

# WITHIN THE EARTH A

MATERIAL INVESTIGATION OF THE BO'NESS LIBRARY

BY AILSA HUTTON

In Scots Gaelic, Nàdair is nature. Nàdair includes both nature; the natural and material world around us, and nature, as in our own nature and the nature of man. The word does not divide nature into us, the human, and the other, the more-than-human world. Nàdair is not divisible, it intrinsically covers all of life.

Bo'ness is a unique place where the collision of humans and industry meet the natural world. In this project I want to investigate how to use what the natural world provides us, to create a space that allows the environment to protect us whilst we are protecting it.

I want to achieve this by considering these four principles:

**EARTH** This principle describes the soil and natural resources available to us on land. How can we only take the materials we need from the earth?

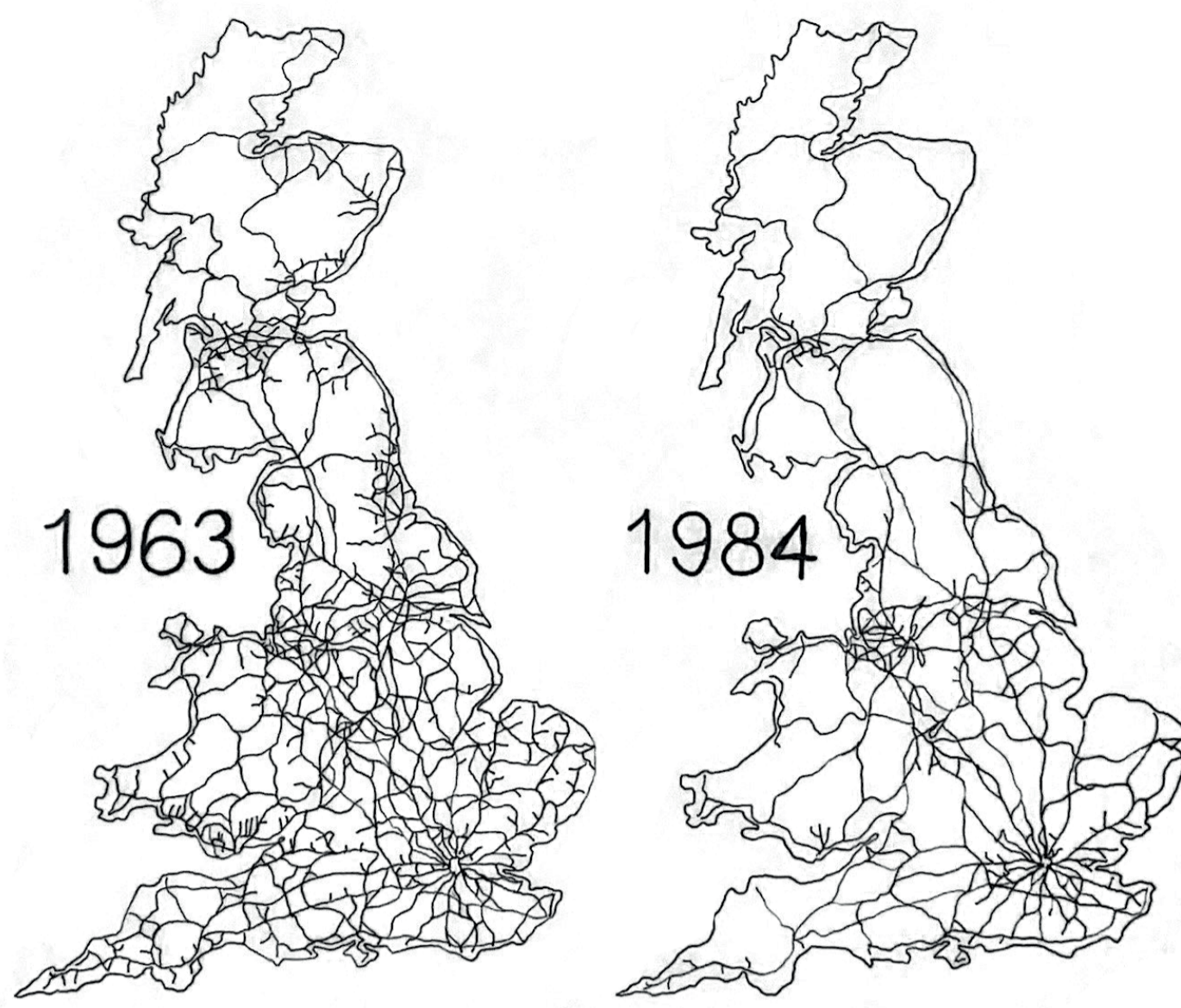
**WATER** This principle describes our connection with water and how it shapes the contours of the land we exist in. How can we form a deeper connection with water through our understanding of its materials and properties?

**PEOPLE** This principle focuses on the individuals using and living in Bo'ness. How can the materials used in this building connect the people of Bo'ness to their landscape?

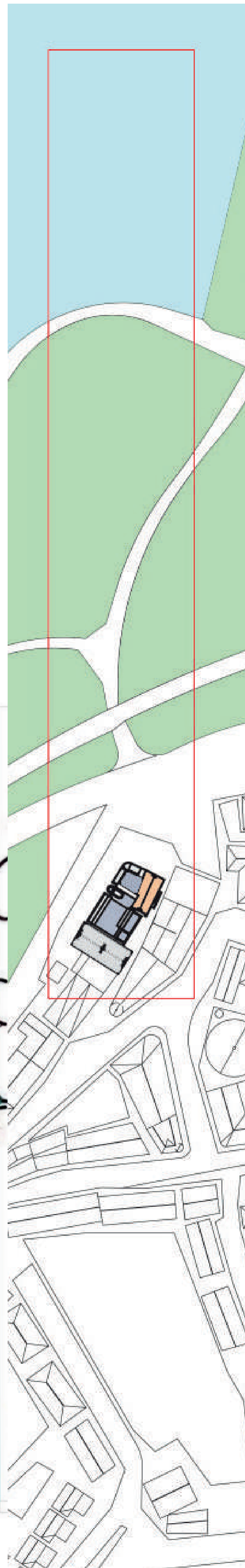
**QUALITY** This principle emphasises the importance of the quality of a building on the people using it. How can the quality of the materials used in the building positively impact the people experiencing it?



Location of Eelgrass in the UK



Effects of the Beeching Report on Railway lines in the UK



# MATERIALS RESEARCH

## CONSIDERING THE 4 PRINCIPLES

During the site visit to Bo'ness, I noticed the interaction between people and materials of the buildings. In Bo'ness there are many buildings that are disused, which made me think about what methods could be used in order to only rely on local products and resources whilst building. Therefore, my design started with analysing and researching materials and innovative ways of using them. The most interesting observation I made was how nature reclaimed the disused buildings in Bo'ness, which helped me understand the importance of nature and architecture as contrasting elements.

Firstly, I wanted to investigate the land and Bo'ness' relationship to the earth. Being next to the coast means that Bo'ness has lots of marine clay deposits near the surface. There is also a lot of debris that has built up over millions of years due to glacial erosion, which also created the very landscape we see today. Considering the most accessible natural resource to any building site is an import factor and the reason for researching the different types of soil in Bo'ness is because I wanted to see if using rammed earth as a material in my design would be an option. Due to the high amount of clays in the area, using rammed earth from the Library site would be a viable option.

As I also want to recognise the connection between Bo'ness and the Firth of Forth. I began to research nature materials used for insulation. One of the most effective natural materials for insulation is seaweed. One of the species of seaweed used for insulation is called Eelgrass, which is native to the UK and happens to grow in the Firth of Forth. This method of insulation is more commonly used as cladding however there are studies that have suggested that it can be used in a panel formation, and this technique has been used in social housing in Spain.

During the 1960s, the government stated the the UK needed to reduce the number of railway lines it had. This led to the Beeching Report where over 7,000 miles of railway and over 2,000 stations were demolished. This led to further division between small towns and cities because of the limited accessibility to smaller, less populated areas meaning businesses in these areas struggled to thrive and people had less opportunities than those in cities. Bo'ness was effected by this action taken in the 1960s and has been negatively affected ever since. In Bo'ness, there was lots of railway scrap near the railway station. It included 14 large cast-iron columns and other smaller supports with intricate detailing. This inspired me as I then began to think about how the waste products from the Beeching Report could've potentially been used as the structural support for buildings. For example, old railway tracks could be used as i-beams and the large supports could be either used as columns in largers buildings or as supports for retaining walls. If over 7,000 miles of railway had been recycled and reused in buildings during the Beeching Report instead of destroyed, how many buildings could have been built with the tracks as beams? How much carbon and mining for steel and iron could have been saved if these railway tracks had been 'Urban Mined'?

