

xamba.

Sustainable social growth on the world stage



"I'm passionate about the green revolution and how it changed the face of agriculture... That mechanization is one of the keys to making Senegal food sufficient. We can have a sustainable future with biofuel in Senegal and I'm going to cross the Atlantic to prove it"

-Dany Bode, Founder, Aywa International

Starting in the autumn of 2013, as part of UC Forward and UC3, The S-Project focuses on sustainable development strategies and the development of a biofuel motor, a biofuel production system, and pilot farm site that demonstrates the growing, processing and oil extraction of the seeds of the Jatropha plant. The oil from this plant is extracted to produce biofuel to power multi-use engines used for transportation on land and water, tilling soil, pumping water for irrigation, generating electricity, and extracting oil from the seeds of the plant. The S-project traveled to Senegal to complete design research and start a multi-year project with Aywa International, a Senegal based NGO focused on assisting community farmers in creating sustainable growth.

In December of 2013 our group went to Senegal to work with Aywa and study ways to assist the farmers in their cycle of work. We studied the

agricultural state from a permaculture perspective and the business and education aspects of the harvest to understand the cultural situation as well as the mechanical implementation of a biodiesel engine installed in the village. Out of that trip and subsequent conversations with Dany, we had the idea to power a traditional Senegalese Pirogue (boat) across the ocean and use that publicity to power the integration of jatropha as a fuel.

I am designing the interior and exterior of the boat that will take us across the Atlantic Ocean as an aspirational set piece. Powered by jatropha oil and built by Senegalese shipbuilders, the boat will represent the story of growth in Senegal.

The opportunity here is to tell a different story out of west Africa. One that reveals the beautiful craftsmanship and sustainable growth already underway. One that inspires the world to get involved, to invest, to meet, to support. One that shows sustainable agricultural, social, and economic growth in Senegal.

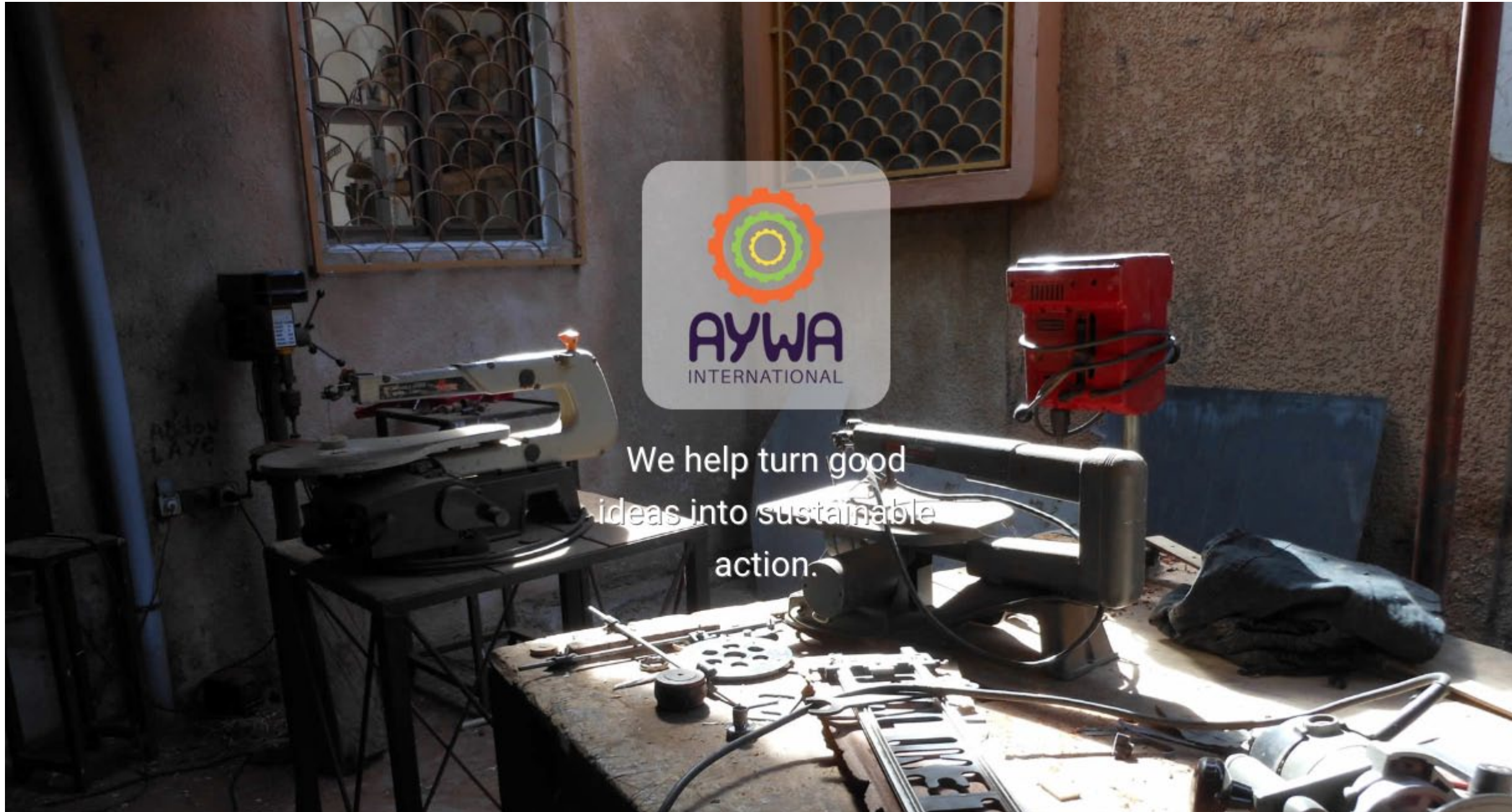


chapter one.

visit to Djilor



In December of 2013 our UC Forward class travelled to Dakar and then on to Djilor



In 2003, Aywa began providing technical training to Senegalese students in wood/metal work, textiles, and other handicrafts and supporting them in marketing, quality control, and business development. A number of Senegalese-owned businesses have been incubated by our program, including Malika Monkeys, an artisan handicraft brand with distribution through stores in Dakar and direct sales around the world.

In 2008, Aywa's focus expanded to include the incubation of technologies and solutions relating to energy, water, and agriculture. That year, our organization was awarded a grant from the World Bank Development Marketplace to develop an outboard motor that would increase mobility and access to markets for farmers along the Sine-Saloum River. Partnering with local women's groups, Aywa planted hundreds of Jatropha trees to test the viability of producing Jatropha seed oil to be used as an alternative fuel for the motor.

Since 2010, Aywa has hosted individuals and groups of design, marketing, and engineering students from organized university programs. As a result of these partnerships, we've not only had a hand in the launch of successful development pilots and design products, but also in the facilitation of cross-cultural and interdisciplinary exchange.

www.aywainternational.org





Subsistence farmers in Senegal struggle to gain in the calories in/calories out world of sub-saharan agriculture. The use of small engines to power heavy labor is cost prohibitive to most. Jatropha seed diesel engines can change that. Aywa International is working with the Djilor villiage leaders to develop and implement this biofuel system to allow farmers to have a closed loop energy system.

Aywa International is devoted to facilitating sustainable social developement in Senegal.







Sadu and Dany of Aywa talking about the permaculture practices at Beersheba preserve.



I learned about Aywa firsthand while working on the S-Project: a multi-disciplinary UC Forward course focused on sustainability and social entrepreneurship. We visited Senegal in December of 2013 to research ways we could help Aywa with their mission.





jatropha.

Aywa has been working with a biodiesel engine run on jatropha seeds for use in small scale farming. Because the seeds can be grown in Senegal, the engine can exist as a self sustaining, closed loop system.

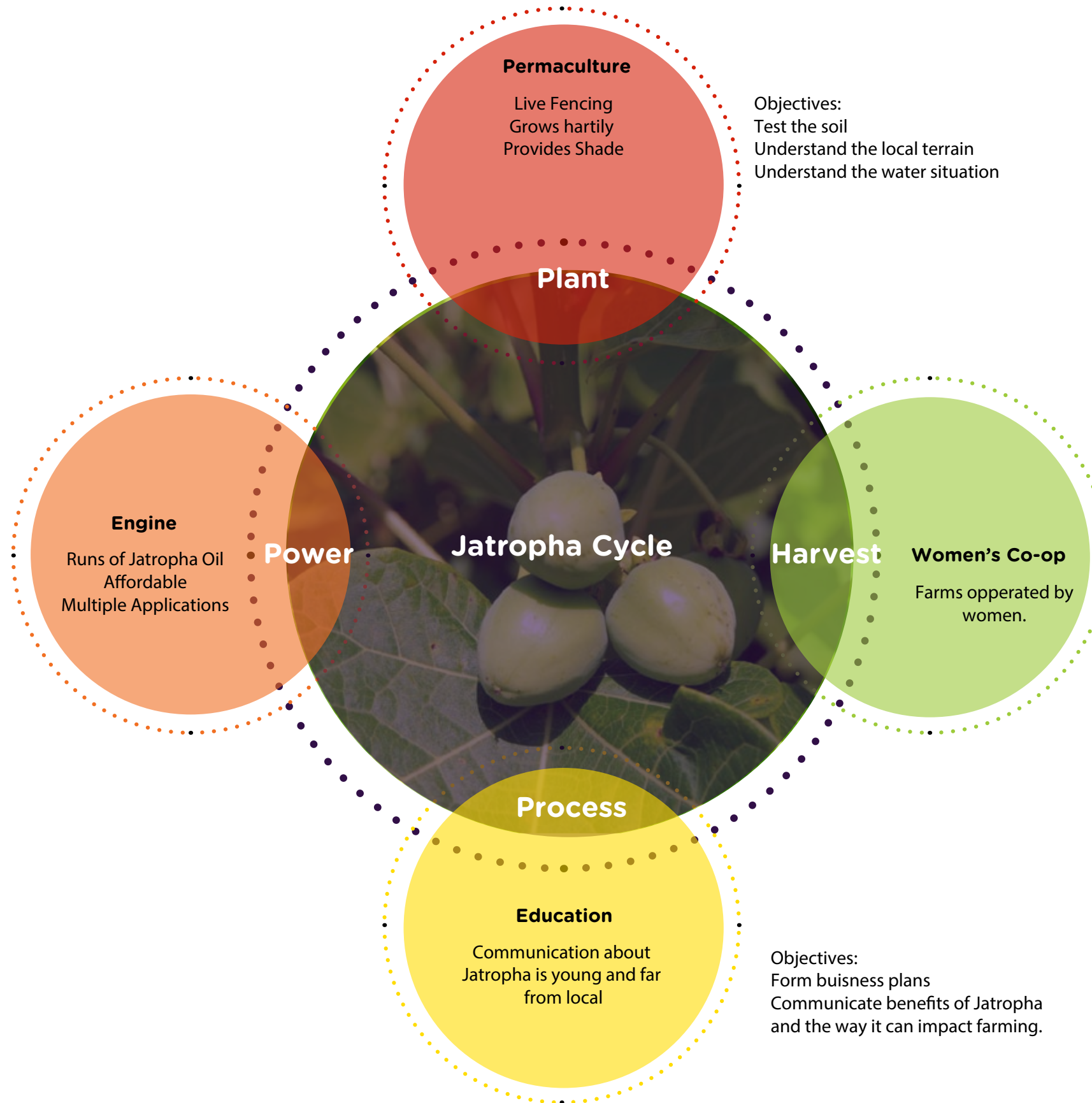
The fuel is made by crushing the jatropha seeds into oil.

The engine must start and stop on pure Diesel, but otherwise runs effectively on Jatropha oil.





Demonstrating and playing with the pump we installed in Djilor.



Objectives:
 Test the soil
 Understand the local terrain
 Understand the water situation

Objectives:
 Design Engine system that is affordable and reliable specifically for this region. Including:

Cage for engine
 Gearbox for multiple applications
 Jatropha seed crusher to make oil.

Objectives:
 Understand how farms are run and who makes decisions.
 Look for opportunities to elevate living situation.

Objectives:
 Form buisness plans
 Communicate benefits of Jatropha and the way it can impact farming.







Toward the end of the trip while we were visiting the dump in Djilor, Dany told me about one of his dreams. "I want to build a pirogue (boat) and cross the Atlantic with it, he said. We could power it with jatropha to show everyone it works. We could get some good press for Aywa and have this crazy adventure! "

The background features a repeating pattern of stylized sunflowers. Each sunflower has a yellow center with a dark green, dotted seed head. The petals are represented by dark green outlines. The sunflowers are arranged in a grid, with wavy, dark green lines separating the rows and columns. The overall color palette is dominated by shades of green and yellow.

chapter two.

the idea

Dany Bode.

Founder of Aywa International

“We can have a sustainable future with biofuel in Senegal and I’m going to cross the Atlantic to prove it”



the pirogue. the seed. the voyage.

the pirogue.

The Senegalese Pirogue is a traditional fishing vessel often used for coastal fishing expeditions of up to thirty days. It is built on a solid mahogany keel for cutting through big surf.





the seed.

Biofuel sourced in part from the village of Djilor will power the boat.





the voyage.

A 1700 nautical mile voyage across the Atlantic and show the world what sustainable growth is possible in Senegal.

The boat will be built in Senegal by master builders and powered by a Jatropha oil biodiesel engine. This blend of traditional craft and current energy solutions combined with a global crew demonstrates what development Senegal is capable of.

The boat also serves as both story and set for the accompanying documentary, telling the story of Aywa International's work in Senegal.

Dakar, Senegal

Fortaleza, Brazil



opportunity.

Tell a different story out of west Africa. Reveal the beautiful craftsmanship and sustainable growth already underway in Senegal. Inspire the world to get involved, to invest, to meet, to support a sustainable agricultural, social, and economic growth.

concept.

Design the interior and exterior of the boat that will take us across the Atlantic Ocean as an aspirational set. Powered by jatropha oil and built by Senegalese shipbuilders, the boat will represent the story of growth in Senegal. Design the boat to safely and comfortably make the voyage.

but why a boat?

Is this the best way to start the green revolution?

voyages that mattered.



Charles Lindbergh

The Spirit of St. Louis:

Proved the possibility of trans-atlantic flight and opened up the world to global air travel.



Thor Heyerdahl

Kon Tiki:

Changed the field of anthropology and challenged century old assumptions. Is also credited for inspiring the next generation of explorers, including the space race.



Buzz Aldren

Apollo Eleven:

The affects of the moon landing on our culture are pervasive and amazing. It produced numerous inventions, and inspired our economy.

A composite image featuring a wooden raft with a large white sail on the ocean's surface. Several people are visible on the raft. Below the waterline, a large shark is swimming. The text 'kon tiki' is overlaid in the center, with 'Case study.' underneath it.

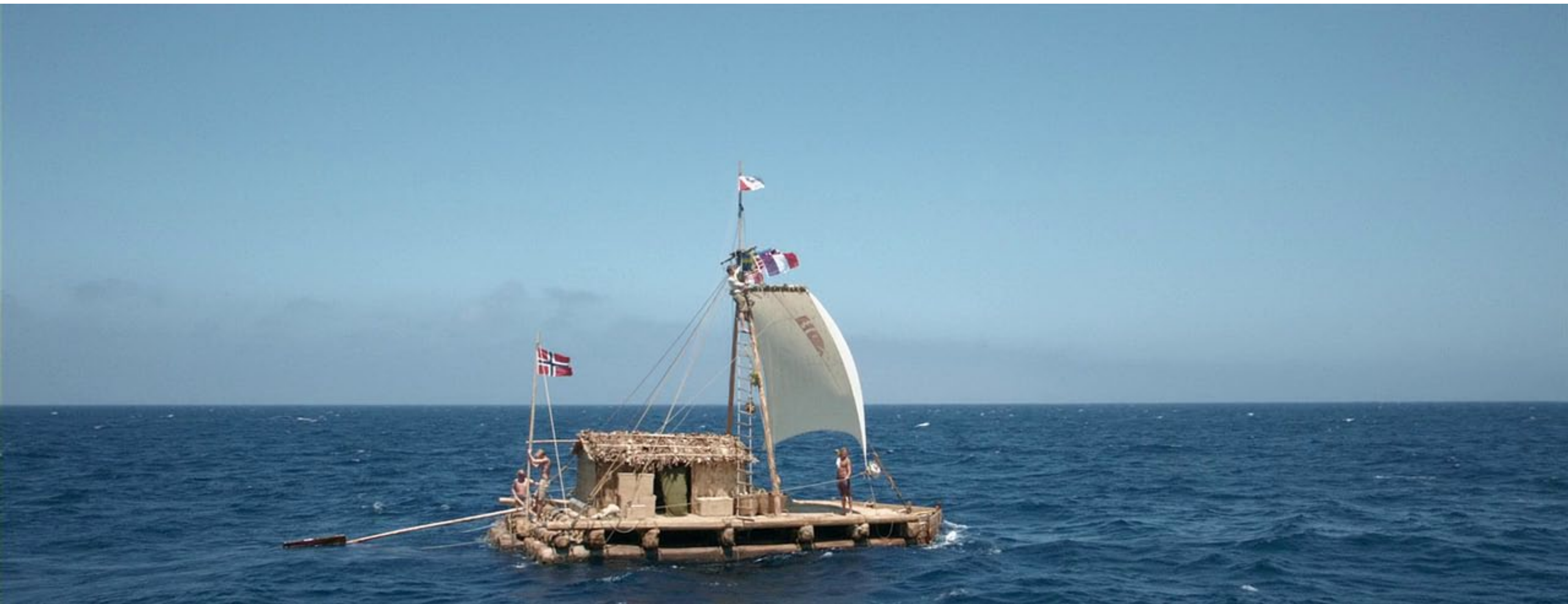
kon tiki

Case study.



Thor Heyerdahl was a young ethnologist whose theory that Polynesia was populated from Peru in the east did not follow the beliefs of the day that Polynesians obviously came from Asia. To prove his theory was possible he built and sailed a raft made from traditional materials available in Peru

and followed the trade winds across to Polynesia. His successful crossing and documentation changed put his theory on the table and inspired a new generation of explorers. Around the world people learned on his theory. His trip proved it was possible, and his documentation and experimentation during the trip was valuable.



*Proved it was possible
Educated the world through his story
Inspired more explorers*



The success of the Kon Tiki depended on strict design principles using only materials that the ancient Peruvians would have had. The design process defined the trip.



For the Aywa boat the success is also dependent on having a design process which promotes sustainable social growth.

a boat can inspire change.

A great adventure can make a huge impact.

The background features a repeating pattern of stylized, dark green leaves. Each leaf has a central circular motif with radiating lines, resembling a sunburst or a wheel. The leaves are arranged in a staggered, overlapping fashion, creating a dense, textured appearance. The overall color palette is monochromatic, using various shades of green.

chapter three.

Gathering the team

the crew.



Dany, founder of Aywa International and leader in sustainable growth in Senegal



Labat, master Senegalese pirogue builder who also works with Aywa International



Erik, our skipper. Has sailed all across the Mediterranean and Nicaragua



Felix, Pirogue captain and fisherman who has worked with Dany on biofuel engines in Priogues



Olivier, works in the film industry. He is here to show the world what Aywa has been doing.



Kristopher, sound engineer and writer. Telling the story of what Aywa is doing.



Peter, naive and enthusiastic design student. Designing the boat for the trip.



Since publicity to raise awareness and inspire people is the goal of the trip, Dany assembled a documentary film crew to film the trip. This picture is from my second

trip to Senegal in April of 2014. We filmed our preparation for the trip. Currently we are pitching the idea to networks looking to get picked up as a documentary



Djiby works as a soft goods designer and craftsman and sells his work in Malika. He provided me with textiles for the boat design.



The Malika Monkey's workshop. The trade school where Aywa trains local boys in trades. I spent two weeks working with them as the resident designer and draftsman. I experienced their skill and resourcefulness firsthand.





Labat, the master boatbuilder hard at work on a priogue order.



chapter four.

the vision

HURRICANE JULY - AUGUST

TRADE WINDS JUNE - JULY

DAKAR

CROSSING:

1678 Nm

13 DAYS AVG. 5 KNOTS

218 kg FOOD 8 PEOPLE x 20 DAY

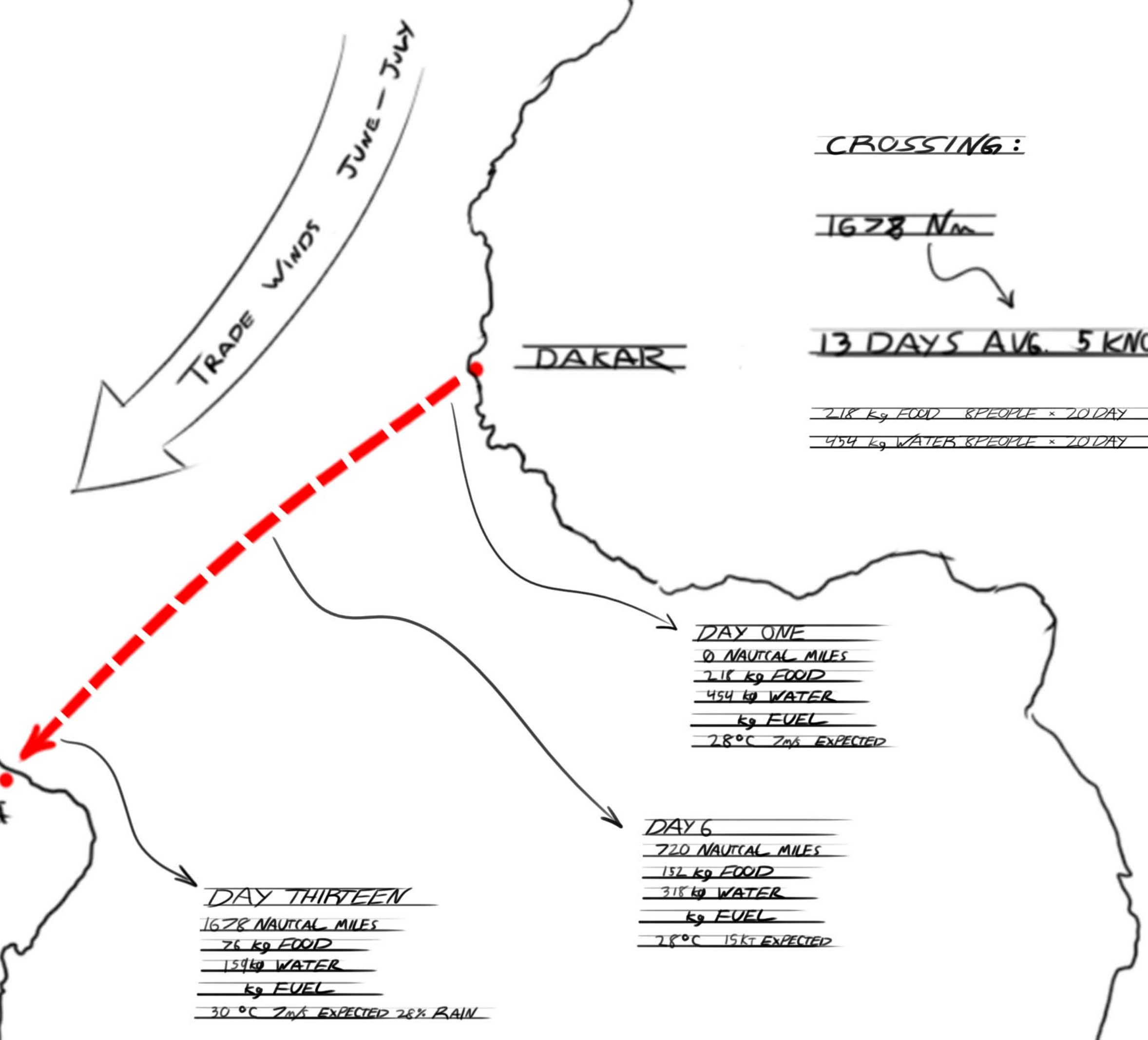
454 kg WATER 8 PEOPLE x 20 DAY

DAY ONE
0 NAUTICAL MILES
218 kg FOOD
454 kg WATER
kg FUEL
28°C 7ms EXPECTED

DAY 6
720 NAUTICAL MILES
152 kg FOOD
318 kg WATER
kg FUEL
28°C 15KT EXPECTED

DAY THIRTEEN
1678 NAUTICAL MILES
76 kg FOOD
159kg WATER
kg FUEL
30°C 7ms EXPECTED 28% RAIN

FORTALEZA



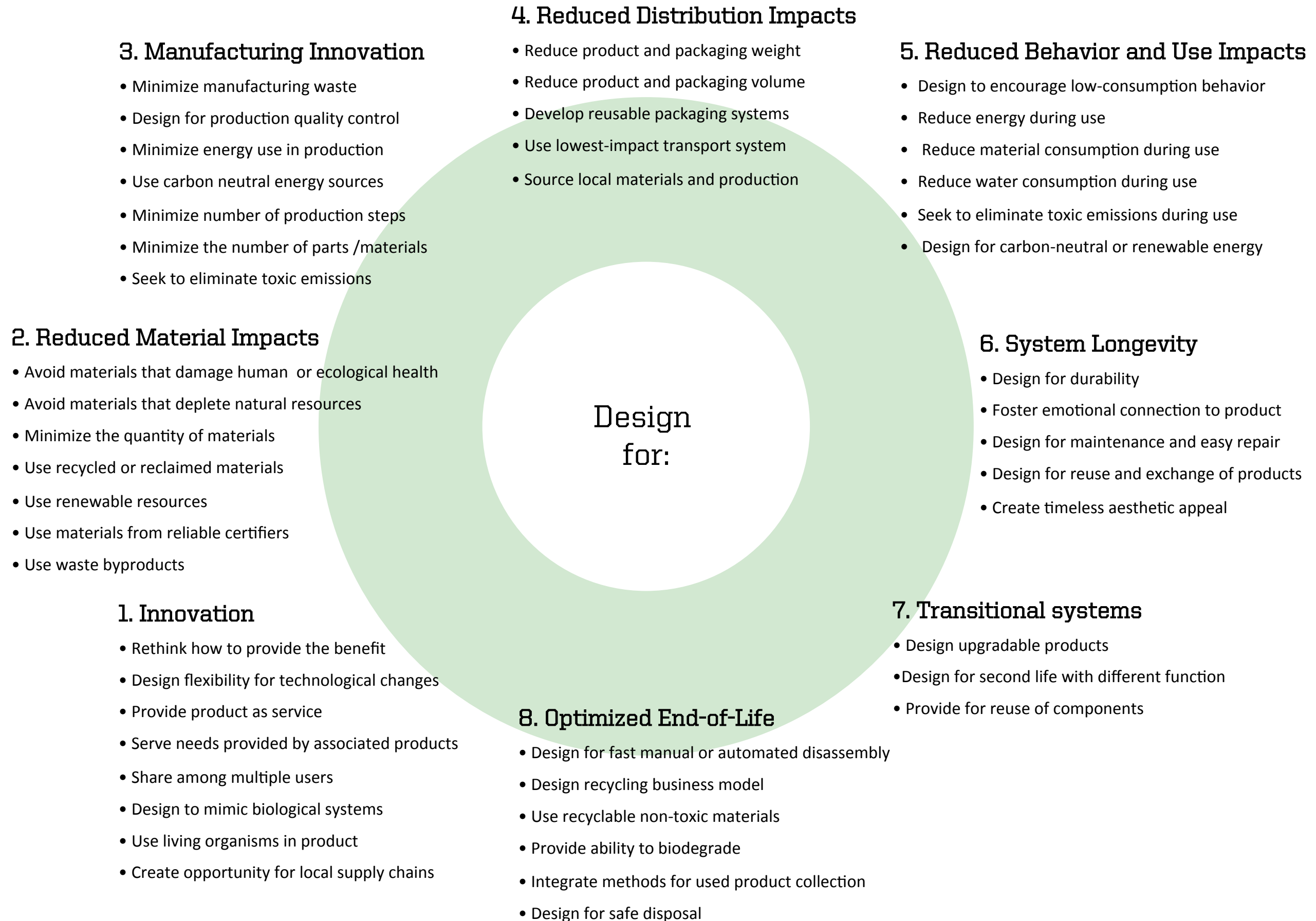
senegalese aesthetic.



