Alternative Designs

Bicycle Sidecar for 16 year old Girl (CP)
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Team #12
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Alternative Design #1
(Please see image below the description.)

This alternative design is based off the JENKEL-HEIMER bicycle sidecar. This type of design allows for easy communication between Abby and her parents, and gives her the feeling of riding a bicycle. Abby would also be able to enjoy the surroundings while riding in the sidecar since it is not enclosed. The sidecar itself is attached to the right side of the bicycle since Abby tends to lean and look to the left, allowing for much easier communication. The main sidecar structure consists of a lightweight aluminum frame, two attachable/detachable hitches, a similar sized wheel compared to the bicycle, and a ramp on the back of the sidecar, which would allow Abby's parents to easily get Abby in and out of the sidecar.

The main structure of the sidecar will be the frame itself. The frame used will be a lightweight and strong aluminum alloy. This is ideal so that it can easily be transported from one place to the other by Abby's parents and for the safety of Abby. The frame will be built from scratch since it needs to be customized in order to fit the specifications for Abby and her wheelchair. On the front and sides of the sidecar, there will be hitches installed that can connect to the wheelchair to keep it from moving backwards and forwards while the bike and sidecar are in motion. The back side of the frame will be detachable from the top of the frame itself, so that it has the ability to drop down and be used as a ramp to get Abby into the sidecar.

A similar tire to that of the bicycle will be used on the sidecar as well. Only one tire will be used on the sidecar since two would cause skidding when turning. To ensure for greater stability when turning and riding, a bicycle tire that is equal to (26”) or slightly
smaller in size than the bicycle tire will be used. The tire used will be wider than usual (about 2” in diameter) to allow for even greater stability of the sidecar when turning and riding. The main component to the tire will be the shocks. In order to accommodate for any random bumps that are passed over while riding, strong/stiff shocks will be used. They will be placed where the axel is connected to the sidecar and would provide adequate support in order to ensure Abby’s safety, since we want to keep her as stable as possible when she is riding.

Another main component to the sidecar is the attachable/detachable hitches that will be used. Since the family has specified that they will be transporting the sidecar attachment to and from their nearby park, it must be able to detach from the bicycle to allow for easy transportation. In this design, two attachments are used, one connecting to the backside of the bicycle frame and the other connecting to the front side of the bicycle frame. These attachments will be spaced out to ensure that there is plenty of room for Abby’s parents to pedal while riding the bicycle. The type of hitch we want to use is a metal clamp design that can securely fit around the bicycle frame, and be able to tighten and loosen when needed. This type of design will ensure the overall safety of Abby and allow for easy attachment/detachment of the sidecar from the bicycle. Overall, we feel this design will give Abby an optimal riding experience and also accommodates all of Abby’s and the parents’ needs. A rough and basic CAD design of the sidecar is seen below.
Figure 1: Design 1 angled view.
**Alternative Design #2**

In this alternative design, there will be a dual hitch attachment of the sidecar to Abby’s father’s bike. This design is based off of a wheelchair sidecar built by JEINKEL-HEIMER seen in figure 1 below. Unlike our first alternative design, however, which is also based off of this sidecar design, our second design will have a built in wheelchair type seat instead of allowing the whole wheelchair to be situated on top of the frame. Rather than a ramp in the back of the frame, this design will be closed off in the back and will have a hitched door in the front that can be opened to place Abby inside and closed for safety measures. This alternative design still allows Abby’s father to have a full view of her so that they can talk and enjoy their ride together.

The seat that we will be implementing for this design will be similar to her current wheelchair design but with modifications made so that it will be more comfortable for her (her current wheelchair seat needs to be altered as well). We will have Abby’s right side open so that she can enjoy her view while she’s riding (it’s not necessary to have supports on her right side since she always leans to the left). Abby will be safely secured into her seat for both comfort and security. We will include supports for her neck, head and torso as well as a “X” shaped strap that will cross over her chest in order to keep her sitting in an upright position and to prevent her from falling out.

The frame of this device will be made out of aluminum since it is lightweight and will therefore be easy for her father to lift in order to transport it. A lightweight frame is also necessary in order for her father to be able to smoothly operate and turn his bike. Along with the comfort of her seat, we will be adding extra cushion for her legs to rest on. There will be Velcro straps attached to the padding so that her legs will stay in place while
she’s riding. Abby kicks when she talks so it is important to have straps to hold her in place for safety.