Due to the isolation effect caused by the Beeching Report, empty shops and businesses in Bo'ness are a big problem. Closures of infrastructure that are important to the population of Bo'ness are a constant battle, not unlike other small towns in the area. Thus the quality of the live/work balance in Bo'ness isn't acceptable, a multi-use space for the people of Bo'ness is essential to the quality of the lives the population leads. This was less of an issue before the Pandemic as Bo'ness was a commuter town, however now due to Covid-19 and the mainstream introduction of 'hybrid-working', people are using Bo'ness not only as a place to live but as a town to experience. This means that the development of the quality of life in terms of infrastructure will be massively impactful for those in Bo'ness.

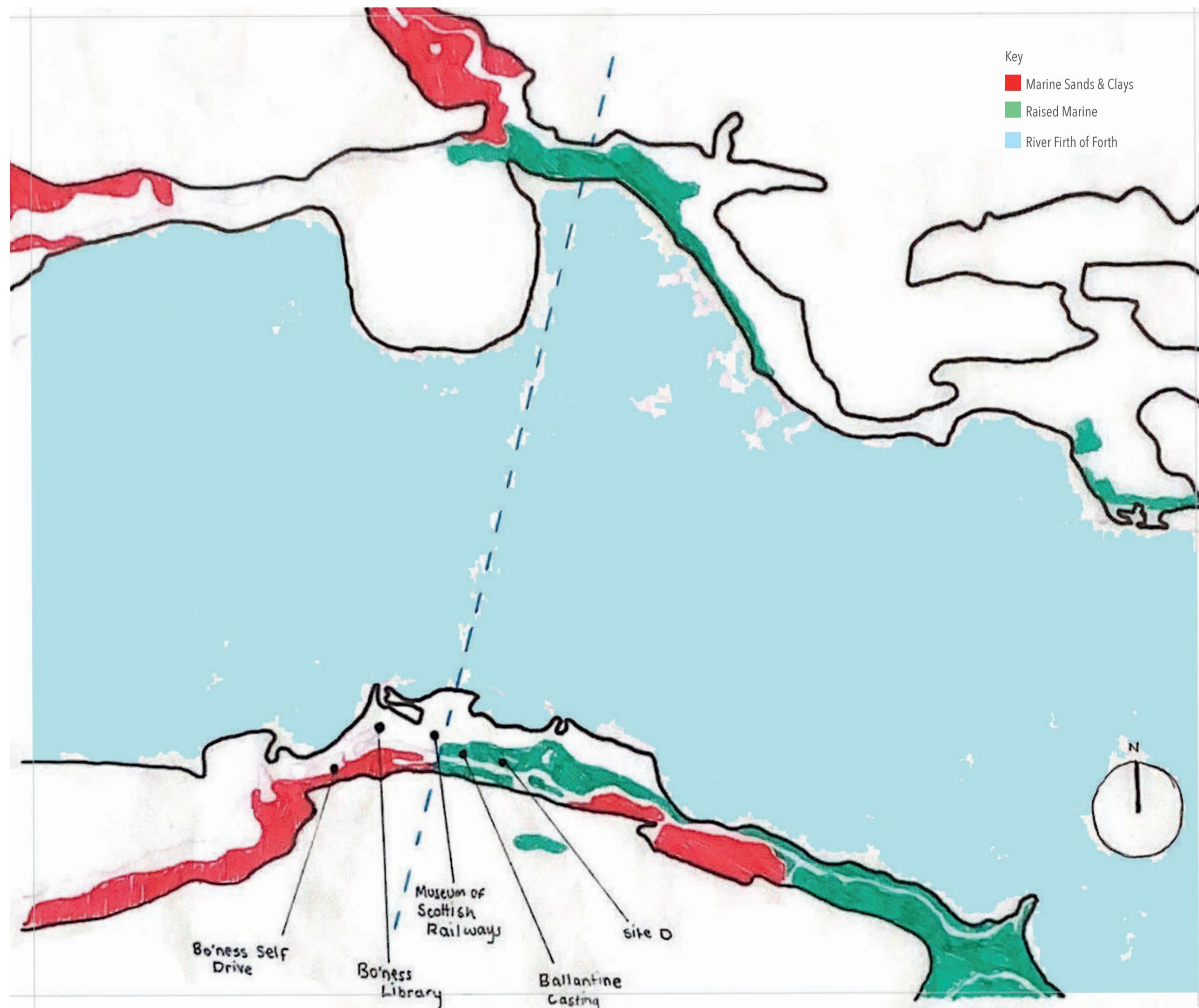
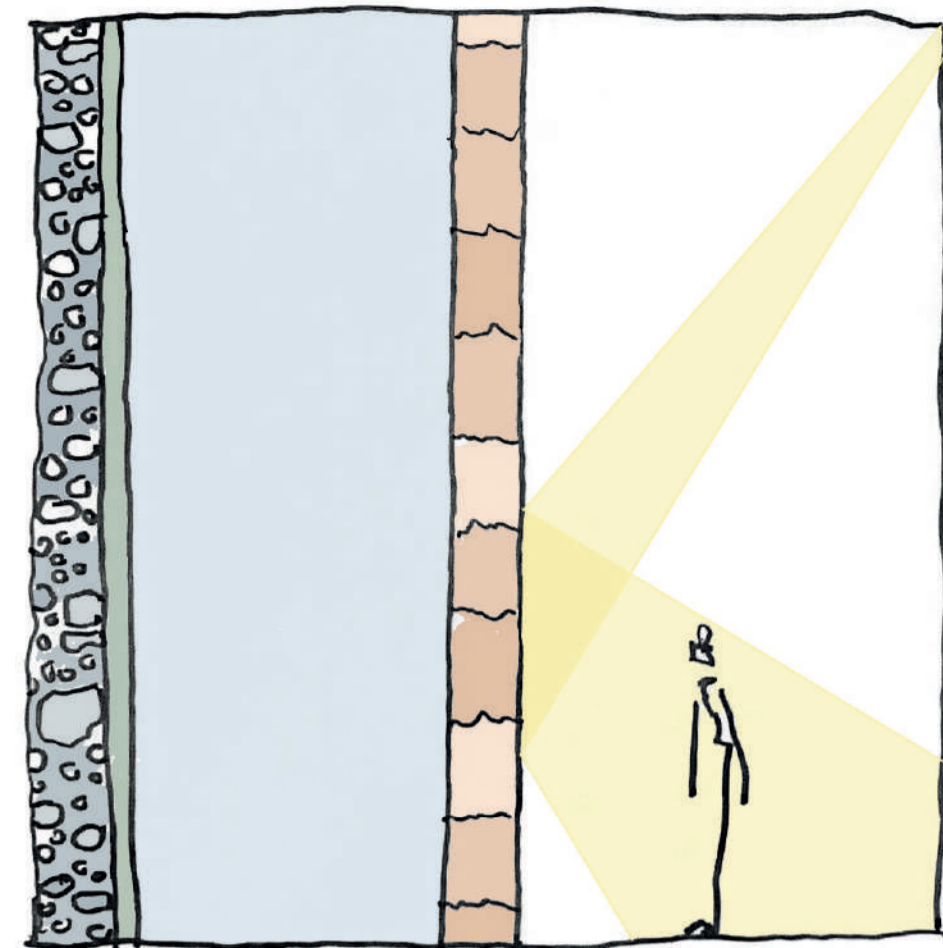
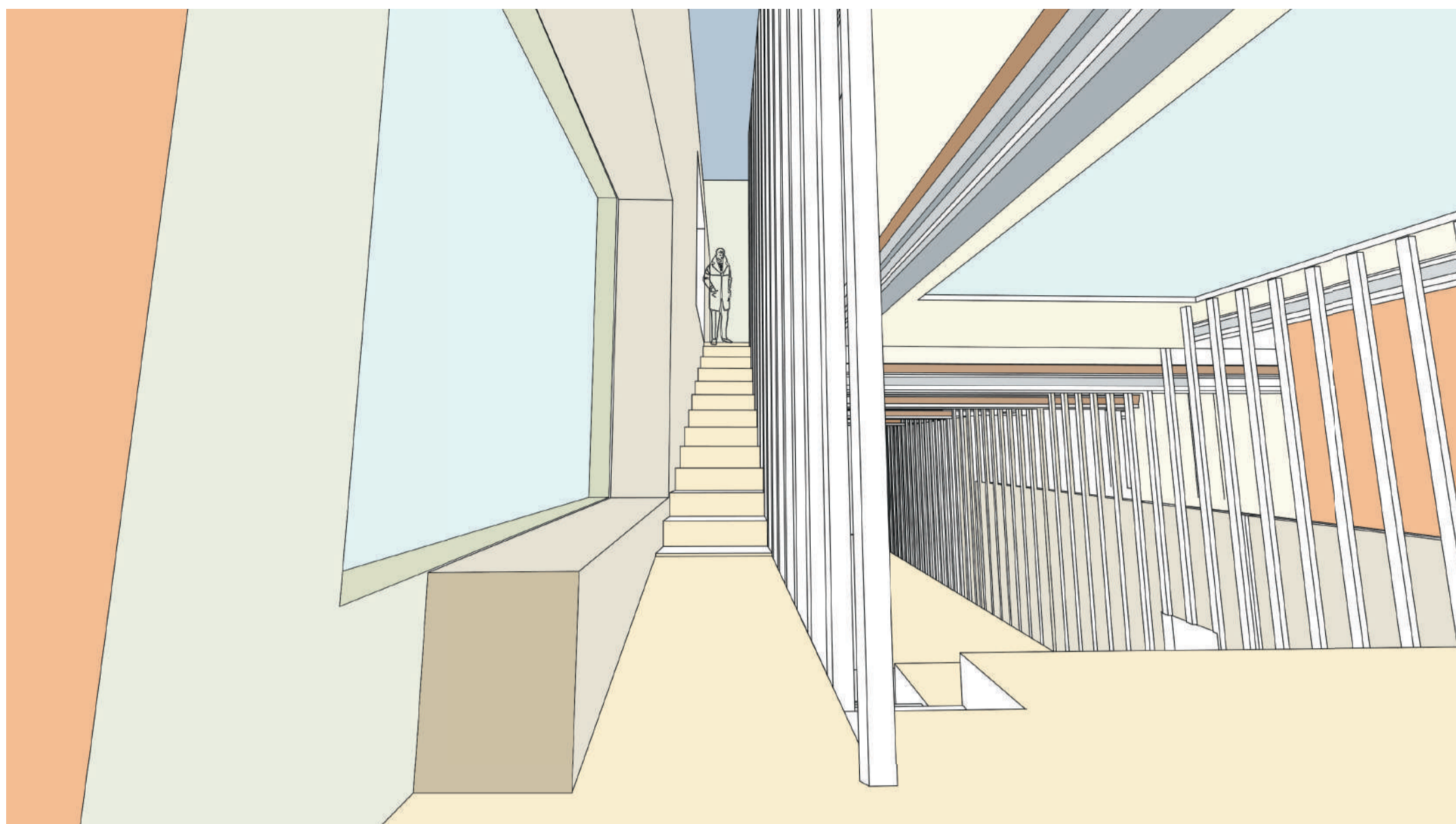


