ZEdit Pro 1.0

Tutorial 3 – Annie

First Edition

DeskArtes: "ZEdit Pro 1.0: Tutorial 3 – Annie"

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Contact Address

DESKARTES OY

Lämmittäjänkatu 6

00880 Helsinki

FINLAND

http://www.deskartes.com

ZEdit Pro 1.0: Tutorial 3 – Annie

Chapter 1 – Foreword

The *ZEdit Pro 1.0 Tutorial 3 – Annie* tutorial introduces the first set of print preparation commands available with ZEdit Pro software. Through this sequence, you will learn how to repair the *Annie.zpr* model by using the Auto Repair functionality and how to hollow the model to save material during the build. You will also add a drain to remove non-binded material from the part. In the final step, you will output the hollowed model for printing with Z Corporation color printers.

This tutorial is the third in a set of five tutorials, each of which covers different aspects of model repair, coloring, and print preparation. The following tutorials are available in the software distribution package:

- *Tutorial 1 – Lamp* introduces basic automatic repair and coloring. Estimated completion time is 60 minutes.

- *Tutorial 2 – Black Bass* covers more advanced repair, including joining surfaces and adding thickness. Estimated completion time is 30 minutes.

- *Tutorial 3 – Annie* addresses repair with hollowing and adding drain holes. Estimated completion time is 20 minutes.

- *Tutorial 4 – Cow* relates to splitting and connecting. Estimated completion time is 20 minutes.

- *Tutorial 5 – Explorer* involves repair with offsetting and joining surfaces. Estimated completion time is 20 minutes.

The tutorial documents and the geometry files for the tutorial examples are found in the *Tutorials* folder and its sub-folders (*Tutorial 1*, *Tutorial 2,* etc.) in the ZEdit Pro installation directory.

If you are using ZEdit Pro for the first time, going through the tutorials in the given order will help to familiarize you with the application. Tutorial 1 is especially helpful because it includes information on the basic use (auto repair, viewing, selecting, painting, and texturing) and different concepts (modes, windows, etc.) in the software.

The **boldface** and *italics* used in this tutorial have designated meanings. A **boldfaced command** is a command or operation that alters the model or is otherwise necessary to reach results similar to the example. A statement in *italics* denotes the different parameters and their values; menu commands; mouse clicks; file names; Model Tree items; or any new terms introduced to the reader.

ZEdit Pro allows you to do full repair and advanced coloring for 3D models for 3D printing with Z Corporation color printers. The Import Package and 3Data Expert® software from DeskArtes (www.deskartes.com) provide additional model manipulation functionality, including surface input and triangulation, and Boolean operations. ZEdit Pro is part of the DeskArtes Expert Series software suite. Optional tools are available through DeskArtes.

Chapter 2 – Fixing the Annie model

In this example, you will go through the steps required to fix the *Annie* model with the Auto Repair then create a hollow model and a drain hole to remove the loose powder from the ready model. The *ANNIE.zpr* model is available in the ZPR format (.zpr) on the ZEdit Pro installation directory (*Tutorials/Tutorial 3 – Annie's Head* directory). After completing model repair and preparation, you will save and store the model in ZPR format for 3D color printing.

Please **input the *Annie* model (*File > Open*)** from the *ANNIE.zpr* file. You should see the following result on your computer screen:
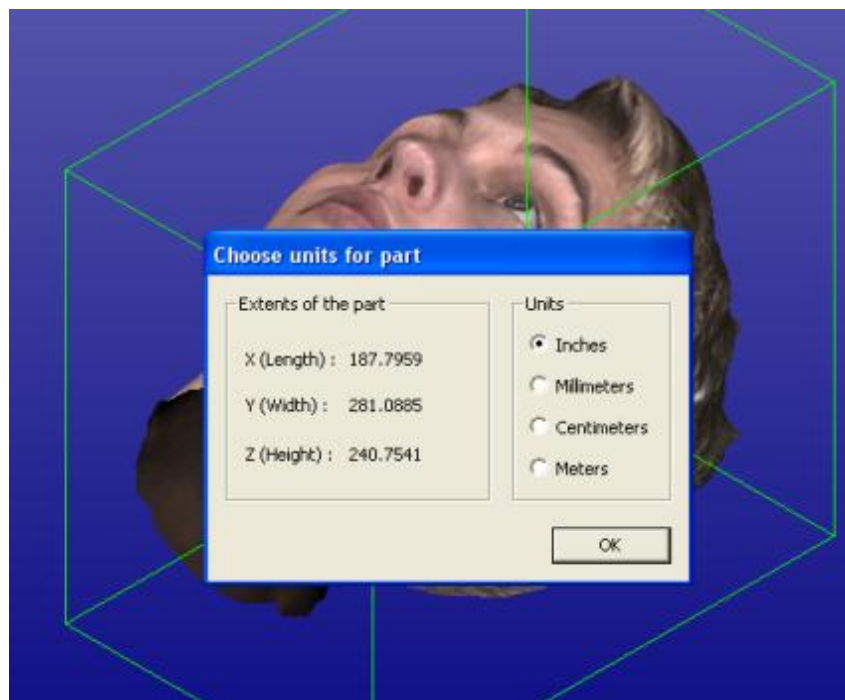
You can also start ZEdit Pro through the ZEdit Pro icon in the ZPrint software (or through the *Edit > Start ZEdit Pro* command). In this case, the model will automatically load to ZEdit Pro.

