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Professor Manzo

HU3910

Final Project Write-Up

The overall scope for this project was to outline the plans for manufacturing a tailor-made guitar case to house and protect a Parker Fly electric guitar. The main drivers for the case design were cost and weight, with weight being a priority but not an overwhelming factor over cost. Another restriction placed on this project was that all manufacturing must be possible utilizing the Washburn Shops. To kick off the project, a modeled Parker Fly guitar was provided which was useful in gauging case size and replicating the complex curvature of the guitar body. Because of the nature of this specific project being completely remote, no actual manufacturing executed, but the documentation to carry out manufacturing plans was completed. At the conclusion of this project, a design was outlined with an estimated weight of ~19.5 lbs. and a cost of $104.87. Additionally, the following items were delivered:

- Cost/Weight Estimation Excel Workbook with Hardware Links
- Engineering Drawings for All Wooden and Foam Pieces
- Esprit CAM files for Foam Block Milling
- Assembly Standard Operating Procedure (SOP) PowerPoint with a General Bill of Materials
- Uploaded All Relevant SOLIDWORKS Part/Assembly and STEP Files

The biggest challenge of this project was balancing the requirements of weight and cost. The initial route that was taken was one that placed a slightly higher importance on cost than weight. For the sake of manufacturability within the confines of the project, the case design was limited to a hard shell. Because many hard-shell cases are wooden, various plywood and other lumber options were explored via Home Depot and Lowe's. The cheapest option for a board of material was OSB, a type of wood comprised of compressed wood chips. Because OSB is made from scrap wood of other types of lumber, it is very cheap. The downside of using OSB is that the compressed chips drive up its density and will typically weight more than other plywood options. After evaluating the cost tradeoff between OSB and a cheaper soft plywood, the OSB was chosen as the material to move forward with (switching to a plywood would increase the overall case price by 40%). In future iterations of this case, the weight can be further reduced through experimenting with different types of wood and case shapes.

The design of the case started with the contour of the guitar. A ½" offset from the guitar silhouette was used to create the top and bottom foam pieces with cutouts. The offset makes up for any manufacturing tolerances and for the velvet case covering. The decision to have the foam cutouts appear in both the bottom and top covers was intended to allow for a slimmer form factor while also cutting down on weight from unnecessary wood and foam. The fastener selections were directly driven by the hardware that they are meant to secure. The hinges, draw latches, and

handle were specifically chosen because of their ability to be mounted with little surface area required. In some cases, the chosen fasteners will drive into the foam, but in no cases will they go near the area containing the guitar.

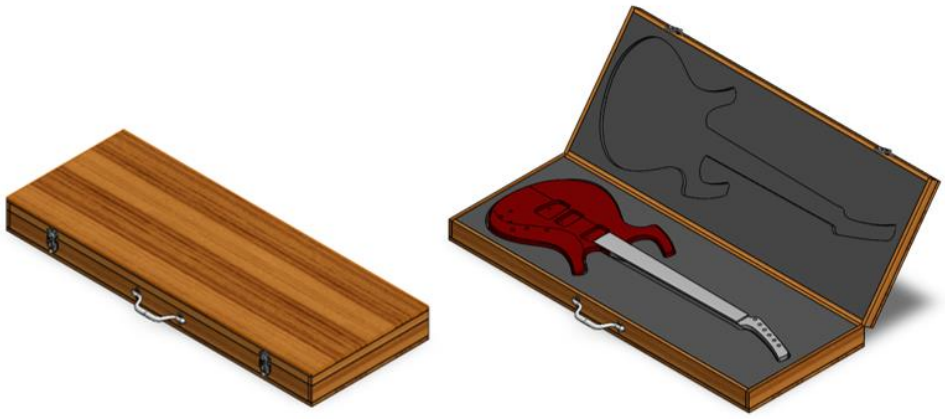

Figure 1. Open and Closed Case with Parker Fly Guitar

Another challenge for this project was choosing which software and programs to use for various tasks. Originally, all the CAD and CAM were going to be kept internal to Fusion360, but I had little to no prior experience with it. Because of this lack of exposure and more familiarity with other CAD/CAM platforms, I decided to use SOLIDWORKS for all design work. As I started looking more into Fusion360 for CAM, I also found that the WPI Washburn Shops provided more help on Esprit CAM rather than Fusion360; for this reason, the CAM operations were completed in Esprit.

