ZEdit Pro 1.0

Tutorial 5 – Explorer

First Edition

DeskArtes: “ZEdit Pro 1.0: Tutorial 5 - Explorer”

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Credits

All Tutorial geometries are courtesy of Z Corporation and used with its permission.

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Chapter 1 – Foreword

The *ZEdit Pro 1.0 Tutorial 5 – Explorer* tutorial introduces the advanced repair functions available with ZEdit Pro software. Through this sequence, you will learn how to repair the *Explorer.wrl* model using the Auto Repair tools as well as the offsetting and surface-joining tools. In the final step, you will output the file for printing with Z Corporation color printers.

This tutorial is the last 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.

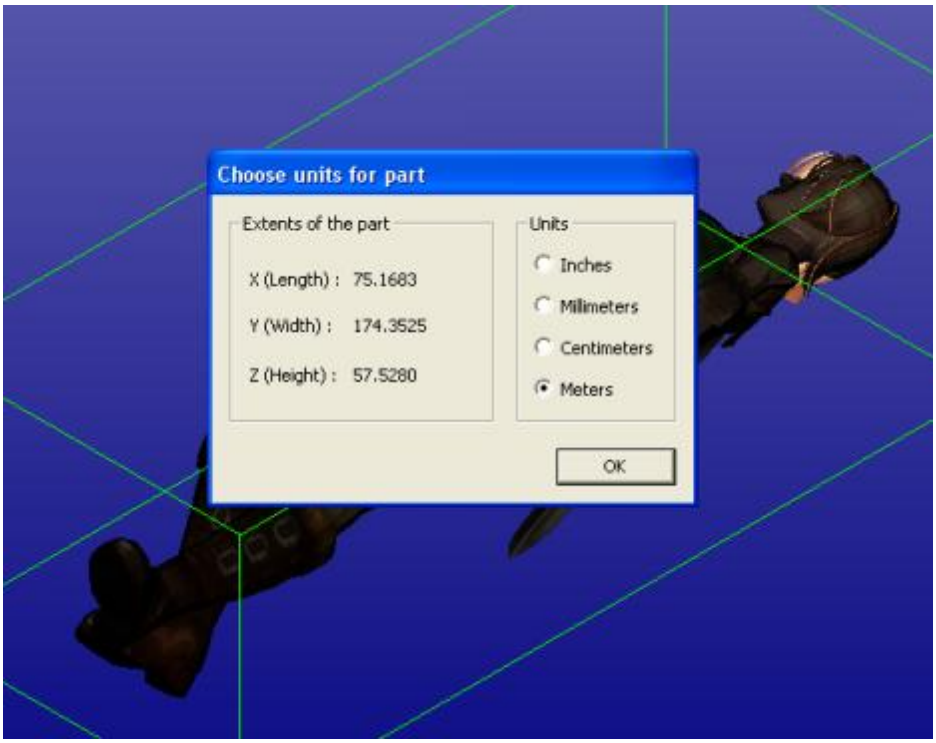
The **boldface** and *italics* used in this tutorial have the following meaning: a **boldfaced command** is a command or operation that alters the model or is otherwise necessary to reach results similar to the example. A statement in *italics* denotes the different parameters and their values; menu 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 Explorer model

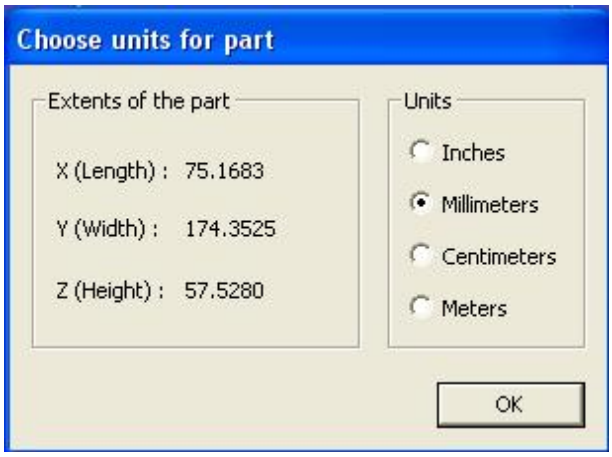
In this example, you will go through the steps required to fix a human figure (*Explorer)* model. The *Explorer* model is available in VRML format (.wrl) on the ZEdit Pro installation directory (*Tutorials/Tutorial 5 – The Explorer* directory). You will start with a VRML model that has full texture coloring. After completing model repair, you will save and store the model in ZPR format for 3D color printing.

Please **input the *Explorer* model (*File > Open*)** from the *Explorer.wrl* file. You should see the following result on your computer screen:

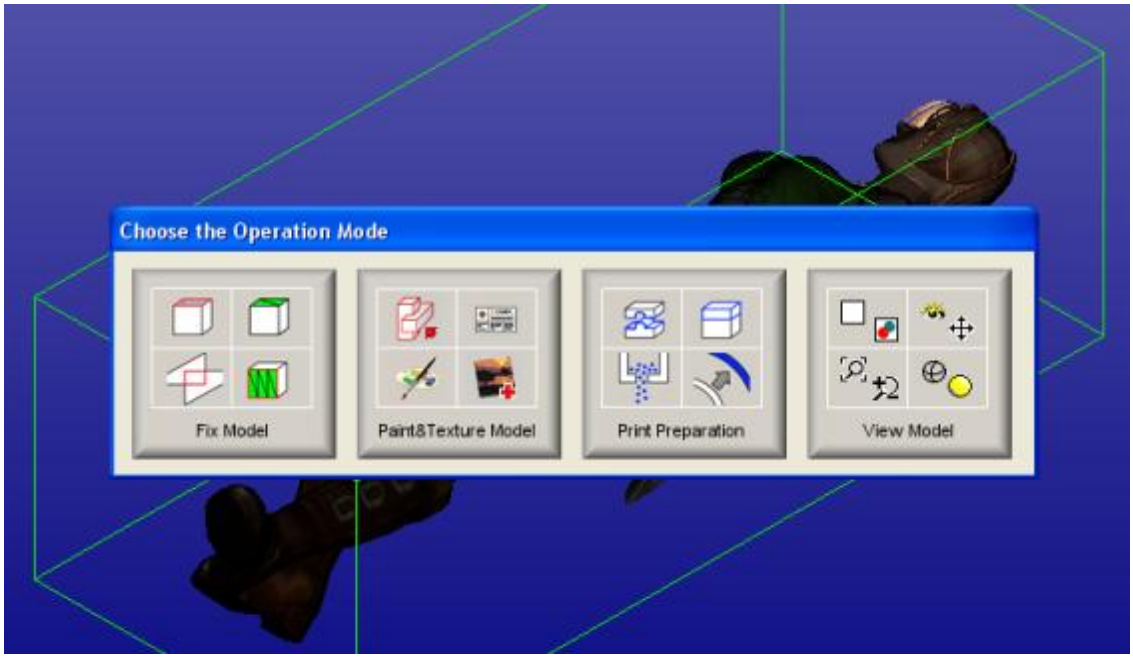


You can also start ZEdit Pro through the ZEdit Pro icon in the ZPrint software (or through the *Edit > Start ZEdit Pro* command). In this case, the model will automatically load to ZEdit Pro. The software will ascribe a temporary file name to the model instead of *Explorer*.

The *Choose units for part* dialog allows you to set the correct unit if the default suggestion is incorrect. The unit will be saved in the ZPR (or 3DE) file when you store the file. For the *Explorer* model, you will choose millimeters. This will allow the model to fit into the build area of the 3D printer.



