UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Clouds and Light An interactive art project for the new SUB

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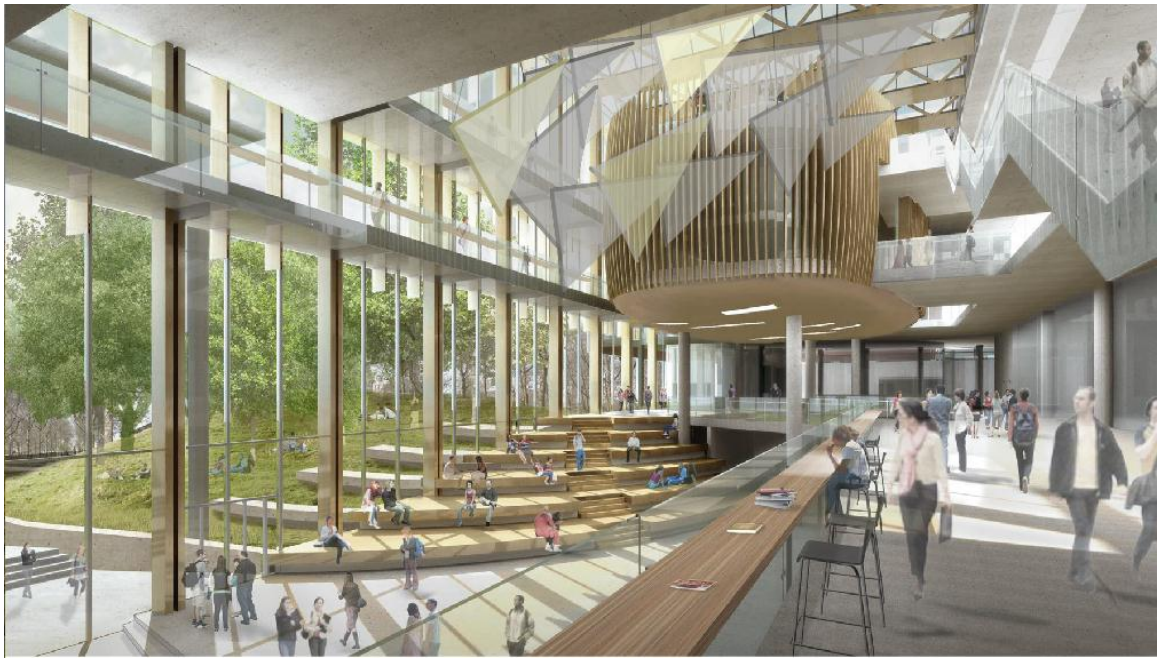

Project Summary Report

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Executive Summary

Clouds and Light is an interactive concept intended as an installation for the new UBC Student Union Building atrium space. It is built around the idea of participatory action and is meant to demonstrate the potential of the human body to generate large-scale kinetic motion and energy.

The installation consists of an array of fabric shapes, each approximately 4-5 meters in diameter, suspended from the atrium ceiling, each connected to a series of pulleys and gears through fabric cables. The pulleys are connected to the floor of the space in such a way that a person may pull on the cables, activating the gear system and causing the shapes to move in a wave-like pattern.

This motion causes two main effects: as the fabrics of the shapes shift in space, the natural light entering the atrium through the many windows is diffused and filtered in a subtle, changing pattern; and the motion of the pulleys turns a generator, sending electrical energy to a series of LED lights which help to illuminate the installation.