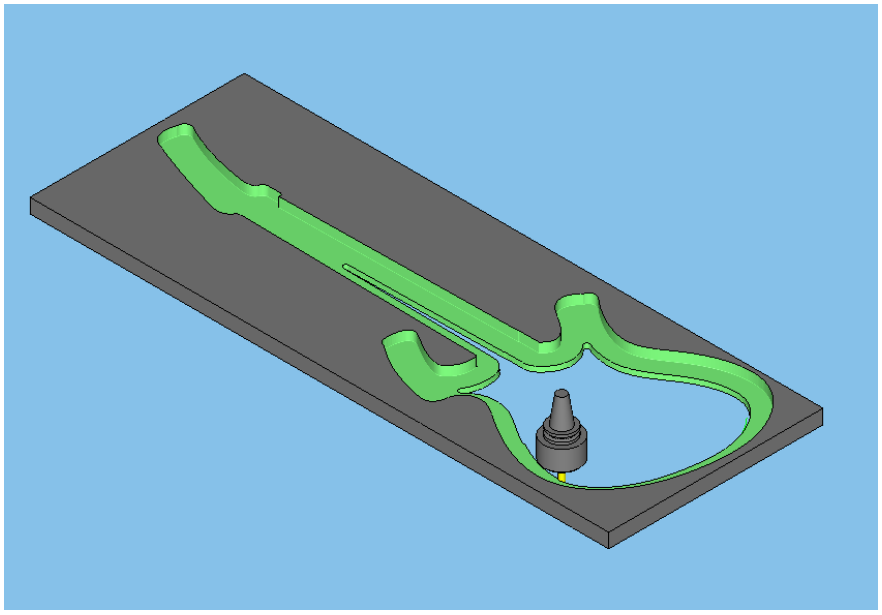

Figure 2. Esprit CAM Foam Cutout Simulation

The first useful document used in the completion of this project was a spreadsheet that kept track of the design cost, essentially acting as a running bill of materials with links. This workbook also contains a sheet that generates an estimated case weight based on the volume and density of the used wood and foam. This document saved time by providing quick feedback on certain design choices before any real modeling was conducted.

Bottom Cover

	Length (in)	Width (in)	Height (in)	QTY	Area (in^2)	Total Area (in^2)
Bottom Board	41.3750	0.4375	15.8750	1	656.8281	656.8281
Short Side Board	15.8750	0.4375	2.0000	2	31.7500	63.5000
Long Side Board	40.5000	0.4375	2.0000	2	81.0000	162.0000

Top Cover

	Length (in)	Width (in)	Height (in)	QTY	Area (in^2)	Total Area (in^2)
Top Board	41.375	0.4375	15.875	1	656.8281	656.8281
Short Side Board	15.875	0.4375	1.000	2	15.8750	31.7500
Long Side Board	40.500	0.4375	1.000	2	40.5000	81.0000

Foam Inserts

	Length (in)	Width (in)	Height (in)	QTY	Volume (in^3)	Total Area (in^2)
Bottom Foam Support				1	607.5000	607.5000
Bottom Foam Guitar Outline				1	404.4400	404.4400
Top Foam Guitar Half Outline				1	505.9700	505.9700

Total OSB Area	1651.9063	in^2
OSB Density	1.4000	lbs/ft^2
Total Foam Volume	1517.9100	in^3
Foam Density	0.0023	lbs/in^3
Est Weight	19.5739	lbs

Figure 3. Weight Estimation Spreadsheet

To help pass on information to future project teams, engineering drawings were created for each individual wood and foam part with all of the relevant dimensions. Holes are specifically marked in the drawings but are not intended to be drilled out. These holes are meant to be created by the wood screws.