After selecting the *millimeters* **Press OK** to continue. The *Operation Mode* window will appear:

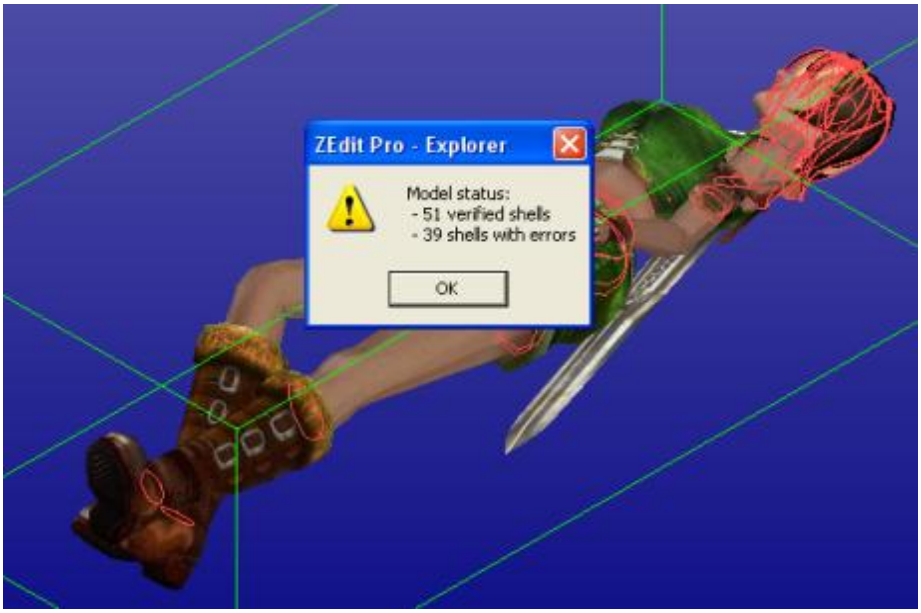


At this stage, the model looks very dark. This is due to the surface normal directions, which are pointing inside the part. In a correctly faceted file for 3D printing, the normals should all point outside. You will fix the model in this tutorial.

ZEdit Pro has three main operation modes: *Fix Model*, *Paint & Texture Model,* and *Print Preparation* mode, as well as a temporary *View Model* mode. You will **select the Fix Model mode**, which takes you to automatic model verification and repair and shows shortcuts to the main tools for repair work.

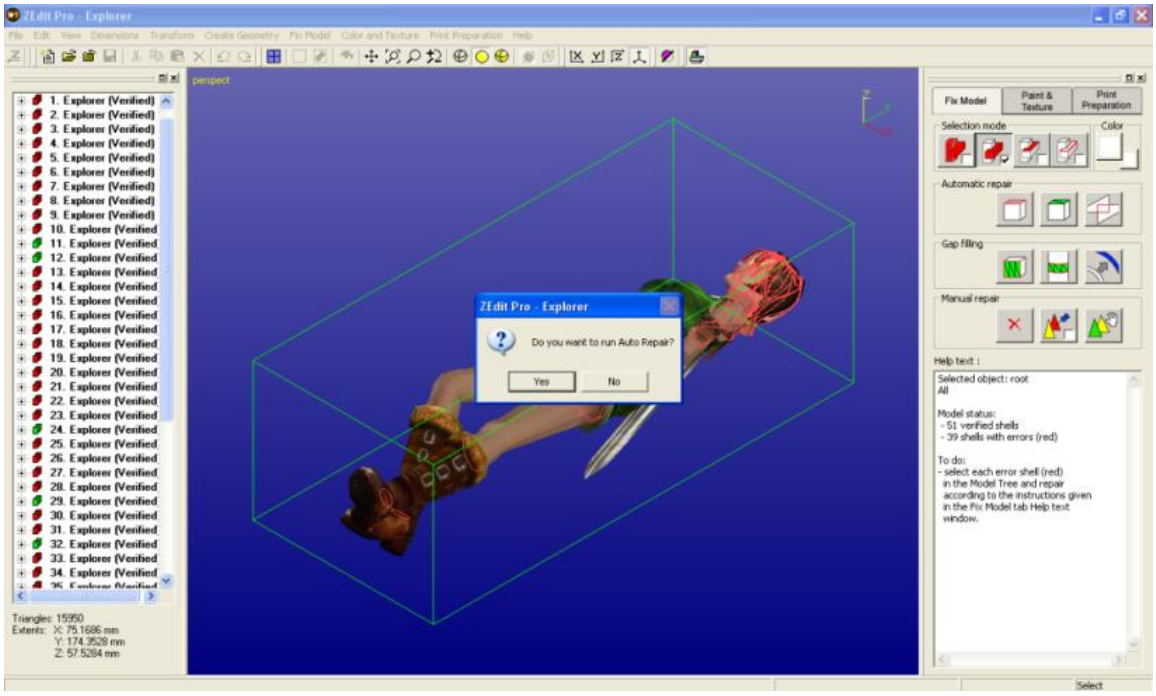
Fixing the Explorer automatically

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 toolbar appears. When the analysis is ready, a *Model status* message box displays:



The message indicates that there are 51 verified shells, of which 39 shells contain errors. The display shows red *Gap curves* through the surfaces. Gaps along with inside-pointing normals are the errors you must fix during the repair process. You can already see that the model now displays with mostly bright surface colors. This indicates that most surface normals are already oriented consistently and correctly outwards.

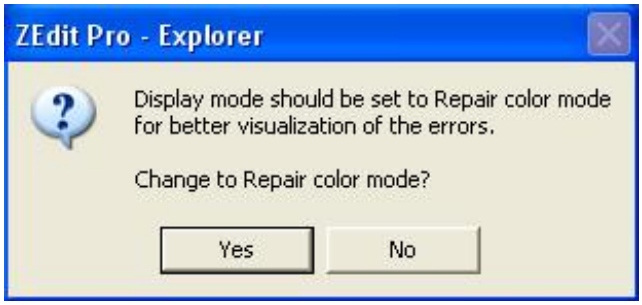
The model is divided into separate shells during verification. In the case of the Explorer, shells include the head, upper torso, pelvis area, legs, and boots. **Press the OK button** in the *Model status* dialog to see the full model structure with different shells in the *Model Tree* (on the left-hand side of the image that follows). The error shells have red icons, and the correct shells have green icons 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.



You are now in the middle of the automatic verification and repair process. ZEdit Pro now asks if you wish to continue with *Auto Repair*:

Auto Repair is the normal path to follow when repairing models so **press the Yes button** to initiate Auto Repair. Auto Repair will attempt fix all shells with errors in the Model Tree.

When Auto Repair is started each shell is run through the automatic repair command (*Fix Model > Repair Shells* command) using automatically calculated parameters. For each shell, a progress bar shows the progress of the repair (and this may cause some flickering on the screen when shells with only a few triangles are repaired). Then you will receive the following message:



You are prompted for the *Repair color* mode. **Press Yes** as you need to find and fix all errors in the *Explorer* model. You will see the *Model status* window:

You may see the short "*Introduction to File Fixing*" splash screen (see the image that follows). The "*Introduction to File Fixing*" page includes a short 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, ZEdit Pro attempts to fill all gaps and to remove non-manifold triangles from the model (to see more about triangle errors, please access the "Triangle errors" page in the Online Help chapter "Handling Faceted Models"). The *Explorer* model includes several shells that are flat and open, and cannot just be filled with triangles, because that would leave several gaps in the file. Many shells are also fixed (green icon) during Auto Repair.