Diagram of the Soil Content in Bo'ness

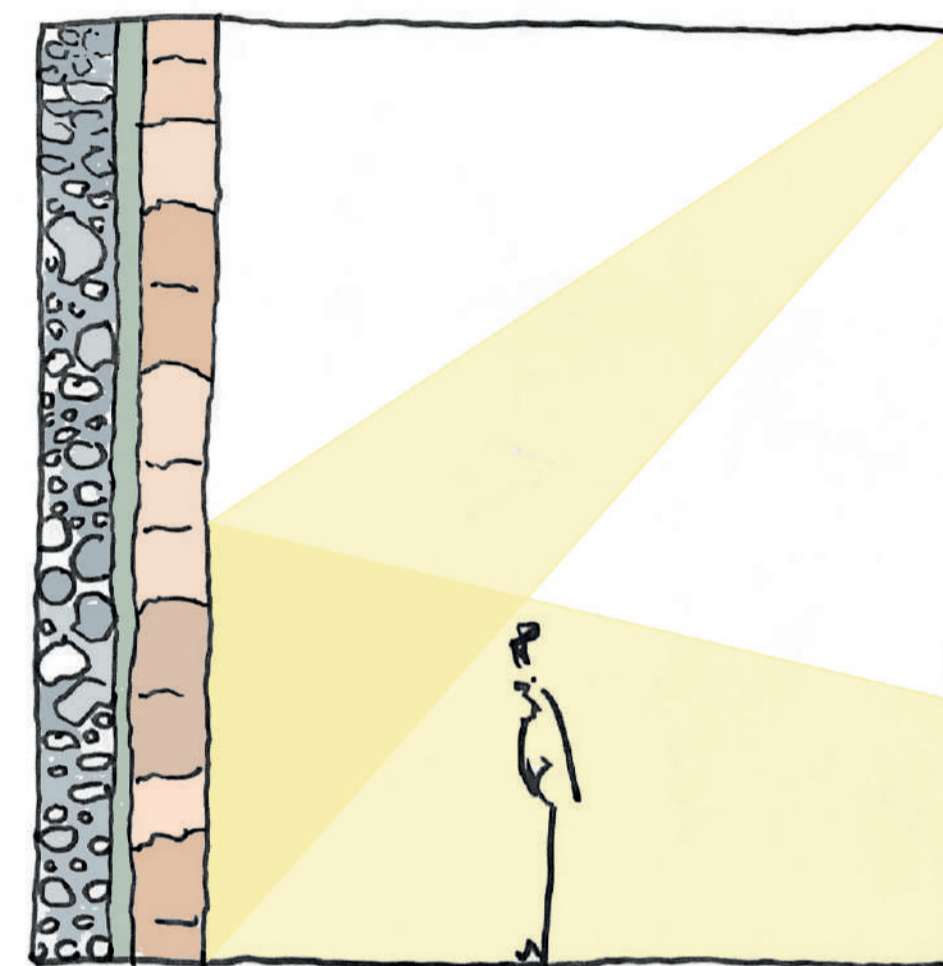




Aesthetic Use of Rammed Earth



Quilted Curtains inspired by the MAAK\_Architecture Foundation Project



Structural Use of Rammed Earth

## DESIGN AND FUNCTION

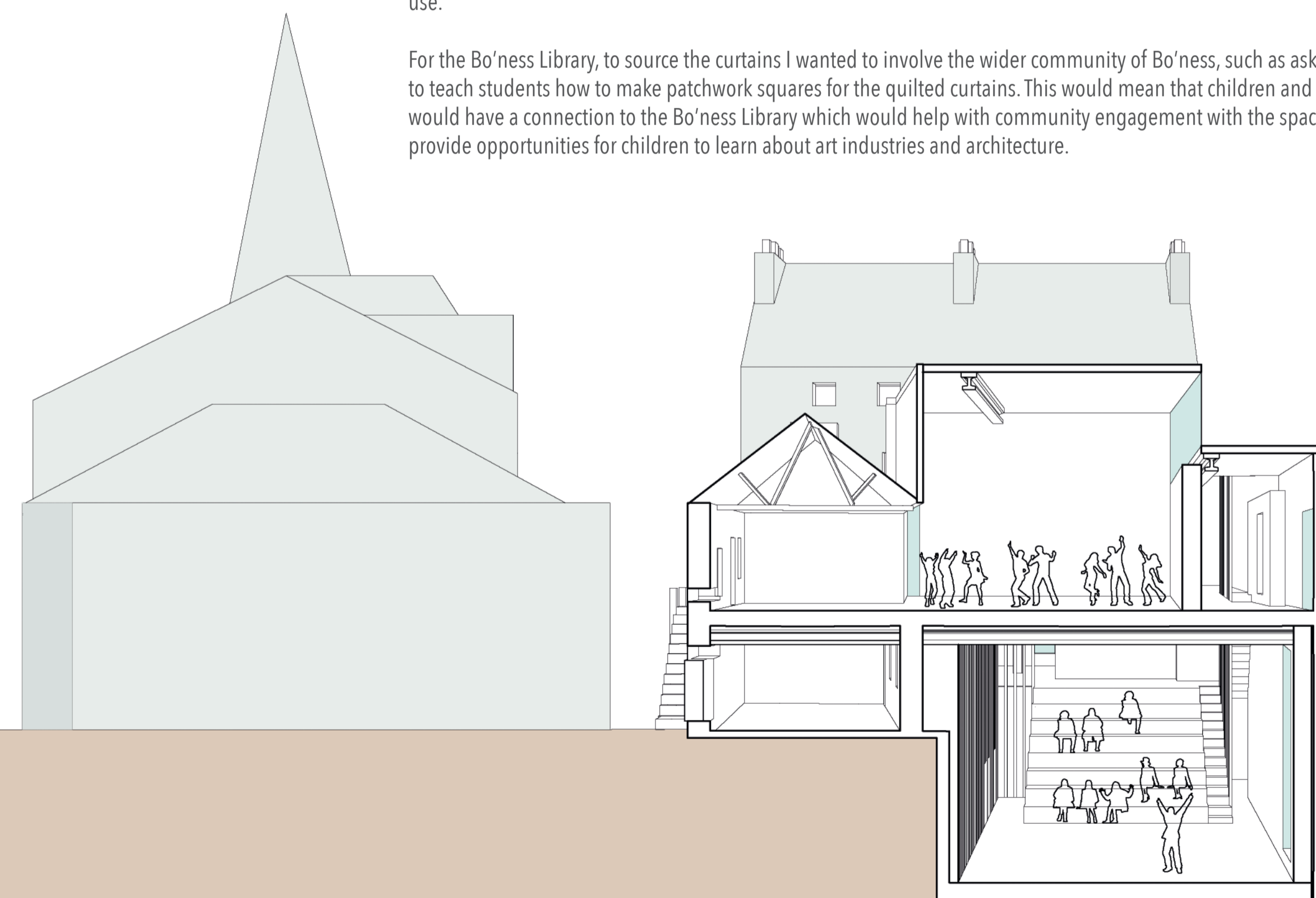
### CONSIDERING PEOPLE AND THE QUALITY OF SPACE

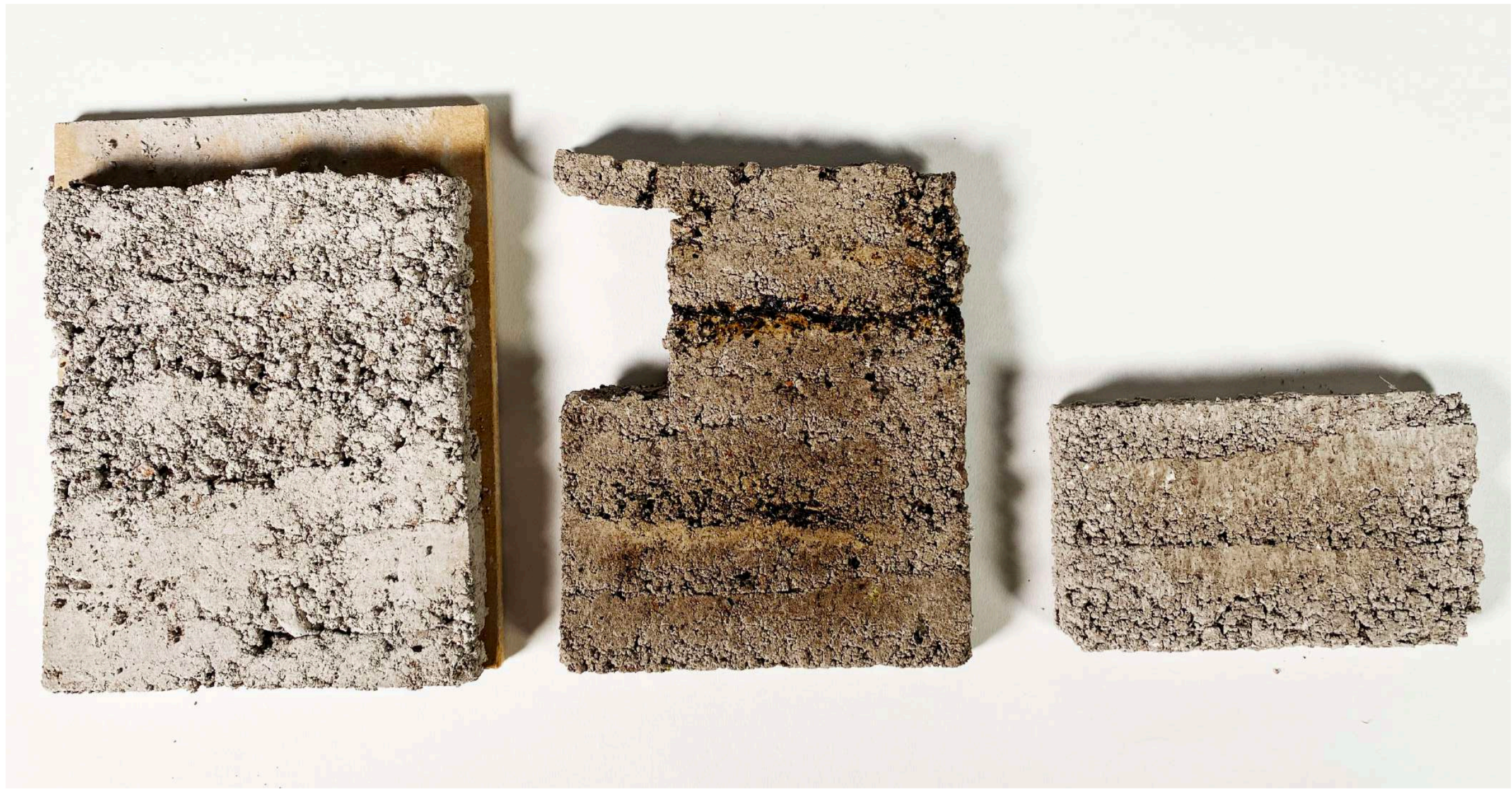
After analysing my initial design proposal, one of the main details I noticed was how to use the rammed earth within the building. Initially it was used for aesthetic purposes, however this meant that some areas of the basement got no natural light and it also made the space less adaptable. Therefore, I am now going to investigate the potential method of using the rammed earth as a structural feature instead. Not only does this mean the space is more open and light, but it also means that the benefits of using rammed earth, such as natural ventilation and low embodied carbon, can still benefit the construction and use of the Library.

The Sections and Adjacency Diagram help summarise the simple layout of the entire building. My goal for the overall design was to create spaces which give local people opportunities that they do not have due to the current infrastructure. This was achieved by creating loose-fit spaces that can be adapted constantly depending on what the space needs to be used for. Curtains will be a key feature in the basement lecture hall space. There will be three sets of curtains and they will be hung on the railway track beam, allowing the space to be made as large or as small as needed for events or everyday use, for example, a school's christmas pantomime.

The MAAK\_Architecture Foundation, in Nyanga, Cape Town on the renovation of the Ulwazi Community Centre has used curtains to replace drywall in order to make the space as adaptable as possible. The curtain is referred to as the "Community Curtain" as it is a quilted piece that has been constructed by individuals in the local area to teach them skills in textile techniques. The precedent truly combines the community influence with architecture and shows the positive impacts of using local groups of people in construction, such as teaching trade skills and increasing the appreciation for community structures to promote use.

For the Bo'ness Library, to source the curtains I wanted to involve the wider community of Bo'ness, such as asking local schools to teach students how to make patchwork squares for the quilted curtains. This would mean that children and their loved ones would have a connection to the Bo'ness Library which would help with community engagement with the space. It would also provide opportunities for children to learn about art industries and architecture.





# RAMMED EARTH

## AN INVESTIGATION OF PROPERTIES AND SOCIAL BENEFITS

An ACAN lecture on 'building with earth', helped me understand how to use earth as a building material in modern day design. I knew it was important to fully understand this material if it was going to be used in this design due to the common lack of knowledge about Rammed Earth. For example:

- You can build multi-story buildings using rammed earth techniques. Some earth buildings have as many as 7-10 stories.
- The material does not disintegrate as soon as it rains and adding cladding can also help the durability of rammed earth in wetter climates.
- Earth can uphold the modern regulation standard for heat equity and can also store more thermal energy.
- It can be aesthetic with the use of natural clay plaster. Clay plaster can make any material look like concrete.
- The use of local materials can give your building different features which have a positive impact on the thermal comfort of the interior. For example, The use of chalk blocks in Dover has meant that the building is less likely to overheat through the large south facing windows as chalk reflects and stores thermal energy.

