Chapter 7
DESIGN BASIS

7.1. Building Layout Design Basis

The building will use a single mass where all activities occurs in just one building. The tanks are the ones that connect the whole areas due to their important role. The room in the building are connected through corridors for easy access to all facilities.

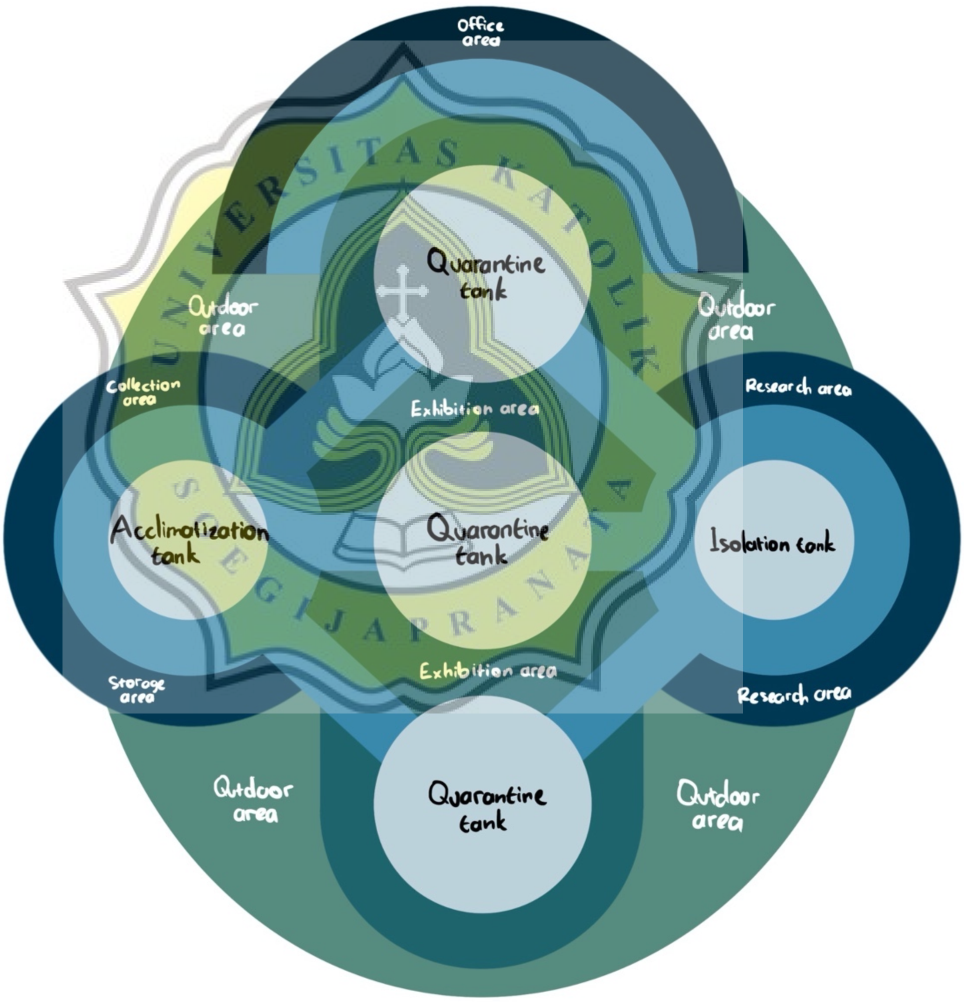

Figure 35. Sketch of building layout
(Source: Personal analysis)

Supporting facilities of the building will be placed outdoors to isolate any sound from the building while the main facilities which are the research and management facilities will be closed for their private activities.

