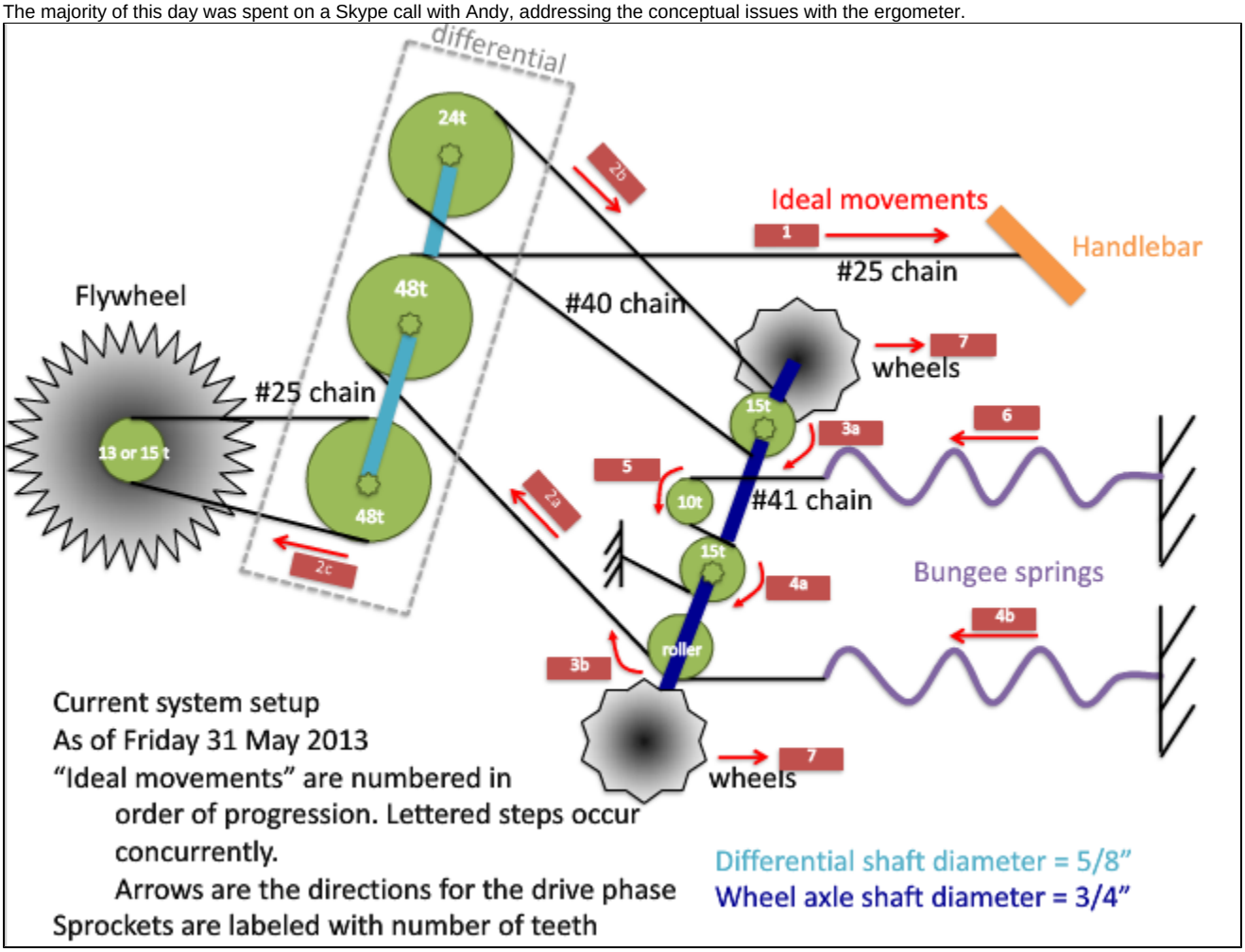
Steven Moses June 1- June 5

aturday, June 1st

The majority of this day was spent on a Skype call with Andy, addressing the conceptual issues with the ergometer.



The main problem we were facing was how to match the gear ratios to what they were with the floating pulley. While Andy had been suggesting that we put the wheel chain in the center of the differential instead of the handle chain, we were nervous about this because of what a major change it would be.

