Project Cyligros

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The graduation project done at **Rayka Design Studio** has pleased me. Therefore I would like to thank them for their attention, time and effort. I truly hope that this report will make a useful contribution to **Rayka Design Studio** as a whole. Hopefully without deriving anyone, I would like to thank some people.

First of all my graduation mentor from the *University of Twente*; ING **T.G.M. Krone**. Your help and support helped me throughout the whole project. The useful feedback that I have obtained helped me to re-think and improve certain aspects which I hadn't foreseen earlier. Thank you for your effort.

Secondly I would like to thank my guide at *Rayka Design Studio*; **Caner Özer.** The meetings we had and the explanations you've given to me helped me to understand the principle of design engineering even better. My time at Istanbul won't be forgotten and the knowledge that I have obtained there will stay with me for the rest of my life. You trusted me into starting and finishing a full project which grew my self-confidence majorly. I hope that my input into this project hasn't disappointed you in any form and the result of the project satisfied you. Thank you.

As a reader I wish you the best of pleasure while reading my graduation paper. If there ought to be any questions please do not hesitate to contact me by mailing me on the following adress: *g.sonmez@student.utwente.nl* .

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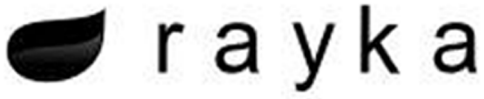
Preface

A surplus of plastic bag use leads to more plastic waste around us. Supermarkets offer their customers plastic bags to help them carry their groceries. However, it is said that the customers take more plastic bags than necessary which eventually end up in the trash bin or outside. This only leads to more pollution and higher costs for both the markets and the government. Therefore one of the largest market-chains in Turkey decided to put the first step amongst its competitors to help build a cleaner future environment. They approached Rayka Design which is located in Rumelihisari, Istanbul. Rayka is known to provide eco-friendly solutions to problems as these.

What the market wanted was a solution for this overly-excessive use of plastic bags. The issue was that it was too easy for a customer to pick many bags at once, even though if he were to use only one. To limit their customers in their habits from doing this they requested Rayka to provide them with a dispenser for these plastic bags. The dispenser should be able to dispense a single bag and at the same time dissuade the user to take out several bags at once.

Rayka accepted this request from the market-chain and started the dispenser project. The goal of this project is to propose a concept of a dispenser which fulfills these requirements. If the concept is later deemed succesful in accomplishing its task, then an agreement will be made to set them up for production.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Abstract

This project is about the creation of a plastic bag dispenser. The goal is to create an eco-friendlier future by reducing the waste and costs due to the overly excessive use of plastic bags. Customers tend to take more of these bags in the markets than really is needed and are then left with a surplus of these bags. These eventually end up in either the bin or outside in the environment.

This goal has been tried to achieve by creating a fully mechanical dispenser which allows the user to take out a single plastic whilst at the same time discouraging the user to take out a second one. The dispenser will be presented to a large retailer in Turkey and, if succesful, taken to production.

To create this dispenser an analysis has been done on the retailer, its background and surroundings. After that a look has been taken into the market of comparative products to come up with strong positive aspects to include in the new dispenser. The analysis has been concluded with a design brief. The requirements in this design brief are then used to start generating ideas.

The idea generation ends with three concepts, from which one has been chosen to be further developed. After making the concept choice the concept has been optimized and further detailled. This chapter ends with a complete dispenser.

After that a prototype of the dispenser will be realized to see if and how it works. Eventual issues that come up during the try-out will be stated and solved before moving on to the mass product.

In the chapter of mass-product the new (improved) parts will be defined. After that the reader will shortly be enlightened on the materials that have been chosen to manufacture the components from and also how these parts can be produced or whether they will be bought. The chapter will be closed with an explanation of the way in which the components are assembled together.

As last the paper will be closed with a short evaluation. The whole project will be reflected upon and the resulting dispenser will be criticized.

Besides this paper there is also an appendix which contains some data regarding dimenions. In the text the reader will be referred to the specific parts of the appendix.

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1 Analysis

Introduction

In this chapter an analysis will be done on Migros T.A.S.; a top retailer in Turkey that owns some of the largest supermarket chains. It will start off with some background information about their history, then some info will be given about the underlying market-chains that they possess and their present competition. After that, the target group, the stakeholders and the main ergonomic aspects will be defined. As last a market research will be done to see how some of the competing products look like. The data sources can be found in Appendix E. The chapter will end in a design brief.

Background information

Migros, founded in 1925 in Zürich, is Switzerland's largest retailing company, supermarket chain and also co-founder of its Turkish chain "Migros Türk Ticaret A.S." in 1954. The basic reason for establishment was due to the growing population of Istanbul, increasing cost of living and the large wage-gap between the city center and its surroundings. With the help and under the control of its municipality Migros introduced a mobile food-service in the same year in which small sales-trucks circulated through the outer suburbs of Istanbul. In the light of providing these lower working-class people with food and supplies; Migros tried to deliver products at a favorable price and quality for them and soon after turned out to become a success. They were also the one to introduce today's modern retail elements, such as hygienic packaging, labeling and applying shelf-life to products.

After various additions and improvements, such as meat processing, Migros began to develop its status as a provider of qualitative, sanitary and economically priced products throughout the years. Ending up with 34 stores in the cities of Izmir and Istanbul by the year of 1989; they had been given the identity of being an "Honest Trader" by its consumers. Following the increasingly changing demands and expectations of Turkish customers they started to expand their merchandising business even more by 1990. That is when a new concept of MM- and MMM-Migros stores arose. The difference between the stores can be found in the product assortment; with the extra M indicating a larger product spectrum. They have also been largely responsible for introducing the part-time working concept, staff-training programs, credit-card use and automated cash registers.

In 1995 Migros created the first discount-brand "Sok" in turkey, and one year later opened "Ramstore" in the capital city of Azerbaijan; Baku. They started building shopping centers in 1997, with the first two being Migros shopping center, Istanbul, and Ramstore shopping center in Moscow. With this rapid growth Migros reached a total of 325 stores in 7 regions by the end of 1999. They introduced the self-checkout service in their hypermarket in Ankara, which turned out to be a success. After that the Ramstores got expanded into two more countries; Russia and Kazakhstan.

By this time another concept was created that went by the name of "Bakkalim"; literally meaning my store. In a short period of time they opened this Bakkalim in roughly 700 points. Whilst still growing, they decided to merge in Tansas, another retail chain, in 2005. Together with this merge they grew up to an astounding total of 722 stores.

The underlying market-chains

Eventually Migros T.A.S. ends up serving its customers with their Migros, 5M, Sok, Tansas, Macro Center and Kangurum (virtual) markets. They are able to respond to different expectations and needs by their customers by maintaining the exclusivity and distinctiveness of their shops, which each serve a different target group. By offering many choices Migros has created a way to stay closely in touch with them. With all these changes that took place over the past few years Migros T.A.S. managed to take 12th place amongst 50 companies that grew the fastest between 2001-2006. This allowed them to enter the list of the top 250 retailers around the world created by Deloitte in 2008. Migros T.A.S. managed to take the 236th place.
Their Virtual Market, Kangurum, later changed its name to Migros Sanal Market (Migros Virtual Market). Besides that, in June 2011, Migros sold their discount chain Sok to Ülker group.

A recent research of Ortakalan.com.tr (see appendix E) shows the amount of supermarkets for each brand in Turkey at the 1st of January, 2013. Looking at the markets that are part of Migros T.A.S. it can be seen that Sok, which is already sold, is the leader with an amount of 1222 shops, followed by Migros with 622 shops and Tansas with 218 shops. Another research shows the top 10 brands that opened the most markets in 1 year, from the first of January 2012 until the first of January 2013. As can be seen; Migros takes the 4th place with 93 markets, and Tansas takes the 6th spot with 34 markets.

At this moment Migros T.A.S. serves her customers with 715 Migros, 202 Tansas, 23 Macro Center and 20 5M shops in 69 regions in Turkey, and 36 Ramstores outside of Turkey,

The (upcoming) competition

Migros hasn't been the only fast-growing market chain. Another table from ortakalan shows the top 10 brands that opened the most stores in the past year. This table can be used as an indicator for their pace of growth. The top spot is taken by A101; a discount market chain that made its entrance with 121 stores in March 2008. They opened 396 stores in total from 2012 to 2013. After A101 comes BIM, another discount market chain which made its appearance in 1995 with 21 stores. They opened 381 stores, which is rather similar to A101. BIM is followed up by DiaSa. DiaSa too is a discount chain which is now being owned by the same group that Sok was sold to: Ülker Group. With a big difference between the top two stores, DiaSa has opened a total of 109 stores in those 12 months. The 4th place is taken by Migros, with an amount of 93 newly opened shops between 2012 and 2013.

The main competition for Migros consists of 4 other brands which take a higher position on the list of store-counts. With only BIM and Migros being listed in the top 250 global retailers report from Deloitte(2011) which state the retail revenues, the top 5 store-owners consist of BIM, A101, Sok, DiaSa and Migros. What draws attention is the fact that these 4 other markets chains are all discount brands, unlike Migros. Another fact to be kept in mind is that Migros has been existing for a rough 60 years, whereas the other discount marks have all recently entered this sector, but have relatively grown dramatically. Migros might have to think about a way to secure its future existence with all these new market chains coming up.

The different brands

So, as has been stated earlier, Migros T.A.S. owns 5 stores at this very moment. Those include Tansas, Migros, 5M, Ramstore and Macro Center. With each of these stores Migros tries to keep in touch with different types of target groups by making each store fulfill a specific role. In this way they can attend to the unique expectations and wishes of their customers.

Macro Center -
The first shop to start off with is Macro center. It aims to serve the higher working-class of the customers. This is being accomplished by offering relatively exclusive varieties of products. The larger part of these products is imported, thus foreign, resulting in higher average prices for the same type of products. Obviously this attracts customers that are more given to luxurious tastes, resulting in Macro's status as serving the more wealthy consumers.

Image A.1 - *The entrance of a Macro Center*

The picture above (A.1) shows the entrance of a Macro Center in Istanbul. As can be clearly noticed, it has a certain style that creates a familiar atmosphere. The use of wood and this type of window makes the customer feel welcome and safe, for he might get the impression of walking into a house rather than an unknown building.

Image A.2 - *An inside view of a Macro Center*

Image A.3 - *Another inside view of a Macro Center*

Images A.2 and A.3 give inside views of Macro center. What can be noticed at first is again the use of wood. The pillars of the building are covered by black glass and wood. Another aspect that catches attention is the use of chrome. This has been done to protect units, such as the pillars, from getting damaged by shopping carts. However, the two blocks on the left, hanging above the cash registers, also seem to have some chrome accents on them. On the right image the concept of black furniture arises. The box in the middle and the boxes on the right are all black. Together with the previously stated characteristics they create a chique overall style. The last aspect that draws attention is the largely spaced placement of units. The customers are given more than enough room to walk through the market.

5M -
Secondly a look has been taken inside the 5M Migros markets. The 5M markets are the largest ones, offering the widest product spectrum in the whole Migros series. These markets are mostly referred to as hypermarkets. Their products range from basic food, fruits and vegetables, to house-products, textile and electronics. Their goal is to deliver as many products as possible for an economic price and therefore their services are meant to reach the largest range of customers possible. Their slogan confirms the previously made statement; "Cok aliyoruz, ucuz satiyoruz!", which literally means: "We buy a lot, and sell it cheaply!" .

Image A.4 - *The entrance of a 5M market*

Image A.5 *- Inside a 5M market*

Image A.6 *- The checkout section of a 5M market*

The difference with Macro market can immediately be seen in these pictures. The entrance to the market is overwhelming the customer; it's filled with labels, flags and banners. The products are all placed densely together and the amounts in which they are sold are larger. The store has its typical use of the color orange, and the sale-signs are of the standard black-on-white concept covered by a red attention-drawing line. Besides that, the shopping carts are simple metal baskets on 4 wheels, which is pretty standard too. The only aspect that really shows itself is the "Jet Kasa" system, which can be seen on the bottom picture A.6. The customers are allowed to check-out by themselves by scanning and paying using a checkout machine.

Tansas -

The third store from Migros T.A.S. is Tansas. This discount market-chain comes in three formats; Tansas Mini, Midi and Maxi. As the names already indicate they represent the size of the store. Tansas is known to be that regular supermarket that tries to offer high quality for a low price. Although Tansas serves its customers with 202 shops spread over 3 store formats, it's the mini-format that takes the major part. In 2009 Tansas seemed to have 146 mini, 97 midi and 59 maxi stores which result in a total of 302 stores.

Image A.7 *- The checkout area of a Tansas market*

Image A.8 *- An inside view of the regular Tansas markets*

Image A.9 *- Another inside view of a Tansas market*

Unlike the other markets, there isn't much special to be noticed in these pictures. Image A.7 shows the exit of a maxi-market with a shopping cart in front of it. The cart seems to be just like a regular one; a simple metal baskets on 4 wheels. What image A.8 shows is the simplicity of the furniture; unlike, for example, macro center, this furniture consists of thin metal-framed boxes allowing a modest amount of products to be placed inside.

The sale-signs are simple papers put in red plastic frames that are attached to a small metal standard.

However, the last image, A.9, does show that Tansas cares about its diabetic customers for they do offer special low-sugar products – "Diabetik Ürünler". It might be a small extra service that they offer, but for its customers it may mean something special.

Migros -
Migros is the first and their truly original store that led to Migros T.A.S. success. As stated earlier the Migros markets come in 3 formats. There is the M, MM and MMM format with each increase in M indicating a larger store with a broader product range. The Migros store-concept is already explained above at the 5M section, therefore this part will focus on the smaller stores.

Image A.10 - *The entrance of a 5M market*

Image A.11 - *The entrance of a 5M market*

Whereas the 5M stores were mainly focused upon providing cheap goods in large amounts, the smaller 3M,2M and M stores are more aimed at quality and their customers. While the stores aren't as big as the 5M ones they still manage to offer a decent amount of products.

Image A.12 - *The entrance of a 5M market*

Image A.13 - *The entrance of a 5M market*

The aspect that draws the most attention is the frequent use of the color orange which can be seen on all of the images. Even the entrances to the stores are covered with big orange letters. This is a strong characteristic of the Migros markets.

On the top left image, A.10, the checkout-section can be seen where Migros offers their customers a regular check-out register, or a self-checkout machine. The point of using these self-checkouts is to avoid long queues at the registers.

On the top A.12 picture it can be seen that Migros offers its customers an iPad. This happens to be something new in Turkey as the package already indicates: "Türkiye'de ilk defa!", which literally means: "First time in Turkey!".

Ramstore -
The way that Ramstore differs itself from the other few stores is by the fact that it operates internationally. They are established in a few countries; Azerbaijan, Bulgaria, Kazakhstan, Macedonia and Russia with a total of 36 stores. Most of the Ramstores are found inside Ramstore-malls. These are big shopping centers that contain many different shops, including Ramstore hypermarkets.

Image A.14 - A Ramstore shopping centre in Macedonia

***Image A.15** - Valentines theme applied inside a Ramstore*

***Image A.16** - An inside view of a Ramstore market*

***Image A.17** - Checkout-section of a Ramstore market*

These pictures give an idea of how Ramstore looks like. Image A.14 shows the entrance to a ramstore-mall in Macedonia. It has its own parking lot next to the building to support its many customers. The second and third images, A.15 & A.16, show that Ramstore applies themes to its shops. This may be a good way to distinguish itself from other stores.

The last image shows the checkout-section of the Ramstore. It doesn't look much different than that of a regular market. Appearently the self-checkout services haven't been introduced here yet.

Target brand

The product that will be designed in this project will be aimed at the regular Migros stores from Migros T.A.S. The main reason for this is the fact that the Migros series are responsible for the major part of the stores that Migros T.A.S. owns. The regular Migros stores are the most widely spread over Turkey and therefore would exert the largest influence on the environment when a new concept would be introduced.

The main competitors from Migros, outside Migros T.A.S.' property, are as shown earlier in the table from ortakalan mainly discount brands. When designing a product for these discount market-chains there are two important things to be kept in mind. Firstly, the amount of stores they own is immense compared to Migros, and secondly, their main goal is to deliver their goods as cheap as possible. Therefore it is understandable that these companies are less likely to invest the same amount of money, as Migros, into introducing a new concept. Hence, they will have to buy much more units to be able to fill all of their stores and therefore the price of this upcoming product will have to be relatively low.

If the price of this product has to be low, this already limits the opportunities for the designer to add (several) innovative features to the design. The product-to-be would eventually end up looking not much different than what is being used today as a plastic bag dispenser, which is a roller of plastic bags on a thin metal standard in its most simple form. Therefore this (probable) small change in design would not be worth the investment costs. Besides this, the new product will be associated with the company that designs it, in this case being Rayka Design, therefore bringing forth another reason not to take the risk of creating a product that is likely to fail.

Choosing Migros, which is not a discount market-chain, leaves out more opportunities for the designer to create a new, innovative and unique design that combines different requirements and wishes into one. Migros, known for its history to be a true trend-setting leader in the supermarket industry, might therefore be very-well the best choice.

Target group

The target group can consist of any person that is able to do the shopping. These persons include grown-up males or females, couples, or couples with children. This means that the age of this group varies from roughly 4 to 70 years; implying that there is a major gap between the youngest and the oldest person in this target group. The ages at both ends of this range can be called extremes. Including both of these ages lead to totally different, specific, product-requirements. Four year old children are small, active and curious. They love to run, jump and play all day long, in contrary to seventy year old seniors. Those people are larger, slower and less flexible in using and understanding technology. All of this has to be kept in mind while designing a product.
In this analysis the main characteristics of this target group will be brought forth. Therefore the target group will first be split into three parts; children, matures and seniors. Each of these groups will be analyzed to come up with specific characterizations for these groups. Eventually these characteristics will be turned into product-requirements.

- Children (4-10)

For children most design-aspects will regard safety. They are small, active and are constantly playing with each other. They are careless and do not pay attention at what's happening around them. Children run around, and might collide with anything around them, hang onto them, pull on them, knock them over or sit on them thinking that it's all just a game. Therefore it is important to create a safe product that does not have any sharp edges or points sticking out that might harm these children. Also known for their curiosity, it might be wise to avoid provocative and challenging colors and features in the product. Besides that, the product should be stable enough and able to take a hit without falling over or breaking.

However, what can be used as a solution to all these potential dangers is their limited height. These children aren't that long and placing the essential parts of the product a bit above their average height already makes it harder for them to reach for it.

- Adults (16-55)

The main target group to be focused on are the adults. They will be the ones making the most use of the dispenser. Therefore this product is to be aimed mainly at this group. The dimensions of the new dispenser will rely on the average human-body measurements; in this way the vast majority of this group can be provided a comfortable product that is also ergonomic in use.

People in this category are likely workers, therefore having little time to do the groceries or not willing to invest much time into it. Therefore it is important that the dispenser should not require much effort to be used. This should also be the case when the user has a basket or a baby in one hand and has only got the other hand free to use. The dispenser should allow 1-handed usage.

When people are in a hurry; another point to be kept in mind is the rough and careless usage of such a dispenser. It is important that the design allows room for such usage. The product should therefore be firm and especially stable.

Another important aspect is the functionality of the product in such a situation. Not only should it withstand rough and harsh usage, but it should also keep its functionality at that time. If the dispenser gives a plastic bag when pulled gently on an arm, it should not suddenly give two when pulling harshly on the arm!

- Seniors (60-70)

The last category of users is the seniors. Being an extreme target group, just like the children, they will also bring forth rather specific requirements to the design. These however will be based especially on product complexity. It shouldn't be forgotten that these people aren't grown up with technology like most people are nowadays. They take a longer time to fully understand certain situations and are less courageous, and therefore less willing to take action at those moments.

This is the main reason why the design should guide the user to its usage without raising any doubt. It should be inviting the user to take a certain action which will lead to a successful outcome. It should be considered to add any form of instruction is the design is believed to be complex.

Besides the indirect influence of the design, also the physical aspect is to be taken into account. Older people aren't as strong as younger ones, so it is of importance that the design does not require much force to function.

Physical representation

An important aspect to take into consideration while designing this product is to keep focusing on the primary users. In terms of creating an ergonomic product one has to consider what lengths, heights and other sizes are optimal to use. Therefore a more detailed look has to be taken into average human-body sizes. These averages consist of different values for most countries due to, for example, the various cultural habits of people. Since this product will be targeted at the Turkish market it is necessary to look for the values that represent the Turkish population at its best.

The total target group includes people ranging from children to seniors. Finding one average for this whole group will be a difficult task due to the large difference in heights and sizes. Therefore an ideal model of a person will have to be created by taking the average of the several provided averages.

Table A.1, which can be found on the next page, is a table representing the average values of height, weight and BMI by sex and age group. The table is split into three main columns whereas the first one represents the average heights in centimeters. The average of all 4 mean values for the different age groups are calculated for both males and females. Now the average of these two values will be taken to end up with one final height.

Average height for males, aged 18-59, is 174.1 cm.
Average height for females, aged 18-59, is 158.9 cm.
Therefore the average height of a person, so regardless of sex, is found to be ; (174.1 + 158.9) / 2 = 166.5 cm.

The mean height of the total target group is now being represented by a single value. By introducing a different model the lengths of different body-parts, as a fraction of the total body-height, can be calculated. In this way the ideal heights can be calculated that should allow the **majority** of the users to interact comfortably with the product. So the focus lies on serving the **majority of the target group** with a functional product, instead of paying special attention to the extreme (sub) target groups; in this case the seniors.

This model will be used later in the concept detailing phase where the final concept measurements will be defined. Also this model can be found on the next page.

Imagine designing a handle that has to be pulled by the user. It would be wise to place this element below shoulder height to avoid user exhaustion or any possible muscle injury. According to the model above the shoulder height, for example, is equal to 0.818 * total body height.

Main stakeholders

It's important to know which stakeholders play a key-role in getting the eventual design to the customer. Each stakeholder plays its own role in the process and there are different and specific requirements and wishes for each of them. From the start until the end the following stakeholders are found; the designer (company), the producer, the consumer, the transporter and the client.

- ***The designer (company)***

The company that created the design has to deliver a good product that representative. The created product will be associated with its company and therefore either strengthen or damage their image. The designing company also holds responsibility for any product-failure, or any accident(s) that it may cause in the future. As last, the designer needs to make enough profit to be able to win back the investments in labour, production and patenting.

