Encourage recycling in a park setting

T217 Design essentials

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Introduction

The Ditchling Beacon National Park has been created to help preserve nature and foster a sustainable lifestyle while providing an excellent area for recreational activities like cycling or hiking. Such locations frequently face challenges connected with the disposal of waste produced by visitors *(Lawhon, 2018)*. Activities such as waste separation, composting or educational initiatives could foster a culture of environmental stewardship. The problem is vast and covers areas such as waste generation, ways in which people dispose of trash, type of waste, placement of receptacles and their design, to name a few.

Park managers want to provide the ultimate visitor experience, but at the same time, they have a responsibility towards the nature they are trying to protect. Existing studies analyse visitor behaviour patterns and try to determine the best placement of receptacles to maximise recycling rates. It has been proven that placing receptacles close to the park entry can simplify the access for disposal trucks but will make it less likely that visitors will correctly dispose of the trash *(N.J. Van Doesum et al., 2021)*. The significance of recycling stations near the picnic areas has been determined.

With nearly three-fourths of visitors correctly disposing of their trash and recycling *(Lawhon, 2018)*, it can be argued that parkgoers have the knowledge and will to recycle. This could be used to further educate them on the matter.

A study by Keramitsoglou and Tsagarakis *(Keramitsoglou, K. and Tsagarakis, K., 2018)* found that various design elements of a recycling bin, such as its shape, size and colour, can facilitate higher recycling rates. Consistent and correct signage can be equally crucial as users seek to dispose of their waste quickly and effectively *(Poirier, Brain and Barajas, 2013).*

Some argue that a national park's most effective recycling system would be a so-called "leave no trace" policy *(Leave No Trace, 2024).* The visitors are asked to dispose of their trash as they return home. Another interesting

Ditchling Beacon

Photo: https://www.photohound.co/spot/ditchling-beacon-south-downs-np-1176

Photo: https://promnicesk.live/product_details/35418307.html tactic is to place "watching eyes" near the recycling/disposal stations to encourage correct disposal behaviour *(N.J. Van Doesum et al., 2021).*

Plastic waste is one of the most voluminous and easiest to recycle. If 75% of park visitors report bringing along a reusable bottle *(Lawhon, 2018),* it could be argued that the most efficient solution would be to provide broad access to drinking water sources throughout the park area.

Lastly, more innovative solutions exist on the market, like smart waste bins (Bin-e) or trash compactors. Could they be adapted and used in a national park setting?

The Goal

This project aims to design and develop an effective method to encourage recycling and minimise the amount of waste disposed of within a national park setting.

Bin-e

Photo: https://bine.world/

User Trip

The user group has been described as active people who enjoy walking and exercising in nature *(The Open University, 2023a).* To better understand the needs of that user group *(The Open University, 2023b)*, I took a user trip to identify existing recycling receptacles' designs in my city.

This user trip was conceived from the perspective of a typical user: a visitor who wants to dispose of their trash and recycling without much hassle.

During the trip, I observed the materials used in the receptacles, their colours and sizes, their placement, ease of use, and the signage provided. These details are crucial in understanding the design and usability needs of the active user group.

Materials

All the receptacles I identified were made of metal alloys or polymers. The polymer (plastic) receptacles were fitted with wheels (left), which suggests they might be permanently kept elsewhere. Sometimes, the metal receptacles are placed underground (right). Some metal receptacles are fitted with rubber flaps around the entry (middle).

Colours

The receptacles intended for organic waste are green. This is one of the two colours (the other is brown) typically used for that type of waste *(Keramitsoglou and Tsagarakis, 2018).*

The receptacles for recycling glass are dark blue, with colourful rims around the opening, signifying which glass colour they serve. The general waste is usually disposed of in a grey or metal receptacle. Next to black, this is also a standard choice for this type of waste.

Finally, the recycling station for plastic waste, which includes PET bottles as well as other polymers, are pale green. A bus station receptacle for recycling, however, is using blue signage for the same type of recycling.

Green receptacle for the organic waste (right).

Blue receptacles for recycling of glass bottles

General waste receptacle (top left); plastic recycling station (right); bus stop recycling station, PET bottles receptacle in blue (bottom left)

Location of the receptacles

Typically, the receptacles are arranged in a recycling station throughout the city. At such a station, glass and metal can be disposed of. Other smaller bins are provided in frequented areas, like bus stops or parks with dedicated picnic areas. These receptacles are usually made of metal, which suggests robustness and ability to withstand weather conditions *(The Open University, 2023c)*.

Receptacles for plastic waste are placed near shops and markets, making it easier for people to dispose of this type of waste when they go to the store.

Metal receptacle at a local park.

Ease of use

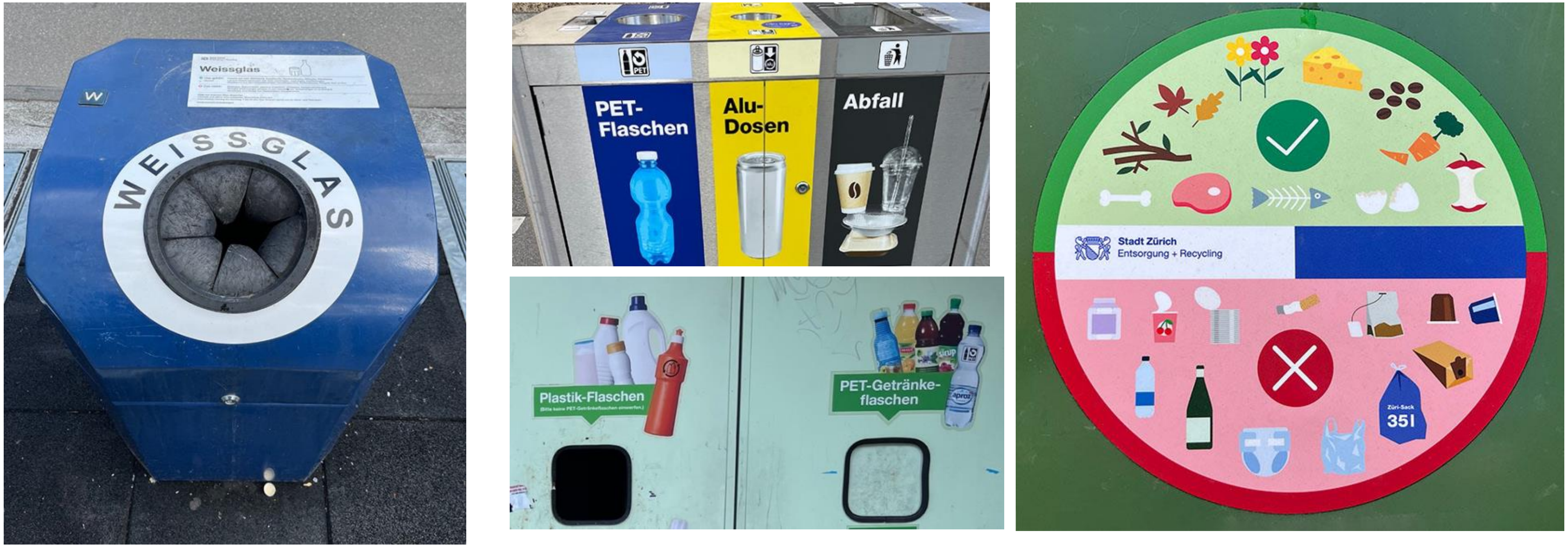
Most receptacles have openings at a height comfortable for an adult. The smaller receptacles at parks and bus stations can also comfortably be used by children or adults in wheelchairs.

All the receptacles were easy to use with just one hand. The only one that required both hands was the metal, built-in waste container for general waste.

Opening of the metal container.

Signage

Proper signage is key to a successful recycling campaign *(Poirier, Brain, and Barajas, 2013).* The types of signage I found included different colours and names of recycling material (left), as well as pictures of the type of materials that the receptacle was meant for (middle). The organic waste receptacle also had detailed information about what type of organic waste belongs in that bin (right).



Different types of signage on recycle receptacles

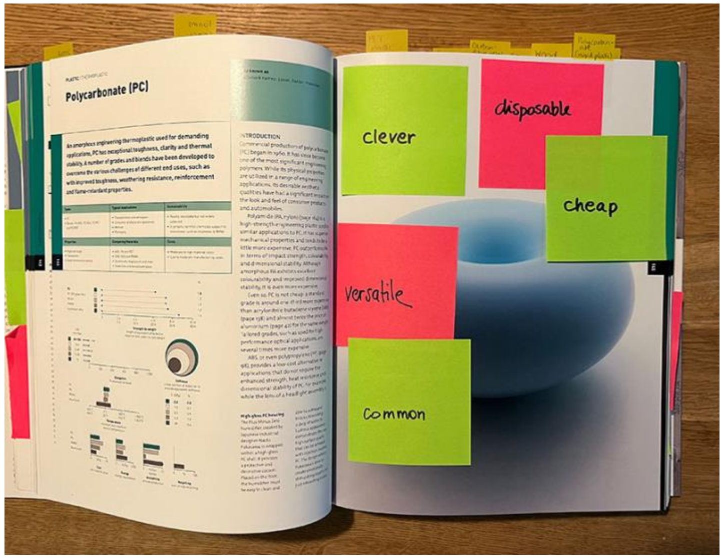
Brainstorming: perception of materials

The last part of my research included conducting a brainstorming session to discover how users perceive different materials. Since most of the receptacles I identified during my user trip were made of metal or polymer, I focused the session on those materials. New materials offer creativity opportunities *(The Open University, 2023d)*. Therefore, I decided also to include some less common materials, like glass, wood, or clay.

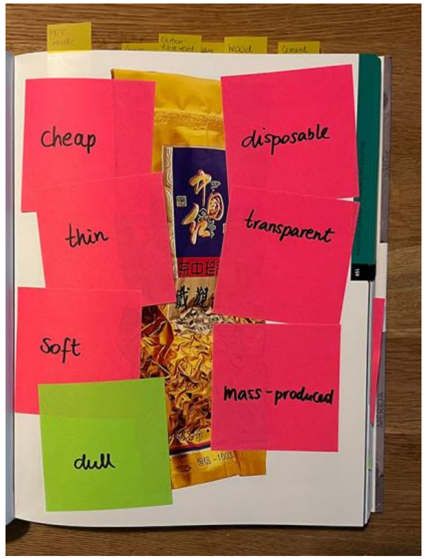
I leveraged the Materials Sourcebook for Design Professionals as a foundation for my brainstorming session. This resource allowed me to present each of the selected materials to the group. We then used the product perception attributes and the aesthetic attributes lists *(The Open University, 2023e)* to write down our personal perceptions of the materials on sticky notes.

Metal

PC Polymer



PET Plastic



Carbon fibre

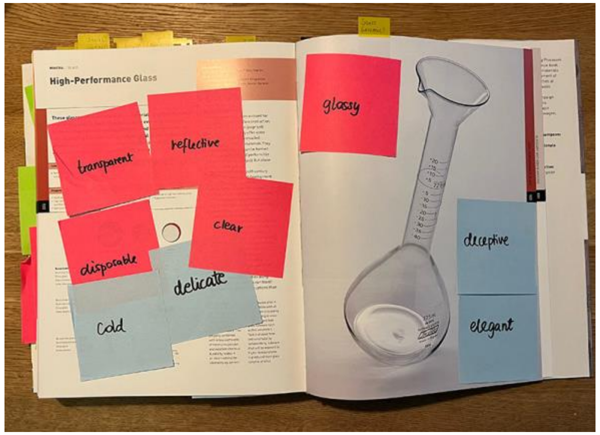
Wood

Clay

Generally, **metals and natural materials were perceived positively** (honest, elegant, lasting), whereas polymers, especially PET and PC, were judged as disposable, common, and cheap. Carbon fibre was perceived as trendy, clever, and exclusive. Both cement and metal were judged as lasting, whereas PET or glass were judged as disposable. Wood and clay were associated with handmade, classic products. At the same time, the more futuristic materials were more exclusive and expensive.

Cement

Glass



The materials' perceptions overlap and sometimes contradict each other. The perception of natural materials as being more classic and closer to nature was well-established throughout the group. This is an essential insight since the project aims to design and develop a solution for a nature park.

The general perception of polymers as cheap and disposable relates to what people judge as "plastic". Carbon fibre, a polymer composite, was assigned more positive attributes.

Design Brief

Goal

To design and develop an effective method to encourage recycling and minimise the amount of waste improperly disposed of within the park.

Context: Different paths to less waste

Nature parks provide an excellent opportunity for visitors to relax and undertake activities like cycling or hiking. But they are also created to protect nature. How can we ensure that the visitors who frequently bring picnics or drinks properly dispose of the waste they produce?

Strategic placement of receptacles is critical to fostering proper waste disposal within parks. Research indicates that park-goers are willing to engage in recycling practices, with **consistent receptacle design** and clear signage proving most effective in guiding their disposal behaviours *(Poirier, Brain, and Barajas, 2013)*. Additionally, maintaining the cleanliness and orderliness of receptacles is advised to sustain user engagement *(Cooley, 2021)*.

Innovative approaches include incorporating "watching eyes" stickers strategically positioned to psychologically influence visitors to present promising avenues for encouraging responsible waste management. Furthermore, the **provision of accessible drinking water sources** throughout the park could mitigate the amount of PET bottles disposed of *(Lawhon, 2018),* a prevalent waste type alongside food waste, glass, metal, and paper.

Moreover, adequate receptacles often feature **informative signage**, employing colour-coding, textual cues, or pictograms to indicate the recyclable materials accepted *(Poirier, Brain and Barajas, 2013)*.

Receptacles are predominantly composed of metal alloys or polymer composites, with a preference for metal in outdoor settings due to its durability and perceived longevity. Findings from the brainstorming session underscore a positive perception of metal. It is described as lasting and modern.

The research pointed to innovative solutions in addition to the standard receptacle, such as a smart waste disposal system or a waste compactor.

Constraints:

- **Accessibility:** the solution must be accessible to visitors of different body sizes. It must allow for a one-hand-only operation and must not require heavy lifting.
- **Understandability:** a good design must be easy to understand.
- **Weather resistance:** the design must consider the elements. The materials used must withstand different weather conditions.

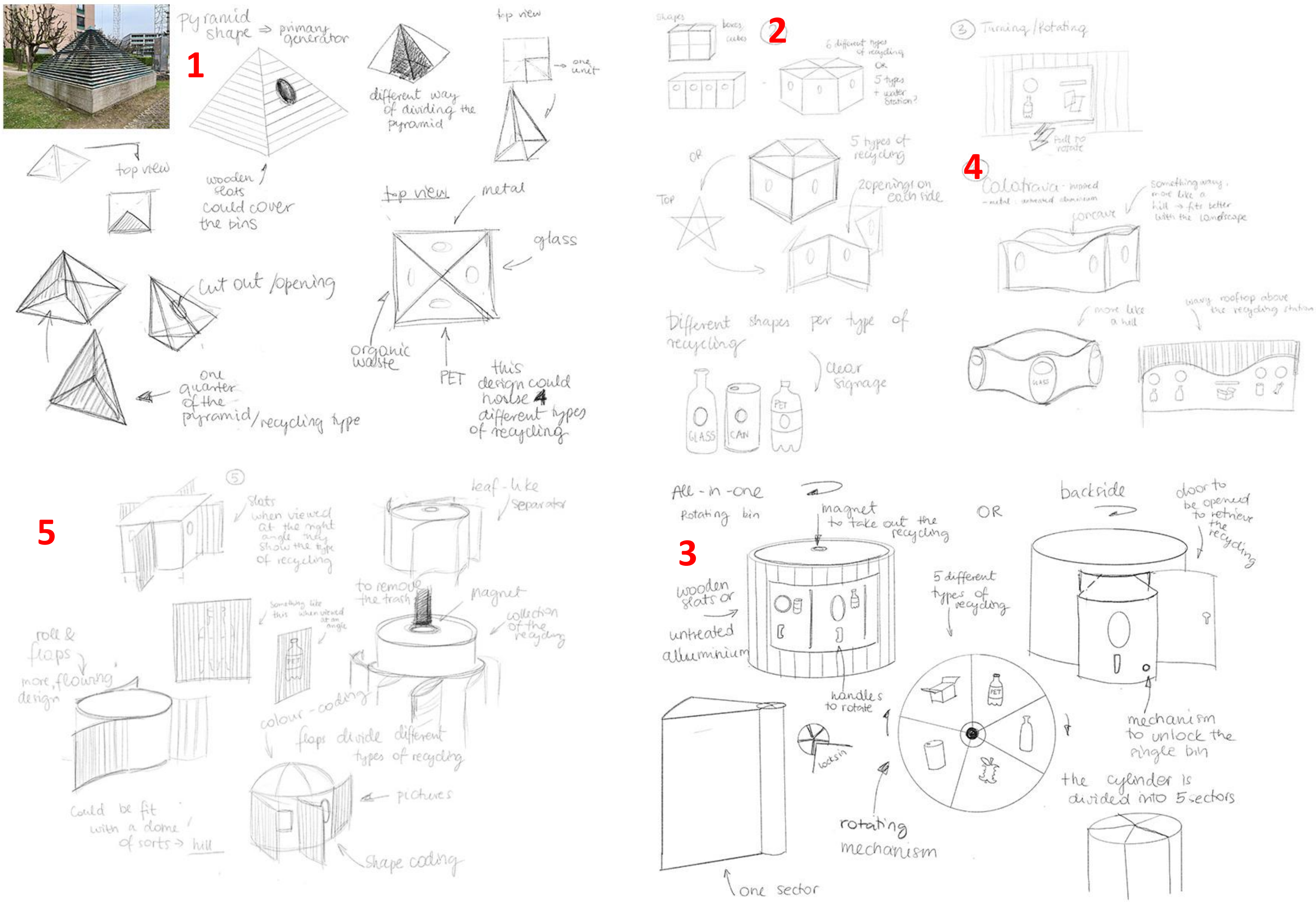
Criteria:

- **Aesthetics:** The perfect solution should match the setting of a nature park.
- **Scalability:** The design should ideally be scalable and replicable in other national parks.