7.2. Building Form Design Basis

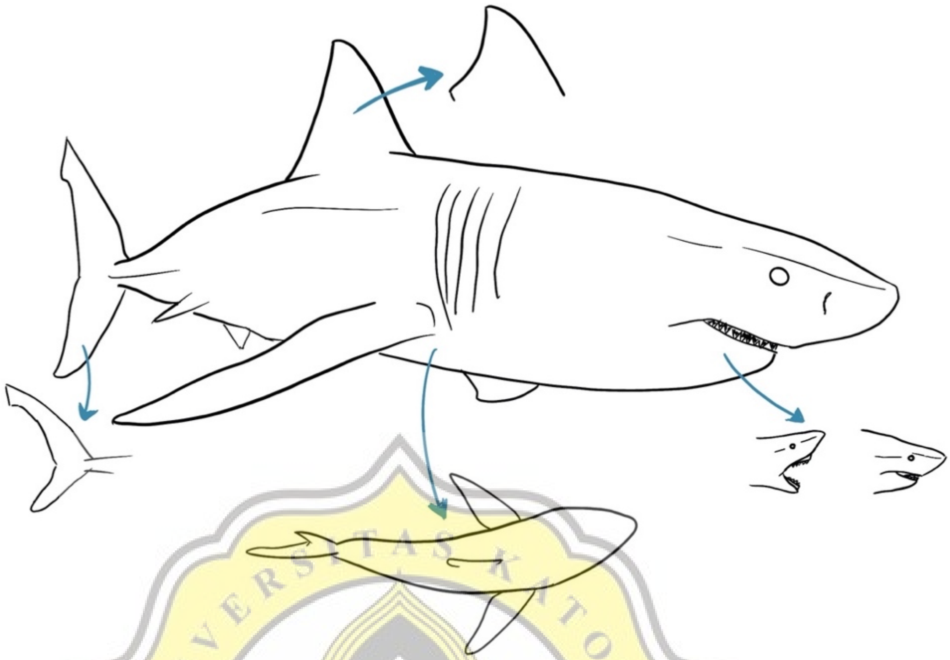

Figure 36. Sketch of main characteristics of shark
(Source: Personal analysis)

In order to create a "building as nature", the building will mimic the shape of the iconic shark, the great white. As the figure above shows, there are four characteristics of shark that can be used.

- The jaw

  The jaw or the shark's mouth is used for eating and breathing support. This element can be used as the entrance of the building.

- The dorsal fin

  The fin usually used for people as a warning since of the shark's presence in the waters, can be used as an ornament as the symbolism of shark.

- The body

  The body of a shark is capable to move fluidly to swim in the ocean. The body element can be used as the building form influenced by the wind flow.

- The tail

The tail element is for swimming purposes. The tail element can be used as another ornament as the wind flow control as explained in chapter 5.

7.3. Building Structure Design Basis

a. Foundation

Pontoon type Very Large Floating Structure (VLFS) is the chosen structure for the building due to its no-elevation platform, allowing for effective shark transports in the building since the bathymetry of the site is classified as littoral zone, near the seashore.

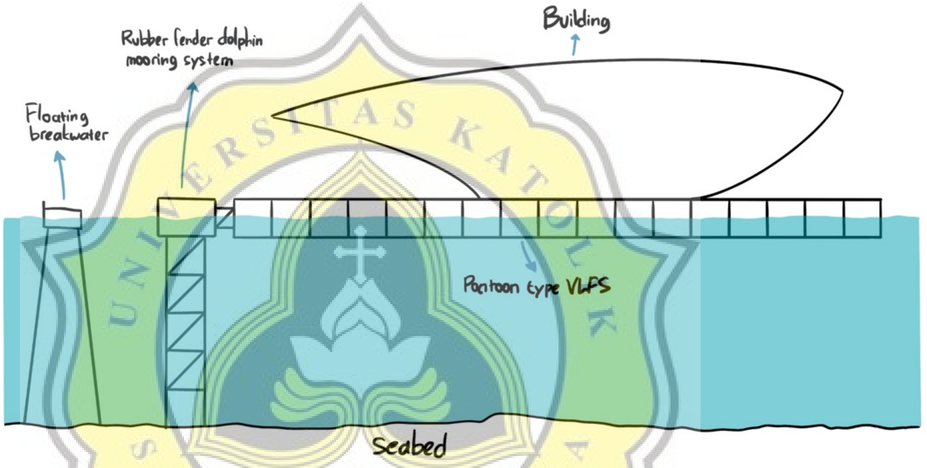

Figure 37. Sketch of building structure
(Source: Personal analysis)

Rubber fender-dolphin mooring system will be implemented due to its effectiveness in restraining the horizontal displacement of the floating structure.

To avoid damages on the coral reefs and the seabed, floating breakwater will be used to minimize the hydroelasticity from the ocean waves.

b. Body

The body of the building will be using steel columns and beams and moreover concrete slabs.