You will notice that the Annie model comes with correct face and hair color. ZPR files, like VRML files, can store model colors and textures for maximum realism with 3D color printing.

The first ZEdit Pro dialog allows you to check and set the units for the inputted part. ZPR (.zpr) files include the unit information, but in this case, the units seem to produce a very large object. **You will change the units to millimeters**. This is a more realistic size, and it also fits into the 3D printer build volume nicely. When

you output the model into a ZPR file at the end of the repair process, the new units will be stored in the file.

Press OK to continue. The *Operation Mode* window will appear:
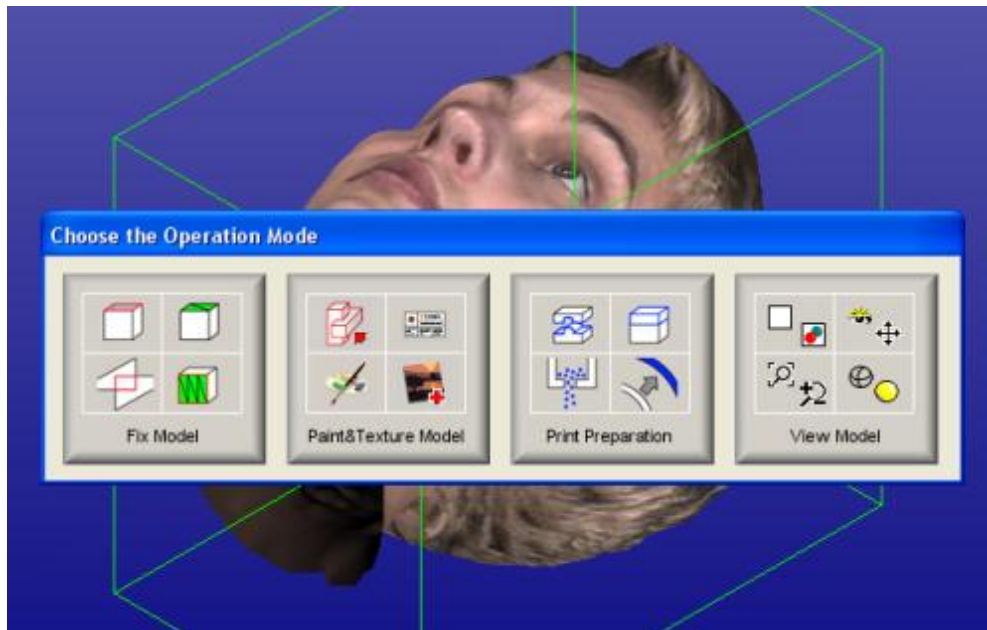
ZEdit Pro has three main operation modes: *Fix Model*, *Paint & Texture Model,* and *Print Preparation* mode, as well as a temporary *View Model* mode. The different modes are used for different tasks, but in this instance you want to start with verify and repair to produce a solid geometry ready for hollowing. Select the Fix Model mode for model repair.

Fixing the Annie automatically

The normal way to start repairing a model is to start with the Fix Model mode. To start fixing **press the Fix Model button** in the Operation Mode dialog now**.** ZEdit Pro will start automatic model verification (*Fix Model > Verify Shells* command). The screen is erased and a progress bar appears. When the analysis, is ready a *Model status* message box displays:
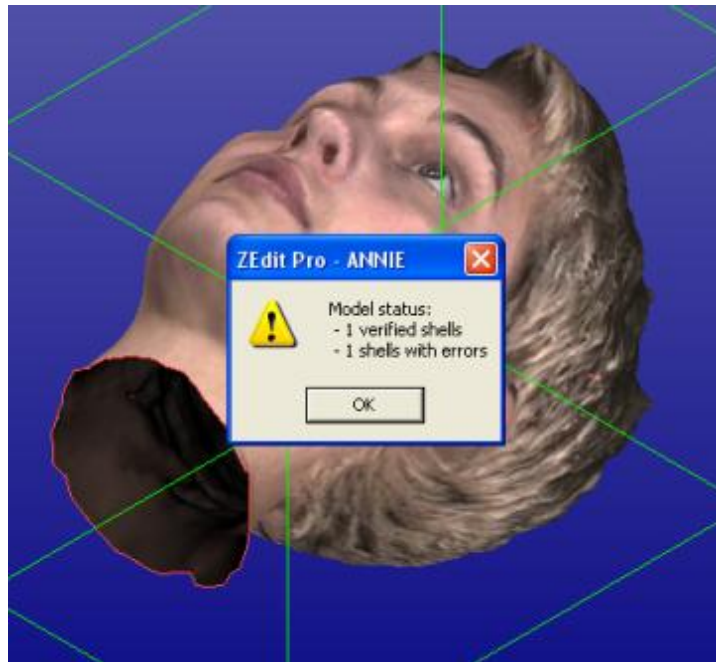
The message indicates that there is one verified shell with errors. The display shows red *Gap curves* indicating errors. Gaps are an error type you must fix during the repair process. The darker surface area inside the red gap curves denotes the inner or back side of the surface (i.e., the inverted normal side). The overall lighter face color denotes the front or outer side (i.e., the normal side of the surfaces).

