
OSE 3D Printer Workbench

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MAIN TOOLBAR

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A FreeCAD workbench for designing 3D printers by [Open Source Ecology](#) for [Distributive Enterprise](#).
For more information on codebase conventions and patterns, see the [OSE Workbench Platform](#).

ADD FRAME

The **Add Frame** tool adds a Frame to the **active** document.

You can use this to begin designing a [D3D Pro](#) printer of any size or axis configuration.

1.1 Custom Properties

Name	Type	Default Value	Description
Has Corners	Bool	False	Whether the frame has 3d printed corners or not.
Size	Length	304.8 mm	Size or dimension of cubic frame.
Thickness	Length	3.175 mm	Thickness of frame.
Width	Length	38.1 mm	Width of frame.

1.2 Attaching Axes to the Frame

See [Add Axis](#) for details on how to attach axes to the frame.

Warning: In order to attach axes to the frame, the frame must **not** be rotated.

1.3 See Also

- [D3D Frame](#)

ADD AXIS

There are three tools in the main toolbar to add an Axis, or **Universal Axis** object in different orientations to the **active** document:

1. Add X Axis
2. Add Y Axis
3. Add Z Axis

2.1 Custom Properties

Name	Type	Default Value	Description
Carriage Position	Percent	50	Position of carriage relative to available rod.
Length	Length	304.8 mm	Length of axis corresponds to rod length.
Orientation	String	x	Orientation of axis: X, Y, or Z.
Rod Diameter	Length	8 mm	Diameter of rod.
Side	String	top	Which side the bottom of the axis faces.

2.2 Attaching Axes to the Frame

You may attach axes to the frame by selecting one of its outer faces, and then clicking a button in the main toolbar to add an axis.

Only certain axes can be attached to certain faces or sides of the frame based on its orientation.

Axis Orientation	Attachable Side(s)
X	Top
Y	Left, Right
Z	Front, Rear

Note: You cannot attach an axis to the **Bottom** face or side of the frame.

The axis-frame attachment logic assumes the frame is **not** rotated, and determines whether the user is attaching the axis to the appropriate side of the frame based on whether the selected face is parallel to the XY, YZ, or XZ plane.

Tip: See the **Report View** for attachment troubleshooting.

ADD HEATED BED

The **Add Heated Bed** tool adds a heated bed to the **active** document.

3.1 Custom Properties

Name	Type	Default Value	Description
Size	Length	203.2 mm	Size or dimension of heated bed.

3.2 Centering Heated Bed to Frame & Elevating to Z Axes

1. Hold-down `Ctrl` key for selecting multiple objects
2. Select one Z axis
3. Select the Frame
4. Click the **Add Heated Bed** button on the main toolbar

3.3 See Also

- [D3D Heated Bed](#)
- [Heated Bed](#)

ADD EXTRUDER

The **Add Extruder** tool adds an extruder to the **active** document.

4.1 Attaching Extruder to X Axis Carriage

An extruder can be attached to the carriage of the top X axis by selecting the top face of the carriage, and then clicking the **Add Extruder** button in the main toolbar.

4.2 See Also

- D3D Extruder
- File:Simpleextruderassy.fcstd
- File:Finalextruder.png

GENERATE CUT LIST

There are two options in the main menu to generate a cut list:

1. Copy Cut List to Clipboard
2. Save Cut List as CSV

Both options generate a cut list with the following:

- **Rods** for axes, heated bed, and spool holder
- **Angled bars** to construct a frame with 3d printable corners

5.1 How it Works

Each option queries the **active** document for Axis objects and the Frame object in order to determine the rods and angled bars for the cut list.

5.1.1 Determining Rod Quantity

- **2** X Axis Rods are added for every X Axis object
- **2** Y Axis Rods are added for every Y Axis object
- **2** Z Axis Rods are added for every Z Axis object
- **3** Spool Holder Rods are added based on the existence of a Frame object
- **2** Heated Bed Rods are added for every pair of Z Axis objects

5.1.2 Determining Rod Length

- X Axis Rod Length is adjusted by **adding 4 inches**
- Y Axis Rod Length corresponds with `Length` of the axis in the document
- Z Axis Rod Length is adjusted by **subtracting 1 inch**
- Length of Heated Bed Rods and **1** Spool Holder Rod are equal to the length of the Frame
- Length of **2** Spool Holder Rods are equal to the length of the Frame **minus 1 inch** (similar to Z axis rods)