Figure 38. Steel structure
(Source: ATAD Steel Structure Corporation)

c. Roof

Gridshell structure will be used to create organic form for the building, creating a long span building with huge spaces for shark husbandry purposes.

Figure 39. Steel gridshell structure
(Source: ATAD Steel Structure Corporation)

7.4. Building Material Design Basis

a. Structure material

- Foundation material

  The pontoon part of the VLFS used will be using prefabricated concrete to lift the building and maintain its stability on the water. The mooring system will be using steel to hold the building in place.

- Body material

  Steel as the body material, to prevent corrosion throughout the material, a metal coating is applied by using eco-friendly metal coatings by Greenkote that doesn't produce any solid, liquid or gaseous toxic byproducts.

- Roof material

  Gridshell structure will be using steel pipe material coated with eco-friendly metal coatings by Greenkote that doesn't produce any solid, liquid or gaseous toxic byproducts.

b. Envelope material

- Flooring
  - Vinyl

    Vinyl floor will be applied in the main areas for research such as laboratories due to its slip-resistant, non-staining, and durable characteristics.

Figure 40. Anti static vinyl flooring
(Source: www.pinterest.com)

- Resin flooring

  Resin flooring will mainly be used for the inside of the building. Resin flooring will provide a greater durability than polished concrete and can express the materials just like the organic architecture intended. The use of resin flooring will moreover give a reflectivity allowing lights to shade the area of the building, giving an immersed experience to the visitors of the underwater world.

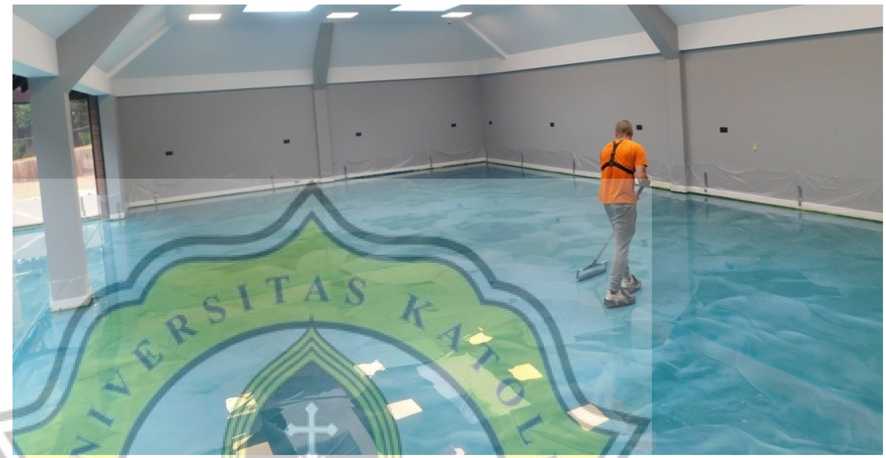

Figure 41. Epoxy flooring
(Source: www.jenflow.com)

- Plywood floor

  Plywood floor will be applied for the boat docks in the outdoor area as they are the transition between the people and the building giving a strong sense of contrast between the building and the outside world.

Figure 42. Marine grade plywood
(Source: www.sfmarina.com)

- Face and roofing
  - ❖ Glass Fibre Reinforced Polymer (GFRP)

GFRPs are used both for the kinetic façade and the roofing due to its efficiency in achieving organic forms. GFRP can be used as cladding material of bent into wire frame structures.

Figure 43. The uses of GFRP in One Ocean Thematic Pavilion
(Source: www.technologyinarchitecture.wordpress.com)

GFRP mainly comes in white without any additional treatment. One of the characteristics of organic architecture is to express the quality of materials. In this case, the use of GFRP can be expressed while moreover giving a sense of purity and innocence.

- ❖ Laminated glass

For skylights, the type of glass that will be used is laminated glass. The use of glass in the building are eco-friendly material since of its recycled characteristics.

Figure 44. Laminated glass
(Source: www.oceangroup.asia.com)

The glass is capable to reduce the thermal heat in the building therefore that the use of air conditioner in the building could be minimized. The glass is moreover considered to be safe for people when it breaks and moreover has an anti UV function.

7.5. **Building Façade Design Basis**

Building façade will give an organic look, making it look alive just like the organic architecture intended in "building as nature".