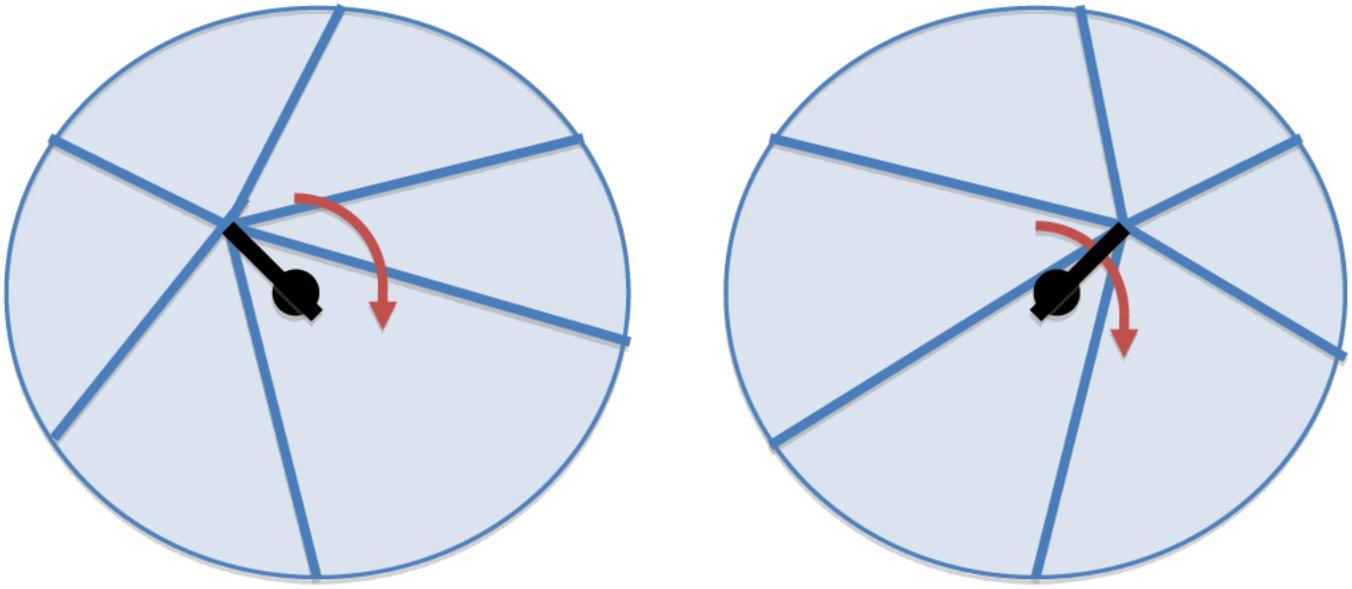
This project has been developed as a roughly 1/10 scale prototype, which demonstrated the concepts of power generation and user-induced motion as well as the aesthetics of the piece. Scaling this project up for the purpose of installation in the new SUB atrium is feasible, but will require further information on the structural makeup of the building as the intent is to suspend the piece from the existing structure. The materials, construction and installation process can potentially be made cost-effective; the details of this are discussed in two possible scenarios.

Introduction

The new SUB atrium is intended to be an open, airy, light-filled communal space. The Clouds and Light project endeavours to complement these qualities by providing an interactive experience that helps to shape the atmosphere of the space through the manipulation of light.

The installation consists of a series of triangular fabric shapes, each 4-5 meters in diameter, suspended via cables to a supporting truss structure attached to the atrium ceiling. The shapes are constructed of stainless steel mesh, giving them the combined properties of light reflectance, light diffusion, and semi-transparency. The shapes are suspended across the length of the atrium's highest area, in a pattern that mimics a gathering of clouds following a wind current, or a flock of birds in flight.

There are several fabric cables extending from the support structure and running to the ground, which can be pulled, flexed and manipulated by a person. This action translates motion to a pulley system, which turns a series of gears. These gears then cause rotation of a central arm, to which is attached the cables suspending the fabric shapes. As the arm turns on its axis, the cables are raised and lowered corresponding to their position around the axis; the net effect is that the suspended shapes move in a wave pattern, subtly changing the natural light patterns in the atrium as they move.



As the arm rotates around the center point (black), the attached cables (blue) are pulled in sequential order, resulting in wave motion translated to the shapes below

The motion induced by the person also translates into other forms of energy. The energy generated by the person's movements is mechanically stored in a suspended mass, which is raised as the cables are pulled; the raised mass can then be released, turning a generator as it slowly descends. The generator sends current to a series of LEDs embedded in the shapes, resulting in the entire installation being illuminated with color.

In order to make this project feasible for construction, two potential approaches have been considered. The first makes use of newly constructed and aesthetically ideal fabrics made principally from post-consumer and post-industrial materials, fabricated by a supplier in the United States known for their sustainable practices. A professional construction and installation team, engineering consultants, and consultation from the original project team are all included in the budget estimate in Appendix A.