- ***The producer***

The producer of the components, not necessarily the assembler, has to deliver the parts that the product consists of. Besides the profit that they need to make, also they will have to think about their image. They need to produce the parts in time and favorably without any mistakes. If the producer does its job well they might be chosen as a producer for another product by the same designing company. To be able to do his job well a producer will therefore require a clear overview and description of the parts that they have to manufacture.

- ***The transporter***

This stakeholder is interested in the size of the product, and in the way it can be packaged. The transporter will have to fill a truck with these products and is looking for the easiest, fastest and therefore cheapest way in which this can be realized. If a transporter can load a truck with a small amount of products at a time, it would mean he has to make more trips. This means it will take more time to transport it and therefore the transporter will earn more.

- ***The consumer***

This user is the eventual user of the product. Only safety and product functionality matter for these users. They require a product that functions well, is safe and easy to use and fulfills its task. Their experience with this product will greatly influence their opinion about the client that offers these products; in this case a supermarket.

- ***The client***

The client is the most important stakeholder. They are the ones who will have to invest money in this product. To be able to do this, the client needs a crystal-clear explanation as how this new product is going to solve the client's problem. If the designer can convince the client of the success of this product the client will be able to 'safely' make their investments. Product-marketing plays a huge role in this part of the whole process.

Age group (years)	Height (cm)						Weight (kg)				BMI			
	Males			Females			Males		Females		Males		Females	
	n	Mean	SD	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
18–29	390	176.1**	6.3	163	162.0	7.0	77.5**	10.6	59.3	9.8	25.0**	3.0	22.9	3.6
30–39	191	172.9**	6.6	112	158.4	5.6	78.1**	10.7	67.3	11.6	26.1**	3.3	26.8	4.5
40–49	102	169.1**	6.9	177	157.1	5.5	75.9**	12.2	70.1	11.5	26.5**	3.7	28.5	4.8
50–59	20	169.7**	5.0	60	156.4	5.2	82.4**	9.7	72.1	11.3	28.4*	3.4	29.7	4.3
Total	703	174.1**	6.9	512	158.9	6.4	77.8**	10.8	67.0	11.9	25.7**	3.3	26.7	5.0

* $P < 0.05$, ** $P < 0.001$, sex difference was tested by a *t*-test.

Table A.1 *- Representing the mean values of height, weight and BMI by sex and age group of the turkish population (B. K. Özer, 2007)*

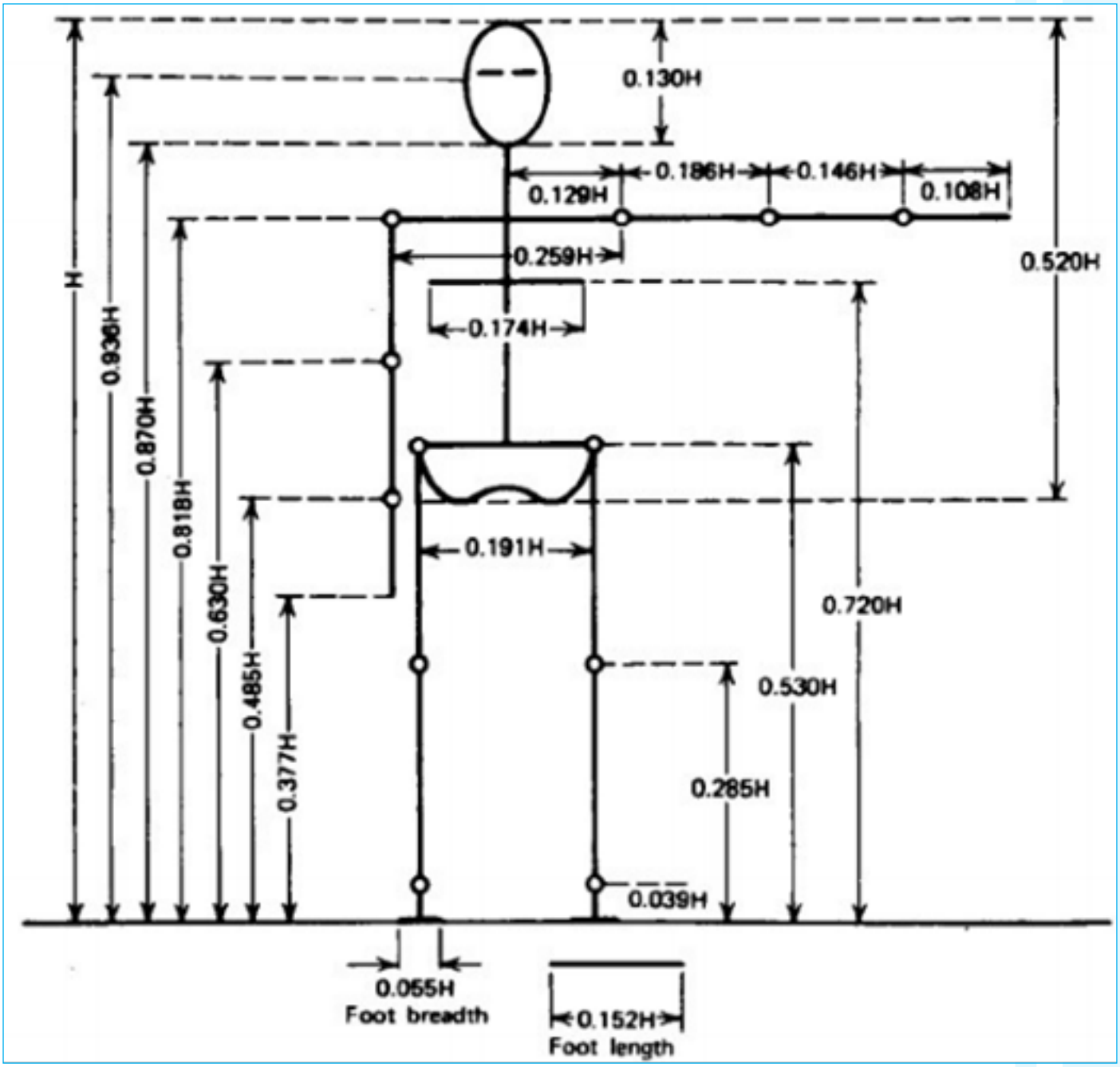


Table A.2 *- Representing the length of different body-parts as a fraction of the total body height.*

Comparative products

At the moment there are many products on the market that function in the same, or a similar way as the plastic bag dispenser. By means of a simple mechanism the product offers the user a single unit of its content. The mechanism's functionality mostly depends on a product's shape combined with a direct user-related force. These products include, but aren't limited to; (wet) tissue boxes, napkin dispensers, foil rolls. Please see the note in Appendix E before reading on.

First a look will be taken at existing products in each category mentioned above. After that the working principle of each of these products will be explained shortly and also how that (possibly) contributed to the product's success. Eventually, various product requirements will be tried to form out of this information.

Tissue boxes

Image A.18 *- An example of a small tissue box.*

This product is a small mobile tissue box. As it can be seen from the picture the roll can be attached to user's belt and carried along during the day. It has a little lid that can be opened to pull out one tissue. Due to its size it cannot hold many tissues at once, and therefore will need to be replenished every now and then. The shell is just empty from the inside and there is no structure in the way the tissues are placed inside the box. The box opening is faced downwards!

Image A.19 *- An example of a cylindrical box of bags*

In this image a simple cylindric box can be seen that has a roll containing bags inside. The bags are structured in such a way that they can be pulled out from the center of the roll. When one bag is pulled out of the roll the user will need to hold the roll to be able to separate bag and roll from another. This is a simple and compact product, yet requires some effort to use.

Image A.20 *- A box containing single plastic bags*

This box contains a pile of bags which are folded in such a way that each bag has its grips placed on top of them. In this way, when a bag gets pulled out the next bag can easily be taken out too because its yellow grips already offer themselves to the user. This can be regarded as a very simple and cheap solution. However, the size of the box indicates that it can contain a very limited amount of these bags, the product requires much effort to be replenished in the same structural way it was before and also limits the user in his choice for replenishment-bags.

Napkin dispensers

Image A.21 *- A common napkin dispenser used in cafes.*

These standard napkin boxes are being widely used in especially restaurants. The functionality of this product depends on a simple principle; it contains a pile of napkins that are being pushed outside by means of (a) simple spring(s). The one the user will always be able to take out a napkin, even when the amount of napkins in the box is minimal.

***Image A.22** - A typical tissue dispenser used in public areas.*

These dispensers can mostly be found in public restrooms. This concept functions due to the way the napkins are placed and structured into each other. When one piece is pulled out it opens up the following piece. Unlike the previous napkin box, this product isn't supported by a spring. It only works by means of gravity; by opening the shell on the bottom-side the need for a spring is completely unnecessary. Due to its relatively large reservoir frequent replenishment is not needed.

***Image A.23** - Another commonly used napkin holder in cafes.*

This is a simple, yet effective, concept. The user is being asked to take out his napkin by separating it from the rest with his fingers. This might be a bit frustrating for the user to do and therefore at the same time makes room to take out two or more units at once. A strong positive about this product is that its functionality doesn't depend on the size of the napkins. Besides that, another big positive would be the ease of replenishment.

Foil rolls

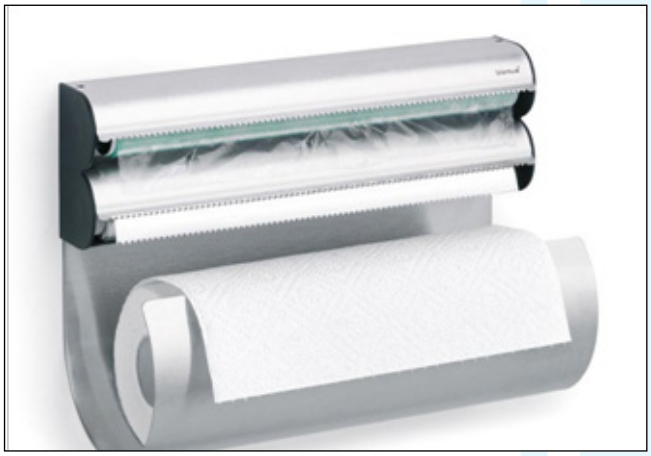


***Image A.24** - A dispenser containing 3 rolls.*

Foil rolls aren't the same type of products as the dispensers mentioned earlier, however, they do function in a similar way. It can be stated that the only difference is the fact that with this product allows the user to cut his own desired unit sizes, whereas the previous dispensers have a reservoir that's filled with pre-cut units. This might be a good and strong aspect to add to the dispenser that will be designed in this project as a unique selling point.
The user is asked to pull out the desired length of foil and cut it off afterwards by using the metal teeth.

***Image A.25** - The user can cut the desired size of the foil.*

This product is almost the same as the previous one, however this one eliminates one risk that the other one has; the chance of miss-cutting the foil. It has a button that slides from one way to the other where it cuts the foil with a knife.

***Image A.26** - A small disposable box of foil.*

This is a disposable plastic-bag product. It has a roll with bags in a box with an edge of metal teeth on the outside. This product is a small and cheap variant of the previously shown products. It is limited in use, not really durable and can be thrown away after the roll is empty.

Plastic bag dispensers

Image A.27 *- A plastic bag dispenser with instructions.*

This green box is a plastic bag dispenser. It contains plastic bags on a thin bar that can be taken out. As the product already states the user needs to pinch in a bag and pull it downwards through the split before it should be taken out. The product is small in size, limited in capacity and bag size. The product itself looks simple and cheap to make. The concept however seems to be pretty unique.

Image A.28 *- A simple box containing folded plastic bags.*

This product looks a lot like the baby-wipe boxes. It has an opening in the middle through which the plastic bags can be pulled out. As one unit is being pulled out another one comes out partially. The next user can easily take out a new unit as this process repeats itself until there are no more bags left. The product is small, easy to use and pretty self-explanatory.

Image A.29 *- A metal frame that holds the plastic bags.*

This metal frame product is used in many markets around the world. The reason for it to become successful is its ease of use. The user can pull a bag open and fill the bag. The bags are stuck to each other somewhere around the top-section which allows the user to easily open up the bag. The arms of the product hold the bag in place while the user puts his recently-purchased goods inside the bag. So actually the product serves as a second user which holds the bag for the primary user.

Plastic bag rollers

Image A.30 *- A bag dispenser where bags can be ripped off.*

In this picture a simple roll can be seen with a shell around it. The bags are pulled through an opening and can be ripped off by using the shape of the hole. The user is free to pull out the amount of bags that is desired. A negative point about this concept might be the risk of the bags falling inside the shell. The next user would then have to put his hand inside to find the bag where the previous user left off.

Image A.31 *- A simple dispenser for a different type of bag.*

This roller consists of an open block where a roll with bags can be placed. At the bottom it offers a V shaped part where the user can separate the desired amount of bags from the rest of the roll. The user will however have to hold the roll to stop it from rotating to be able to rip off the bags.

Image A.32 *- A roll containing wrapping paper.*

This product consists of 2 main parts; the bar where the roll can be placed onto, and the long thin piece of plate where the wrapping-paper is pulled through. Due to the distance between the roll and the metal plate the risk of miss-cutting the paper is decreased and therefore is almost guaranteed to succeed in most cases. The plate has a small cutting edge on the bottom-side which can be used to cut off the paper as the user pleases.
The wide frame offers to hold a thick roll so it can be re-placed once in a relatively long time.

When the analysis of the comparative products is summarized the positive and negative design aspects, listed below, can be found. The positive aspects should be considered to be realized into the new dispenser and the negative aspects should be avoided as much as possible.

Strong & positive aspects;

- Direct the dispensed bags towards the user (vision).
- Allow one-handed use of the product.
- Allow the replenishment of bags.
- After usage product should be ready for another user.
- Provide two-sided usage (mutual reservoir, 2 dispensers).
- Indicate the remaining bags in the reservoir.
- Allow for quick recovery/maintenance when product fails.
- Support universality - support the use of different bag sizes.
- UNIQUE; allow the user to cut his own desired bag-size.
- Using metal teeth to easen bag seperation.
- Keep the product out of children's reach (use height).
- Allow the bags to be cut apart, or ripped apart - two ways.
- Avoid product complexity; the principle of offering a bag should be kept simple!
- The product should be highly durable - will be subject to high amounts of repetition.
- Using the colour white suggests hygiene.
- Use shape to indicate the desired user-actions.

Weak & negative aspects;

- Avoid the need for frequent replenishment.
- Avoid the need for any dissassemblement when replenishing.
- Limit the amount of actions that the user needs to take for the product to function.
- Limit the risk of a product failure.
- Limit the severity of a product failure.
- Avoid the need for bag seperation (bags are thin, might be frustrating when they're stacked into one big pile)
- Discourage or limit the user from dispensing multiple units.
- AVOID dangerously sharp/cutting edges.
- Avoid the use of elastical components over large ranges.
- Limit the need for long instructions - the product should be self-explanatory!
- AVOID the possibility for the user to reach the inner mechanics.
- Avoid the use of weak and susceptible components. Soft and tender use of the product is NOT guaranteed.

The design brief

Here below is a list representing the full design brief for the new dispenser that is to be created. The product-to-be-created must;

- dispense plastic bags

- be usable single-handedly

- require, mostly, 3 actions to function

- be replenishable within a minute

- avoid the need for any dissassemblement when replenishing

- offer a reservoir to hold several rolls/stacks of bags

- not be larger than 50x50 cm

- in some way discourage or limit the user to take out more than one unit

- offer an object to help seperate a bag from the rest

- not pose threat of any possible harm to the user (sharp edges on the outside etc.)

- stay out of children's reach

- have its mechanical parts protected/covered

- be stabile and not fall over

- withstand rough and frequent usage (durability)

- allow for simple recovery/maintenance when product fails

- allow the user to see it when there are no bags left

- offer a clear using-time advantage over the current method

- Should require just little force to function properly

- a small component failure should not lead to complete loss of product functionality

The small list below represents the wishes to the new dispenser. These can be realized, but are not seen as obligatory. The product-to-be-created may;

- open up the bags while dispensing them

- fully limit the user to dispensing a single bag only

- avoid the use of elastical components

- direct the user into right way it's meant to be used

Conclusion - The product meaning

So after a complete analysis it is now clear what can be expected and what has to be created to eventually solve the problem; a mechanism that allows a potential user to take out one plastic bag preferably by using a single hand. The product will have to be easy to understand, simple in usage, and provide a clear benefit over the current method.

End-user

For the final user the product itself should not be too complex, but rather easy to understand. The user should be directed in the way it is meant to be used and woulnd't therefore have to encounter any difficulties. As a result, the user should be quickly offered one plastic bag, and at the same time in some way limited to take a second.

Market employee

From the perspective of a market employee it's imporant that the dispenser should in some way offer a reservoir that allows for quick replenishment of the rolls that are placed inside.
Another important aspect is that it doesn't require much effort for an employee to switch an empty roll with a new one. This will have to be done several times a day and is therefore deemed to be a considerable requirement.

Market owner

From the view of the market-owner the desired requirements are more financially and business related.
The first point is the safety of the product. One can imagine the disastrous consequences for the supermarket if the new product were to injure a (young) user. Not only would the situation harm their image as a consumer-friendly market, but also bring up the possibility of a lawsuit against them.

Secondly, the investments need to be earned back. The product is expected to function well even after a certain period of usage. Therefore it is deemed important that the product itself is durable; it should not require much maintenance or a replacement due to component failure. This will be a difficult aspect to work on regarding the fact that the product is, probably, to be used several thousand times a week and will therefore have a rather limited lifecycle.

Thirdly, the product has to function near flawlessly since it will be associated with the markets name, image and customer service. Being a trend-setter in a certain area can leap that business ahead of its competitors, assuming the product succeeds in fulfulling its role. It's a risky concept, because the rewards can be great, but the losses can be greater. In the contrary case, where the product does not fulfill its requirements, as stated that it would, then not only the investments are lost, but also the service-quality of the market will be affected in a negative way. This could lead to unsatisfied customers, and therefore to lost sales.

As last, the product has to show its advantage over the current method. There is no reason at all for a marketing-department to invest in a new concept if it's unclear what the new product has to offer. Therefore it is deemed necessary to have at least one unique selling point, and clear advantages over current methods onn the other design points.

