THE CORKY SIDE OF ARCHITECTURE

An investigation into the aesthetics of cuteness and innovative applications of cork in architecture.

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An investigation into the aesthetics of cuteness and innovative applications of cork in architecture.

CHALMERS
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DEFINITION

Corky :

1. Having the nature or character of cork; cork-like.[1]

2. Light, trifling, frivolous; buoyant, lively, springy; hence, skittish, ticklish, restive [1]

3. Cute & dorky [2]

[1] OED, Oxford English Dictionary ,“corky”, http://www.oed.com/view/Entry/41571?redirectedFrom=corky#eid
[2] Urban Dictionary, https://www.urbandictionary.com/define.php?term=corky

ABSTRACT

Facing the challenges of environmental degradation and resource depletion, the material industry is focused on material innovation through two tendencies: the invention of new materials and the rethinking of new potentials for existing/ traditional ones. From the perspective of the second trend, this master's thesis aims to re-introduce cork, a natural and recyclable material extracted from the cork oak tree. By analyzing its production, its qualities, its properties and through investigation and experimentation with other materials and digital fabrication, the author seeks to explore new possibilities and applications of cork in the architectural field.

To formulate the design proposal, the focal point lies on the definition of corky, which not only addresses the resemblance to cork but is also connected with the notion of cuteness. Therefore, the thesis analyzes the aesthetics of cuteness in character and product design, as well as in animations to comprehend and define the rules behind cute elements and form the cute toolbox for architecture. Cuteness affects the psychology of the users and enables their take-care behavior, meaning that designing for cuteness could evolve into a powerful strategy for people to start take care and protect the environment they live in. Therefore, the design scenario sets on redesigning the waste/recycling chambers (soprummen), infrastructures that exist among housing units reflecting zero beauty or pleasure.

Built from timber frames, cork blocks and cork & PE sheets and following the principles identified for cute architecture, the composition aims to represent the "corky" definitions and show how the cork materiality adds a cute approach in architecture.

Stacked cork bark (Amorim)

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BACKGROUND/CONTEXT

Cork planks (Amorim, 2014)

The last decades, the environmental crisis and the resource depletion has shifted the architectural agenda towards a sustainable development that needs to take into consideration the environmental, social, economic, cultural, historical and demographic aspects. In the building scale, to achieve a sustainable approach, the material selection is based on the use of new creative Eco-friendly elements or the recycle and reuse of materials from construction sites and demolitions. Following this tendency, the material industry focuses on the invention of new compelling matter or the rethinking of new potentials for the existing/traditional ones.

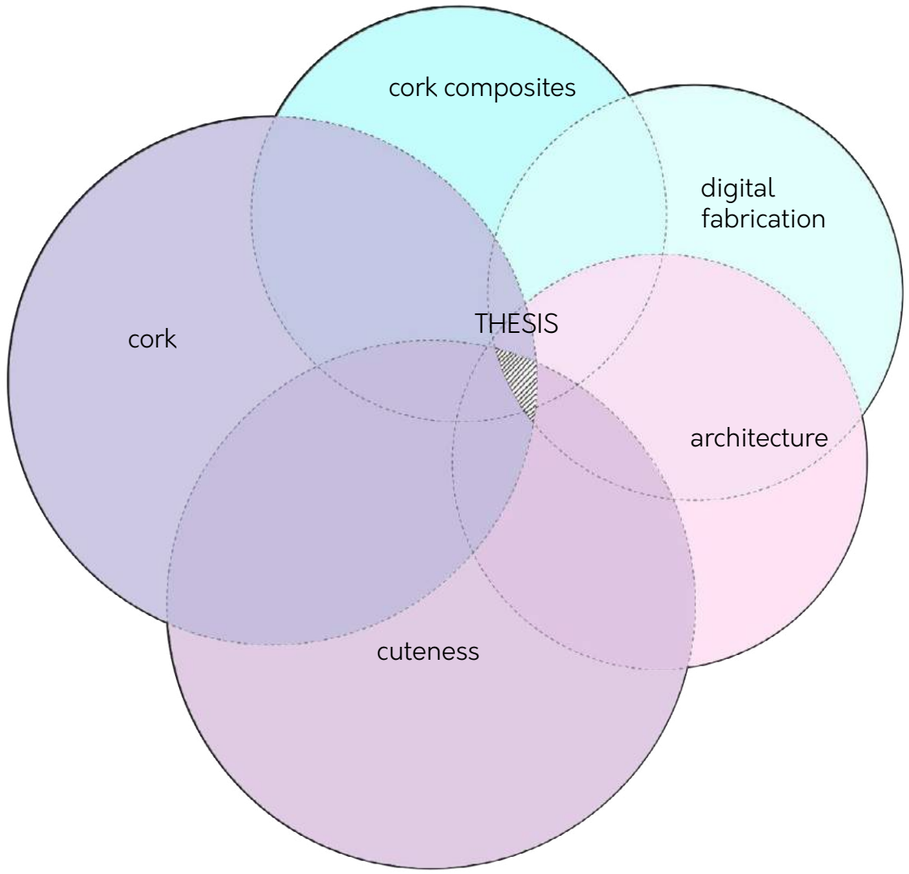
Thus, from the scope of the current trend, this master's thesis' point of departure is the exploration of cork, a natural and recyclable material extracted from the cork oak tree. The author aims to re-introduce it and indicate new possibilities and applications in the architectural field, outlining the texture, the qualities and properties and the corky materiality through the use of digital fabrication in a design proposal.

"*Cork is such a sensual material. It's very rare that a material have such a rich and beautiful expression while having so many structural and functional properties.(F. Cappello)*" [3]

Starting from the definition of corky, this master's thesis addresses not only the resemblance to cork but also the notion of cuteness. We live in a fast-paced world, where stress, anger and depression characterize the modern societies. Cuteness affects the users and reminds them of something fun and beautiful. Therefore, to formulate the design scenario, the focal point sets on the notion of cuteness. The thesis explores the aesthetics of cuteness in character and product design, as well as in animations to comprehend and indicate the rules behind the design of cute elements and form the cute toolbox for Architecture. Architects often seek the conception of interesting, beautiful, complex, unique, contradicting, but what about the cute, the ingenious, the adorable and mostly how can we bring these qualities into the discourse?

For the design scenario, the findings of the

[3] Amorim, (2016), "Amorim, The Future is our Present", p.162



above mentioned research indicate the redesign of the waste/recycling chambers that are located among housing units in Gothenburg. People recycle because of their bad consciousness but the boring infrastructures lack any level of beauty or cuteness. The proposal aims to rummage the way to deploy cuteness in architecture and add a pleasure to the recycling act to inverse this zero degree architecture. The composition concentrates not only on cute forms but also on the materiality of cork to boost the cute perception.

All in all, this thesis is a process of design experiments with cute forms, cork materiality and cork composites, as well as with digital tools and fabrication but the technical and mechanical aspects are not in the focus.

"Cork [...] can be very expressive. [...] it communicates something sensory and aesthetic. (M. Aires Mateus)" [4]

[4] Amorim, (2016), "Amorim, The Future is our Present", p.152

THESIS QUESTIONS

• What establishes the notion of cuteness? Where is the line between cute and disturbing? What rules define the formalism of the cute? How can it deployed in architecture and mostly how can you bring adorableness into the design process?

• How can cork as material fulfill the agenda that is set from bringing cuteness into the architectural terrain?

• What is cork and how is it extracted? What properties and qualities does it have? What are the different types of natural cork and cork composites? How is it used in architecture so far?

• What different aesthetics can cork express? What composites can be created? Color agents? How can digital fabrication contribute to use cork more in architecture?

METHODS & TECHNIQUES

This thesis is based on research by design and thereby the corky proposal is perceived through digital models, texture investigation and the cute form manual (The Cute Toolbox).

Initially, the design process begins by looking at the references and from that point distinguish and indicate the characteristics behind cute architectural representations. Further on, and by creating a list (manual) of how to transformed the building elements into cute components, different variations of volumes are tested in Rhino to examine and understand the principles of the manual. Parallel to this process, a texture investigation using a CNC machine to mill cork surfaces is conducted as well as discovering a new materiality by bonding cork granules with low density polyethylene (LDPE) and color agents .

ABOUT CUTENESS

THE NOTION OF CUTENESS

INTRODUCTION

Google self-driving car

Cuteness is a characteristic commonly used in product and animation design, mostly because of the psychological impact on the users. For the designer, cute could mean the allowance to lack in precision and accurateness in proportions as well as a strong reaction to the enhancement of the "normal". On the other hand, for the user, cuteness is related with enjoying the adorable side of things. "Psychologists Gary Sherman and Jonathan Haidt theorize that cuteness triggers [...] a childlike response that encourages fun."[7] In addition, cute is usually connected with size. Miniatures and small things are usually indicated as cute because they are cleverly made.

When an object is cute, it awakes the fullest attention to the user and cultivate a "take-care" behavior so that it will not break, get lost or damaged. Google uses the notion of cuteness for the self-driving cars, claiming that this characteristic would make the drivers use them less pursuing their longer lifespan. The Skynet Marshmallow Bumper Bots pictures an adorable vehicle design that targets the human psychology. "Our brains are hardwired to treat inanimate (or animate) objects with greater care, caution, and reverence when they resemble a living thing."[8] Moreover, "cuteness is used to quell some of the road rage that might emerge from being stuck behind one of these things."[8] Thus, interacting with something cute in the surrounding environment, provokes contentedness and calmness.

However, cuteness is also identified through the materiality. Studies have proved that the combination of shape, hue and texture outlines the level of cuteness and attractiveness.

[7]Dana G. Smith, (2018), " Why do we think tiny things are cute?, Popular Science
[8] Matthew Inman, "6 things I learned from riding in a Google Self-driving Car ", The oatmeal

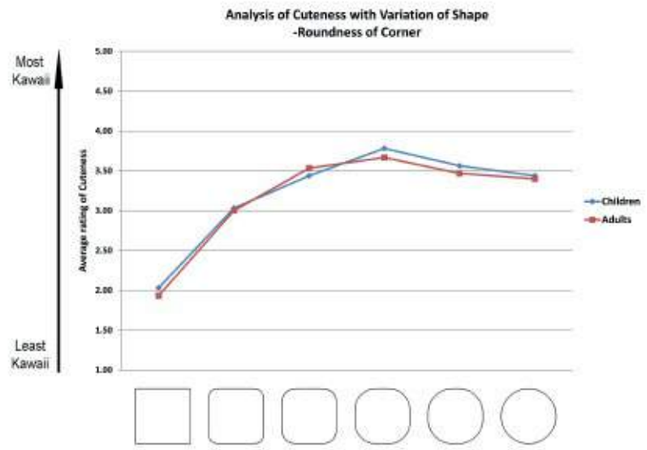
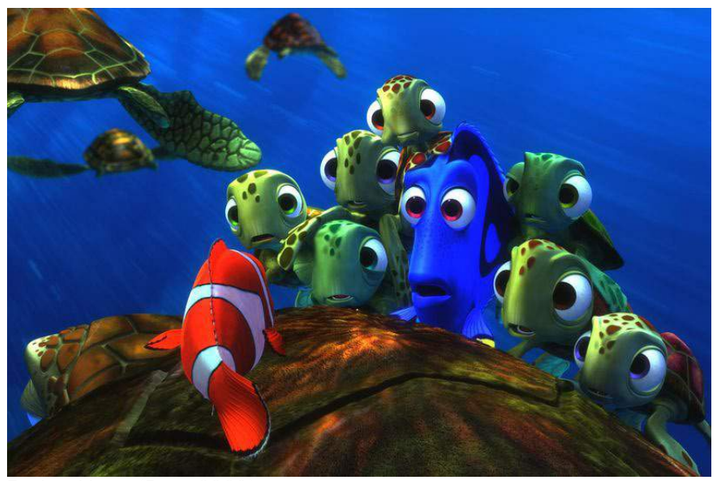


Diagram showing the relation between different shapes and level of cuteness (Cheok, A.D., Fernando, O.N.N.,2012, "Kawaii/Cute Interactive Media")



Finding Nemo (Pixar, 2003)

CHARACTER & PRODUCT DESIGN

In the product design, cuteness is often used to intrigue people. Thus, to create objects that are appealing to the audience, the focus sets on cute forms as well as on other factors like the color, the materials selected and the size. For example fluffy objects are cuter than plastic and pink ones are cutter than green or blue.

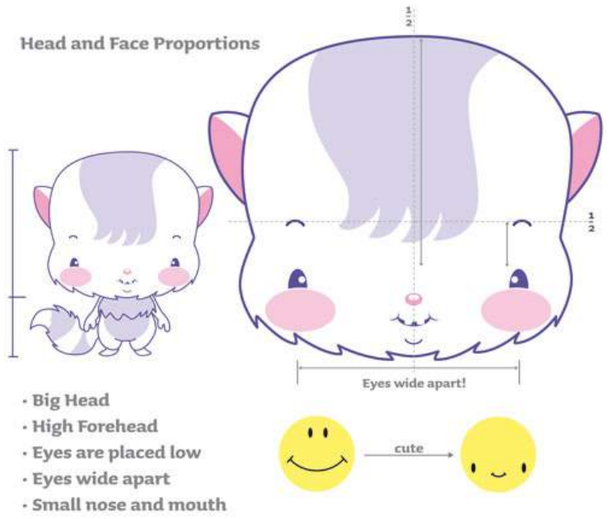
"Cuteness includes the feelings and emotions that are caused by experiencing something that is charming, cheerful, happy, funny, or something that is very sweet, innocent, or pure. It can stimulate a feeling of adoration, sympathy, or stimulating the care response."[9]

In the animation movies the characters are so cute because they are designed to develop an emotional connection with the audience and appeal to the care-giving instincts. To achieve that result every line and curve of their design augment their attractiveness. But what makes a cartoon character cute? Considering the most famous cutest characters (Pokemon, Tweety, Winnie the Pooh, Olaf) the answer lies on a few key traits: big eyes and head (reminding the proportions and the expressions of a baby), fluffiness, chubbiness (looking well fed), shyness or coyness and clumsiness. Baby eyes and ears are situated comparatively wide apart and far down the face and skull and in addition baby eyes are also noticeably forward-facing. The last characteristic is also observed in all the popular Disney character, even in species that in reality have eyes on the sides of their heads.

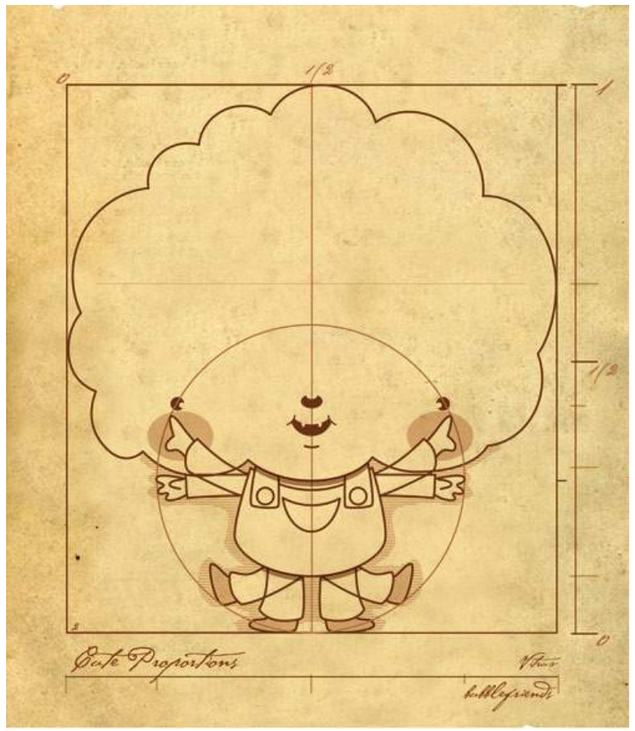
"Cuteness is distinct from beauty, researchers say, emphasizing rounded over sculptured, soft over refined, clumsy over quick. Beauty attracts admiration and demands a pedestal; cuteness attracts affection and demands a lap. Beauty is rare and brutal, despoiled by a single pimple. Cuteness is commonplace and generous, content on occasion to cosegregate with homeliness." [10]

On the next pages, the reference images illustrate the assortment of aspects and behaviors that make something look cute with an extra focus on the proportions.

