A Solution to Coastal Flooding in Irish Cities

Abstract

We set out on this project with the purpose of creating a solution for protecting the coastlines of Irish cities in a new, community-friendly way. We became intrigued by the Clontarf bay area in Dublin. The residents of Clontarf have disputed the construction of a standard flood wall in the past on multiple occasions. They described the proposals as a "cheap and nasty solution" and an "eyesore". Instead, sandbags were put along Clontarf coast to protect the homes, which is even more of an eyesore than a standard flood wall. We thus set out to come up with a new solution for areas like Clontarf that would protect the area from the danger of rising sea levels and flooding, but would also respect the residents' opinions and needs.

During the design process, we decided that a retractable flood wall was the way to go forward. We began designing a flood wall controlled by **water pressure,** as it would not block sea views constantly. We issued a survey to **1,500 homes** along Clontarf bay proposing this new concept. From our survey, it became evident that the residents of Clontarf supported this idea immensely, with only **three percent** of people not in favour.

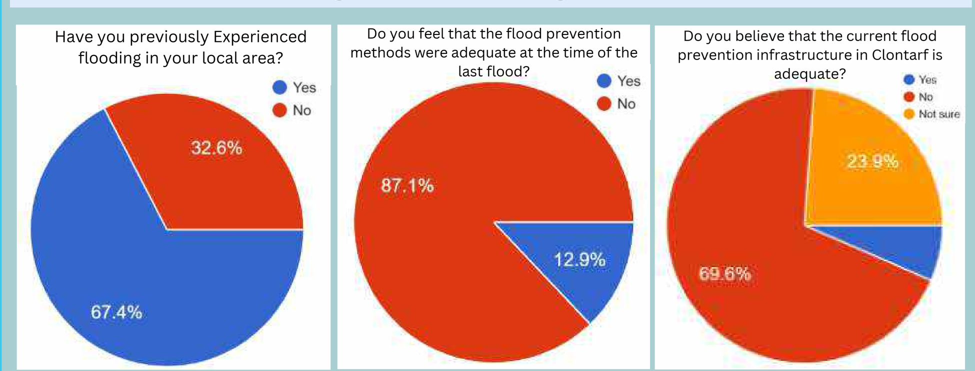
We conducted experiments on concrete and soil samples to assess their water absorption capabilities. We also tested the corrosion resistance of various types of steel to sea water to help with the design proposal and landscaping plans of the wall.

-Ineffectiveness of these *"temporary"* sand bags

Research

Survey

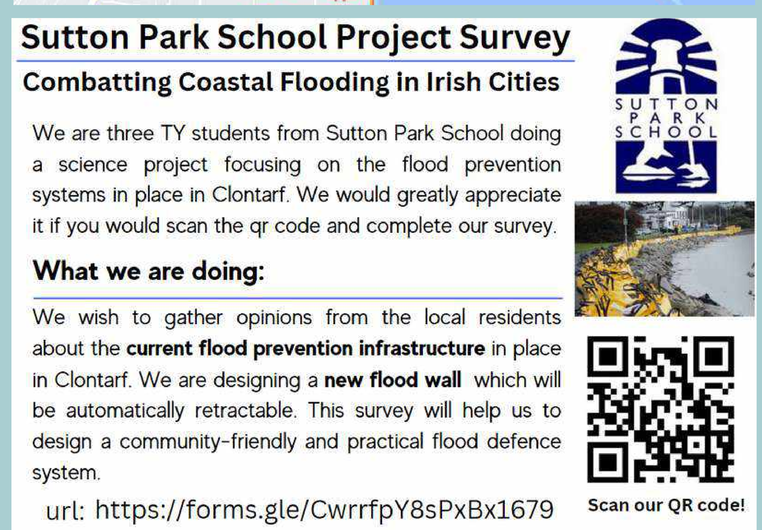
We created a survey to be handed out to the residents of Clontarf to gain their opinions and ideas. The results gave us great insight into the general opinion of the Clontarf residents, the possible solutions, and the things we needed to include in our design. We spent several hours walking across and distributing the above leaflets in the coastal area of Clontarf. We distributed approximately 1500 leaflets to most of the homes within 300 metres of the sea in Clontarf. The responses received were extensive and very helpful in the design of our wall. Some interesting statistics we gathered:



-The rough area that we surveyed

-Map showing the height of flood wall needed in the different areas along Clontarf Bay

-Flooding in Clontarf in January 2014



Sutton Park School Project Survey

Combatting Coastal Flooding in Irish Cities

We are three TY students from Sutton Park School doing a science project focusing on the flood prevention systems in place in Clontarf. We would greatly appreciate it if you would scan the qr code and complete our survey.