The Tip text (if displayed) recommends:

"*Please select each shell with errors (red icon) from the Model Tree to see the required repair action in the Fix Model Help text window. Compare also to neighboring shells to see if Join Gaps or Offset should be used to create solids.*"

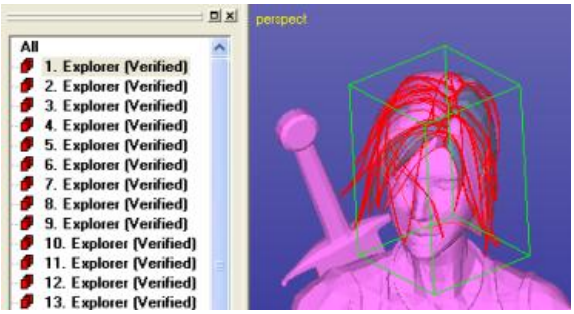
This is exactly what you need to do. You will gain a general understanding of the remaining errors through a visual investigation and from the Help text in the Fix Model Tab.

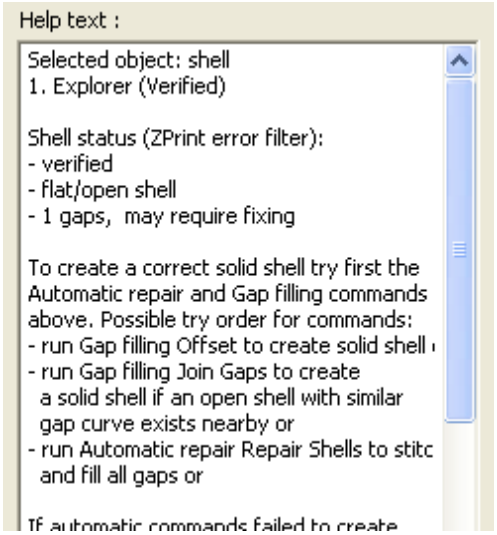
Filling a gap in a shell by Offsetting

The Model Tree contains several shells with errors indicated by red icons. The errors involve gaps left in the shells. Auto Repair will not fill flat shells with large gaps or small shells with relatively large gap areas to avoid creating erroneous geometry. The final repair decision on these shells is left to you, the user.

You should now examine each error shell with a red icon in the Model Tree to develop a better understanding of the errors. Make sure **the Shell selection mode is on**:

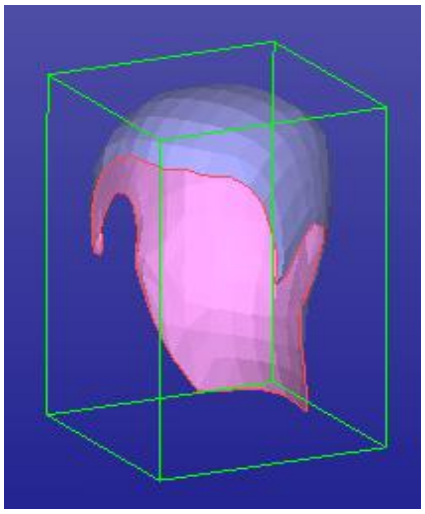
Start with the shell *1. Explorer (Verified).* You can **select it directly from the Model Tree** (or click on it in the display area), as shown in the left-hand image that follows. When the shell is selected, Help text is displayed on the Fix Model Tab as shown in the left-hand image:

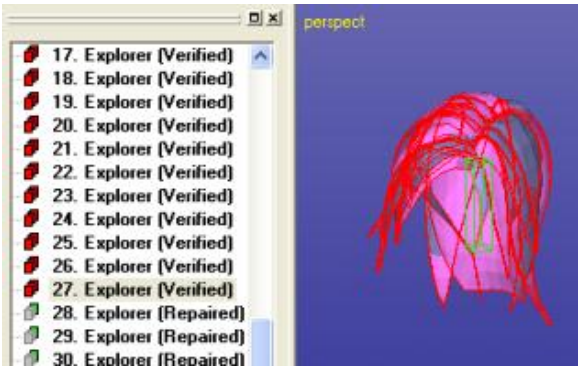




The Help text gives the status of the selected shell first: *verified, flat/open shell, and 1 gaps*. Each shell must be a solid so we need to fill the gap in shell 1.

The Help text suggests three ways to fix the model: either use the *Print Preparation* > *Offset* command, run the *Fix Model* > *Join Gaps* command, or run the *Fix Model* > *Repair Shells* command on the shell. The first suggestion (related to a flat/open shell) is to use offset to see if there are other similar surfaces nearby. Closer investigation (**Select and Fit shell *1. Explorer:* icon + RMB**, **display shells 2-27: select one by one in the Model Tree**) of the first and nearby open shells reveals that there are no other shells with similar gap curves nearby. The other open shells are smaller hair locks that need to be fixed separately, as shown in the right-hand image that follows:

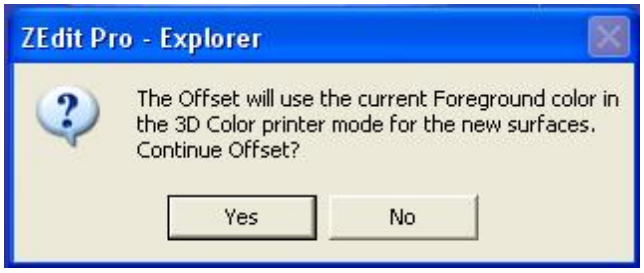




We will select the first choice and *Offset* the shell to make a solid. Running *Fix Model* > *Repair Shells* would also generate a solid but it may not generate a good fill surface due to the shape of the open surface edge.

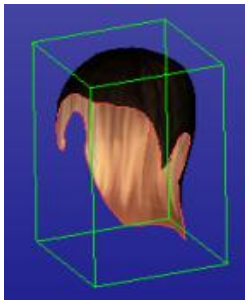
First reselect and Fit the *1. Explorer (Verified)* shell and then give the *Print Preparation* > *Offset* command or **press**

the Offset button in the *Gap filling* group in the Print Preparation Tab. First, you may get the warning dialog (only once per session):



The offset command generates new surfaces. You should select a good color for the new surfaces before performing the offset, otherwise you will need to color the surfaces later using the Paint commands. **Press No now** to select the *Foreground* color used for the new surfaces. To select the correct Foreground color, do the following:

- **Turn on the 3D color printer mode** by pressing the icon. The hair base should look like the image that follows:

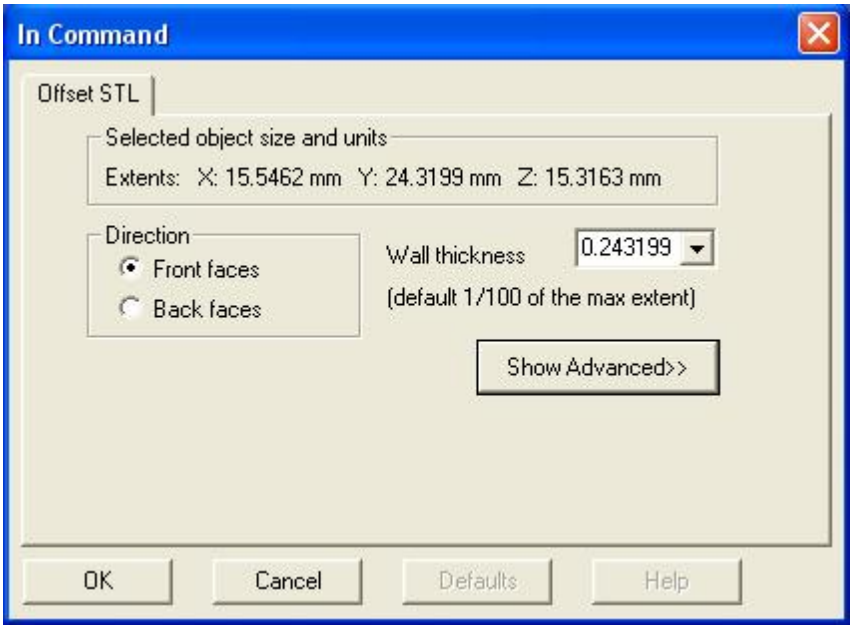


- **Press the Foreground color button in the *Color* group with the *right mouse button* (*RMB)*** to enable the **eyedropper** to select the color from the screen.