Bold, loose, full of life, Islamic, gestural humanistic forms, nature inspired patterns.

Okala Ecodesign Strategy Wheel

Modified from the Ecodesign Strategy Wheel,
J. Brezet and C. Van Hemel, 1997



design methodology goals.

4. distribution impact

Lowest impact transport system

Source local materials

5. behavior

Encourage low consumption during use

Design for renewable energy

3. manufacturing

Minimize manufacturing waste

Use carbon neutral energy sources

2. material impacts

Minimize quantity of materials

Use recycled or reclaimed materials

Use renewable resources

Use waste byproducts

1. innovation

Rethink how to provide the benefit

Provide product as service

Share among multiple users

Design to mimic biological systems

Use living organisms

Create opportunity for local supply chains

8. end of life

non-toxic materials

provide ability to biodegrade

6. system

Design for durability

Foster emotional connection with product

Design for maintenance and easy repair

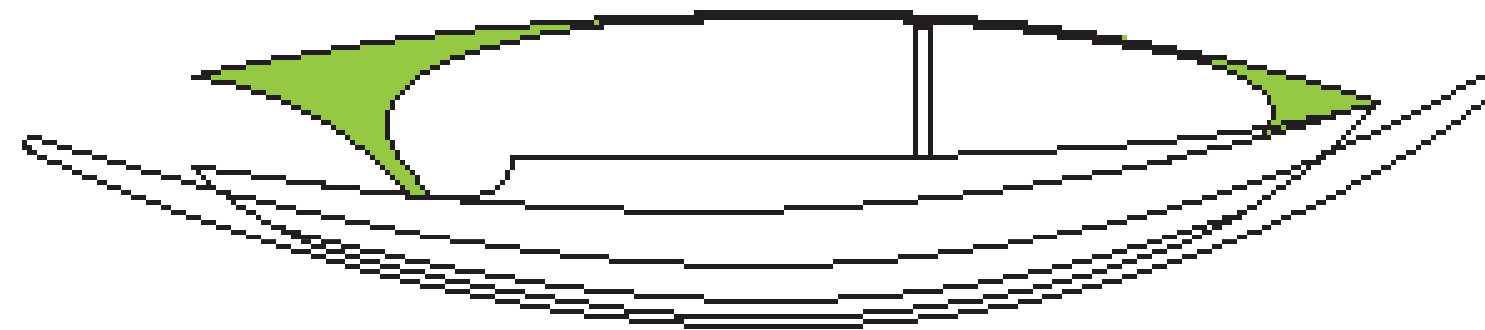
Reuse and exchange

Timeless appeal

7. transition

Design for second life with different functions

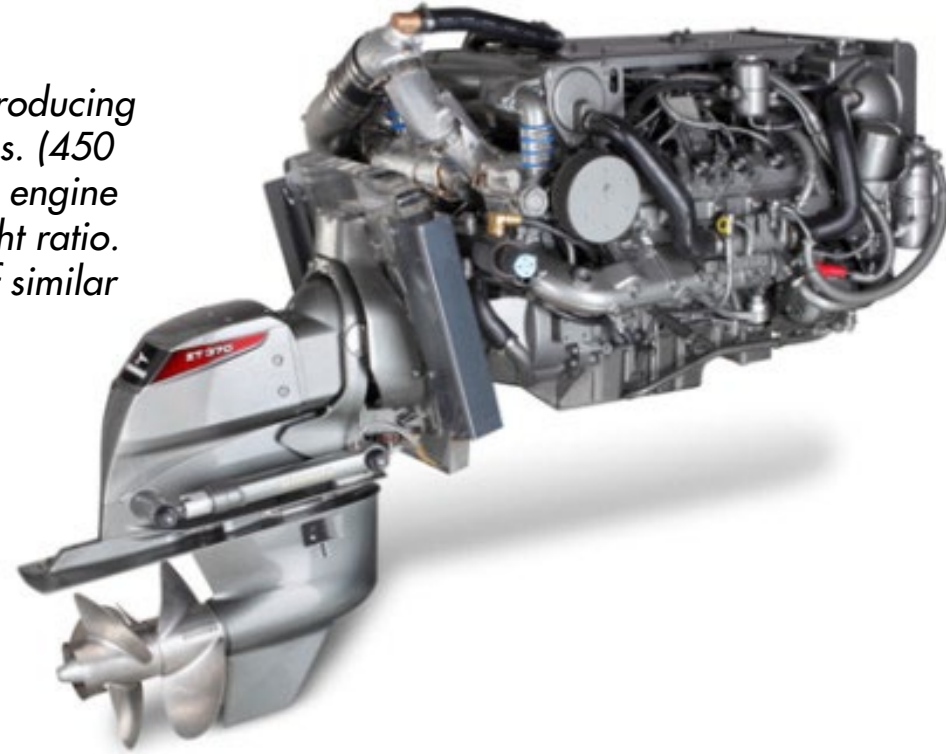
Provide for reuse of components



yanmar

Yanmar stern drive diesel engine. This is the primary engine for the boat.

Yanmar's 8LV is a light-weight V8 producing 370-hp. Weighing in at only 992 lbs. (450 kg) the new 8LV is the lightest diesel engine in class, has the best power-to-weight ratio. It is even lighter than gas engines of similar horsepower.



At 3.7 Knots the boat will need to carry **109 gallons of fuel**. Assuming perfect fuel efficiency and 20% extra for safety.

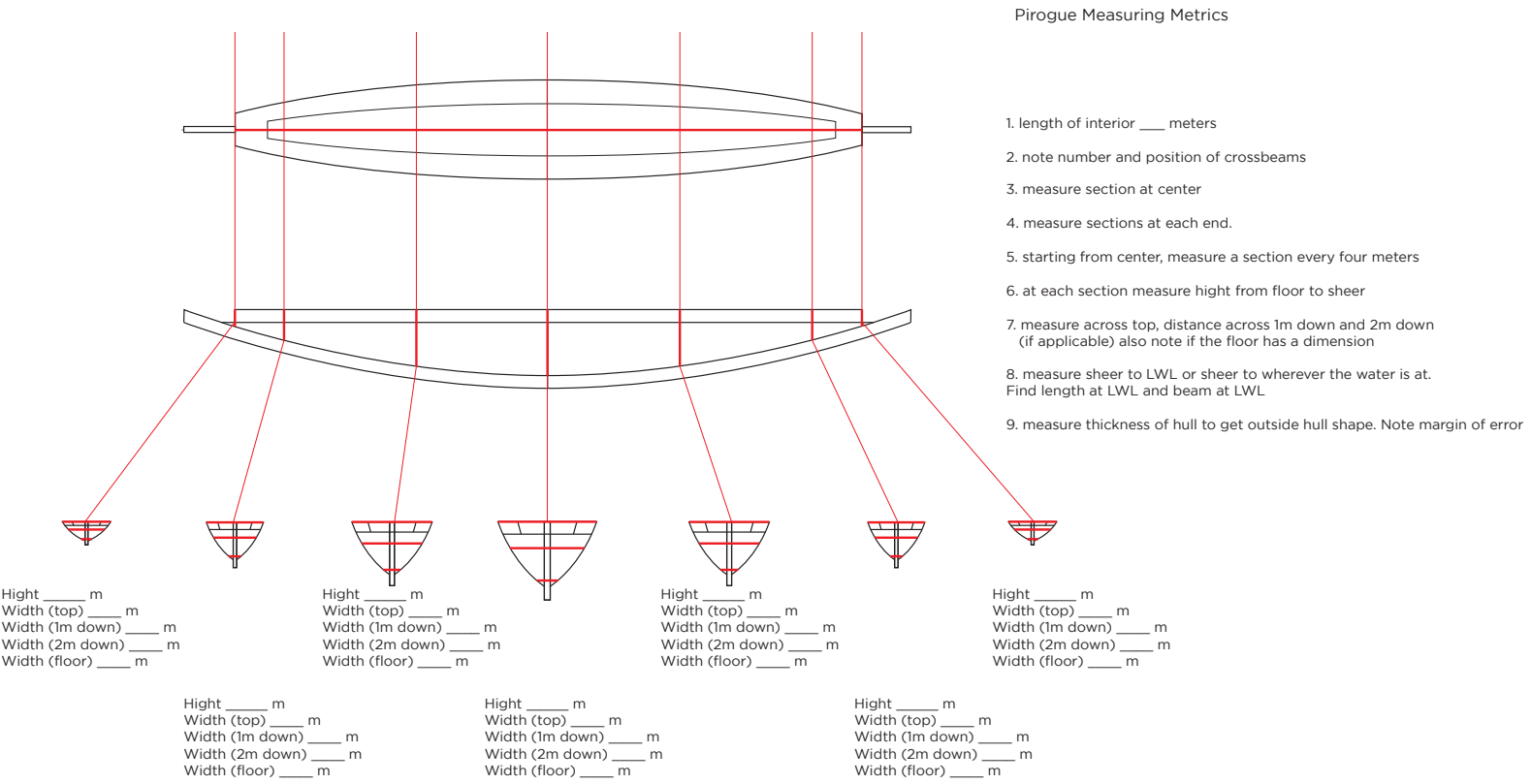
At 5.8 Knots the boat will need **160 Gal.**

At 7.7 Knots, or 15000 **503 Gal**

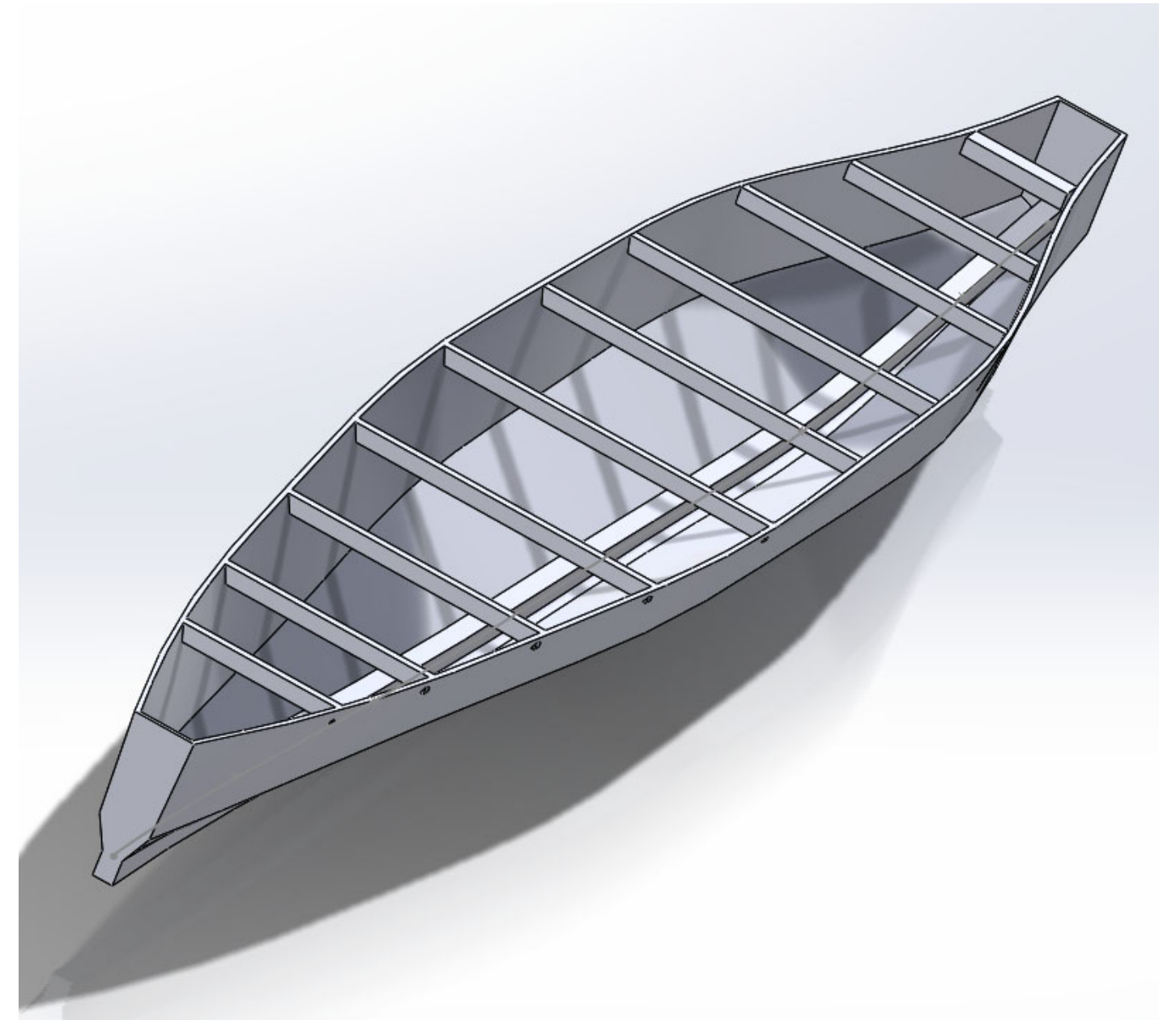
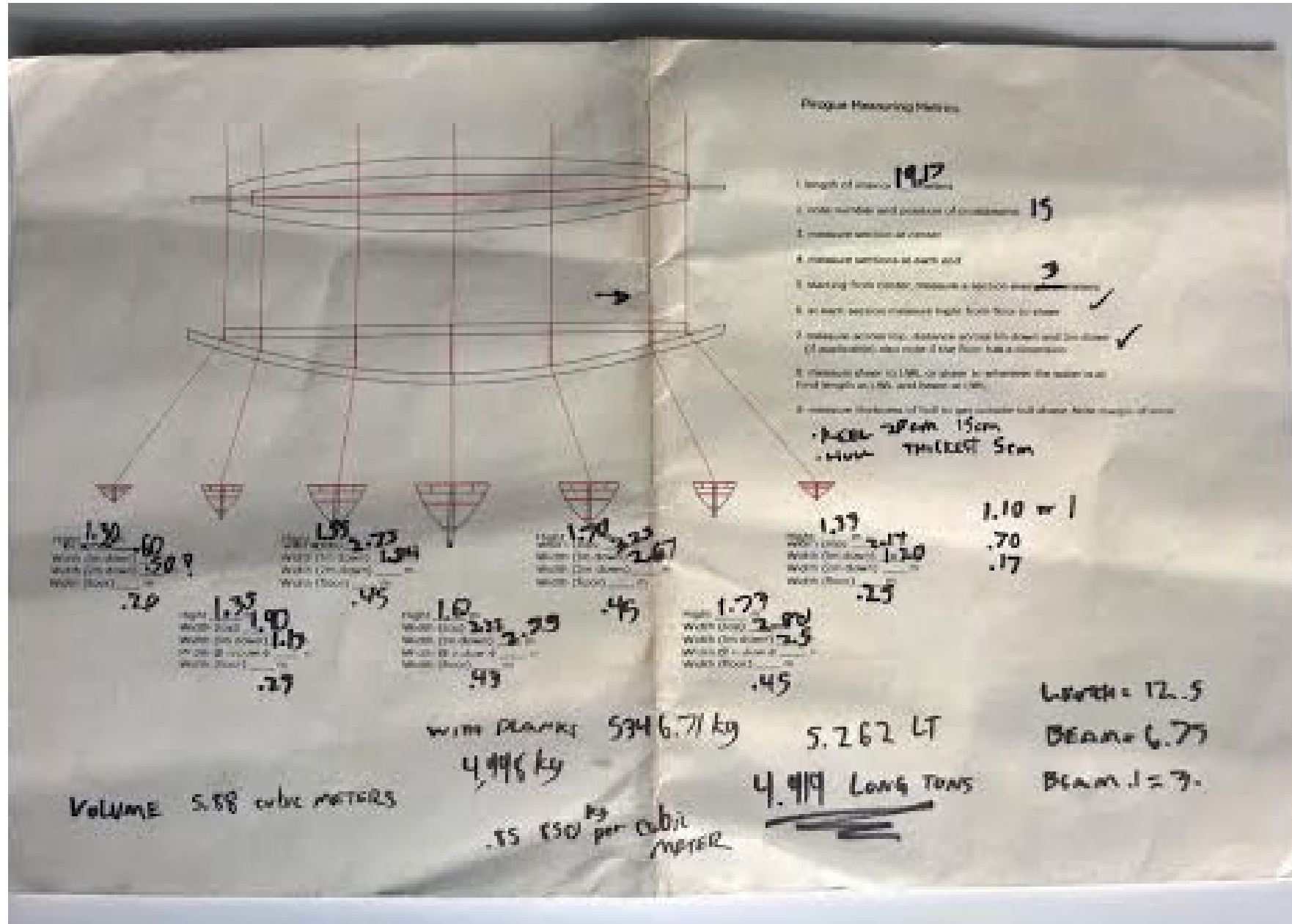
Test Power: 1 x 370-hp Yanmar 8LV-370

RPM	MPH	Knots	Total GPH	MPG	NMPG	Range			KPH	LPH	KPL	dBA
						Stat. Mile	NM	KM				
550	4.3	3.7	0.20	21.25	18.48	3137	2727	5049	6.9	0.76	9.03	64
800	5.4	4.7	0.40	13.38	11.63	1974	1717	3177	8.7	1.51	5.69	64
1000	6.7	5.8	0.55	12.09	10.51	1785	1552	2873	10.8	2.08	5.14	65
1300	7.8	6.7	1.25	6.20	5.39	915	796	1473	12.6	4.73	2.64	71
1500	8.8	7.7	1.90	4.63	4.03	684	594	1101	14.2	7.19	1.97	72
1800	9.9	8.6	3.30	2.98	2.60	441	383	710	15.9	12.49	1.27	74
2000	10.7	9.3	4.35	2.46	2.14	363	316	584	17.2	16.47	1.05	75
2300	13.7	11.9	6.30	2.17	1.88	320	278	515	22	23.85	0.92	76
2500	16.4	14.2	7.35	2.22	1.93	328	286	528	26.4	27.82	0.94	89
2800	20.5	17.8	9.30	2.20	1.92	325	283	523	33	35.2	0.94	82
3000	23.3	20.2	10.50	2.21	1.93	327	284	526	37.5	39.75	0.94	83
3300	27.0	23.4	13.20	2.04	1.78	301	262	484	43.5	49.97	0.87	83
3500	29.3	25.5	15.50	1.89	1.64	279	242	449	47.2	58.67	0.8	84
3700	31.5	27.4	17.40	1.81	1.57	267	232	430	50.7	65.87	0.77	85
3800	32.6	28.3	18.70	1.74	1.52	257	224	414	52.5	70.79	0.74	86

hull measurements.



hull dimensions



key equations

In order to establish full design requirements, there are several parts of the boat that must be quantified in order to correctly estimate it's ability.

Essentially, we need to know the weight and drag of the boat in order to calculate how much fuel it will need to make it the 1678 nm (+20% for safety) across the Atlantic Ocean.

Source for equations:

Understanding Boat Design
by Ted Brewer

Total mass of hull: 5346.71 kg = 5.262 LT

Total volume: 6.27 m³

5cm planks all out of African mahogany
with 10cm crosspieces and 15cm keel.

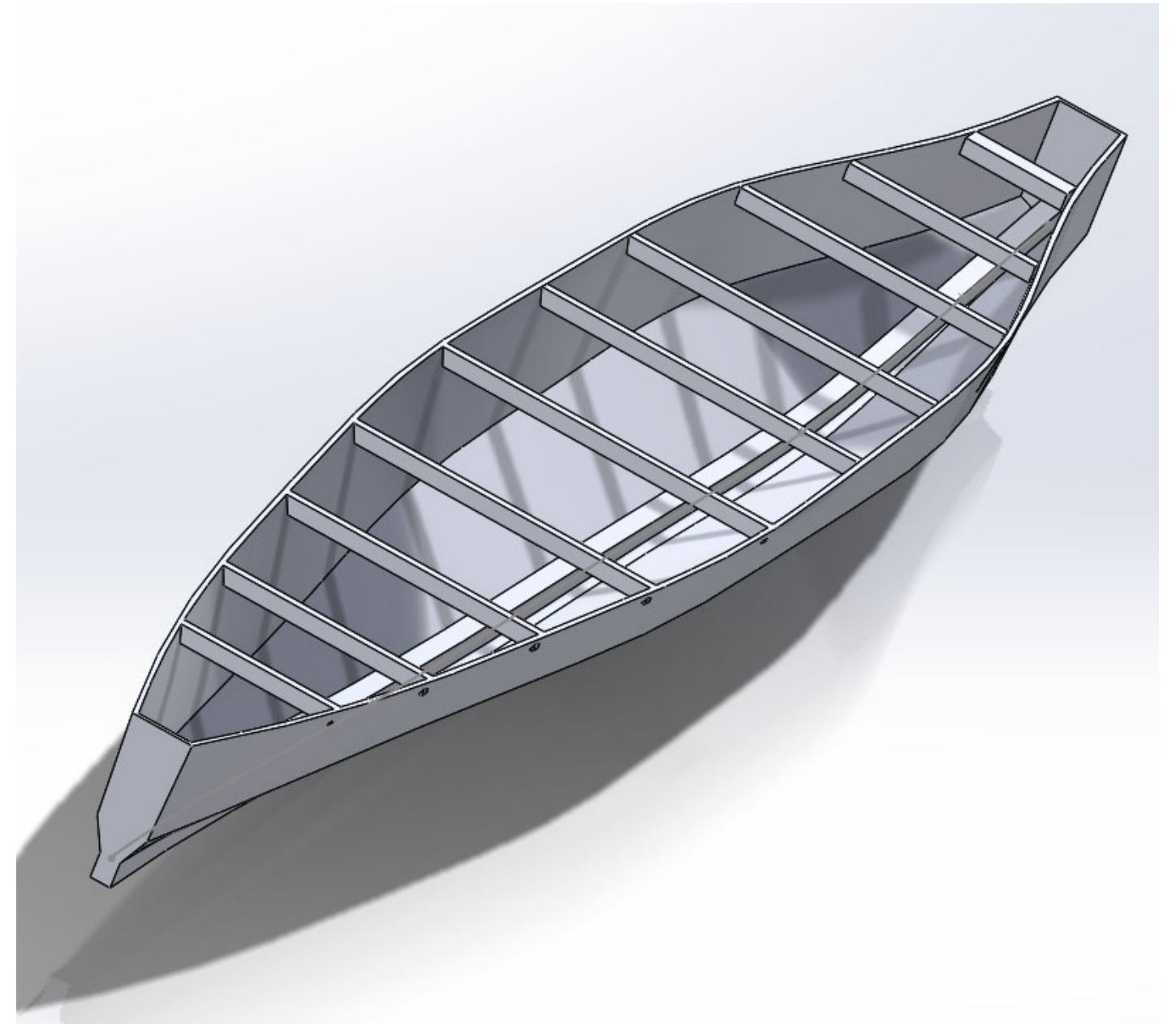
Prismatic Coefficient:

Displacement / (Amidships Area x LWL)

A coefficient of .54 is desirable

Speed/Length ratio:

5 knots/ square root of LWL



design input.

Input on the hull shape and rigging for the boat from Erik Algeria, the skipper.

I know it is important to keep it as true to the **original design of the pirogue as possible**. However it would make a huge difference if we could have a **running keel** to keep the boat from drifting too much and make it more sea worthy.

If a running keel is not possible, we should think of lee boards which are attached to the sides and lowered when needed. But lee boards cause stress on the hull and they are one more moving piece to consider and handle while sailing.

The other point I want to stress is if we could make the **boat beamier (wider) it would be better**. As it is it is quite sensitive to weight shifts and it makes it a bit "nervous" in heavy seas. If it is beamier it can carry more cargo and will sail better in open seas.

I have considered having a Lateen rig and a Gaff rig. Though the Lateen rig is more traditional and more African-Mediterranean, the **Gaff rig** is better, easier to handle, more efficient, it can have a shorter mast, no back stays and a lower center of effort and is easy to reef. Also we can have different types of Jibs and Genoa's so we have more choice of sails.

