CAVE

Computer Aided Vertical Experience

An On-Campus IQP Proposal

Students: Felipe Polido, Thomas Liu, Morgan Quirk, Karl Gibson, Sanado Barolli, Evart Fairman, Jay Lanzafane, Dan Nuzzo-Mueller, RJ LaMura

Advisor: Carolann Koleci

Contact Info: iqpclimb@wpi.edu

Abstract

The CAVE is a conceptual design for a hi-tech indoor bouldering wall on campus. A bouldering wall is a rock climbing wall that is not high enough to warrant ropes or gear other than floor padding. This wall would be small enough to fit in an existing room at one of WPI's athletic facilities. The technological design aspect of the project facilitates use of the wall by a lighting matrix to enhance the climbing experience. This proposal illustrates the motivation for constructing the wall, identifies its use and projected popularity on campus, and details any difficulties that may be encountered. It also covers legal issues such as insurance policies, liability of WPI, proper staffing, and safety regulations for the wall.

History

Rock climbing is a sport commonly believed to be quite dangerous. While it is true that mistakes can lead to serious injury, climbers are very careful and prepared. In a controlled environment like a climbing gym, safety is the primary concern; as a result, the risk involved with rock climbing is low. But even climbing in an indoor gym still involves a rope, which can be unnerving to some and a hassle to others.
Bouldering is a rapidly growing offshoot of rock climbing which involves climbing low walls (usually less than 15 feet high) without ropes or other gear. Bouldering started as a way to train for climbing, but quickly turned into a sport for its own sake. These days, bouldering competitions are held all around the world and bouldering walls have become commonplace in many gyms. Climbers can either climb to the top of a wall and simply jump down when finished, or they can top out by climbing over and onto the top of the wall. In either case, the fall is low enough that the padding prevents injury. This removes the potential danger of height and ropes while presenting a unique and more technical approach to the sport.

Rock climbing in general creates a friendly atmosphere in which people are brought together. Its man versus nature conflict means that climbers work together to tackle a common problem, and it focuses on self-improvement rather than direct competition. Climbing also fosters a great deal of trust between people -- each climber must completely trust their belayer or spotter to avoid injury. Such a reliance between climbers helps create great friendships and contributes to this friendly atmosphere.

The safety and convenience of bouldering allows new participants to get involved with climbing without having to worry about the high cost of gear or potential injury. No ropes are involved -- the only needed preparation is a pair of climbing shoes. The workout achieved in bouldering can be even more intense than sport climbing. In one day, a climber could send (complete) three to four outdoor walls or, alternatively, dozens of bouldering routes in as little as a few hours.

Community

Climbing as a sport can have several physical as well as psychological benefits. The sport as a whole aims to achieve a balance of focus, flexibility, coordination and strength. The most apparent but not necessarily the most important is physical strength. Strength in climbing is important to success but can be partially made up for by other skills. In fact, it is preferred that someone new to climbing is not particularly strong so that they can develop their other skills and not simply brute force their way through climbs. Balance
and flexibility are critical to successfully completing a route; difficult climbs rely increasingly more on advanced techniques.

The RIT Red Barn bouldering gym.

Focus also plays a big role in climbing, if not the biggest. For a difficult route, a climber needs to prepare, understand and plan out what they are going to do or risk running out of steam midway through the climb. This is especially true for bouldering where climbers often bring themselves to their physical limits attempting to send a route. Failing to send a boulder problem results in the climber rethinking their approach to it rather than engaging in more physical training and usually in success on their second or third attempt. Climbing and bouldering are constant problems that need to be solved and resolved with one goal in mind, self-improvement.

Climbing creates a very relaxed and easy-going environment where people can pace themselves completely and do as much or as little as they want to. This makes it a very easy sport to get into, especially for people that don't usually participate in sports. In addition, the goal of climbing is not to compete with other climbers, but to get everyone up the wall. This creates a great spirit of cooperation; experienced climbers provide beta (specific advice on a climb) to others before and during their climbs. Many notice significant improvements after as little as a week or two and continue to improve so long as they keep climbing. Rock climbing is one of the most physically intensive sports around, comparable to other sports that work an athlete's entire body, such as swimming.

**WPI Interest**

The question of community interest in this project has come up, and we have already gathered some data to address it. During A-term we created a poll on MyWPI to try to gauge interest. Our question was, "If there was a climbing wall on-campus, would you use it?" Overwhelmingly, the WPI community embraced the idea: 71.64% of those who voted (1,119 students), voted that they would use it.

To judge the project's potential benefit to the community, we have looked at the recent success of the WPI Outing Club. The club had been recreated from scratch at the beginning of the 2007/2008 school year, and now runs weekly trips mountaineering, hiking, rock climbing, and so on. The outing club has nearly 200 members on the mailing list, and our meetings have had as many as 60 attendees. Every week, we walk with at least a dozen members to the local YMCA, located over a mile away, to climb on their climbing wall at $5 per person. We believe a local, free, bouldering wall would have significantly more attendance. We also hold twice a week workouts at the alumni gym, and slacklining (essentially tightrope walking) on the Quad when weather permits.
The WPI Outing Club at climbing events this year.

Left: outdoor bouldering at Lincoln Woods in Rhode Island.
Right: rock climbing wall at Worcester’s central branch YMCA.