First, the wheel chain had a different pitch and size as all of the other chains on the erg. Putting the wheel chain in the center of the differential would require purchasing several more axels. Second, the erg is the easiest to use when the handle chain axel aligned with the seat. If the wheel chain was in the center, the handle chain would no longer be aligned with the seat, creating a lot of bad lateral action on that gear.

With these problems present in rearranging the order of the chains on the differential, we decided to keep things in the same order and change the gear ratios on the wheel chain. With the size of all three gears being the same at this point, we needed to make the wheel axel on the differential four times smaller to match the gear ratios from the floating pulley setup. Later, when shopping, we discovered that such an axel didn't exist. We instead found an axel half the size of what was on the differential, and then doubled the size of the axel directly on the wheel axel; this creates the same gear ratio.

We also had been having a hard time with all of the different chain pitches; since we were buying two new axels anyways, we got them with #25 chain to limit the number of chain types we were working with.

Second, on the chain and bungee system labeled #6, there is a conceptual issue in that there is a bungee on one end, and a fixed end on the other; while the bungee can expand and contract, there's nothing else to account for the its change in lengths. At best, we could make a tense bungee leave some slack on the chain near the fixed end. Our solution was to put a very soft and non-stretched end just to hold up the slack.

However, Andy additionally pointed out that axel #5 was still unnecessary. We could eliminate the extra axel by putting that new soft bungee right underneath the hard bungee that was already there. After this discussion with Andy, we were left with this design:

