Media Computing Project — Group07

Brickify Manual

by

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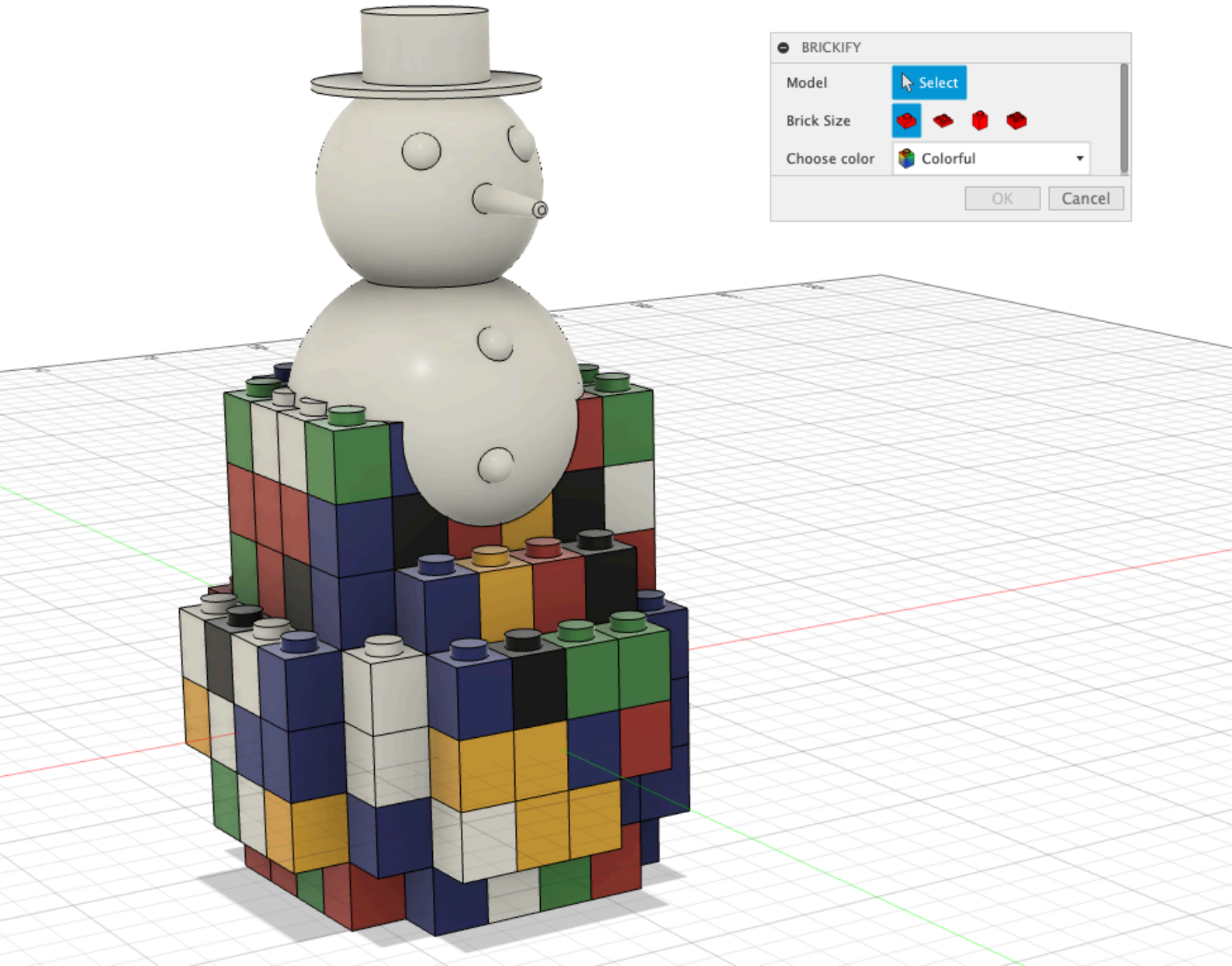
Brickify for Autodesk Fusion 360 will enable you to speed up your prototyping processes significantly by reducing the need for time-intensive 3D printing in early stages of product development. With Brickify simply select your Fusion 360 3D model and have it transformed into its toy brick representation at the press of a single button!
In a second step you are able to select bricks in the brick model, which are to be reverted back to the original 3D model. The result: a ready-to-print cutout of the original 3D model, that allows you to combine speedy prototype building by toy bricks with the stunning detail of 3D printing

