Proposal

Beach Wheelchair

Team 13: Maya Alfonso, Matthew Ellis, Danielle LaPointe, Kyle O’Brien

Project for Matthew and Jack Davies

Client Contact: Thomas and Kathleen Davies, 14 Chesterwood Court, Cheshire, CT 06410.

(203) 250-7508
Executive Summary

The following document is a proposal for the design of a beach wheelchair fitted to a child who suffers from both cerebral palsy and scoliosis. The client is virtually dependent on those around them and has very limited limb dexterity. The client has very poor posture and lacks the ability to fully support himself.

1.1 Background

The purpose of this project is to design a beach wheelchair for use by Jack Davies, a 12 year-old boy with Cerebral Palsy. Cerebral Palsy (CP) is a disease that affects the neurological system. Usually diagnosed during very early childhood, the disease permanently affects muscular movement. Though there are varying degrees of debilitation resulting from Cerebral Palsy, Jack’s condition requires the use of a wheelchair pushed from behind in order for him to be mobile. Jack’s family spends time every summer in the beaches of Rhode Island. The wheelchair that Jack uses daily is not suitable for sandy terrain, which makes it very difficult for his parents to transport him around the beach. The beach wheelchair will offer the mobility Jack enjoys in his regular wheelchair, but will provide him access to the beach and allow his parents to easily transport him over the sandy terrain.

1.2 Purpose

The overall purpose of this design project is to create a beach wheelchair for Jack that will offer him the security, support and comfort of his daily wheelchair, but allow him to be easily transported around sandy terrain. The current system of
transportation for Jack on the beach involves using a tow cart not designed to transport children (Figure 1). Our aim, therefore, is to provide him with a very safe and comfortable wheelchair that will allow his parents to easily push their son across the sand. The wheelchair will have features like his normal wheelchair, including a reclining seat rest, a platform to attach his current cushioning system, neck and back supports, and a place for a feeding tube apparatus to hang. Additionally, the wheelchair will have large, rounded wheels that will travel well over sandy terrain. The chair will also be constructed from a material that has little tendency to rust in humid and salty air.

1.3 Previous Work Done by Others

1.3.1 Products

Many products have been released that allow wheelchair users to access the beaches. One of these products, released in the United States in 2007, is the Joy on the Beach Wheelchair. Manufactured by the Italian company NEATECH, the wheelchair is classified as an “all-terrain” vehicle. In addition to having very large wheels, the chair is lightweight and was constructed similar to some lounge chairs, with the main seating platform created from fabric stretched across a frame. There is no electrical component, so the chair can roll into the water, and can also be used for snow. However, the chair does not feature any safety constraints or neck or
back support, and is not really tailored to a small child with cerebral palsy. It is a very simply design, aimed to make beach mobility available to the masses. The cost of this chair is $1,600 before add-ons.

Another beach wheelchair currently on the market is the Landeez Beach Wheelchair, manufactured by Natural Access in Santa Monica, California. This wheelchair is much more similar to the structure of a regular manual wheelchair. It has soft, large tires, is extremely light, and can be collapsed to pack down into a car easily. It also features a tilt-in-space option, which allows the user to recline while taking pressure off of their sciatic nerve, a sore spot for many children with cerebral palsy who are confined to a wheelchair. However, this chair also lacks the very specific restraints that a child with cerebral palsy would require. It retails for $3,600 before add-ons.

1.3.2 Patent Search Results

In 2005, the William Penn Charter School in Pennsylvania passed a patent for a dignified broad footprint beach wheelchair. It has a removable seat, and can be folded like a pair of glasses to fit in a smaller space. It operates using and two front skid wheels with springs, which provide very low resistance over bumpy, sandy terrain. The rear wheels are wide and create a broad footprint to disperse the weight of the chair and rider. Their shape is similar to that of a dogbone, which helps create a wide profile as it rolls through the sand. The body of the chair is able to recline to support the weight of the users legs.
2. Product Description

2.1 Objective

The main objective of this design project is to create a wheelchair that can roll easily over sand and into shallow water at the beach. The chair will be designed such that it will be easy to push from behind and will have very little resistance rolling over wet or dry sand. Many special customizations have been considered to create a wheelchair that will be tailored to Jack’s specific needs. These include the option to recline the chair at different angles to take pressure off of Jack’s back and allow him to relax, and a mounting system for the feeding apparatus. Additionally, the chair will be set up so that the cushion system Jack already owns can be mounted on the chair and then removed to allow it to fold up easily.

Because Jack also suffers from scoliosis, the neck and back supports are a very important part of the wheelchair that will allow him to be comfortable and properly supported during most of his time on the beach. He cannot hold the weight of his own head or sit up straight, so the supports guide the side of both his head and his middle back to allow him to sit up. The chair cushion Jack already owns offers support along the flat surface and some of the side of his back, as well as a safety harness feature that keeps him set in the chair.
Our goal is to mount this cushion system in such a way that it is stable and able to recline to different degrees.