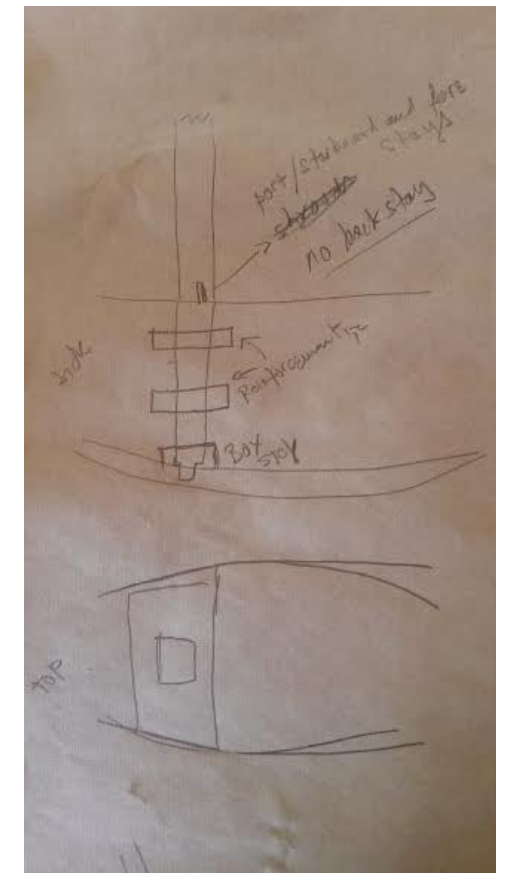
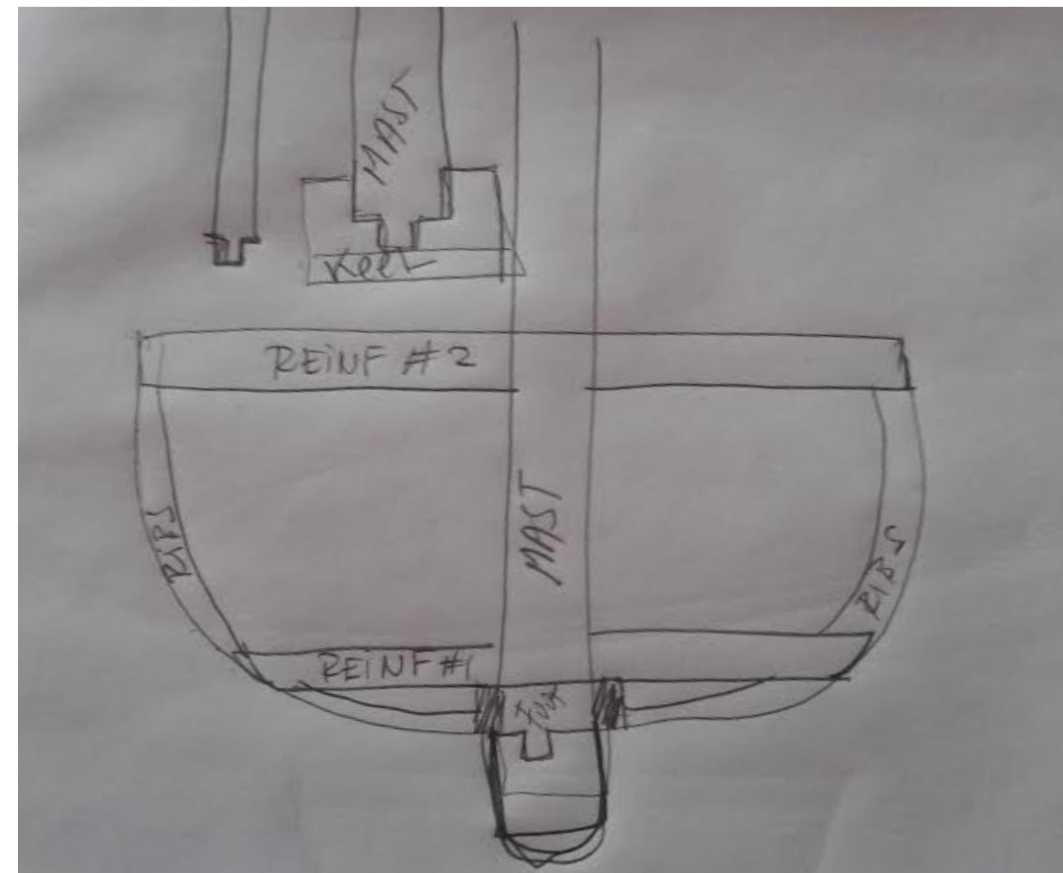
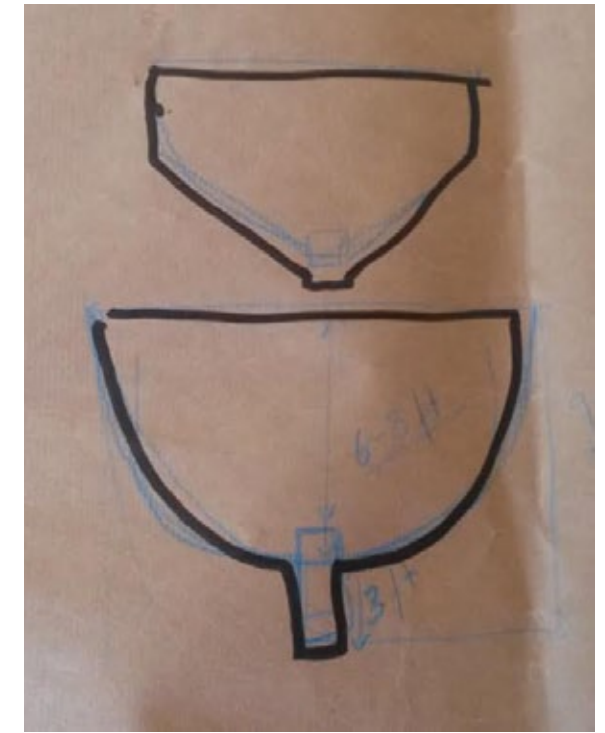
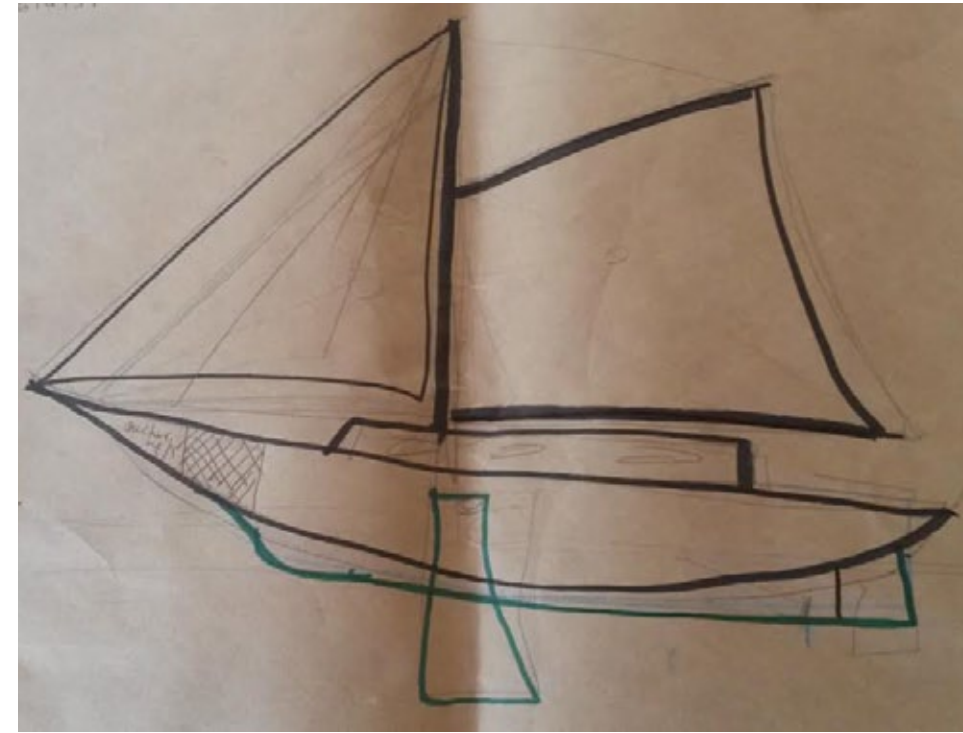
We also have to consider the cargo. Where and how will we get it in and out, The weight should ideally be at the bottom and middle of the boat. The berths and living quarters should be fore and aft.

Another point to consider is that we might crash into half sunken containers, reefs, logs, etc and that will always be in the front of the boat. So I suggest that right after the anchor well we should build a **water tight compartment and fill it with foam**, so that if we do crash, the water will be contained and give us time to fix it.

The rudder: I prefer a **traditional rudder** with a tiller than a wheel, but for long trips perhaps a wheel is better and takes up less room. In any case we should have a safety mechanism in case the rudder brakes and we should have a replacement or the materials and tools to fix it. Nothing worse than a ship without a rudder...

I think we should have an inboard motor and use that as the main engine, but we should also have a spare out board, long-leg motor that runs on diesel as an emergency back up. It should be mounted as it is on the original pirogue design we saw in Dakar.

The head should be built either at the very front or very back and go straight to sea not inside. The less holes we have in the hull, the better.



design feature goals.

Celebrate and show seed engine

- expose drive train
- graphic call out
- make central feature of interior

Safe + Seaworthy

- Watertight
- rounded corners
- railings
- canopy covers against elements

24 hour interior solutions

- Eight person crew in four shifts of two
- set places for sleeping in shifts
- eating arrangements for four shifts
- compartmentalized solutions for living

Culturally engaging interior

- Showcase Senegalese influence
- Draw from traditional life in pirogues:
have tea time, sit around a communal plate, Senegalese stools,
safer versions of cooking over the open fire
- open and pleasing to film

Iconic silhouette

- traditional upper deck matching hull
- gestural canopy to contrast tradition and bring excitement
- livery to draw attention to boat

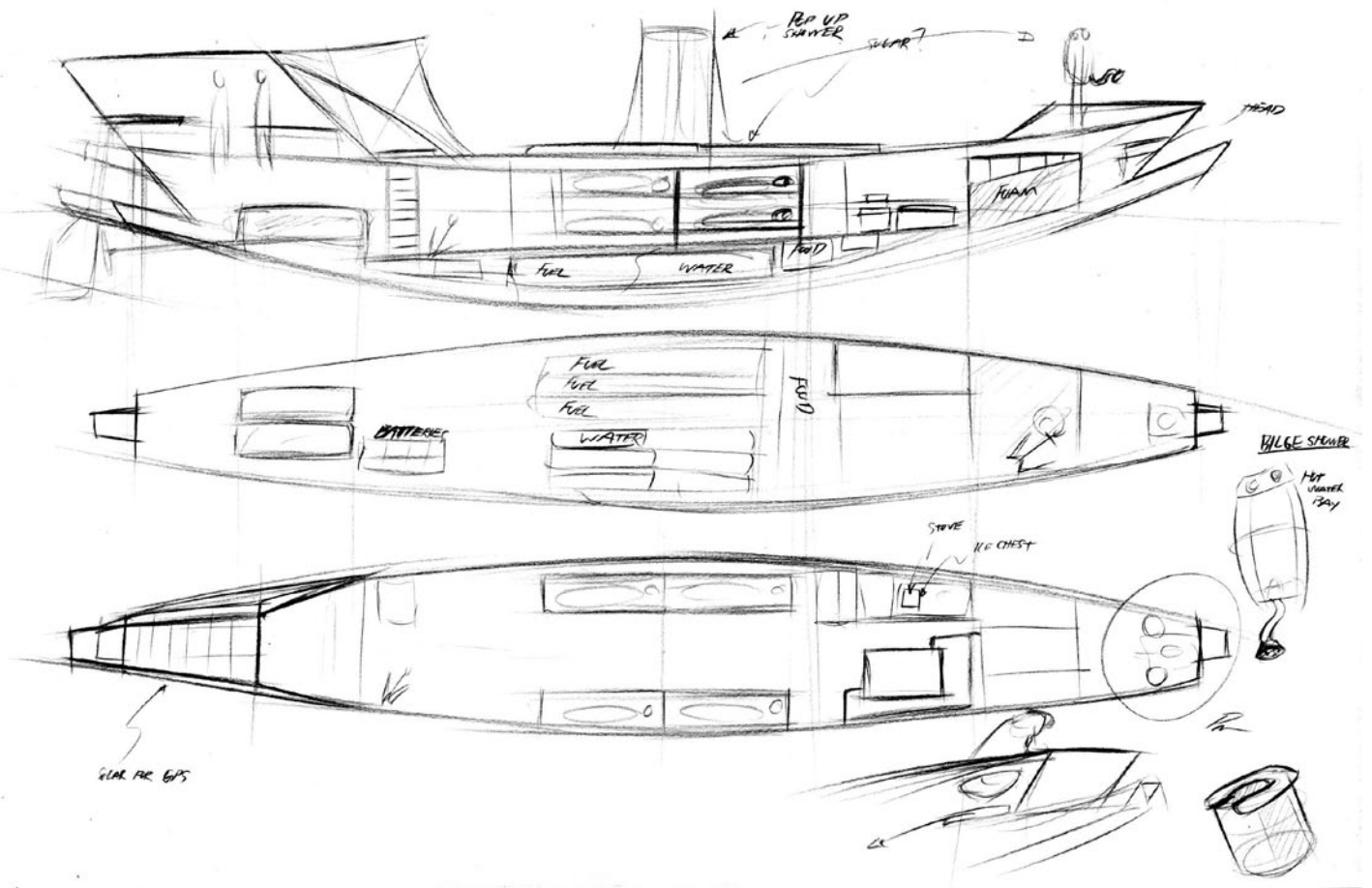
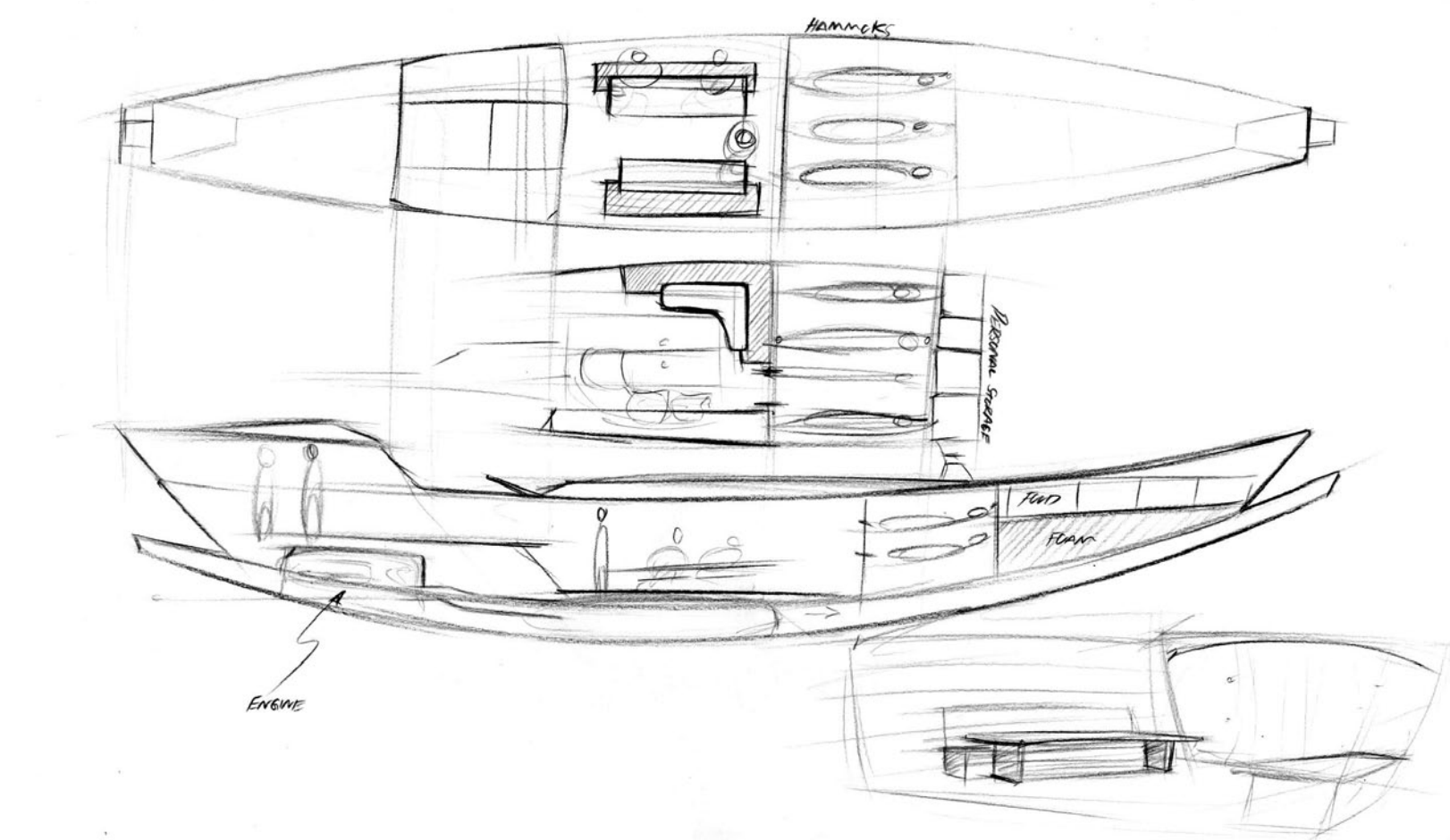
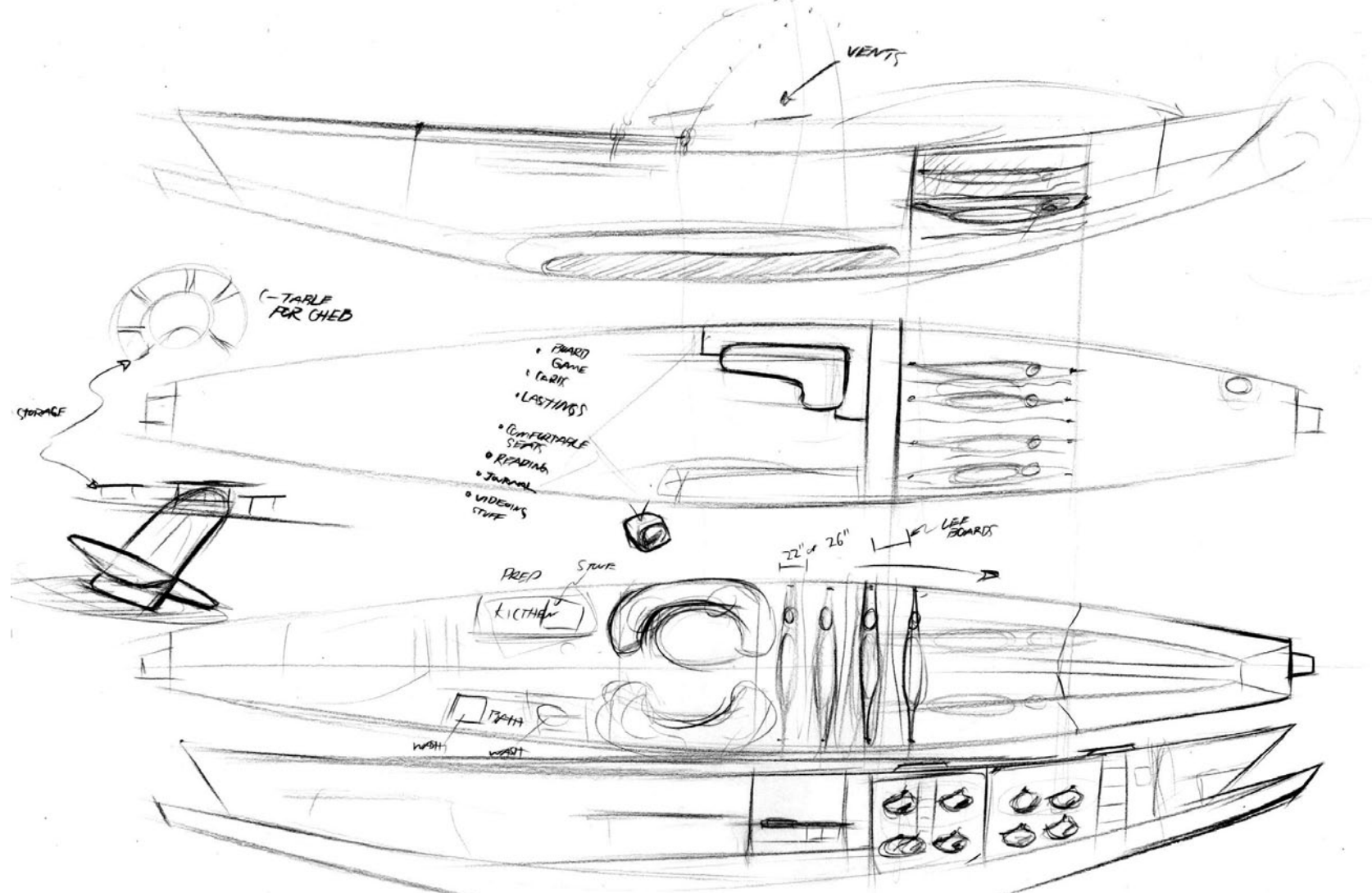
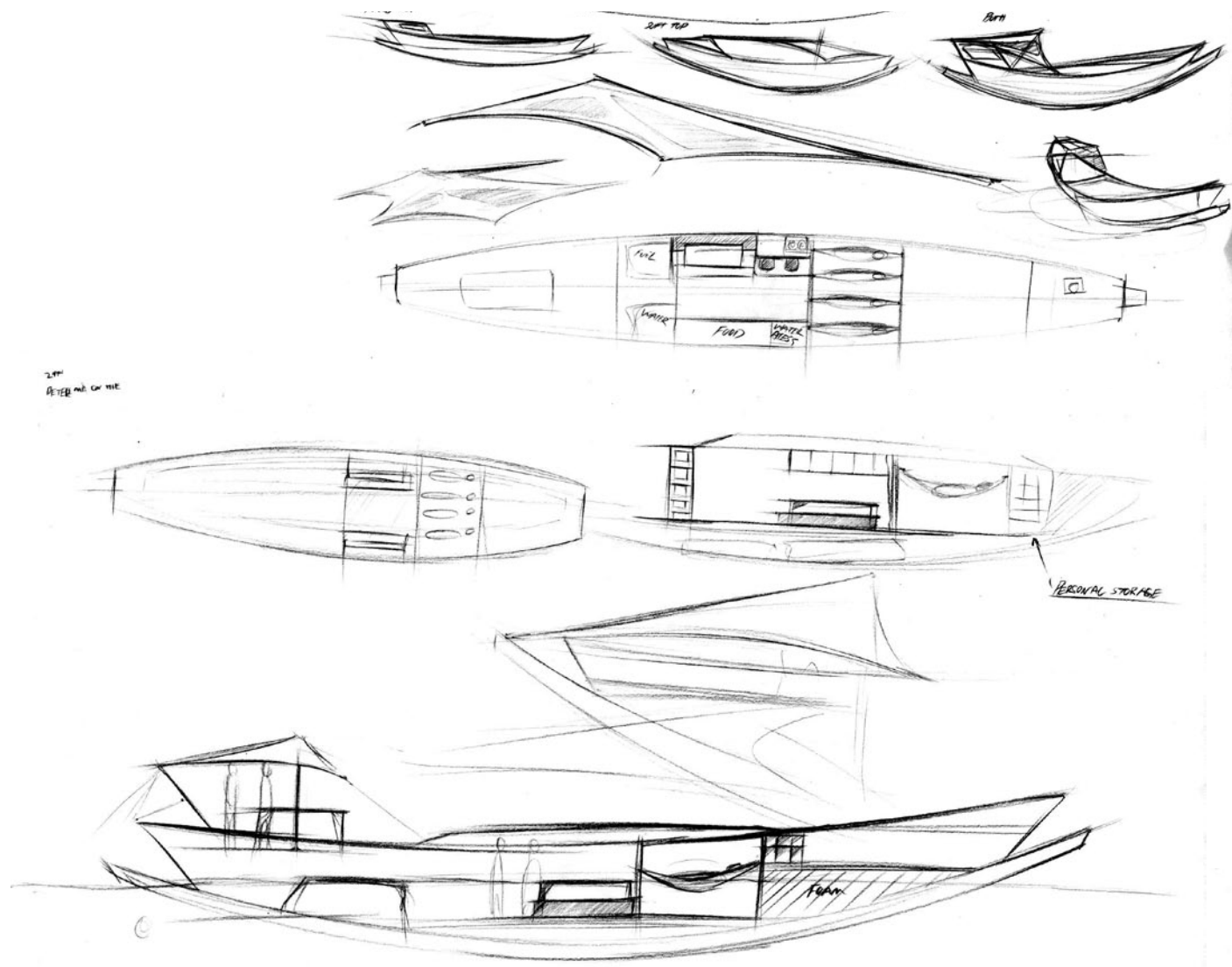
Connect to aywa and backers