Vision

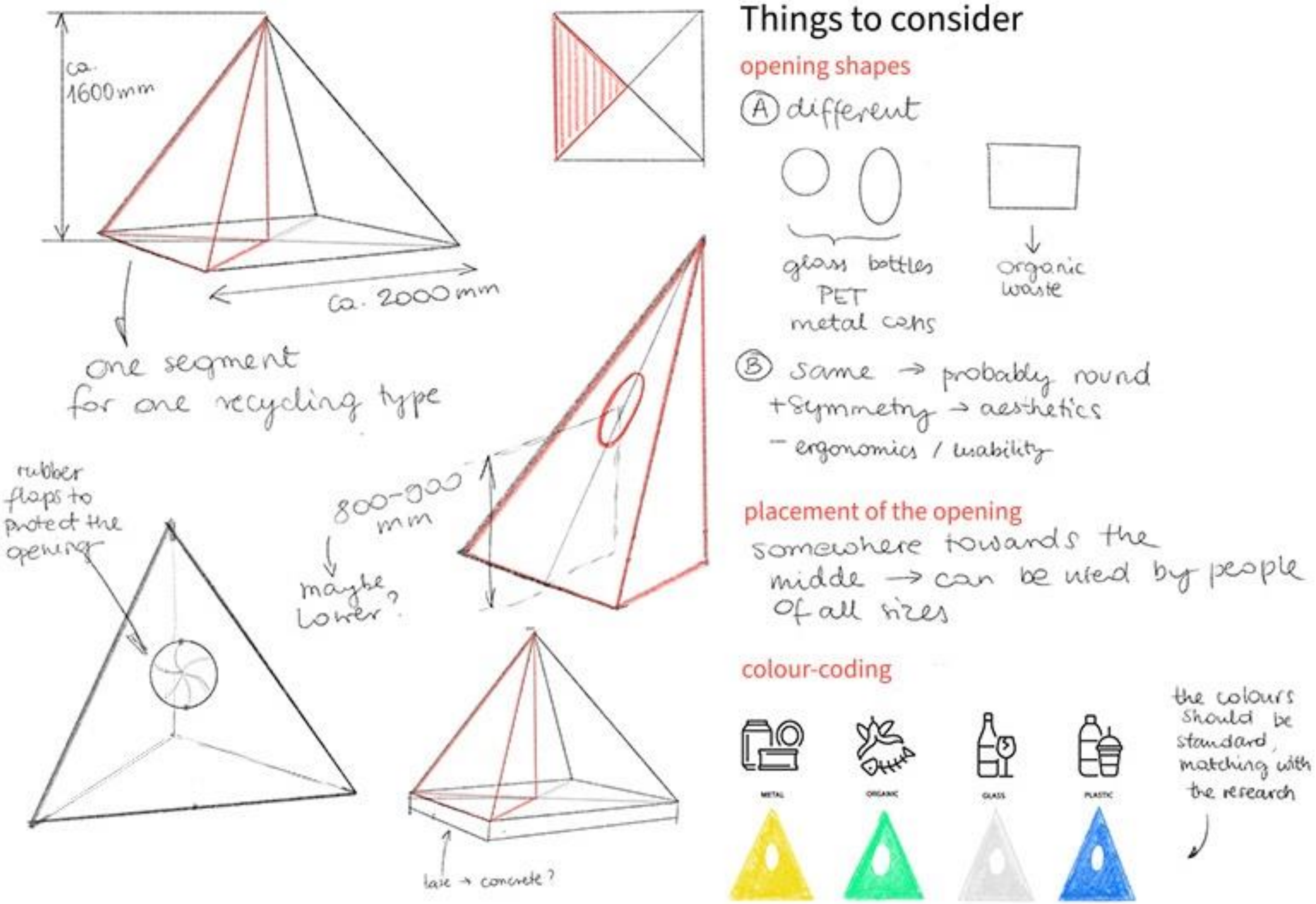
Natural materials + metal
What to recycle?
PLASTIC
GLASS
ORGANIC
METAL
PAPER
Clear signage
Recycling centre

Concept design



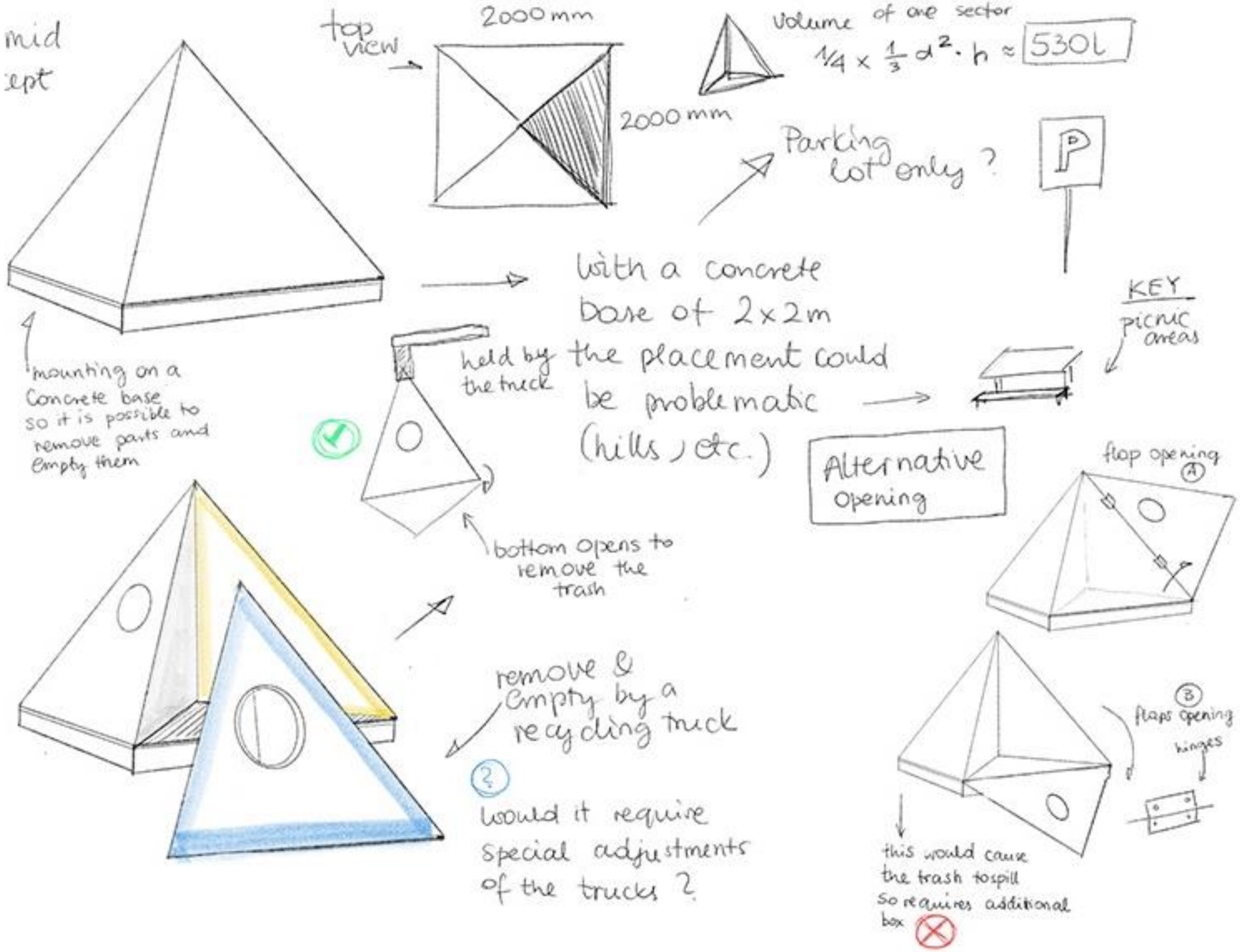
Idea 1: Pyramid-shaped recycling station

This idea was based on a primary generator *(The Open University, 2023f)* – a pyramid in a residential area. The receptacle would be divided into 4 equal parts, providing space for 4 different types of recycling. Because of the location (nature park), the most popular types identified would be PET plastic, metal, glass and organic waste.



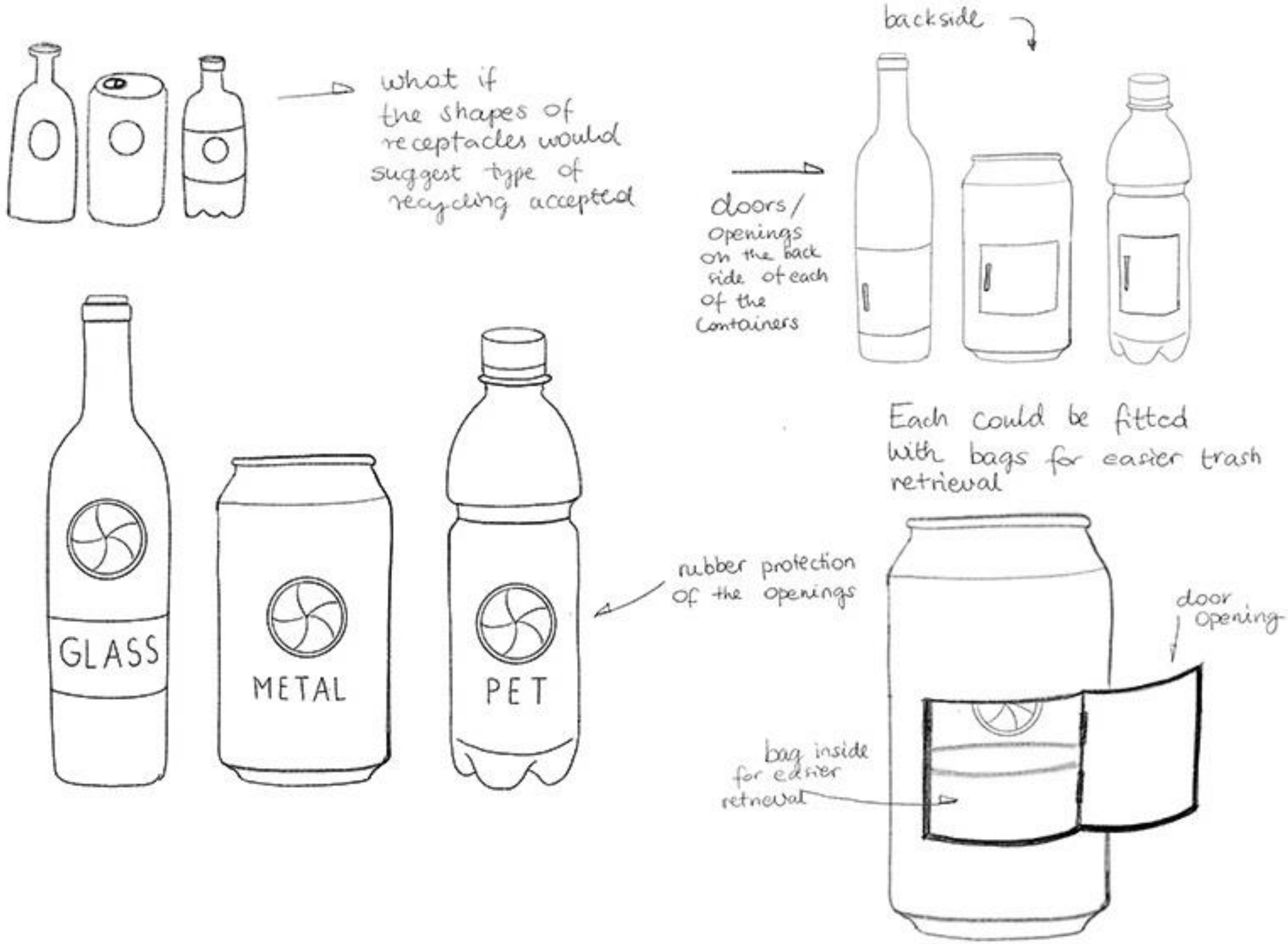
Further exploration revealed significant challenges. For instance, the pyramid must be placed on a concrete base, ensuring the recycling doesn't touch the ground directly. Constructing such a system on a hilly, protected terrain poses a considerable challenge.

The second problem identified is retrieving the waste from the bins. I considered opening the sectors in various ways, but this could lead to a spill during the retrieval process. Another solution would require retrofitting the recycling trucks.

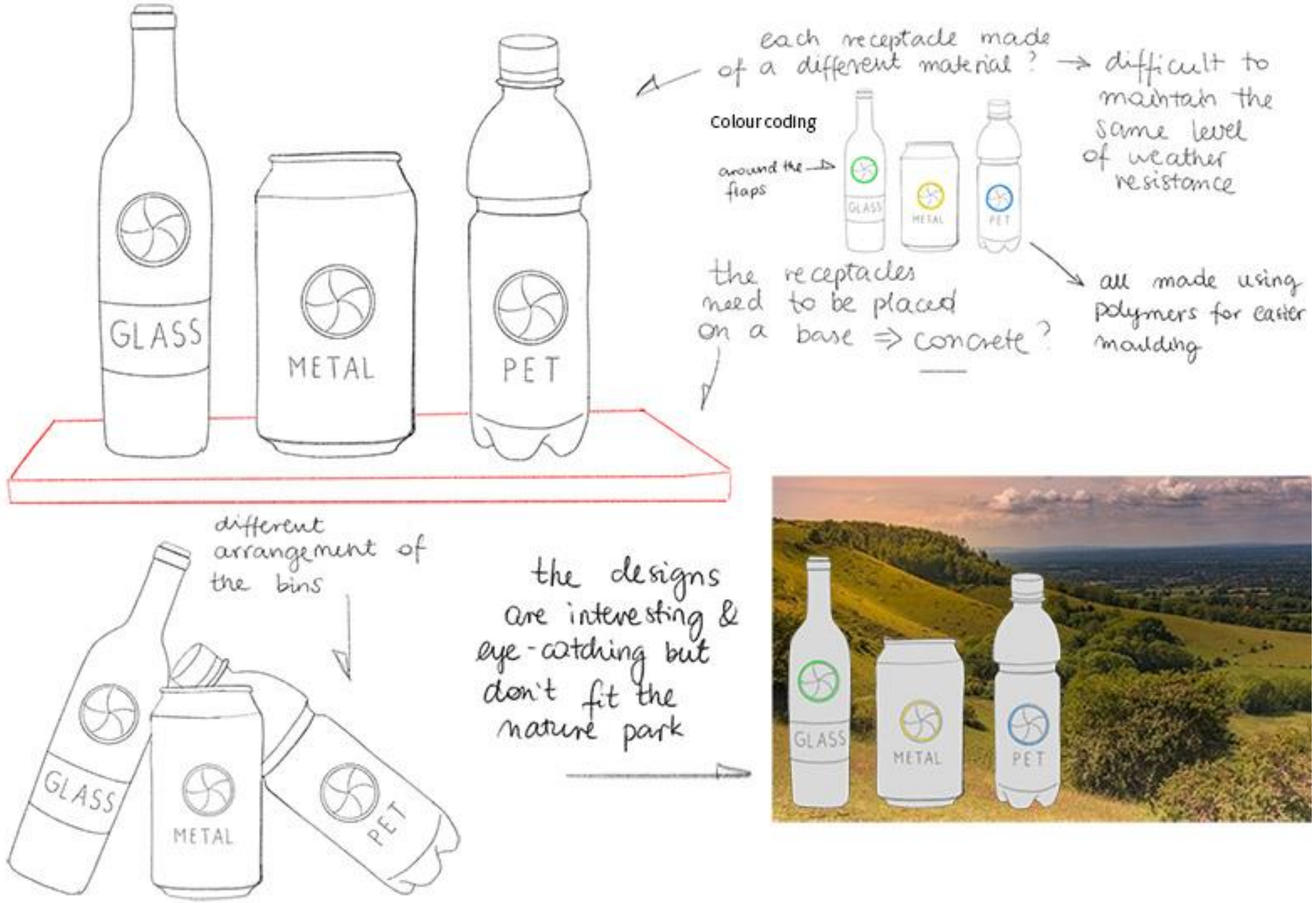


Idea 2: Giant containers

This concept is based on an analogy *(The Open University, 2023g)* to the materials that are to be recycled. For that purpose, I chose the three types of common recycling materials: PET, metal, and glass.

