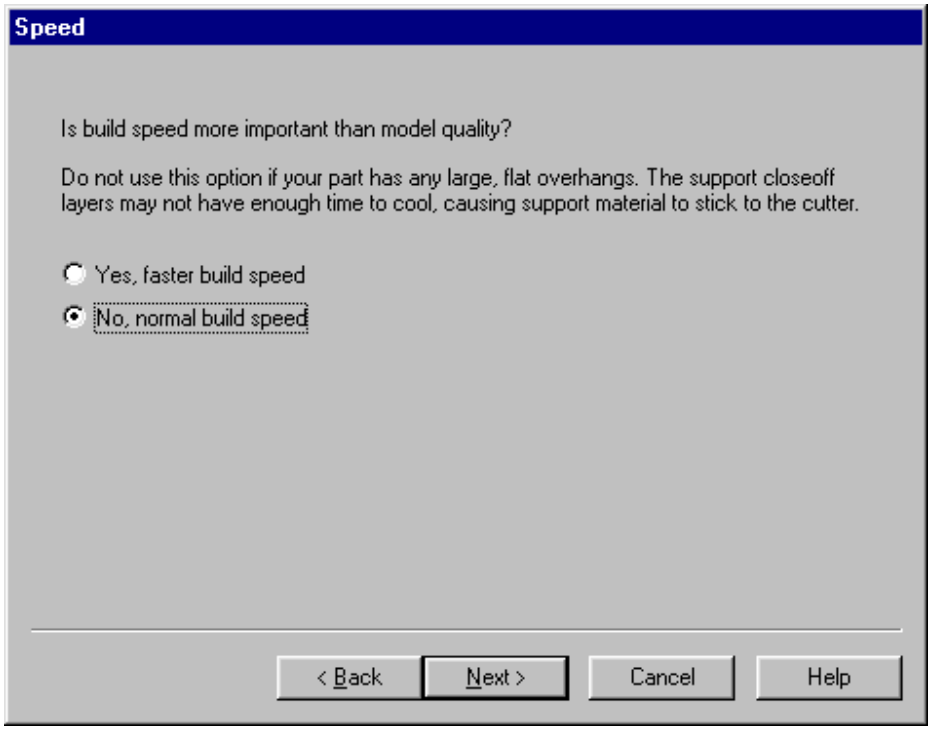

Figure 16: Wizard - Speed Page

Once you have chosen settings for each slice range, the following pages will guide you through further settings for the entire build. The Extra Support Cells page, shown in **Figure 17: Wizard - Extra Support Cells Page**, lets you specify

extra support to surround and brace thin, isolated features. This increases the build time, but may be needed for some delicate parts.

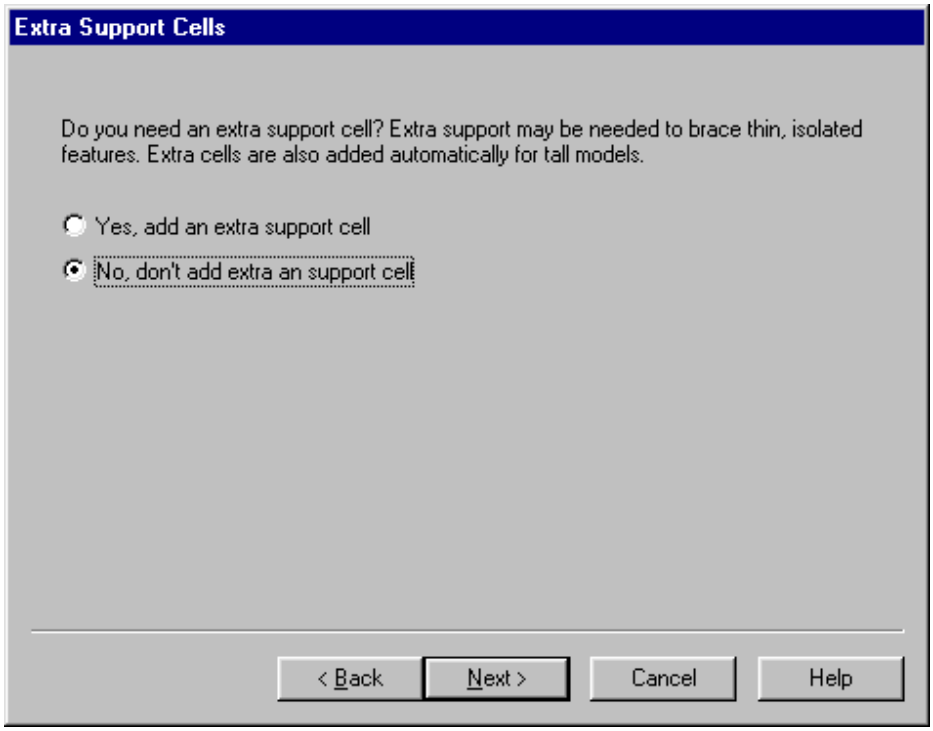

Figure 17: Wizard - Extra Support Cells Page

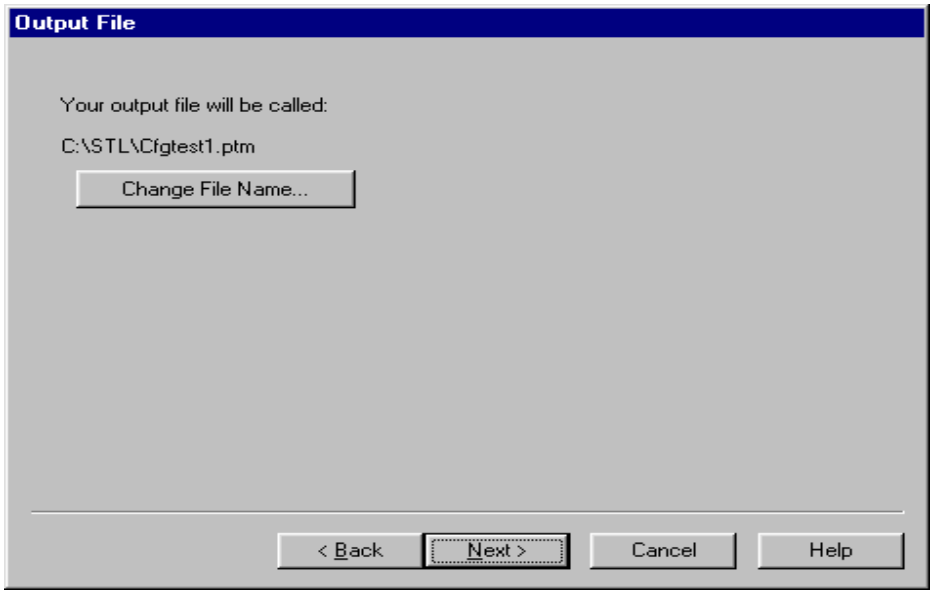

Figure 18: Wizard – Output File Page

The Output File page, shown in **Figure 18: Wizard – Output File Page**, displays the default file name for the build file. To change the file name or the location, press the Change File Name button and enter your selection. Click Next when you are done.

Figure 19: Wizard - Summary Page shows the final page in the 3ZWorks Wizard. A summary of the options you have chosen is displayed, along with the configuration that was selected for you. If you chose to use slice ranges, each range is listed. If you wish to change an option, hit the Back button. Use the Print button to print a copy of the page.

When you hit Finish, 3ZWorks will automatically start the slice and fill process. This can take several minutes to complete. When it is done, a Time Estimate is displayed, as described in Time Estimate on page 47. Use 3ZAnalyzer to display the build file before moving it to your machine to build.

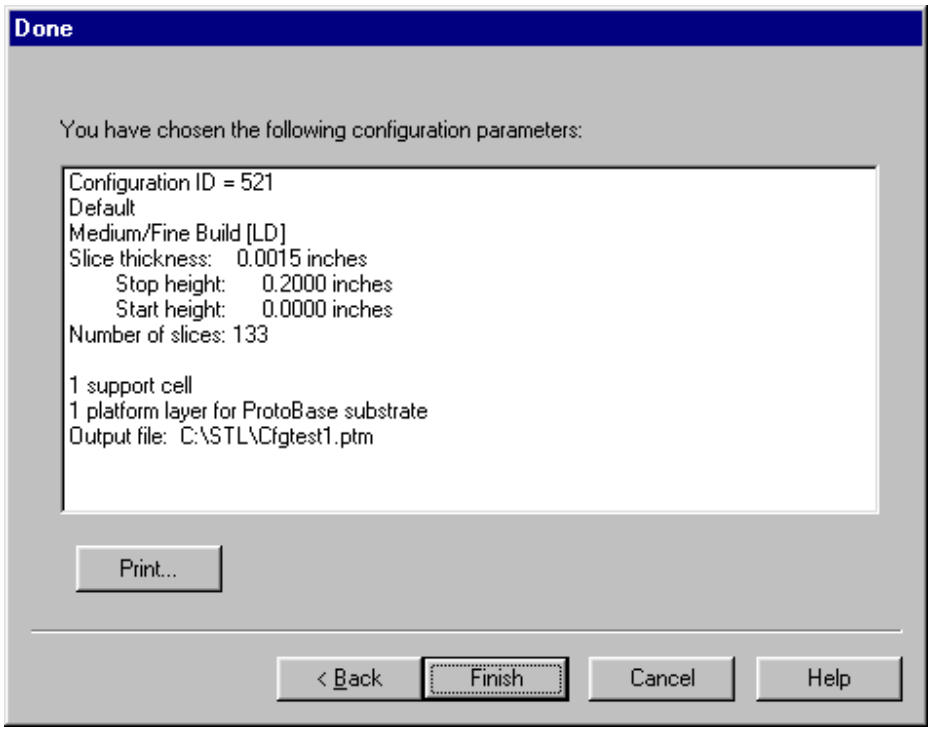

Figure 19: Wizard - Summary Page

Tools

The Tools commands are used to generate the binary files that are needed to build models on the machines and to display a build time estimate. The dialog boxes for these commands are accessed from the Tools menu, or by using the buttons located in the Main Toolbar.

Model Extents

Extents displays the Extents dialog box, which shows the maximum and minimum values in X, Y and Z for the selected model as it is positioned on the build plate, as well as the overall length in each direction and the number of facets or slices in the model. The same information is shown for all models currently loaded. The extents are useful for positioning models on the build plate. They can also help determine if the units have been set correctly. The Extents dialog box is shown in **Figure 20: Extents Dialog Box.**

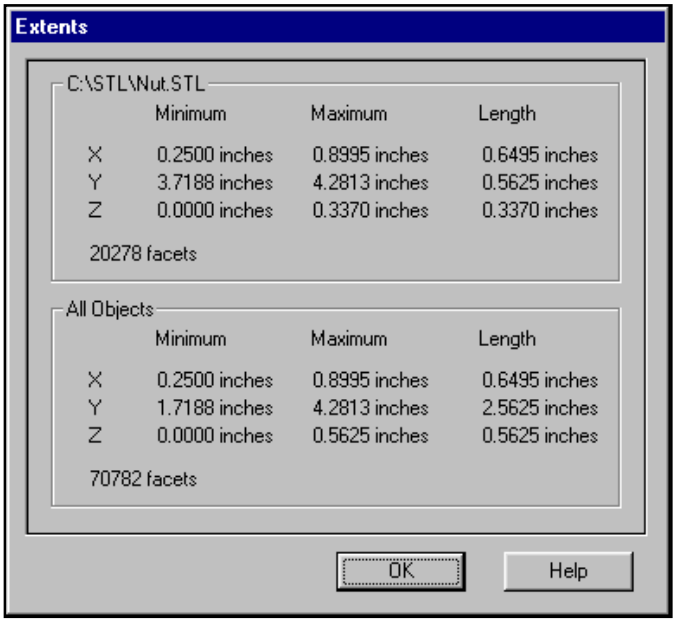

Figure 20: Extents Dialog Box

Slice Ranges

Slice Ranges displays the Slice Ranges dialog box. This command is used to specify multiple slice thicknesses for a model. Some models, such as tools, are made up of a detailed section that must be built with a small slice thickness and a section with very little detail which can be built with a larger slice thickness to save time. Slice ranges are used to specify these sections, and the configuration

and other options for building each section. Slice range data may be edited multiple times before the model is built. Slice Ranges can also be used to slice a portion of a model, by using a single range and adjusting the start and stop heights. The Set Slice Ranges dialog box is shown in **.**

Figure 21: Set Slice Ranges Dialog Box**.**

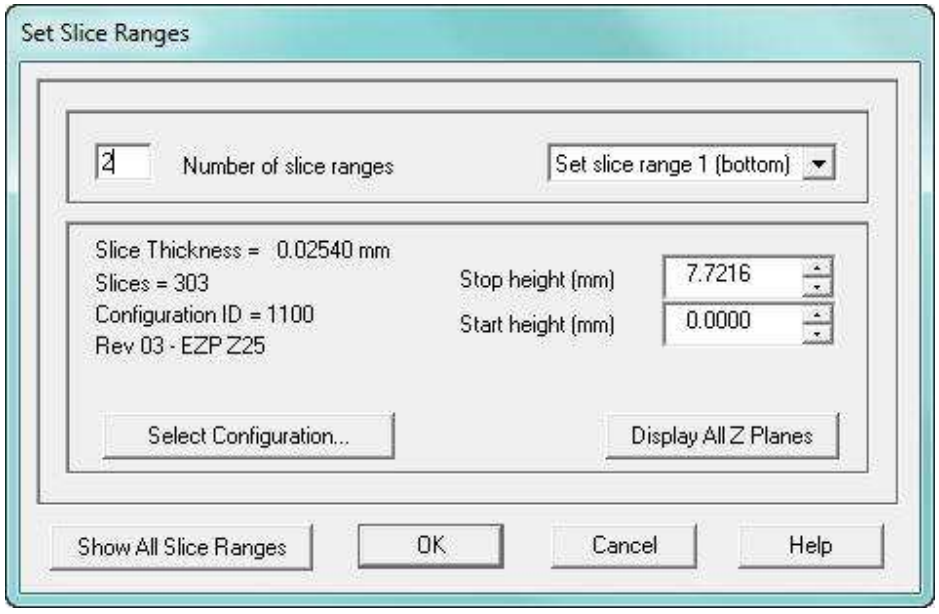

Figure 21: Set Slice Ranges Dialog Box

Set the number of slice ranges first, and then select which slice range to edit from the pull-down menu. Ranges are numbered in the order they will be built with range 1 at the bottom of the model. There is no limit on the number of slice ranges that can be specified; however, only two or three slice ranges are needed for most models. The lower part of the dialog box displays information on the current slice range, including the configuration and the start and stop Z values.