Figure 45. One Ocean Thematic Pavilion EXPO 2012 by soma architecture
(Source: www.archdaily.com)

The façade will show the curvature of the shape with shark characteristics making it a shark like building. Kinetic façade is moreover applied with gills concept, based on the shark gills. This will allow the wind to flow inside, providing natural ventilation. The building will be fully covered in white using GFRP material to express the cleanliness of the ocean and moreover to represent the purity and innocence of a shark.

7.6. **Site Layout Design Basis**

Outdoor area of the building is divided into transportation area for visitors and managers, alternative energy area consisting of energy server area and greenhouse area and greenspace for natural ventilation purposes. The whole area will be connected using pontoon bridges.

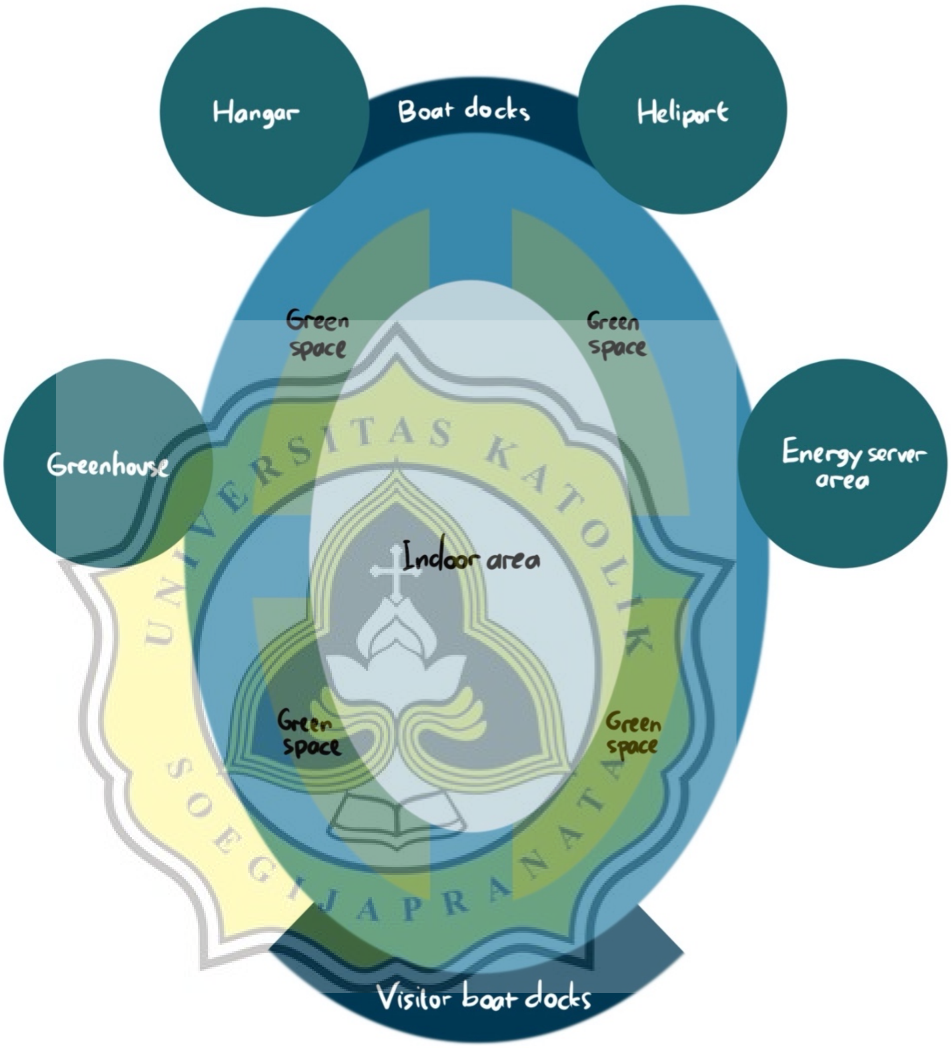

Figure 46. Sketch of site layout
(Source: Personal analysis)

7.7. Building Utilities Design Basis

- Electricity

To produce power for the facility, the building will use fuel cells provided by Bloom Energy Server. Each unit are capable of generating 250kWh of electricity or 2,190,000 kW per year.

