Smart Shelter Research

Report on Architecture with Waste

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Group D

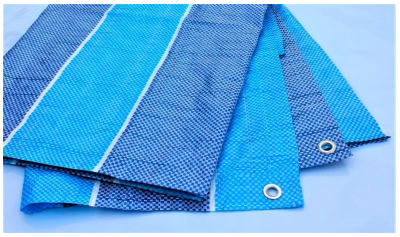
Content

1.0 Workshop - Material Study

1.1 Chosen material and Description

At the initial stages, our group suggested we use cardboard as our recyclable material, as we all had a surplus amount of cardboard laying around our houses and was readily available. Cardboard is a strong material and it is easy to cut and shape it into whatever shape we wanted. However we found out that a couple of groups were also using cardboard as their material, so we were advised by Dr Martijn to reconsider our material choice.

One of our team mates suggested we use ground cover (construction canvas) as our material. The material was already widely available by our team mates as their parents work in the construction industry. Dr Martijn had high hopes for our project, as this choice of material was not a conventional one. Off the bat, the material was flimsy and had almost zero structural integrity. Despite that, we took on the challenge to create a structure out of a cloth-like material.



Floor guards in construction are protective coverings or materials used to safeguard the flooring of a construction site. They are designed to shield existing floors, like finished concrete, hardwood, or tile, from damage caused by heavy construction equipment, foot traffic, and spills. They help prevent scratches, dents, and stains, preserving the floor's aesthetic and structural integrity. Floor guards often have anti-slip properties, providing better traction for workers and minimising the risk of accidents. On top of that, floor guards help maintain a cleaner and more organised work environment by containing dust, debris, and other materials commonly associated with construction activities. This reduces the amount of cleaning required after construction is done.

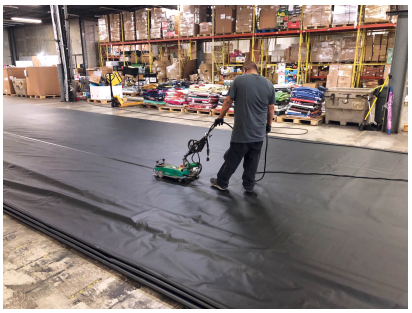
1.2 Problems & environmental impact

While floor guards play a crucial role in protecting surfaces and enhancing safety, they can also contribute to waste in construction in the following ways. Many floor guards are designed for one-time or limited use, meaning they are disposed of after a project is completed. This disposal adds to the overall waste generated by construction activities. In addition, floor guards are often made

from non-biodegradable materials, such as plastic or synthetic materials, which can persist in landfills and harm the environment. Heavy equipment and high-traffic areas may require frequent replacement of floor guards, leading to a continuous cycle of waste generation as old guards are discarded and new ones are used. To minimise the waste associated with floor guards in construction, it's important to consider more sustainable alternatives, such as reusable or recyclable guards, and to use them efficiently to extend their lifespan. Additionally, proper disposal and recycling practices can help mitigate the environmental impact of these protective materials.

1.3 Possible solutions & global improvements

Reducing waste from construction ground cover and finding ways to reuse or recycle them is crucial for minimising the environmental impact of construction activities. Firstly, construction companies can opt for reusable ground cover materials. Products like heavy-duty fabric tarps or industrial-grade mats can be used repeatedly on various construction projects, reducing the need for disposable coverings. These companies can also invest in biodegradable or eco-friendly ground cover options made from natural materials like jute or coir. These materials will break down naturally over time, reducing the waste impact. Moreover, construction groups can reuse ground covers for different projects by regularly cleaning and maintaining ground cover materials to extend their lifespan. For example, remove debris and dirt from tarps or mats to prevent wear and tear. When a project is complete, the construction team should carefully dismantle and store ground cover materials for future use.



With that being said, some disposable ground cover materials, such as plastic sheeting or construction paper, can also be recycled. Check with local recycling facilities or waste management services to determine if these materials are accepted for recycling. By implementing these strategies, construction projects can minimise the waste generated from ground cover materials and, when necessary, find responsible ways to recycle or reuse them. Reducing waste not only benefits the environment but can also lead to cost savings and improved sustainability in construction practices.