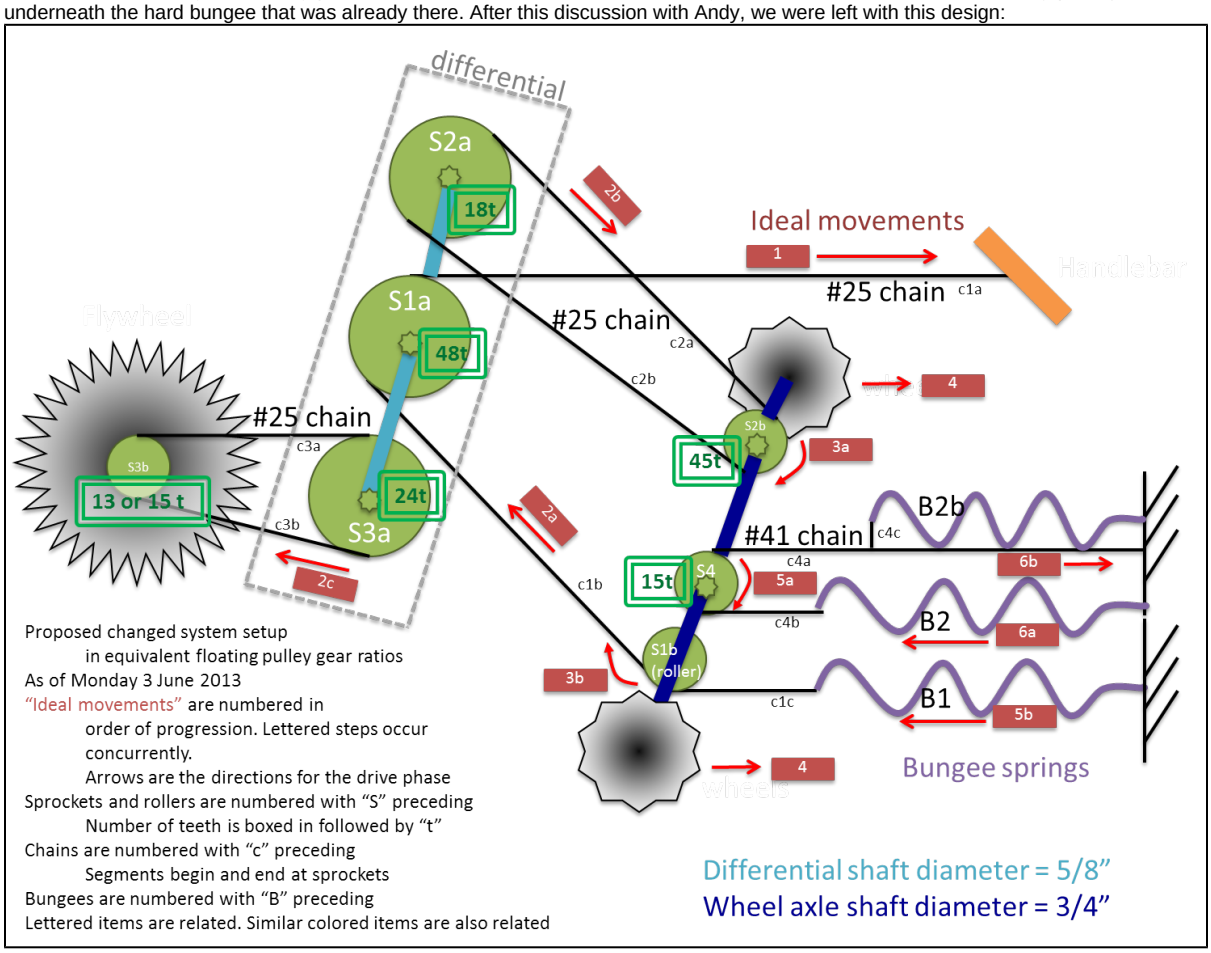


Figure 1: Rowgometer Setup

Shortly after calling Andy, we put together a schedule for the week:

Plan for the week:

- Presentation:
  - finish CAD, although not necessary
  - run Brian's version of Tennant's code, or find a floppy drive
  - make clear that all observations are of the floating pulley, erg,
    - want to develop differential model
- clean up slides
  - some slides are incomplete
  - Contact Concept II
    - get contact info
    - draft email or phone message
    - Work on erg
      - compressing a chain doesn't make sense
        - idea: bungee cord at end of #41 chain – clear with Ellen and Andy
        - Order sprockets - ASAP
          - changing gear ratios
          - Set up a blog
            - wordpress, blogspot, piazza?

Deadline: June 15th – have a meeting set up with Concept II

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Monday, June 3rd

We began to conquer the schedule we made after calling Andy on Saturday. Because of the delay in shipping, we decided to start by ordering the appropriate new axels for the wheel chain and its axels. We measured the dimensions around the chains to make sure we were producing the same gear ratios as the floating pulleys and made sure the axels we wanted to order actually fit. After confirming these, wrote up and sent the order to Joe.

After, I went back to work on the presentation. Many of my edits were eliminating text, saying the same things in fewer words. The less words there are on the slide, the more visually appealing it is. My other changes made the presentation more visually appealing. I kept the text sizes as similar as I could from slide to slide, made sure all text was large enough to read, made the graphs easier to read, took some new pictures to make them more appropriate to their slide, and the like.

There are two things here I dislike that I want to ask Andy about. First, I dislike the two slides labeled "Forces." I think some of the information is not completely accurate. For example, it's the job of the flywheel, not the bungees, to create the drag force of the water. Also, even if I completely agreed with all of the information in these slides, I don't see how they help sell our erg. The slides before it completely explain how the differential makes our erg superior because the erg itself actually moves - these two "Forces" slides don't add anything.

Second, I really feel like asking for more than one stationary erg to use for parts is too much . The only reason we want more than one erg is for comparison at the end. It seems silly to ask for an erg to only use once. We can easily go to Teagle to get any comparisons we need there.

Tuesday, June 4th

I received Andy's reply to my email about the presentation from the day before.

First, he insisted that we keep the "Forces" slides. After spending some time looking at the other diagrams and figuring out what these forces were, I went back and reworded the forces to make it clearer what they were. I also changed the title to "Accelerations & Forces" to again enhance the clarity of what these slides were talking about.

Second, Andy said it was okay to only ask for the one stationary erg. I liked this because we'll seem more reasonable to Concept II if we ask for less stuff, and seeming more reasonable will make it more likely for them to give us what we actually need.

Back to the erg, we need a chain long enough to create the entire chain that wraps around axel 15c in figure 1. We do not have enough of the chain that fits that axel, so we head down to the bike rack in collegetown to buy more chain so we can make this system. Upon taking the chain to college town, we discover that this one chain we found that fit the wheel axel actually had four different types of chain in it. We spend a while struggling to find the right type of chain and chain link to buy, but after a few trips back and forth, we have the chain we need.