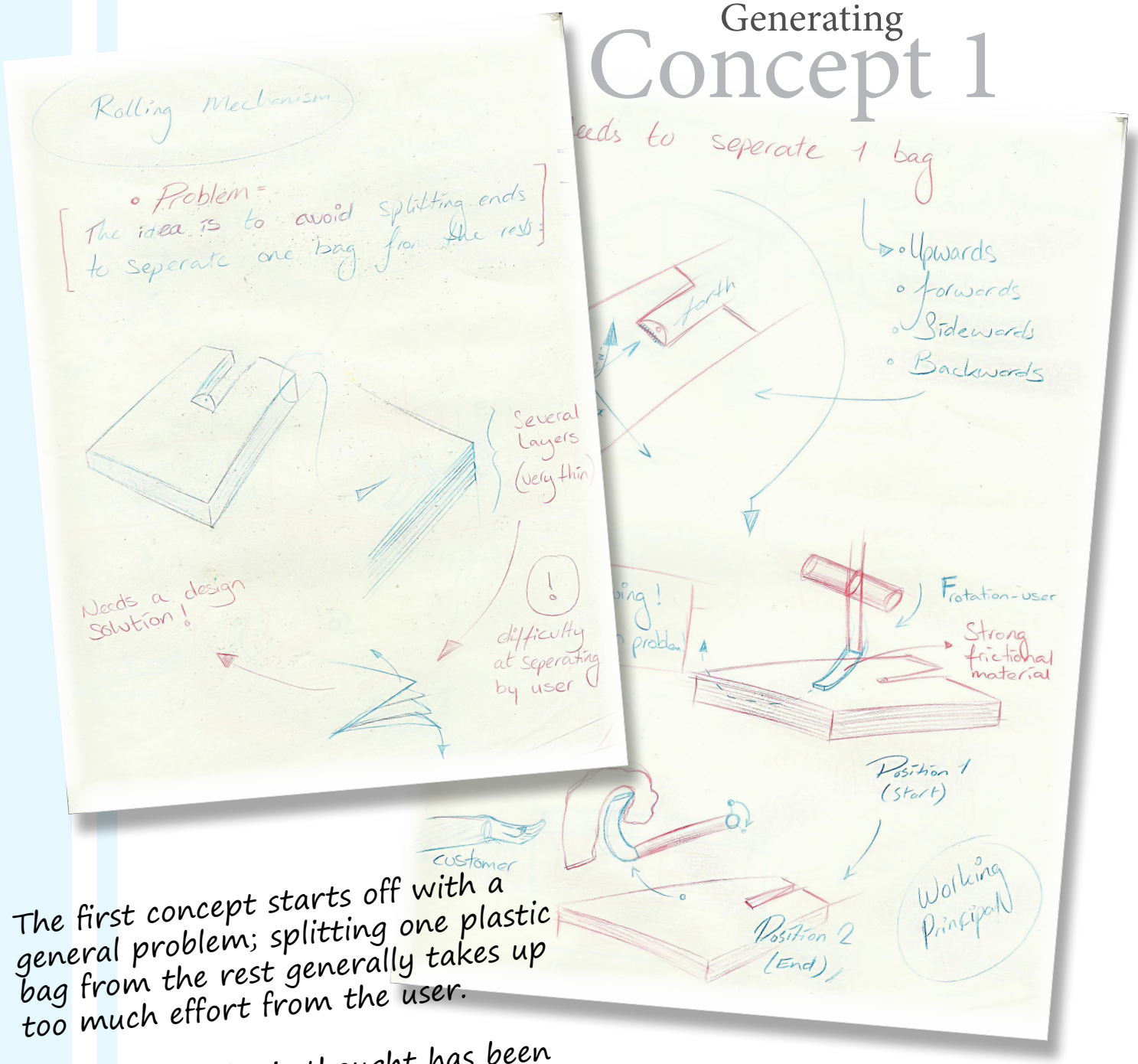
2 Concept

.1 Creation

Introduction

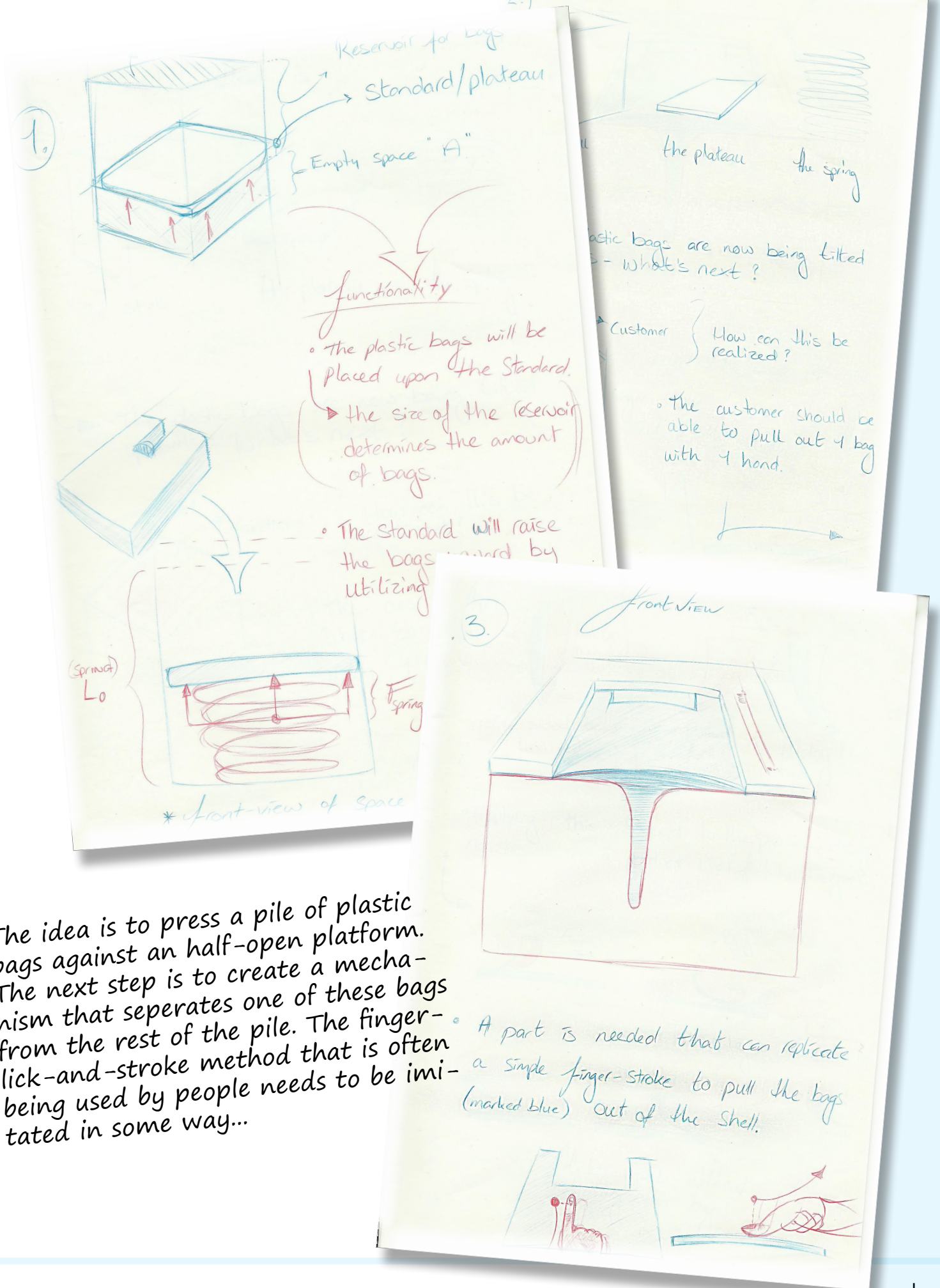
The goal of this concept generation phase is to come up with ideas that serve as (partial) design-solutions for the problem stated in the previous chapter. Each idea in this chapter will be worked out in a rather structural way to solve its sub-problems and so eventually to come up with a functional solution. The first series of sketches will lead to a concept that works for plastic bags which are stacked in a pile, the second and third series lead to a concept that works with a roll of plastic bags. The main focus while developing these concepts will lie upon dispensing single units.

2.1.1 -- Idea generation



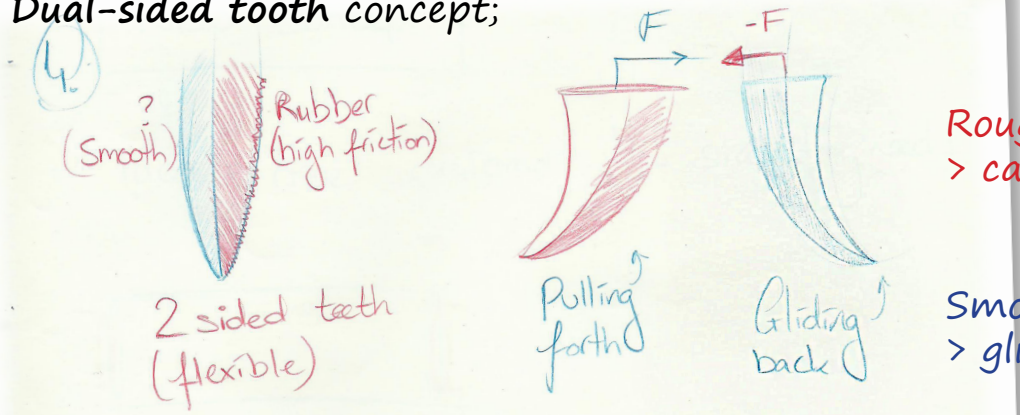
The first concept starts off with a general problem; splitting one plastic bag from the rest generally takes up too much effort from the user.

Therefor this basic thought has been chosen as a starting point for the first concept.



The idea is to press a pile of plastic bags against an half-open platform. The next step is to create a mechanism that seperates one of these bags from the rest of the pile. The finger-lick-and-stroke method that is often being used by people needs to be imitated in some way...

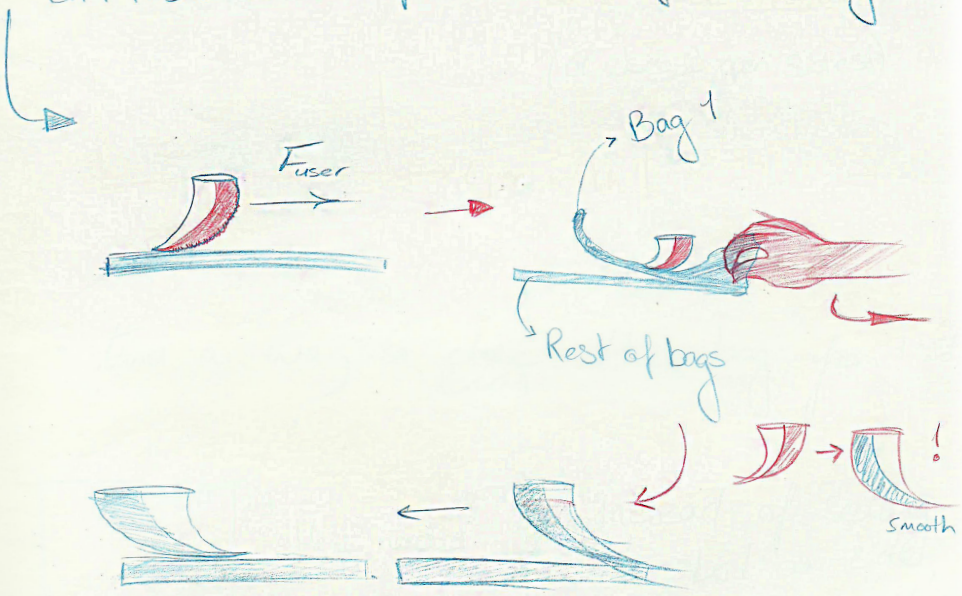
Dual-sided tooth concept;



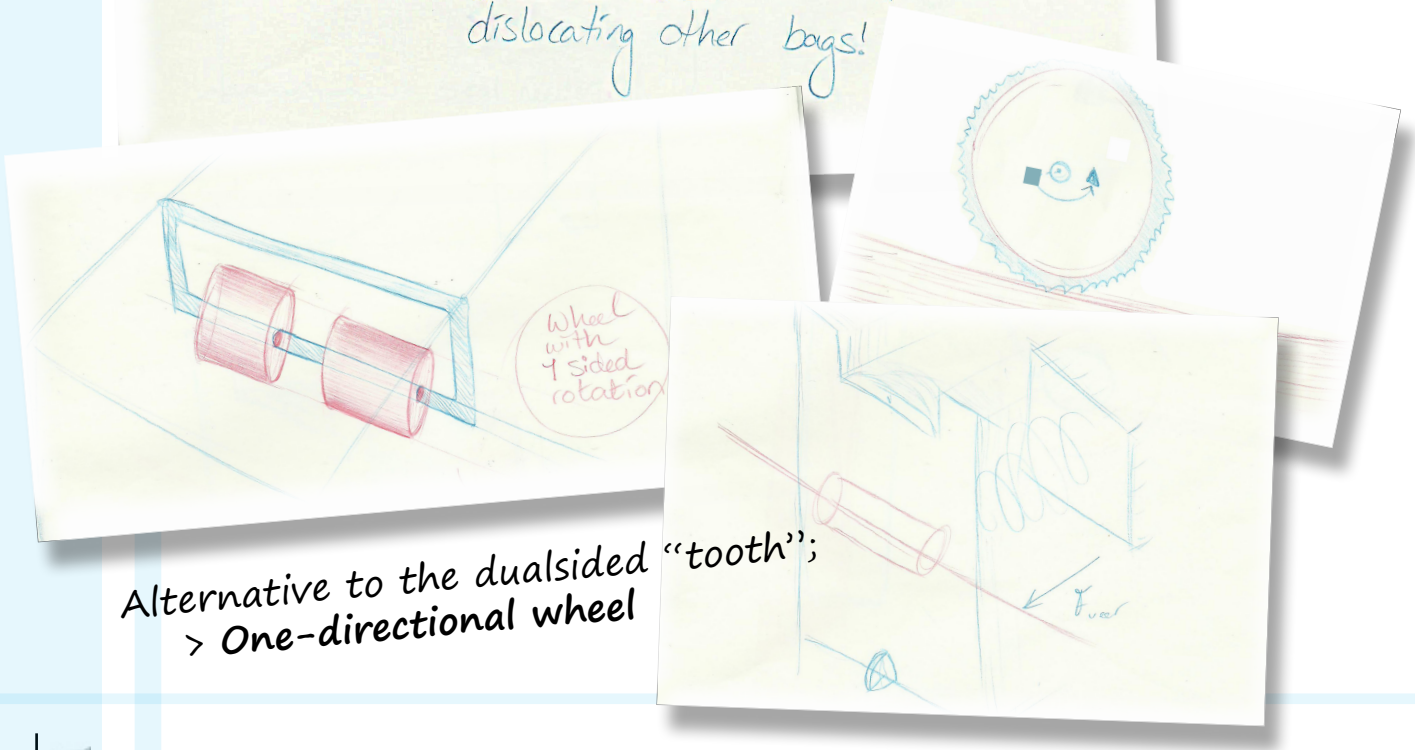
Rough surface ;
> causes friction

Smooth surface;
> glides easily

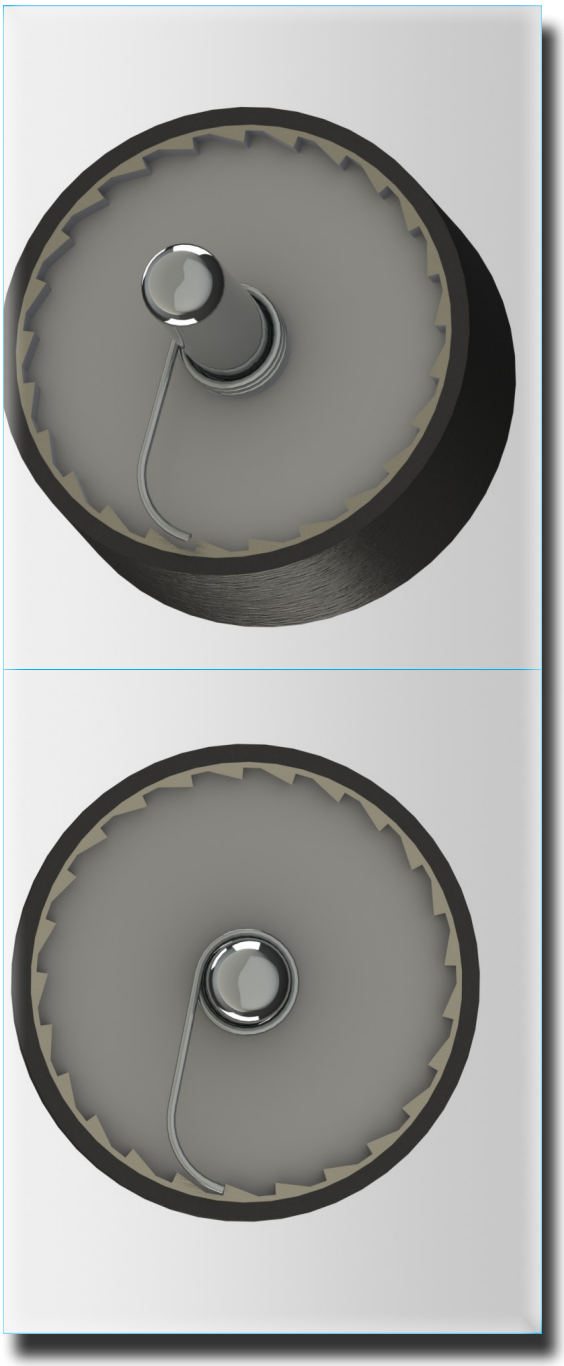
- Applying this concept to the previous design can result in a product that fulfills its goals.



Glides back without dislocating other bags!

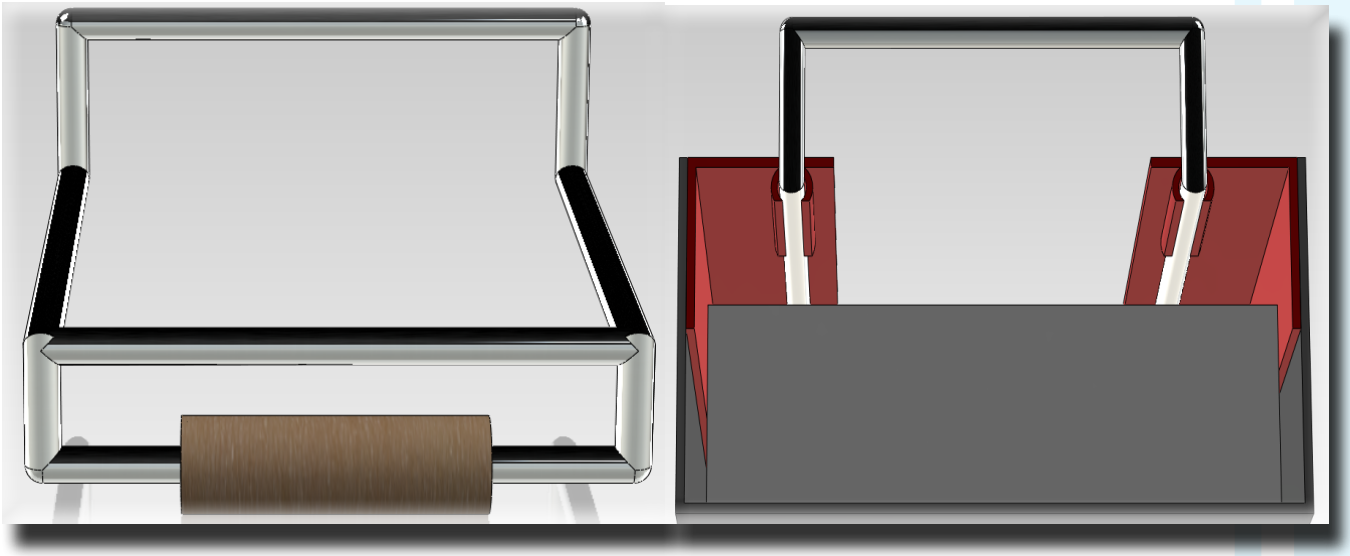


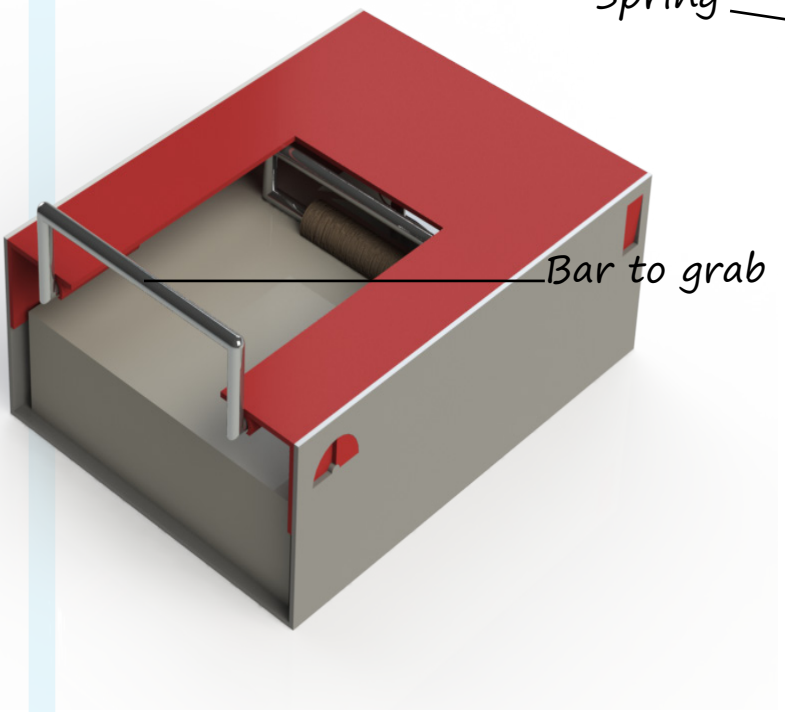
Alternative to the dualsided "tooth";
> **One-directional wheel**

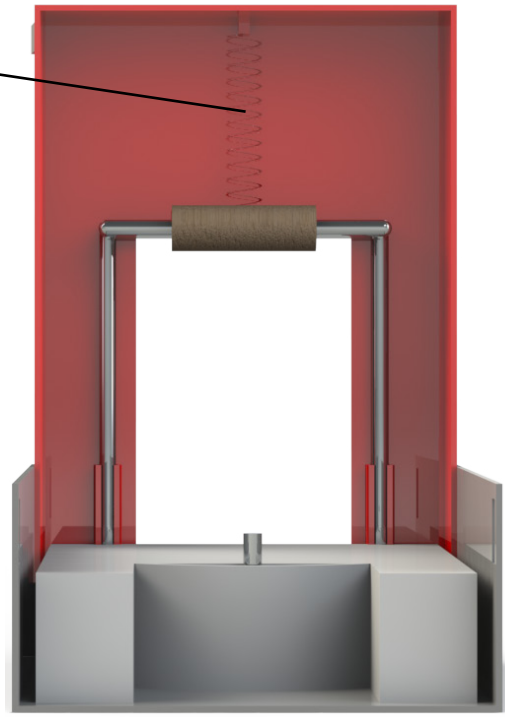


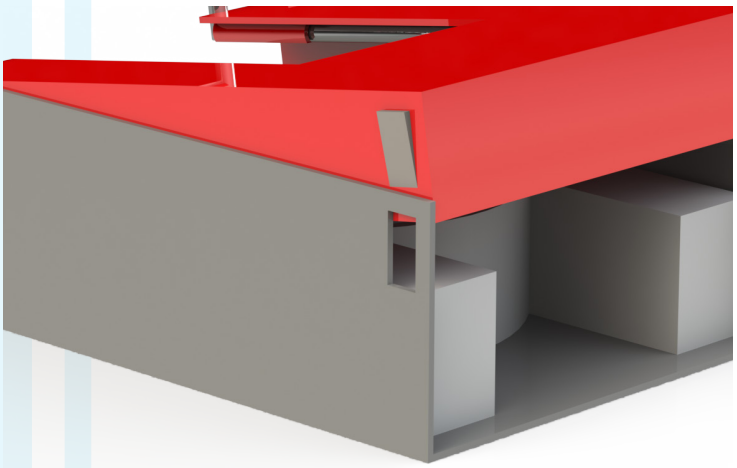
The one-directional wheel is an easier solution because it does not need to flip, like the "tooth" does, to switch sides. The wheel will simply provide friction in the first half of the motion by not rotating at all, and will then roll back to its original position over the pile of bags in the second half of the motion. See the images on the left for it.

The two images below show the frame where the wheel is connected to and how this frame is placed inside the shell itself. The two connection-units on the right picture guide the frame in its motion.
The user will be asked to hold the bar and pull it towards himself (first half of the motion, wheel won't rotate, cause friction and rip a bag off the pile) and the spring inside it will pull the frame back to its original position (wheel rotates, won't interfere with the rest of the bags).



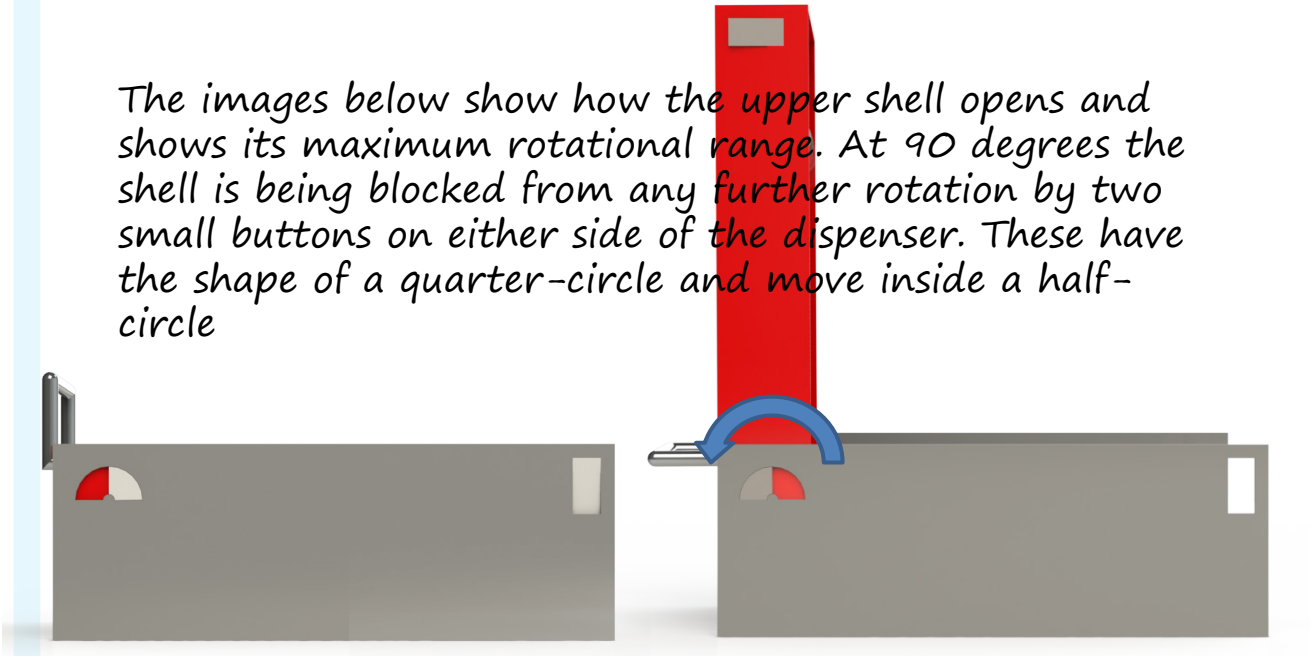






The picture on the left shows how the upper shell can be connected to the lower shell. The upper part can be opened again by pressing the grey button inwards. This way the plastic bags can be replenished.