To specify the slice thickness and other configuration parameters for the current range, use the Select Configuration button to bring up the Configuration Notebook. The selected configuration parameters will be used for the current slice range. Note that the configuration options are set independently for each individual slice range. See Configuration Notebook on page 40 for more information on specifying configurations.

Set the start and stop Z values for the current range by either using the view to specify the location on the part, or by typing the values in the appropriate field.

The arrow buttons will increment or decrement the Z value by the slice thickness for the range. The start Z value is the start height where the first slice will be built. The stop Z value for a range is the height after the last slice is built. The start Z for the range above the current range will automatically be set equal to the stop Z of the current range. A range must contain an integral number of slices, and should not contain less than six slices in order for features in the Z-axis to be built accurately. The Z values are initialized to the model maximum and minimum Z values, and cannot be set above or below the model limits.

To use the view to set the Z values, move the dialog window to the side, if necessary, and click on the border of the Z plane. Then click again to drag the plane up or down. The view can be changed, for example to a side view or a wireframe display, to make it easier to see the part features. After changing the view, you may need to reset the cursor by hitting the Select Z Plane icon, as described in Selection Modes on page 25. If you have a complex part and the display refresh is too slow, set the Show bounding box during interactive edit option in the Options dialog to display the part bounding box while the plane is being dragged.

The Display Z Planes button will display all the start and stop Z planes for comparison with the model. These are best seen with the model in the Front or Right view, and using Wireframe display mode.

The Show All Slice Ranges button will display a summary of all the defined slice ranges, which may be printed for reference.

When you are finished defining all the ranges, hit OK to exit and save the settings, or Cancel to discard the changes. 3ZWorks will validate the ranges and will make adjustments automatically, if necessary.

Configuration Notebook

The Configuration Notebook is accessed through the Fill dialog or through the Slice Ranges dialog. The Configuration Notebook contains a database of settings that determine how a model is built. There are many different configurations for a wide variety of models. **Figure 22: Configuration Notebook** shows the Configuration Notebook dialog.

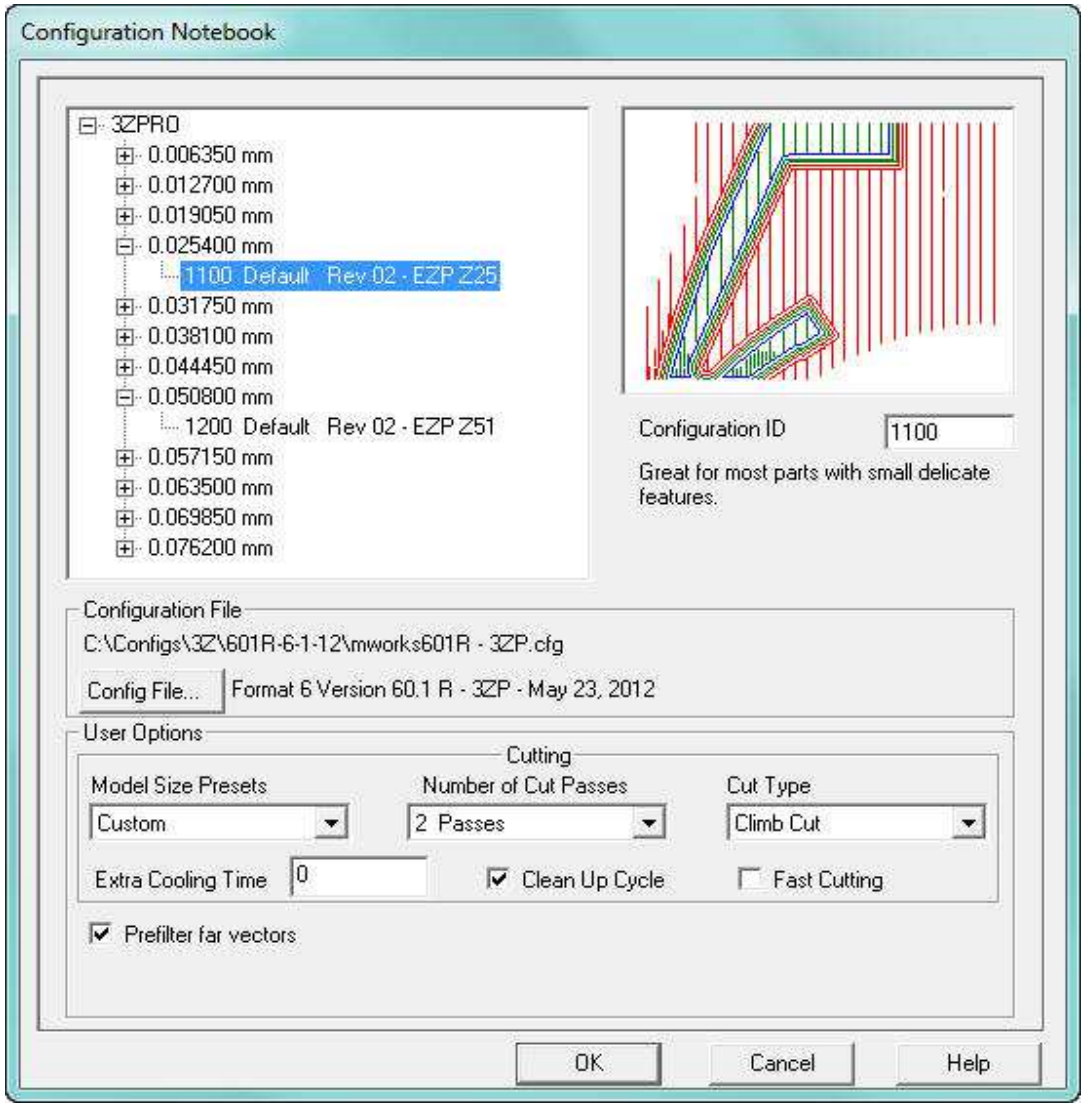

Figure 22: Configuration Notebook

Select a configuration by slice thickness, using the tree display on the left. Or select the configuration directly by typing the ID number in the space provided on the right. The configuration picture displays an example of how the build is generated using this configuration, to assist in the selection.

Configuration Options

Some parameters in the configuration can be adjusted for each build. These options are available once the configuration is selected in the Fill dialog box. The options are listed below.

Model Size Presets

This option is based on generic model size and used to provide a cutting profile that will yield best results (least amount of dust, best Z-Axis accuracy, minimal cutter gumming, etc.). Use the pull down menu to select a model size that matches what you are building.

Custom Cutting Options

If Custom is selected in the Model Size Preset menu, then you can directly specify the cutting profile. You may select the Number of Passes (i.e. the number of times the cutter will move over the model in between each layer), the Cut Type (whether it cuts moving from left to right, right to left, or both), the use of a Clean Up Cycle (an extra pass over the model without moving the z-axis table to help remove residual dust), and Fast Cutting (which doubles the attack speed of the cutter for use with small models). The default is 2 passes, Climb Cut, and Clean Up Cycle.

Extra Cooling Time

This option is available to users who run their machine in warm environments that promote cutter gumming. It increases the set up time between the last deposition of material and the start of a cut on each layer. In warm environments, the materials cool more slowly and may require additional set up time before they are hard enough to cut. If you are experiencing gumming (material stuck to the cutter blades), then increase cooling time in increments of 10 seconds until the gumming ceases.

Prefilter far vectors (Normally Checked)

Before computing intersections, 3ZWorks Prefilters Far Vectors to increase speed and remove features known to cause certain model defects. On rare occasions, very small convex sections are inadvertently filtered out. This results in a model defect known as bowties. In the model it appears as unexpected surface roughness. In 3ZAnalyzer, it is observed as perimeter lines crossing each other. It is preferred that such defects be prevented by moving or rotating the model slightly. If this does not prevent the problem, uncheck the Prefilter Far Vectors checkbox. Be aware that this may cause unfilled model sections and should be disabled sparingly.

Configuration File

Use this option to choose a configuration data file. The current configuration file name is displayed above the button, along with the version number of the file. If you have several machines of differing types, you may have to switch between configuration files to support each machine.

Filling Models

The Fill operation produces a binary file with the slice and vector information needed to build the model on a Solidscape machine. When clicking this button, the Fill Options dialog box displays as shown in **Figure 23: Fill Options Dialog Box.** This dialog box is used to specify the current configuration and slice thickness, and support perimeter options, support fill options, platform options and build options. The options in the Fill dialog box are explained below.

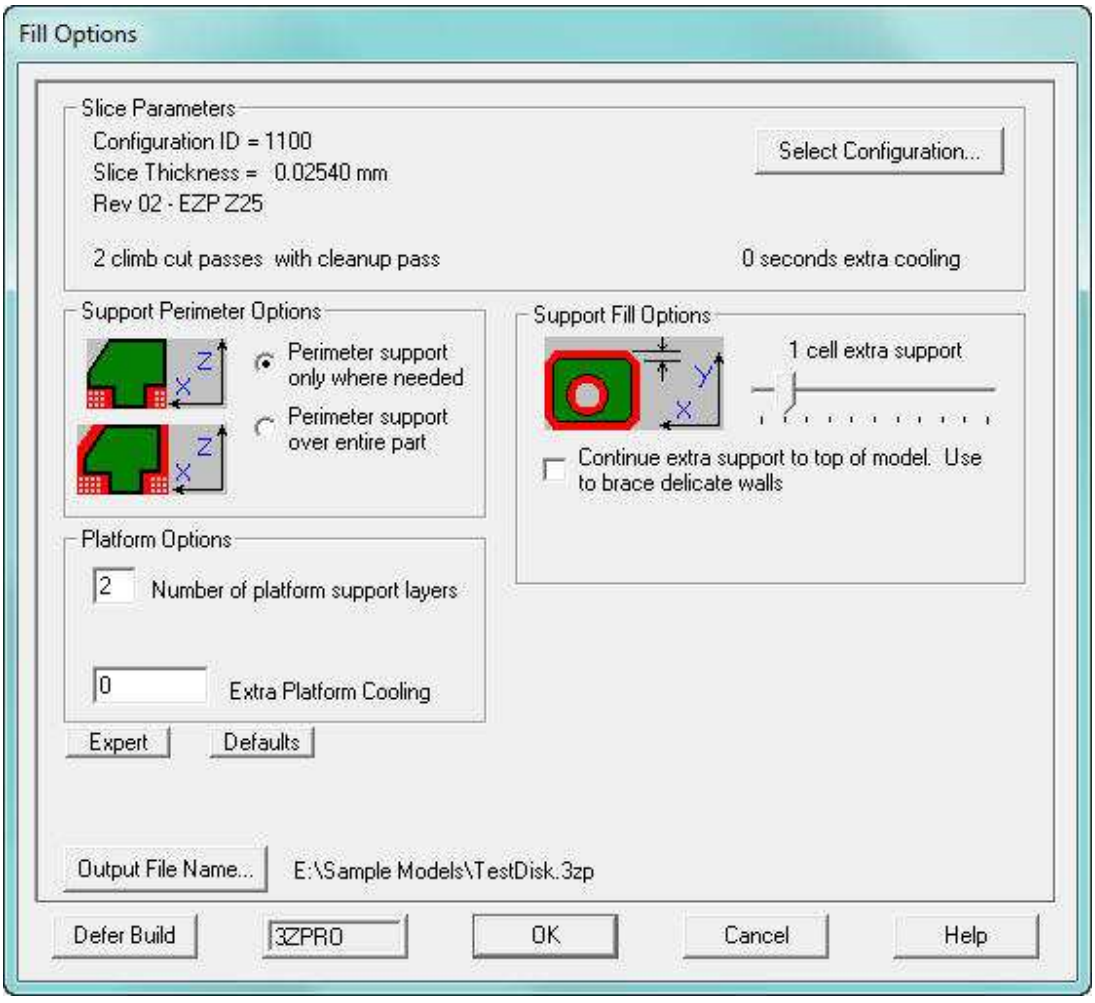

Figure 23: Fill Options Dialog Box

Support Perimeter Options

The Support Perimeter Options control the perimeter lines for the support areas.

- Perimeter support only where needed specifies that support perimeters will be drawn around the model only where necessary, that is, only on layers that have support fill.
- Perimeter support over entire part is the default option. Support perimeters are drawn around the part on every layer. Adding perimeter support walls around the entire model can produce a better surface finish, by protecting the build material from the cutter.

Support Fill Options

The Support Fill Options allow selecting three parameters for the support fill.

- The Excess support slider bar adds excess support around the model, specified in number of support cells. The default setting adds one additional cell of support material around the outer edges of the support areas. If support is generated only where needed, the support edges tend to sag and chip off while being built so that insufficient support is left. Solidscape recommends one extra support cell for this reason. For tall or thin models, the one extra cell may also chip off as the model is built so they may require two or even three extra cells of support. Add one extra cell of support for each three to four inches in the Z direction.
- Continue excess support to top of model is used to brace delicate features and tall, thin models. The excess support is added to every layer to protect the model. This is the default. Extra support cells can also help to brace the part.
- Eliminate All Support. Use this option only when no overhangs exist on the model. This option does not affect the platform support. If the Number of platform support layers is also set to zero, no support calculations are performed.

Platform Options

- Number of platform support layers sets the number of platform layers to build under the model.
- For ProtoBase foam substrate, the default is to build one platform layer. For parts with large flat bottoms, using zero platform layers (building the part directly on the ProtoBase foam substrate) can help prevent part curl or warping, but will produce a rougher surface finish on the bottom of the part. Using multiple platform layers can make it easier to remove the part from the foam after it is built, in order to reuse the foam substrate. Two platform layers are recommend for use with InduraBase.
- Mill off platform layer is another choice to help prevent parts from warping when using the 3Z reusable foam. One platform layer is deposited, which is then milled off, leaving a small amount of wax in the

foam substrate. This produces a good bond between the model and the foam substrate, but leaves enough support material in the foam to enable the part to be removed. This option will also produce a rougher surface finish on the bottom of the part.

Output File Name Option

The output file name can be changed from the default setting with the Output File Name button in the lower left corner. By default, the file is given the same name as the model, but with the appropriate machine type extension. The current file name is displayed to the right of the button.

OK Button

Select the OK button when finished with all the preceding settings to start the slicing and filling process. Selecting Cancel returns to the 3ZWorks screen and does not perform slicing and filling.

If a facet file is loaded, it is sliced before creating the build file. These slices can be saved after completing the slicing and filling operation, using the Save As function as described in Saving Model Files on page 20. If a slice file is loaded, the slice step is omitted.

While the model is slicing and filling, status information is displayed in the Status Bar along the bottom of the screen. Press the ESC key at any time to stop the process. When 3ZWorks is finished generating the build file, the time estimate will be displayed automatically.

