Project 1: Design of FRP catamaran for river taxi service on Brahamaputra, at Guwahati.

IDC
IIT Bombay

Samudra®

Samyak Khobragade
176390011
Mobility and vehicle design

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited of from whom proper permission has not been taken when needed.

Samyak Khobragade
176390011
Mobility & Vehicle Design

ACKNOWLEDGEMENT

I would like to sincerely thank Mr. Unni Mohan, designer at Samudra Shipyard Ltd. for his valuable guidance and creative input throughout the project.

I would also like to thank Dr. S Jeevan, CEO of Samudra Shipyard Ltd for giving me this opportunity to work for his firm and gain a better understanding about water transportation.

Thanks to all the employees at Samudra for their endless support and hospitality during the month I spent there. Also to my friends who were there with me all along.

Certificate of completion

Samudra®

Ref: SSPL/GN / 2018/191
Date: 07th May 2018

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. **Samyak Khobragade** (176390011), student from Industrial Design centre (IIT Bombay) has completed his internship with us from 7th May 2018 to 12th June 2018 on design of **Water Taxi for Assam Tourism.**

For **Samudra Shipyard Pvt.Ltd.**

Dr.S.Jeevan
Chairman & Managing Director

the art & science of BOATBUILDING
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1. PROJECT BACKGROUND

The project was done as a part of an internship at Samudra Shipyard Ltd, based in Kochi, Kerala. Samudra Shipyard specializes on applying Fibreglass Reinforced Plastic (FRP) technologies to build a wide variety of boats and related equipment for different purposes. Having an experience of more than three decades in this field, Samudra has also taken part in a number of collaborative projects with other organizations and the government.

The project was done as the preliminary stage of biding on a tender issued by Government of Assam: Design, construction, commissioning and supply of FRP catamaran for river taxi service on the river Brahamaputra at Guwahati. It provided an opportunity to learn about the various aspects of water transport and the unique challenges faced while designing solutions for water based mobility.

2. PRELIMINARY RESEARCH

As a part of getting familiar with the different types of water transport and also the overall atmosphere of Kerala, we spent a few days travelling around places such as Kochi, Alappuzha and Kollam. The observations done as a part of this provided a highly beneficial groundwork for the completion of the project.

Shikara – Alappuzha

The Shikara is a concept borrowed from the famous day-cruising boats used in Dal Lake, Kashmir. These are typically small boats which can seat up to 10 people. The superstructure is open from sides to allow maximum visibility around while the roof provides shade and basic rain protection. The driver sits up front which gives him good command of manoeuvring. The passengers have plush chairs, divans and cushions lined along the sides of the hull for seating. The superstructure uses a combination of materials for construction. GI pipes and bamboo are used for framework, along with wooden pillars and covered with woven bamboo sheets. Coir, a traditional rope made using coconut fibres, is used to tie the structure together as well as wrapping some rods or beams. The open structure and the sedate pace make the Shikara a relaxing day cruiser.

Comfortable seating.

Safety equipment.

State Transport Boat – Alappuzha to Kollam

The backwaters of Kerala houses the National Waterway – 3, stretching from Kollam to Kottappuram. The state government employs a number of passenger boats along the waterway. The boat has two levels: a closed lower deck and an open upper deck with roof. The lower deck is appointed in a similar way to the government buses, with cushioned seats and rexin seat covers, while the upper deck uses bare steel chairs. Devices like life jackets and life buoys are easily visible and accessible, but kept unsystematically, often piled up on one of the empty seats. There are typically 4 crew members: a driver who controls the steering, another driver who controls the throttle and reverse, and 2 crew members who guard the doors as well as secure the boat to the jetty while docking. The short distance routes in Kochi, Alappuzha and Kollam are often crowded.

Hop On, Hop Off Water taxi – Muziris

Muziris is an ancient port town, renowned as one of the oldest centres of spice trade in Kerala. The state department of tourism uses air conditioned boats known as 'Hop On, Hop Off' for guided tours along the historic locations in Muziris. The name comes from the concept that the boat is used on a multi-stop journey, where the passengers 'hop off', enjoy the sights and 'hop back on' before continuing to the next destination. The body of the boat is based on a Tempo Traveller, and has a contemporary design. The interiors also take cues from tour buses, with relaxing seats, overhead AC vents and lighting.

Solar ferry “Aditya”- Vaikkom and Thavanakkadavu

Aditya, India’s first solar ferry, is a solar-powered ferry operating between Vaikkom and Thavanakkadavu. It is India’s first solar-powered ferry and the largest solar-powered boat in India. The 20-metre-long and 7-metre-wide catamaran is covered by 140 square metres (1,500 sq ft) of solar panels rated at 20 kW, which in turn connect to two electric motors of 20 kW, one in each hull. The interior of the vessel is spacious and it has comfortable seating for 75 people. It also has a television and decent sound system for the entertainment of passengers. the overall experience of the journey in Aditya was silent and pleasent.

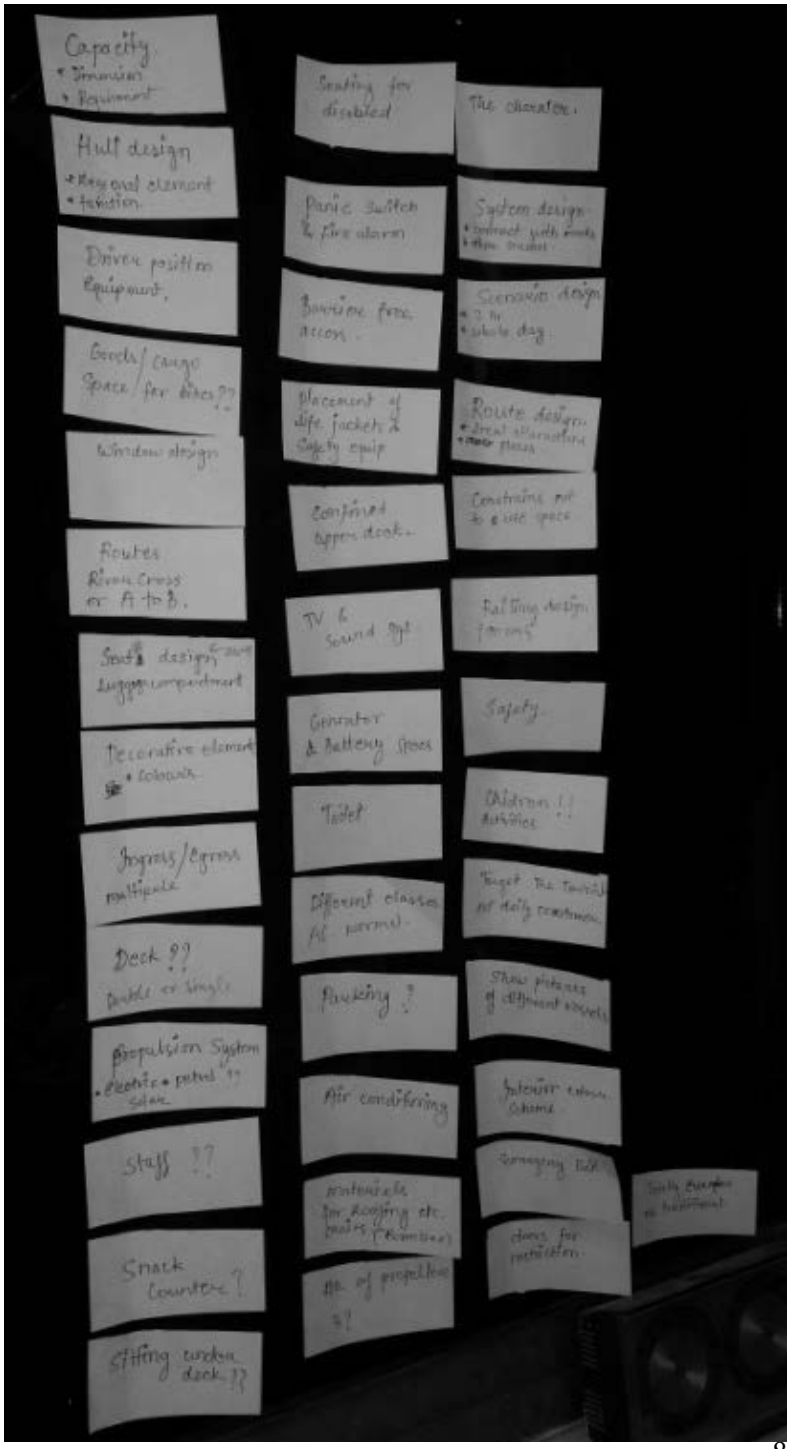
3. PROJECT OUTLINE

The initial project brief was to design a water taxi for guwahati considering tourists and commuters as target users. The vessel should fulfill the basic requirements of the users such as comfortable seating, storage compartment, sanitation etc. Since the project had to be done in colaboration with the government, meeting the government officals and discussing the overall service and future plans was also part of this project.
The need for such vessel was also taken in consideration. The existing service vessels are big, inefficent and slow. Some small vessels are run by local boat makers and buisness men, so a reliable, fast and affordable government ferry service is required in guwahati.

4. INITIAL BRAINSTORMING

A brainstorming session was carried out in order to extract a number of keywords which would be beneficial for later stages. The keywords were initially accepted without question, and later grouped and eliminated based on relevance.

Capacity, hull design, Driver position and equipment, window design, Routes, Seat design, luggage compartment, Decorative elements, Ingress/egress, Deck, propulsion system, snack counter, staff, rooms, barrier free access, safety equipments, entertainment systems, generator, toilet, air conditioning, materials for hull, foldable furniture, no. of propellers, desirability, system for connection with roads, deliberate constrains, railings, activities for children, target users, interactive user study, interior color scheme, emergency exit, foldable doors.