Later, it was time to actually put in effect the changes that we discussed with Andy on the skype call on Saturday. First, we ordered new the sprockets to connect the differential and the wheel axel to produce the same gear ratios and torques we had in the floating pulley setup. This involved putting a smaller sprocket on the differential axel and a larger sprocket on the wheel axel, thus increasing the torque that will be applied to the wheel axel. While this, in theory, results in less motion of the erg, our current setup doesn't apply enough torque to move the erg at all. We need to lessen the theoretical distance that the erg should move in order to get the erg to move at all. We also decided to get sprockets with #41 chain because the big thick chain we have now is completely unnecessary, and the project will be simplified if we limit how many different chain types we have. We found the best sprockets for the price and put the order in with Joe.

After we ordered the sprockets, we started to figure out how to actually assemble the system labeled B2 on figure 1. We took the stiff bungees that we coiled over themselves several times (figure 2,) and took one more bungee off, taking it down to three total. We did this because with the four bungees it had before, it barely stretched no matter how much you pulled on it. We removed the bungee so it could actually stretch a little bit, allowing it to act more like a bungee and less like a chain.

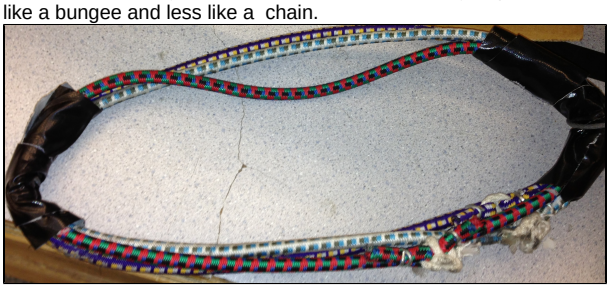

Figure 2: The Stiff Bungees

We then went hunting for a soft bungee to put in parallel with the spring on the top. The only purpose of this bungee is to collect the chain, to it doesn't need to have a high force. In fact, it's best to keep the force small because the higher the force this bungee exerts, the more resistance the rower will feel. It needs to be stiff enough to collect the chain slack, but nothing more.

Wednesday, June 5th

One of our main events of the day was to going to Teagle to test out their ergometers to learn about how they work and get a feel for how they row. After getting permission to use the crew team's room, we were given to stationary ergs both directly on the floor and on sliders.

The stationary erg, while it got very exhausting very quickly, didn't feel anything like what rowing on water could feel like; it felt like nothing more than me pushing myself back and forth with my feet. It would be the same sensation as me putting my feet on a table and rolling back and forth in a wheeled-chair.

The stationary ergs with sliders were even worse. While rowing on it, it felt like I wasn't moving at all, and that I was just pushing the erg back and forth with my feet.

A member of the crew team was rowing when we arrived, and he let us take a short video of him on the sliders: https://cornell.box.com/files/0/f/724664803/1/f_8513255425. This video shows the sliders looking the same as the felt, the rower wasn't moving at all.

This experience gave me two new insights to the rogometer. First, seeing how unrealistic of the motion of the erg was, I have much more appreciation for the type of erg we're making. Second, the trend here was that the ergs did whatever they had to do to minimize their total momentum. This explains why our project was so challenging - not only do we have to fight this trend, but the amount of energy we need to get from the rower to create the motion to pull the erg we need to is far more than what can be done with the stationary erg designs we looked at. Our erg has to have more resistance in the handle than these ergs just because it has to go to not only the flywheel, but also the kinetic energy to roll the erg back and the potential energy in the bungees to roll the erg back forward.

Back at the lab, we were finishing our assembly of the system labeled 2B in figure 1 to actually work. We first discussed how to set this new system up on the erg. We universally agreed that the hard bungees wrapped around each other should go directly on top of the bottom bar (the bar below what the seat slides on.) This was the clear choice because it could easily just rest on top without getting in the way of anything else. The bungees even had a hook on one end so it would be easy to fix it to the boward end of the erg.

The question was where to put the soft bungee and chain in parallel. One possibility we considered was to put them inside the bar that the seat slid on. While this would keep them from tangling up with anything else, we would have very limited access. If we needed to make a change, it would be very hard to get to. The other possibility was to try to hang the soft bungee and spring beneath the bar. While this setup would be much easier to set up and edit, we had the fear of it dipping too far down and getting tangled with the chain and bungees below it since there wouldn't be any solid object separating them.