5.1.3 Determining Angled Bar Quantity

- 12 Angled Bars are added based on the existence of a Frame object

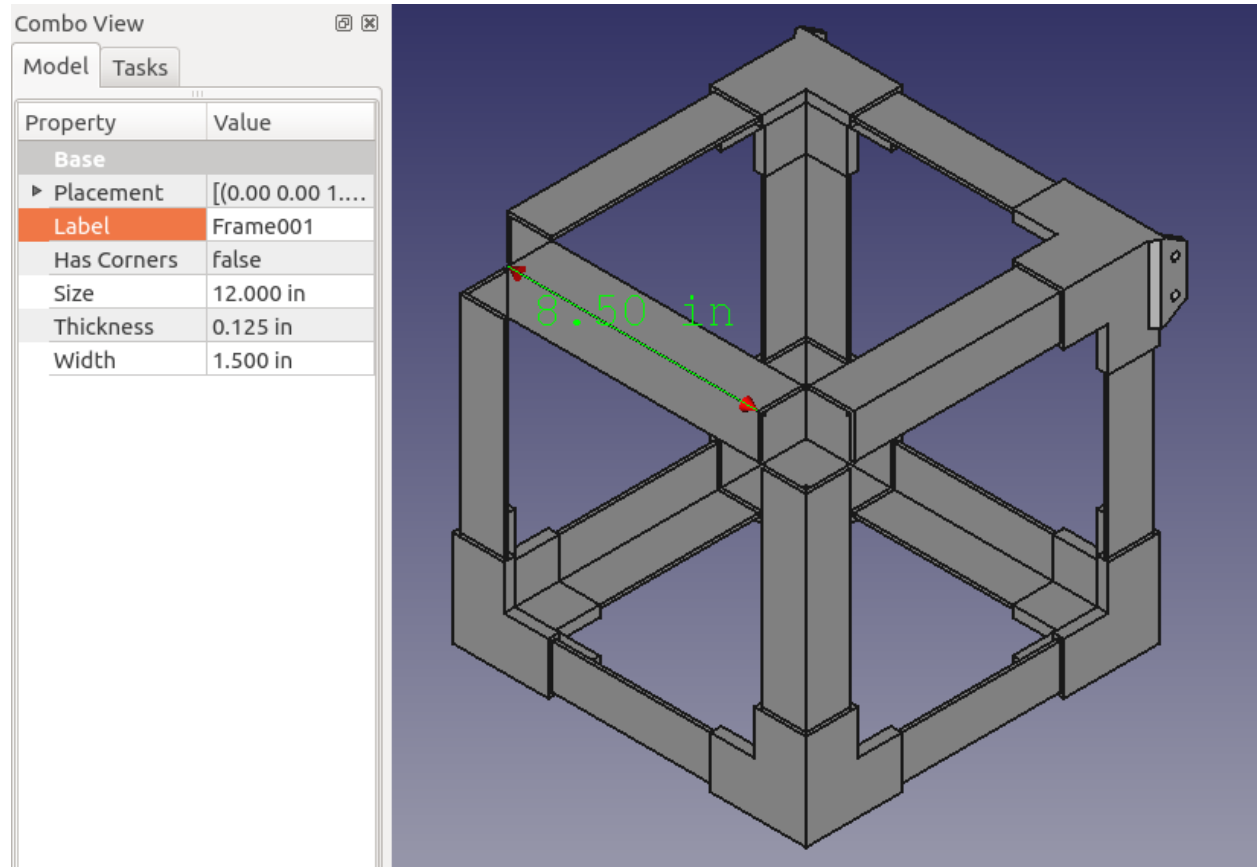
5.1.4 Determining Angled Bar Length

Angled bar length is calculated from the following formula:

$$\text{Frame.Size} - ((\text{Frame.Width} + (\text{Frame.Thickness} * 2)) * 2)$$

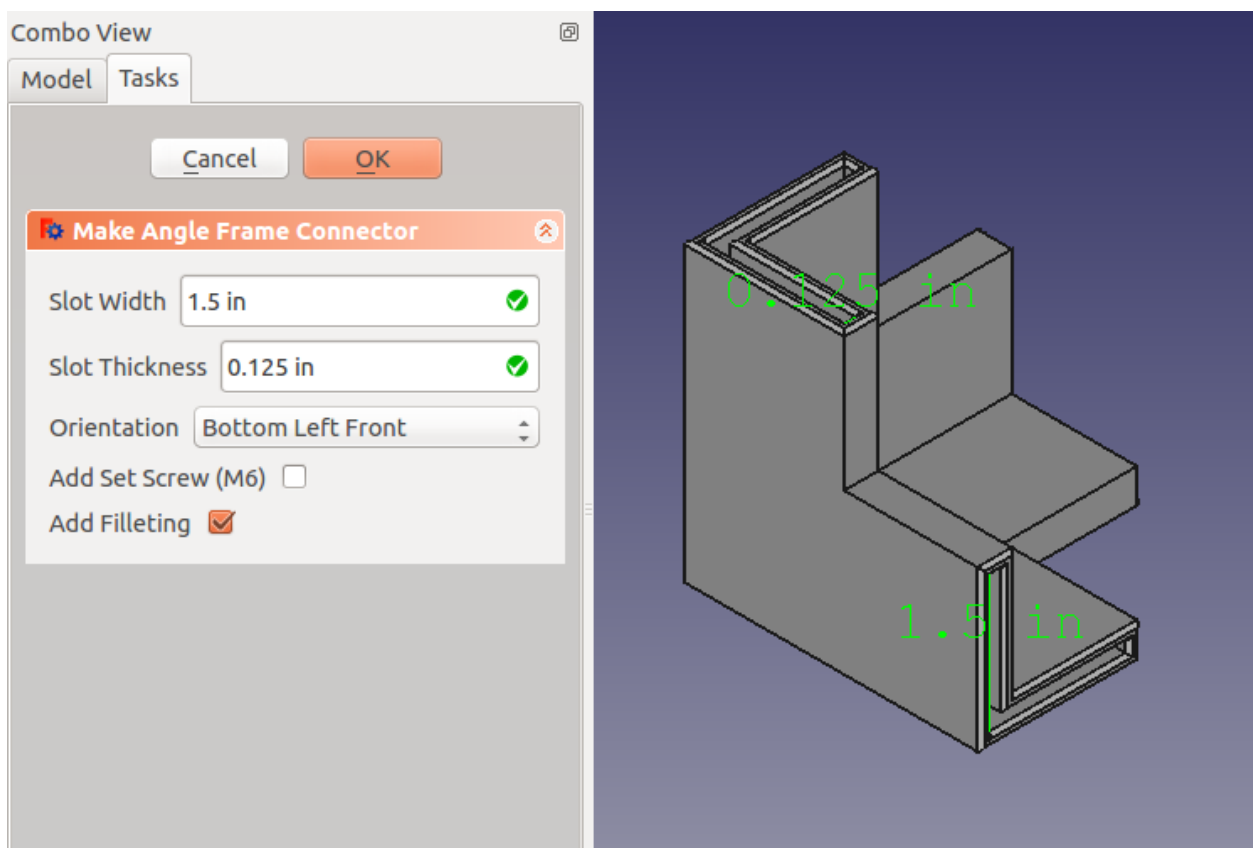
For example, a 12 in frame with a 1.5 in Width and 0.125 in Thickness could have **8.5 in** angled bars.