- **Select a suitable color from the lighter side of the shell with the eye dropper**, like the light-brown shown below:

From now on all new surfaces will be generated using the selected color (until it is changed or the program is restarted, in which case the initialized color is white).

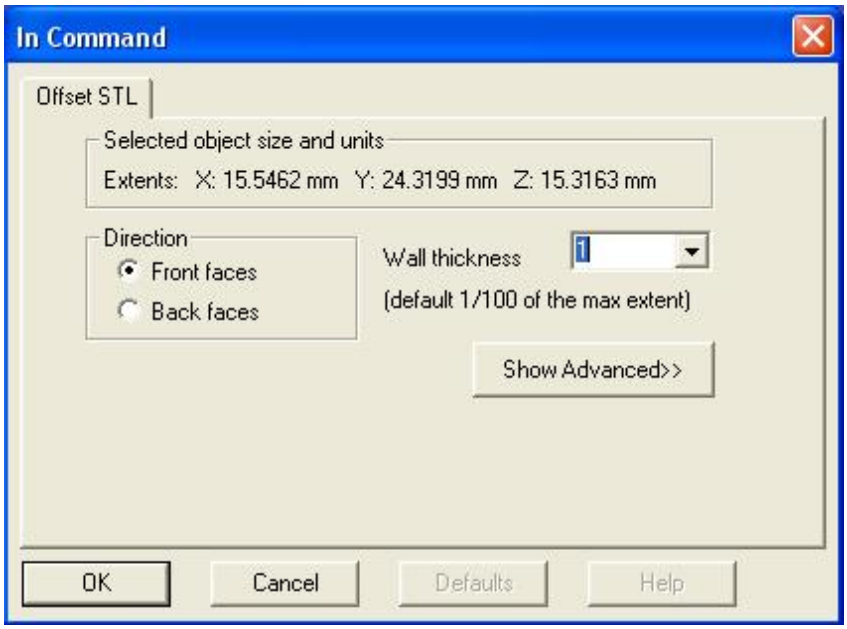
Restart the offsetting by pressing the Offset button again. This will bring forward the *Offset STL parameter dialog*:



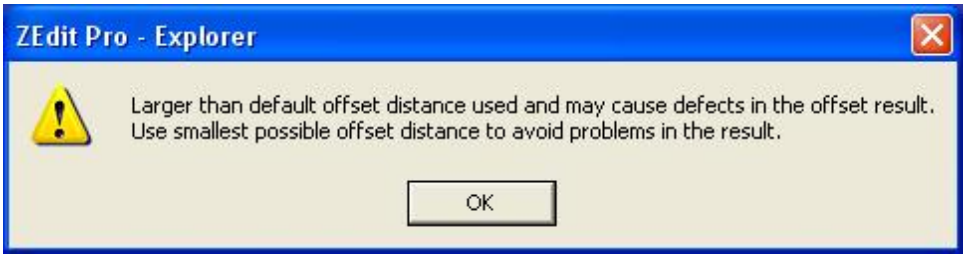
The parameters have the following meanings:

- *Direction* will select the direction of offset of the shell either to the *Front faces* (i.e., normal direction, lighter side) or to the *Back faces* (i.e., opposite side, darker side).
- *Wall thickness* will give thickness to the offset. The thickness should be large enough to make the part strong enough after the build.

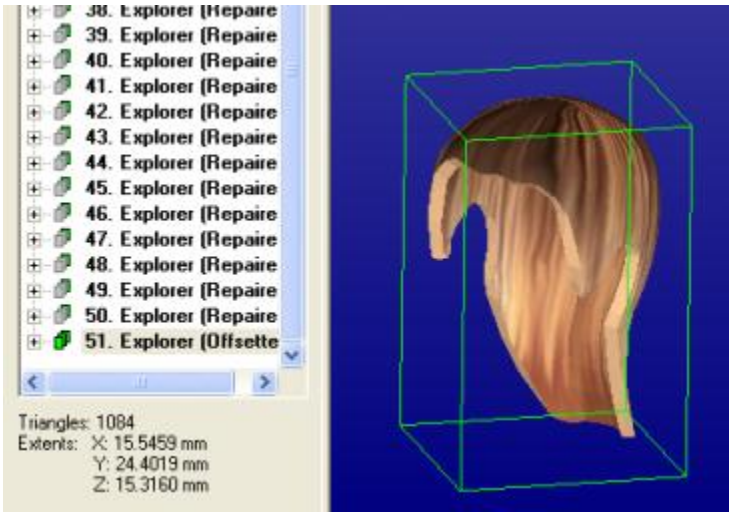
You will select the *Front faces* for the hair setting so it will glue properly to the head part (shown with clipping later). You will also **set the *Wall thickness* to 1.0 mm** to make the hair base more robust than the default thickness evaluated by the size of the shell:



When you make the *Wall thickness* larger than the default value a warning is issued due to the complexity surrounding the creation of offsets larger thicknesses than the default values. You can ignore the warning and **press OK to close the window**:



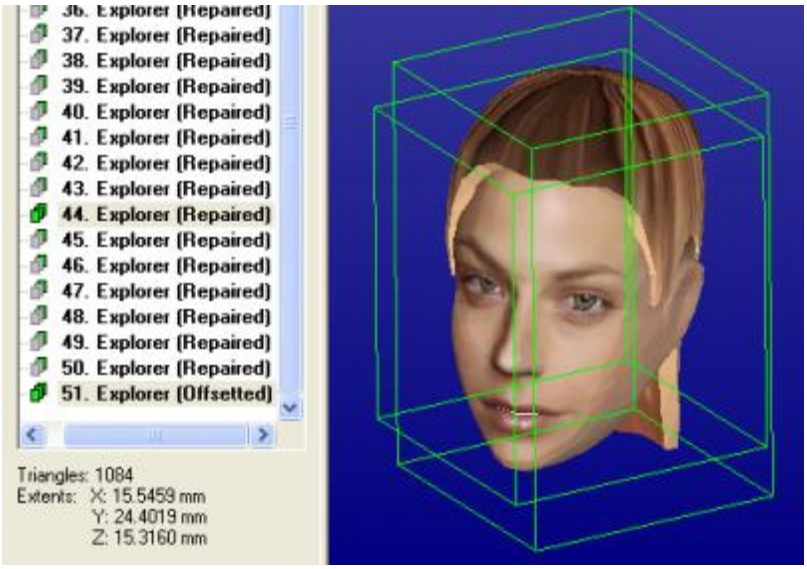
Press OK to start the Offset command. When the result is ready, it is checked into the Model Tree:



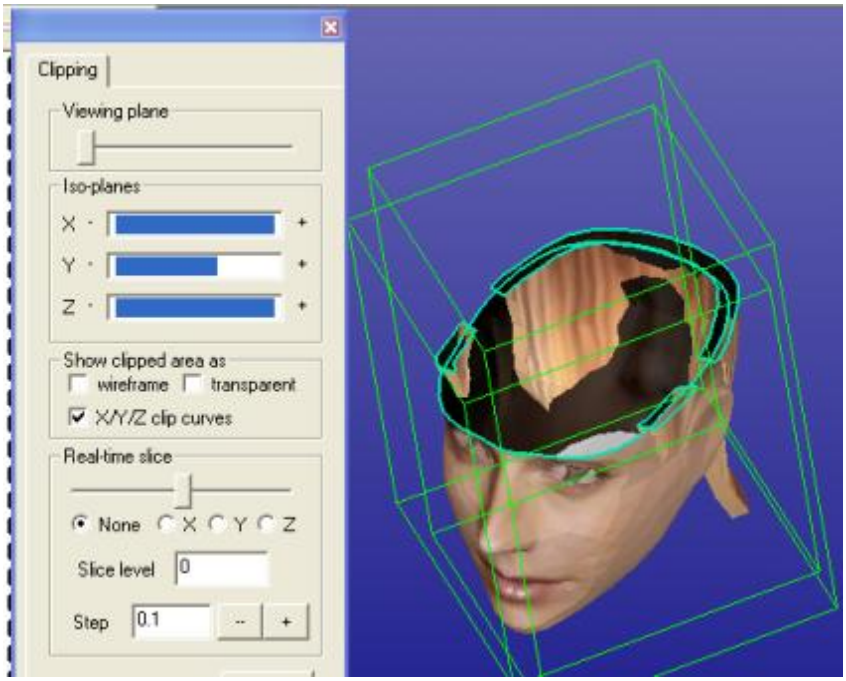
The new offset surface has exactly the same texturing as the original surface. The connecting surface between the original surface and the offset surface is using the previously set light-brown *Foreground* color.

The offset result is stored at the end of the Model Tree as *51. Explorer (Offsetted)* shell. The shell 51 icon is green so it is ready for printing.

You should now check that the solid object you have just generated will intersect other parts of the model so it can be connected with the rest of the model during the build. To check the intersection, first display only the two shells, *44* and *51*, on the screen (**press Hide All ☐ icon with the *left mouse button (LMB)*** then **select the shells *44* and *51*** from the Model Tree using multiselection):



Then **display the Clipping Tab** (with icon) to examine inside the part. **Also, use the *X/Y/Z clip curves*** to see the blue clipping curve at the ***Y*** clip plane. As shown in the image that follows, the two shells intersect each other and will be fastened together during the printing of the real part.

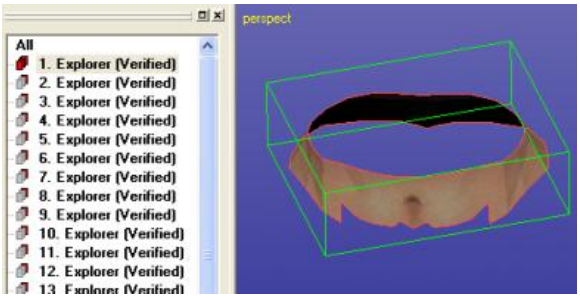


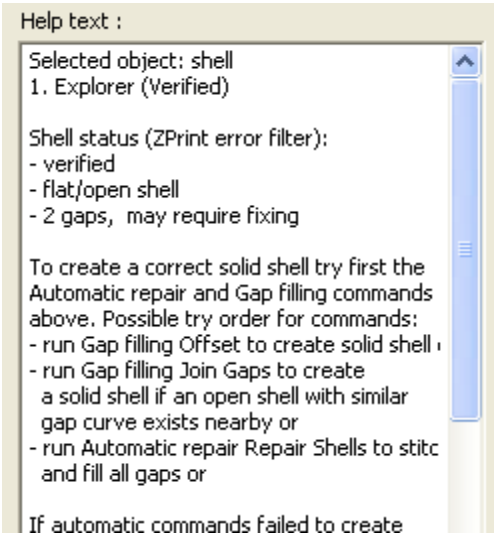
Now press the Reset button to remove clipping and the **close the Clipping Tab** by pressing the clipping icon again.

You have now completed offsetting the first open shell to make a printable solid. Now look at the top of the Model Tree again.

Filling a gap in a shell using Repair Shells

Erase the screen using the Hide All icon and then **select shell *1. Explorer (Verified)*** from the Model Tree. When the shell is selected, Help text is displayed on the Fix Model Tab as shown in the image that follows:



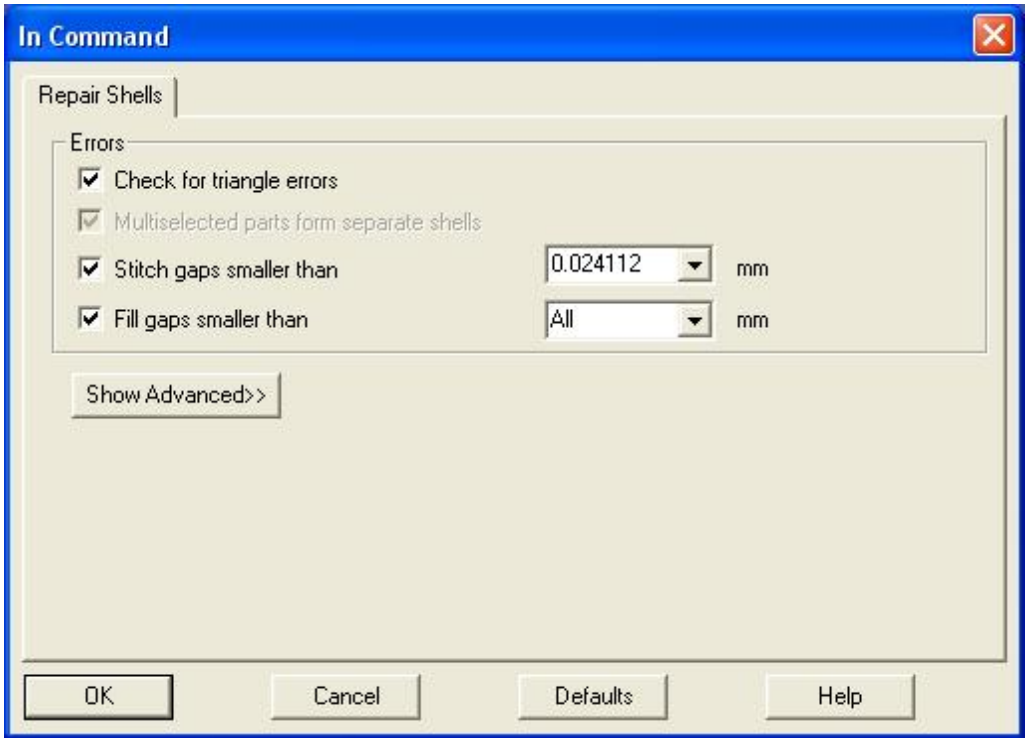


The Help text gives the status of the selected shell first: *verified, flat/open shell, and 2 gaps*. Each shell must be a solid so you need to fill the gaps in shell 1.

The Help text suggests three ways to fix the model: either use the *Print Preparation > Offset,* the *Fix Model > Join Gaps*, or the *Fix Model > Repair Shells* commands on the shell. Offsetting is the first choice. If you look at shell 1 and the two shells above (upper torso, shell *27*) and below it (pelvis area, shell *50*), it seems clear that a fully solid block would be more appropriate in this location (to build a more robust part). Also, closer investigation of shell 1 and the nearby shells reveals that there are no other shells with similar gap curves nearby. Therefore, you should select the last suggestion and use the *Fix Model > Repair Shells* to fill the two gaps.