Between these two choices, we decided to take the risk of tangling and try hanging it below the bar the seat rolls on. If this does not work because of tangling, we can easily undo it and put it in the bar without much lost time.

We hooked the bottom bungee onto the stern of the erg, attached the chain to the other end of the bungee, and wrapped the chain around the wheel axel. The chain then wrapped all the way back to the stern of th erg.

For the loose bungee on top, while it would be easy to attach the one end to the stern, how to attach it to the chain half way across the erg was a challenge. The only solution we could think of would be to wrap something really tightly around the bungee and the chain, and hope there is enough friction to hold the two together. We took a twist tie and wrapped it around the two, and hoped for the best. (Figure 3)

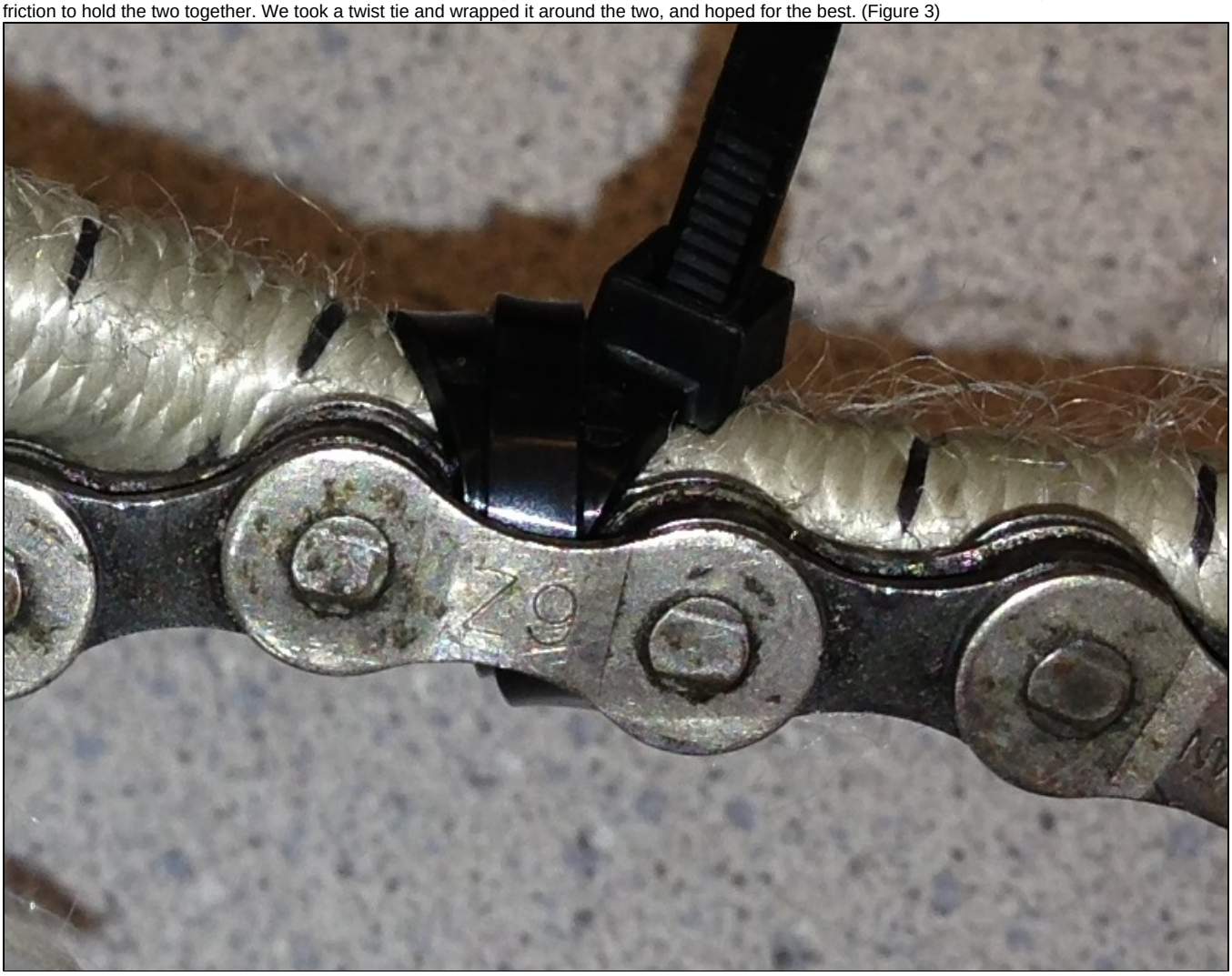

Figure 3: Twist tie around the bungee and chain

To hold the loose end of the bungee, we looped it around itself a few times and taped it beneath the footrests so it's out of the way. The system, as a whole, looked like figure 4.

