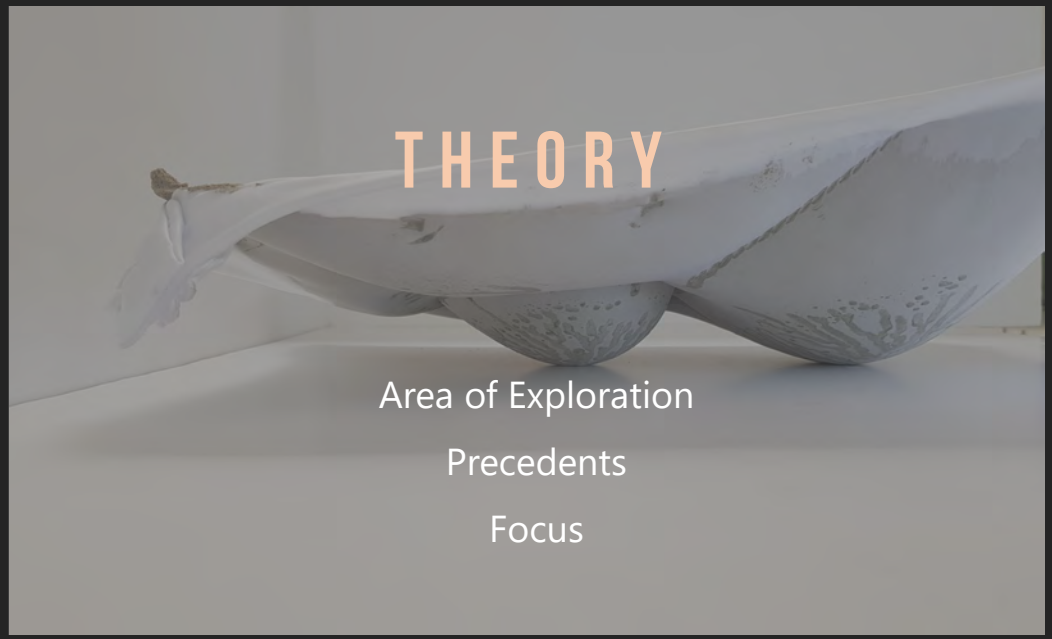
GRADUATION PROJECT

Substance without form(work) : Exploring alternatives for constructing form-finding concrete formwork

Nick Lucchese

In partnership with

aurecon


THEORY
Area of Exploration
Precedents
Focus

THEORY +

AREA OF EXPLORATION

Developing a contemporary method for the construction of formwork for complex concrete geometry

THEORY

PRECEDENTS

1. Philippe Block – Cable-net and fabric formworks for concrete shells

2. Jo Nagasaka - Casting concrete in a fabric bag

3. Neal Aronowitz - Exploring applications of Concrete Canvas

4. ETH Zurich – Thin-shell concrete roof structure

1.

2.

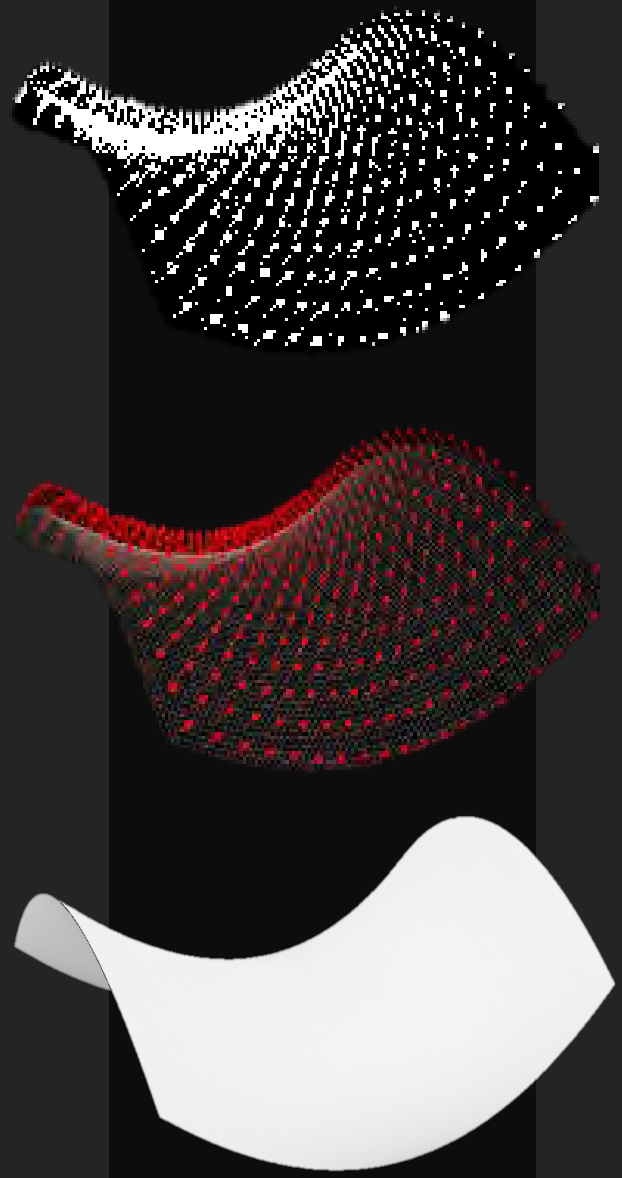
3.

4.

THEORY +

FOCUS

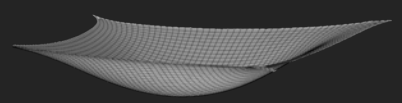
This research will challenge this method of pre-tensioning the fabric into the desired shape. It will instead use a form-finding process.

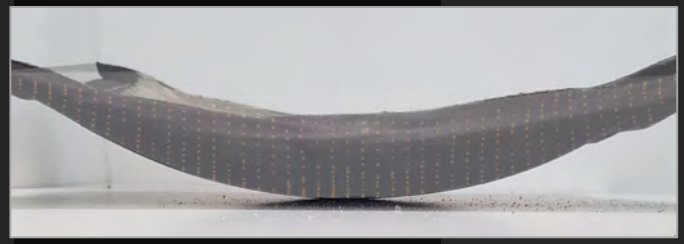
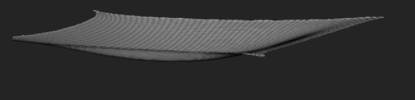


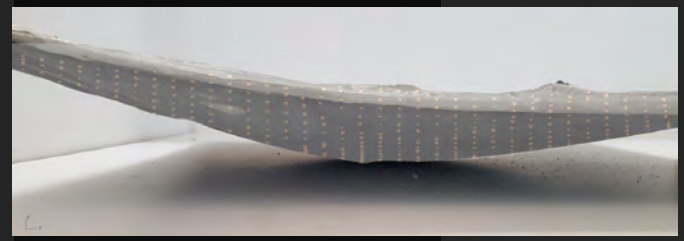
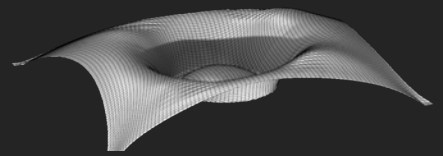

