Upward of Global Temperature Projects on Building 'Thermometer' Scales

Extinction Value:
With 95% of organisms extinct, the planet will face total catastrophe and ecological disaster in full swing.


Biological Extinction


Global Catastrophe

Hazard Value:
A 2 ℃ rise in temperature is a major "tipping point" for the planet, because if it does happen, it will mean that the global warming trend will be completely out of control and that there is no way back for mankind to change the temperature of the planet.


Natural Disasters


Starvation Crisis

Threshold Value:
The Paris Agreement, reached in 2015, sets out to strengthen the global response to the threat of climate change by limiting the increase in global average temperature to 2 degrees Celsius above pre-industrial levels and working towards limiting warming to 1.5 ℃.


COP21


Climate Finance

Current Value:
With global temperatures having risen by 1.2 ℃ all regions of the world are facing unprecedented changes in the climate system and adverse climate impacts are already more profound and extreme than expected.

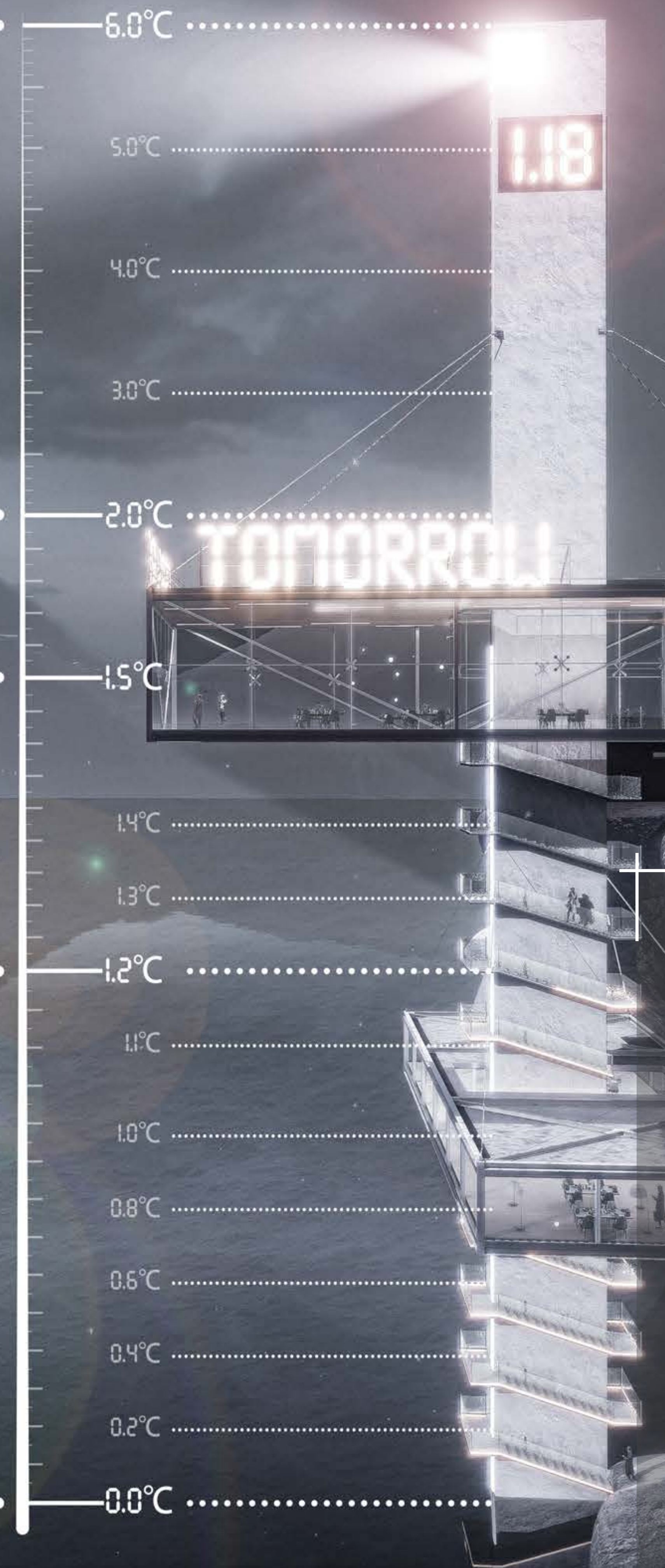

Coral Reef Bleaching


March for Environment

Based Value:
Global warming began 180 years ago, earlier than previously thought, and the warming of the planet has been linked from the beginning to the rising concentrations of greenhouse gases caused by the Industrial Revolution, Nature notes.