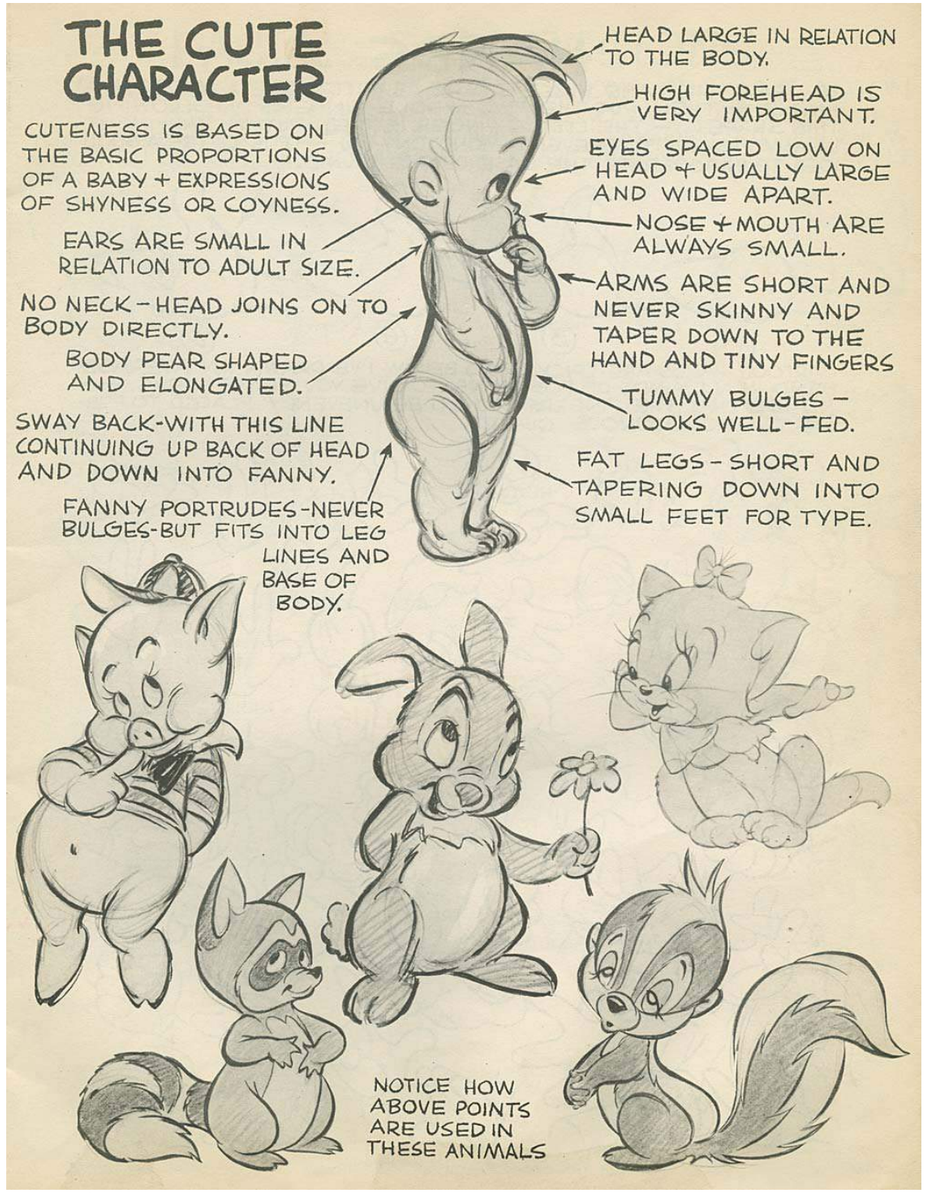
[9]Cheok, A., D., Newton Fernando, O., N.,(2012), " Kawaii / Cute Interactive Media", Springer
[10]Angier,N.,(2006), "The cute factor", The New York Times



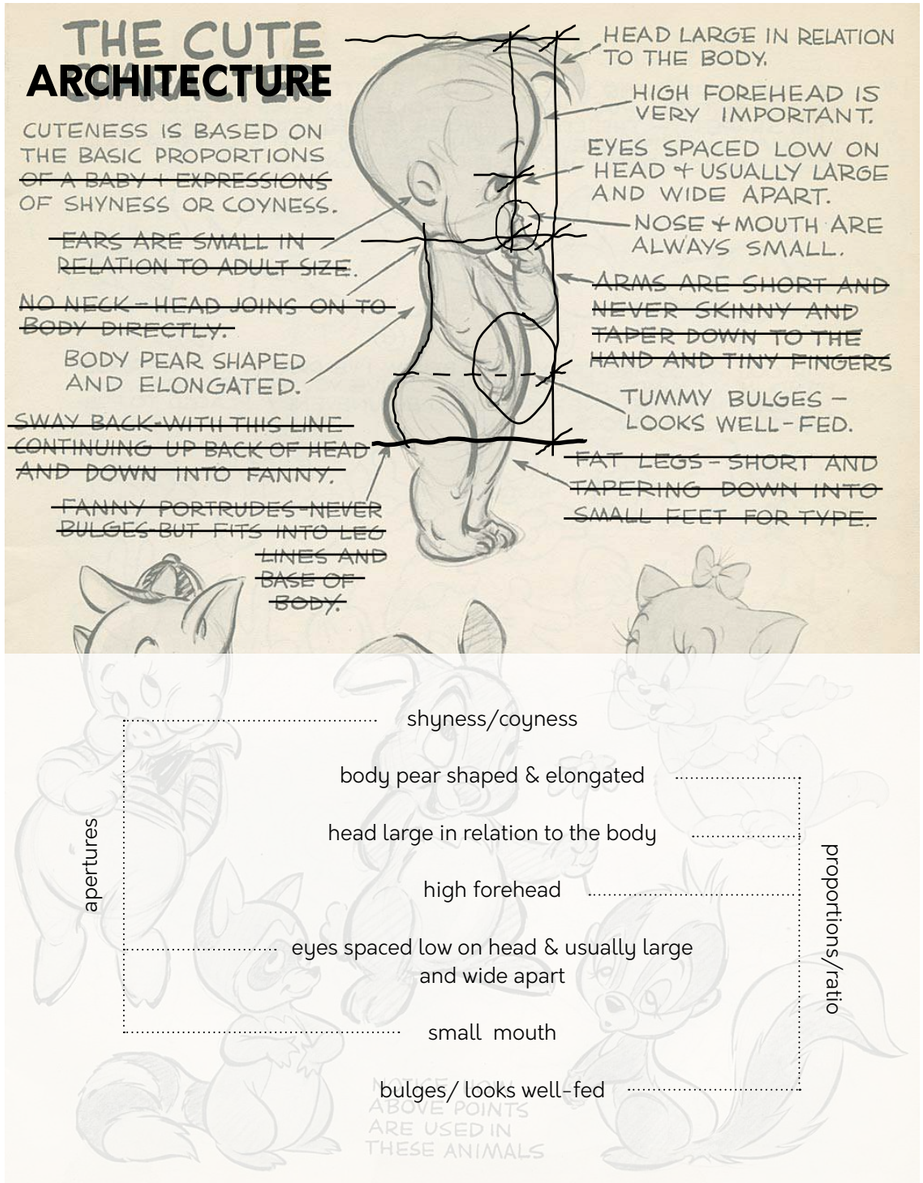
Preuss, S., 2010, “The Elements of Cute Character Design”



Preuss, S., 2010, “The Elements of Cute Character Design”



Blair, P., 1947, “Advanced Animation”



CUTE ARCHITECTURE & DESIGN

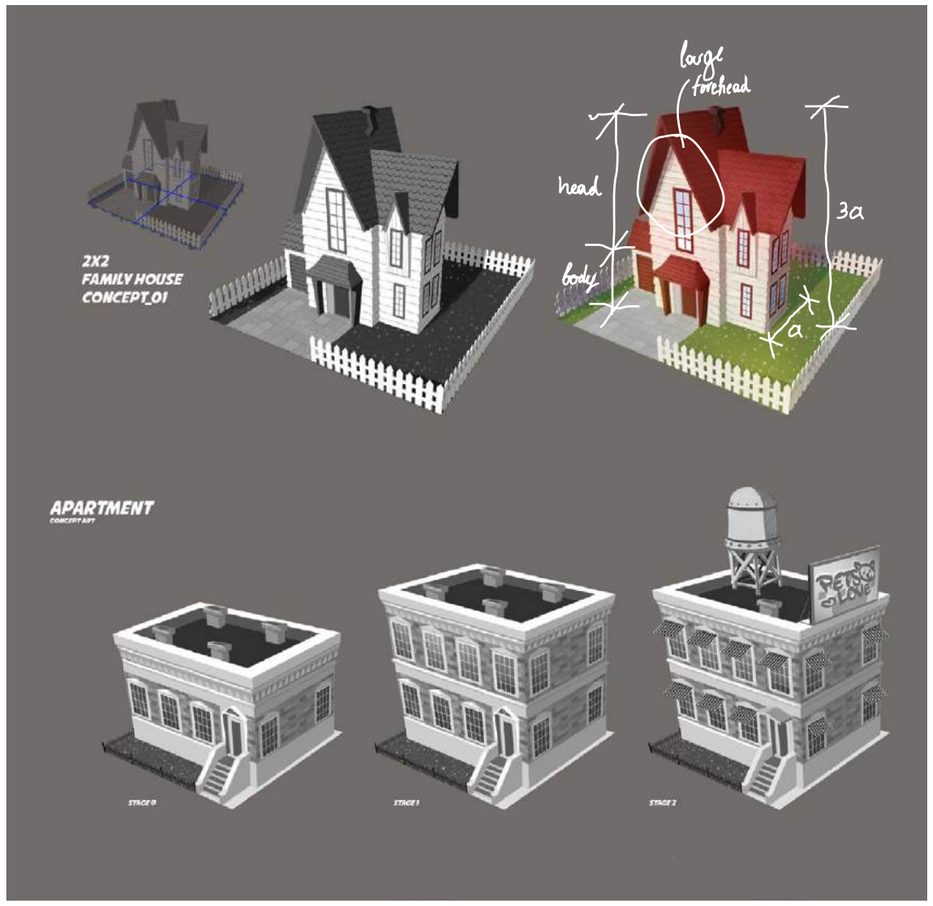
Cute is not always represented with the use of -what are defined as- “cute” shapes. For the animated characters, cute is depicted with “funny” proportions, tummy bulges and baby’s expressions. But how can this rules be applied in architecture? To answer this query, the next step is to form a manual for creating cute architecture .

The research is divided in two parts. The first one targets the animated architecture and the way Disney, Pixar and Illumination represents architecture in their movies. Animated characters are always considered extremely cute and therefore so does the environment that surrounds the characters. Thus, the following study collects examples from animated buildings in popular movies or others that are inspired from existing ones in real life. When transferring these real buildings in animations, the volumes and their proportions change to express the movie’s cute atmosphere combined with the cute colors selection. Followed by the distinction of the characteristics applied for the cute animated architecture, a case study of a small house transformed by the previous identified principles, explores the proximity to create adorable architecture.

On the second part, the focus sets on actual buildings or proposals that communicate a cute impression. The purpose for recognizing the elements that express cuteness in the selected references, is to enrich the catalogue of features for designing cute architecture.

In both study cases, the clarification of the aspects is based on “the cute character” guide, illustrated before.

From a personal perspective and interpretation, adorable architecture, is portrayed through the resemblance with intimate figures (the phenomenon of pareidolia), the adoption of colors, the utilization of simple forms reminding children’s toys and the antithesis in proportions and scale comparing to the human one. However, the user does not express the “aww” emotion by looking at them. On the other hand, a “bulging” design, like the “Fat House”, provoke that feeling



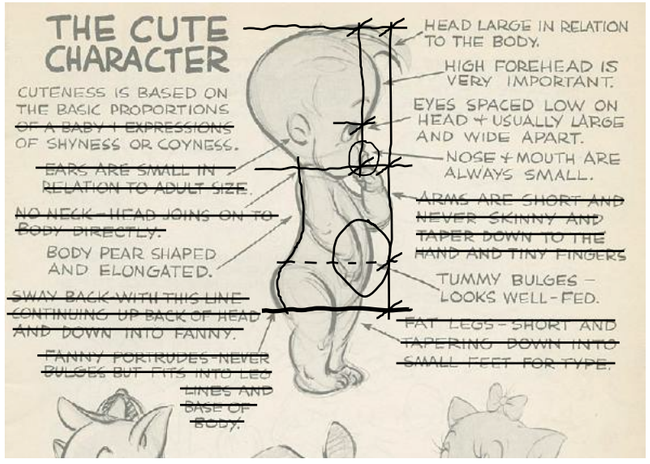
Ratio and proportions research on Jakub Mathia's illustration based on "The Secret Life of Pets"

proving the golden rule about the well-fed look when designing cute characters.

Proportions and ratio, always consist a central axis for architectural decisions, but could they also be-in their maximum range-the core for a cute approach? How would the building perception change by having bulges in its main volume? How adorable could a facade look with the application of hues? As the examples reveal, could the cute side of architecture hide in the resemblance with familiar pattern? Is pareidolia the aspect of transforming a building into something cute and appealing? Furthermore, could the employment of minimalism in the form of a building and the closeness to the toy-ish version of it, be identified as a key to deploy cuteness?

THE CUTE TOOLBOX 1.0

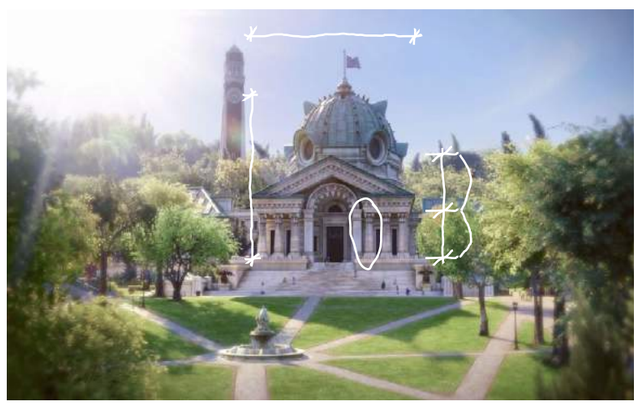
Starting from the picture showing the rules behind the cute characters, the current toolbox derives from the interpretation of these principles in architectural elements.



CHARACTERISTICS	ARCHITECTURAL INTERPRETATION
◇ shyness/ coyness	- grouping - composition of volumes - relation between building/ infrastructure/wall and number of apertures - close character - surrounded by wall
◇ body pear shaped	- lower part/floor larger than upper
◇ body elongated	- narrow and tall - width in relation to height
◇ bulges	- shapes enlarged/distorted - bloating effect
◇ head large in relation to the body	- tall roof in relation to the height of the building
◇ high forehead	- high gable
◇ eyes spaced low on head	- windows of the top floor placed low on gable wall
◇ large eyes	- windows of the top floor, narrow and tall
◇ eyes wide apart	- windows of the top floor in distance

CUTE ANIMATED ARCHITECTURE

Harvard Business School (Thong, J., K.)

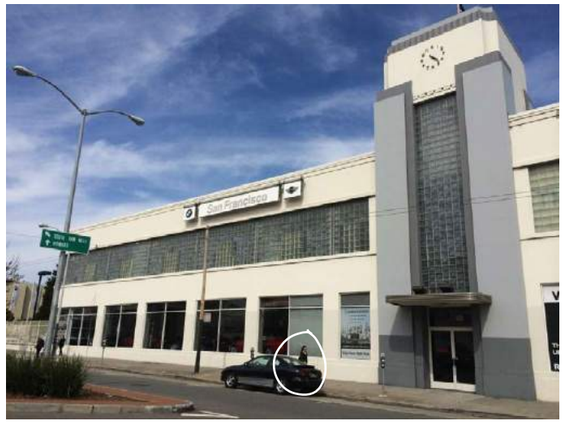


"Scare Building", Monster's University, Disney - Pixar

- hidden monster face / monster features dialed down

- bold framed windows

- proportions of volumes
  columns shorter and "fatter"
  roof larger



San Francisco BMW Dealership (Graff, A.)

The bus station, Inside out, Pixar

- thiner and fewer apertures

- close character

- proportions of volumes shorter and closer to human scale

Chateau De Chillon, Lake Geneva ,Switzerland (Kluck, E.)

The Little Mermaid, Disney

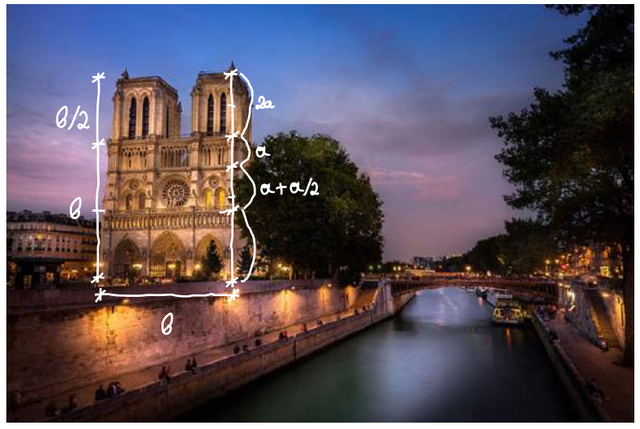
- small and few apertures compared to the large scale of the composition/ close character

- combination of volumes in different heights and width

- rounded roofs

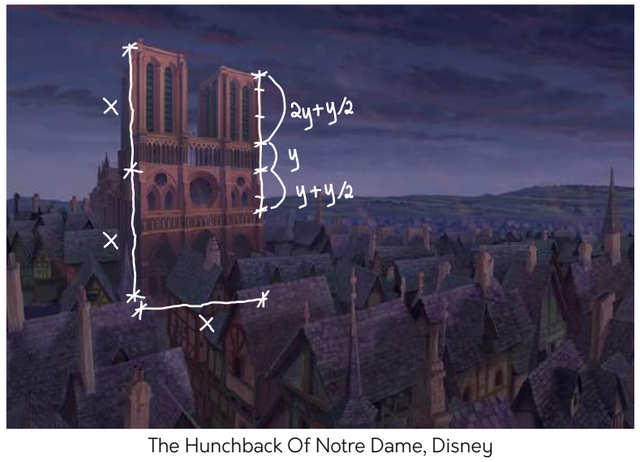
-rounded shapes, smoother volumes

- pear shaped/volumes larger at the base



Notre Dame Cathedral, Paris, France(Briand, S.)

