

Cajón Design and Comparison

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1. Cajon Background

History

The cajon is a six-sided, box-shaped percussion instrument originating from Peru. It is generally played by slapping the front face, called the tapa, with your hands, fingers, or other various tools. Slaves from west and central Africa are credited with the origin of the cajon. It was developed during the periods of slavery in coastal Peru using wooden shipping crates. Cajons could easily be disguised as seats or stools, therefore making them a prime instrument during the Spanish colonial ban of music for slaves. The cajon is now widely used in Peru and the popularity has grown throughout the Americas, even reaching mainstream American music.

Motivation

I have always wanted to play an instrument ever since I was little, but my parents never bought me an instrument or encouraged me to play. All my life, I have been told I have long, piano-playing fingers, so then when I finally had the money and the time, I bought a keyboard for my dorm room. After a year of trying to teach myself to learn the piano, starting from scratch, in the midst of busy years in college with relatively no knowledge of music - I gave up. I sold the keyboard and started to look for a simpler instrument to play. One day during a concert, I saw a cajon being played and the timbre, the design, the playing style; it all intrigued me. I started to look up the cajon and I fell in love with it more and more. This is when I decided that I would make my own cajon during winter break, since they were expensive to buy. After winter break and not starting on the cajon, I knew that I would not be able to have the motivation or the time to make one during the semester, so I decided to make one during the summer. Coming into Physics 406, I did not know what to expect from the class. I was surprised when Professor

Errede announced that we could base our semester projects off of something we want to do and something we love. I did not expect that out of a 400-level physics class, but I was not going to complain. I started to think of all these different designs and experiments that I could do, but as usual, my dreams always over-reached my capabilities. After a couple of weeks, it dawned on me that I do not have to make a complicated designs like some of my friends in the class. I wanted to pursue my passion, no matter how simple it is, which is what helped me decide to build a cajon for my semester project.

2. Cajon Design

Materials List

Once I decided to build a cajon, I started to look up instructables and directions online on how to make a cajon on a budget. I was surprised to find so many different and detailed designs. I took many techniques and advice from many different instructables online but I mainly used the one called: “Built your own Cajon (a drum) for less than 25.- Euro” on instructables.com.

The materials list below was created from reading a variety of different materials list as well as seeing what was available at local stores and shops.

Materials:

Front face: one 13 inch by 19 inch piece of plywood with 3mm thickness (tapa)

Rear face: one 13 inch by 19 inch piece of plywood with 5mm thickness

Sides: two 12 inch by 18 inch pieces of Birch plywood with $\frac{1}{4}$ inch thickness

Bottom and Top: two 12 inch by 12 inch pieces of Birch plywood with $\frac{1}{4}$ inch thickness

Wood Glue

Wood Screws

Rubber Feet

20-strand Drum Snare

Wood Stain

The tools list below was made available to me by the Newmark Structural Engineering Lab, the lab on the 5th floor of Engineering Sciences Building, Professor Errede, and the garages of a few friends.

Tools:

- Power Drill with different drill bits for countersinking
- Screwdriver
- Orbital Sander
- Table Saw
- Band Saw
- Sand Paper
- Dremel
- Brush
- Finish Nailer

The total cost of the materials list turned out to be approximately \$30 and the tools were made available to me free of charge.

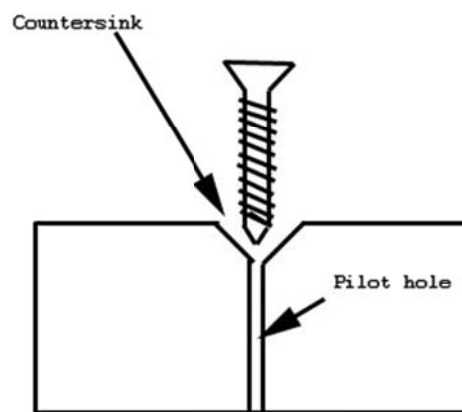
Construction

Below is the step-by-step process that I took to construct the cajon:

1. Have the side, top, and bottom pieces of Birch Plywood cut to the dimensions listed in the materials list
2. Use excess pieces of wood to use as supports to join the pieces together
3. Glue each piece of Birch plywood together and glue the support onto the vertex
4. Lather and rub the joint into the vertex to rid the glue of air pockets
5. Let the glue dry and compress the pieces together using weights or clamps
6. Cut and sand a sound hole with the diameter of a CD on the rear face
7. Glue the rear face onto the rear of the sides, top, and bottom pieces
 - Make sure to sand the edges of the cajon to have a tight hold



