ARTIFICIAL REEF SCULPTURES

Underwater Nature Conservation Project

EXECUTIVE SUMMARY

Objective
To increase Qatar's sport and eco-tourism attractions by building artificial coral reefs which shall have a positive impact on the environment.

Goals
Develop individual themed diving sites, designed using environmental friendly materials.

Solution
To enrich the marine life and allow it to thrive, the sites will be protected from fishing in order to keep the nurseries safe.

Project Outline
Qatar's seabed is mostly sandy and lacking any hard substrate, which is essential for coral growth. Qatar has some breathtaking natural reefs, yet unfortunately due to the ongoing developments, Qatar's marine life, such as the coral close the shores is decreasing and many others are threatened.

The purposes of this project:

1- Environmental benefits:
   a. Provide hard substance for Corals to grow.
   b. Provide a suitable habitat for reef life marine.
2- Tourism benefits:
   a. Diving destinations
   b. New sport attraction
   c. Provide variety of different experiences around Qatar

Project team members:

Noor Al Tememi, Project Manager

Noor Al Tememi is a Qatari environmentalist, holding a MSc in Managing the Environment from Aberystwyth University, UK. BSc in Chemistry/ Biology from Qatar University. She is very passionate about environmental protection. Volunteered in Madagascar for a month for a Coral Conservation Project, she participated in coral reefs identification and surveying. Conducted and participated in many beach cleanups and underwater cleanup campaigns.
As a diver she values the importance of marine life as a potent part of the country's economy from many different aspects.

Mohamed Al Jaidah Project consultant

Technical Colonel Mohammed Yousef Al Jaidah is an environmental consultant delegated to the Ministry of Municipality and Environment. He is the founder of Marine Section in Qatar Science Club (QSC) in 1989, then he was assigned as the head of Natural Science Section in 1998 at QSC. Mr. Mohd was the manager of the Environmental Protection Department at the Ministry of Environment. In addition he is the project manager of Whale Shark study since 2010.

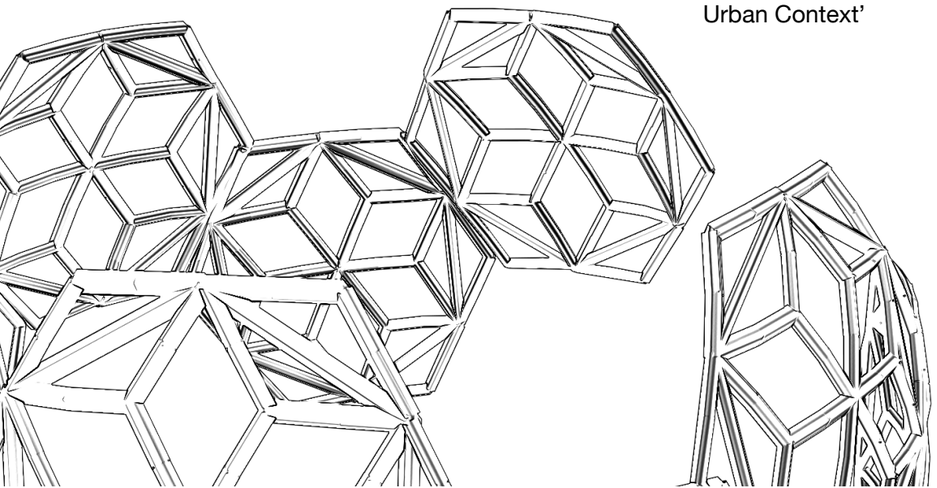
Hana Al Saadi Artist

A Qatari artist who received her Bachelor of Fine Arts (BFA) from Virginia Commonwealth University in Qatar, 2015. She studied Painting and Printmaking, while pursuing her interest in sculpture making. During her period in VCUQ, she discovered her passion in carpentry and started making installations as she developed her conceptual thinking skills. In January 2014 during her third year at University, Hana's efforts led her to winning the Damien Hirst Art competition in Qatar.
Hana's work tends to be quirky, light hearted and fun to look at, she likes to make mistakes happen and embrace them. Sometimes she takes objects people do not give a second look at, and manipulates them to her personal interest, where she gives them a sense of character. Other times Hana takes regional issues and turns them into jokes. By doing so, Hana's works investigate the relationship between the individual and collective, personhood and society, focusing on the politics and stereotypes of gender roles.

Maryam Al Suwaidi Artist

A Qatari urban designer and artist, she is a PhD Candidate at Qatar University - School of Engineering, Major Urban Planning and Design.

Maryam obtained her MA from Qatar University in Urban Planning and Design. She had her BA from Virginia Commonwealth University, Interior Design Major. Maryam Al Suwaidi participated 50X50 Exhibition Qalandiya International - Doha 2018 | Curator Russia, in 2017 she participated as an artist in Garage Gallery - Doha Firestation.



Mohammed Al Suwaidi Artist

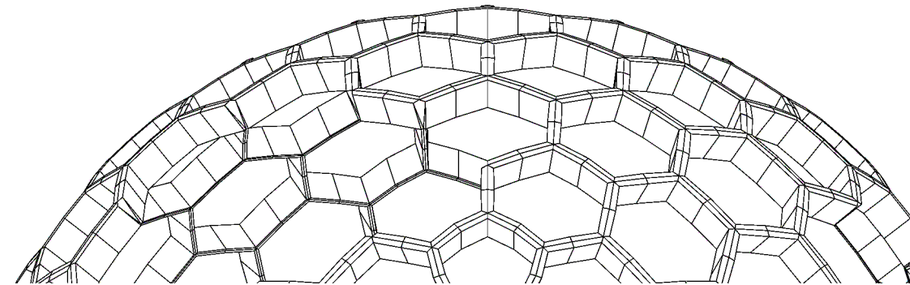
A Qatari digital artist, architect and designer, Mohammed Faraj obtained his BA in Architecture from Plymouth University and his MA in Architecture from the University of Liverpool, with research focused on kinetic based architecture through the use of parametric software. His design process involves the use of digital fabrication tools and simulation data to create a dialogue between sketch based ideas that are then integrated into 3D forms and physical output. The data output is used to explore the contrasting development and emotion of the 'individual' in contrast to the 'Wider Urban Context'

Othman Khunji Artist

Othman Khunji is an interdisciplinary artist / designer. His work ranges across the fields of product, and interactive installation design. The social behaviors, from an Islamic perspective, triangulating how the relationships between religion, culture, and society can be expressed through the language of design are his particular areas of interest. Whether educational or critical, evocative or reminiscent, his interactive creations invite a reawakening and exploration of faith-based practices and social justice issues that will establish platforms for dialogue in the hope of generating new progressive schools of thought.
A graduate of Master in Fine Arts in Design Studies from Virginia Commonwealth University in Qatar, Othman's studies include his latest publication, RITUALS, Our Past, Present & Future: Glimpses of Islamic Enrichment and its accompanying collection, The Five Pillars of Islam.

Maryam Al Semaitt Artist

A designer, artist, and a multidisciplinary thinker. maryam holds a bachelor's degree in business administration with a minor in architecture from cmu-q. this is when her interest in art & design started flourishing, and she decided to pursue a master's degree in service design from the royal college of art in london. during that time, she also got a diploma in traditional arts. she has built different competencies through stepping outside her comfort zone by trying new things and participating in hands-on workshops, conferences and a variety of courses to give her the experience she needs to be a multidisciplinary thinker. using the knowledge she gained through these experiences, she co-founded Makery; a startup focused on delivering branding, service design consultancies and enhancing customer experiences through human-centered design methodologies.



Facts about Qatar Natural Coral Reef

Qatar seabed is mostly sandy and it's lacking of hard substrate which is essential for coral growth. Qatar has some beautiful natural reefs but unfortunately with the ongoing developments Qatar marine life lost lots of corals near to the shore and there are many corals are threaten.

Conditions for coral growth are best on the northern and eastern coasts of Qatar, while the western coast is subject to extremes of temperature and salinity. The coral fauna found in Qatar is similar to that in UAE, with 18 species recorded, although this figure would probably rise with further study. The best coral growth in Qatari territorial waters is on the offshore islands, including Halul Island where strong Acropora regeneration has occurred recently. This island, however, contains the main oil and gas marine terminal of Qatar Petroleum and is subject to significant human impacts including dredging for harbour construction and marine outfalls. There has been very high coral mortality in the past 10 years from bleaching and human impacts, particularly affecting the shallow coral communities on the mainland coast, from Fasht al Dibal to Khor Al Oudeid. For example, several hectares of shallow (1-4 m) Acropora beds, with Porites mounds east of Doha suffered nearly 100% mortality in 1998. Prior to 1998, heavy siltation from construction of a breakwater and land reclamation for the new Doha International Airport severely stressed these communities. At other sites near the mainland, there is about 10% live cover of Porites or Cyphastrea remaining.

Despite the severe degradation of shallow communities, coral reefs in deeper water have some live coral cover, presumably because of reduced mortality from thermal stress. The new data from Qatar are from seabed surveys for environmental impact assessments or engineering works. Much of the seabed surrounding the oil and gas rigs in the eastern sector of the Qatari exclusive economic zone (EEZ) is a flat limestone cap rock with an occasional veneer of sediment. Coral communities can grow where this platform rises slightly, and are usually dominated by faviidae and siderastreids. Although the live cover of these communities is low (5% or less) they may provide brood stock for future recovery of shallow communities.