The Industrialisation Period


Watt Steam Engine



2 m Sea level rise

Ice cap reduce 13 %

1 ℃ 30 % Animal extinct

Coral reefs reduced 70 %

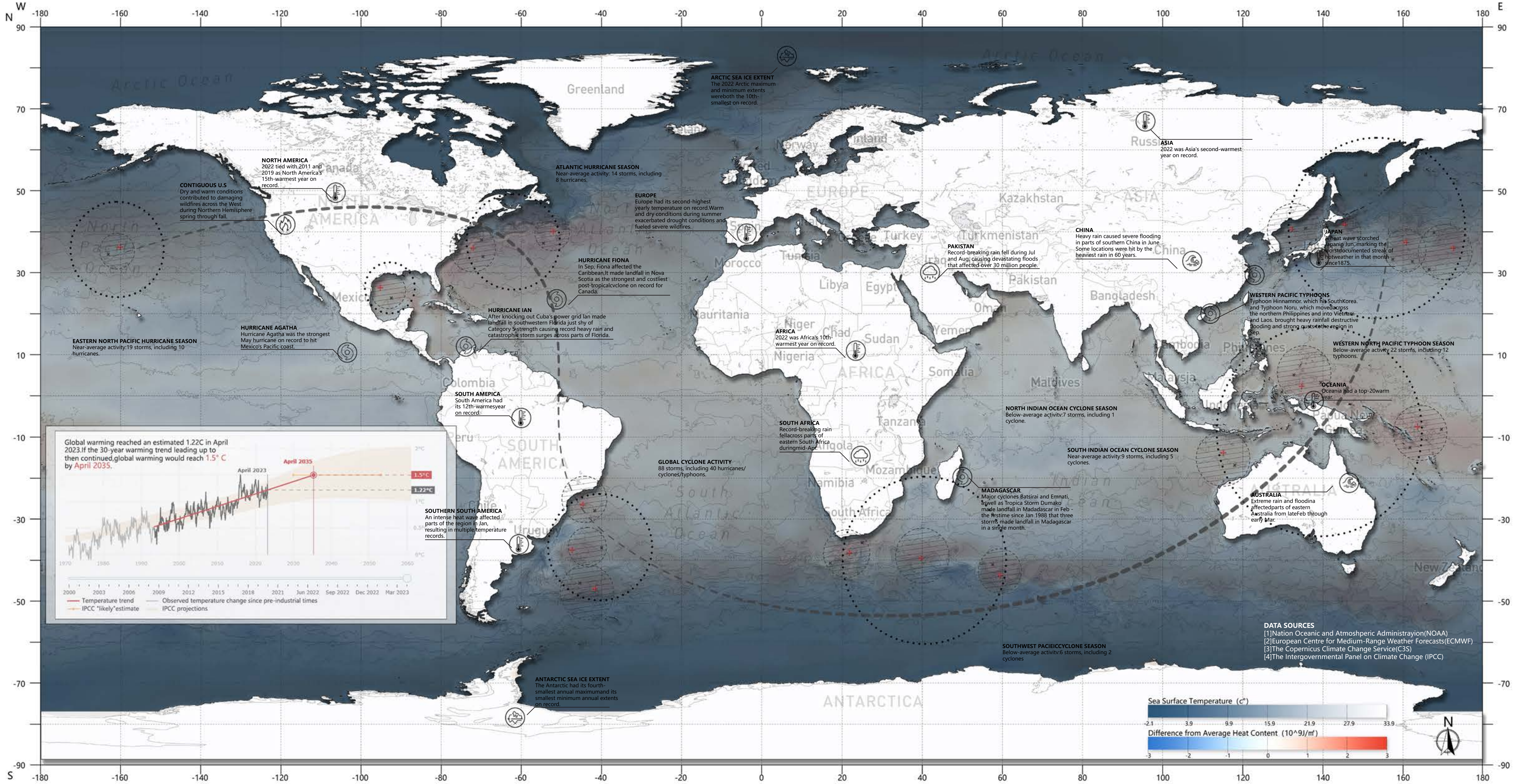
MEASURE TOMORROW

LOCATION: Great Barrier Reef, Australia
TYPE: Exploring Architectural Structures and Materials
Area: 2887 ㎡

Currently, global temperatures are already about 1.2 ° C above pre-industrial levels. The last four decades have been warmer than any decade since 1850. A 1.0 degree warming means that more extreme weather will occur more frequently and extreme weather will be more severe or last longer. The planet has reached a moment of extreme crisis!

In order to visualize the temperature in a more tangible way, I chose to design a "thermometer" that would measure the global temperature and reflect the sea surface temperature. This project attempt to strengthen the building by utilizing shellcrete, an eco-friendly material produced from the sea, and optimizing the building's form and structure through scan&solve and karamba softwares, which reduces our reliance on non-renewable resources and the ationalization of the realization structure. By visually displaying thermometer data, we hope to raise awareness and encourage individuals to take more responsibility for their impact on the environment, helping to drive positive change towards a more sustainable future.

MAP OF SEA SURFACE TEMPERATURE CHANGE IN A GLOBAL CONTEXT IN 2022



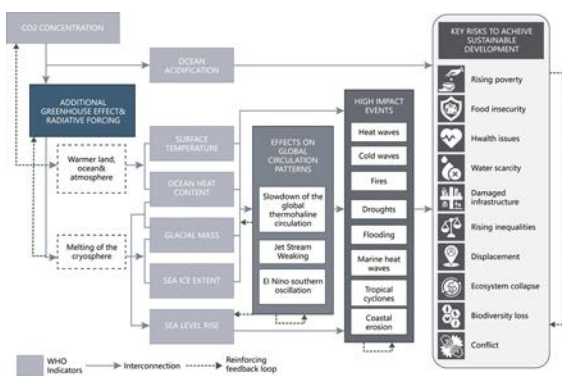
SST DEFINITION

Sea surface temperature (**SST**) **is the temperature of the sea between 1 mm (0.04 in) and 20 m (70 ft) below the sea surface**, which is **essential for** understanding and modelling **global climate**.

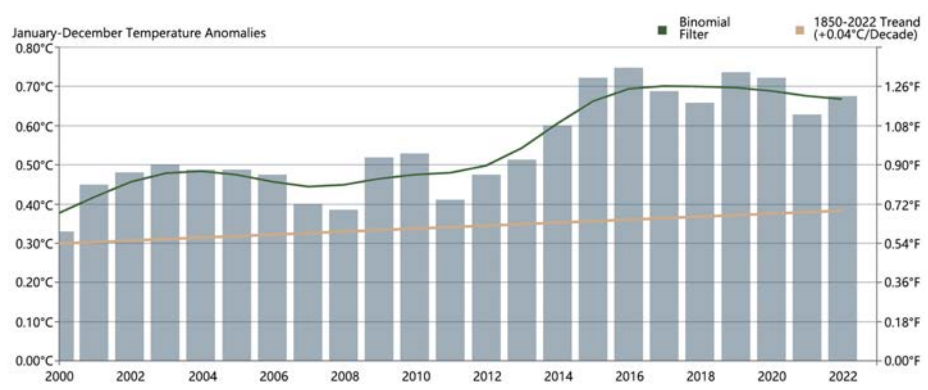
GLOBAL TEMPERATURE DEFINITION

Global temperature is calculated by **averaging the temperature at the surface of the sea and air temperature over land**. It provides valuable information to make informed decisions and take necessary actions to address **climate-related challenges**.