What we are doing:

We wish to gather opinions from the local residents about the **current flood prevention infrastructure** in place in Clontarf. We are designing a **new flood wall** which will be automatically retractable. This survey will help us to design a community-friendly and practical flood defence system.

url: https://forms.gle/CwrrfpY8sPxBx1679

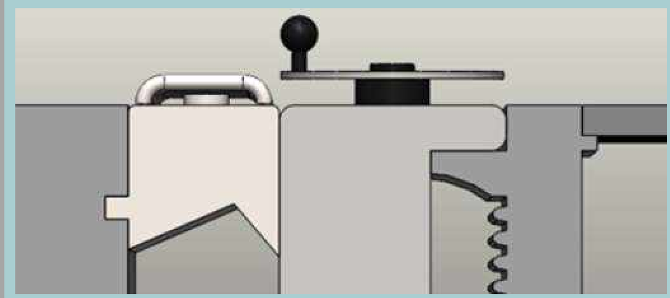
Scan our QR code!

Field Research

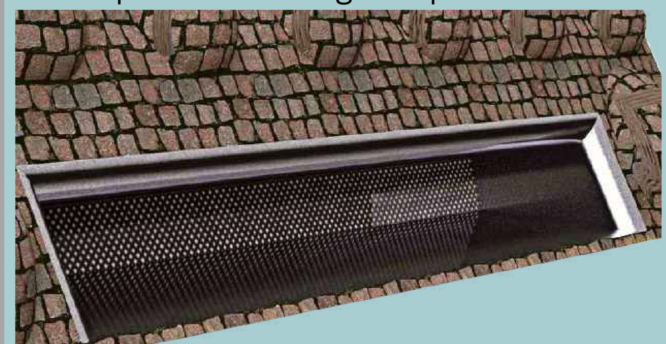
We visited Clontarf, Sutton, and Sandymount to see the current flood prevention infrastructure in place.
We then interviewed Mr Roy O'Donnell, the Dublin City Council's Gullies Manager, and Mr Bill Powderly, the ex-Chief Civil Defence Officer for North Dublin (who also happened to live in Clontarf, and thus has been involved with the past infrastructure proposals). We also attended a Dublin City Council Public Consultation Workshop on a flood defence infrastructure proposal for the South Campshire Realm Project. These interviews and experiences greatly helped us create a list of everything we needed to achieve with our solution, and they brought many things we previously did not consider in our design to our attention.

