By Joanna Fong, Maya Chopra and Harshini Sornaraj

# The Elevating House Report

We were set the task of designing a flood proof house. We approached this idea by conducting some research which helped guide us to our finished product. Upon further research, we took inspiration from the floating houses in the Netherlands, where they also have varied weather, and adapted it to suit our everyday London life. Our outcome was an improved version with added features. We decided upon a house which would rise using hydraulics and named it the elevating house.

**So, how does the elevating house actually work?**

First, the large dome next to the house has a sponge like structure where water is able to penetrate in. As the water level rises, it will allow the float to rise with the water. The pressure of the float will allow biofuel to flow through the tubes into the hydraulic jack. Next, the hydraulic pump will receive the fuel and pump up to raise the house as the water rises accordingly. The four poles on each side of the house connect the house to the ground and make sure that it does not float away when the flood comes. We have included solar panels and wind turbines to collect renewable energy which is then stored in a power wall and used later as a back up during the flood.

We then researched about the advantages of the elevating house. The house has the ability to adapt to changes in water level, and is naturally resistant to rising water levels and because of the added features it will create a more environmentally friendly area, decreasing the amount of pollution.

**Our starting point**

Our initial idea was that our house would be floating and connected to the ground by four chains in each corner. Underneath the house, a propeller was to be attached to stabilise the floating. However, we then realised that the chains would drag and the house would be prone to floating away and potentially crashing into neighbouring houses. For our second idea, we came up with the idea of a floating house with four poles on each corner which the house could move up and down on without extending the poles. The propeller was still incorporated in this idea and to make our house more eco friendly, we decided to include solar panels which would provide energy for the house. However, the disadvantages of this house was the propeller would cause too many waves and the noise would affect neighbouring people. The propeller would also not support the house enough. Since the house was also a floating house, it would have needed to rely on weight and balance, so it would have to be extremely delicate.

**Biomass and Pyrolysis**

We conducted some research on biomass, which could be turned into renewable fuels, and ended up choosing a species of algae called Chlorella. Chlorella is an algae that traps $CO_2$ from the atmosphere. The maximum amount of absorption of $CO_2$ is 0.412 litres a day. We looked more into converting biomass into a renewable fuel and found out that through pyrolysis, a thermochemical treatment, this was possible. Pyrolysis is the process of

exposing materials to high temperatures without oxygen, going through chemical and physical separation into different molecules.

**Materials**

So, what materials can we use to make our house with?
Recycled steel. It was more cost efficient than non recycled steel. We conducted some research and found out that the price average from a range of companies was £120 for 1000 kg of scrap metal.

Another potential option for our design is by using recycled glass.
Recycled glass is sustainable being 100% reusable, recyclable and refillable. Each tonne of recycled glass used is approximately equal to 580 kg of Co2 being cut off from the supply chain. Not only Its strength makes it an ideal material to be used in structural applications. It can also be used as a partial clinker replacement in the production of cement.

Another material that we are considering is rammed earth.
Rammed earth is extremely strong and durable making it ideal in construction. It also has a high thermal mass, it is low maintenance, extremely cost and energy efficient and naturally sustainable.
Firstly, we have recycled steel. Construction is already one of the biggest steel consumers and this material is easily recycled with about 40% of all steel production already using recycled materials. Steel buildings can almost entirely be recycled with close to zero waste and the resulting steel has the same strength and durability as the original product.

First, recycled steel is a lot more cost efficient than normal steel. We conducted some research and found out that the average price from a range of companies was around £120 per 1000 kg of scrap metal.

Another benefit of using recycled steel in our design is that it reduces the consumption, time, energy and expenses that would otherwise be used on mining valuable resources to create the original material from scratch. For every tonne of steel recycled, one and a half tonnes of iron ore is saved along with half a tonne of coal and 40% of the water used to produce steel.

This material also saves energy and reduces pollution, the use of scrap steel actually saves around 74% of the energy that would otherwise be used to create steel from raw, virgin materials. Additionally, it is low maintenance and extremely versatile in its uses, being used in all sorts of constructions varying from cement production and road construction to marine environment restoration.