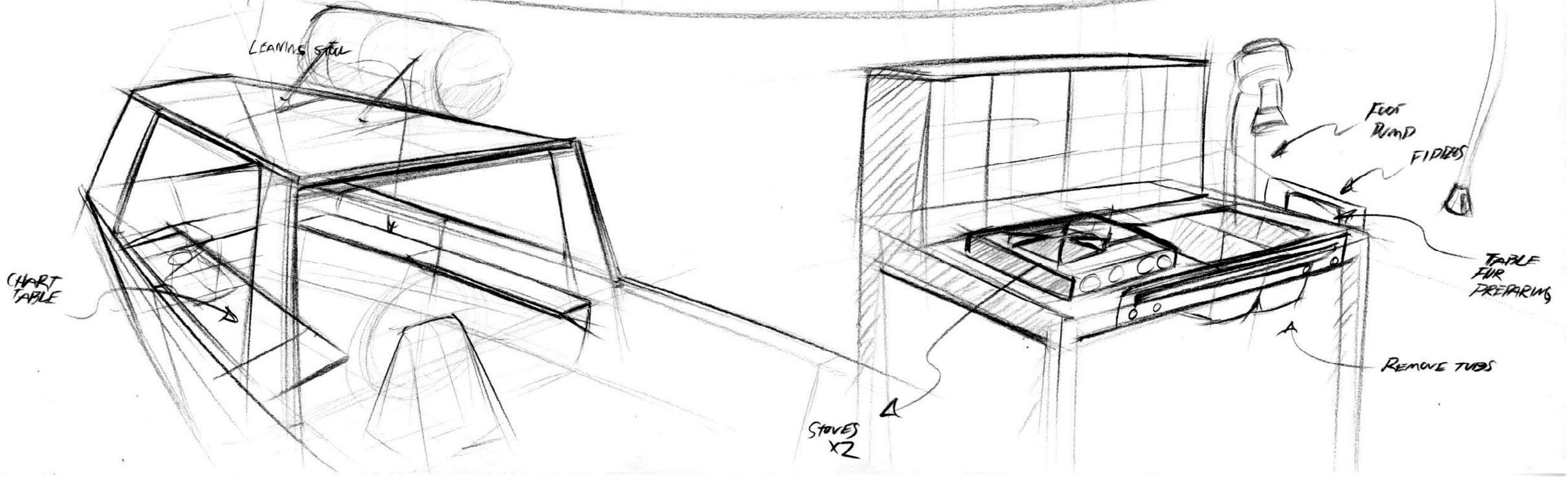
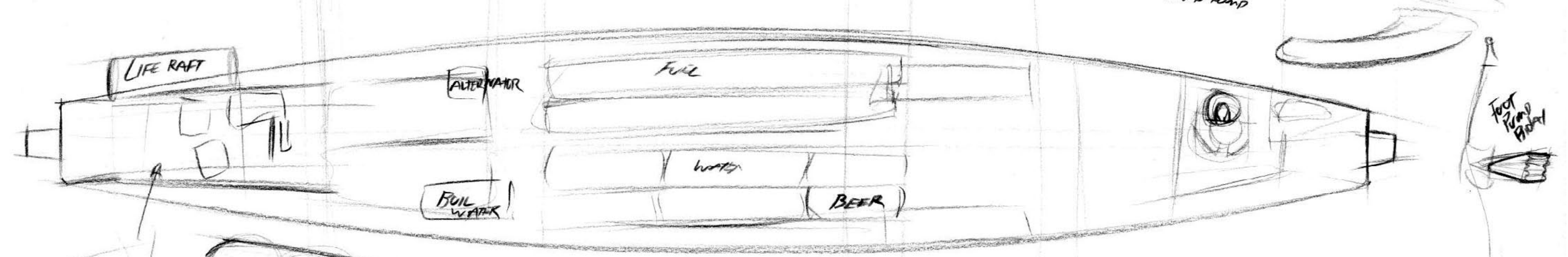
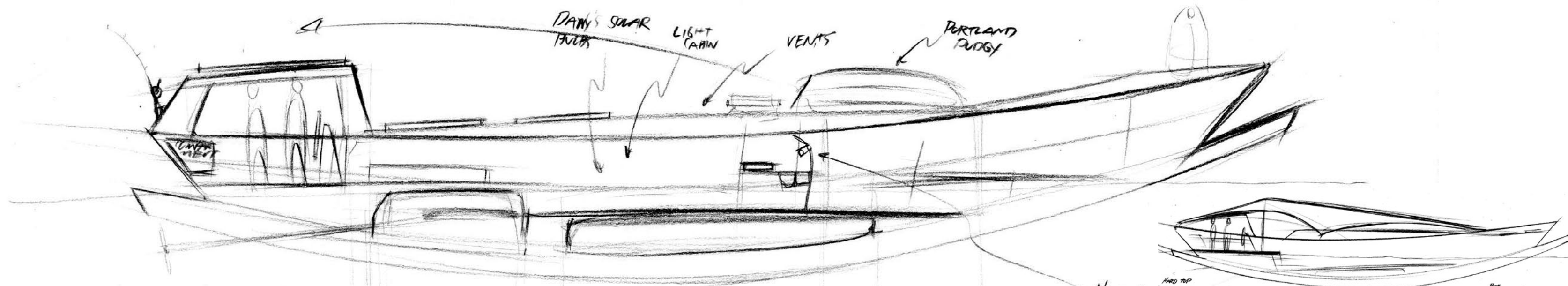
- Live cam options
- gps tracking
- instagram connections
- backers integrated into Livery



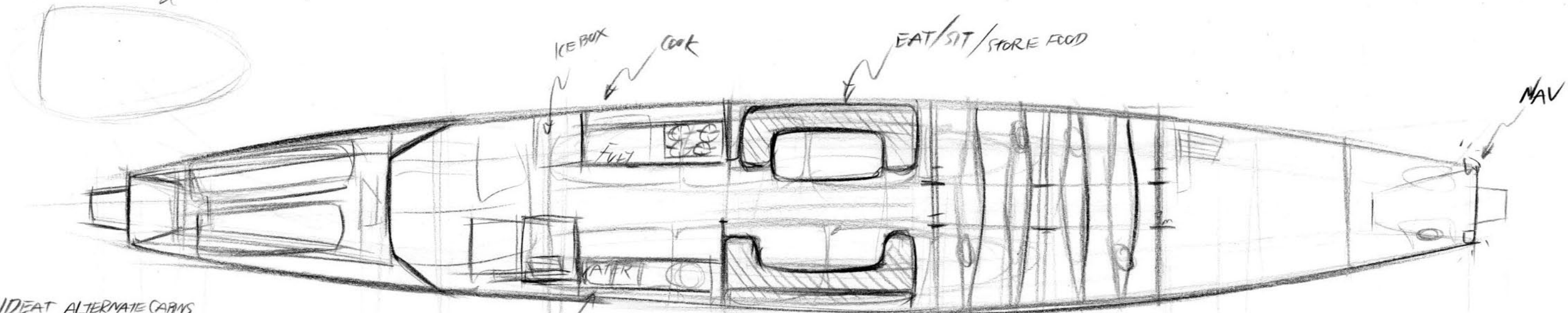
chapter five.

The boat

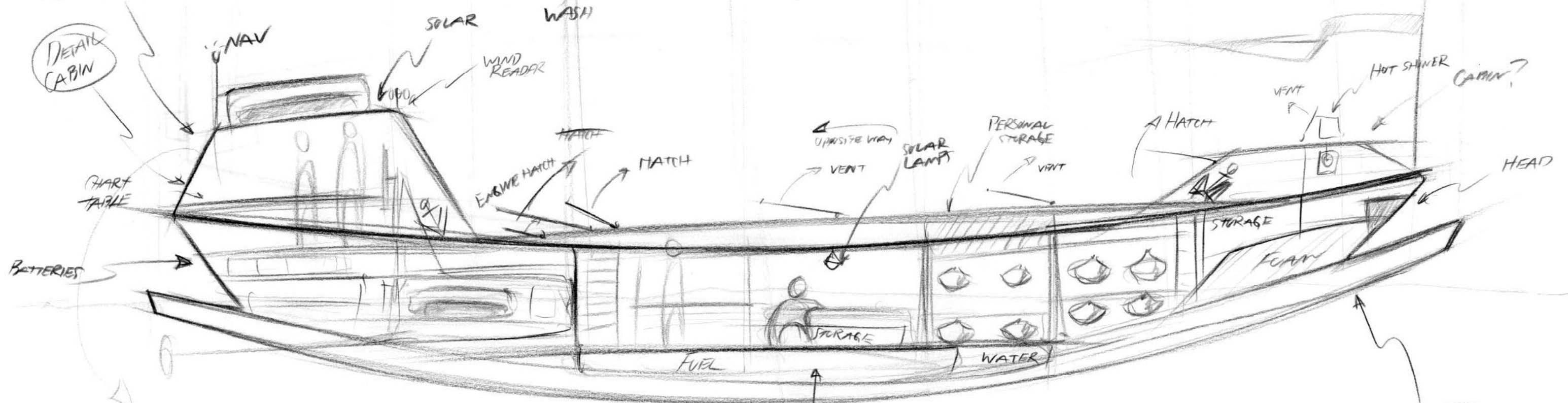




PORTLAND
PODS



IDEAL ALTERNATE CABINS
+ VISIBILITY
+ WEATHER
+ SITTING



LOOKOUT POOP

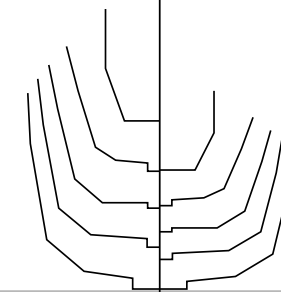
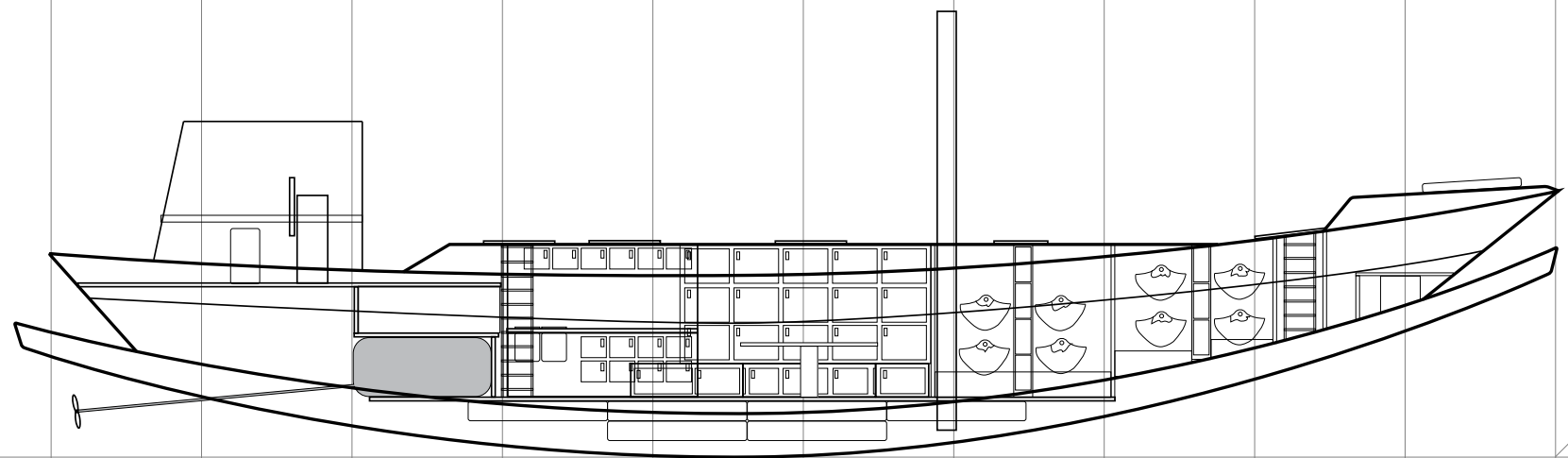
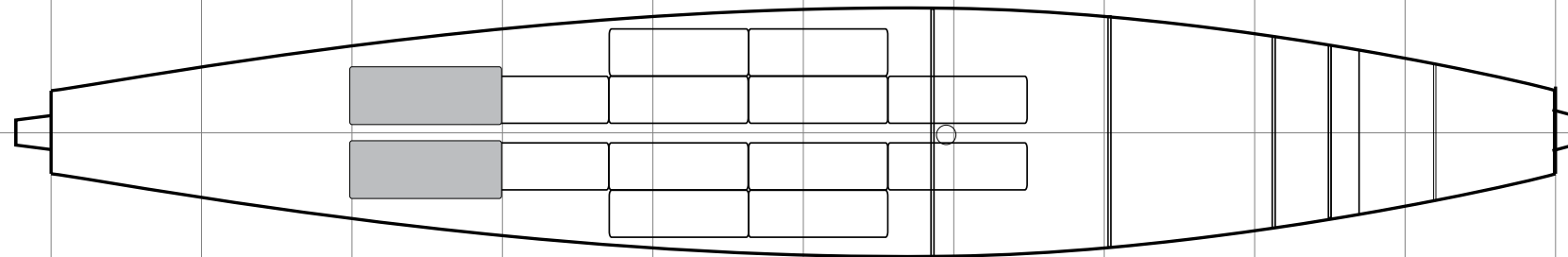
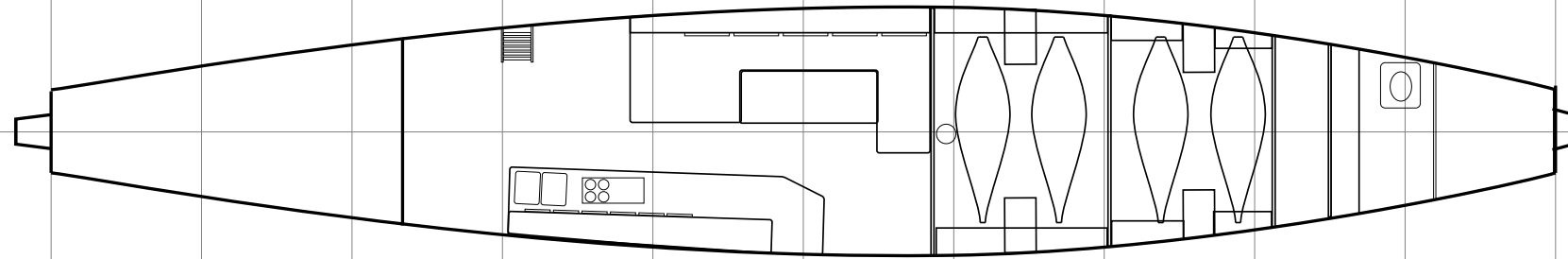
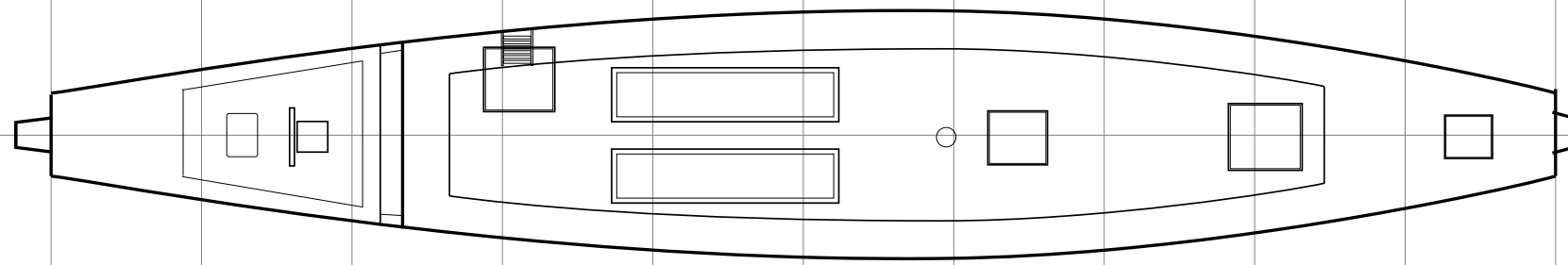
DETAIL
KITCHEN

DEFINE
FUEL
SIZE
+
WATER SIZE IN LINEAR METERS

DETAIL
SITTING
+ STORAGE

DETAIL
HEAD +
SHOWER

R



0m 2m 4m 6m 8m 10m 12m 14m 16m 18m 20m

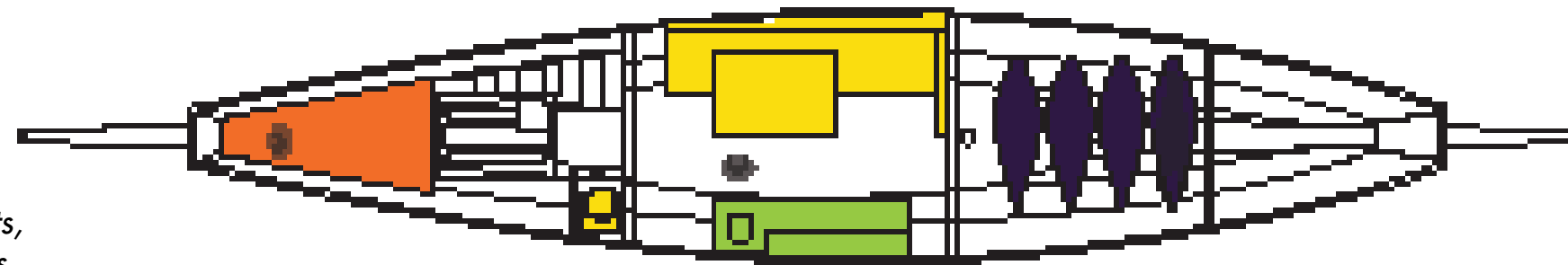
24 hour interior solutions

8 men on four shifts

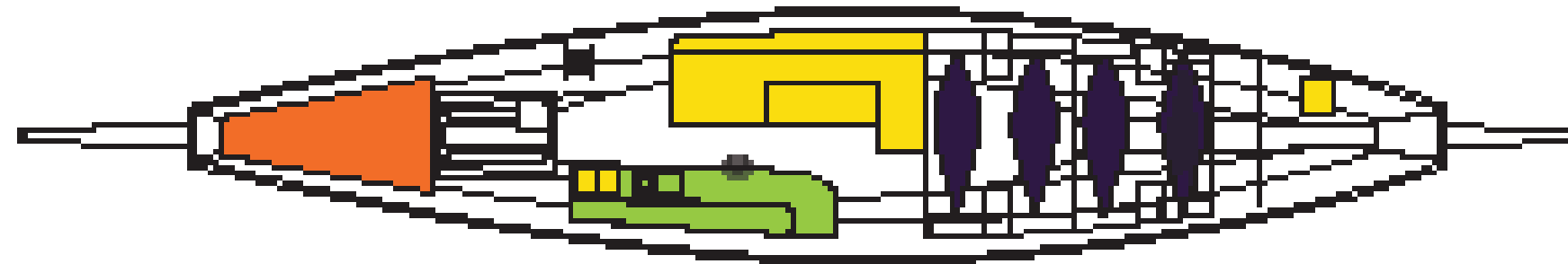


24 hour interior solutions

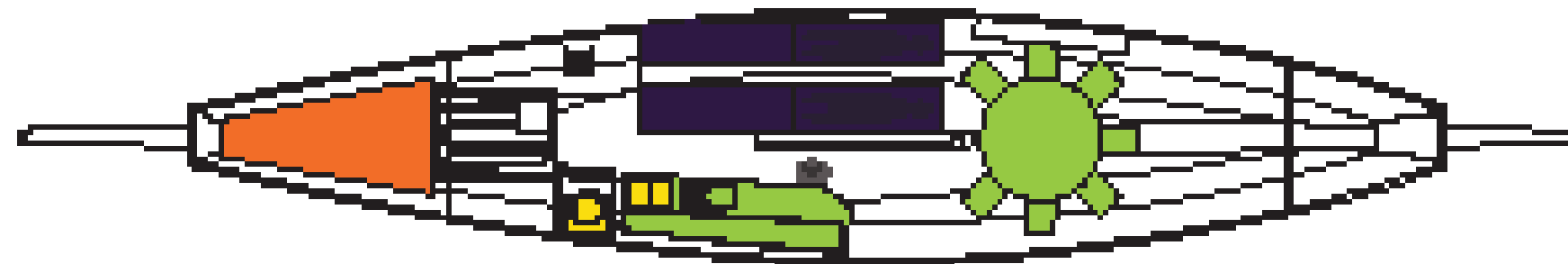
Steer boat, check charts,
chart table, rudder, gps,
radio



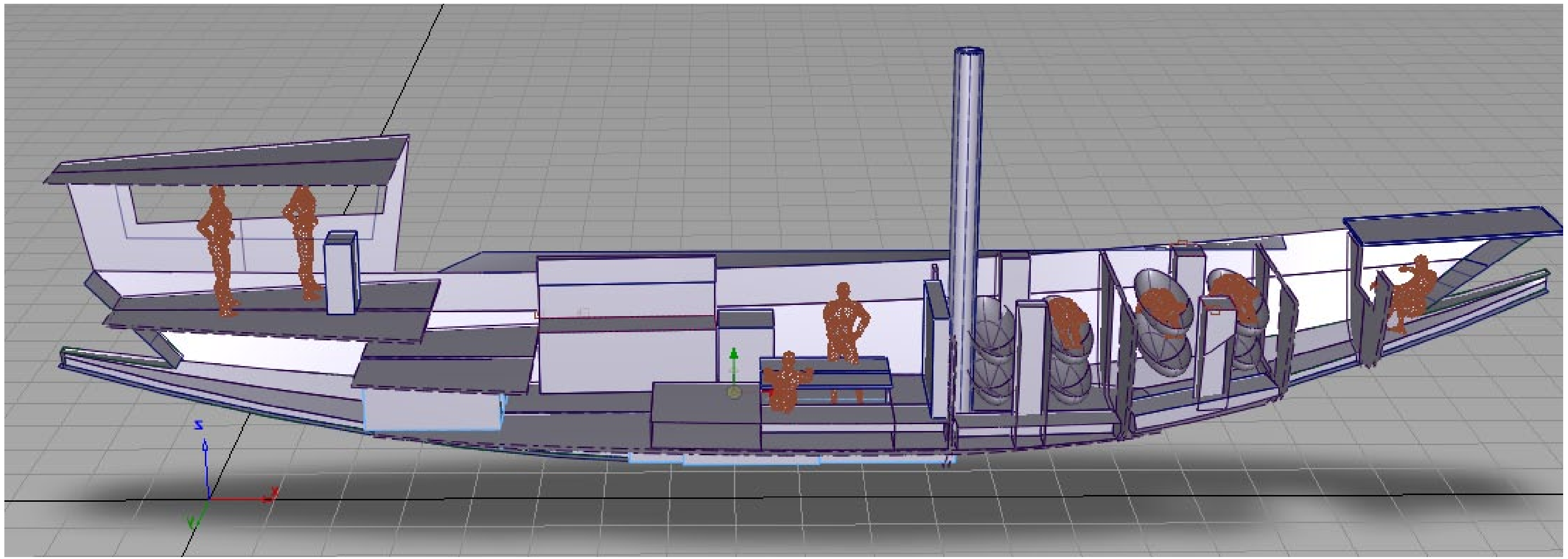
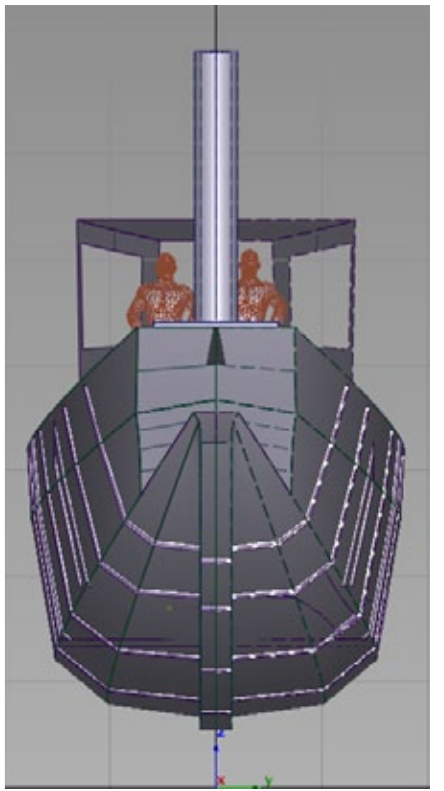
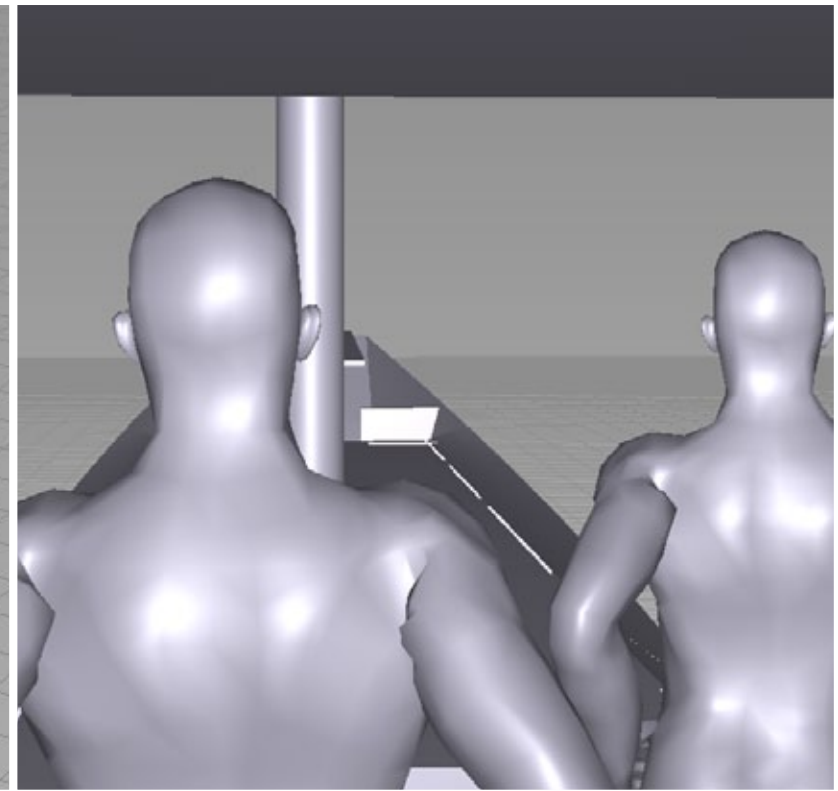
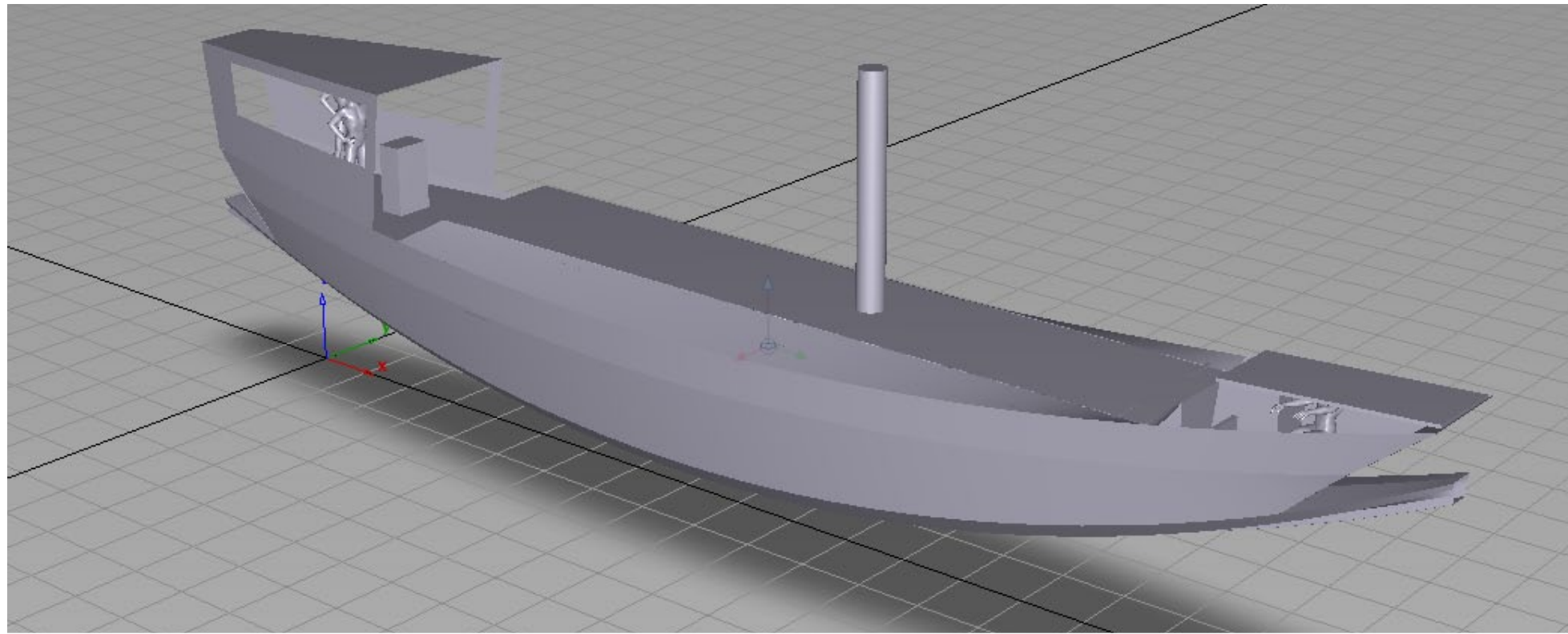
At least four Hammocks or
swapable bunks.
Locker for clothes