5. Tender details

Meeting with Sri Musfiquar Rahman, Joint Director of Inland water transport in assam made the design brief more clear. Sri Rahaman also provided a soft copy of the tender floated by the government of assam for the design and construction of the river taxi. The technical section of the tender had important guidelines for the design and construction of the vessel.

The dimensional requirements:

Length Overall	15 meter (minimum)
Molded Beam	4.5 meter (minimum)
Depth molded	1.7 meter (minimum)
Draft	0.85 meter (maximum)
Air Draft	4.5 meter (maximum)
Cabin Floor Area	30 sq meter (minimum)

Non air-conditioned

Performance requirements:

Displacement	10 metric tons (minimum)
Dead Weight	5 metric tons (maximum)
Tonnage Speed (Cruising)	12 Knots (downstream)
	10 knots (Upstream)
Fuel Consumption at 75% throttle	Not exceeding 25 Liter/hour

Appearance: The Vessels shall be of aesthetically pleasing and contemporary design with superior fit and finish as per international standards.The passenger cabin would be of aero-dynamic shape with a sloping front windshield and inset doors and windows. The vessel would have a front and rear open-deck section and the interior shall be of contemporary design allowing comfortable ingress and seating arrangements.

Material of Construction: The Catamaran Vessels (Hulls as well as Cabin/Deckhouse) shall be made of Fiber Reinforced Plastics (FRP) of superior quality as per standard marine practice with FRP Composite sandwich construction in PVC-core or other compliant and approved composite material sandwich panels UV-proof marine grade Gel-coat surface as approved by Classification Society.

Design of Hull Structure: The Hull design shall be done by a Naval Architect and shall have a low Block and Prismatic Coefficient, low draft, small water plane and wetted surface area and narrow waterline beam for high efficiency, speed and low water resistance.

Guard rails: Guard rails to be fitted on the fore-deck and aft-deck and fabricated out of SS 316 tubes of at least 50mm OD and 1.5mm wall thickness and provided with toe guards.

Engine & Gearbox: The vessel shall be powered by twin modern low pollution, fuel efficient and light weight Naturally-Aspirated or Turbo-Charged 4-stroke Diesel self starting Engines with Marine Hydraulic Gearboxes and Propellers. The engines should be either Marine grade or certified Marinized with a closed loop cooling system using a heat-exchanger or keel cooler.

Fuel Tanks: The River Taxis shall have adequate capacity of fuel oil storage for endurance of two (2) days with daily 10 hours of service. Two (2) diesel tanks each of 200 liters capacity, one fitted in each hull with individual diesel level indicator shall be provided.

Helm and Dashboard: The driver's seat and controls shall be fully enclosed and located in the forward part of the vessel and shall have clear unobstructed view. Clear-view glass with provision for easy opening and closing are to be provided with the center frontglass at steering wheel position and provided with at least one wiper. Dashboard shall also be fitted with all engine gauges, indicator lights and switches as well as all navigation equipment.

Power Backup: Domestic Battery Bank (minimum 12 volts 200 amps deep discharge) which is separated from the main engine Battery banks. In addition eco friendly solution like Solar panels can be installed for keeping the batteries topped up.

Deck Design: The Deck would be of FRP Sandwich construction with a non skid surface. The width of the deck shall at least 3.5 meters wide to accommodate the full width of the passenger cabin with an open fore-deck and a aft-deck area. The Passengers Cabin would be mounted atop the Deck area and comprise of the Driver's enclosure at the fore followed by rows of passenger seats.

Canopy: The coach roof of the vessel shall be designed to be aerodynamic and fabricated out of FRP composite sandwich with a PVC core with provisions for draining off rain water as is necessary during rainy season. The Canopy would also have sufficient strength to support the weight of 2-3 crew members without buckling who would periodically have to climb up on it for cleaning and maintenance purposes.

Entry and Exit: The entry and exit of the river taxis shall be designed so as to allow smooth and safe boarding and disembarking of passengers both from the sides as well as from the rear of the vessel.

Toilet and Fresh Water Pump: One Toilet is to be arranged at suitable place usable both for passengers and crews with all its necessary outfit, equipment and accessories. River Taxi shall be provided with SS fresh water tank having capacity of 150 ltrs.

6. Secondary research

In order to get familier with the inland water transportation on brahamaputra a brief research was carried out in the guwahati city. The aim of this reaserch was to identify the types of users, vessels and the types of services.

The floating terminal

Due to change in frequent change in water levels of Brahamaputra river floating terminals are used instead of low level jetty in this region for boarding and de- boarding. These terminals are steel catamarans provided by Inland Water Transportation department.

Floating terminal on the river bank.

Vessel mounted on the terminal.

Private ferry service: Guwahati to north guwahati

These small traditional boats are used for crossing the river by the daily commuters, students etc. The service is cheap and less time consuming compared to the journey by road. The vessels are also used for transporting goods and two wheelers. The capacity of the vessel is 50 people and 10-15 two wheelers.

Government Transport ferry

The government transport ferry is a reliable and cheap source of transportation for crossing the river. The vessels run between Guwahati and North guwahati but the frequency of the service is less. It is used mainly by commuters and students.The capacity of the vessel is 100 people and 20-25 two wheelers.

Boat restaurant: Alfresco grand

This private boat restaurant is a good place to spend an evening with family. It provides short sunset trips (1hr trip) on Brahmaputra and also the vessel is also used for various functions i.e. conferences, birthday parties etc. The capacity of the vessel is 230 people and it also has rooms to accomodate people.

River cruse: M.V Mahabahhu

This vessel provides Luxury cursing experience and the users are mainly foregin tourists. It provides Different packages from three to nine days and covers long route on the Brahamaputra. The vessel can accomodate 80 people including the crew and passengers.

7. User research

The user research was carried out in the form of friendly conversations with the boat driver, crew and passengers. Some question were prepared in advance but the conversations were mostly user driven.

Conversations with the driver and crew

Where do you make the boat?
On North Guwahati Ghat.

How much does it cost?
7 lacs

How many trips do you make every day? (across river)
10-12 trips

How many vessels are there on North guwahati ghat?
8-10

How many passengers and vehicles in one trip?
50 people and 7-8 two wheelers

What are the charges?
10rs for passenger and 20rs for two wheeler

Every boat has three crew members.

The drivers seat and controls.

Traditional boat making

What is the lifespan of the boat?
3-4 years with maintaince

What materials are used?
Wood, tin roofing sheets.

What are the working hours?
7am to 9pm

How many tourist trips?
2-3 trips per week

Trip duration and distance?
15 min trip 1.5-2 km distance.

Dimentions- length: 20m Width: 3.5m Height:2m

Boat making on north Guwahati ghat.

Newly made vessel.

Conversations with the users

What kind of experience do you want?
Silent, spacious and comfortable

How many trips do u take?
2 trips on week days
2-3 trips per week

Any other requirements?
Toilet
Better seating
Better ingress/egress
Good windows
Safety equipments
Better aesthetics
Eco friendly

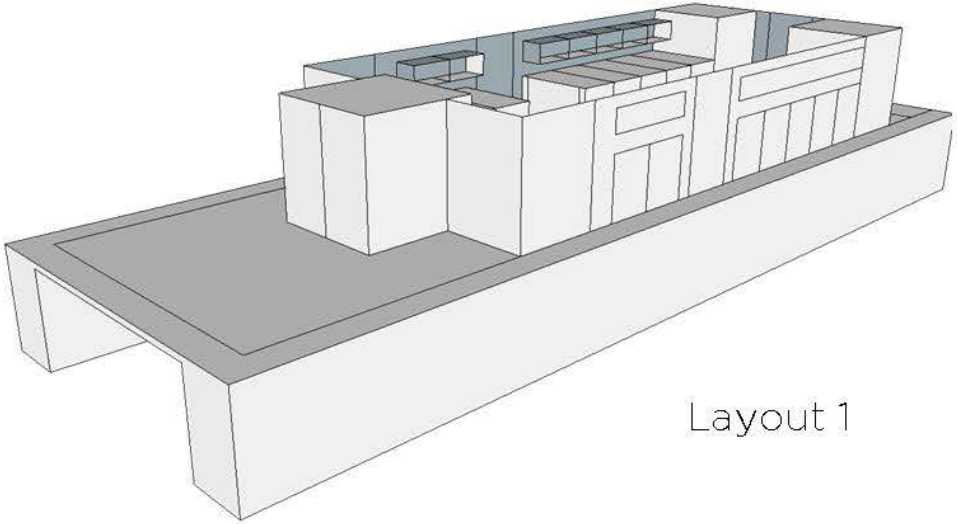
What kind of aesthetics do you want?
Modern, colorful.

What kind of entertainment system?
Television, music, phone charger.

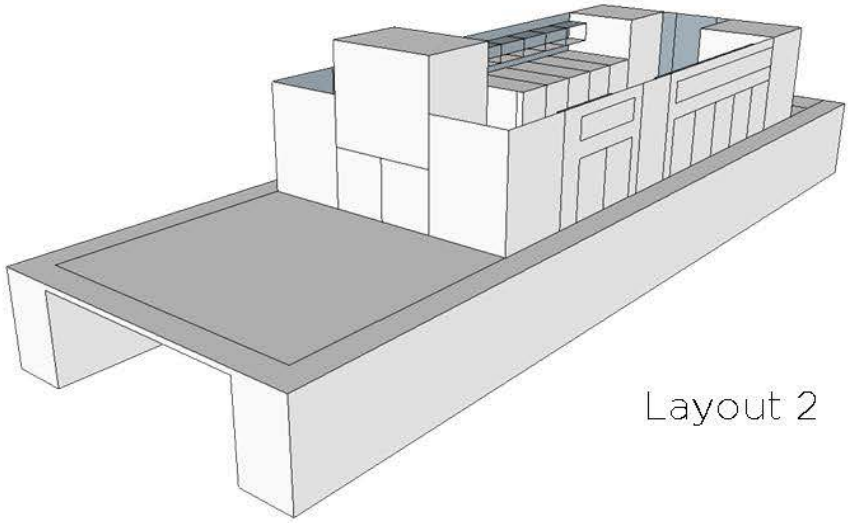
How many people do you travel with?
2-3 co-workers, family members

Last mile connectivity?
Auto rickshaw, motorcycle, walking.