Expert Button

The Expert button reveals four checkboxes. These are specially designed to eliminate certain, rare occurring problems within a model file.

Suppress Bowties

This is a more aggressive filter for reducing ‘bowties’ in models. It deletes vectors that are very close but do not numerically intersect. Depending on part geometry, it is more likely to delete valid geometry and therefore is more likely to adversely affect the model quality. It is recommended that Prefilter far vectors be tried first.

Reduced Colinear Filtering

This function disables some of the filtering that joins small, non-printable vectors into longer printable vectors. It results in slower models with more accurate curves. See **Figure 24: Expert Mode.**

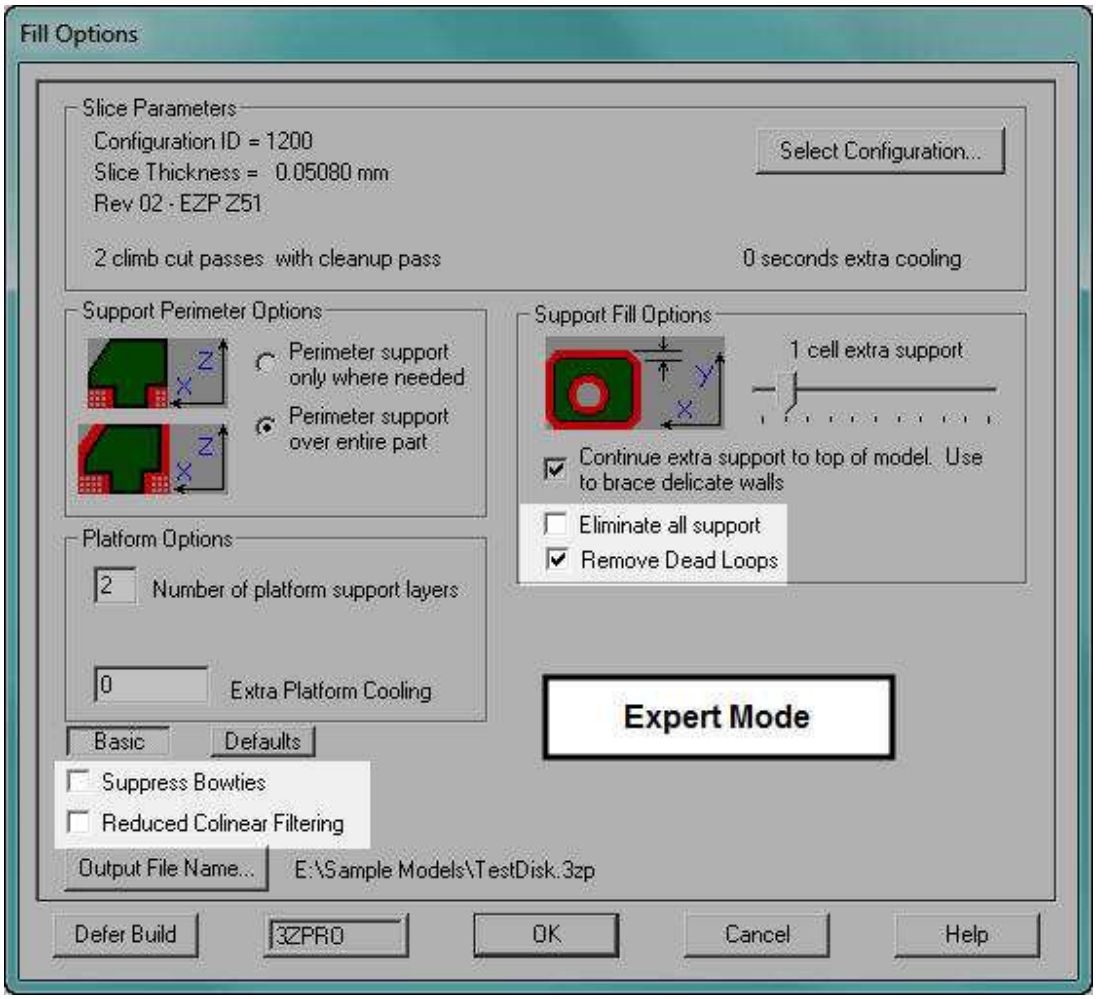

Figure 24: Expert Mode

Eliminate all support

This function will cause on build vectors to be generated. No support structure will be generated.

Remove Dead Loops

Dilation and contraction algorithms can generate inverted loops that need to be removed. STL defects increase the likelihood that an undesirable loop remains. This switch enhances that algorithm that removes dead loops, but on highly faceted models, it may result in dropped support.

Time Estimate

- Time Estimate calculates the build time of a model based on a machine type specific binary file. The estimate is computed using the number of build and support vectors in the file, their lengths and the velocity at which they are drawn. The Build Time Estimate displays automatically after filling a model, or at any time by using the Time Estimate command and selecting a binary file. If slice ranges were used, the Show All Slice Ranges button will display all the slice ranges used in the file, including configurations and Z height ranges. The estimate can be printed using the Print button at the bottom of the screen. The estimate also contains the amount of material needed to produce the model. See **Figure 25: Build Time Estimate dialog box.**

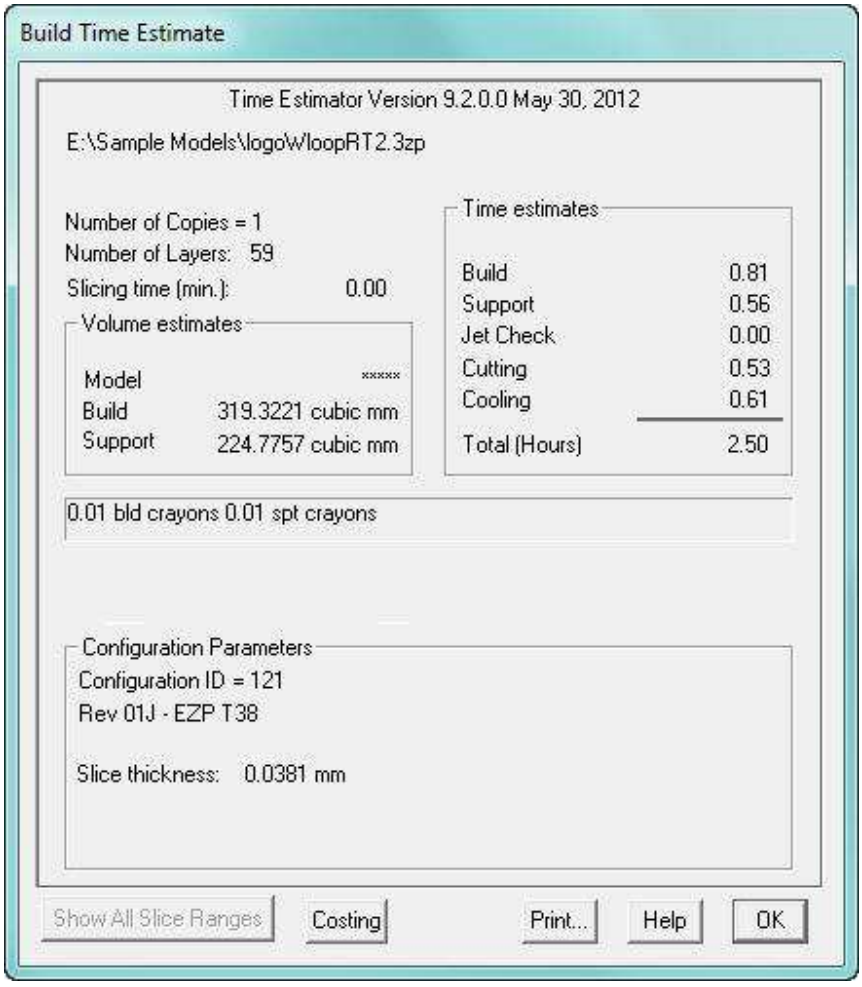

Figure 25: Build Time Estimate dialog box.

Using the Printer Driver

Overview

3Z The Printer driver is a graphical interface similar to other windows based desktop printer drivers. It provides the user with a quick means to locate a printer or other output device, set the printing parameters and then generate a print job for the 3Z printer. The printer driver works within 3ZWorks. See **Figure 26: Printer Driver.**

The printer driver allows the user to:

- Define and select the destination for the processed file.
- Determine the status of the printer (Network only).
- Select the properties for the print job.
- Send the processed file to the printer or other destination.
- Process the file to a deferred location for later use.

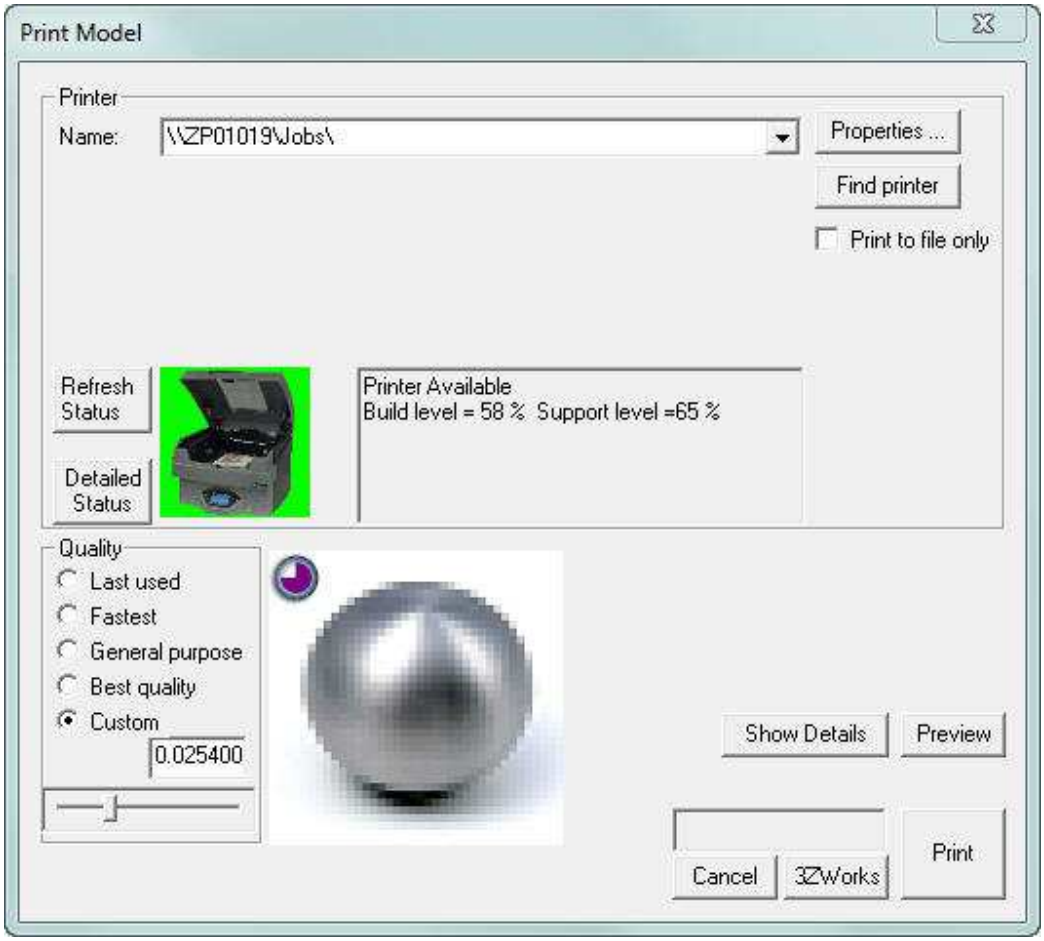

Figure 26: Printer Driver

File Destination

The upper half of the dialog box is used to define and check the status of the 3Z printer(s) or other destinations such as a Flash Drive. It also controls the properties of the defined printer.

Define a printer as a destination

There a 3 methods to define a printer as the destination of a model file. The printer **must be on a local area network** in order to be located and defined. The first method is to allow the software to automatically locate (AutoSearch) the network address for you. The second is to (Browse) your network to locate the printer. The third method is to (Manually) enter the network name of the printer. See **Figure 27: Find Printer.**

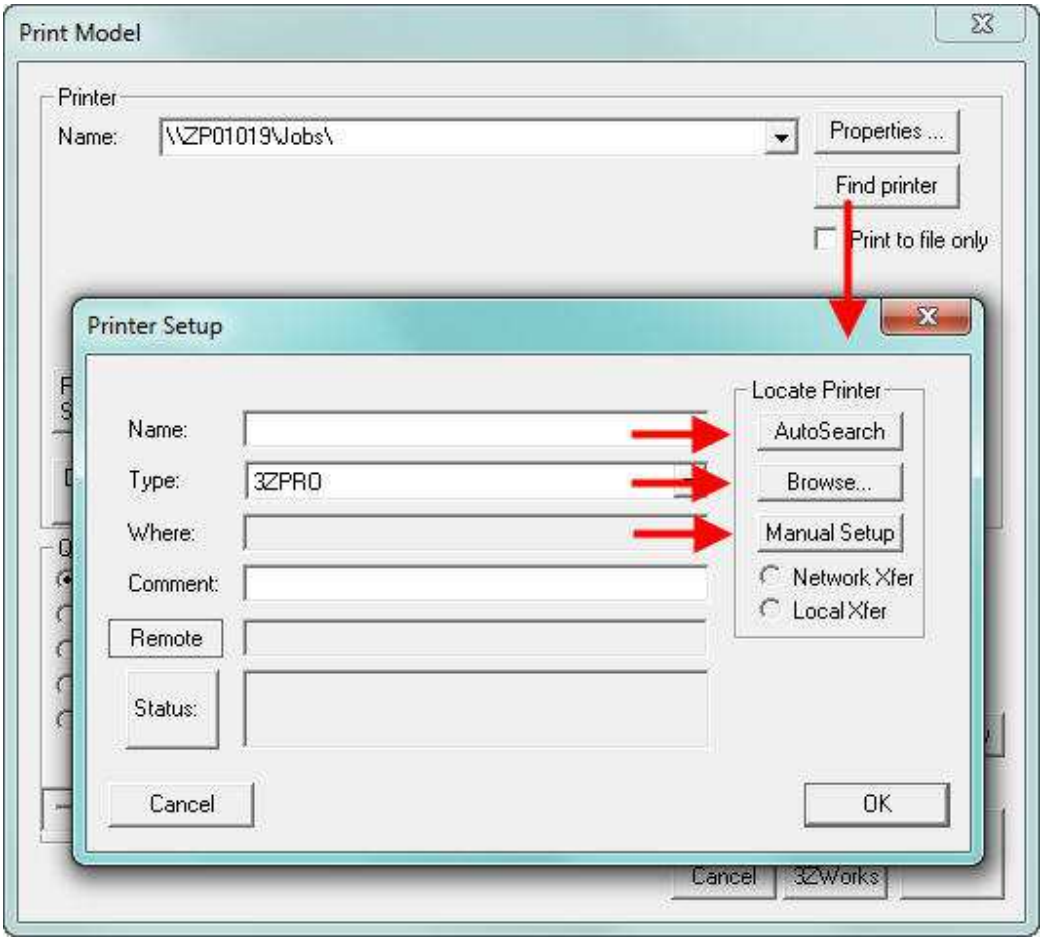

Figure 27: Find Printer

AutoSearch

To automatically search for a printer, click on the Find printer and then the AutoSearch button. See **Figure 28: AutoSearch Window.**