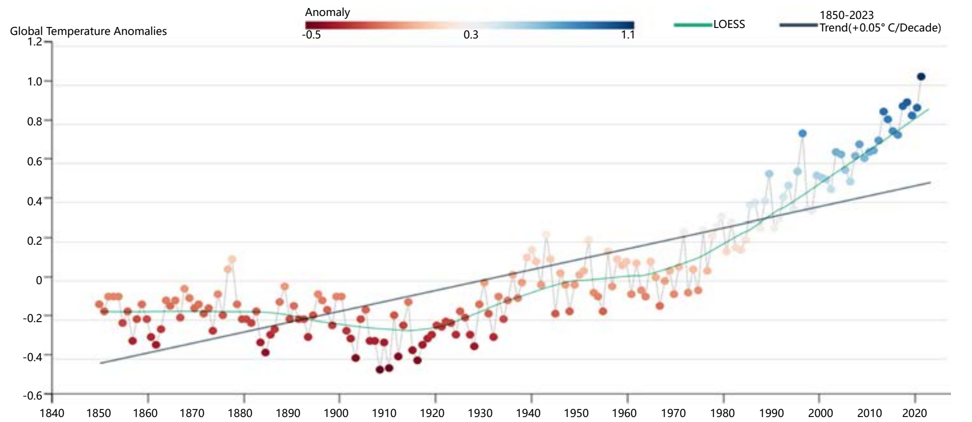
STRUCTURE OF THE ISSUE



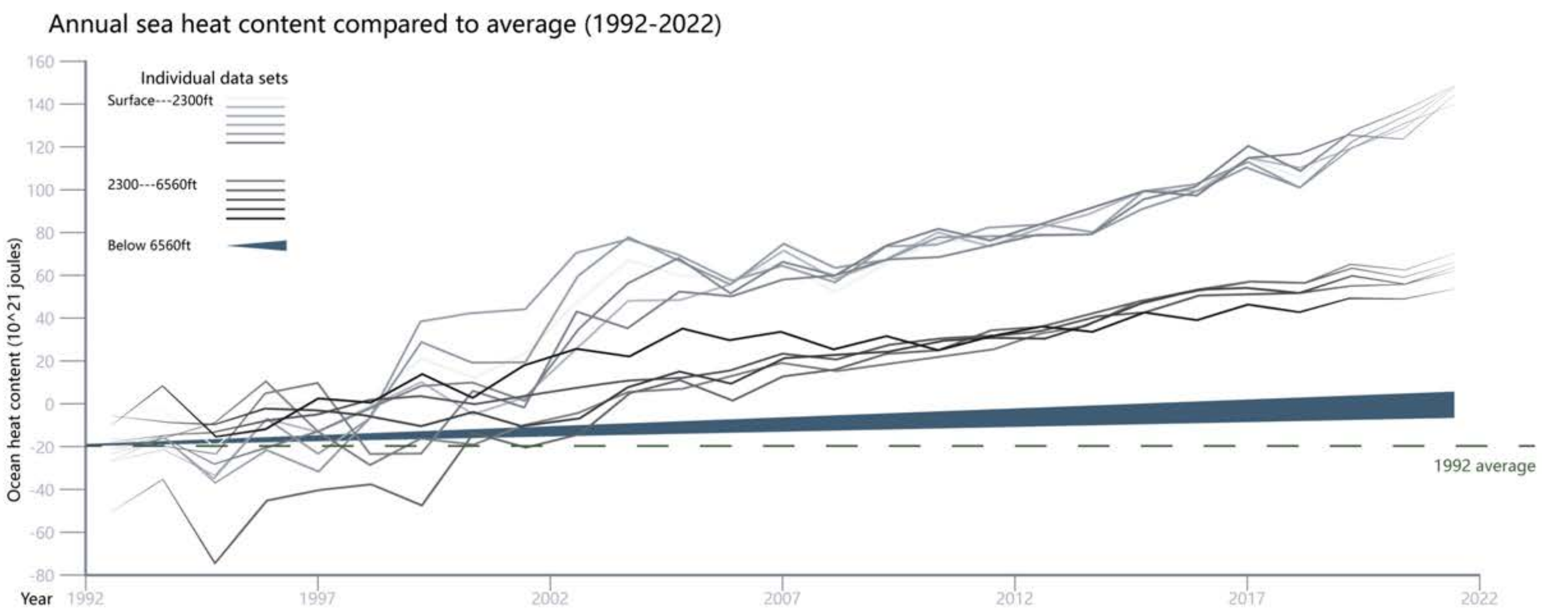
SST ANOMALIES TRENDS IN THE 21ST CENTURY



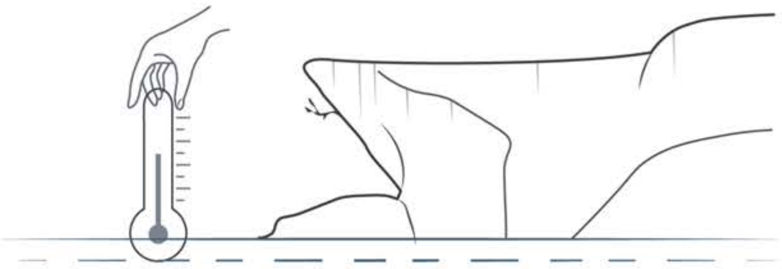
GLOBAL TEMPERATURE ANOMALIES



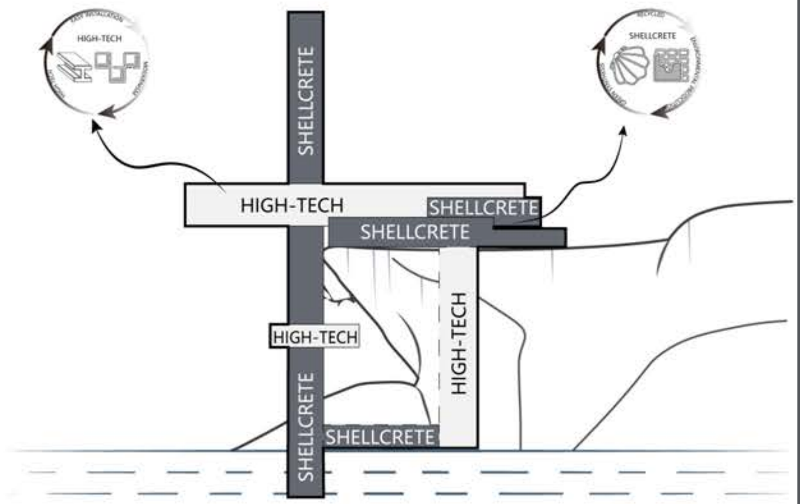
DESIGN CONCEPT



Since the onset of the 21st century, **the SST have been steadily rising** as a consequence of exacerbated issues like the greenhouse effect, heralding a multitude of detrimental consequences.

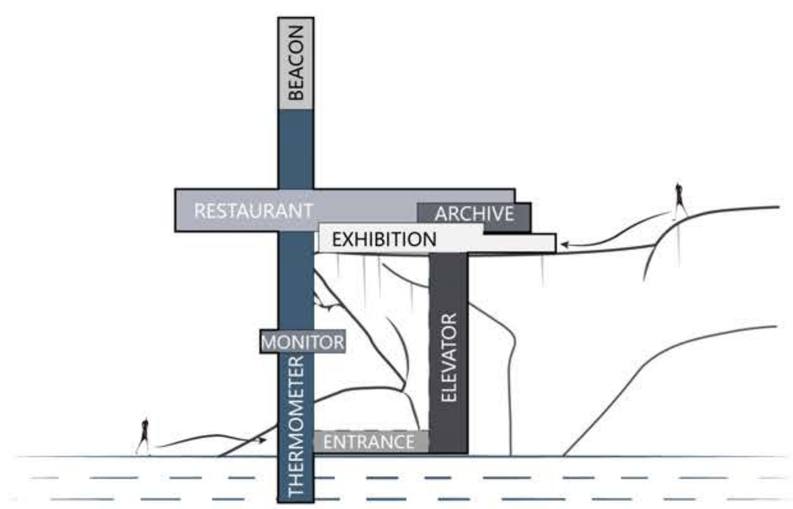


There is a idea of **a building that is capable of** actively and accurately **monitoring the dynamic Temperature**, resembling a **thermometer** ,thereby providing crucial real-time data for scientific research and environmental analysis.