PRODUCT
End Result

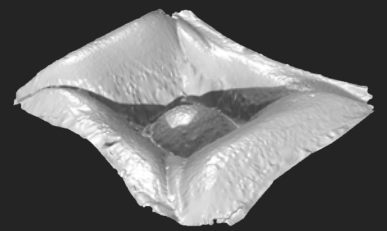
PRODUCT +

FINAL MODELS







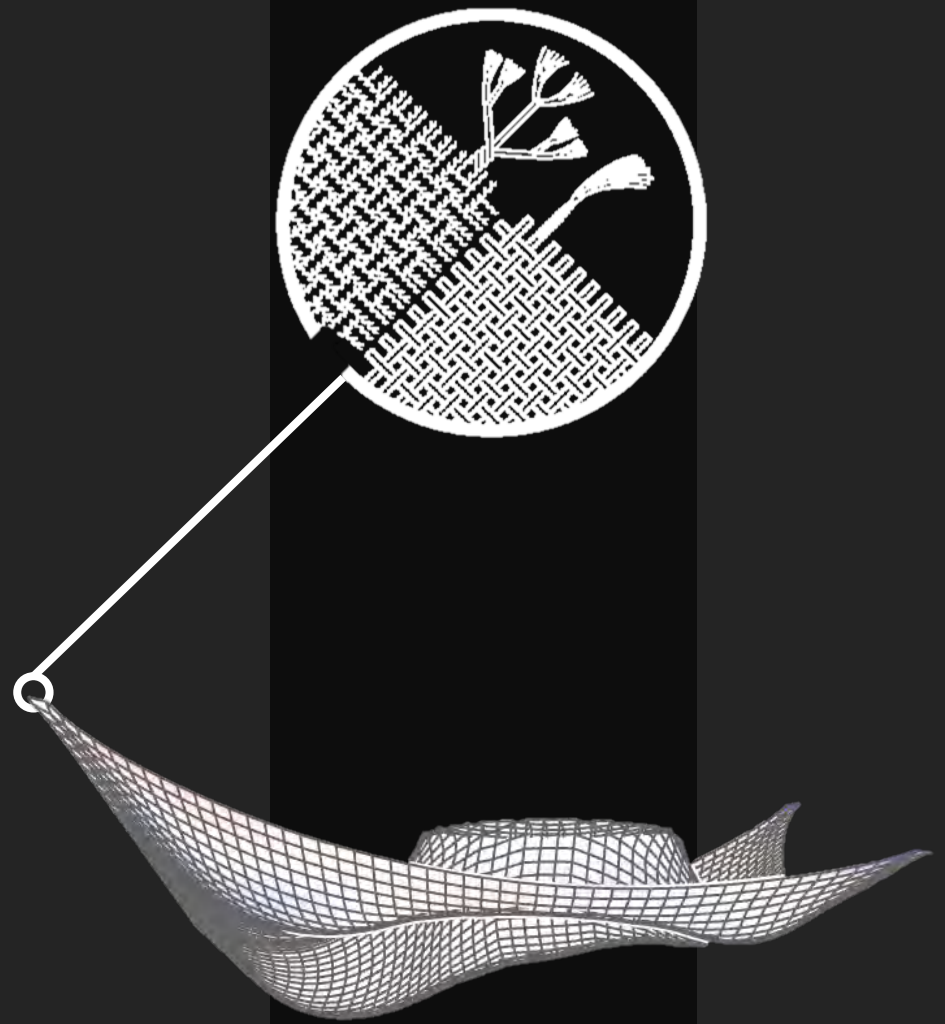
PROCESS
Digital Model
Physical Model
3D Scanning

PROCESS

MATERIAL DISCUSSION

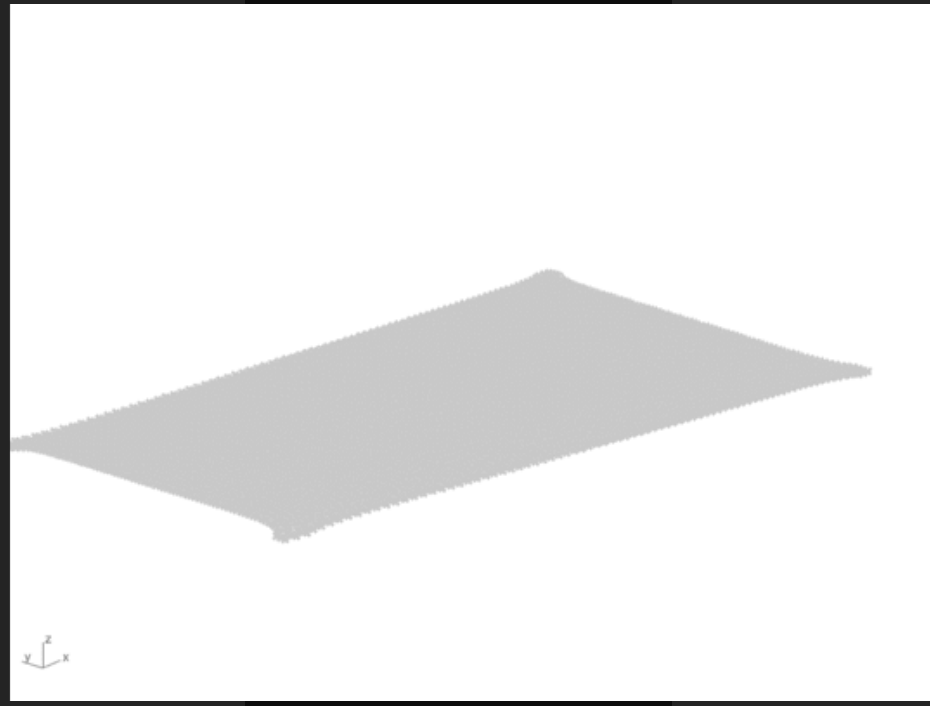
Mechanical properties are essential when comparing fabrics suitable for formwork.