The model contains only one shell. **Press the OK button** in the *Model status* dialog to see the model structure in the *Model Tree* (on the left-hand side of the image that follows). The error shell has a red icon in the Model Tree. The *Fix Model Tab* on the *Tools Window* (on the right-hand side) provides shortcuts to the commands available for repair. The *Help text* window at the lower part of the Fix Model Tab also contains information for repair actions.

When the OK button is pressed, the new windows appear and a request for Auto Repair is prompted:

Press Yes to run Auto Repair on the Annie model. Auto Repair is the best path to follow when repairing normal models. Auto Repair will attempt to fix all shells with errors in the Model Tree.

When the Auto Repair is started the shell is run through the repair command (*Fix Model > Repair Shells* command) using automatically calculated parameters. A progress bar appears and after a while, the following message displays:

The model is correct and requires no further repair work. **After pressing the OK button**, the following dialog appears:
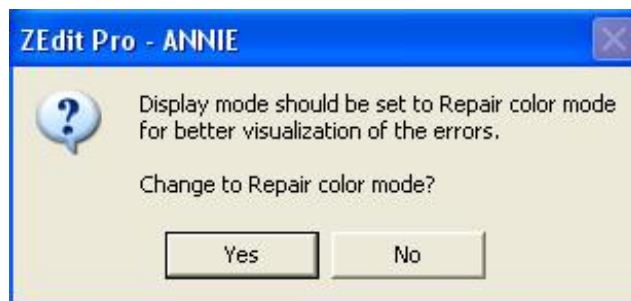
You are prompted for the *Repair color* mode. **Press No** because you already have a correct model and only wish to make it hollow and add a drain hole. You will see the *Model status* window:

You may also see the short "Introduction to File Fixing" splash screen. The "Introduction to File Fixing" page includes a description of what file fixing is and where to find more help.

Press the OK button to close the *Model status* window after Auto Repair.

A *Tip Window* with useful tips on viewing and selection mechanisms may be displayed after Auto Repair (please see the *Tutorial 1 – Lamp* page 14 for details). You can just **Close** or **Minimize** the *Tip Window* and the "Introduction to File Fixing" page for later reference during the repair. You can also permanently turn them off when you become more familiar with the use of the repair tools through the *Show Command Tips* and *Don't show the window after Auto Repair* settings in the dialogs. You can restart both windows through the Help menu.
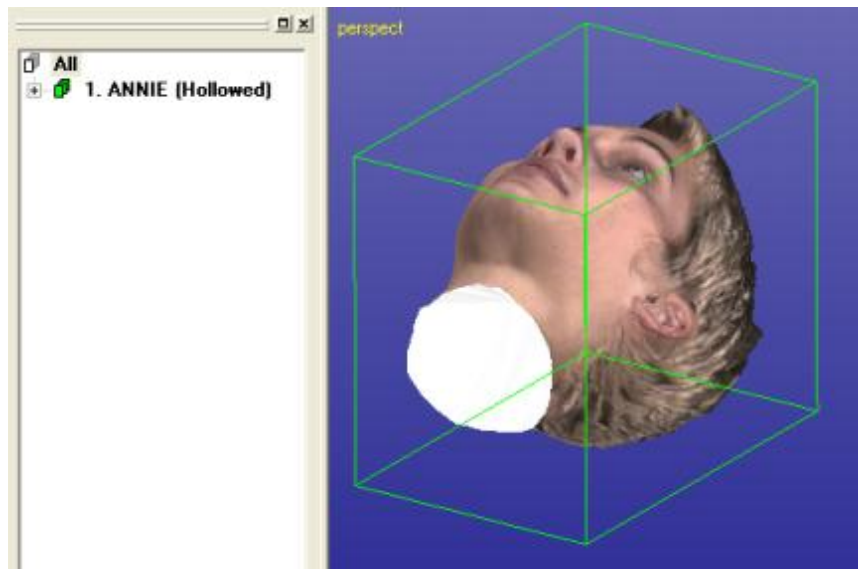
During Auto Repair, you have generated a correct model and can now proceed to the Print Preparation commands to hollow the model.