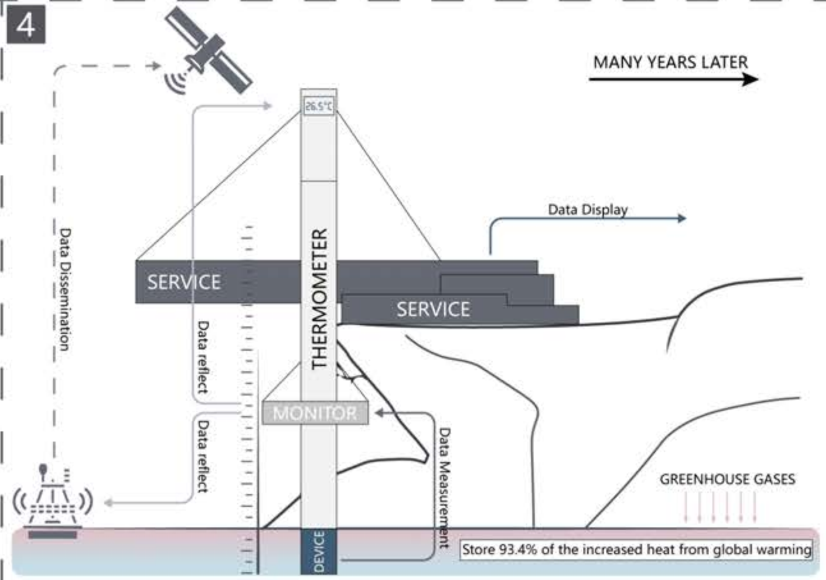


To mitigate the environmental impact associated with building construction, a eco-friendly material---**shellcrete** was incorporated into the structure, utilizing shells as its primary raw material, which can be responsibly sourced from the sea.

1 2
3 4

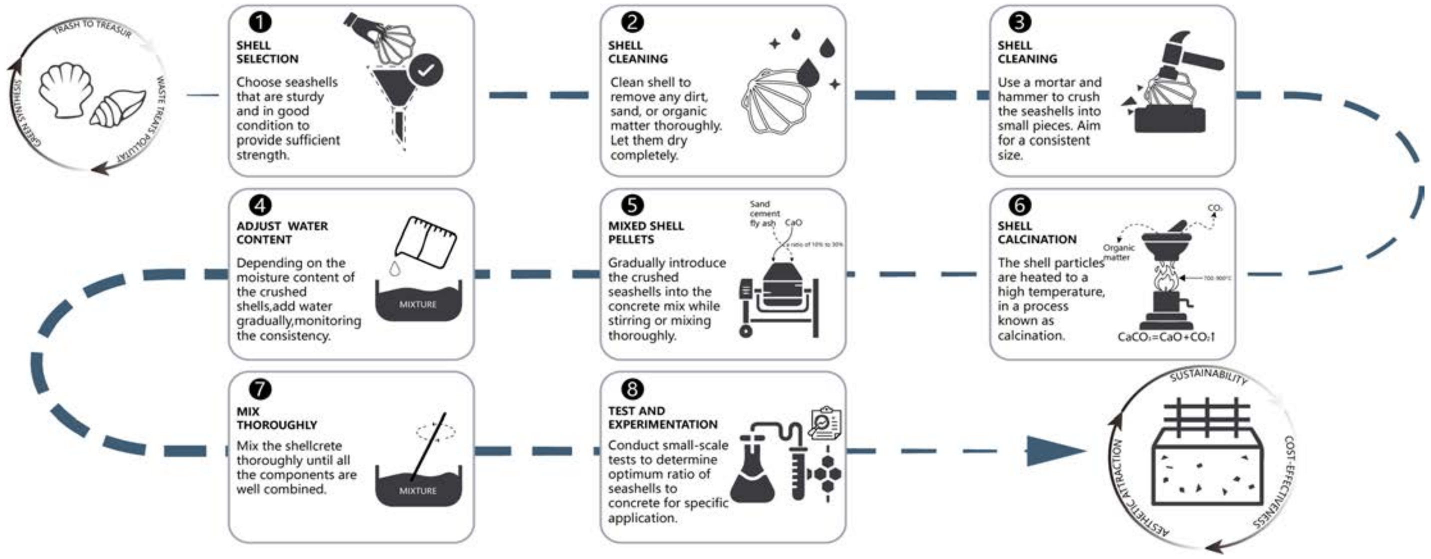


After establishing a building that serves as a functional equivalent to a thermometer for presenting the temperature, a range of **complementary complexes** are incorporated on the top of the cliff.



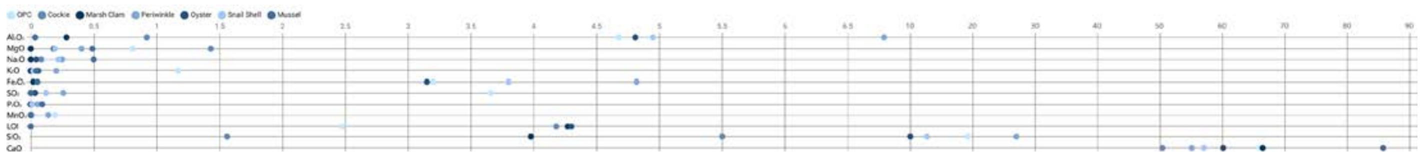
Many years later, the building constructed with seashell cement could serve a dual purpose:**measurement** tool to assess the response to **SST** and **Global Temperature** over the years, and to **display** and **disseminate** this data.