- Youngs Modulus
- **Thread Count**
- **Weave Type**

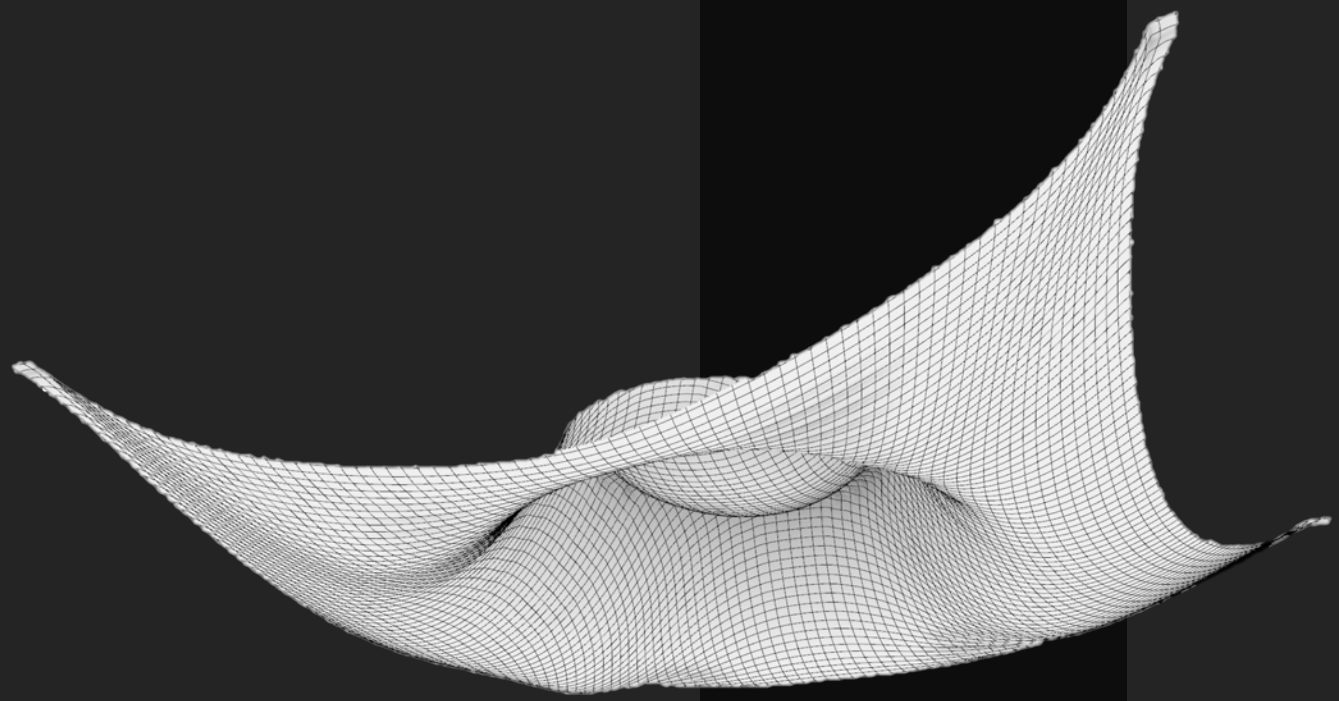


PROCESS

DIGITAL MODEL



Parametrically designed to assist with an accurate deformation of fabric in a digital scape.



PROCESS

PHYSICAL MODELS

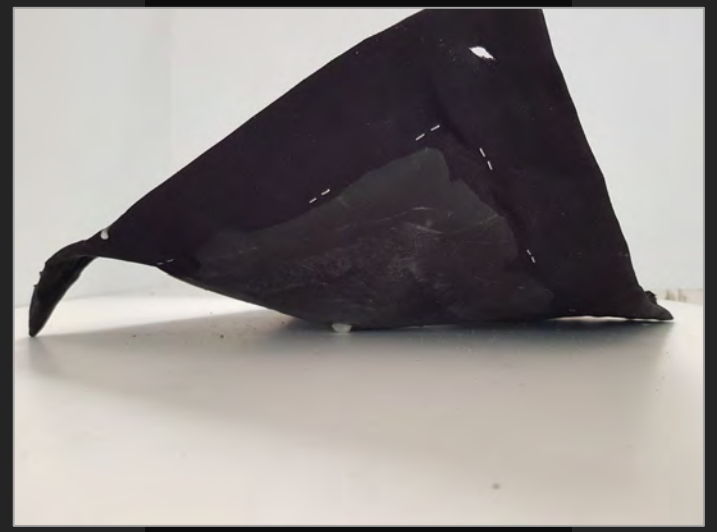
Explores various materials and applications in an attempt to create a solution for current formwork issues

PROCESS

PHYSICAL MODELS - WAX

Preliminary models were poured from wax to inform later iterations.

- Verified material concerns
- Material constraints



PROCESS

PHYSICAL MODELS - CONCRETE .1

These scale concrete models explore several areas that will later inform future iterations

- Method of Application
- Material properties

PROCESS

PHYSICAL MODELS - CONCRETE .2

Tested another application, spraying cement onto fabric

PROCESS

PHYSICAL MODELS - CONCRETE .3

Fabrics with more elastic properties were tested to extend the form-finding result.

PROCESS

PHYSICAL MODELS - CONCRETE .4

Utilising the fabric from iteration 3, an attempt to achieve an organic, form-found geometry based from the digital model, was explored

PROCESS

PHYSICAL MODELS - CONCRETE .5

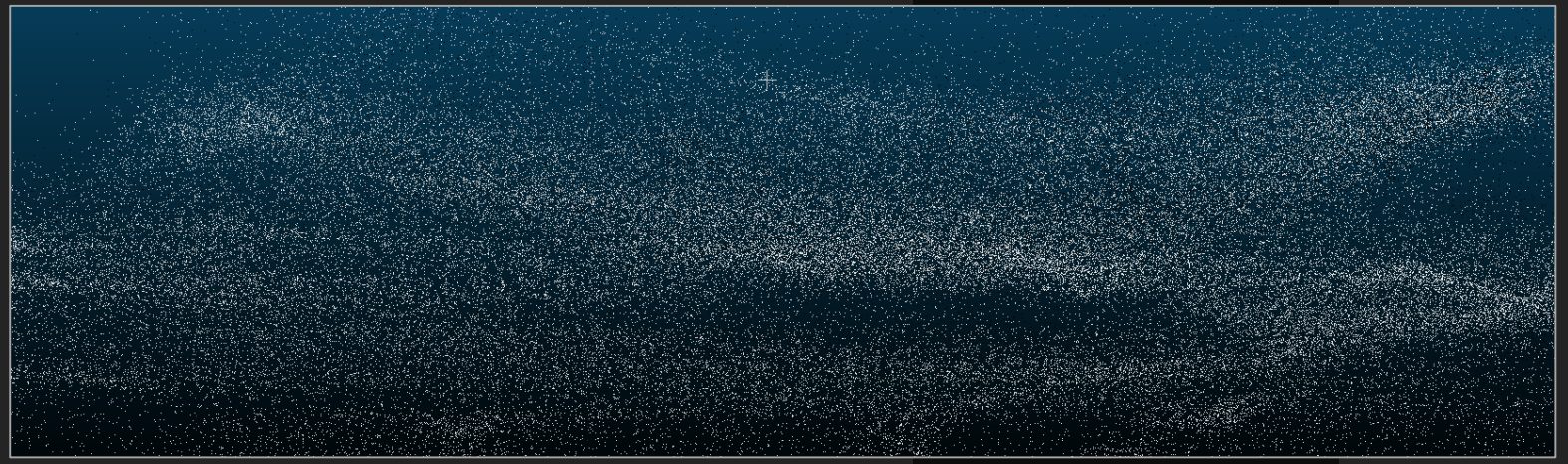
Process from iteration .4 was refined to minimise interference in form-finding process to ensure most structurally sound result.