-Attending DCC Public Consultation Workshop

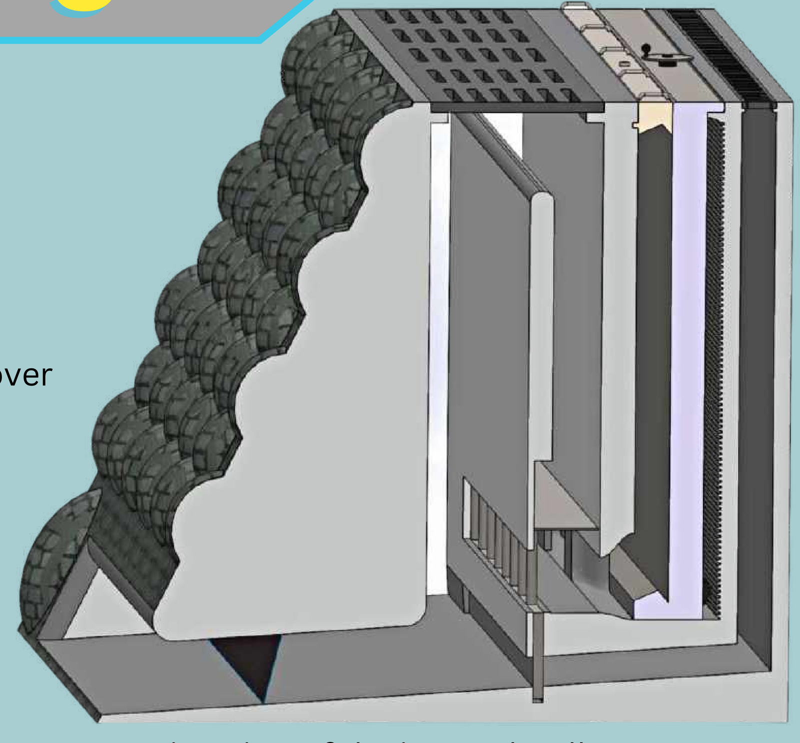
Design



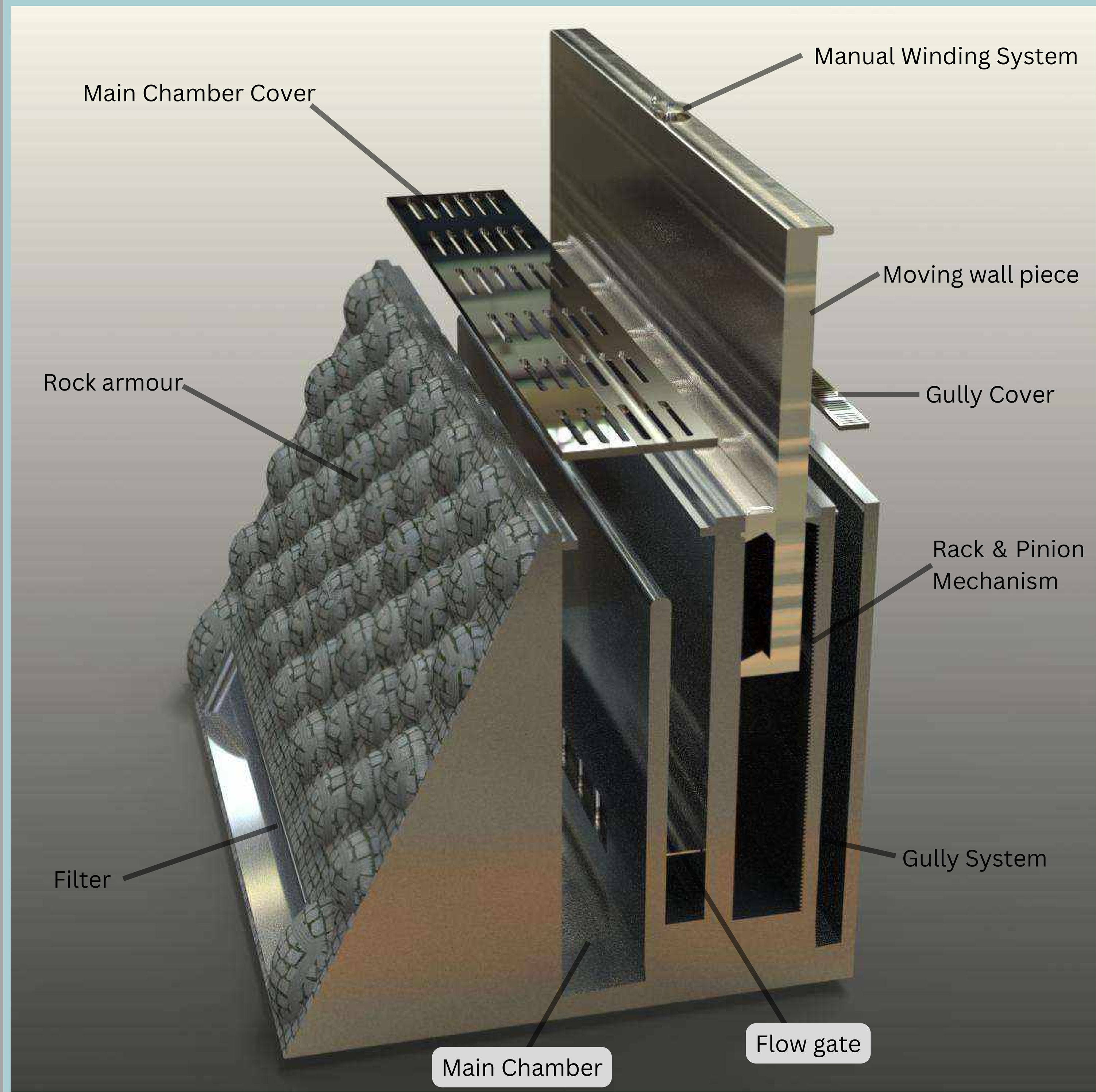
-the top of the moving wall piece and wall cover