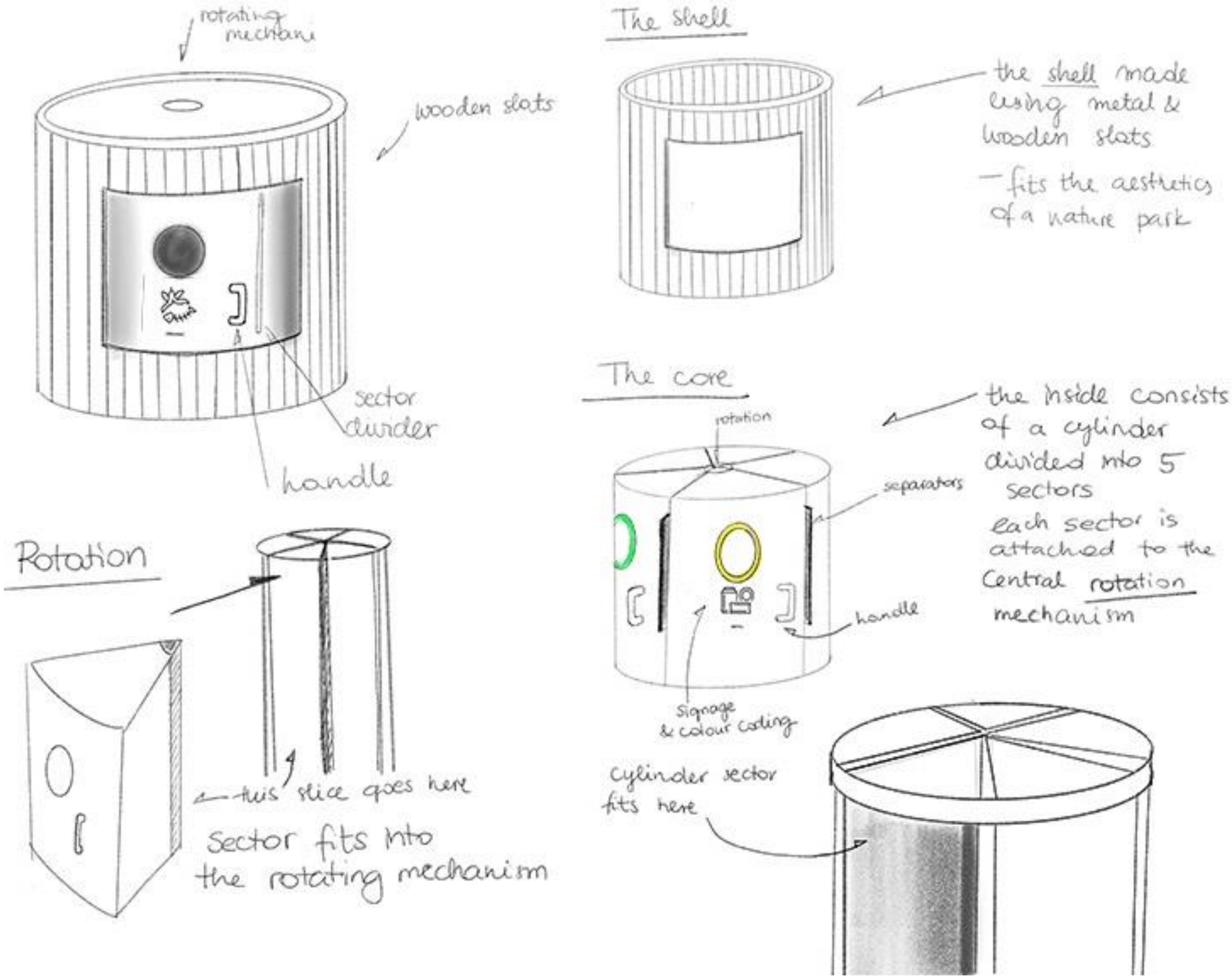


Aesthetically, this design does not fit the environment. It would better suit, e.g. a futuristic, modern building or even a standard recycling station in an inner city.

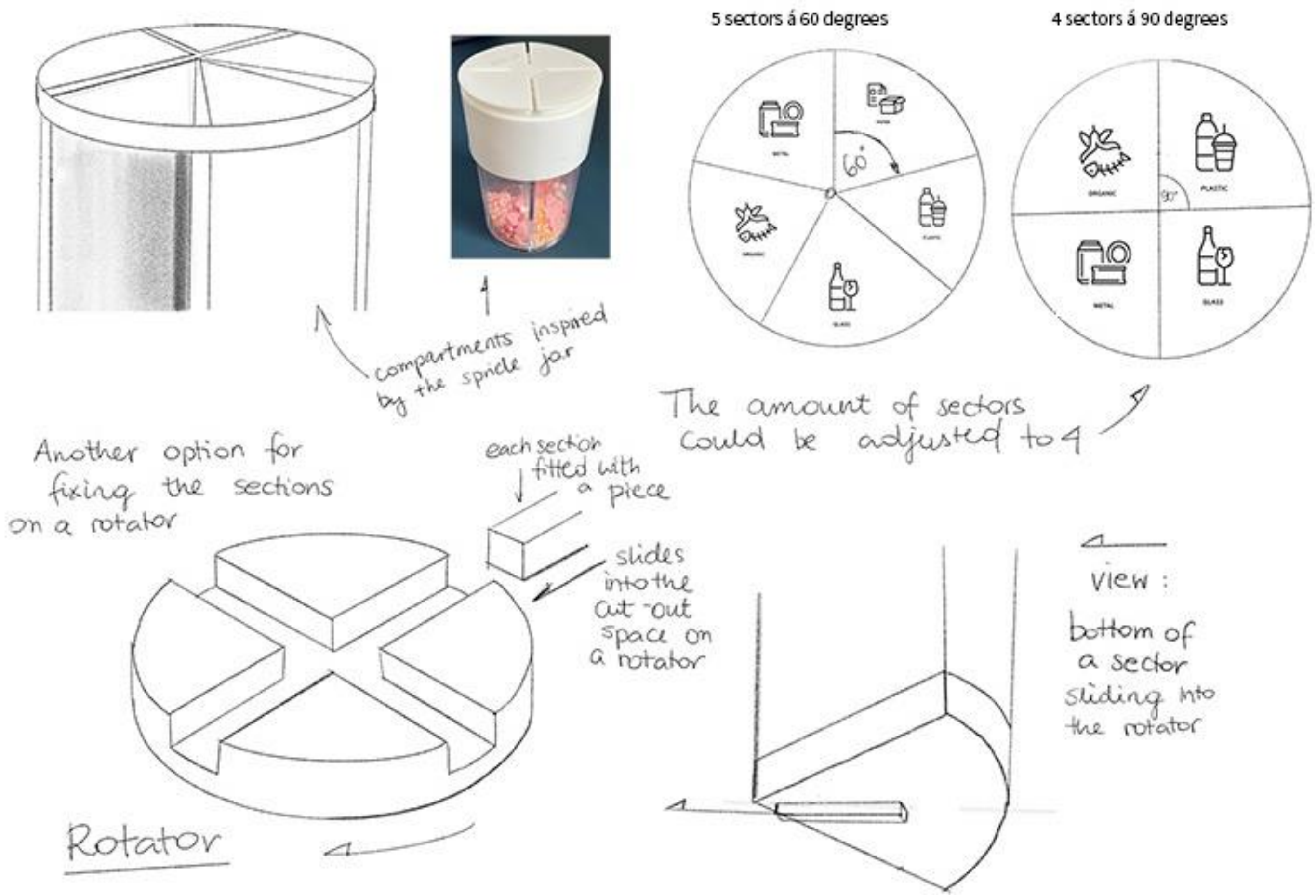


Idea 3: Rotating receptacle

This idea transfers *(The Open University, 2023h)* the solution from a jar of sprinkles. A cylindrical shape is divided into sectors, each serving as a receptacle for a different type of waste.

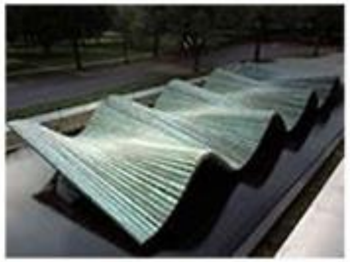


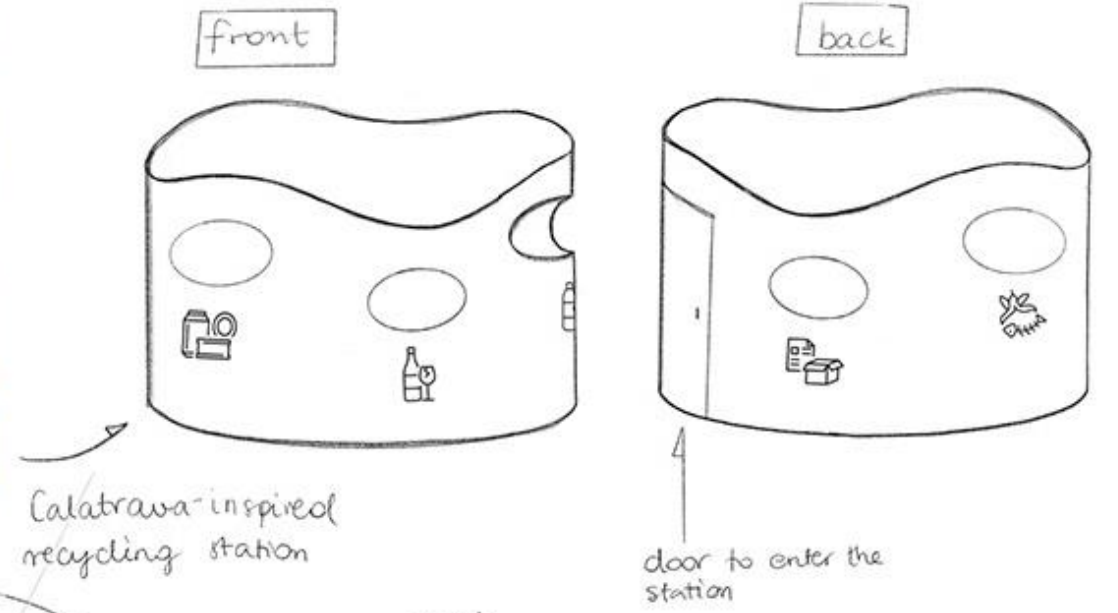
This idea incorporates a transfer from a different product – a sprinkle jar. It also uses the principle of rotation and involves an exciting idea for fixing the sections on a centrally placed rotator. The rotating receptacle could be placed inside a shell made from metal and wooden slats. These materials would correspond with the nature of the location in which they are placed.

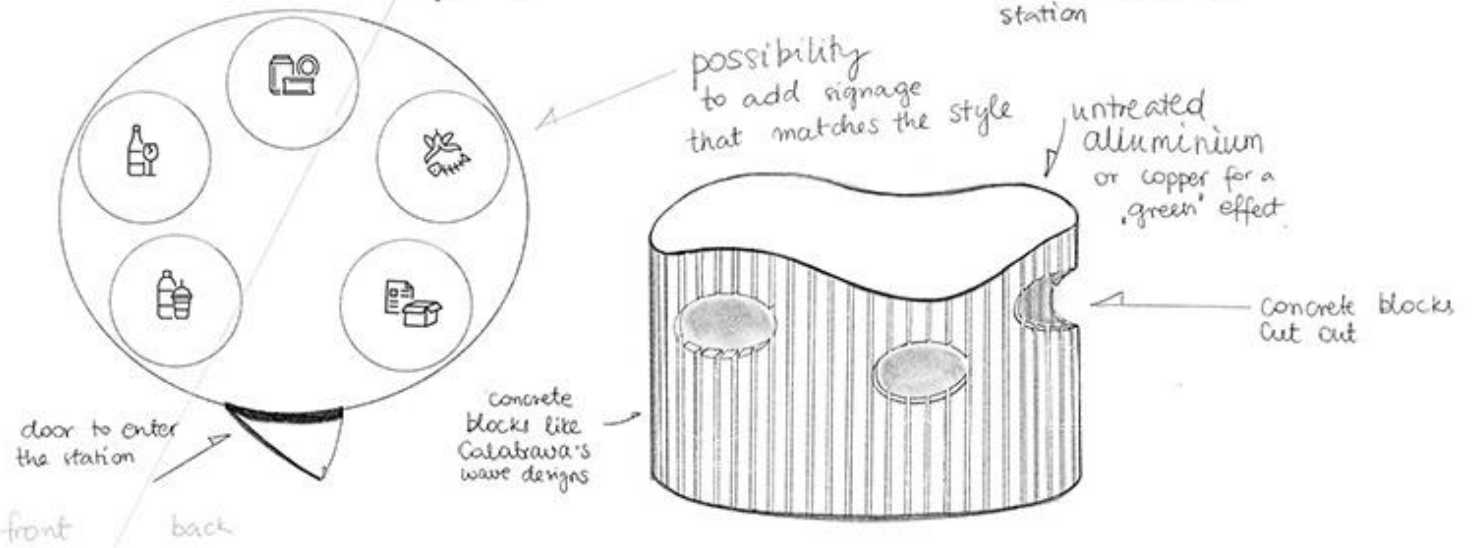


Idea 4: Inspiration: Calatrava

This idea was inspired by the works of the famous architect Santiago Calatrava *(Calatrava, 2024)*. His works (photos below) frequently employ bold waves and unorthodox shapes. Those fluid, flowing shapes are examples of nature-inspired design *(The Open University, 2023i)* and could work well in a nature-preserving park.

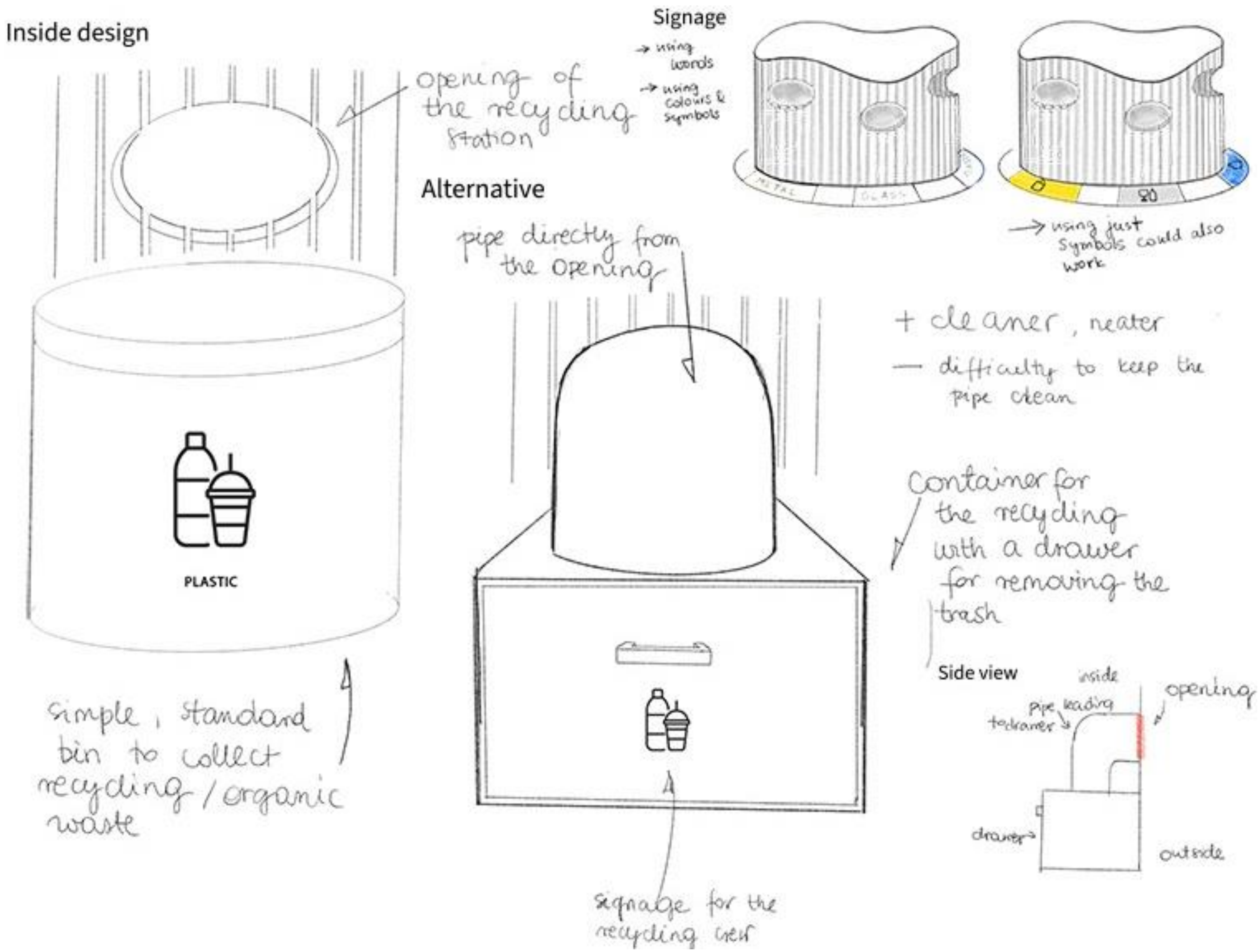






This wavy recycling station would house receptacles for different types of recycling. I explored various options for adding signage. I decided the signage must be placed on the floor to make the design work well.