1.4 Working with ground cover (Tower and Arch Structure)

At first look, this material does not look like it can stand on its own, let alone create a structure out of it, as ground cover is like a cloth and it bends easily. Since floor guards are essentially films that can be applied to any kind of surface to provide protection, they are inherently delicate and sensitive. If we had the ability to use other materials such as rope or metal rods, it would have been a lot easier to create a sturdy and firm structure with the cloth. Despite the circumstances, we were determined to make sure we could create something that stood tall and create an arch structure with the one material we had. With that being said, the first step was to make a flimsy mat on the ground stand.

Our initial thought was to roll up the ground cover and use the strips of the cloth to tie up the rolls. So we got some scissors and cut smaller strips of the cloth and rolled up the rest of the cloth. The problem with that method was that the rolls ended up getting tied too tight, thus making the pole structure that we rolled unstable. If we didn't tie the rolls tight enough, the rolls would also lose their sturdiness, and the overall structure would become too weak to support itself.

I was messing around with the material, until I figured we could burn the ground cover to make it stick to each other without the use of any adhesive. As the ground cover we were using consisted of 2 layers (one layer being the plastic foam mat to prevent the ground cover from slipping and the other layer being the synthetic to hold the dust from construction) we burnt the foam layer and that allowed us the possibility to roll up the ground cover into a pole-like structure without using strips or other adhesives. Essentially, we found a way to make the ground cover stick to itself. However, we soon realised that an unfavourable smell came out from the cloth when we burnt it. Dr Martijn stepped in to check on us and pointed out that it was not entirely environmentally safe to create our structure this way, as burning plastic produces toxic gases. So we were careful not to smell the burnt plastic, but proceeded with this method anyway. In all fairness, this was one of the better methods we found out to make our ground cover structure stand, with all the trial and error we made. If we had a little more time, maybe we could've figured out a more environmentally safe method to make our rolls stick to each other.

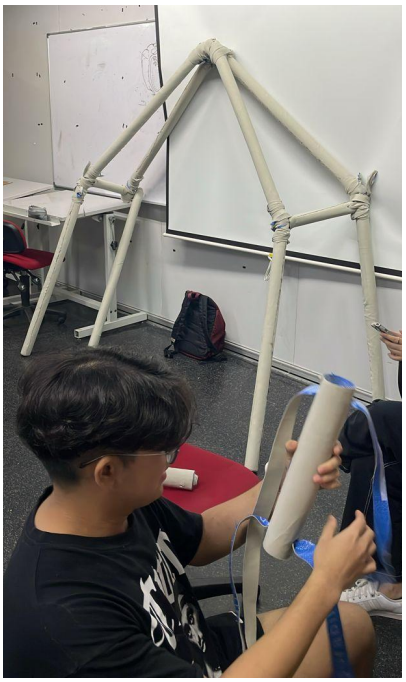
We repeated these initial two steps several times as we used the same method for both the tower and the arch. After making enough of them, we started connecting them by using strips of the floor guard. To do this, we cut thinner but longer strips and wrapped them around the connection points to secure them tightly. Depending on where the connections were, we sometimes used a blade and scissors to create a hole in the rolled-up floor guards. This allowed us to feed a strip of floor guard through to tie and secure the two rolls together.

The design of our tower had three points at the base that transferred the load from the top of the tower to the ground. Above these three base rolls, there were three additional rolls connected to the top of the base rolls. In between the base three rolls and the rolls above them, there were three short horizontal rolls. These served two purposes: to prevent swaying between the bottom and top rolls and to make the entire tower more stable. The three horizontal rolls had holes for securely feeding strips through to hold the tower steady.

The three rolls sitting on top of the base rolls converged at a single point, surrounding the final top roll that added extra height to the tower. To secure this last roll, we wrapped multiple strips of the ground cover around the three top rolls and tied them tightly together to prevent any swaying and ensure the stability of the tower. Similarly, for the arch, we used the same techniques, but instead of building vertically, we worked horizontally and then bent the structure to create an arch.