PROCESS

3D SCANNING
- LIDAR (ZEBREVO)

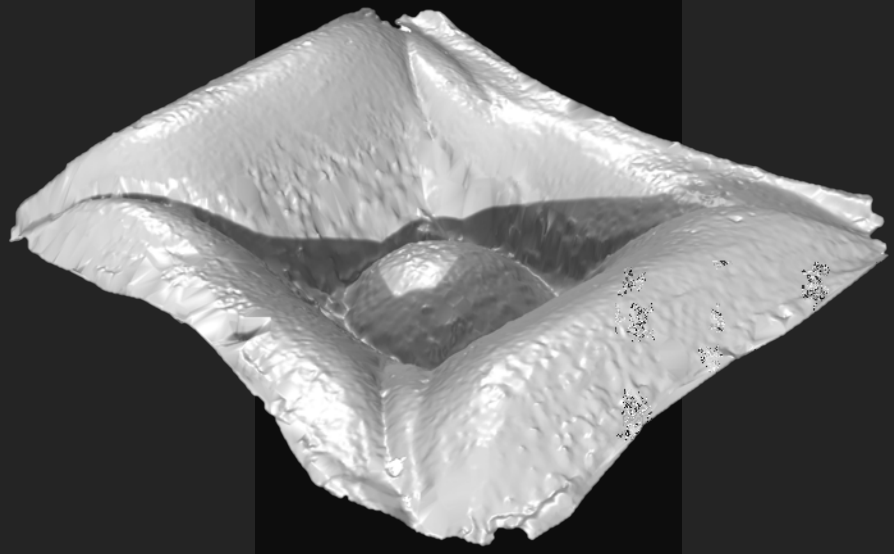
Lidar was the first form of 3D scanning tested to compare the digital and physical models.

* ZEB REVO 3D scanner

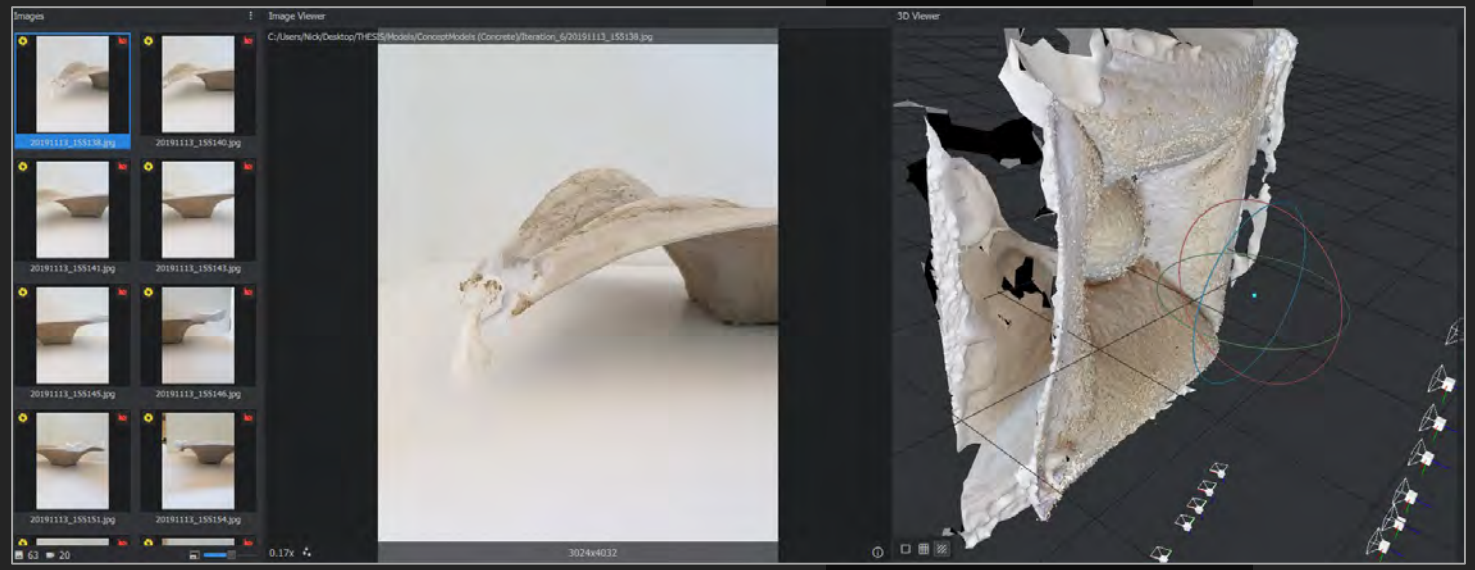


PROCESS

3D SCANNING
- PHOTOGRAMMETRY



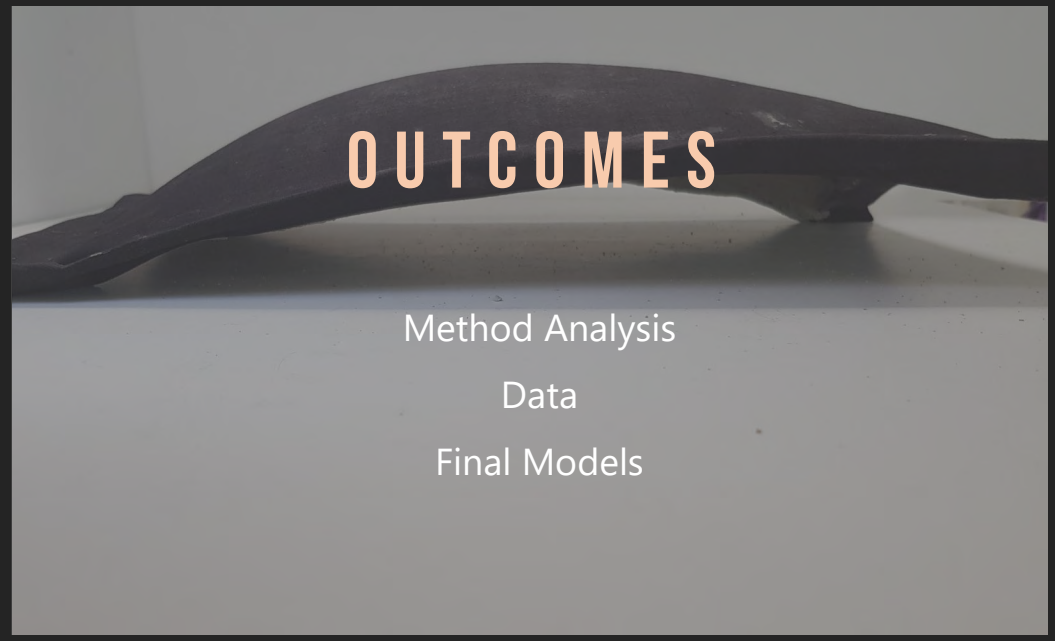
Preferred method of scanning for the results due to scale and size of objects.