Artificial Reefs

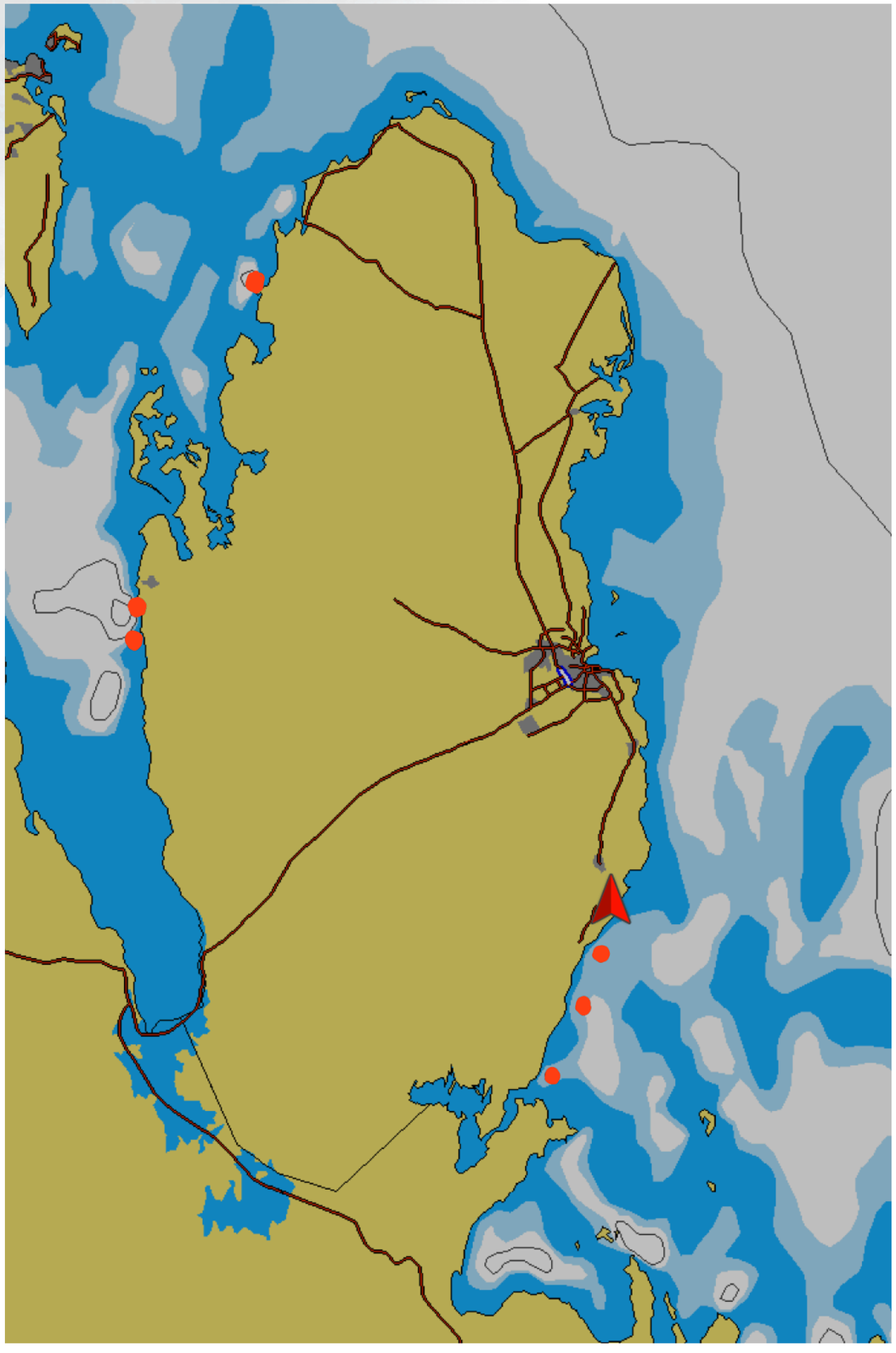
Artificial reefs are

Types of Artificial Reefs: Shallow, deep and suspended
Artificial reefs have potentials as a positive management tool that can be used to allow the stressed natural site to recover, and to develop quality fishing grounds close to access points. With the concomitant beneficial effects for recreational divers, anglers and the economies of local communities by increasing stock sizes of reef fishes as well as enlarging overall population numbers of species present in a particular area.

Advantages of an Artificial Reef

- Artificial Reefs provide shelter, calm waters, influence water currents so that fish save energy while swimming against the current.
- Attract smaller organisms which are vital sources of Food for different marine species.
- They also serve as visual reference points for fish that forage away from the reef and increase the all over reef area which can host a larger number of reef fish.
- These reefs, if properly constructed and properly buoyed, can be used to enhance existing rough bottom habitat, develop quality fishing ground close to access areas.
- Development of aquaculture along with the constructions of artificial reefs, helps in fisheries management, to enhance the wild population in aquaculture systems.

In short, the development of environmental friendly alternatives as well as the potential of artificial reefs favors the epifauna filter-feeding community to act as biofilters; enlarge and allow rehabilitation of stressed natural habitats, and quantitatively boosts many marine species.



Disadvantages of an Artificial Reef

Although artificial reefs usually do not have that many negative impacts, they can cause troubles if poorly designed and mounted. In general the major disadvantages are:

- Insufficiently weighted materials which end up miles away from the reef site by strong winter storm (such as tires, etc.) can damage sedentary organisms of nearby natural reef sites and play havoc with the nets of commercial fishermen's bottom trawl.
- Inadequate buoys and buoy chains, lost buoys, increase the amount of materials dumped into the sea, interfere with shipping or mineral development, apart being difficult to find.
- Use of toxic materials that pollute the aquatic environment (benzene-, heavy metals containing substrate) increase the already huge anthropogenic impact.
- Artificial reefs are not marked so fishing or other vessels can't avoid them.

How to Overcome these Disadvantages?

Constructing an Artificial Reef with Direct Current

A test series in the bay of Tensing Pen (Jamaica) is the largest research lab for artificial reefs.
At present scientists operate on a procedure to let artificial reefs grow by a type electrolysis. A power DC source connected via long cables are attached at the artificial reef, usually constituting a simple metal lattice construction.

The current causes that calcium-carbonate (lime) separated from the sea water settles on it and laminates the lattice, which is immediately followed by a natural settlement of corals. At the anode, the positive pole oxygen and chlorine are separated, enriched at the negative pole, the cathode, calcium carbonate and magnesium - a new corral reef can develop.

Type of reef and geographical location

Type of Artificial Reef	
low profile reefs - major sport fishery	demersal (benthic) species such as sea basses, groupers, snappers, crabs, lobsters, flounders, codfishes, tautog, rockfishes, sheepshead, seatrouts, croaker, black drum, porgies, grunts, groupers
high profile reefs	increase productivity
pelagic species	mackerels, jacksn, bluefish, spadefishes, amberjack, tunas, barracudas, and cobia
floating structures	pelagic species
combination of low and high profiles	effective for both demersal and pelagic species.

The current comes in this separated area from solar cells. Coral growth achieved by the new method not only is faster but result also in more resistant colonies. The corals prosper even with bad water quality, if natural reefs already die.

The most interesting discovery of the scientists was however the effect of weak current on the polyps themselves. They current led directly to diseased corals resulted in a quick recovery of already bleached stocks within only few days.

This new technique uses for the first time the almost unlimited occurrence of dissolved minerals in the sea. If one wants to deposit these minerals on the metal lattice, one needs only current - for example from solar power.

Meanwhile, also the industry is beginning to show interests for this new method. First industrial applications included the construction of breakwater systems in tropical regions to protect the shorelines, dock areas, and harbor sites.

Reef shape and size
Material should not be scattered over wide areas, but clumped with open spaces between clumps. Like in a cycle or square with a central opening less than 20m across. Japanese researchers have found that small, low objects are best for promoting growth of shellfish and seaweed.

Structures with many small holes and crevices are best for attracting invertebrates (shrimp, crab, lobster) and juvenile fishes. Higher, larger structures with numerous crevices are best for larger fishes.

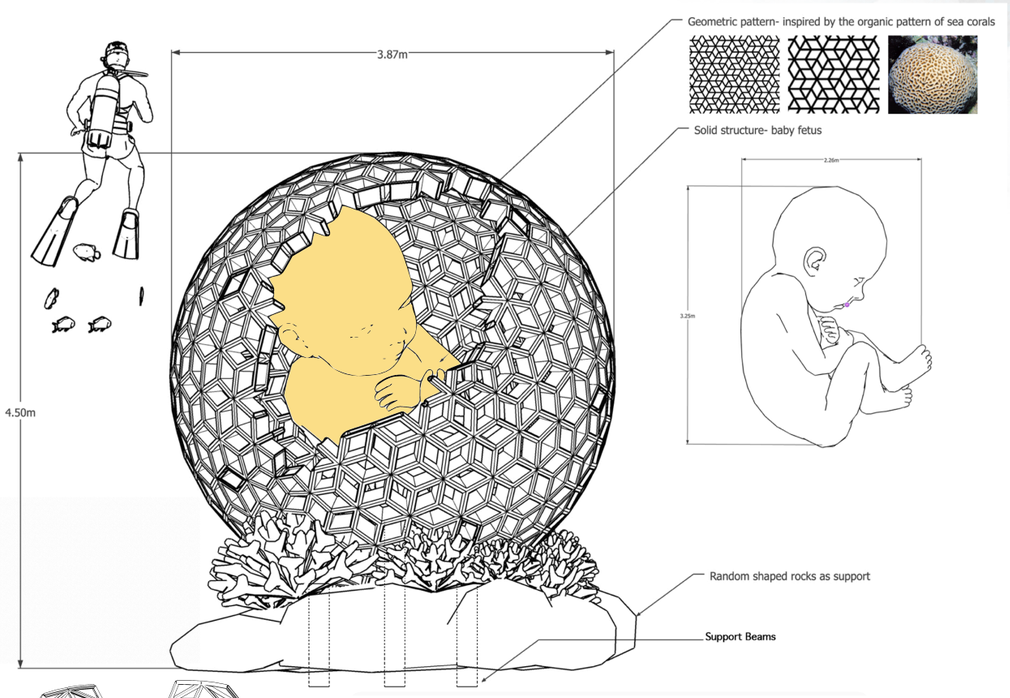
Marking the reef site
A minimum of two buoys should be placed on the reef site prior to construction, so that together they will indicate the reef boundary; one will mark the reef location when the other is being renovated or replaced. Most of these buoys are made of tough, hard plastic filled with foam, making them very economical.