8. Layouts



Layout 1



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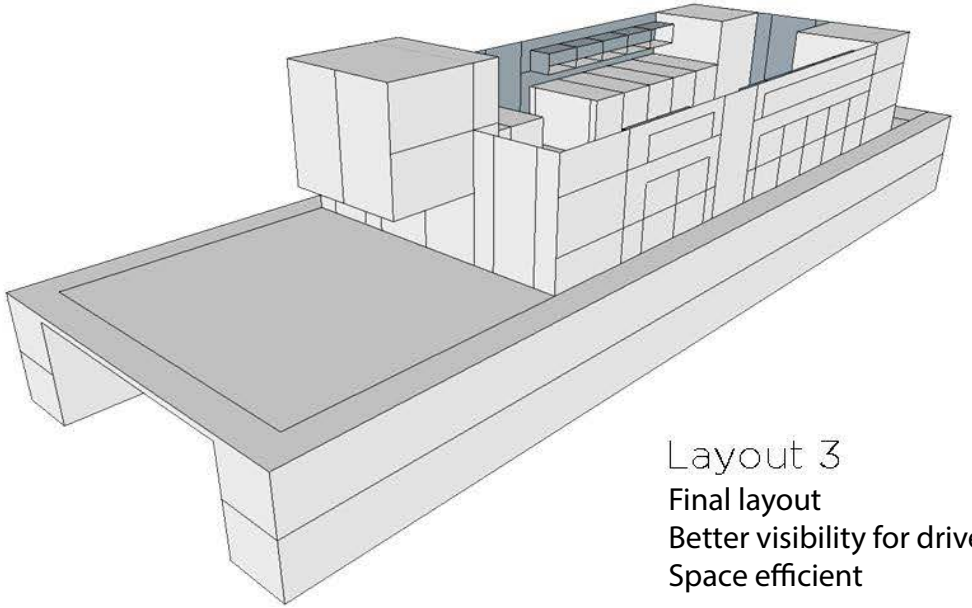
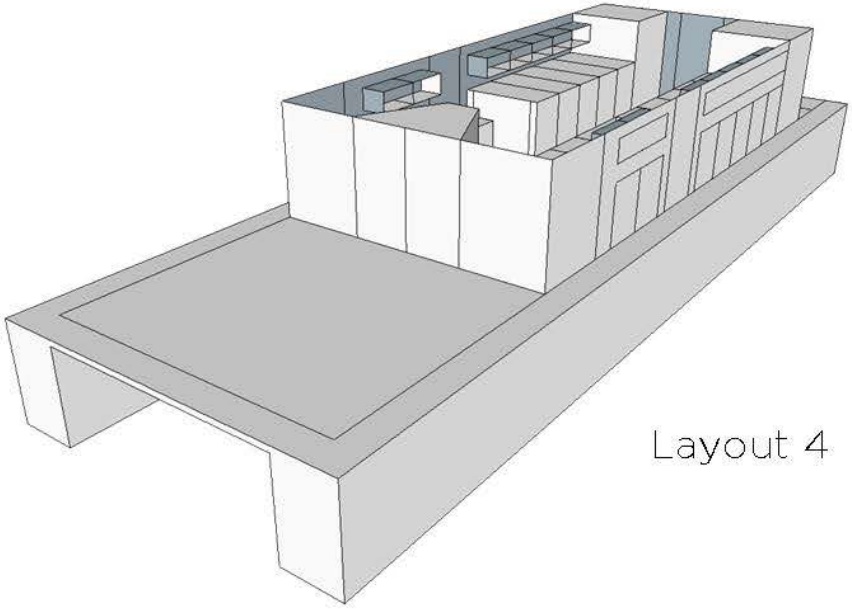
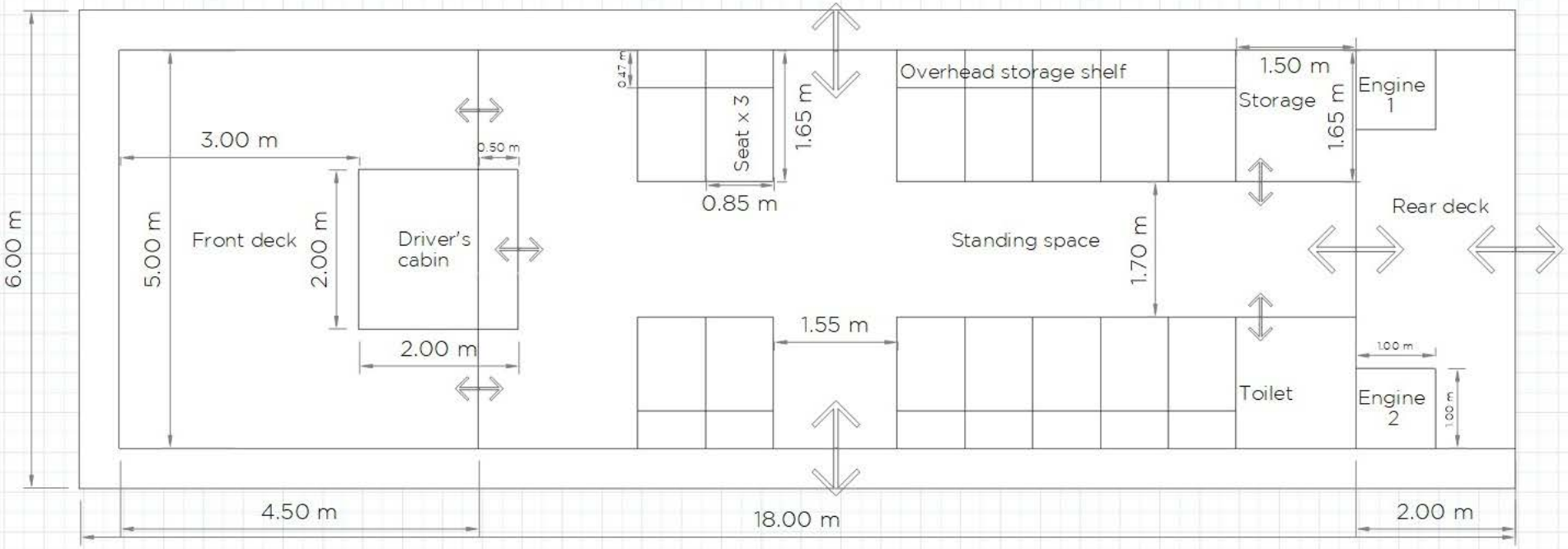


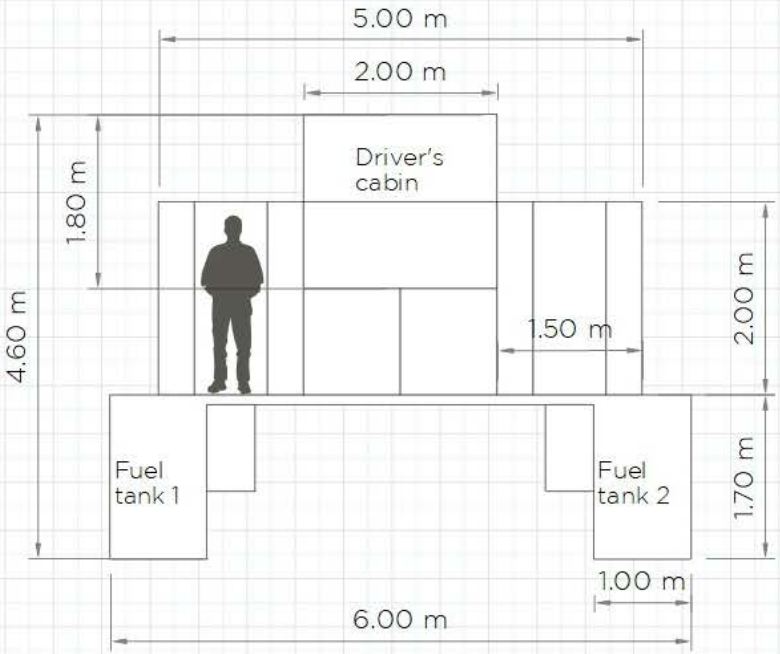
Layout 3

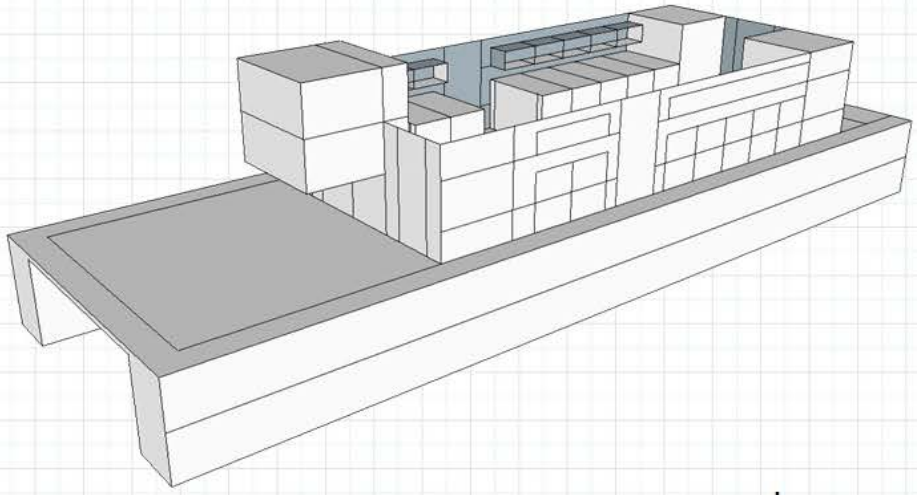
Final layout
Better visibility for driver
Space efficient