The second approach considers the method of sourcing purely recycled materials and parts, and involving students in the process with the goal of reducing overall carbon footprint. The sourcing and construction process could take place within a student team, perhaps as a credited course

offering, though the installation and commissioning would certainly require a professional team and structural engineering consultation. Cost estimates for this scenario may also be found in Appendix A.

Project purpose

This project is intended to fulfill 3 major objectives:

- To demonstrate the energy potential of human motion
- To create an interactive space for multiple participants
- To provide an aesthetic centerpiece for the SUB atrium

Project Team

This project was initiated by Andrew Strang, an Engineering Physics undergraduate student with a background in lighting design, who has worked on several unique installations around the UBC campus, including the Ladner clock tower LED lighting refurbishment and an experimental daylighting system for the Hennings building.

Outcomes

Integration into the new SUB atrium:

The installation will be suspended from the ceiling structure, with the interactive pulleys located along the walls. It thus requires negligible floor space and instead makes use of the abundant overhead space in the atrium. The shape and movement of the fabrics is intended to compliment the look and feel of the existing space, and the manipulation of natural light is intended to enhance the spatial aesthetic and create a sense of relaxation and welcome.

Creative, artistic and aesthetic contribution to the new SUB:

As mentioned, one of the primary purposes of this installation is to compliment the space aesthetically, through the use of shape, motion and light. Creating an artistic, multi-sensory centerpiece for the space was considered highly important in the development of this project – using engagement of the senses as an effective communication tool for the concept of sustainability.

Reduction of ecological footprint:

The fabric shapes which make up the bulk of the material requirements for this project are to be made from lightweight stainless-steel mesh. GKD Metal fabrics in Maryland, USA has been identified as a potential supplier of post-consumer and post-industrial recycled stainless steel mesh fabrics. Metal fabric contributes to LEED points under the Energy and Atmosphere, Material and Resources, Indoor Environmental Quality, Innovation and Design and Site Selection categories.

GKD metal mesh in a static application

Increased student engagement:

One of the project's primary goals is to engage students in a participatory interaction process, potentially engaging several students at a time in the act of creating motion and generating light throughout the suspended piece. The project is meant as an evolving interaction, wherein repeated engagement by students will result in a progression of their understanding of the interactive movement characteristics and how to control it to achieve a desired effect.

Education and outreach:

In order to create a large-scale, impactful illumination of the piece by powering the integrated LEDs, a number of students will be required to operate the pulleys at one time. Potentially, a single student could exert

enough energy to illuminate all of the LEDs, but in either case, the energy exerted is a clear demonstration of how much power is required for even a moment of light. This interaction may inspire consideration of the real power required to simply flick on a light bulb – a small physical act representing a much larger output of energy to the bulb. It is conceivable that courses offered at UBC could make use of this demonstration for the purposes of teaching physics, environmental science, human kinetics and other subjects.

This project also has the potential to engage the larger community by creating a sort of public theatre; the installation could be used by theatre, dance or music ensembles – or inspired individuals – to create a unique performance space.

Longevity and feasibility:

The feasibility of this installation is somewhat linked to the design of the atrium ceiling space. The spatial requirements and structural considerations will need to be thoroughly detailed as only minimal information was available at the time of this report; based on existing floorplan drawings no spatial conflicts are anticipated. The major concern will be the method of suspending the system from the building's structure.

Because the installation is suspended and is intended to move, a regular maintenance schedule will be required, involving lubrication of the pulley and gear systems, cleanliness checks and general inspection of mechanical components for wear or misalignment. The use of non-corroding materials such as stainless steel means that with regular maintenance the installation would be expected to last the lifetime of the building.

The fabric cables running to the floor will be accessed along the walls, with pulleys located near floor level to prevent climbing. The bulk of the cables will recede into the wall when not in use (via spring tension), preventing soiling or tripping hazards.