The construction system used for the arch was pointed out to us by Dr Martijn and Dr Siti that it was more of a post and beam structure rather than an arch. Due to time constraints, we couldn't amend that issue, but with the limited time we had my group and I are just in awe of what we have achieved to create a structure with a flimsy material such as the ground cover.

1.5 Making amendments to the structures



It was an absolute pleasure working with my teammates as they were present, cooperative and most importantly very communicative about our project. We would often sit around together and discuss the many ways to tackle certain issues we faced while making the structures. With that being said, we overcame many problems that we faced and triumphed through the construction process. One issue that we faced was how our structure started to get weaker over time. This resulted in our structure not being able to stand and as a result, it would fall and lose its firmness. As a result, we all stayed back after classes to untie and undo all the connections and strips that we painstakingly tied a few days back. We worked together to tie everything back with stronger poles and connections just before our presentation.

As for design, our tower and arch structure could have been improved by strengthening the structural integrity of our constructions, we may have included more foundation rolls and horizontal connecting rolls. This would have minimised their exposure to wind and any concerns with base roll placement. Instead of using the same vertical rolling and connecting procedure for the arch, an interesting alternative would have been to roll and connect the rolls horizontally. The structure would have been modified from a standard post and beam design to a more flexible, fluid shape, allowing us to generate numerous arch shapes with support beneath the highest point. While we could still create holes and feed connecting strips through, this horizontal approach would have made the arch look more like a true arch, rather than a rigid structure.

2.0 Practical Applications

As previously mentioned, using construction floor guards was an unconventional choice for building structures, as most people typically opt for materials with greater structural strength and the ability to stand independently. As a result, there are few, if any, examples of undertakings or artistic creations that use this material. However, it's worth mentioning that other waste materials, such as textiles like canvas and cotton, have certain parallels with building ground cover. These materials are soft and flexible by nature, making them perfect for creative construction and artistic uses.

2.1 Artistic examples of fabric art

One artistic example of recycled fabric art is the work of El Anatsui, a renowned Ghanaian sculptor. He is known for creating magnificent sculptures and tapestries from discarded materials, particularly recycled bottle caps and aluminium cans. Anatsui weaves these materials together to produce large, shimmering, and textured artworks that resemble traditional African textiles or draping garments. His art not only showcases the beauty of recycling and reusing materials but also conveys themes of cultural identity, consumption, and environmental awareness. El Anatsui's recycled fabric art has been exhibited in museums and galleries worldwide and is celebrated for its innovation and aesthetic appeal.

2.2 Interesting examples of product design

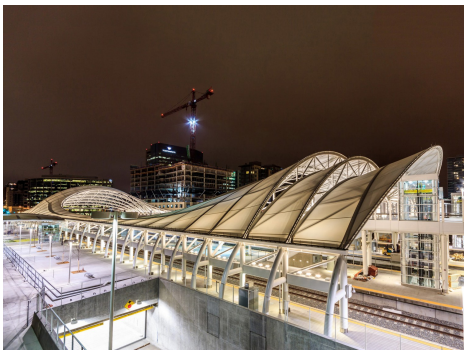
One product design example of recycled fabric art is the "Ecoalf" line of sustainable fashion and accessories. Ecoalf is a Spanish brand that specialises in creating high-quality products using recycled materials, including fabrics. They design a wide range of items, such as backpacks, sneakers, and clothing, all made from recycled fabrics like PET bottles, discarded fishing nets, and other post-consumer waste.

For instance, they produce stylish coats using recycled polyester fabric, which is derived from plastic bottles. These backpacks not only serve a practical purpose but also highlight the potential of recycling materials to create fashionable and eco-friendly products.

Ecoalf's commitment to using recycled fabrics in their product designs not only reduces the environmental impact but also demonstrates how recycled materials can be transformed into attractive and functional consumer goods.