The images below show how the upper shell opens and shows its maximum rotational range. At 90 degrees the shell is being blocked from any further rotation by two small buttons on either side of the dispenser. These have the shape of a quarter-circle and move inside a half-circle

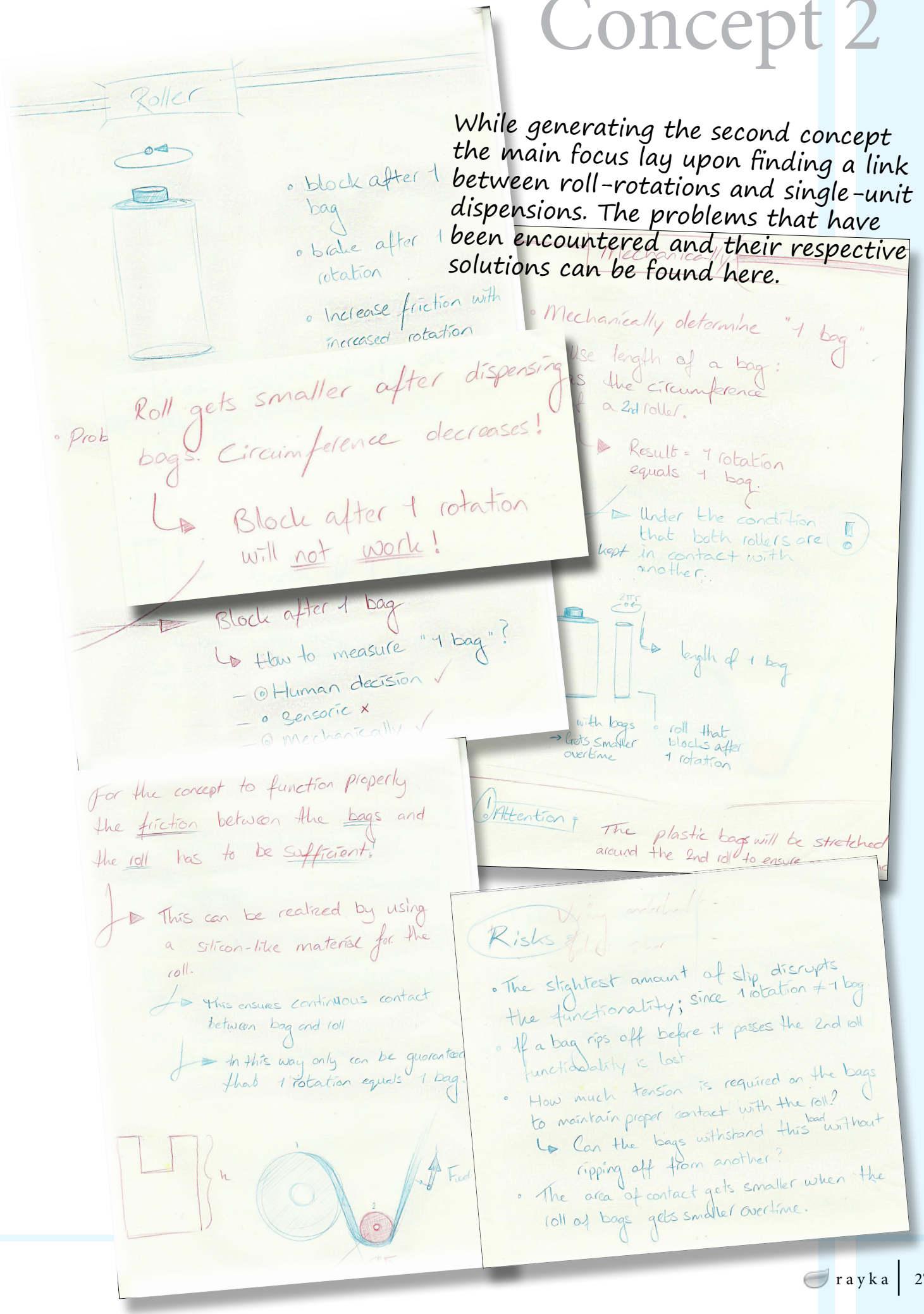


Concept 1

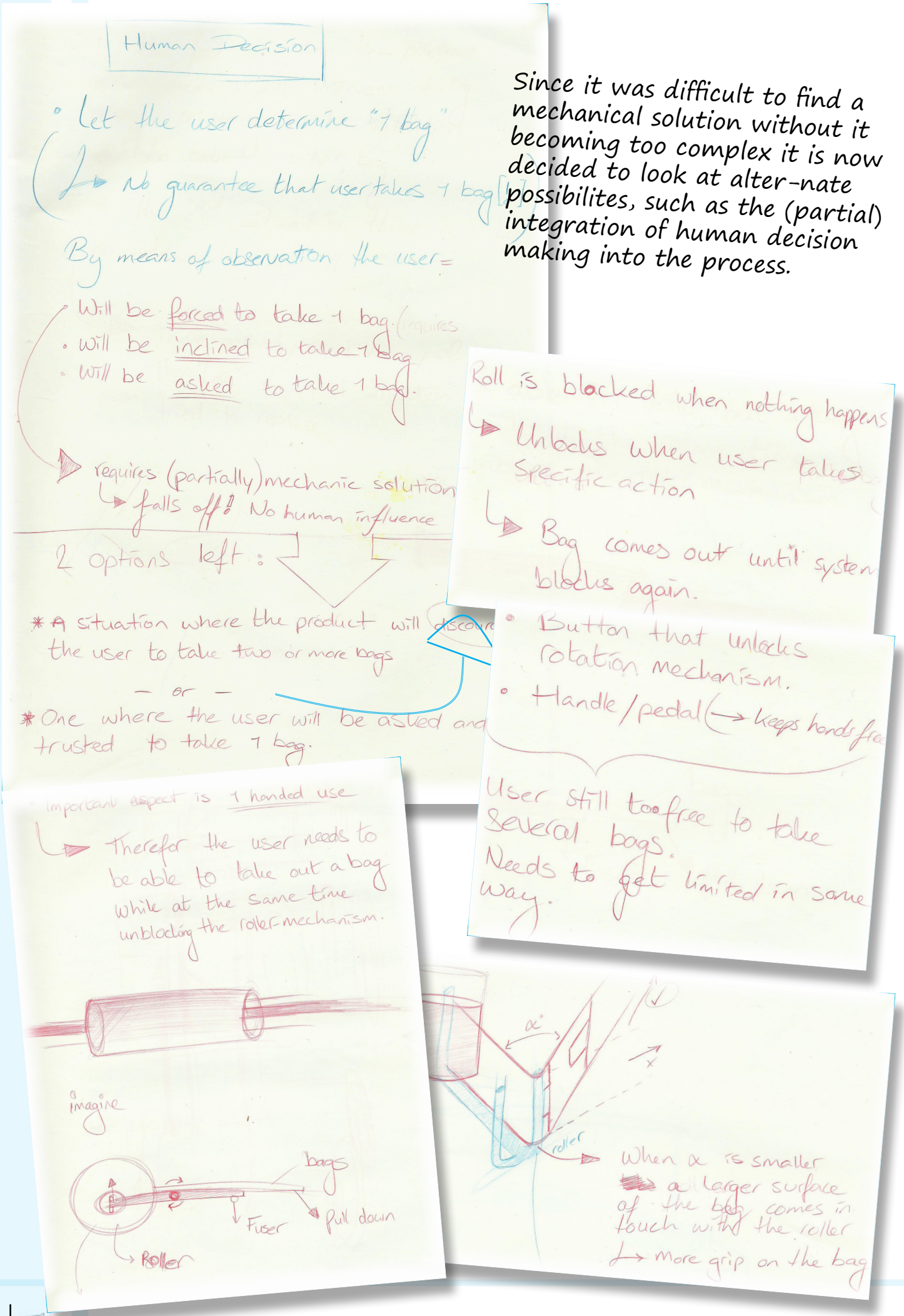
Generating

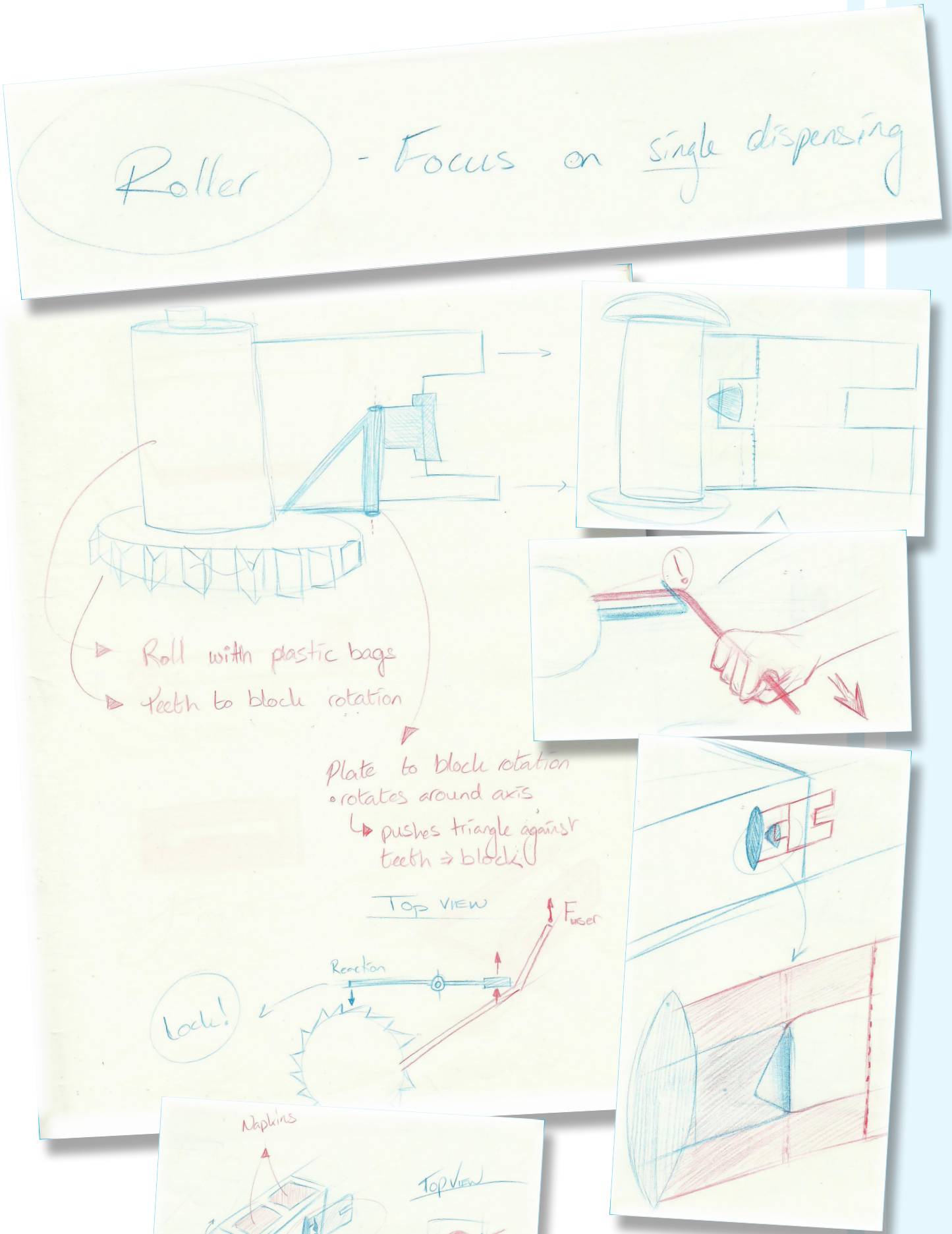
Concept 2

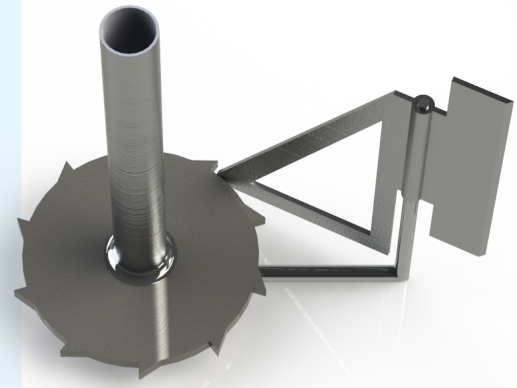
While generating the second concept the main focus lay upon finding a link between roll-rotations and single-unit dispensions. The problems that have been encountered and their respective solutions can be found here.

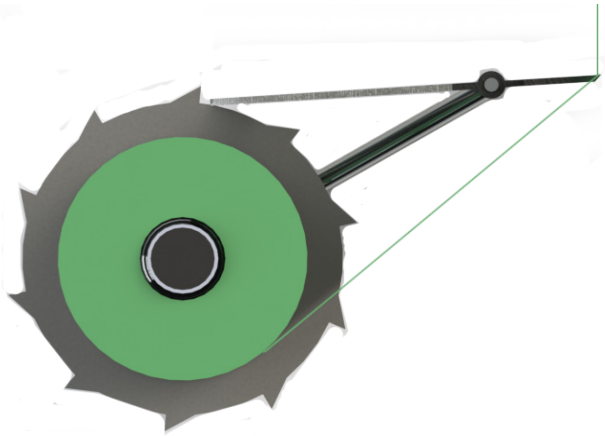


Since it was difficult to find a mechanical solution without it becoming too complex it is now decided to look at alter-nate possibilites, such as the (partial) integration of human decision making into the process.

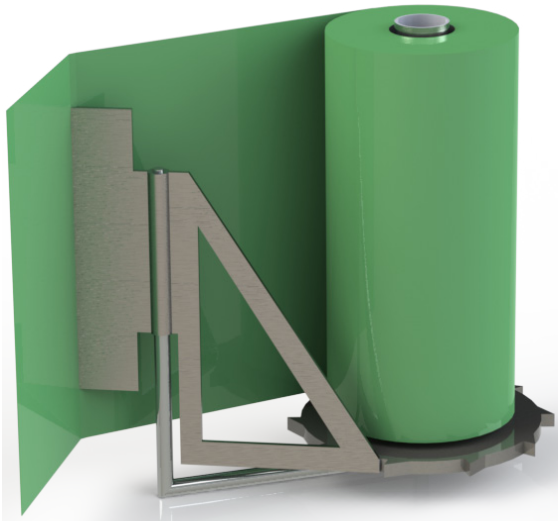


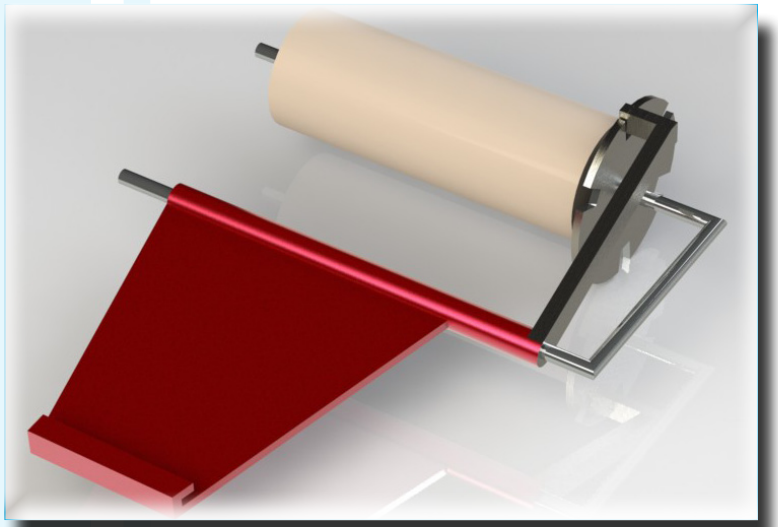

Roller
- Focus on single dispensing
Roll with plastic bags
Teeth to block rotation
Plate to block rotation
• rotates around axis
↳ pushes triangle against teeth ⇒ block
Top view
F user
Reaction
Lock!
Napkins
Top View
Plastic bag rolls

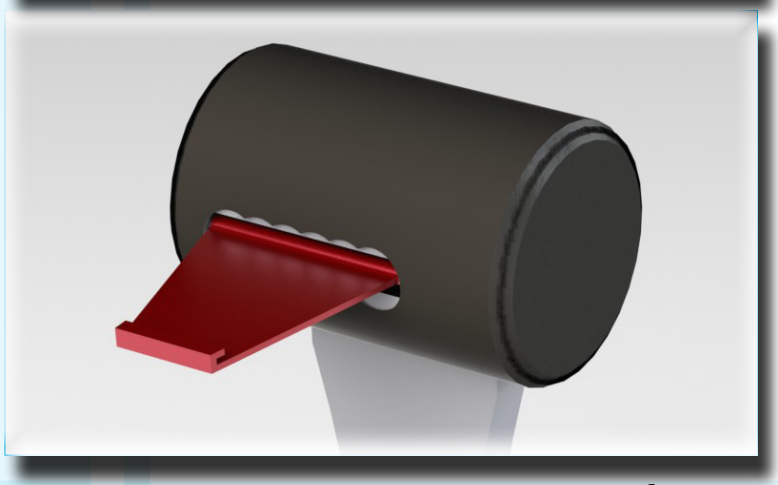




The idea is to have the mechnism unlocked in its initial state, until usage of the dispenser occurs. The user will be asked to pull onto a bag, and pull it towards the platform to lock rotation and therefor allow for seperation of the bag from the rest on the roll. This process can be seen on the right picture.







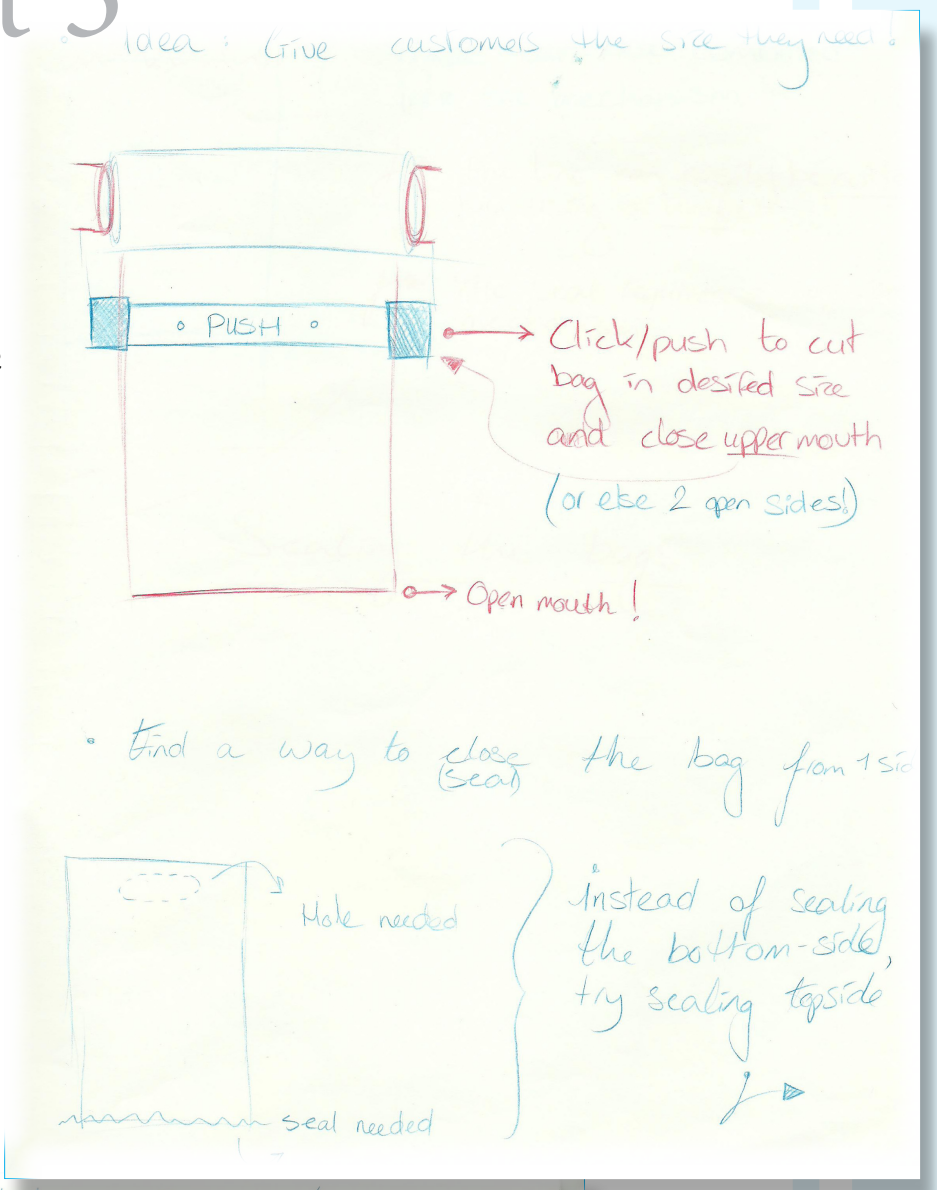
The two pictures on the left represent the final second concept. In contrary to the previous concept mechanics; this one works in the opposite way. The mechanic will unlock when a user pulls a bag downwards onto the red platform, and only allowing the roll to rotate when a downforce is being exerted onto it. However, when the user does this the broad hook at the edge of the platform will hook into the opening between two bags. This forces the user to rip it off. As a result, a single bag is dispensed.