Recommendations

The nature of this installation is such that aesthetic quality and lasting impact are greatly influenced by the quality of materials and construction. In order to achieve the most immersive sensory experience with the most efficient system requiring the least maintenance, it is strongly recommended that the installation be constructed of custom-fabricated materials from the identified supplier, along with good-quality mechanical components, with the final construction and installation performed by a professional team of fabricators and engineers. This approach, though significantly more costly, is perhaps more reflective of true sustainability – employing artisans, craftsmen and businesses who focus their work on less wasteful, less consumptive methods of creation and progress.

An alternative approach would be to create a student project around the installation, with the construction and material sourcing largely handled by a group of dedicated, interested students and supervisors. This approach would increase student engagement and provide a sense of accomplishment in the final installation, as well as bringing costs down.

In either case, it is important that the project meet a high aesthetic standard as well as all spatial, structural and safety requirements. The methods for achieving this will certainly evolve as the installation is planned and discussed.

Appendix A: Proposed Budget

Estimated costs:

Mesh Fabric - 300m^2 @ \$250/m^2	\$75,000
LEDs and electrical components	\$5000
Mechanical components	\$4000
Generator	\$1000
Support structure	\$5000
Fabric cables and pulleys	\$2000
Construction	\$12,000
Installation	\$24,000
Consultancy fees	\$48,000
Total	\$176,000

Estimated costs for student project:

Fabric 300m^2	N/C
LEDs and electrical	\$2000
Mechanical components	\$2000
Support structure	\$2000
Fabric cables and pulleys	\$1000
Construction	\$2,000
Installation	\$12,000

Consultancy fees	$24,000
Total	$45,000

Notes on Budget:

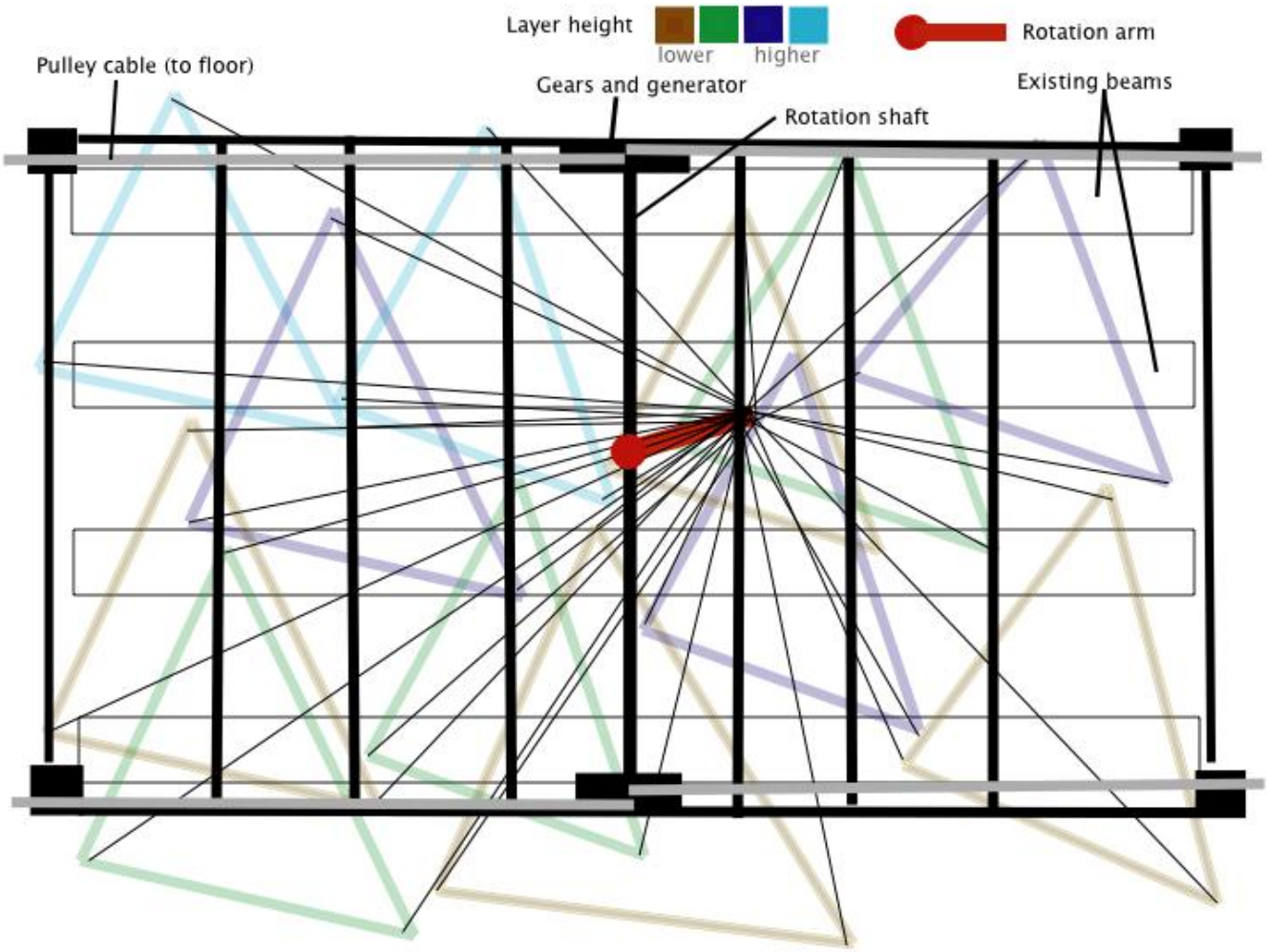
Recycled fabric could be donated or found; GKD fabric would be the preferred option