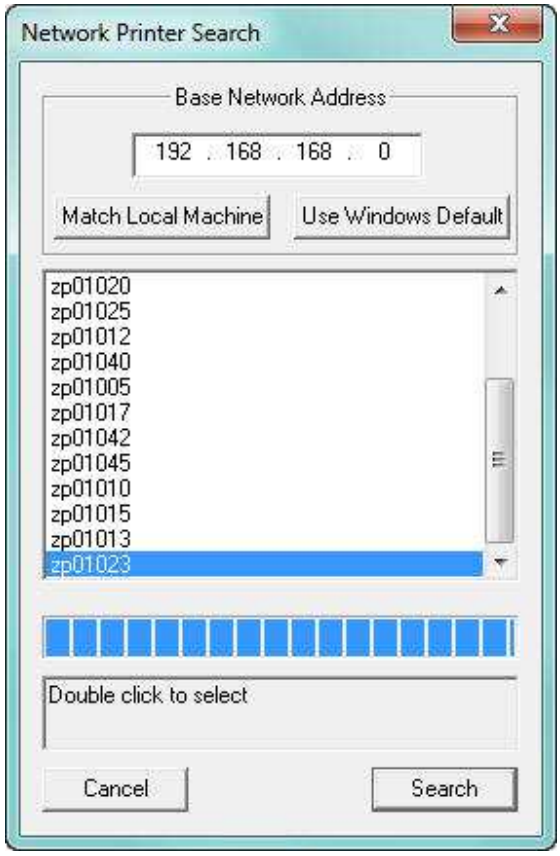

Figure 28: AutoSearch Window

The base IP address of your local area network must be defined in order for the search to be successful. If you are not sure of your local area network address, click on the **Match Local Machine** button or contact your system administrator.

Once the base address is established, click on the Search button and the program will automatically search the network for all the 3Zprinters that are powered on and active on the network. All responding printers will be listed with the network name and serial number. To select a listed printer, simply double click on the serial number desired.

Browse

To browse the network, click on the **Browse** button. Locate the desired printer on the network and double click on the serial number to access it. Finally, select the jobs folder and click open. See **Figure 29: Browse for printer.**

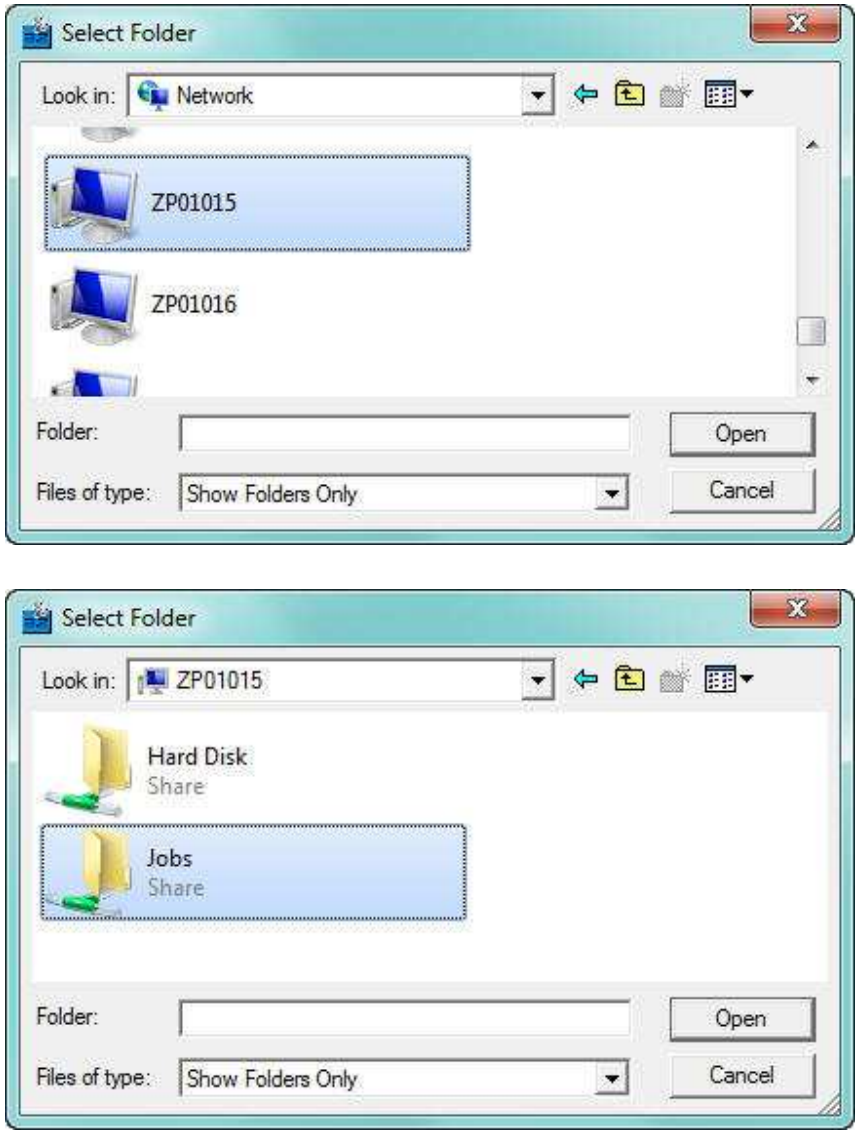

Figure 29: Browse for printer

Manual Setup

To manually select the printer, click on the Manual Setup button. Set the Type to 3ZPRO and manually type in the network name of the printer.

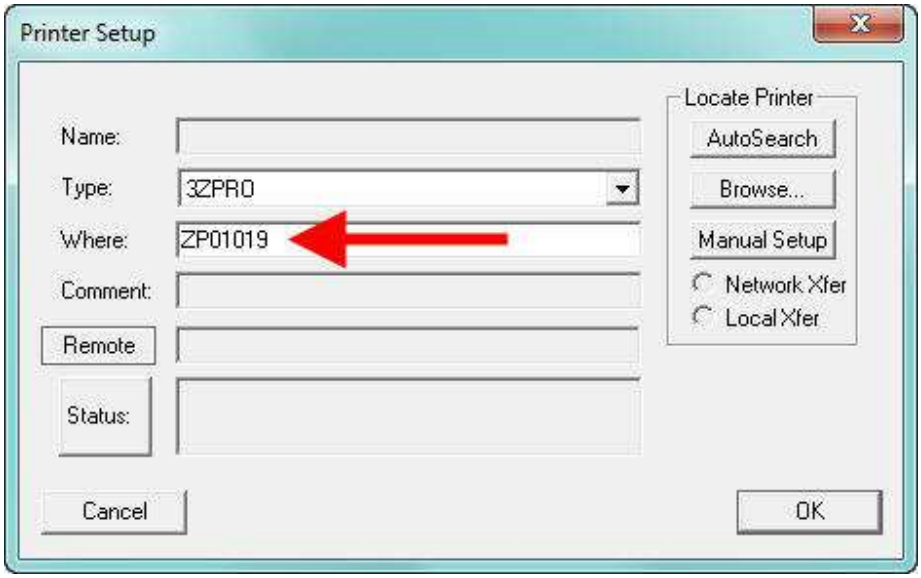

Figure 30: Manual Setup

Define a Flash Drive as a destination

Install the flash drive in the host pc and insure that is defined and accessible with a drive letter. (E:) for example. Select the **Browse** button. Navigate the PC to locate the Flash drive and then click **Open.** You may also enter a name for you Flash drive in the comment section. See **Figure 30: Manual Setup** , **Figure 31: Locate Flash Drive** and **Figure 32: Flash Drive Named.**

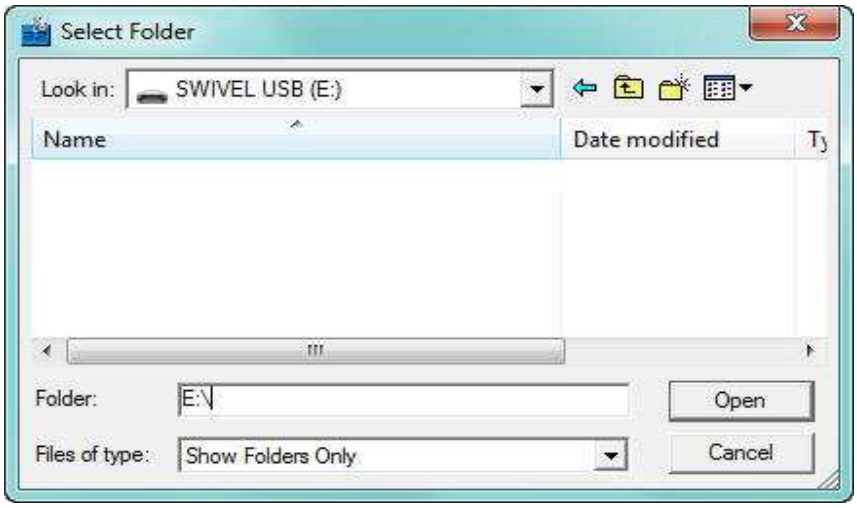

Figure 31: Locate Flash Drive

Figure 32: Flash Drive Named

Print to file only

If this box is checked, the file will be processed and sent to the location of the original STL file. It will not be sent to any other location. This can be used if the printer is busy. See **Figure 33: Print to file only.**

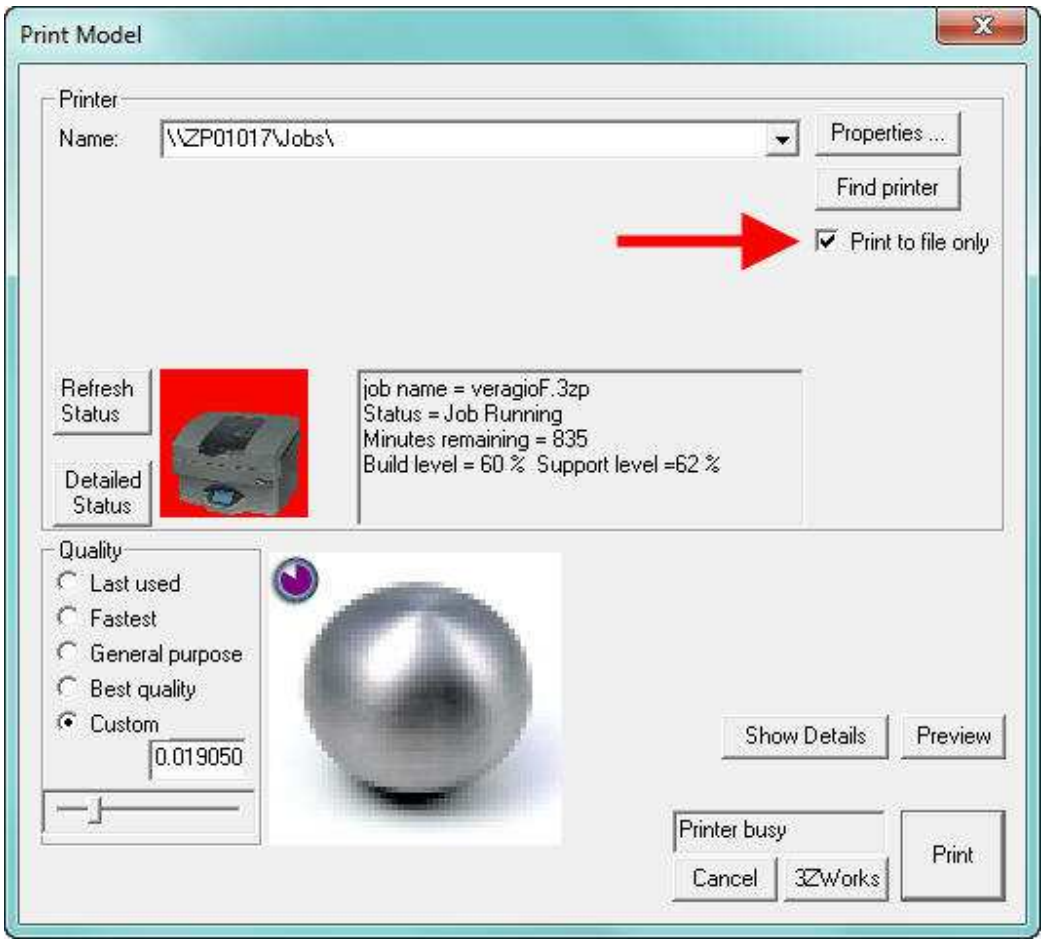

Figure 33: Print to file only

Properties

Clicking on the **Properties** button will allow the user to select specific instructions to be used during file processing. There are four tabs within the properties dialog box. See **Figure 34: Properties dialog box.**

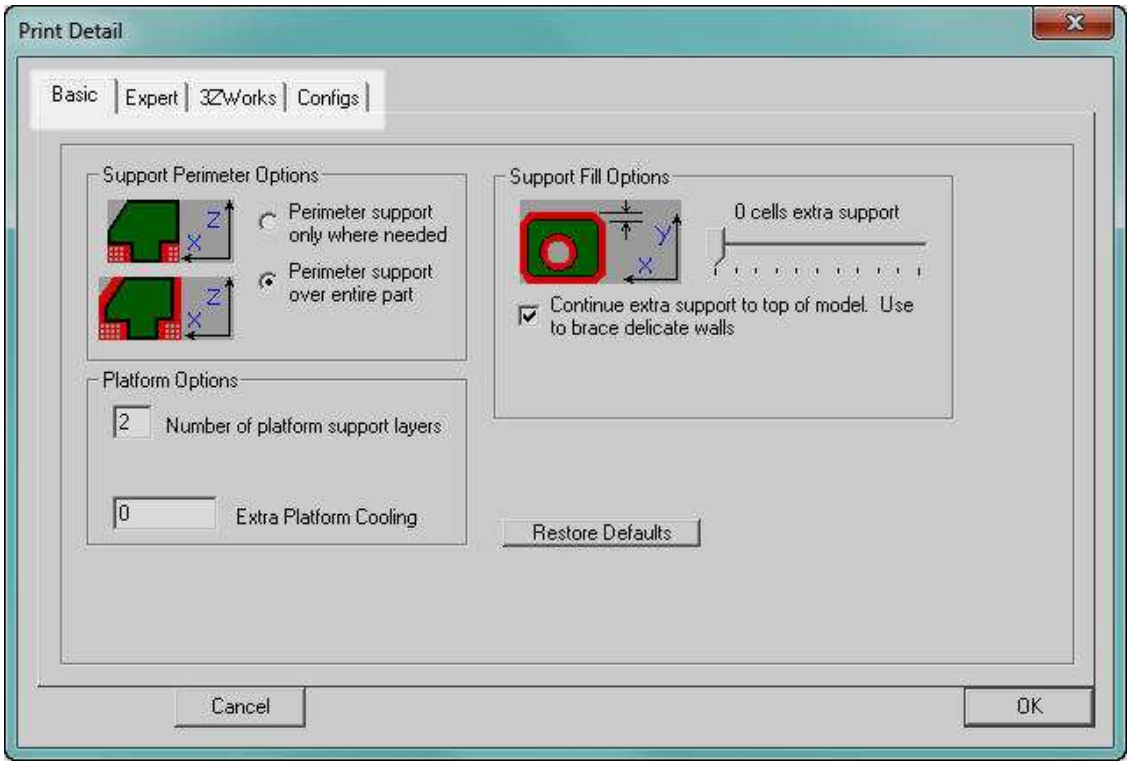

Figure 34: Properties dialog box

Basic - Refer to page 43 for details.

