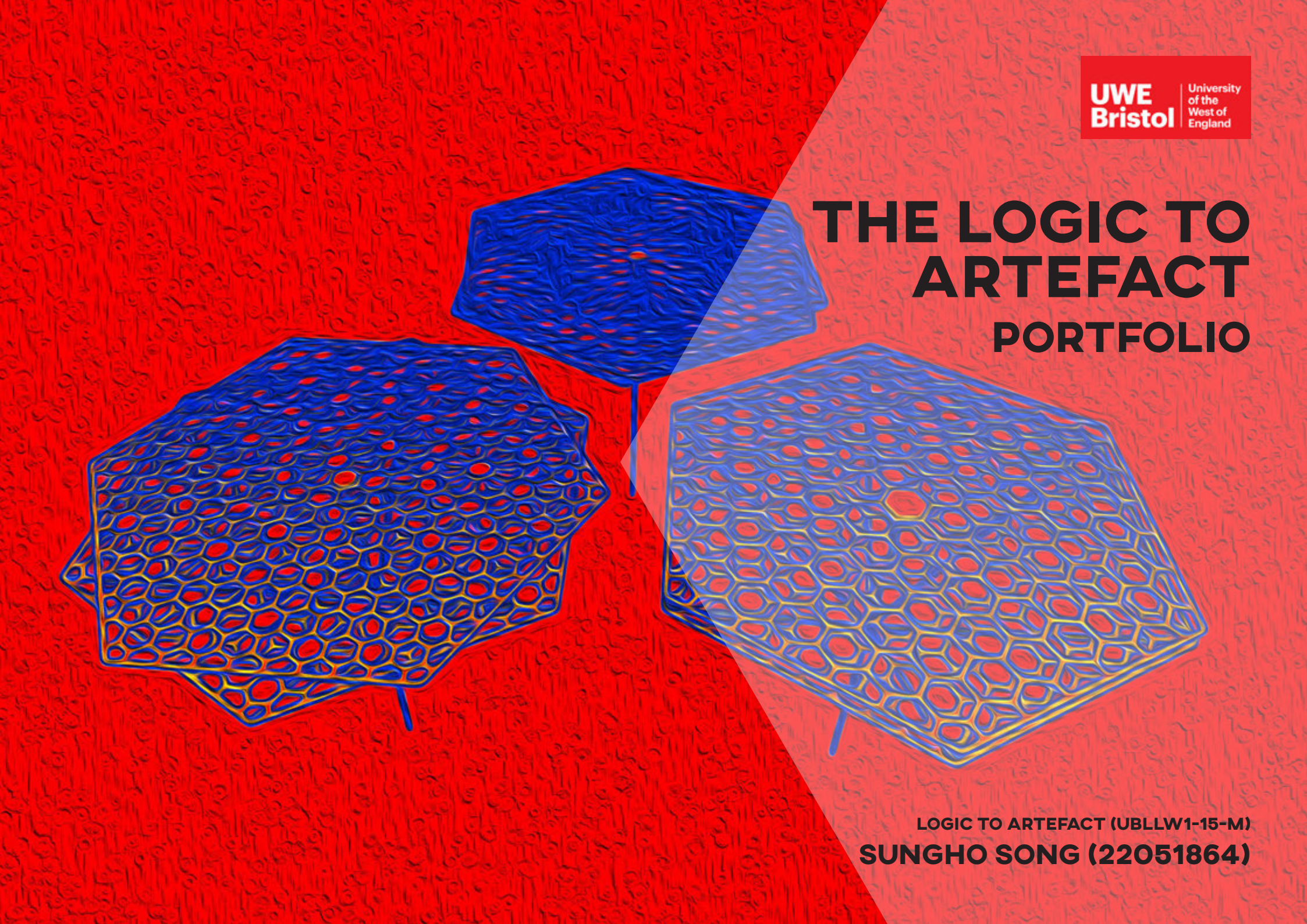


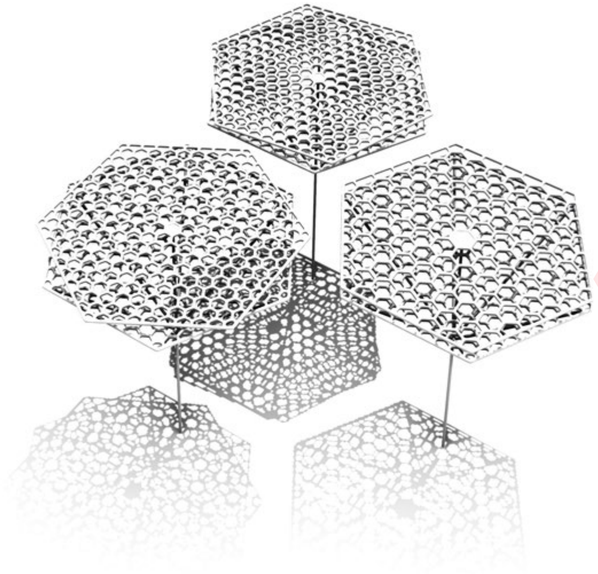
UWE Bristol | University of the West of England

THE LOGIC TO ARTEFACT

PORTFOLIO

LOGIC TO ARTEFACT (UBLLW1-15-M)

SUNGHO SONG (22051864)



CONTENTS

LOCATION

Queen Square in Bristol is chosen as a potential location for a shelter structure to simulate and maximise the computational method. It also perfectly fits the shelter's usage and concept for the final project.

The site is a Georgian park area in the heart of Bristol that connects residents, commuters, and visitors to their homes, workplaces, and final destinations through a 6-sided junction. Furthermore, the square is a popular hangout for nearby workers and visitors looking to unwind. It is surrounded by Georgian townhouse-styled office buildings that were once residential areas for the merchant elite.

INTRODUCTION

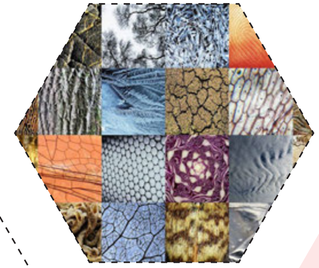
PROJECT BRIEF

The project is based on a clear set of principles that, when implemented repeatedly, resulting in a sophisticated structural framework. The primary objective of the final artefact structure is to establish the rules as the fundamental logic for a modest structure that can shelter one to three people. The previous theoretical submission presented evidence to support the logic's development, research data from prior studies, and a hypothesis of potential computational approaches to address the issue computationally.
The final artefact is a scaled or scale-free model produced using digital fabrication methods, including laser cutting and 3D printers.