Taj Mahal, Agra, India (Ciuca, R.)



The Hunchback Of Notre Dame, Disney

- pink-ish color range

- changes in the proportions of the actual building

- chamfered edges for smoothness

“The Sultan’s Palace”, Aladdin, Disney

- pink-ish color range

- small and few apertures compared to the large scale of the palace / close character

- multiplication and combination of volumes in different heights and width, spaced close together

- distorted domes/ bulging

- smooth edges

Tiny yellow House, Up, Disney - Pixar

- colorful

- pear shaped body and elongated

- large forehead

- proportions / ratio

- textured facade

- framed windows

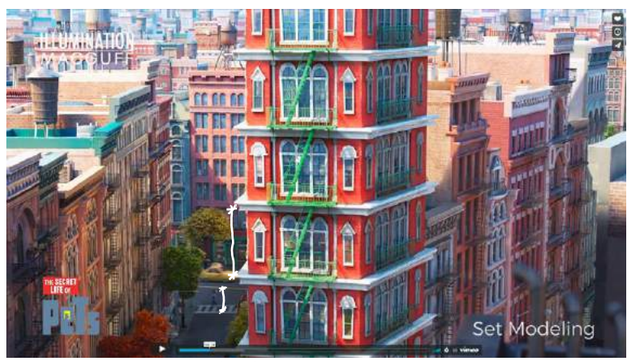
Little Rodentia, Zootopia, Disney

- colorful /pink-ish range

- bold framed windows/ different shapes on the same building/ smooth edges

- textured facades

- proportions / ratio



The secret life of pets, Universal - Illumination

- colorful

- bold framed windows/ different shapes on the same building

- narrow & tall apertures

- ratio/ thin & tall buildings

- floor height closer to human scale

The secret life of pets, Illumination

- ratio/ thin & tall buildings

- textured facade

- framed windows

- narrow & tall apertures

City Hall, Zootopia, Disney

- pear shaped body and elongated

- proportions / ratio

- textured facade

- close character / few apertures

Zootopia, Disney

- colorful/ pink-ish range

- textured facade

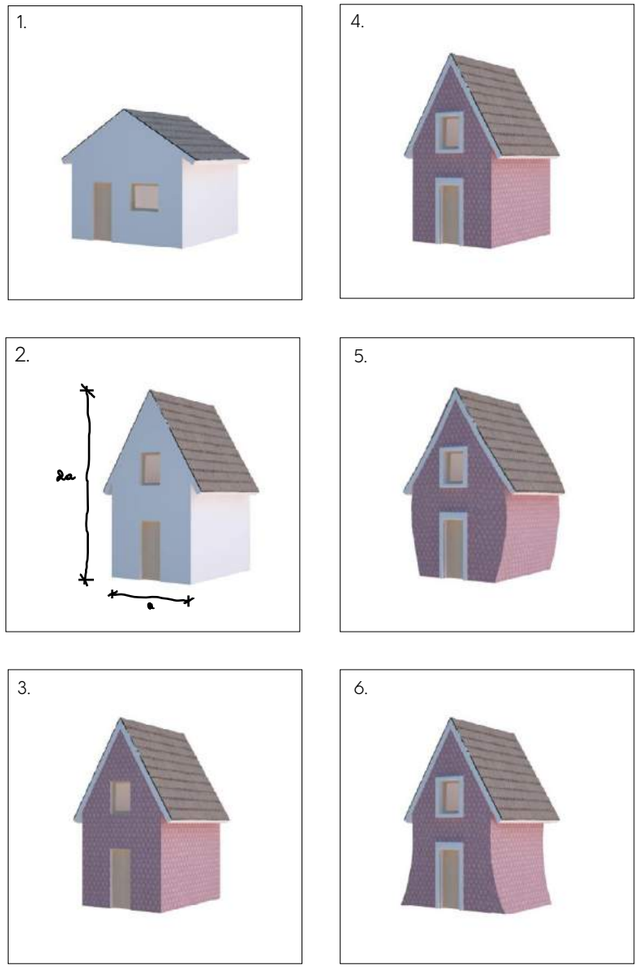
- bold framed windows

-narrow buildings

THE CUTE TOOLBOX 2.0

The following toolbox is a collection of the characteristics distinguished from the previous research in animated architecture organized in three categories, composition, apertures and materials.

ELEMENTS	TRANSFORMATION
◇ composition	- play with human scale, floor height closer to human scale - ratio of height/width= 4/3 or 2 - roof/top floor/top part larger in relation to the rest structure - distorted proportions: elongated, pear shaped or bulging/bloating effect - multiplication and combination of volumes in different heights and width, spaced close together - rounded edges, smooth surface representations
◇ apertures	- bold framed apertures, rounded edges - narrow and tall windows - few apertures on large scale buildings or extremely small windows on large volumes/ close character - when the proposal is linked with a theme, the apertures use the pareidolia effect to hide features of resemblance to it
◇ materials	- big proportioned textured elevations - pastel colours, usually pink-ish colour range



TESTING THE PRINCIPLES IDENTIFIED

The following case study tests the instructions derived from the toolbox 2.0 and explores the level of enhancement of the cute perception when following them.

SOFTWARE : 3DS MAX / VRAY & PHOTOSHOP

1. Starting with a simple house design / small pitched roof structure.

2. The volume is transformed, elongated based on the ratio height/ width=2. The roof (head) is larger compared to the size of the body. The apertures are few and narrow.

3. The edges are chamfered to have a smoother outcome and a colored texture is added on the elevations.

4. The apertures are framed with bold shapes of rounded edges.

5. The volume is distorted to look bloated.

6. The volume is distorted to look pear shaped and elongated.

CUTE ARCHITECTURE

Adolf Loos, (1928),"Villa Moller", Elevation view, Vienna

- resemblance to a dog/ hidden

- large head

- eyes low on head

Rossi, A., "Theater of the world", Venice (WikiArquitectura)

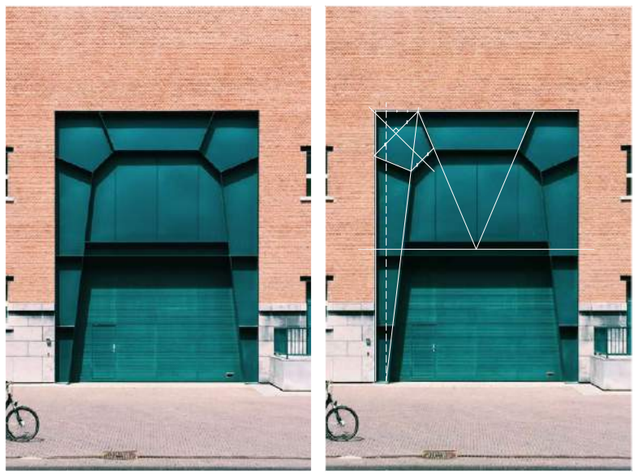
-resemblance to children's toy

- "funny" proportions/ toy out of scale

- simple volumes

- small openings

- faceted cone /edges like a cardboard structure



Rossi, A., “Bonnefantenmuseum”, Maastricht
(Taylor-Foster, J.)

- hues

- large body

- pattern with mathematical relations/ hidden symmetry

- combination of shapes

Wurm, E., (2013), “Fat House”, Vienna
(Stoll, J., 2017, Belvedere/ Bildrecht)

- resemblance to a face

- big forehead

- eyes wide apart & placed low on head

- character/ bulges

- smooth ends

- funny proportions/ ”marshmallow”out of scale

Wurm, E., (2011), “Narrow House”, Dornbirn
(Fessler, R.)

- large head / short body

- big forehead (elevation)

- big ratio in width/height

Bureau Spectacular,(2018), “Architectural Voltron: Cats and Socks”

- resemblance to children’s toy

- colors and patterns

- combination of volumes / miniatures

- no clear use/ sculptural object

- “funny” proportions /small size structure despite the use of volumes that refer to larger objects in real life

Bureau Spectacular, (2014), “Township of Domestic Parts”, Venice Biennale, Venice

- colors

- volumes that refer to children’s toys and playgrounds awaking the feelings of “play” & “fun”

- larger scale than expected, addressing to adults and not kids/ funny proportions

- different volumes grouping together

Grant, J., Lai, J., (2013), “Castle of Misfits”, Revival of the Silo: Home-made Dessert, competition

- resemblance to children’s toys

-funny proportions/ very tall comparing to the human scale

- close character/ shyness/none or very few apertures

- different volumes grouping together

-very smooth shapes or very sharp edges

Klecheski, S., Ma, Y., Ren, S., (2016), “Cute seams, seems cute”

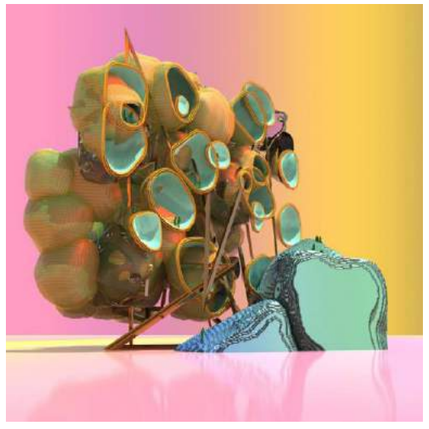
- colors

- combination of volumes

- sculptural object

- very big comparing to the human scale

- smooth shapes grouping together



Iheartblob, “Cuteness in Architecture”

- colors

- combination of volumes and smooth shapes

- no clear use/ sculptural object

-“funny” proportions / very tall comparing to the human scale

- semi-close character

THE CUTE TOOLBOX 2.1

The toolbox 2.1 is the updated version of the toolbox 2.0 with the addition of the identified elements that contributes to the cute impression the previous selected references express.

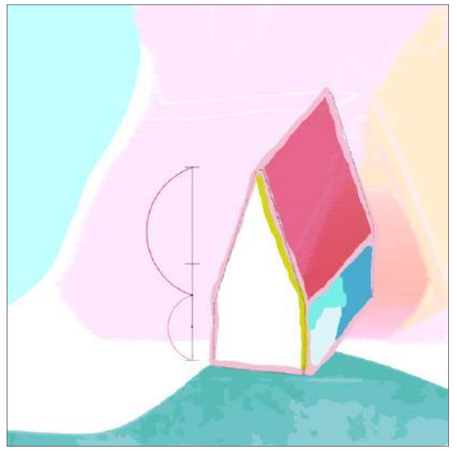
ELEMENTS	TRANSFORMATION
◇ composition	- play with human scale, floor height closer to human scale or extremely tall - ratio of height/width= 4/3 or 2 - roof/top floor/top part larger in relation to the rest structure - distorted proportions: elongated, pear shaped or bulging/bloating effect - multiplication and combination of volumes in different heights and width, spaced close together - rounded edges, smooth surface representations - sculptural object - simple volume design
◇ apertures	- bold framed apertures, rounded edges - narrow and tall windows - few apertures on large scale buildings or extremely small windows on large volumes/ close character - when the proposal is linked with a theme, the apertures use the pareidolia effect to hide features of resemblance to it
◇ materials	- distorted proportioned textured elevations - pastel colors, usually pink-ish color range

THE CUTE TOOLBOX

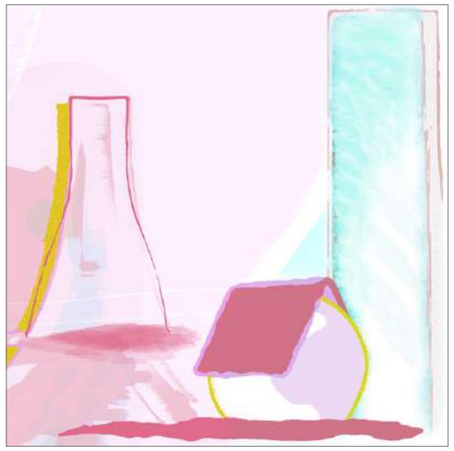
Combining the first manual and the last version of the second, this chapter consists of the final handbook for designing cute architecture.

- play with human scale,
- floor height closer to human scale or extremely tall

- ratio of height/width = 4/3 or 2



- roof/top floor/top part larger in relation to the rest structure
- high gable



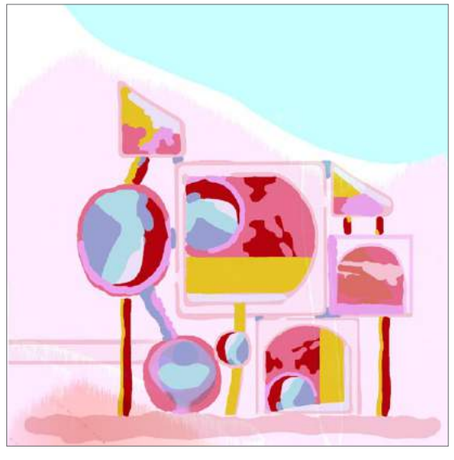
- distorted proportions: elongated, pear shaped or bulging/bloating effect

- multiplication
- grouping and combination of volumes in different heights and width
- spaced close together or surrounded by wall

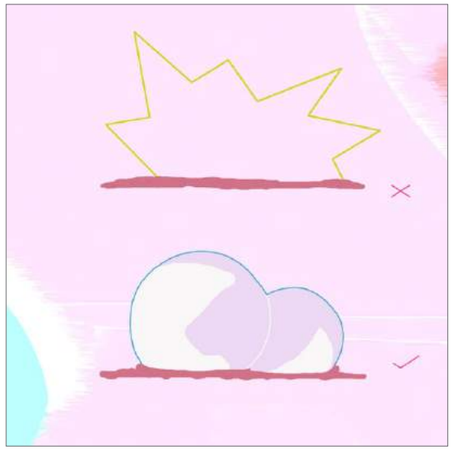
- rounded edges
- smooth surface representations

- bold framed apertures, rounded edges
- narrow and tall windows
- few apertures or extremely small windows on large volumes, close character
- windows placed low and in distance on gable wall

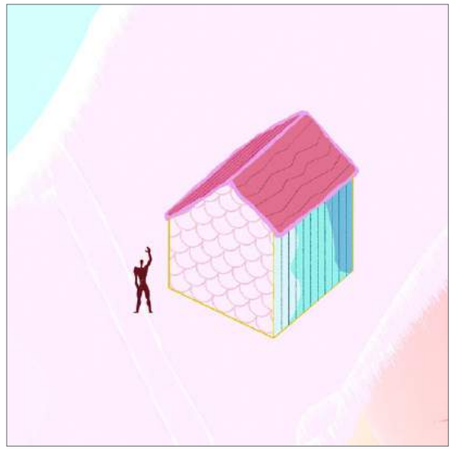
- anthropomorphism
- apertures and the design use the pareidolia effect to enhance the resemblance to a theme



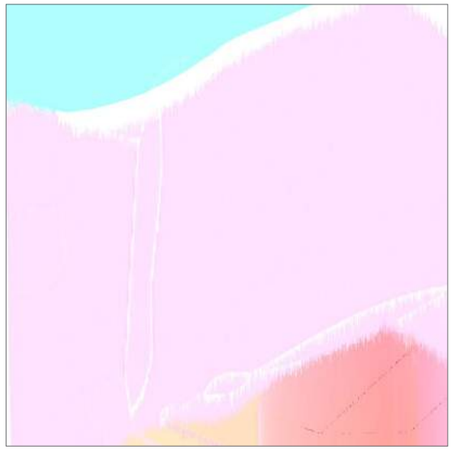
- sculptural object, plasticity in architecture