Layout 4


6.00 m
5.00 m
3.00 m
Front deck
2.00 m
Driver's cabin
0.50 m
2.00 m
4.50 m
0.47 m
Seat x 3
1.65 m
0.85 m
Overhead storage shelf
1.50 m
Storage
1.65 m
Engine 1
Rear deck
Standing space
1.70 m
1.55 m
Toilet
1.00 m
Engine 2
1.80 m
18.00 m
2.00 m

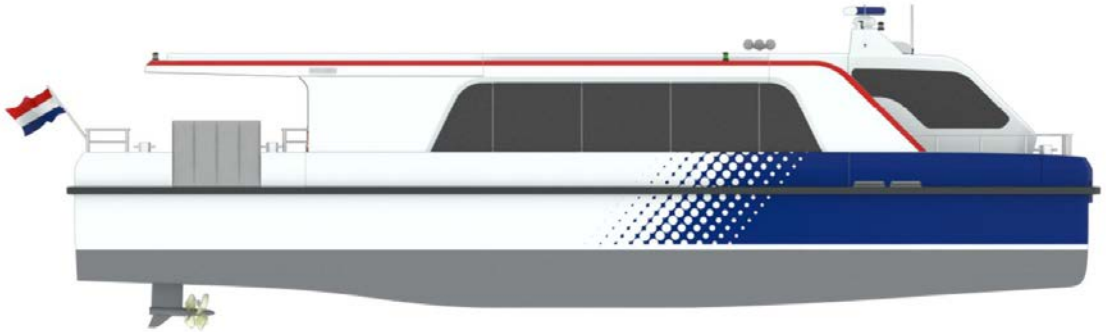

5.00 m
2.00 m
Driver's cabin
1.80 m
4.60 m
1.50 m
2.00 m
Fuel tank 1
Fuel tank 2
1.70 m
1.00 m
6.00 m

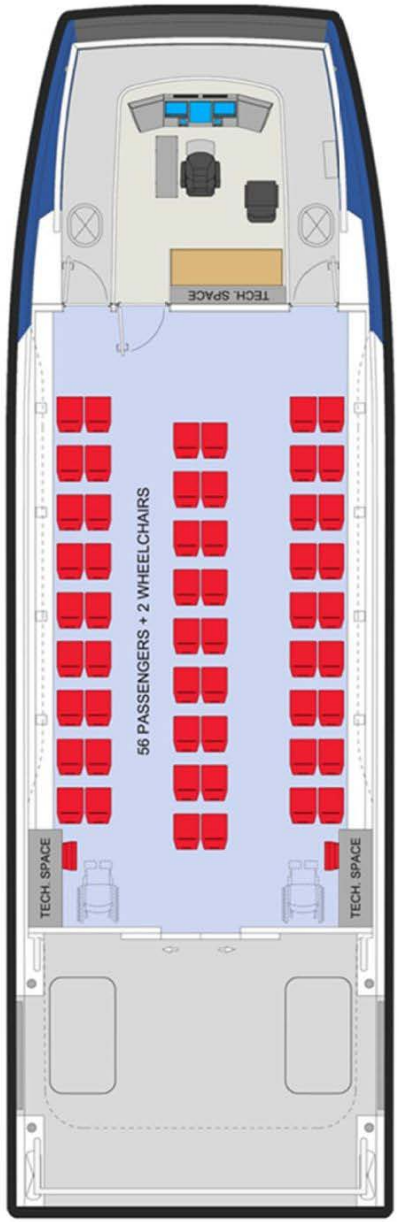


Layout 3

9. Bentchmarking

After selecting the layout and dimentions, a brief research was done to find similar products for the purpose of bentchmarking. Damen Group is a Dutch shipbuilding, and engineering company and their water bus 2007 (Urban Shuttle) was selected as a bentchmark due to similar dimentions and layout.