In order to portray microscale design in response to a primary brief, the ultimate project's outcome is to identify and apply the types and principles of visual programming, material testing, and digital fabrication processes. Moreover, using pattern and form-finding techniques in design processes results in an artefact that is well-crafted for simulation and fabrication.

Flexibility and creativity shall be applied to selected appropriate computational and fabrication methods by proactively undertaking substantial investigations to address an architectural system design. And finally, to present an interpretation of fundamental pattern language and form-finding theories in a crafted artefact, a graphical and verbal illustration at a high level of abstraction, arguing from competing perspectives.

CONCEPT
INITIAL STAGES



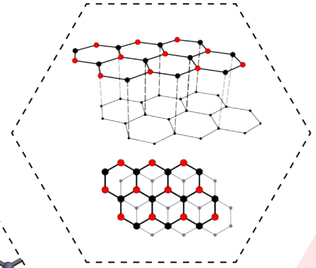
The concept of the final project has developed from various stages.

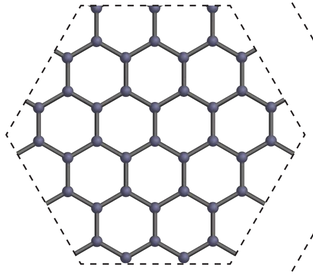
The initial idea began and derived from a previous group theoretical presentation which is 'Patterns in nature'. The aim of the theoretical concept was to apply features of patterns in nature to a shelter design. The reason behind this is that nature is adaptive, responds to the environment and has a living structure. The are several benefits of using patterns in a design, it can reduce construction or fabrication time by using modular systems and reduce material also the cost.

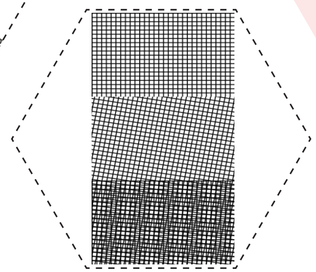
Then the initial idea moved onto the next stage by implementing a book, 'Stuff Matters: The Strange Stories of the Marvellous Materials that Shape Our Man-made World' by Mark Miodownik to the concept.

Materials have different arrangements and different types of atoms which declares them as different materials from each other. For example, diamond and graphite have very different looks even from the colour but it has the exact same number of carbon atoms. Which means they are just organised in a different sequence or arrangement. That also means that if there is a way to rearrange the arrangement of carbon atoms, diamond could become graphite and graphite become diamond.

CONCEPT
FINAL STAGES







The concept of the carbon atoms in graphite has developed into a substance known as graphene, whose name is derived from graphite.

The building block of graphite, which consists of a monolayer of carbon atoms organised in a hexagonal lattice, has gained popularity in recent years due to its many potential applications.

With more investigation into graphene, a final design idea for the shelter structure was developed. A remarkable characteristic of graphene known as "magic-angle graphene" has emerged in recent years.

Meaning that the superconductivity of graphene can be switched on and off with an electric pulse by stacking up 2 layers of graphene and twisting at a typical angle that creates a moiré pattern.

As a final concept, "magic-angle graphene" and the Moiré pattern have been used in creating a shelter that serves as a shaded place for the people who use Queen Square on hot days.

PRECEDENT STUDIES

GIANT LAMP INSTALLATION

Giant lamp installation is situated in Piccadilly Place, Manchester, and has been utilised as a shelter during the day and night which also provided seating and electric heating during the winter.

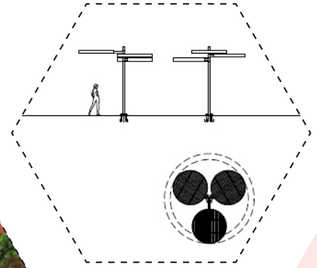
There are ideas or a logic that is interesting to be extracted.

Its strategic location serves not only as an artistic landmark but also as a functional structure that enhances the experience of the pedestrianised street often where has a lack of shelter or shading devices during sunny days for people to escape from the heat through its towering structure, the lamp provides a large shade area where people can comfortably escape from the heat

It also promotes sustainability by reducing the necessity for energy-intensive solutions to cooling and shading.

PRECEDENT STUDIES

OMBRA IN CITTÀ: PETALS



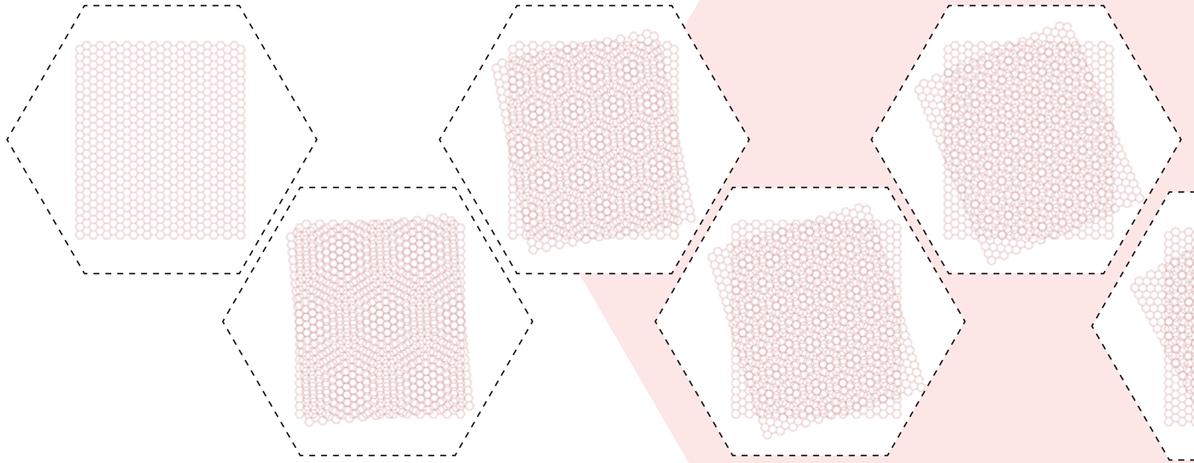
The shading structure, which is made up of a supporting column and three circular steel frames arranged at different heights, is a simple alternative for preventing excessive overheating of the environment.
It is, however, restricted in its scope and lacks flexibility in installation and positioning.

