Personal CAD Project: CATA Bus

Nick Caggiano, EDSGN 100-012

My CAD project was inspired by the typical Centre Area Transit Authority (CATA) buses that service Penn State's University Park campus. CATA operates buses from a variety of bus manufacturers; my CAD model is based on the newest addition to CATA's fleet: New Flyer's XN40 Xcelsior model bus (Figure 1). I chose to create a bus for my project because CATA's buses are a defining feature of the University Park campus and State College community. Stand at any street corner long enough or simply take a walk through campus, and you are bound to see at least a few of the white and red buses and hear their distinctive rumble. I've always been interested in transportation in general; the modes of transportation humankind has developed have enabled the movement of people and goods that defines our world today, in which the nations and continents are ever becoming more connected and interdependent.

Figure 1: New Flyer XN40 in CATA's fleet
Source: http://onwardstate.com/wp-content/uploads/2012/03/new-cata-buses-have-arrived.jpeg

The New Flyer XN40, which entered service in 2012 for CATA, features more modern styling than its older brethren, some of which still remain in CATA's fleet. The XN40 features many smooth curves and sweeps, a stark contrast to the box-like older models that have many sharp corners and edges. As a result, the new design was likely adopted both for aesthetic reasons and for improved aerodynamics and fuel economy. However, this made creating a bus that looked visually similar to the New Flyer XN40 a more difficult task than I had expected.

First, I had to figure out the dimensions of the bus. After some searching, I found that the New Flyer XN40, in accordance with its model number, is a 40-ft long bus[1]. However, I was unable to find any more dimensions of the bus, and I couldn't exactly go up to a bus and measure it. Therefore, the lack of information about the bus's dimensions lead the project to be more focused on being a bus inspired by the XN40 rather than a reproduction. I used Figure 1 as a guide to create a rectangular block the approximate size of the bus, using 1 inch in the SolidWorks model to represent 1 foot of the full-size bus. From Figure 1 I was able to create a rough model of the bus.

In order to more closely observe the details of the bus, I took a walk to a bus stop near my residence hall and waited for a bus to come. I captured the picture below (Figure 2) and observed that the front windshield, as well as the top of the bus, were curved. I attempted to recreate this curvature in SolidWorks (Figure 3). For the windshield, I drew a spline on the slide of the block and used the extruded cut feature in SolidWorks to remove material. I had never used the spline feature of SolidWorks before, and drawing a spline with the correct curvature required a bit of experimenting. For the top of the bus, I had to use a fillet instead of a cut. As evidenced by the Figure 3, the fillet did not match the shape of the bus as well as the windshield. This is most likely due to the fact that the fillet tool rounds corners off using a fixed, user-specified radius. The actual curvature of the XN40, however, does not have a fixed radius.