This material does provide us with some challenges though. It can be quite difficult to purchase and substances like paint on the material can sometimes contaminate it rendering it unusable. It can also be challenging to separate from mixed materials and the quality of finish achievable may be found unsatisfactory due to imperfections resulting from minor corrosions or the dismantling process. This may be an undesirable factor to those looking for a neat, smooth, seamless finish.

The next potential material for our house is recycled glass. Recycled glass is not only sustainable, being 100% recyclable, reusable and refillable but each tonne of this material used is approximately equal to 580 kg of Co2 being cut from the supply chain. Each tonne used is also a lot less material that would otherwise be going into landfills. A glass bottle in a landfill can take up to a million years to decompose.

Recycled glass is a feasible option as it is very strong and sturdy, making it an ideal material to be used in structural applications. It can also be used as a partial clinker replacement in the production of cement. With its strength, durability, versatility and eco-friendly properties reusable glass is an excellent choice for construction.

The downsides to using recycled glass are that in some cases glass mixed in with concrete can chemically react, causing some expansion and even cracking over time. Consistency in quality may also pose a challenge, as the varied types of glass and possible different impurities make it hard to keep up the quality of this material.
Even though glass can be recycled there are a few exceptions to this. Glass containing ceramics and other impurities cannot be used as they will contaminate the whole process of recycling. The process of sorting glass by color is rather labour intensive and actually quite complicated. Due to lack of facilities where we live this process would most likely have to be done overseas making it pretty costly.
lift the glass is broken down too finely it becomes almost impossible and extremely tedious to sort and is not able to be reprocessed. The finely broken glass can also enter other recycling streams contaminating recyclables like paper, cardboard and plastic, lowering their value.

Lastly, we are considering using rammed earth. The process of creating rammed earth has been used for thousands of years. It involves ramming together a mixture of aggregates like sand, clay and gravel, recycled glass and steel can also be used as aggregates, into a formwork.

This can then be molded to create walls, which, once dry become completely solid and extremely durable. These walls require little maintenance and can last up to a hundred years making them not only eco friendly but sustainable as well.
This technique uses locally sourced, natural materials making it entirely recyclable and reusable. Using rammed earth also equips the house with a high thermal mass and is extremely energy efficient as well as cost efficient due to the materials being very common and easily accessible.
Using rammed earth does however create a heavier structure making it more difficult for our house to lift, it would be potentially vulnerable to water damage and corrosion and it would be very labour intensive and time consuming to build as it needs to be compact and will take time to dry.

**Key figures for flooding**
As you can see, these key figures show the impact of floods globally. if we are able to introduce the elevating house, these numbers would go down massively in the next few years. Over 7,600 people have died in 2023 globally. This shows how much of an impact

floods have on our world.  6,000,000 properties in the UK are located in high risk flooding areas.

One in four houses in the UK will be affected by flooding in 2050 and over 23% of the world are currently directly affected by floods.

We were tasked with designing a flood resistant house. We researched floating houses in the Netherlands and adapted the design to suit everyday London life. Our result was an improved version with added features.

First, it could be made more sustainable to target this problem. We decided to use renewable fuel instead of fossil fuels.
Secondly, our design could be more cost efficient. To overcome this, as our design gets more popular, we could introduce a new system where people are able to split the cost and pay it over a period of time.
Lastly, it could be less dependent on the climate. We solved this by adding additional wind turbines as well as the pre existing solar panels, since flooding is usually prompted by storms this ensures that no matter the weather, energy is still being created and stored.