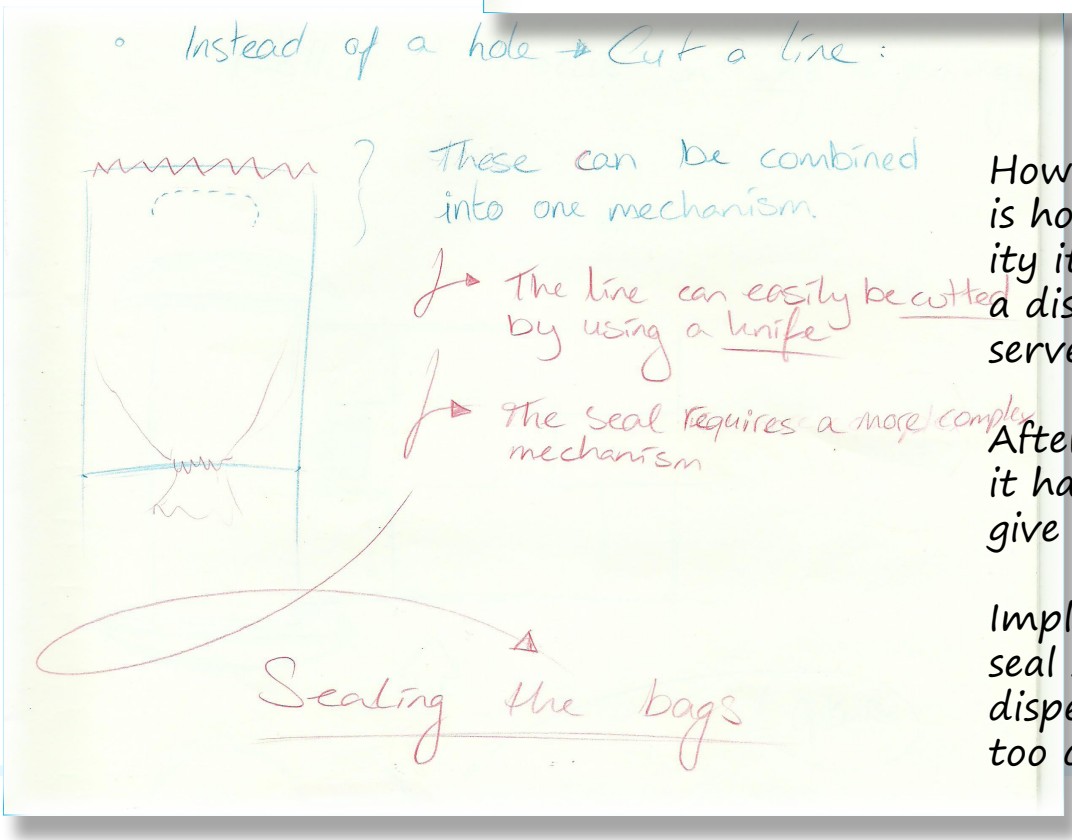
Concept 2

Generating
Concept 3

As for number three the intention is to create a dispenser that defines the length of "one plastic bag" in different ways.

The first pair of sketches is a unique idea where the users themselves are expected to cut their desired bag-lengths. This would redefine the whole concept of dispensing a "single unit" because the users are able to create their own definition of a single unit.

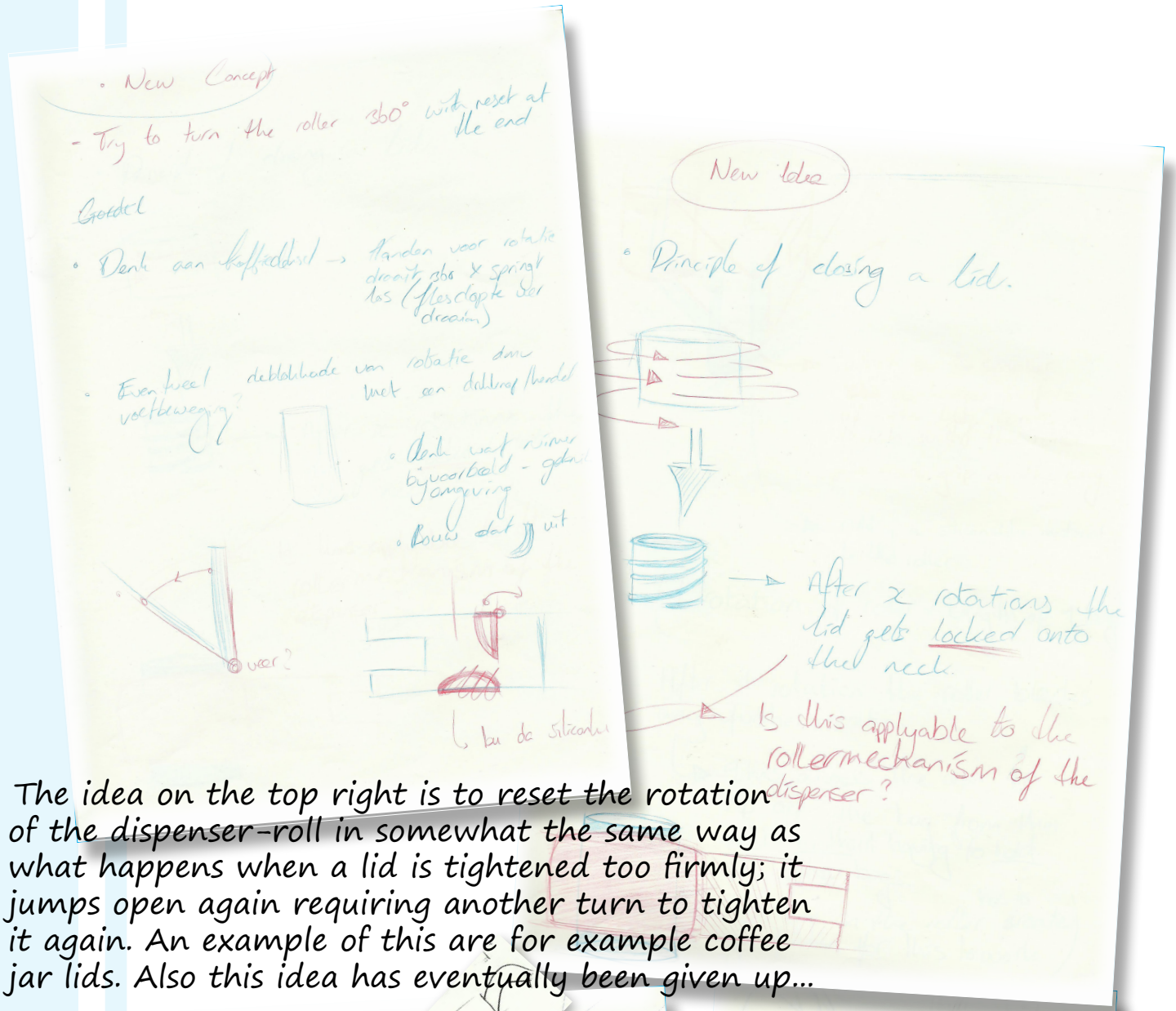




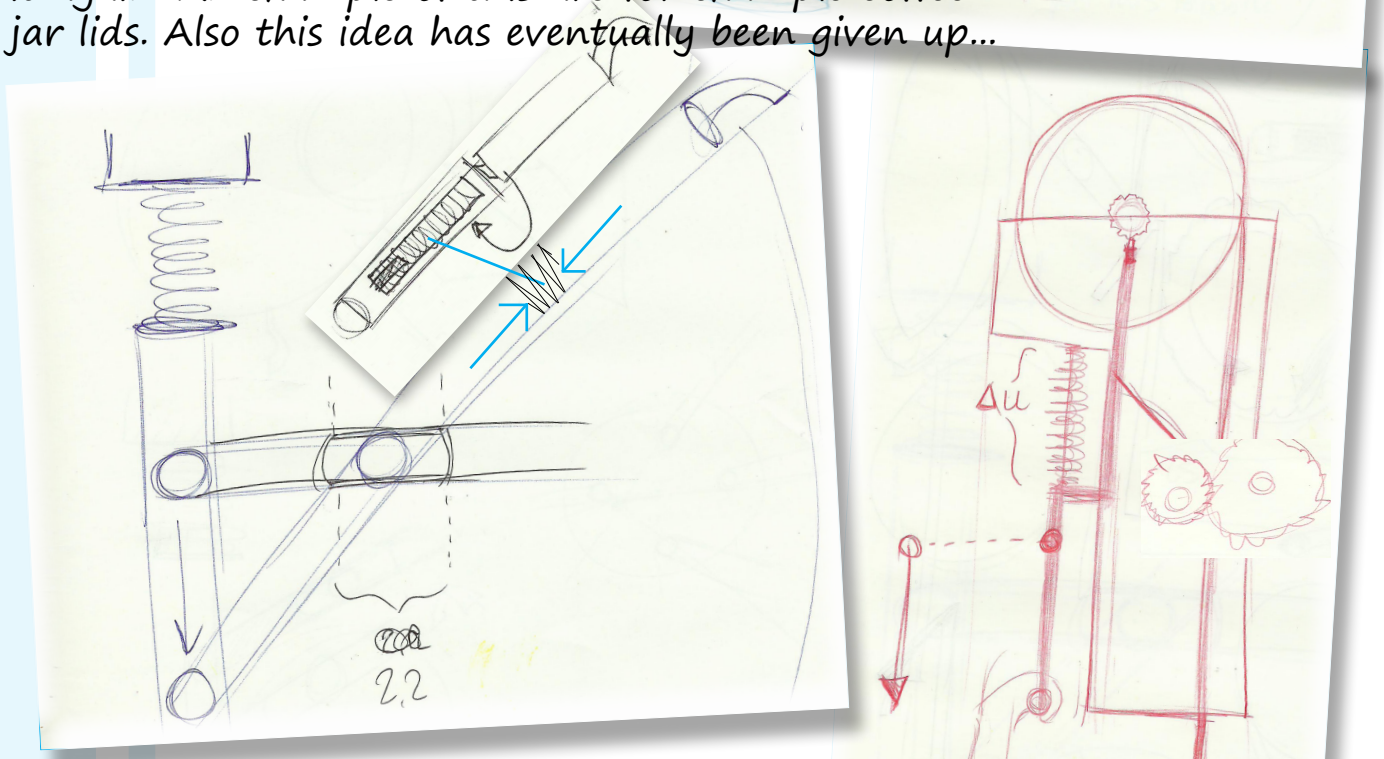
However, the question is how much complexity it will bring into a dispenser that is to serve a simple goal...

After some thinking it has been decided to give up on this system.

Implementing a cut & seal system into one dispenser will become too complex and risky.

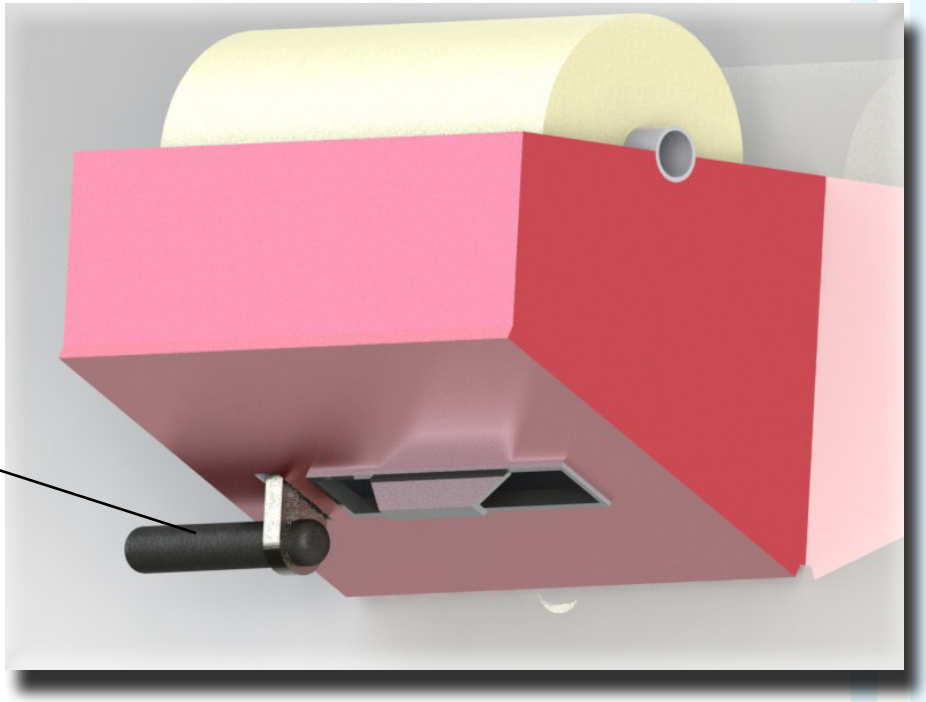


The idea on the top right is to reset the rotation of the dispenser-roll in somewhat the same way as what happens when a lid is tightened too firmly; it jumps open again requiring another turn to tighten it again. An example of this are for example coffee jar lids. Also this idea has eventually been given up...



A new idea to use gears to create a movement that matches with the length of one bag proved itself more successful. The result is a linear movement that is turned into a rotation. Adding two single-directional wheels to the concept allowed for the single-unit dispension of the bags.

This is the grip connected to the board below. A pull onto this grip will rotate the wheels, on the bottom picture, inwards.



Concept 3

2.1.2 -- In-depth views

Now it's known how and for which main reasons each idea evolved into its present concept form. For each of these concepts it will now be explained how they work and in which way they are thought to fulfill their goals. This will be done step by step with the first step being an explanation of its working principle, the second step will be the composition of a list stating the pros & cons while the third and last step will result in a speculation of the concept's success potential. This will be done by going down the design brief and checking how well the concept suffices each one of the requirements in it. Eventually the outcome of this small analysis will be used in picking a concept for further development.

- Concept 1 -

- Working principle

The first concept is in fact just a box holding a pile of bags that are stacked together. It consists of a platform with a spring attached to it. This spring causes the platform to push against the plastic bags. On the other side is a long wheel. In this way the plastic bags push against the wheel constantly ensuring continious contact between the two (an alternative to this could be to attach a spring to the wheel itself). The wheel rotates single directionally and is locked onto a small framework. What the user is asked to do is to grab and pull onto this framework from the outside. This will cause the wheel inside the product to slide over the plastic bags that are pressed against it.

In this **first part of the motion** the wheel will not rotate but block. The friction between wheel and bag that results from this action causes one bag to get seperated from the rest. The main functionality of the product depends on this friction. Therefore it is deemed important to pick the right material for the wheel; a material that has no chances of slipping over the bags' surface.

In the **second half of the motion** a spring makes sure that the framework is restored to its original position. Here the wheel will rotate so that the other bags under it will not be disarranged. The user can now pull out the loose bag which hangs out of the dispenser. The dispenser is now ready for re-usage.

- Strong & weak aspects

A strong point aspect of this concept is that it actually dispenses a plastic bag rather fast and easy. With a single pull the user is offered a plastic bag which he can take out. Another strong point is the ease of refilling the bags. To open the dispenser the user needs to push two small knobs inside. This will unlock the upper shell of the dispenser so it can open by rotating it outwards. As last, another strong feature is its compactness. The dispenser is in fact a small rectangle with a height that needn't be much larger than the height of the pile of bags inside of it. It just requires some extra room for the wheel to fit inside.

A weak aspect of this concept is its reliability. The wheel needs to be thoroughly thought out in order for it to function as intended. For example, if the wheel were not to freely rotate on the way back, it would disrupt the other bags and they would get stuck inside the dispenser which could lead to product failure.
The open upper shell should allow for a quick manual fix, however this will take time and is not the way the dispenser is meant to function. The chance of failure is therefore rather high.
Another point is the fact that a spring is needed to pull the framework back to its origin. This spring will be stretched over a pretty long distance many times a day. The question is how long it will last before it loses its sternness?

- Success potential

This concept fulfills most of the requirements stated in the design brief, at the end of the analysis phase. However, it lacks a few features, such as a reservoir and durability. This means that the product will in fact become a small compact box that contains a limited amount of bags. It also means that its lifecycle is rather limited (due to the usage of the long spring).
This, however, does not mean that this concept has no chances of becoming successful. The shell can be larger than the measurements it was initally given. In this way more plastic bags can be put into it leading to a lesser need for replenishment. An alternative could always be to add an external reservoir.
As limited durability concerns; this is due to the use of one component, which is the long spring inside. The question here is if it's really necessary to use one. The answer to that question is easy, it is necessary. The framework will eventually need to be taken back to its original position. The movement has to be a linear translation which therefore leaves out many other possibilities. The question is now how disastrous the consequences are if the spring loses some of its stifness over time. The consequences are not disastrous, because the concept can still pull a bag out of the dispenser. Whether the bag is being pulled outwards for half its size, as it is intended to do, or a few inches less, it doesn't matter as long as the user is still able to get a decent grip on the bag.
In short, the concept is an easy and quick to use dispenser. It is usable single-handedly and dispenses one plastic bag at a time with just a single action. It can be attached to a background and easily be opened up for replenishment. Reliability might still be an issue though, because the chances for failure can be rated as medium.

- Concept 2 -

- Working principle

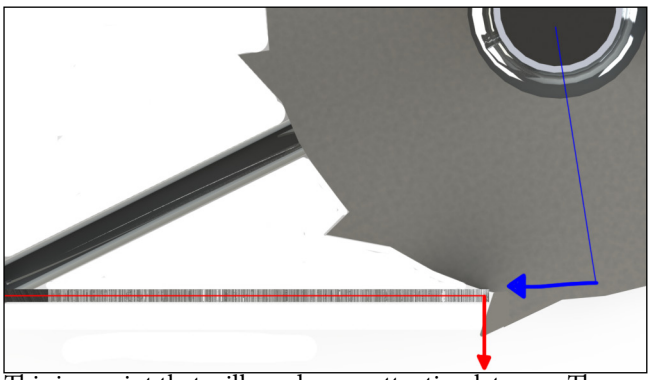
The second concept is a dispenser that, unlike concept one, works with rolls of plastic bags instead of stacks. It consists of four main components; these are the (red) platform, the cog-like part, the blocking arm to slide in between the cog-teeth and the tube to hold a roll of bags. To be able to unlock the rotation of the roll the block arm will have to be raised. To raise the blocking arm a downwards force needs to be exerted on the outer edge of the red platform. The user is asked to pull the bag, laying over this platform, downwards. On the edge of the platform there is a U-shaped segment which interrupts the flow of bags that roll out. It sticks itself in the opening between two bags. This means it holds the rest of the bags from coming further, which allows the user to seperate the single bag by ripping it off from the rest. So the role of little segment could actually be seen as a

secondary hand. When a plastic bag is ripped off from a roll of bags one hand is generally used to hold the roll itself, while the other hand is used to pull the bag in the opposite direction so that it seperates. This corresponds exactly with the function of the U-segment.

What can not yet be seen on the renders of concept 2 is a short spring. This spring is supposed to pull the blocking-arm back in between the teeth. It needn't be long and neither a stiff one. This is where the functionality of this concept depends on, because this spring ensures that continous downforce needs to be exerted on the platform, which on its turn assures that the U-segment hooks into the opening between 2 bags. In this way only can be guaranteed that the dispenser limits (and discourages?) the user to take out a second bag at the same time. If the user were to pull onto the bags without pushing the platform downwards it would mean that the mechanism would not unlock and therefore the roll will not rotate along.

- Strong & weak aspects
The strongest point of this concept is its reliability. It has little chances of failing in functionality. The idea is simple; pull a down downwards to unlock the mechanism so the roll can rotate and give out a bag. Another strong point, like concept 1, is its compactness. The platform doesn't need to be as long as shown and could be shortened to a certain minimum. Besides that, it can be easily seen when the roll is empty and needs to be replaced.

The weakest aspect is the strong contact that is made between the blocking arm and the teeth of the rotational component. A user is asked to pull on the plastic bags, which forces the cog-like component to rotate. However, because of the blocking arm it isn't able to start rotating. At this moment there is a frictional force between the two; the arm and the teeth. This is when the user also pushes the platform downwards, causing the block arm to move up. Due to the initial tension/friction between the two parts it is hard to say whether this will cause a problem.


This is a point that will need some attention later on. The area of contact between the two should be changed in some way. This will result in lesser required force to lift the blocking part and less chances of it getting stuck.

Another small point that needs consideration is the bearer of the rolls. This tube needs to make sure that the bag rolls fit onto it firmly so that they wont slip during usage of the product. At the same time though they shouldn't get stuck onto it requiring increased effort to get it off to change it.

- Succes potential
This concept actually fulfills every requirement in the design brief. It is simple to use, it is fast and also usable with one hand. It dispenses a single bag and actually limits the user in taking a second. However, unlike concept one, this concept requires the user to take three actions. The first action is to hold the bags and pull them upwards out of the U-segment, the second action is pull them downwards together with the platform and the third and last action is to rip off a bag when the U-segment hooks in the opening between this and the next bag. The good thing about this is the lower chances of product-failure that it brings. When the majority of the required actions has to come from the user this means that the product has less ways in which it can fail. This on its turn leads to increased product reliability which is well worth the extra actions that need to be taken.
For this concept also, to be successful, a solution will have to be found for the strained contactpoint. This problem heavily affects the product's sustainability and can therefore decreases its lifecycle. The solution needn't be a complex one; a simple change of geometry would suffice.
Besides that, the roll-bearing tube was said to be point of attention. Also this can be simply solved by changing the geometry of the bearer. Whereas it should still stay in the form of a cylinder adding a few features could already make a great difference. One can imagine the effect of a few ridges on the surface, from top to bottom, which are put all the way around it. A roll of bags can then be easily slided onto it, however the contact between the ridges on the bearer and the inside of the roll will create enough friction to avoid slipping.
As a conclusion this concept has also got a few points that need strong attention, however they are not to be seen as problems but just aspects that need some extra thinking. The concept is clear and simple in usage, fast and guarantees to dispense a single bag at a time. Its reliability is a strong positive that could give this concept an edge over its equivalents; concepts 1 & 3.