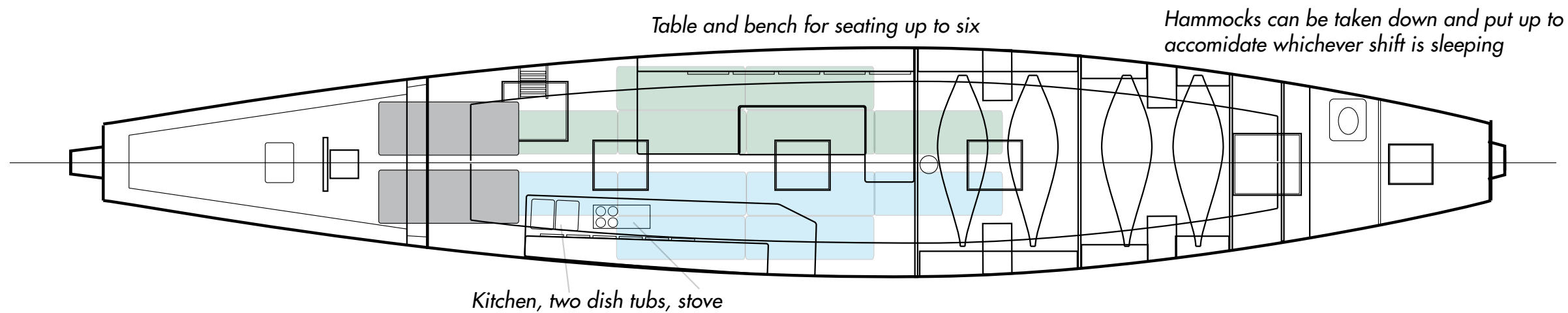


Table, stove dishes, basin, ice
chest, water access



Basin Table mirror, storm
bucket





Concept one

Feedback from Dany:

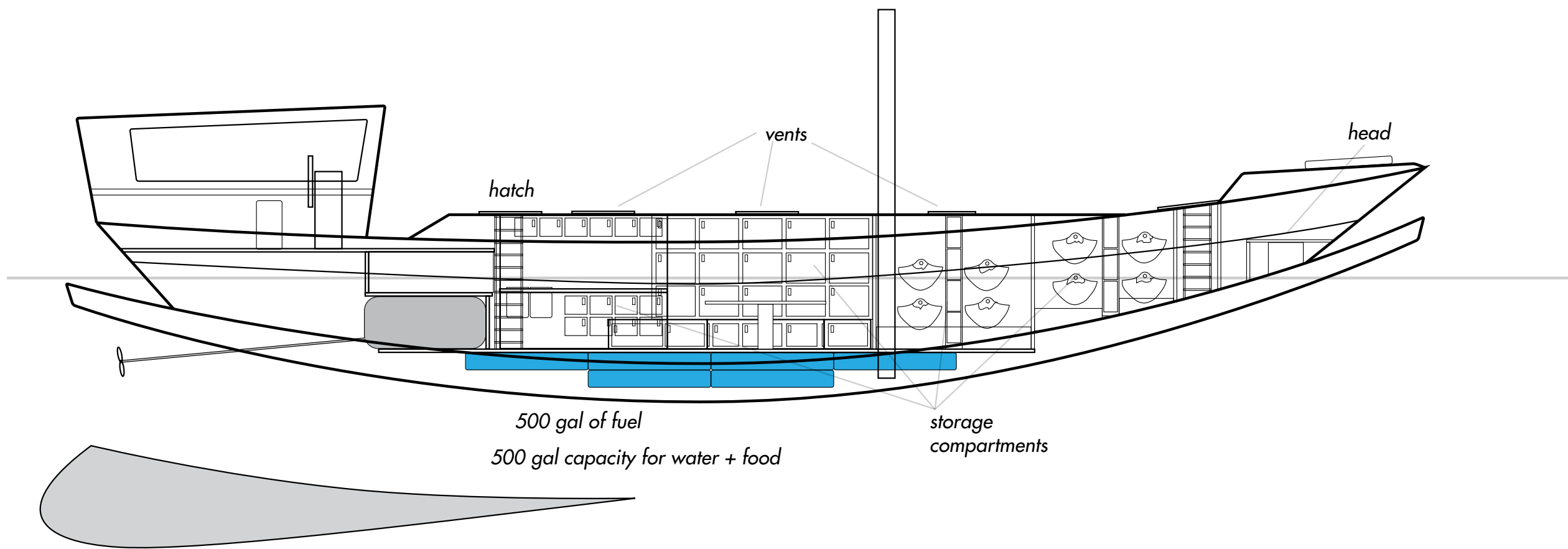
More light in the cabin

Keel integration

Not hammocks

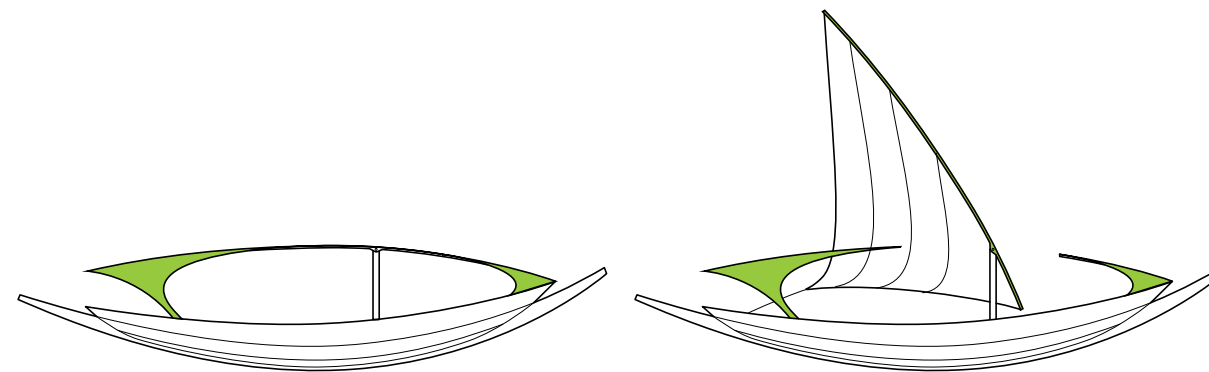
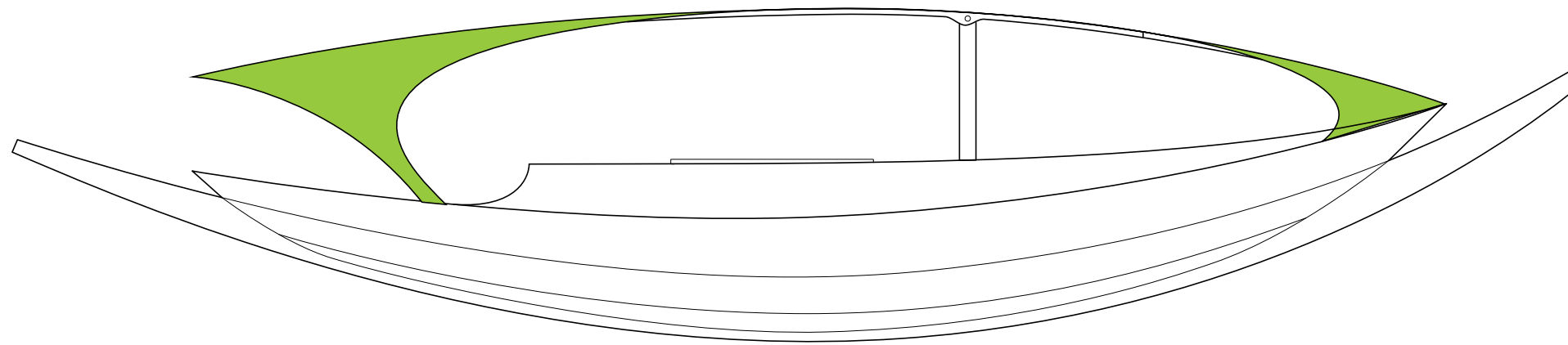
move bathroom from the front.

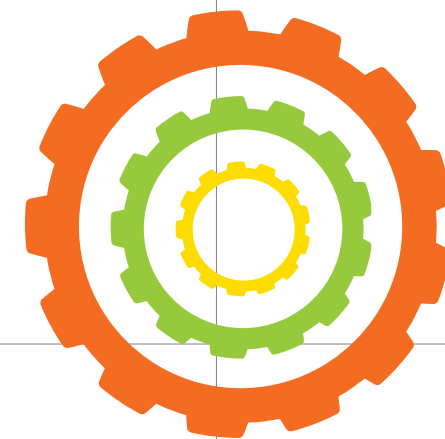
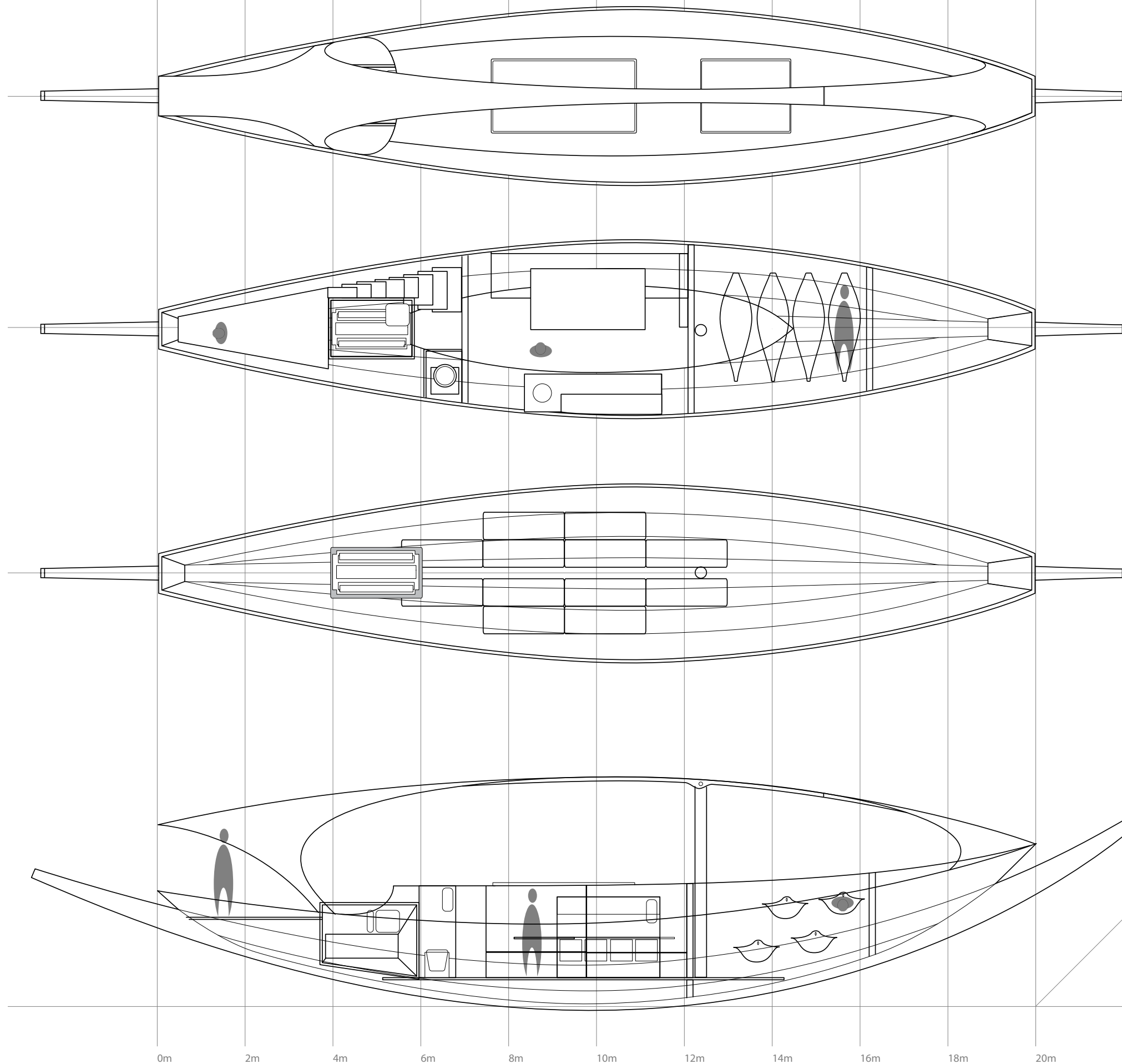
other power options



iconic silhouette

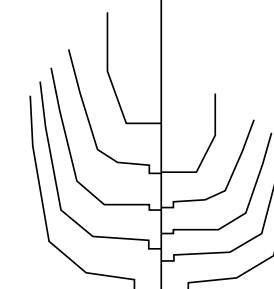
Sprout: Inspired by Jatropha





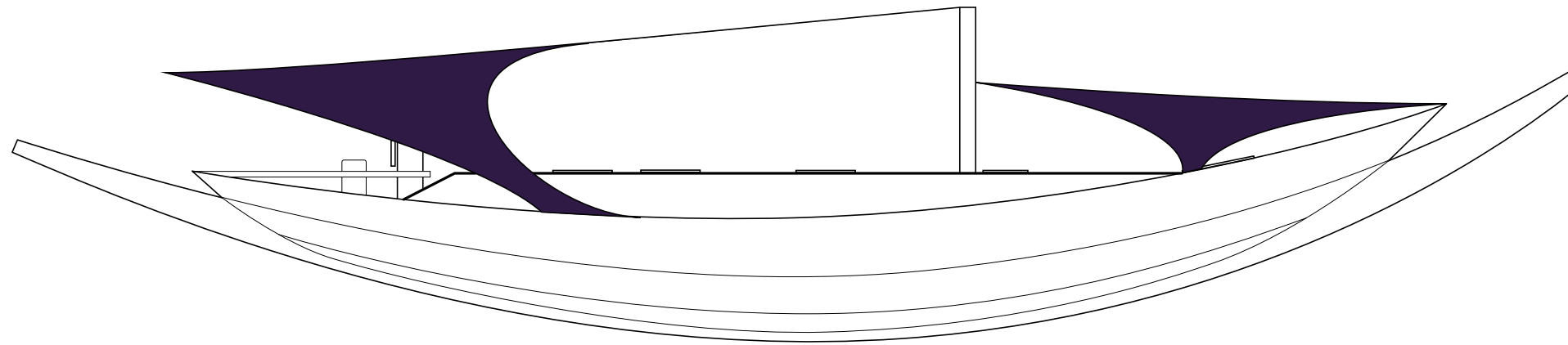
AYWA
INTERNATIONAL

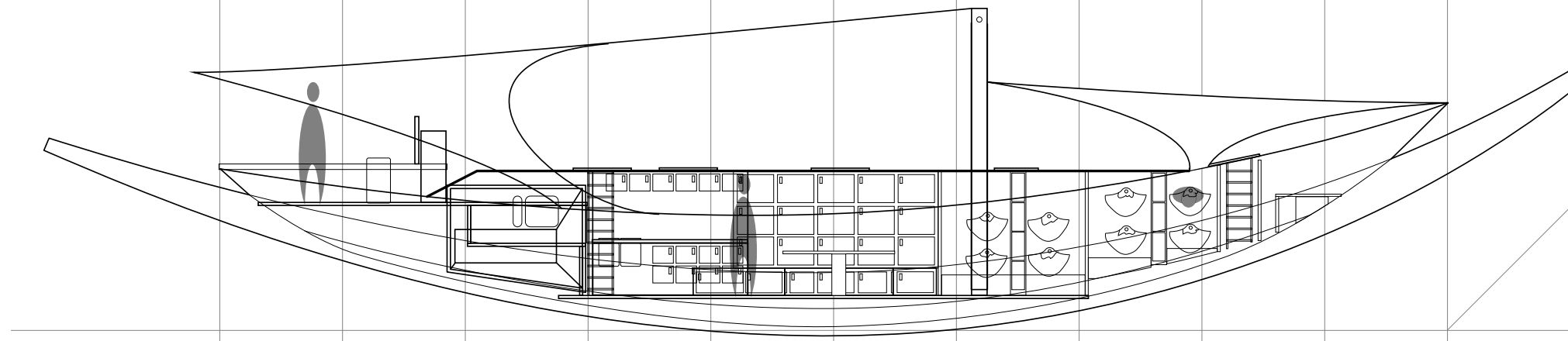
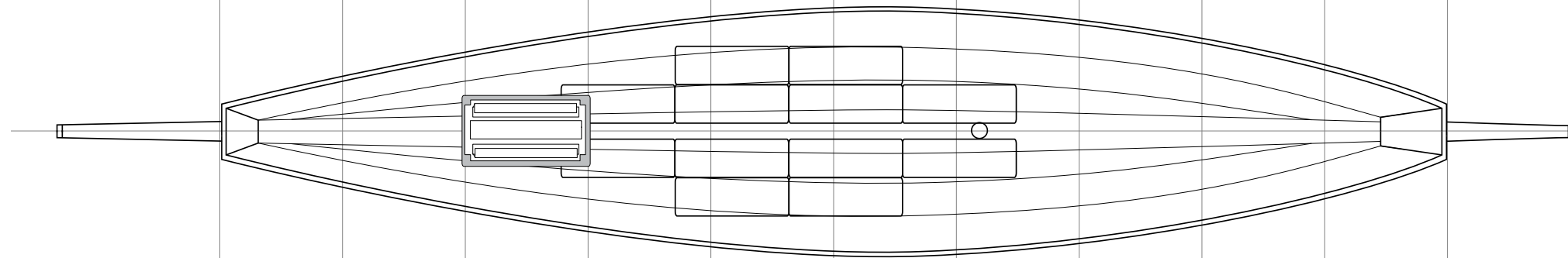
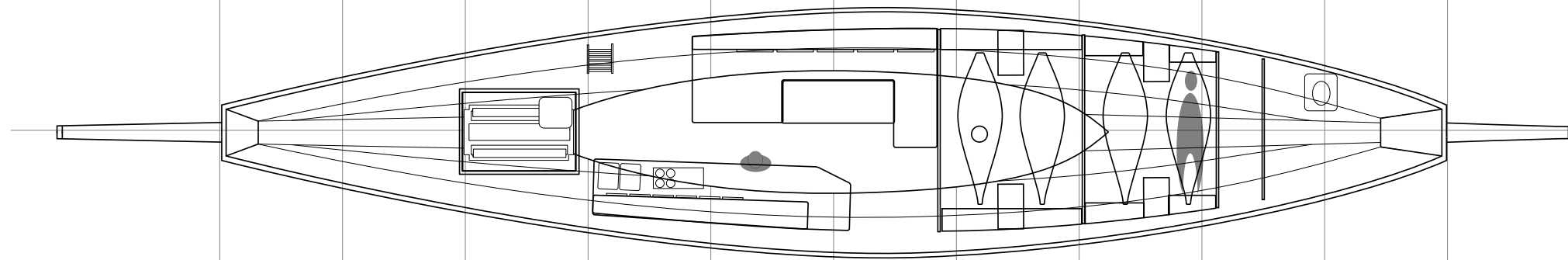
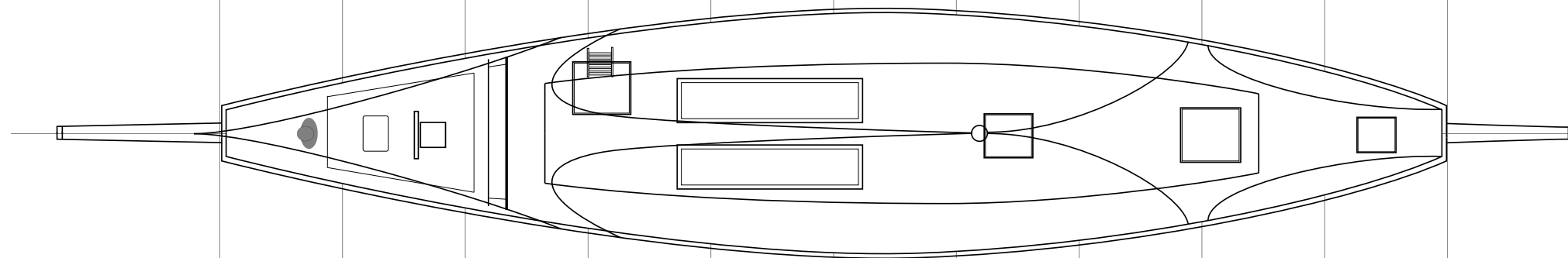
concept A



