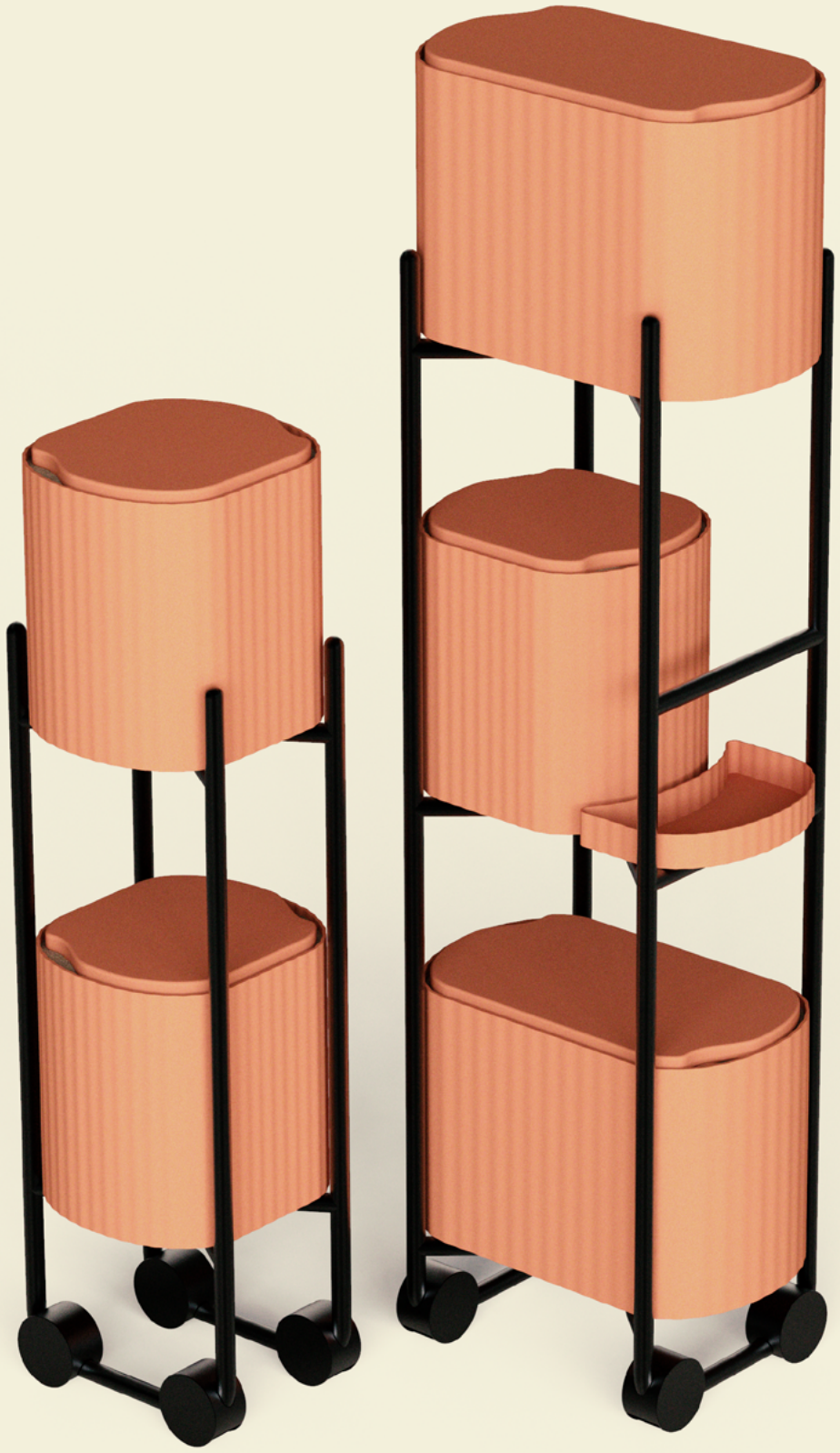
TERRACOTTA VESSELS

- FOOD STORAGE ADDRESSING GLOBAL CHALLENGES



MALIN BJÖRKLUND

TERRACOTTA VESSELS

- FOOD STORAGE ADDRESSING GLOBAL CHALLENGES

MALIN BJÖRKLUND

DEGREE OF MASTER OF FINE ARTS IN DESIGN

KONSTFACK - UNIVERSITY OF ARTS, CRAFTS AND DESIGN

TUTOR - KATJA PETTERSSON, MARTIN ÁVILA AND MARIA PERERS

EXAMINER - MARTIN ÁVILA

SPRING 2021

KONSTFACK
University of Arts, Crafts and Design

ABSTRACT:

Terracotta vessels are about understanding how we can store food by using a new product solution and how we could use less energy and waste less food in doing so. This project is an attempt to minimise the energy usage in our homes but also to gain greater understanding about the food we choose to bring into our homes and what we can do to avoid throwing it away.

KEYWORDS:

food waste, design, sustainability, industrial design, product design, terracotta, clay, food storage, global goals, UN, food, concept design, green design, nudge, behaviour, evaporative cooling, evaporation, emotional durable design, zeer pot, pot-in-pot cooler, refrigerator, fridge, appliances, low tech, ceramics

TABLE OF CONTENTS

INQUIRY

"The struggle for a sustainable future on this planet will be won or lost in our cities. In the next 30 years we expect a doubling of the urban population and with that a doubling of the urban infrastructure. That is a very short window of opportunity to get things right."[1]

CARINA BORGSTRÖM-HANSSON, ECOLOGICAL FOOTPRINT EXPERT, WWF

There are several issues with the food system we have on our planet.[2] As the general population is increasingly moving from the countryside to the cities,[3] more people rely on the infrastructure and the specific distribution channels of cities to get to their food as we move further away from the countryside where most food grows.[4] Due to a lack of care for food, both in regard to its poor transportation and harvesting practices, an estimated one third of all food produced in the world ends up in bins. Taking that into account, and the fact that around 30% of global energy consumption is used by the food industry, it is clear that real change is needed.[5] Average households account for 29% of the total global energy usage, and despite technological advances towards greater energy efficiency, their energy usage has continued to grow.[6]

A way to work with the challenges of the above topics is to attack the problem from a design perspective. Through this project, I wish to contribute by relieving stress on the ecosystem by decreasing our demand on food by taking care and using what we already have.

Food is something we all have a relationship with and most of us in the western world have food in excess. We take food for granted to the extent that we lose the respect for the time and energy it takes to produce, harvest, ship and enter our homes.

1 Youtube, https://www.youtube.com/watch?v=o86Ut6kAEMQ, The urban Green, Carina Borgström-Hansson, Ecological Footprint Expert, WWF (2021-02-15)

2 United Nations sustainable development goals, https://www.un.org/sustainabledevelopment/sustainable-consumption-production/, Goal 12: Ensure sustainable consumption and production patterns (2021-01-27)

3 Boverket, https://www.boverket.se/sv/samhallsplanering/bostadsmarknad/bostadsforsorjning/flyttningar/urbanisering/ Urbanisering (2021-01-27)

4 Lee, Jenny (2018). Det moderna köksrummets historia in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.25

5 United Nations sustainable development goals, https://www.un.org/sustainabledevelopment/sustainable-consumption-production/, Goal 12: Ensure sustainable consumption and production patterns (2021-01-27)

6 ibid

I would like to challenge this poor relationship through a new take on how we store food in our Nordic urban homes. This leads to many questions for my thesis, some of which I wish to find answers to throughout my research. Can the way we store most of our food impact how we respect it, and by placing it in a new context, can we raise its value and make us reconnect with it? Has the technological introduction of fridges impacted our relationship with food in a negative way? Could we create a meaningful relationship to an object that serves us well and helps us store our food?

These questions lead to my investigation of how food can be stored without the use of electrical energy, as opposed to the way fridges are powered today. Looking at how we have historically and traditionally preserved food in our homes, did we also create a relationship with food to care and nurture it? By going back to taking care of food ourselves, can we build this relationship once again and perhaps stop excessive consumption?

I have found three potential reasons to store food in another form than a fridge:

- Lower food wastage by storing food in another product that creates a better overview of food.
- Lower the usage of electrical energy in the home by not using the fridge all year around and slowly moving away from using it all together.
- Prepare for crises, with an uncertain level of energy flow into our homes in the future. Where can we keep our food cool?

THE HISTORY OF FOOD PRESERVATION AND KITCHENS

As the kitchen changed throughout time, so did the space for storing and preserving food. Therefore, it is important to describe the history of the Swedish kitchen to understand where this project has started and from where it is heading.[7]

A kitchen is a very different can not be seen as any room compared to the amongst others in a household as it constantly has to cooperate with the flow of groceries entering and leaving the household. The kitchen is a room for activity and work and therefore a kitchen always needs to be functional, compared to the other rooms in a home. This is especially a concern when living in an urban context where you have to rely on specific distribution channels and systems that the city requires of you.[8] Throughout time the kitchen has changed due to many factors, one force behind the changing kitchen has mainly been technical innovation and ideas of efficiency and rationalisation, but also the diminishing number of maids working in households. There was no longer staff that could take care of the big inefficient homes and the kitchens needed to be rationalised so that working citizens could manage the household work without domestic help.[9] How to rationalise our homes was a long and thoughtful research process that at a later stage became the Swedish kitchen standard.

Throughout history there have been numerous spaces and solutions for how we have taken care of our food based on which grocery you intend to preserve. There are different factors to take into account to during preservation such as the temperature and humidity of the food.[10] Therefore I have looked into four different food preservation solutions throughout history for this project, each with possibilities and constraints in its adequateness to maintaining and storing food.

THE OUTSIDE ROOT CELLAR

The root cellar was an early version of a cold space for food storage to prolong its shelf life. It is believed that people began using root cellars between the 18th and 19th century in Sweden as a way to store potatoes long term after the harvest.