# Flood Resistant House

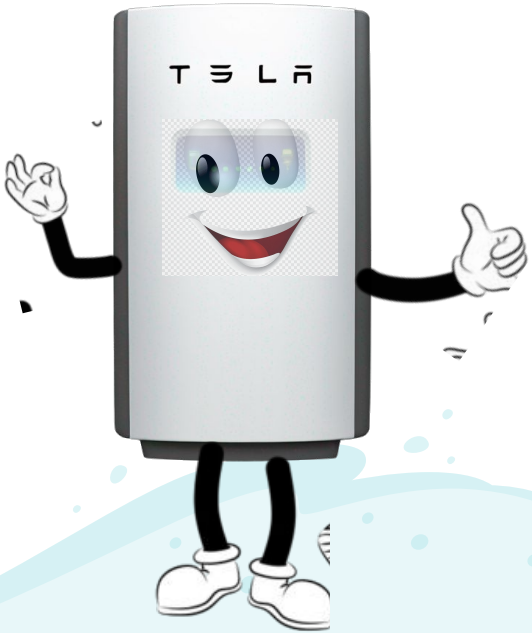
A house where flooding has no impact

Joanna Fong, Harshini Sornaraj and Maya Chopra.
Year 8

# Introduction

Floating houses in the Netherlands

## Elevating House



# MISSION and VISION

## Mission

Our mission is to help people targeted by floods to live their daily lives normally.

## Vision

In the future, we hope that fewer people are affected by floods in high risk countries such as Bangladesh and Egypt.

# How does the ELEVATING HOUSE work?

1. **Water float -** a mechanism which floats and pushes renewable fuels up
2. **Hydraulic pump -** contains renewable fuels to pump to the ramps.
3. **Hydraulic jack -** receives renewable fuel to lift up the house.
4. **Solar panels and wind turbines -** to power the hydraulic system.
5. **Power wall -** all energy will be stored in a power wall.

## Advantages of the Elevating house

- Has the **ability to adapt to the change of water** levels
- **Naturally resistant** to rising water levels
- Due to added features, it will create a **more environmentally friendly area**

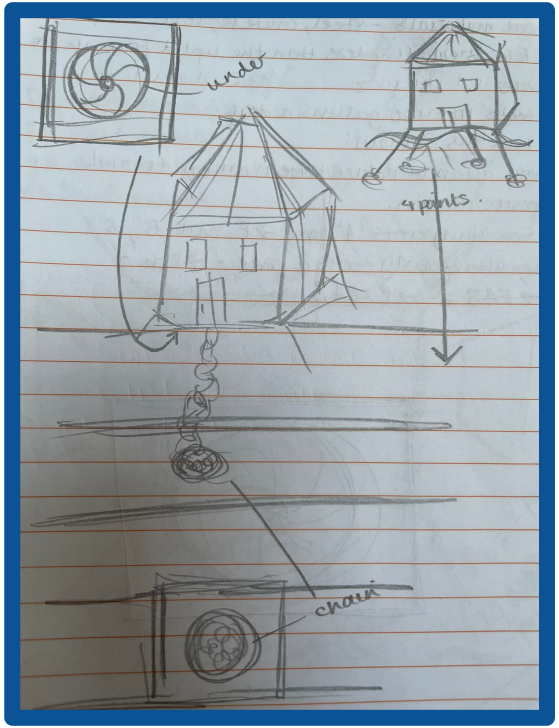
## Disadvantages of the elevating house

- The elevating house would **require more maintenance** than normal houses
- **Cost more** due to high maintenance, especially water resistant materials
- **Climate** may affect how much energy is being collected

# Ideas And Inspiration

Some of these pictures helped guide us towards our final product.