PROCESS

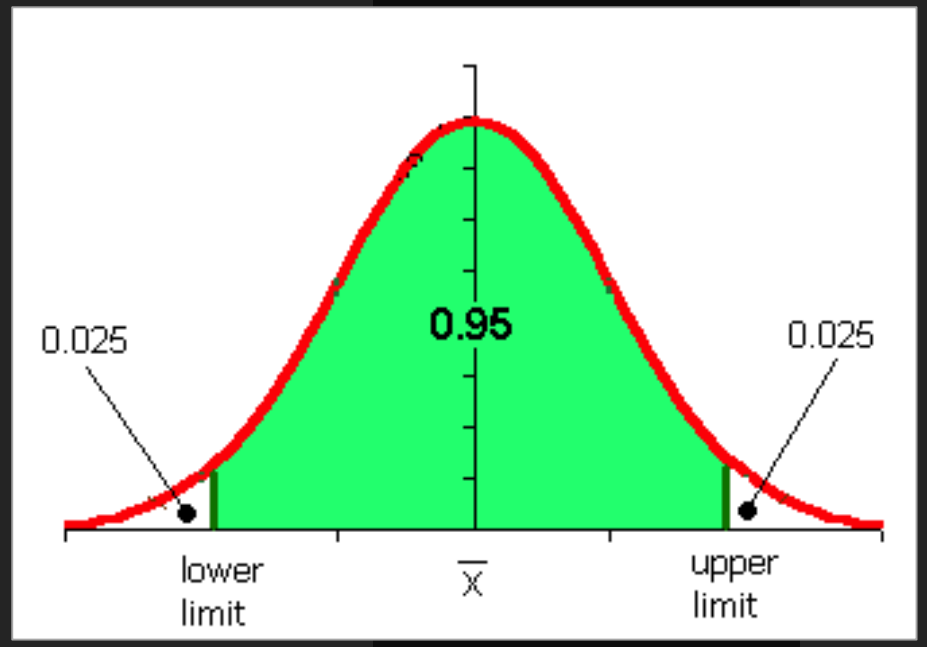
3D SCANNING - SPOT CHECK

Both methods were bench marked against direct measurements taken from the physical model as a form of validation.

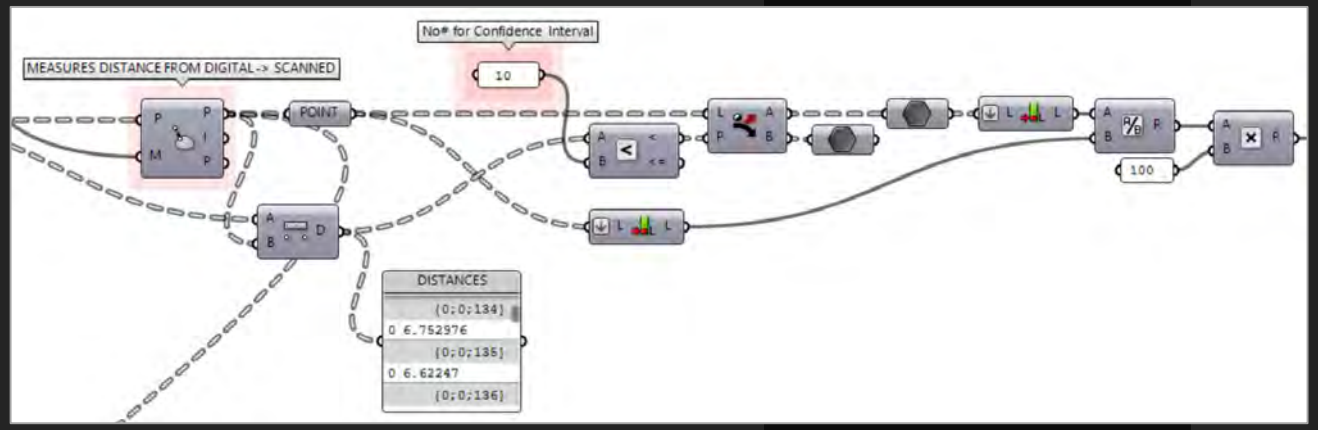

OUTCOMES
Method Analysis
Data
Final Models

OUTCOMES

METHOD ANALYSIS



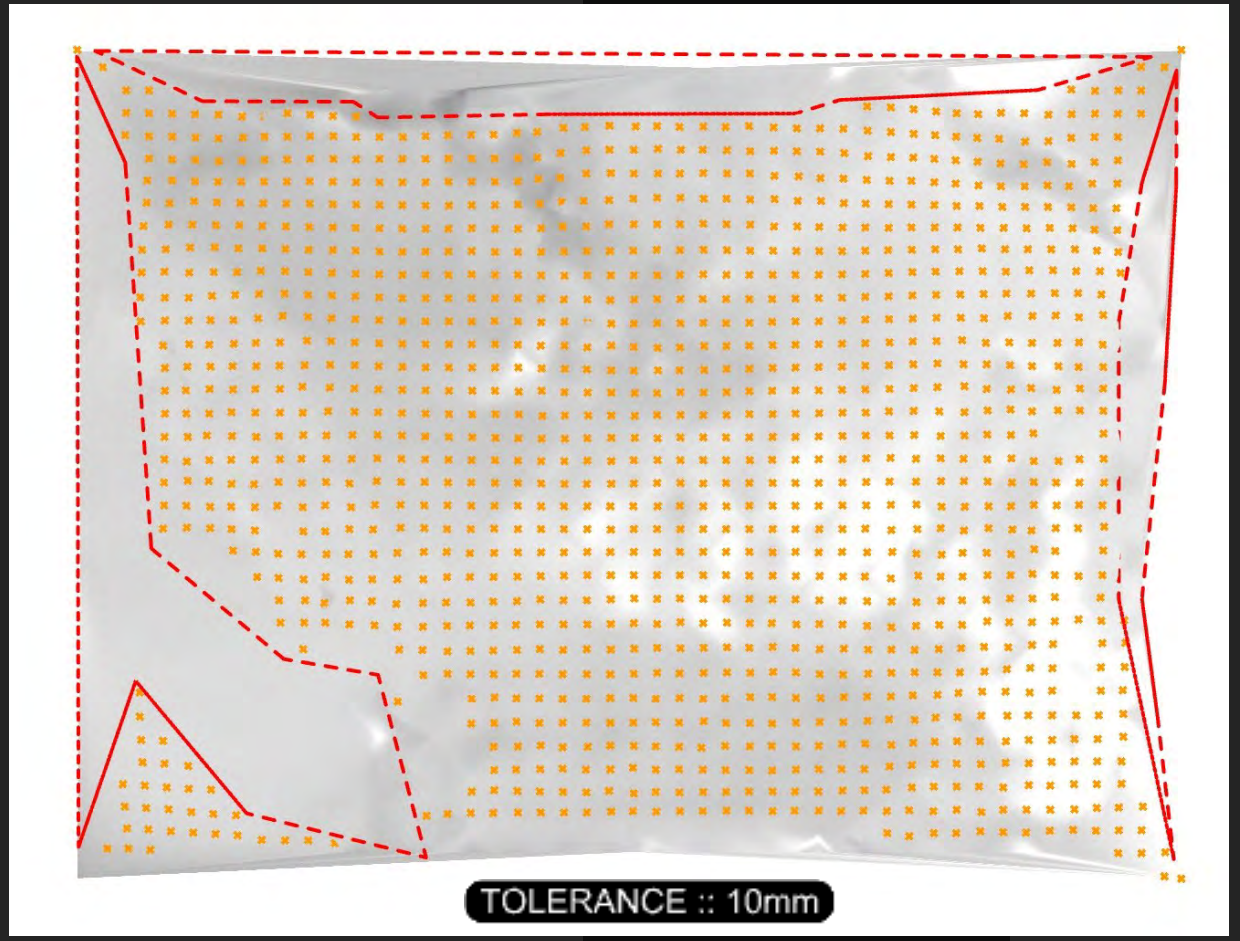
Several methods were explored however, the most accurate for this process was a confidence interval.