The color of the fill triangles for the gap is white (see previous page). White is the default Foreground color for newly generated surfaces. This color is set through the *Foreground* color button in the Fix Model Tab *Color* group:
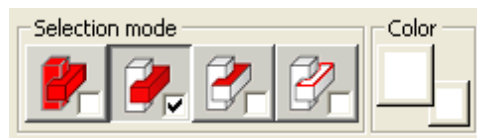
Chapter 3 – Hollowing and draining

You will now make the Annie model hollow and create a drain hole to remove the non-binded material from the part after the build. These commands are available in the *Print Preparation mode*, which is entered by selecting the *Print Preparation Tab* from the Tools Window:

Pressing the Print Preparation Tab displays the shortcuts to Print Preparation commands. A short *Help text* is given for each command at the bottom of the Print Preparation Tab.
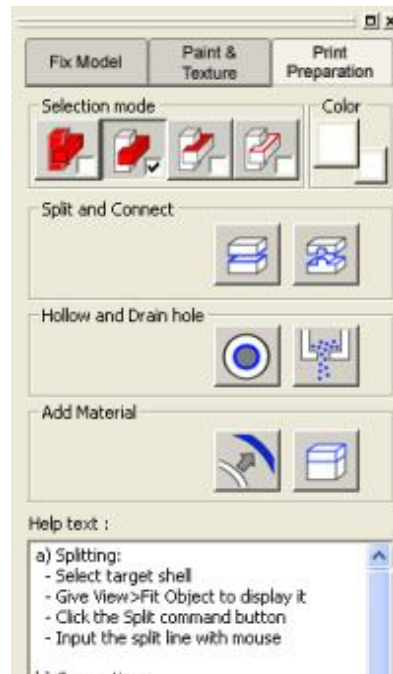
Selecting shell for hollowing

The selection mechanisms for selecting objects in Print Preparation mode is very similar to the selection of objects for coloring in Paint & Texturing mode as described in the *Tutorial 1 – Lamp* tutorial. First, you should set the correct selection level using the *Selection mode* buttons in the Fix Model Tab:
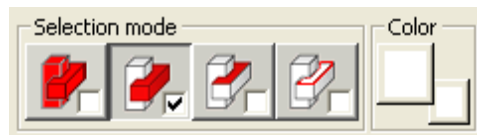
The four buttons refer to the following selection levels: whole model (part), shell, surface, and gap. The *Shell selection* level is the default when the software is

initialized. If not activated now **press the Shell selection level button** selected above because shell selection is appropriate for model hollowing.

Now **single-click on the Annie model** on the screen. You will see that the selection in the Model Tree changes and the shell *1. ANNIE (Repaired)* is highlighted. Also, a green bounding box is displayed on the selected object (if not, make sure that the *Show bounding box* ⬜ icon is activated). In the image that follows, shell *1. ANNIE (Repaired)* is selected:
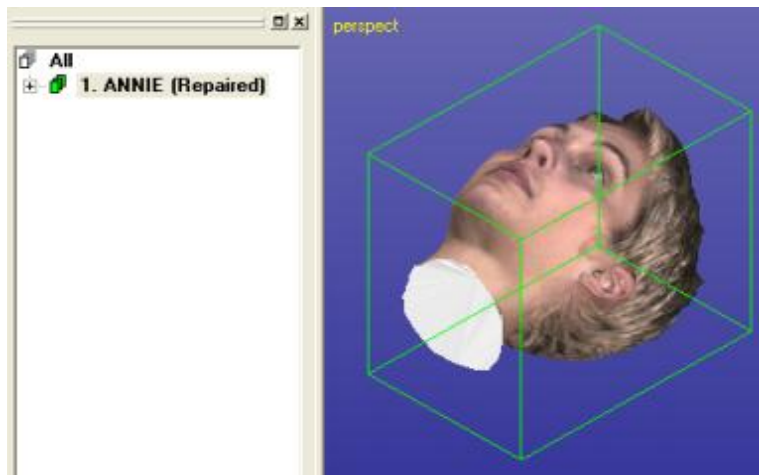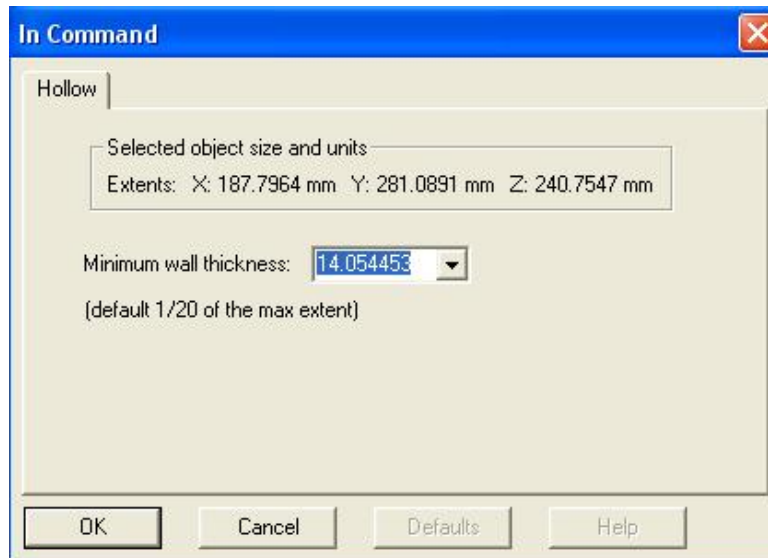

Of course, you can also select the *1. ANNIE (Repaired)* directly from the Model Tree.