$$12 \text{ in} - ((1.5 \text{ in} + (0.125 \text{ in} * 2)) * 2) = 8.5 \text{ in}$$



MAKE ANGLE FRAME CONNECTOR

The **Make Angle Frame Connector** tool makes a 3D-printable [Angle Frame Connector](#) with the specified **parameters** entered from the Task Panel.



6.1 Parameters

Slot Width Width of three inner slots.

Slot Thickness Thickness of three inner slots.

Orientation One of eight possible corners of the frame.

Add Set Screw Whether to add a set screw mechanism.

Useful for larger frames when worried about slips or frame mis-alignment.

Attention: Assumes **M6** set-screw and nut.

Add Filletting Whether to round edges of three inner slots.

Tip: Makes inserting angled bars later a little easier.

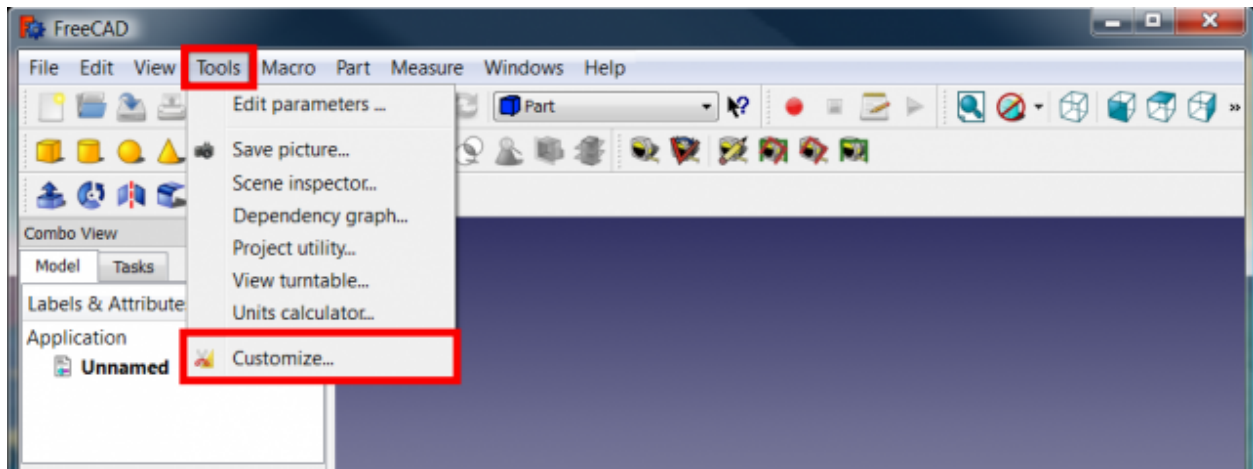
6.2 See Also

- [FreeCAD Wiki - Export to STL or OBJ](#)