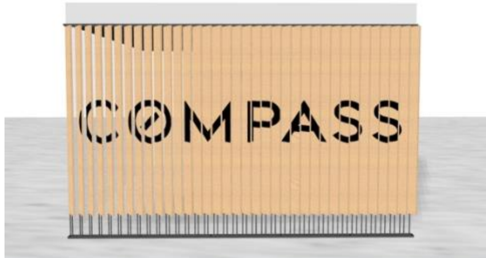
Inside the recycling station, a pipe from the opening leads directly to a dedicated drawer. This ensures that any waste that doesn't make it into the receptacle is safely collected, minimizing the risk of environmental contamination.

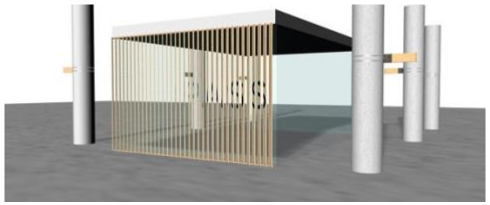


Idea 5: Integrated signage

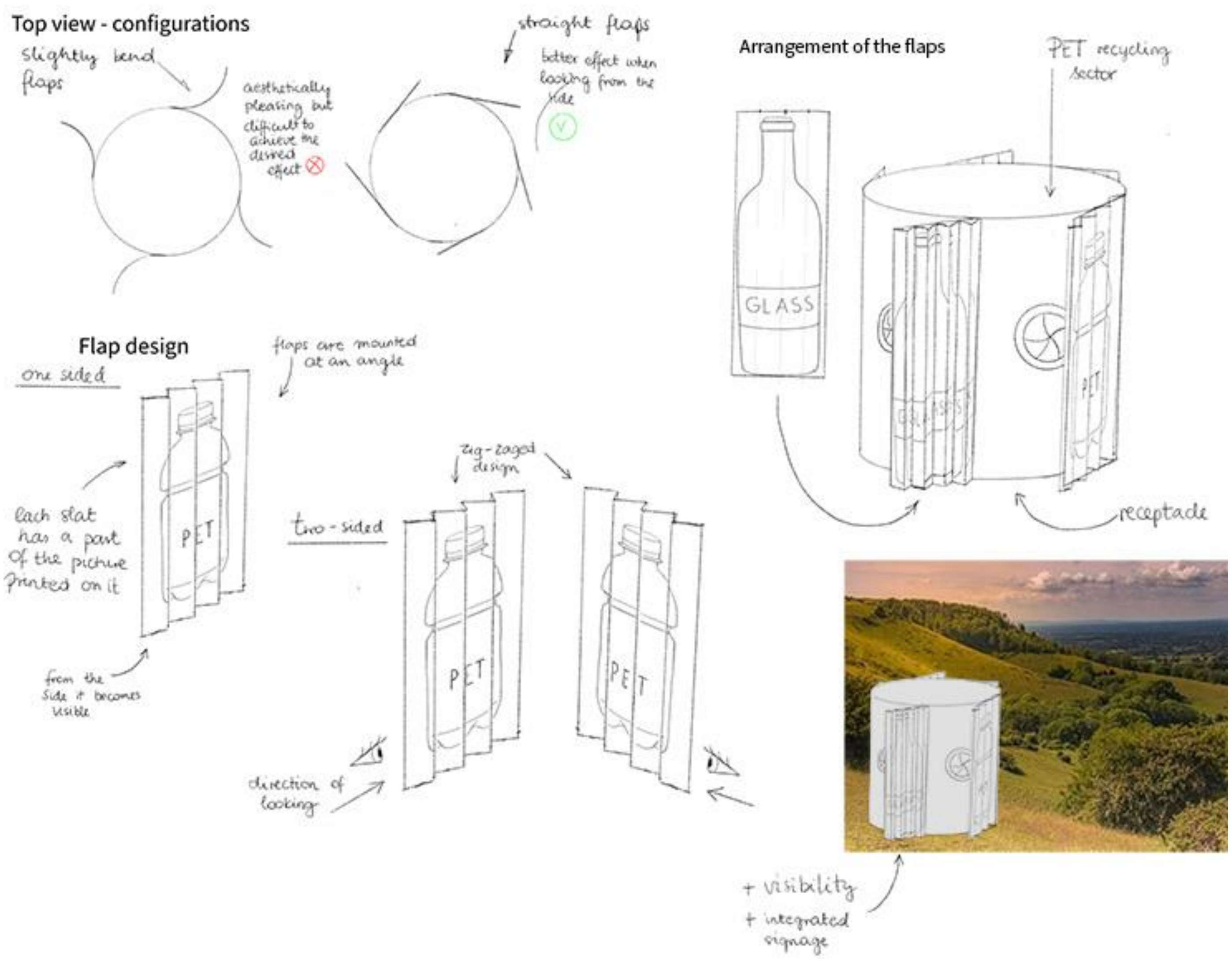
The challenge here was to integrate the signage into the receptacle's design. This idea is inspired by an optical illusion, where the picture is visible from the side but somehow gets distorted when approached from the front.

During the research phase, I identified a similar design produced by the Tinkering Monkey studio (link below).

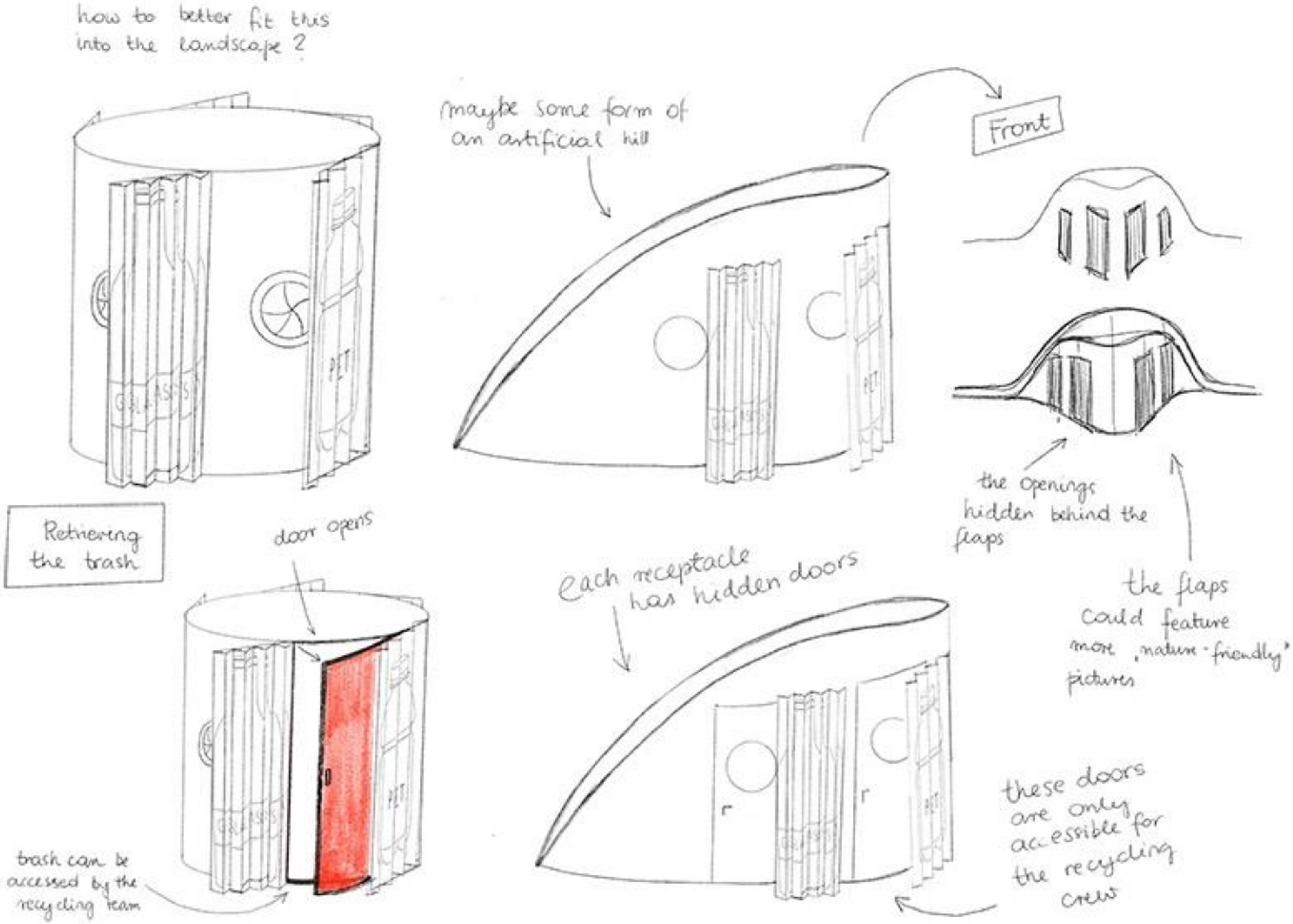




Reference link & images above:
https://www.tinkeringmonkey.com/behind-the-scenes/now-you-see-it-now-you-dont-behind-the-magic-of-a-disappearing-sign/



The result is a combination *(The Open University, 2023j)* of the previous ideas and the research on optical illusions. The central theme, integrating the signage into the design, has been broadened by better integrating the design with the environment in which it will be placed.



Selection Matrix

Criteria	Idea 1 Pyramid	Idea 2 Giant containers	Idea 3 Rotating receptacle	Idea 4 Calatrava-inspired	Idea 5 Integrated signage
Accessibility	0	0	+	0	0
Ergonomic openings	0	+	+	+	0
Easiness of access by the disposal teams	-	0	0	+	+
Signage: understandability	0	+	+	0	0
Signage: integration in design	0	+	0	-	+
Weather resistance potential	-	0	+	+	+
Aesthetics: matching the setting	0	-	0	+	+
Aesthetics: engaging design	0	+	+	+	+
Scalability	+	+	+	0	-
Total +	1	5	6	5	5
Total -	2	1	0	1	1
Total + less Total-	-1	4	6	4	4

Idea Selection

To aid in selecting the idea for further development, I employed the selection matrix *(The Open University, 2023k).* All the designs were assigned scores against the nine criteria, primarily based on the design brief. During the idea development phase, I noticed that good signage should not only be easy to understand but also integrated into the design. Another critical aspect of the receptacle design is to provide a way for the disposal team to access the bins easily.

Based on the selection matrix, I decided to develop the **Rotating Receptacle concept further (Idea 3).**

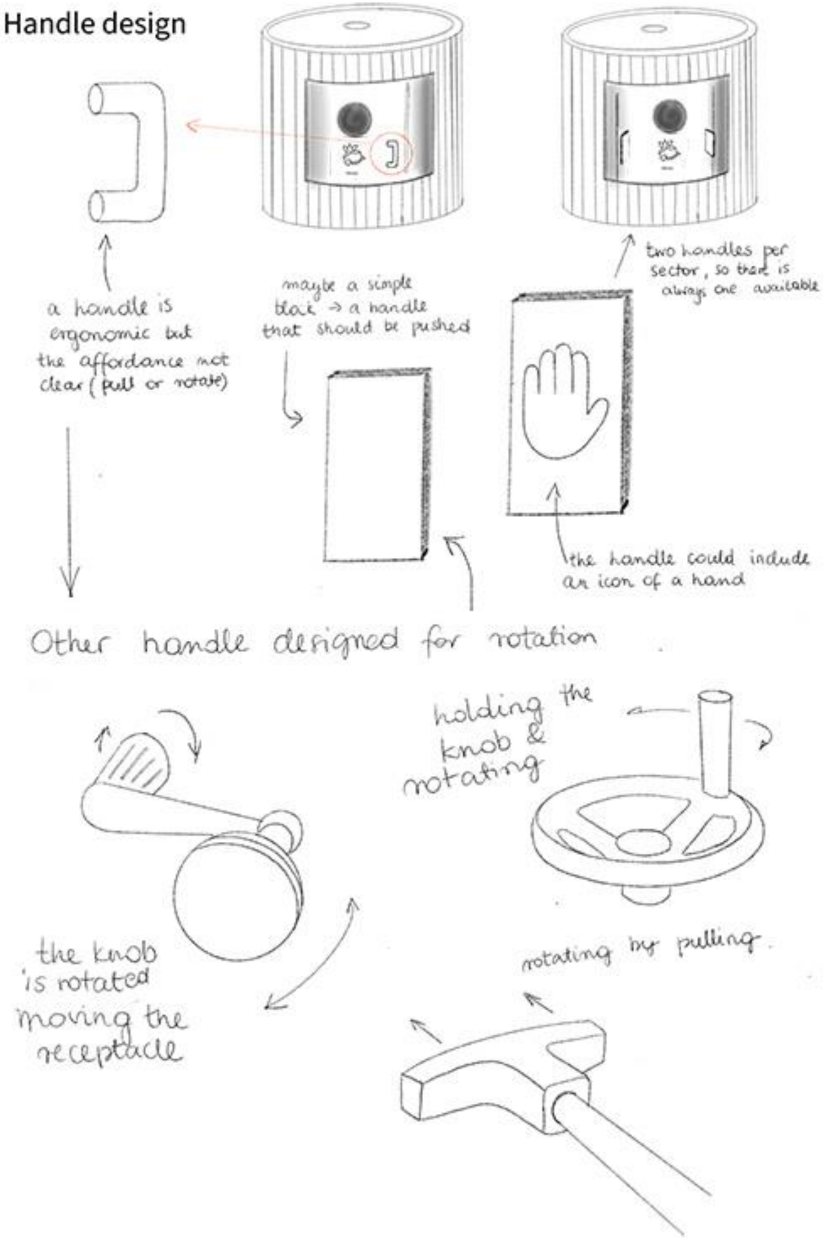
For further concept and layout design development, I will return to the three usability aspects as described by Don Norman *(The Open University, 2023l)*:

- **Visibility:** clear signage, visible openings.
- **Feedback to the user:** each type of material gives a different sound when thrown into the bin.
- **Affordance:** rotating the receptacle reveals other bins, and openings suggest the recycling type accepted.

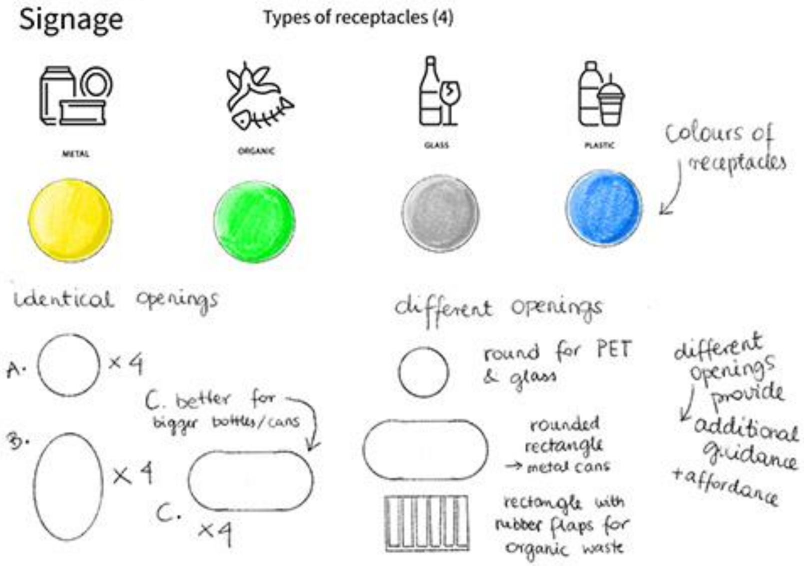
The goal is to make sure that the usability aspects are fulfilled, and all potential gaps discovered and resolved.