Hollowing Annie

The hollowing is done by giving the command *Print Preparation > Hollow* or **pressing the**

button in the Print Preparation Tab. When the command is given, the following parameter dialog appears:

The software automatically calculates the default value for the *Minimum wall thickness*. This value (1/20) is based on the maximum extent of the selected shell (*281.0891mm)*. **Change the value to an even *15* mm and press OK to hollow the model.** An hourglass icon appears. When ready, the cursor returns to a normal arrow cursor.

Use clipping tools to look inside the model. **Press the Clipping** [icon] **icon** in the Clipping toolbar. The *Clipping Tab* appears with several different clipping possibilities. **Use the X axis clipping as shown on the image that follows** (inside green ellipse).

While moving the *X Iso-plane* clipping control you will see the white inner surface. The hollowing is created by filling the inside of the Annie model with small boxes so that the wall thickness is not less than the given *Minimum wall thickness* value.

Generally, the smaller value you use for the *Minimum wall thickness* the more triangles you will need to create the white inside surface. The smaller the value, the smaller boxes will be that are used to create the void inside the part. Small boxes will follow the original surface more accurately but create more triangles. Avoid using unnecessarily small values. In the end, the inner surfaces are not visible in the final part.

You may freely try other clipping properties. **Press Reset** when you are done experimenting. **The Clipping Tab is closed by pressing the Clipping** [icon] icon again.
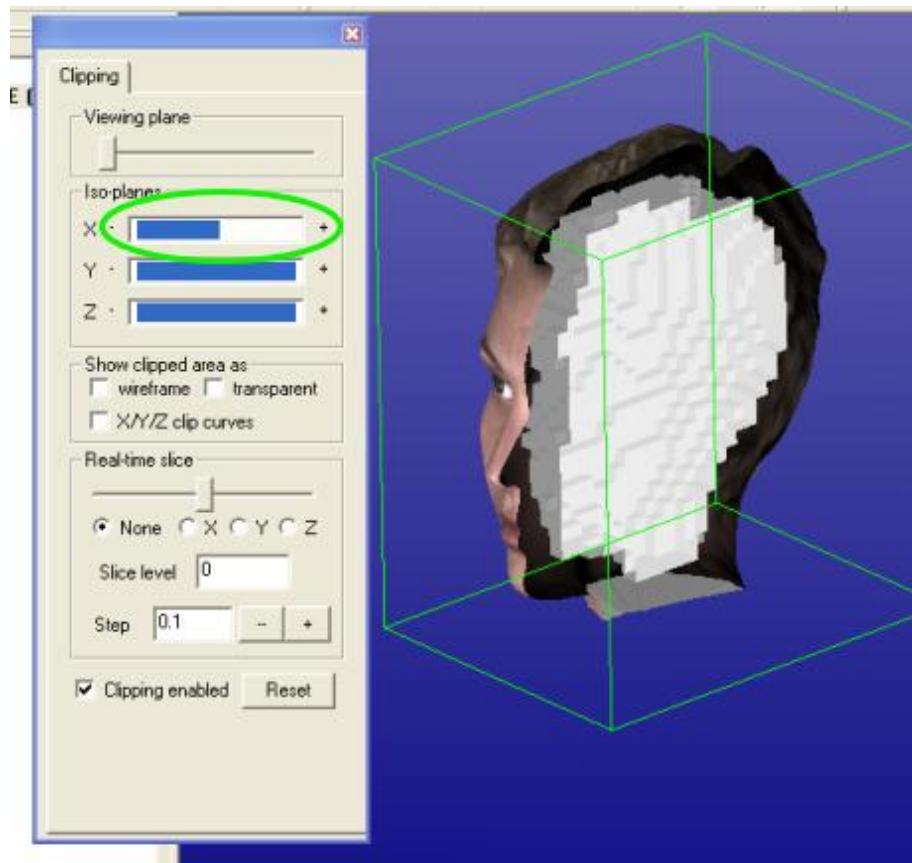
The newly generated inner surface has a white color. If the color is different, check the Foreground color setting in the Print Preparation Tab Color group:
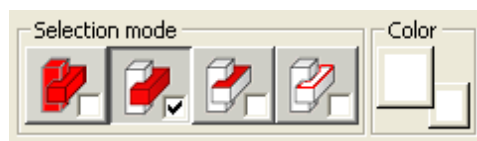

Now you have a correct hollow model and can create a drain hole.

Creating the Drain Hole

The purpose of the Drain Hole is for removing the non-binded powder from the part. This will allow great savings in material usage when building large parts.