- simple volume design



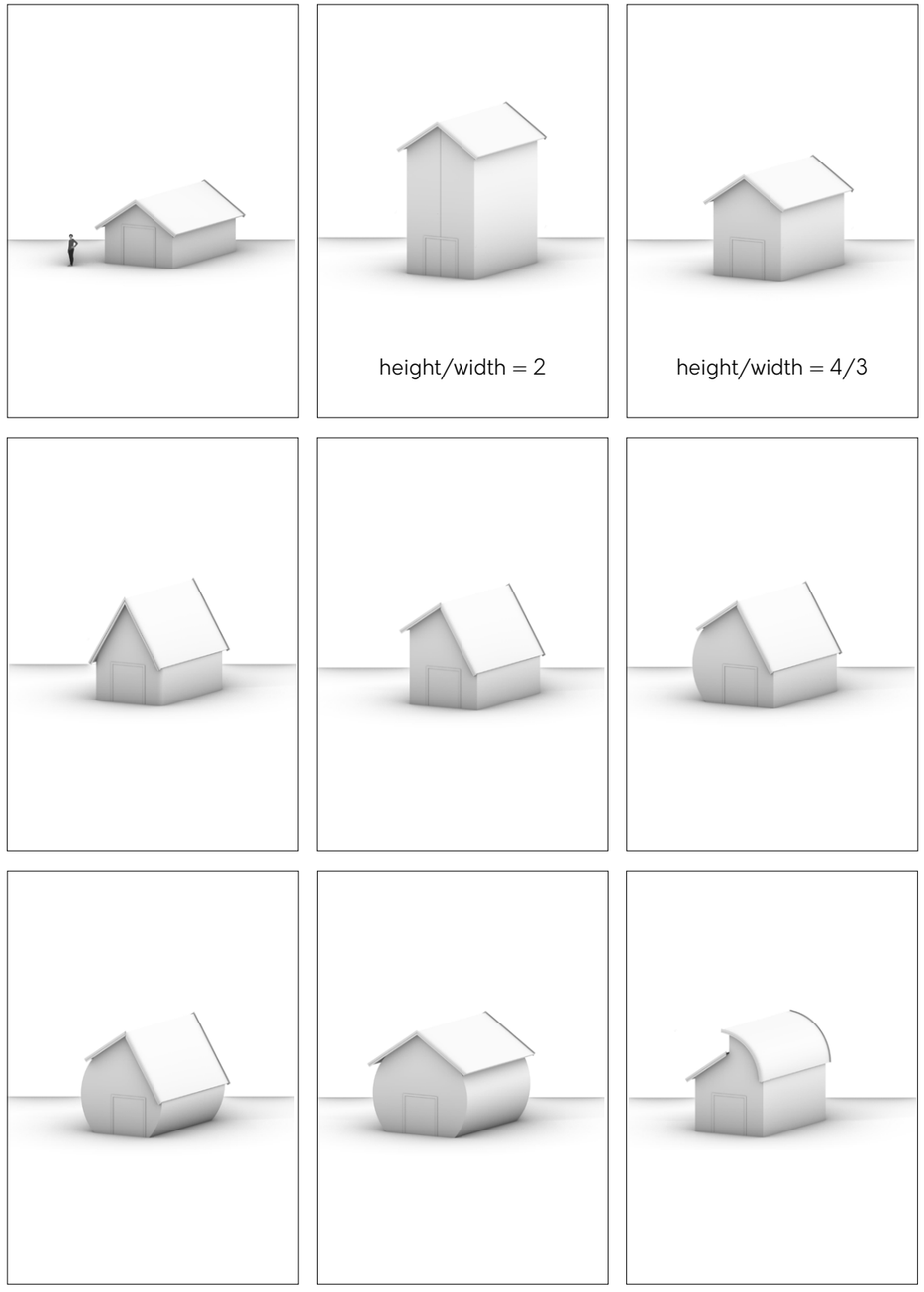
- distorted proportioned textured elevations

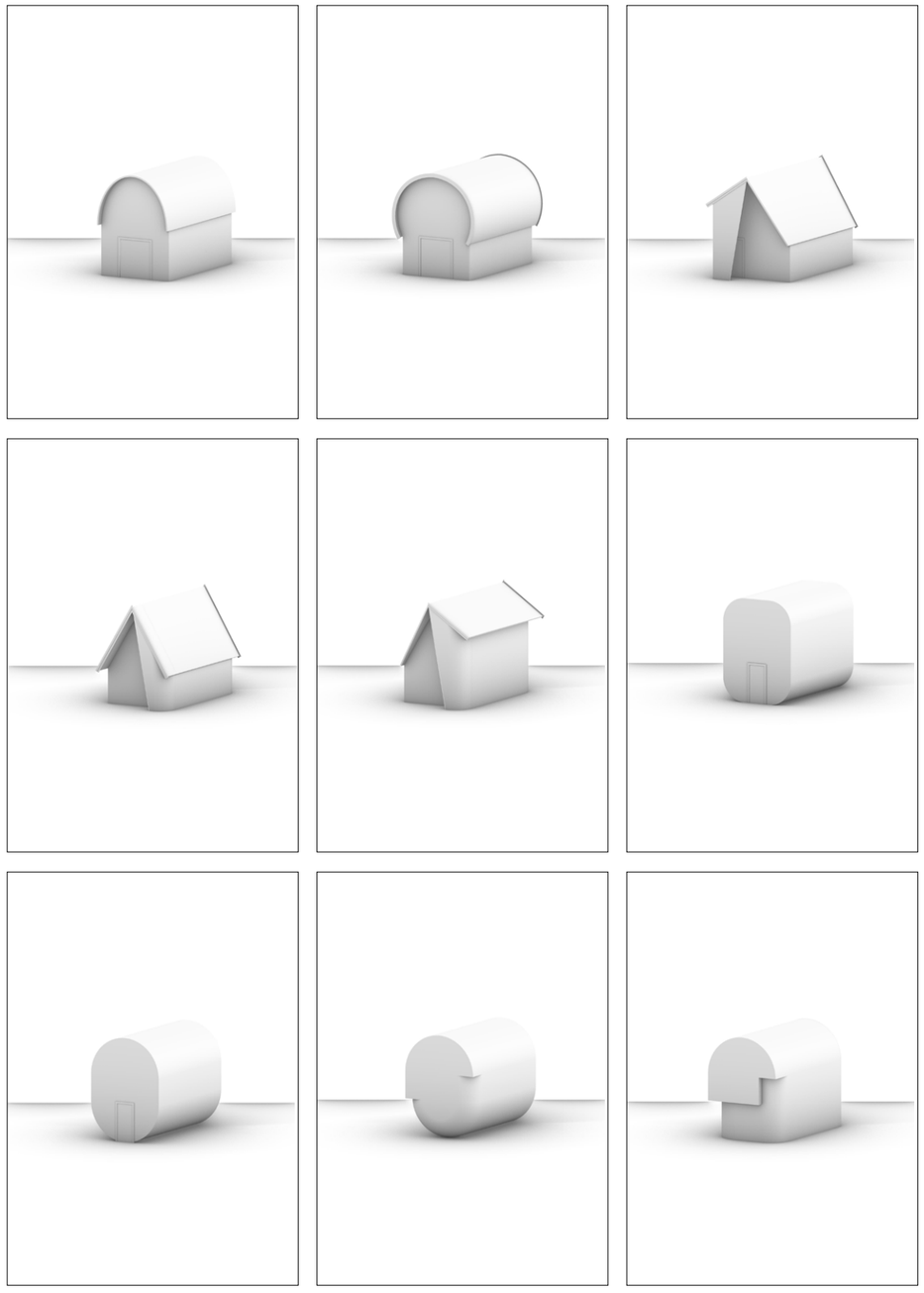


- pastel colors,
- usually pink-ish color range

CUTE FORM RESEARCH

The Cute Form Research investigates the transformation of a simple pitched roof house by changing the ratio of the height to the width, the ratio of the roof to the building, and the perpendicularity of the surfaces and adding curvature or rounded edges.





FINDINGS

The Cute Form Research outlines a risk and that is the thin line between cute and caricature. As it is shown on the previous pages this line becomes sometimes blurry. So the design proposal should indicate a cute composition rather just an uncanny design. Furthermore, the previous research makes unequivocal that the cute perception is emphasized when is displayed as a synthesis of designs rather than a single building.

ABOUT CORK

CORK : PROPERTIES & APPLICATIONS

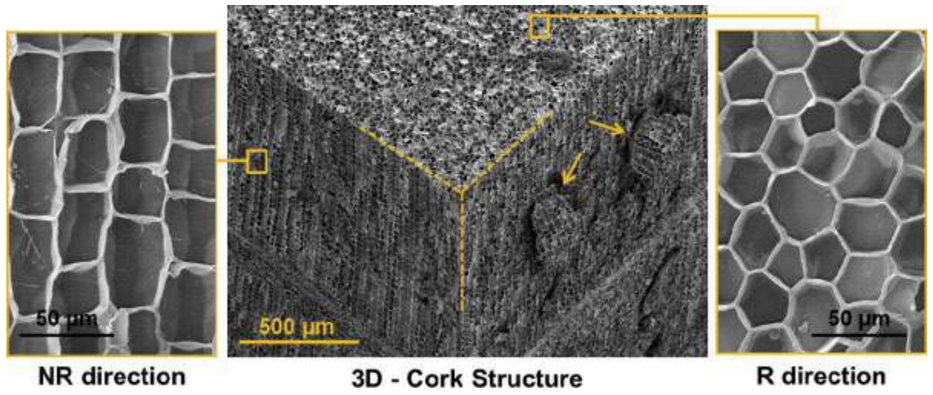
INTRODUCTION

Cork granules

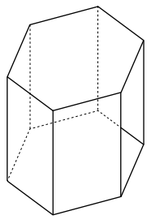
Cork is a natural and recyclable material that is extracted from the cork oak tree. In plant anatomy, it is actually a tissue, that protects and separates the living cells of the tree from the external environment. *Quercus Suber L*, as its binomial name is, flourish on particular regions of the Western Mediterranean, Spain, Southern France, Italy, Morocco, Algeria, Tunisia and with higher percentage in Portugal.. Adapted to these semi-arid regions, the tree entails plenty sunlight, but furthermore low rainfall and high humidity. The quality and thickness of the bark range depending on its growth conditions.

The method of cork extraction, the "stripping", starts when the tree reaches the age of 25 years. The process happens in cycles of 8 or 9 years and always between May and August. At that period the cork oak tree is at its most active stage of growth and is easier to remove the bark while ensuring that the tree is not harmed. After every strip the bark regenerates, creating an even smoother texture. On average, a tree can be stripped around 16 times during its 150-200 years lifetime.

STRUCTURE&MORPHOLOGY



SEM micrographs of the 3D cork morphology showing in detail the non-radial direction (NR) and radial direction (R). (Fernandes, E. M., Correlo, V. M., Mano, J.F., Reis, R. L, (2015), "Cork–polymer biocomposites: Mechanical, structural and thermal properties")

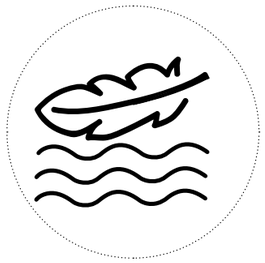


Schematic representation of a cork cell.

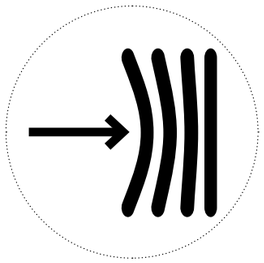
Cork is consisted from cells, about 42 million per cubic centimeter, grouped into a honeycomb structure. The first cell was identified by Robert Hooke (1664) through a microscope examination of thin cuttings of cork, revealing its anisotropic cellular anatomy. Cork cells are perceived as polygons with sides variation between four and nine, but mostly pentagonal and hexagonal, regularly arranged in rows perpendicular to the trunk of the cork oak. The average dimensions of cork cells depend on the season in which they were formed. Thus, cells in the early growing season (early cork) are larger and have thinner walls than the cells in the late growing season (late cork). Normally the cell height is less than 5µm.

Cork's cellular structure is chemically composed of suberin (45%), lignin (27%), polysaccharides (12%), tannins (6%) and ceroids (5%) [7] . Cork cells are filled with a gas mixture, (60% of a cork plank is consisted of gases) contributing to its low density and therefore to extraordinary lightness (0.16 grams/cm^3), but also to its low thermal conductivity and high sound insulation. Furthermore the Suberin encloses the walls of each cell blocking off the mixture of gases and giving cork its impermeability.

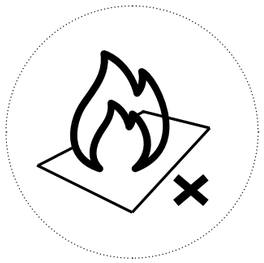
[7] Torres Marques, A., Novoa, P., Moura, M., Arteiro, A., Cork-Based Structural Composites, (2017), Handbook of Composites from Renewable Materials, Volume 2, Design and Manufacturing, Edition: 1st, Chapter: 19



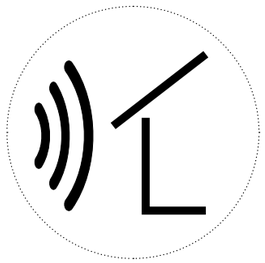
light & buoyant



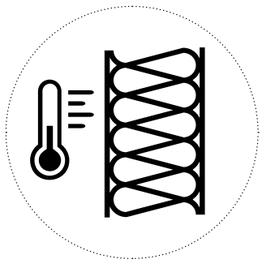
elasticity & compressibility



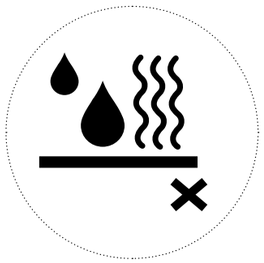
fire retardant



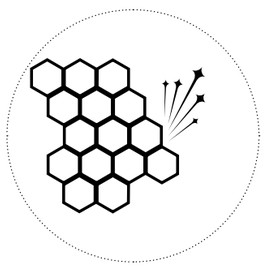
sound insulation



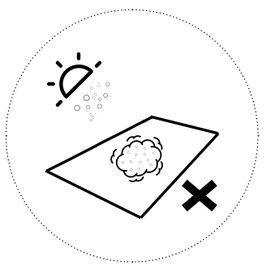
thermal insulation



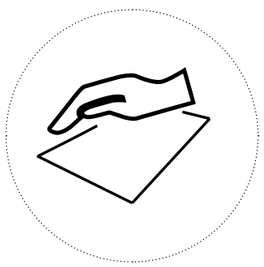
liquid & gas impermeability



friction resistance



hypoallergenic

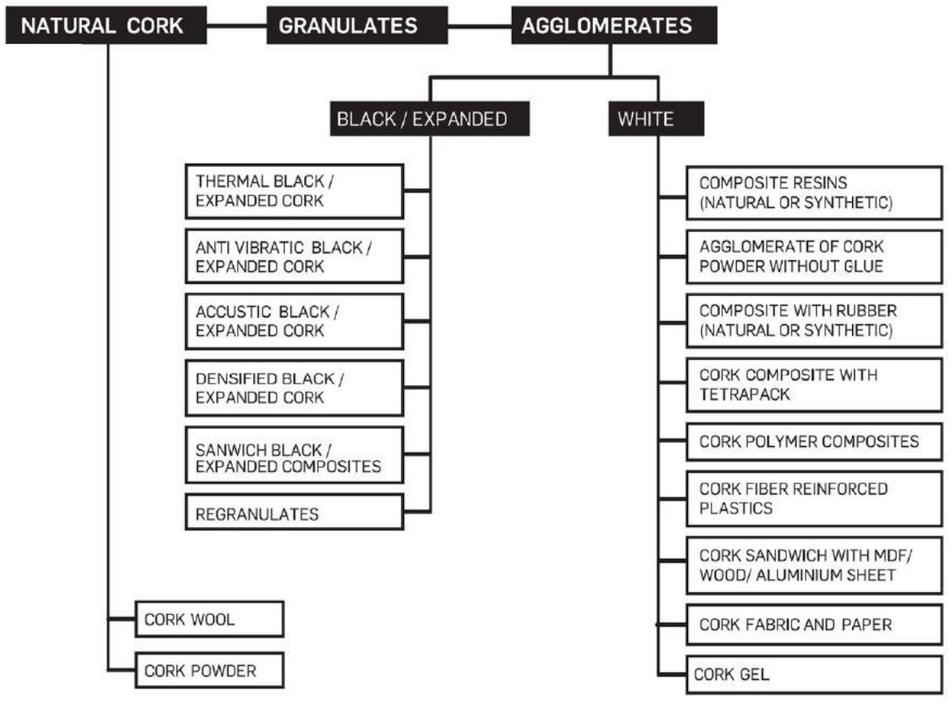


tactility & warm feeling

MECHANICAL & PHYSICAL PROPERTIES

As mentioned before, cork has a high percentage of gas content enclosed in its cells, which cause a low density and low heat transfer. The first one, in combination with the high porosity of the material, result in efficient sound barrier, by partially transform the absorbed sound into thermal energy. Cork also performs as an adequate dielectric material. [7] Moreover it does not rot or decay and is also resistant to fungus growth. Cork presents low stiffness and low strength, but on the other hand exceptional levels of flexibility, elasticity and compressibility. Compared to other flexible or rigid polymer foams materials, cork performs better mechanical behavior.[7] In addition, its anti-slip properties, introduce a competitive advantage to cork floors, interior or exterior.

[7] Torres Marques, A., Novoa, P., Moura, M., Arteiro, A., Cork-Based Structural Composites, (2017), Handbook of Composites from Renewable Materials, Volume 2, Design and Manufacturing, Edition: 1st, Chapter: 19



Schematic figure of cork materials (Mestre, A.)