# Design process



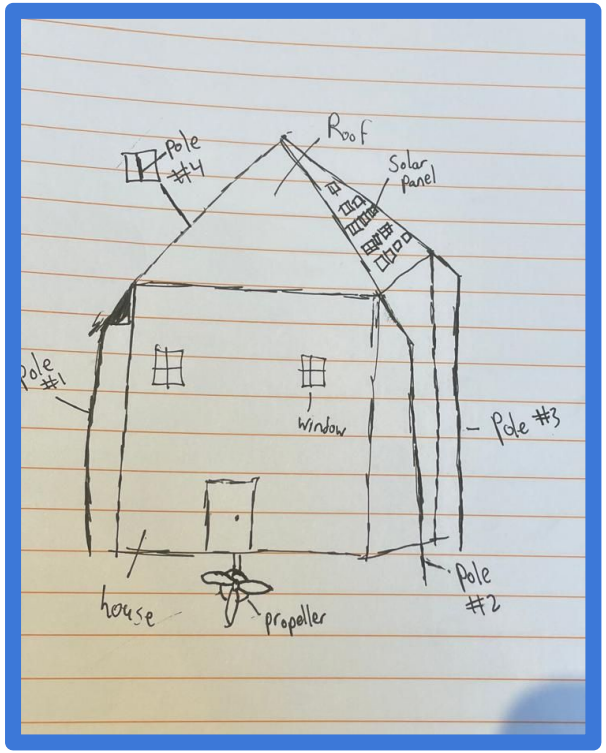

IDEA:

- **Floating house**, attached to the ground by **chains**
- **Propeller** under the house which supported it floating
- **Four points** to the chains

NEGATIVE:

- The chain would **drag** and **not extend** enough.
- The chain would **not be stable enough**
- The house would **float away.**

# Design process



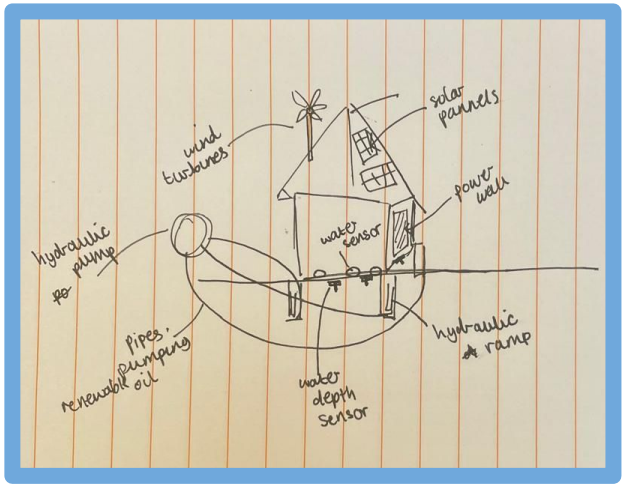

IDEA:

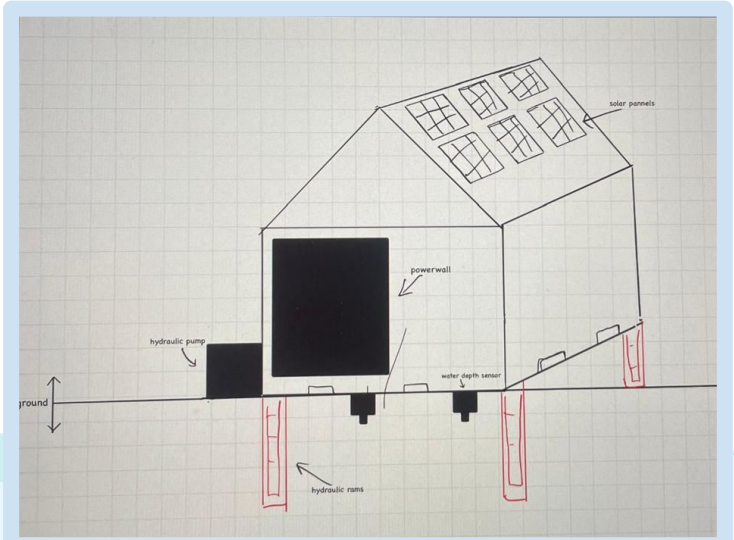
- **Floating house** with four poles on each corner
- **Propeller** to support it
- **Solar panel** to provide energy for the propeller
- Poles that the **house move up and down** on

NEGATIVE:

- The propeller would cause **too many waves** and **noise**
- House would be too **delicate**
- Propeller would not support the house enough.