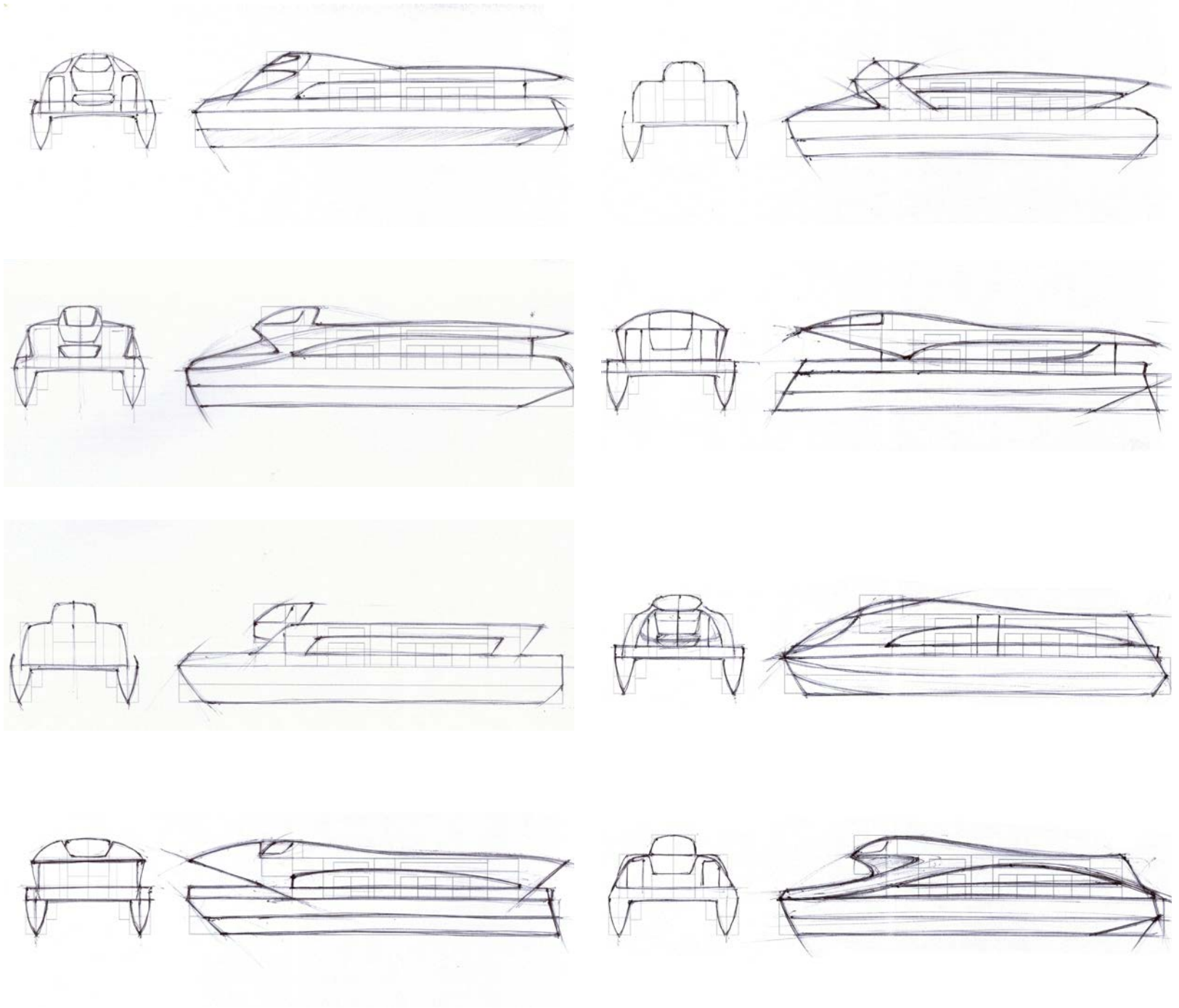


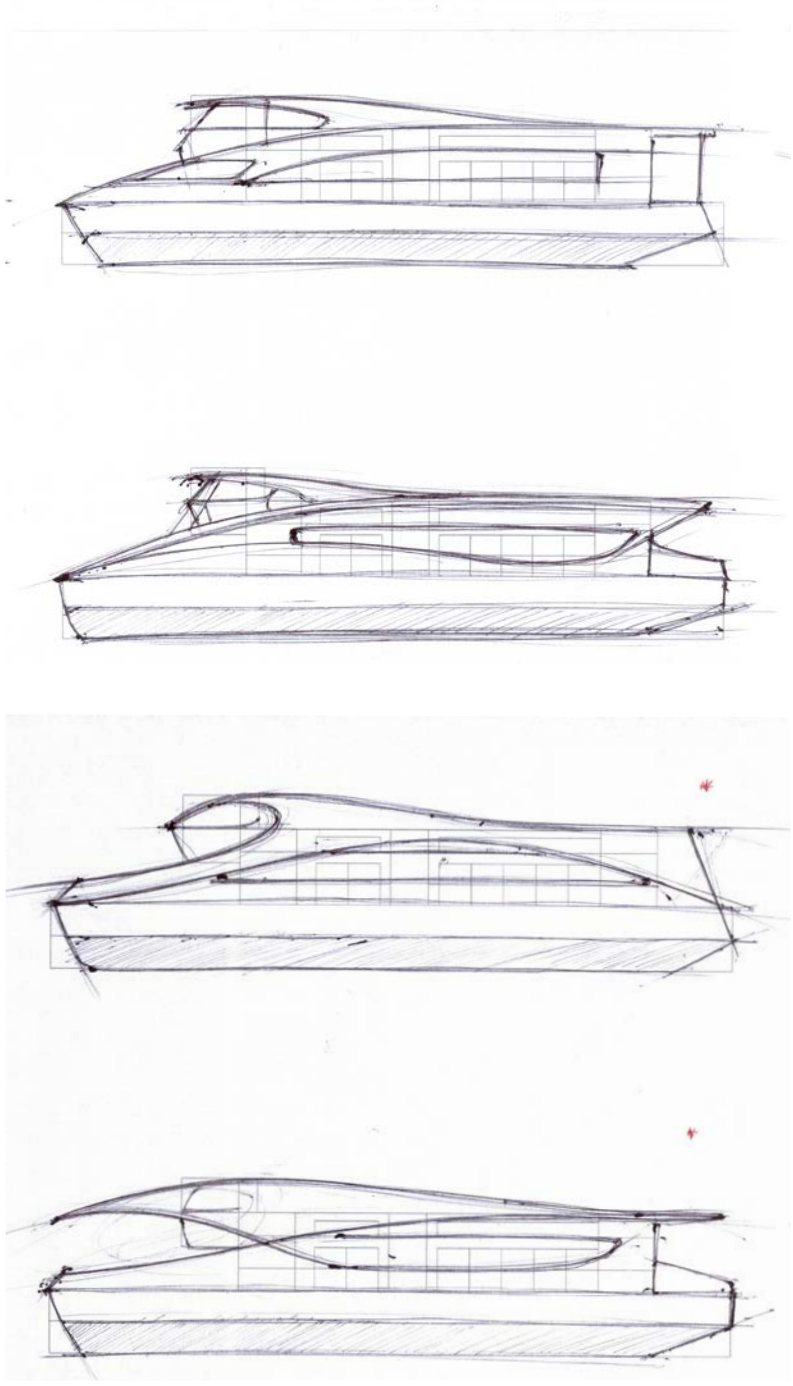


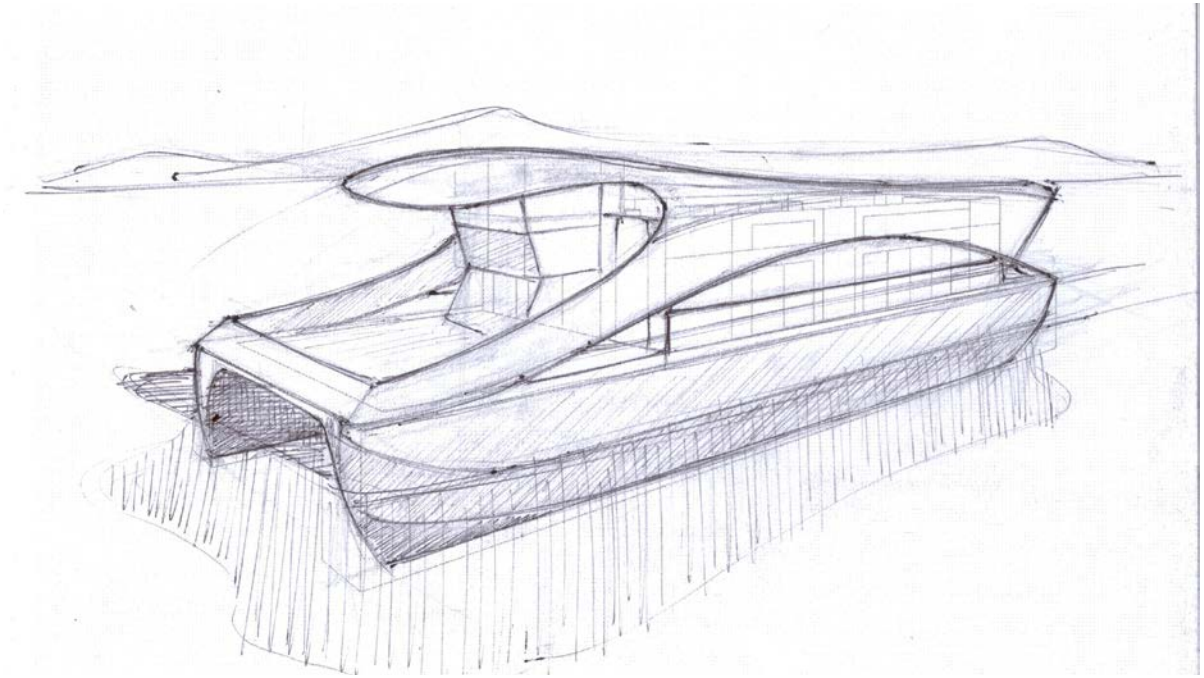
10. Exterior design

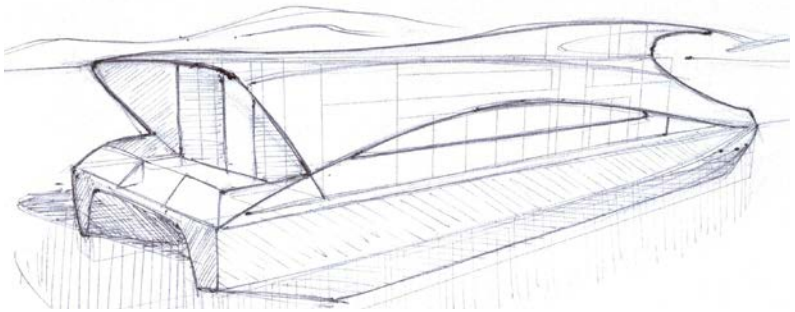
Moodboard
Keywords:
Aerodynamic
contemporary
Sleek