Mechanical components could be sourced from recycled bike parts; new parts would be preferable

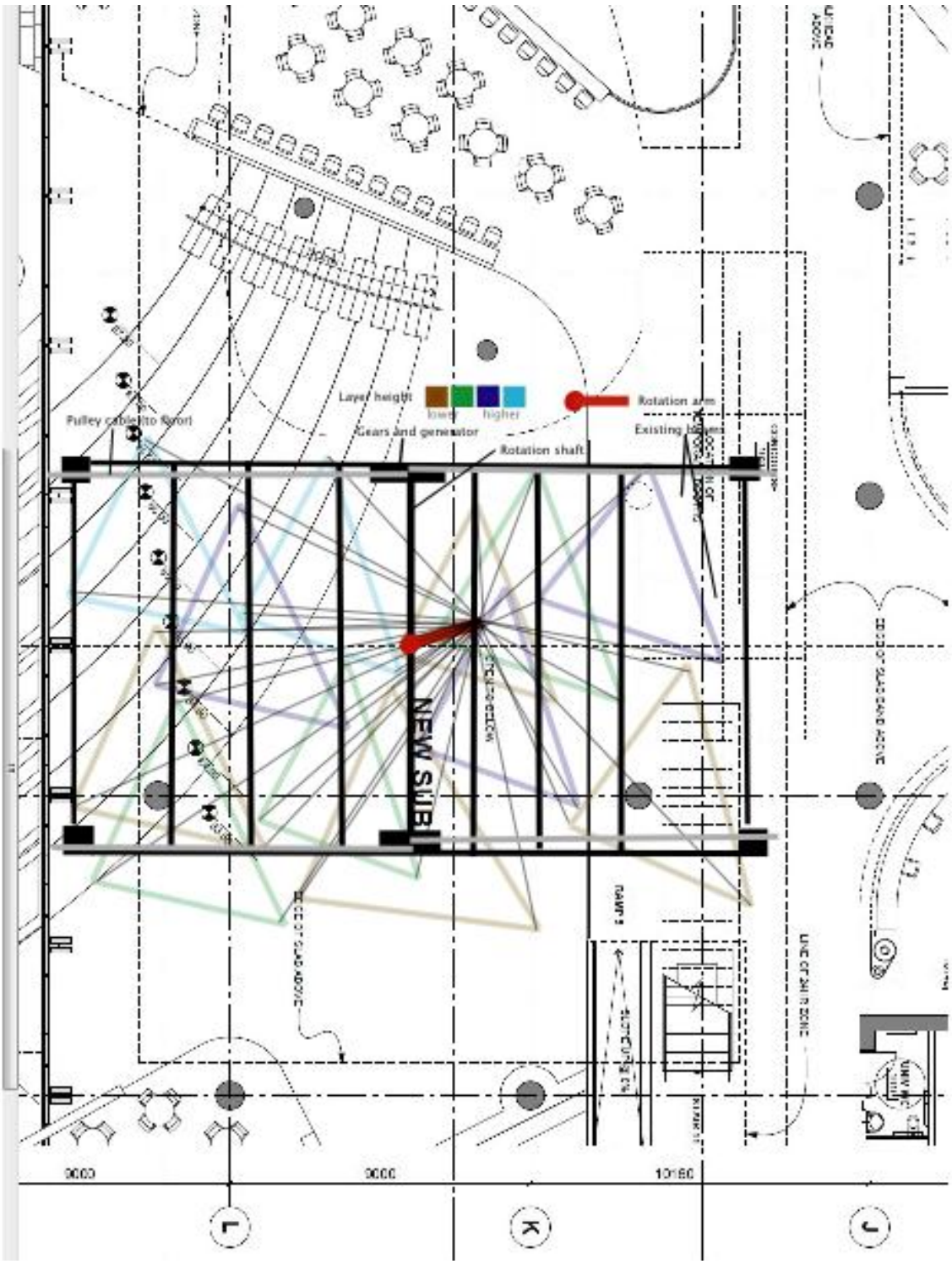
Support structure will require structural engineer sign-off and UBC operations approval regardless of construction approach

