Thesis Project Portfolio

Rock-slide: Developing an Indoor Climbing Volume with a Linearly Actuating Hold

(Technical Report)

The Demographics of Climbing

(STS Research Paper)

An Undergraduate Thesis

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Contents of Portfolio

Executive Summary

There is no confusion that indoor climbing is exploding in popularity. It was featured for the first time in the Olympics in Tokyo and the number of gyms in the US has doubled in the last 10 years. Indoor gyms have seen all kinds of technological advancements, from safer and more reliable auto-belaying systems to standardized bouldering walls that allow new routes to be created and shared by anyone. My capstone group largely consisted of rock climbers, and being mechanical engineers we wanted to make a novel piece of climbing technology. All of these technologies have led indoor climbing to stray further and further away from its original purpose – to train for outdoor climbing. Outdoor climbing is a much greater commitment than indoor climbing for someone new to the sport, and this is evident in participation rates. Indoor climbers are made up of roughly 50% male climbers and 50% female climbers. These rates, however, do not translate to outdoor climbing where women only make up 33% of the climbers. I wanted to explore what factors contribute to this disparity.

After brainstorming my capstone group converged on the idea of a moving climbing hold. Typically climbing holds are bolted either directly on the bouldering wall or on a protruding feature attached to the wall called a "volume". Time and cost were the main considerations in determining what form the device would take. Dreams of a whole climbing wall with multiple moving holds reduced down to a single moving hold that could be placed on a pre-existing wall. We decided to design a trapezoidal prism-shaped volume that could be placed in any position on the wall with the hold bouncing from side to side on the front face of the volume, dubbed "Rock-slide". Mainly drawing from what we had learned in machine elements and mechatronics courses, we took to SolidWorks to 3D model the device exactly as it would be built and simulate its ability to hold weight. We utilized many machines such as a mill, drill

press, band saw, water jet cutter, laser cutter, and many others in the construction of the Rock-slide. Ultimately the device was crippled by our timeline and budget as on the last day of the semester we had to make a quick-fix to an electronics problem that could have otherwise been debugged and a part we purchased for a too-good-to-be-true price literally exploded under internal stresses.

For my STS research paper, I wanted to explore all the possible reasons creating this lack of female outdoor climbers and the culture of what kind of climbing each gender "should" be good at. I examined claims regarding both social and physical aspects of climbing through quantitative studies as well as accounts from women about their experience in climbing. I relied heavily on a PhD thesis that took on a feminist perspective for an ethnography of climbing and other sources surrounding social interactions in climbing and statistics related to climbing injury rates and strength by gender. My results showed that there are certain climbing styles and specific moves that women are less inclined to participate in. In interviews, women shared how they shy away from moves with a higher perceived risk of injury, while men are largely attracted to these "flashier" moves. Injury statistics support this claim as men make up the majority of injury cases. Studies have also shown that women have lower scores in tests surrounding climbing ability such as maximum percent of body weight pull ups, but this gap decreases with more advanced climbers. This connects to a point brought up in the thesis of how women develop into "smart climbers", as a person who lacks the physical strength to muscle up a climb may have to adapt a more technical climbing style.

As expected, physical differences and social norms affect how men and women climb. What I found through the research, however, was the snowball effect societal notions regarding masculinity and femininity have. Existing biases of what each gender is good at shape how new

climbers believe they should climb. Climbers then stick to their style, which reinforces the gender differences, which then influences new climbers. My technical project had fewer lessons about climbing and more regarding the creation of a prototype. Realizations such as how much it costs to build something from scratch, how much time it takes, and how much can go wrong were commonplace throughout the semester. I would still say the results were great, as my professor said, the product of the senior design class is not the device, but the engineers we become.