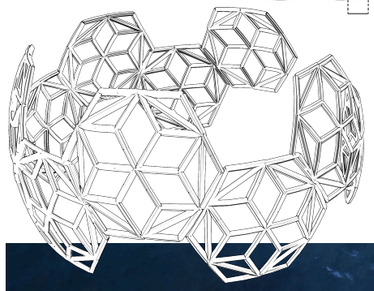
Proposed locations

1- Khor Al Audaid
2- Sealine
3- Dukhan
4- Madynat Shmal Al Khor

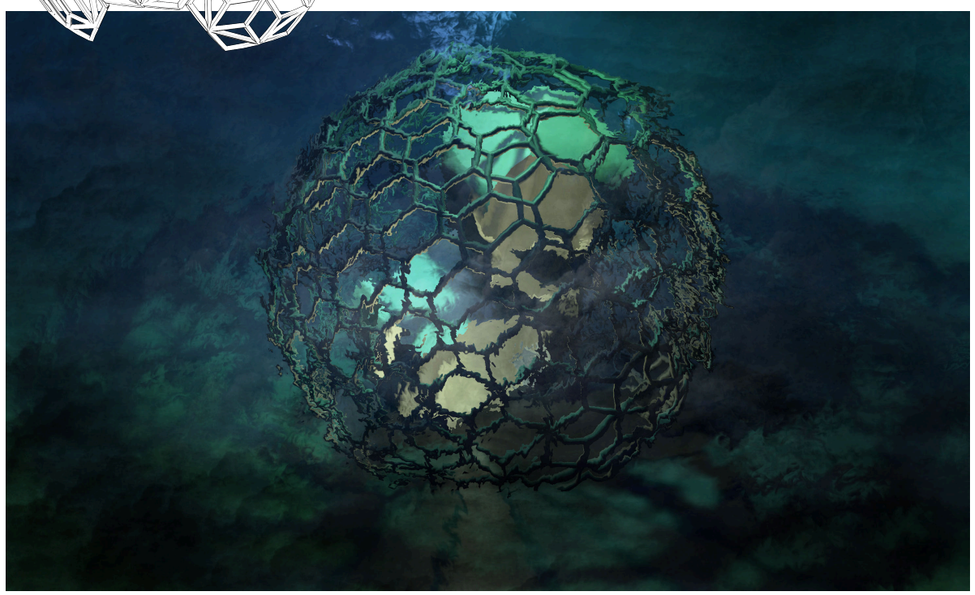
The proposed locations are marked by red dots in Figure (10)

AL DANA

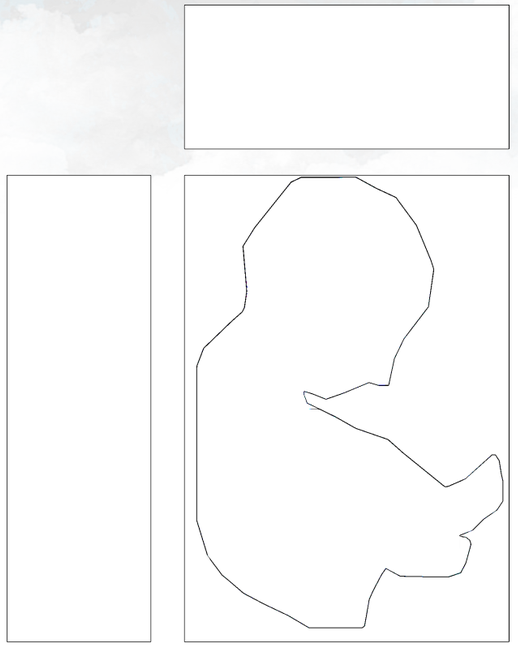


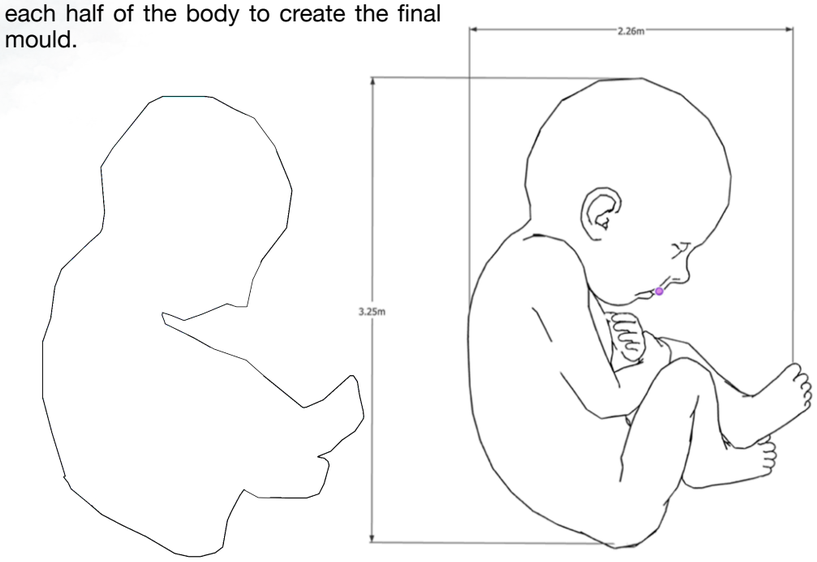


PROPOSAL BY: MARYAM AL-SUWAIDI



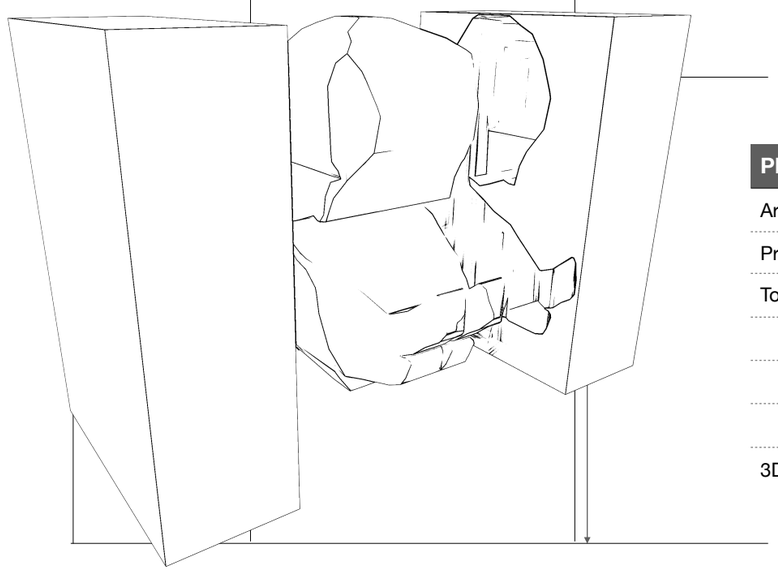
Wood will be used to border the casting of the styrofoam baby using the displayed dimensions. The styrofoam body will be split in two halves and the the mould will be filled to the brim of each half of the body to create the final mould.





For this proposal, the design of the baby encased in the spherical pattern will be a solid body with complete infill. As an option, the shape could be hallow with a 50mm thickness to conserve material use and reduce weight for ease of transportation to site and installation phase.

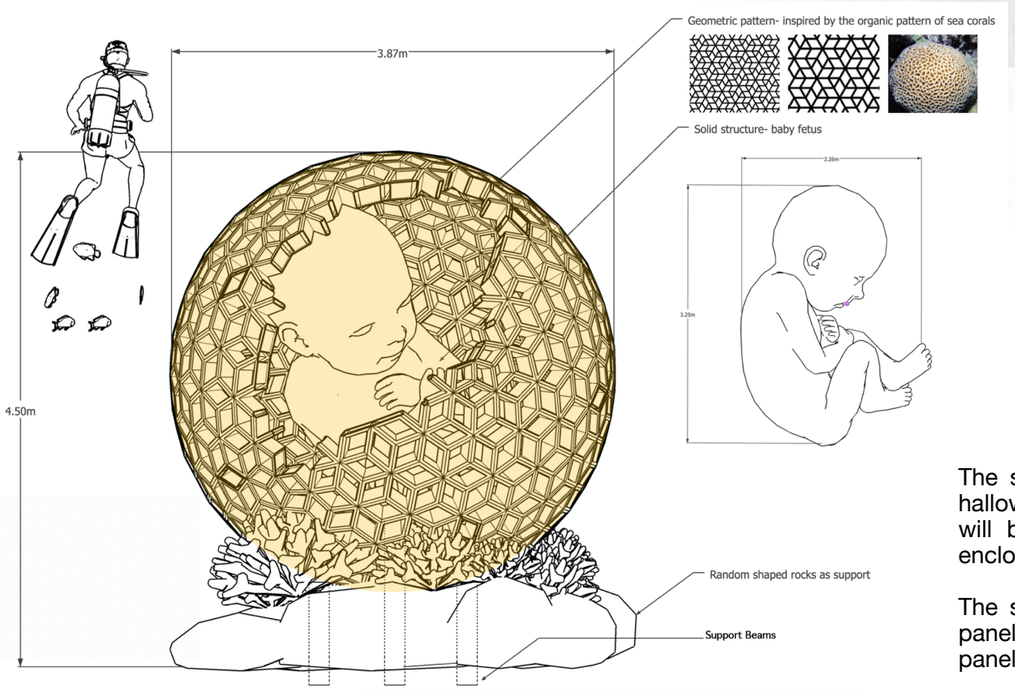
The mould will be using the above dimensions as a frame, casted from sculpted styrofoam. The mould will be secured together and the concrete will be poured from the head down to fill up the interior space. The two half moulds will be coated with a release agent which allow for ease of release of the cast. This will allow the client to reuse the mould if needed for additional output.

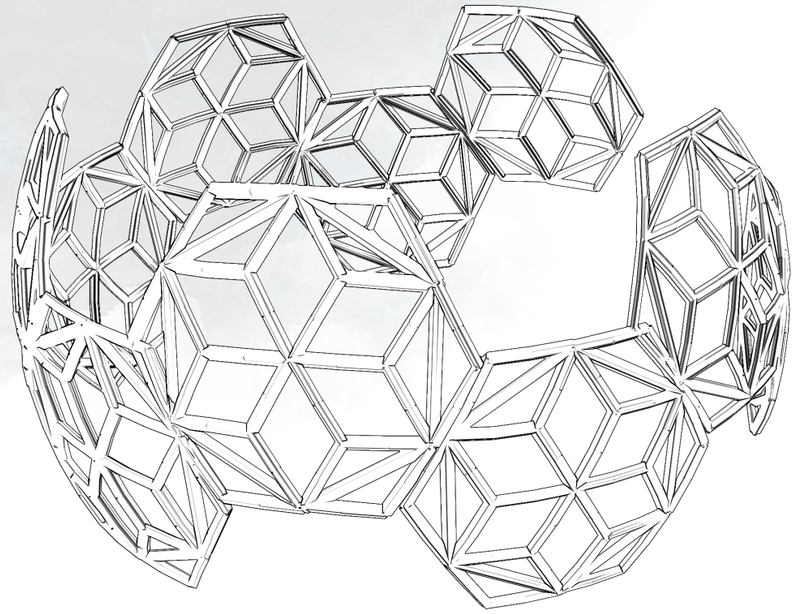


PROJECT:		
Artist	MARYAM FARAJ AL-SUWAIDI	
Project Name	AL DANA (Baby)	
Total Area & Volume (m):	OUTPUT x1	
Concrete -	Area: 21.85 m^2	Volume: 5.5 m^3
Mould -	Area: 62.5 m^2	Volume: 10.4 m^3
3D file Preperation By:	MOHAMMED FARAJ AL-SUWAIDI	

AL DANA

PROPOSAL BY: MARYAM AL-SUWAIDI





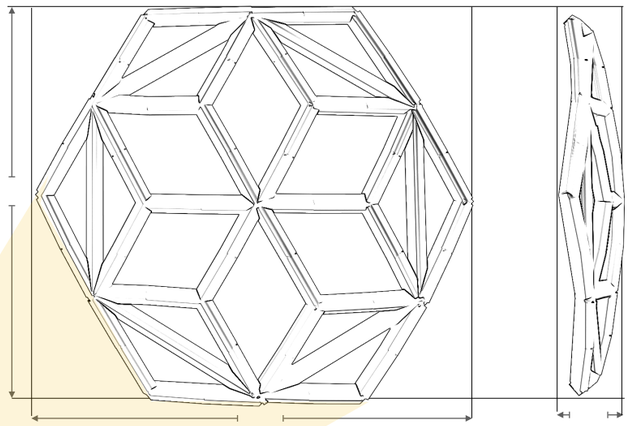
There are two fabrication methods currently in discussion. The first is the use of a single silicon mould which will be reused to create a series of modules with added joints that will then be assembled to create the sphere. This process will be cost efficient, although installation and transport methods have to be considered above/under water conditions.