The Repair Shells command is started by **pressing the Repair Shells**

button in the Fix Model Tab group under *Automatic repair*. This will display the Repair Shells parameter dialog:

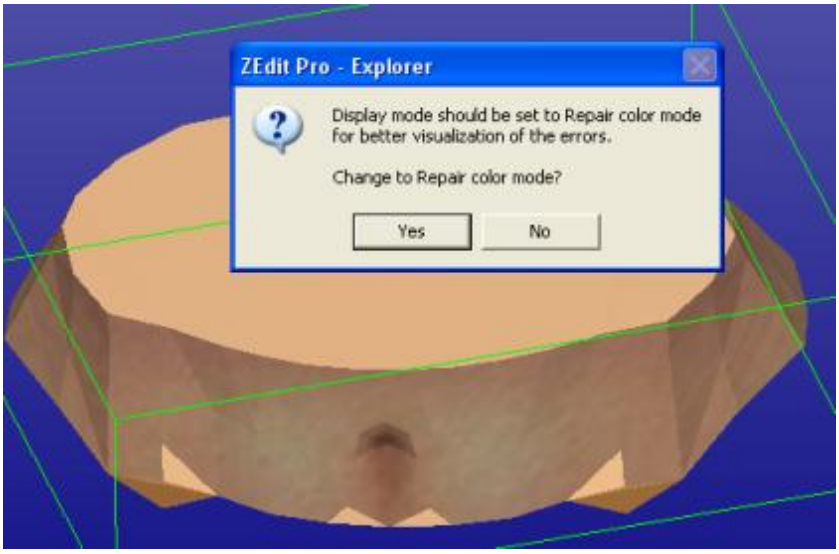


The parameters have the following meanings:

- *Check for triangle errors* will recheck any intersecting or overlapping triangles in the shell when repairing it (on by default).
- *Stitch gaps smaller than* will give the maximum width of a gap to fix by stitching (i.e., by connecting close opposite gap edges together with the value automatically calculated for each shell).
- *Fill gaps smaller than* gives the limit on how large triangles can be added to fill a larger round gap (all gaps are filled by default).

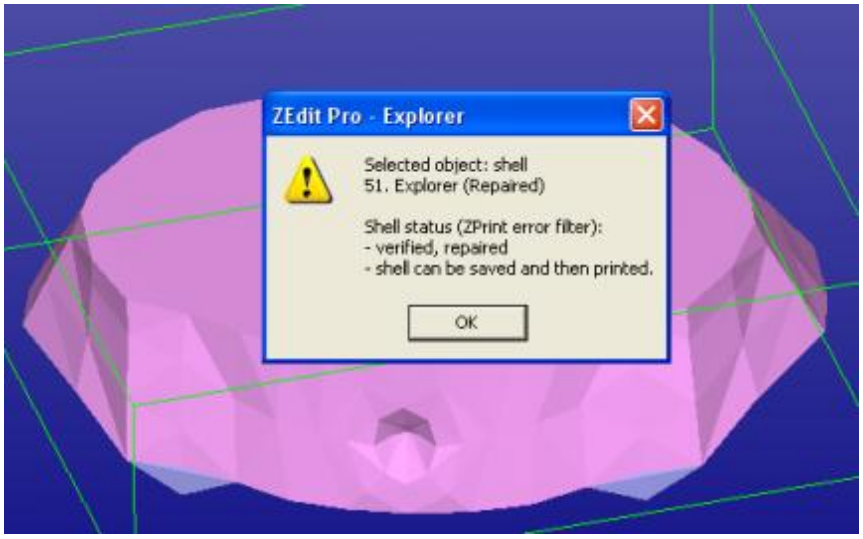
You should normally not change the values of these parameters; they are usually set correctly for the model repair for Z Corporation 3D printers. When you become more experienced with the software and go through some advanced training material, you can tune the repair results by changing the values. For more details press the Help button, which takes you directly to the *Repair Shells* command Help page.

Press OK to accept the parameters and to **run the Repair Shells command**. After a while the message



appears. You can see that the gaps are filled with the previously selected hair color, which is good enough for this purpose too. If required, you can easily paint the surfaces later.

The *Repair* color mode is always prompted after you run the *Repair Shells* or *Verify Shells* commands. **Press Yes to continue** in the *Repair color* mode normally used with the fixing process.



The resulting shell is correct and it is moved to the end of the Model Tree, as usual. Also, the *(Verified)* suffix is replaced with *(Repaired)* text. Green icon indicates that there are no more errors in the shell.

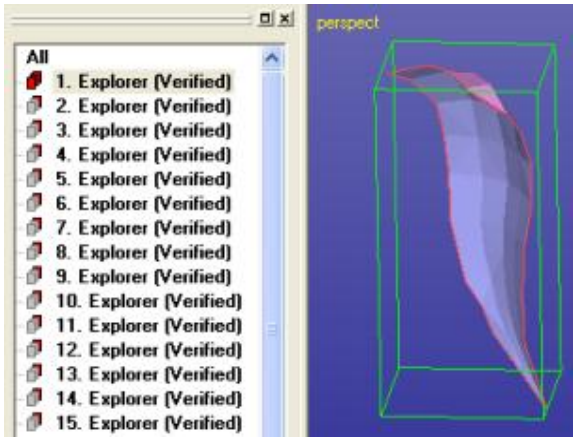
If you look closely at shell *51. Explorer (Repaired)*, you will see that some of the triangles (front bottom) show the blue inverted normal side (inner side).

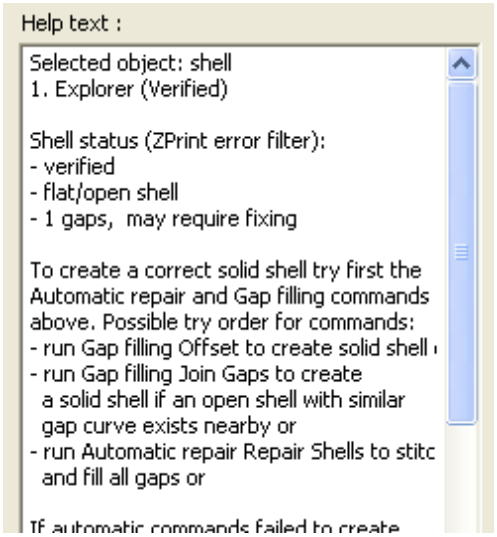
Generally, this could be considered an error. Fortunately, Z Corporation 3D printers with ZPrint software can print models with this kind of simple self-intersecting loops correctly as long as the triangle normals are consistently oriented when traversing from one triangle to its neighbors. The ZEdit Pro software is in *ZPrint error filter* mode by default. In this mode, simple loops like this are not reported as errors.

Self-intersecting surfaces may cause problems with Print Preparation commands (*Split*, *Connect*, *Drain Hole*, or *Offset*). If this happens the user is prompted to verify and repair the shells in *Normal error filter* mode (please see Online Help for more details) to produce files that fully comply with STL format requirements for accuracy. The self-intersections are removed with the *Fix Model > Remove Self-intersections* command. More information is available in the Online Help.

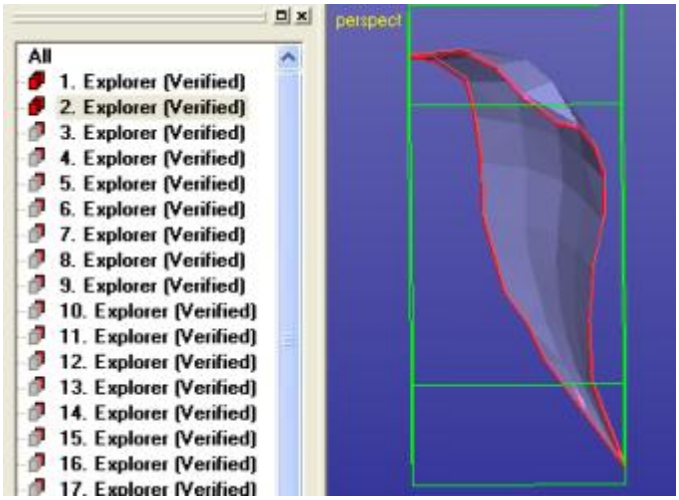
Filling gaps by joining open shells

Now **select and Fit the shell 1 again**. The first shell now contains a hair lock, as shown in the left-hand image that follows. The blue surface color indicates that you are looking at the inverted normal side of a surface in the *Repair color* mode (pink is the normal side color).