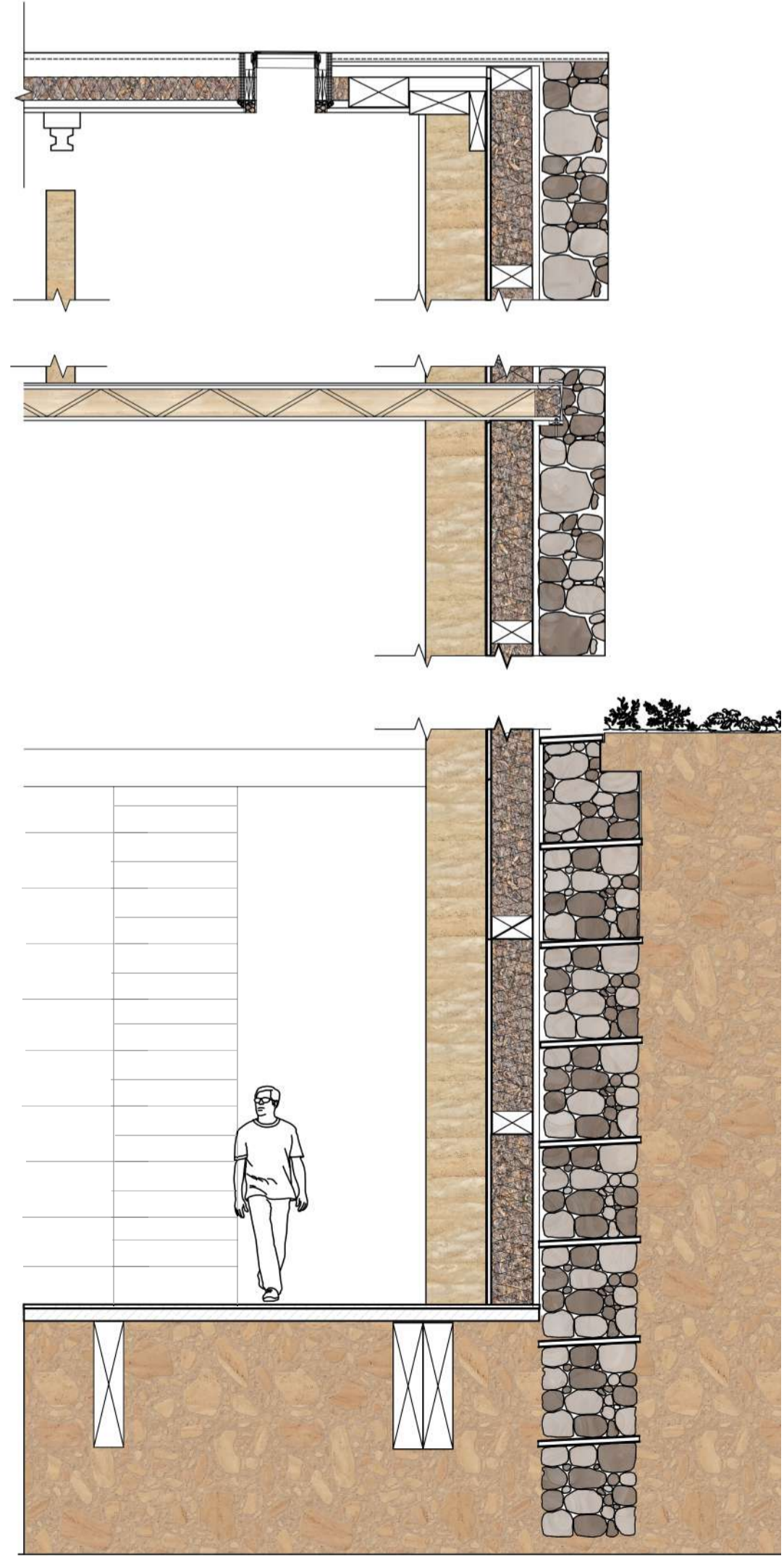
I wanted to experiment with earth samples from Bo'ness to investigate further into what this material is capable of. Each sample has a different ratio of soil to plaster, and some even has added clay solution to help it bind together. The result was that rammed earth can hold its shape and be cut (when still wet) in order to create openings. This small model investigations were helpful in reassuring the process and concept of the wall envelope design.

The reason I made the wall envelope is because I wanted to recognise the controversy around building with natural materials. I think it is important as designers to experiment and learn about vernacular methods of construction so we can apply them to modern architecture. The building of the wall envelope helped me understand the pros and cons with using rammed earth. For example, the soil collected from the derelict petrol station in Bo'ness didn't have as much clay within as needed to the wall wasn't as strong as it needed to be. However, I think using rammed earth would still work for this design as the basement is deep enough to reach the marine clay underneath the top soil. A pro of using this method is how simple it is to make, thus the method of construction would be easy to teach and there would be no need for a specialist on site to oversee construction, meaning its an accessible material for people to use and continue using in the future.

My conclusion for building with earth is that it is a adaptable material the has massive positives, for example, its completely sustainable and efficient as you can get your materials on site. It is also really good for people's wellbeing as it can improve the quality of air in the space. The amount of positives for this material is overwhelming however when looking into how realistic it would be to make earth a commonly used building material, there are some problems. For example:

- Building with earth is labour intensive, therefore you need a large team even just to make small structures.
- You need tradesmen who specialise in this area of construction which are hard to find but essential in making sure the building meets regulation standards.
- Weather conditions can massively impact how easy construction is; if it is too wet then the earth is too moist to compress and shape into bricks/walls meaning construction could be set-back for months at a time especially in winter.

Considering these problems it is understandable why earth has not been introduced as a mainstream material. However, I think if these issues with the use of rammed earth are considered as part of the design, the impact that they have can be reduced. Building the rammed earth in a wetter environment is one of the problems that I am facing, but I think I have minimised that issue by making sure all the rammed earth walls are in the interior. Also understanding that the material is labour intensive means that I was careful when deciding the volume of this material to use. I do think that if people take the time to learn and understand this material, they will see how positive this material will be in the long term.