In addition to the comfort and safety features, the chair must be able to fold down so that it will be small enough to fit into a Toyota Sienna modified for a handicapped child. The car also has a ramp that folds down, so the chair’s width, including wheels, should be narrow enough to allow it to roll smoothly down the ramp.

2.2 Methods

Because the dimensions of the chair and the support system need to be so custom-fitted, the design team will build most of the parts of the chair. Because there is no need for a motor on this wheelchair, the design components are purely mechanical. They are broken down in the following section.

Seat

Due to the fact that the seat is the main support system for Jack’s upper body, it is extremely important that the features and dimensions are very specific to his body. For this reason, we will be using a form of cushioning that Jack’s family already owns, and which has been designed to support a boy his size. The seat also has a harness system that safely and comfortably anchors Jack. The seat will be mounted to the chair so that it can be easily removed to allow the chair to fold down smaller. In addition to allowing the chair to fold easily, this will also allow the family
to substitute a new cushion system for Jack as he grows without having to redesign the whole chair.

**Body**

The main body of the chair will be a frame that forms a platform and back frame to which Jack’s seat cushion can be mounted. The seat will be anchored to the body of the chair using a very strong velcro adhesive, which will allow the chair to be removed easily and will not harm the cushioning system. The body will be designed so that the chair can recline to some degree, allowing Jack to relax and taking some of the pressure off of his lower back. The frame will be hinged on either side to allow the body of the chair to fold, similar to the way a pair of eyeglasses folds. This will allow for the chair to be packed into the family’s car without taking up a great deal of space. This portion of the chair will be built from scratch out of metal.

**Chassis**

The chassis of the chair is the lower section that sits under the seat platform. It houses the axles, and is also the weight bearing portion of the chair. This will also be built from scratch, and will be designed so that it will support Jack’s weight as he grows older. The chassis must be able to withstand any external forces during operation of the wheelchair, and will be designed so that it can absorb some of the shock as the wheelchair is navigated over hilly, sandy terrain.

**Tires**
The tires are one of the most important features of the wheelchair, and the main difference between Jack's regular wheelchair and the beach wheelchair being created by the design team. By using very wide tires, the weight of the chair and rider can be dispersed over a greater area, and the chair will have much less tendency to sink into the sand. Using wide tires will make it much easier for Jack's parents to push him across the beach. The back tires will be large, PVC rubber tires with a small amount of tread. The front two tires will be smaller PVC rubber tires, designed with a spring system so that they absorb the shock of the terrain. The spring system will also allow the chair to glide over the terrain, making it easier for Jack to be pushed.

**Suspension**

The suspension system will be designed to absorb any extra forces from the uneven, sandy terrain. It is important to keep Jack sitting relatively upright, so the suspension will aim to keep Jack's chair from tipping too far in any direction as the wheelchair is navigated through the sand. This is also an important safety feature, as the suspension will help keep the center of gravity of the chair low and stable, to avoid tipping.

3. **Budget**

The following list is a preliminary estimate of the cost of the components to fabricate the beach wheelchair. Because the seat cushion system is already accounted for, and most of the parts will be manufactured from scratch, the custom
wheelchair we are creating will be much cheaper than a typical custom beach wheelchair, which can range anywhere from $3,600 to $7,000 or more.

<table>
<thead>
<tr>
<th>Part</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>$1,000</td>
</tr>
<tr>
<td>Chassis</td>
<td>$1,000</td>
</tr>
<tr>
<td>Tires</td>
<td>$200</td>
</tr>
<tr>
<td>Suspension</td>
<td>$800</td>
</tr>
</tbody>
</table>

Total Cost: $3,000

4. Conclusion

The beach wheelchair for Jack Davies will be a custom chair that provides him and his family with the opportunity to traverse the beach environment much more easily. By creating a chair that can be more easily pushed across the sand, Jack’s parents will have more ease of mobility. The wheelchair he currently owns has small tires that are not useful in sand, because the chair just sinks. In order to transport him across the beach now, his parents have resorted to using a cart designed to tow coolers across the beach. Jack and his family need a wheelchair that is designed with their family vacations in mind.

The wheelchair will be similar in structure to a standard wheelchair, but will have a few key features that will ensure its success in sandy terrain. The most important feature will be the tires, which will be very wide to keep them from
sinking in the sand. The two smaller front tires will be set up on a spring system that will allow the wheelchair to glide well over the uneven sand. The suspension system will also help the chair glide well, in addition to helping keep Jack’s seat oriented in a nearly upright position.

All of these features combined will come together to create a beach wheelchair that is safe and easy for Jack and his family to use. Having a chair that is designed for the sand will make it a great deal easier for them to navigate the sand at the beach, and overall will create a much more enjoyable experience for the Davies family.

5. References


Dignified broad footprint beach wheelchair United States William Penn Charter School (Philadelphia, PA, US) 6869084

http://www.wheeleez.com/
http://www.neacare.com/
http://www.laneez.com/
http://www.mobility-usa.com/