Concept development- elements

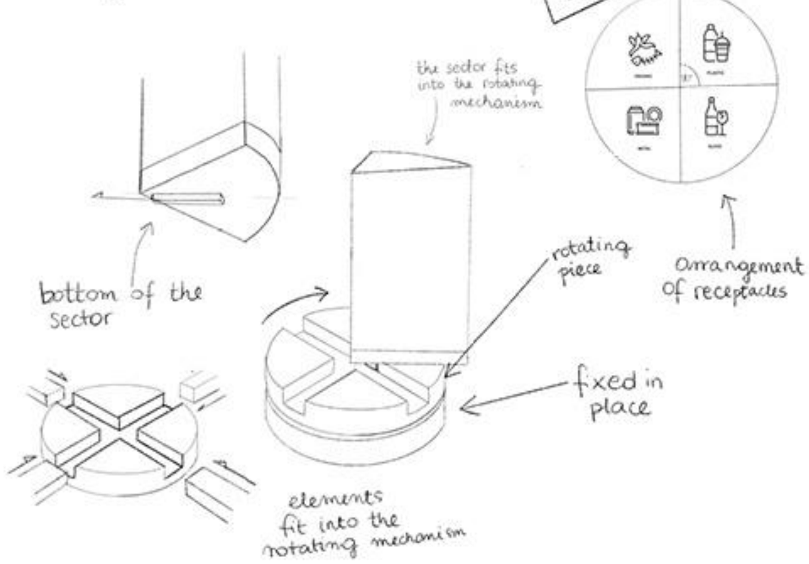
Handle design



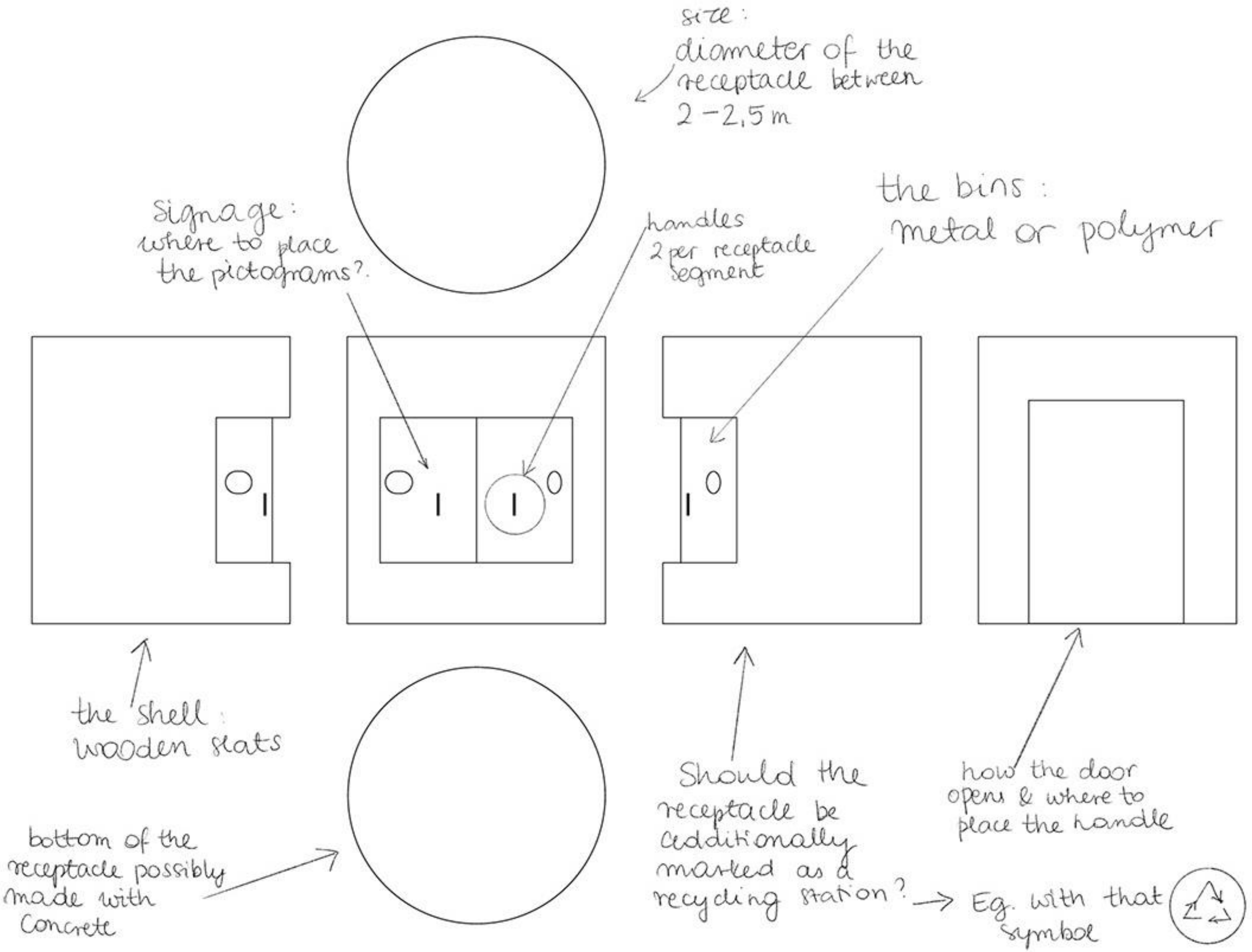
Openings Signage



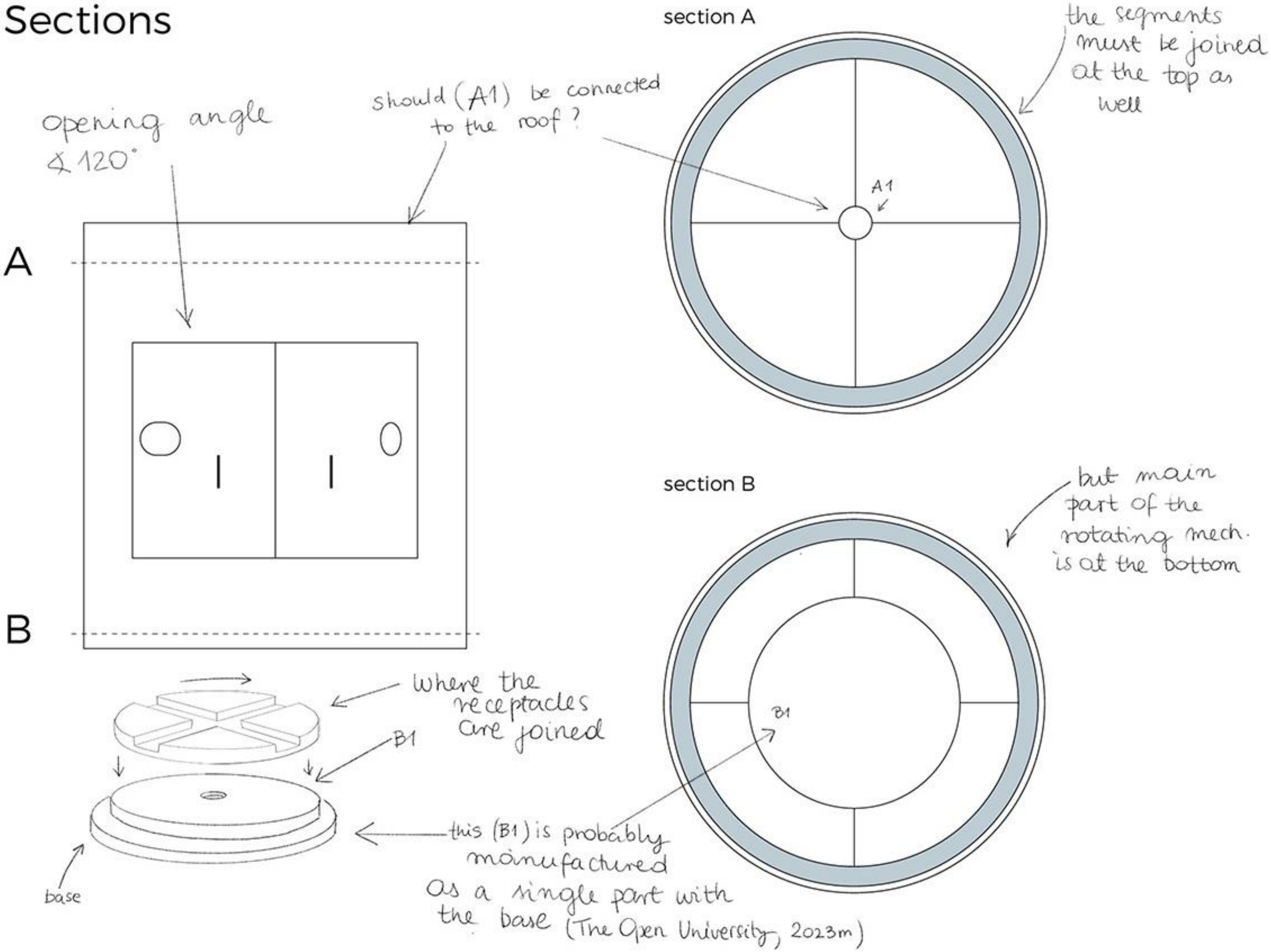
Rotating mechanism



Concept development

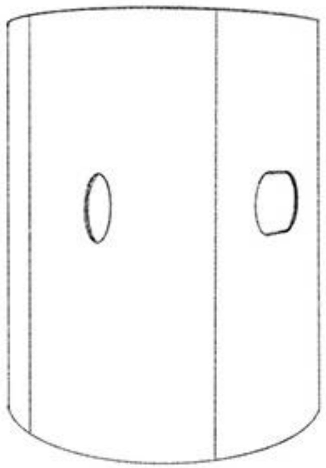


Sections

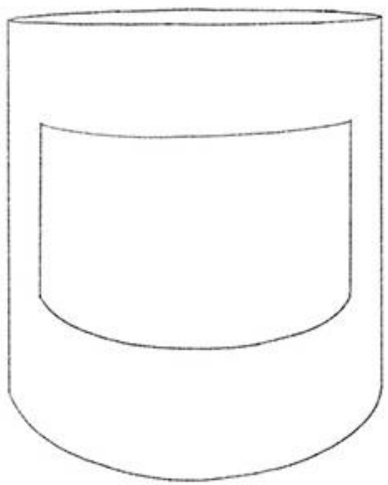

section A
the segments must be joined at the top as well
should (A1) be connected to the roof?
A1
opening angle ∡ 120°
A
B
section B
but main part of the rotating mech. is at the bottom
where the receptacles are joined
B1
B1
this (B1) is probably manufactured as a single part with the base (The Open University, 2023m)
base

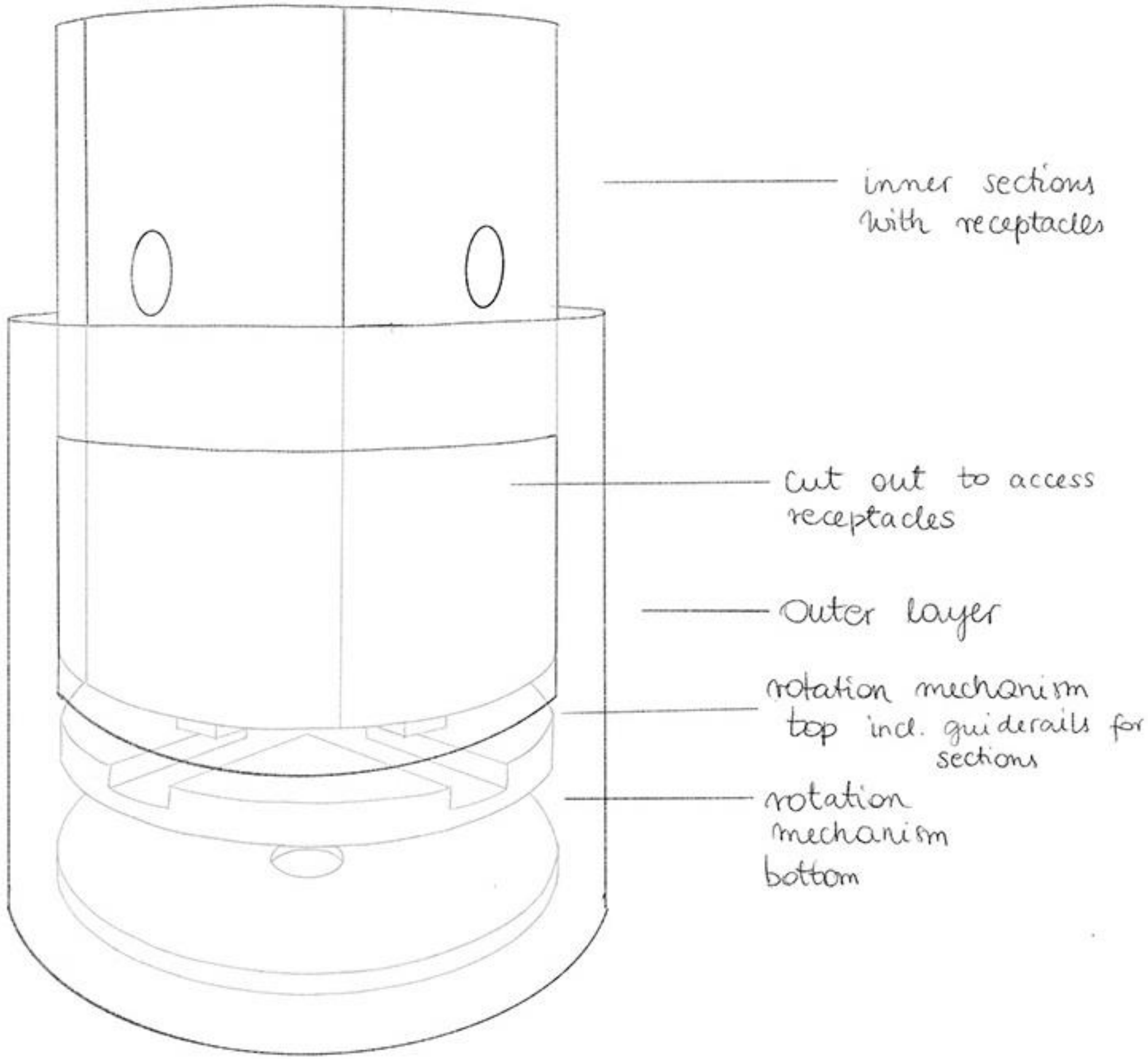
Perspective drawings

Inner section



Outer shell





Layout design

The process of creating a layout design could be simplified by defining its four main points *(The Open University, 2023n)*:

1. Identifying the main parts
2. Exploring arrangements
3. Defining the connections
4. Defining the shape, material and appearance

For this project, I decided to follow this process to arrive at the desired layout design of a recycling receptacle for a nature park.

1. Identifying the main parts.

During the concept development, the receptacle took the shape of a cylinder. The **outer shell** includes a cutout that reveals the receptacles that can be rotated (revealing further bins). The disposal workers can recover the receptacles using a door in the back of the shell. The inner part includes **receptacles divided into four sections,** forming a rotating cylinder. The sections are placed on top of a **rotating mechanism**. These are the core three parts of the design.