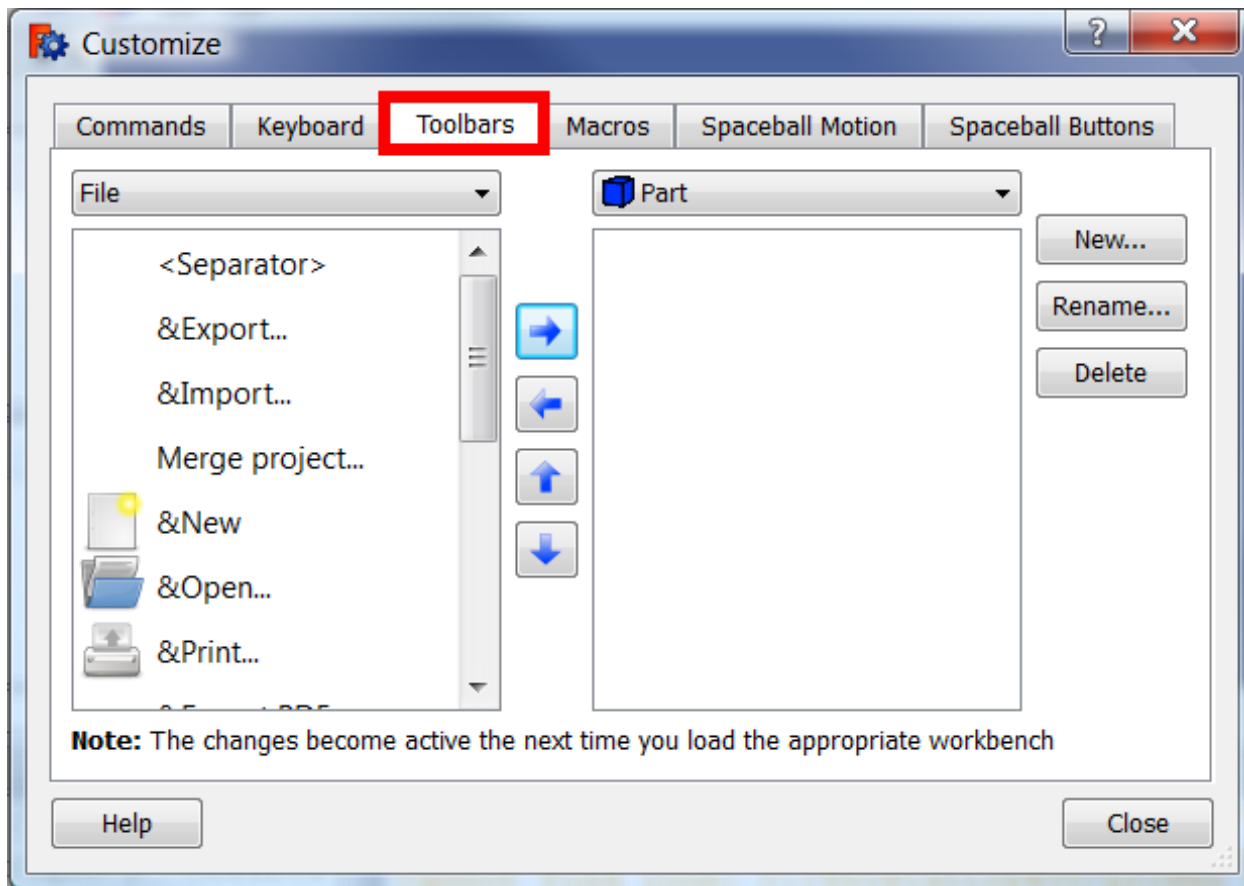
INCLUDING MOVE AND ROTATE TOOLS

This document covers how to include the **Move** and **Rotate** functions of the **Draft Workbench**.

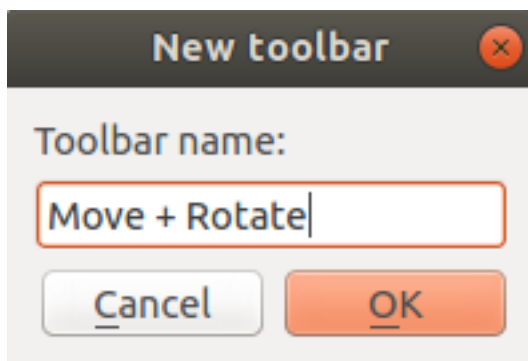
1. Load the Draft Workbench by selecting it from the workbench dropdown.
2. Select **Tools**, and then **Customize** from the Main menu.



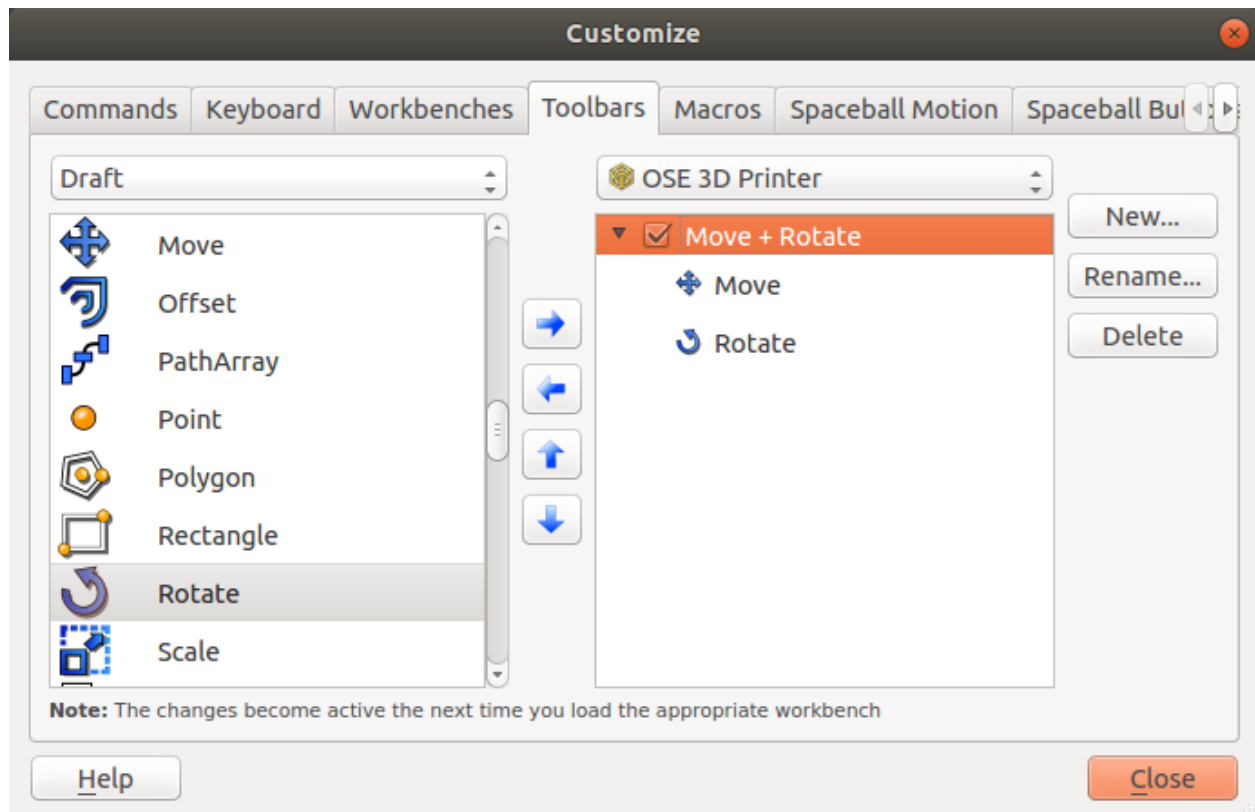
3. Next, select the **Toolbars** tab.