7 Thörn, Kerstin (2018). Skafferiet, rummet som försvann in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.65

8 Lee, Jenny (2018). Det moderna köksrummets historia in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.25

9 Ibid, p.29

10 Thörn, Kerstin (2018). Skafferiet, rummet som försvann in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.65

Around the year 1827 the set up and building of root cellars began on almost every courtyard, built with locally available materials and techniques from the area, sometimes limestone and other times granite.[11] The root cellar was set up in the yard with the door facing north according to early drawings. The basis of a root cellar is a building in a large hole in the ground made out of a stone material for its construction and a thick layer of soil cladding the inside walls to keep the temperature right for food. It is often covered on the outside with surrounding vegetation, making it look like a big grassy molehill.[12]

THE VENTED LARDER

When the population moved from the countryside and into the cities, new solutions for storing food were needed. From the end of the 19th century to the beginning of the 20th century, all kitchens had a special cupboard, a cold pantry also known as a larder, equipped with a window or a ventilator. This was one of the few ways in which we could keep food cold. Throughout the 40's and 50's, the larder was placed next to the exterior wall of a building[13] which was north-facing and put constraints on how the kitchen could be organised.[14] Through technological innovation and slow introduction of fridges more people saw the disadvantage of the larder. The larder worked better during the winter months than the summer, the hole in the wall for the vent felt unsanitary as any vermin or pollution could enter, and mentioning vermin, the groceries in the larder required food to be sealed properly for food hygiene reasons.[15]

It was not until the late 60's that fresh air vented larders stopped being built and we moved towards using fridges to store our food cold.[16] Households with kitchens that still had a larder but could afford a fridge, often switched off the fridge during the winter months and used the larder to cut costs on electricity.[17]

11 Hajdu-Rafis, Ann-Charlot (2015) Länge leve jordkällaren, Länsstyrelsen i Västra Götalands län. https://www.lansstyrelsen.se/download/18.1dfa69ad1630328ad7c7ec57/1526068323011/artikel-lange-leve-jordkallaren.pdf, (2021-05-01) p.2

12 Ibid, p.4

13 Stadsmuseet, https://stadsmuseet.stockholm.se/utforska/byggnader-och-miljoer/varda-ert-hus-historia/husets-alla-delar/kok/skapsinredning/ Skåpinredning (2021-01-13)

14 Sandgren, Fredrik (2018). Kylan, källaren flyttar in, in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.95

15 Ibid, p.95

16 Stadsmuseet, https://stadsmuseet.stockholm.se/utforska/byggnader-och-miljoer/varda-ert-hus-historia/husets-alla-delar/kok/skapsinredning/ Skåpinredning (2021-01-13)

17 Thörn, Kerstin (2018). Skafferiet, rummet som försvann in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.71

THE COMFORT OF THE FRIDGE

The refrigerator, known as the fridge, was introduced in Sweden through the modernisation and technical innovation that society went through in the 20th century. The cities grew and so did the need for a changed food storage systems in our homes.[18]

Most people today have a fridge in their home and use the fridge daily. It is an object, a device that we take for granted and do not think too much about. Therefore, it is not surprising that many use the fridge incorrectly. A fridge has different compartments that serve different purposes with different zones of temperature. By storing food incorrectly in the fridge, you might cause your food to spoil and end up in your bin. A common misconception is that a crowded fridge is the absolute best one but a fridge should not be overly packed. You need to have space for cold air to be able to flow around your food to prevent pockets of warm air.[19]

It is important to stress that the intention of the fridge is to prolong the lifespan of groceries and to secure the prevention of bacteria and microbe growth that could spoil food and cause food poisoning.[20]

THE FREEZER

The freezer is another modernity that from the beginning was a utility often shared amongst neighbours as it was very expensive to own one of your own. Commonly you created a freezer compartment association, where you together with neighbours bought into a commercial freezer and rented a small box or unit.[21] There were other attempts at finding solutions for managing food on a communal basis towards the end of the 19th century, ideas from collective living where each floor in an apartment building would share kitchens to dining clubs that people could join.[22]

18 Lee, Jenny (2018). Det moderna köksrummets historia in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.29

19 Janowiak, Maria and Felman, Adam "How to Organize Your Fridge So Food Keeps Longer – and Your Energy Bill Works Harder" (2020-12-20) https://greatist.com/eat/ultimate-way-organize-your-fridge#does-it-need-refrigerating (2021-01-13)

20 Ibid

21 Harradine, Linda "Lär av historien för att köket ska bli klimatsmart" (2019-10-31) https://www.oru.se/nyheter/nyhetsarkiv/nyhetsarkiv-2019/lar-av-historien-for-att-koket-ska-bli-klimatsmart/ (2021-01-13)

22 Lee, Jenny (2018). Det moderna köksrummets historia in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag. p.26

From these inventions, there are several aspects that I brought into the formgiving of my design suggestion, some weighed heavier than others. From the root cellar and larder I was inspired by the close relationship that that type of storage required from its user. Its necessity of being aware of what is stored and for how long seems to create a valuable bond. Whilst from the refrigerators and freezers, their modularity in which they can be placed wherever in a home, kitchen, garage or hallway made me think of the accessibility of it in our homes.

APPLIANCES FROM AN ENERGY PERSPECTIVE

To understand how our food storage systems could be developed it is essential to look at today's solutions and how they work from an energy perspective.

White goods or appliances are some of the products in our homes that use the most energy, especially fridges and freezers that are on day and night.[23] There are a couple of things we can do to minimise the energy usage of fridges in the home like keeping it at the correct temperature of 5 degrees celsius and not keeping the fridge door open for too long. Today, most electric white goods need to have an energy efficiency label and fridges and freezers are the two that have used this labelling for the longest time as seen on fig 1. The most efficient energy classification has the label grade A+++.[24]

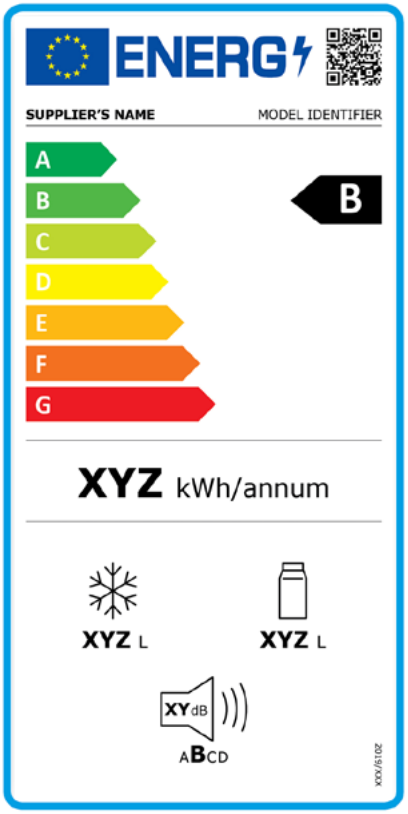


Fig 1, european energy efficiency labeling

23 Larsdotter, Anna "Kylskåpsrevolutionen under lupp" (2019-12-13) https://popularhistoria.se/vardagsliv/kylskapsrevolutionen-under-lupp (2021-01-13)

24 Energimyndigheten, https://www.energimyndigheten.se/energieffektivisering/jag-vill-energieffektivisera-hemma/inkop-av-produkter/vitvaror/, Vitvaror (2021-02-15)

A standardised combined fridge-freezer of today uses around 200 kilowatt-hours per year compared to 15 years ago when the usage was triple the amount. The change in energy efficiency is thanks to better compressors and isolations of the units.[25] Worth noting though is that energy efficiency has less importance from a global warming perspective, if your source of household energy generates greenhouse gas emissions.[26] From an energy point of view in the making of white goods and the recycling of them, appliances have a lifespan that also leads to Planned Obsolescence.

PLANNED OBSOLESCENCE

Planned Obsolescence is the practice in which electrical goods are programmed or made to have a predetermined end date after which the product will no longer work and will be almost impossible to repair. This also includes companies that introduce software updates that are not compatible with the existing hardware on your product. This is a poor financial deal for consumers who constantly have to buy and update their electrical goods and it is as much of a bad deal for the planet.[27] From an article in The Guardian it was found that out of the 50 million tonnes of e-waste thrown away globally each year, only around 20% was recycled and half of the amount was represented by heating- and cooling equipment and household appliances.[28]

RECYCLING OF WHITE GOODS

According to Naturskyddsföreningen, which is the non-profit organisation Swedish Society for Nature Conservation, about 91% of all white goods are recycled in Sweden. For the refrigerator specifically, the recycling percentage is at around 97%. According to a study of the environmental impact of refrigerators and fridges), the life expectancy of a modern refrigerator-freezer is 12-15 years.[29] Throughout its lifecycle there is an expectation that the energy efficiency

25 Ibid

26 Alex, Oskar, "Så kan äldre kylskåp bli miljövänliga" Forskning & Framsteg, https://fof.se/tidning/2020/7/artikel/sa-kan-aldre-kylskap-bli-miljovanliga (2021-02-21)

27 Spinks, Rosie, "We're all losers to a gadget industry built on planned obsolescence" (2015-03-23) The Guardian: https://www.theguardian.com/sustainable-business/2015/mar/23/were-are-all-losers-to-gadget-industry-built-on-planned-obsolescence (2021-02-28)

28 Harris, John, " Planned obsolescence: the outrage of our electronic waste mountain" (2020-04-15) The Guardian: https://www.theguardian.com/technology/2020/apr/15/the-right-to-repair-planned-obsolescence-electronic-waste-mountain (2021-03-01)

29 Lindman, Pär. (2013) Undersökning miljöbelastning kyl & frys. Stockholm: Naturskyddsföreningen, http://mb.cision.com/Public/514/9434267/a1f2acb61a89ab4f.pdf (2021-01-23)

will decrease as the product gets older and even the insulation can become less efficient. There is also a chance of leakage from the coolant agent that is commonly isobutane (R600a) in modern fridges. This upon releasing in the atmosphere has a 4 time stronger effect on greenhouse gas emissions than co^2.[30]

Fig 2, recycling station, unknown location in Europe

30

There is clearly room for improvement in the storage of food from an energy perspective. The main is lowering our overall energy usage in households. Energy efficiency of homes is essential on the road towards a more sustainable future as using less energy will lead to less emissions of greenhouse gases. Ways to work with lower overall usage of energy in our homes can be done through inventions and change of behaviour. That is why it has been of interest to explore alternative ways of cooling and storing food.[31]

Fig 3, terracotta butter box

31 Naturvårdsverket https://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Energi/Energieffektivisering/ Energieffektivisering (2021-05-14)

ALTERNATIVE COOLING POSSIBILITIES

HEAT AND EVAPORATION

There are several alternatives to creating a cool climate similar to a larder without using electrical energy. One of the techniques is called "evaporative cooling" and is the basis of the cooling system used in my product suggestion. Evaporative cooling is when water evaporates from a surface with the help of air passing over the surface. When the water evaporates it draws energy from its surroundings creating a cooling effect on the surface and its inside.[32] This system is used in pot-in-pot coolers where there are two porous material vessels, one big and one smaller, with sand between the two that is watered. The water will evaporate from the sand, through the outer porous vessel and make the inner porous vessel cold.[33] A material that is commonly used is terracotta, which is a body of clay with a porous quality that can hold big volumes of water, hence it is regularly used in plant pots.