To address these restrictions, a series of modular structures with shading purposes can be imagined, interpreting the primary purpose of these structures in different manners while taking functional, structural, and installation factors into consideration. The result is a highly versatile system derived from the research of a modular element that can be oriented at various angles.

The modular design provides excellent positioning flexibility and a play of overlap, resulting in a more natural perception of the shade. Unlike the existing shading structure, which can only be adjusted during installation based on a set of predefined positions, the modular system can generate a wide range of spatial combinations, making it ideal for shading large areas.

Furthermore, the modular system provides more than just shading. It can be used to generate visually impressive open spaces that offer shade, privacy, and a sense of calm. The modular system's adaptability allows it to be adapted to a variety of settings, which include parks, public squares, and private gardens, adding value to the built environment.

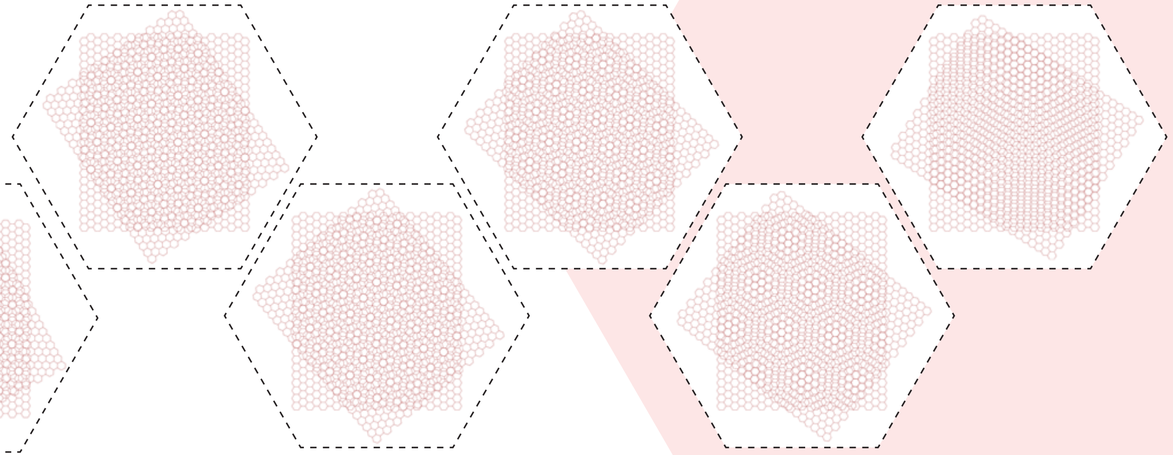
THEORY
MOIRÉ PATTERN



The combination of hexagonal shapes and moiré patterns in a shading panel bilayer is a sensational solution that enhances the effectiveness of shading structures. The shading panel can provide shades at various angles that can be adjusted based on the time of day or the amount of heat and sunlight by combining these two design elements.

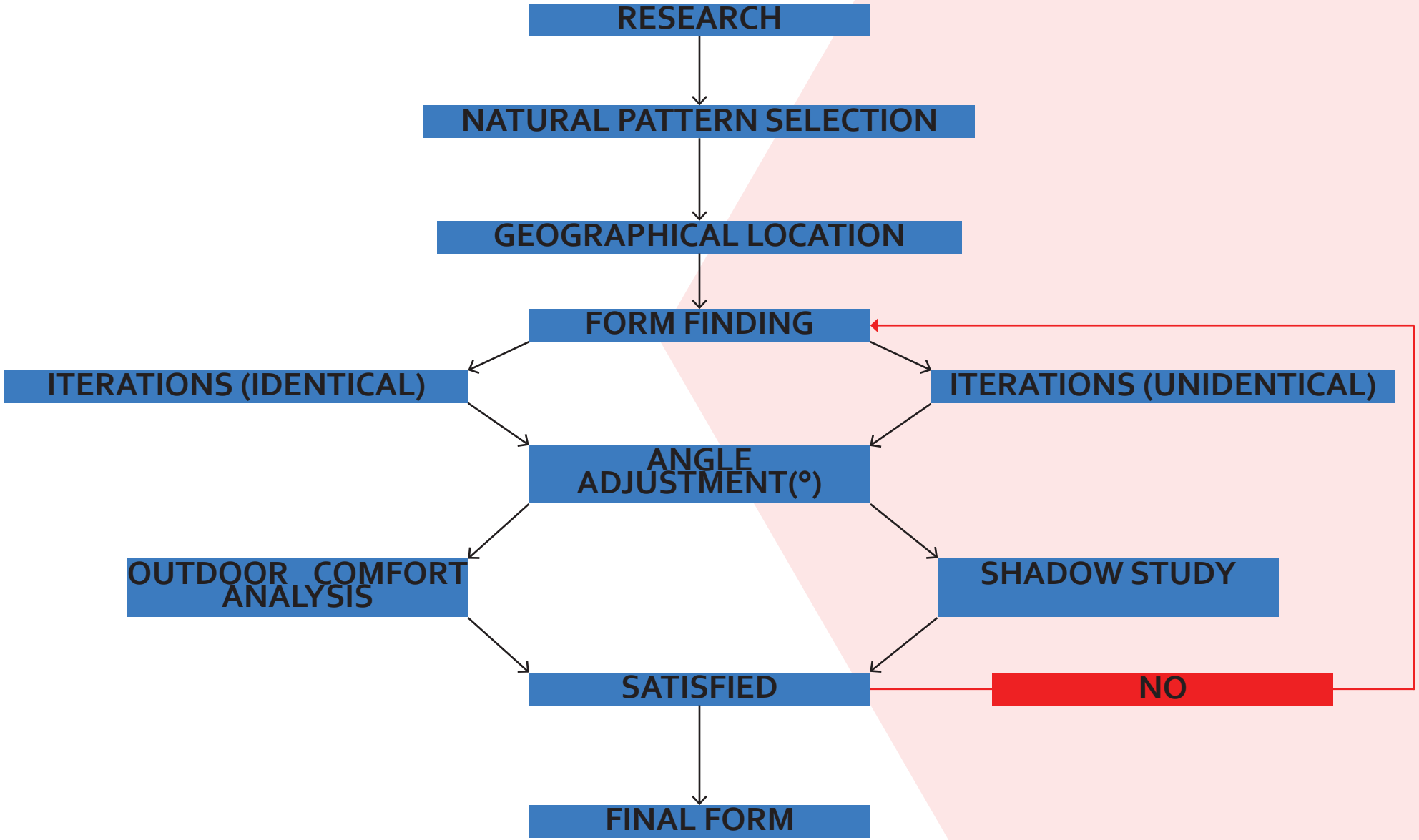
The hexagonal shapes generate a visually appealing pattern that enhances the shading panel. The moiré pattern, on the other hand, lifts the design by creating a dynamic visual effect that can be adjusted based on the viewer's angle.