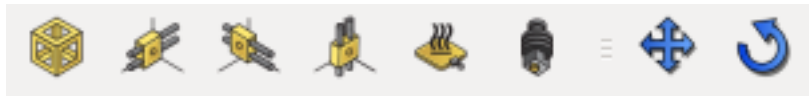
4. Select **OSE 3D Printer** from the dropdown in the right pane.
5. Click the **New...** button.
6. Name the toolbar **Move + Rotate**, and click **OK**.



7. Select the **Draft** workbench from the dropdown in the left pane.
8. Find the **Move** and **Rotate** tools and use the **Move right** button, or right arrow to add them to the **Move + Rotate** toolbar.



9. You should now have the **Move** and **Rotate** tools alongside the OSE 3D Printer tools.



See Also

[Customize Toolbars](#) on the FreeCAD Wiki.

OSE3DPRINTER

The `ose3dprinter` package is:

- Independent of the `freecad.ose3dprinter` package
- Must not know about the FreeCAD GUI (i.e. `FreeCADGui` or `Gui`)
- Executable from a command-line context

8.1 `ose3dprinter.attachment`

Attachment functions to make 3D Printer parts appear attached to each other.

8.1.1 `ose3dprinter.attachment.get_axis_frame_attachment_kwargs`

`get_axis_frame_attachment_kwargs`

`get_axis_frame_attachment_kwargs` (*frame, selected_frame_face, axis_orientation*)

Get the length, placement, and origin translation offset for creating a axis object attached to a selected frame face.

`get_default_axis_creation_kwargs`

`get_default_axis_creation_kwargs` (*axis_orientation*)

`get_placement_strategy`

`get_placement_strategy` (*face_side*)

8.1.2 `ose3dprinter.attachment.get_extruder_axis_attachment_kwargs`

`get_extruder_axis_attachment_kwargs`

`get_extruder_axis_attachment_kwargs` (*axis, selected_axis_face*)

8.1.3 ose3dprinter.attachment.get_heated_bed_frame_axis_attachment_kwargs

`get_heated_bed_frame_axis_attachment_kwargs`

`get_heated_bed_frame_axis_attachment_kwargs` (*frame, axis*)

8.2 ose3dprinter.model

Models for 3D Printer parts.

8.2.1 ose3dprinter.model.axis

`axis_model`

```
class AxisModel (obj,      length=304.8,      carriage_position=50,      orientation='x',      side='top',
                  placement=Placement      [Pos=(0,0,0),      Yaw-Pitch-Roll=(0,0,0)],      ori-
                  gin_translation_offset=Vector (0.0, 0.0, 0.0))
```

Bases: `osecore.app.model.Model`

Encapsulates the data (i.e. topography and shape) for a Axis, and is separate from the “view” or GUI representation.

Type = 'OSEAxis'

`calculate_carriage_box_x()`

`calculate_top_of_carriage_box_for_z_axis()`

`execute(obj)`

Called on document recompute

`is_x()`

Return whether or not this axis is a X axis.

This assumes the axis is parallel to the XY, YZ, or XZ planes, and not rotated in a weird diagonal or skewed way.

Returns Whether this axis is a X axis.

Return type bool

`is_y()`

Return whether or not this axis is a Y axis.

This assumes the axis is parallel to the XY, YZ, or XZ planes, and not rotated in a weird diagonal or skewed way.

Returns Whether this axis is a Y axis.

Return type bool

`is_z()`

Return whether or not this axis is a Z axis.

This assumes the axis is parallel to the XY, YZ, or XZ planes, and not rotated in a weird diagonal or skewed way.

Returns Whether this axis is a Z axis.