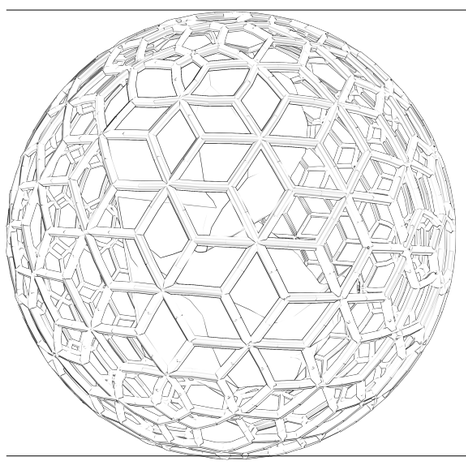
The second method involves 3D printing with concrete, this will allow the whole body or segmented sections to be printed separately as a unified body which will increase the structural strength and decrease production time.

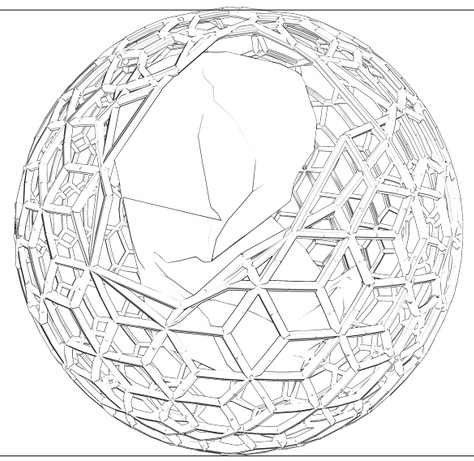
The second half of this proposal will be a ‘deconstructed’ hallow sphere covered with a hexagonal pattern. The sphere will be broken down in certain areas to reveal the baby enclosed within the shape.

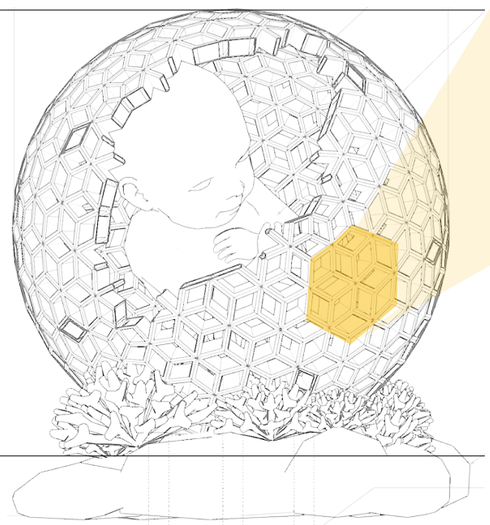
The sphere will be constructed using a series of repetitive panels that will be casted using a reusable silicon mould. The panel casted will the shape displayed on the right >

Approximately 32 panels will be used to compete the spherical body, this number is altered based on how much of the baby will be visible.









A silicon mould will be used to enable recasting, although the initial body will be CNCed to get an accurate shape to create the silicon mould from. Several silicon mould can be made to speed up the

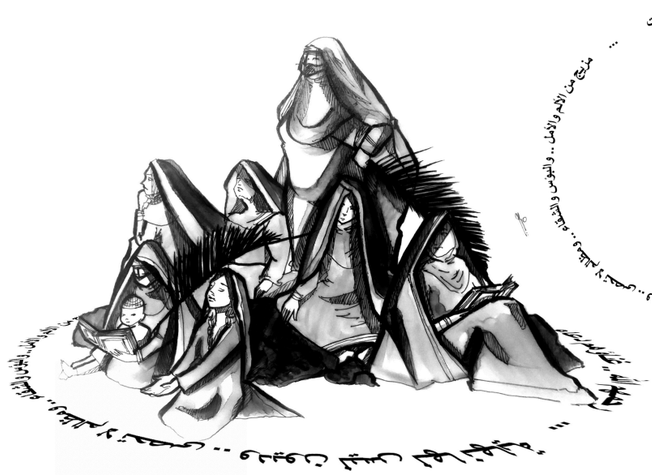
PROJECT:		
Artist	MARYAM FARAJ AL-SUWAIDI	
Project Name	AL DANA (Sphere)	
Total Area & Volume (m):	OUTPUT:	
Concrete -	Area: 12.5 m^2	Volume: 8 m^3
Mould (**x1** Silicon reusable) -	Area: 4.5 m^2	Volume: 0.4 m^3
3D file Preperation By:	MOHAMMED FARAJ AL-SUWAIDI	

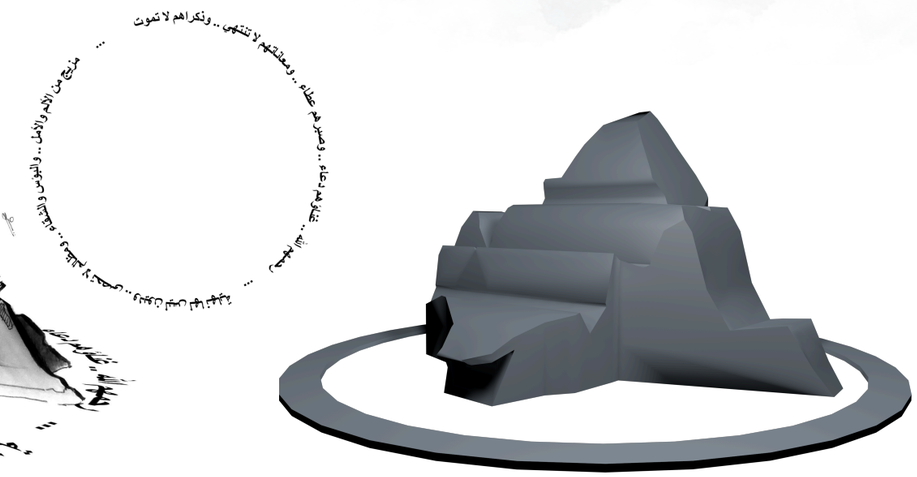
SAD MELODY (b)

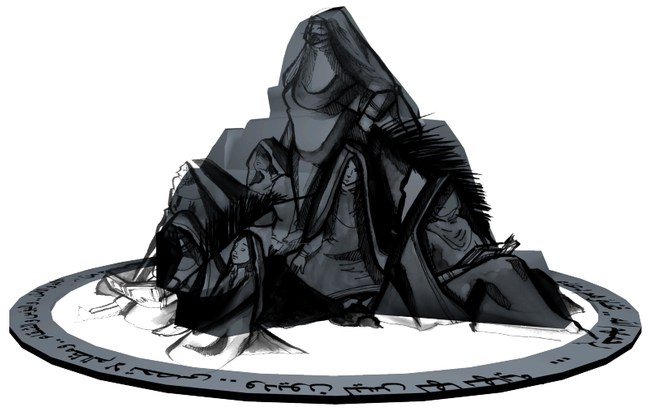
PROPOSAL BY: MARYAM AL-SUWAIDI

Sad melody consists of two separate pieces to create the overall concept. Part ‘A’ will be submerged underwater and Part ‘B’ will be adjacent to the submerged piece but is placed at the shore facing the sea.

Materials used for Part ‘B’ will be cost affective compared to the materials used to cast the underwater proposals. General concrete is currently the material that will be used to cast the body and the Arabic text surrounding it.



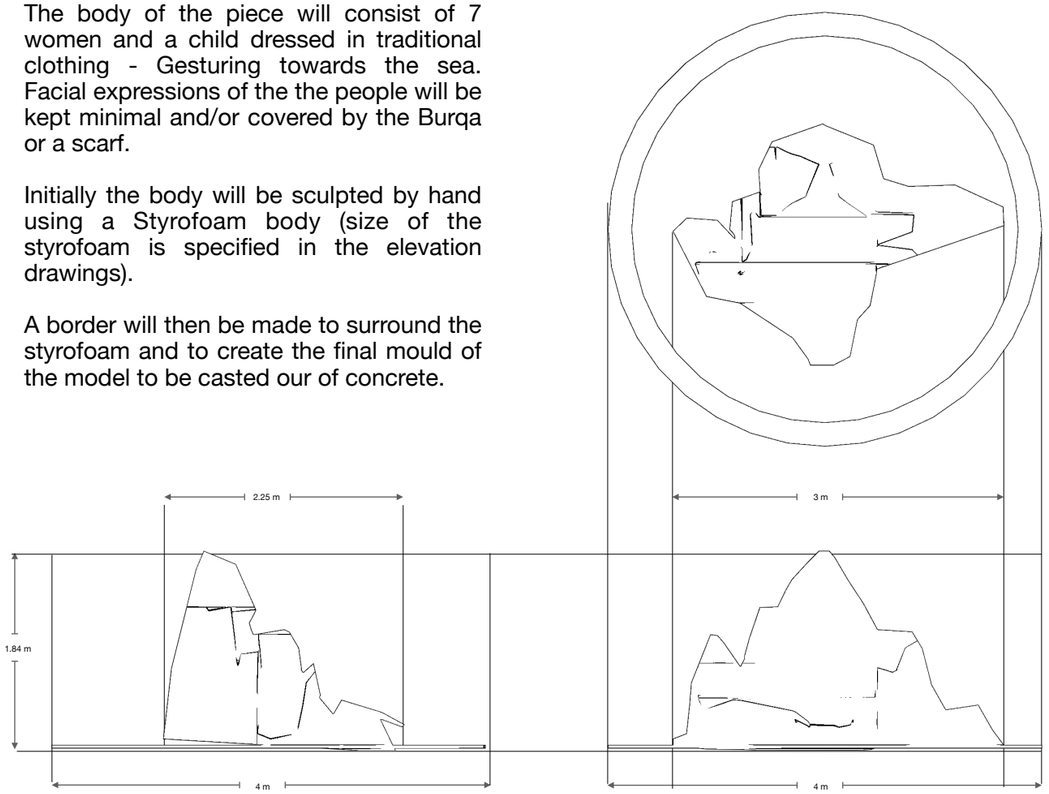




The body of the piece will consist of 7 women and a child dressed in traditional clothing - Gesturing towards the sea. Facial expressions of the the people will be kept minimal and/or covered by the Burqa or a scarf.

Initially the body will be sculpted by hand using a Styrofoam body (size of the styrofoam is specified in the elevation drawings).