With this design, it is easy for Abby’s family to get her in and out of the device. Although it may seem more convenient to be able to roll the wheelchair onto the frame like in design 1, this would make the device a lot heavier for her dad to control. Having a supportive wheelchair-like seat already built into the frame will allow her parents to easily lift her into the device and once she’s in, they can tie the straps so that she is secured.

The sidecar will only have one wheel on its right side. The wheel will be similar to a bicycle tire (smaller or equal in size to her father’s bicycle tires to allow for equal rotation of the bike and sidecar). Since her family expressed the need for a device which will be easy to attach/ detach from her father’s bike to make transportation easy, we have modified this design so that this is possible. In order to attach the sidecar to her father’s bike, only a few simple tools are needed, which are within our budget and will be provided to the family (will be kept in a small box that will be attached to Abby’s sidecar for convenience/ prevention of being lost). The hitch attachment to the bike will be implemented on the bottom part of the bicycle (frame near pedals). Using a metal clamp, the device will be strongly secured to the bike but also easy to remove.

Figure 2: JENKEL-HEIMER wheelchair-accessible bicycle sidecar.
**Alternative Design #3**
(Please see images below description.)

This alternative design was based off of the commercial idea of the Chariot Sidecar. This would allow Abby to feel as close to riding a bicycle as possible. The open-air design of this sidecar would give her the sensation of the air rushing by as bike moved. Also, she would be in very close proximity to her parents, which would allow optimal communication and interaction. The bike will be riding along the right side of the bike because Abby tends to lean to the left. This will allow her to be able to see more of her surroundings when she is looking outwards.

The basic structure of the bike attachment for Abby is an undercarriage frame, full body supported seat, wheel with a protective fender and the use of the Chariot Sidecar bicycle attachment.

The frame of the sidecar is a very important aspect because it will be supporting the seat and Abby. To ensure the safety of Abby a strong aluminum alloy will be used. There are a few types of hollow alloys, which provide the necessary strength, but will reduce the weight for transportation. The back of the frame has two contact points to the seat, which secures it and gives adequate support. In the front there is another square cavity where Abby’s feet will be able to be contained. The front wraps around and dips in line with the chair to make it as easy as possible for Abby and her family to get her in and out of it. The front crossbar sticks out further than the rest to give the needed room between the sidecar and the bike. This distance gives the rider of the bike enough room to comfortably pedal.

The end of the frame will have the Chariot Sidecar bike attachment connected to it for easy attachment.

The seat of the sidecar is a very prominent aspect of the design. It must be made so that it will fully support Abby’s torso, neck, and head. The seat design of this sidecar has
many supports to ensure that it happens. There are two side supports for both the legs, full torso, and for the neck/head. This will keep her body in the seat and not slide around when going around turns. There will also be a 5-point restraint harness to make sure that she will not fall out if she started to move around or if the bike had to stop abruptly. To keep Abby safe during the entirety of the ride a place where she can rest her feet were added. Her parents can strap her feet to the foot plate and make sure that she cannot kick with them and hurt herself. Since there are moving parts around her keeping her from injuring herself by accident is important. Keeping the feet strapped to the foot plate will not allow her to accidently kick her parent riding the bike or get her foot caught in the sidecar or bike wheel or get caught and dragged on the ground.

The wheel attached to the outside of the sidecar will be a bicycle tire. This will keep the entire bike/sidecar wheel maintenance simple. If the tire were to be low on air pressure it could be pressurized the same way the other tires would be. Also, the tire size will the 26 inches to match both of Abby's bike. This will make sure that turning and overall wheel rotation is same on all three of the tires. A fender was added to the side of Abby's seat and over the tire for safety reasons. Just with the foot plate it would be very dangerous to have the wheel exposed and possibly get Abby's hand or arm caught in the moving spokes. The fender will allow Abby to still move her arms and torso freely, but in a safer manner. The wheel will also be easily detachable for storing/transportation purposes. A similar bike wheel hinge mechanism will be used to secure it in place and will be convenient to put on or off.

The Chariot Carrier Company has created a hitch which is used in their sidecar model. The hitch will make assembling and detaching the sidecar from the bike very
simple, easy and safe. For this design the hitch will be purchased and incorporated into the sidecar. The hitch will be added to protruding bar on the inner most part of the frame. It will attach to the bottom of the bike’s frame close to where the pedals and gear is. This attachment will allow the transfer from one bike to the other relatively simple. Overall this design for Abby’s sidecar would optimize the bike riding experience by being a very open-aired design, yet ensuring her safety.

Design Images:

Figure 3: Angled View

Figure 4: Side View