Expert - Refer to pages 41 through 46.

3ZWorks - Refer to page 23 for details.

Configs - Refer to page 40 for details.

Printer Status

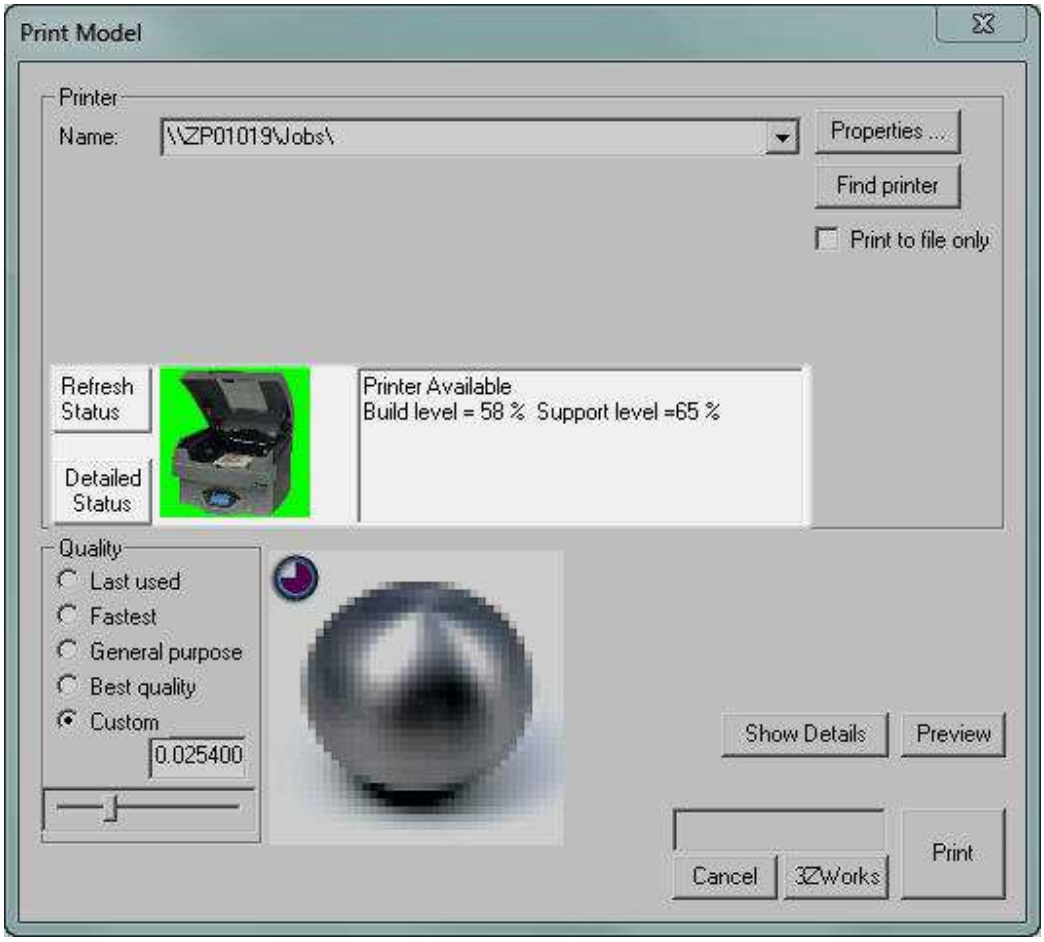

Figure 35: Printer Status

The status of the current printer or other destination is shown to the right of the image. Clicking on the **Refresh** button will send a request to the device for current settings. Clicking **Detailed Status** will display a more detailed status of the printer including printhead information. See **Figure 35: Printer Status** and **Figure 36: Detailed Status.**

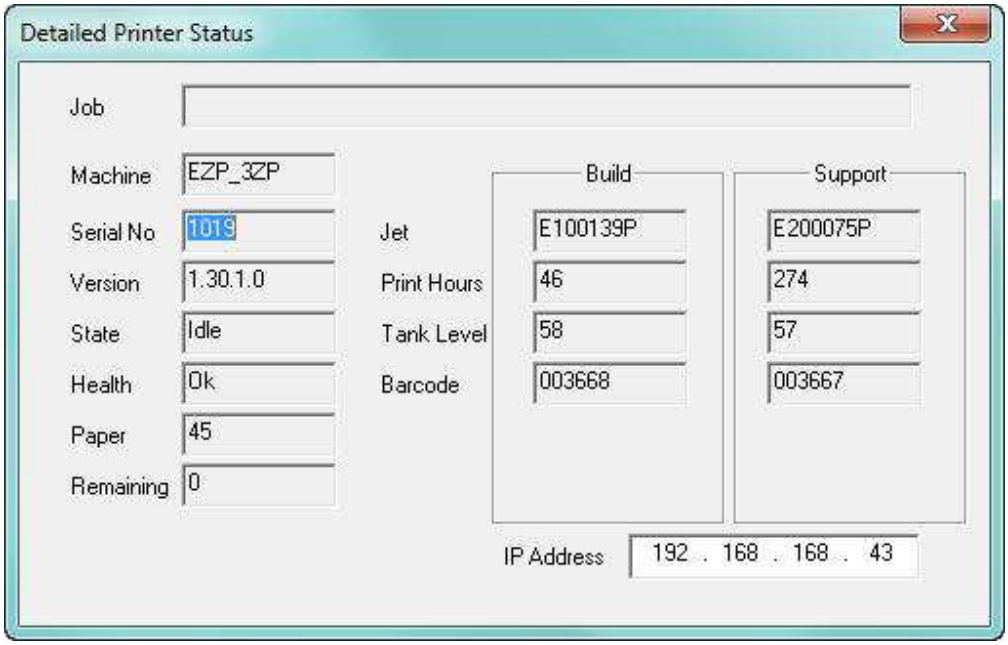

Figure 36: Detailed Status

Printing a Model

The lower portion of the printer interface is used for setting the print resolution, accessing 3ZWorks, and for executing the print job.

Quality

The Quality section of the printer driver is used to set the Z axis resolution for the print job. See **Figure 37: Quality selection** and **Figure 38: Radio buttons and Dynamic slider.**

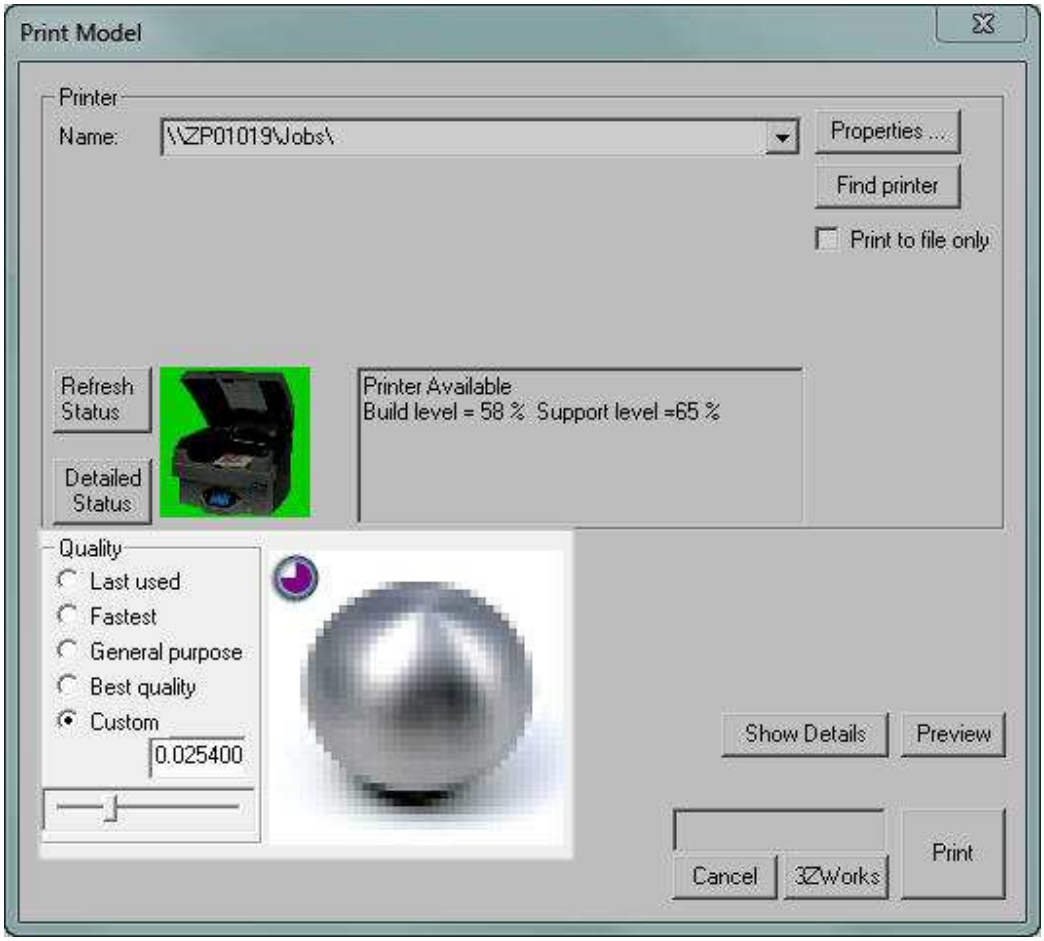

Figure 37: Quality selection

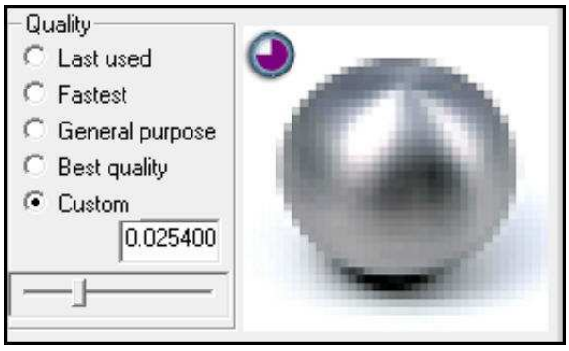

Figure 38: Radio buttons and Dynamic slider

The user has a choice of Z resolutions from 0.00635 mm to 0.0762mm in .00635mm increments. The resolutions can be selected via preset radio buttons or a dynamic slider. The radio buttons are set as follows:

- **Last Used -** The resolution will be set to the same resolution used when the last file was processed.
- **Fastest** - The resolution will be set to 0.0762mm, the coarsest available.
- **General purpose** - The resolution will be set to 0.04450 mm, a medium setting.
- **Best quality** – The resolution will be set to 0.00635 mm, the finest available.
- **Custom** – This indicates a resolution was selected with the dynamic slider.

The dynamic slider allows an incremental resolution selection from left to right with the far left being the finest and the far right being the coarsest.

The currently selected resolution is displayed above the slider. Refer to

Figure 3: Model Stair stepping for more information on configurations.

The sphere and clock visually indicate the selected resolution and relative time to print a model. See

Figure 39: Visual Resolution and Time indicator**.**

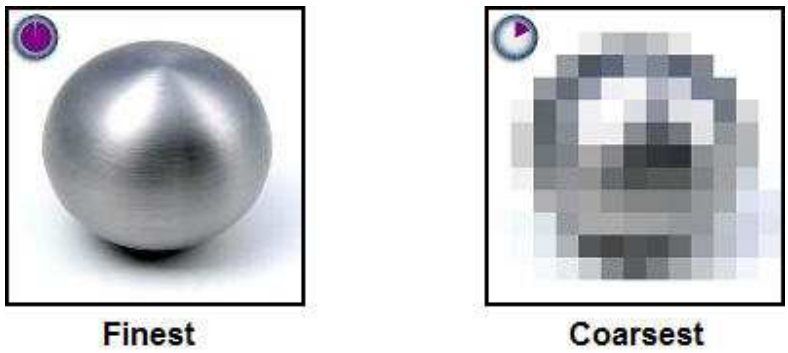

Figure 39: Visual Resolution and Time indicator

The image on the left indicates the finest resolution and the clock indicates the maximum time to print. The image on the right indicates the coarsest resolution and the minimum time to print.

Interacting with 3ZWorks

There are 2 methods of switching between the printer driver and 3ZWorks. See **Figure 40: Interacting with 3ZWorks.** The preview button will alternately show and hide the 3ZWorks build plate layout and will keep the printer driver dialog box active. The 3ZWorks button will close the printer driver dialog box and open the 3ZWorks window for full control. The printer driver must them be reopened by clicking the printer driver icon  from 3ZWorks .