The Drain Hole should be created in an area that has no functional value or is not visible to the user. With the Annie model, you should create the Drain Hole on the bottom of the part at the gap fill triangles.
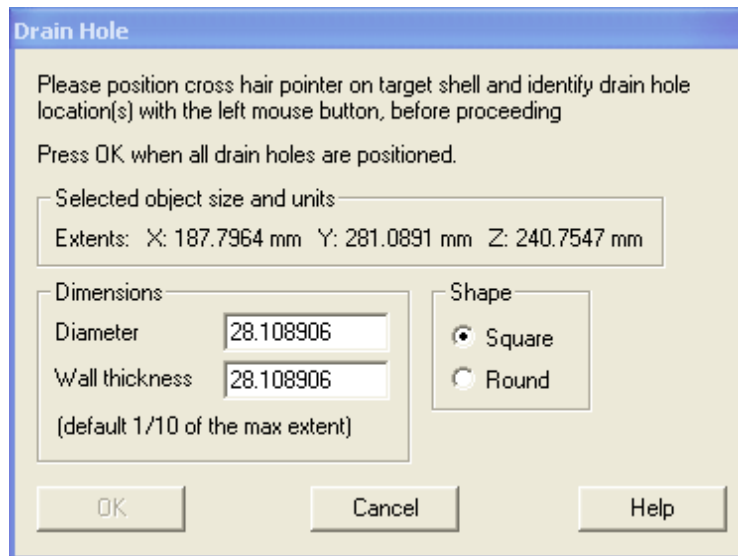
First, select the shell *1. ANNIE (Hollowed)* from the Model Tree or the display. Then **take a suitable view** to see the white bottom of the part, like in the image that follows:
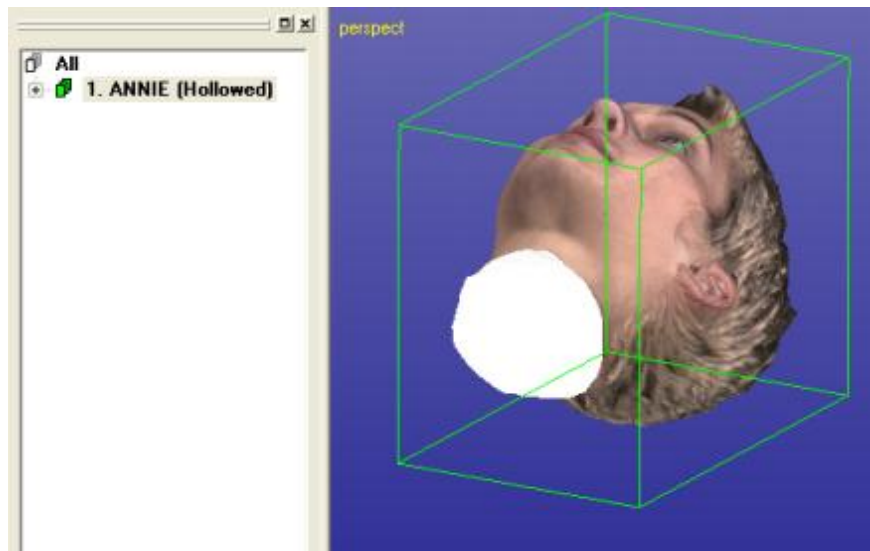
Now give the *Print Preparation > Drain Hole* command or **press the Drain Hole**

button in the Print Preparation Tab. A dialog with Help text and parameters appears:

The *Dimensions* of the Drain Hole are set automatically according to the maximum extents of the selected object. The *Diameter* and the expected *Wall thickness* is set to *1/10* of the maximum extent of the Annie model (*281.0891mm*). The values may be changed at will but keep in mind that the diameter should allow for the removal of powder from the part and the wall thickness value should allow the drain hole primitive to cut through the wall of the hollow object. You can use either *Square* of *Round* Drain Holes.