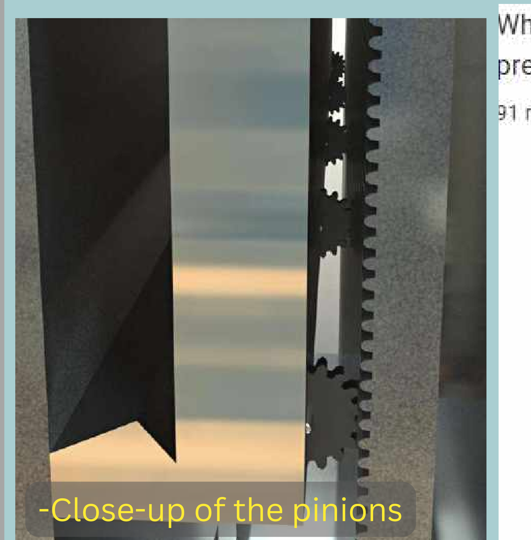
-the main entrance with the filter



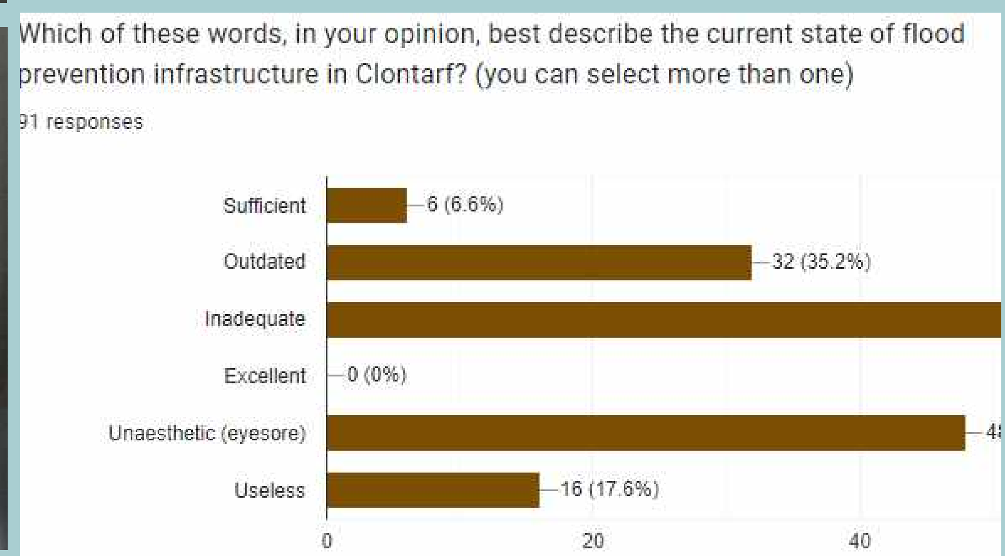
-A section view of the internal wall structure.



In our final design, the sea water enters through a gate into the main wall chamber. In this gate is a filter which stops debris such as seaweed and fish getting into the main structure. Once filtered, the water level rises in the chamber until it goes over the top of the divider. The water then begins flowing down, and the force of this pushes the main gate into the wall chamber open, while also closing the gully system. Thus, large amounts of water can now enter the wall chamber, which in turn causes the moving wall piece, which is buoyant, to raise itself.
The moving wall piece also features a manual winding system, which allows for the wall to be raised and lowered in cases of emergencies. Our wall design also features a gully system which helps with the drainage of the promenade. The gully cover, the main chamber cover piece, and the wall cover pieces can be easily removed to allow for maintenance in an efficient and simple manner.