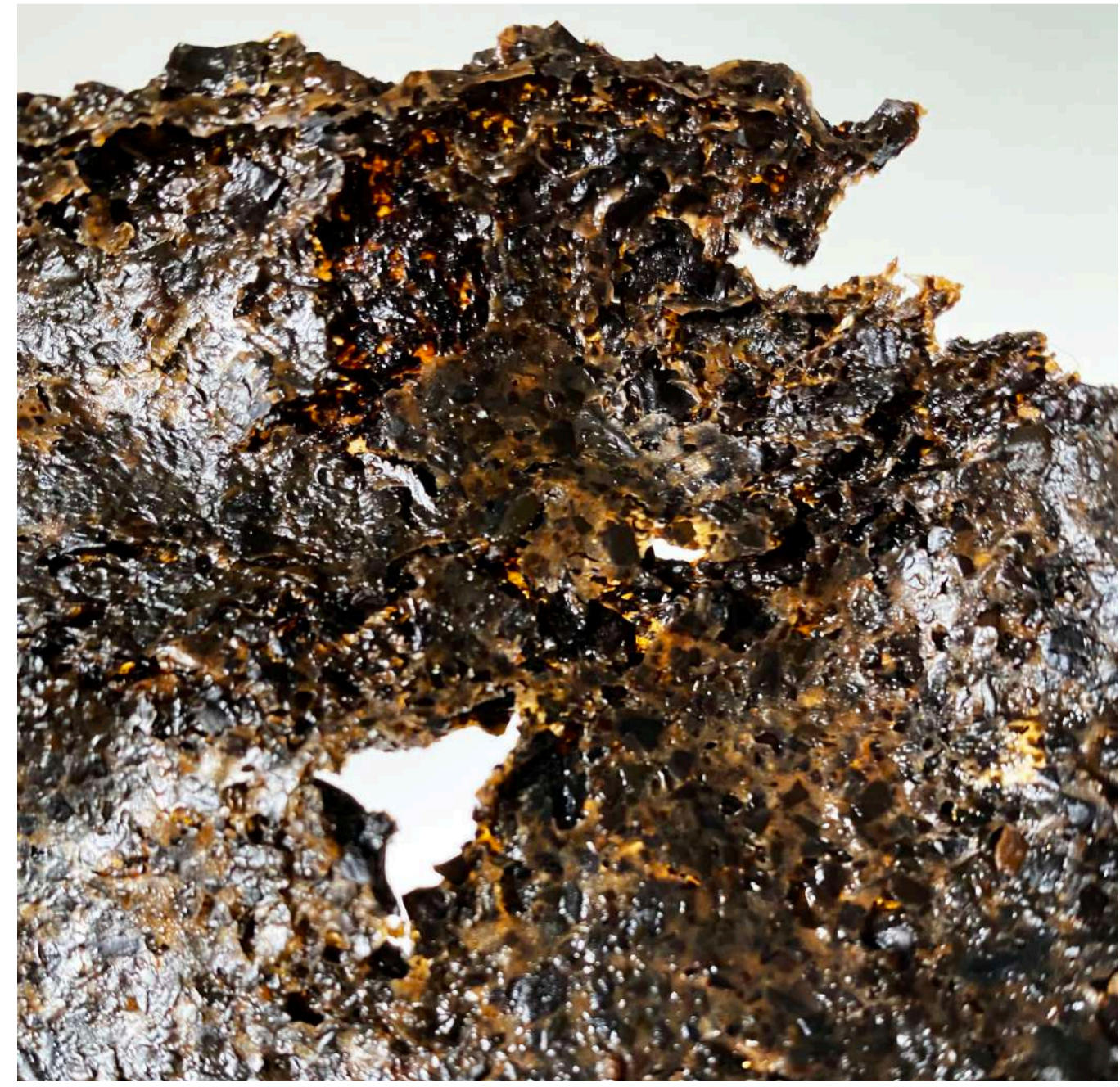


# RAILWAY

## USING SCRAP MATERIALS STRUCTURALLY

In Bo'ness, there was lots of railway scrap near the railway station. It included 14 large cast-iron columns and other smaller supports with intricate detailing. This inspired me as I then began to think about how the waste products from the Beeching Report could've potentially been used as the structural support for buildings. For example, old railway tracks could be used as i-beams and the large supports could be either used as columns in largers buildings or as supports for retaining walls. If over 7,000 miles of railway had been recycled and reused in buildings during the Beeching Report instead of destroyed, how many buildings could have been built with the tracks as beams? How much carbon and mining for steel and iron could have been saved if these railway tracks had been 'Urban Mined'?