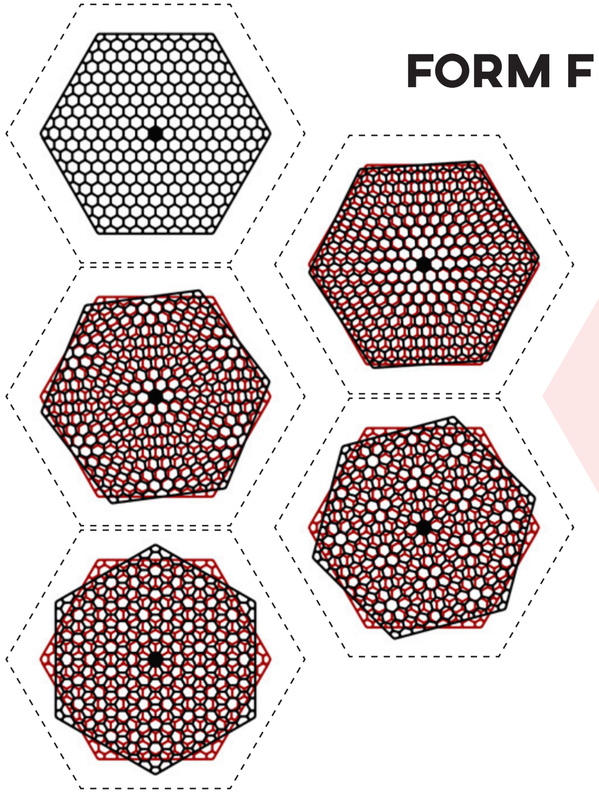
THEORY
MOIRÉ PATTERN



Further to that, by stacking two layers of panels and applying the moiré pattern, the gap between each pattern of panels can be filled in to create various combinations of natural patterns and better shading. This is an impressive way to balance functionality and aesthetics.

The moiré pattern can be adjusted to produce a variety of shading effects that can be customized depending on the environment. During the hot summer months, for example, the panels can be adjusted to provide maximum shading, while during the cooler months, the panels can be adjusted to allow more sunlight to enter the space.


RESEARCH
NATURAL PATTERN SELECTION
GEOGRAPHICAL LOCATION
FORM FINDING
ITERATIONS (IDENTICAL)
ITERATIONS (UNIDENTICAL)
ANGLE ADJUSTMENT(°)
OUTDOOR COMFORT ANALYSIS
SHADOW STUDY
SATISFIED
NO
FINAL FORM



FORM FINDING_ITERATION 1

IDENTICAL PATTERN

Exploring an identical pattern that has the exact same dimensions for the shading panels.
Exploring potential patterns that can provide a better shading solution that is optimized for the specific weather conditions of the location.

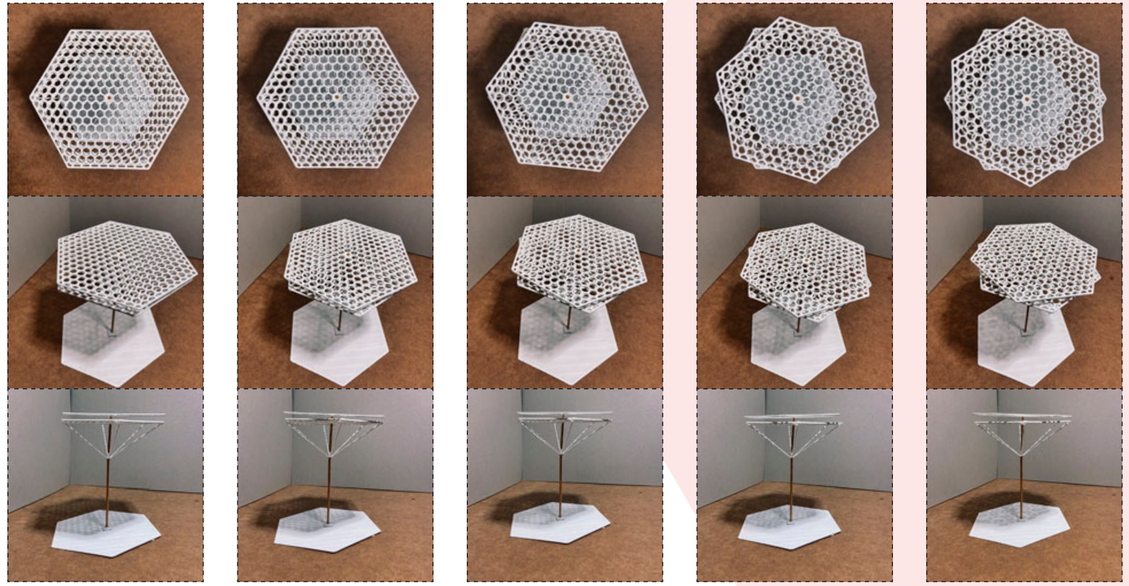
The panels should also be adjustable by users to control the amount of sunlight that enters the shelter.
This feature allows for flexibility and ensures that the shading system can adapt to changing weather conditions throughout the day.

To determine the optimal pattern for the shading panels, conducted a shadow study that analyses the pattern and the outdoor comfort analysis for the users.
By setting adjustable angles into 5 different variables, it can test out various patterns and evaluate their effectiveness in providing the necessary shade and comfort.