-Close-up of the pinions



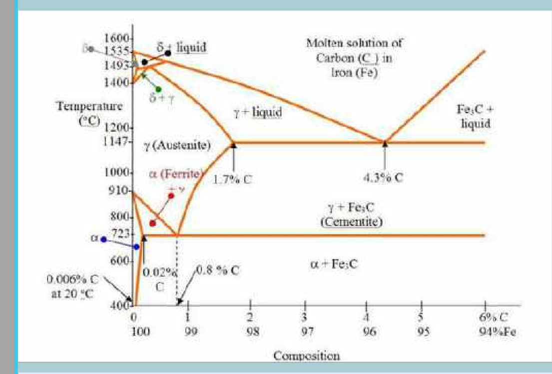
Materials

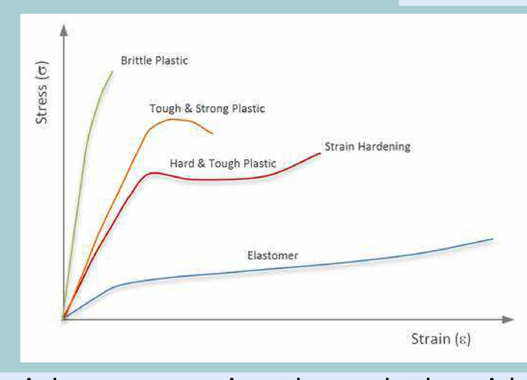
We began conducting research around materials, as we knew that this was a vital part of making our design successful. After help from Dr Niamh Plunkett and much research, we decided that steel would be best suited for the moving wall piece. We conducted a series of experiments to do with materials:

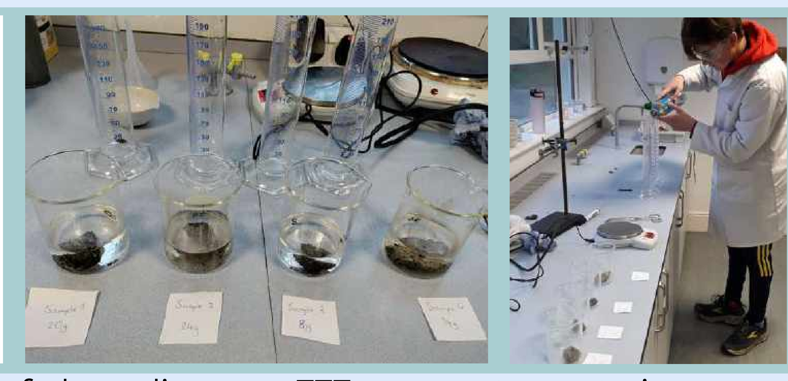
Testing the resistivity to corrosion of various steel types
We conducted an experiment comparing ferritic steel (439), martensitic steel (416), austenitic steel (316), and molybdenum-rich austenitic steel (317L). We put steel wool samples of each type into a strong salt water solution for 72 hours to see how they corrode. The sample that did the best was 317L, followed by 316, 439, and lastly 416. Thus, 317L steel will be used for many of our components.

Testing the water absorption capabilities of various soil types
The type of soil on a promenade/coastline has a great effect on floods in the area, as the more water that can be absorbed, the less the impacts caused by a flood. We tested brown earth, podzol, and peaty soils, as they are the types most commonly found in Ireland. We concluded that brown earth soil can absorb the most water, followed by peaty, and podzol.