Figure 2: Roof and windshield curvature
Source: Personal Photo

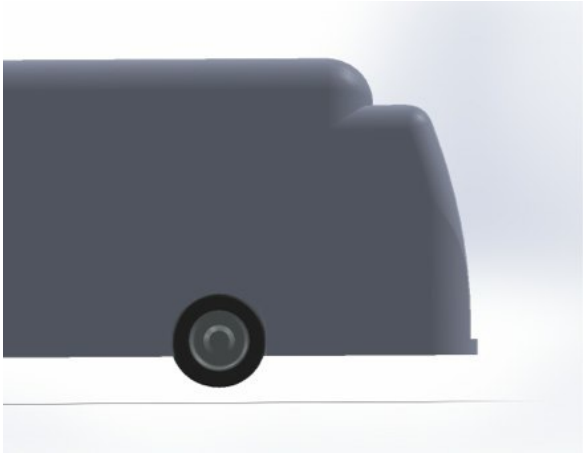

Figure 3: Attempted recreation of curvature in SolidWorks

[1] http://en.wikipedia.org/wiki/Centre_Area_Transportation_Authority

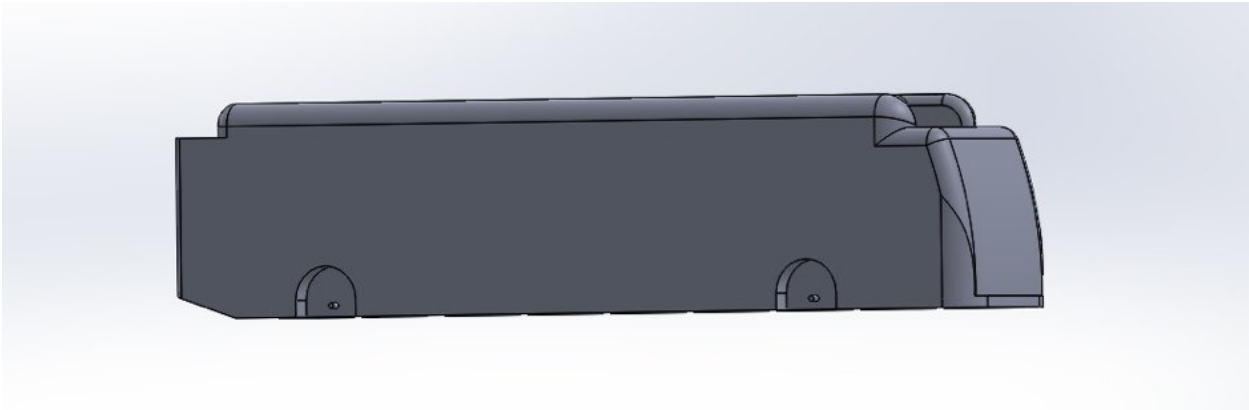

Figure 4: SolidWorks model with cutouts for wheels

I created a general model for the bus (Figure 4) with cutouts for the wheels. These cutouts also included a stub of an axle, to which the wheels would be attached when both parts were put into a SolidWorks assembly. At right is a picture of the wheel I created (Figure 5). I changed the materials on the wheel so that it would stand out from the rest of the bus in the final assembly. (If it were the default gray color, it might have blended in with the rest of the bus.) The black on the wheel is set to a rubber material, while the inner part is set to a polished chrome material. This project also helped me learn how to use the materials options in SolidWorks, which I had never used before.

Figure 5: SolidWorks model of bus wheel

Lastly, I observed some additional details of the New Flyer XN40. While walking on the the third floor of Penn State's Hammond Building, I observed that the fuel tank on the top of the bus is not as long as it appears to be from the side. While the beams on the side of the tank (on which "powered 100% by clean natural gas" is printed) extends almost the full length of the bus, the actual tank tapers off near the "p" in "powered" (Figure 6). Additionally, I noticed that the bus has a small LED screen on its back that indicates what route the bus is operating on (Figure 7).

Figure 6: The fuel tank on the roof of the bus is not as long as the bus itself.
Source: Personal Photo

Creating the fuel tank was perhaps the most difficult part of the whole project. I had already created a box shape on the top of the bus that extended the full length of the bus. In order to create the taper, I first had to cut out part of that box shape while still preserving the edges that would be viewed from the side. Additionally, the fillet on the beam had to be preserved on the side visible to the street, but the inside edge of the beam needed to be flat. First I drew a rectangle the approximate size needed and used the extruded cut feature to remove the material. Then I used the chamfer feature in SolidWorks to recreate the flat taper of the fuel tank. I then used the extrude feature (and materials options) to create the rear LED screen (Figure 8). After working on more intricate details such as these, I created a SolidWorks assembly with the wheels attached (Figure 9) and created a drawing of the assembly (Figure 10).