OUTCOMES

MODEL 1

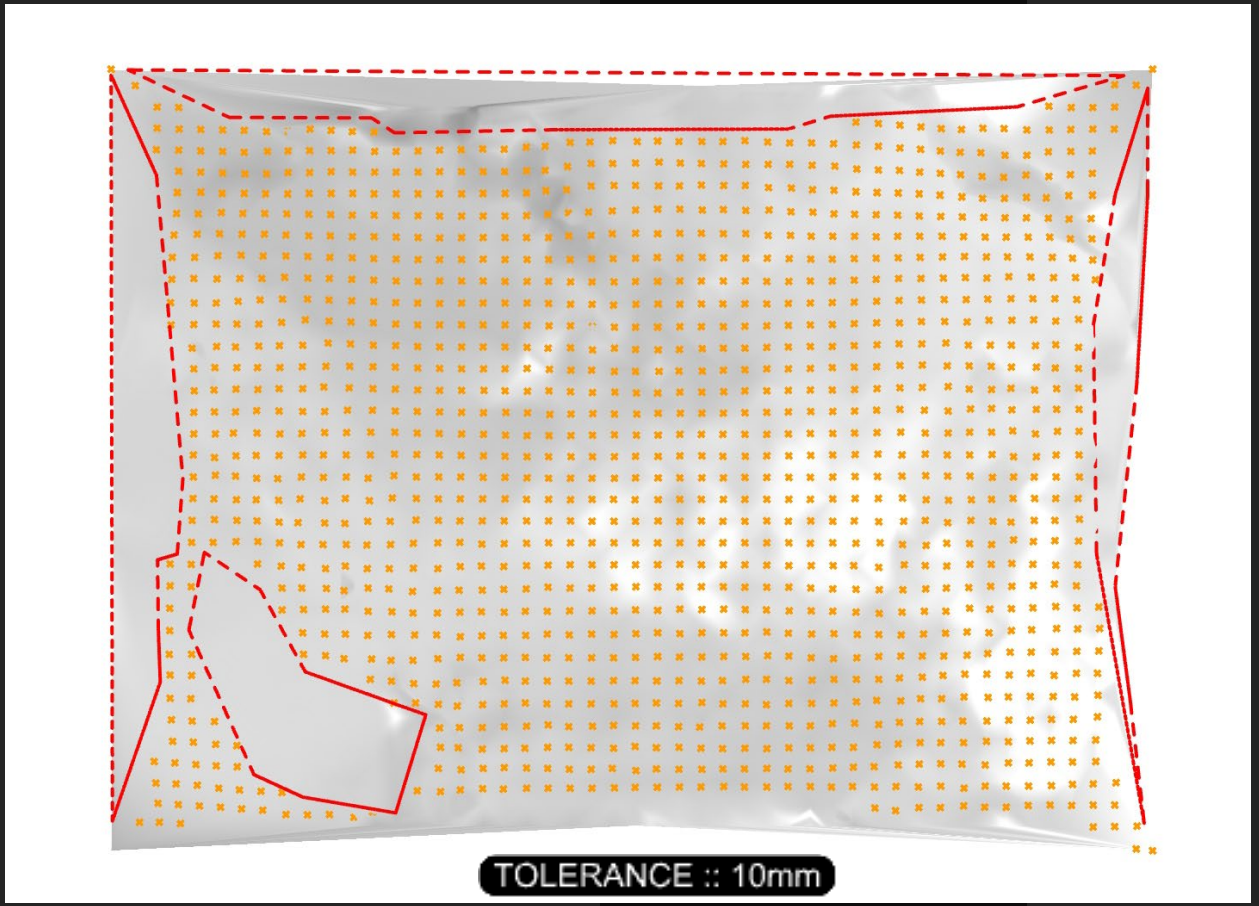
Outlined are areas of concern that were not within the designated tolerance.



OUTCOMES

MODEL 2

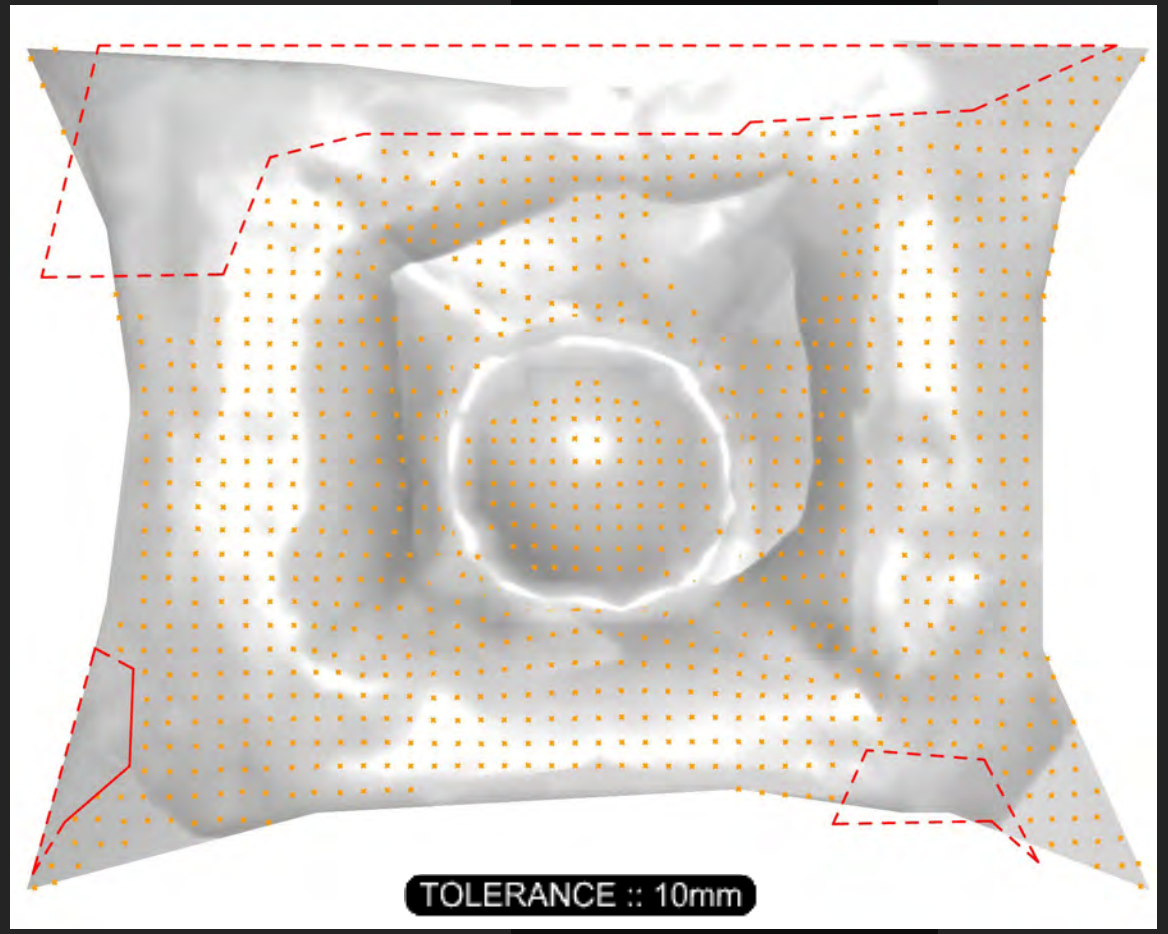
Outlined are areas of concern that were not within the designated tolerance.