SHELLCONCRETE PRODUCTION METHOD



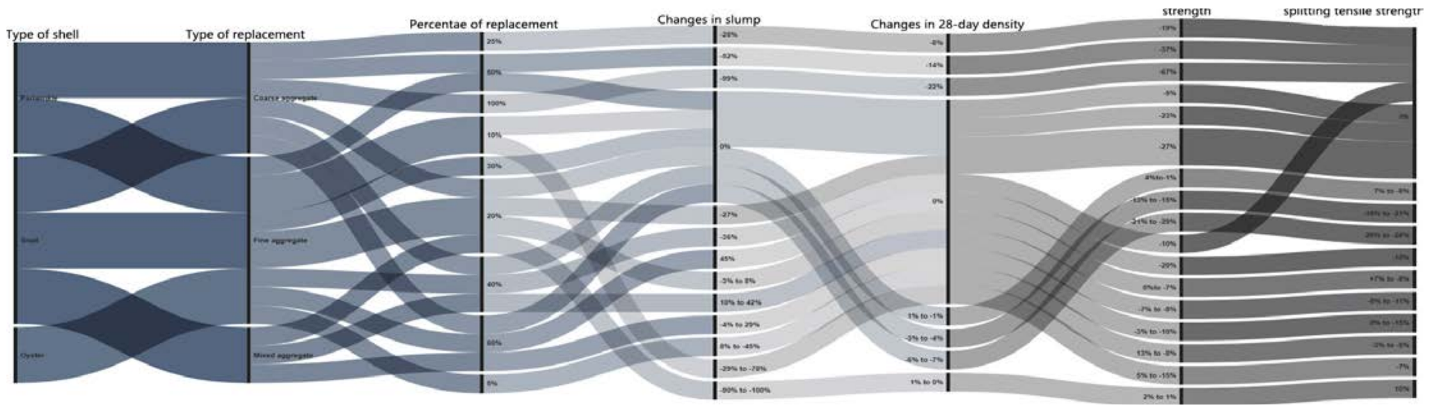
RESEARCH ON SHELLCONCRETE

SHELL ASH POWDER CHEMICAL



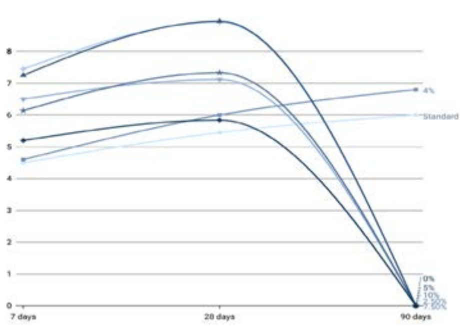
The results show that **periwinkle (PSA), oyster(OS), and snail shells (SSA)** have **high percentages of CaO and SiO2**. The amount of Sulphur trioxide (SO3) present in each of the shell ashes lies within the optimum acceptable or recommended range of not more than 3.0%. The relatively high percentage of silica present in PSA, OS and SSA suggests their propensity to be pozzolanic and could also be a potential material for supplementary cementitious materials or a good precursor for synthesis of alkaline activated binder or geo-polymer if doped with alumina.

COMPARISON OF MECHANICAL AND PHYSICAL PROPERTIES

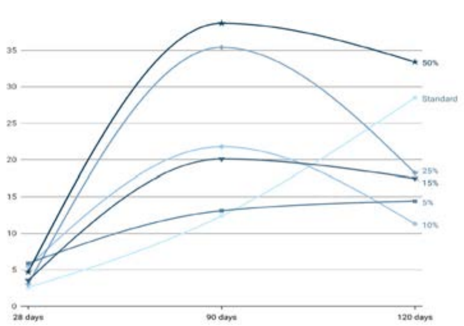


Comparing the **mechanical and physical properties**,**periwinkle (PSA)** appeared to be the **best types** for producing shell ash, among the various types of seashells.

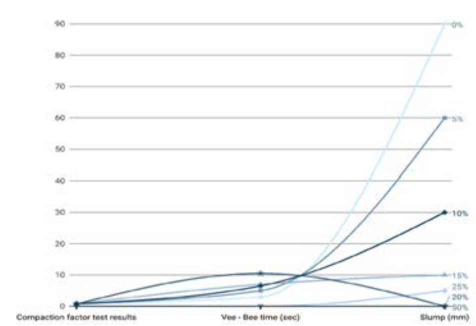
THE FLEXURAL STRENGTH VALUES(MPA)



WATER PERMEABILITY(10^-11 M/S)



COMPRESSIVE STRENGTH(N/MM²)



Although **the compressive strength is lowered** by using seashells as cement replacement, concrete made with inclusion of shell ash still have **acceptable strengths** for various structural. The optimum substitution level of cement with seashell ash was found to be **5-10%**. Using seashell cement clearly **enhances the splitting tensile and exural strengths of concrete** by enhancing the bond at the cement paste interface.

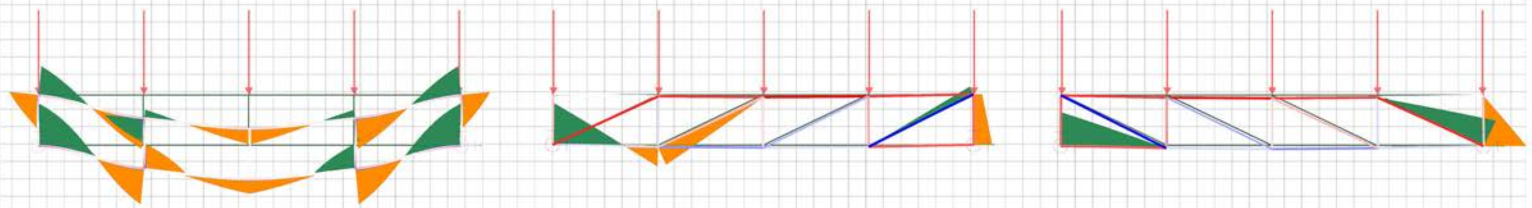
LITERATURE REFERENCES

[1]Bassam A. Tayeh, Properties of seashell aggregate concrete(2019)
[2]Bassam A. Tayeh Mohammed W. Hasaniyah, Properties of concrete containing recycled seashells as cement partial replacement(2018)

DERIVATION AND OPTIMISATION OF BUILDING STRUCTURES

STRUCTURE SELECTION

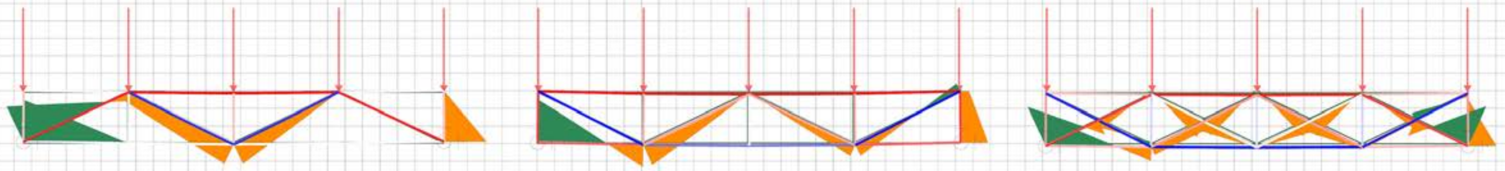
Material: Steel S235
Cross Section: □-Section Height: 30cm, Width: 30cm
Load: Point Loads10kN, Gravity



S1: Without internal diagonal brace
Max Displacement: 1.92cm

S2: /-shaped internal diagonal brace
Max Displacement: 0.42cm

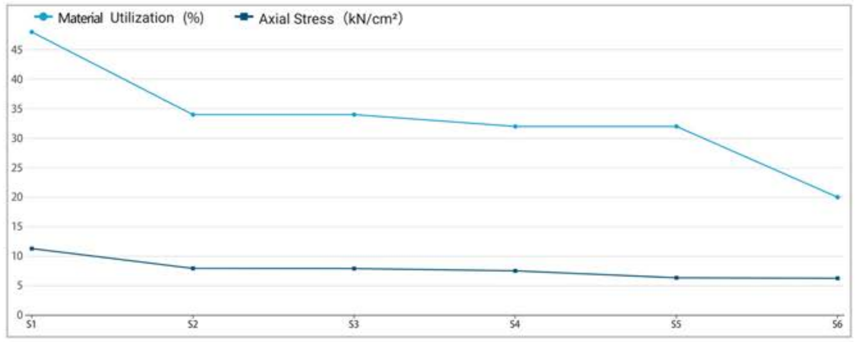
S3: \-shaped internal diagonal brace
Max Displacement: 0.42cm