Return type bool

8.2.2 ose3dprinter.model.extruder

extruder_model

class ExtruderModel (*obj*, *placement=Placement [Pos=(0,0,0), Yaw-Pitch-Roll=(0,0,0)], ori-*
gin_translation_offset=Vector (0.0, 0.0, 0.0))

Bases: `osecore.app.model.Model`

Encapsulates the data (i.e. topography and shape) for a Extruder, and is separate from the “view” or GUI representation.

Based on: <https://wiki.opensourceecology.org/wiki/File:Simpleextruderassy.fcstd>

See: <https://wiki.opensourceecology.org/wiki/File:Finalextruder.png>

Type = 'OSEExtruder'

execute (*obj*)

Called on document recompute

8.2.3 ose3dprinter.model.frame

ose3dprinter.model.frame.get_face_side

between_bounds

between_bounds (*value, lower_bound, upper_bound*)

face_side_strategy

class FaceSideStrategy

Bases: `abc.ABC`

get_face_side (*frame, face*)

face_side_strategy_factory

class FaceSideStrategyFactory

Bases: `object`

static create (*axis_orientation*)

get_face_side

get_face_side (*frame, face, axis_orientation*)

x_axis_face_side_strategy

class XAxisFaceSideStrategy

Bases: *ose3dprinter.model.frame.get_face_side.face_side_strategy.FaceSideStrategy*

y_axis_face_side_strategy

class YAxisFaceSideStrategy

Bases: *ose3dprinter.model.frame.get_face_side.face_side_strategy.FaceSideStrategy*

z_axis_face_side_strategy

class ZAxisFaceSideStrategy

Bases: *ose3dprinter.model.frame.get_face_side.face_side_strategy.FaceSideStrategy*

ose3dprinter.model.frame.get_faces_for_side

filter_faces_parallel_to_plane

filter_faces_parallel_to_plane (*faces, plane*)

get_faces_for_side

get_faces_for_side (*frame, side*)

Gets a dictionary of outer faces of the frame by their Side.

Parameters **frame** (*Document Object*) – Frame object

Returns Dictionary where the keys are a Side, and value is a Face

Return type dict

get_faces_for_side_of_cnc_cut_frame

get_faces_for_side_of_cnc_cut_frame (*cnc_cut_frame, side*)

get_faces_for_side_of_frame_with_corners

get_axis_orientation (*side*)

get_faces_for_side_of_frame_with_corners (*frame_with_corners, side*)

TODO: Doesn't include faces of angle frame connector tabs

Parameters

- **frame_with_corners** (*Document object*) – Frame object with HasCorners property = True

- **side** (See *Side enum.*) – Side of frame.

Returns List of faces within bound of side for a frame with corners.

Return type List[Part.Faces]

ose3dprinter.model.frame.get_outer_faces

get_outer_faces

get_outer_faces (*frame*)

Get outer faces of a frame.

get_outer_faces_of_cnc_cut_frame

get_outer_faces_of_cnc_cut_frame (*cnc_cut_frame*)

Get outer faces of a frame constructed by cutting six sheets with a CNC machine.

Assumes the 6 largest faces are the outer faces of the frame.

get_outer_faces_of_frame_with_corners

get_outer_faces_of_frame_with_corners (*frame_with_corners*)

sort_faces_by_area_descending

sort_faces_by_area_descending (*faces*)

frame_model

```
class FrameModel (obj,      size=304.8,      width=38.1,      thickness=3.175,      has_corners=False,
                    placement=Placement      [Pos=(0,0,0),      Yaw-Pitch-Roll=(0,0,0)],      ori-
                    gin_translation_offset=Vector (0.0, 0.0, 0.0))
```

Bases: osecore.app.model.Model

Encapsulates the data (i.e. topography and shape) for a Frame, and is separate from the “view” or GUI representation.

See D3D Frame on the Open Source Ecology Wiki: https://wiki.opensourceecology.org/wiki/D3D_Frame

Type = 'OSEFrame'

property XMax

property XMin

property YMax

property YMin

property ZMax

property ZMin

property distance_between_axis_side_mount_holes

```

execute (obj)
    Called on document recompute

get_face_side (face, axis_orientation)

get_faces_for_side (side)

get_outer_faces ()

```

8.2.4 ose3dprinter.model.heated_bed

heated_bed_model

```

class HeatedBedModel (obj, placement=Placement [Pos=(0,0,0), Yaw-Pitch-Roll=(0,0,0)], ori-
                       gin_translation_offset=Vector (0.0, 0.0, 0.0))
    Bases: osecore.app.model.Model

    Encapsulates the data (i.e. topography and shape) for a Heated Bed, and is separate from the “view” or GUI
    representation.

    Type = 'OSEHeatedBed'

    execute (obj)
        Called on document recompute

```

8.3 ose3dprinter.part

Parts for 3D Printer.