A border will then be made to surround the styrofoam and to create the final mould of the model to be casted our of concrete.



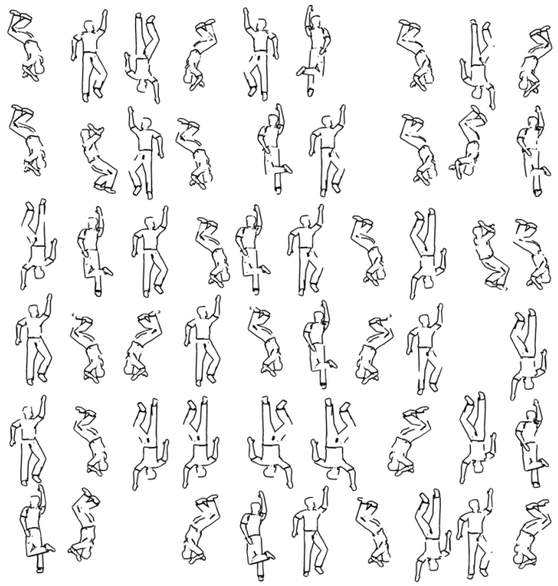
Due to the detailed of the text surrounding the body. The text will need to be CNCed in 3 sections to create the mould which is assembled to create the complete circle of text surrounding the body.

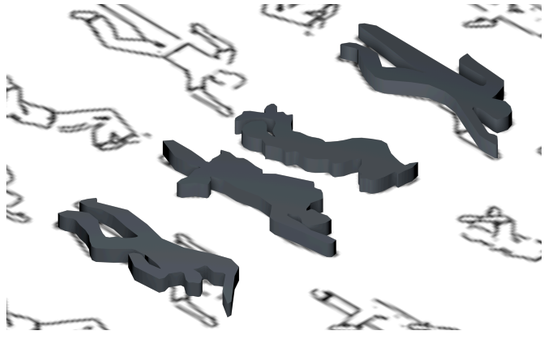
the production method of this design either be hand carved with styrofoam and then reverse casted to make the moulds, or physical models will be 3D scanned and reprinted in concrete material.

PROJECT:		
Artist	MARYAM FARAJ AL-SUWAIDI	
Project Name	SAD MELODY	
Total Area & Volume (m):		
Concrete (not underwater) -	Area: 15.8 m^2	Volume: 3.5 m^3
Mould (for surrounding text)-	Area: 6 m^2	Volume: 0.4 m^3
3D file Preperation By:	MOHAMMED FARAJ AL-SUWAIDI	

SAD MELODY (a)

PROPOSAL BY: FARAJ AL-SUWAIDI





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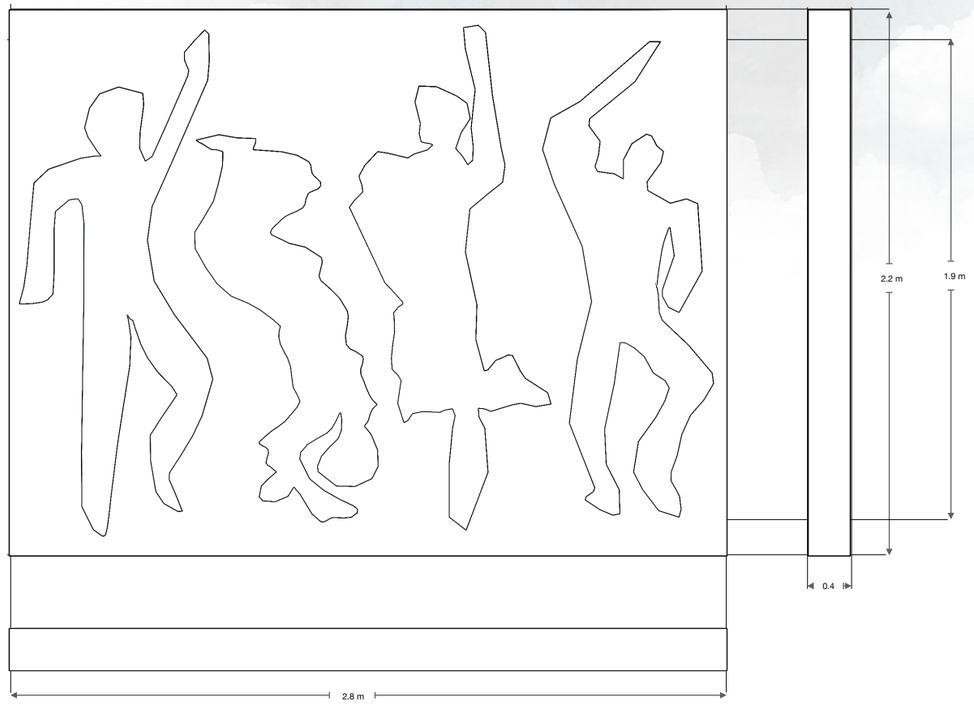


The second part of the sculpture piece will consist of 12-18 men lying on the bed of the water. Four initial moulds of men will be used, which will initially be sculpted out of styrofoam and then used to create the mould.

The drawing above showcases the dimensions that will be used to create the border to cast the mould. Each mould will be used to create 4 bodies. Each body of the four will be in a different position. The casts will then be dispersed around a certain area on the bed of the water in various spaces to give a feel of variety

the production method of this design either be hand carved with styrofoam and then reverse casted to make the moulds, or physical models will be 3D scanned and reprinted in concrete material.

The estimates of the volume required to cast the moulds displayed below are calculated to create 4 moulds to create 12 bodies. Four initial designs are duplicated four times to create this output.

If the client requires additional moulds to be made, then calculations can be made to estimate the additional required of material needed to create the additional casts.

PROJECT:		
Artist	MARYAM FARAJ AL-SUWAIDI	
Project Name	SAD MELODY	
Total Area & Volume (m):		
Concrete -	Area: 32.4 m^2	Volume: 2 m^3
Mould -	Area: 66 m^2	Volume: 10 m^3
3D file Preperation By:	MOHAMMED FARAJ AL-SUWAIDI	

IQRA

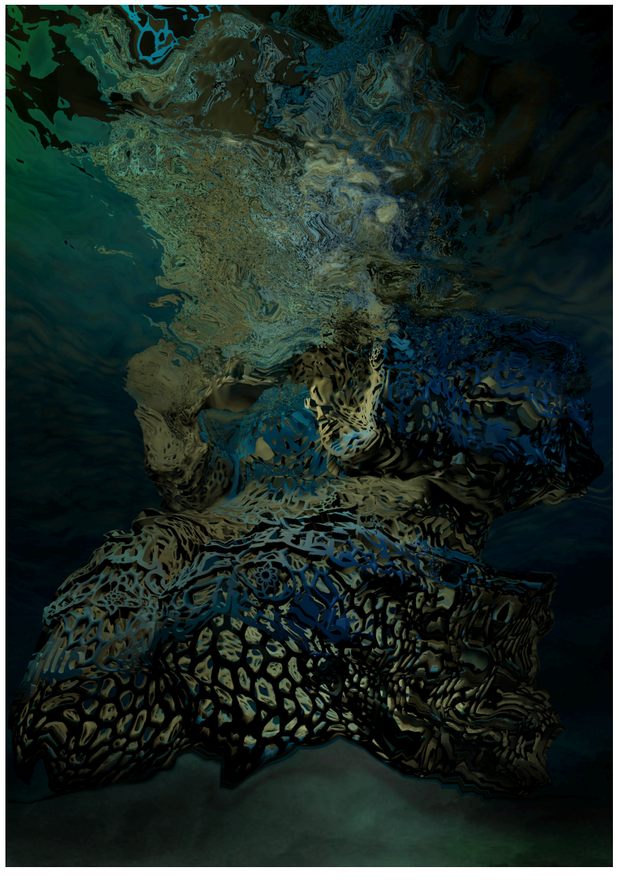
PROPOSAL BY: OTHMAN KHUNJI

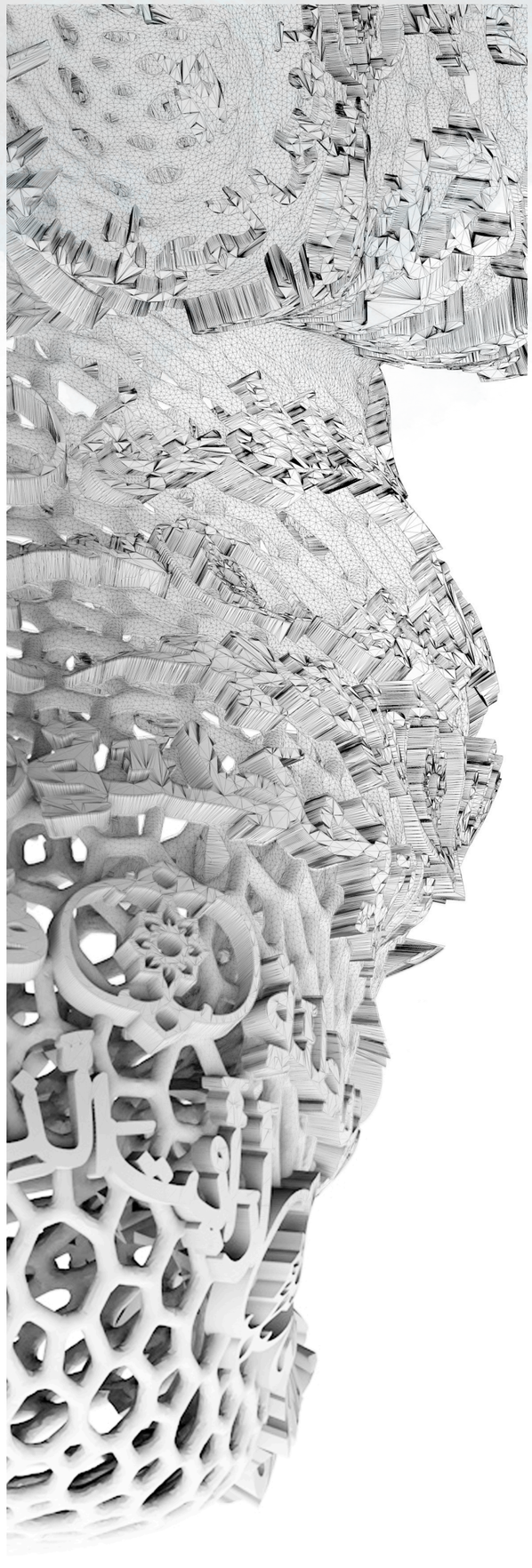
A 7 meter high sculpture shaped in a male hollow figure in the seating position, reading the holy Quran. The sculpture is formed from Arabic text: the verses from Surat Al Alaq which have been the first revelation to Prophet Muhammad in Mecca at cave Hira. The surat stresses the importance of focus on the righteous path and furthering one's education.

