Construction of a Steel Pan

Ben Wooley

PHYS 406 5/3/2012

1. Introduction

After completing a separate study comparing digitally synthesized versions of analog keyboards and ensuring a completed and successful project, I also wanted to attempt a construction project despite the fact that success was in no way guaranteed. After hearing a recording of a Duke Ellington chart entitled “Queenie Pie Reggae” featuring a soloist on the Trinidadian steel pan in middle school, I became fascinated with the instrument, and after participating in the steel band ensemble at the University of Illinois this year, I decided to attempt to construct my own pan for the purpose of practicing without having to trek across campus. While acoustically complicated and requiring great skill to do effectively, making a steel pan is a relatively low-tech process, and seemed a manageable endeavor. After searching the internet for any information on how to do so, I found a book on the topic by Ulf Kronman entitled *Steel Pan Tuning*, and the method I chose to use in constructing the drum is the same outlined in the text.

2. Obtaining materials and tools

While the overall design of the instrument has been refined since its first widespread appearance in the 1930s, the basis for the construction of a modern steel drum still consists solely of a 55 gallon steel drum, most commonly an oil drum. For this project, one was obtained from an architectural salvage business in downtown Champaign, selected from a choice of three on the grounds of being the least rusted. A small amount of residual petroleum was disposed of, and the drum was ready to be worked on.

A professional pan maker typically has an arsenal of around a dozen different hammers, each serving a specific function at various stages of the pan making process, but for the sake of keeping the budget as small as possible, I primarily used two hammers: an old rounded off sledge hammer (weight unknown, but likely around 6 pounds and rounded so as not to cut into the metal when hammering and a standard household hammer. Later, in the grooving process, the shaft of a removable screwdriver head was used as an improvised metal punch, and in several other stages common tools such as a marker, ruler, and measuring tape were also employed. In the tuning stage, large and small rubber mallets were used in tandem with a playing stick to determine the progression of the tone. Throughout the entire process, ear plugs proved to be a necessity due to the loud nature of an activity consisting largely of hitting metal objects together repeatedly.

3. Sinking

Since the top of the oil drum has a capped opening protruding from the surface, the playing surface was constructed from the bottom of the oil drum by hitting it repeatedly with a large hammer. After taking several practices blows to the topside of the barrel to get comfortable with both the hammer and how the metal would react to it, the cap was removed (to allow air to escape as the volume of the drum is reduced during the sinking) and the drum tipped upside down to allow access to the bottom surface. Prior to beginning, the center was located and several concentric circles drawn to aid in ensuring the shape of the drum was symmetrical as the hammering took place, and is shown in **Figure 1**.

Figure 1: Concentric circles drawn on the bottom of the drum for aiding in the shaping. Photo taken after several blows from the hammer had been delivered

Also visible in the photo is the stamped lettering on the bottom of the barrel. A common problem in steel pan construction, these stamped letters are thin points in the metal and often crack and burst during the formation process. This did become an issue, but simple welding jobs later on were able to rectify the situation.

Using a rough profile pattern obtained from *Steel Pan Tuning*, the surface was repeatedly struck with the sledge hammer and progressively shaped into a concave dome, as shown in **Figure 2.** As the metal in the center of the drum was stretched progressively thinner, an effort was made to work from the outside rim in towards the center to make use of the thicker, less stretched metal near the edge by slowly working it towards the center. During this process it was also necessary to keep constant watch on the overall shape of the drum, as hitting too hard in one area would lead to other areas popping up, and as such all hammering had to be done in a circular manner, constantly rotating around the drum to avoid uneven shaping.

Figure 2: A view of the sinking process

Eventually, the final sinking depth of around 8 inches was reached.

3. Smoothing

After the rough shape of the final drum was obtained in the sinking process using the sledge hammer, a finer adjustment to the overall shape was carried out in the shaping process to ensure a smooth uniform curvature (or as close as could be attained). In order to have more control over the hammer blows, the standard household hammer was used instead of the sledge. However, given the much sharper edges of the household hammer, it was observed to be slightly cutting into the metal surface in a manner counterproductive to the shaping process. This was remedied by placing a thin rag in between the hammer and drum surface to soften the blows from the sharp hammer edges, and had the added benefit of making the hammering process substantially quieter.