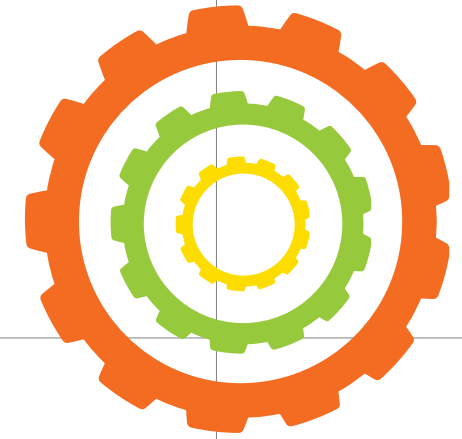
iconic silhouette

Authentic Tarp Story



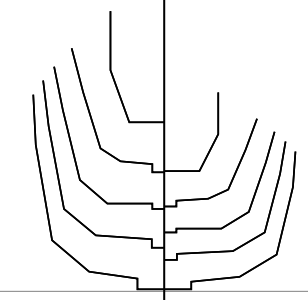


0m 2m 4m 6m 8m 10m 12m 14m 16m 18m 20m



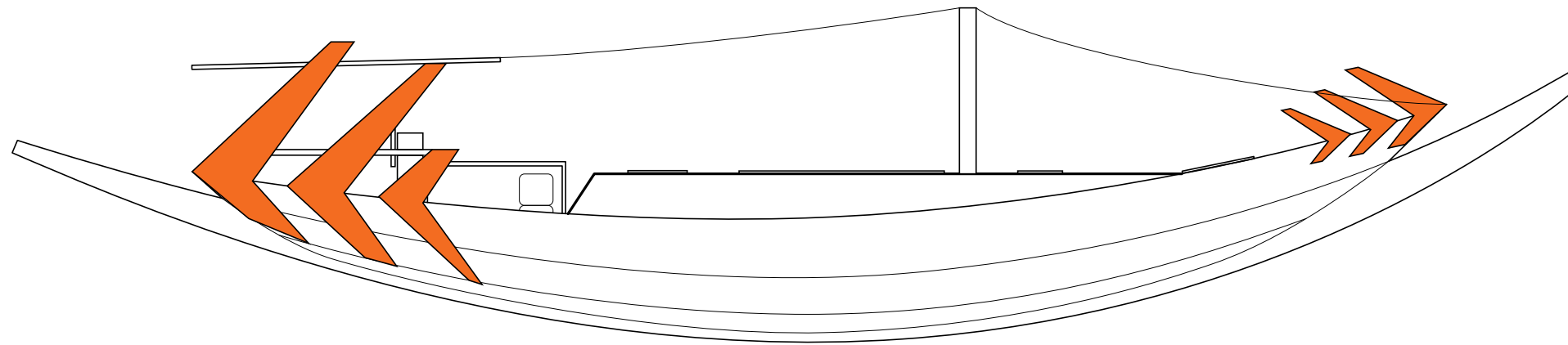
AYWA
INTERNATIONAL

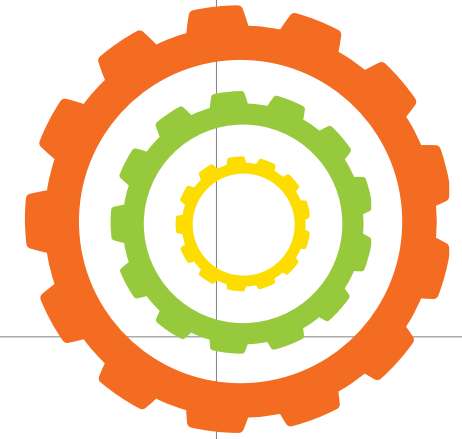
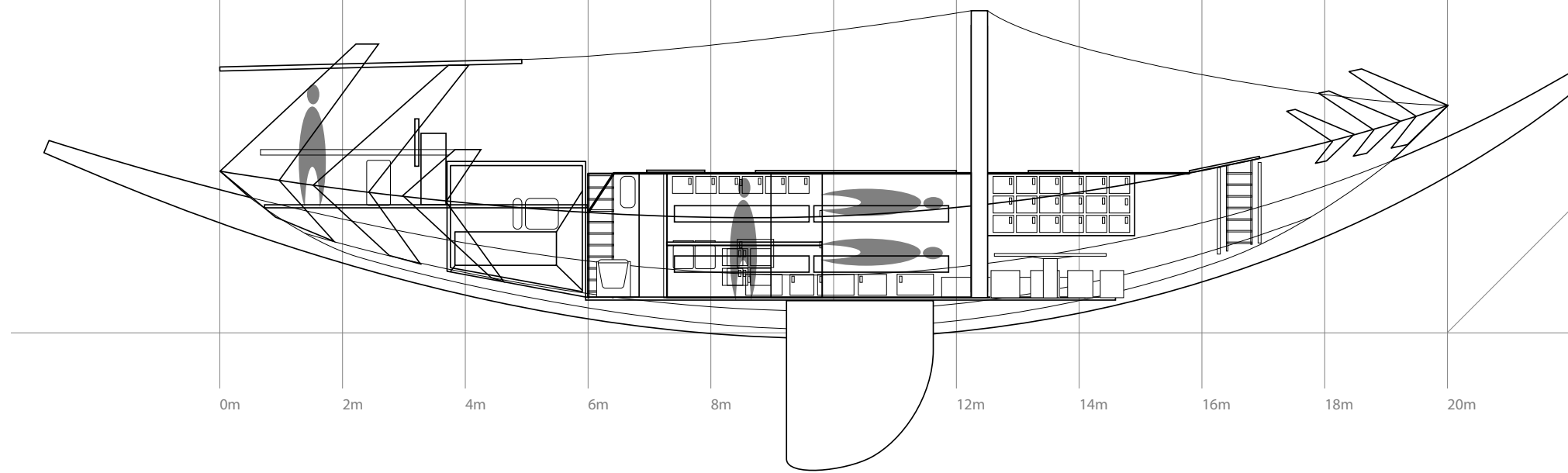
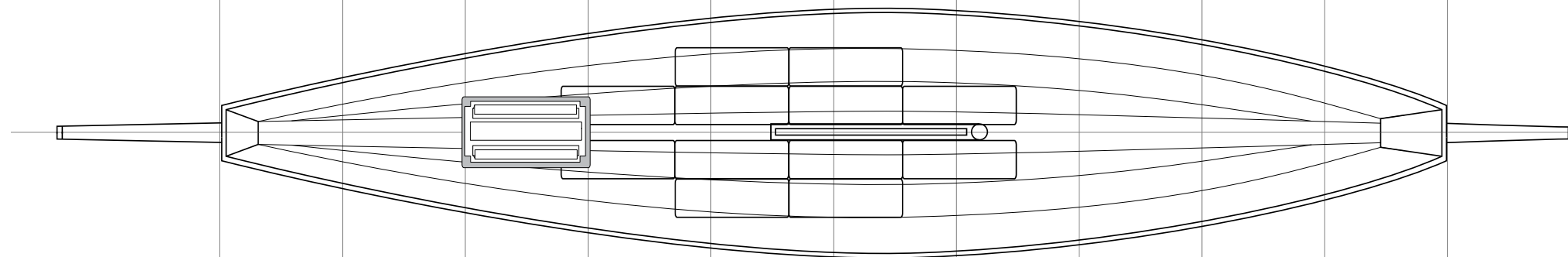
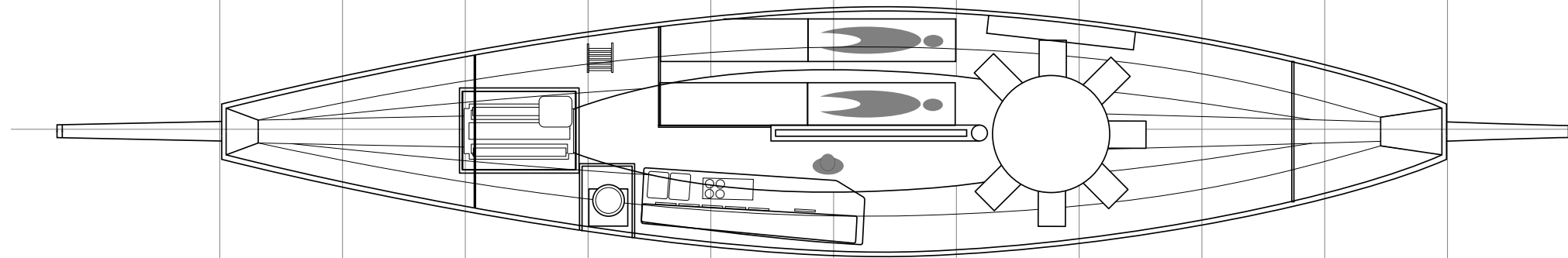
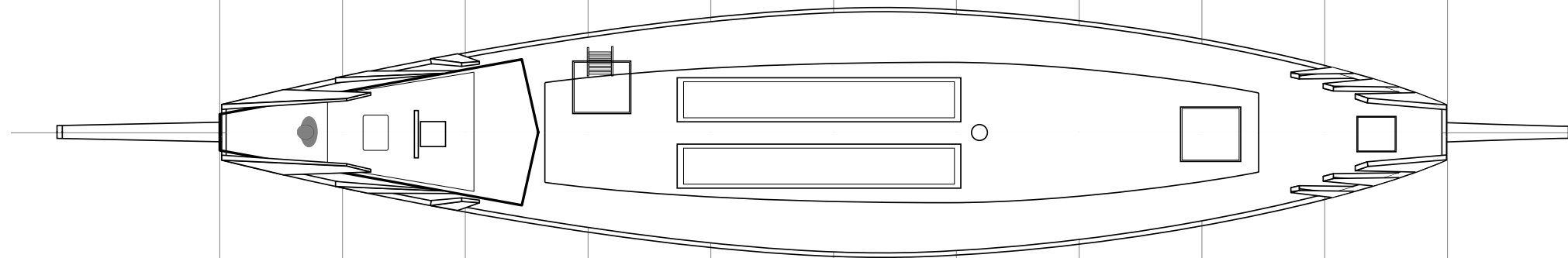
concept B