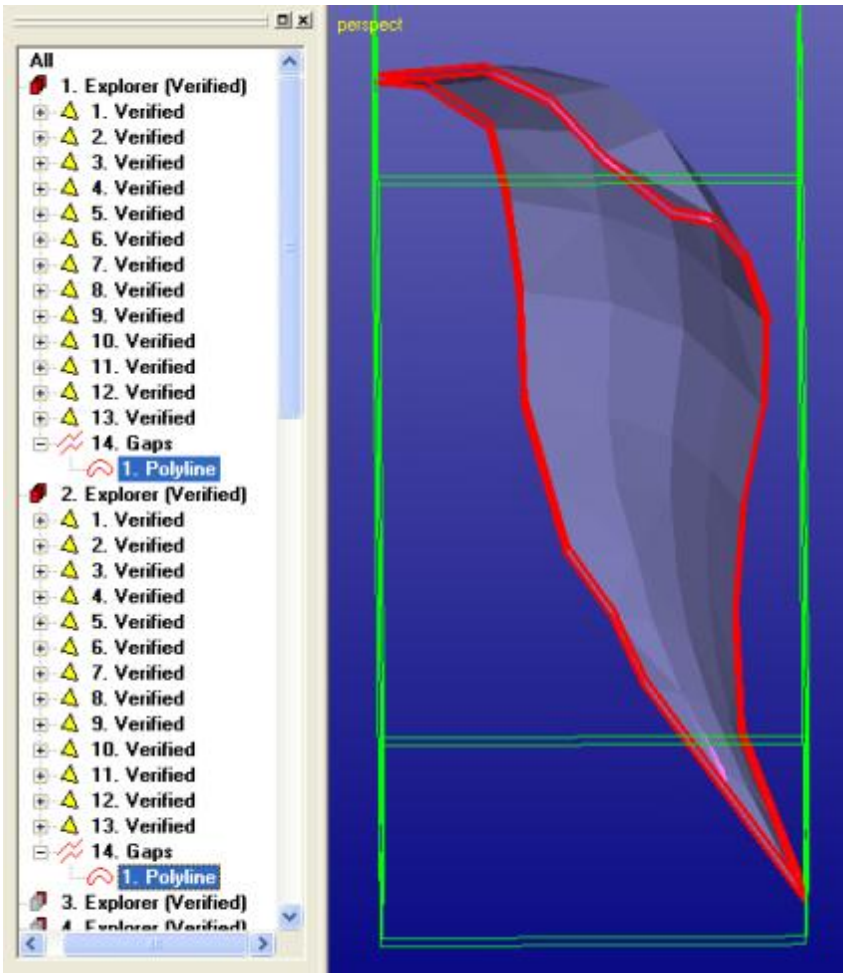


Once again, the Help text for the selected shell is available on the Fix Model Tab (right-hand image above). You have three repair possibilities to create a solid: *Offset* can be used to create a solid from the flat and open shell, *Join Gaps* can be used to connect to a nearby shell, or normal *Repair Shells* can be used to fill gaps. As mentioned earlier, you need to make a visual inspection of the nearby shells to find the correct solution. When you **select shell *2. Explorer (Verified)*** in the Model Tree you will immediately see that there is a shell with a matching gap curve nearby:



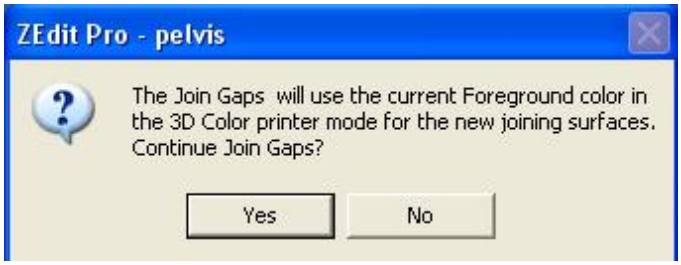
The correct command to make a solid shell is to join the two surfaces (shells) with the Join Gaps command. **Set Selection mode to Gap selection**:

Then **select the two gap curves using multiselection** (*Ctrl* + *LBM*) from the display area as shown in the image that follows. You can also select the gap curves directly from the Model Tree:

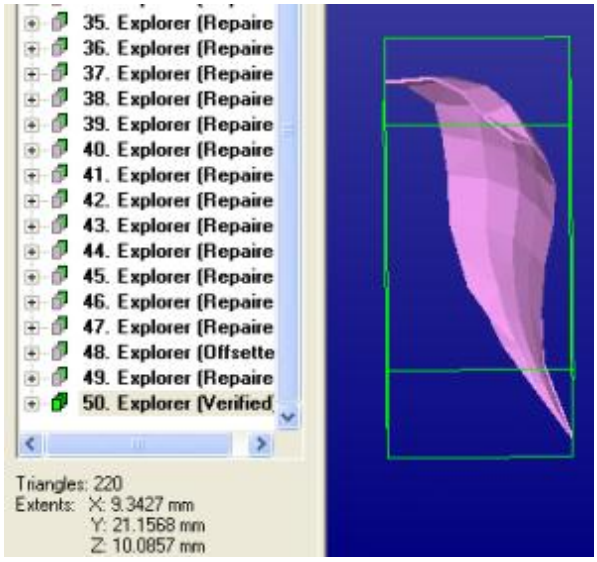


Then give the *Fix Model > Join Gaps* command or **press the**

Join Gaps button in the Gap filling group in the Fix Model Tab. You will get the warning message:



Press Yes to continue and soon you will find the joined shell with no gaps and correct normal information at the end of the Model Tree.



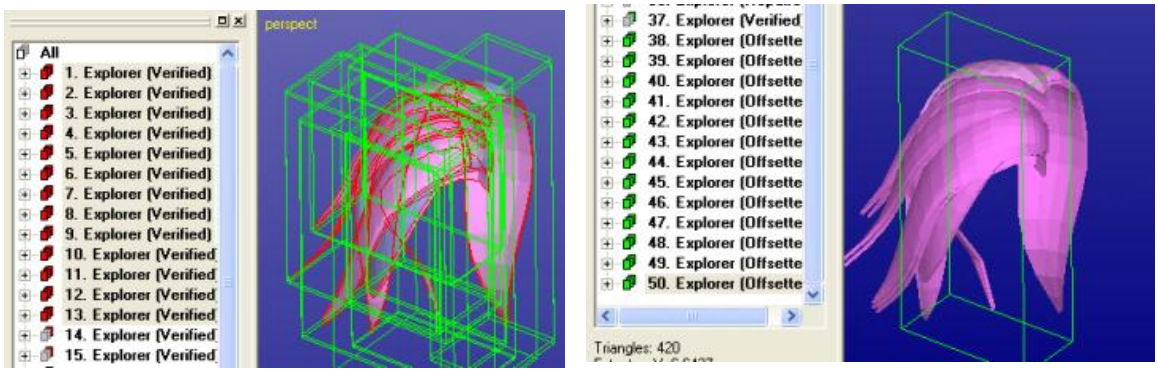
The newly created shell is actually rather thin. You may want to add material to it using the *Create Geometry* > *Extrude Surface* > *from Surface* command. The use of this command, as well as how to check shell thickness, is explained in the *Tutorial 2 – Black Bass*. You do not need to add any material now but you may do it later if you wish to print the model. This stage in the repair process is stored in the *Explorer-stage1.zpr* file in the *Tutorial 5* directory.

