Eric Harmatz
December 19th 2008
Period 1

Karl's Final Exam: Toy and Semester Reflection

1. What did you learn this semester and how can it help you in life?

At the beginning of the semester, I was stoked for "Karl's Klass". I heard from Rose that the class was designed to be hard and that last year only a few students received an "A" at the end of the semester. I enjoyed engineering over the summer when I attended COSMOS at University of California, San Diego. After going through this engineering class, I learned not only engineering content, but real life skills. For example, I learned that in the real world, there will be deadlines. During our *Careers in Engineering* project, I went into a panic attack over the short deadline to get the work done. However, I came to a realization that in the real world I'm going to be faced with deadlines that I may personally feel are unreasonable, but I still need to work and get the product done. I worked extra hard to try and get the product finished with a late night run to FedEx Kinko's to make the deadline. I made the deadline and received an "A" on the project. This shows that in the real world I will have deadlines like these that I need to make and can't use excuses such as "I couldn't go to FedEx Kinko's because my mom wouldn't let me out." In the real world, the project will be due whether or not you are done and ready. Also, as with all courses at High Tech High Media Arts, this class is still experimental. Karl is constantly learning from the execution of the class and is building on his new knowledge for future classes. I have to accept that in the real world, I will be faced with "beta" and "experimental" ways, programs, or ideas. I need to be able to accept the fact that errors and mistakes will happen and I will need to work around them and offer feedback as to how the problems can be approached next time.

2. What did you learn about the design process when building your toy?

The design process is the 11 step systematic approach for engineering. The first step is to define the problem. What is it I need to do? Our problem in our toy project was to create a toy for a less fortunate child for Holiday 2008. Secondly, we needed to brainstorm our ideas. Each member of my group went home over the first weekend to brainstorm their ideas. We all had different ideas for how our toy was to look like. My idea for propulsion of our “Cat Car” was to have a windup tail that stored energy. My group members mainly brainstormed the cosmetic and output facets of our toy. We then refined our ideas based on the Required Performance Criteria, the next step of the design process. Our toy needed to appeal young kids, work for 10 minutes without requiring service, and to have 3 outputs that utilized simple machines. The next two steps are to develop and then to refine our solutions. I developed a solution to use gears to turn the tail, the output I was assigned to complete. When using gears to turn the tail seemed not feasible, I refined my solution to incorporate a pulley in the third (tail) section instead of a gear, since the chance for error is high as a gear assembly as a lot of moving parts lowers the reliability. My group selected our solutions that we wanted to execute. We decided to pursue our ideas for a three-segment car with one output per segment. The next step was to build our cardboard mockup. This was the one step that I didn’t think was necessary. I was proven wrong after building the mockup, as that is when I discovered that there was a design flaw with my tail. The mockup allowed me to refine my ideas for the prototype, the next step. I wanted to skip the prototype, but after building it, I had no regrets. After the prototype was finished, we tested our project, the 9th step of the design process. After we tested, we realized there were some serious issues with the output that we needed to refine. We totally revamped the toy for the final model, and were able to successfully complete the project. The last step of the Engineering Design Process is review and reflections. The reflections for our toy are available on my DP.

Looking back at this process, I see that without going through each step our project wouldn’t have been successful. We needed to go through each step in order to get ideas on how to make our project work. Without doing this, our final model would have looked much like our prototype: a three segmented train that

3. What is friction and why is important?

Eric Harmatz
December 19th 2008
Period 1

Friction is a force that opposes motion. Friction is created when two objects "rub" against each other. Friction slows down movement and creates heat. To combat the heat, lubrication can be used. Friction may seem like a nuisance, but it is essential for motion. Friction helps with traction, and without traction we wouldn't have linear motion. For example, when it raining, the lack of friction causes vehicles to hydroplane, losing control due to the lack of friction. As you can see, friction is important as without out traction wouldn't be possible.

4. Where do you want friction to occur and where do you want to limit friction in your toy?

In our toy, we want friction to occur underneath the wheels. We added rubber bands to try to add more traction. We need friction to occur underneath the wheels or else the car wouldn't move as smoothly, the wheels would spin around without actually moving the cat car. We want to limit friction where the cam meets the output lever, as friction there will cause the parts to heat up and slow down.

5. What simple machines are at work in your toy?

Looking at our toy, the first apparent simple machine at work is the wheel and axel. The wheel and axel is used for transferring torque to a linear force to allow the toy to move forward and backwards. Also, we use a lever on which the three outputs rest. The tongue of the cat is a first class lever, as the fulcrum is located between the effort and the load. The mouse and the tail are third class levers, as the effort is on the same side of the lever as the load. The cam acts as lever for the output lever. The cam rotates until the notch, which then drops the output lever down. This creates the effect that the cat is sticking its tongue out, the mouse is riding the cat, and the tail is moving.

6. What mechanical advantage (if any) do the simple machines in your toy provide?

Eric Harmatz
December 19th 2008
Period 1

Each simple machine in our toy has mechanical advantage. Mechanical advantage is a multiplier of force (i.e. If you exert 1 N of force with a 5 Mechanical Advantage, the output force is 5 N). Since we weren't informed that we needed to calculate the mechanical advantage in our toy, my partners redrafted the dimensions of our toy in order to hypothesize the mechanical advantage. Mechanical advantage for the wheel and axel as well as the lever is calculated using the equation **MA = LE/LR**. Where LE is the length of the effort arm and LR is the length of the resistance arm in a lever. In a wheel and axel assembly, LE is the radius of the wheel and LR is the radius of the axel. The radius of our main wheels are 1.75" and the radius of the axle is 3/16". This is equal to a mechanical advantage of **9.33** in the main wheel and axel assembly. The mechanical advantages for the other simple machines in our toy are as follows:

CAM: **3.33**

Tounge (as a resistance to the output lever): **5**

Mouse (as a resistance to the output lever): **.88**

Tail (as a resistance to the output lever): **.8**

Mechanical Advantage Table Calculated by Kate-Lee and Sara, who had the toy at the time of this document's publication.

7 . What is torque and what unit is torque measured in?

Torque is a twisting force. Torque is measured as "Feet per Pounds" also known as "Foot Pounds". Since I am studying to become a pilot, I see torque a lot in the real world. Since a propeller turns clockwise along an axis, the plane has a tendency to fly to the right. This is because of the torque created by the spinning propeller.

8. What mechanisms did you use to transfer torque in your toy and how did they work?

In our toy, we use a wheel and axel to transfer torque. When the toy is being dragged along, torque is being created in the wheels and must be transferred to a linear force in order for the toy to move forward and backwards. Torque is also transferred to the output by turning the cam with the axel to allow the output lever to bob up and down.

9. What was your favorite thing about this course?

My favorite thing about this course was that Karl gave us academic freedom. Taking into account the required performance criteria, we were able to approach the problem in anyway that we wanted to. Karl was supportive of us wanting to explore engineering at our own level. That is what truly made this class unique from any other class.

10. How could you improve this course?

As stated in prompt 1, everything we do at High Tech High Media Arts is still in an experimental stage. Because of this, our instructors learn from what went well and what didn't in previous semesters and amend the class based on that. In future executions of "Principals of Engineering", I recommend more organization on the instructor's part. Organization seems to be a key component that affects this course. With more organization on the instructor's part, deadlines would be set reasonably and thus met on time, as well as the class timeline be followed more carefully.