TERRACOTTA

Terracotta has been one of the most common materials used in pot-in-pot coolers thanks to its material quality of being porous and its accessibility worldwide. It is well-known for its rusty red colour and is commonly used in plant pots. The material can withstand quick changes of temperature without cracking which makes it very functional.[34] Besides functioning as plant pots it is used in other innovative contexts such as the above mentioned pot-in-pot cooler, low-tech air humidifiers, ventilation and small scale food storing (fig 3). Therefore I decided to continue working with terracotta as my main material in my exploration in this master thesis.

32 Noble, Neil, Evaporative cooling. Warwickshire: Practical Action, https://infohub.practicalaction.org/bitstream/handle/11283/621665/Evaporative%20cooling%20-%20zeer%20pot.pdf?sequence=1(2021-03-01)

33 Rebuilding civilization, http://rebuildingcivilization.com/content/build-evaporative-refrigerator-no-moving-parts-no-electricity, Build an evaporative refrigerator - no moving parts, no electricity, (2021-01-06)

34 D'Souza, Sara, https://www.thesprucecrafts.com/all-about-terracotta-4152002 The history and uses of terracotta (2021-05-17)

FOOD WASTE

As mentioned in the introduction of this thesis, an estimation by the United Nations shows that one third of all food produced in the world ends up in bins.[35] As a result, the Swedish government has assigned the Swedish Environmental Protection Agency, The Swedish Food Agency and the Swedish Board of Agriculture, two assignments to work on the reduction of food waste and food loss. In February 2020, a report summarised the latest conclusions on how to work with these issues, and two of the action plan points stress the generation of "measures to help the consumer to do the right thing" and "research and innovation ... aimed at reducing food loss and food waste".[36] Food waste in this context is the terminology of the intended and unintended waste of groceries aimed at human consumption. The intended can be eggshells, fruit peel and coffee-grounds while the unintended could be food that has spoiled due to consumer negligence. The report has shown that the average Swedish citizen contributes to 129kg of food waste yearly. This then leads to the conclusion that a change of consumer behaviour is of utmost importance as the consumer is the biggest individual contributor to food waste. Some of the factors to this are over-purchasing behaviour, and the poor handling of groceries and the lack of care for leftovers.[37]

Through my project I will address these issues by changing the way we look at how we can manage food in our modern homes, something that is an alternative to the fridge that we take for granted.

FORECASTING THE FUTURE

In 2030 we can forecast eating patterns that are somewhat similar to today's but with less consumption of animal based meat products, and more plant based alternatives. We will introduce algae to our diet and buy more locally produced food from our nearby framers.[38] Meat consumption will be more occasional and planned instead of eaten on a regular basis like today according to Mintel,

35 United Nations sustainable development goals, https://www.un.org/sustainabledevelopment/sustainable-consumption-production/, Goal 12: Ensure sustainable consumption and production patterns (2021-01-27)

36 Livsmedelsverket (2020) Halverat matsvinn i sikte 2030. Livsmedelsverkets regeringsuppdrag. Uppsala: Livsmedelsverket, Jordbruksverket och Naturvårdsverket https://www.livsmedelsverket.se/globalassets/om-oss/redovisade-reguppdrag/2020/slutrapport-minskat-matsvinn-2017-2019.pdf, page 9.(2021-01-15)

37 Ibid

38 Balkow, Klas (2020) Mat 2030 Axfoods förslag till en hållbar livsmedelsstrategi för Sverige. Axfood AB https://www.axfood.se/globalassets/startsida/hallbarhet/publikationer-och-rapporter/axfood_mat2030_2020.pdf (2021-01-29)

Fig 4, decomposing potato

the world's leading expert of consumer analytics and consumer behaviour.[39] Consumers will be more aware of their eating habits and the environmental effect they have, which will lead to consumers asking for transparency in what it is they are purchasing and where it is from. The continuous goal to minimise food waste is pushing innovative food management systems forward[40] and with innovation we can change the places where we can grow food, and therefore make fresh produce more accessible and local even to urban habitants. Vertical farms, indoor hydroponic systems and other technological innovations will be common in our cities by 2030, which will lead to changed food supply systems.[41]

39 Mintel, report on Global Consumer Trends in 2030, https://www.mintel.com/global-consumer-trends-2030 p.6 downloaded (2021-03-23)

40 Ibid, p.10

41 Ibid, p.36

CARING FOR AN OBJECT

An idea that has been explored in this project is the idea of "emotionally durable design". In his book Emotionally Durable Design, Jonathan Chapman discusses how empathy and meaningfulness have moved from long term human relations to short term material relations, starting with the "fast food culture of nomadic individualism and excessive materialism".[42] The idea of emotionally durable design stems from creating a more sustainable and long term bond between objects and people, with the intent to lower consumption and material goods waste. Chapman mentions the challenge of working with people's desire for new material things, as he finds that as soon as old needs are met, new needs will arise, and increase the durability of the relationship between objects and humans.[43] Through this change of empathy, we start to seek meaning from material things around us with the instant gratification of constantly consuming new goods.[44] Chapman continues by writing about consumer motivation and the deep meaning of why we continue consuming on a planet that clearly cannot provide for our emotional needs; "material consumption is driven by complex motivations … it is an endless personal journey towards the ideal desired self".[45] But there seems to be an exception according to a study by Jääskö, Mattelmäk and Ylirisku, that shows that the meaning can be found in the service that an object provides creating a longer relationship between people and the object.[46] A big hurdle to this longer material relationship could be the automation of the everyday objects around us. The user's passive role in relation to objects establishes a feeling of not being needed and therefore the emotional attachment to the object decreases or does not commence at all.[47]

The idea of my project is partly to explore whether a better designed object from a user perspective could lead users to care more for it and by doing so also take better care of the food that is stored in them. By taking care of the food better and wasting less, we would also cause less stress on our environment. My hope is that my design would increase the sustainability in our everyday lives and homes.

42 Chapman, Jonathan (2015) Emotionally durable design. London: Routledge. p.23
43 Ibid, p.21
44 Ibid, p.23
45 Ibid, p.32
46 Ibid, p.46
47 Ibid. p.79

SUSTAINABILITY

Our increasing demands on food, water and natural resources is causing great stress to the planet.[48] Summarizing the urgency of this matter, professor Johan Rockström from the Potsdam Institute for Climate Impact Research & Stockholm Resilience Centre, states:

> *"Global food production threatens climate stability and ecosystem resilience. It constitutes the single largest driver of environmental degradation and transgression of planetary boundaries. Taken together the outcome is dire. A radical transformation of the global food system is urgently needed. Without action, the world risks failing to meet the UN Sustainable Development Goals and the Paris Agreement. "*[49]

UN GLOBAL GOALS & SUSTAINABLE DESIGN

In 2015, the United Nations gathered world leaders to agree on the 17 Global Goals that would work towards sustainable development for Planet Earth and the aim is to reach these goals by 2030.[50] My project will take off from Global Goal 12 "Ensure sustainable consumption and production patterns" with a focus on how we take care of and manage our food in an urban context with the intent to use less energy.[51]

Fig 5, UN global goal 12.3

48 https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html Planetary Boundaries, Stockholm Resilience Centre

49 EAT, (2019-01-16) Commission Food in The Anthropocene: the EAT-Lancet Commission on Healthy Diets From Sustainable Food Systems. https://eatforum.org/eat-lancet-commission/eat-lancet-commission-summary-report/ p.19 (2021-01-29)

50 The Global Goals for sustainable development https://www.globalgoals.org, 17 Global Goals, (2021-01-27)

51 United Nations sustainable development goals, https://www.un.org/sustainabledevelopment/sustainable-consumption-production/, Goal 12: Ensure sustainable consumption and production patterns (2021-01-27)

DESIGN PROCESS

The design methods and process have not been as linear as described below. But to make the process clearer, I have divided the methods into different sub categories. Many of these processes happen in parallel with each other and I was constantly switching between them in my research.

Fig 6, four stereotypical fridges from my questionnaire

CO-DESIGN

Questionnaires

To gain a deeper understanding of what is actually going on in our homes and how we deal with food, I have reached out to users around me. My first questionnaire was based on understanding what consumers stored in their fridges, and I asked each participant to upload a picture of what their fridge looked like (fig 6). In total I received 34 answers. The aim was to see how and what people store in the fridge and how similar it is to the recommendations of how food is meant to be stored according to guides on food safety and prolonging its life span. As can be seen in fig 6, people tend to store food in the fridge using advanced balancing techniques and placing food wherever it fits at that specific moment. The fridges range from fully packed to not that full at all, showing incorrect storing techniques and wastage of energy. The most prominent problem with over-packed fridges is that the users will not see what they have. Leading to food spoiling in the back and over consumerism by buying produce that you already own.

