

## Assignment 14: Packaging and Enclosure Design

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For this assignment, you will make progress on the packaging and enclosure design. Since students have different levels of previous experience with manufacturing and enclosures, you have multiple options to complete this assignment.

### Option A: Complete a 3D CAD tutorial (FUSION 360)

Computer aided-drafting (CAD) tools are used to create 3-dimensional models that can be later fabricated using a wide variety of manufacturing processes (e.g. laser cutting, 3D printing, injection molds, etc). Fusion 360 is a very popular and powerful design tool that is produced by one of the industry leaders in 3D CAD, Autodesk. FUSION 360 is also free to students

<https://www.autodesk.com/education/edu-software/overview?sorting=featured&page=1>



If you are inexperienced with 3D CAD modeling, or would like to expand your knowledge of this particular set of software tools, you can complete an online course on using FUSION 360

<https://help.autodesk.com/view/fusion360/ENU/courses/AP-GET-STARTED-OVERVIEW>

or you can learn how to use FUSION 360 via tutorial videos from the internet. A popular set of tutorial videos for beginners is posted on the following page, however, you are free to use whatever learning resources you like.

### Submission for Option A

As evidence of completing the tutorial, you must design a simple box that is roughly the size of your PCB and can encapsulate your board. This box does not necessarily need to represent your final enclosure in anyway, but rather, it is the simplest structure you can make that shows you have a basic level of proficiency using FUSION 360.

Please Submit the following:

- An image showing your box
- Your design files

# ABSOLUTE Part 1 BEGINNER



**F** AUTODESK® FUSION 360™

# ABSOLUTE Part 2 BEGINNER



**F** AUTODESK® FUSION 360™

# ABSOLUTE Part 3 BEGINNER



**F** AUTODESK® FUSION 360™

## **Option B: Preliminary Enclosure Design**

For teams that already know how to use 3D CAD modeling tools, you may complete this assignment by submitting a preliminary design for your Bop-It project, designed using the 3D CAD software of your choice. The design that you submit for this assignment is not final and may be missing important features that you will add later. At this stage, you are just demonstrating that your team has the capability to complete a design and starting on its development.

### **Submission for Option B**

If you elect to complete this assignment via option B, Please Submit the following:

- An image showing your preliminary design, displayed within the CAD environment
- Your design files

## **Option C: Detailed Enclosure Design**

You are not required to design an enclosure using 3D CAD tools. Some may opt to use their own artistic ability and craftsmanship to produce an enclosure design. If you opt to do this, then you should submit a detailed description of your design. In your submission, you must specify all relevant measurements and dimensions, a complete list of materials and tools needed, as well as a description of your assembly steps. While you are not required to design an enclosure using 3D modeling tools, it is still expected that your design is neat looking and functional.

### **Submission for Option C**

If you elect to complete this assignment via option B, Please Submit the following:

- Clear, neat images showing the details of your, including all relevant measurements and dimensions
- A list of materials needed
- A list of tools needed
- A description of the assembly steps

## Future Considerations

### *Don't reinvent the wheel*

There are numerous resources and designs available on the internet. For this assignment, you are permitted to reference other designs and modify them to suit your purposes. Here are just a few, of many, sites where you can find inspiration for your design

<https://www.instructables.com/The-Ultimate-Guide-to-Laser-cut-Box-Generators/>

<https://www.thingiverse.com/>

<https://www.tinkercad.com/>

### *3D Print , Laser-Cut or something else?*

If you use a 3D modeling tool, you will likely either use a laser cutter to produce your design or a 3D printer. Both technologies have advantages and disadvantages.

#### **Size & Complexity:**

The first thing to consider when deciding between laser cutting and 3D printing is the size and complexity of your enclosure. If you are designing an enclosure that isn't very complex, laser cutting is going to be the best option both in speed and design complexity. If you are designing a complex but large enclosure, laser cutting will still be the better option due to size constraints with 3D printers. The best time to use a 3D printer for an enclosure would be a small, complex enclosure.

#### **Turnaround Time:**

When deciding on laser cutting vs. 3D printing, turnaround time is a big consideration. A decent sized 3D printed enclosure could take upwards of 40 hours to print whereas a comparable laser cut enclosure would take under 20 minutes to cut. It is also quicker to make design changes when laser cutting instead of having to wait another 40 hours for a minute change.

For manufacturing in-house, we have several options. We currently have several 3D printers and a Laser cutter that you are welcome to use.

You may also choose to use an external vendor, such as <https://www.xometry.com/>, to fabricate your prototypes. Please coordinate with your instructor to decide what the best option is for your team.