S4: A-shaped internal diagonal brace
Max Displacement: 0.38cm

S5: V-shaped internal diagonal brace
Max Displacement: 0.35cm

S6: X-shaped internal diagonal brace
Max Displacement: 0.23cm

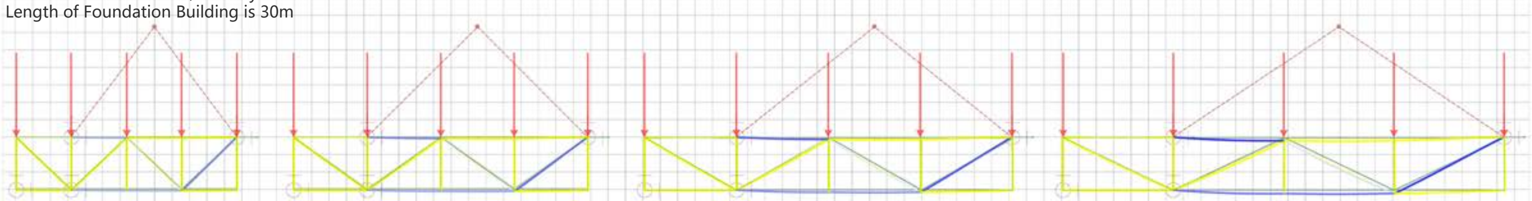


CONCLUSION

Controlling the variables, only the structural form of the truss diagonal brace was changed, given the same load, cross section and material, and their deformation results and material utilization were observed.
The graphs and deformation results show that the **V-shaped** internal diagonal brace structure achieves the **best utilization and the best structural strength** while ensuring the **minimisation of axial stress and max displacement**.

CANTILEVER DISTANCE

Material: Steel S235
Cross Section: H-Section Height: 30cm, Width: 30cm, Thickness: 1cm
Load: Point Loads50kN, Gravity
Length of Foundation Building is 30m

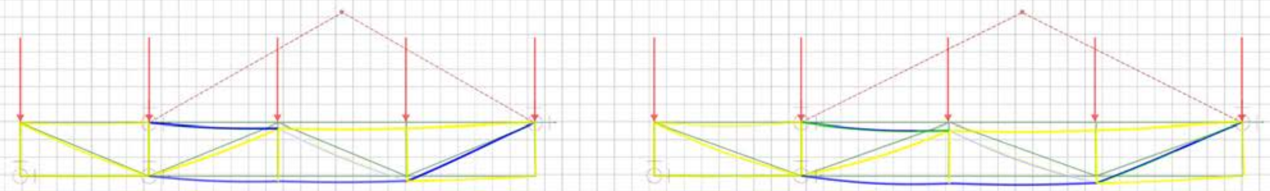


Cantilever Distance: 0m
Max Displacement: 1.69cm

Cantilever Distance: 10m
Max Displacement: 3.13cm

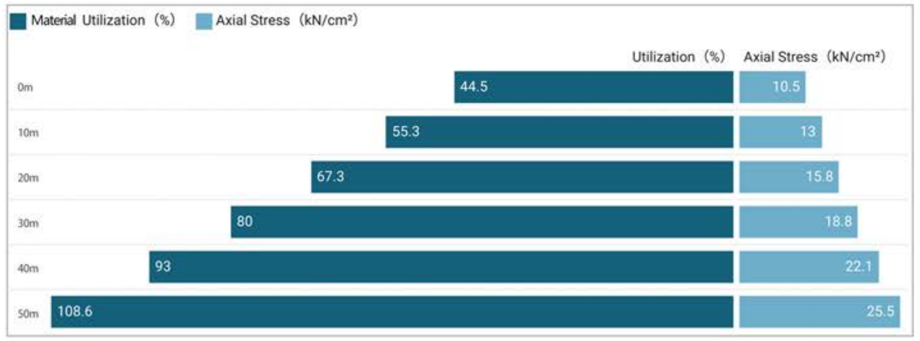
Cantilever Distance: 20m
Max Displacement: 5.72cm

Cantilever Distance: 30m
Max Displacement: 9.72cm



Cantilever Distance: 40m
Max Displacement: 15.5cm

Cantilever Distance: 50m
Max Displacement: 23.6cm

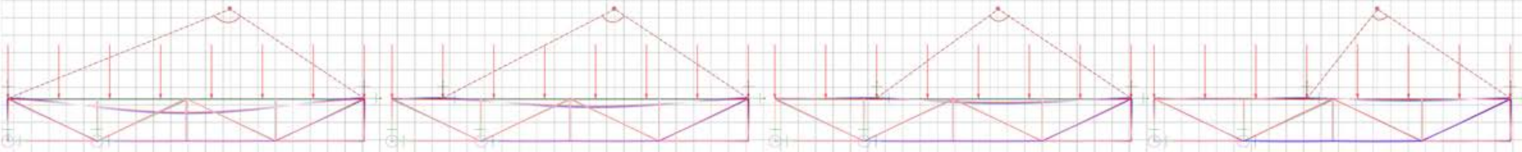


CONCLUSION

In order to investigate **the length of the building's cantilever distance**, a comparison was made between the **absolute values** of the five different cantilever distance's max length displacements and the set **displacement thresholds**, in order to obtain the optimum **cantilever distance of 30m**, which not only results in a larger cantilever distance, but also ensures the stability of the structure and the utilization of materials.

SLING ANGLE

Material: Steel S235
Cross Section: H-Section Height: 30cm, Width: 30cm, Thickness: 1cm
Load: Point Loads50kN, Gravity