# Final Design

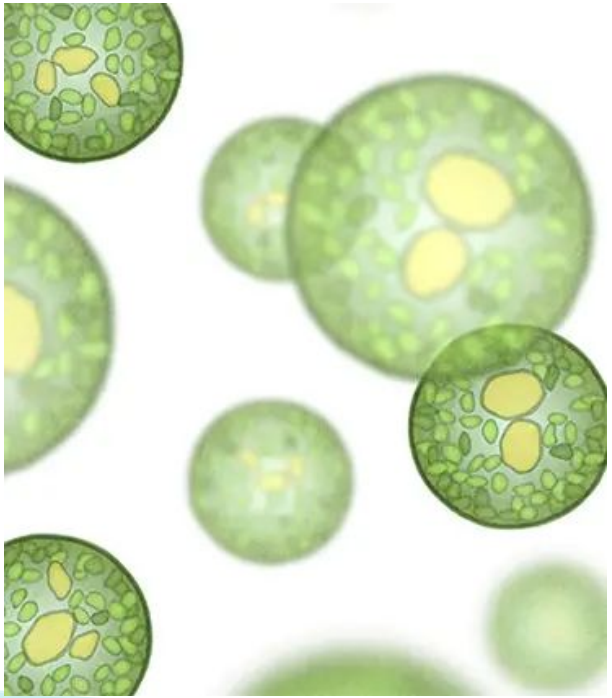



**IDEA:**

1. A water float will rise and push against the hydraulic pump.
2. The higher the water level gets, the higher the float will go
3. Fuel pressure pushes up the hydraulic jack which lifts the house
4. Solar panels and wind turbines collect energy which is stored in the power wall to be used in the hydraulic system
5. In case of flash flooding, the bottom of the house would be built slightly slanted in so the amount of pressure is decreased, allowing the house to have a more stable structure.

# Chlorella



Chlorella is a species of algae that traps $CO_2$ from the atmosphere

- Maximum rate of absorption of $CO_2$ = 0.412 L a day
- Maximum volume of $CO_2$ utilized in a 1 day = 8.125L

70 million tons of $CO_2$ is released into the atmosphere a day.

- Used to be converted into biofuel

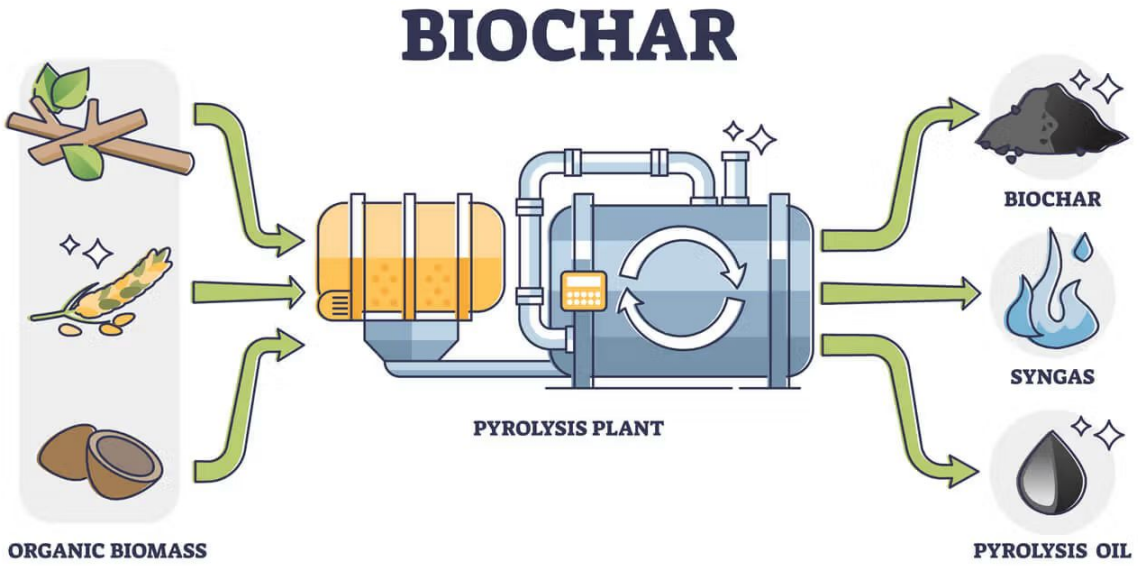
Every to months, chlorella will be collecte. It will then be converted into biofuel and be distributed