Figure 47. Bloom Energy Server ES5-250kW
(Source: www.bloomenergy.com)

This server consists of solid oxide fuel cells, which are attractive since they can be made out of low-cost materials with high energy efficiencies. The cells can run on a variety of fuels, including traditional fuel, natural gas, biomass gas, landfill gas, and ethanol.

According to Minister of Energy and Mineral Resources Regulation of the Republic of Indonesia Number 13 of 2012 concerning Electric Power Usage Saving, offices with AC use 8.5 until less than 14 kWh/m2/month efficiently.

Total = 14 x Building area x 12
= 14 x 9,812.6 x 12
= 1,648,516.8kWh/year

Based on the calculations above, the building should need 1,648,516.8 kWh amount of electricity for one year, therefore 1 unit of Bloom Energy Server should be enough to power the building in one year. However, as a backup, another unit should be ready in case the server is damaged. Therefore 2 units should be implemented in the building.

Table 78. Energy server area analysis
(Source: Personal analysis)

Facility	Area	Capacity	Total area
Energy server	4.5m x 2,46m = 11.07m2	2	22.14m2
User	0.63m x 0.63m = 0.4m2	5	2m2
Total			24.14m2
Circulation			40%

Total	33.8m2

The building will need an area of 33.8 square metre to house 2 units of Bloom Energy Server.

- Clean water

The building will be using Reverse Osmosis as its desalination of seawater for freshwater production.

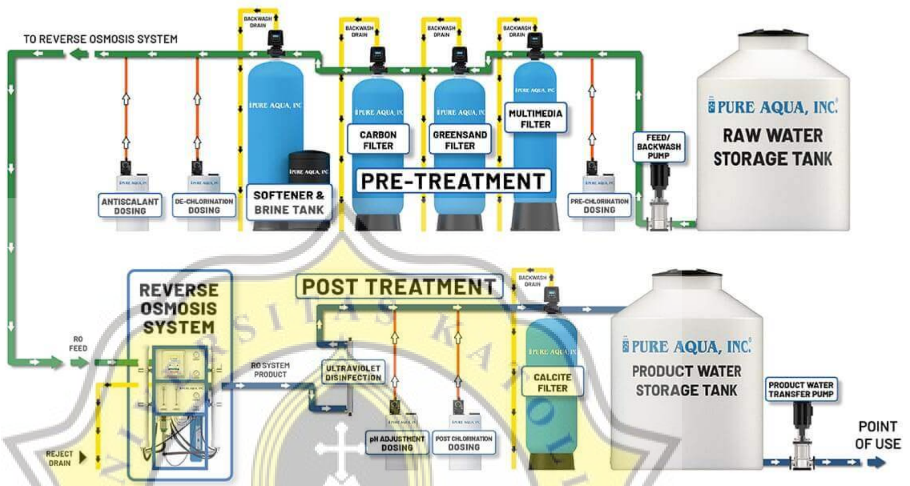

Figure 48. Commercial Reverse Osmosis Diagram
(Source: www.pureaqua.com)

It will be provided by Pure Aqua, Inc with can produce 600 up to 18,000 gallons per day. For this building, the 600 gallons Skid-mounted RO System will be used producing 2,271.25 litres per day

Figure 49. Commercial Reverse Osmosis RO Systems RO-200
(Source: www.pureaqua.com)

According to Government Regulation of Jakarta Number 122 of 2005 concerning wastewater management (PERGUB DKI), the average number of clean water that is needed for laboratory is 150 litre/staff/day, and for performance building is 10 litre per staff per day, while the office produce 50 litre per staff per day. To calculate the total of skid mounted RO unit, every user in the building will be summed up based on the user classifications in chapter 3.

❖ Main user

Area	=	(120 x Building capacity) : 2,271.25
	=	(150 x 11) : 2,271.25
	=	0.73 unit

❖ Supporting user

Area	=	(10 x Building capacity) : 2,271.25
	=	(10 x 190) : 2,271.25
	=	0.84 unit

❖ Manager

Area	=	(50 x Building capacity) : 2,271.25
	=	(50 x 112) : 2,271.25
	=	2,47 unit

The total of skid mounted RO unit needed for the facility is 0.73 unit + 0.83 units+ 2.47 unit = 4 units.

