4. Optimal Design Saddle Eating Chair

Introduction

This chair is designed to give Elysa freedom of motion with her legs while sitting in the chair and also this chair will allow her arms free motion. This chair will provide minimal restriction. The chair has a base with locking wheels. The base will be made from aluminum rectangular tubing 2 inches in length and one inch wide. A figure of the base design from above is shown in figure 4.1. The base is wide to prevent lateral tipping. The piece connecting the base and the seat will be telescoping tubing and will be the same width and length as the base piece. The telescoping tubing will be used to adjust the seat height. Holes will be machined in the tubing. As the seat is pulled higher the user will align the holes and spring loaded pin can be inserted through the hole and hold the seat at the desired height. Also there will be an additional support attached between the base and the seat adjustment that will allow the seat to be tipped forward or backward. The mechanism will be similar to the one pictured in figure 2. The seat will be a modified bicycle seat that was a leftover part from past senior design projects. I will add a pommel and additional cushioning to the seat. Another extra part available from the lab will act as the lower back support and this piece will be mounted by connecting it to the chair. I will fabricate the rest of the seat back from wood and cushions available in the lab.

4.1 components

4.1.1 Wheels

Caster wheels from the McMaster-Carr website will be used to allow the chair to be mobile.

figure 4.1 wheels
http://www.mcmaster.com/#78155t62/=egsoum
In figure 1 you can clearly see the locking mechanism is attached on the side of the wheel. Each wheel and caster has a 100 lb capacity. This is also a swivel mount to allow for easy movement of the chair in any direction. The holes will allow the wheel to be attached directly by screws through machined holes in the aluminum base frame. The design plans for 8 wheels. This will allow an 800lb capacity. This is clearly safe enough to handle Elysa (32 lbs) and the weight of the frame and seat. The wheels are non-marking so will be good to use indoors. The 4 holes will allow 4 attachment points that will provide a very secure connection to the tubing frame. The mounting is 2 and ½ inches off the ground.

4.1.2 Frame

The base frame will be made from rectangular aluminum tubing. The dimensions will be 1 inch wide by 2 inches long. This will also be ordered from McMaster-Carr. The wall thickness is 1/8 inch the frame will have a similar shape to the following device that was found at the neat marketplace.

The frame for our design will be very similar to figure 5.3. There will be another piece of frame perpendicular to the frame at point one. This extra piece will be about a foot and half this will help with any lateral motion. Two wheels will be placed on the ends of the additional perpendicular piece. A wheel will be placed under the frame in the position labeled 2 in figure 3. Wheels will be placed under sections labeled: 3,4,5, and 6. The aluminum frame will be able to
withstand the weight requirements and also be easy to weld. Aluminum is also lightweight. Where the frame has bends those will be formed by pieces that were cut and welded together.

4.1.3 Seat post

Telescoping Aluminum rectangular tubing with the same length and width as the base frame will be used to connect the seat to the base frame. The telescoping tubing will allow easy vertical adjustment of the seat. The placement of this tubing will be similar to the figure 3 and 4 except the distance depicted by point A will be about a foot and a half.

Figure 4.3 Seat Post

As shown by point 1 in figure 4.3 the telescoping tubing is attached to the lower frame by a hinge. Also at the point labeled 3 there is another hinge. At point 2 this support is also telescoping tubing. The telescoping tubing at point 2 and the hinges at point 1 and 3 create the mechanism to tip the chair forward and back. Locking mechanisms keep them firmly in place. In the frame for our design the seat will need to be at least 18 inches off the ground for Elysa to sit and at the lowest table height of 28 inches. That is obviously much higher than this picture. So the tubing section under the seat depicted as between point 1 and 4 will be about 18 inches when the inner tube is completely inside the outer tube. If this piece is 18 inches this will allow the next table height of 36 inches to be reached easily.
4.1.4 Seat

The seat will be a modified bicycle seat from the spare parts from the senior design lab. The seat is 11 inches wide. This is wide enough to comfortably fit under Elysa and fully support her. The length of the seat is 11 and ½ inches. Three rods are already underneath the chair to allow for easy mounting. A sheet of aluminum will be welded to the telescoping inner tubing. Holes can be drilled through this sheet and the 3 rods insert into these holes. The rods are threaded so by using the appropriate nut the bicycle seat can be attached to the lower frame.

Figure 4.4 seat

Figure 4.5 Seat attachments

Another spare part from the design lab, shown in figure 5.7 will be used to add lower back support arms rest and extra stability to keep Elysa from bending her torso too far to either side. A small pommel will be fabricated by the group from cushioning material in the lab. This will keep her from slipping forward and also help with her posture.
In the back you can see any rectangular rid can be used to attach this to the sheet under the bicycle frame. Any simple hinge and bolts can be used. This would allow the seat back to be adjusted slightly.
Her shoulder width is 9 and 1/2 inches so the support for her upper back and shoulders will be that wide. We will fabricate it ourselves from the memory foam cushioning, fabric and wood as the back. For around her head extra cushion will be added.

The piece to be used to support her shoulders and head will be similar to the picture shown below.

![Figure 4.9 seat back support will be similar to this design](image)

Here the back and head rest are attached to a rod the connect to the seat bottom. This will be similar to our design. Our design however will have two rods to connect the seat back to the seat bottom.

### 4.1.5 Harness

To strap Elysa securely to the chair the EZ on adjustable vest will be used
we chose this vest because it is minimalist. It has easy zipper adjustment for quick changes. It can also be put on Elysa before she is placed in the chair for ease. The attachment above the shoulder will keep her shoulders firmly back into the chair. The attachments low on the waste will help keep Elysa’s lower back firmly against the seat. Multiple attachment points will help her posture in the seat. These will be attached through straps that will attach to the chair back. They will be adjustable.

Testing

Before we send this chair to Elysa the whole apparatus will be fabricated. To test it it should be able to take the weight capacity of any group member sitting in it. We will spend hours sitting in the chair and wheeling it over even and uneven surface to see any point of possible wear. Also we will test the locking of the wheels by locking all wheels then progressively unlocking wheels to see what the minimal amount of locks that need to be engaged to prevent movement. We will test for lateral tipping by sitting in the chair and bending to both sides. The lightest group member is around 115 pounds. Providing enough safety so secure that user should ensure tough enough testing to stand up to anything Elysa can produce.

4.2 Realistic restraints
The caster and wheels will be able to support up to 800 lbs which is easily be 6 times more weight then the frame seat and Elysa combined. The 1/8 inch thick frame will be able to withstand more than Elysa’s weight. It is rated well above 500 psi. All the parts including the wheels, chair back, and seat all have components for easy attachment included. Aluminum has good machining qualities and is easy to weld. It is lightweight and the type 6061 for this design is easily within budget.

4.3 Safety

The four attachment points of the wheels should be very secure and ensure that the wheels will not slip from the frame and make the chair tip and possibly injure Elyssa also having 8 wheels will also allow more pressure distribution and should keep the frame stable. Also the wheel and caster has the lowest mounting height in order to keep the frame lower to the ground. The lower the center of gravity the less likely this is to top.

The frame shape will prevent tipping as well. The frame parts that extend laterally will help this. Also in the frame is long enough that should Elysa kicks the table the chair will not be able to tip backward. Also the frame extends far enough in front to keep her from tipping forward as well.

The extra pommel adds stability to keep her firmly in the chair and from slipping off. The strapping system is very secure and will surely keep her from falling off and keep her safe.