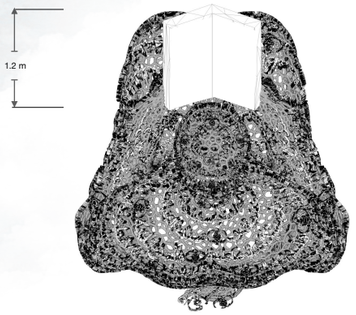
The design features of this sculpture involve solar panels installed within the only solid object, an open book representing the holy Quran, to charge up a set of installed LED lights that would act as a lighting installation during the night. The body of the sculpture is also 2/3 submerged under water, which makes the book that is directing the light affect hovering just above the sea level. In result the illumination shall attract life (small fish and creatures) to gather and serve as bait for the larger creatures which forms a stronger and healthier under water life cycle.

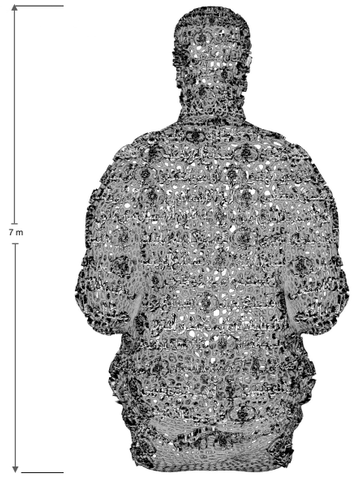
This sculpture creates a hallow interior which is accessible by the user to explore. This text is placed around the body in a spiral motion starting from the head covering the body throughout. Due to the text involving accents and bracket symbols, the body itself is supported by an organic web like structure underneath the text that supports all the characters throughout. The sculpture shall be made of a specific family of concrete that shall encourage the growth of coral etc. to beatify and bring the installation to life.

Due to the intricacy of this design, the production method shall be 3D printing in concrete to achieve the ultimate solidity and durability possible. The height of the structure would also determine the structural load that has to be considered. The current proposed height of the design is 7m, but this will be altered based on the location, direction and placement of the proposed sculpture.





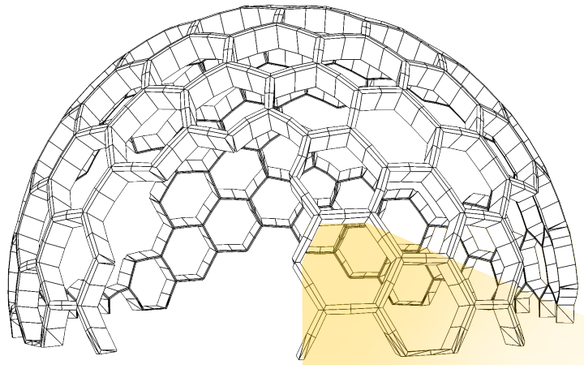




PROJECT:		
Artist	OTHMAN KHUNJI	
Project Name	IQRA	
Total Area & Volume (m):		
Concrete -	Area: 108 m²	Volume: 15 m³
Mould -	Area: 159.52 m²	Volume: 24 m³
3D file Preperation By:	VECTORIZE QATAR	

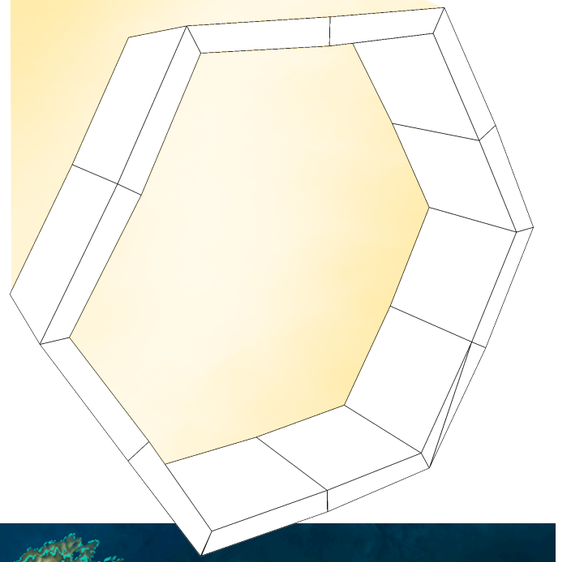
LUGEE

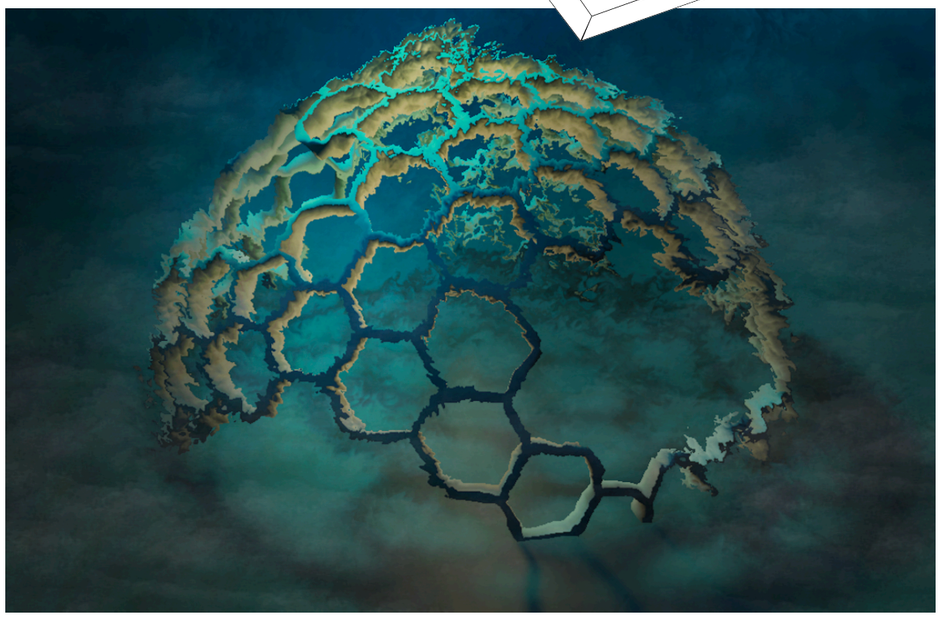
PROPOSAL BY: MARYAM AL-SEMAITT



Maryams design will consist of a repetitive replication of a single module mould. Joints will be installed on each corner of the module to then allow a collection of modules to be connected together to create the hallow spherical dome displayed in the above diagram.

the design is not meant to fully create a sphere as the artist intended to create a series of large entry points for the user to access and explore the interiors of the sphere.

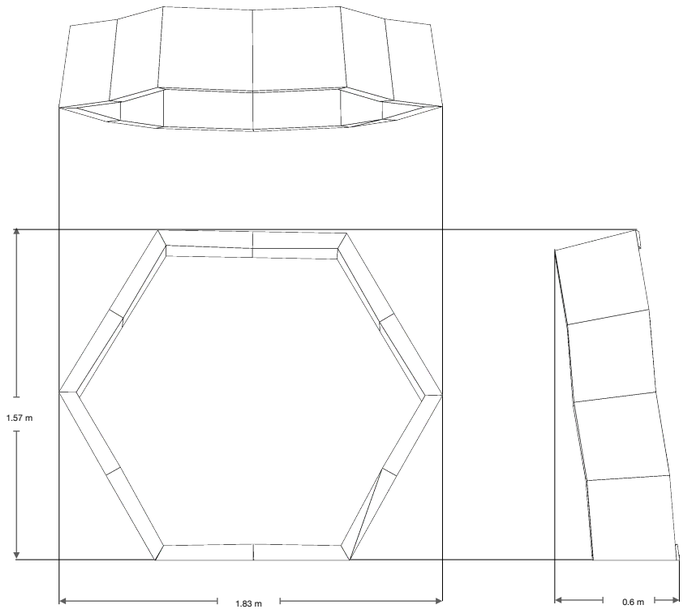


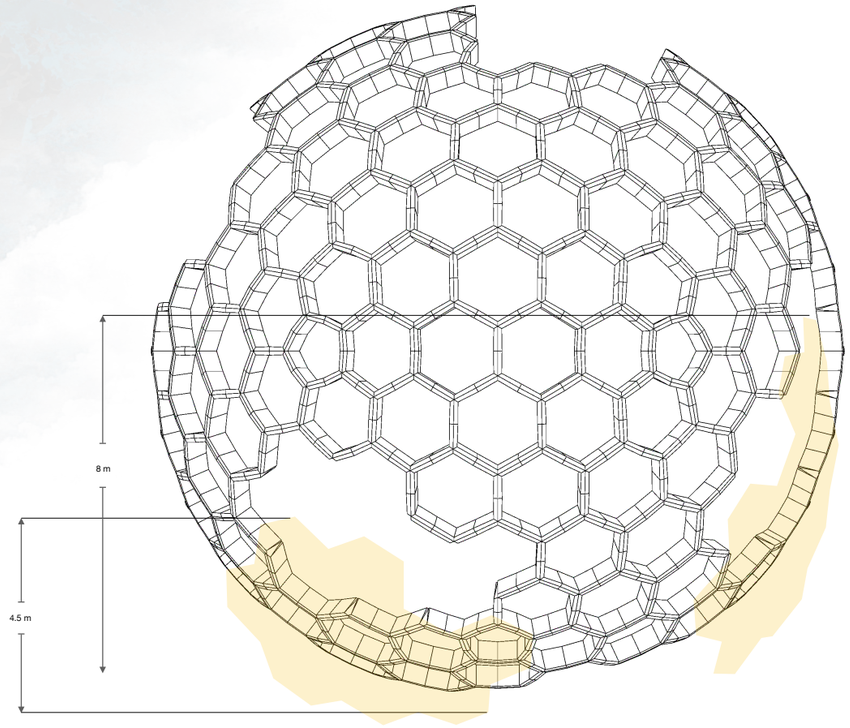


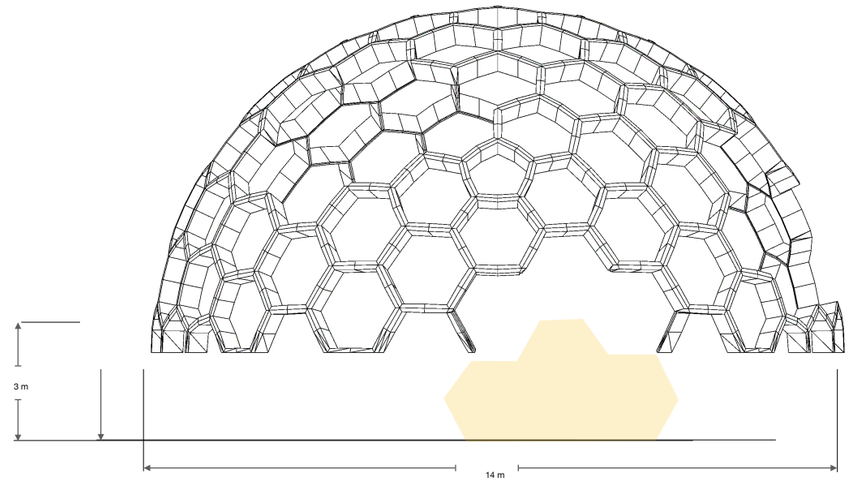
The design is still in the devilment status as the artist still intends to create a text design which will be placed on the sphere body (location and the design of this is yet to be confirmed).