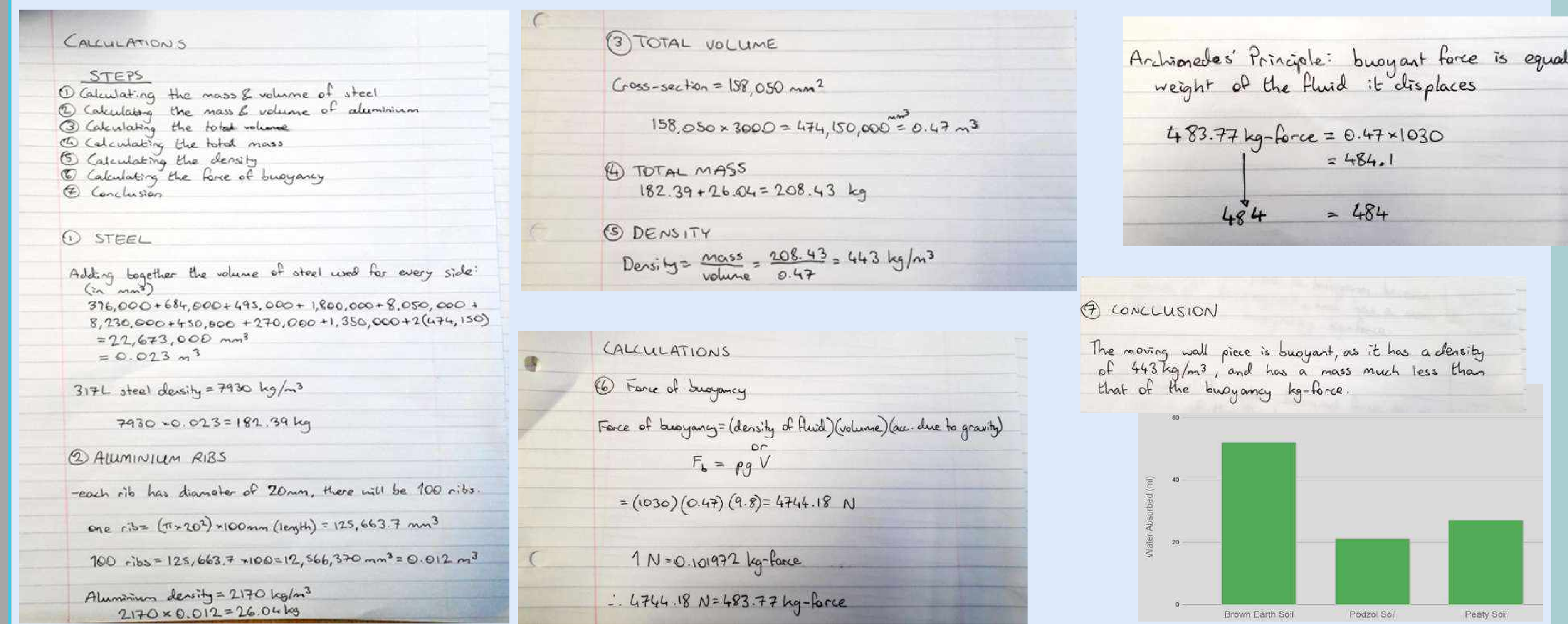
Testing the water absorption capabilities of concrete
We wanted to prove that concrete does not absorb water, as it would be a good material for the wall structure if in a sulphate resisting version. This experiment also showed us that we should use as little concrete as possible on the promenade, as it doesn't absorb water.