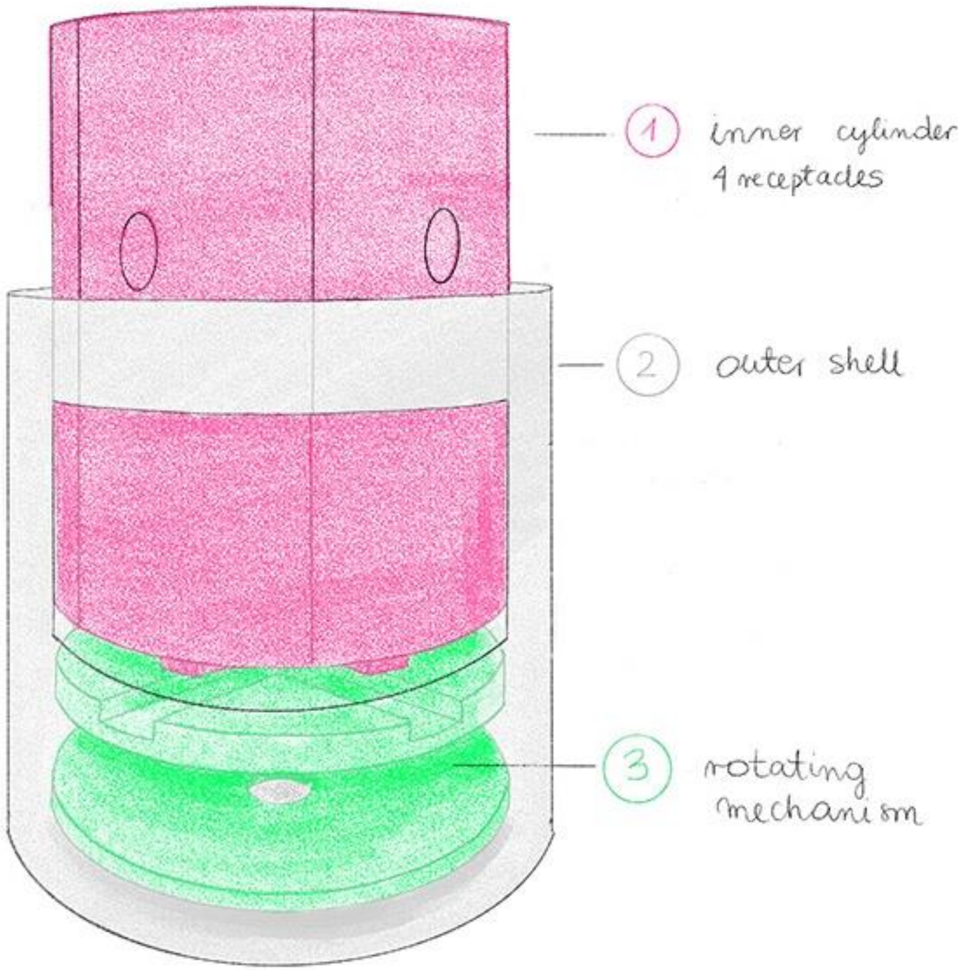
2. Exploring arrangements

By definition, configurations explore the different parts of a design and their connections *(The Open University, 2023o)*. Therefore, in this phase, I will focus on the following aspects of the arrangement:

A) size of the inner receptacle & outer shell, the opening

B) receptacle section: placement of elements (opening & handle)

C) signage



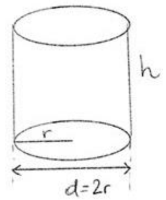
A.1) Size of the inner receptacle

Receptacle size

Standard outdoor receptacle (in CH) – 660 l

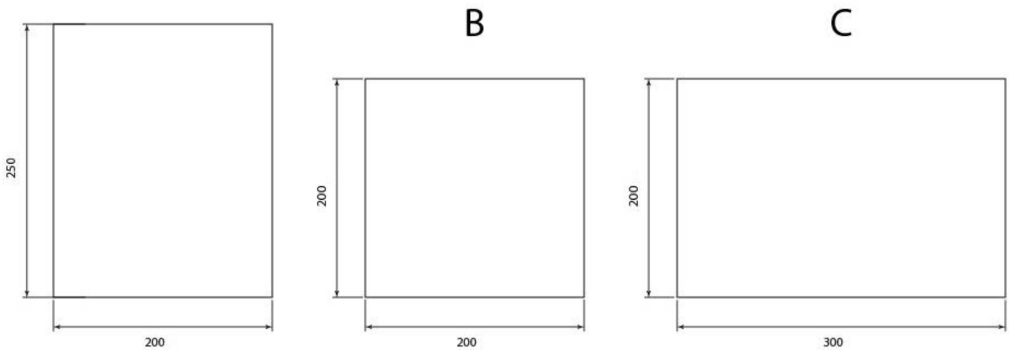
For the station of 4 it would be 4 × 660 = $\boxed{2640\,l}$ = 2,64 m³

Considering that the volume of a cylinder



$V = \pi r^2 \times h$

A



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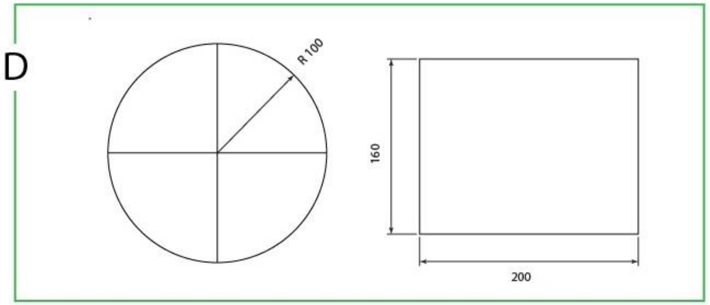


(A) Diameter = 2m
Height = 2.5 m

⇒ Volume = 7.85 m³

Divided by 4 ⇒ ca. 2m³ (2000 l) per receptacle

(B) Diameter = 2 m
Height = 2 m

⇒ Volume = 6.28 m³

Divided by 4 ⇒ ca. 1.6 m³ (1600 l) per receptacle

(C) Diameter = 3 m
Height = 2 m

⇒ Volume = 14.13 m³

Divided by 4 ⇒ ca. 3.5 m³ (3500 l) per receptacle

(D) Make the receptacle shorter so it is easier to handle for the disposal team.

Diameter = 2 m
Height = 1.6 m

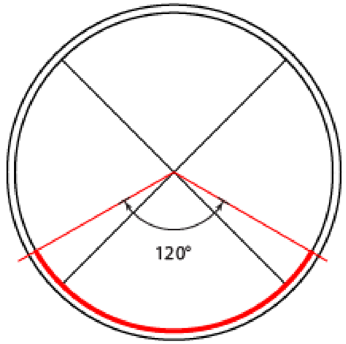
⇒ Volume = 5.024 m³

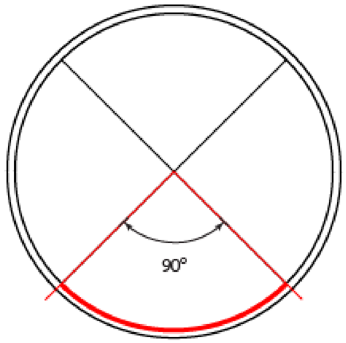
Divided by 4 ⇒ ca. 1.26 m³ (1260 l) per receptacle

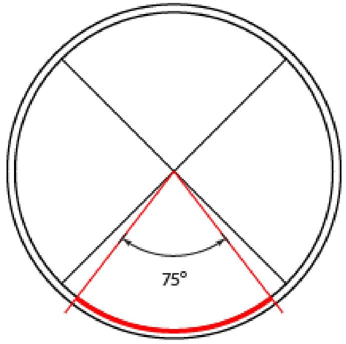
+ already twice the size of a standard (660 l)

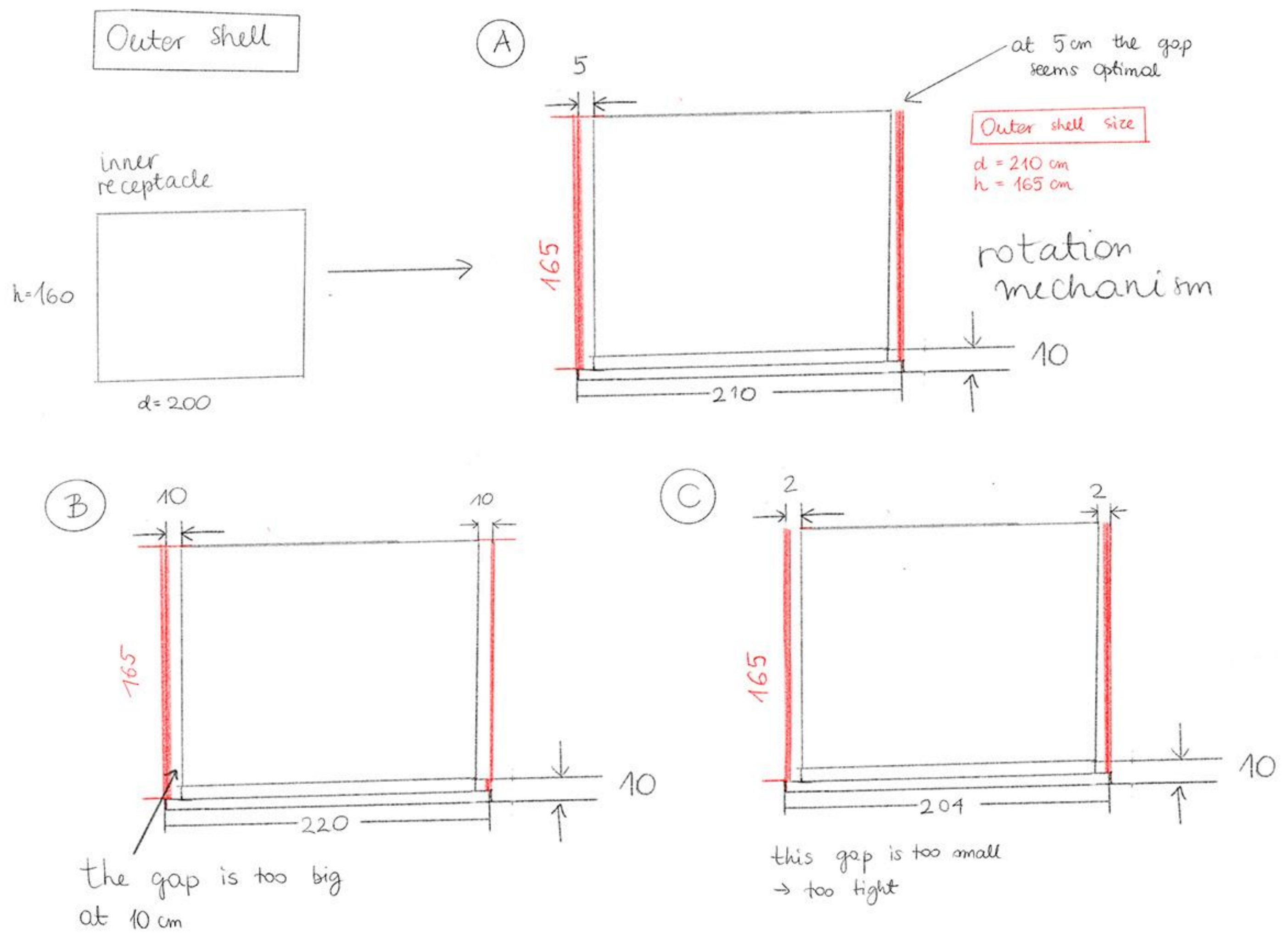
+ smaller, lighter, easier to handle

A.2) Opening and outer shell

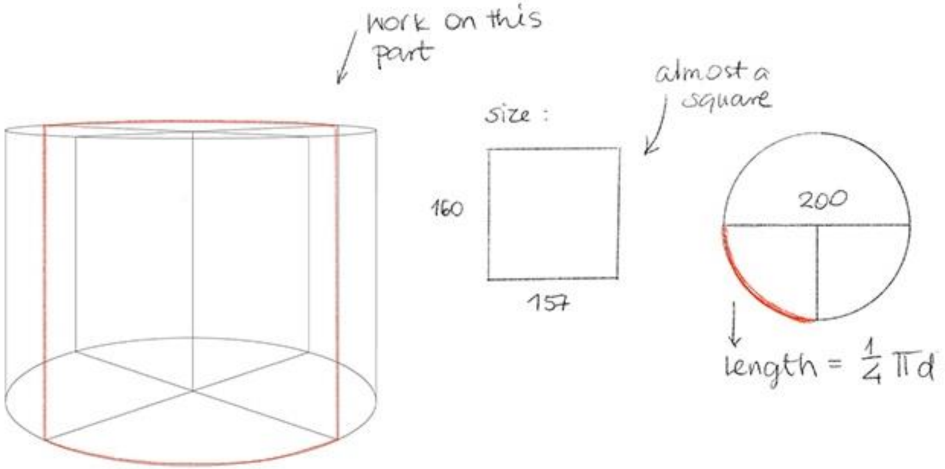








B) Receptacle: opening & handles arrangement



length = $\frac{1}{4}\pi d$ = 1.57m

Requirements (based on Project for Public Spaces, 2008) :

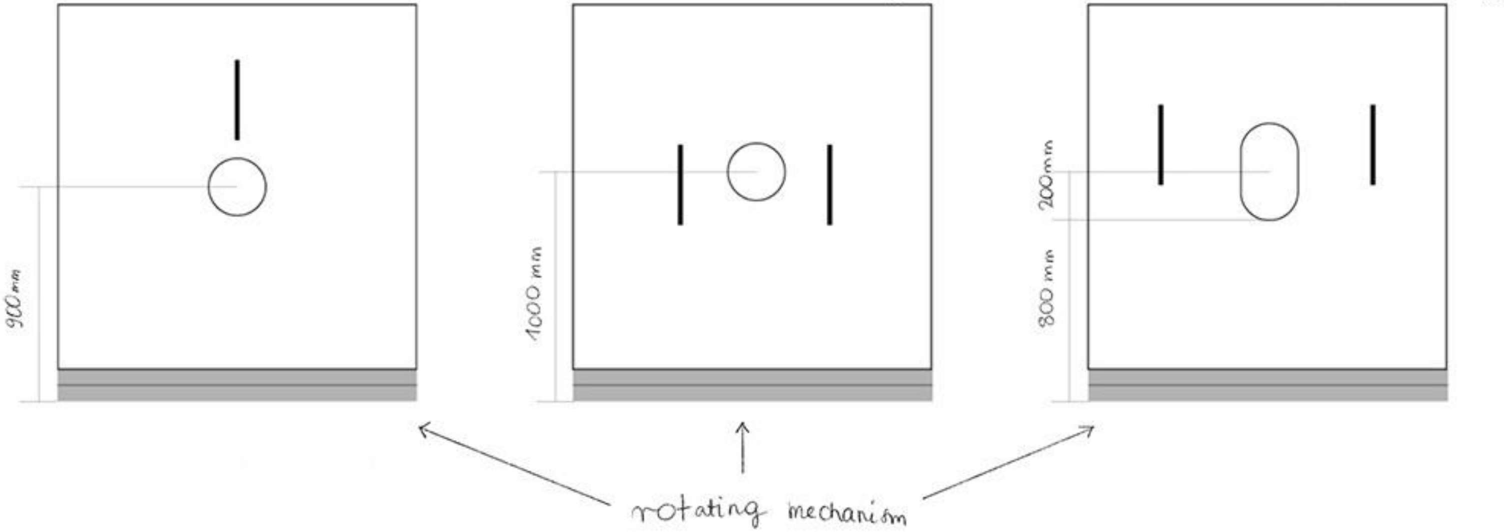
→ the ideal opening should be placed at 36 in (ca. 90 cm) ⇒ between 80 - 90 cm

→ the opening should be 10 in wide ⇒ between 20 - 25 cm diameter for a round opening

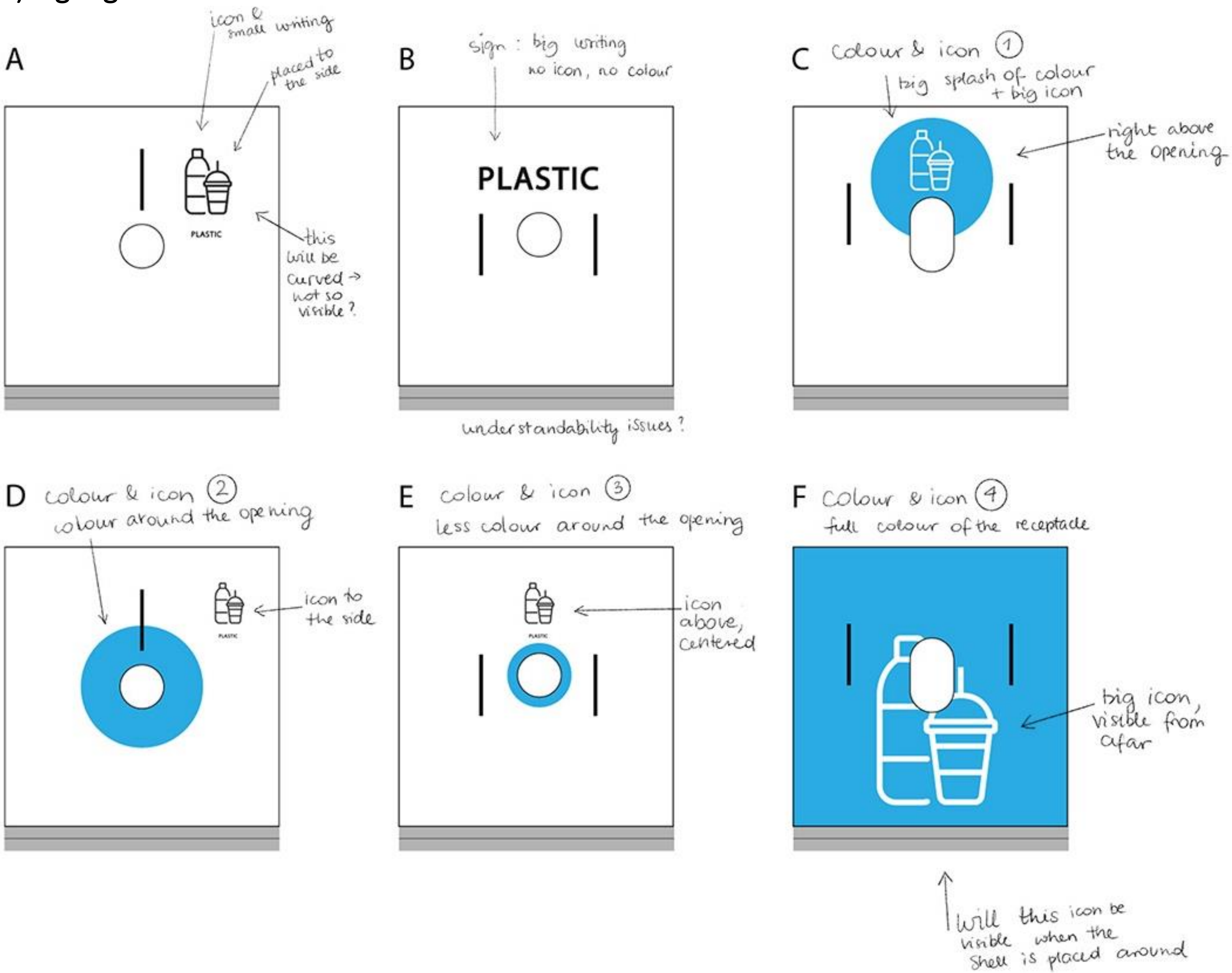
→ one handle per receptacle
→ placed above the opening