OUTCOMES

MODEL 3

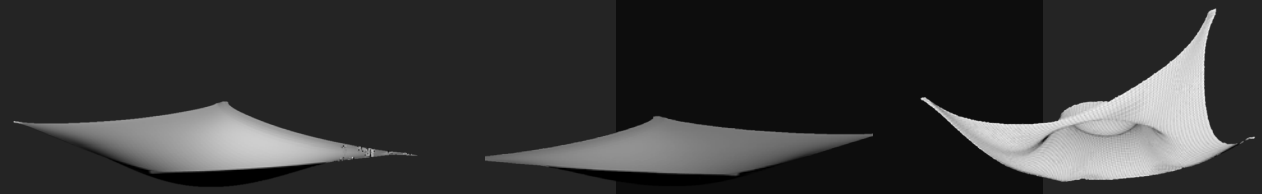
Outlined are areas of concern that were not within the designated tolerance.



OUTCOMES

DATA

Data extrapolated from the Confidence Interval procedure.



Tolerance for (planar) cross-sectional dimensions

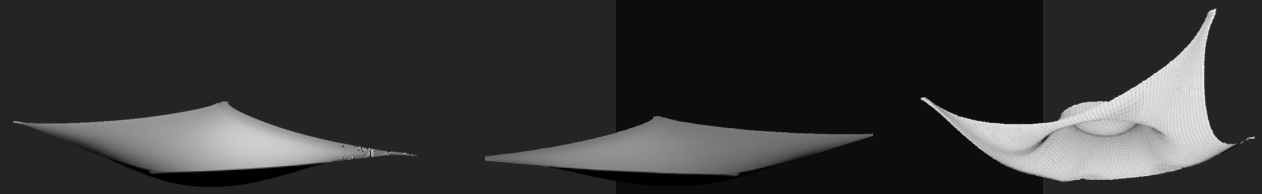
(+) 10mm : (-) 5mm

CONFIDENCE INTERVAL	MODEL 1 (%)	MODEL 2 (%)	MODEL 3 (%)
5mm	40	43	39
10mm	90	92	82
15mm	100	100	93
20mm	100	100	98

OUTCOMES

WHAT DOES THIS MEAN?

The data is a form of validation for this methods reliability.



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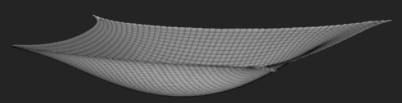
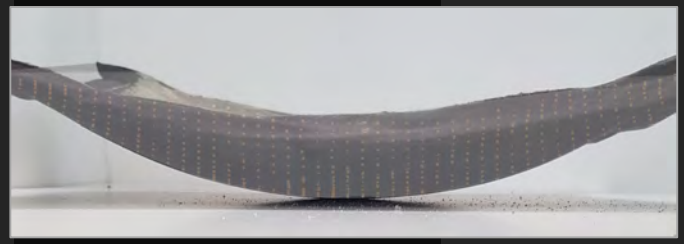
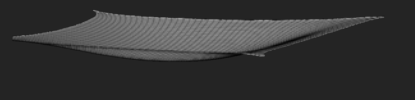
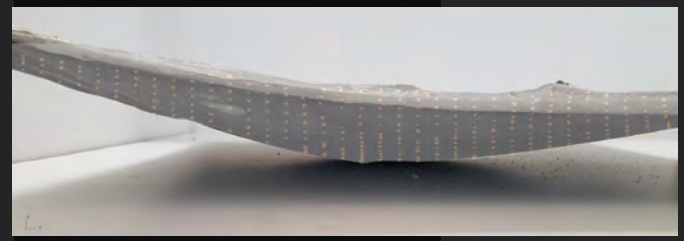
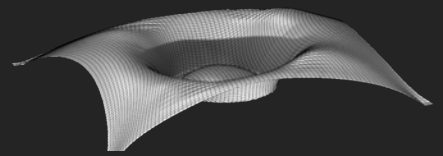
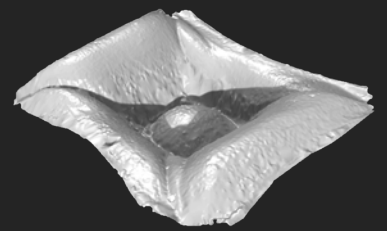
PRODUCT +