2.3 Examples of top-end architecture

One architectural element example that incorporates recycled cloth and canvas is the use of tensile fabric structures in building design. Tensile fabric structures are architectural elements that utilise high-strength, lightweight fabrics, often made from recycled materials, stretched over a framework to create innovative and visually striking elements within buildings or outdoor spaces.



For instance, the fabric canopy in a modern sports stadium or an airport terminal often consists of high-performance recycled fabrics. These materials are known for their durability and flexibility, and they allow for the creation of large, airy, and aesthetically pleasing architectural elements that provide shade, weather protection, and unique design features.

The use of recycled cloth and canvas in tensile fabric structures not only showcases sustainable design practices but also offers versatility in achieving various architectural elements, such as canopies, awnings, and decorative facades, while reducing the environmental impact through material reuse.

3.0 General Observations

3.1 What did you like and what did you not like about this workshop?

Personally, I really enjoyed this workshop as it allowed us to think outside the box by using limited resources to create structures. This workshop helped my teammates and myself to really research and look through the different ways and methods to build using ground cover, and we wouldn't have come this far if we weren't challenged by our tutors and Dr Martijn himself. I appreciate the workshop's emphasis on sustainability and eco-friendly design by using recycled materials to create structures. It promotes environmental awareness and innovative thinking, showcasing the potential to reduce waste and repurposed materials.

However, I have concerns about the potential limitations of recycled materials, particularly in terms of structural integrity and long-term durability. With limitations to one material that we chose for our structures, we were short handed on how to create a strong and lasting structure out of ground cover. I learnt that it's important to ensure that safety and functionality are not compromised when working with recycled materials. Proper engineering structures and quality control are essential to address these challenges.

3.2 What did you learn, were there expected and unexpected outcomes?

Attending the workshop on building structures with recyclable materials allowed us students in architecture and design to be more conscious and aware about sustainability and the importance of repurposing resources. I also expected to gain hands-on experience in working with recycled materials, learning techniques for construction and design. On top of that, I knew that this challenge of creating structures using recyclable materials would encourage us students to think creatively and innovatively find solutions for sustainable design.

Nevertheless, I managed to develop fresh and new perspectives on different materials, waste, and design while watching my friends and peers creating structures out of daily waste items that we use once or twice. It also mustered a sense of community among us students

who share common interests in sustainability. I managed to chat with a few of my peers working outside my group and discovered more about the different materials that they were using and it really opened up my perspectives on their own materials as well. Finally I also wasn't expecting to discover my group's artistic side and explore ways to create unique structures from something flimsy such as ground cover.

3.3 Do you see scope to include such new ideas and philosophies in your future work?

Yes, because I have observed and come to terms with how recycling materials and adopting sustainable philosophies in architecture is not only a growing trend but also a necessity for addressing environmental concerns. It's crucial for architects to take responsibility for the environmental impact of their designs. Using recycled materials reduces the demand for new resources, lowers energy consumption, and minimises waste in the construction industry. Besides that, The construction industry is one of the largest consumers of raw materials. Recycling materials allows architects to contribute to resource conservation and reduce the depletion of natural resources. Moreover, recycled materials can be cost-effective and most of the time readily available. This aids in providing an economic advantage for projects, especially when working with limited budgets. Not only that, but recycling materials can lead to innovative and creative architectural design solutions. It encourages architects to think outside the box and experiment with unconventional materials.

3.4 What is the potential for using solutions with your material in the Malaysian context?

Malaysia's tropical climate, characterised by high temperatures and occasional heavy rainfall, makes fabric structures a desirable choice, offering shade, shelter, and ventilation while minimising heat absorption. These structures can also be engineered to withstand common wind and rain. Malaysia's increasing focus on sustainable and eco-friendly construction aligns with fabric structures, often using recycled or locally sourced materials to reduce their environmental impact. This commitment to sustainability is in harmony with Malaysia's green building practices. Additionally, fabric structures provide a canvas for incorporating cultural and aesthetic elements reflecting the country's rich heritage and diverse architectural traditions, offering design flexibility for both traditional and contemporary expressions. Their versatility extends to various uses, from pavilions, event spaces, playground covers and architectural elements like canopies, awnings, and facades.