→ opening higher
→ 2 handles on both sides of the opening

→ bigger opening
→ 2 handles, placed higher & further away

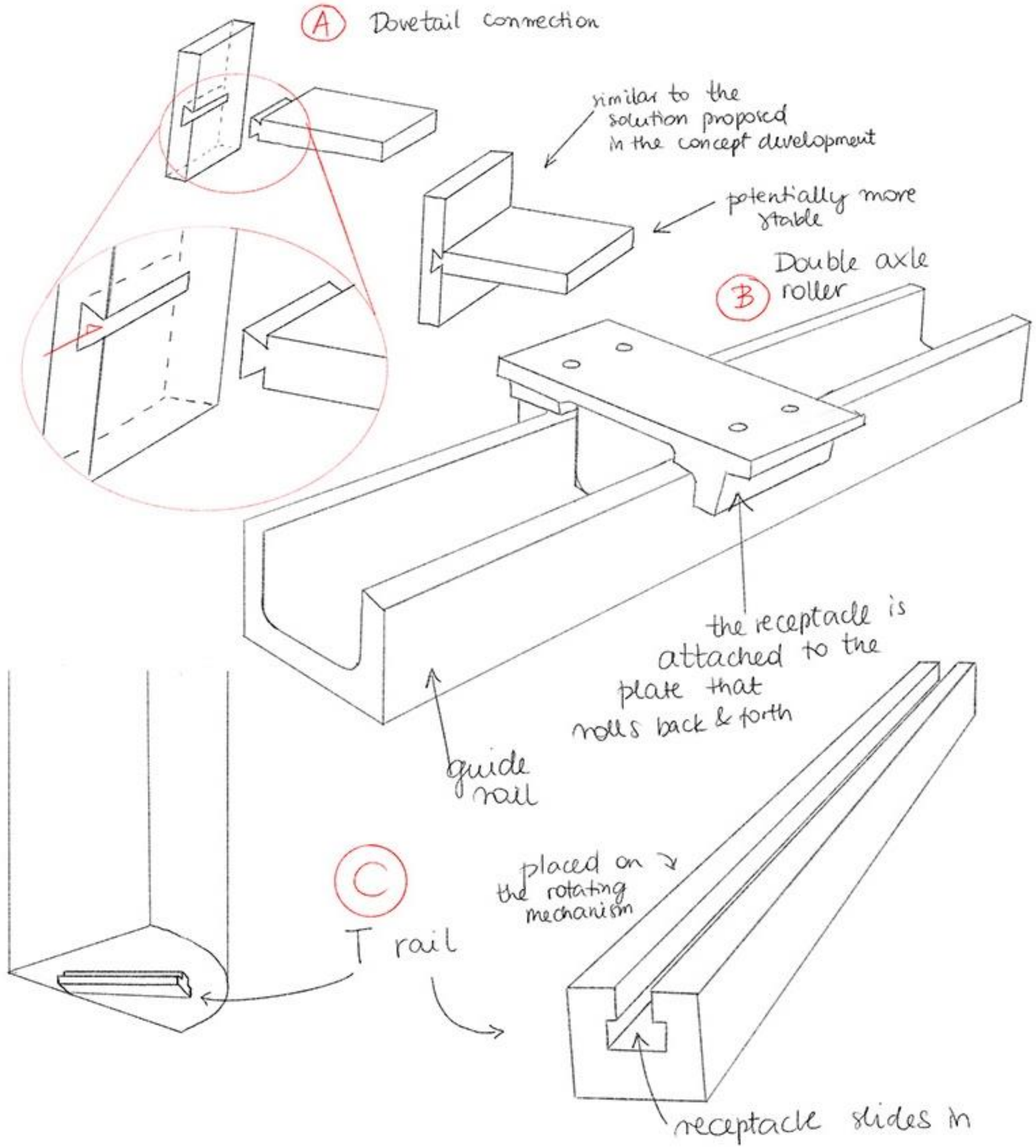


C) Signage


A
icon & small writing
placed to the side
PLASTIC
this will be curved → not so visible?
B
sign: big writing
no icon, no colour
PLASTIC
understandability issues?
C
Colour & icon 1
big splash of colour + big icon
right above the opening
D
colour & icon 2
colour around the opening
icon to the side
PLASTIC
E
colour & icon 3
less colour around the opening
icon above, centered
PLASTIC
F
Colour & icon 4
full colour of the receptacle
big icon, visible from afar
will this icon be visible when the shell is placed around

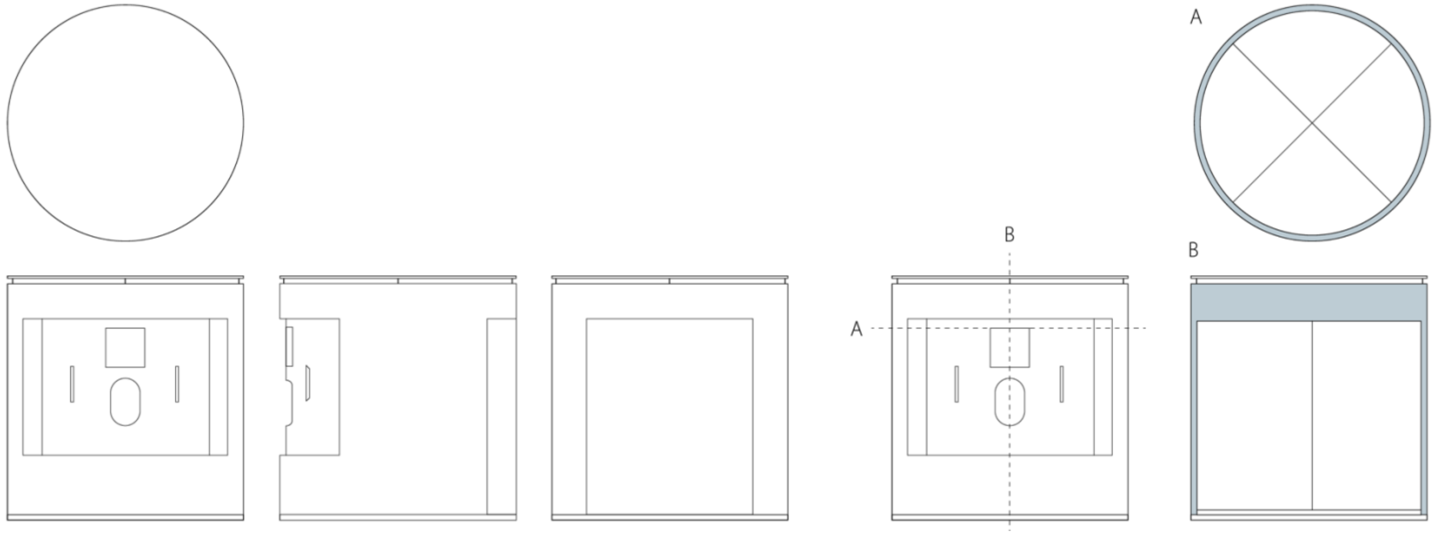
3. Defining the connections

The key connection in this design is the connection between the 4 receptacles and the rotating mechanism. Further research revealed a few designs that are widely used in engineering.

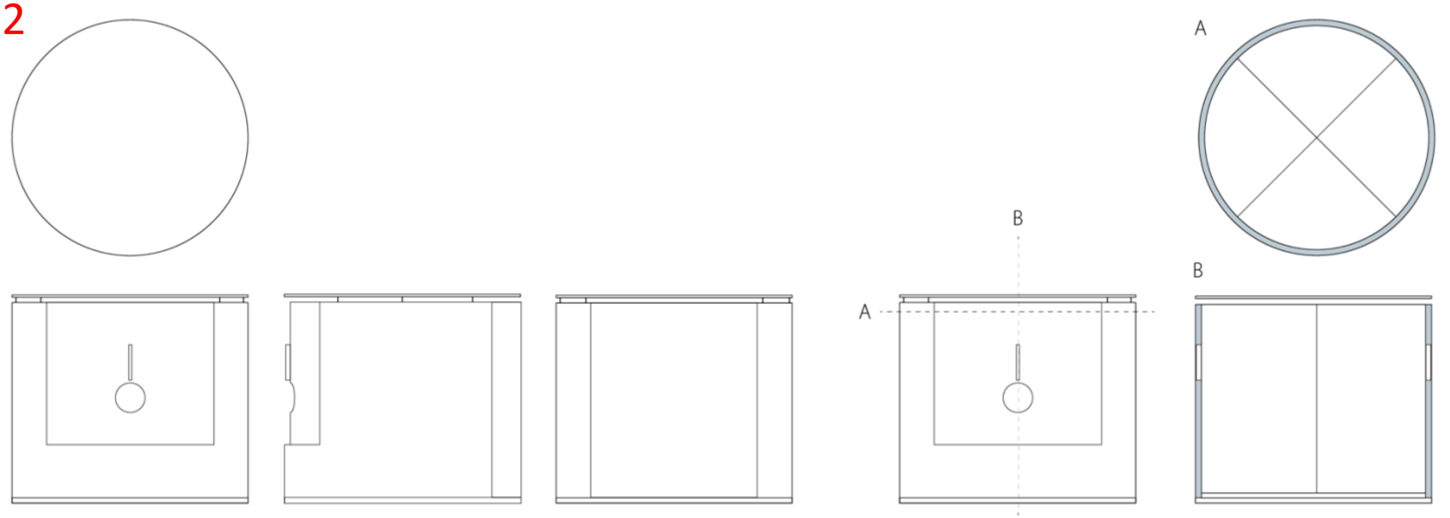


4. Defining the shape, material and appearance

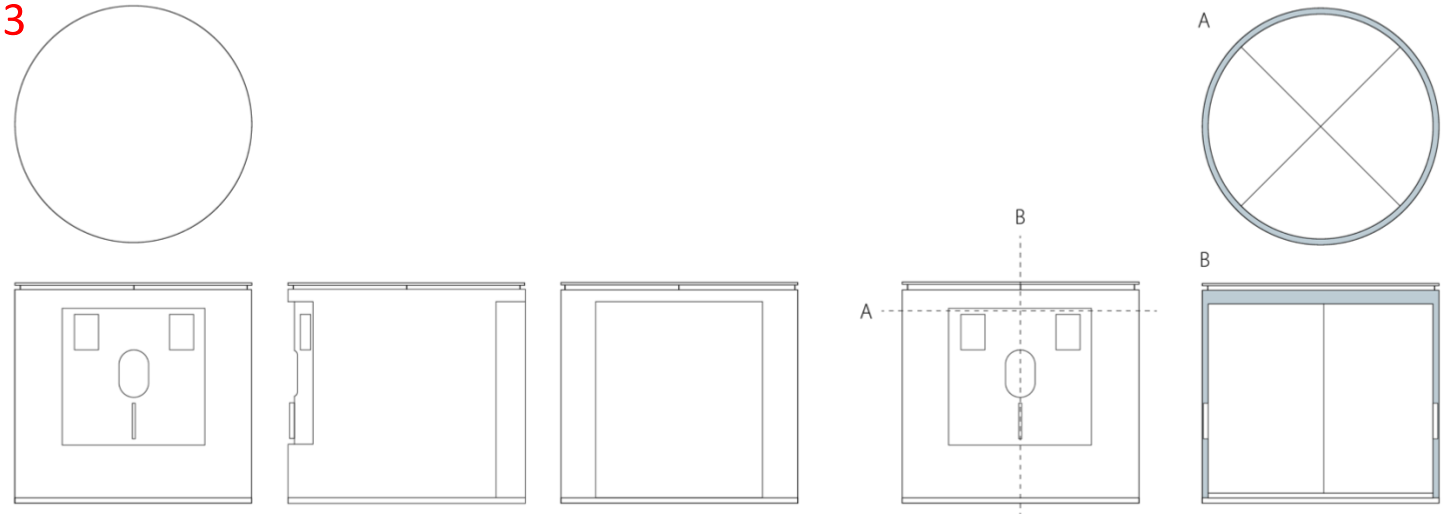
The next chapter will deal with the material selection for the design. Here, the focus will be on shape and appearance. The three alternative layouts below draw on the exploration and research done in the earlier steps of this process.



2



3



Layout selection

The **usability** of a product is concerned with how a particular arrangement of components affects the user's experience *(The Open University, 2023p)*.

The bigger opening in a receptacle makes it easier to throw in the trash. Layouts 1 and 3 employ that type of opening. It could also be argued that the lower the opening (within a certain margin), the more inclusive the design (smaller children or adults in wheelchairs can use it, too). Here, designs 1 and 2 are most appropriate.

From the visibility perspective, including at least two different forms of signage (e.g. colour & icon) provides the information for a broader audience, whereas using just the colour (2) could exclude, e.g. those who are colour-blind.

The widest opening indicates that other receptacles can be accessed by rotating the cylinder (1). Additionally, two handles with hand icons further reiterate the ability to turn (1).

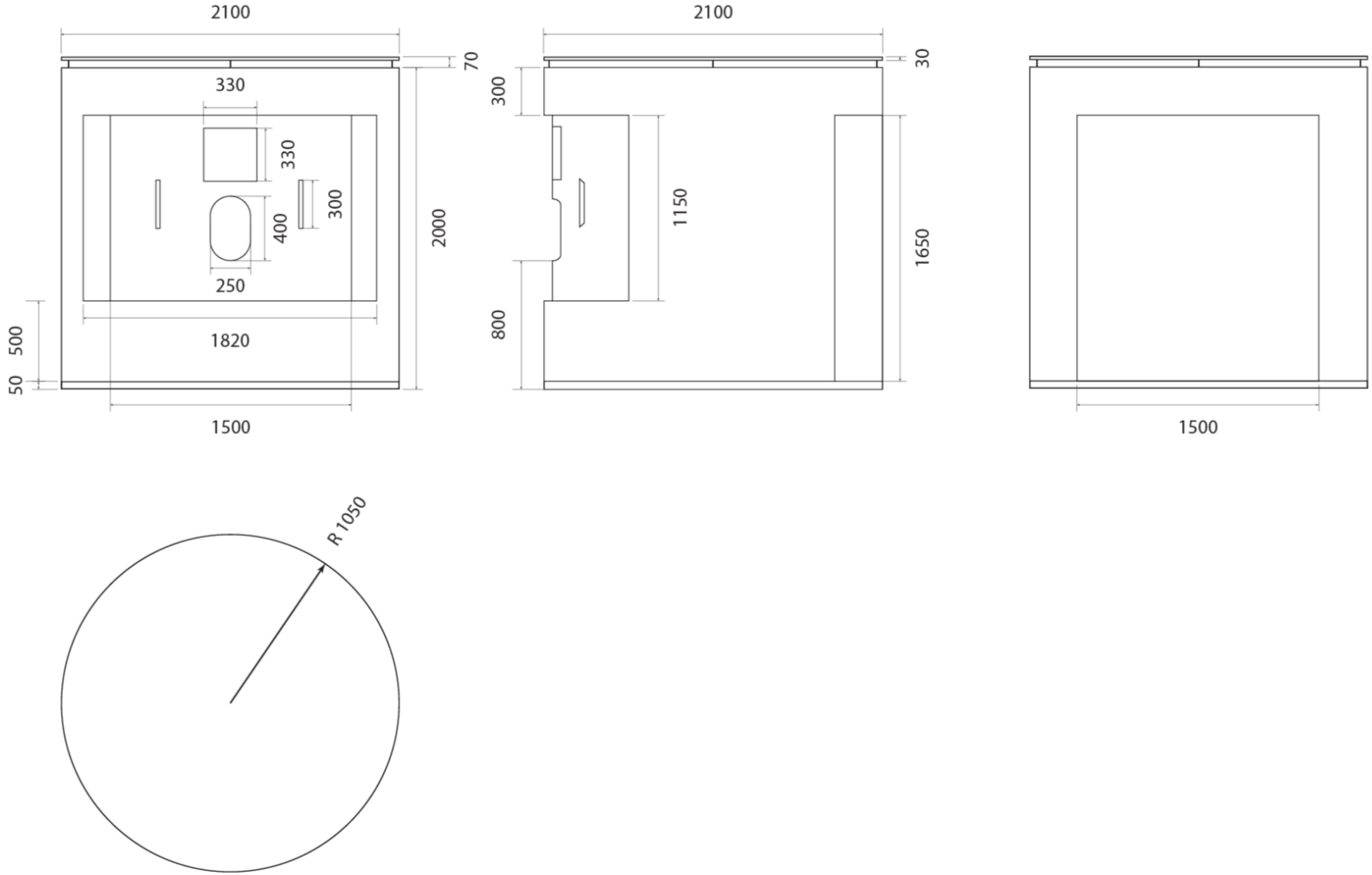
From the **aesthetic** perspective, the tallest design (1) is balanced. The second design, on the other hand, employs a minimalist approach, which can also be appealing. The last layout has the smallest shell opening. Provided that the material used for the shell (see next chapter) will be well-ageing larch wood, the coverage can be aesthetically appealing in the context of the nature park.