CORK MATERIALS & APPLICATIONS

Cork is a versatile raw material that can be used in many forms and different technological transformation processes. The following classification, introduces the most important cork materials and composites as presented in A. Mestre's PHD dissertation: [8]

i) Natural cork: The basic form of cork, resulting from the extraction process, is the cork planks. After the stripping, these cork planks rest for six months to stabilize before any further transformation. The cork intended for industrial use is boiled in steel closed and filtered tanks to have any organic articles enclosed in the pores removed and allow the material to attain the quintessential moisture level for processing. Then, the cork is sorted in various thicknesses, followed by another categorization regarding different qualities, segmentation and suitability for various applications. Boiled cork planks are used to obtain cork stoppers, cork discs or the ends of fishing rods.

ii)Granules: They are made by scraps, virgin cork, pieces or stopper production waste, and undergo through different kinds of milling. They are mainly used as raw material to manufacture agglomerates, but they are also used directly for thermal and acoustic insulation and as a resistant layer under floors. Moreover, they are used to reduce weight in building elements as well as for the fabrication of building blocks. Granulation and density may vary among 0.25-22.4mm and 70-90kg/m^3. [9]

iii) Black / Pure / Expanded Agglomerate: Made through a process agglutinating granules of crude virgin cork, mainly falca (which has a high extractive level and functions as a natural inter-granular binder) and other types of cork of inferior quality. The agglomeration is carried out by the autoclave process which also works as a mold. The granules are subjected to heat and pressure, with superheated steam at 350°-370° C. During this expansion process and the granules are self-bonded by exuding their own resin (suberin) without any adhesives. These are usually produced in the form of boards of different thicknesses (though other forms may be obtained), followed by corrections in size

[8] Mestre, A., CORK DESIGN: A Design Action Intervention Approach Towards Sustainable Product Innovation, 2014, PhD thesis Delft University of Technology, The Netherlands, Faculty of Industrial Design Engineering
[9] Gil, L., Cortiça - Produção, Tecnologias e Aplicação, 1998, Lisbon: INETI.


1.


2.


3.


4.

1. Cork bark
2. Cork granules
3.Expanded insulation cork board
4. Coarse-grained agglomerated cork board

and squareness. One or both of the larger sides of the slabs may be sanded. This is a natural product, of vegetable origin. No synthetic agents are used, therefore it is a product with excellent ecological characteristics. [9] Divided into subgroups:

• Thermal Black Agglomerate: Uses granules between 5 - 22 mm with density of around 115 kg/m^3 and thermal conductivity of around 0.045 W/(m·K). It is used in the building industry for thermal insulation. [9]

• Black Anti-Vibratic Agglomerate: Has a higher density, usually above 170 kg/m^3, and greater mechanical resistance than the black thermal agglomerate. Its elasticity allows to bear relatively high loads. It is used as anti-vibratic insulation in machinery, building foundations and joints, and for other anti-vibratic purposes. [9]

• Black Acoustic Agglomerate: Uses granules with a typical granulation between 5 and 10 mm. It has lower density (around 95 kg/m^3) than the thermal and anti-vibratic agglomerate. It has a high capacity for acoustic absorption, decreasing reverberation times. It is used in civil construction for sound correction and reduction.[9]

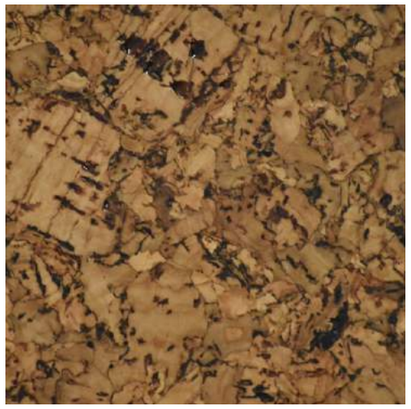
• Sandwich of black cork agglomerate with natural fibers or other materials: A process that uses panels of black agglomerate in a sandwich with other materials, for different purposes, namely to improve thermal performance. Some materials already used industrially are coconut fiber and neoprene.[8]

• Regranulates: Produced by using the waste from expanded agglomerate, these are essentially used to fill walls, terraces and coverings, and may be mixed with concrete.[9]

iv) Densified Black Agglomerate Boards: The black cork agglomerate densification is a completely natural (without glues) process, involving compressing boards of ordinary black agglomerate in a heated plate press, at a pressure, temperature and pressing time suited to the type of boards used and the characteristics required for the final product. Afterwards the boards are removed from the press and allowed to cool and stabilize in the air, for the time necessary to reach correct dimensional stability. This process allows greater control of the final density (much higher than the existing ones), a better surface finish without extra operations, with different physical-mechanical characteristics and an apparently competitive manufacturing cost, which makes it possible to extend their potential field of use. The process that has been developed is easily adapted to current manufacturing systems and new products for new applications. This makes it possible to diversify production and provide greater added value to the traditional agglomerate.[10]

v) Composite agglomerate with natural or synthetic resins: The composite

[9] Gil, L., Cortiça - Produção, Tecnologias e Aplicação, 1998, Lisbon: INETI.
[10] Gil, L, Portuguese Patent nº100647- Densified Black Agglomerate Boards, INETI, Editor 1999: Portugal.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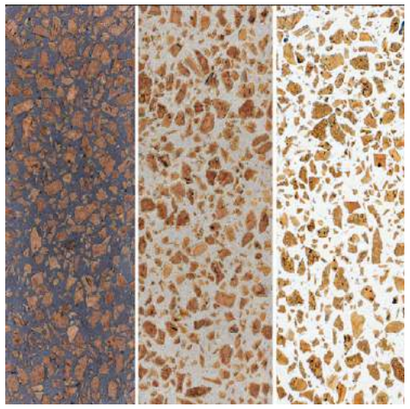

6.


7.


8.

5. Adhered Cork tiles
6. Corcrete, concrete and recycled cork
7. Cork Rubber
8.Acoustic insulation Corkoco

agglomerate best known and most widely used in industry is white agglomerate. This is made from waste products from the transforming cork sub sector, giving value to waste, to recycle (used cork stoppers) or to reuse cork products. By maintaining all the properties of cork and being able to acquire extra characteristics, it can take on numerous forms and combinations. Agglomerates are made out of a process of agglutinating the cork granules with a specific, pre-determined granulation and density, through the joint action of compression, temperature and an agglutinating agent, depending on the final product desired. The most common process uses synthetic resins of polyurethane, phenols (phenol formaldehyde) and melamine, and sometimes also resins of vegetable origin, to give a mixture of granules and resin. In most industry uses, the agglomerates are usually produced in molds, which are normally metal (or fiberglass for high frequency systems) for the manufacture of blocks or rolls (the casts are respectively parallelepiped and cylindrical in shape), which it is then possible to laminate. The sheets formed in this laminated process may have various kinds of surface finish: wax, synthetic varnish (acrylic or polyurethane), treated by ultra-violet radiation (UV) or dried in hot air tunnels or re-covered with different films (PVC, for example). White agglomerates can be used in molding, turning or cutting processes for many different purposes, from civil construction (coverings, insulation) to industry (automotive, aeronautical) or home products (furniture, accessories). [9]

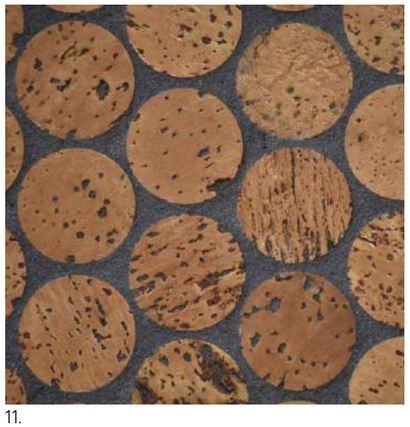
vi) Agglomerate of cork powder without addition of glues: This is a process of manufacturing agglomerate from cork powder, with the possible incorporation of other components, without using glues in the agglomeration. First, the cork suberin is depolymerised, with basic alternative solutions and acidification, followed by an operation to eliminate the liquid stage until a certain percentage of humidity is obtained in the solid material. Heat compression is then carried out, which also includes various alternative solutions. In this stage various chemical constituents of cork are polymerised, functioning as agglutinating elements. This also allows mixing with other non-cork particles and the adhesion of covering films. It is thus possible to carry out the agglomeration of very small particles, with a wide specific area, without the technical and economic problems associated with the usual processes. This is a material that adds value to the greatest waste in the cork industry and provides an opportunity to create different products. [11]

vii) Composite Agglomerate with Rubber (RubberCork): Rubbercork or CorkRubber is a kind of cork agglomerate that can be

[9]Gil, L., Cortiça - Produção, Tecnologias e Aplicação, 1998, Lisbon: INETI.
[11]Gil, L., Portuguese Patent n°88239 - Agglomerate of cork powder without addition of glues, 1994: Portugal


9.


10.


11.

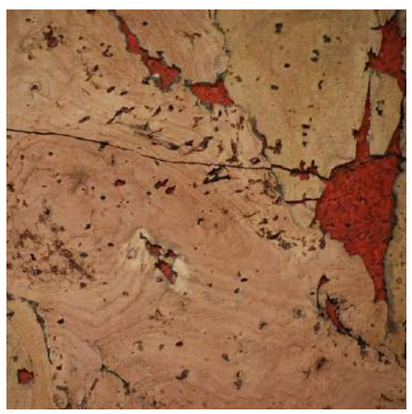
9. Lifocork, cork/elastomer composites
10. Cork Bricks
11. Cork Mosaic Tile

formulated in different ways, and is made by mixing and agglomerating cork granulate with natural or synthetic rubber (in powder or small particles) and other agents (vulcanizing agents, anti-oxidants, polymerization accelerants, colorings). These are homogenized, compressed and heated in rotating cylindrical mixers. Finally, the mixture is rolled out until it produces a homogeneous mass that will be cut into boards and placed in molds, compressed and treated just like the composite agglomerate with synthetic or natural resins, thus giving blocks that are later cut to the required sizes. RubberCork can have a density that ranges between 250 and 950 kg/m^3. It combines the compressibility and elasticity of cork with resistance to oil and gas and the flexibility of rubber in a product that provides great compatibility with liquids, minimum distortion through compression, reduction of vibration and an excellent capacity for recovery. Some uses are in gaskets, floors and anti-vibratic insulation. [9]

viii) Composite Cork Agglomerate with Tetrapak® cardboard waste packing for liquid foods: this uses the process for producing composite agglomerates but includes in its composition a combination of fibers and particles deriving from the shredding and/or grinding of Tetrapak® packaging, optionally including other materials, preferably without adding external binding agents, but optionally with the incorporation of glues, by compression and heating, using appropriate operating conditions for the agglomeration to consolidate the agglomerate. This process is preferentially applied to residues of used Tetrapack® packaging but may also be applied to industrial residues. Materials are obtained with a wide range of characteristics for multiple applications, coverings, anti-vibratic insulation,floorings, which are anti-electrostatic and with the possibilities of being used as intelligent materials. [12]

ix) Cork Polymer Composites (CPC's): Can be produced with cork powder (50% wt.) and mixed with polypropylene (PP), polyethylene (PE) or Polyurethane gel by pultrusion with the purpose of preparing cork-based composite by compression molding, thus the aggregation of the particles (and in some cases the adhesion of the covering particles) is due to the use of different kinds of thermoplastic binder. CPC have good dimensional stability, lower water uptake, a better acoustic insulation performance, greater rigidity as opposed to the flexibility of the usual cork agglomerates and similar behavior in terms fire resistance, flexural modulus and impact resistance when compared with traditional solutions, although inferior in terms of mechanical strength[13,14]. This process is not structurally very different from the competing ones and may therefore be easily adapted to industry

[12]Gil, L. and P. Silva, Process for the production of composite agglomerates and products obtained through the process., 2005: Portugal.
[13]Gil, L., Cork Particle Agglomerate with thermoplastic binders, 1998: Portugal.
[14] Fernandes, E.M., et al., Properties of new cork-polymer composites: Advantages and drawbacks as compared with commercially available fibreboard materials. Composite Structures, 2011. 93: pp. 3120-3129.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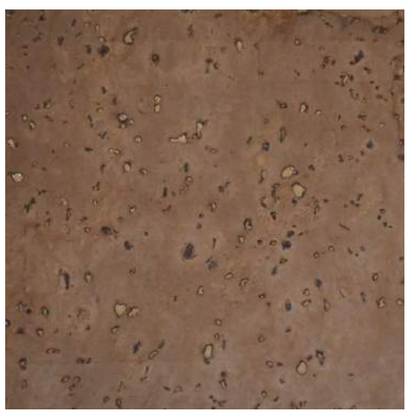
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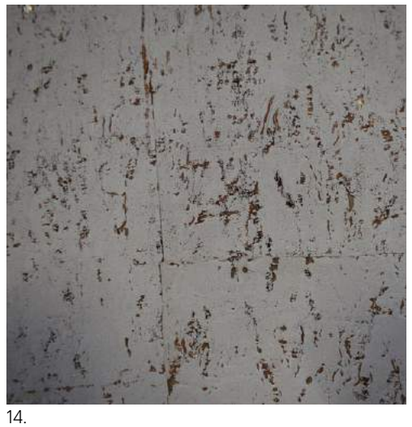

14.


15.

12. Cork Wallpaper
13. Cork textile for wall and floor coverings
14. Metal and Carbonized Cork Wall-covering
15. Laminated cork fabric

which also allows different uses from the normal ones. Thus, the CPC materials have showed important characteristics to be considered as good candidates to be applied in the design of flooring and construction systems [14] and have extended possibilities of their application (still at an exploratory stage) in the area of comfort and the medical field. Another innovation is the development of cork composites with bio-plastics, contributing to research and development in renewable base cork composites [15].

x) Cork Fibre Reinforced Plastics (FRPs): Provide another series of opportunities in the realm of technologies for reinforced plastic composites with fibers, which may be used in industrial applications, such as trains, ships, buses and aeronautics. One example already being commercialized uses carbon fiber and is used in kayaks. In this field, the use of natural loads (in addition to cork) in new composites has been considered, providing the mechanical requirements of the materials and market demands are satisfied. [8]

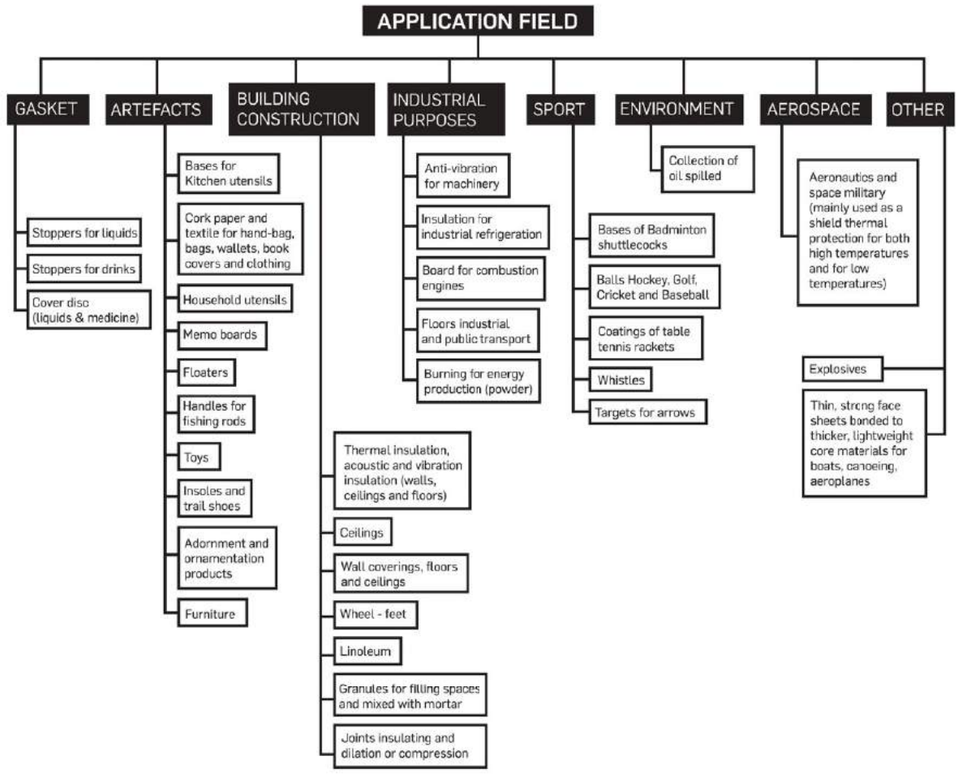
xi) Agglomerated cork sheet sandwich wood, MDF, aluminium or other materials: This process can use a great variety of base materials, namely sheets or panels of wood, MDF and aluminium. The sheets of cork are glued and pressed on to the selected materials. Some tests have been carried out in this area using sheets of cork agglomerate on sheets of wood, MDF and aluminium for various furniture applications. [8]

xii) Cork gel: A compound of silicone with natural cork granulate. Commercially known and used as tape for bicycle handlebar grips because of its excellent qualities: adhesive, it absorbs shock and impact, is comfortable, resistant to heat, water and sweat and is elastic. It is produced and sold in the form of tape in different colors and finishes. [8]

xiii) Cork Fabric and Paper: It is also known as cork leather or cork skin and is produced from very fine laminated sheets of natural cork (usually with a thickness of 50-500 µm) or agglomerated cork glued on a textile or paper base. The grade of the backing varies depending on the use of the cork fabric. This fabric has a long durability and its texture is that of cork, which can be felt on touching it. Various types of pattern are produced and used in accessories, namely in decorative leather-work, fashion and clothing. [8]

xiv) Cork Wool: May be applied for different purposes, as in certain kinds of packaging, but also in filling mattresses, pillows or sofas. There are special inherent properties: absence of toxicity, compressibility and power to recover, durability, lightness,

[8] Mestre, A., CORK DESIGN: A Design Action Intervention Approach Towards Sustainable Product Innovation, 2014, PhD thesis Delft University of Technology, The Netherlands, Faculty of Industrial Design Engineering
[14] Fernandes, E.M., et al., Properties of new cork-polymer composites: Advantages and drawbacks as compared with commercially available fibreboard materials. Composite Structures, 2011. 93: pp. 3120-3129.
[15] Mestre, A., Design Cork for Future, Innovation and Sustainability. 1st Edition 2008,Lisbon: SUSDESIGN.