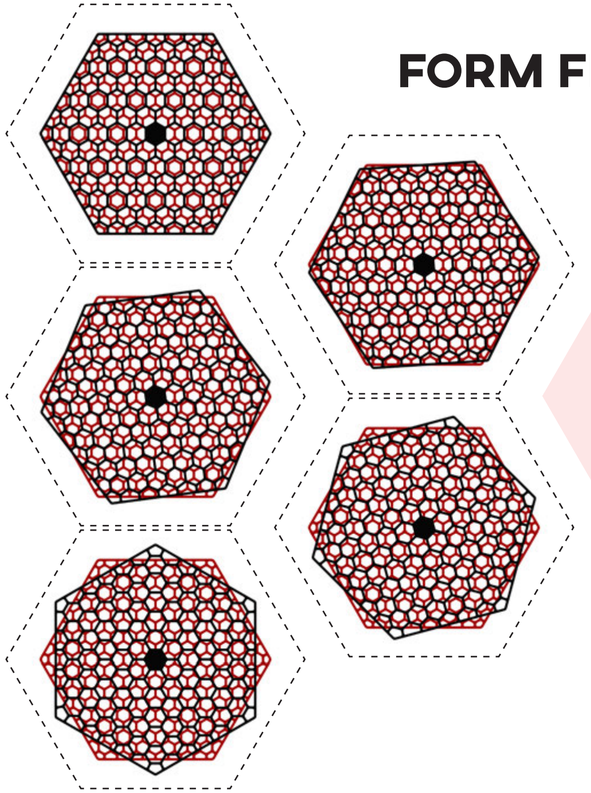
The goal is to find a final form of the shading system that meets the specific needs of the users and the environmental conditions of the location. By considering factors such as pattern, adjustability, and angle, it can provide a shading solution that enhances the overall comfort and functionality of the space.

FORM FINDING_ITERATION 1

IDENTICAL PATTERN



0° 3.75° 7.5° 15° 30°



FORM FINDING_ITERATION 2

UNIDENTICAL PATTERN

Exploring an unidentical pattern that has the different dimensions for the shading panels.
Exploring potential patterns that can provide an optimal shading solution that is suitable for the specific weather conditions of the location.

The panels must be adjustable by inhabitants to control the amount of sunlight that enters through the shading panel. This feature allows for flexibility and making sure that the shading system can adapt to changing weather conditions throughout the day, especially during the hot day.

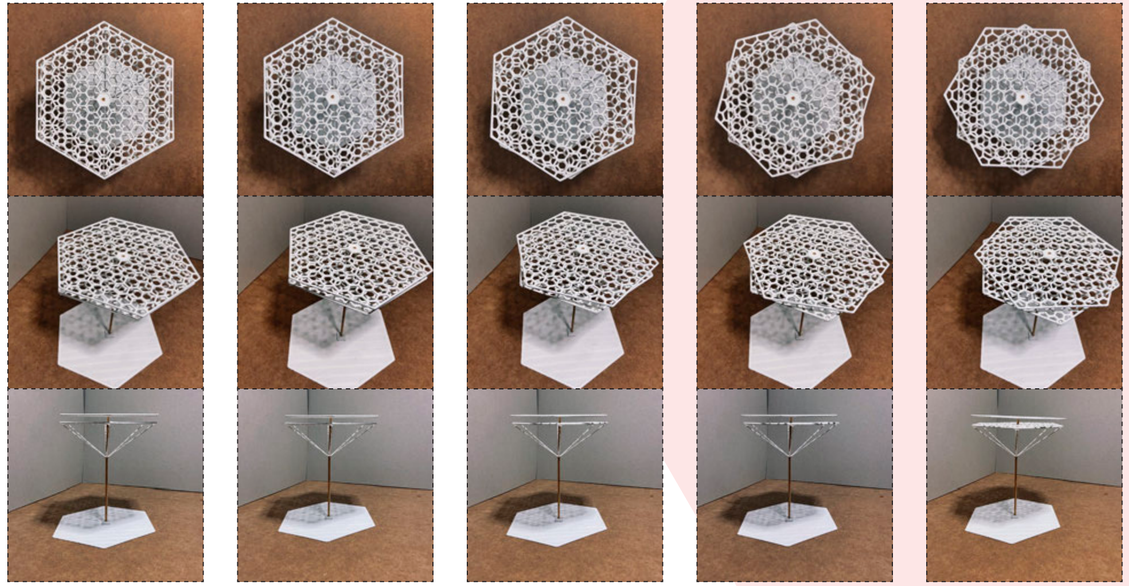
To determine the optimal pattern for the shading panels, conducted a shadow study that analyses the pattern and the outdoor comfort analysis for the users.
By setting adjustable angles into 5 different variables, it can test out various patterns and evaluate their effectiveness in providing the necessary shade and comfort.

0° 3.75° 7.5° 15° 30°

The objective is to find a suitable form of the shading system that meets the specific needs of the users and the environmental conditions of the location. By considering factors such as pattern, adjustability, and angle, it can provide a shading solution that provides better overall comfort and functionality of the space.