Placing the sign above the opening and including two symmetrically arranged handles (1) can also positively affect the design's appearance.

Based on the above discussion of different layout designs, **layout 1** is the most fitting. It shows great promise in usability while remaining aesthetically pleasing, with a symmetrical and balanced receptacle design.

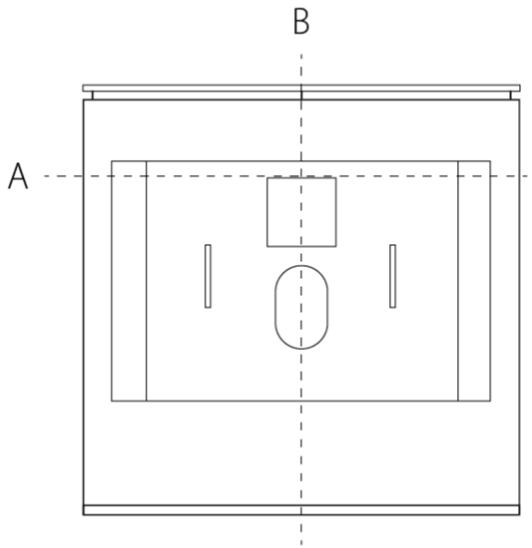
Orthographic drawings with measurements

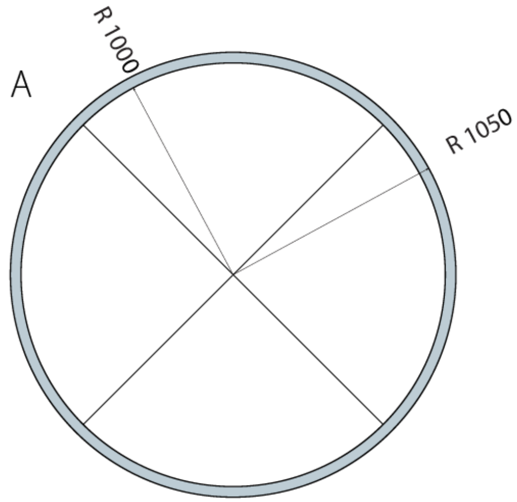
(all measurements in millimetres; scale 1:10)

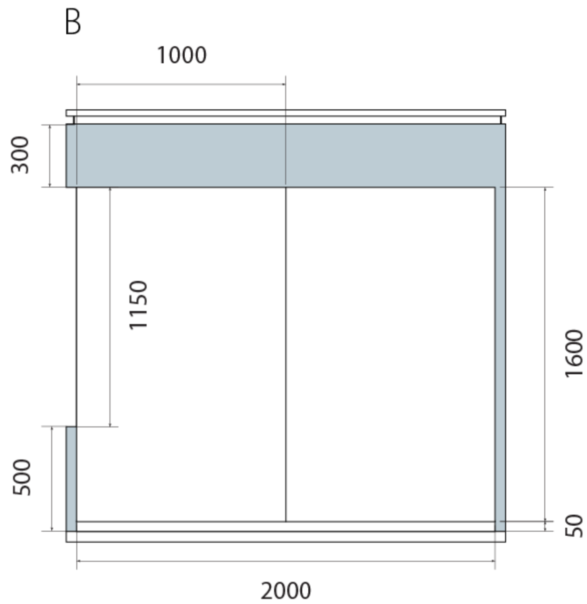


Orthographic drawings with measurements: sections

(all measurements in millimetres; scale 1:10)







Materials and making

User research indicated that people positively respond to natural materials, like wood. Especially in a park, using materials that fit the environment can ensure a positive experience. Wood, which is perceived as soft and warm *(The Open University, 2023q)*, seems like the perfect choice for the receptacle's cover.

The idea of creating a cover by attaching wooden slats to metal rings came early in the concept design process. The right sort of wood had to be sustainably sourced, durable (withstanding weather conditions well), and age well to preserve the aesthetics of the design. The production of coniferous timbers like spruce, pine or fir has a minor environmental impact, using very little energy *(Thompson, 2021a)*. However, being vulnerable to the elements, these types of wood are used indoors. Another sustainable option and one that has been used widely for centuries in outdoor construction is **larch**. This type of wood grows in many parts of the world, from America through Europe and Asia. Untreated larch will turn grey over time, but its high resin content makes it durable and protects it from rotting *(Thompson, 2021b)*. This should be a reasonable choice for receptacle cover.

For the receptacles themselves and the joining elements for the cover, I considered using **polycarbonate** (rigid plastic) and **steel**. Plastic's benefit is its relative lightness, reducing the transportation weight *(Thompson, 2021c)*. It can also be reinforced with glass fibre for additional durability. Plastic receptacles are already widely used, and both the cover and the roof should provide enough protection to allow this type of material to be used.

Steel is a common construction material. It ages well and is cheap to source. Thousands of steel sorts exist, depending on the proportion of iron and carbon (the main components of steel) and other alloys. For the purpose of this design, low-carbon steel could be sufficient. It is cheap and malleable *(The Open University, 2023r)*, which should make it perfect for forming the backbone and roof of the receptacle cover.

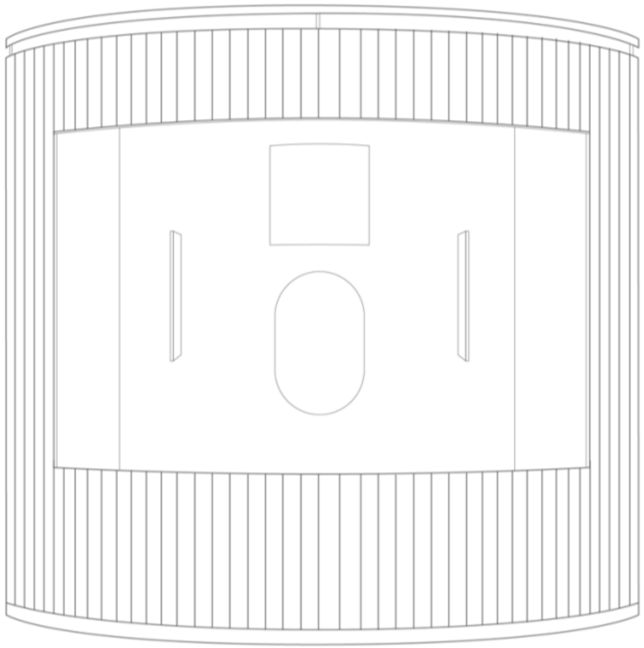
For the base with the rotating mechanism, I have chosen to use cement. Cement mixed with water produces concrete, one of the most widely used construction materials *(Thompson, 2021d)*. It is durable, cheap and widely available. It can also be pre-cast to ensure the correct dimensions.

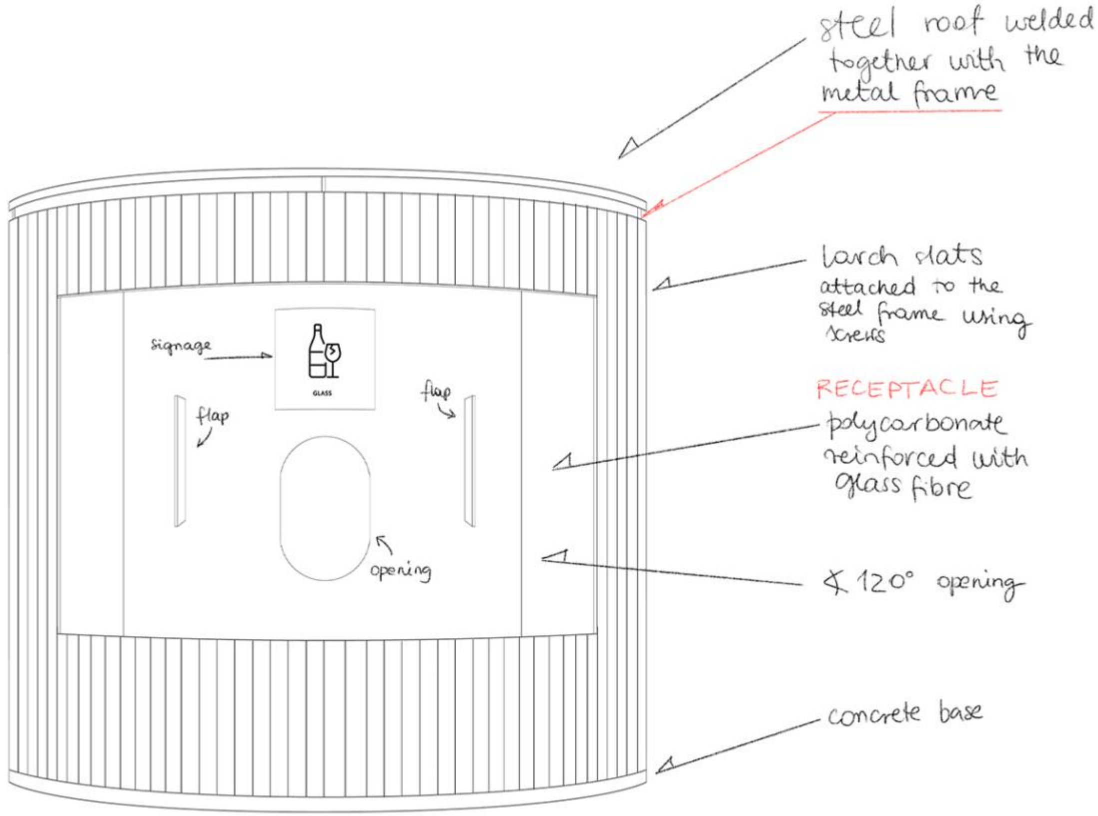
Creating the metal frame for the cover would require welding to join all the steel elements together. The larch slats could be attached using screws. The receptacles would be manufactured using moulding techniques and connected to the concrete base using pre-manufactured T rails. Wood treatment could be avoided using larch, but it would probably be advised to paint or galvanise the steel elements to protect them from corrosion *(Thompson, 2021e)*.

The construction process would include several steps. After installing the concrete base, the receptacles would slide inside the T rails, and the whole construction would be covered with the pre-manufactured steel and wood cover.

Design proposal

The **rotating receptacle** is an innovative solution combining different recycling receptacles under one roof. The cover protects the collected waste from the elements and ensures the design fits nicely into the park setting.



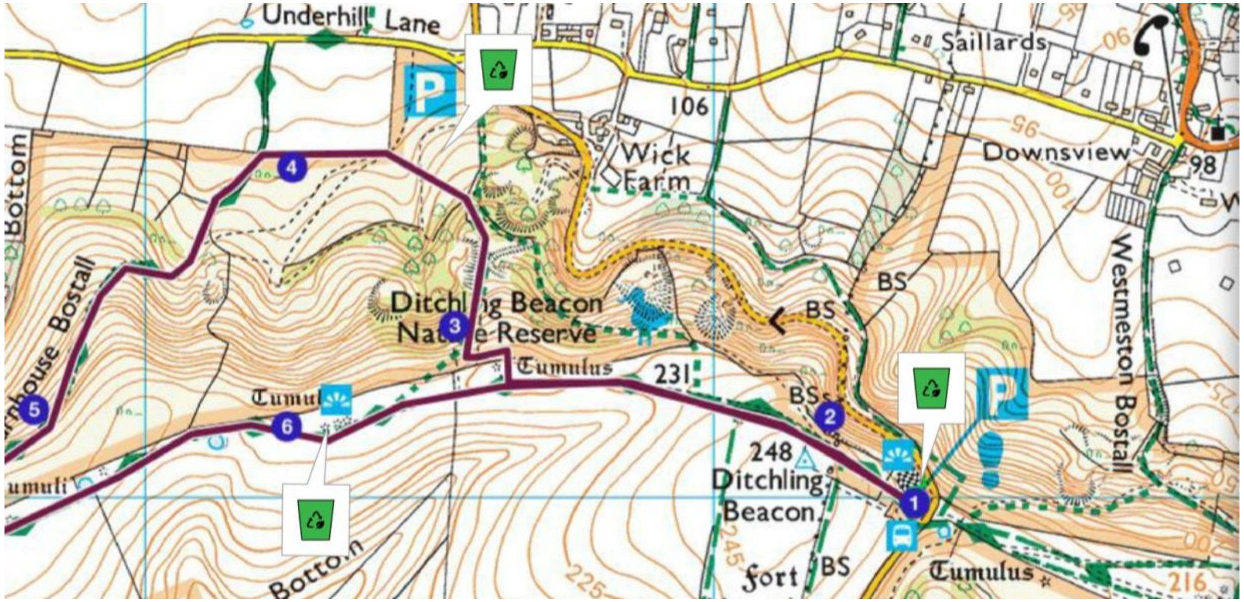


The map shows suggested locations for the new rotating receptacle. Parking lots and the viewpoint (close to number 6 on the map) are key spots where visitors might want to recycle their waste.

Below is an image of the receptacle placed near the viewpoint.

Map image from: https://www.nationaltrust.org.uk/visit/sussex/ditchling-beacon/walk-through-history-at-ditchling-beacon

Photo source: National Trust/Glen Redman



A view across Blackcap on the Ditchling to Ashcombe Bottom walk | © National Trust/Glen Redman

Lessons learned

User research indicated that proper collection and disposal of recycling in a nature park setting can pose a challenge. Even though most visitors are willing to participate in such activities *(Lawhon, 2018)*, the decision about where to locate the receptacles and how they should look remains an open question. Many of the existing recycling stations are bulky and unappealing. Confusing or unclear signage might lower recycling rates *(Poirier, Brain and Barajas, 2013)*. Lastly, there is the question of how to manufacture the receptacles so that their production is sustainable and they can serve their purpose well for as long as possible. The three lessons learned touch on these perspectives: aesthetics, usability (understandability), and manufacturing.

Aesthetics

As the saying goes, beauty is in the eye of the beholder. However, the truth is that an essential aspect of aesthetics is concerned with a person's emotional reaction to the object's form, colour or texture *(The Open University, 2023s).* This emotional response to the materials was practically tested during the brainstorming session. The most significant learning outcome here was the realisation that it is not only the colour and shape that matter and that the materials used to design an object will influence how users perceive it. In a nature park, visitors want to spend time outside and appreciate pristine nature and its beauty. This made me realise that the receptacle design must fit in that setting. It had to be visible and, at the same time, remain "footed" in nature. Hence, the decision was made to design a wooden cover using larch, a well-aging, sustainable timber type.

Understandability

User-centred design is highly concerned with the needs and wants of the users *(The Open University, 2023t)*. By defining the potential user group, in this case, park goers, active people, and people who like being in nature and who care about it, it became apparent that proper recycling (= taking care of nature) is already something this group wants. The critical issue was to make the act of waste disposal efficient and easy. My particular concern was with the signage: a) make it clear what type of waste goes to which receptacle and b) show the user how to rotate it. I kept returning to the three usability aspects defined by Don Norman. Finding the right balance between too much and too little signage (section: Layout design) and effectively incorporating the affordances needed has been challenging. The key lesson here is that usability remains the most important and one of the most difficult aspects of modern design efforts.

Materials and manufacturing

Overall, the most significant learning from this design project is the vastness of the available materials and manufacturing processes. Delving into the different manufacturing processes *(The Open University, 2023u)* and The Materials Sourcebook revealed an entirely new aspect of design. Choosing the suitable materials is an art in itself. It involves a lot of compromises, as certain materials are more sustainable but also more vulnerable to weather conditions. Considering the materials in the early stages of the design process is vital to a successful product design *(The Open University, 2023v)*.

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Word Counts

Section 1: Introduction and user research: 1501 words

Section 2: Concept design: 648 words

Section 3: Layout design: 552 words

Section 4: Materials and making: 480 words

Section 5: Design proposal: 516 words

Total word count (excluding titles, references, photo credits, table descriptions, and in-picture annotations): 3697 words