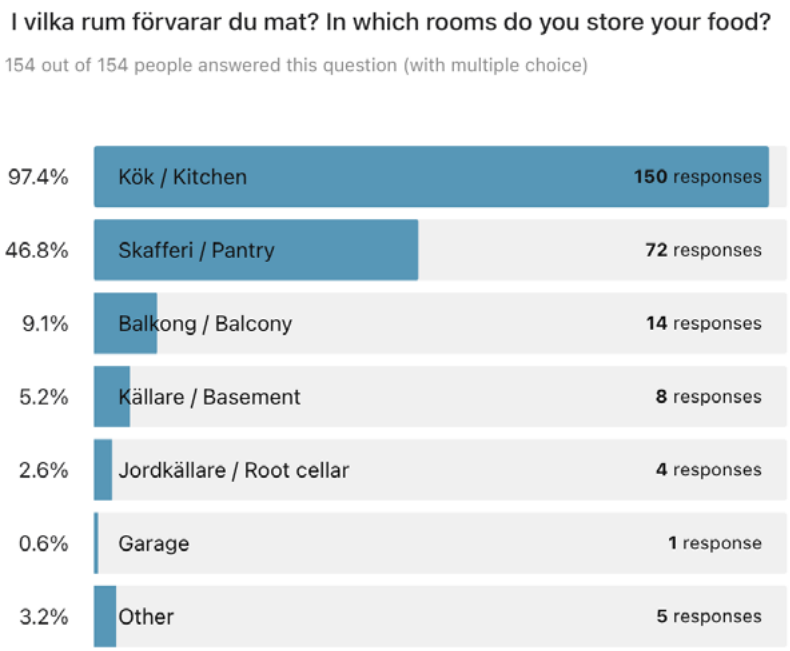


Fig 7, results from questionnaire about food management patterns

The second questionnaire was more in detail about how participants took care of their food and understanding the physical space in which the food storage is placed. The main questions were about food waste, to what extent do participants go out of their way to care for it, like food preservation techniques etc. I was also curious about if participants had considered the energy usage of their fridge and how prepared the household would be in case of a longer power cut. This received 154 answers some of which you can see in fig 7 and 8. In the received answers I could conclude that the spaces in households that we store most food in are the kitchen and that the food we waste the most are vegetables, root vegetables, dairy and fruit, see fig 8. This is in line with the previous research about food wastage in Sweden.

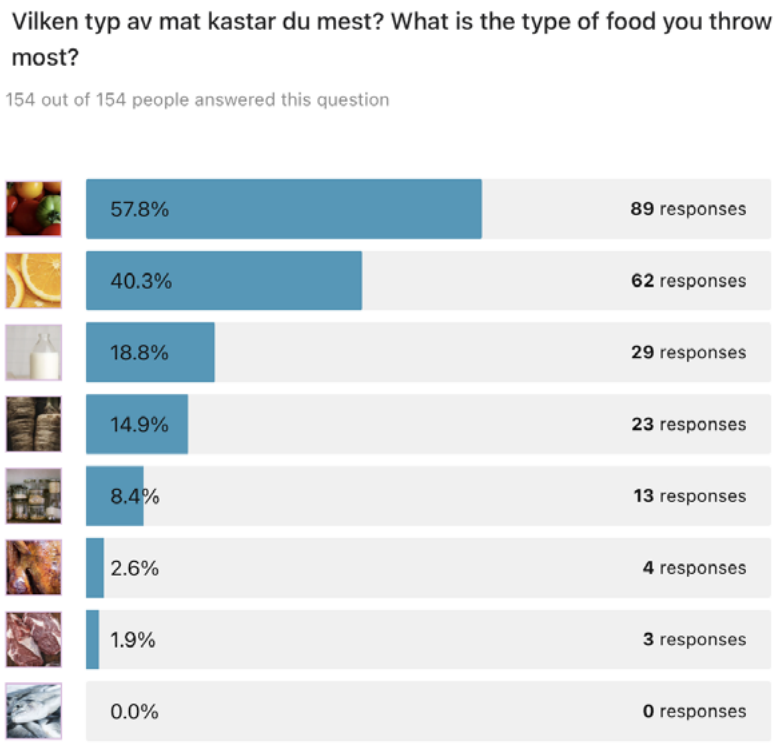


Fig 8, results from questionnaire about food management patterns

The key learnings from my own questionnaires in relation to what the research entails: users do not store food correctly and we waste a considerable amount of food that could have been eaten. What I brought into my design is a storage solution allowing for consumers to more easily see what they have, creating a closer bond to the managing of food and allowing food to be separated by the

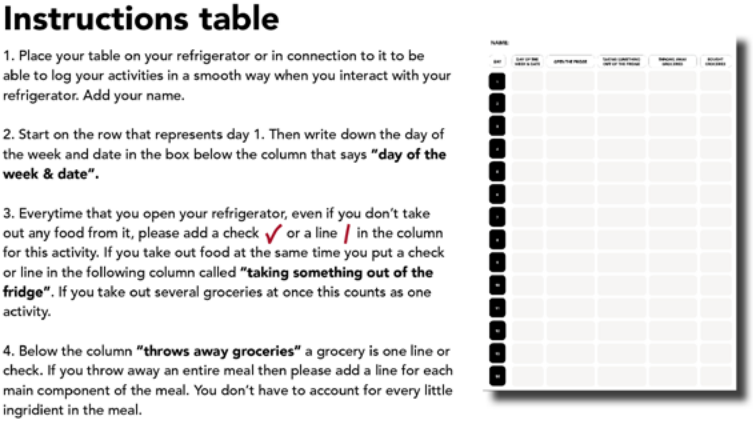
foods compatibility. I wanted to find a modular system where it would be easier to scale your storage up or down depending on how much food you consume.

Probe kit

From the questionnaires, I gathered 6 individuals to be part of my focus group and receive probe kits to their homes. Probe kits are a way for designers to get closer to end users without the risk of interfering with their behaviour, behaviour that can be valuable learnings for the design process. The probes are used to register various aspects of users' daily lives, depending on what the designer is interested in registering. [52]

The probe kits that I designed were a two-part assignment. Step one was for users to write a daily log of interactions with their fridge and the food they bought, through an activity sheet (fig 8) that users put next to their fridge. The second part was a journaling assignment where users were encouraged to answer 3 questions each day to analyse the behaviour of that day.

All my test results showed that people tend to open the fridge on a regular basis without taking out any food. This leads to many small opportunities of cold air to get lost from the fridge leading to energy loss as seen in fig 9. What I considered in my design solution was to create smaller storage units so when you open one you will not lose cold energy for the entire food storage volume.



Instructions table

1. Place your table on your refrigerator or in connection to it to be able to log your activities in a smooth way when you interact with your refrigerator. Add your name.

2. Start on the row that represents day 1. Then write down the day of the week and date in the box below the column that says **"day of the week & date".**

3. Everytime that you open your refrigerator, even if you don't take out any food from it, please add a check ✓ or a line / in the column for this activity. If you take out food at the same time you put a check or line in the following column called **"taking something out of the fridge"**. If you take out several groceries at once this counts as one activity.

4. Below the column **"throws away groceries"** a grocery is one line or check. If you throw away an entire meal then please add a line for each main component of the meal. You don't have to account for every little ingridient in the meal.

Fig 9, instructions table for probe kit

52 Friis, Silje Kamille. Co-creation cards, nr:16. Design School Kolding, 2015.

NAME:

DAY	DAY OF THE WEEK & DATE	OPEN THE FRIDGE	TAKING SOMETHING OUT OF THE FRIDGE	THROWS AWAY GROCERIES	BOUGHT GROCERIES
1	Saturday Feb 13	✓✓✓✓	✓✓		✓
2	Sanday Feb 14 ♡	✓✓✓✓✓	✓		
3	Monday Feb 15	✓✓✓✓	✓		
4	Tues Feb 16	✓✓✓✓✓	✓✓✓		
5	Wed Feb 17	✓✓✓✓✓✓✓✓✓	✓✓✓✓✓		✓
6	Thur Feb 18	✓✓✓✓✓✓			
7	Fri Feb 19	✓✓✓✓✓✓✓✓	✓✓✓		✓
8	Sat Feb 20	✓✓✓✓	✓✓		
9	Sun Feb 21	✓✓✓✓✓✓✓✓	✓✓✓✓✓		
10	Mon Feb 22	✓✓✓✓	✓✓✓		✓✓
11	Tues Feb 23	✓✓✓✓✓✓	✓✓✓✓✓		
12	Wed Feb 24	✓✓✓✓	✓✓		✓
13	Thurs Feb 25	✓✓✓✓✓✓✓	✓✓✓✓✓		
14	Friday Feb 26	✓✓✓✓✓✓	✓✓✓✓✓	✓	

Fig 10, table with data about how often the fridge door is opened (column 3) and if you take out food at the same time (column 4)

After the probe kits, two individuals participated (fig 10) further by receiving a mockup of a pot-in-pot cooler. The interest was in understanding what was required from a user in taking care of an object and if this affected your awareness towards food stored in them.

Fig 11, mockup tests at users households

It is difficult to come to a deeper conclusion about the mockup test as there were few testers due to the Covid-19 pandemic. But the insights they gave me were the following. The watering of the sand should be made easier so watering can be done with the lid on to avoid water spilling into the food vessel. A comment was also to be able to divide the inner vessels into divisions suitable for your storage needs.

Workshop

The workshop assignment was to explore the possibilities of how these terracotta vessels would fit in a home without directly touching the floor nor walls. As found from research the terracotta vessels need to have a full airflow and be freestanding. Participants were designers from Konstfack's design programs.