4. Establishing note areas

After the playing surface had been sufficiently smoothed into an approximately symmetrical shape, it was necessary to establish where the note areas would be. This was again accomplished with the aid of patterns from *Steel Pan Tuning*, with careful attention given to ensuring as many cracks were placed between notes, and not on their surface, as possible. The end result is shown in **Figure 3**, with the outlines of these note areas traced in marker shown in **Figure 4.**

Figure 3: Patterns for the note areas placed on the steel drum

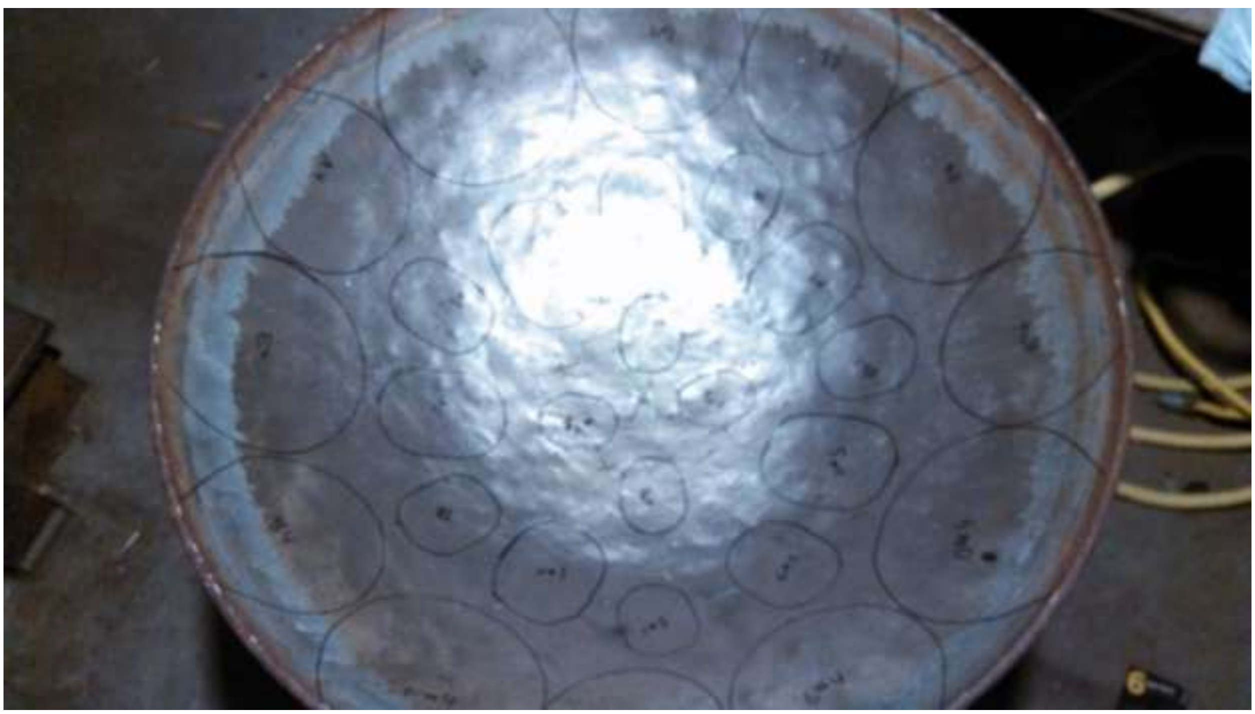

Figure 4: Outline of the note areas in marker on the drum surface

4. Shaping and grooving

In order to effectively resonate at an independent pitch, several steps were taken in the creation of the note areas. One was ensuring the notes have a convex shape relative to the rest of the playing surface. However, since the drum was still enclosed on all sides, it was impossible to hammer up from the bottom to create this convexity. As a result, instead of hammering up on the notes, the regions between the notes were hammered down. This was accomplished using the sledge hammer in the thicker outer regions, and the normal hammer in the thinner inner regions, and was again performed in a cyclical manner to ensure that the overall shape and symmetry of the playing surface was maintained.

