

SOFTWARE/PRODUCT/FINISHING

OVERVIEW

Build optimization is dependent on a part's function (conceptual model, functional prototype, manufacturing tool or end-use part). Based on the part's function, the user must select the appropriate orientation to balance or optimize surface finish, strength or build time of the part.

1. OPTIONS

1.1. Surface Finish

Part orientation impacts surface finish due to the process of slicing and printing the part in increments in the Z direction. Orienting the part so that curved or angled surfaces are built parallel to the Z axis will result in smoother surfaces (Figure 1).

1.2. Strength

Proper orientation of a part can dramatically increase feature strength. Small features can become stronger by simply rotating the part (Figure 2). Generally, orienting a feature parallel with the build layer maximizes feature strength.

1.3. Speed

Part orientation can affect support material usage and build speed of the part. Rotating a part to a different orientation can decrease support usage and the build time of a part (Figure 3).

In general, orienting to minimize Z height and support material will maximize the build throughput. However, it is recommended to orient the part for surface finish or strength, since orientations optimized for build speed can negatively impact strength and surface finish.

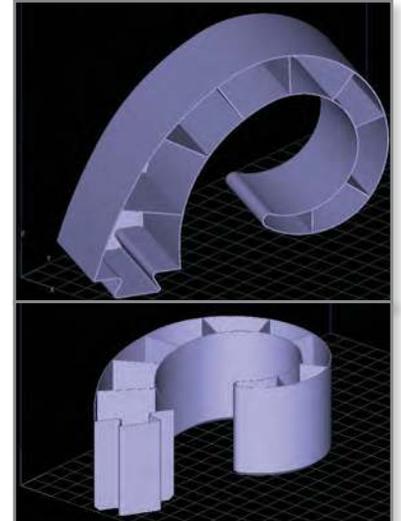


Figure 1: A curved surface will be stair-stepped (top); positioning the curved surface in a different orientation will prevent stair-stepping (bottom).

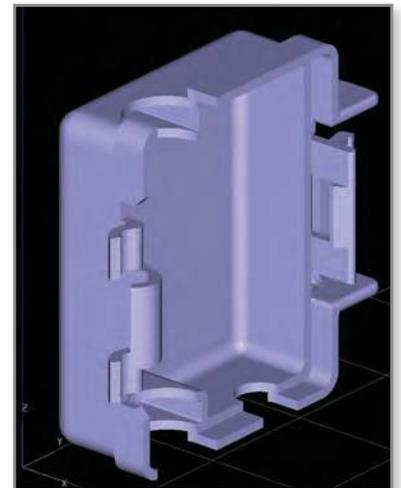


Figure 2: Orientation of a part can impact the strength of small features such as hinges and snap-fits.

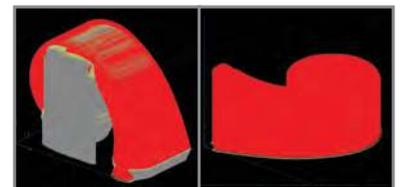


Figure 3: Orientation impacts build time and material consumption (left); proper orientation can reduce both (right).

2. PROCESS

2.1. Orienting for Surface Finish

STEP 1: Configure the modeler.

STEP 2: Open the STL file in the Insight™ software.

STEP 3: Identify the critical surface or surfaces of the part. When orienting the part, these surfaces should be built parallel to the Z axis.

TIP: Critical surfaces include curved or angled surfaces.

STEP 4: In the **STL** dropdown menu, select **Orient by selected facet** and select the desired context (**Top**, **Bottom**, **Left**, **Right**, **Front** or **Back**) (Figure 4).

TIP: The STL may also be rotated using the **Rotate** option found in the **STL** menu. This allows specification of the angles of rotation about each axis (Figure 5).

STEP 5: Click on the facet that you would like oriented in the selected context direction. The part will change orientation.

STEP 6: Click  to slice the file. Click  to view all layers of the sliced part and view from different angles to verify you have eliminated stair-stepping on the critical surfaces. If stair-stepping remains on a critical surface, re-display the STL and return to Step 3.

NOTE: The term “stair-stepping” refers to a vertical shift between layers.

STEP 7: Orienting for Surface Finish procedure is complete.

2.2. Orienting for Strength

STEP 1: Configure the modeler.

STEP 2: Open the STL file in the Insight software.

STEP 3: Identify how the part will be used and any forces that will be acting upon it. Also identify any functional features. When orienting the part, these surfaces should be built perpendicular to the Z axis and in orientations that maximize the surface area of these features (Figure 6).