8.3.1 ose3dprinter.part.axis

axis

```

class Axis
    Bases: object

    classmethod calculate_carriage_box_x (rod_length, carriage_position)

    carriage_box_width = 52

    classmethod cut_holes_in_motor_side_box (motor_side_box, box_height, mo-
                                             tor_box_length)

    distance_between_hole_and_inner_motor_side = 12.59

    distance_between_holes = 22.44

    classmethod distance_between_idler_side_holes_and_outer_edge ()

    classmethod distance_between_inner_motor_side_holes_and_outer_edge ()

    hole_radius = 3.39

    idler_box_length = 66

    idler_box_width = 26

```

```

classmethod make (rod_length: float, rod_radius: float, carriage_position: int, orientation:
                  str, side: str, initial_placement: Base.Placement, origin_translation_offset:
                  Base.Vector) → Part.Compound

motor_box_width = 59.5

x_distance_between_holes = 23.36

get_placement (orientation, side, box_height, length, motor_box_length)

```

8.3.2 ose3dprinter.part.extruder

cooling_and_sensor_mount

```

class CoolingAndSensorMount
    Bases: object

    Cooling and Sensor mount for extruder, and sensor itself.

    Based on: https://wiki.opensourceecology.org/wiki/File:ExtruderActiveCoolingAndSensor.FCStd
    See: https://wiki.opensourceecology.org/images/thumb/d/dd/Secondxtruderpart.png/120px-Secondxtruderpart.png
    Sensor: https://wiki.opensourceecology.org/images/thumb/9/9e/8mmsensor.jpg/120px-8mmsensor.jpg

    classmethod make (slanted_side_width, main_part_length, main_part_bottom_base_overhang_width)

    vent_box_width = 5

make_cooling_and_sensor_slanted_side (thickness, length)

    20

    |155|19
    ____
    |7
    87

make_sensor_and_sensor_holder (sensor_holder_box_width, sensor_holder_box_height)
    /____|O|____

```

extruder

```

class Extruder
    Bases: object

    static make (placement, origin_translation_offset)

make_motor ()

```

main_extruder_part

class MainExtruderPart

Bases: object

Main extruder part

Based on: <https://wiki.opensourceecology.org/wiki/File:Mainextruderpart.fcstd>

See: <https://wiki.opensourceecology.org/wiki/File:Mainextruderpart.png>

base_height = 7

classmethod make (*width, length, bottom_base_overhang_width*)

make_slanted_side (*width_or_thickness, height*)

25.25

1150111

128.27

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51.10

8.3.3 ose3dprinter.part.frame

angle_frame_connector

class AngleFrameConnector

Bases: object

Encapsulates the data (i.e. topography and shape) for an Angle Frame Connector, and is separate from the “view” or GUI representation.

An angle frame connector is made up of three brackets.

axis_side_mount_length = 27.75

axis_side_mount_width = 5

classmethod calculate_bracket_length (*width, thickness*)

classmethod calculate_bracket_width (*thickness*)

classmethod calculate_y_axis_overhang_distance ()

classmethod distance_between_axis_side_mount_holes_and_frame ()

classmethod make (*width, thickness, corner='bottom_left_front', with_set_screw=False, with_filleting=False*)

Make an angle frame connector.

Parameters

- **width** (*float*) – Width of the angled frame.
- **thickness** (*float*) – Thickness of the angled frame.
- **corner** (*str, optional*) – Which corner to orient the angle frame connector to. Defaults to bottom left front corner.

- **with_set_screw** (*bool*) – Whether to include set screw mechanism.
- **with_filleting** (*bool*) – Whether to include filleting.

Returns an angle frame connector

Return type Part.Shape

cut_screw_screw (*bracket, width, height, thickness, set_screw_block_width*)

cut_set_screw_hole (*bracket, height, thickness, cylinder*)

fillet_bracket (*bracket, height*)

find_top_wires_parallel_to_xy_plane (*bracket, height*)

fuse_nut_ramps_to_bracket (*bracket, thickness, set_screw_cutout_length, set_screw_cutout_width, ramp_height*)

Fuse nut ramps to bracket so nut doesn't spin when tightening screw.

||_

Parameters

- **bracket** (*Part.Shape*) – Bracket
- **set_screw_cutout_length** (*float*) – Length of set screw cutout
- **set_screw_cutout_width** (*float*) – Width of set screw cutout

get_angle_frame_connector_placement (*corner, length*)

get_inner_points (*width, thickness*)

get_is_top_shape (*height*)

get_outer_points (*width, thickness, set_screw_block_width, with_set_screw*)

get_placement_by_corner (*length*)

is_wire_parallel_to_xy_plane (*wire*)

make_angle_connector_corner (*bracket_length, bracket_width*)

make_cylinder (*radius, height*)

make_set_screw_cutout (*length, nut_height, height*)

Make set screw cutout in the shape of a pentagon, or home plate in baseball.

make_tri_bracket (*width, height, thickness, with_set_screw=False, with_filleting=False*)

Make tri-bracket.

Three tri-brackets make up the angle frame connector.

Parameters

- **width** (*float*) – Width of bracket.
- **height** (*float*) – Height of bracket.
- **thickness** (*float*) – Thickness of bracket
- **with_set_screw** (*bool*) – Whether to include set screw mechanism.
- **with_filleting** (*bool*) – Whether to include filleting.

angled_bar

class AngledBar

Bases: object

static make (*length, width, thickness, orientation='bottom_front_flat'*)

Make an angled bar with bottom-left-most corner in the origin (0, 0, 0)

Parameters

- **length** (*float*) – Length of angled bar.
- **width** (*float*) – Width of angled bar. after an inner sheet is cut out of the center.
- **thickness** (*float*) – Thickness of angled bar.
- **orientation** (*str*) – Orientation of angled bar. Must be one of AngledBarOrientation. Defaults to AngledBarOrientation.BOTTOM_FRONT_FLAT.