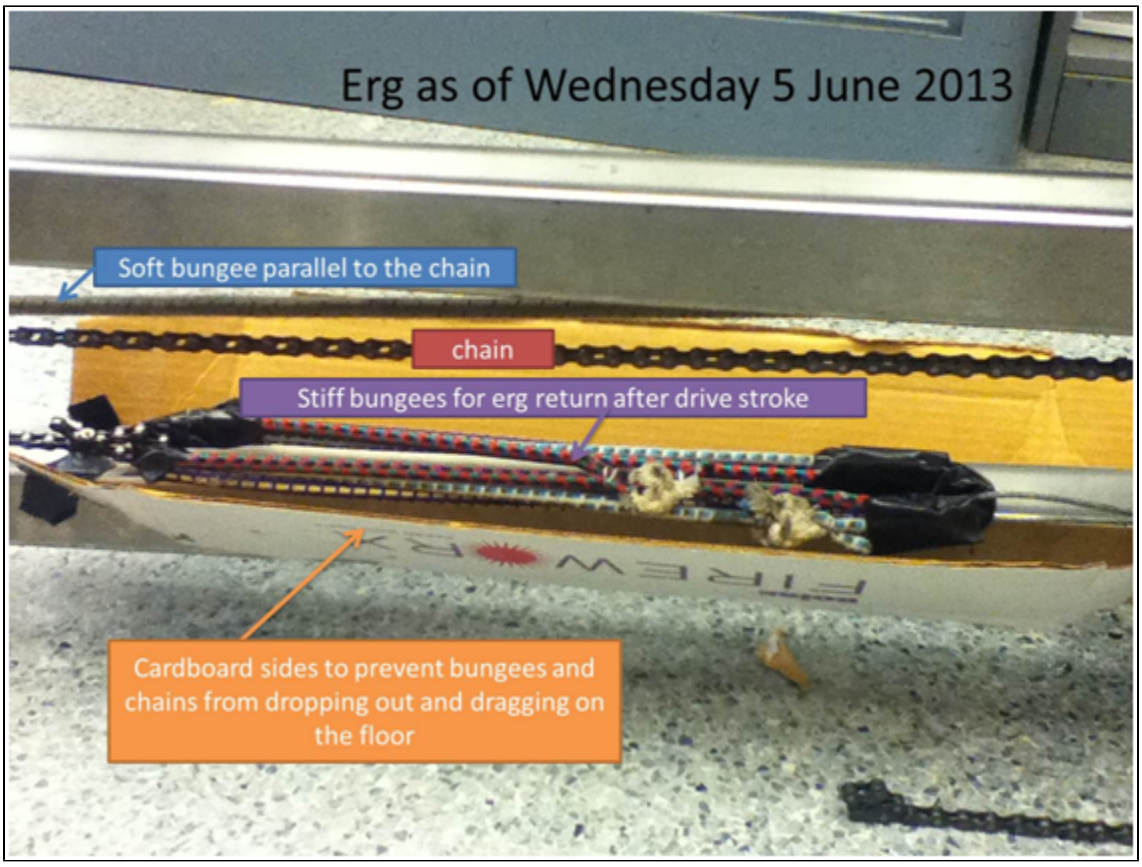

Figure 4: The completed Setup
When the bungees are slack (unlike they are in the figure,) they become wider and fall off the edges of the bar. The cardboard pieces on the sides keep the bungees from falling off of the sides.

The key part of this setup that we were worried about is the upper chain getting tangled in the stiff bungees. Luckily, this did not turn out to be an issue because the soft bungee successfully kept the slack from falling down too far.

Upon testing this system, however, it didn't work. The problem, as it has been the whole time, that the wheel axel on the differential didn't turn. This new system we just installed worked perfectly as far as we could tell - there just wasn't enough torque to power it. Hopefully these new axels we ordered will fix this problem.