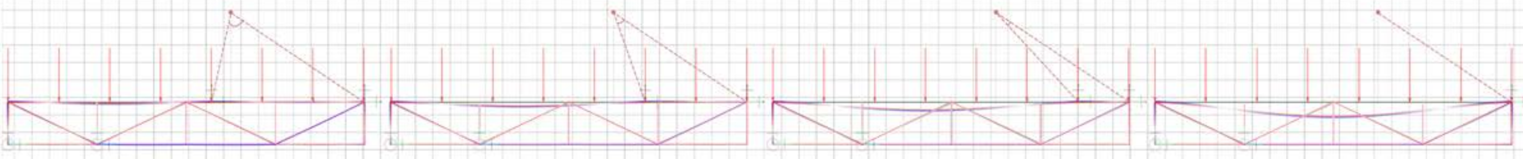


Joint at 0 / 7 of the length
Max Displacement: 12.2cm

Joint at 1 / 7 of the length
Max Displacement: 7.09cm

Joint at 2 / 7 of the length
Max Displacement: 3.79cm

Joint at 3 / 7 of the length
Max Displacement: 1.53cm

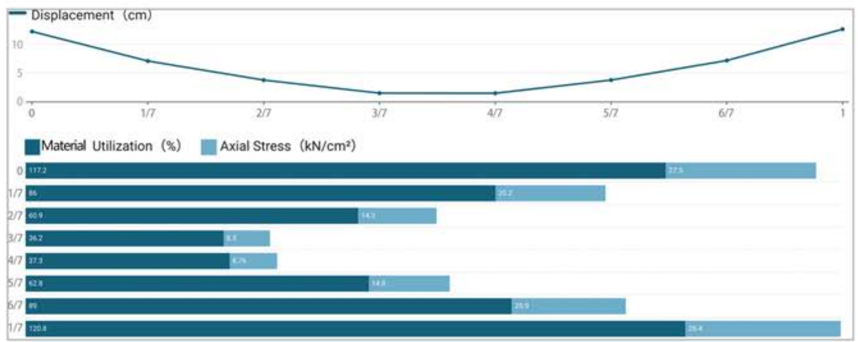


Joint at 4 / 7 of the length
Max Displacement: 1.51cm

Joint at 5 / 7 of the length
Max Displacement: 3.79cm

Joint at 6 / 7 of the length
Max Displacement: 7.18cm

Joint at 7 / 7 of the length
Max Displacement: 12.6cm

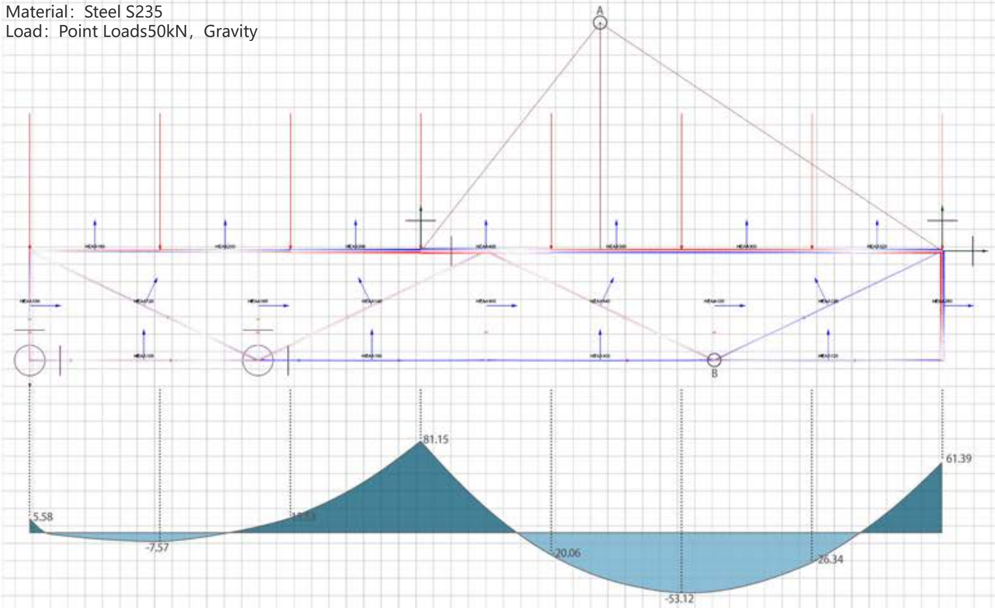


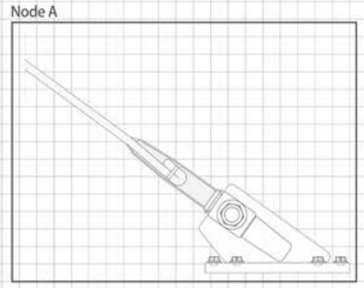
CONCLUSION

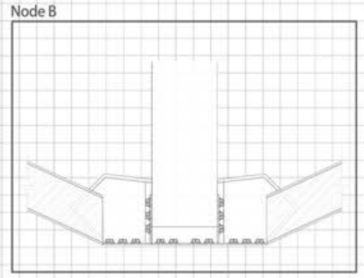
The building projections is to ensure that they are structurally fixed by slings. Therefore, it is necessary to study the optimum angle between the slings, while **keeping one section of the slings fixed**, through another fixing point, by axial stress, displacement and utilization, to find the optimum fixing point **between 3/7 and 4/7** of the building length. This will help to achieve the best balance between stability, aesthetics and cost-effectiveness of the building projections.