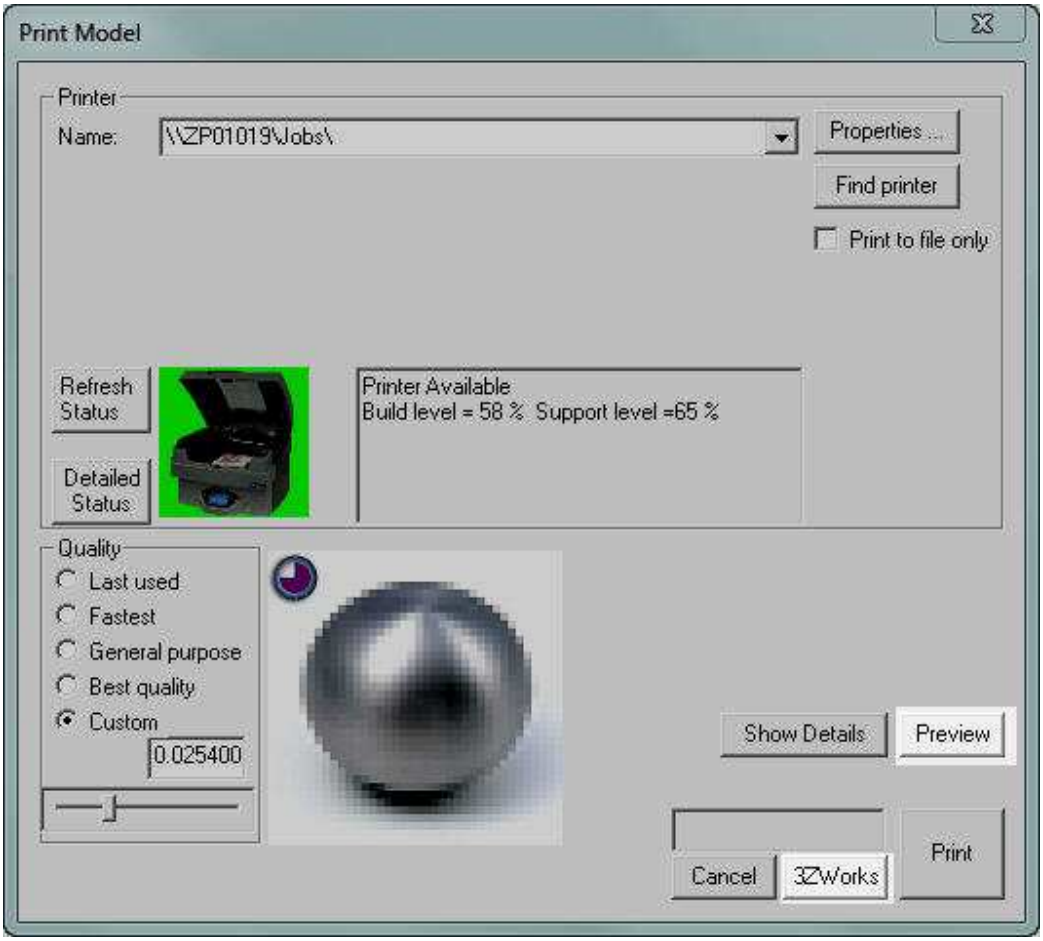

Figure 40: Interacting with 3ZWorks

Show Details

This button will toggle to alternately Show and hide more detailed information regarding the selected printer and the processing display. See

Figure 41: Printer Driver Details**.**

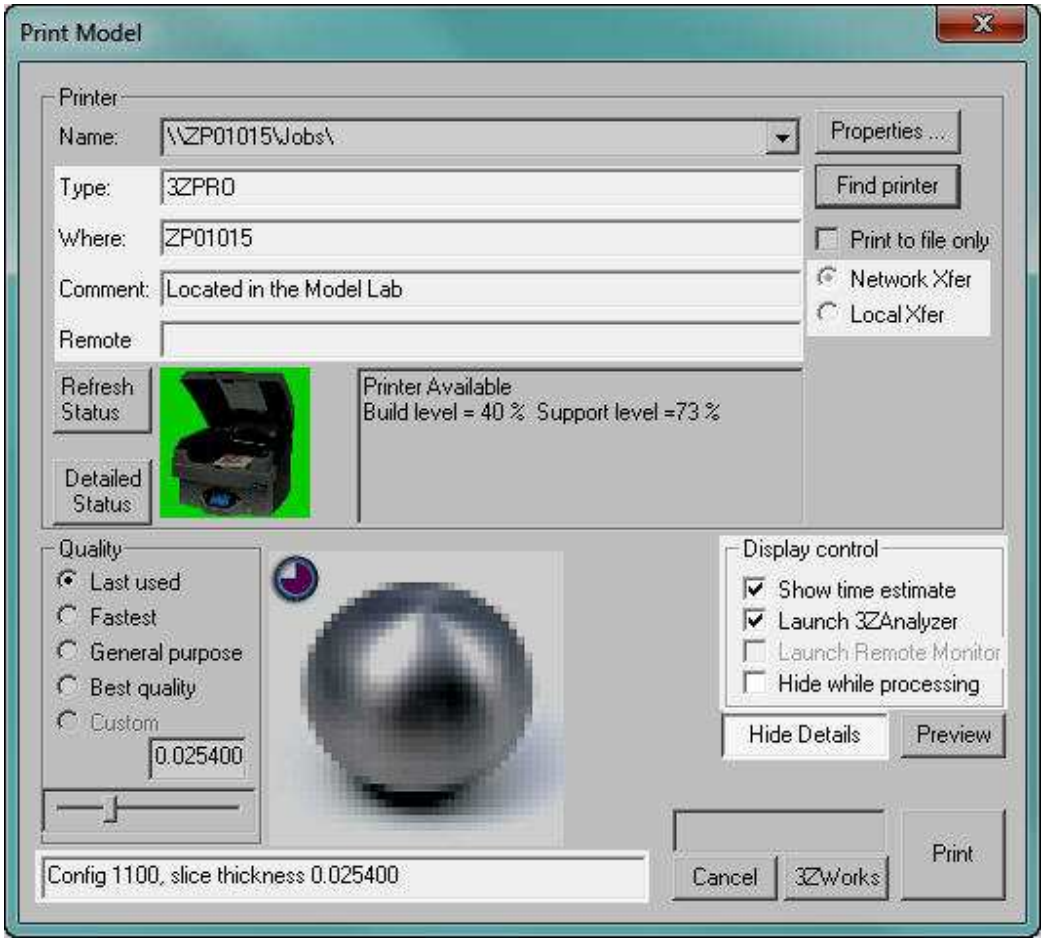

Figure 41: Printer Driver Details

The details shown include:

- The Type of printer selected.
- Where the printer is located (Device Name).
- Any Comments entered when the device was initially located and defined.
- The status of the **Remote** information.
- The type of data transfer (Xfer) selected for this device.
- The Display control allows the selection and display of the time estimator, whether to launch 3ZAnalyzer after processing the file, launching the remote monitor and whether to hide all windows when processing a file.
- Detailed **configuration information** is displayed below the Quality selection.

Click on the Hide Details button to hide the details.

Printing the File

To complete the printing process, click on the **Print** button. The file will be processed. Depending on the display control settings, the file will be sent either to 3ZAnalyzer or directly to the destination previously specified.

If the printer is currently busy, the print button will indicate **Deferred Transfer.** The file will be sent to an individual folder assigned to that printer serial number. If 3ZOrganizer is active, the file will automatically be sent to the printer when the current job completes. See **Figure 42: Printing the file.**

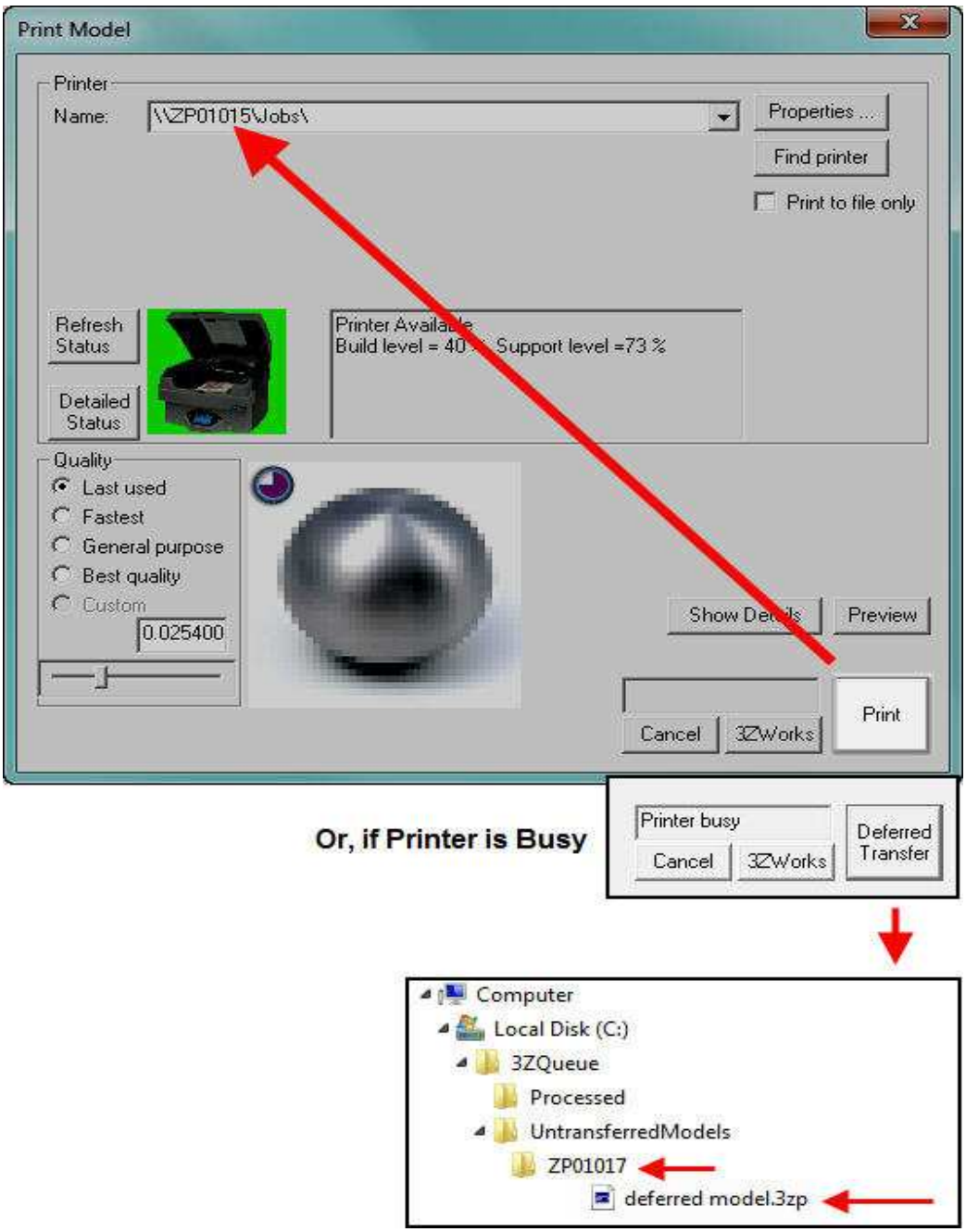

Figure 42: Printing the file

Using 3ZAnalyzer

Overview

3ZAnalyzer is a slice viewer designed to view the files generated with 3ZWorks. The viewer displays slice cross sections with the fill patterns. Exact vectors are drawn that trace the jet path over the build platform for each slice. Support material is shown in red and the build material is shown in green and blue.

Measurements can be extracted from this file using the digital readout in the Status Bar at the bottom of the screen. The units of measurement are in thousandths of an inch (mils) or in millimeters. When taking measurements from the screen, be aware that the material laid down along the path of the jet has a finite thickness that is not shown on the screen. The slice number and the Z height of the start of the current slice are also displayed in the Status Bar, in inches or millimeters.

Figure 43: 3ZAnalyzer Screen Layout shows the general layout of the screen with a portion of a slice from the `TestDisk.stl` model.

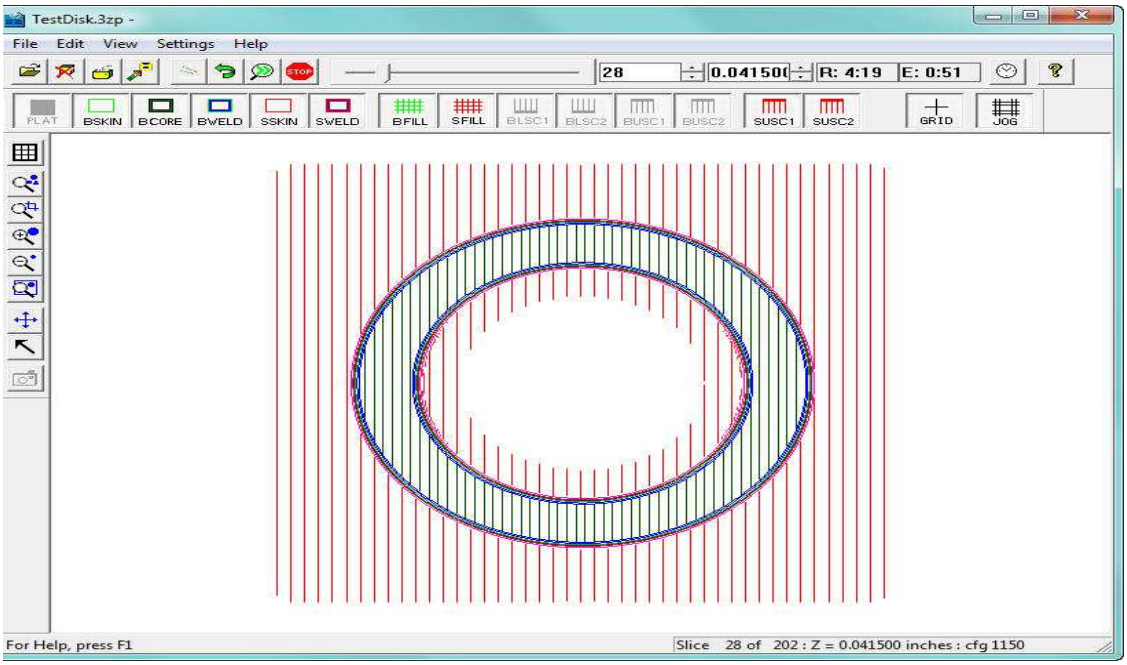

Figure 43: 3ZAnalyzer Screen Layout

The View and Linetype toolbars are dockable and can be moved to other sides of the 3ZAnalyzer window, or optionally not displayed. To toggle the display of the toolbars or the Status Bar, use the options in the View menu.

3ZAnalyzer Buttons and Commands

This section explains the 3ZAnalyzer commands. These commands can be accessed through the pull-down menus or by using the buttons on the 3ZAnalyzer screen as shown in **Figure 43: 3ZAnalyzer Screen Layout.**

Loading Files

Open opens a browse window to select a particular Solidscape binary file. The file type corresponds to the machine type for which it was generated. The file is loaded into 3ZAnalyzer for viewing. Files can also be loaded by selecting the name of a recently opened file from the File menu, by dragging and dropping a file into the 3ZAnalyzer application window, or by double-clicking on a Solidscape binary file.

Delete deletes the current file from 3ZAnalyzer. It is not necessary to delete a file before loading another, unless you wish to reload the same binary file.