FORM FINDING_ITERATION 2

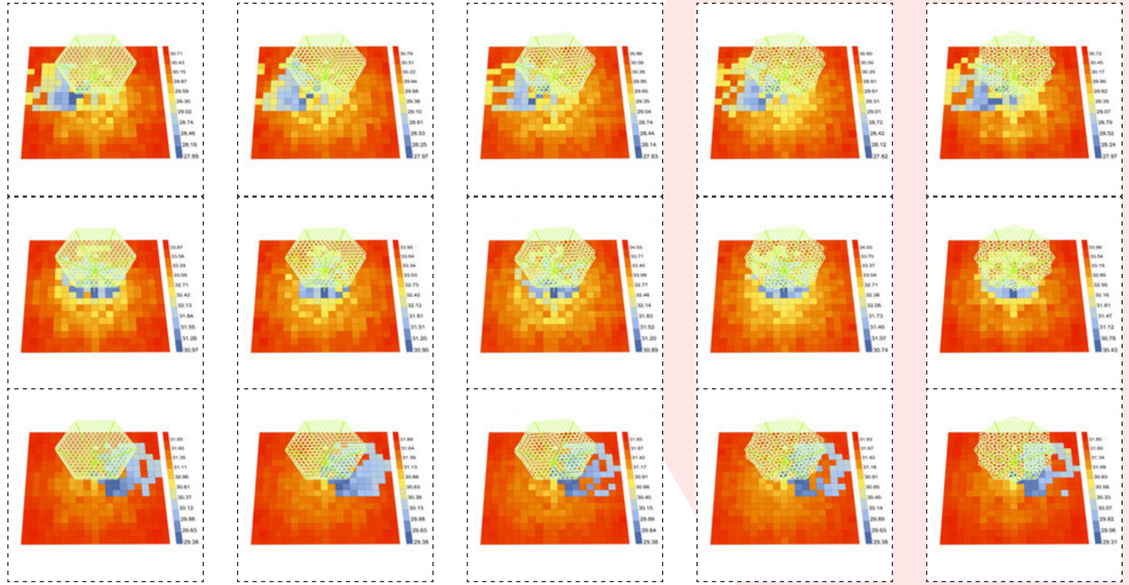
UNIDENTICAL PATTERN



0° **3.75°** **7.5°** **15°** **30°**

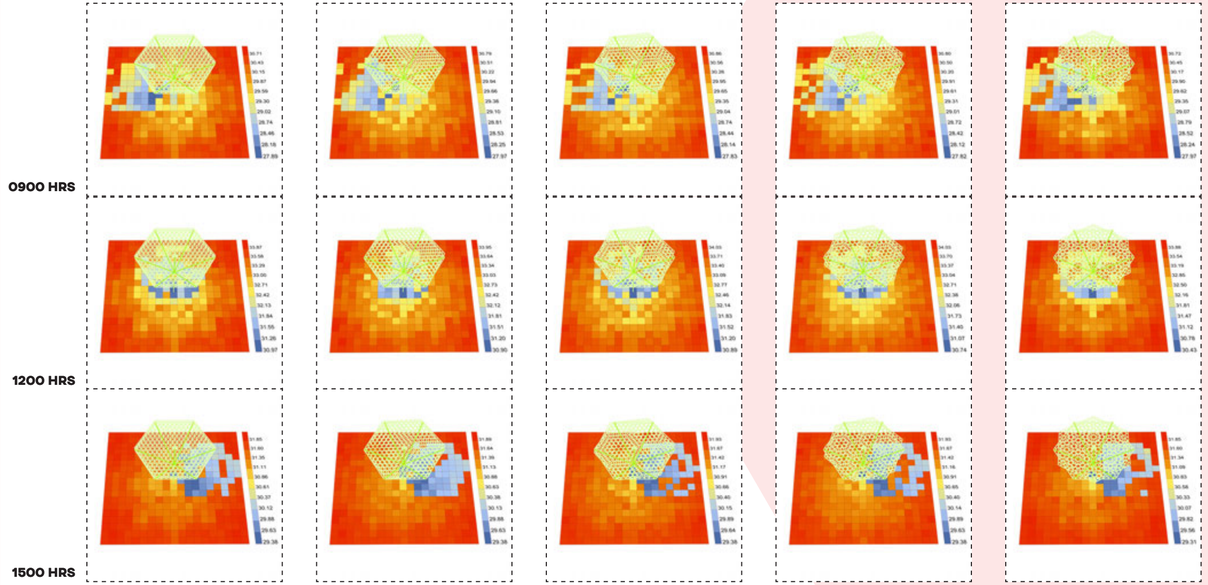
METHODOLOGY

OUTDOOR COMFORT ANALYSIS (IDENTICAL PATTERN)



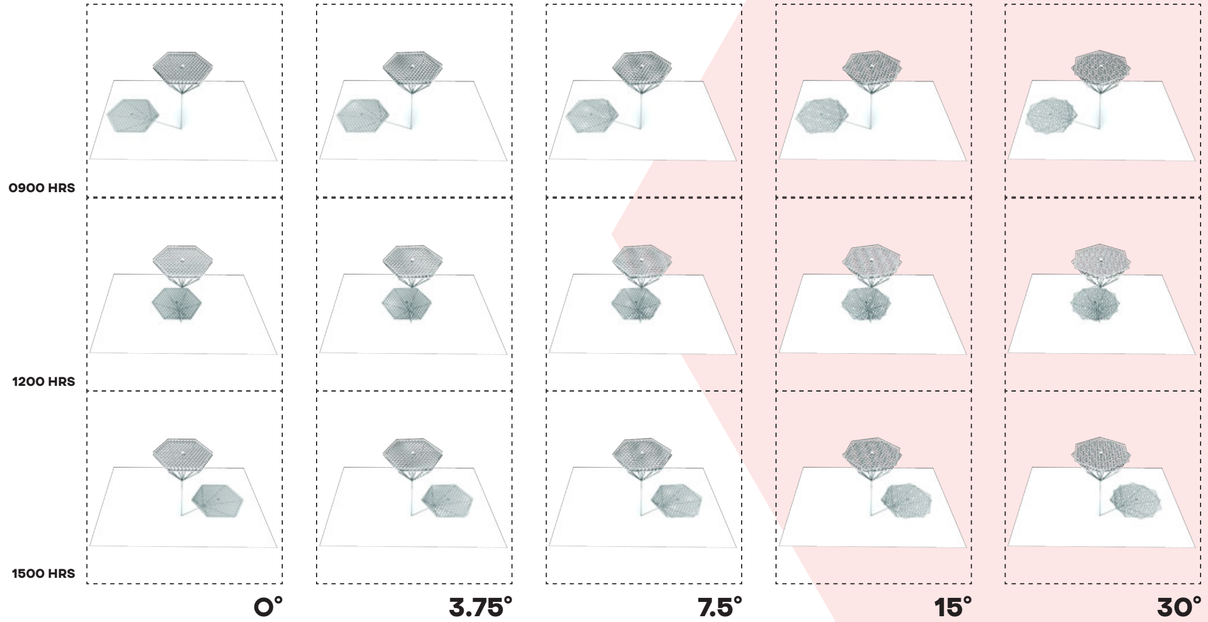
METHODOLOGY

OUTDOOR COMFORT ANALYSIS (UNIDENTICAL PATTERN)