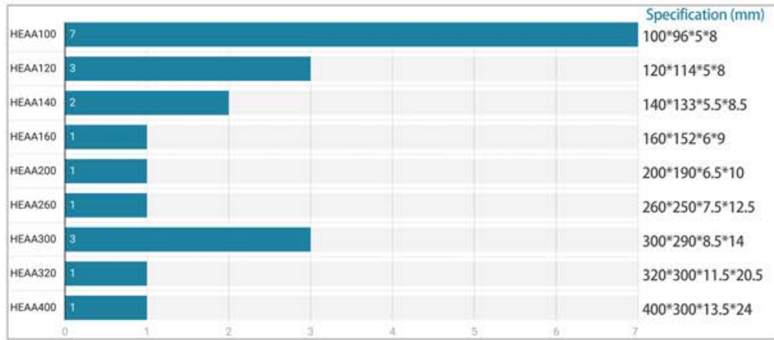
CROSS SECTION

Material: Steel S235
Load: Point Loads50kN, Gravity





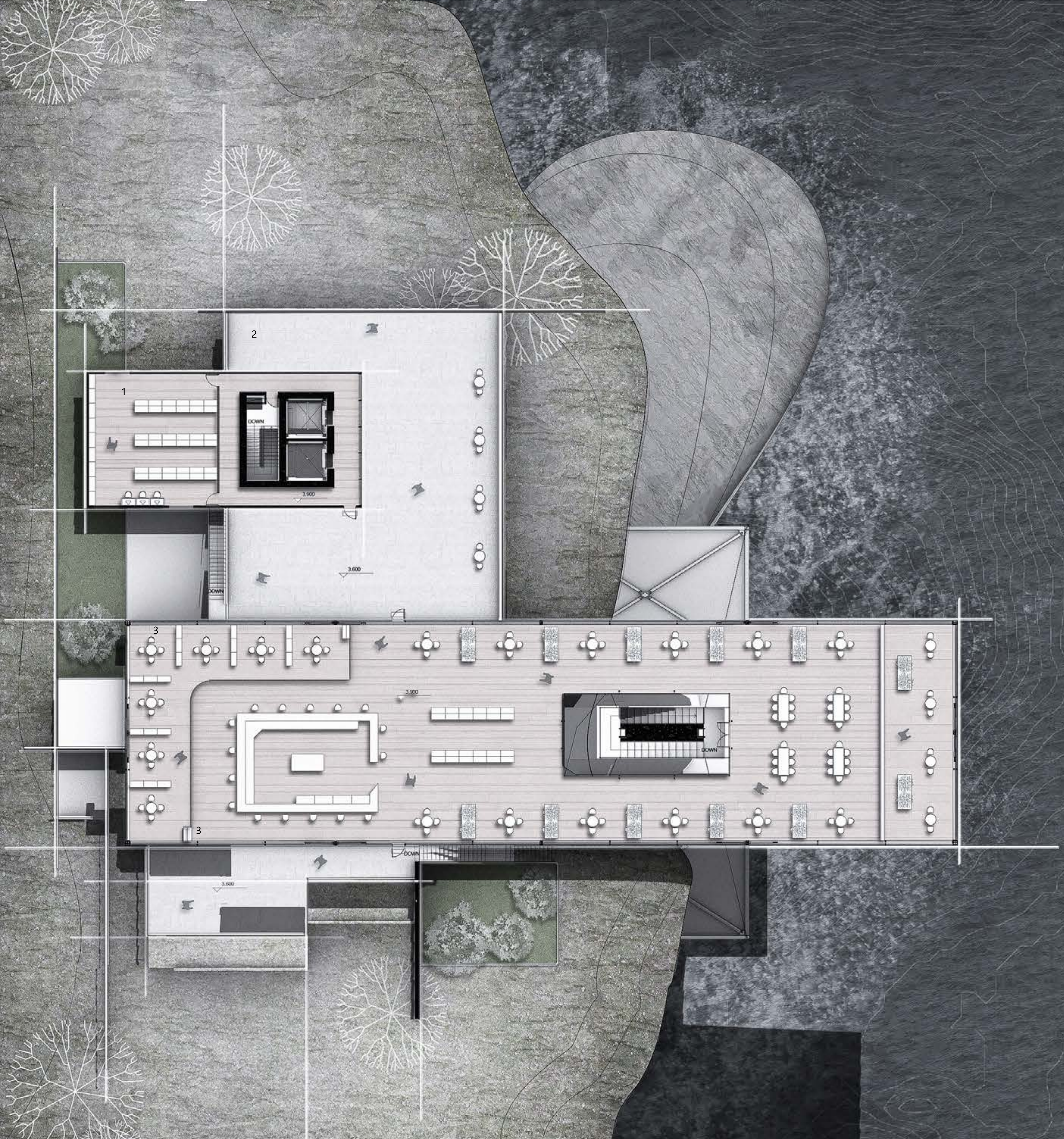




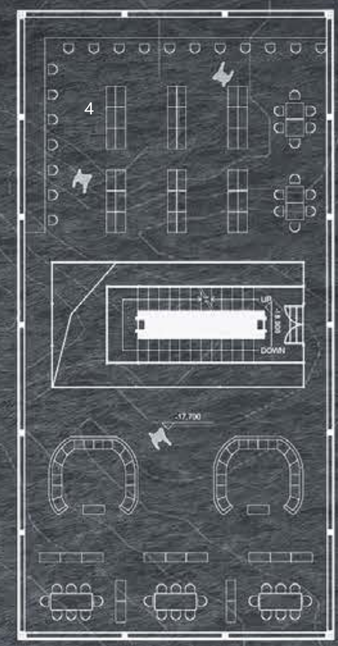
CONCLUSION

Based on the determination of the form and structural selection, the most suitable cross-sectional dimensions for each part of the H-steel are obtained and its bending moment diagram is generated by means of a **genetic algorithm**.
By means of the **karamba algorithm**, the entire building design is structurally optimized to obtain **the most reasonable and suitable building structure**. This process ensures that the building design achieves the optimal balance between aesthetics and functionality.

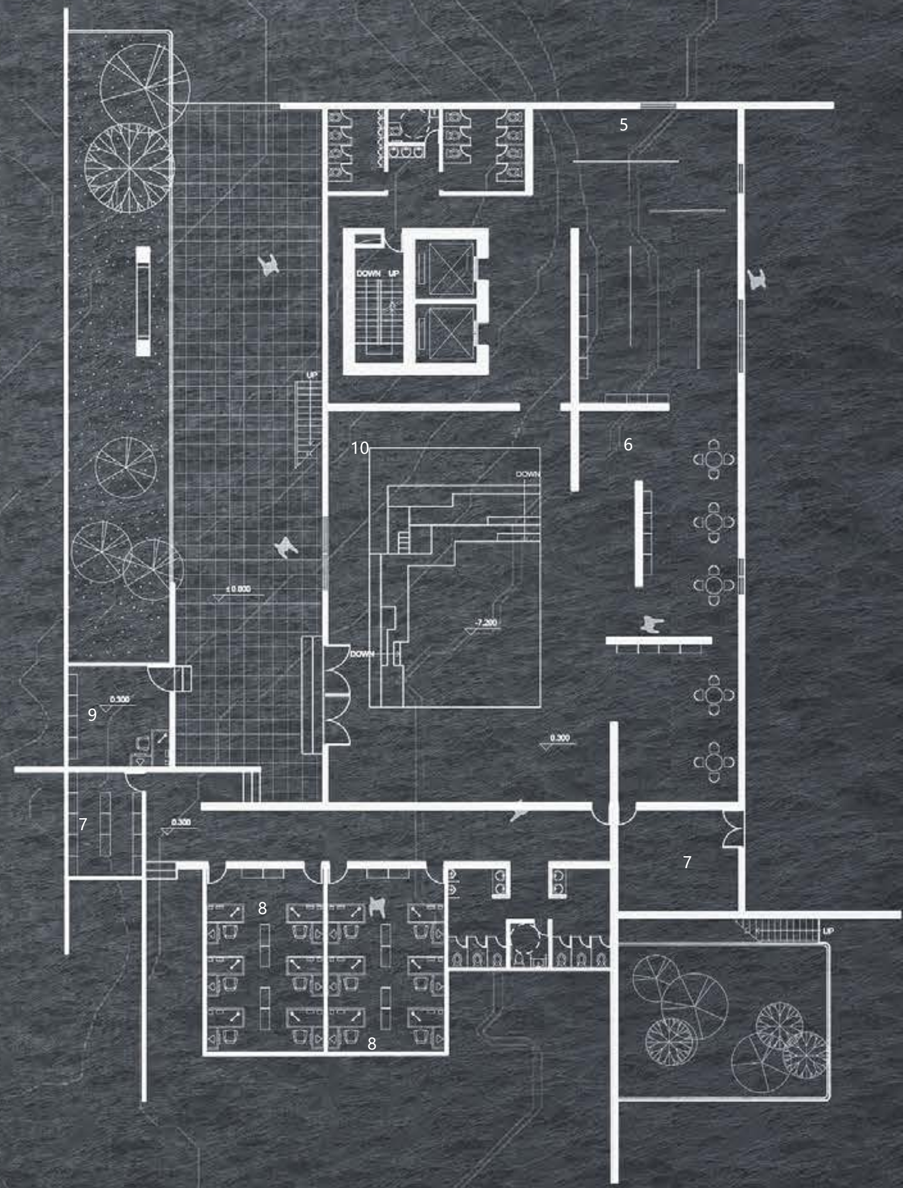
2 FLOOR PLAN 1：400



-1 FLOOR PLAN 1：450



1 FLOOR PLAN 1：450



Space Name Search

1、Archive
2、Outdoor Terrace
3、Restaurant
4、Research Institute
5、Exhibition
6、Leisure
7、Logistic
8、Office
9、Security Room
10、Lobby

PROFILE1：300