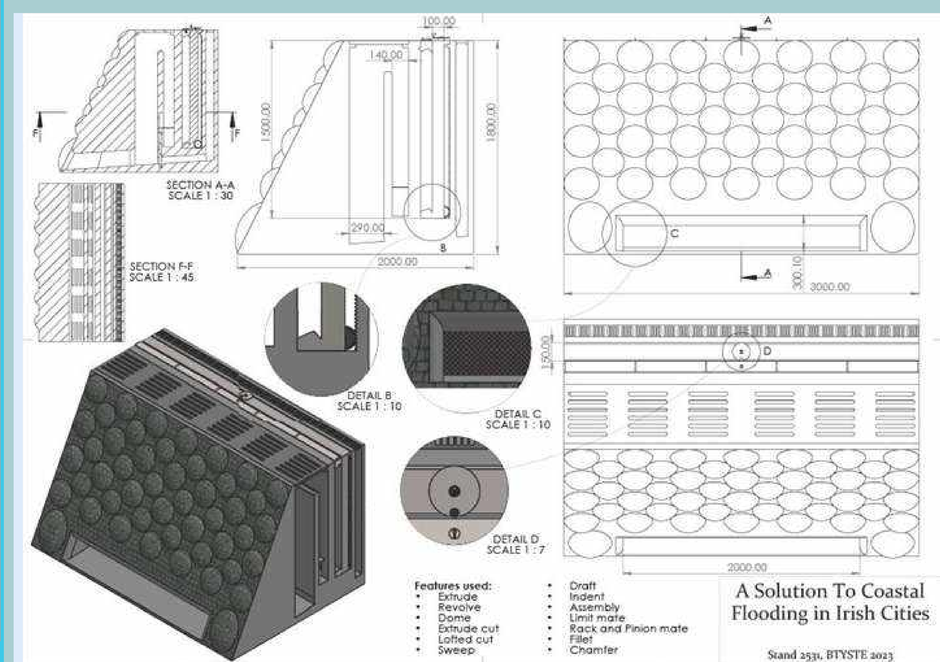




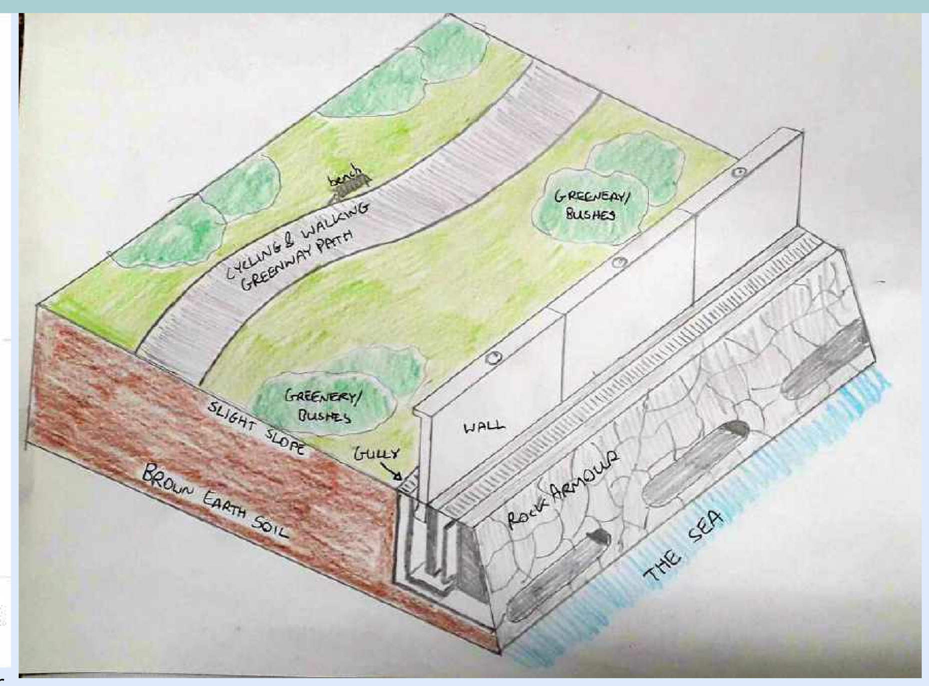
We also learnt more about the materials we are using through the aid of phase diagrams, TTT curves, stress-strain curves, and granular structures. (above) For a full breakdown of the materials we are using, please read the report book.



Our Proposal



Without a doubt, our redesigned flood defence system and overall proposal for redeveloping and protecting the coastlines of Irish cities would be of great benefit to any area it would be implemented in. Our solution not only protects the coastal area from flooding, it also allows for the residents' opinions to be taken into account. Their sea view will remain unblocked, their quality of life would be improved, and home insurance would be much easier to get. Our proposal creates a long term solution that can be easily maintained and upkept by the city council, and it includes the most durable of materials to further ensure the longest lifespan possible. The costs of constructing this proposal that we have suggested are much lower than the potential costs of damage caused by future flooding, especially in areas such as Clontarf, Sutton, and Sandymount. We are confident that our proposal would be of immense benefit to any area it would be constructed in, especially for the environment, residents, and any existing infrastructure. Thank you for reading about our project.



Our final proposal is a community-friendly solution that protects coastal areas from flooding, helps with drainage, takes the voices of citizens into account, and also features landscaping plans. It is a solution that could be implemented in many places across the country, and would bring so many benefits. (see left)
If you would like a full breakdown of our proposal, please read the report book.