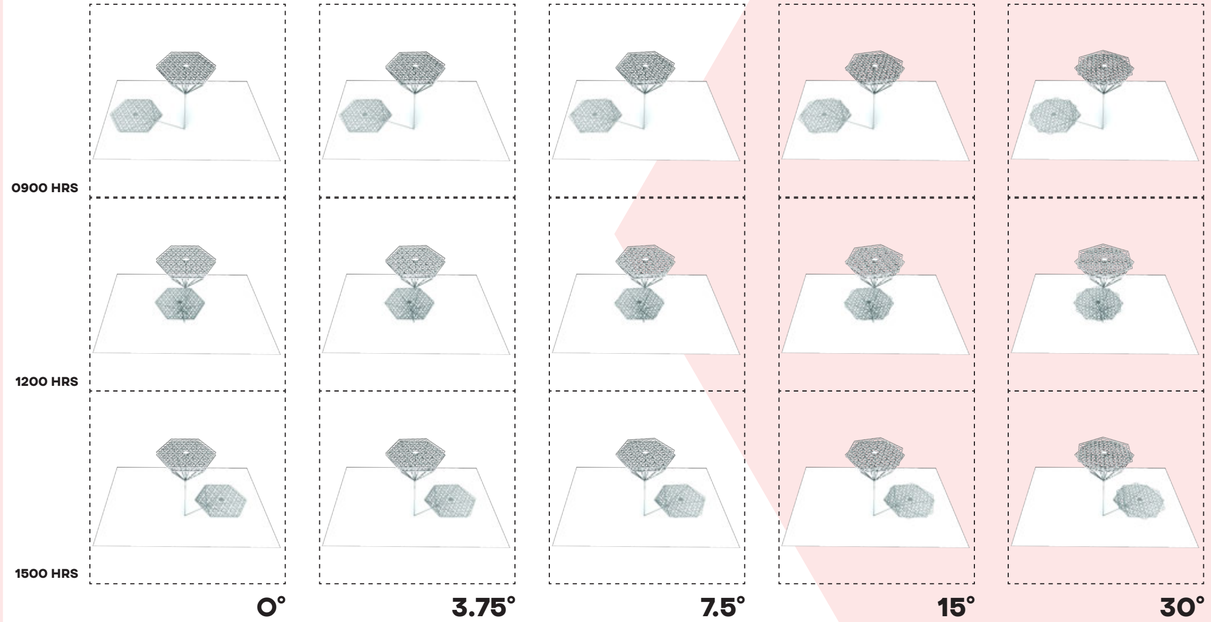
METHODOLOGY

SHADOW STUDY (IDENTICAL PATTERN)



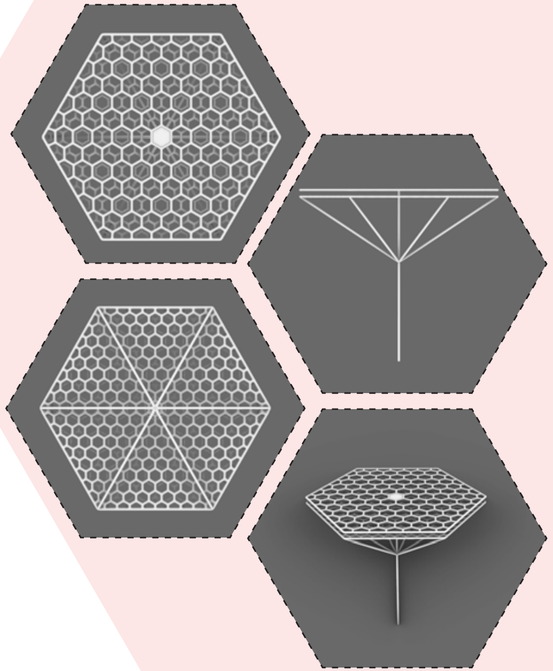
METHODOLOGY

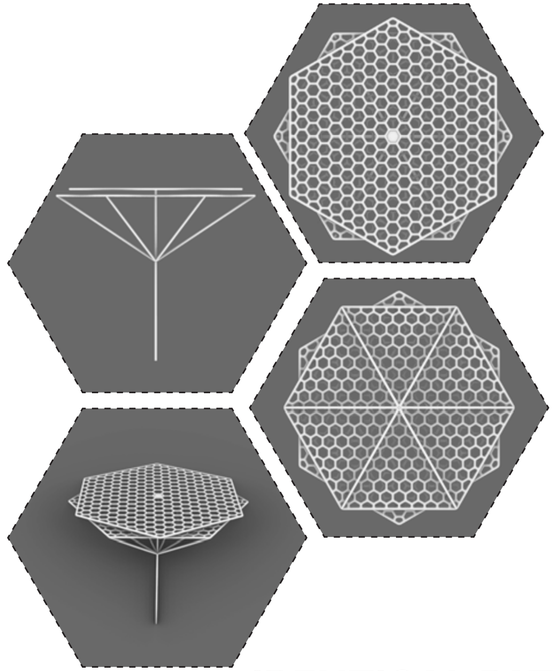
SHADOW STUDY (UNIDENTICAL PATTERN)