You also may have used the *Print Preparation* > *Offset* command to create a solid from each shell separately. This approach is the one you will take in this tutorial.

Repairing the rest

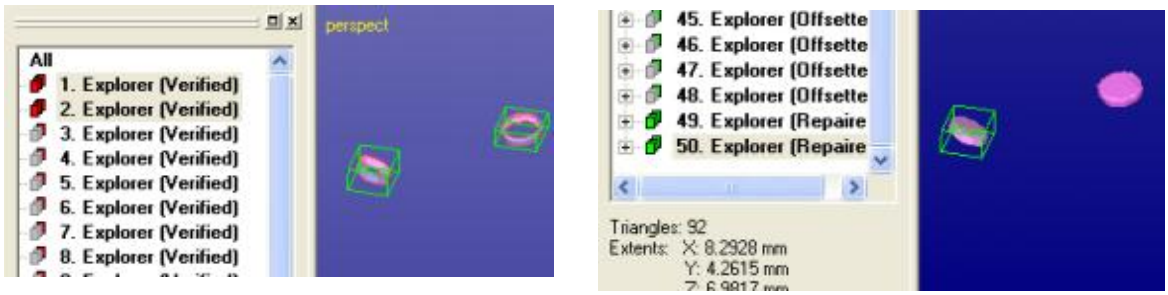
Now you need to repair the remaining shells. If you need to restart with the *Explorer-stage1.zpr* file, select the *Fix Model* mode and press **No** when the program asks about Auto Repair.

You will use multiselection to speed up the repair work. First, **select shells 1 to 13** as shown in the right-hand image that follows. Then **give the Offset command to create thickness** for each shell. Use the default calculated parameters (thickness about 0.2mm). The resulting solid shells appear at the end of the Model Tree.

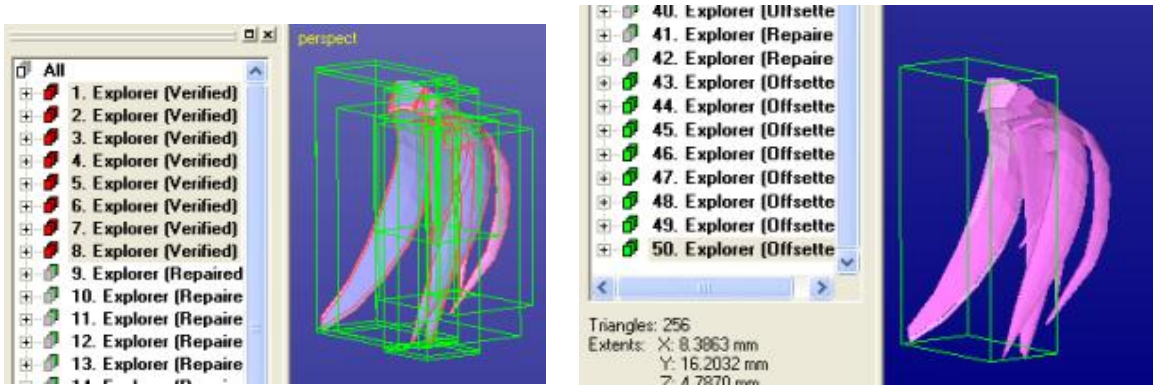


Then **select shells 1. and 2.** as shown in the left-hand image below. Now **give the command *Repair Shells*** to create solid shells. **Press *OK* to accept the default parameters**. The software warns about filling flat/open shells, **press *No*** to allow it to fill *flat/open* shells:

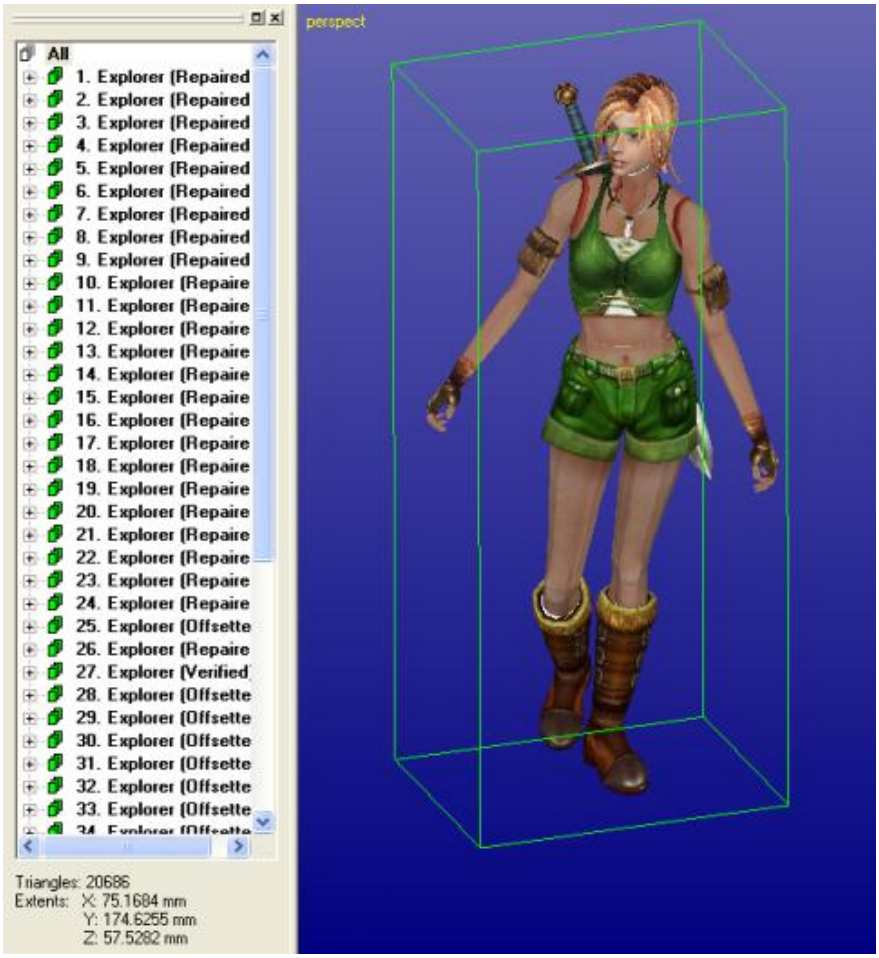
The resulting solid shells appear at the end of the Model Tree, as shown in the right-hand image that follows.



You can now **select the remaining red shells (1-8) and offset to default thickness:**



You have now created a correct model made completely out of solid shells with just a few simple steps, as indicated by the green shell icons in the Model Tree. Press the 3D color mode icon to see the final model in full color.



Saving the file

When saving the file to the ZPR format with the *File > Save As* command you must take some care. The final model contains many shells (50), which all can be outputted separately without making the whole model. The best practice is to display the Model Tree (*F8* key) and **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. The final result can be found in the file *Explorer-ready.zpr.*

If ZEdit Pro was started from the ZPrint software, **pressing the *Return to ZPrint***  icon will transfer the whole model back to ZPrint automatically.

Chapter 4 – Conclusions

Congratulations for reaching the end of this tutorial! The process and commands you have just learned will help you to fix models when Auto Repair leaves open shells in the model. Join Gaps command and Offsetting can also be actively used to connect open flat shells into one solid shell.

This is the final tutorial in the set of five tutorials covering different aspects of the use of the ZEdit Pro software. You can now use ZEdit Pro for normal everyday work while preparing models for 3D color printers.

ZEdit Pro is part of the DeskArtes Expert Series software suite. To learn more about the capabilities of 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.