Before pressing OK, you must select the positions for the holes. With the Annie model, it is sufficient to make one large Drain Hole in the bottom of the part. **Click with the left mouse button** (*LMB*) in the middle of the bottom area to see the approximate location of the Drain Hole with a red box:
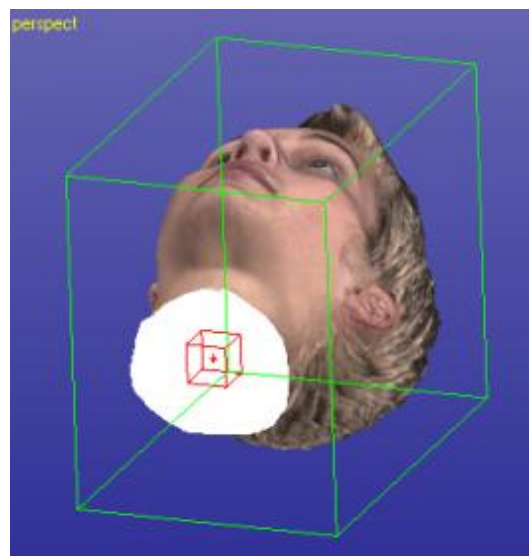
You can rotate the view with the middle mouse button (*MMB*) while checking and finding the correct location for the Drain Hole. These viewing shortcuts are available: pan – Ctrl + RMB, zoom – mouse wheel, rotate – MMB. Also, if you select the wrong location you can remove it by clicking the red box with the *LMB*. **Make sure your location is more or less as shown in the image above and press OK**. A progress bar will appear and soon you will see the final result:
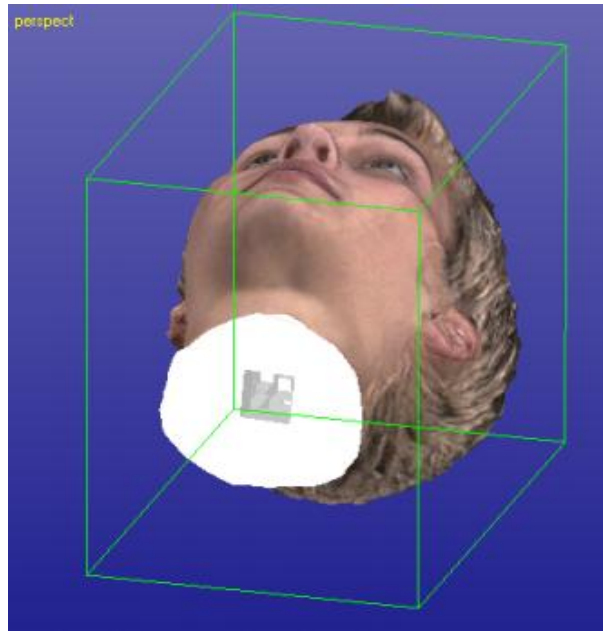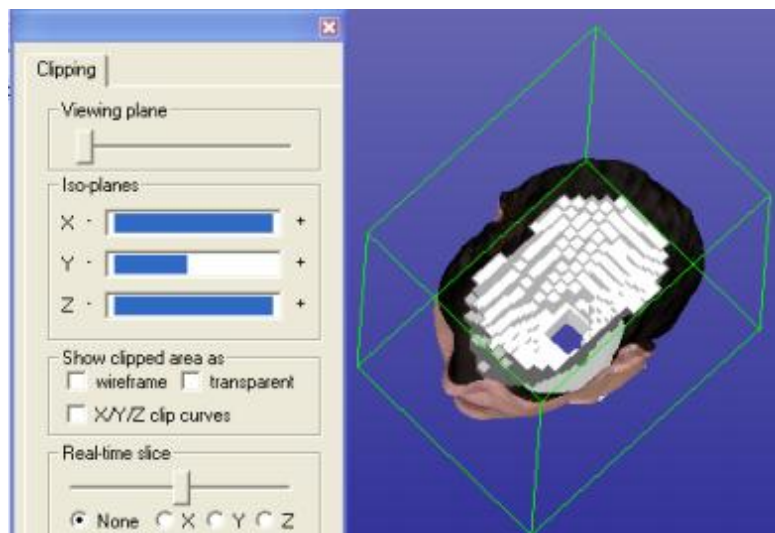

The Model Tree contains a renamed and hollowed shell *1. ANNIE-drain_hol (Drain hole)*:
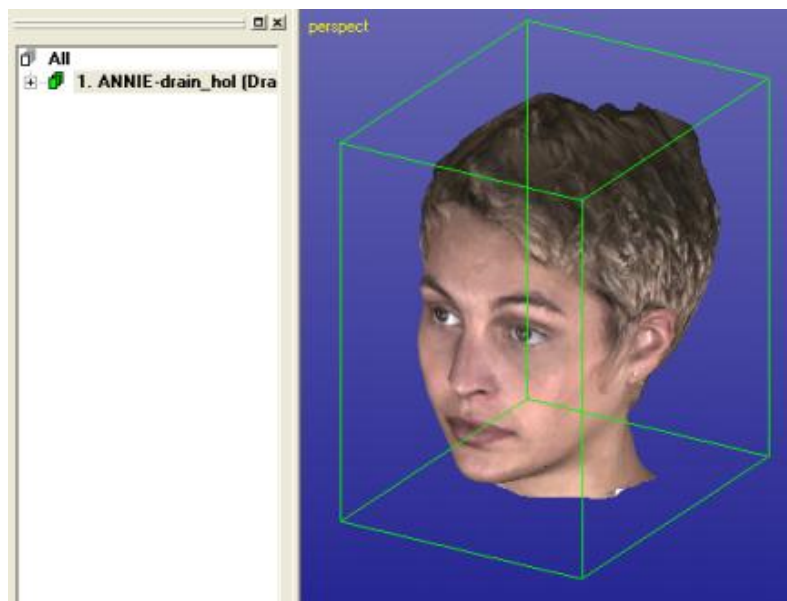
You can use clipping tools to make sure the drain hole cuts through the model wall correctly:

The final model can be found in the *ANNIE-drain_hole.zpr* file in the distribution package.