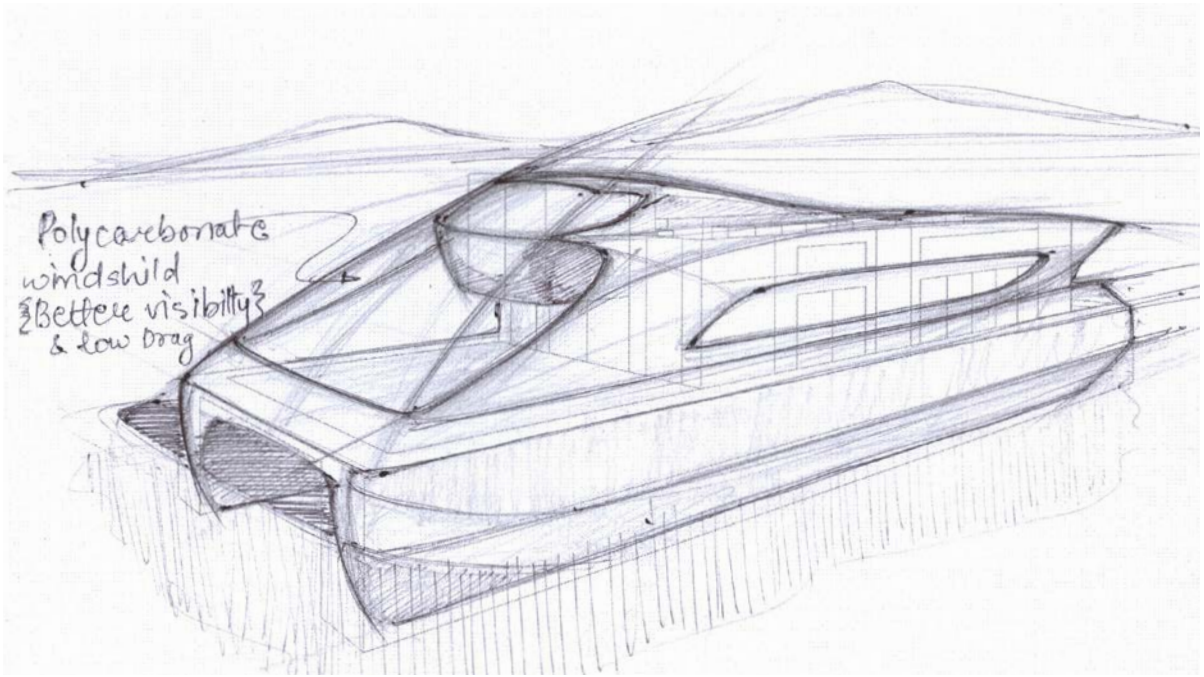
Ideation

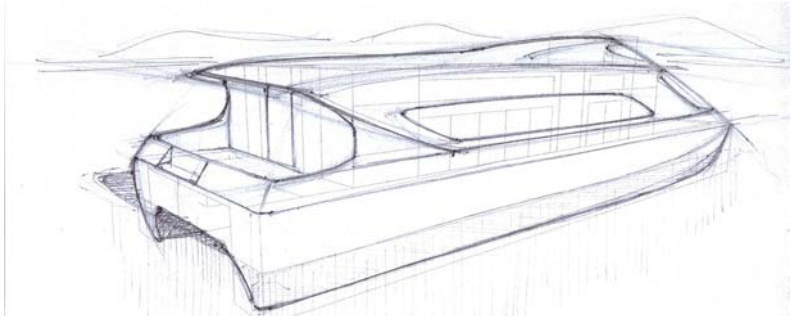


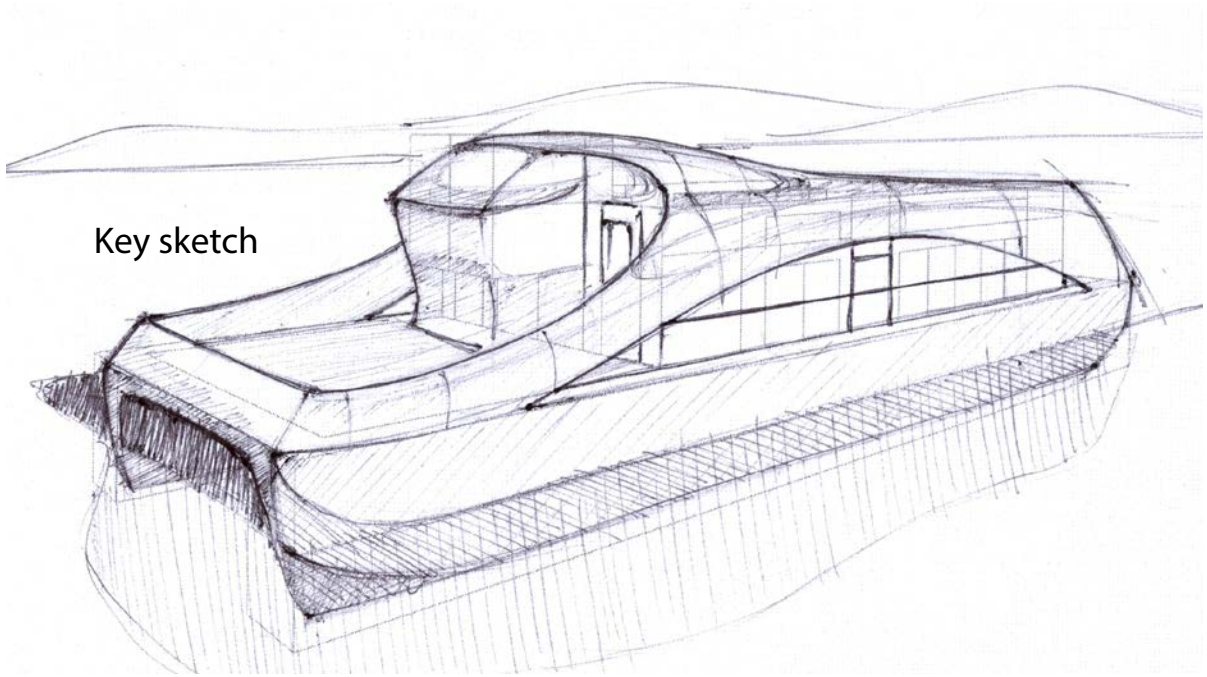

Air

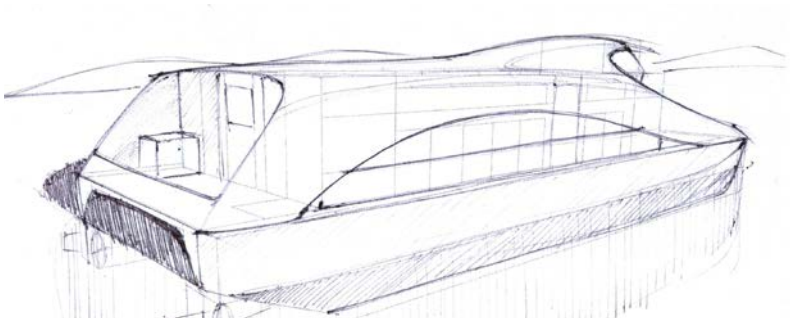


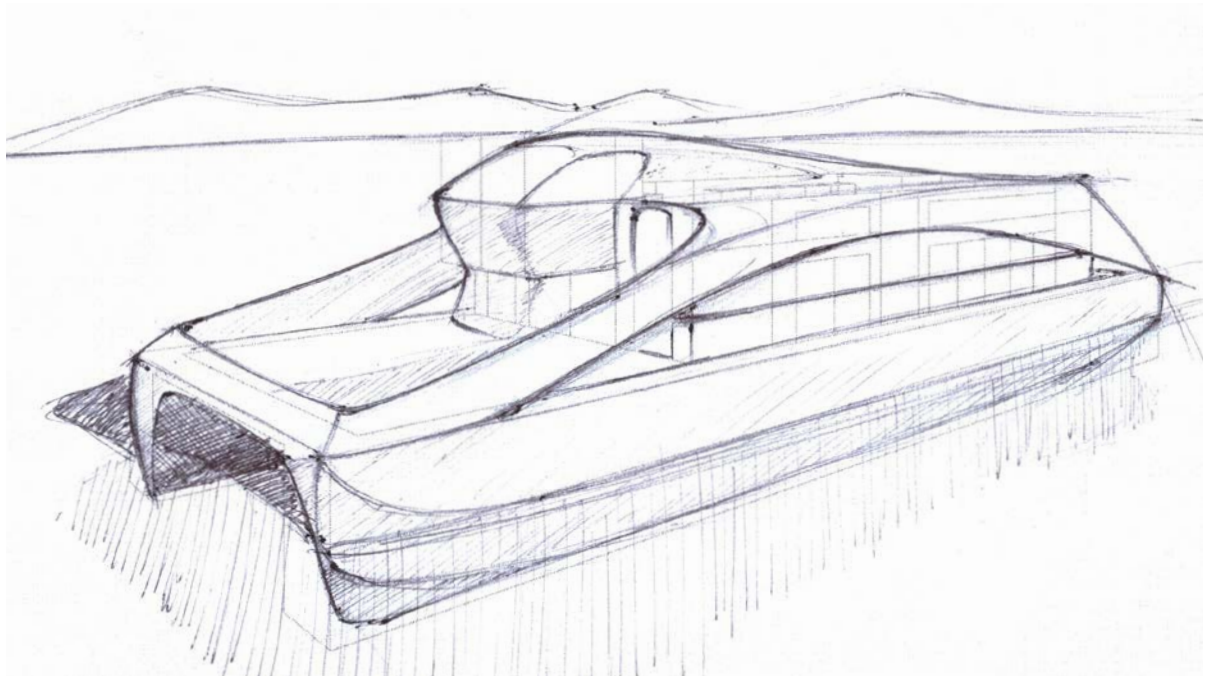


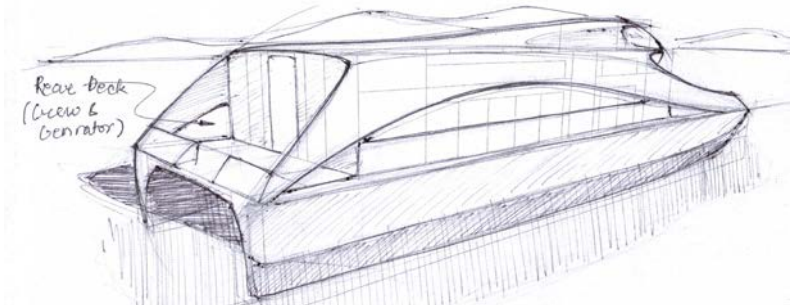