FINAL MODELS





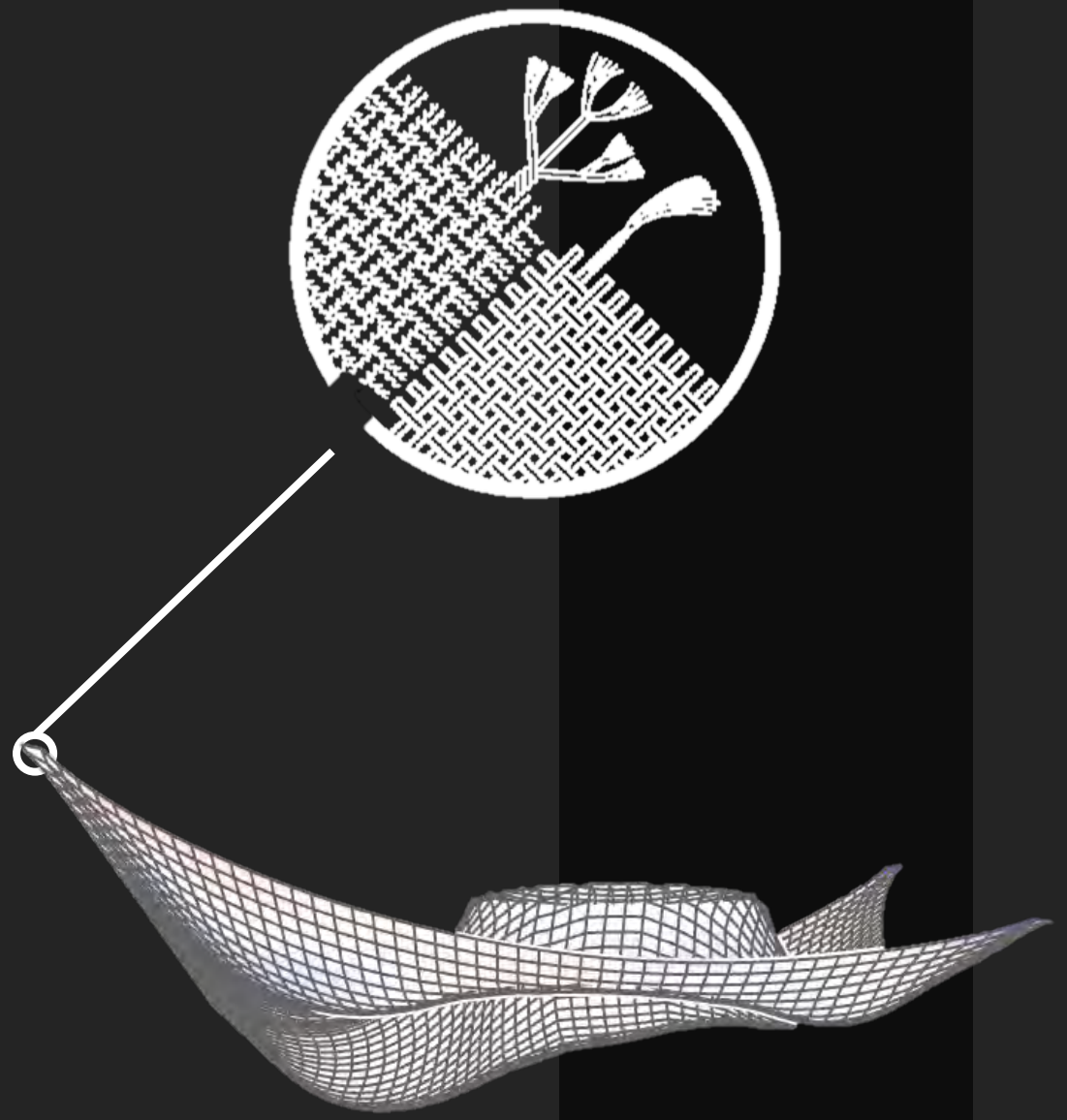


FUTURE
Material Studies
Structural Reinforcement

FUTURE +

MATERIAL RESEARCH

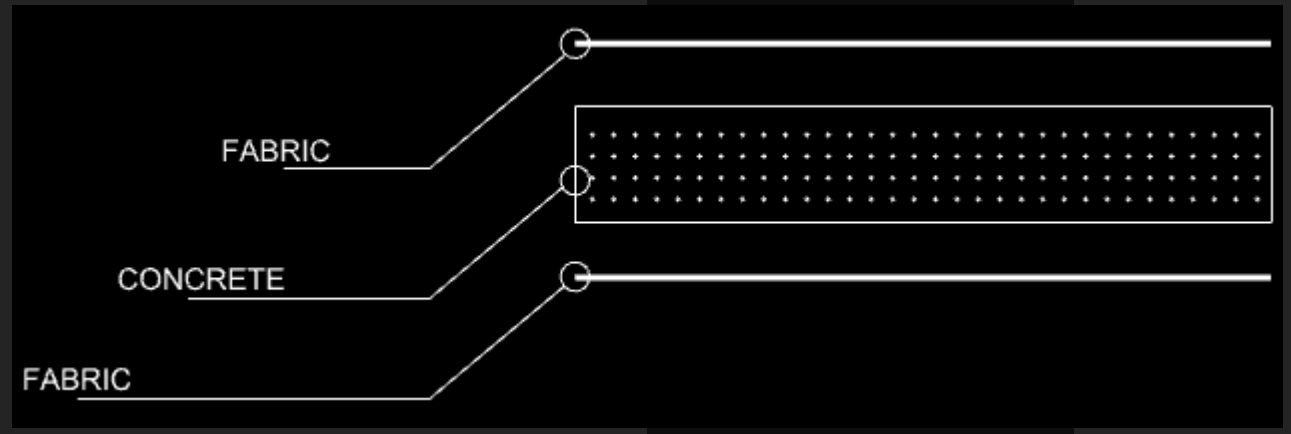
Exploring the impact of different weave counts, thread patterns and other fabrics.

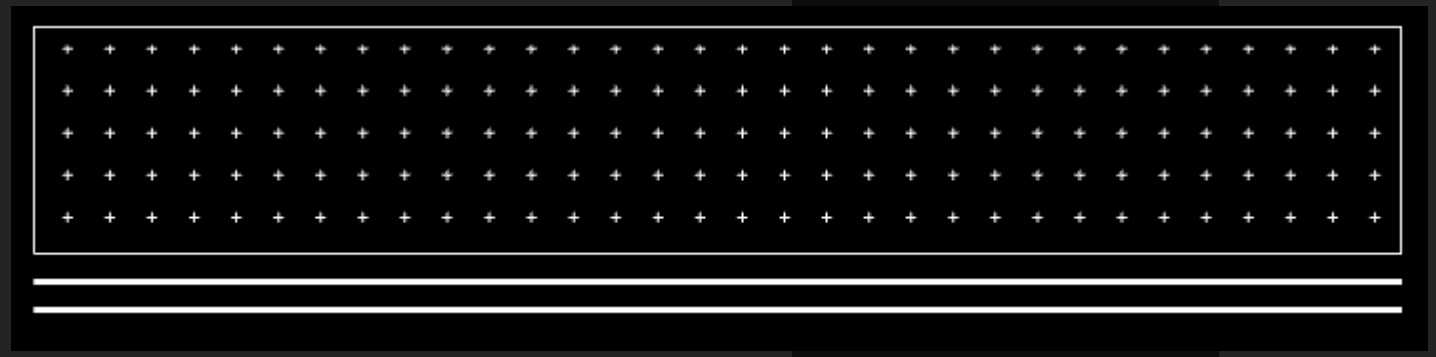


FUTURE +

STRUCTURAL REINFORCEMENT

Embedding fabric within the mixture during pouring process to reinforce the concrete instead of steel bars.





GRADUATION PROJECT

As. 3 : Design Documentation

Substance without form(work) : Exploring alternatives for constructing form-finding concrete formwork