Figure 7: The rear LED screen indicates the bus's route
Source: http://i.imgur.com/ArSN8WB.jpg

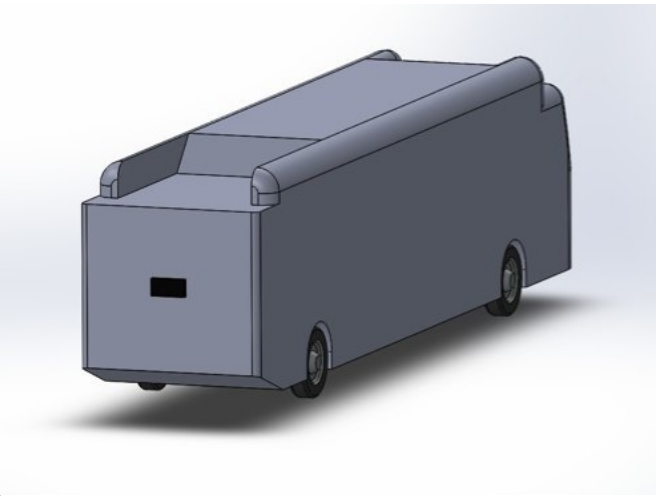

Figure 8: The rear LED screen and the chamfered edge of the fuel tank in SolidWorks

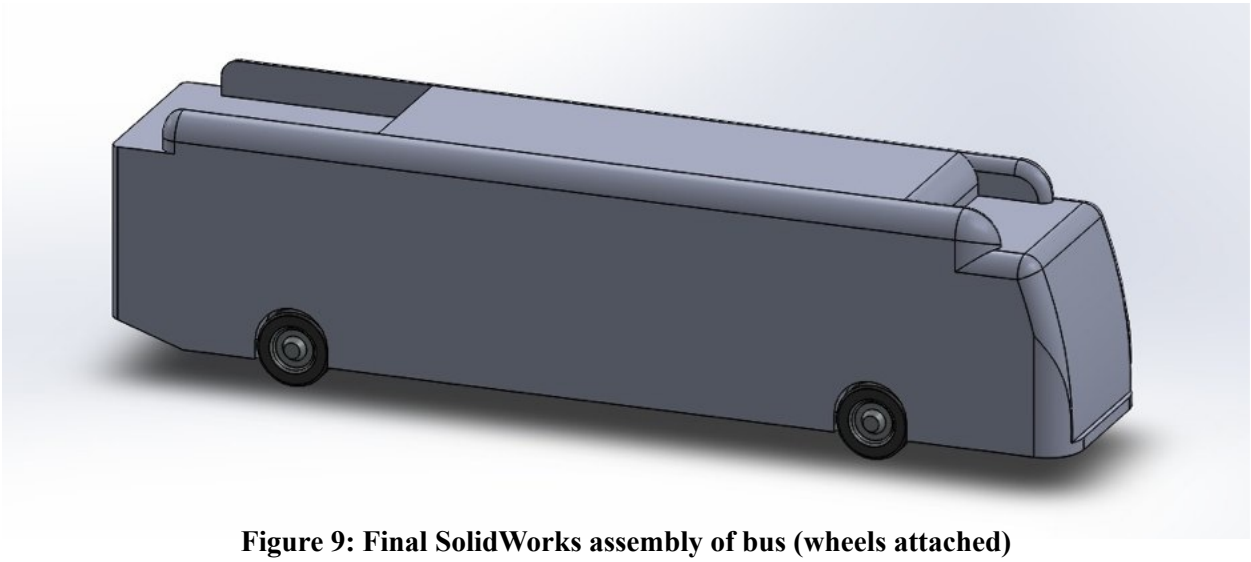

Figure 9: Final SolidWorks assembly of bus (wheels attached)