Slice Playback

The Slice Playback feature dynamically displays all the slices in a file, one after the other. This gives a preview of how the part will be built and can be used to quickly check for bad slices.

Play plays the slices dynamically on the screen starting at the current slice.

Stop halts the dynamic slice display. The ESC key can also be used to stop the slice display.

To adjust the playback speed, select Options in the Settings menu. See .

Options on page 70 for more information.

If the cursor is hard to see during slice playback, you may need to turn off pointer trails. This option is located in the Windows Control Panel, under Mouse, Motion options.

Slice Navigation

Individual slices can be displayed using the slice navigation fields, located in the Main Toolbar.

Use the Slice Location slider to move anywhere in the file. Moving the slider all the way to the left will display the first slice, and moving it all the way to the right will display the last slice. Clicking the cursor on the slider to the right or left of the position pointer will move up or down 10% in the file. You can also use the Page Up and Page Down keyboard buttons to move up and down the file.

To display a particular slice, enter the slice number in the Slice Number field. Or, enter a Z value in the Slice Z height box to display the slice closest to that Z height. The Z height includes the height of any platform layers. Use the arrow buttons to the right of either field to move up or down a slice. You can also use the up and down arrow buttons on the keyboard to move up and down, one slice at a time.

Time Estimate

Time Estimate displays the time estimate for the current build file. See Time Estimate on page 47 for more information on build time estimates.

Help

Help Topics displays the 3ZAnalyzer on-line help. Help can also be displayed by selecting Help Topics from the Help menu, or by hitting the F1 key.

To display version and copyright information for 3ZAnalyzer, select About 3ZAnalyzer from the Help menu.

Grid Lines

The Grid Lines button is used to toggle the display of platform grid lines, drawn in black. These lines can help determine the size of foam substrate required, and where to position it on the build plate. Grid lines are drawn at one inch or one centimeter intervals.

Zoom Buttons

The zoom buttons adjust the portion of the slice visible on the screen, by changing the magnification. To view the entire build platform, use Zoom Platform. Use Zoom Extents to view the portion of the build platform containing the model vectors.

 Zoom Extents zooms to fit all the build and support vectors for the current slice onto the screen. The F9 key can also be used for zoom extents.

 Zoom Window zooms in on a specific area of a slice. Click the left mouse key and drag the cursor across two diagonal points on the drawing area of the screen. Release the mouse key after reaching the second diagonal point. The screen refreshes with an enlargement of the area selected in the center of the screen.

 Zoom In increases the magnification toward the center of the screen by 25 percent.

 Zoom Out decreases the magnification of the part by 25 percent.

 Zoom Platform adjusts the view so that the machine platform fills the screen. The F10 key can also be used for zoom platform.

Panning

 Pan moves the viewpoint up and down or from right to left so that different parts of the slice are displayed. Click on this button, and then click on the view. Holding the left mouse button down, drag the view to the desired position.

Linetype Display

The linetype buttons are used to turn the display of the various linetypes on or off. The buttons are located in the Linetype Toolbar, or the commands can be accessed through the View menu.

Each linetype is used to build a specific portion of the part, or of the support region. Not all linetypes are used for all parts. In particular, no build closeoff linetypes are used for solid configurations.

Perimeter lines define the outer surface of the parts, and echo the part boundary. Perimeters are also drawn around the inner edge of the support material, to protect the part and to anchor the support fill region. Fill lines define the basic grid structure used to build the interior of parts and support. In some configurations, a weld perimeter line is used to join the build perimeter to the build fill structure.

Build closeoff linetypes are used to seal the inner grid structure as the part geometry changes from layer to layer, and they form part of the outer surface of the part. Both upper and lower surfaces need to be closed off. Similarly, support closeoff linetypes are used to build a solid support surface, before build material needs to be deposited in that area. Only upper closeoffs are used for support.

The following buttons turn the display of a particular linetype on and off.

Build Perimeter defines the outer boundary of the part.

Weld Perimeter is a perimeter drawn in the build material, used to join the Build Perimeters to the Build Fill. The Weld Perimeter is displayed in blue in 3ZAnalyzer.

Support Perimeter forms the inner boundary of the support region. It is also used to protect the Build Perimeter while the part is being built.

Build Fill forms the interior of the part.

Support Fill forms the support regions.

Build Lower Surface Closeoff 1 is the first pass closeoff for lower surfaces of the build material. It is used to form a solid surface under the open Build Fill grid, and forms the lower outer surface of the part. Parts built using solid configurations do not require build closeoff.

Build Lower Surface Closeoff 2 is the second pass closeoff for lower surfaces of the build material. It is used to form a solid surface under the open Build Fill grid. Parts built using solid configurations do not require build closeoff.

Build Upper Surface Closeoff 1is the first pass closeoff for upper surfaces of the build material. It is used to form a solid surface on top of the open Build Fill grid. Parts built using solid configurations do not require build closeoff.

Build Upper Surface Closeoff 2 is the second pass closeoff for upper surfaces of the build material. It is used to form a solid surface over the open Build Fill grid, and forms the upper outer surface of the part. Parts built using solid configurations do not require build closeoff.

Support Upper Surface Closeoff 1 is the first pass closeoff for upper surfaces of the support material. It is used to form a solid surface on top of the open Support Fill grid, two layers before build material is built on top of the support region.

Support Upper Surface Closeoff 2 is the second pass closeoff for upper surfaces of the support material. It is used to form a solid surface over the open

Support Fill grid on the layer before build material is built on top of the support region.

Settings

The Settings menu contains various options for modifying the 3ZAnalyzer display. See **Figure 44: File Settings Dialog Box.**

Units

The units used for displaying numeric values are set in the Settings menu. Select either Inches or Millimeters. When the display units are set to Inches**,** the Z value for the current slice is displayed in inches, and the coordinate position of the cursor is displayed in mils (1/1000 inch). When the display units are set to Millimeters, both the Z value and the position of the cursor are displayed in millimeters.

Machine Type

The machine type setting is used to calculate accurate time estimates for each particular type of machine.

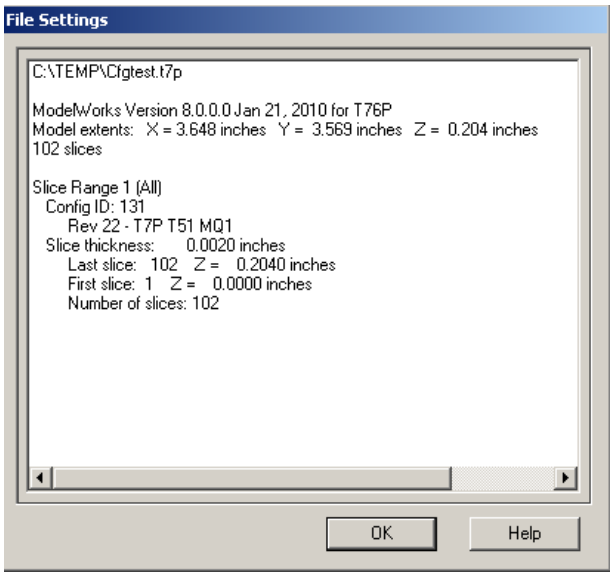

Figure 44: File Settings Dialog Box

File Settings

File Settings displays information from the binary file. This includes the generating program, the machine type, the model extents and the number of slices. If multiple copies or model offsets were set, these are also shown. Configuration data for all slice ranges is included. The File Settings dialog is shown in **Figure 45: Options Dialog Box.**

Options

Click on Options to display the Options dialog, as shown in **Figure 45: Options Dialog Box.**

\

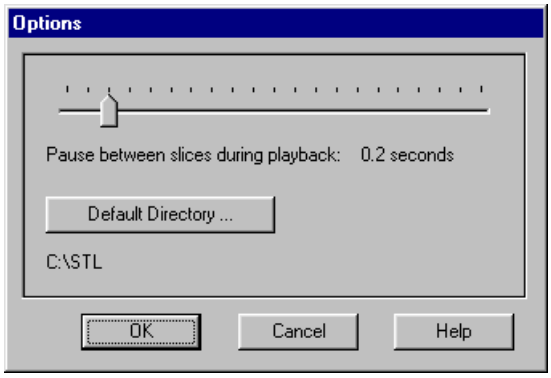

Figure 45: Options Dialog Box

Use the slider to select the amount of time to pause after displaying each slice. This time varies between zero and two seconds, in increments of 1/10 second. The default is to play slices as quickly as possible, with zero pause.

The Default Directory sets the default location to use when loading build files. Click the Default Directory button and select the directory to use.

View Options

The view options, located in the View menu, are provided to give additional information about the file and the individual layers.

Vector Sequence Numbers toggles the display of vector sequence numbers on and off. This is used to locate vector endpoints and to determine the order in which vectors are laid down.

Using 3ZOrganizer

Overview

3ZOrganizer is a program that retrieves, and process STL or SLC files automatically. Files can be dragged, copied or exported to an input folder. 3ZOrganizer will then automatically load, auto arrange, and process the files to create a printer file for any of the 3Z family of printers. 3ZOrganizer works in conjunction with 3ZWorks, 3ZAnalyzer and the 3Z printer driver. The program is launched, settings are established, and then the program is minimized and resides hidden from view. When a file or folder of multiple files is sensed in the input queue, the program will execute and process the files.

Starting the program

3ZOrganizer is automatically installed as part of the 3ZWorks installation process. To start the program, locate the file 3ZOrganizer.exe. It is located in the same folder that 3ZWorks was installed.

To start the program, open the file 3ZOrganizer.exe.

The opening screen is shown in **Figure 46: Opening screen and program folders**

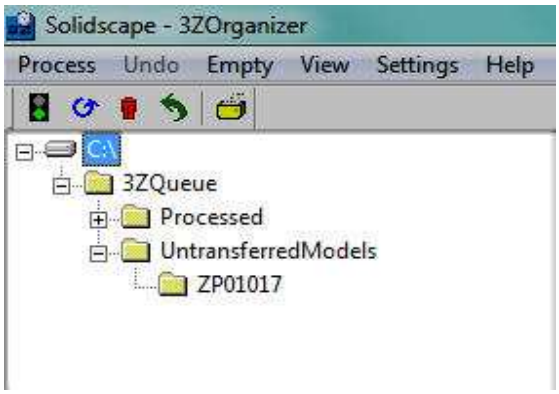

Figure 46: Opening screen and program folders

Folder Functions

The folders used by 3ZOrganizer are shown **Figure 46: Opening screen and program folders.** The folders function as follows:

- **3ZQueue.** This folder is the origin point for all files to be processed. The STL or SLC file(s) are dragged, dropped, or exported here. Depending on the refresh time settings, the folder will be accessed and reviewed by 3ZOrganizer. Any new files will be retrieved and processed.
- **Processed.** This folder contains all files retrieved from the 3ZQueue folder and processed through 3ZWorks. It will contain the original files and files ready for the printer.
- **Untransferred Models.** This folder contains a processed file ready for the printer. The files are held in this folder until the currently busy printer is finished printing. Each printer serial number available will have its own unique separate sub folder.

Settings

3ZOrganizer settings determine how files are processed, how often the program looks for a new input file and also indicates where program information is located

The top section of the settings dialog box displays where the various program files are located and allows the user to validate these locations. If checked, 3ZOrganizer will display the Data and or Models directories. See **Figure 47: Directory settings.**

- The **3ZOrganizer directory** is the location where files should be dropped or copied into. This is the folder that 3ZOrganizer will look to for new files.
- **Show Data Directory** , if checked, will display the location of all the folders associated with 3ZWorks and 3ZOrganizer in the opening screen.
- **Show Model Directory** will display the location of the folder where model files will be loaded from as specified in *Settings>Options > Default Model Directory* 3ZWorks.
- **Validate 3ZWorks** Will display the location of 3ZWorks and launch the program.
- **Configure 3ZWorks** will launch 3ZWorks and display the printer driver detailed settings. See page 62 for more information.
- **Validate 3ZAnalyzer** Will display the file location and launch 3ZAnalyer.

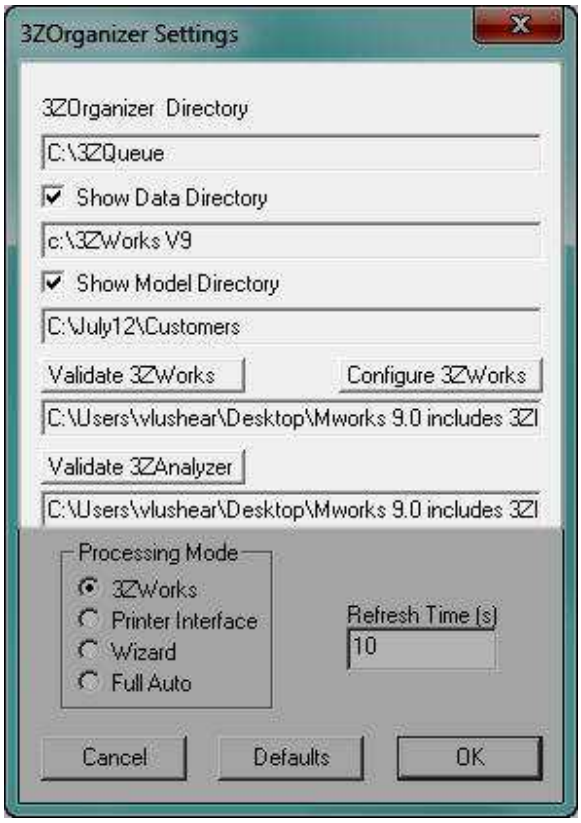

Figure 47: Directory settings

The bottom section of the settings dialog box, displays the processing mode and refresh time. See **Figure 48: Processing and Refresh times.** The processing mode determines how 3ZWorks will process a file when it is retrieved from the 3ZOrganizer job queue folder. The processing modes are as follows:

- **3ZWorks** The file(s) will be loaded into 3ZWorks and 3ZWorks will be opened for full user control.
- **Printer Interface** The file(s) will be loaded into 3ZWorks and the printer driver will be initiated and displayed.
- **Wizard** The file(s) will be loaded into 3ZWorks and the 3ZWizard will guide the user through the file preparation process.
- **Full Auto** The file(s) will be loaded, processed with the last configuration used, and sent directly to last destination used. This process will run totally in the background with no visual or user interaction occurring.
- **IMPORTANT !** Models must be oriented properly within the design software prior to using the **Full Auto** setting. The models will be auto arranged on the XY axis only and processed as received.