- Waste management
  - Solid waste

    Solid waste in the building will be stored in the garbage storage room.

Figure 50. Waste management room
(Source: Commercial and Multi-family Developments Waste Management Design Guidelines, n.d.)

The solid waste will then be collected by garbage collectors and transported using garbage ships to Sorong.

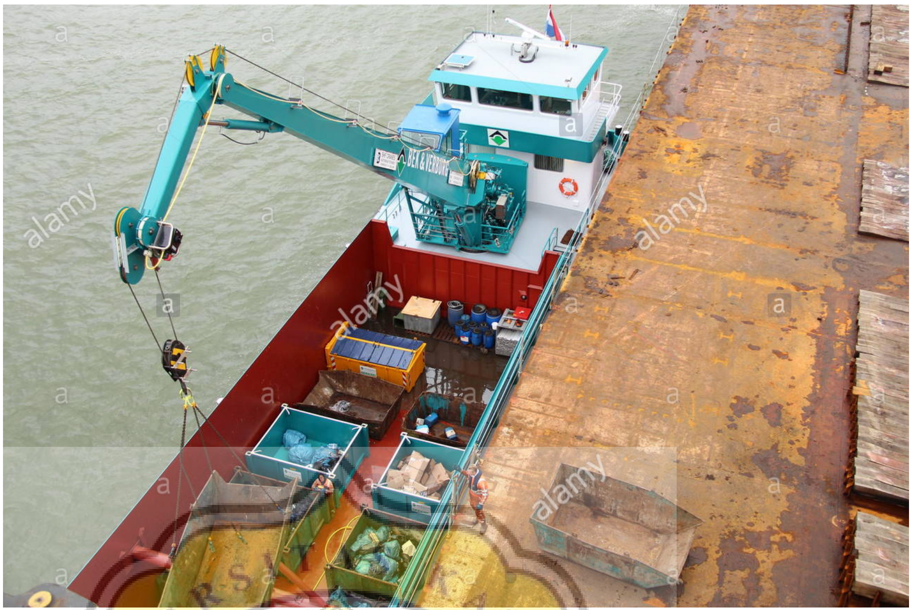

Figure 51. Garbage boat
(Source: www.alamy.com)

- Liquid waste

Liquid waste in the building consists of greywater and blackwater. Both will be discharged using a living machine.

Figure 52. Living Machine Findhorn
(Source: www.urbangreenbluegrids.com)

The living machine will be design in a greenhouse designed with the building. The greenhouse will moreover be using a floating concept or commonly known as a floating greenhouse facility.

Figure 53. The Jellyfish Barge floating greenhouse concept
(Source: www.interestingengineering.com)

Based on Government Regulation of Jakarta Number 122 of 2005 concerning wastewater management (PERGUB DKI) , the average number of wastewater production for laboratory is 120 litre/staff/day, and for performance building is 9 litre per staff per day, while the office produce 40 litre per staff per day. To calculate the water tanks, every user in the building will be summed up based on the user classifications in chapter 3.

❖ Main user

Total unit = 120 x Building capacity
= 120x 11
= 1,320L

❖ Supporting user

Total unit = 9 x Building capacity
= 9 x 190
= 1,710L

❖ Manager

Total unit = 40 x Building capacity
= 40 x 112
= 4,480L

Therefore the wastewater produced in the building is 1,320 litre + 1,710 litre + 4,480 litre = 7,510 litre. The tanks use standard type tanks with the capacity of 1,000 litre therefore 7,510 litre : 1,000 litre = 7,51 units or 8 units of water tanks.