Fig 12, making foam board models in workshop

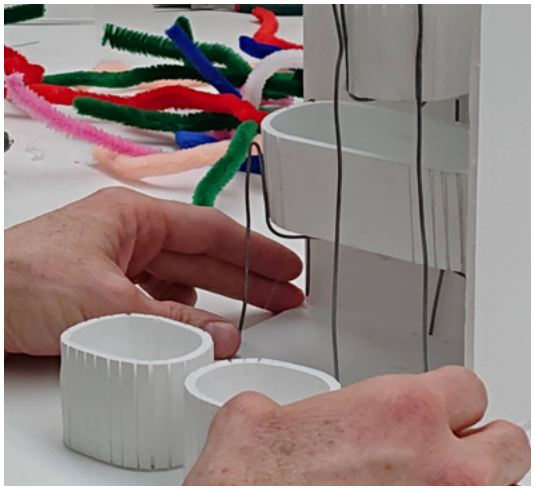


Fig 13, making foam board models in workshop

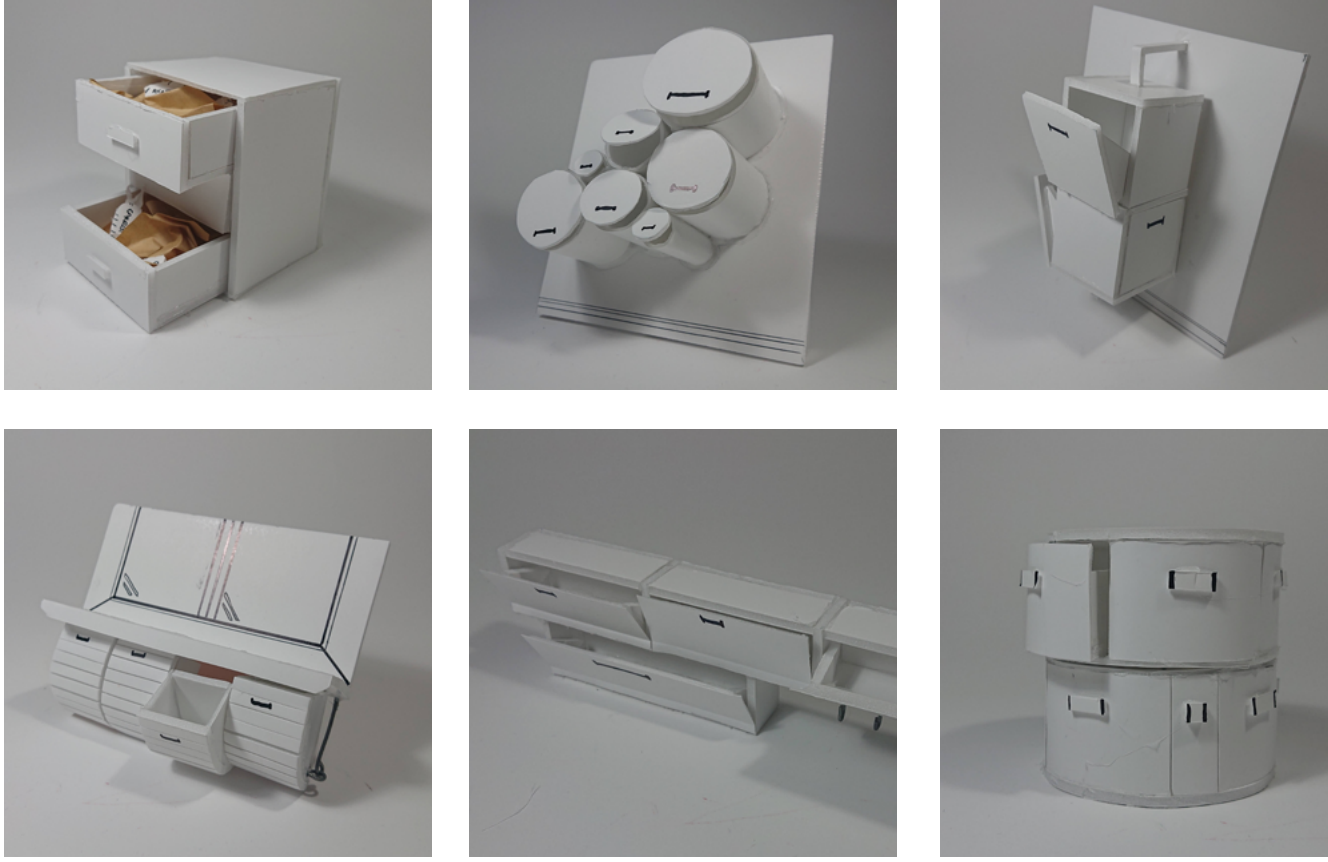


Fig 14, initial ideations of what a alternative storage solution could be

MAKING

Mockups and Ideation

Changing the way we store food in our homes is also challenging the way our homes are arranged. Since the 1930s, the refrigerator has been the unquestionable main storage space for most of our fresh produce, and hence the layout of our kitchens has followed in its presence. Therefore, it has been essential for the process to work physically in the space with mockups to understand volumes, what it does to a room, and potentials in form and placement.

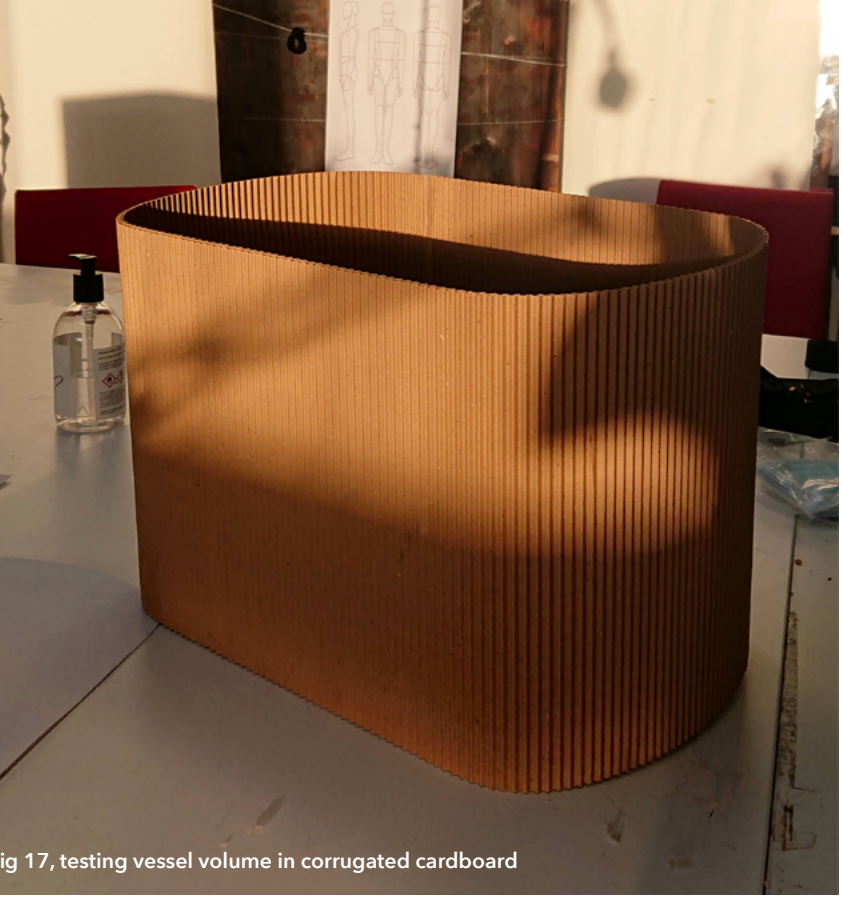
The initial phase of making and creating mockups were investigated before the technique of the pot-in-pot cooler was decided upon hence some of the formgiving does not match the requirements of the terracotta vessel technique. The main goal when starting to make these models was to understand where in our existing homes food could be stored and how. Could we place it in drawers for easier access, build the storage into our walls to use the natural cool temperature of brick walls?

From the miniatures I scaled up to work with 1:1 models. It was important to understand the volumes that were required for storing all the food but also what these spaces did to the room. Where would this product be situated, should it only fit the standards of the Swedish kitchen or be modular enough to be placed in other rooms in homes.

Fig 15, mockups exploring spatiality, scale and height of vessels in a carrying structure

The vessel's shape could not only be defined by the chosen material and its requirements. I also needed to investigate appropriate volumes necessary for the food. The conclusion would be to have two to three different volumes depending on the content and its size, a thought was to also incorporate some kind of separators that you could

Fig 16, exploration of vessel volume and how they would work with each other



ig 17, testing vessel volume in corrugated cardboard

add if needed to divide the vessels to even smaller volumes.

Materialisation
The surface of the terracotta walls should have a three dimensional texture, as it has an important technical value. By adding any texture to the surface, the surface area grows and with that does the evaporation. The greater the evaporation, the greater the cooling effect. To explore different textures (fig 18) both from an aesthetic point but also a functional I made terracotta tests and fired them in the kiln.

The results showed various expressions from architectural elements to more graphic patterns. The architectural patterns that reminded me of Swedish wooden barns had the wrong expression for my indoor bodily vessels so I decided to move towards a more soft wavy pattern.