- Concept 3 -
- Working principle
This final concept also work with plastic bag rolls. The roll is put on top of the product, as can be seen on the renders of concept 3. The bags are (party) pulled out and tightened in between both wheels. There is an initial length to which the bags must be inserted in between the wheels. The idea is to match the line of contact between both wheels with the middle-line of the bags. The user is asked to pull onto the handle which causes to wheels to rotate for a specific amount of turns. These turns should match with the length of a plastic bag. That means after each pull on the handle one plastic bag will be dispensed. When a bag hangs out of the dispenser the user can easily seperate it from the other bags by using the metal part component around the opening of the dispenser.
The handle that is being pulled on by the user has teeth on it. With a specific gear ratio this linear movement caused by the user is translated into a few rotations. These rotating wheels are single-directional too and work in the same way as the wheel from concept 1 (see the render of the one-directional wheel at the end of concept 1). So, when the handle is pulled down the two wheels rotate which leads to the dispension of one plastic bag. When the handle is pulled back up by a spring on the inside of the dispenser the wheels

will not rotate. Now the dispenser reached its original state again and has a plastic bag hanging out of it. The user is expected to rip off this bag from the rest and the dispenser is now ready for another usage.

- Strong & weak aspects
Some positive aspects of this concept are its simplicity regarding comprehension of the design and usage. When the user sees a handle it is made quite obvious what is being expected from him/her. The user pulls on a handle and a plastic bad appears. Only two actions are needed to reach their goal from which both are self-explanatory.
Another strong point is its mechanical reliability. The lengths of the bags are all the same, so every pull on the handle will deliver exactly one bag. This is determined beforehand and applies to each rotation of the wheels.

This concept has also got some negative aspects. First of all, for rolling mechanism to work an initial action is required from the market employees. When a new roll is placed the employee will have to prepare the mechanism by pulling the first bag of the roll through both wheels. This doesn't cost much effort, however doing this several times a day can generate some frustration and costs some time. Secondly, the users will most probably know what to do when they see a handle, but will they also know what to do when the bag comes out? The intention is to use the metal component to rip one bag off so that the rest of the bags won't have to endure any strain. This is because the danger of slipping is also present in this concept. If the user doesn't use the metal clip and therefore pulls onto all the bags together, unintentionally, the wheels may not be able to hold the bags in their position and the initial set-up may get disturbed. This would result in bags that don't come out one by one. The mechanism would still dispense 'x' centimeter (length of 1 bag) worth of bags but the start and ending point would change. For example, a user is not allowed to see relative large part of bag sticking out of the dispenser because this might confuse him and cause a conflict in his thoughts whether to pull on the handle or not. The user won't know if a bag is already "dispensed" and therefore he needs to pull it out, or that a bag still needs to be dispensed.

- Success potential
Unlike the other two concepts this one has lower chances of becoming a success. The concept lacks on a few points and will require some more development compared to the other two. The success potential of this concept is therefore deemed to be somewhat lower.
On the renders of concept 3 it could be seen that the top of the dispenser was left open so the roll of bags could be seen. This can be seen as a positive, but also as a negative. The good side about it is the fact that it is easily estimable when the roll will be out of bags and about when it will need replacement. It's always good for a market employee to know this as to keep it in consideration while planning ahead. Not to mention the ease of roll replacement that comes with it. Since the roll is already on the outside some time can be saved in this way. On the other hand, leaving the top side open allows room for user interference. The user should not touch, take out or play with this roll at all since it could lead to loss of functionality. Therefore it might be wise to close it off with a lid. However, this again leads to more required effort when the dispenser would need to be restored.

Another point that can withstand the success potential is the lack of user limitation. A user could be inclined to take out more than one bag if this were rather easy. In this case the use of a handle in the dispenser can prompt the user to pull on it again. This could be repeated until the user reaches his desired amount of bags and which he would then rip off and walk off with. This doesn't mean that the other two concepts fully block out this possibility, but they at least limit the user in a more effective way.
A third point is its durability. The use of gear wheels and teeth in a dispenser which is used high frequently can cause them to wear out rather early in its lifecycle. An option would be to use strong iron alloyed wheels, though these can be pricey. Besides the gear wheels there is also a spring that pulls the handle back up every time. It is important that this spring pulls the handle component up to its original position because the rotations of the single-directional wheels depend on it. If the teeth on the handle component would for example go up halfway, the wheels would not finish the required rotations and only half a bag would be dispensed.
To round it all up, this concept might be a bit too complex to serve as a platic bag dispenser. It has lots of components, is very mechanism dependent and therefore has a high risk of failing often, which is an important factor to minimalize in this project.

2.1.3 -- Further development choice

As already stated one of these three concepts will be chosen to develop into a final product. Each concept will be given a score on a scale from 1 to 10. This score will be an average of several subscores that cover some main design aspects. These subscores are determined as a result of the concept analysis that has been done in the previous part. The design aspects where the concepts will be criticized on can be divided into two types; product-specific and general design aspects.

It should not be forgotten that this project is about creating a product that is going to replace a fairly simple, short and quick task. The key to success lays in keeping it that way. It is that what makes this such a difficult task to realize. When something that is already simple is tried to make easier the designs are ought to get more complex. Therefore it is deemed important to keep focusing on what is truly important and to make sure the product reflects that.

In this case that leads to the following product-specific design aspects:

- Simplicity: *How complex is this concept (going to be)? How will this increase its chances of failure?*

- Usability: *Is the goal worth the invested effort? Which of the concepts requires the least effort to get the biggest results?*

- Limitation: *How strong is its ability to limit the user in taking more bags than truly is needed?*

- Guidance: *How strongly does the concept guide the user in the right way? Is the concept sufficiently self-explanatory? Would it eventually require the provision of extra instructions?*

Besides the previously mentioned product-specific aspects the concepts will also be criticized on the following general aspects:

- Durability: *How long will the product last? Will it require periodly maintenance of (some) components? Is its lifecycle longer compared to the other concepts?*

- Safety: *Are there any chances of danger? If so, what is the severity of this danger that could occur? Could these risks partly, if not fully, be eliminated?*

These are the 6 design aspects that will be graded for each concept.The questions in italic represent what has been considered to obtain the grade. So the answer to these questions will be not stated, but rather be combined into a number on a scale of 1 to 10.

Also, each of the 6 aspects will be given a specific weight factor. This means that some aspects are regarded more important than the others. So it can be seen that simplicity has the highest weight factor. It has already been stated before that simplicity plays a major part in this project. The concept will eventually take over a fairly simple task, therefore it is important to keep this simple, low in costs and risks. One can imagine the frustrations that occur when a simple task is made more complex and at the same time isn't executable due to product failure.
Usability has the second highest weight factor. To put this simply; a task which originally requires 2 seconds (estimation) shouldn't require 4 seconds due to the introduction of some mechanism. This could eliminate the product's chance of success.
Guidance has the third highest ratio. The reason is similar to the previous story. A new system is being implemented to replace a specific task. It should be made clear to the user how this new system works. Instead of making the user find this out by himself, he should be introduced to this new method. He should be willing to embrace the new system and accept the fact that it is better than the previous one.
Limitation, having the lowest weight factor of the product-specific aspects, comes last. It is a part of the important design requirements and is therefore chosen to be graded. It's not as important as the other 3 and has therefore been given a WF of 1.1 .

The concept scores can be seen in table C.1 below. As can be noticed it is **concept 2 that scores the most points** and hence will be chosen for further development.

Unlike its other 'competitors' it excels at simplicity and scores higher at limitation. It is however the simplicity of the concept that makes it a winner amongst the three. Besides that, it scores fairly well on limitation and medium on durability and safety. The two lowest points are given to guidance and durability, so these will need some extra attention later.

In the next phase the concept will be completed by optimizing it first and then taking a look into the details of it.

	Concept 1	Concept 2	Concept 3	Weight Factor
Simplicity	6	9	4	**(x 1.5)**
Usability	8	6	7	**(x 1.4)**
Guidance	5	4	8	**(x 1.3)**
Limitation	6	8	4	**(x 1.1)**
Durability	4	5	6	**(x 1.0)**
Safety	9	6	5	**(x 1.0)**
	6,34	**6,42**	**5.70**	

Table C.1 *- An overview of the scores that have been given. The mean values can be found in the bottom row.*

2.1.4 -- Proof of concept

Before the concept will be further developed it's wise to make a simple mockup of it. So a quick proof of concept has been set-up to see whether the basic idea behind the concept is indeed functional and has potention to grow out to become a working concept.

This is not to be confused with the eventual prototype, which is a neat model that represents a specific aspect of the final product, such as its looks, or its usage. The prototype will come later in this documentation.

The mockup has been made with some random parts that resemble the original ones. These parts have been found and bought at the industrial market in Karaköy, Istanbul.

The image below shows what the mini-model looked like. The small image in the top right corner shows the components that have been used in making the model. A total of six parts have been used.

As can be noticed on the picture there is a metal cog-like wheel, a holder that holds a roll of toilet paper, an arm that blocks the rotation of the wheel (unless the paper is pushes downwards) and 2 axes where the components are placed on.

Even though this model is just a quick set-up, to test whether the concept functions as intended, there are some things that immediately came forth during the set-up. Those were; the lack of a small pin to stop the blocking arm from getting raised more than needed, the overly large distance between both axes, the high effort it took to get the roll over its holder and the bending of the right axis when the toilet paper was being pushed down.
Also the problem with the contact-areas,that has been predicted before, showed itself. When the arm is tried to lift by exerting a downforce it wouldn't move until it suddenly unlocked and shot upwards.

These points will be taken into consideration while further developing the concept in the next phase.

A simple model of the concept that will be developed.

2.2 Development

Introduction

The concept will first be optmized by reducing, if not eliminating, its problems and, where possible, strengthening its positive aspects. Also its weight will be tried to lowered without any loss of functionality. In this phase solutions will be created where needed and the concept will be fully thought out. The result will be a semi-finished dispenser. After the concept optimization there will be a concept detailization. Here the smaller, yet important, aspects will be brought forth and thought out. The result will be a complete plastic bag-dispenser.

2.2.1 -- Optimization

Area of contact

The first point that needs to be worked on is the contact-area between the the teeth and the blocker. Right now the two parts work against each other. While the 'gear wheel' wants to rotate it gets blocked by the arm. While the arm wants to move out of the gear wheel one of its teeth pushes against it and causes friction and therefore refrains it from moving freely. The solution here, which is completely geometry dependant, lies in finding balance between the two. Instead of opposing one another both components should assist each other. So the question here becomes which part is going to assist in what way?

The user will be pulling on a bag first before pushing it against the platform, so that means that the rotation will take place first. The rotational component will therefore need to be adjusted. The blocking arm will then be adapted to this new wheel.

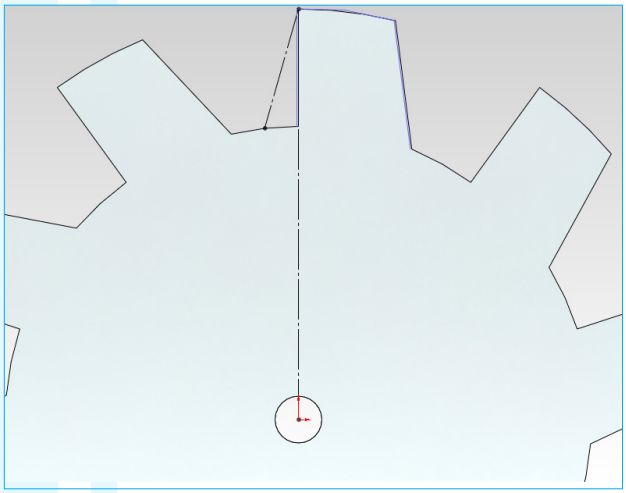


Image O.1 *- The newly constructed wheel.*

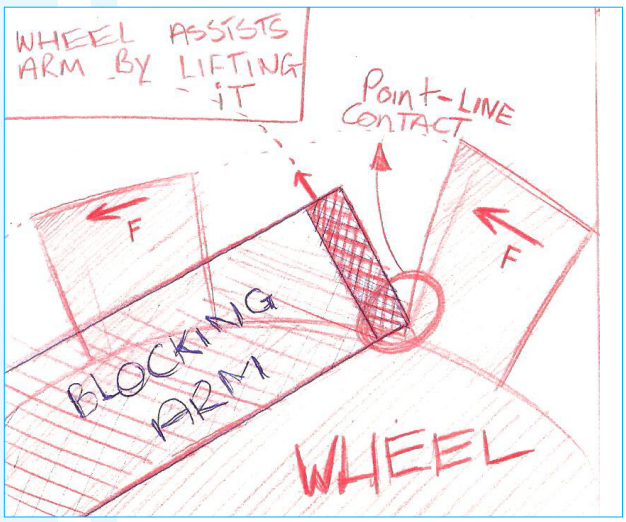


Image O.2 *- Original position of the arm.*

Image O.1 shows the new wheel. It can be seen that the left side of a teeth is co-linear with the midpoint-line. With proper definition of its length the blocking arm can be positioned in such a way that it gets lifted upwards when the wheel rotates. This position can be seen in image O.2, where the blocking arm is situated such that it makes slight contact with the wheel-teeth. By the time the teeth passes the midpoint-line the arm will have been lifted upwards instead of being pushed down and locking it further (which will happen when the teeth surpasses the midpoint line shown in image O.1)

Roll-holder

The second component that needs an adjustment is the roll-holding pipe. When a roll is placed onto this pipe it is supposed to stay on its place firmly. Any chances of slipping should be excluded. At the same time though the roll should easily be removable again when it's empty and needs to be changed. This means that the roll-holder needs be of such a specific shape that it provides sufficient resistance to avoid rotational slipping and a small, yet sufficient, bit of resistance in its linear direction (putting the roll on the pipe/taking it off). A possible solution can be found in the image

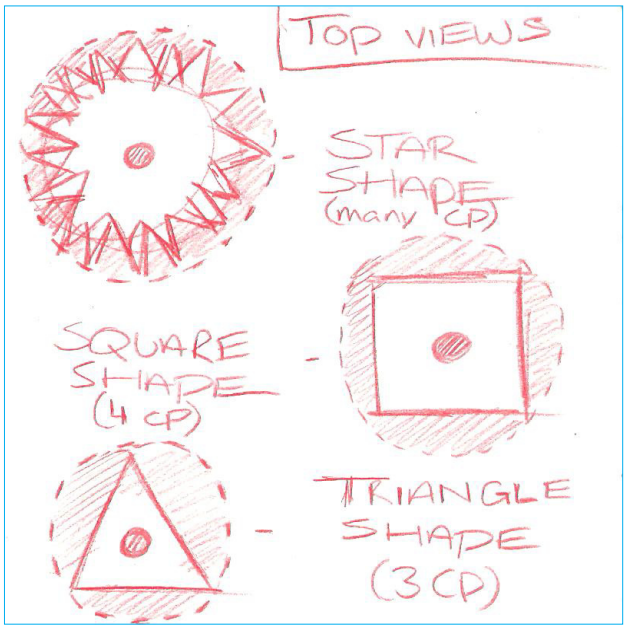


Image O.3 *- Top views of 3 roll-holding shapes.*

The shapes in image O.3 above represent the three possible shapes which can be applied to the roll-holder. The first one, the star shape, has many contact points and therefore provides the most resistance. Integrating this 2D shape over the full length of the roll-holder may provide a bit too much friction though. That is why shapes 2 and 3 might be better.

Shape 2 has 4 contact points and therefore delivers more resistance to slip than shape 3. Therefore this shape will be chosen.
Image O.4 below shows how the resistance to the linear movement of the roll will be applied.

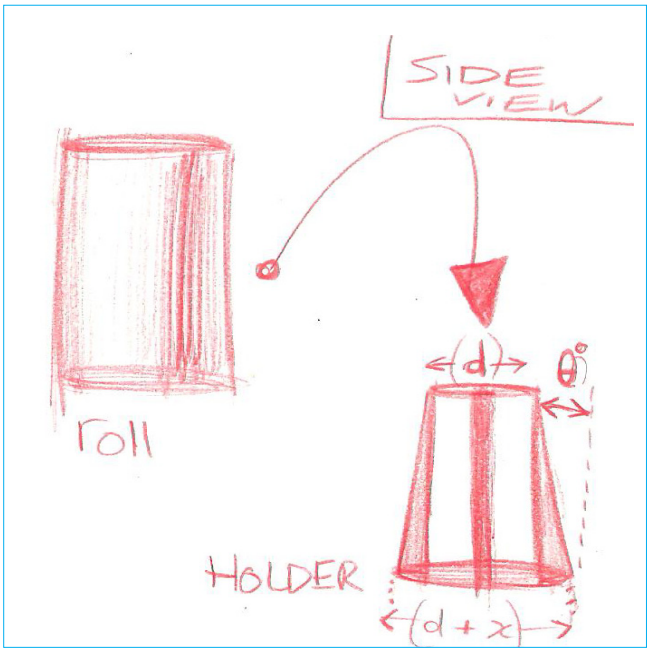


***Image O.4** - Side view of the roll-holder.*

In the image above (O.4) a side-view of the roll-holder can be seen. What can be noticed here is that that roll increases in diameter towards the bottom of it. A slight amount of increase should be enough to put sufficient stress on the roll so it won't easily slide off.

Platform
A third point of attention is the relatively large platform connected to the blocking arm. The platform doesn't have to be this large to function and therefore has to be changed. As long as it contains a surface to allow the user to exert the required force onto it, to unlock the rolling mechanism, then it should be solved. However, besides that it has a few more functions that need to be integrated into it. These are, first of all, to avoid bags sliding off from one side of the platform. This will mean that the U-segment on the edge won't be used which would lead to total loss of user limitation.

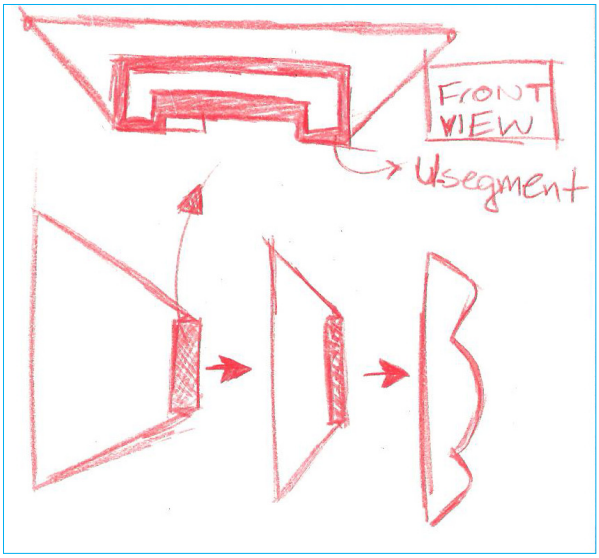


***Image O.5** - Platform adjustment / development.*

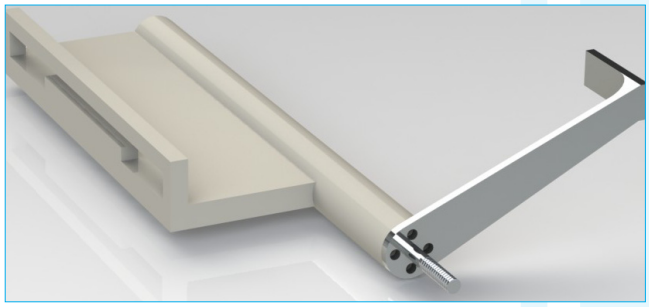


***Image O.6** - Redesigned platform (connected to blocking-arm)*

The render above respresents the redesigned platform (O.6). The addition of the square opening at the end of the platform will makes sure that the plastic bags won't glide off the platform while the user is pulling the bags downwards. Whilst the problem is actually solved, it still doesn't really look practical. The platform can be made smaller, and thinner. Also, the segment used to seperate a bag from the rest could be changed into a design that assists the user in this process. The image shows an example of such a plate (O.7).

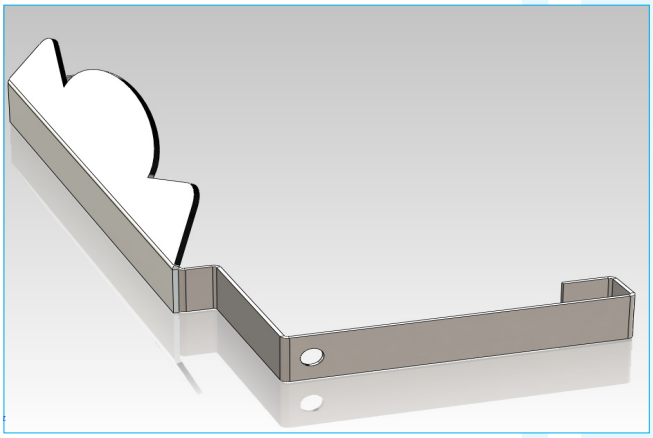


***Image O.7** - The final platform (connected to the arm).*

The shape of the plate is chosen in such a way that the middle oval section grabs into the opening between one bag and the rest of the bags on the roll, and its high outer edges make sure the bags dont slide off the blade and fall off. This can be seen below in image O.8 .

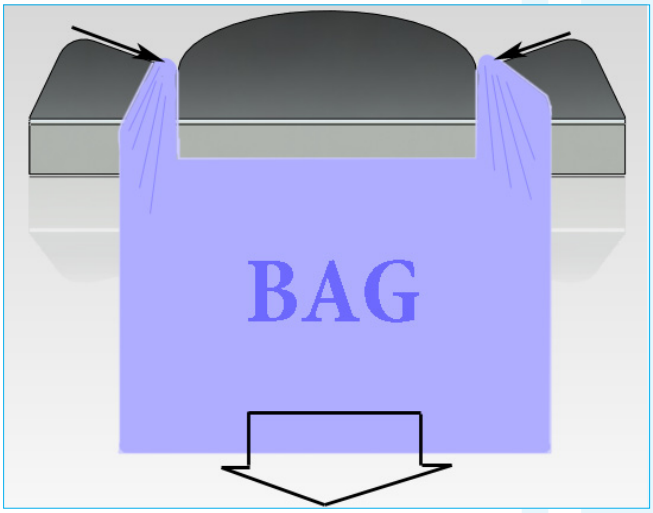


***Image O.8** - The working principle of the plate.*

Spring

The sping inside the dispenser would be the fourth aspect that needs attention. The dispenser is going to be used daily on a frequent basis. Adding an elastical component to such a product can be risky. The spring will lose its stifness over time; the rate in which this happens depends on the amount of stretch that occurs with every single usage of the dispenser. The goal here is therefore to keep this stretch amount as small as possible. The first parameters which can be adjusted here is the positioning of the attaching-point of the spring, which will define how much the spring will be stretched each time and therefore what the initial length of the spring has to be. The second parameter is the spring constant, which on its turn depends on the spring characteristics. The spring also shouldn't require much force to be stretched, because the user needs to apply this force with another component (the platform), which is connected to the arm which stretches the spring. The length of this arm creates the need for a specific amount of momental force. If this moment, which the user needs to provide, is sufficient enough to create the required force to stretch the spring, only then the blocking mechanism will unlock.