FINAL ARTEFACT

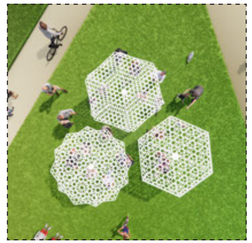
UNIDENTICAL PATTERN





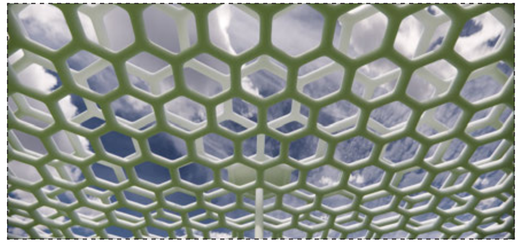
IDENTICAL PATTERN

RENDERED

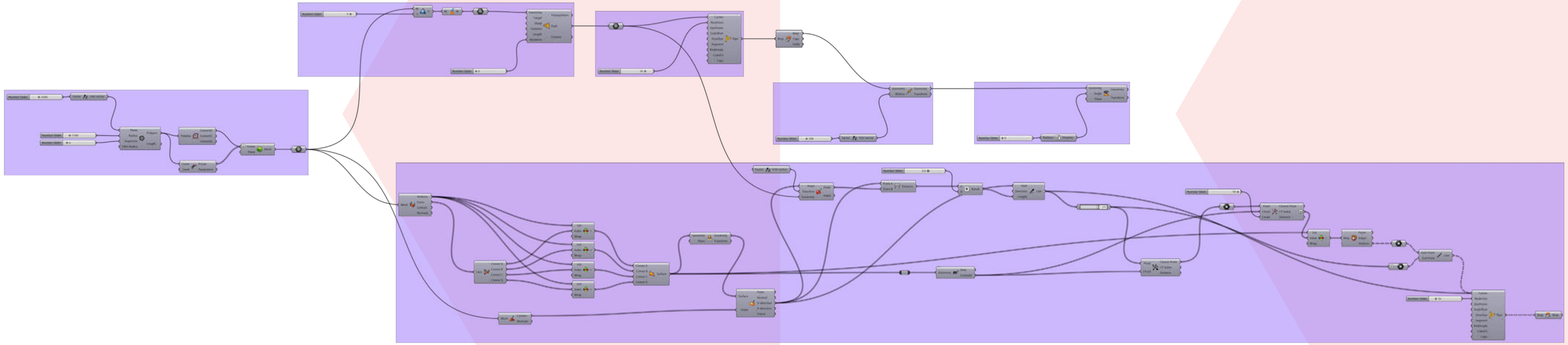


RENDERED

RENDERED

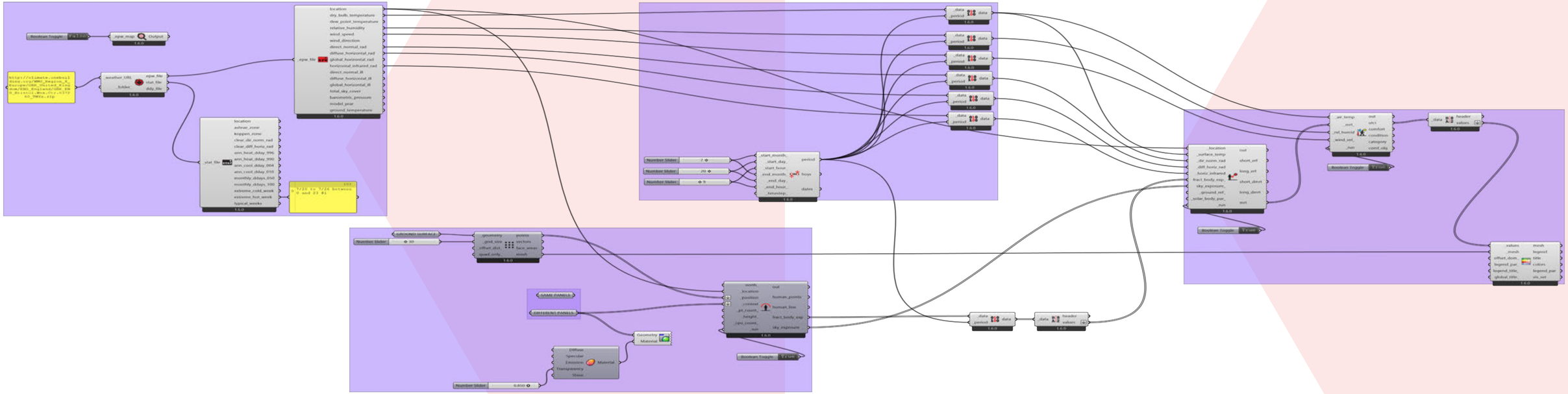


GRASSHOPPER SCRIPT
FORM FINDING



GRASSHOPPER SCRIPT
FORM FINDING

GRASSHOPPER SCRIPT
OUTDOOR COMFORT ANALYSIS



GRASSHOPPER SCRIPT
OUTDOOR COMFORT ANALYSIS

CONCLUSION

In conclusion, the shelter created through the implementation of computational methods has positively achieved its functional and aesthetic objectives. The use of the moiré effect with a hexagonal pattern not only enhances the visual attraction of the structure but also provides optimised shading solutions.

The design process involved several iterations and analyses to make sure that the final form of the shading system met the specific needs of the location and its users.
Through the execution of outdoor comfort analysis and shadow studies, it was able to determine the most efficient patterns and angles for the shading panels.

The adjustable panels also provide users with the flexibility to control the amount of sunlight entering the space, ensuring that the shading arrangement can adapt to changing weather conditions throughout the day.

Overall, the computational approach used in the design and creation of the shading shelter has produced a functional and efficient structure that enhances the comfort and functionality of the space.
By merging form and function, this shading system serves as an interesting sample of how computational methods can be used to create progressive and effective solutions for modern design challenges.

REFERENCE

Miodownik, M. (2014) Stuff matters : exploring the marvelous materials that shape our manmade world Boston, Houghton Mifflin Harcourt.

'The Range of Action That Integrates Shadow In Urban Spaces' (no date) Landezine. [online]. Available from: https://landezine.com/metalco-advertorial-shadow-in-urban-spaces/ [Accessed 19 February 2023].

'OMBRA IN CITTÀ: PETALS' (no date) Metalco Mobiliar. [online]. Available from: https://metalco-mobiliar.cz/prodotti-en/ombra-in-citta-petals/?lang=en [Accessed Accessed 25 February 2023].

Taggart, E. (2018) Manchester's Giant Lamp Installation Shines a Light on the City's Rich History My Modern Met.12 July 2018 [online]. Available from: https://mymodernmet.com/giant-lamp-public-art-manchester-acrylicize/ [Accessed 5 April 2023].

Bistritzer, R. and MacDonald, A.H. (2011) Moiré bands in twisted double-layer graphene. Proceedings of the National Academy of Sciences. [online]. 108 (30), pp.12233–12237. Available from: https://www.pnas.org/content/108/30/12233 [Accessed 25 February 2022].

MacDonald, A.H. and Bistritzer, R. (2011) Graphene moiré mystery solved? Nature. [online]. 474 (7352), pp.453–454. Available from: https://www.nature.com/articles/474453a [Accessed 19 February 2022].

Community, N.P.E. (2019) Moiré excitons in a 2D semiconductor heterobilayer Nature Portfolio Engineering Community.25 February 2019 [online]. Available from: https://engineeringcommunity.nature.com/posts/44519-moire-excitons-in-a-2d-semiconductor-heterobilayer [Accessed 01 March 2022].

Cao, Y., Fatemi, V., Fang, S., Watanabe, K., Taniguchi, T., Kaxiras, E. and Jarillo-Herrero, P. (2018) Unconventional superconductivity in magic-angle graphene superlattices. Nature. [online]. 556 (7699), pp.43–50. Available from: https://www.nature.com/articles/nature26160 [Accessed 01 March 2022].

'Moire Patterns in Quantum Information' (no date) NIST. [online]. Available from: https://www.nist.gov/image/moireopng [Accessed 05 March 2023].

'Moiré patterns on 2D heterostructures via atomic force microscopy' (no date) www.parksystems.com. [online]. Available from: https://www.parksystems.com/learning-center/nano-academy/articles/2271-moire-patterns-on-2d-heterostructures-via-atomic-force-microscopy [Accessed 05 March 2023].

'Wikiwand - Moiré pattern' (no date) Wikiwand. [online]. Available from: https://www.wikiwand.com/en/Moir%C3%A9_pattern [Accessed 09 March 2023].

Gibney, E. (2019) How 'magic angle' graphene is stirring up physics. Nature. [online]. 565 (7737), pp.15–18 [Accessed 09 March 2023].

'Study: Superconductivity switches on and off in "magic-angle" graphene' (no date) MIT News | Massachusetts Institute of Technology. [online]. Available from: https://news.mit.edu/2023/study-superconductivity-switches-and-magic-angle-graphene-0130#:~:text=Magic%2Dangle%20graphene%20refers%20to [Accessed 20 March 2023].