The structure that would hold the vessels up from the floor had to be made in a

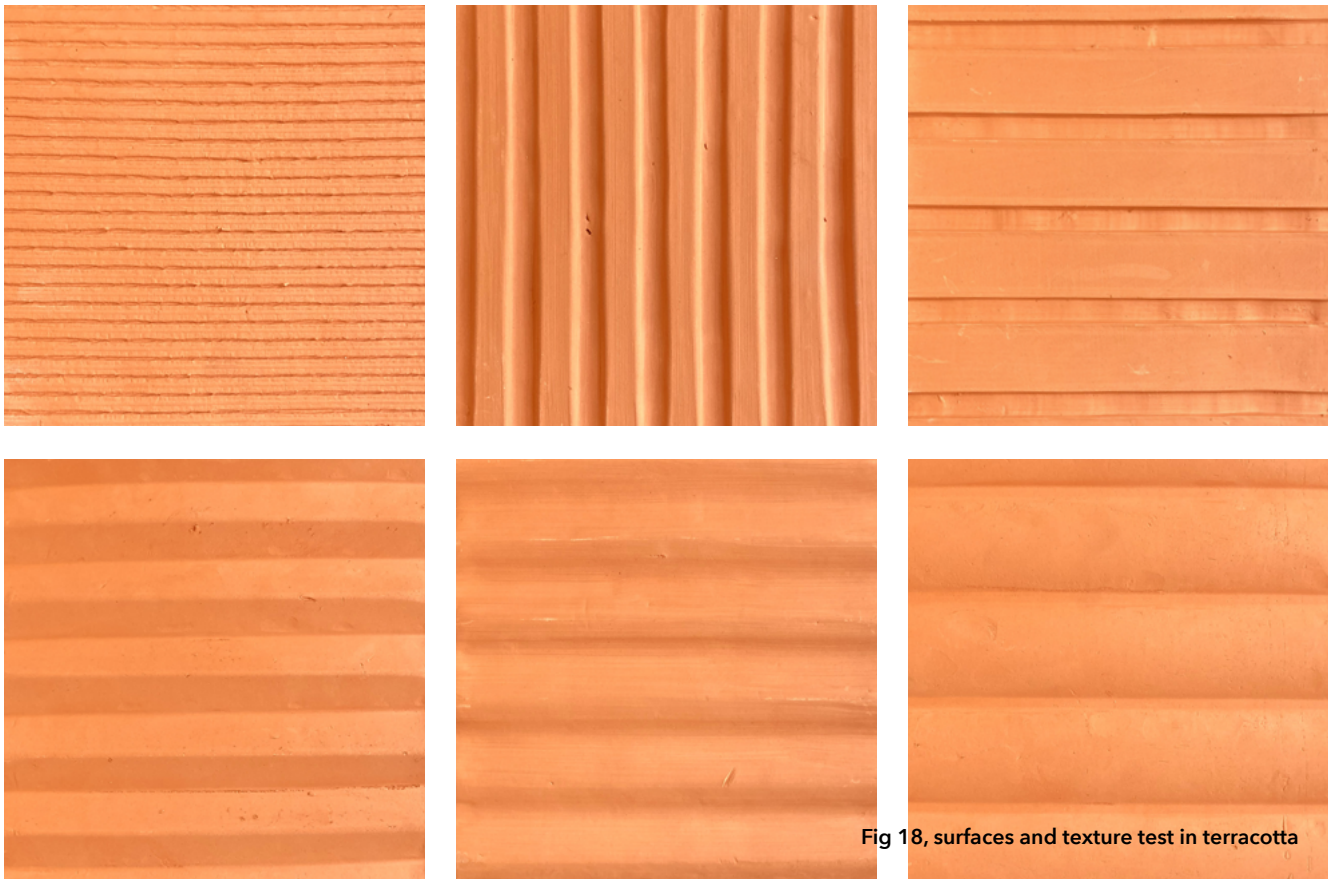


Fig 18, surfaces and texture test in terracotta

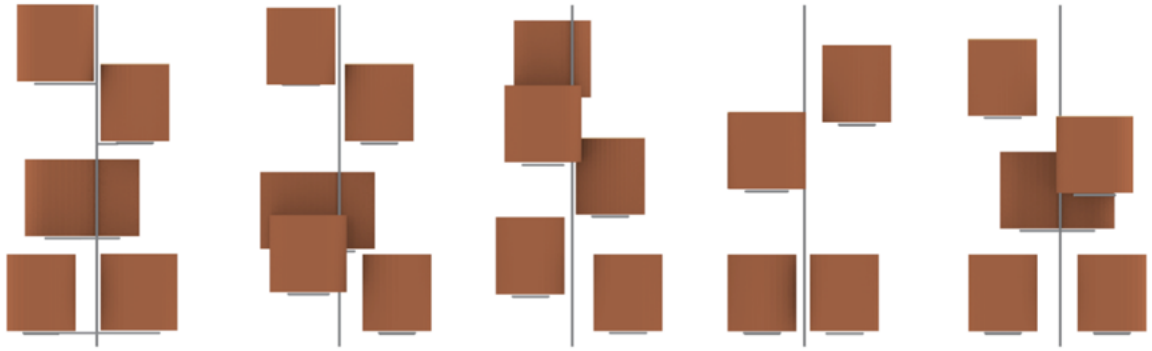


Fig 19, branch like carrying structure

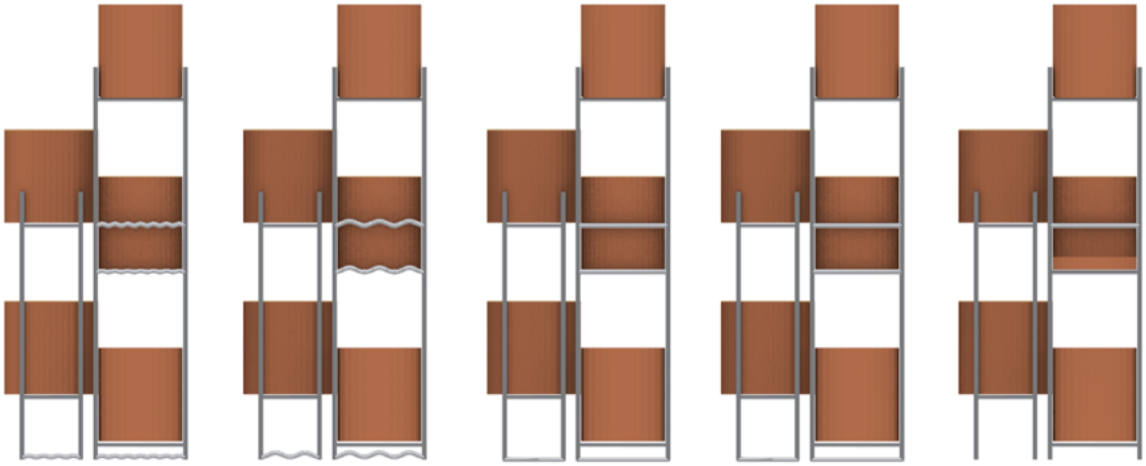


Fig 20, grid like carrying structure

material that was strong, could withstand humidity and be stable. Hence I worked with steel pipes that I could bend and weld into the desirable structure I needed. I explored numerous expressions of the structure. I started playing where the vessels would come out from a centre point, similar like branches to a tree trunk, see fig 19. But as it needed to be supportive of the aesthetics of the vessels but not take centre space in the overall design language and be stable, I went for a more grid like structure that would allow modularity, see fig 20.

DESIGN PROPOSAL

Fig 21, testing structures and the fitting of the vessels

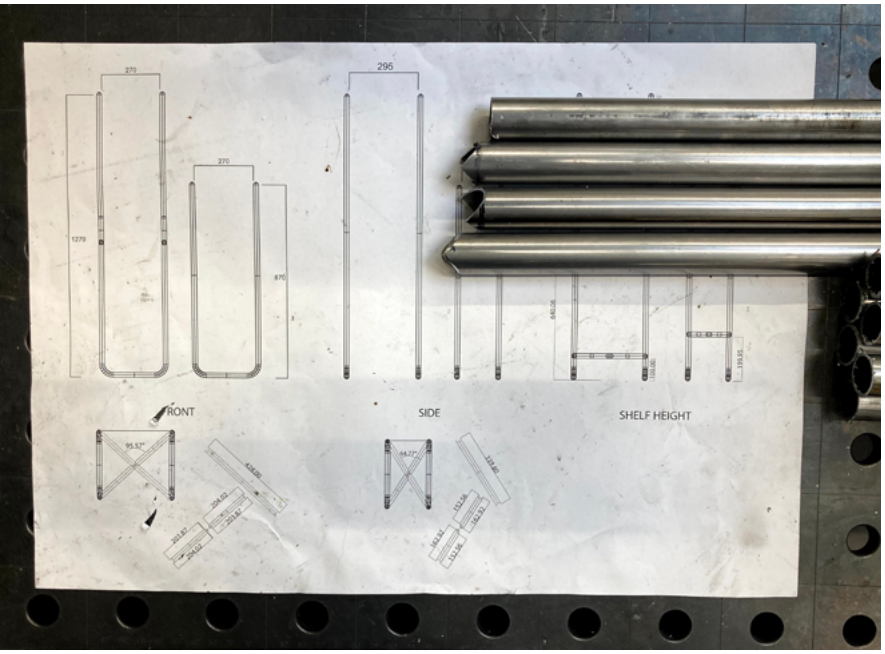


Fig 22, steel pipes welding template and joints

Fig 23, welding structure in metal workshop

The design proposal consists of several smaller terracotta vessels. This is a more functional choice for many reasons. First and foremost, the evaporative cooling works better on smaller vessels than bigger ones, secondly food and produce can be divided by the food compatibility as some food don't match. If you live in a co-living space you could divide the vessels in-between the inhabitants of the apartment/house. By also having smaller units, the overall energy loss from opening one vessel instead of a full door opening the entire space up will lead to less energy loss. The size of the vessel will come in two sizes, the set-up of how many you want of each will be up to the consumer. Content net-volume of the bigger is around 20 liters whilst the smaller has around 13 liters.