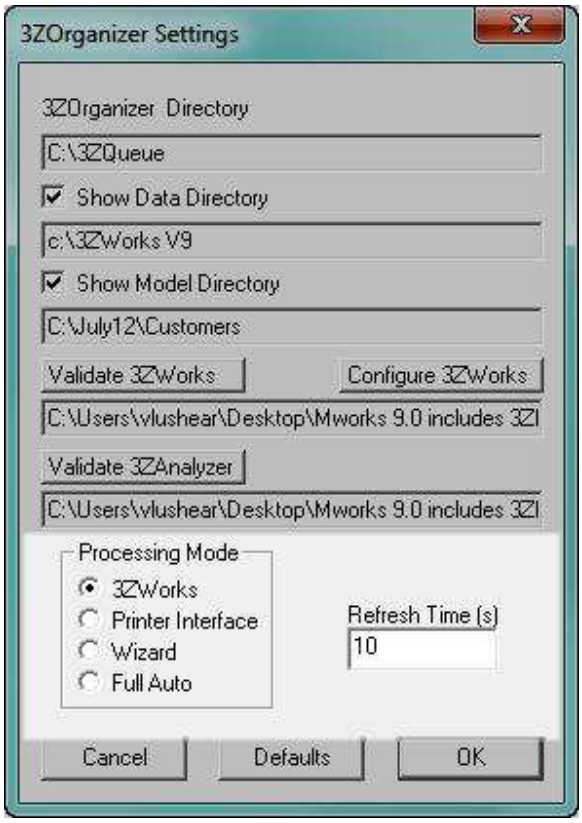

Figure 48: Processing and Refresh times

The refresh time is the interval in seconds that 3ZOrganizer will look at the job queue folder and retrieve files for processing.

Menu Bar

Figure 49: Menu Bar

Figure 49: Menu Bar shows the 3ZOrganizer menu bar. The functions are as follows:

Process

3ZOrganizer will immediately process all files in the job queue folder.

Empty

Allows the user to empty the contents of the Job queue, processed, and untransferred models folders.

View

Enable the viewing of the Toolbar, Status Bar, and current printer status. Refresh all views.

Settings

See Settings section

Menu bar Icons

The menu bar icons are described in **Figure 50: Menu bar Icons**

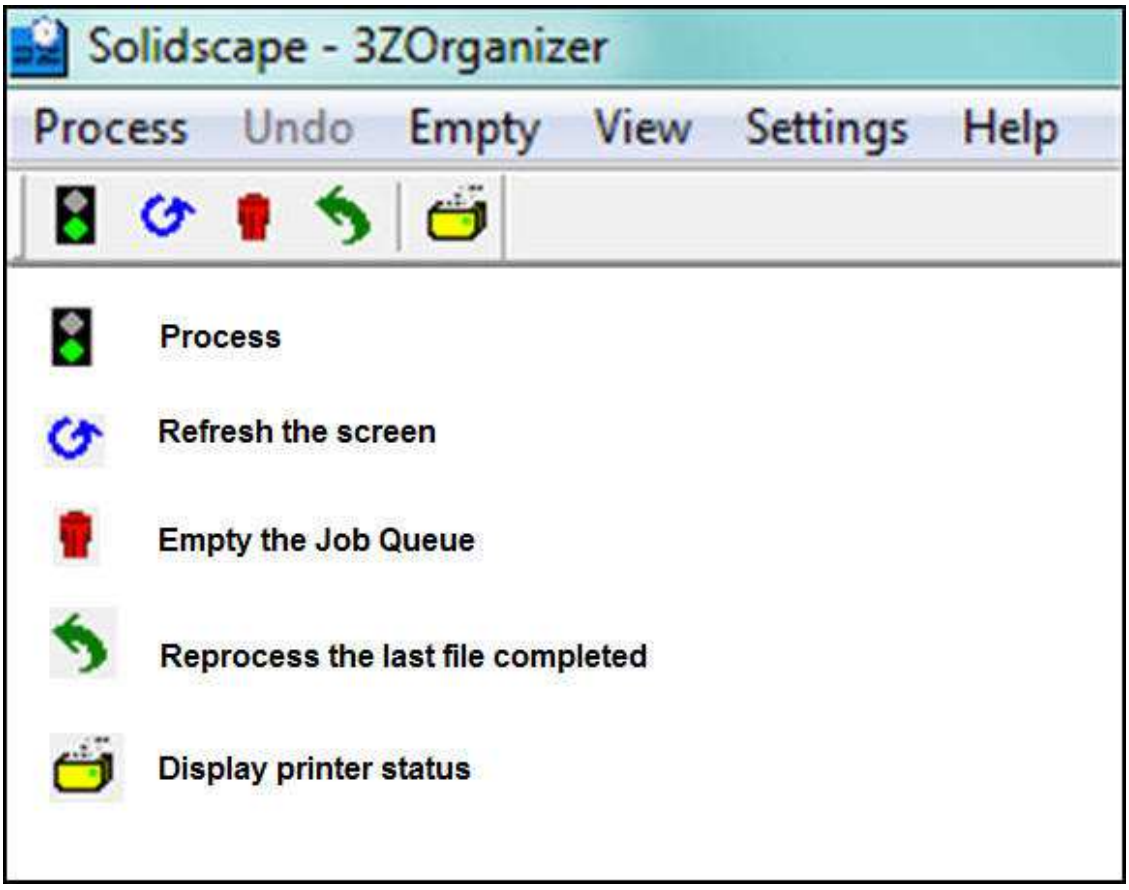

Figure 50: Menu bar Icons

CAD Guidelines

This section provides basic guidelines for transferring CAD files to 3ZWorks using STL and other file formats. Recommendations for specific CAD programs are also included.

Geometric Requirements

Before creating a facet file or a slice file, make sure your CAD model meets the following conditions:

- Surfaces must completely enclose a volume, forming a watertight solid with no gaps between surfaces
- Surfaces must be trimmed to their intersection boundaries. Separate pieces must be booleaned together if they are intended to be one piece.
- Surfaces must have their outer unit normals pointing away from the solid material
- Solid models must form a valid solid
- Multiple models must not touch or intersect
- Features on the model should be no smaller than 0.010 inches (.254mm) with an aspect ratio less than three.

Do not generate support structures manually since this is done automatically by 3ZWorks. For slice files, do not use any tool width compensation since this is also calculated automatically by 3ZWorks.

STL Tolerances

The facet and slice files used for building models are approximations to the original CAD model. Most CAD products have tolerance settings used for generating STL and other files. Matching the file tolerances to the tolerances of the Solidscape machine is an important step in building accurate parts. If tolerances are set too large, the facets will be visible on the final model and the part will look coarse, and could be inaccurate. If the tolerances are too small, however, far too many facets can be generated producing a very large file and slowing down 3ZWorks slicing and filling operations. Facets that are smaller than the individual droplets of build material produced by the machine's jets are obviously below the tolerance of the machine.

Typically, CAD products have a setting for STL chord height tolerance or mesh tolerance. This is the maximum perpendicular distance between a facet and the model surface, which is also the maximum error between the facet file and the CAD model. The recommended setting for Solidscape machines is 0.0005 inches (.0125 mm) but no less than 0.0001 inches (.0025 mm). A chord height tolerance greater than about 0.005 inches (.125 mm) will produce visible facets, and will not decrease build times significantly.

Some CAD products also have a setting for an angle tolerance, which is used to specify the shallowest angle between facets. The recommended setting is either 175 degrees or 5 degrees, depending on the how the angle is measured.

Some CAD products only provide a relative tolerance, such as a range of settings from “fine” to “coarse”. Determining the optimum setting in these cases is not as direct, and can take some experience. When a facet file is displayed in 3ZWorks using a shaded view, the individual facets are displayed much as they will appear on the finished part. If these look too coarse, regenerate the file using a finer setting. To determine if the setting is too fine, slice the STL file using the configuration you intend to use and with the Eliminate All Support option selected. (Eliminating the support speeds up the slicing and filling times.) Then look at the build perimeter vectors in the build file using 3ZAnalyzer. Turn on Vector Sequence Numbers in the View menu. If there are too many vectors along a curve, or if there are many very short vectors (less than 0.002 inches (.0125 mm)) a coarser tolerance setting should be used for generating the STL file.

CAD Products

3ZWorks supports several file formats for transferring 3D CAD models to the 3Z Printer. These formats are STL, AutoCAD DXF, and Alias/Wavefront OBJ. Supported slice formats are SLC, modified HPGL, and 3ZWorks slice format. Virtually every 3D CAD package is able to produce at least one of these file formats. When a CAD package provides a choice of facet file formats, binary STL format files are preferred because they are much more compact than ASCII STL or DXF format files.

Specific guidelines for each CAD system are discussed in the following subsections.

SolidWorks

In general, SolidWorks provides excellent STL files. When generating STL files from assemblies, do not save all parts to a single file unless a non-zero clearance has been specified between all components of the assembly. In SolidWorks 99 or later versions, use the Check for Interferences option under STL Export Options to check for this condition.

JewelCad

Although JewelCad will produce STL files, they are not recommended for input to 3ZWorks. Instead, use SLC slice files to transfer jewelry models to 3ZWorks. Choose a slice thickness that matches one of the available slice thicknesses in the 3ZWorks configurations, especially when using metric. In addition, be sure to orient the part relative to the build platform before generating the SLC file, since slice files cannot be rotated in 3ZWorks. If the part needs to be scaled to compensate for shrinkage in the casting process, it must be scaled in JewelCad before generating the SLC file.

Pro-Engineer

In general, Pro-Engineer provides excellent STL files. Observe the geometric requirements listed above.

IDEAS

In general, IDEAS produces excellent STL files. Observe the geometric requirements listed above.

Intergraph I/Design and EMS

These two products provide excellent STL files. In I/Design, be sure that individual surfaces are trimmed to their intersecting boundaries. Also ensure that the surfaces match at their common boundaries to within 0.0001 inch.

In EMS, be sure individual models are Boolean Unioned together. This operation trims intersecting surfaces and removes redundant surfaces from inside the model. Any overlapping solid must be unioned. Solids that are disjoint (separated in space) do not have to be unioned. Observe the geometric requirements listed above.

Unigraphics

STL files are produced from Unigraphics if the model was built with solids. To ensure redundant faces are not surfaced, the model must not contain multiple solids that share the same faces or interfere with each other. If multiple solids are used to construct a model, ensure they are merged into one solid entity. Use the solid to surface function to create a set of surface entities that accurately define the boundary of the model. Use these surfaces in the STL module to create a clean STL file.

CATIA

The STL translator provided by CENIT-GMBH produces excellent STL files from CATIA formatted files. Observe the geometric requirements listed above.

AutoCAD

AutoCAD files are imported into 3ZWorks using the STL and DXF file format. Both surface and solid models can be imported. The following table gives a quick guideline for exporting models from AutoDesk products.

AutoDesk Product	Export Method
AutoCAD r13 and above	File Export STL
AutoCAD r12, r11, r10	Explode polyface meshes to 3D Face elements and export using DXFOUT
Designer	DXF, see procedure below
AME	STL, see procedure below
AutoSurf	DXF, see procedure below

Most rapid prototype machines require that surfaces be positioned such that the normal vector to the surface points outward, away from solid material. This is also true for rendering surfaces in AutoCAD. The rule is *if the surfaces are properly rendered with back faces removed in AutoCAD, then the surfaces will be oriented correctly in 3ZWorks.*

The model will not shade correctly if the outer unit normals are incorrect. In some cases, the facet normals can be repaired in 3ZWorks, but it is always preferable to fix them in AutoCAD before the model is exported.

3ZWorks can import AutoCAD DXF files provided they are prepared according to the guidelines given below. It is recommended that model files be saved as STL binary files since DXF files occupy large amounts of disk space by comparison.

Preparing DXF Models in AutoCAD

Convert AutoCAD files to 3DFACE elements before exporting them to a DXF file. The specific steps needed to do this vary depending on the AutoCAD modules used to produce the 3D models. The following are the most common model types with specific steps for 3DFACE and DXF conversion:

- Designer – Use the ADMESH command to turn the mesh on and specify the mesh tolerance. When the model is meshed, save the model in a new temporary drawing file. Explode the copied mesh twice to reduce it to 3DFACE elements and DXFOUT the result. Discard the temporary drawing file because it has been permanently altered by the explode command. In some cases, arrowheads from dimensions are erroneously exported. If this occurs, a work-around in AutoCAD-R12 is to move the mesh away from the area where it was created, then DXFOUT entities only. Select only the mesh using a window or fence.
- AME – Set the SOLWDENS variable to reflect the density of the desired mesh. Use the SOLMESH command to mesh the model. When the model is meshed, save the model in a new temporary drawing file. Explode the mesh twice to reduce it to 3DFACE elements and DXFOUT the result. Discard the temporary drawing file because it has been permanently altered by the explode command.

Note:

Use SOLSTLOUT to produce the STL file directly from AME.

- AutoSurf – Prepare the model by making sure all surface normals are correct and that the surfaces define a closed volume. In Surface Display, select Polyface Mesh and Unhide. Also check the Display Tolerance box and insert a value small enough to give a smooth mesh. To break the AutoSurf model down into 3DFACE elements, use the IGES translator supplied with AutoSurf. This is not the standard IGES translator that is supplied with AutoCAD-R12.

The procedure is to export the model as an IGES file, and then read it back in again. This breaks the individual surface meshes out of their AutoSurf format. Use the following steps:

  - Click on Edit Options in the IGES translator dialog
  - Click on IDP Mappings
  - Check the Polyface mesh option on
  - Start a new AutoCAD drawing and use the IGES translator to re-enter the IGES model. This time, on the IGES dialog, make sure the Use AutoSurf Mappings item is not checked. Re-read the mesh into the AutoCAD drawing and use the copy command to make a copy of the mesh. Explode this mesh and then DXFOUT the model.

Alias / Wavefront

In general, Alias provides acceptable STL files and also provides OBJ and DXF files. The recommended file format is STL. Observe the geometric requirements listed above.

3DStudio and Simply3D

These products are capable of exporting 3DFACE elements directly in DXF files. Be sure to verify that the models render correctly with back-face rendering turned off. This will ensure that unit normals are oriented correctly.

CADKEY and Picture-It

Excellent STL files can be generated in Picture-It and in CADKEY designs of solid models. Observe the geometric requirements listed above. In general, if the STL file displays correctly in Picture-It, the STL file will work in 3ZWorks. CADKEY's Advanced Modeler program is not recommended for use as an STL file generator for the PatternMaster or ModelMaker.

File Formats

This section provides a brief description of the file formats that can be used for building models with 3ZWorks.

STL Binary and ASCII

3ZWorks uses the format specified in the Stereolithography Interface Specifications (STL) from 3D Systems, Inc. part number 50065-S01-00, October, 1989/December 16, 1991

DXF File

3ZWorks uses the standard AutoCAD DXF (drawing interchange file) format. Only 3DFACE elements are read from the file. All other geometry is ignored.