Schematic figure of cork's application field. (Mestre, A.)

impermeability and insulation, and it is cited as being able to eliminate certain sleep disturbances. It may also be used in association with different aromas for health-related purposes. [8]

xv) Cork powder: The residue derived from the industrial transformation of cork, a series of chemical compounds may be obtained from it for different purposes and applications, namely for medical purposes or as an energy source [16]. The valorization of this residue combined with thermoplastics may allow for the creation of new cork-polymer composite (CPC) materials with interesting properties provided by cork. The impact, hardness, water absorption and acoustic properties are being investigated to create new products from cork powder with high added-value [17, 14].

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CORK PROJECTS

The selected projects showcase intriguing and innovative designs that devised a new terrain for cork applications. Apart from cork's technical characteristics and the material's dynamic and aesthetic qualities, the examples display that cork can be carved, cut, shaped and formed in different geometrical solution.

Aires Mateus,M. "Cork Space"

With a simple design, the architect Manuel Aires Mateus, manipulates corks sensory and aesthetics properties to create a Cork Space ideal for a pause, contemplation or meditation.

Herzog & de Meuron, Ai Weiwei, "Serpentine Gallery Pavilion 2012"

The Serpentine Gallery Pavilion used more than $80m^3$ of cork to cover the entire underground space and furnishing. Cork was not only elected because of its acoustic properties and sensory characteristics but also because can be easily carved and it's easily mouldable.

De Azambuja Varela, P., Merritt, T., (2016), "CorkVault Aarhus

Cork Vault Aarhus explores a stereotomic design space of cork realized from cork sheets cut using a CNC water-jet cutter. Expanded agglomerated cork boards are selected for the construction material since cork is highly resistant to compression and its softness to abrasion make it a very interesting material for water jet cutting.

De Azambuja Varela, P., João de Oliveira, M., Novo, E., "Vaulted Cork Pavilion"

The pavilion is built from expanded agglomerated cork boards using computational design and digital fabrication technologies. The design investigates new architectural possibilities and design challenges for cork as the free-form construction offers a unique experience of light, sound, smell and touch. The grass in the exterior presents the possibility of using cork on roofs for growing living plants.

Sousa, J.P., Veiga, G., Moreira, A.P., (2015), "Robotic Fabrication with cork"

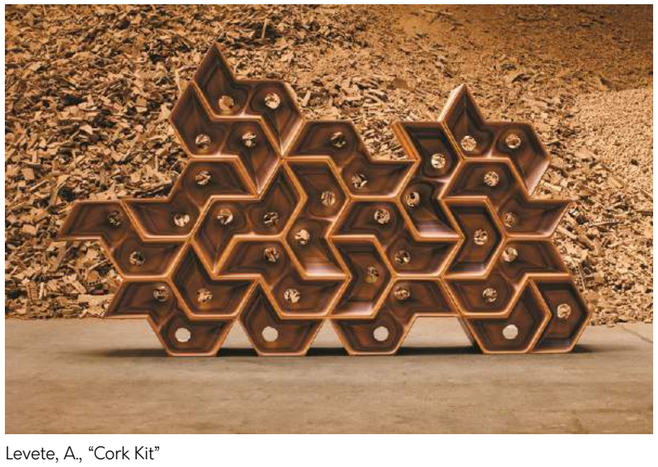
A research into the robotic milling of cork produces a series of panels for an architectural façade. By designing the milling paths and not by modeling the surface and with a customized Ø100mm end-ball milling tool, the fabrication of the shown surface took only 6 minutes per 1000x500x70mm cork panel.

Sousa, J.P., Martins, P., De Azambuja Varela, P., (2016), "The corkcrete arch project"

The Corkcrete Arch is an investigation into the production of a building system from cork and concrete that merges the sustainable, lightweight, acoustic, thermal and vibration insulation properties of the first with the structural efficiency of the second by using robotic fabrication technologies, customized prefabrication and easy on-site assembly

Siza, A., “Stool”

The proposal is a nest of two cylindrical stools of different dimensions where cork offers an experience of maximum comfort and impact absorption capacity.



Levete, A., “Cork Kit”

Cork Kit consists of two geometric pieces that their combinations create a modular, self-supporting system can be used as a stool, table, small stair or a wall element with soundproofing properties. The design emphasizes on cork’s lightness and color tonal range expressed as a gradient running from light to dark by laminating the sheets of cork together.

Nimtim Architects, “Cork House”

Nimtim Architects chose to use cork as an exterior and interior cladding not only to create a consistent textured surface to complement the aesthetic of the existing building but also because since is water resistant, sound absorbing and thermally efficient, the building would not require any extra foam insulation. In addition cork is also breathable and free from chemicals that creates a healthy interior environment.

Studio Bark, “The Cork Studio”

With this project Studio Bark aimed to see whether cork could be used as the primary structure eliminating the need for frames, linings, glues, tapes, breather membranes and wet trades. Comparing the high density cork blocks to the conventional building blocks, the result displays a viable low-cost zero-waste method of building that respects the cradle to cradle principles.

FINDINGS

Cork is a very easy to use material that can undergo lots of different fabrication processes. The projects presented in the previous pages indicate how cork can perform structurally, synthetically and aesthetically in simple or advanced geometries with the utility of digital fabrication.

Digital fabrication technologies are a very vibrant field in architecture. The potentials offered, broaden the experimentation field with cork, contributing to more innovative applications for the built environment, apart from the already known insulation strategies in the construction industry. The selected references of cork projects reflect the above mentioned pushing the properties of cork in scale, complexity and fabrication method. Consequently this means that there is a very small limitation when it comes to the application range of cork as you can mill, laser cut or compress it in heated molds to shape it as desired.

Furthermore, the cork based material list show that cork can be combined with a variety of different materials for their properties' improvement.

EXPERIMENTATION

INTRODUCTION

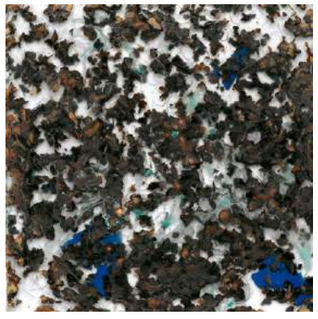
The next chapter of this thesis consists of the experimentation phase to explore cork textures and potential architectural qualities that they may offer. The phase departs from the intention to fully understand cork as material and how the cork boards are composed. Therefore, using a heating compression molding machine (Bucher-Guyer KHL 100, hydraulic press) from the Material Processing Laboratory at Chalmers, the first step is to bond the cork granules in the heated mold by releasing their suberin substance. After understanding how the process actually works and how the pressure affects the color and the strength of the cork samples, the next stage is to experiment with color agents and the transparency.

In the papers about cork composites, it is mentioned that sometimes suberin is not enough and adhesives are included in the mold to bond the granules. Thus, searching and reading about adhesives, the possibility of polymers arrived since syberin is actually a type of polymer. As a result, the experimentation continues with polyethylene granules (PE), commonly used in packaging, bottles and plastic bags. Polyethylene, the most popular thermoplastic, has the advantage to melt and be recycled and reused multiple times when heated. The addition of the PE in the mold in different ratios to the weight of granules, result in the creation of different levels of transparent and colored cork samples. The composites could be easily fabricated in larger scale with the use of a bigger mold and even with cork pieces instead of cork granules.

CORK & PE COMPOSITES

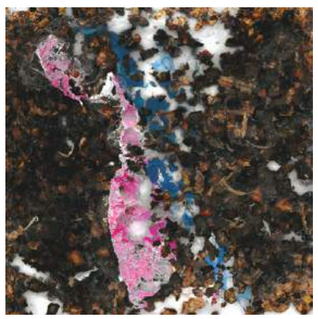
The process starts with heating the mold, after thoroughly cleaning and coating it. The machine (pic.1) requires approximately 45 minutes to reach 125 °C. During that time the cork and PE granules are weighted to define their ratio in the mold. (pic.2) When the desired temperature is reached, the mixture is entered in the mold (pic.3,4) with a 40bar pre-pressure for two minutes followed by the application of a 500 bar high pressure for one minute. After this time span, the heating system is put off and the cooling system is activated. As soon as the temperature reaches 40 °C, first the high pressure's switch and then the pre-pressure's one are turned off and the mold is ready to be opened. The new material is now ready to be removed and the cleaning steps to start, carefully since the mold is still quite hot. Just after the thermometer shows 14 °C, the cooling system is shut down and as soon as the mold is clean and coated, the procedure starts again for the next experiment.

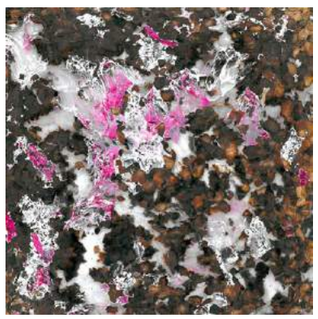
5g cork
10g PE



9g cork
6g PE
blue agent
green packaging

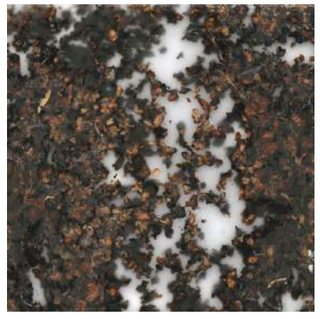
9g cork
6g PE
blue & pink packaging

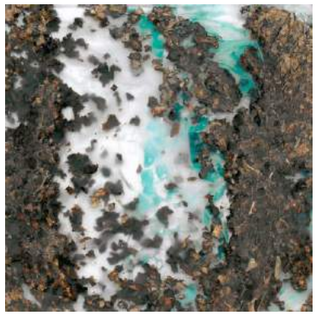




9g cork
6g PE
pink packaging

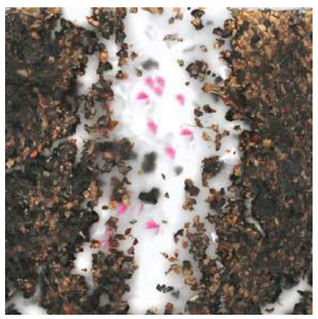
12g cork
7g PE





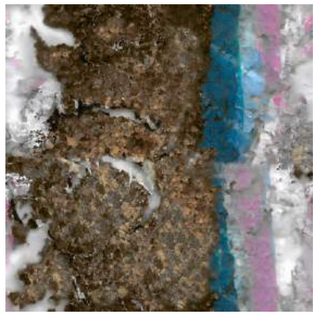
12g cork
9g PE
green packaging

11g cork
10g PE
blue packaging



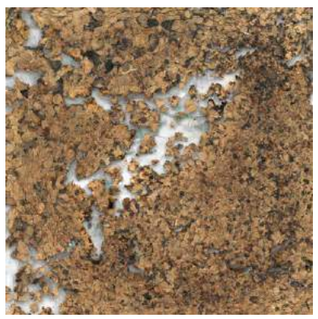
12g cork
7g PE
pink packaging

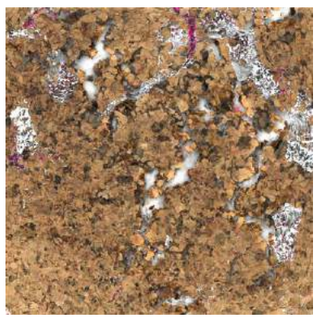
18g cork
9g PE
mixed colors packaging



13g cork
2g PE
green packaging

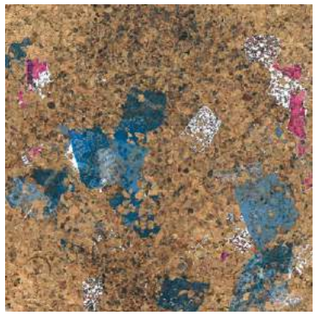
10g cork
5g PE
green packaging





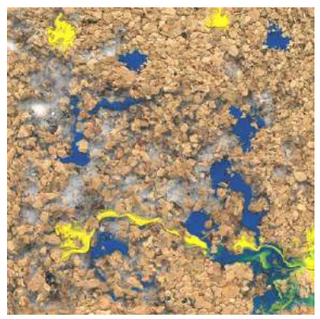
14g cork
1,5g PE
pink packaging

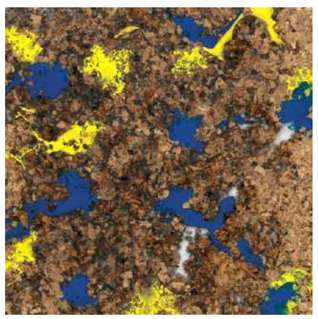
14,65g cork
0,35g PE



12g cork
9g PE
green packaging

13g cork
3g PE
blue & yellow agents
no high pressure



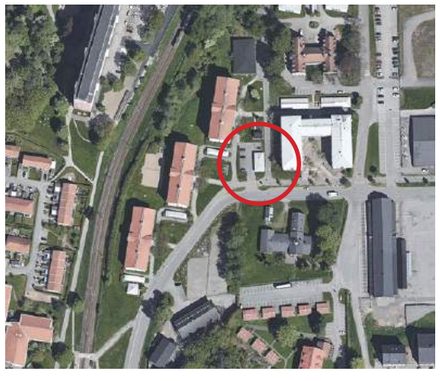


12g cork
4g PE
blue & yellow agents

THE PROPOSAL

THE CORKY WASTE/RECYCLING CHAMBERS

Current infrastructure

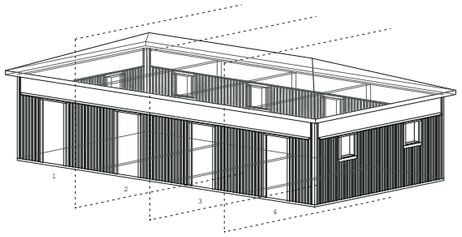


Location among student housing

ABOUT THE PROPOSAL

The design scenario deals with the redesign of the waste/recycling chambers (soprummen), infrastructures reflect zero beauty or pleasure to the users, located among the student housing units in Kviberg, Gothenburg. The current infrastructure consists of four different chambers. By breaking the volume in these four pieces, each volume is transformed differently resulting in a composition of four new silhouettes. The main material is expanded cork agglomerated blocks that perform as exterior/interior cladding attached to timber framing as well as the primary structure in the third structure. To create a bright and colorful interior atmosphere, the apertures are covered with cork&PE sheets emerged by the experimentation with cork granules, PE granules and plastic packaging.