Fig 24, vessels with food

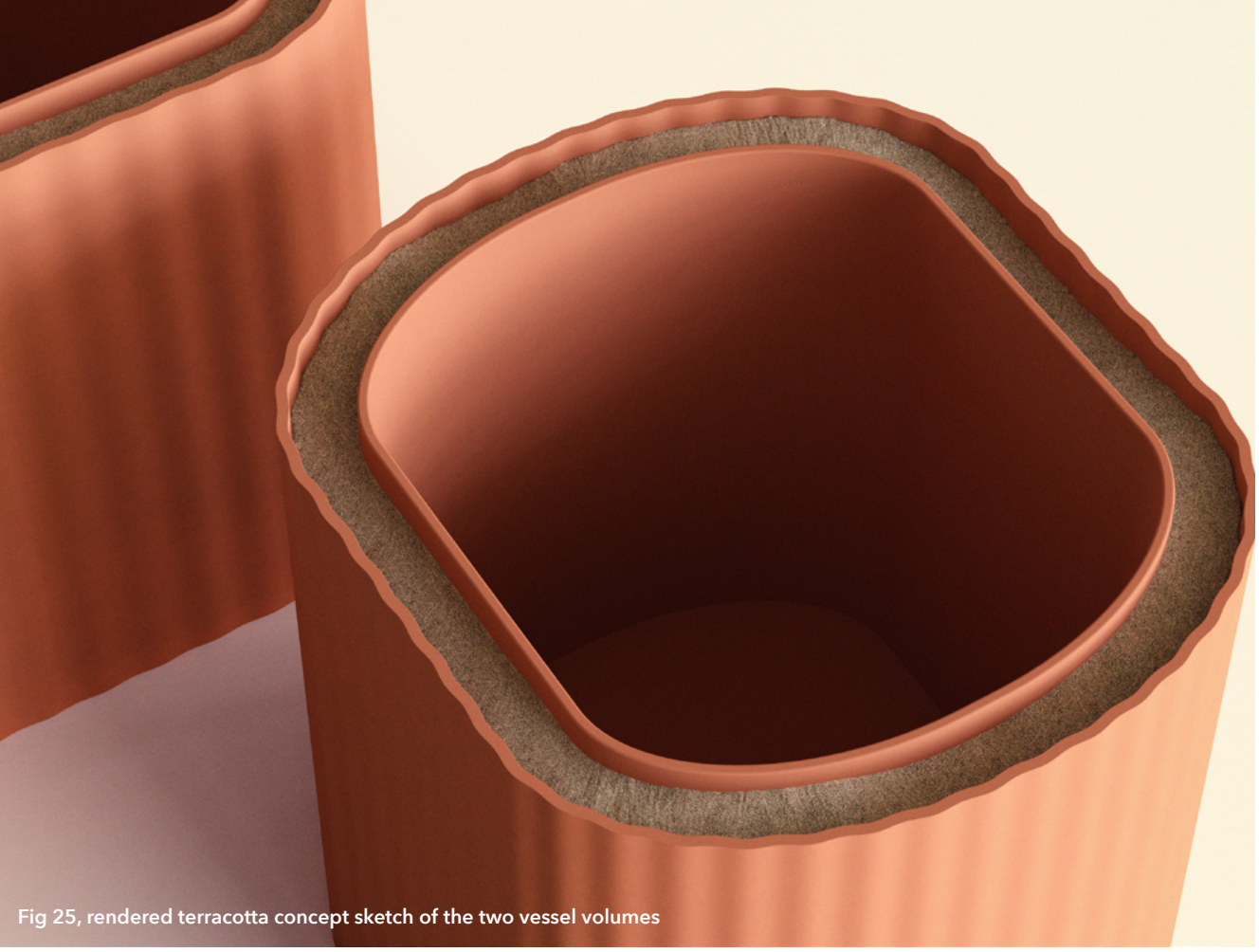


Fig 25, rendered terracotta concept sketch of the two vessel volumes

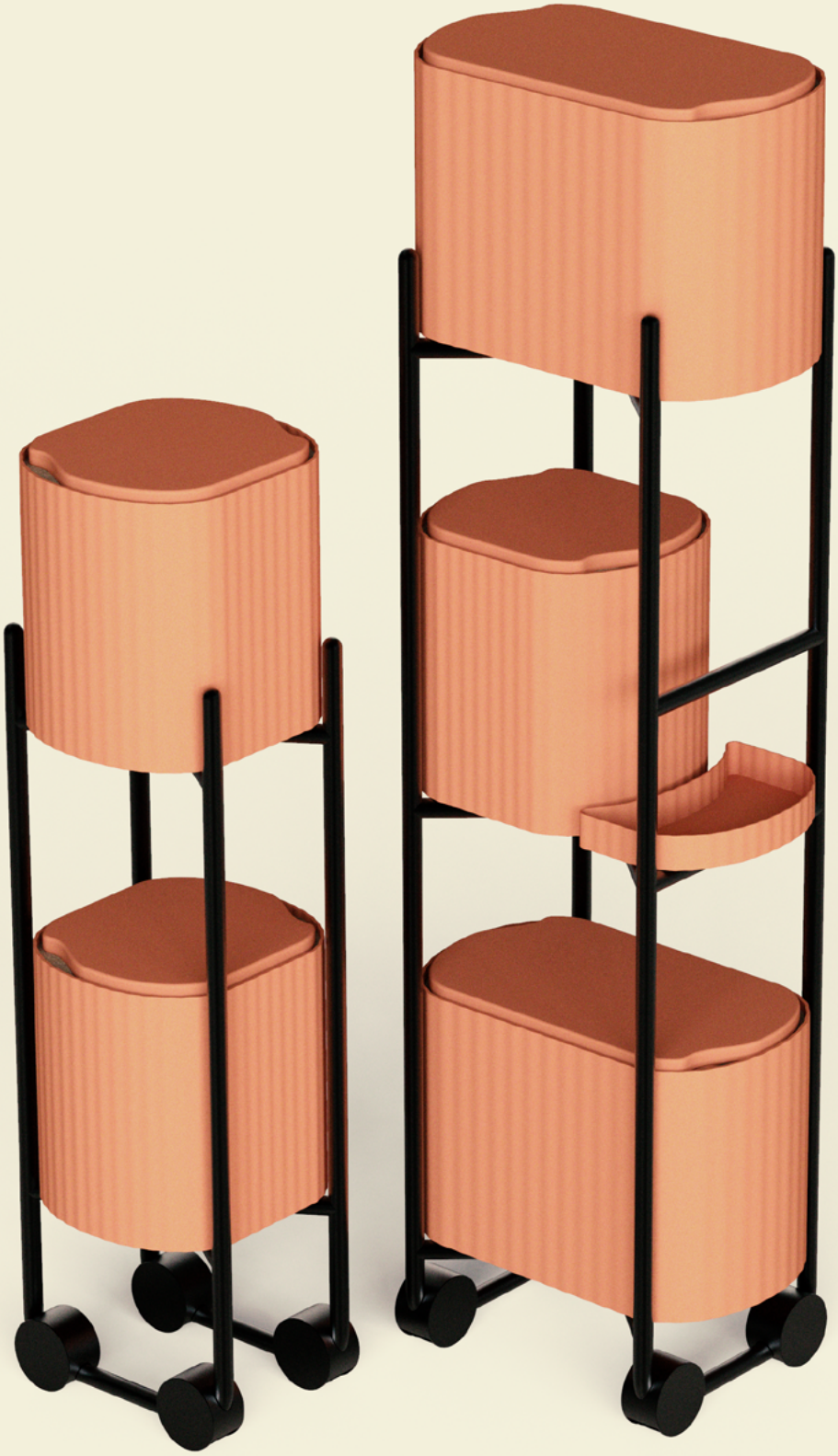
Fig 26, rendered terracotta concept sketch with lid

The opening of the vessels will be at the top of each unit. This is the most efficient place to have the opening from an energy perspective as hot air rises and in this way the warmest air of the vessel will be lost at each opening.

The surface of the terracotta walls has a soft wavy texture, the texture does not only function as an aesthetic addition but also as an important technical asset. By adding waves to the surface, the surface area grows and with that does the evaporation too. The greater the evaporation, the greater the cooling effect. The soft waves remind of the soft waves of water moving across the surface of a lake.

Fig 27, vessel in relation to fresh produce

Fig 28, rendered terracotta concept sketch with vessels in carrying structure



With the structure I started working from a grid like frame to create dynamic levels of which the vessels would float in space. The vessels were to be hugged by the frame but not imprisoned, giving it easy access for the user to reach and water, and taking them out easily upon cleaning. The weight of the vessels would only be a problem if the structure was too advanced for the user to assemble and disassemble on a regular basis. Each vessel is extra secured by a smaller metal pipe going up 2 cm in which the vessel sits on, see fig 29.

My design proposal fits the future forecasting of 2030 which means we will continue eating less and less animal produce and buy more fresh produce when we intend to eat them.

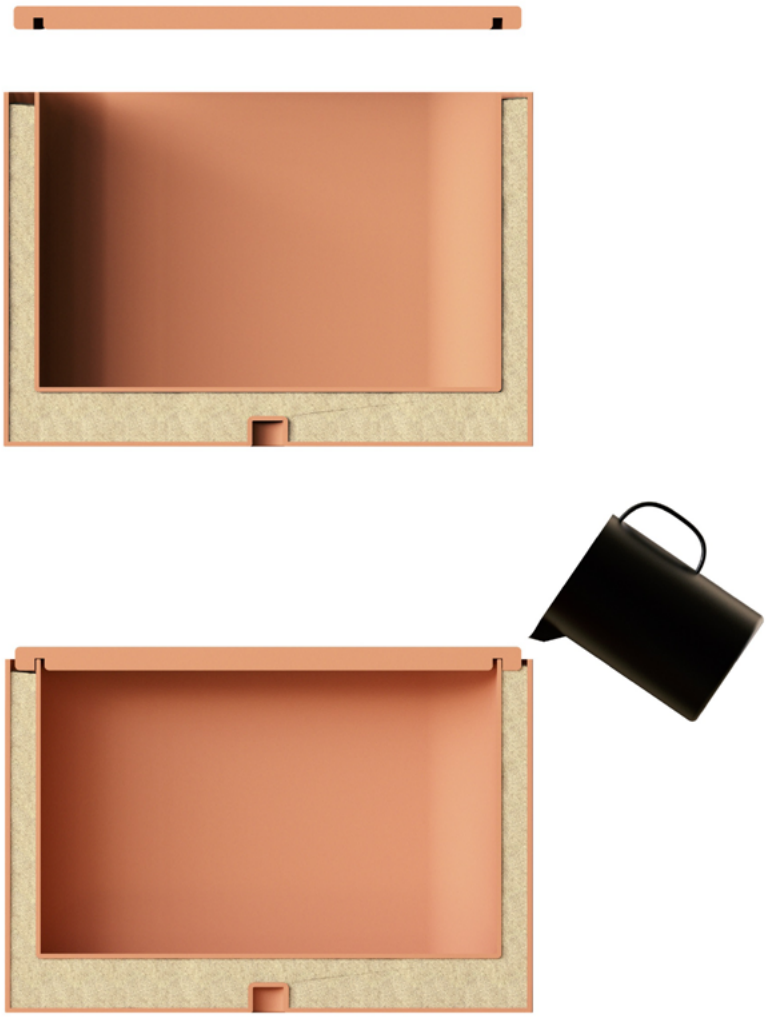


Fig 29, functional sketch of how to water and the fitting hole in bottom for metal pipe

Fig 30, photograph from exhibition at Konstfack

KONSTFACK DEGREE EXHIBITION 2021

The exhibition space was planned to set the scene of a kitchen and home environment. To have the design solution popping out of the environment I kept a white backdrop with black contrasting text. I set up a wall coming out from the main wall of the corridor to create a spatiality for the exhibition room. I added a small skirting board to the bottom to enhance the feeling of a home compared to the school corridor the exhibition was set in. To further communicate my project to visitors I created 4 posters with informative text about the project and one poster showing a use case scenario and one showing how to take care of the vessels. I wanted my design pieces to be approachable so I pulled them far out from the walls, but still giving a notion of their appropriate placement in a home by the hooks that would keep them in place. Some of the vessels were kept open with fruit and vegetables showing whilst some were closed to showcase their full aestetic.