Polycarbonate
windshild
{Better visibilty}
& Low Drag



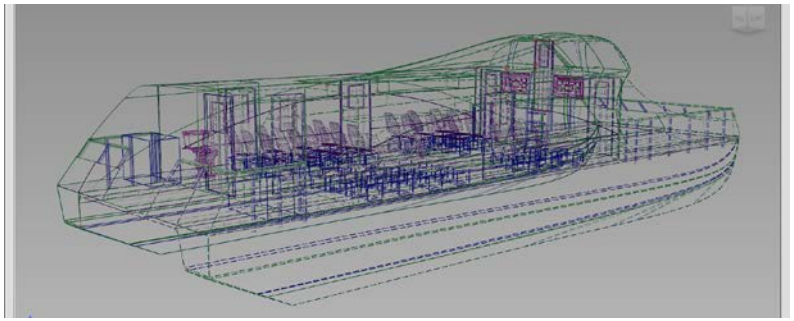

Key sketch

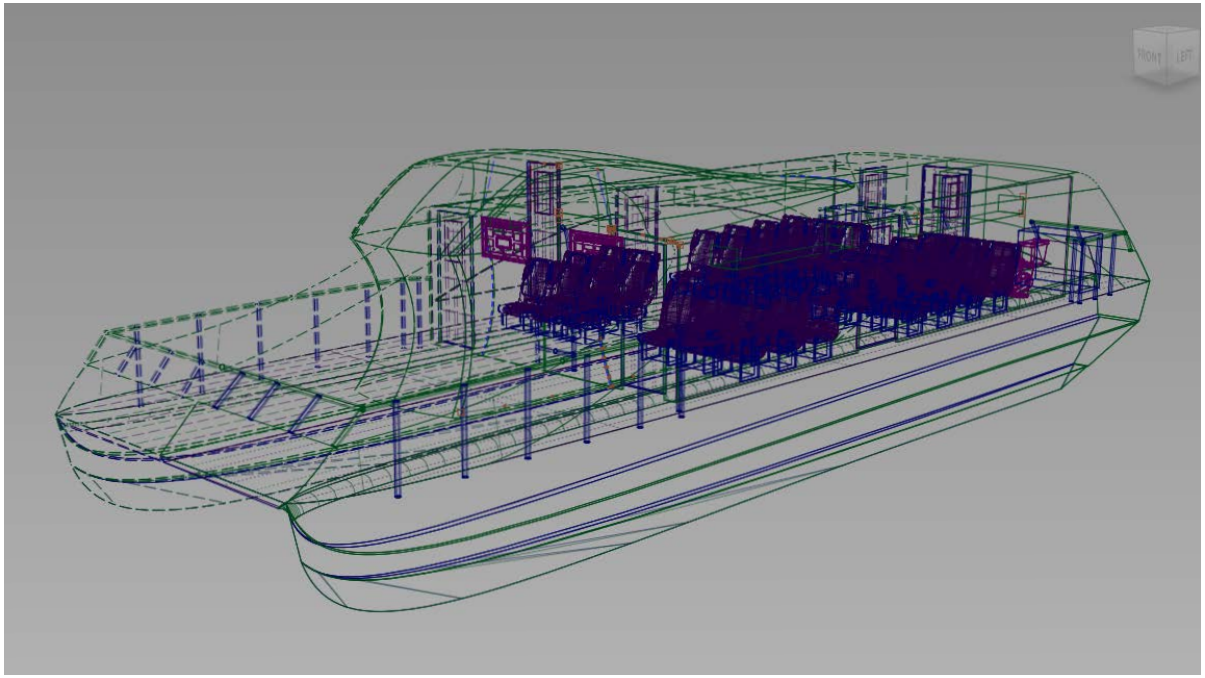


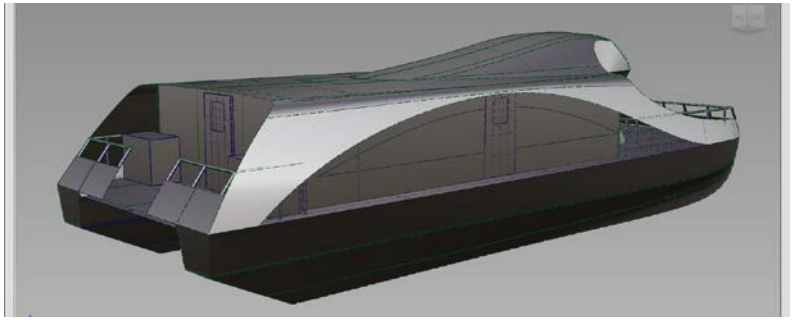


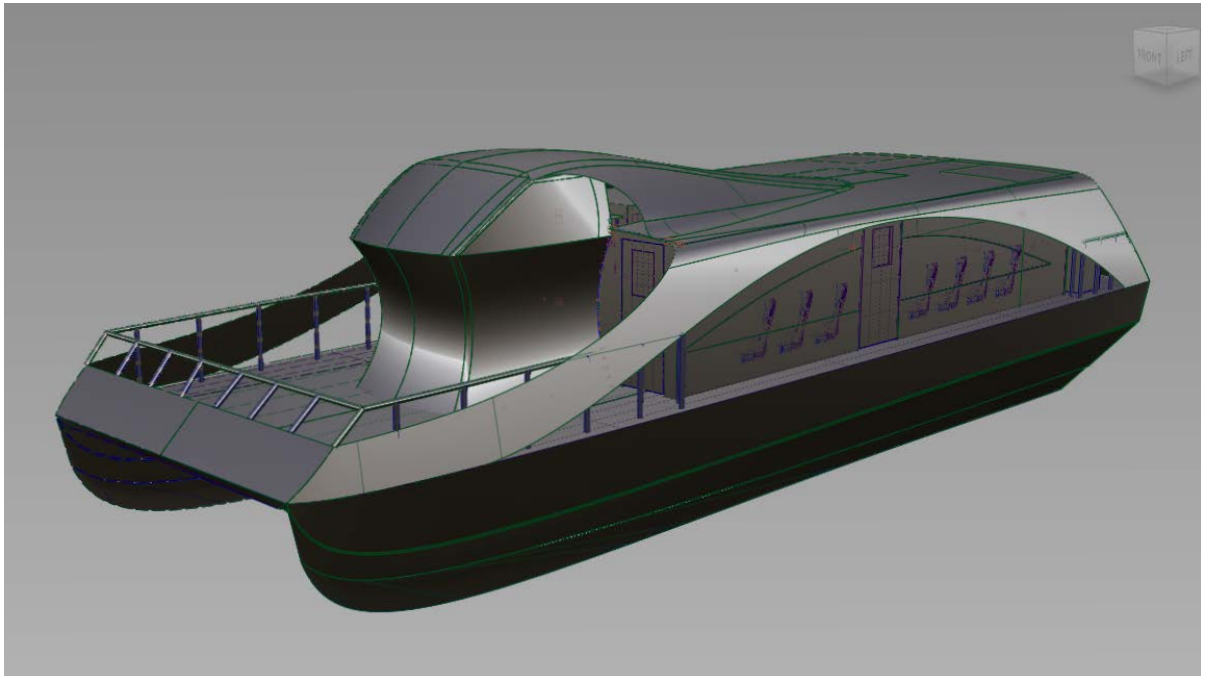

Rear deck
(crew &
generator)