NOTE: Functional features are characteristics of the part that facilitate its operation and function, without which the part would not perform as designed. Examples include pins, tabs and hinges.

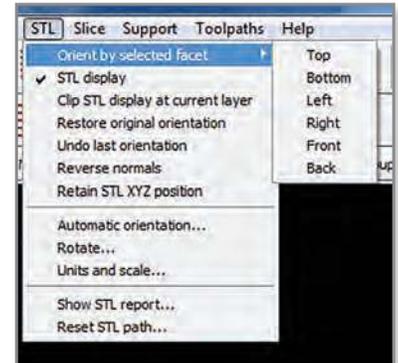


Figure 4: Orientation options based on a selected facet can be found in the STL menu.

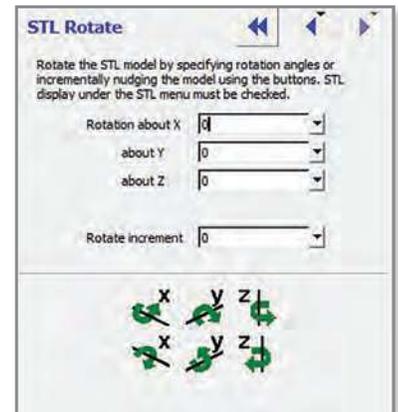


Figure 5: Specifying the rotation about each of the axes for finer control over orientation of the part.

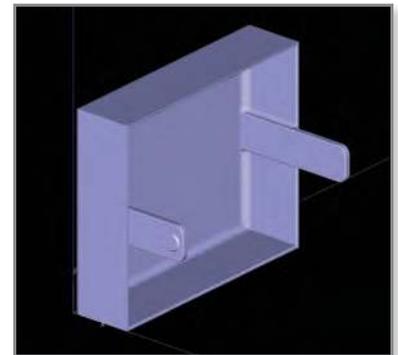


Figure 6: Functional features (tabs) are oriented perpendicular to the Z axis for strength.

STEP 4: In the **STL** dropdown menu, select ***Orient by selected facet*** and select the desired context (***Top, Bottom, Left, Right, Front or Back***).

NOTE: The STL may also be rotated using the ***Rotate*** option found in the **STL** menu. This allows specification of the angles of rotation about each axis.

STEP 5: Click on the facet that you would like oriented in the selected context direction; the part will change orientation.

STEP 6: Orienting for Strength procedure complete.

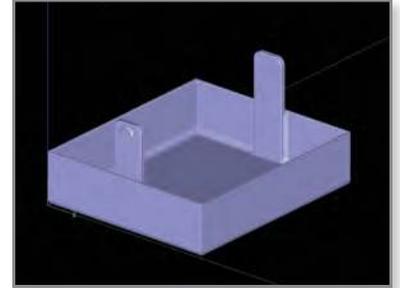


Figure 7: Model shown oriented for minimum Z height.

2.3. Orienting for Speed

STEP 1: Configure the modeler.

STEP 2: Open the STL file in the Insight software.

STEP 3: Identify the orientation that minimizes the Z height and will also require the least support material (Figure 7).

NOTE: Support usage is minimized by minimizing the height of the build.

TIP: Support usage can be further minimized by following design for FDM® best practices such as:

- Utilizing self-supporting angles
- Using custom sparse fill support towers
- Converting support columns to model material

STEP 4: In the **STL** dropdown menu, select ***Orient by selected facet*** and select the desired context (***Top, Bottom, Left, Right, Front or Back***).

Tip: The STL may also be rotated using the ***Rotate*** option found in the **STL** menu. This allows specification of the angles of rotation about each axis.

STEP 5: Click on the facet that you would like oriented in the selected context direction. The part will change orientation.

STEP 6: Click  to slice the file.

STEP 7: Click  to generate supports.

STEP 8: Click  to generate toolpaths.

STEP 9: In the *Toolpaths* menu select *Estimate time*.

STEP 10: Click **OK** and the Insight software will calculate and provide an estimate of the build time and support material required (Figure 8).

Tip: You may want to try this process in different orientations to verify you are minimizing the build time.

STEP 11: Orienting for Speed procedure complete.



Estimate Build Time

Click the OK button to calculate the approximate time to build the current part.

Estimated build time: Unknown

Model volume: 0,000 in³

Support volume: 0,000 in³

Fortus 900mc	0,0100 slice height
Model T16 bp	PC
Support T16 bp	PC support

Part interior style: Solid - normal

Support style: Basic

OK  

Figure 8: A build time estimate can help determine the material consumption and build time for different orientations.

3. TOOLS & SUPPLIES

3.1. Software:

- Insight software (documented with Insight 9.0)

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