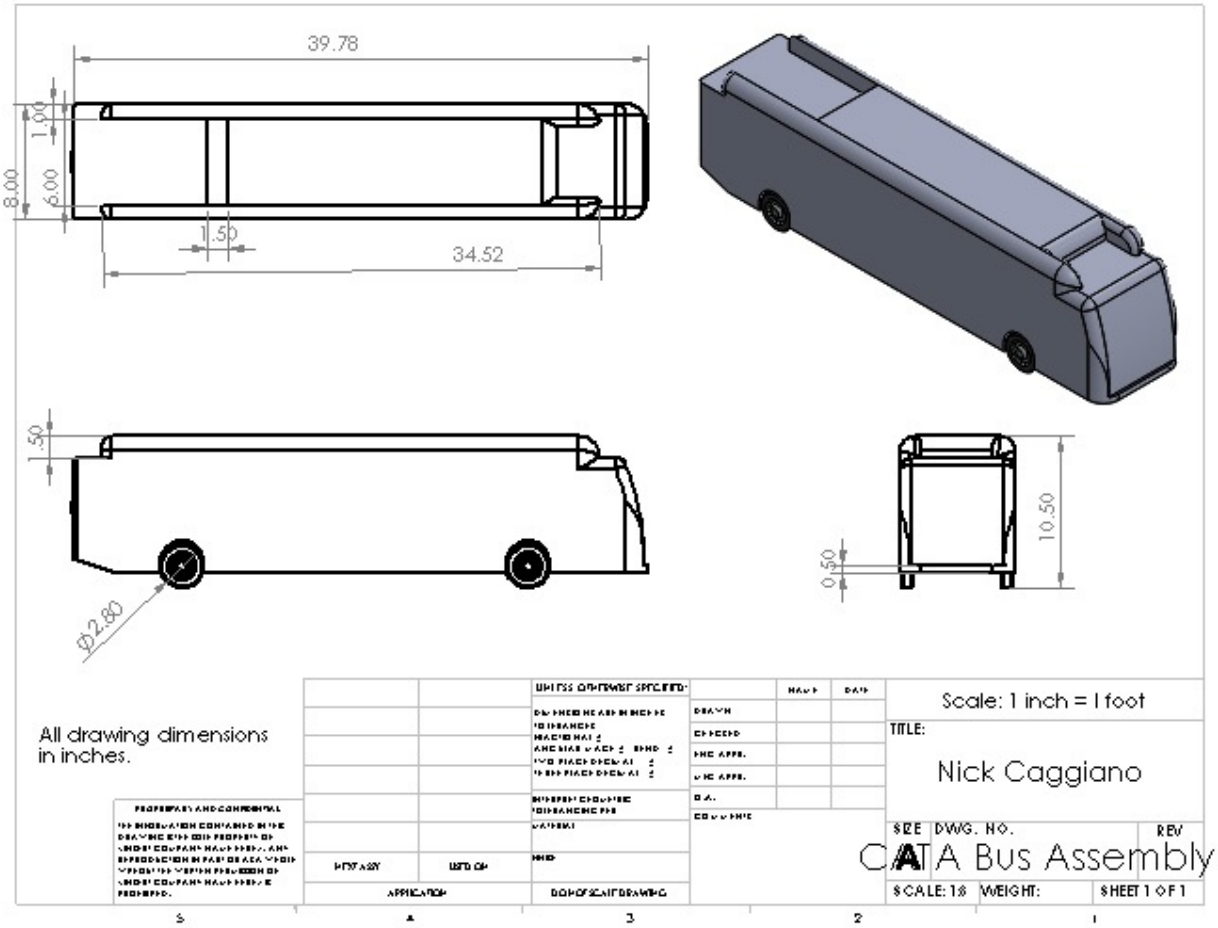

Figure 10: Drawing of the final SolidWorks assembly

Overall, the personal CAD project was a fun, as well as educational, project. It helped me further develop my skills in SolidWorks in an open-ended manner. This enabled me to experiment with different features of the software that would allow me to create different features in the design. SolidWorks is a powerful tool for engineers, enabling accurate modeling and designing work to be carried out. I hope that in the future I will be able to develop my SolidWorks skills even further and be able to apply them in future classes or even careers. If nothing else, I believe that learning the basics of SolidWorks will be beneficial to me as a foundation for learning about other CAD software that I may need to use as an engineer.