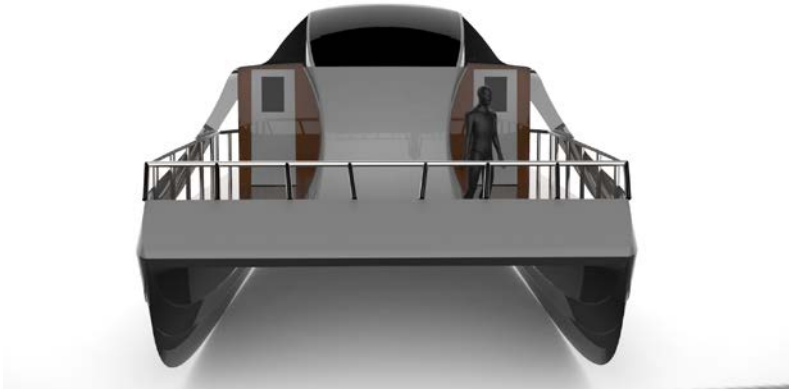
Surface model in Alias

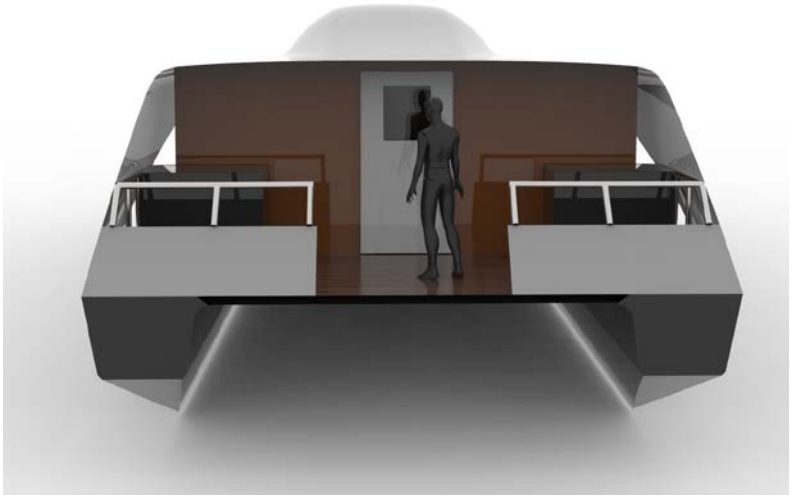








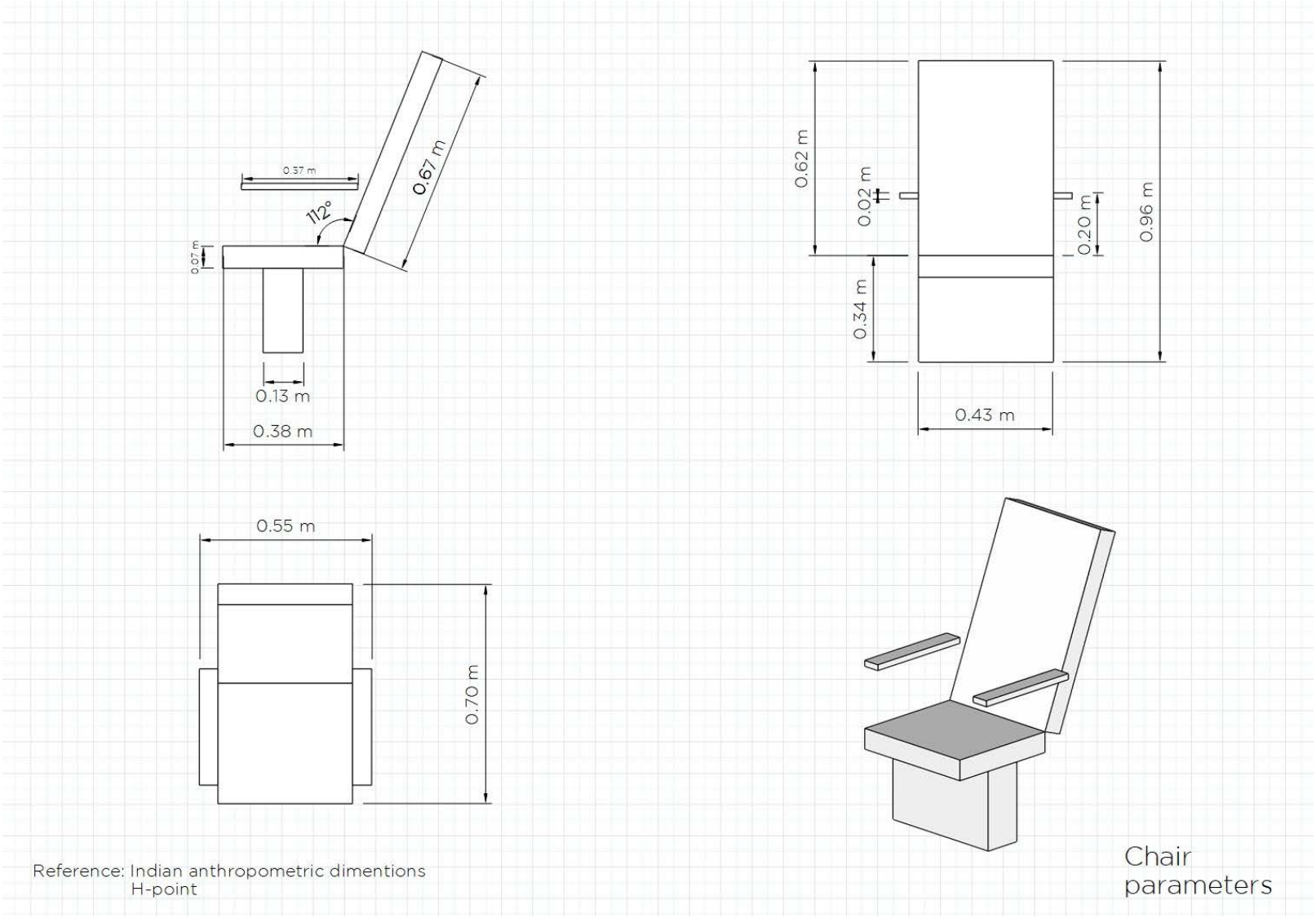


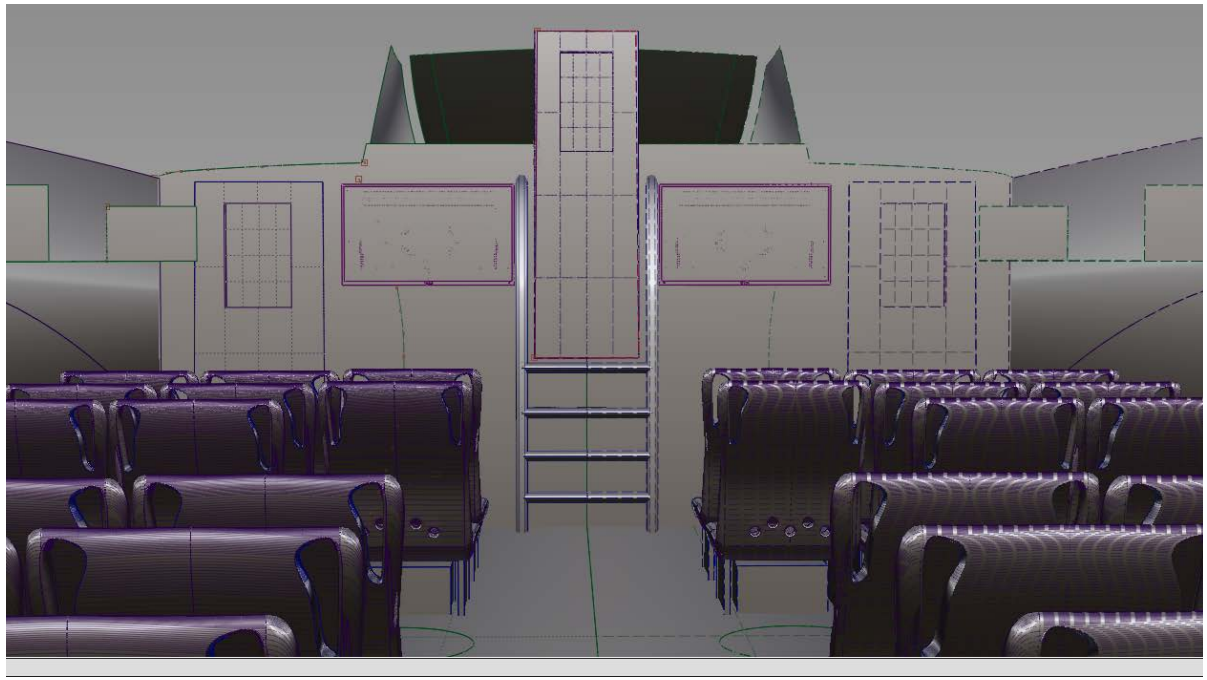


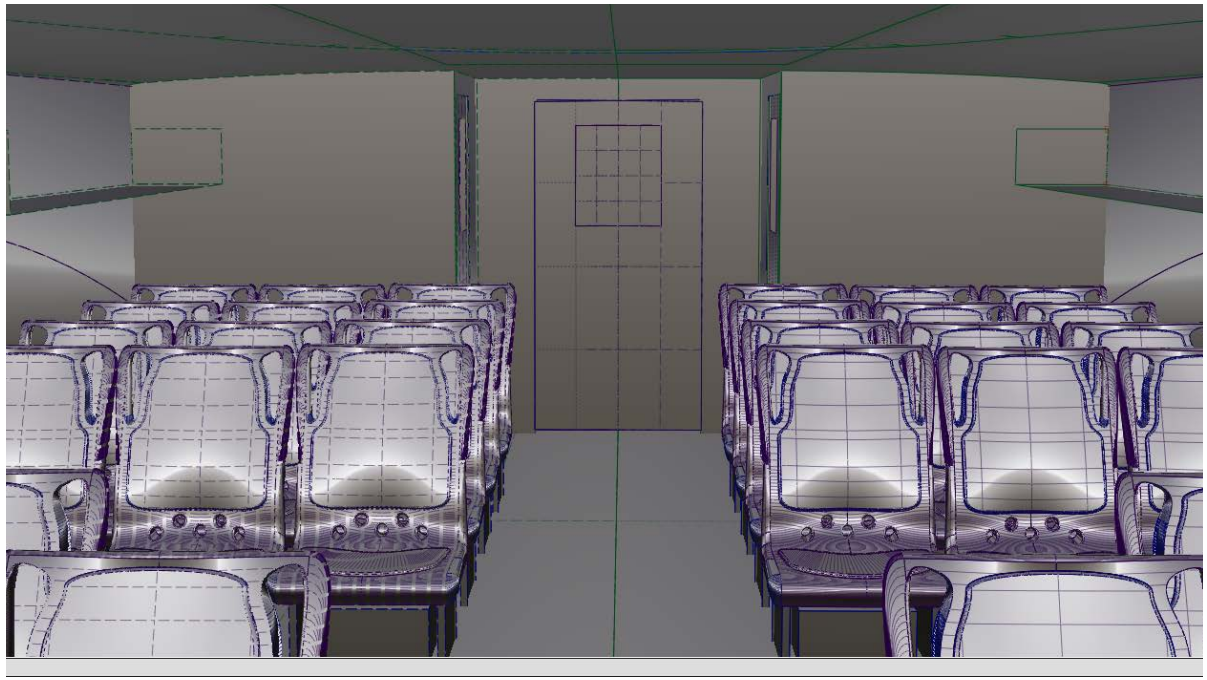
Final renders

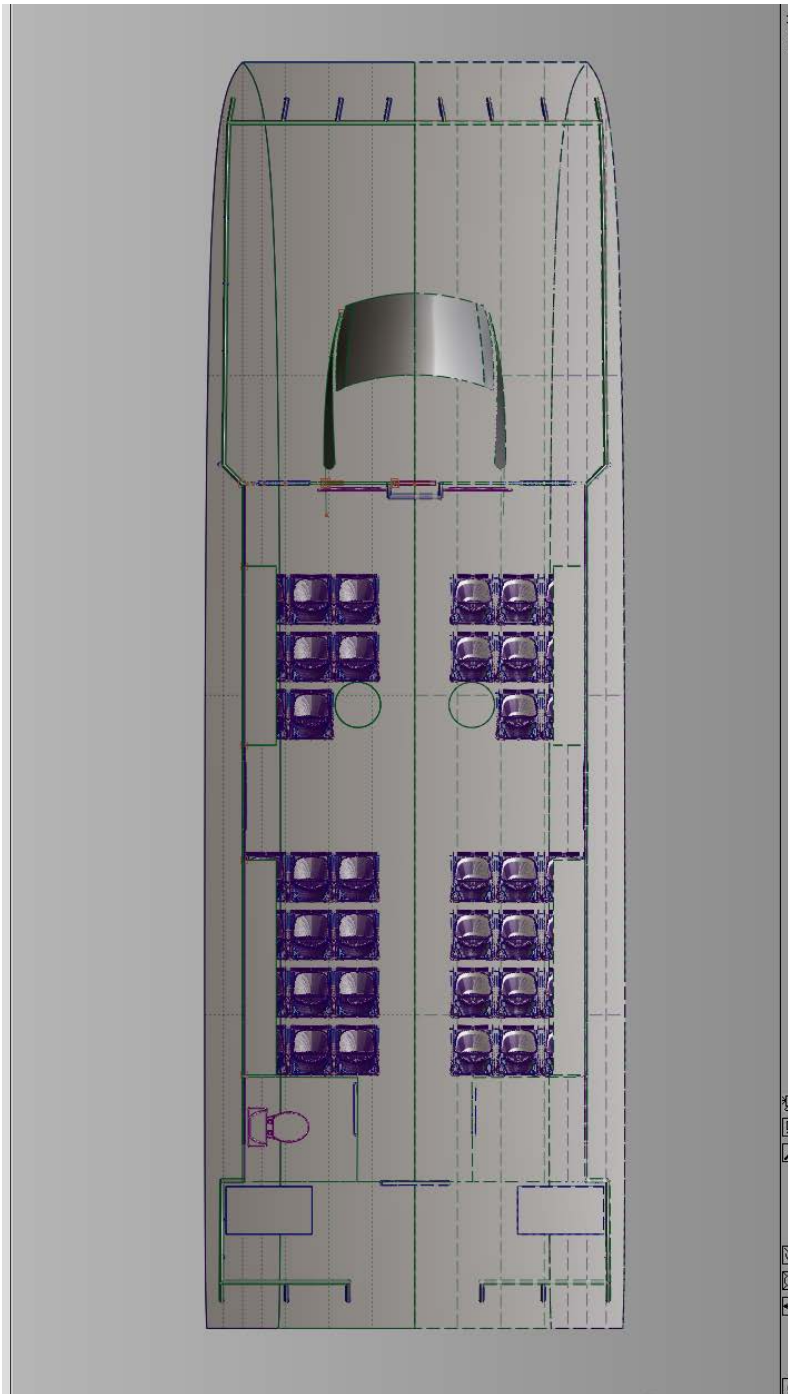
10. Interior design

Ergonomic chair design









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