After the notes are shaped in this fashion, the other method of acoustically separating each note area was begun in a process known as grooving. This was accomplished using the standard hammer and a removable shaft of a screwdriver acting as a metal punch, and consisted of making a continuous indentation along the outline of each note area. The difficulty in this process is achieving an appropriate depth of the grooves; if they are not deep enough, the notes will not be entirely acoustically separate and ring when others are struck, but if they are too deep there is a risk of puncturing the metal. An image of the playing surface following the grooving process is shown **Figure 5.**

Figure 5: The drum post-grooving

After the grooving was complete, it was necessary to "take out the fat," to use the terminology of the industry and in *Steel Pan Tuning*, and insure that the areas between the note areas (which were raised during the grooving process) are once again lowered so as not to interfere with the playability of the drum. This was accomplished using the standard hammer, and also resulted in the opening of a few more cracks in some of the weaker areas of the drum.

5. Cutting

After "taking out the fat," the most substantial hammering work was complete and the drum could be cut down to the size of the actual instrument, which is much smaller than the full 55 gallon drum in order to optimize the resonance for the smaller, higher frequency notes. The length of the side of the drum, or "skirt," was marked using a measuring tape and marker and cut using a Sawzall obtained from the UIUC Physics Machine Shop and operated by Prof. Steve Errede, as shown in **Figure 6.**

Figure 6: Cutting the drum to the appropriate size

After being reduced to a far more manageable size, the cracks that had appeared in the playing surface were welded by the Physics Machine Shop to ensure they would not grow larger.

6. Tempering

Before the drum could be tuned, the metal had to be tempered in order to return to a more uniform tension. During the work hardening involved in shaping the steel pan, local tensions were introduced into the crystal structure of the metal as a result of dislocated atoms. By tempering the drum over a hot fire, the added thermal energy is enough to allow these misplaced atoms to relocate to the normal crystal structure, removing the local tensions and making the metal surface more uniform and possible to tune. It also burns off the layers of paint on the drum, which will ultimately allow for a much freer resonance of the finished instrument. The process is shown in **Figure 7**, taking place over a wood burning fire. Traditionally, tires are also used as a heat source as they burn much hotter and the process is completed more quickly, but due to environmental concerns a wood burning fire was used in this instance.

Figure 7: The steel pan being tempered over a wood fire

Unfortunately, the science of tempering a steel drum is far from exact, and is essentially described in *Steel Pan Tuning* as being allowed to sit over a burning fire until it looks right, as indicated by the carbon present in the steel and any rust spots adopting a blue-ish hue. As a result, it is entirely likely that the pan in this project was not tempered enough, or was tempered too much, but without a large amount of experience in the construction of steel pans it is difficult to say.

Following the tempering process, there was a large amount of soot and excess paint to be removed, which was accomplished by using a stiff wire brush attachment on a power drill, and the results can be seen in **Figure 8.**

Figure 8: Polished steel drum

9. Tuning

Up until the tuning stage, the project had gone rather smoothly, but progress was impeded when tuning began, primarily because of the time consuming nature of the procedure. Each note area must first be stretched by pounding it up and down repeatedly, making the region slightly more malleable and more resonant. Then each area must be hammered to its approximate final pitch by hammering in the center of the note, but this rough tuning is compromised as other notes are tuned and must be repeated cyclically as the process goes on. After a rough pitch is established, harmonics are added to the note (typically the 5^{th} and the octave, but occasionally the 3^{rd} is substituted for the 5^{th} due to restrictions of how far the metal will stretch) by hammering on the sides of the note. Following this, the octave pairs around the instrument are tuned to insure they blend well, and following the application of a protective wax (or electroplated) coating, a final fine tuning is made. Clearly, it is a lengthy and involved process.

Unfortunately, possibly due to a lack of proper tempering or grooving, the pan I am constructing presented many obstacles in the early tuning phase as a result of note areas not appearing to be acoustically distinct, i.e. adjacent notes would both same pitch, and getting them to remain separate notes was difficult. As such, tuning them to the approximate final pitch was difficult, but appeared to become easier by stretching the note areas more than I initially thought necessary.

This is as far as the project has progressed so far, but potentially with increased time to work on tuning over the summer, a more complete version can be realized. Even if I cannot get it to sound exactly like a professionally made pan, just having the correct general pitches would be sufficient for my intent to have a practice instrument, and if it is not possible with this particular pan, it is always an option to obtain another barrel and try again to build on the experience gained from this first attempt in hopes for a successful future endeavor.

Acknowledgments: Special thanks to Prof. Steve Errede and the UIUC Physics Machine Shop for their assistance in cutting and welding the drum

References:

Kronman, Ulf. 1991. *Steel Pan Tuning.* Arlöv: Musikmuseet