iconic silhouette

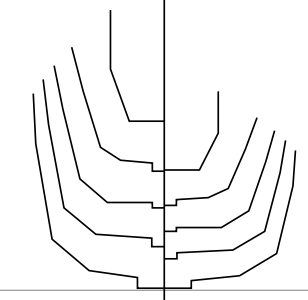
Symbols inspired by the livery

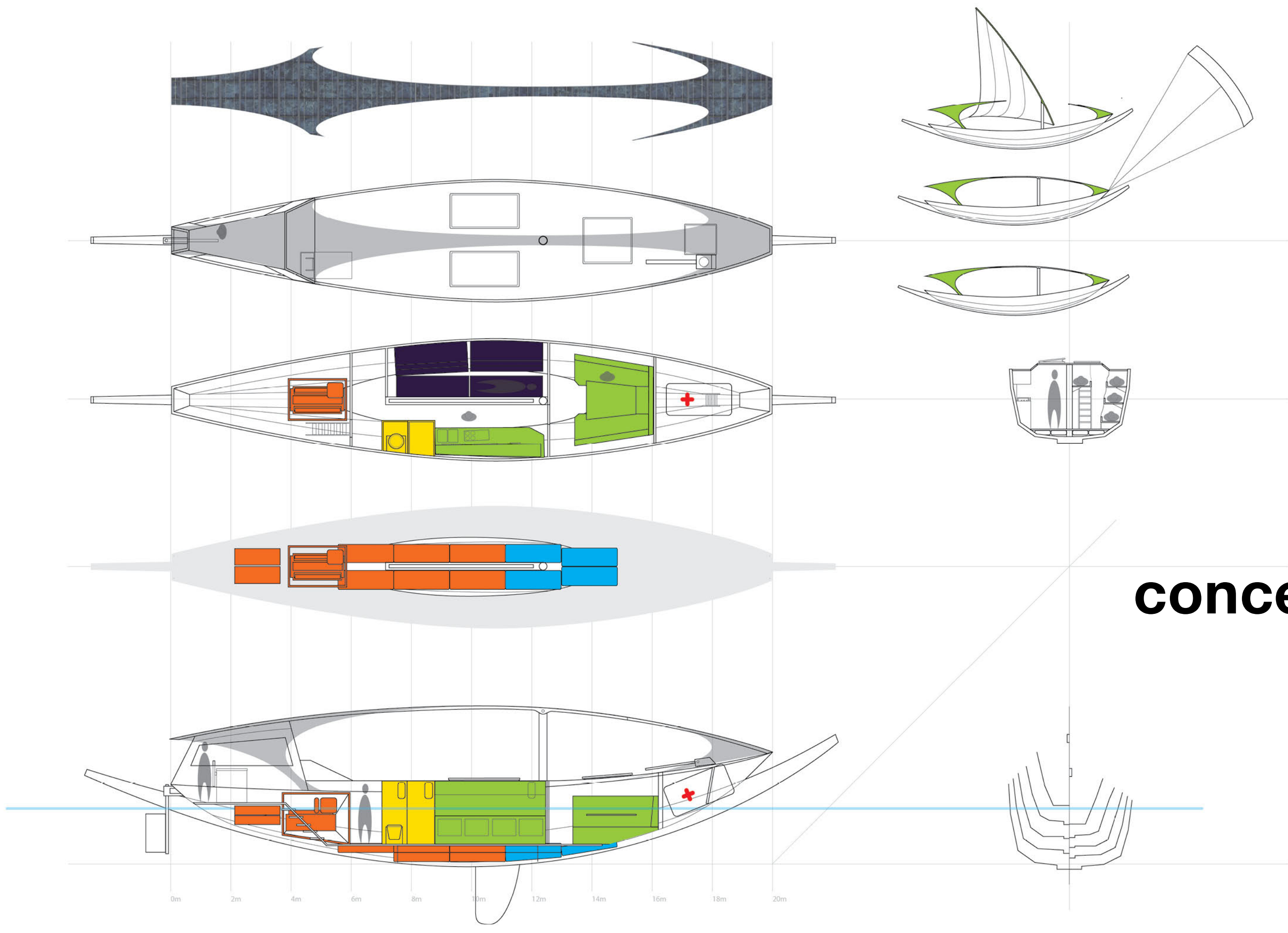




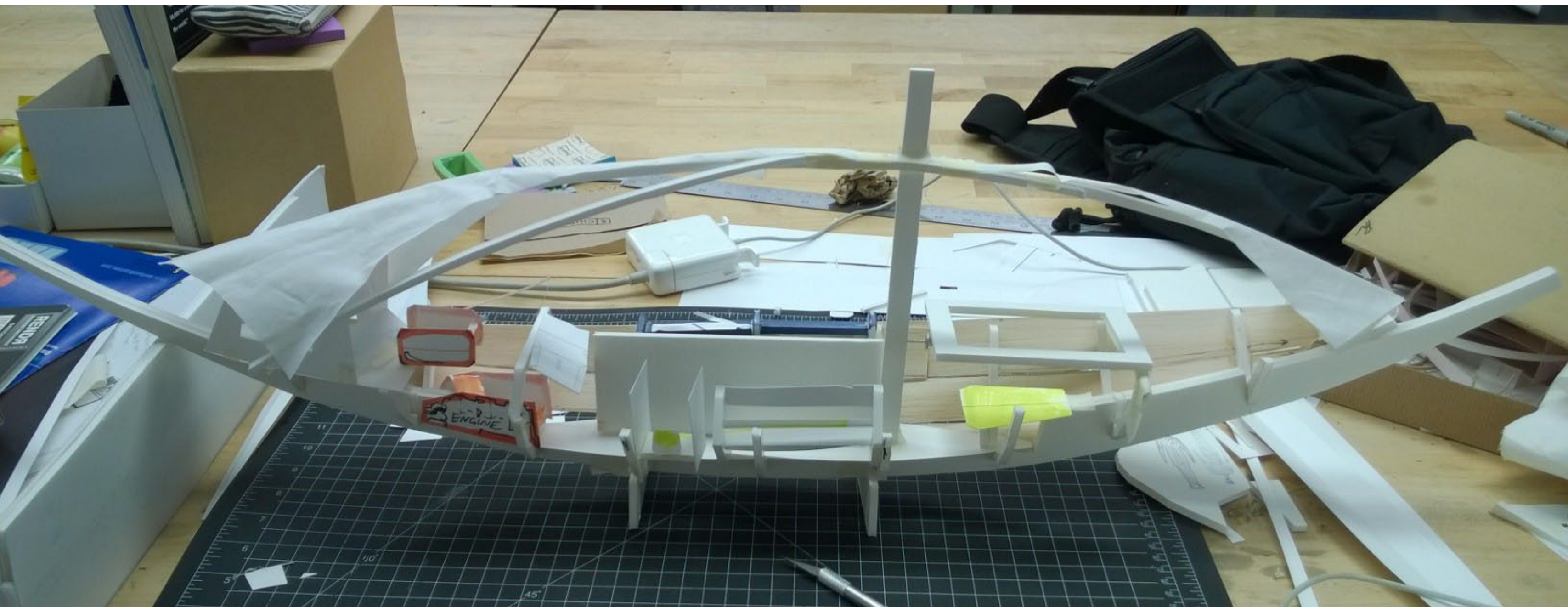
AYWA
INTERNATIONAL

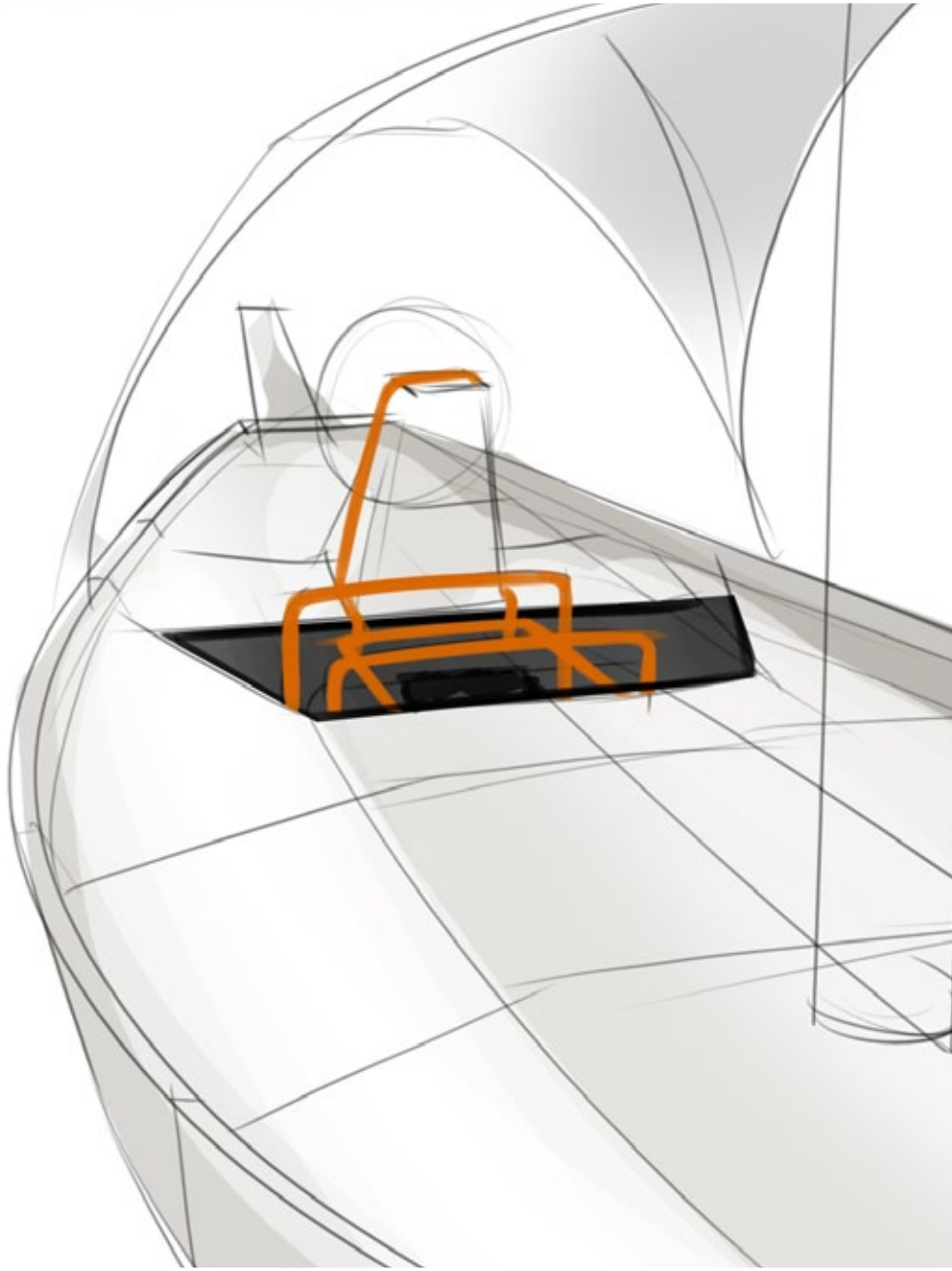
concept C



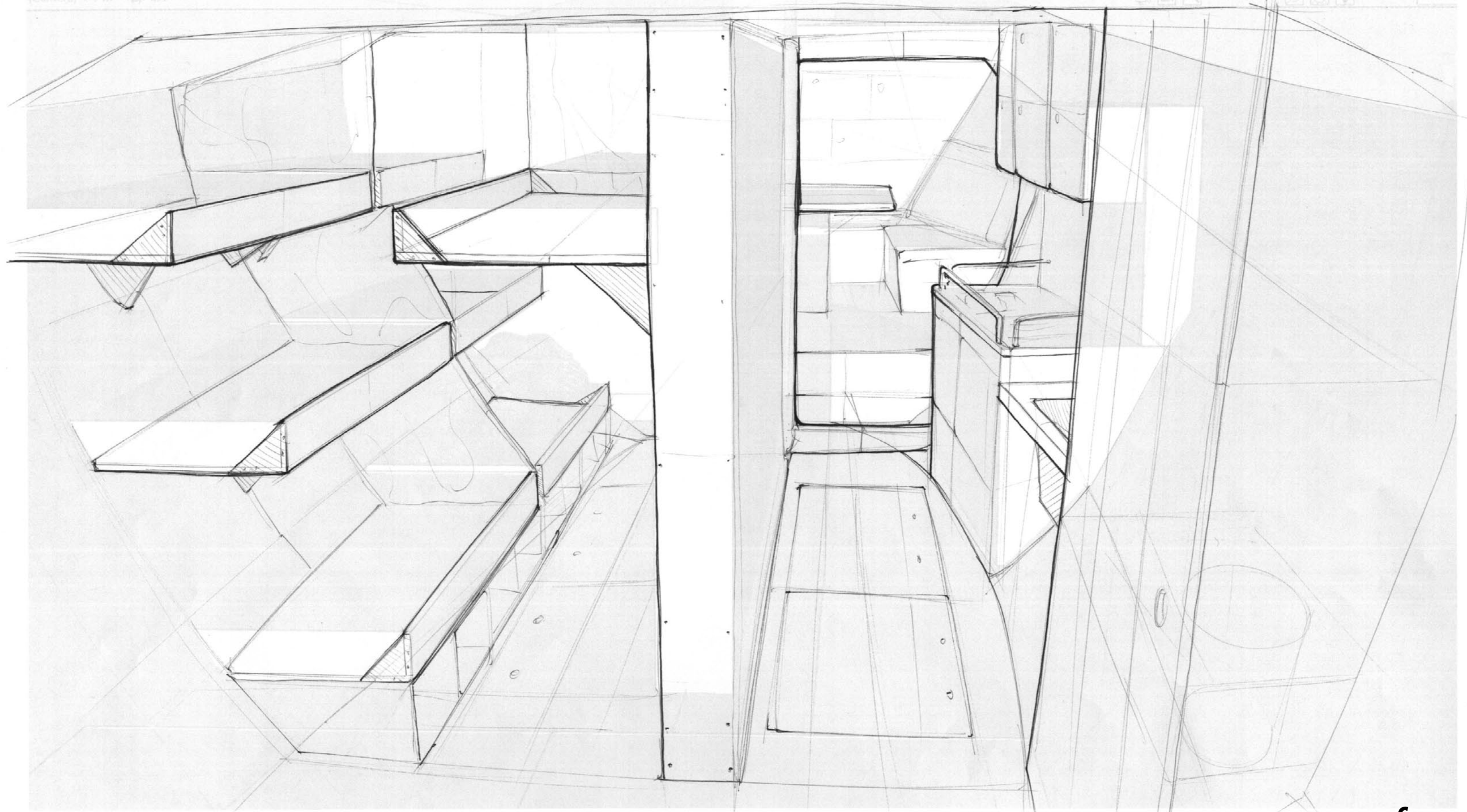


concept A2

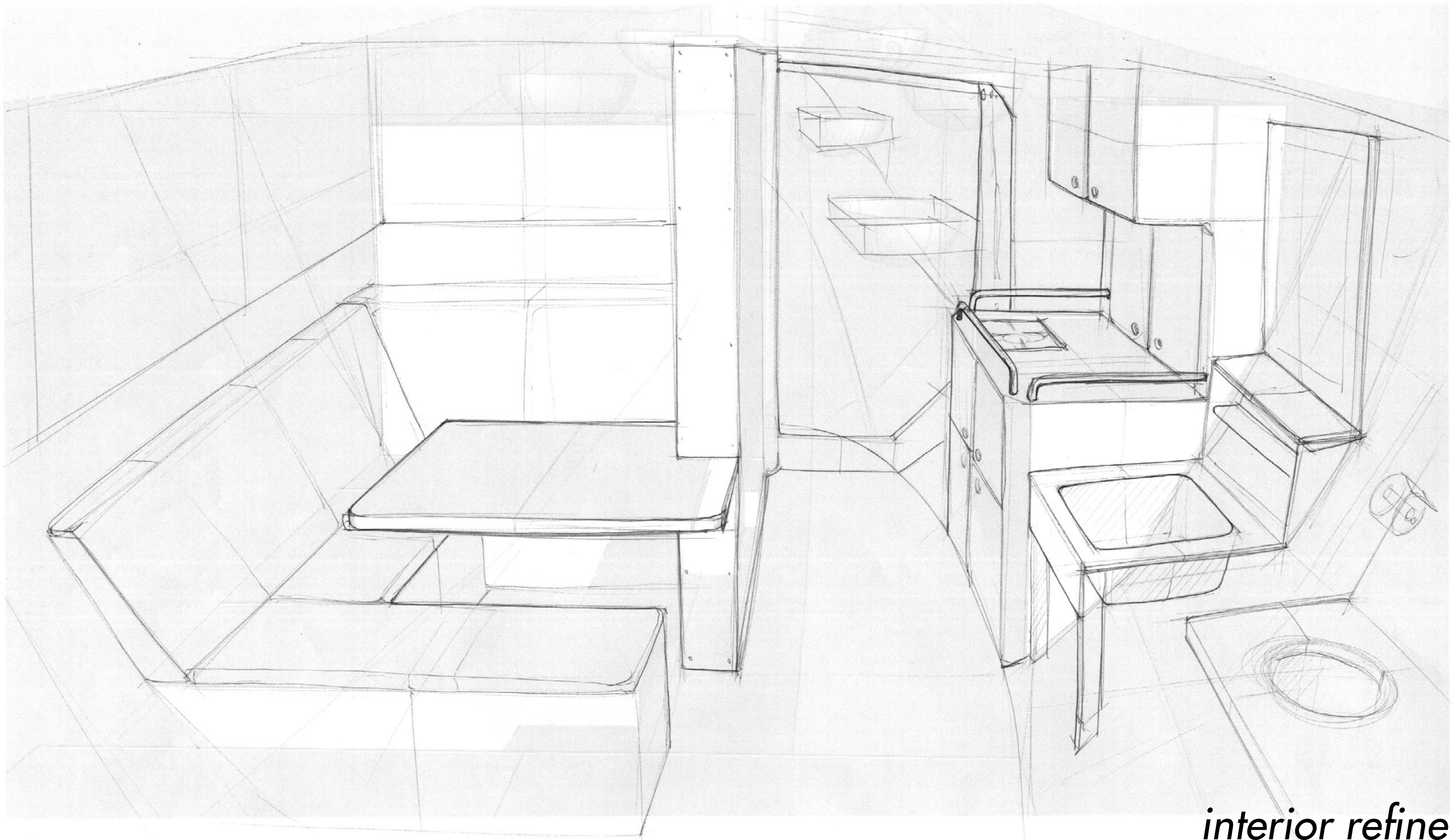




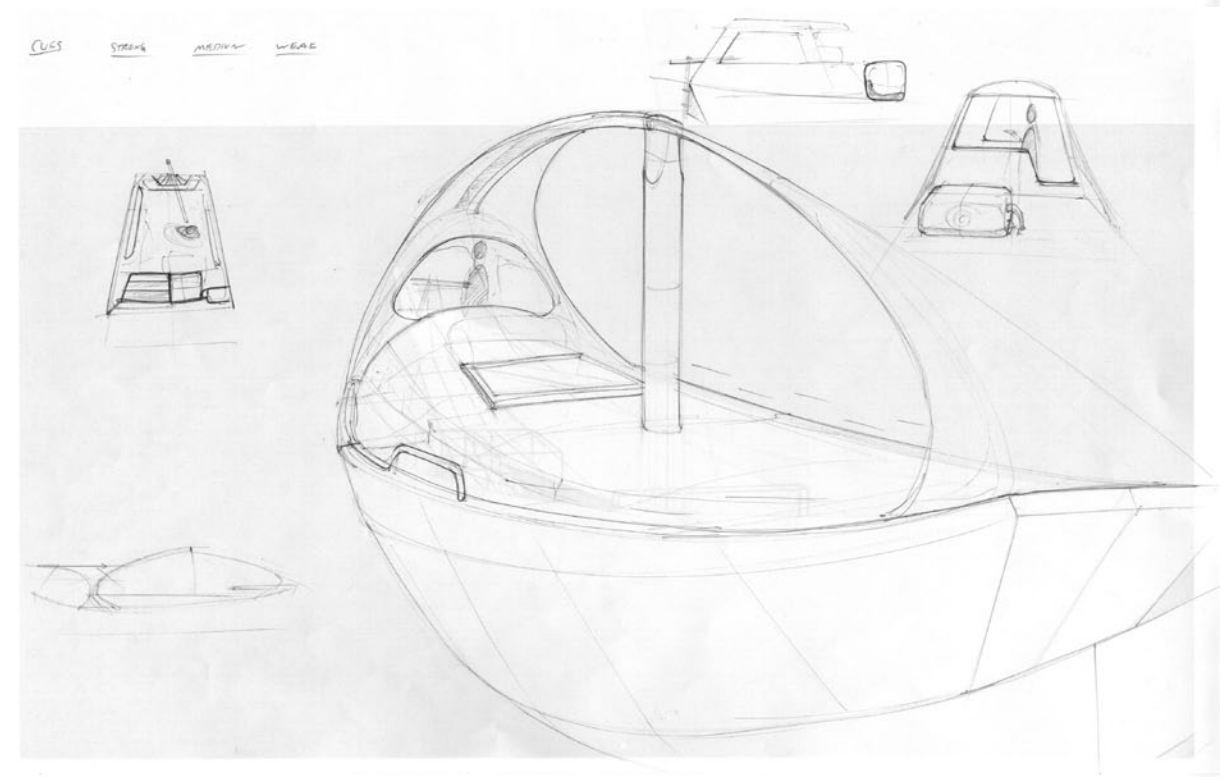
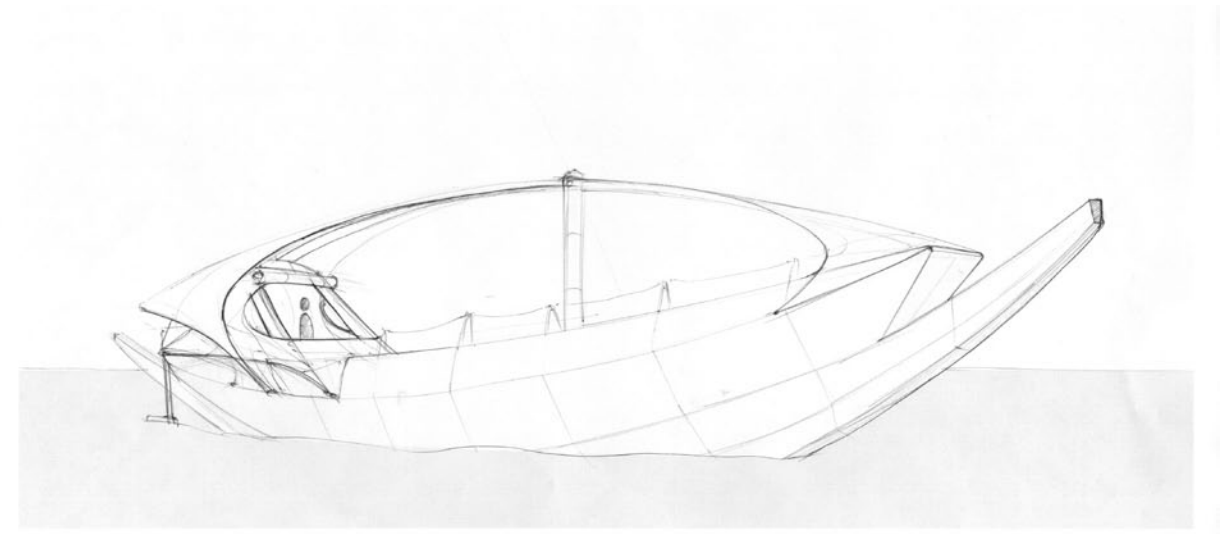
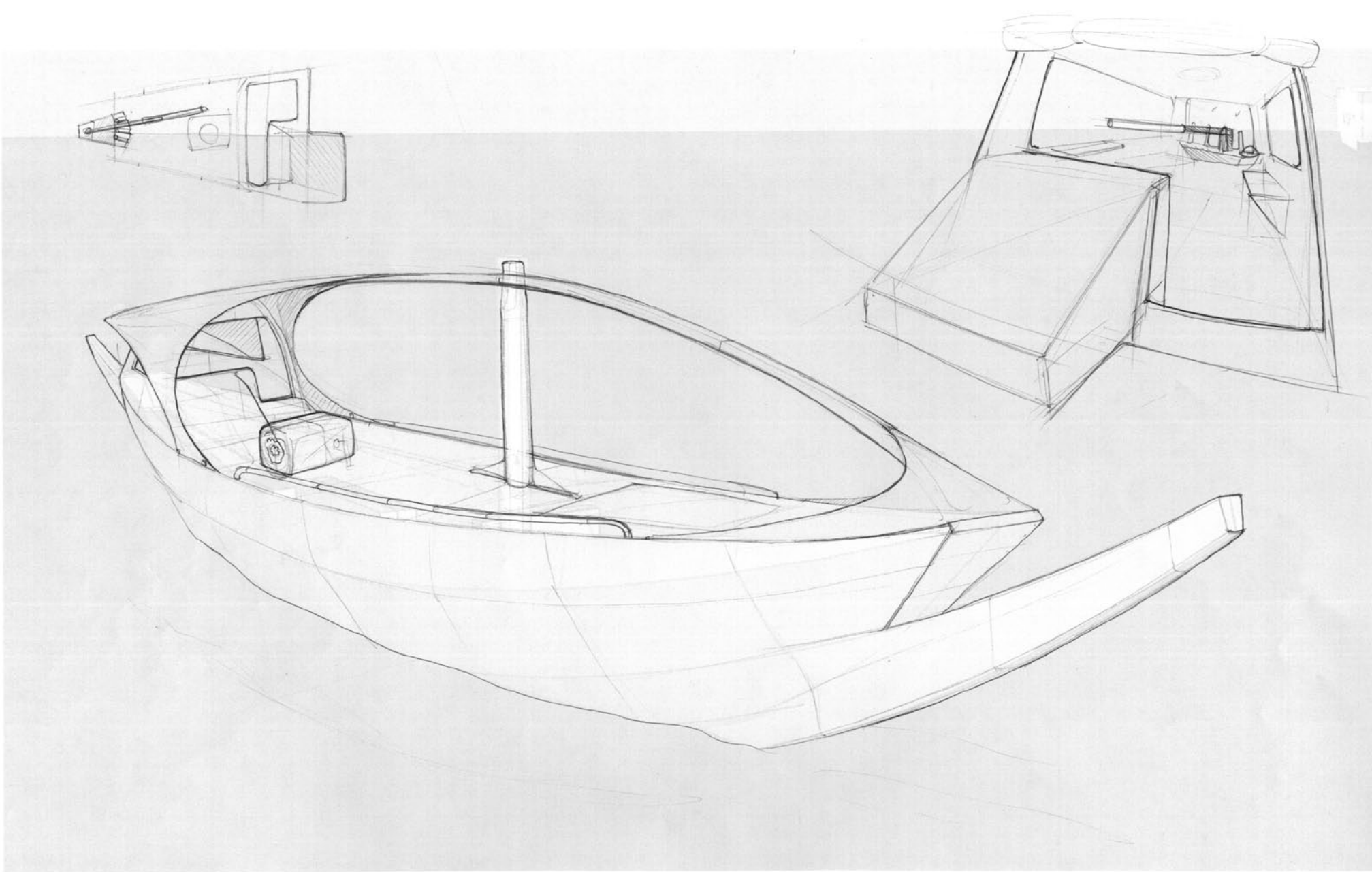




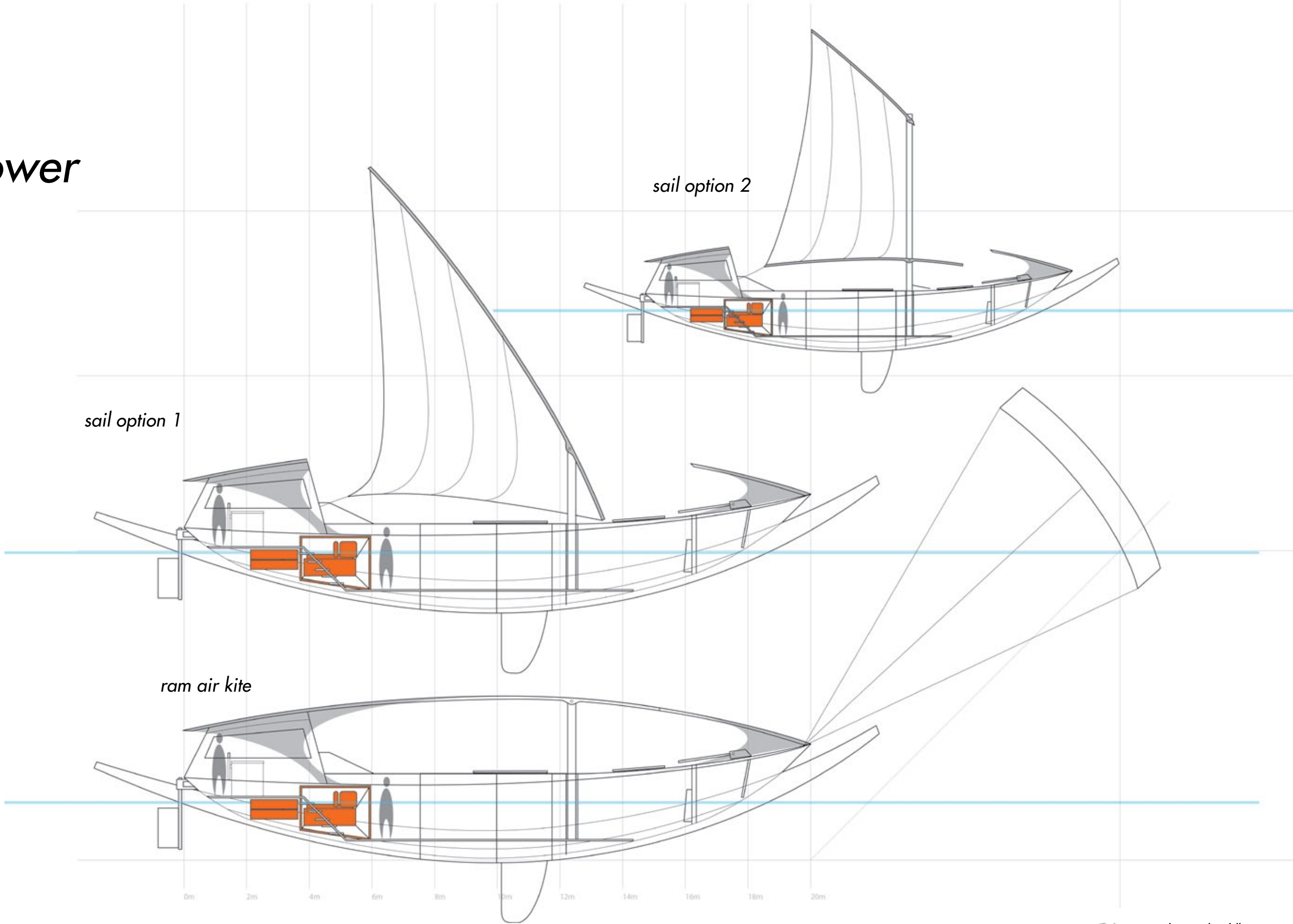
interior refine

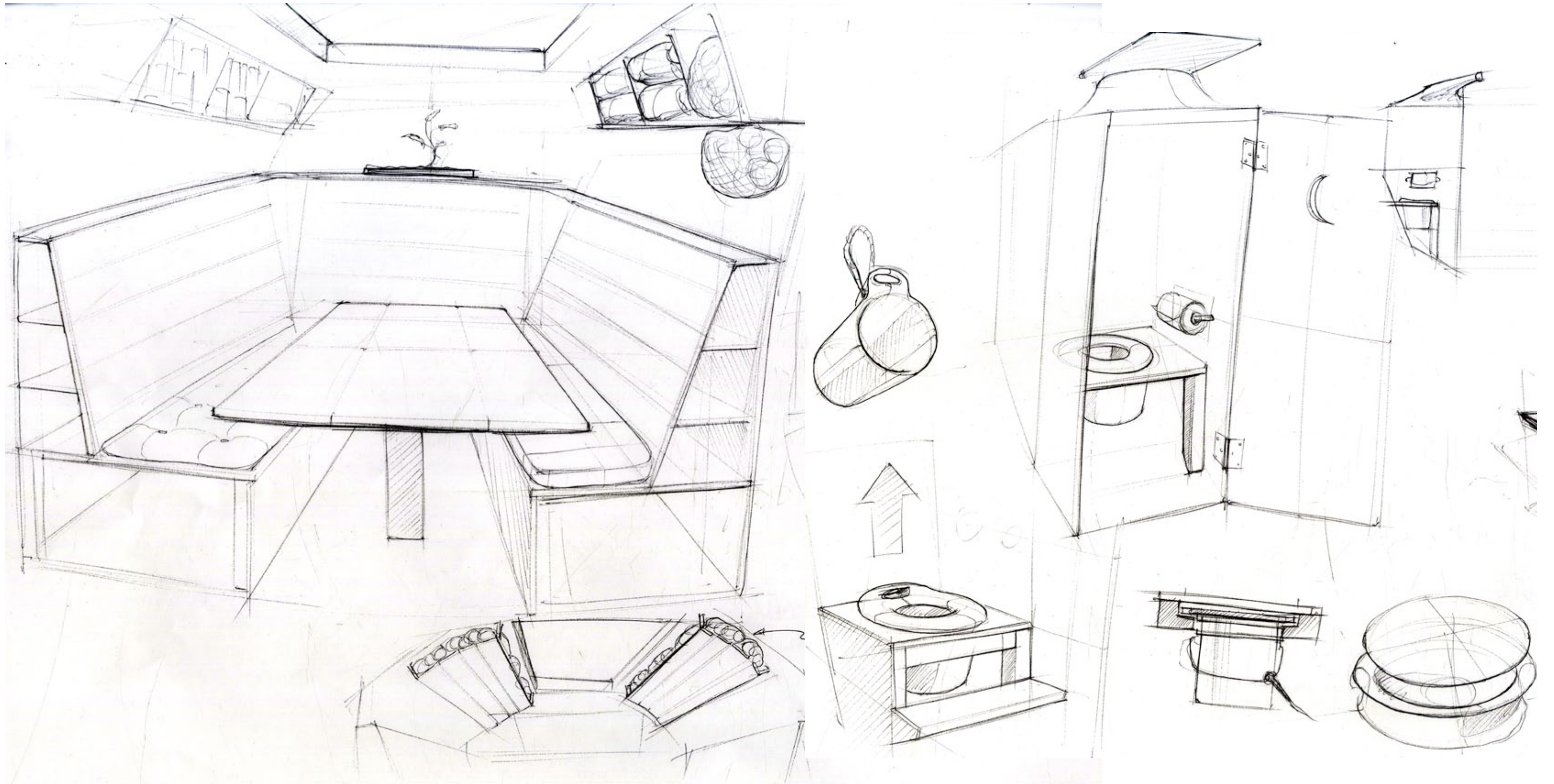


interior refine

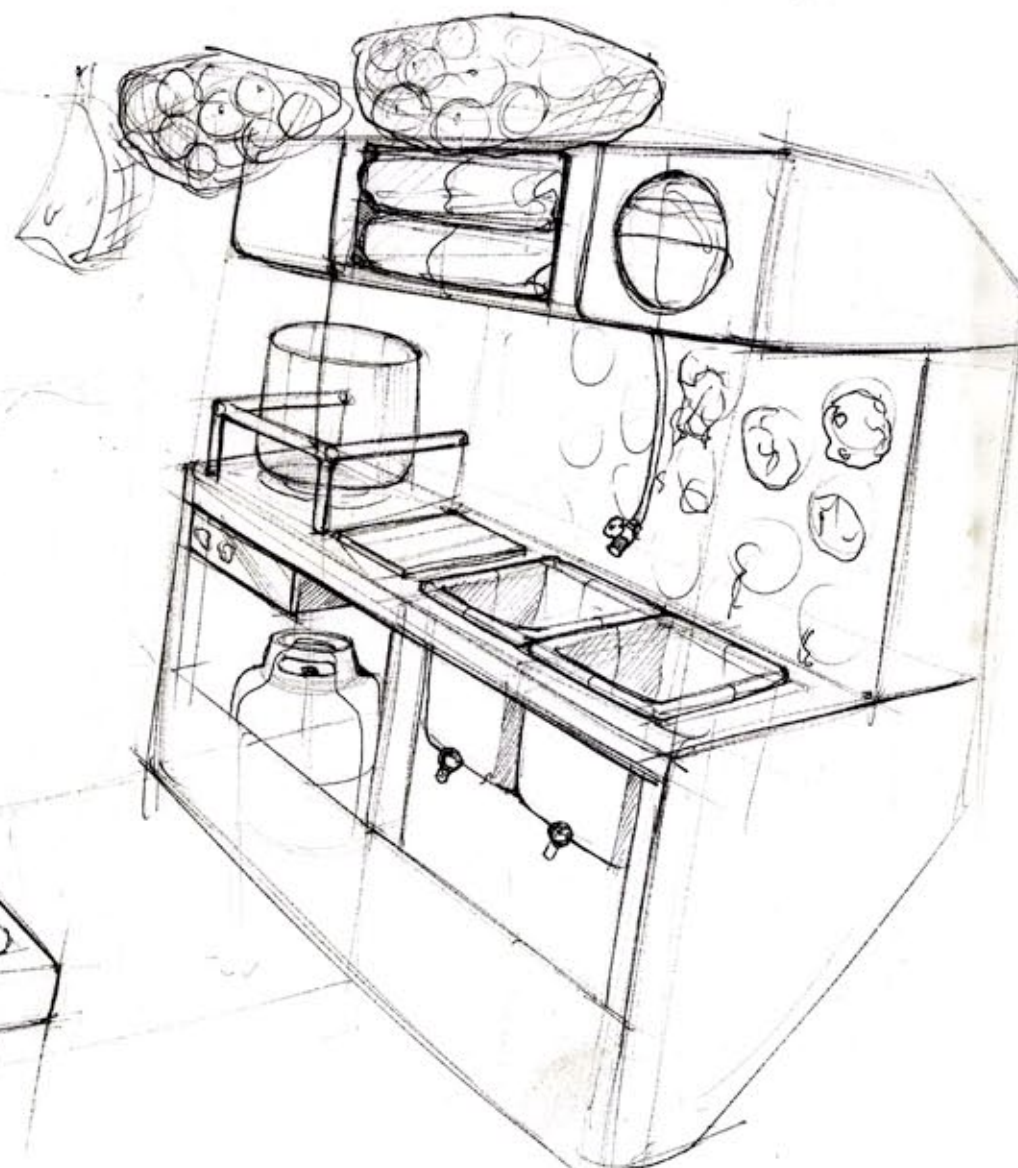
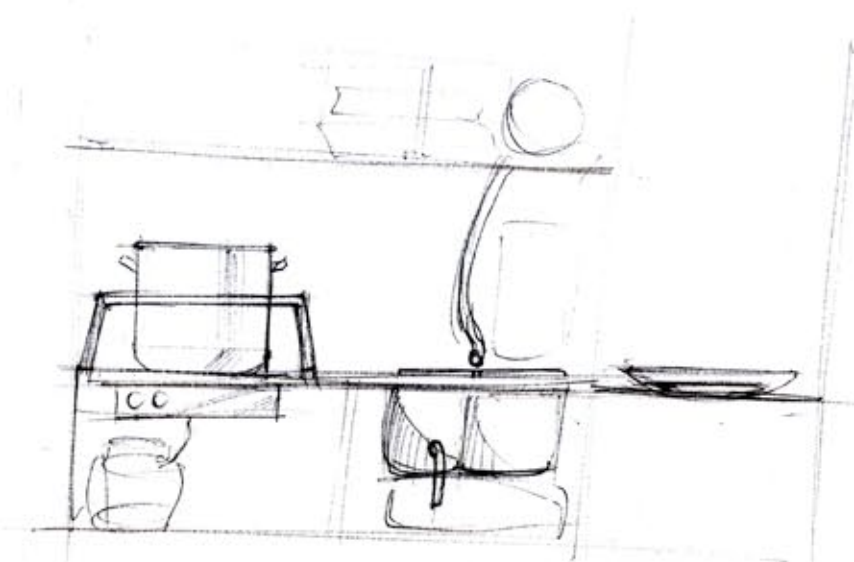
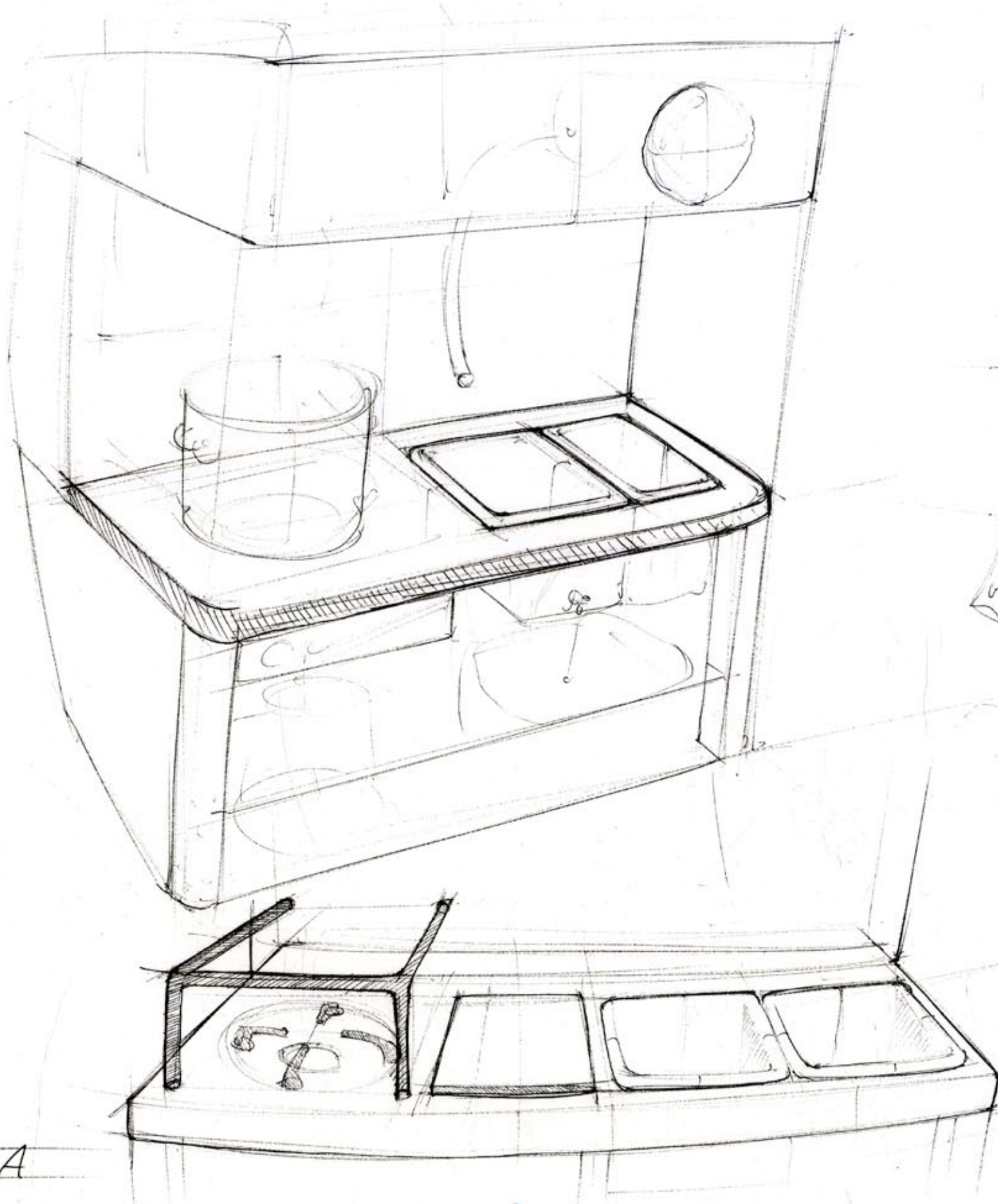