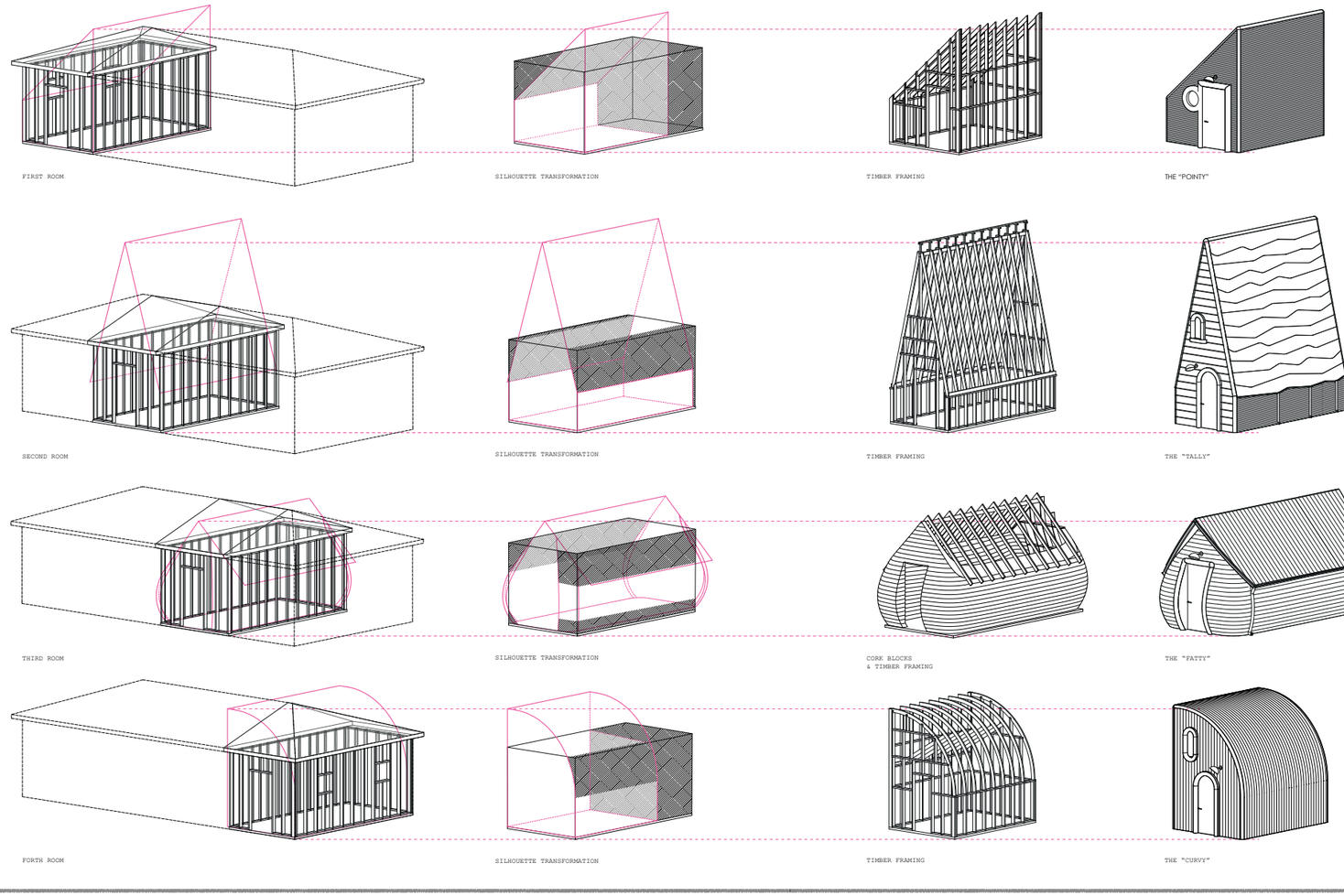
The proposal aims to inspire not only to use more cork and expand the terrain of cork applications in architecture but also to provoke discussions around the new approach that cuteness brings to design.



FROM...

THE CURRENT INFRASTRUCTURE

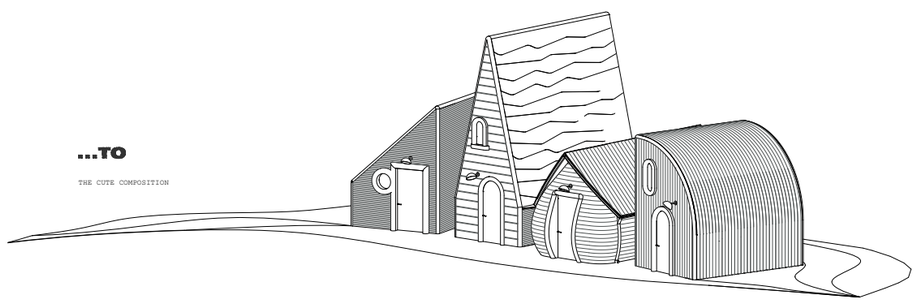
HOW ?

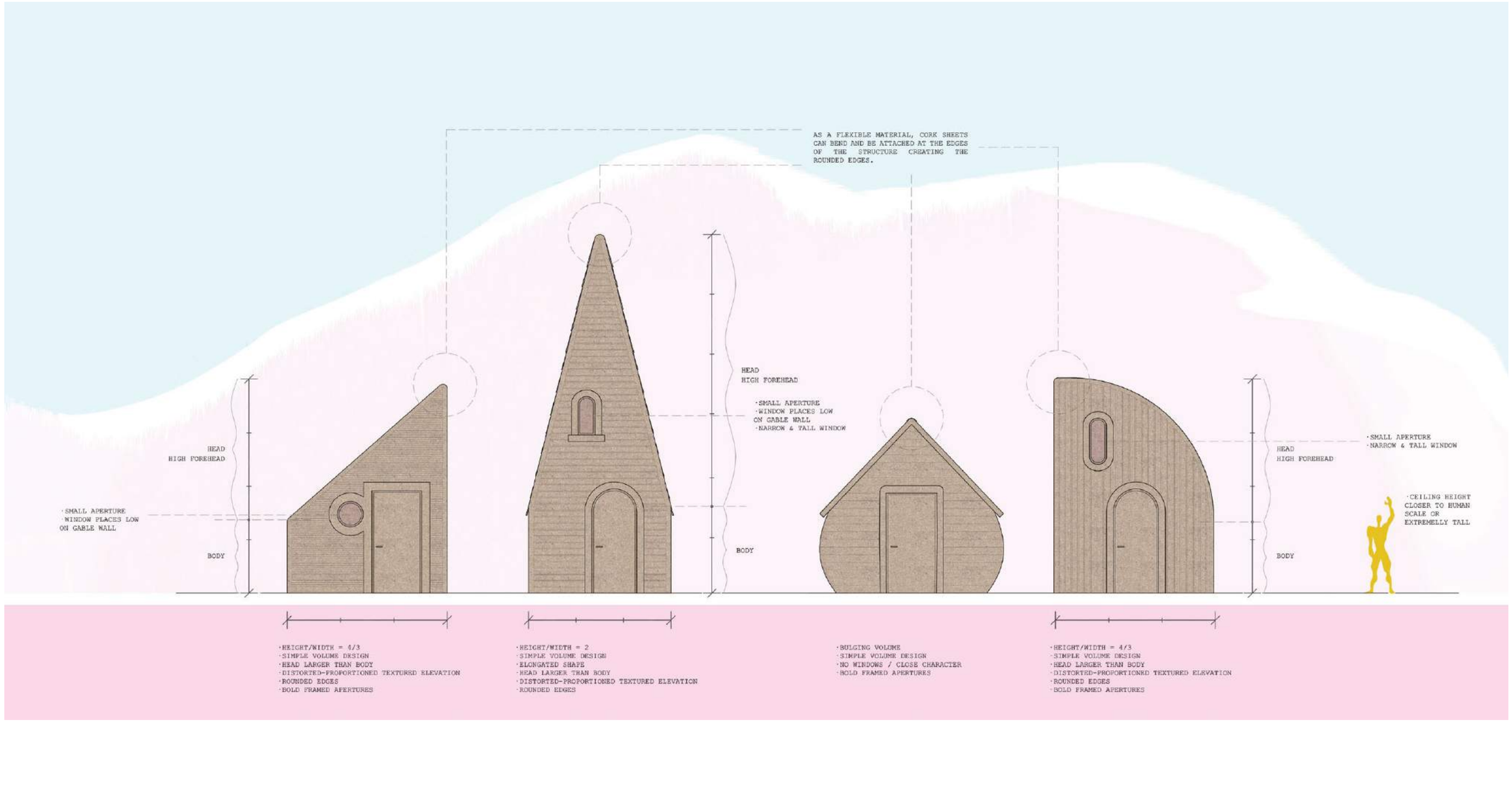


According to the cute toolbox, cuteness is highlighted when you see it in group, in a collection of things, rather than just one building Therefore the initial volume is broken into four pieces to reflect this rule. The current infrastructure is a typical wooden house construction with an inner timber framing. Since the main idea is to redesign this building, the new proposal follows the same construction type since this could mean that some parts of the timber framing could be up-cycled and reused in the new composition. The diagram here presents the silhouettes' transformation into the new cute form, the inner structure before the attachment of the cork surfaces and the final outcome with the exterior cladding and the bold frames.

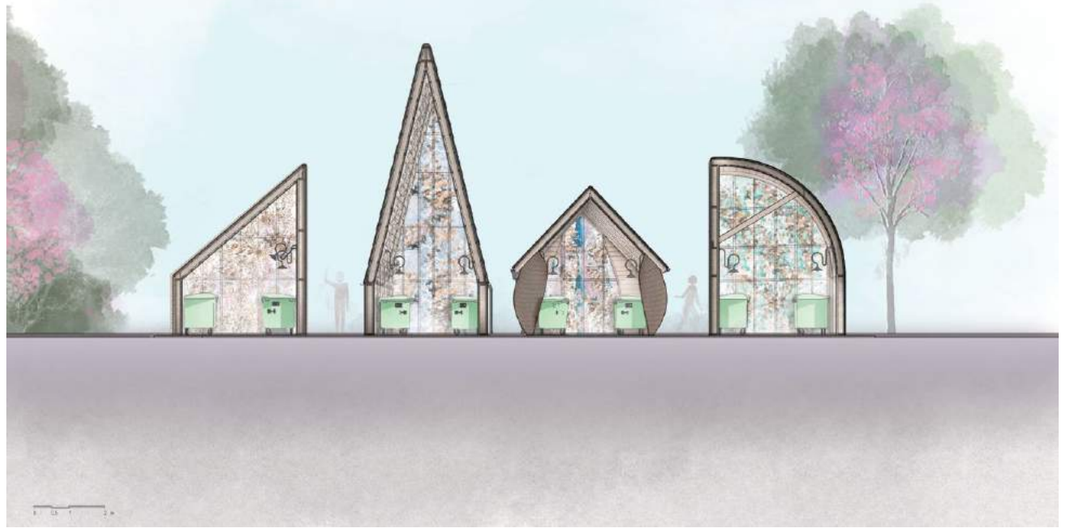
...TO

THE CUTE COMPOSITION

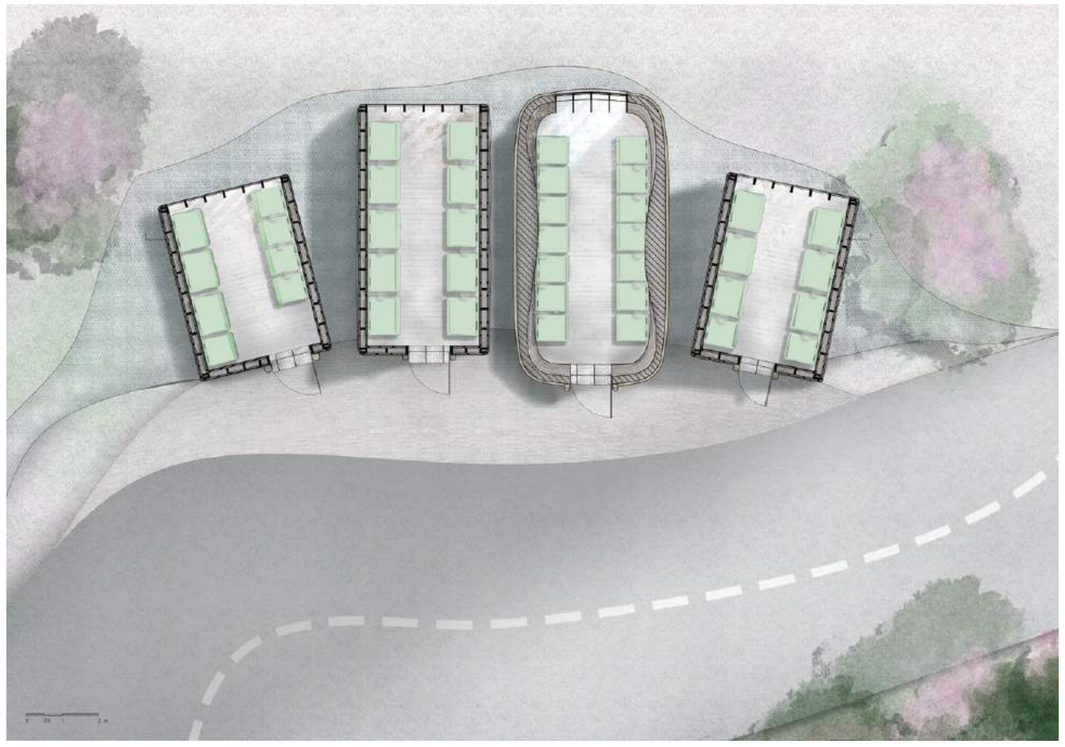




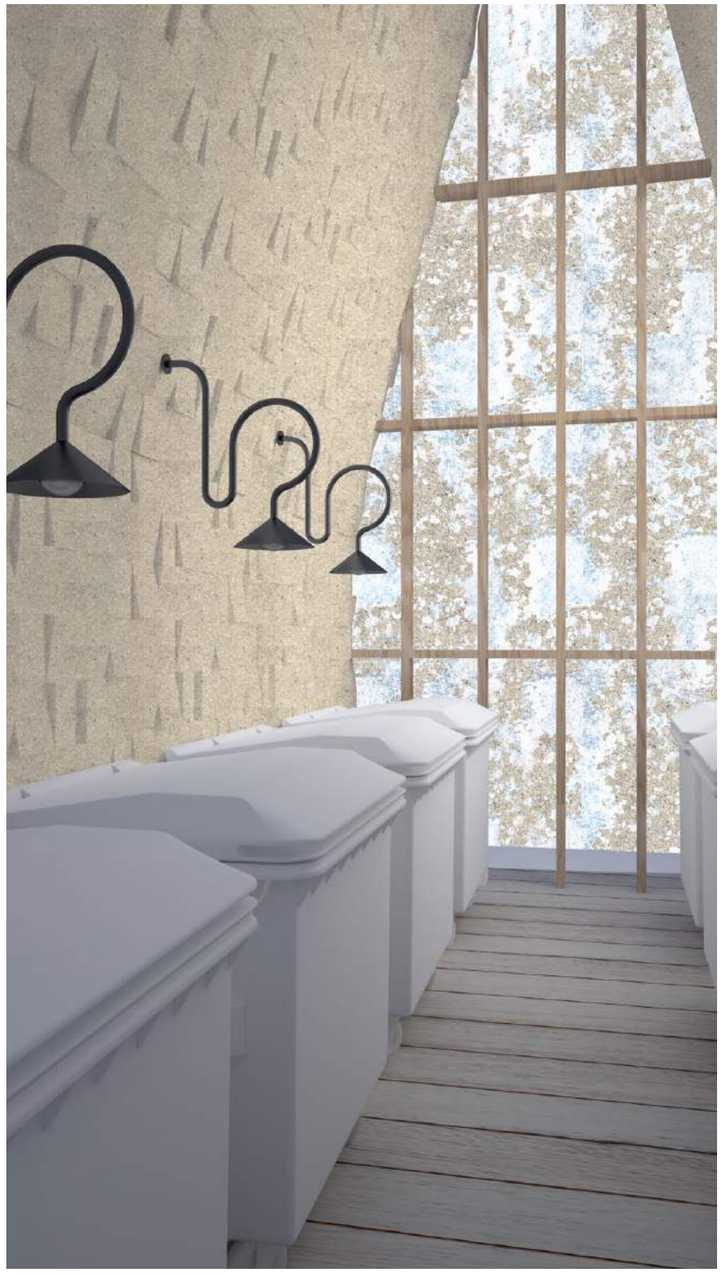
The cutified elevations based on the cute toolbox