Consultancy fees will reflect structural engineer, architect, fabric supplier consulting, mechanical consultant and project designer fees. Some of these fees may be waived in the case of a student team

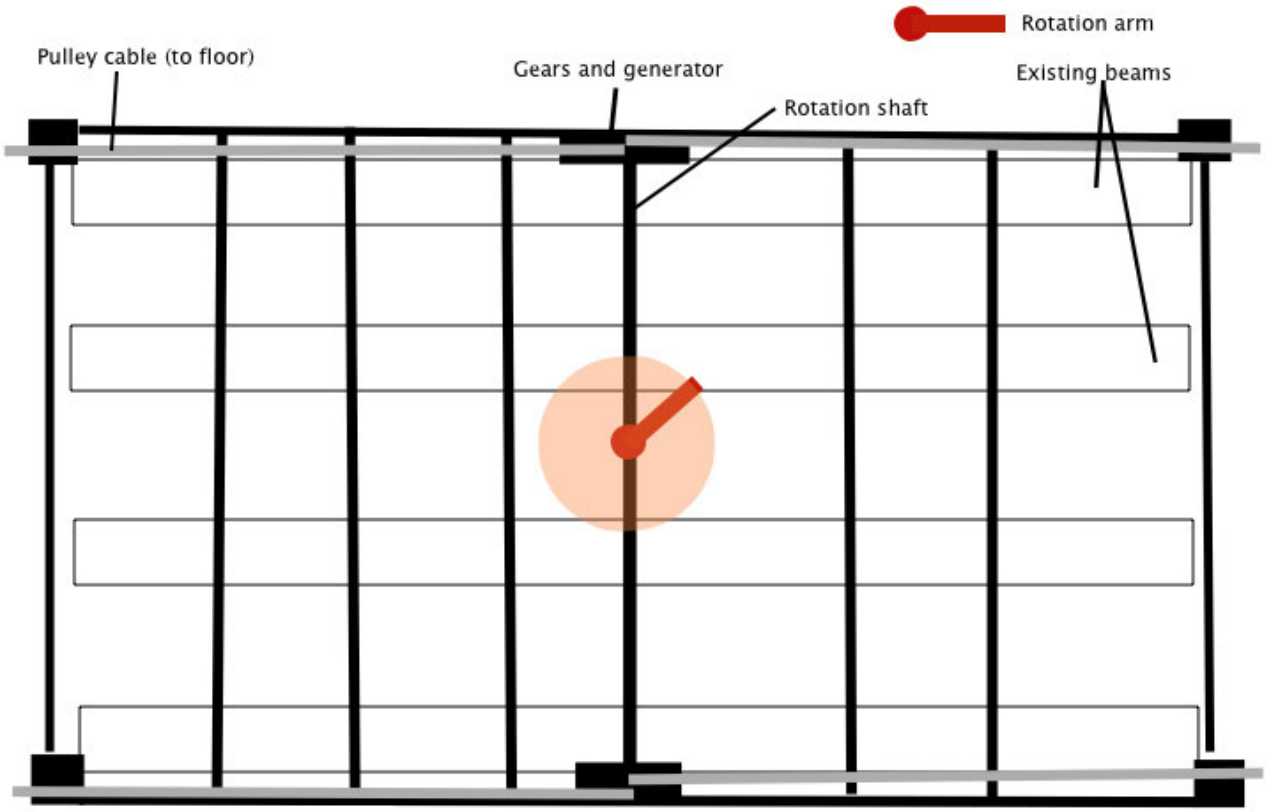