Orientation

The last point, which hasn't been mentioned before, is the dispenser orientation. Right now it is 'laying' on its side and both of the axes that hold the components are attached to the shell. The weight of a roll on its axis can lead to bending. If this were to happen the roll-holder wouldn't rotate as it used to, but rather get stuck and cause a product defect. Also the force that is being pulled with on the platform can cause this second axis to bend too. Maybe the axes won't bend, but the point of attachment on the shell will be stressed too much and cause it to deform or break!

Therefore it has been decided to turn the mechanism 90 degrees. This means that both axes will stand vertically and the deformation issue will be less of a problem now. However, changing the orientation will also affect the usage of the dispenser. Whereas the user first had to pull on a bag downwards over the platform, he will now have to make make a sideways motion.

The newly oriented dispenser can be found in image O.10, located on the next page.

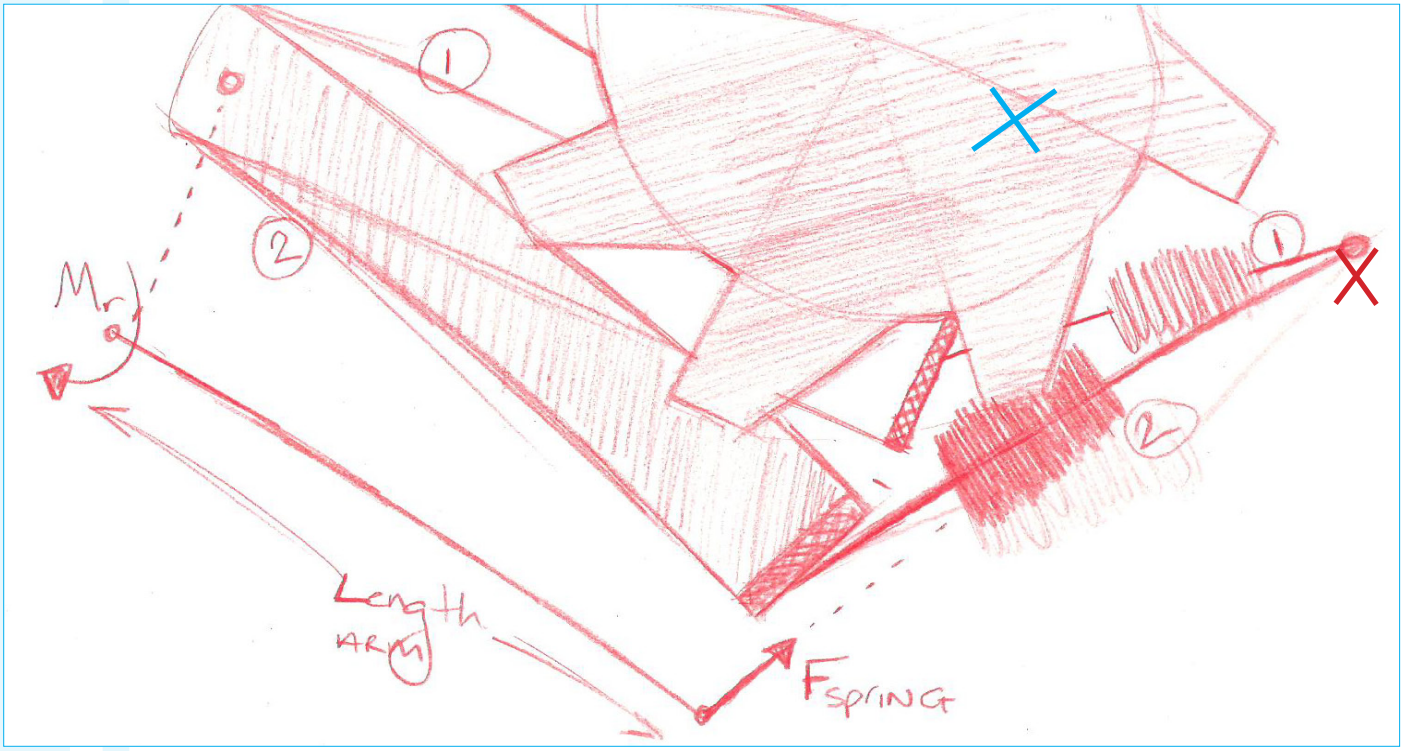


Image O.9 *- Positioning of the spring.*

The way the spring is positioned in image O.9 will make the spring stretch the least, while it's still exerting a pulling force on the blocking arm which pulls it in between the teeth. If the spring were to be positioned below the wheel (for example at the BLUE cross) the spring would have to stretch more and would cost the user more effort. The spring would be able to pull harder on the blocking arm in that way, however only the slightest amount of force suffices its function, which simply is to hold the blocker in between the teeth.

Now this semi-finished concept will be taken to the detailling phase. Here a look will be taken at the smaller, yet as important, aspects. Then this has been finished the concept is ready to be realized in the form of a prototype.

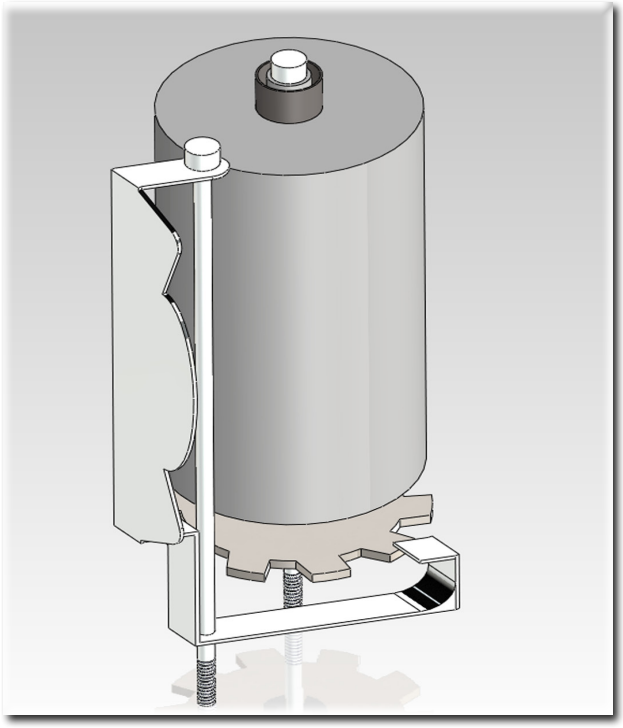


Image O.10 *- Vertically oriented mechanism.*

2.2.2 -- Detailling

In this part a more detailled look will be taken into the positions, heights and lengths of several components. For each decision an explanation will be given to show why that specific value is thought to be the most optimal one.
Some renders from the CAD model will be used to support the statements and choices. An overview with the original measurements of each component can be found in the appendix.

The blocking pin

The purpose of this pin is to stop the blocking arm from rotating besides a certain point. When the blocker moves out of the area between the 2 teeth it needn't go any further, as long as the wheel has the possibility to rotate freely. The series of images on the right (O.11.x) show where the blocking pin can be placed. Image O.11.1 shows the position of the arm when the blockage is active while O.11.2 shows the position when the mechanism is unlocked. This second position should also be the maximum range of motion because the mechanism is already unlocked and there is no reason for it to further rotate.

What is now left to do is to pick a location for the pin. As can be seen on image O.11.3 two possibilities have been given; numbers 1 and 2. The advantage of placing the pin at number 1 is the relatively low reaction force that the pin will have to provide due to the length of its momental arm (2.5L as an indication). Its disadvantage is however that the velocity of impact of the arm is higher here because this point on the arm is located further from the origin(pivot) and therefore makes a larger swing. Number 2 is exactly the opposite of 1; here the pin will need to provide a relatively large reaction force but the power of the impact between the two will be smaller. Now the question becomes which one of the two issues is easier to solve; lowering required reaction force, or damping out the vibrations due to the impact? Damping could easily be realized by applying a soft coat of (damping) material onto the pin. Therefore 1 has been chosen.

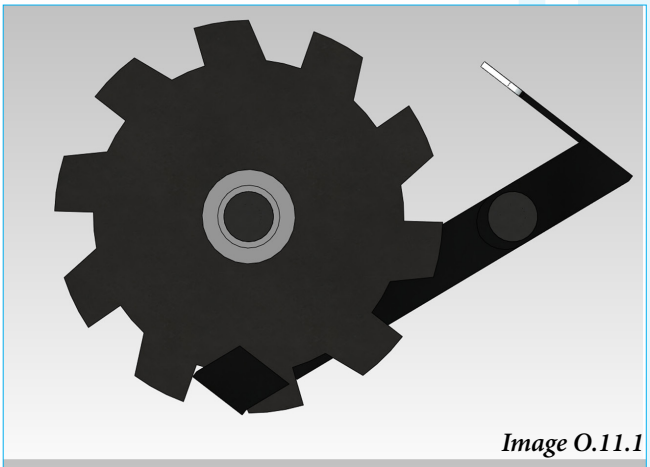


Image O.11.1

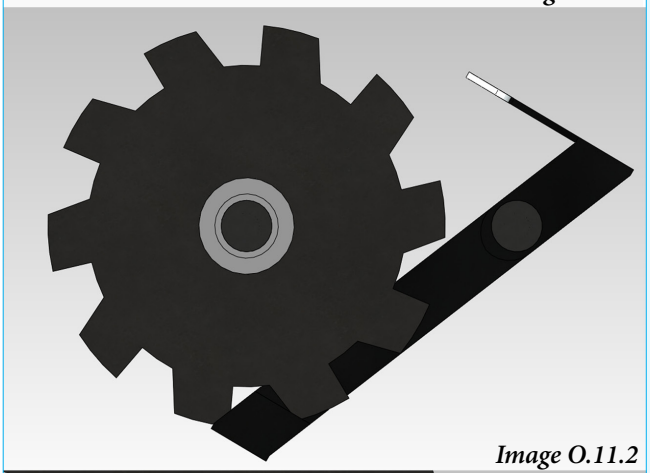


Image O.11.2

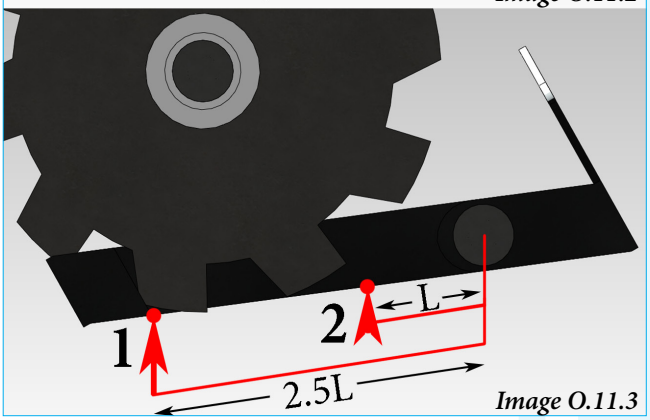


Image O.11.3

The spring attachment

As is already mentioned earlier the spring should be close to the blocker (the part at the end of the blocking arm) to avoid excessive stretching.
First of all, the user has to provide the force to stretch the spring through another component; the platform. The length of the arm between this component and the rotational point (pivot) is relatively short compared to the length of the blocking arm (which serves as the arm for the moment created by the spring). This means that the user needs to counter this moment with a relatively short arm, suggesting that he will have to provide much more force than the spring does.
Secondly, the whole function of the spring is to keep the blocker in between the teeth of the wheel. It doesn't have to apply much force to do this because the wheel only needs to be blocked when the platform is not in use. Therefore the spring will only have to stretch a minimal amount which is just enough to undo the blockage.

The image-series on the next page explain why the certain position has been chosen.

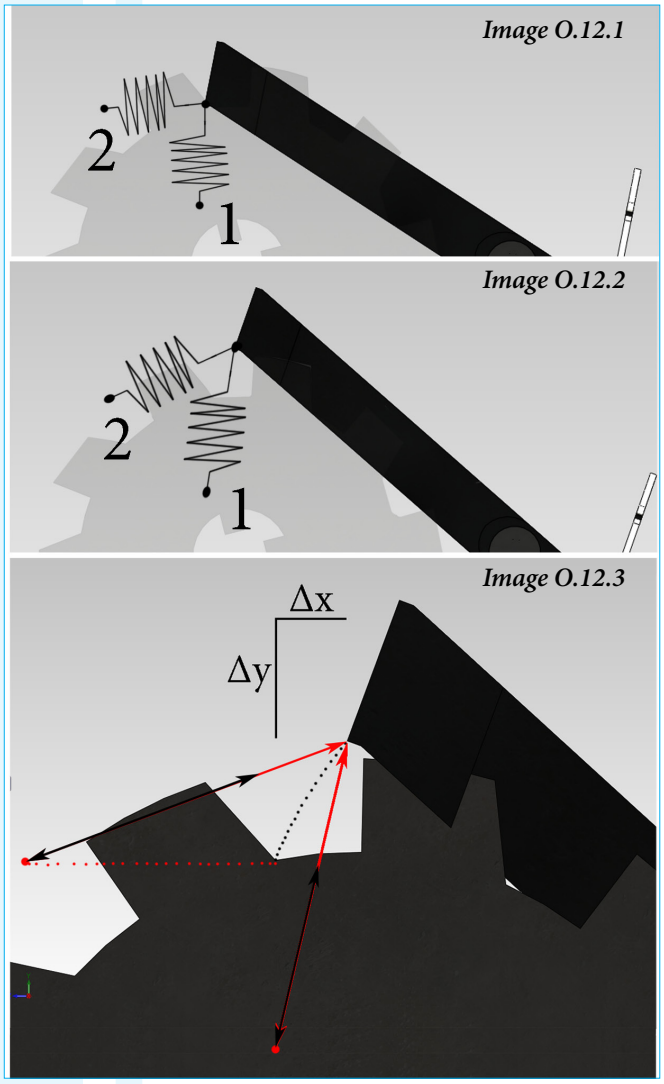


***Image O.12** - Positioning the spring origin.*

Numbers 1 & 2 represent two seperate springs each located in a different way. A look has been taken into the motion that the blocker creates when it moves upwards. The path that it travels is mostly in vertical and partly in horizontal direction as image O.12.3 shows. Therefore it would be spring number 1 which would stretch the most and so require the most effort to unblock the mechanism. Spring 1 can, for the largest part, only move in vertical direction, thus having to cover the largest path, while spring 2 would mostly have to cover the movement in horizontal direction, which is obviously shorter. As so, the location of spring 2 has been chosen.

The platform position

One of the functions of the platform is to seperate one single bag from the rest of the chain of bags. To do this, the platform is best to be positioned right in front of the roll of bags. This means they both have to be at the same height, but also that their heights correspond with each other. Therefore the width of a plastic bag, which can be found in appendix A with the rest of the dimensions, will equal the width of the platform.

This however does mean that the platform needs to have two guiding shapes on both edges of it. These triangular shapes will lay higher and so cause the plastic bag grips to glide towards the center and get stuck in the two sharp cuts right next to the two holes. Image O.13 resembles this event.

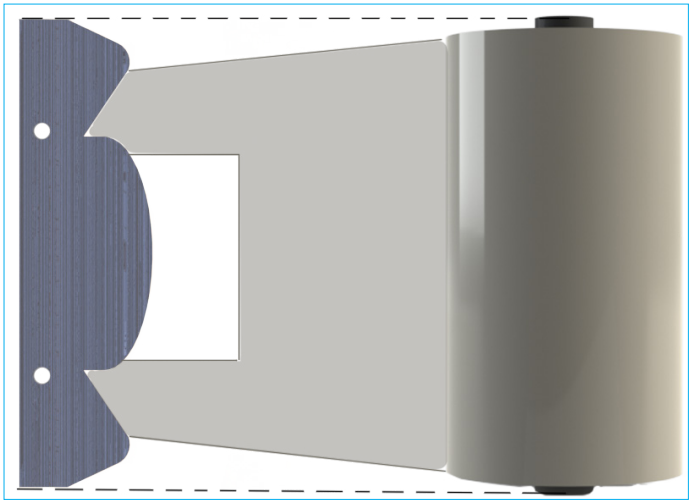


***Image O.13** - Platform next to the roll.*

The blocking-arm

To keep the mechanism as compact as possible the length of the arm will have to be as short as possible. However, at the same time it should still be able to block the wheel from rotating without disrupting the fixed contact area between the two. Another point is the one mentioned in the "spring attachment" part; if the arm gets longer the user will have to exert a greater counter-momental force. To minimalize this effort the arm is to be kept as short as possible. Image O.14 below shows the arm and its position in between the teeth.

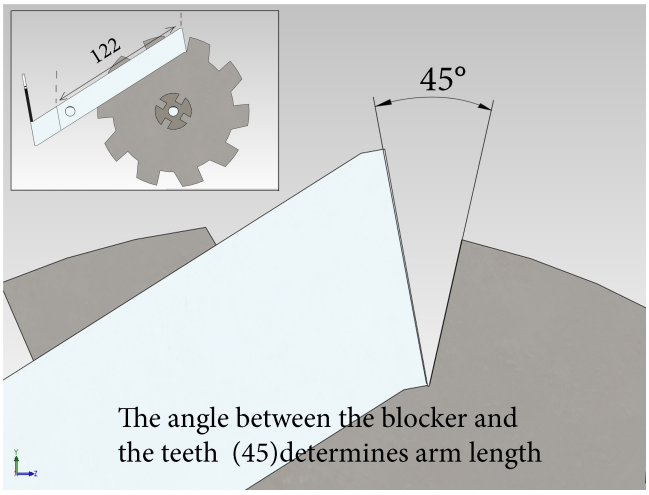


***Image O.14** - Positioning the blocking arm.*

The shape of the blocker (located at the end of the arm) will depend on the way in which an external force acts on it. Image O.15 on the next page shows a simple overview of this force and resulting deformation that wants to take place.

As can be seen the blocker is being forced to make an inward rotation because the wheel-teeth creates a momental force around the point 'o'. If the force was sufficient enough the blocked would be bending inwards.
A solution to counter this moment is by filling the corner at "o" with extra material that would block this resulting motion. Examples of such are ribs which are often used to strengthen materials.

The true question however is whether it is necessary to add the ribs at all. The force that the teeth pushes with against

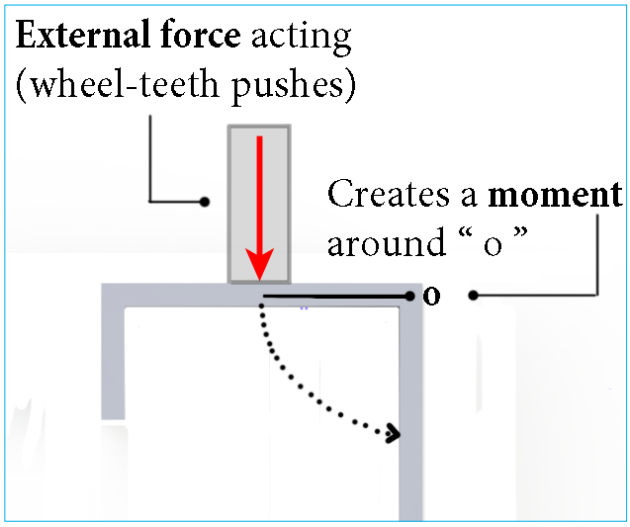


Image O.15 - Simple overview of the force.

the blocker is being determined by the force with which the user pulls on the bags. The rotation of the roll and so the holder are connected directly to the wheel and its teeth. The maximum force that a user can pull with on a bag, and therefore can exert on the components, is measured to be roughly 3 kgs (a simple quick experiment that was set up manually). If more force is applied the bag will rip apart from the rest of the chain of bags. This means that the maximum pushing force of the teeth in image O.15 becomes 21.9 Newton. Image (O.16) below presents this scenario with the resulting deformation in the blocker. The result is satisfying!

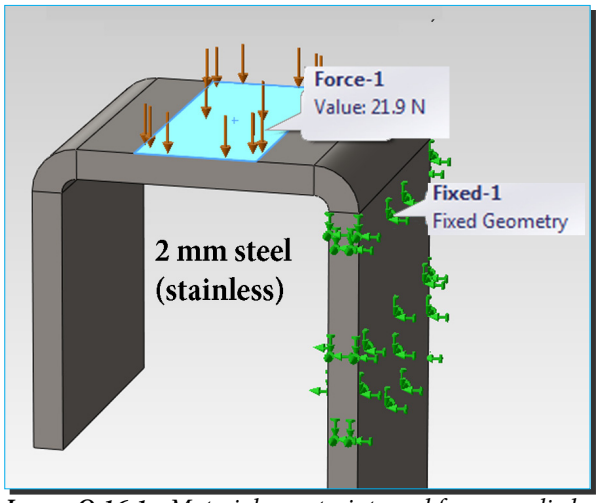


Image O.16.1 - Material, constraints and forces applied.

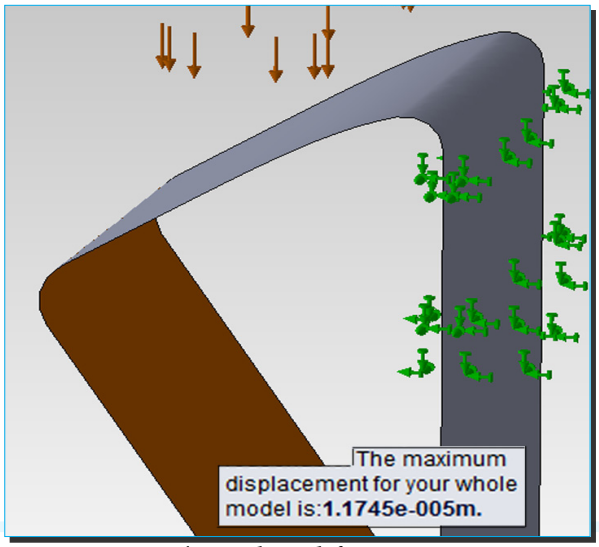


Image O.16.2 - The resulting deformation: 0.01 mm.

Housing

The last aspect left is the shape of the housing. It is of primary importance that its 'mouth', the opening of the shell, lines out perfectly with the platform. This should allow the platform to make the small rotating motion without touching the upper-shell. The platform should be placed into the opening so that it is easy to take out bags without much effort. A second point is that it limits the user from reaching the inner mechanics. This will minimalize the chances and risks of injury. The mouth can be seen in image O.18.