Returns An angled bar.

Return type Part.Shape

fuse_parts (**parts*)

get_angled_bar_placement (*orientation, length, width*)

get_placement_by_orientation (*length, width*)

angled_bar_frame

class AngledBarFrame

Bases: object

Frame made from 12 angled bars connected by angle frame connectors.

static make (*side, width, thickness*)

Make a frame from from 12 angled bars connected by angle frame connectors. No welding or epoxy required, and the frame can be disassembled.

Parameters

- **side** (*float*) – Side or dimension of frame from one corner to the opposite corner.
- **width** (*float*) – Width of angled bar.
- **thickness** (*float*) – Thickness of each angled bar.

Returns A frame made up of angled bars, connected by angle frame connectors.

Return type Part.Shape

make_bottom_or_top_of_angled_frame (*bar_length, width, thickness, bar_orientations, corners, bracket_length, rear_translation, rear_bar_translation*)

angled_bar_orientation

class AngledBarOrientation

Bases: object

Represents the orientation for one edge of an angled bar frame.

BOTTOM_FRONT_FLAT = 'bottom_front_flat'

BOTTOM_LEFT_FLAT = 'bottom_left_flat'

BOTTOM_REAR_FLAT = 'bottom_rear_flat'

BOTTOM_RIGHT_FLAT = 'bottom_right_flat'

FRONT_LEFT_UPRIGHT = 'front_left_upright'

FRONT_RIGHT_UPRIGHT = 'front_right_upright'

REAR_LEFT_UPRIGHT = 'rear_left_upright'

REAR_RIGHT_UPRIGHT = 'rear_right_upright'

TOP_FRONT_FLAT = 'top_front_flat'

TOP_LEFT_FLAT = 'top_left_flat'

TOP_REAR_FLAT = 'top_rear_flat'

TOP_RIGHT_FLAT = 'top_right_flat'

axis_side_mount

class AxisSideMount

Bases: object

TODO: Rename to TopAngleFrameConnectorTab?

attachment_overlap = 10.22

classmethod calculate_distance_between_holes_and_connector (*length*)

classmethod calculate_overhang_distance (*length*)

distance_between_hole_and_outer_edge = 9.38554

height = 65.2

hole_radius = 3.39

classmethod make (*width, length, top_corner*)

Returns which side of the angle frame connector to add the axis mount to.

Parameters

- **width** (*float*) – Width of axis side mount.
- **top_corner** (*str*) – A top corner: top left front, top right front, top left rear, or top right rear.

Returns Axis side mount

Return type Part.Shape

classmethod make_slanted_edge (*slanted_edge_distance, width*)

```

|||___
classmethod make_trapezoid_tab (width, length, attachment_overlap)

    ///|_____

get_placement (top_corner, height, attachment_overlap)
get_placement_by_top_corner (height, attachment_overlap)

```

cnc_cut_frame

class CNCCutFrame

Bases: object

static make (*side*, *width*, *sheet_thickness*)

Make a frame from flat sheets cut by a CNC machine, then welded or epoxied together.

This approach works best with welding.

See Also: https://wiki.opensourceecology.org/wiki/D3D_Frame

Parameters

- **side** (*float*) – Dimension of one side of a cubic sheet.
- **width** (*float*) – Width of outer sheet, after an inner sheet is cut out of the center.
- **sheet_thickness** (*float*) – Thickness of each sheet.

Returns A frame “welded” together from eight CNC cut sheets.

Return type Part.Shape

make_sheet (*side*, *width*, *thickness*)

Make one side of the frame or “sheet”.

```

_____|
|||
|||
|_____||

```

```

|_____|

```

A sheet is a cubic plane of metal with dimensions specified by *side*, thickness specified by *thickness*, and inner sheet cut out of the center, leaving the outer width with a dimension specified by *width*.

Parameters

- **side** (*float*) – Dimension of one side of the cubic sheet.
- **width** (*float*) – Width of outer sheet, after an inner sheet is cut out of the center.
- **thickness** (*float*) – Thickness of the sheet.

Returns A sheet, or one side of a frame.

Return type Part.Shape

corner**class Corner**

Bases: object

Represents corners of a cube. TODO: Rename to CubeCorner?

BOTTOM_LEFT_FRONT = 'bottom_left_front'**BOTTOM_LEFT_REAR** = 'bottom_left_rear'**BOTTOM_RIGHT_FRONT** = 'bottom_right_front'**BOTTOM_RIGHT_REAR** = 'bottom_right_rear'**TOP_LEFT_FRONT** = 'top_left_front'**TOP_LEFT_REAR** = 'top_left_rear'**TOP_RIGHT_FRONT** = 'top_right_front'**TOP_RIGHT_REAR** = 'top_right_rear'**is_top_corner** (*corner*)

Returns whether a corner is a top corner.

Parameters **corner** (*str*) – A corner.**Returns** Whether the corner is a top corner or not.**Return type** bool**8.3.4 ose3dprinter.part.heated_bed****heated_bed****class HeatedBed**

Bases: object

static make (*size, placement, origin_translation_offset*)

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