Appendix B: Schematic Drawings



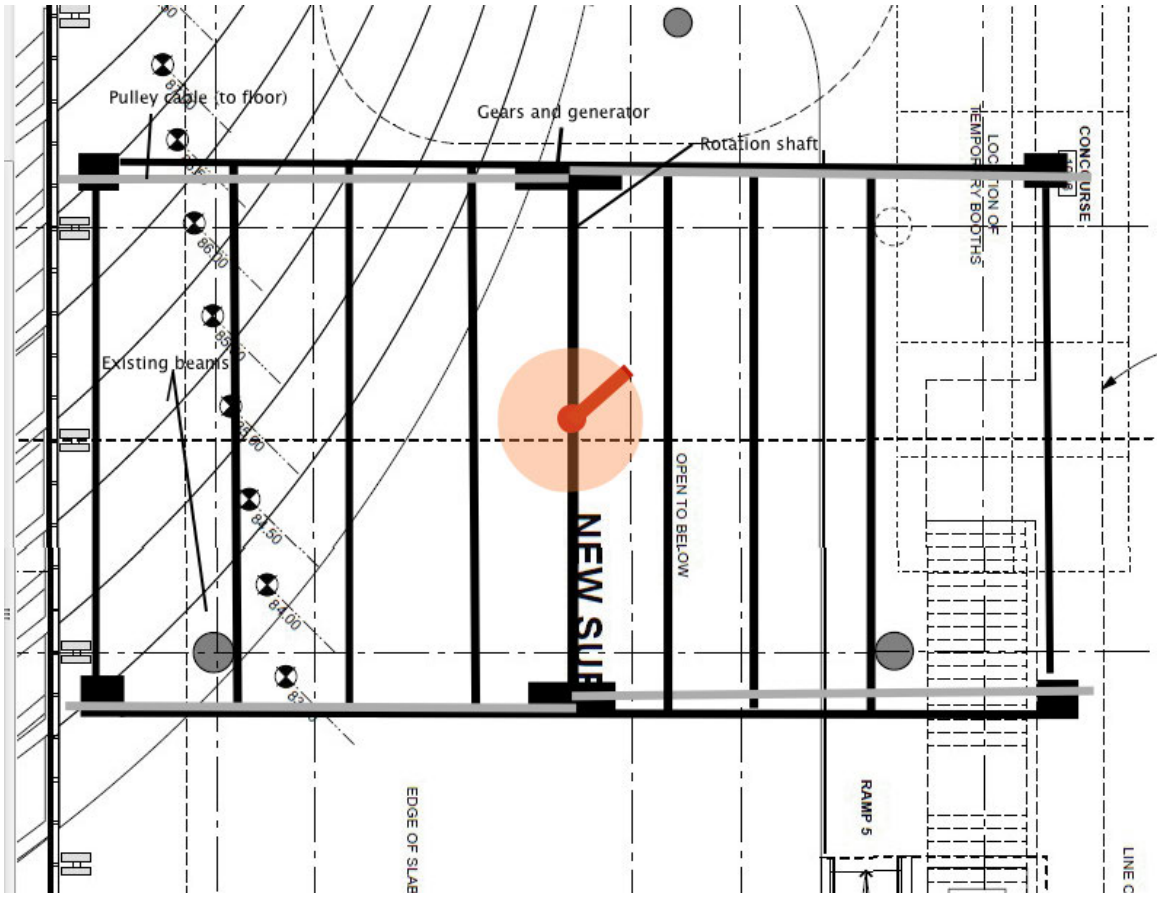
Overhead view of installation, including support structure (black) fabric shapes (colors), and rigging lines. Actual location and dimensions of existing beams is estimated