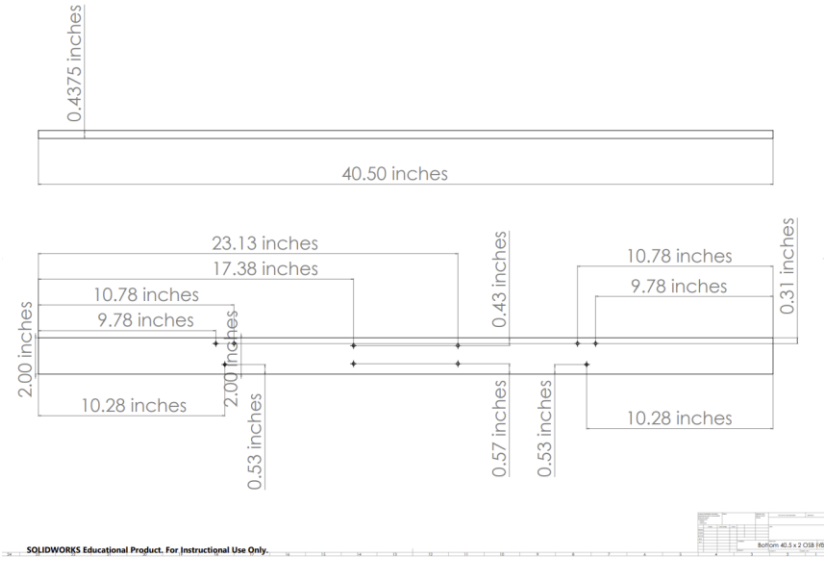

Figure 4. Engineer Drawing of 40.5" x 2 " Wood Piece

Lastly, to help facilitate a smooth assembly process, a slide deck was put together that walks through every step. A sample slide is shown below.

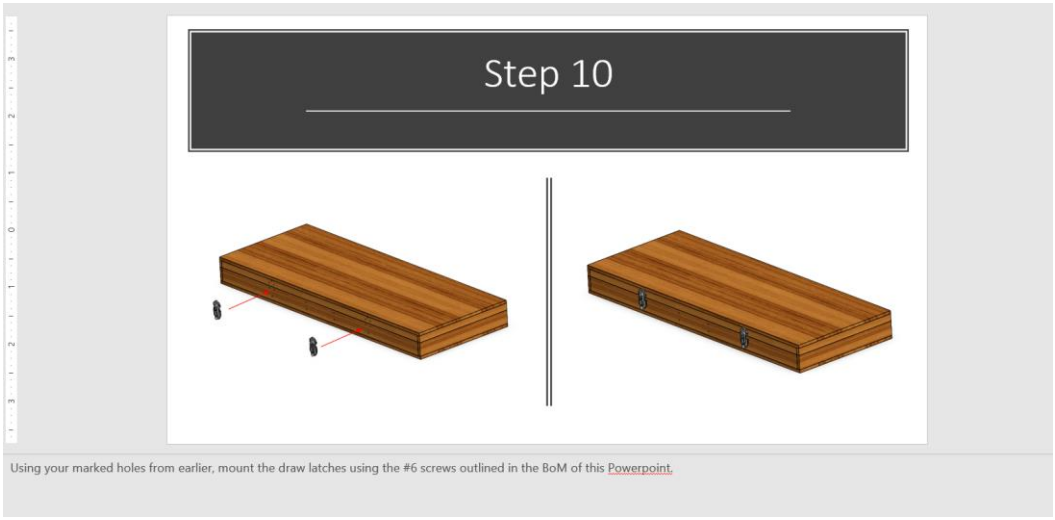

Figure 5. Step 10 of Parker Fly Guitar Case Assembly

All of the above related materials can be found on the project website, Wiki page, and through the Fusion360 project. As far as future work is concerned, getting a first prototype manufactured and assembled is a big first step. For any future teams that may take on this project after the first prototype is constructed, one recommendation would be to look at the issue of balancing cost efficiency with weight and mass savings as it pertains to material selection (maybe change to something rigid but not wood?). Lastly, an exploratory study could be done into different case structures, both externally and internally, to look at how those designs may affect cost and weight as well.