There are two fabrication methods currently in discussion. The first is the use of a single silicon mould which will be reused to create a series of modules with added joints that will then be assembled to create the sphere. This process will be cost efficient, although installation and transport methods have to be considered above/under water conditions.

The second method involves 3D printing with concrete, this will allow the whole body or segmented sections to be printed separately as a unified body which will increase the structural strength and decrease production time.



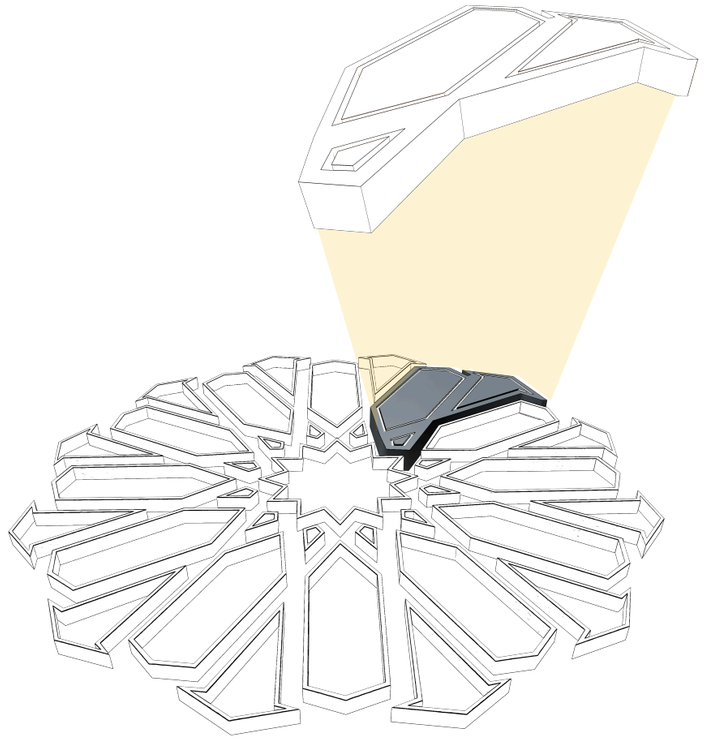




PROJECT:		
Artist	MARYAM AL-SEMAITT	
Project Name	LUGEE	
Total Area & Volume (m):		
Concrete -	Area: 300 m^2	Volume: 18 m^3
Mould (**x1** Silicon reusable) -	Area: 11 m^2	Volume: 0.8 m^3
3D file Preperation By:	MOHAMMED FARAJ AL-SUWAIDI	

SYMBOLIC MAZE

PROPOSAL BY: HANA AL-SAADI



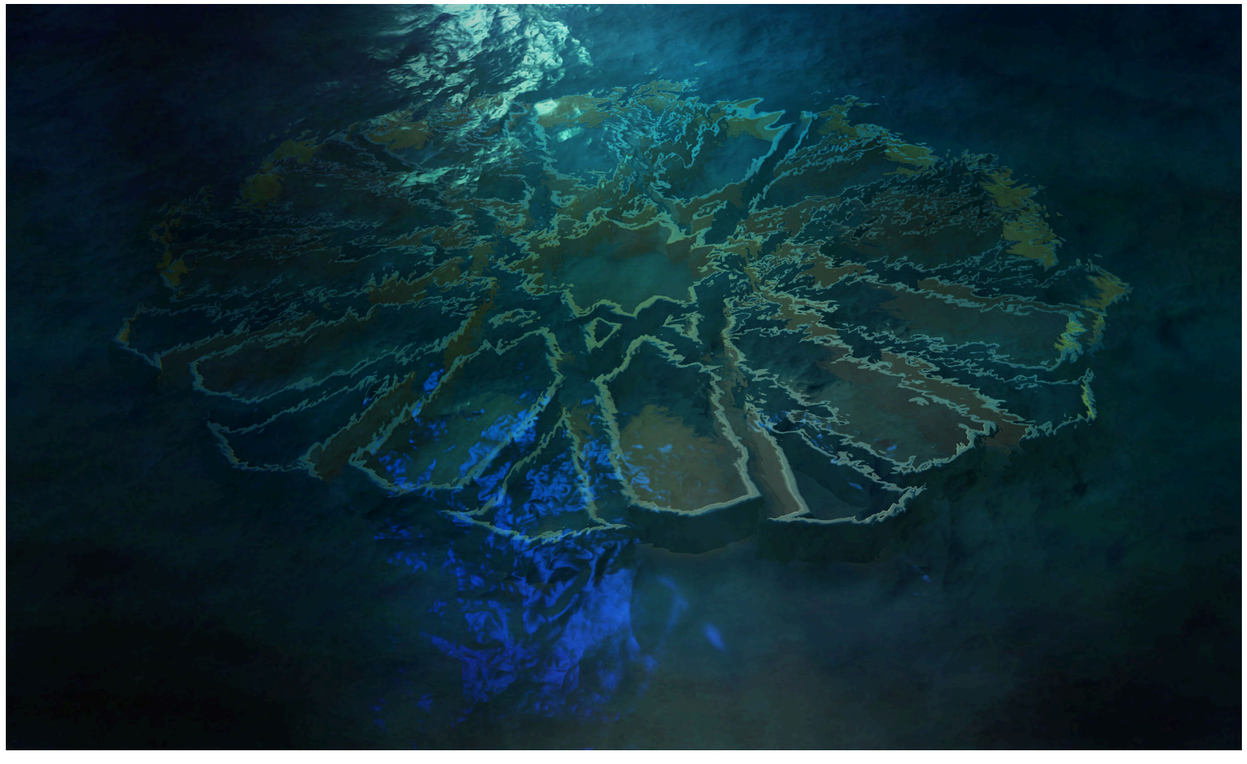
This is the largest proposed design which creates a dynamic space which promotes interactivity and exploration to the user. The symbolic maze stretches a large surface area with a length and width of 60 m and a height of 5.5m, with passageways that are 2m wide for the user to access.

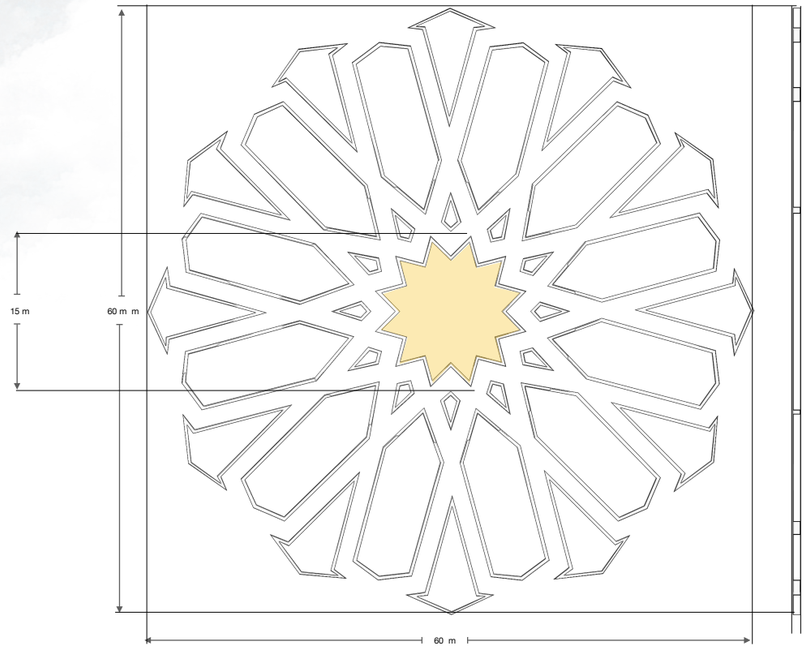
due to the large scale of this proposal, the design will be created in segments of 3 main shapes which will be replicated 12 times, with the addition of a central star shape compose the whole shape.

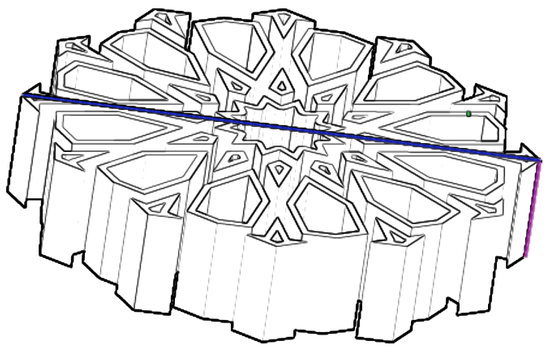
As part of the development strategy, the walls of the maze will be made ‘semi-transparent’ by creating small entry points as a pattern. various shapes will be tested to create a nursery space for the fish and coral to grow.

The production method of this design will vary on the complexity of the pattern chosen for the wall. The initial method is to create each separate wall casted on the intended pattern design and then assembled on site. This would ease on transportation and underwater assembly.

3D printing with concrete is the second proposed method to create this design as it would be more time efficient during the production phase.