It should also be noted that most outing club members were not previously involved or interested in sports or other organized physical activity. We estimate that many more students will become interested in climbing or other sports if the CAVE is to be built.

Concept

There are many schools which have already developed climbing walls on their campuses, some of the more notable schools being Rochester Institute of Technology, Rensselaer Polytechnic Institute, Harvard, and Massachusetts Institute of Technology. In 1984, students at Rochester Institute of Technology began developing their gym in an abandoned barn on campus. By 2006, RIT decided to open their wall to people outside of the RIT community. They charge admission per day or per quarter, with a discount to individuals with RIT IDs. They also rent climbing shoes at $2 per pair. Using this money, they have been able to keep their gym open for the past twenty-four years. Currently, the gym is open every weekday for five hours.

Rensselaer Polytechnic Institute’s climbing gym is fairly new, and they are beginning to train a climbing team to bring to competitions in their gym. The gym is open whenever volunteer students are around to watch it, and is free to the Rensselaer Polytechnic Institute community, although it is mainly intended for their outing club.

A bouldering wall under construction.

Harvard keeps their new gym open for six hours daily, and charge admission per day or semester, as does RIT. Staff watches the gym; some of the staff are students.
themselves. They also have two older gyms on campus, one of which is a small training gym. Harvard holds competitions in the new gym.

The most influential model for the CAVE is the MIT climbing wall. MIT's wall was conceptualized, constructed and funded by MIT students entirely in 2000. All aspects of the wall were handled by the MIT Outing Club, including insurance and liability issues. Their wall is staffed by students who are trained in first aid, CPR, and wall safety procedures. The wall was inspected for safety by a professional company when it was first built, and is also inspected by the wall staff every semester. Their main method of raising money to maintain the wall is by renting climbing shoes to climbers there. The wall itself is free of charge to use, but climbing shoes are all but necessary to climb. The wall is also used by MIT's physical education staff for climbing lessons, so students can earn PE credit through the wall.

The student-built MIT bouldering wall.

In MIT's case, they were given an unused squash court to convert into their wall. Other places, such as the local YMCA in Worcester, have also converted their squash courts into climbing walls. A squash court is an ideal place for a small climbing wall -- it is indoor, closed, can be locked off, and of ideal size and height. The total cost of the MIT wall's construction was about $6,000, which includes lumber and hardware ($1,500), climbing holds ($1,500), floor padding ($2,000), and liability costs ($1,000). Maintenance costs are low enough so that they are covered by the shoe rentals.

**Liability and Safety Procedures**

While bouldering is relatively safe, lackluster protection and wall procedures can lead to injuries. As thus, CAVE will follow a number of standards to keep climbers safe.

The ground will be padded with at least four inches of padding akin to tumbling mats found in a gymnasium. In addition to this, there will be several crash pads that can be moved around the wall to arrest falls in specific areas of the wall. We will provide adequate fall protection meeting the America Society for Testing and Materials (ASTM) standards for construction and placement of playground equipment. The wall will be inspected before each use for loose and broken holds. Unofficial monthly structural inspections will also be held. We will consult a structural engineering company to ensure that it meets safety standards for climbing walls.
Climbers should never climb alone. A spotter stands behind and below the climber out of way of the wall in order to prevent a climber’s head from hitting the ground. Unsupervised use of the wall will be prohibited. The wall will be locked unless a member of the wall staff is present to supervise. Wall staff will be trained in CPR, First Aid, and basic wall procedures. Each climber will be required to sign a liability waiver before they climb for the first time.

**Technological Component**

Typically, indoor climbing and bouldering consists of acrylic rock holds bolted into a wall in intricate patterns. A climbing route is specifically a set of holds that can be used to get to the top of a wall, often marked by colored tape. Routes vary greatly in difficulty, and are rated on a scale from V0 to V16, with V0 being the easiest. Routes make it possible to have many different paths to climb on the same wall.

The CAVE will replace the traditional method of using colored tape to mark specific climbing routes with a computer-controlled lighting system. Each climbing hold will be transparent. Each possible hold position will be wired to a 3-color RGB LED, so that each hold can change to any color at any time. There will be a computer console at the wall that will control the LED matrix, allowing climbers to display specific routes at certain times and staff to program in new routes at any point with minimal effort. Given the size of the wall, the matrix would likely end up being about 16x16 lights, giving 256 individual 3-color LEDs. This project would require technical knowledge from multiple fields to create, such as electrical computer engineers, mechanical engineers, and computer scientists. The total estimated cost of adding the lights and computer console is roughly $2,000 -- $500 in LEDs, $500 in wiring, $600 for electronics and hardware, and $400 for a computer console.
**Request**

If this project is perceived as viable by the administration, our group will require adequate insurance provided by the school, space to build the wall on campus, approval for proper training through the outing club, and approval for this project as an IQP or other project. At this time we are not asking for any money as we intend to acquire the necessary funds through fundraising, corporate sponsorships, and Student Government Association through the outing club.

Suggestions for adequate rooms would include: one of the rarely used squash courts, the storage room on the second floor of Alumni Gym, or any other location of similar size and height (12’+) which can be locked.

The CAVE, being a student project, would be designed, built and (if possible) run by students. This project would not require extensive labor on the part of the WPI staff, and it would be an excellent addition to the community. We are highly enthusiastic about the CAVE and will submit a more formal request detailing design specifications, liability issues, and all other details of the wall, if this proposal is approved.