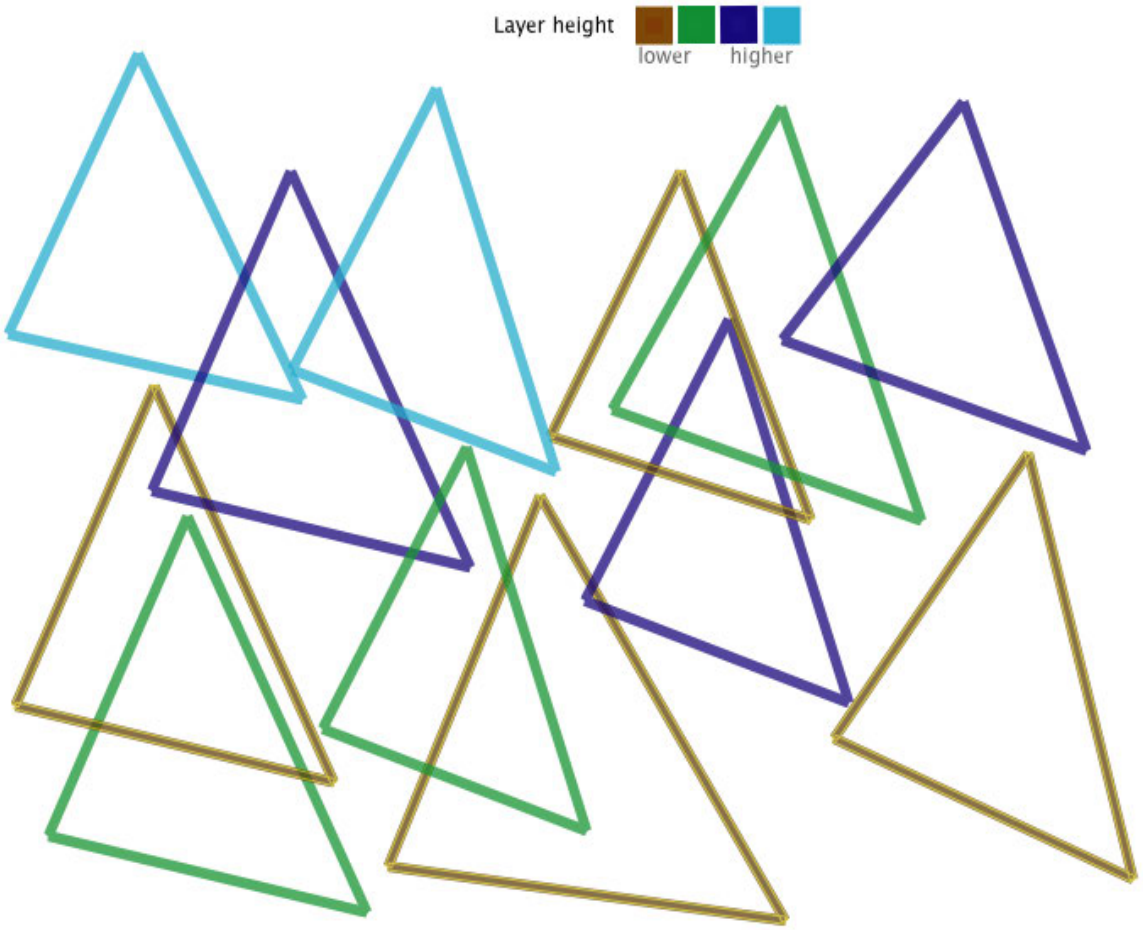
Overlay of installation on new SUB atrium floorplan



Support structure, with rotation circle of rigging arm indicated



Overlay of support structure on SUB floorplan



Shape layout – estimated total area is 17 x 12 meters (roughly 200 m^2)