Saving the file

When saving the file to the ZPR format with the *File > Save As* command, the best practice is to **select the whole model first** (i.e., the Model Tree root *All*). When *All* is selected, every shell will be written to the output file. If something other than the *All* root is selected a warning is issued before the file is written.

If ZEdit Pro was started from the ZPrint software, **pressing the *Return to ZPrint***

⧉ icon will transfer the whole model back to ZPrint automatically.

Hollowing models effectively

To hollow models effectively you will need to have a basic understanding of the hollowing operation. This will prevent you from creating hollowed models with too many triangles or with too thin walls.

Hollowing a solid triangle shell is based on the subdivision of the 3D space inside the model into small cubes or voxels. In the image that follows, you can see an elliptic solid model (actually a 2D projection) and the space subdivision around it. In the subdivision each voxel edge length *T* is set to the given *Minimum wall thickness* parameter divided by 2 *(T = Minimum wall thickness/2.0).*
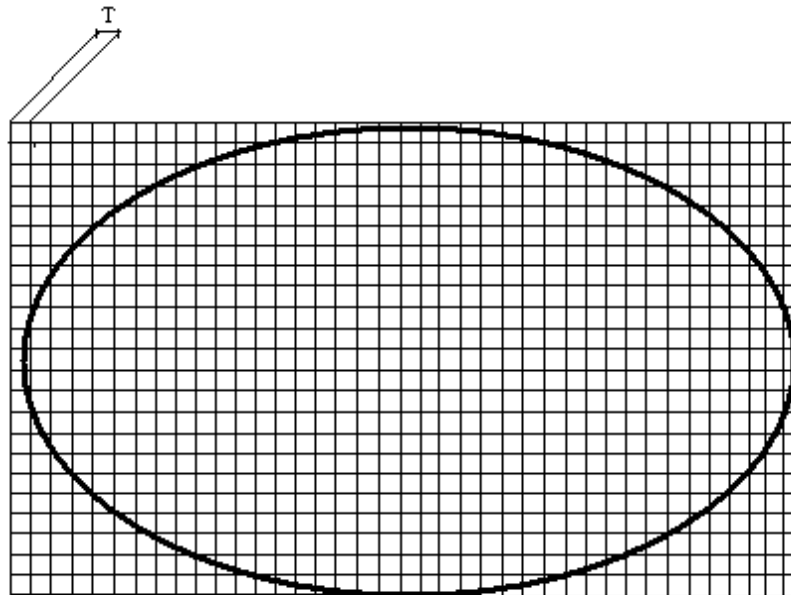
After the subdivision each cube that is closer to the original surface than the given minimum wall thickness is marked as *close voxel*. This can be done on the inside or outside normal side of the original surface, but for hollowing, you are

only interested in the internal side. In the image below the *close voxels* (=closer than *2*T* units to the original surface) are shown with gray color.
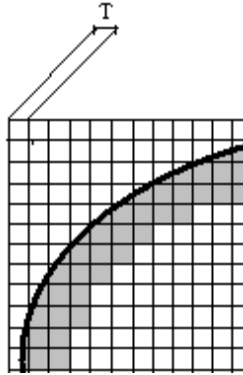
The inner surface triangles to make a hollow model are generated where a *close voxel* is adjacent to a normal voxel. In the end, the newly generated triangles are connected at edges to create a solid inner surface.

From the above illustrations, you can see that the smaller the *Minimum wall thickness* is the more voxels will be generated inside the original model. This in turn causes more and smaller triangles to be generated. Generally, it is very important to use a suitable value for the *Minimum wall thickness* parameter, like 1/10 of the maximum extent of the original part. Too small a value for the *Minimum wall thickness* would cause the number of inner surface triangles to grow very fast and slow down the process. Also, too small a value for the *Minimum wall thickness* may generate walls that are too thin during the build and cause the hollowed part to break during cleanup.

Chapter 4 – Conclusions

Congratulations for reaching the end of this tutorial! The process and commands you have just learned will help you to hollow a model and to create a drain hole to remove non-binded powder material from the printed part.

We recommend that you to continue on to *Tutorial 4 – Cow* to learn more about the ZEdit Pro software and its model manipulation capabilities, such as splitting and creating connectors between split parts.

ZEdit Pro is part of the DeskArtes Expert Series software suite. To learn more about the capabilities of other Expert Series software for 3D data fixing, coloring, preparation, or 3D model generation, please visit www.deskartes.com:

- 3Data Expert for full model repair and manipulation, including 2D Dimensioning; triangle reduction and refining; support generation; model slicing; etc.

- Import Package for importing native surface models from Pro/ENGINEER®, Unigraphics®, and Catia® 3D CAD systems, and STEP files for 3D Printing.

- Design Expert for generating your own free-form 3D geometries with an easy-to-use and powerful 3D CAD system.