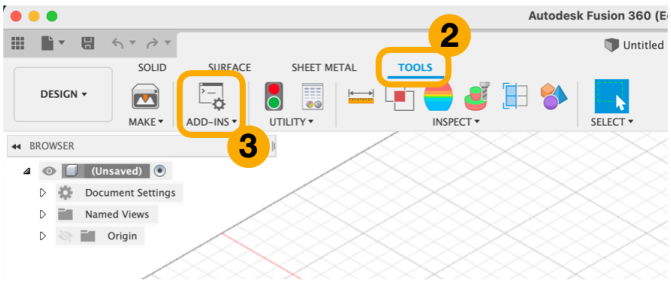


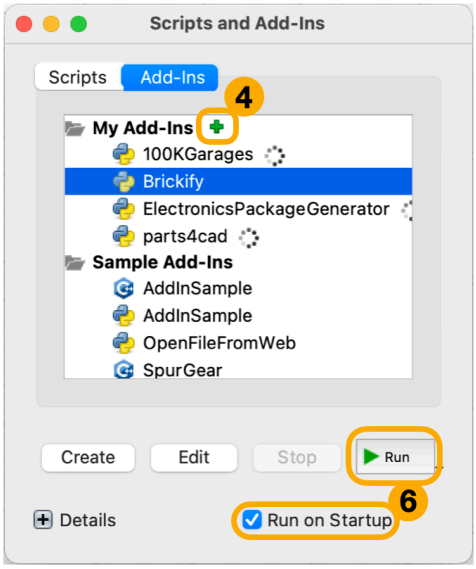
Installing Brickify | macOS & Windows

Brickify works with Autodesk Fusion 360 on Apple macOS (10.15 and later) and Microsoft Windows 10 (1902 or later). Installing Brickify is done in just 6 easy steps:

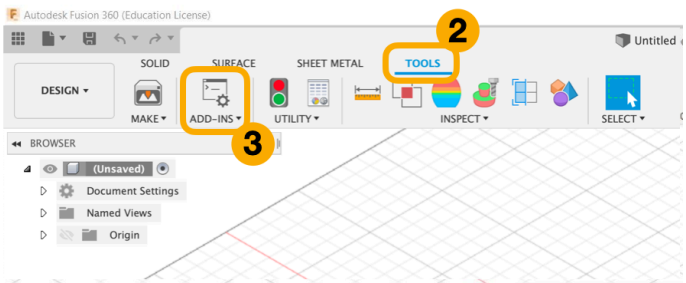
1. Open Autodesk Fusion 360
2. Select the Tools tab in the design menu.
3. Open the *Scripts and Add-Ins* submenu
4. In the Add-Ins tab, click the small green ✚ button next to *My Add-Ins*
5. In the following popup window, select and open the *Brickify* folder, which contains the Brickify add-in, from your filesystem
6. Brickify is now displayed in the Scripts and Add-Ins menu. To have Brickify available every time Fusion 360 starts, activate the checkmark next to *Run on Startup*

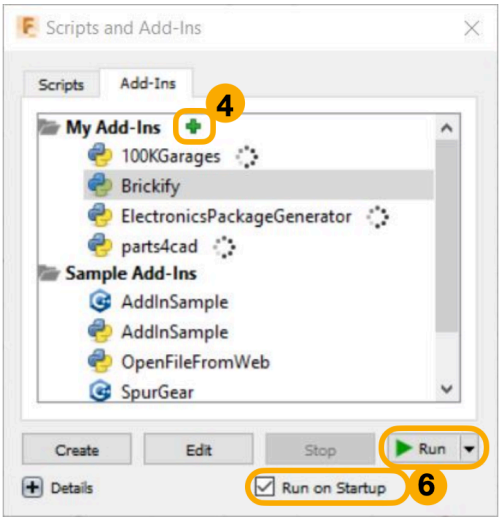
MacOS





Windows

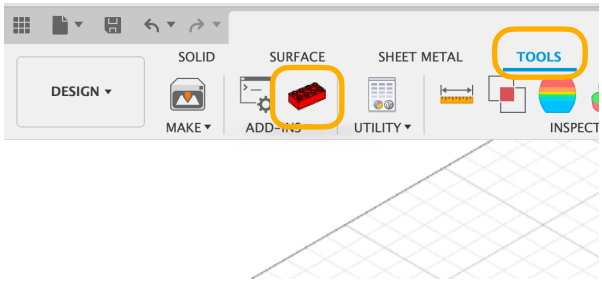




Using Brickify | The how-to

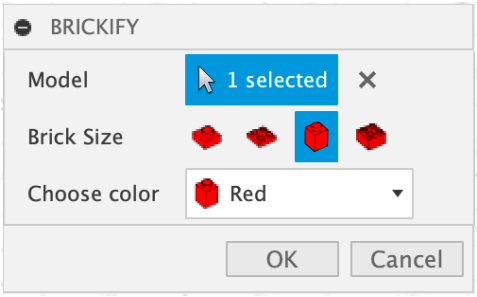
Once Brickify is installed and started by *Run on Startup* or manually run from the Scripts and Add-Ins menu, and the model, that is to be transformed into bricks, is opened in the current design, Brickify presents its results with just a few clicks:

1. Select the Tools tab in the design menu.



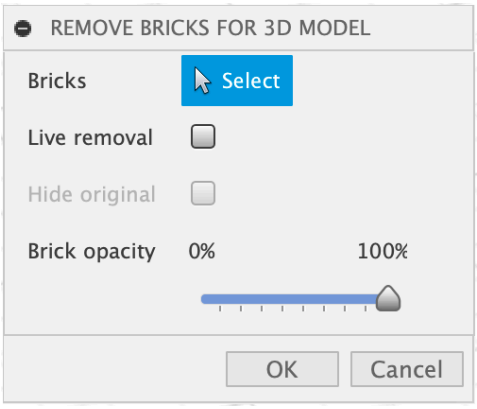
2. Fusion 360 presents the red Brickify-button next to the *Scripts and Add-Ins* button. Brickify can be started by clicking this button.

3. Brickify presents a popup tool window. You can now select the model, that is to be transformed into a brick model. Furthermore you can select the brick size that will be used in the brick model. The brick size influences the amount of detail in the brick model. The highest amount of detail can be achieved by selecting *Plate 1x1,* the least amount by selecting Brick 2x4. Of course, the number of bricks needed for the model increases with a selection of smaller brick sizes. Along, the necessary processing time increases as well.



4. With a click on the OK button, the brick model will be generated. Depending on the original model size, this process can take up to a few minutes. The current progress is displayed by progress bars.

5. Upon finishing, Brickify already presents a brick representation of the original body and a new popup window. Now, you probably want to have some fine details from the original model incorporated into the brick model.
You can select all bricks that shall be replaced by the original mode's feature at that place. The default options allow to only select bricks on the outmost layer of the brick model. If you want to replace bricks below the surface, activating the *Live removal* checkbox uncovers those bricks by removing selected bricks live.



Per default the original model cannot be removed from the view. *Hide original on select* checkbox overrides the live removal lock, to help you uncover further blocks in the brick model.
The opacity of the brick model can be adjusted by the *Brick opacity* slider, to help you find the original features that you want to uncover from the brick model.

6. A click on the OK button creates independent cutout parts of the 3D model, which can be printed and fit a brick model of the generated form perfectly.

Working Procedure | How the Plugin works

At the beginning, a single lego brick is generated in the size that the user selected. It is not a perfect copy of a real lego brick, which is hollow on the inside. Our lego brick is solid and only has perfect cutouts for the pins at the bottom, so that no empty space is left inside a stack of bricks.
The plugin determines the bounding box of the selected object, and fills it with a regular grid made from the generated brick. In the next step, the Fusion 360 interference function is used to determine which bricks are in contact with the selected shape. The bricks which do not touch it at are deleted, resulting in a rough approximation of the selected object.
The plugin then uses a boolean operation to cut the lego bricks (which were not selected by the user) from the model. Because the grid of bricks contains no empty space, the resulting shape contains only the part of the original shape which was not inside the bricks. If a lego brick was below it, the pins of the brick will cut out small holes where the pins of a real lego brick can be inserted. If a lego brick is at the top of the shape, the holes at the bottom of the brick will leave behind extruded pins, so that a real lego brick can be stacked onto the printed shape.

Limitations | What the Plugin cannot do (well)

One major limitation of our plugin is that the simple block grid is not a stable structure. Stacked lego bricks are obviously connected in the vertical direction, but there are no horizontal connections between the columns. In reality, one would need to use different sizes of bricks to create offsets between every layer. Our plugin therefore can only be used to create a 3D-printing shape. Another group has also worked with lego, and they focused on creating physically stable lego models. In theory it should be possible to combine both our approaches to create stable lego structures which can be combined with 3D printed elements.

Another limitation is naturally the size of the lego bricks and the resulting calculation speed. The shape can be only as small as the smallest lego brick, a 1x1 plate. Smaller shapes have to be 3D printed. On the other had, very large objects take much longer to compute. As we operate in a 3D space, the calculation time should roughly increase cubically with the mesh bounding box volume. Even small objects can contain thousands of lego bricks, which was almost unmanageable in our tests. To alleviate this problem, lager base bricks can be chosen: The 2x2 brick requires 12 times fewer instances as the 1x1 plate to fill the same shape.