Fig 30, photograph from exhibition at Konstfack

REFLECTION/APPENDIX

The exhibition at Konstfack was open from the 22nd-28th of May 2021. Luckily we were visited by a great number of guests keeping the distance safe during the current Covid-19 restrictions with the help of booking slots for visitors. It was great to get the amount of positive feedback I received for my project. Many visitors expressed interest in a food storing solution that required you to be more attentive to what you stored and how the fresh produce was doing. Some elder visitors reminisced the days of root cellars and how canning, pickling and sugaring was a part of managing food. The terracotta vessels would be like inviting the root cellars back into the households. Many visitors appreciated the aesthetics of the vessels, that they felt natural in relation to their function of storing food but designwise industrial to fit our Scandinavian homes. Having the ability to move around and place the units in the rooms that are suitable for your home was also noticed as something positive. But having four wheels that could fully turn 360 degrees is something that I have to re-visit in my design as not all of my wheels could do the following.

Discussions that arose during the final presentation of my project was the stability of the structure and whether or not the expression of the frame affords for the vessels to be taken out on a regular basis or not. The intent of the vessels are to

allow easy access to them whilst watering and during the assembly and cleaning of them. My argument is that the weight of them after assembly and full of food would speak against the feeling of wanting them to be taken out of the structure on a regular basis.
We also discussed how the design needs to be accompanied with a shorter instruction booklet about food, how it is taken care of in the best way and storing instructions.

I see myself continuing working with this project and testing the vessels further. Due to this degree project occurring amidst the Covid-19 pandemic in Sweden, my possibilities of working closely with users and testing the design throughout the degree project were next to impossible. Therefore I look forward to future testing of my prototype to get feedback on the user experience. I am specifically interested in the input of the watering and how accessible it is physically to reach the watering points. The lids need testing on how easy they are to grip and remove whilst picking up food. Having the input from long time users that could give you those answers that are the make it or break it truths for making the design sharp is something I still want to achieve. Further on I want to contact a specialist that could help me calculate the most beneficial relations between the amount of sand, volume of vessels and the thickness of the terracotta walls.

Fig 31, photograph from final presentation at Konstfack

LIST OF SOURCES

PRINTED SOURCES:

- Chapman, Jonathan (2015) Emotionally durable design. London: Routledge
- Friis, Silje Kamille (2015) Co-creation cards, nr:16. Design School Kolding.
- Lee, Jenny (2018). Det moderna köksrummets historia in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag.
- Sandgren, Fredrik (2018). Kylan, källaren flyttar in, in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag.
- Thörn, Kerstin (2018). Skafferiet, rummet som försvann in Köket: Rum för drömmar, ideal och vardagsliv under det långa 1900-talet. Stockholm: Nordiska museets förlag.

INTERNET SOURCES

Youtube:

- https://www.youtube.com/watch?v=o86Ut6kAEMQ, The urban Green, Carina Borgström-Hansson, Ecological Footprint Expert, WWF (2021-02-15)

Publications from internet:

- Boverket, https://www.boverket.se/sv/samhallsplanering/bostadsmarknad/bostadsforsorjning/flyttningar/urbanisering/ Urbanisering (2021-01-27
- EAT, (2019-01-16) Commission Food in The Anthropocene: the EAT-Lancet Commission on Healthy Diets From Sustainable Food Systems. https://eatforum.org/eat-lancet-commission/eat-lancet-commission-summary-report/ p.19 (2021-01-29)
- Energimyndigheten, https://www.energimyndigheten.se/energieffektivisering/jag-vill-energieffektivisera-hemma/inkop-av-produkter/vitvaror/, Vitvaror (2021-02-15)
- Energimyndigheten, labeling Energimärkning, https://www.energimyndigheten.se/globalassets/energieffektivisering_/jag-ar-saljare-eller-tillverkare/bild-overgang-ny-markning_4.png (2021-03-01
- Livsmedelsverket (2020) Halverat matsvinn i sikte 2030. Livsmedelsverkets regeringsuppdrag. Uppsala: Livsmedelsverket, Jordbruksverket och

Naturvårdsverket https://www.livsmedelsverket.se/globalassets/om-oss/redovisade-reguppdrag/2020/slutrapport-minskat-matsvinn-2017-2019.pdf, page 9.(2021-01-15)
- Mintel, report on Global Consumer Trends in 2030, https://www.mintel.com/global-consumer-trends-2030 p.6 downloaded (2021-03-23)
- Naturvårdsverket https://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Energi/Energieffektivisering/Energieffektivisering (2021-05-14)
- Planetary Boundaries https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html, Stockholm Resilience Centre
- Rebuilding civilization, http://rebuildingcivilization.com/content/build-evaporative-refrigerator-no-moving-parts-no-electricity, Build an evaporative refrigerator - no moving parts, no electricity, (2021-01-06)
- Stadsmuseet, https://stadsmuseet.stockholm.se/utforska/byggnader-och-miljoer/varda-ert-hus-historia/husets-alla-delar/kok/skapsinredning/Skåpinredning (2021-01-13)
- The Global Goals for sustainable development https://www.globalgoals.org, 17 Global Goals, (2021-01-27)
- United Nations sustainable development goals, https://www.un.org/sustainabledevelopment/sustainable-consumption-production/, Goal 12: Ensure sustainable consumption and production patterns (2021-01-27)

Articles from internet with author:
- Alex, Oskar, "Så kan äldre kylskåp bli miljövänliga" Forskning & Framsteg, https://fof.se/tidning/2020/7/artikel/sa-kan-aldre-kylskap-bli-miljovanliga (2021-02-21)
- Balkow, Klas (2020) Mat 2030 Axfoods förslag till en hållbar livsmedelsstrategi för Sverige. Axfood AB, https://www.axfood.se/globalassets/startsida/hallbarhet/publikationer-och-rapporter/axfood_mat2030_2020.pdf (2021-01-29)
- D'Souza, Sara, https://www.thesprucecrafts.com/all-about-terracotta-4152002 The history and uses of terracotta (2021-05-17)
- Hajdu-Rafis, Ann-Charlot (2015) Länge leve jordkällaren, Länsstyrelsen i Västra Götalands län. https://www.lansstyrelsen.se/download/18.1dfa69ad1630328ad7c7ec57/1526068323011/artikel-lange-

leve-jordkallaren.pdf, (2021-05-01) p.2
- Harradine, Linda "Lär av historien för att köket ska bli klimatsmart" (2019-10-31) https://www.oru.se/nyheter/nyhetsarkiv/nyhetsarkiv-2019/lar-av-historien-for-att-koket-ska-bli-klimatsmart/ (2021-01-13)
- Harris, John, " Planned obsolescence: the outrage of our electronic waste mountain" (2020-04-15) The Guardian: https://www.theguardian.com/technology/2020/apr/15/the-right-to-repair-planned-obsolescence-electronic-waste-mountain (2021-03-01)
- Janowiak, Maria and Felman, Adam "How to Organize Your Fridge So Food Keeps Longer — and Your Energy Bill Works Harder" (2020-12-20) https://greatist.com/eat/ultimate-way-organize-your-fridge#does-it-need-refrigerating (2021-01-13)
- Larsdotter, Anna "Kylskåpsrevolutionen under lupp" (2019-12-13) https://popularhistoria.se/vardagsliv/kylskapsrevolutionen-under-lupp (2021-01-13)
- Lindman, Pär. (2013) Undersökning miljöbelastning kyl & frys. Stockholm: Naturskyddsföreningen, http://mb.cision.com/Public/514/9434267/a1f2acb61a89ab4f.pdf (2021-01-23)
- Noble, Neil, Evaporative cooling. Warwickshire: Practical Action, https://infohub.practicalaction.org/bitstream/handle/11283/621665/Evaporative%20cooling%20-%20zeer%20pot.pdf?sequence=1(2021-03-01)
- Spinks, Rosie, "We're all losers to a gadget industry built on planned obsolescence" (2015-03-23) The Guardian: https://www.theguardian.com/sustainable-business/2015/mar/23/were-are-all-losers-to-gadget-industry-built-on-planned-obsolescence (2021-02-28)

IMAGE REFERENCES:

- Henry Watson's Pottery, https://www.henrywatson.com/product/butter-dishes/butter-box-in-terracotta.html, Original Suffolk Collection, Butter Box in Terracotta (2021-05-13)
- Fyndiq, https://fyndiq.se/produkt/luftfuktare-i-lera-2-pack-rod-9236c791e32040fb/?gclid=Cj0KCQjwnueFBhChARIsAPu3YkQDuzPxCWJBWm-peYrzmVxx1AVOVrwDsZZHrYYJXJkFd_KT7p4pj6caAstLEALw_wcB, radiator humidifier in terracotta (2021-05-13)
- Architectural Digest, https://www.architecturaldigest.in/content/natural-air-cooler-terracotta-design-inspired-by-beehive/, Ant Air-Cooling System by Ant Studio (2021-05-13)

ACKNOWLEDGEMENTS

Martin Ávila
Katja Pettersson
Jenny Althoff
Cheryl Akner-Koler
Anna-Maria Orrù
Sara Kristoffersson
Maria Perers
Simon Whitfield
Gunnar Söder
Loove Brooms

Fredrik Forsman from SVID
Sara Ilstedt at Green Leap, KTH
Workshop participants
Classmates
Experts

My Daniel, for always believing in me
My family for the endless support
Linnéa for always putting a smile on my face
Sarah, Hajar, Ebba, for being my forever design-bollplank