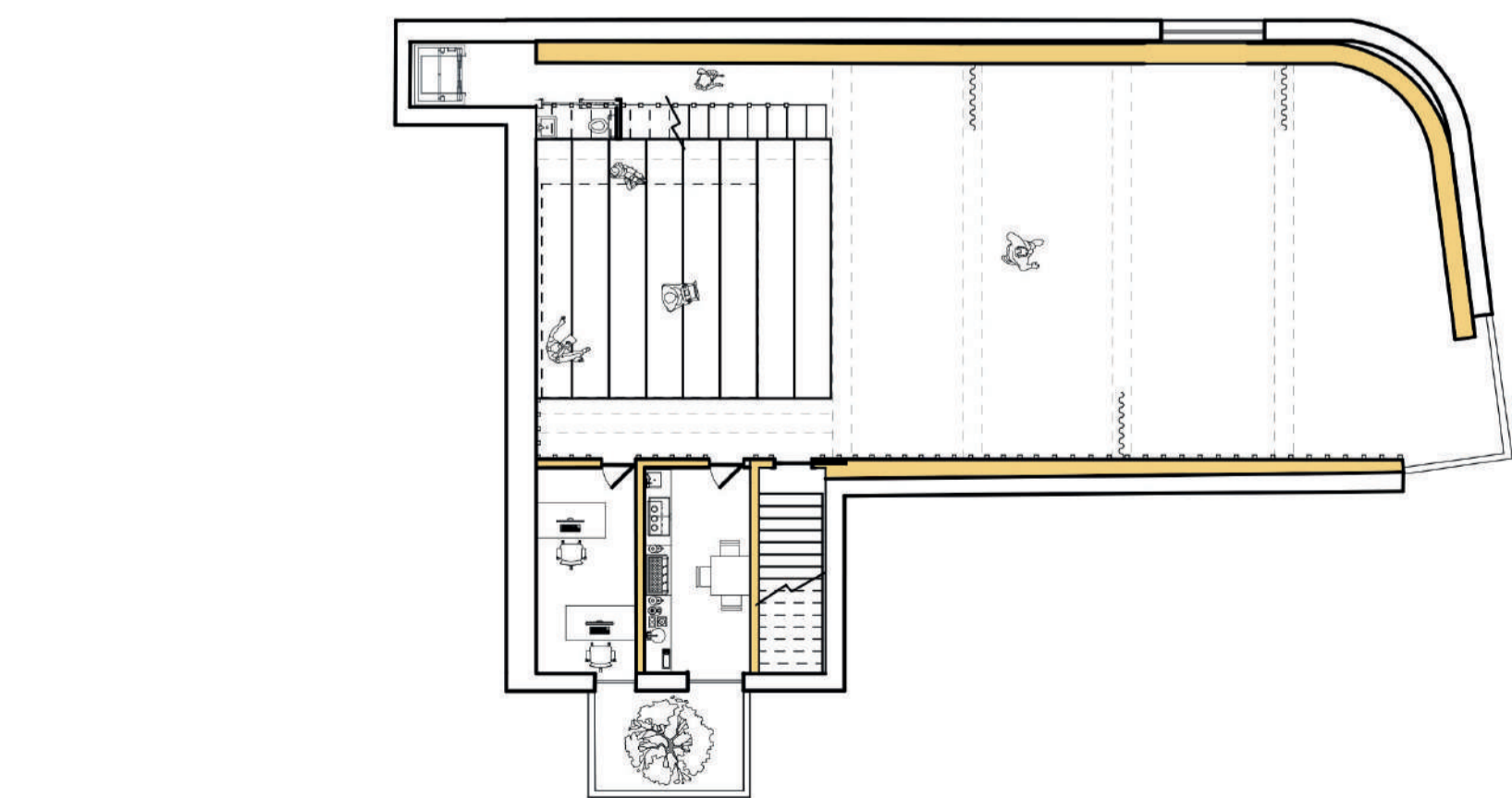
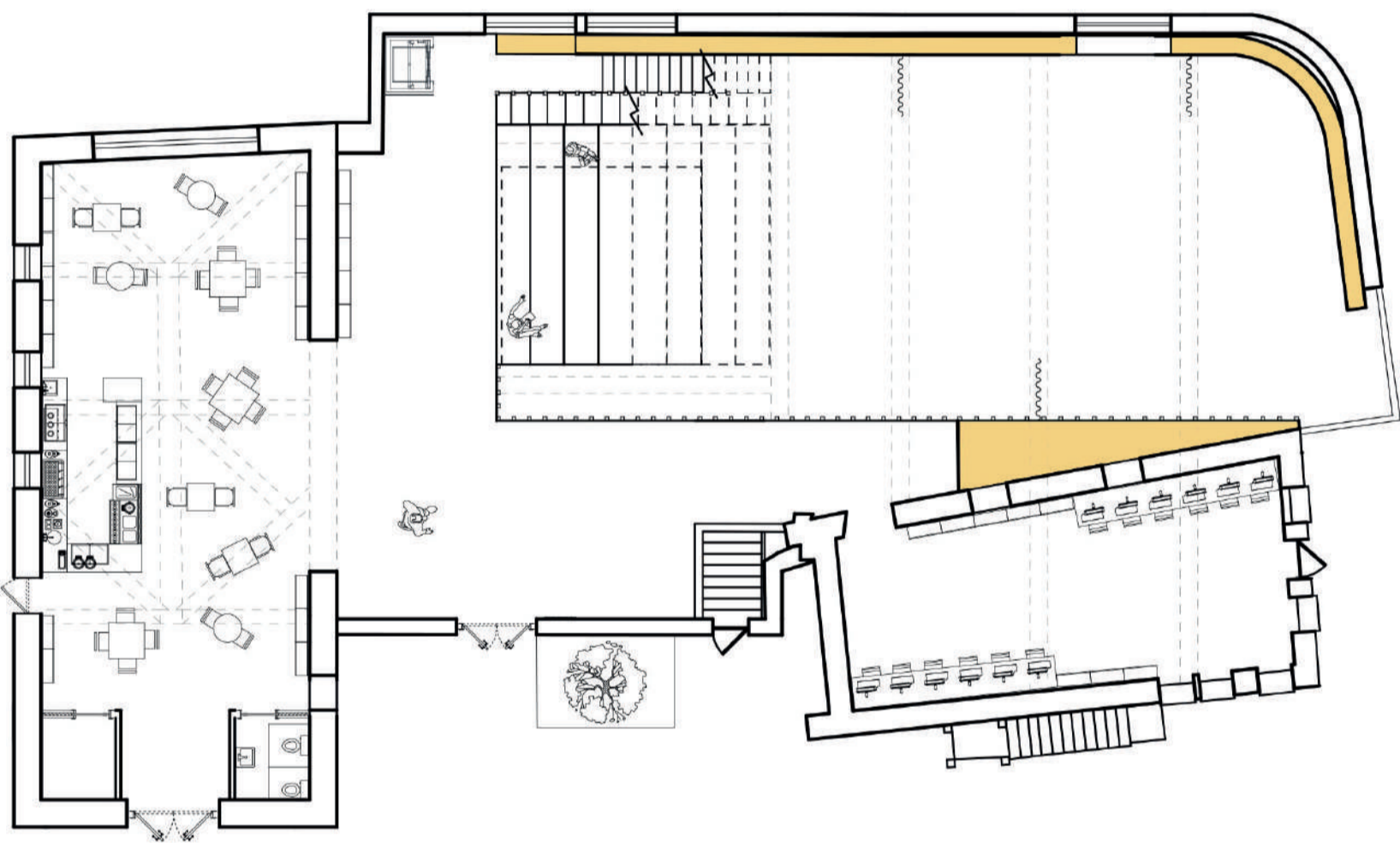
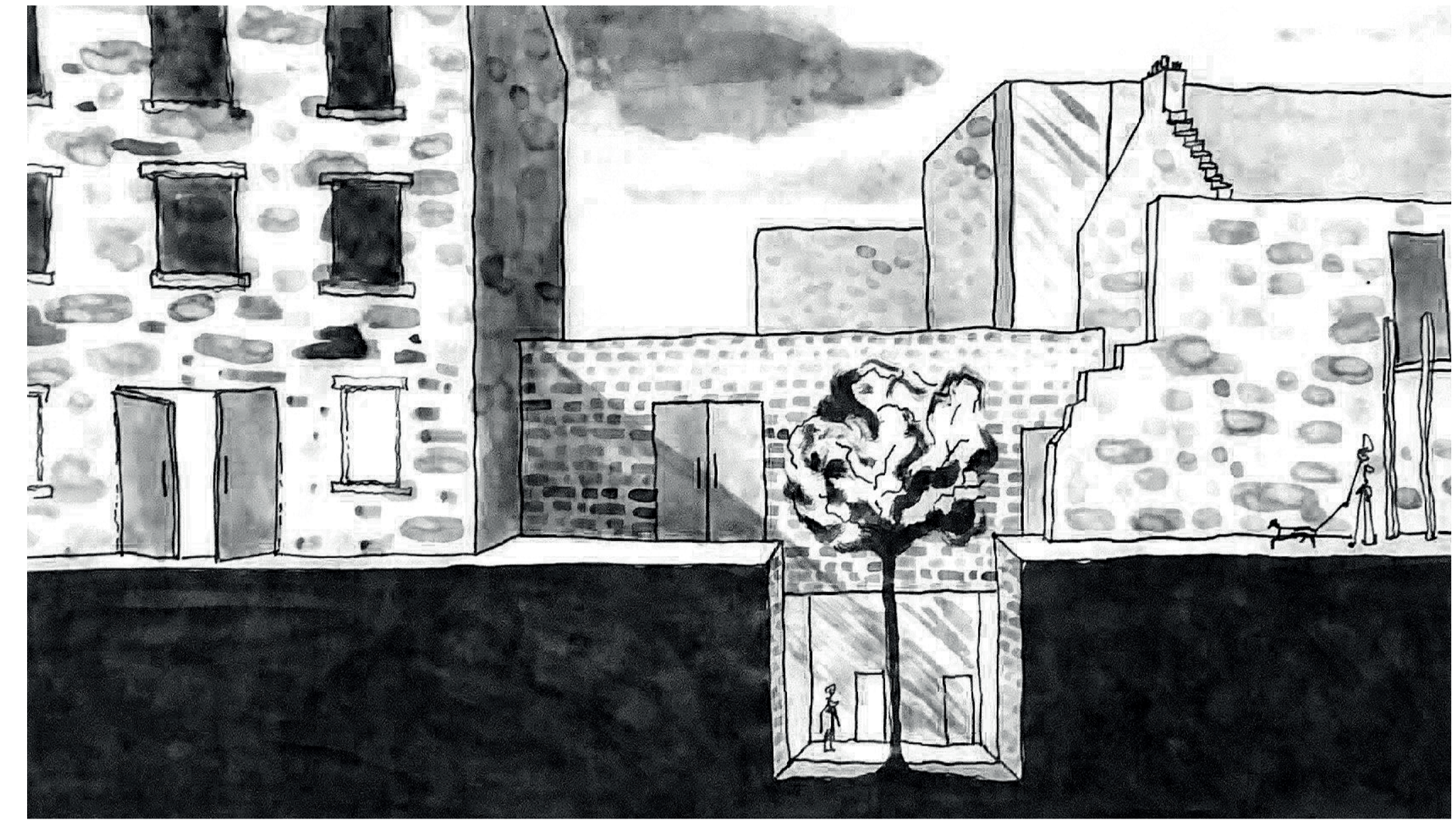
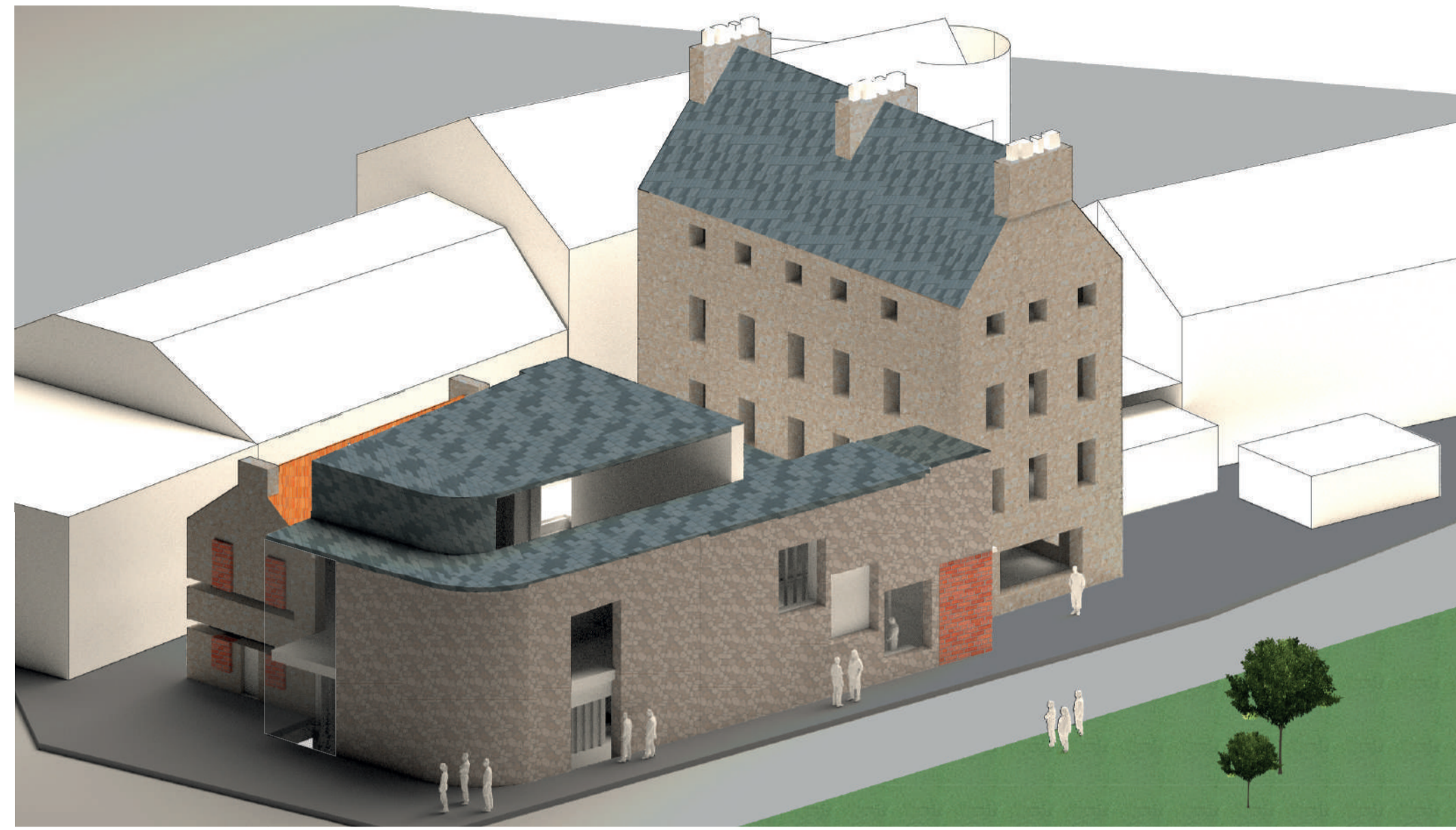
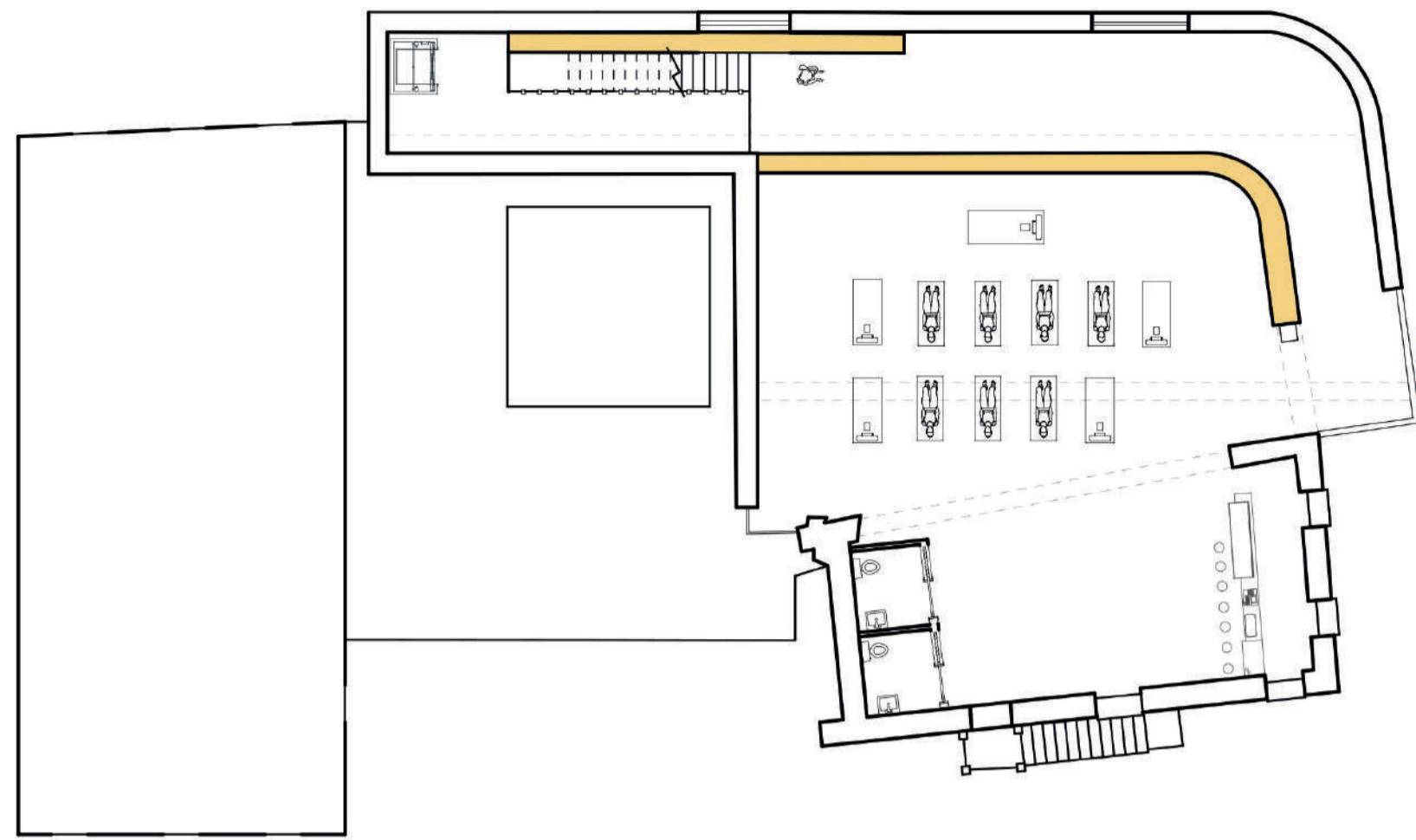
This barn conversion used scrap pieces of railway tracks as part of the structure of the building. It has a system of railway track beams supporting the first floor at a spacing of three metres. It was apart of the original farm barn structure, which was constructed by the farmer who owned it. Therefore, this building considers inovative methods of construction used by people building vernacularly. As all these building methods are generally inspired by individuals who were just using materials around them, this fits in well with my four principles of earth, water, people and quality.