Section

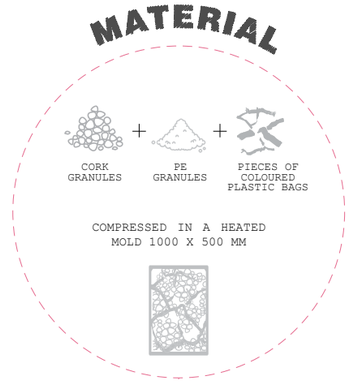


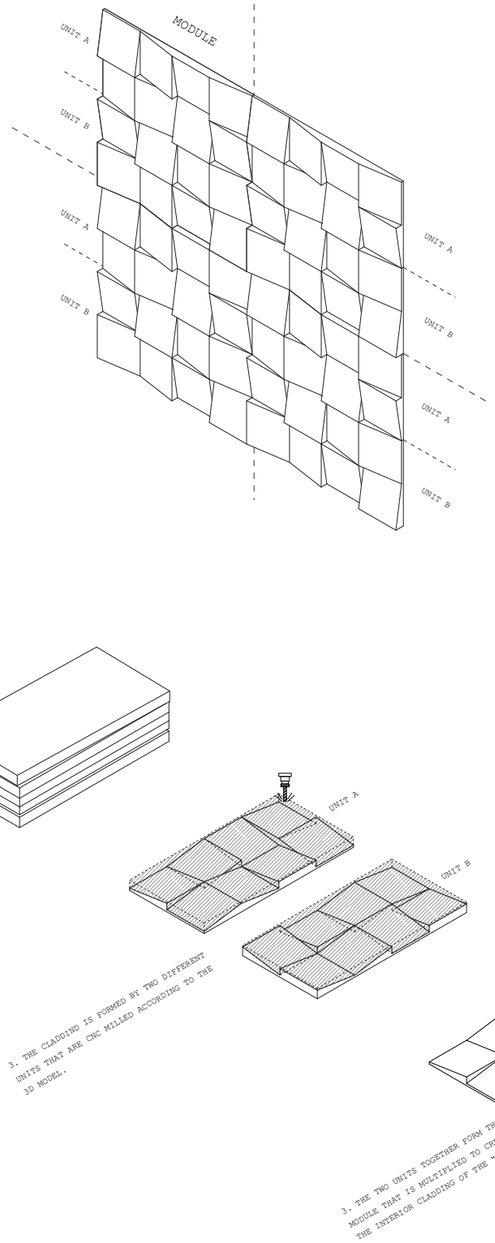
Floor plan



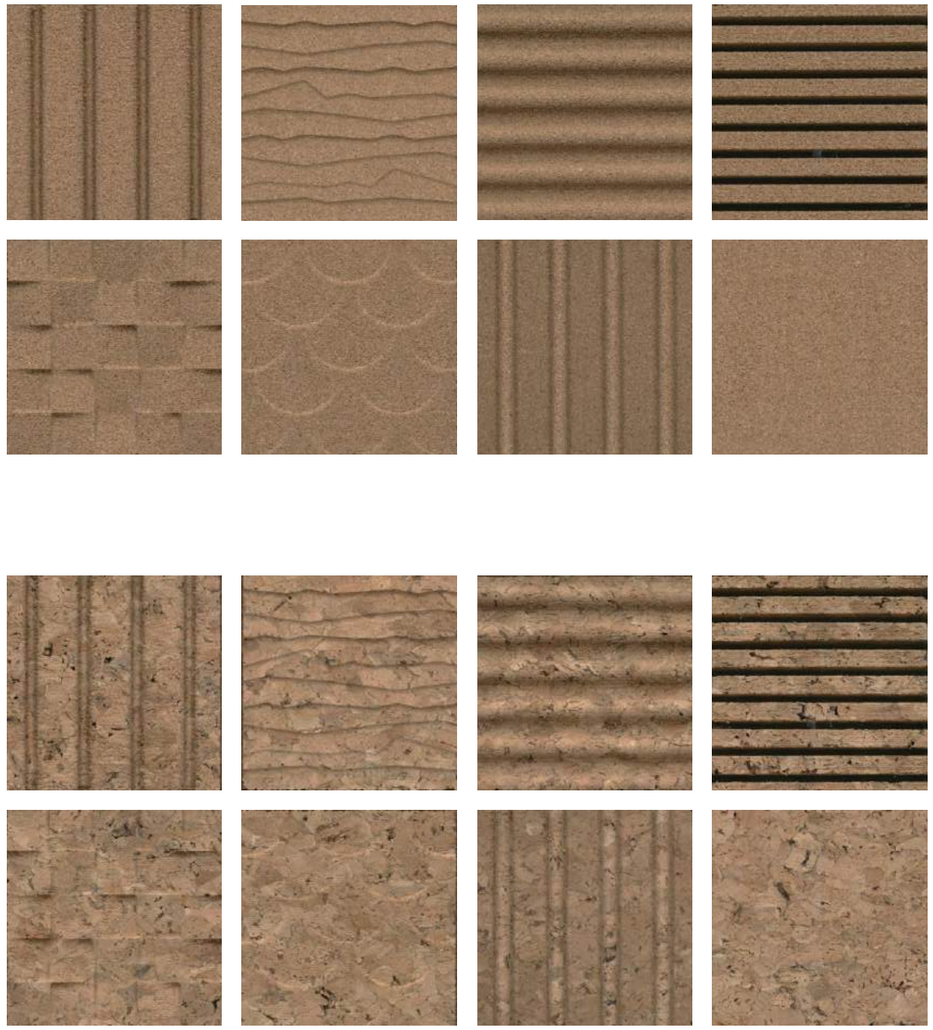
The interior view of the Tally

On the back side of the designs as shown in the section, the material is a semitransparent cork colored surface emerged from the experimentation with cork granules, polyethylene and plastic bags. The composites have different levels of transparency and colors resulting in the interior experience

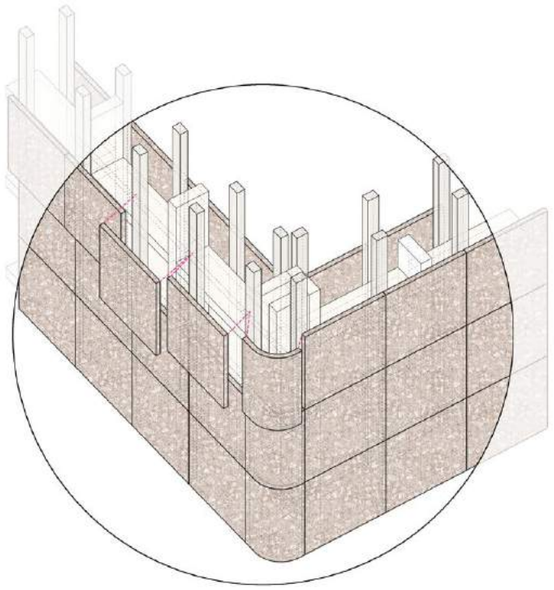


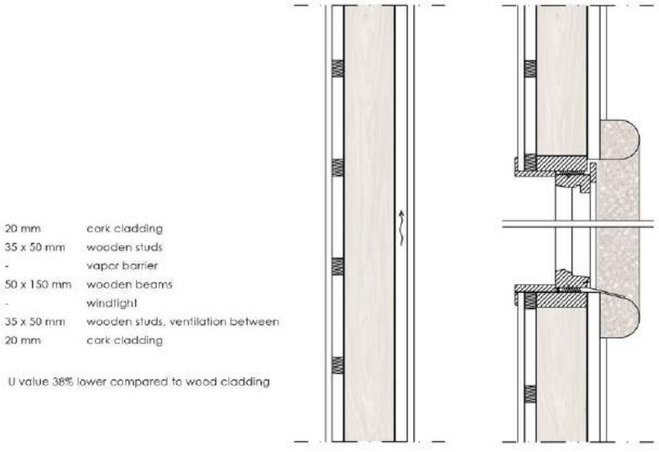


The fabrication of the interior cladding



Cork cladding experimentation in CNC





Construction detail

View of the Fatty

Cork can also function as the primary structure,therefore the Fat House is built from cork blocks of high density, carved in a CNC according to the 3d model and placed and secured with nails. To create the rounded edge effect on the roof, thin layers of cork boards that are flexible and can bend are attached on the roof cladding. The threshold has a bold frame around, fabricated by compress cork granules in a heated mold.

2 LAYERS OF 6 MM AGGLOMERATED EXPANDED CORK SHEETS. CORK'S FLEXIBILITY ALLOWS THE MATERIAL TO BEND AND BE ATTACHED ON THE CLADDING.

VERTICAL TIMBER ROOF CLADDING

6 MM CORK SHEETS CUT AS GLAZING BEADS

20 MM CORK & PE SHEETS ATTACHED TO THE TIMBER FRAMING WITH NAILS

25 MM PLYWOOD FRAMING

35 x 35 MM STUDS AND ROOF BATTENS

35 x 50 MM STUDS

INNER CLADDING

50 x 120 MM RAFTERS

1000 x 500 x 180 MM EXPANDED CORK BLOCKS

RAINWATER DRAINAGE WITH RAIN GUTTERS AND DOWNPIPES

OUTDOOR LIGHTING

CORK GRANULES BONDED IN A HEATED COMPRESSED MOLD

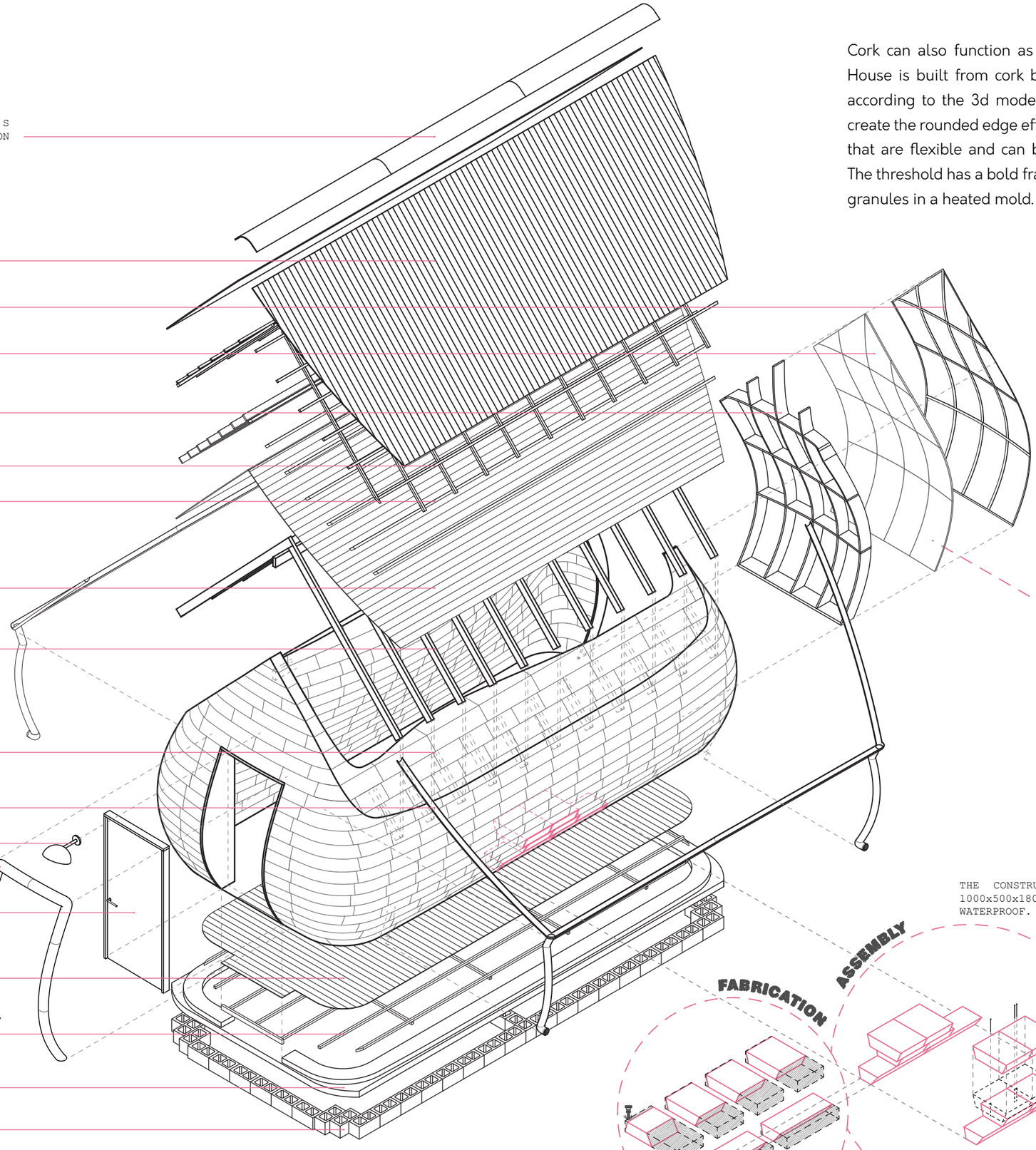
DOOR

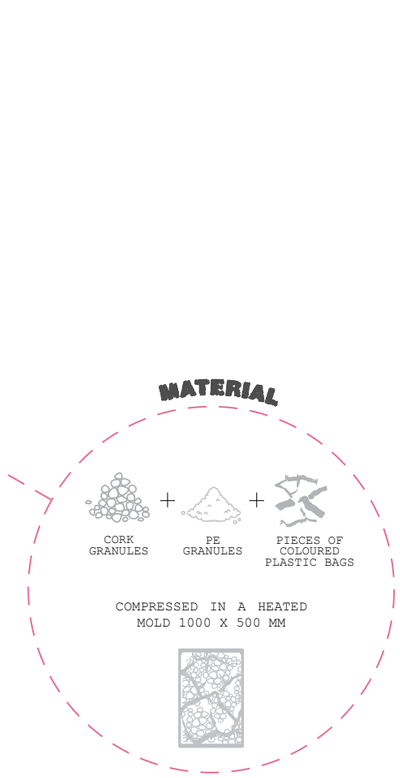
WOODEN FLOOR

35 x 35 MM BATTENS

100 MM CONCRETE SLAB WITH 80 MM FRAMING TO PLACE THE CORK BLOCKS

CONCRETE BLOCKS FOR THE FOUNDATION





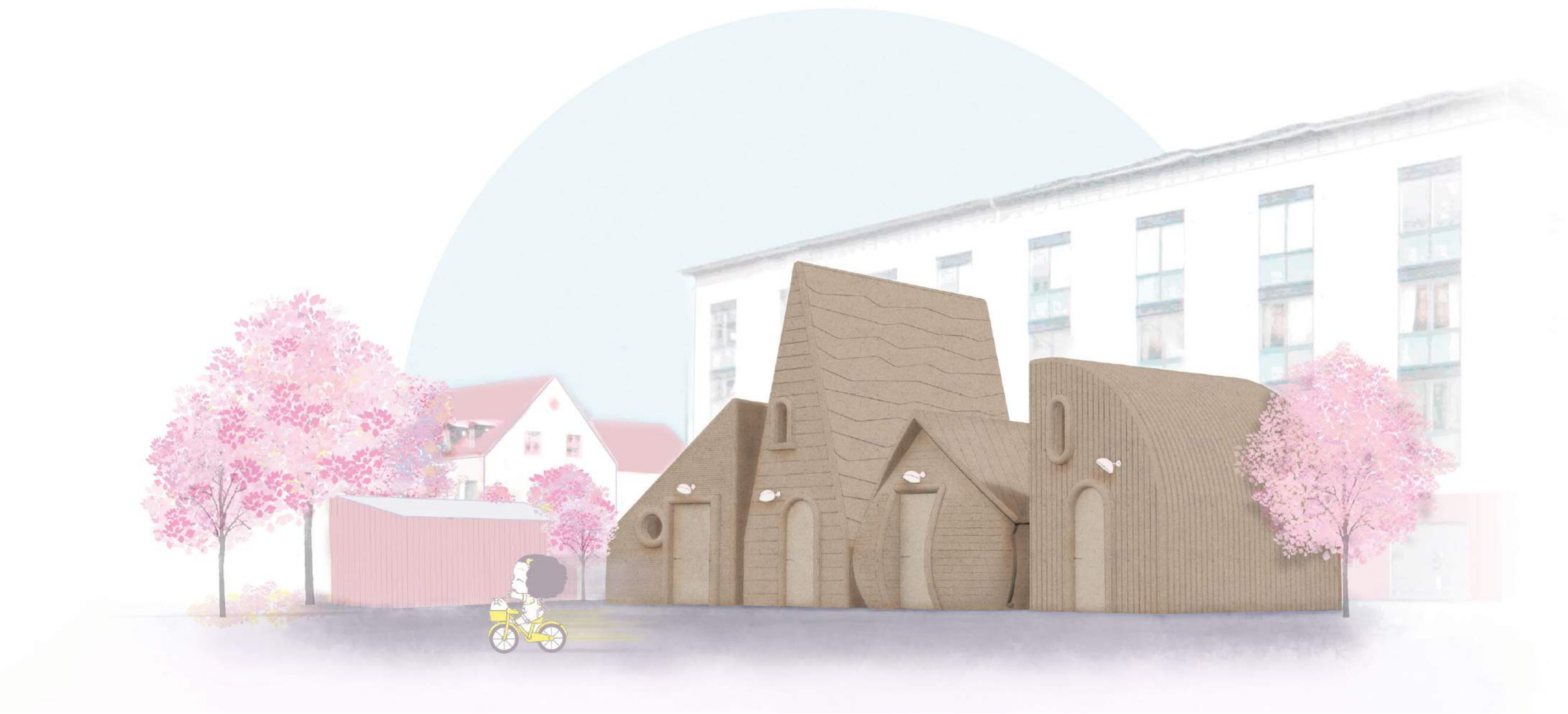
THE CONSTRUCTION USES EXPANDED CORK BLOCKS 1000x500x180MM OF HIGH DENSITY SINCE THEY ARE WATERPROOF.

USING A 5-AXES CNC MACHINE*, EACH CORK BLOCK IS MILLED ACORDING TO THE 3D MODEL.

*maximum depth 300 mm with a 25.4 mm (1") diameter end mill tool

EVERY PIECE IS PUT TO PLACE AND SECURED WITH 7x210MM NAILS.

Axo of the Fatty



The cute composition

This thesis is a research about the principles that define the cute structures and how combined with the materiality, the qualities and the aesthetics of cork can result in creating corky architecture. Cork's terrain in architecture is still expandable and cuteness sets a new approach and an agenda for cork to fulfill.

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