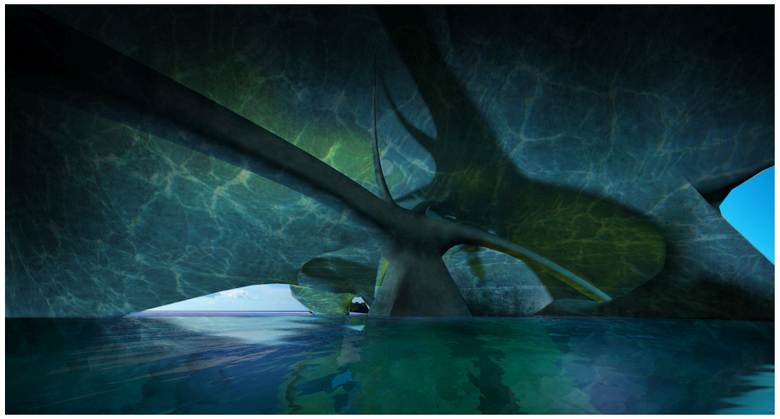


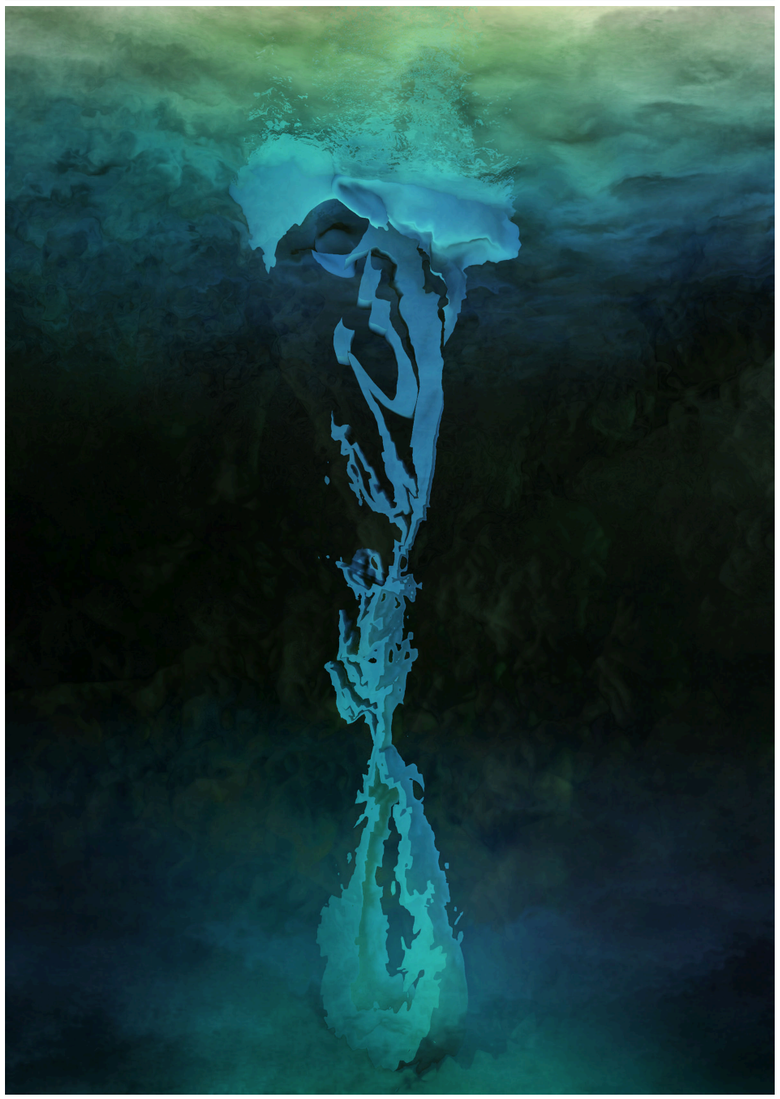
approximate wall thickness: 25 cm approximate overall width: 22 m approximate height: 10 m

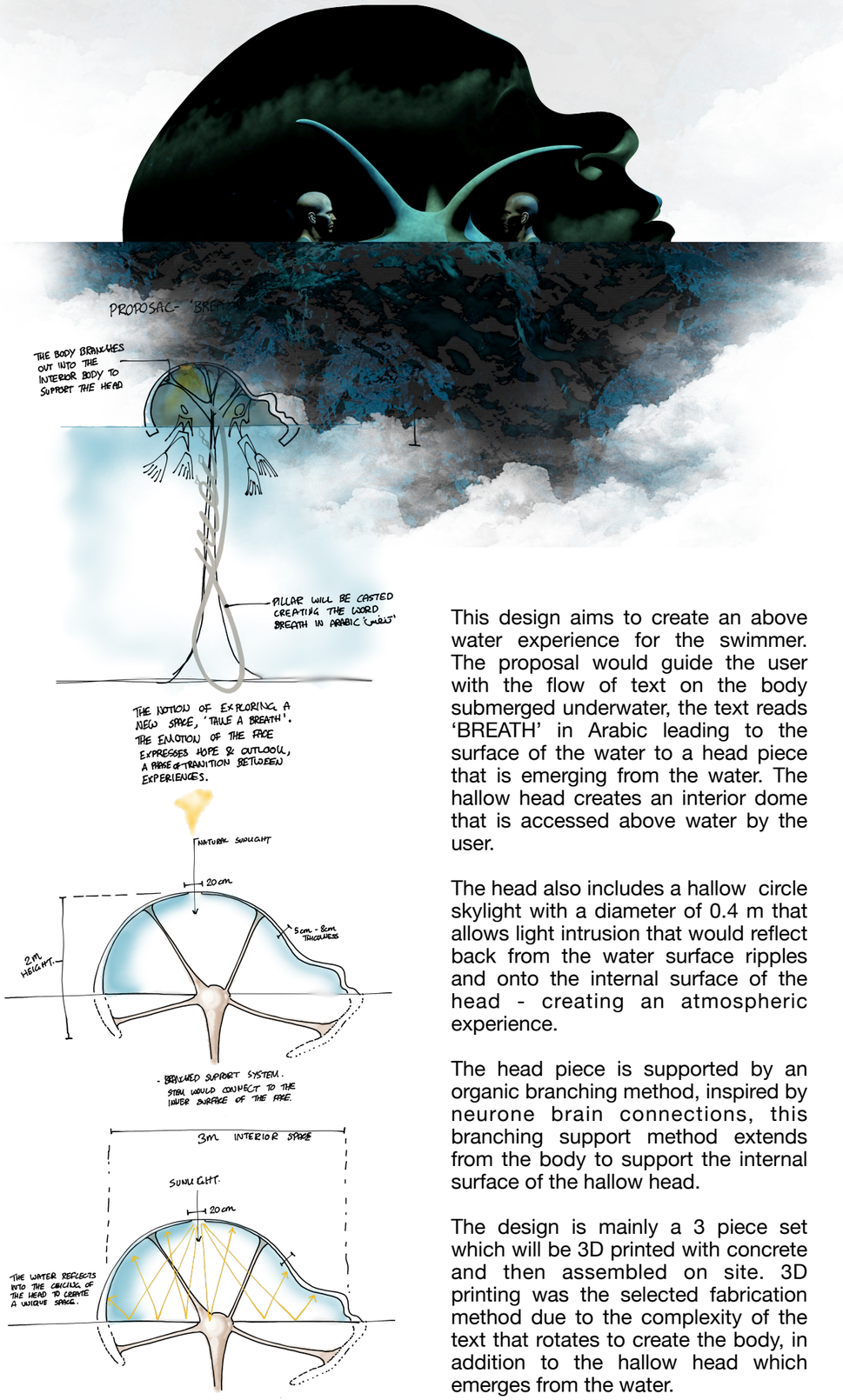
PROJECT:		
Artist	HANA AL-SAADI	
Project Name	SYMBOLIC MAZE	
Total Area & Volume (m):		
Concrete -	Area: 8868 m^2	Volume: 2180 m^3
Mould -	Area: 750 m^2	Volume: 180 m^3
3D file Preperation By:	MOHAMMED FARAJ AL-SUWAIDI	

BREATH

PROPOSAL BY: MOHAMMED FARAJ





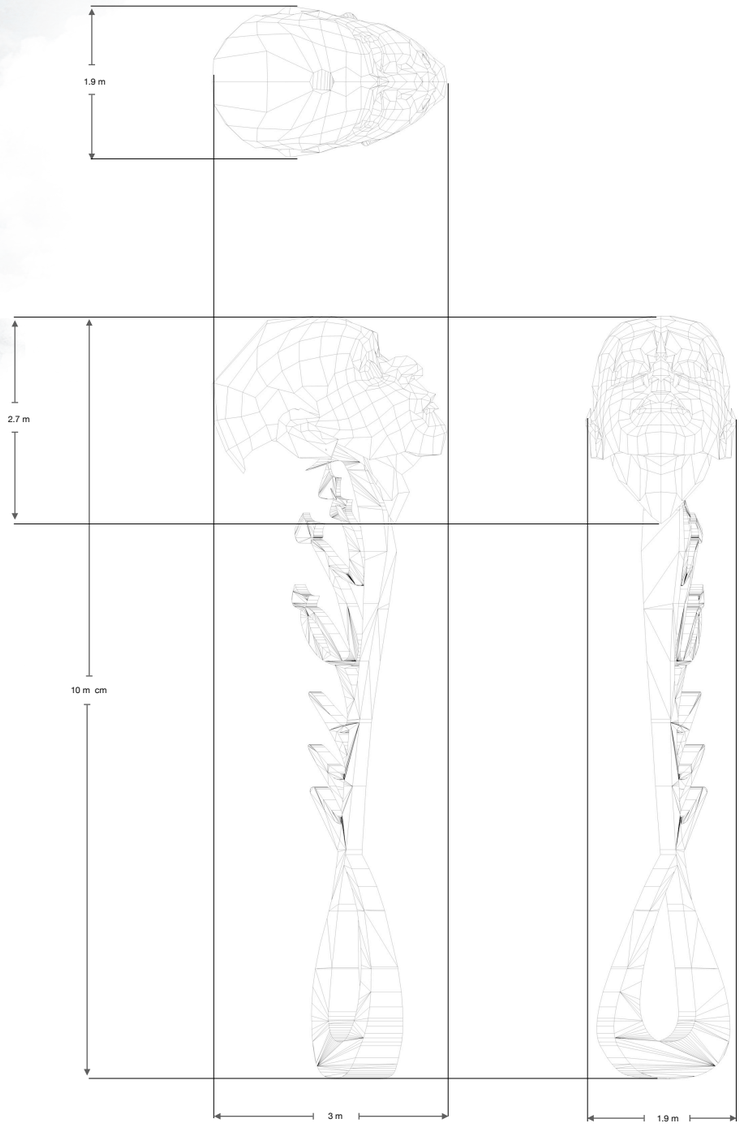


This design aims to create an above water experience for the swimmer. The proposal would guide the user with the flow of text on the body submerged underwater, the text reads 'BREATH' in Arabic leading to the surface of the water to a head piece that is emerging from the water. The hallow head creates an interior dome that is accessed above water by the user.

The head also includes a hallow circle skylight with a diameter of 0.4 m that allows light intrusion that would reflect back from the water surface ripples and onto the internal surface of the head - creating an atmospheric experience.

The head piece is supported by an organic branching method, inspired by neurone brain connections, this branching support method extends from the body to support the internal surface of the hallow head.

The design is mainly a 3 piece set which will be 3D printed with concrete and then assembled on site. 3D printing was the selected fabrication method due to the complexity of the text that rotates to create the body, in addition to the hallow head which emerges from the water.



PROJECT:		
Artist	MOHAMMED FARAJ AL-SUWAIDI	
Project Name	BREATH	
Total Area & Volume (m):		
Concrete -	Area: 75 m^2	Volume: 7.5 m^3
Mould (null - 3D print) -	Area: 0 m^2	Volume: 0 m^3
3D file Preperation By:	MOHAMMED FARAJ AL-SUWAIDI	