8. Countersink the tapa and the sides edges of the front face to allow screws to fit
 - First make a pilot hole with a thinner drill bit than the wood screws
 - Then use a drill bit the size of the screw head to have a space for the screw head to rest (process pictured below)



9. Screw in the wood screws into the pilot holes made using the drill

10. Sand the edges using an orbital sander in order to have a nice, smooth finish



11. Use wood stain to stain the outside of the cajon for a nice finish

12. Cut the 20-strand snare wires in half using a wire cutter

13. Using excess wood, create a support and mount for the snare wires

14. Glue the support onto the inside of the cajon at an angle in order to have the snare wires rest on the inside of the tapa



15. Countersink the bottom of the cajon on the edges where the supports are in order to create pilot holes for the rubber feet



16. Screw in the rubber feet using a drill or screwdriver

17. Screw on the tapa and it becomes ready to play



3. Comparison

LP Aspire Cajon (\$215)



The LP Aspire has a Siam Oak tapa with three sets of snare wires for extra sensitivity on the tapa compared to the two snares I have on my cajon. It is also 1 inch thinner and 2 inches shorter. The sound is brighter due to the sound hole being in the middle of the rear face, the smaller size, and the larger amount of snare wires. Since the tapa is tightly onto the cajon, the vibrations are minimized and the snare sound takes over, which also does not allow for as deep of a bass sound. The LP Aspire has a more comfortable playing height at 17 inches rather than 19 inches like mine. The higher quality woods are what creates the disparity in prices, but I do not believe that a \$200 difference is worth the higher production and material quality.

LP Aspire Accents Cajon: Darkwood (\$246)



The LP Aspire Accents has variable hard wires to adjust the tension to change the sound and for authentic Flamenco trills. The height and the sound hole placement are similar to that of the LP Aspire, which creates the same type of sound. The Accents is different from the regular Aspire only in that the Accent has variable hard wires on the inside of the tapa. It has more of a tight, compressed snare sound compared to the normal LP Aspire. The hard wires are tight on the tapa which causes the snares to ring anywhere you hit the tapa. On the other hand, my cajon has a deep bass sound independent of the snares which causes two distinctively different sounds which was the reason for the lower sound hole placement and greater height. The extra sensitivity from the snares compared to my cajon make it easy for the snares to sound, but it is at the cost of having the kick drum sound come along with a prominent snare sound.

Conclusions

The LP Aspire and LP Aspire Accents have similar sounds to one another, except one has higher adjustability than the other. My cajon has distinct sounds from the other two, but has a greater range of versatility in the sounds due to its size and design. When recording different beats on the three different cajons, people could tell that the cajon that I made when I shared the high, snare sound due to the LP Aspires' extra sensitive wires and my cajon's distinct Latin percussive sound. When sharing the mid-hits and bass hits, people could not accurately guess which track was associated with the cajon that I made for \$30 and the other cajons that could be bought for more than \$200. When putting the beats together, people could not tell between the three cajons, more specifically, people could not tell which one was made by me for \$30 and which one was professionally made. The conclusion that I came to after having the common ear compare the different sounds of these cajons is that cajons are easy to make and have sale value due to its market economy and simple design. Also, the common person cannot really tell between a homemade cajon and a store-bought cajon, so why waste the money?

4. Conclusion

Design and constructing a cajon from scratch was my first woodworking project and was definitely one of the most fun and rewarding projects I have ever done. Due to the homework assignments and lectures in class, I became very interested in the acoustical physics of music and I wanted to apply it to a tangible project. I wanted to make an instrument so that I could be able to learn more about physics and apply physics by playing it and just having fun. The class has really showed me how I should apply what I learn in my physics classes and that is through these types of projects. I have learned more about music and physics through this project than any other physics class that I have taken. In normal labs, we would do experiments and write long lab

reports without any passion or desire to learn, just a need to complete. Due to the time that I took to learn, design, and construct the cajon, not only did I learn about physics and music, but I learned how to play an instrument as well. After all the research and homework, playing the cajon when it was fully completed was one of the most rewarding experiences of my college career. I have been able to play the cajon on stage with a worship band and just have fun jam sessions with my friends after long days at school. This project and this class has provided me with much more than I had ever thought when coming into the class. It has given me insight on how to tackle education in general, and that is to have passion. The passion that I had to continue this project is what drove my motivation and eagerness to learn more physics. And I could not have been able to have such a rewarding experience if it was not for Professor Errede and the Teaching Assistant Matt Ziemann for helping me every step of the way, advising me what to do, as well as helping me first-hand with the project as well, and for that, I am eternally grateful.