# Pyrolysis

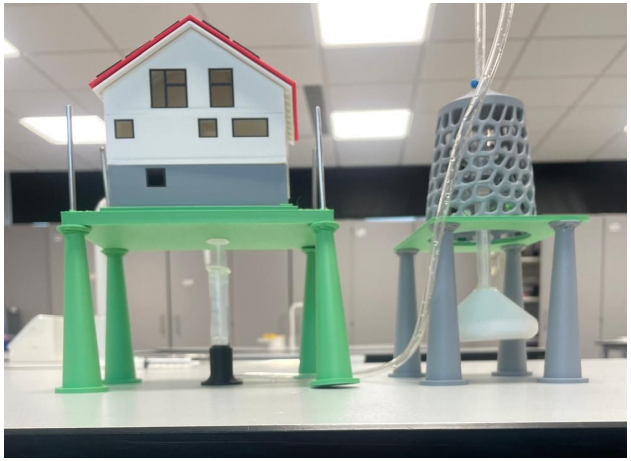
Through pyrolysis we are able to use Chlorella as a renewable fuel for the hydraulic jacks.

Pyrolysis is a thermochemical treatment.

- It is the process of exposing materials to high temperatures without oxygen, going through a chemical and physical separation into different molecules



# 3D MODEL



# VIDEO

# Materials

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Another material that we are considering is rammed earth.

- Rammed earth is extremely strong and durable making it ideal in construction. It is also has a high thermal mass, it is low maintenance, extremely cost and energy efficient and naturally sustainable.

# Recycled steel

## Pros of using recycled steel

- Strong and durable
- Cost efficient, average of £120 per 1000 kg of scrap metal
- Easily recycled with little waste
- Low carbon footprint
- Low maintenance
- Sustainable and eco friendly
- Versatile in its uses

## Cons of using recycled steel

- Difficult to purchase
- Can be contaminated by substances like paint
- Can be difficult to separate from mixed materials
- Quality of finish achievable

# Recycled glass

## Pros of using recycled glass

- 100% recyclable, reusable and refillable
- Prevents material filling up landfills
- Cuts a lot of CO2 of from the supply chain
- Strong and sturdy
- Versatile
- Eco friendly
- Sustainable
- Retains quality

## Cons of using recycled glass

- Potential for causing chemical reactions
- Quality consistency
- Not all glass can be recycled
- Broken glass is difficult to sort
- Glass can become a contaminant
- High cost can sometimes be associated with recycled glass

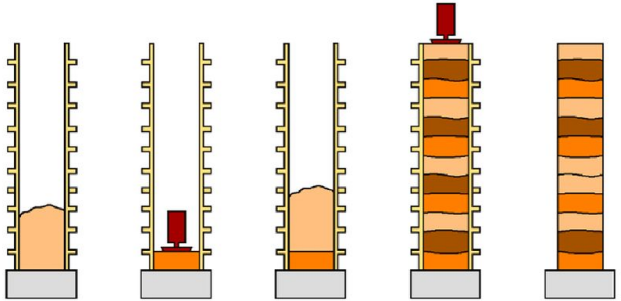
# Rammed earth

## Pros of using rammed earth

- Low maintenance
- Eco friendly
- Naturally Sustainable
- Strong and durable
- High thermal mass
- Extremely cost efficient
- Extremely energy efficient

## Cons of using rammed earth

- Causes heavier structure
- Potentially vulnerable to water damage
- Time consuming to build
- Need specialized guidance
- Labour intensive



# Key figures of flooding

**7,600**

People died from floods globally in 2023 from floods

**1/4**

Houses in the uk will be affected by floods in 2050

**6,000,000**

Properties in the uk are located in risk of flooding areas.

**1.50m**

Is the average height of which floods go to in the UK

**23%**

Percent of the world are directly exposed to floods

# Conclusion

**What was our task?**

We were tasked with designing a flood-resistant house. We researched floating houses in the Netherlands and adapted the design to suit everyday London life. Our result was an improved version with added features.

**How can our design be improved?**

- It can be made more sustainable
- It could be more cost efficient
- It could be less dependent on the climate