emergency power



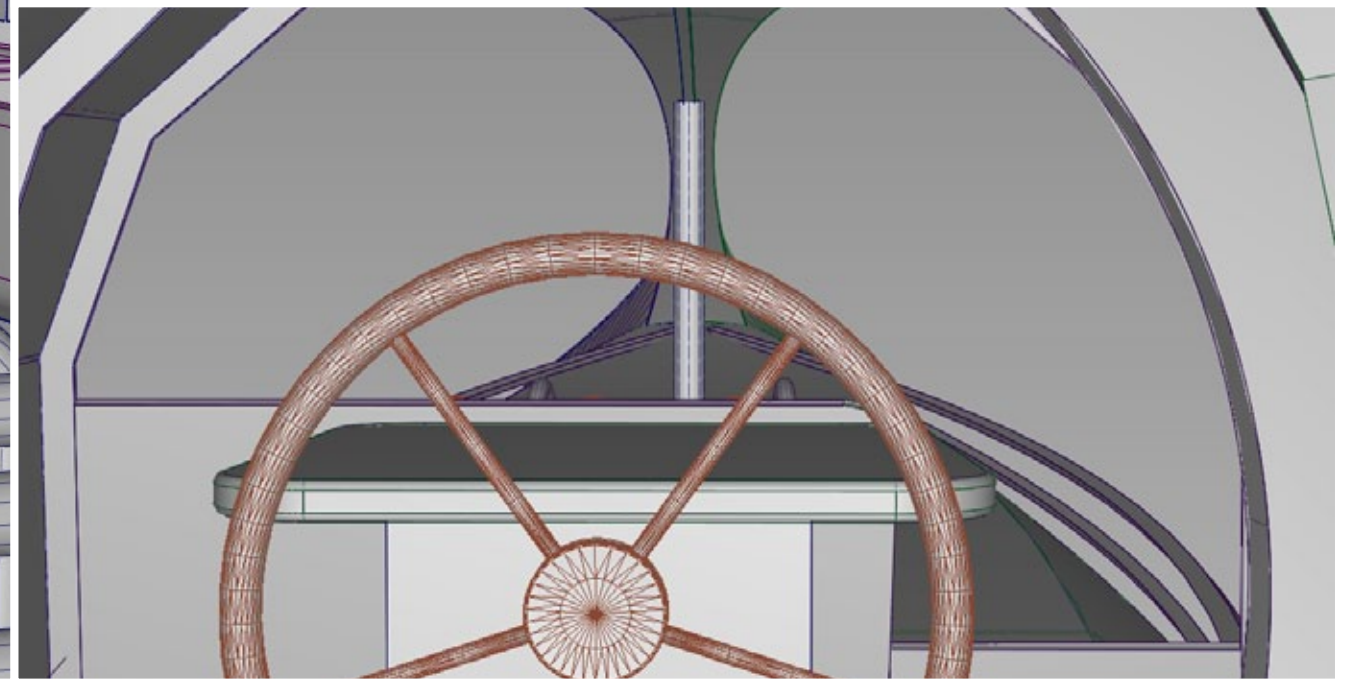
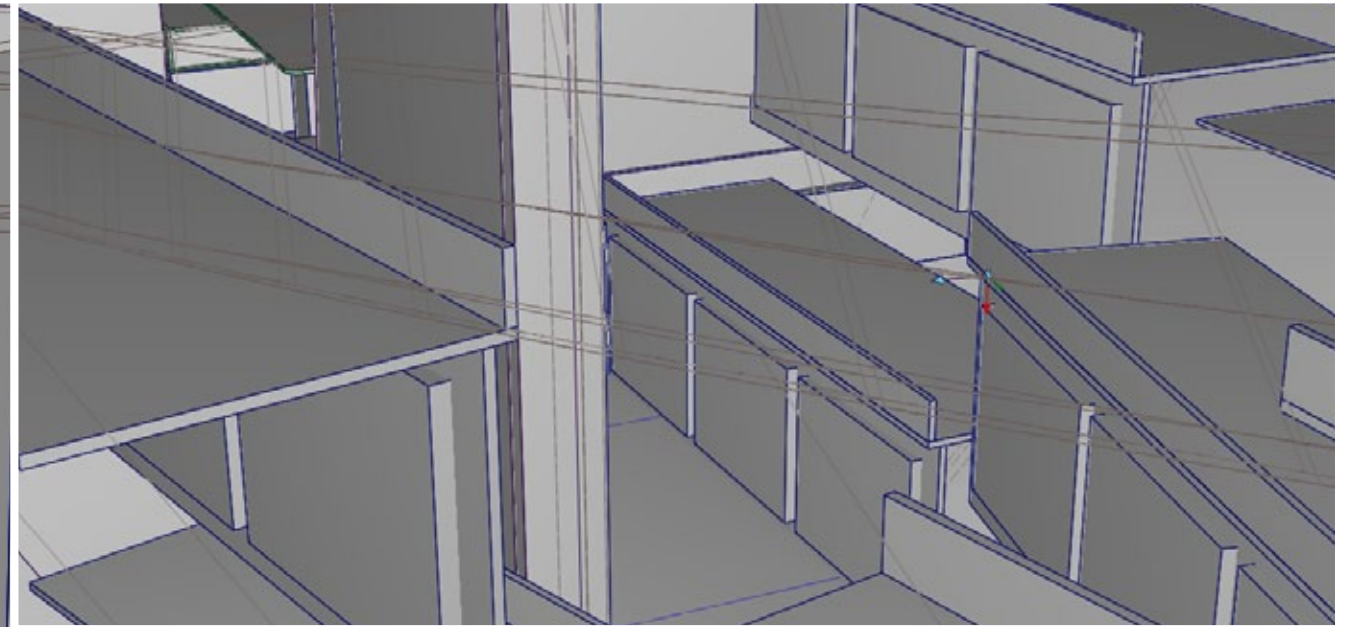
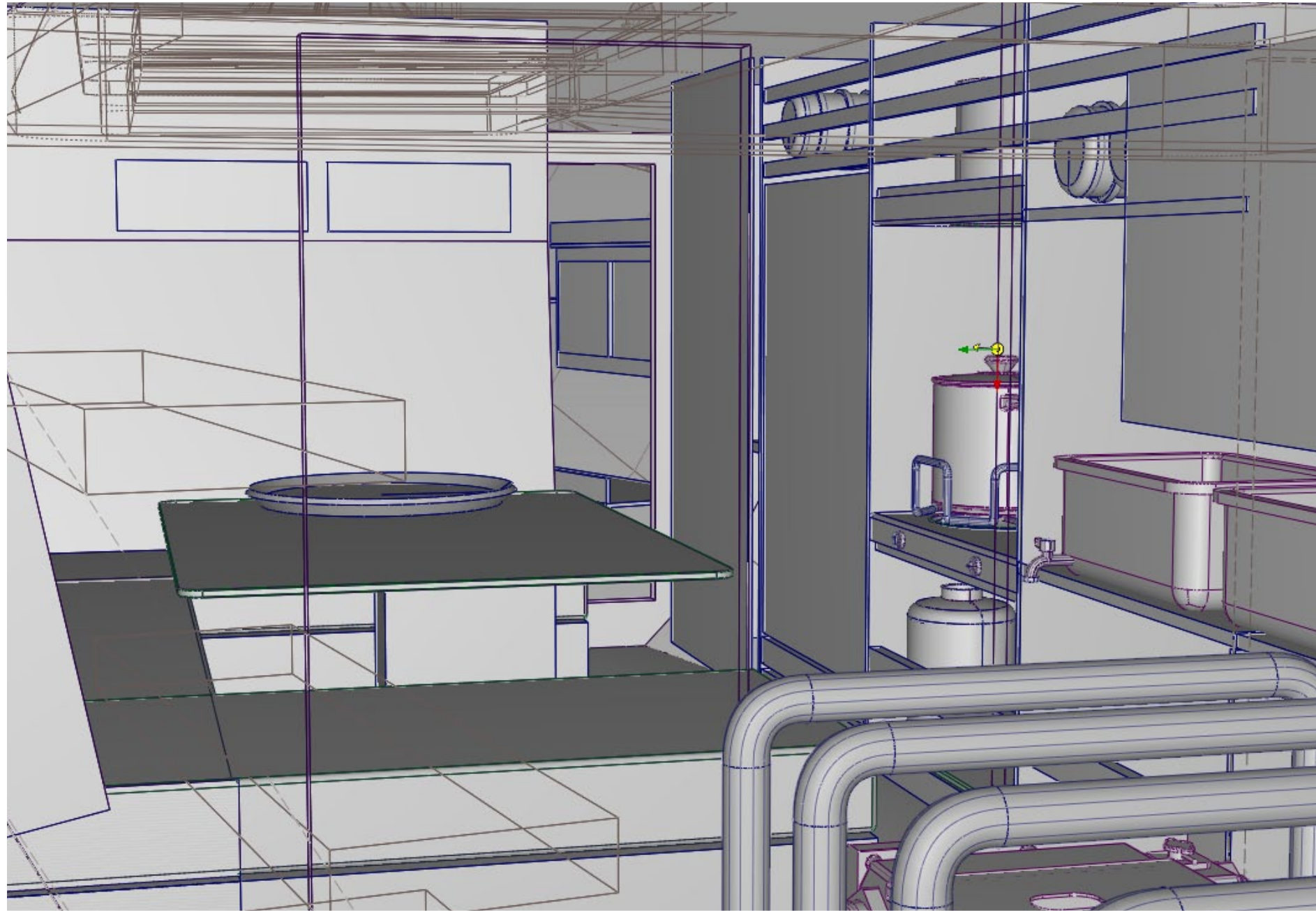


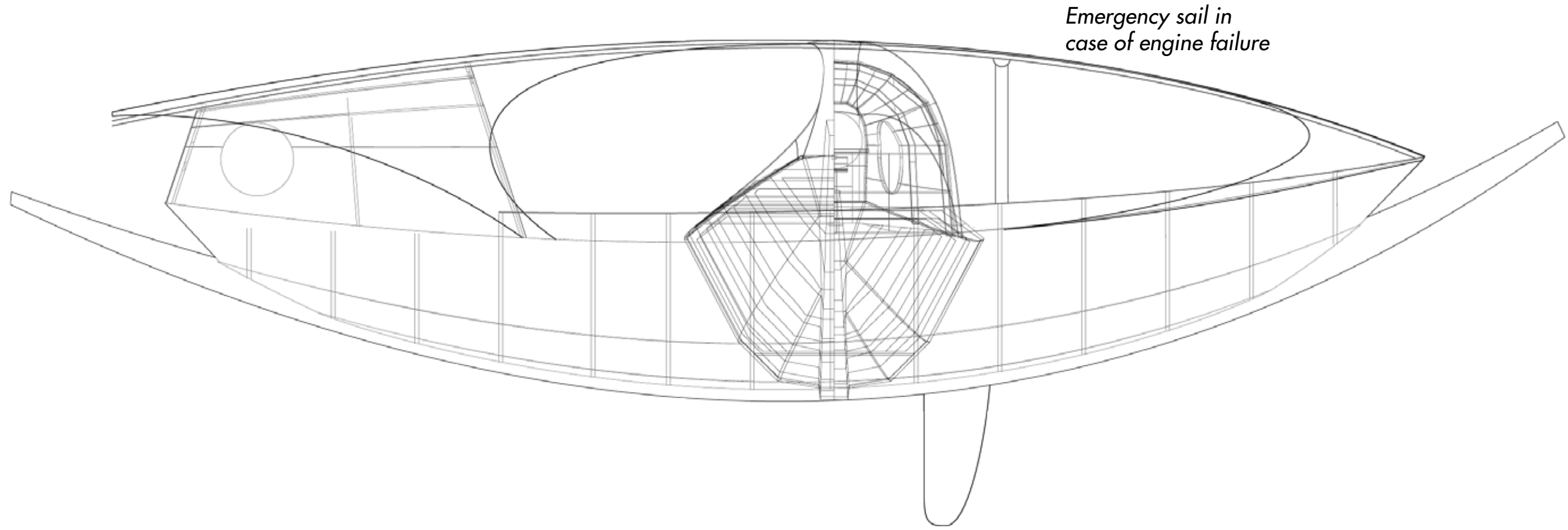
workstation refine



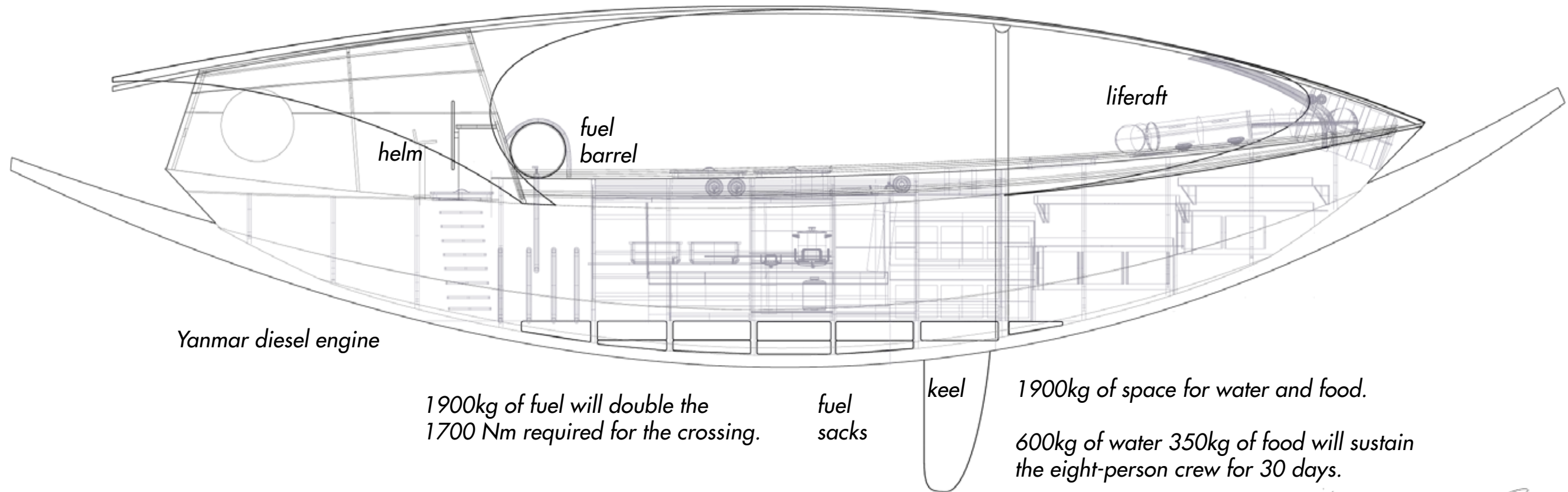
KITCHEN A

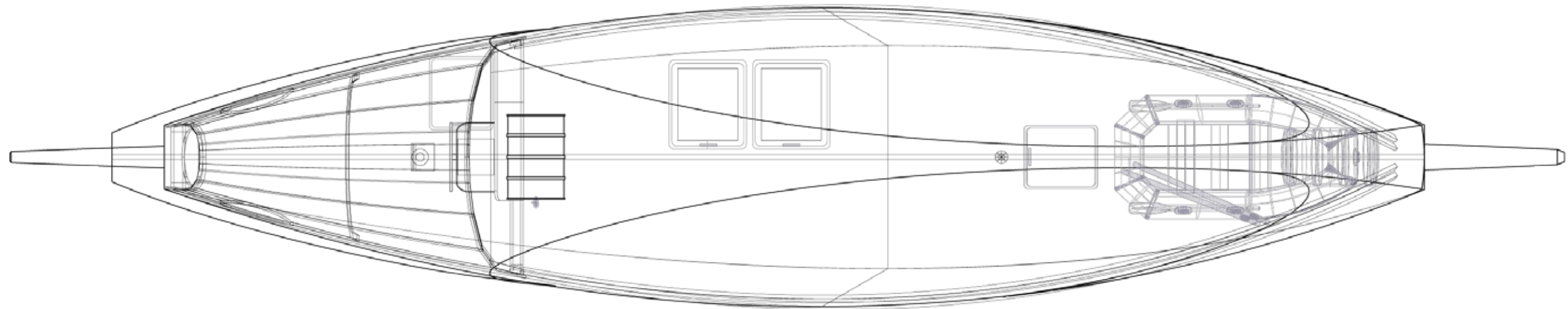




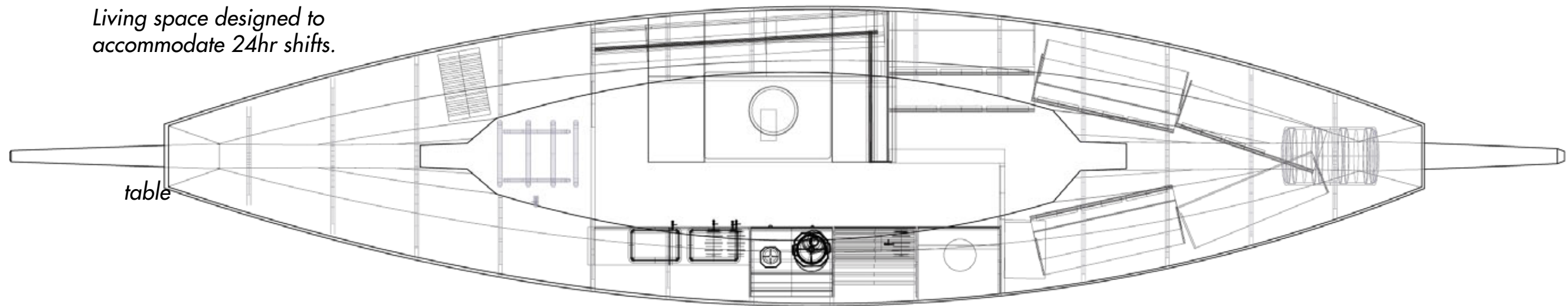


Emergency sail in case of engine failure





Living space designed to accommodate 24hr shifts.



beds

table

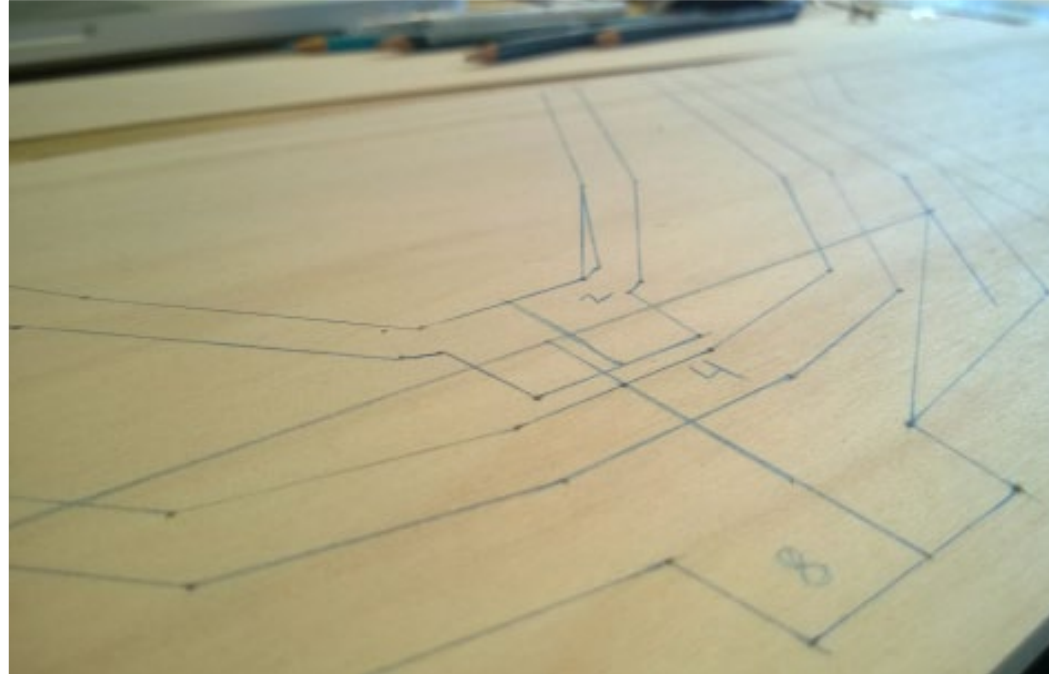
washing and prep

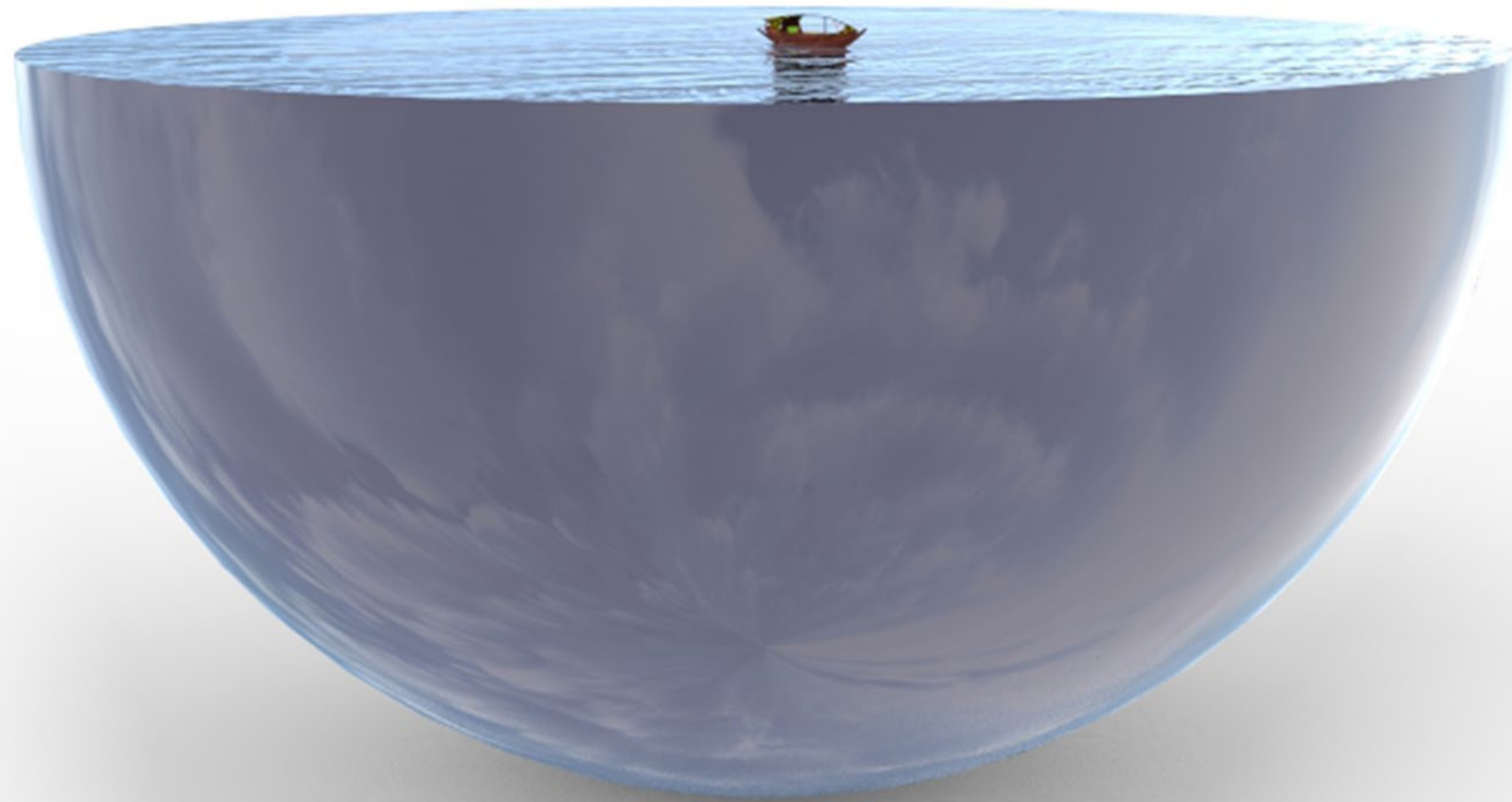
stove

bathroom

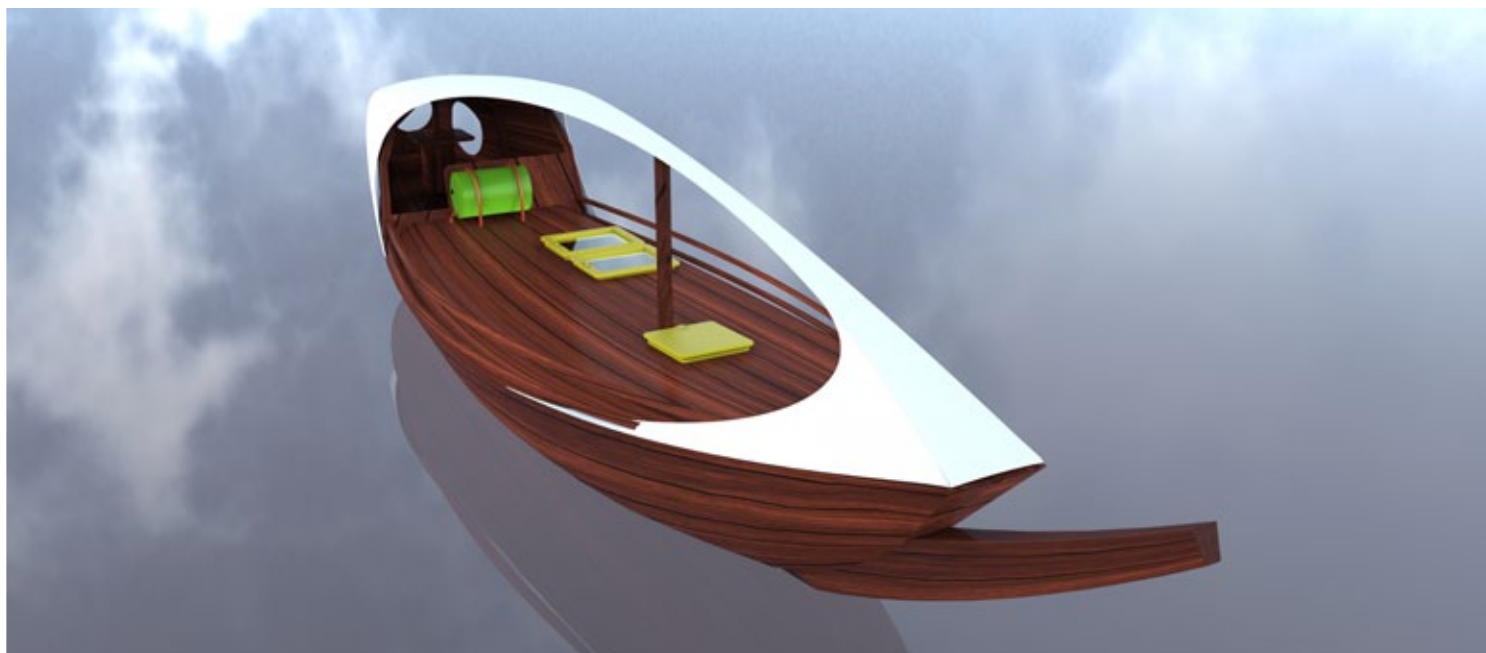
toilette







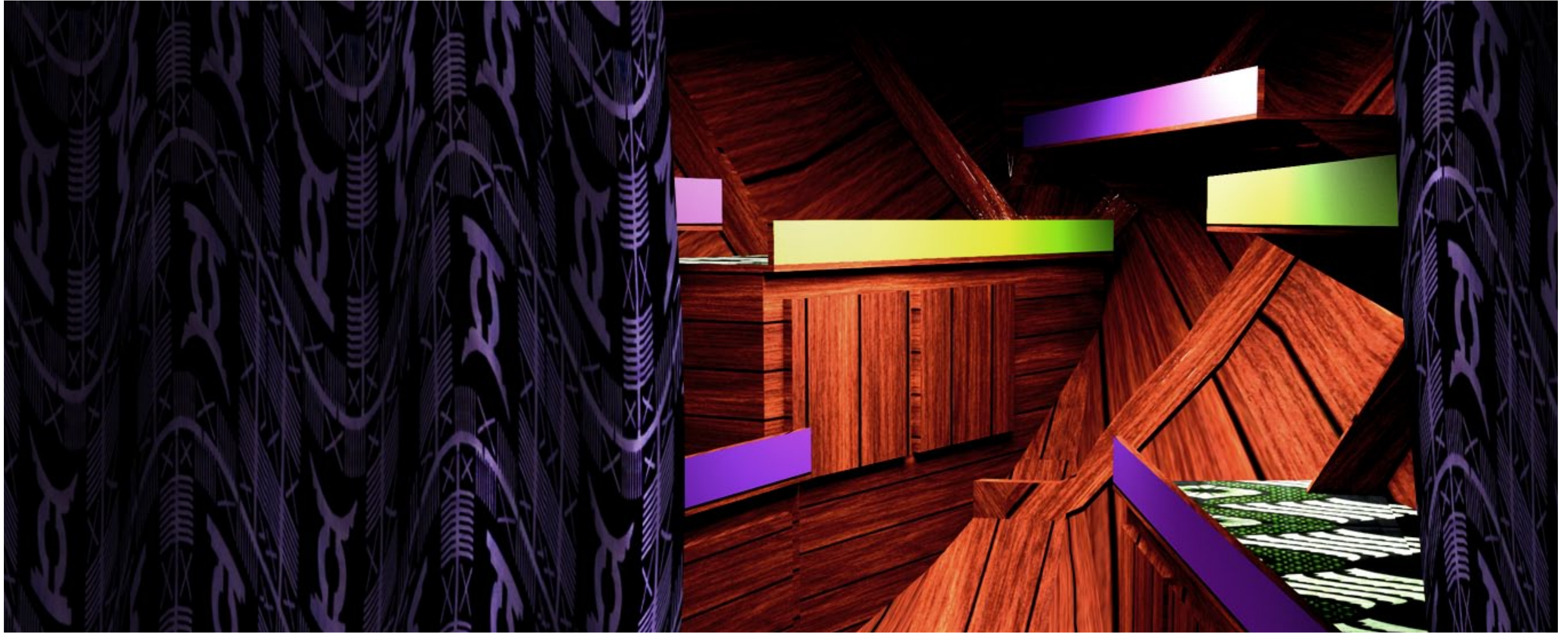
at the edge of the earth

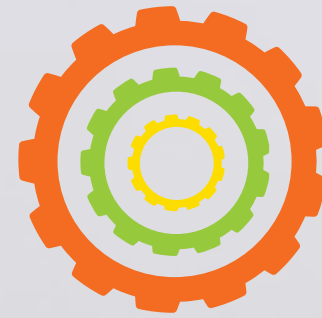












xamba

Wolof; v. stoke the fire

A handwritten signature in black ink, appearing to be 'PM', with a long, sweeping horizontal stroke extending to the right.

Ad maiorem Dei gloriam

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