# SEAWEED

## AN INVESTIGATION OF USE AND SUSTAINABILITY

I collected seaweed from the coast at Bo'ness because I wanted to understand how the material reacts to being dried and manipulated. I firstly made a model of the seaweed insulation panels that will run throughout my building because I wanted to understand the scale and amount of seaweed needed for this technology. I also made bioplastic out of crushed up seaweed and Agar flakes because it was interesting to discover different properties that seaweed and thus other marine plants could have. This helped me understand how many potential uses this material has and question how it can be applied in other ways to my design. The main problem concerning the use of seaweed as insulation in buildings is how the eelgrass is harvested. Which is why it is important for many sustainable materials to be used for insulation in the future to protect the sources.



## IN CONCLUSION

In this overall design, the three main centres are the lecture hall in the basement, the cafe and library area on the ground floor and the event/community space on the first floor. My goal for the overall scheme of the building was to keep the floorplan simple to support the adaptive use of the building. This helps recognise that the building's unique features are more subtle, with the longterm impact of the space being more positive and efficient.

Using materials as a focal point for this project helped me design with care. The style was dependent on the limitations that were set from the beginning. Almost like when you need to cook the tea and you just have to use the ingredients you have in the cupboard. Setting these limitations at the start of a project is not only helpful in design but also means that the design identifies important factors other than aesthetics. These materials helped me decide what I thought was important to the overall outcome of the project. The material factor encouraged me to understand the way life happens in Bo'ness and the impact of providing moments for people to share.

The project involves the four principles stated at the beginning.

The earth, being the vessel that we take for granted and ignoring the vast potential of its properties. Using this material in a new way helped me understand how adaptable and accessible the material is, and how to use it in the Scottish Climate.

The river, silently being a key part of this landscape, provides materials that solve problems due to their adaptation in unique climates. The potential of what lies beneath the waves is vast and unknown, and seeing the difference a small aspect of the building can make, is intriguing.

The people of Bo'ness, their struggles and needs are generally ignored and are expected from a small town. Providing the opportunity to use spaces efficiently for smaller communities is important and not always considered in architectural design. This space prioritises function over style.

The quality, all three previous principles combined give quality to the design. The materials provide structural quality as well as ventilation quality in the building. The biomaterials also increase the ethical quality in terms of the environment and carbon emissions. The quality of life for people in Bo'ness improves, as the design provides social development, education about biomaterials and environmental design. It provides a space for people to organise groups and put on events, thus improving mental health whilst the buildings quality also contributes to improving physical health.

The design is aimed to work holistically, taking care of the people using it just as they've taken care of its environmental impact. It shows the massive potential that nature has to take care of us, provided we take care of it. It's a design of life itself.