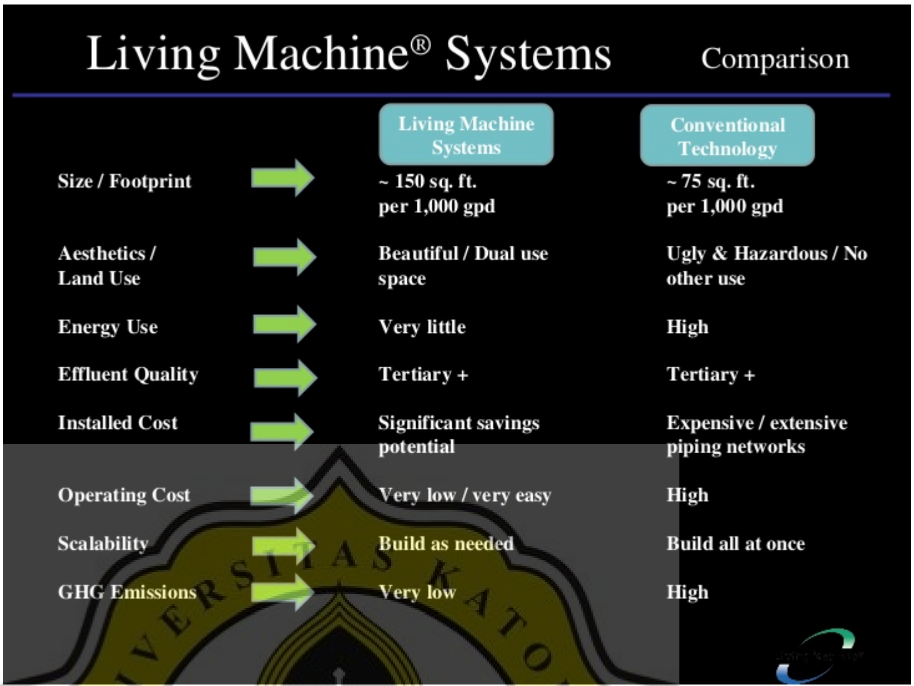

Figure 54. Living machine and conventional technology comparison
(Source: Fraker, 2008)

The living machine system should take an area of 45 square metre per 3,785.41 litres per day for the greenhouse facility. To calculate the living machine area, every user in the building will be summed up based on the user classifications in chapter 3.

❖ Main user

Area = (120 x Building capacity) x 45/3,785.41
= (120 x 11) x 45/3,785.41
= 15.69m2

❖ Supporting user

Area = (9 x Building capacity) x 45/3,785.41
= (9 x 190) x 45/3,785.41
= 20m2

❖ Manager

Area = (40 x Building capacity) x 45/3,785.41
= (40 x 112) x 45/3,785.41
= 53.26m2

Therefore the total area needed for the greenhouse, housing the living machine is 15.69m2 + 20m2 + 53.26m2 = 88.95 square metre.

- Cooling system

Cooling system for the building will be using cassete type Air Conditioner for the public areas and Split type Air Conditioner for private areas.

- Lighting system
  - Natural lighting

    To provide natural lighting, skylight system will be used using laminated glass attached to the gridshell structure and kinetic façade of the building

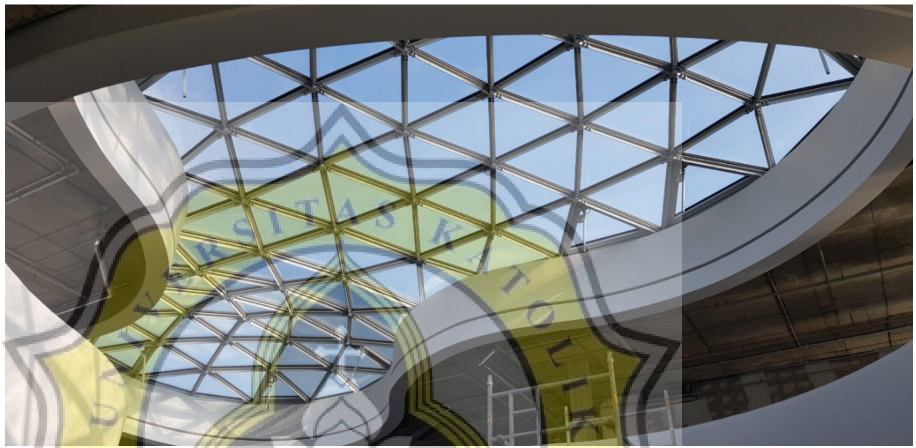

Figure 55. Skylight on gridshell structure
(Source: www.vikingdome.com)

  - Artificial lighting

    Controllable lights are needed for shark husbandry purposes. To control the lighting of the building, the design will use smart lamps such as light bulbs and light strips provided by Phillips Hue Series.

Figure 56. Phillips Hue lighting
(Source: www.daniellebrustman.com)

These lights can be controlled via remote to change the lights' colours and intensity.