The main function of the upper shell is to hold the components inside the dispenser and provide enough stifness to safely lock them into their positions. This part of the housing should be able to take on the forces that are being exerted by the user on the dispensing mechanism.

The housing will extend downwards and rest on the floor. The mechanism is located rather high, which means that by pulling on a plastic bag the user would be creating a moment around the base of the housing. An extra plate will therefore be added to the bottom to ensure that stability is being maintained during usage.

The length of the supporting lower-shell will determine the height from which the dispenser will serve. Table A.2 from the analysis phase can be used to create an ergonomic height for the users. The opening of the upper-shell will be aimed at the chest area. This means that the users will have to reach for this height to get their plastic bag. This is depicted in image O.17 on the right.
The table shows that the average shoulder-height is 81.8% of the overall user height. With the overal user height being defined at 166.5 cm this means that the upper limit for the dispenser-mouth becomes roughly (0.818 * 166.5) 136 cm .

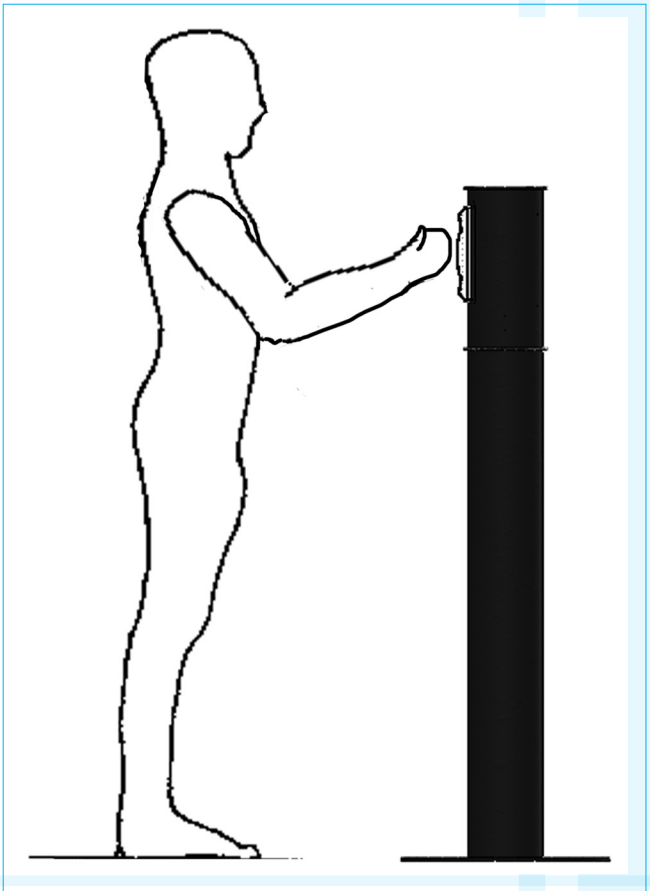


Image O.17 - Using the dispenser on chest height.

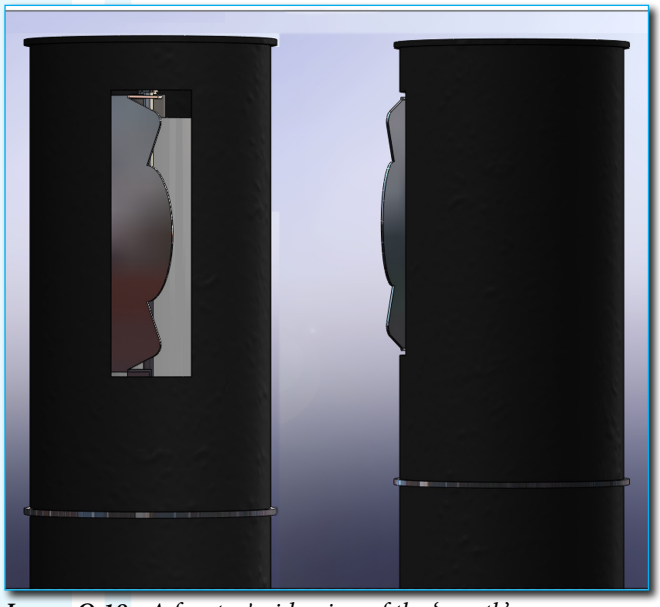


Image O.18 *- A front- & side-view of the 'mouth'.*

The image-series on the right show; firstly, the moment that can be created by the user on the roll-holder. When the roll is on lock, but the user insists and keeps on pulling he will be able to exert a maximum force of 3 kg (as stated earlier: this is where the bag rips from the rest of the bags). If a user were to keep pulling with this force it would result in a momental force being created around the bottom where the axis, which holds the roll-holder, is connected to the shell. This situation can be seen in image O.19.1 . A structural view of the result can be seen in image O.19.2 . The material of this bottom plate is ABS and the material for the axis is simply stainless steel.

The momental force will push the axis and cause stress on the connector of the shell. Depending on the amount of stress this connector unit might break from the shell which would be disastrous. Therefore a simulation has been made to make sure this won't happen. The result of the simulation has been depicted in image O.19.3 .

As can be seen the result is positive; the stress in the green area on both sides of the connector is around 2000-3000 N/mm² . With the maximum yield strength being 30 000 000 N/mm² this should create absolutely no problem at all.

The lid

One of the last components left is the lid that closes the top of the dispenser. It is of necessity that this lid is quick and easy to use. The dispenser will be replenished several times a day so the lid shouldn't be locked in a complex way, because this will take too much time for such a task. Therefore it has been chosen to do this with the use of a small rubber strip on the inside of the upper shell. Image O.20 on the next page shows the position of the rubber strip. When the lid is being closed a little force will be required to push through the rubber and lock the lid in its place. Whereas the solution is rather simple it does bring forth a point of attention. The simple lock will allow for user interference. The customers in the market shouldn't be opening the lid. However, the lid doesn't have any form of a button or handle on it which could excite the user into interaction.

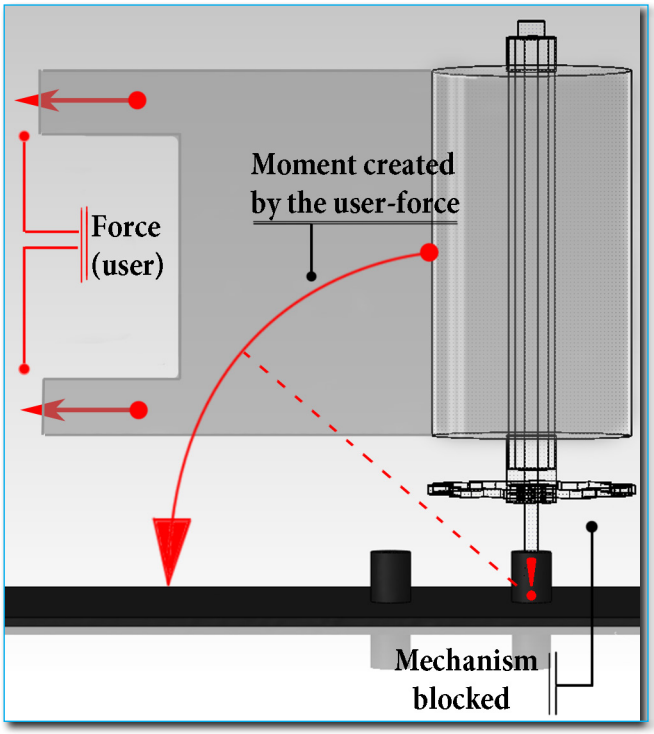


Image O.19.1 *- Overview of the moment and direction.*

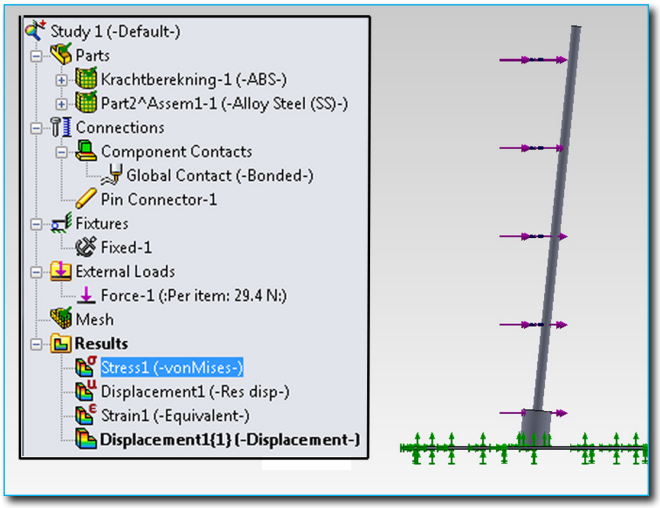


Image O.19.2 *- Material, constraints and forces.*

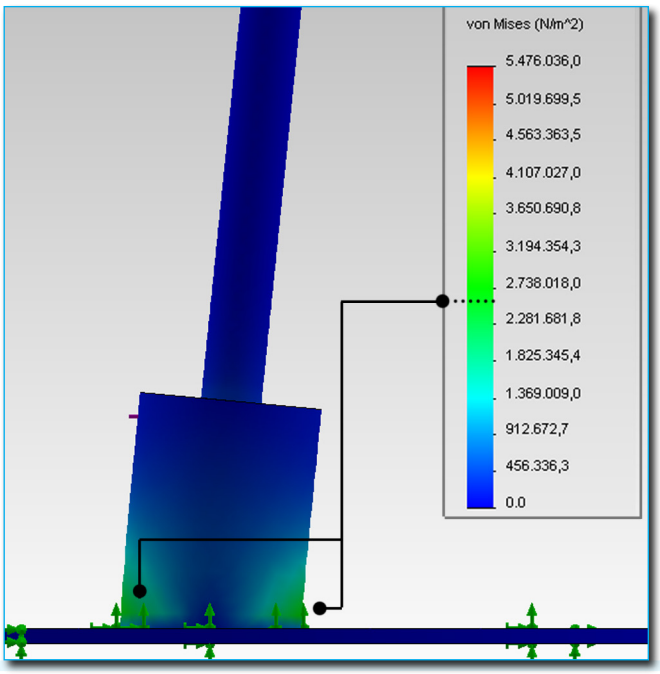


Image O.19.3 *- Simulation result: 2000-3000 N/mm² .*

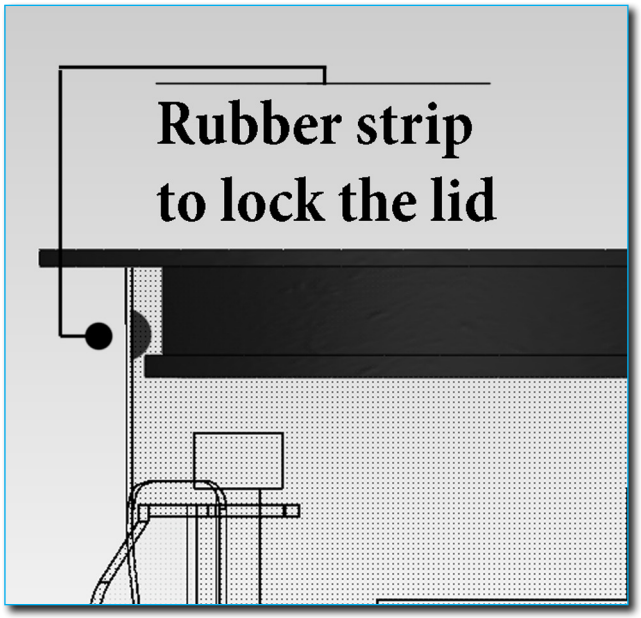


Image O.20 - The rubber locks the lid in its place.

2.2.3 - The final concept-model

Now that the sub-problems have been solved on a more detailed level the concept can be regarded as complete. This chapter will be closed with some renders of the final mode.

The next step is to make a prototype to test the concept. Only the upper-part of the housing will be turned into a prototype. The aspects that will be tested and the outcoming results can be found in the next chapter.

Image O.22 - The upper part of the housing.

Image O.21 - A frontal view of the dispenser.

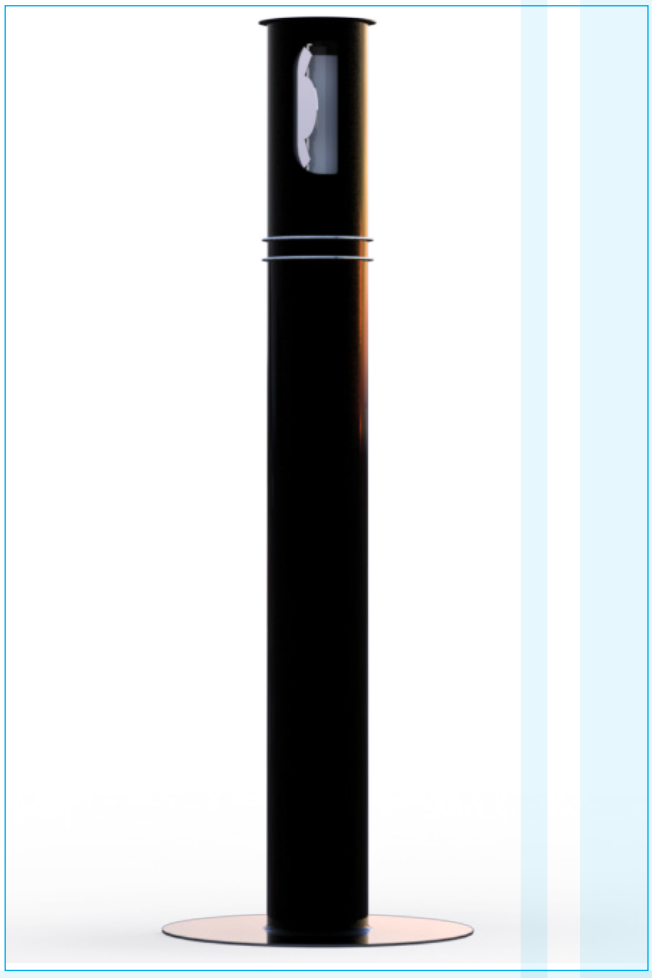


Image O.23 - A second frontal view of the dispenser.

3 Prototype

Introduction

In this chapter a testmodel will be created of the concept that has been developed in the previous parts. This testmodel will help notice problems that haven't been foreseen earlier. First of all the model and its components will be shown. More details about the measurements can be found in appendix B. Secondly, it it will be explained what aspects of the dispenser will be focused on while testing the model. These aspects will be observed carefully and the results will be noted. As last, the chapter will end with a list of improvements for these new problems.

3.1 -- Evolving the proof-of-principle model

The first testmodel was made in Istanbul; the previously shown "proof-of-principle" model (at the end of chapter 2.1 - concept creation) . This model had eventually been built into a more representative model of the final dispenser. The parts remained largely the same, however some extra parts were added. All these parts had been bought in an industrial market in Karaköy, Istanbul. Image P.1 below shows a picture that has been taken there. On the picture a small shop can be seen where some of these parts can be found.

***Image P.1** - A view of an industrial shop in the area.*

This model had been to used get a feeling of the dispenser's size, height and its usage. The blocking mechanism wasn't properly included in it, the platform sticked out too much outwards and the roll-holder was too large which caused the rolls to get stuck on the holder each time. However, what could be tested was the platform shape and its result on the plastic bags. Images P.2 and P.3 show this first testmodel. In image P.4 the model can be seen during usage.

***Image P.2** - A frontal view of the first testmodel.*

***Image P.3** - An inner view of the first testmodel.*

So this model was more of a showmodel to witness its true size and proportions in reality. It however provided some useful feedback on not only the platform, but also other points. The image P.4 below shows the testing of the shape of the platform. The list with the resulting feedback has been stated below the image.

Image P.4 *- A quick try-out of the platform.*

3.2 -- Preparing the prototype

Obtained feedback

Some other points which have been noticed during the usage of this testmodel are the following;

The distance between both axes can be shortened which also means that the diameter of the housing can be made smaller. This will make the dispenser more elegant, hence for it looking taller and smaller.

As it can be seen om image P.4 above the plastic bags are being directed from behind the axis (which holds the platform). The original idea was to direct the bags just along the frontside of axis. This way, however, more tension is being put on the bags and there is less tendancy to fall back into the dispenser. The axis holds the bags on their positions rather firmly like this. The combination with a platform that could hold the rest of the chain of bags would lower these chances of these bags falling back even more. This is also the next point of attention.

The platform still lacks some sort of locking mechanism to stop the long chain of bags from constantly falling back and disappearing into the dispenser. This function will need to be added to significantly reduce this chance. Another point is that both of the triangular parts on both ends of the platform do not guide the bags the well enough. There is still the possibility for a bag to slide over to the outside instead of the inside. Also this will need to be adjusted. A few solutions to these problems will be introducted later in this chapter.

Another point is the placement of the platform in general. An important aspect is the angle in which the platform is put. This angle affects how well the force that the user exerts can be turned into a rotational motion. Image P.5 below illustrates this situation.

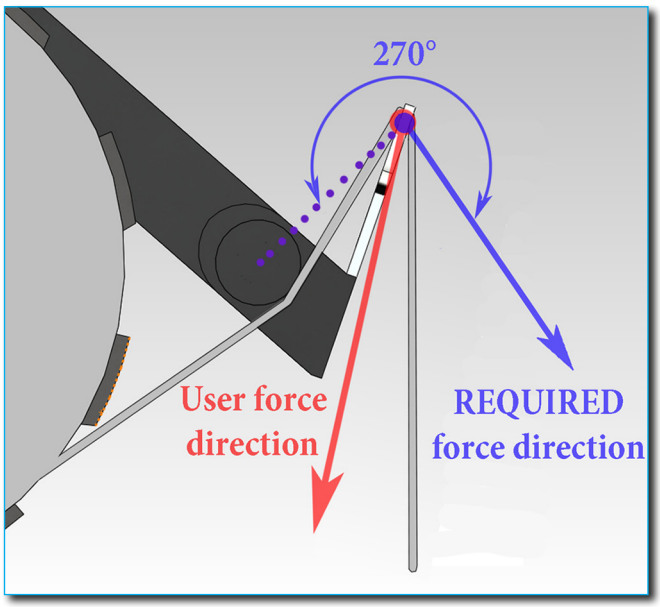


Image P.5 *- The force directions exerted on the platform.*

As the image shows the force that the user exerts (on the platform) by pulling a bag to the left (vertically on the image) does not correspond a single bit with the required force direction. So what the user mainly does now is forcing the platform and the its attached to against the rotation point (the axis). Therefore the platform should be bended more inwards, so that the direction of the user's force matches more with the required direction.

The last point is the bottom plate where both axes are mounted on. The original 1 mm plate isn't thick enough to stop the axes from swinging due to the external forces acting on them. Therefore the bottom plate needs to become thicker for the final prototype.

Processing the feedback

Using this feedback the newer prototype can now be prepared. Parts of this preparation are, firstly, the creation of one or several new platforms. Several different shapes will be used to see which one works best.

Secondly, a new platform angle needs to be thought out so it can be applied to the new platforms. It's a small adjustment but the result affects the usage in a rather significant way. Unblocking the mechanism also takes less effort in this way because a larger part of the exerted force is now directed into the rotation itself.

As last, the wheel will be a complete different and new part now, so the attachment with the roll-holder needs to be thought out. The roll-holder was already defined earlier as a long square-shaped holder (2.2 - Development : roll holder).

The platforms
The adjustment to the platform will have to ensure that the rest of the bags are withheld from drawing back. So what the platform needs to offer is a shape-based lock that will stop the grips of the plastic bags from gliding out. On the image below some possible solutions can be seen. Each of these solutions will be tried out to see which one fits its role the best. As last, a final platform will be shaped from the feedback that is obtained from the final prototype.

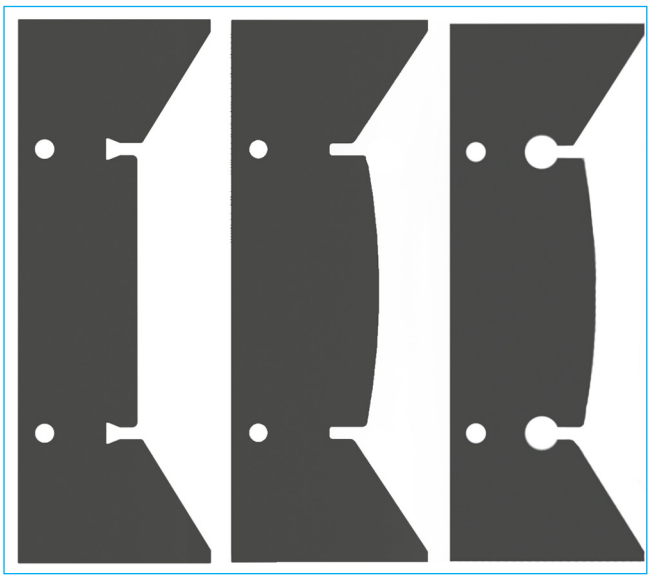


***Image P.6** - Three possible platform-shapes.*

Each one of these plates has its own unique shape; the plate on the left has triangular shaped incisions and a short grappling range (the middle section to hold the rest of the bags). The plate in the middle has rectangular shaped incisions and a large grappling-area. The right plate has roundly shaped incisions with a small horizontal guide to it. The grappling-area has a rather large range like the second plate.

The platform angle
Now that the possible platforms have been defined the angle in which they will be bended is still unknown. If the plate would be aligned with the required force direction this would lead to more efficiency in turning the user pulling force into a rotational force. To do this the plate would have to be bent 45°. From a top view the plate will then look like the one in the image below (P.7).

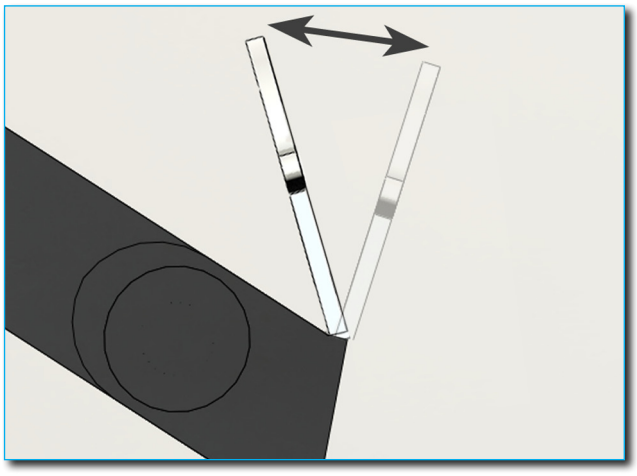


***Image P.7** - The change in platform alignment.*

Connecting the wheel & roll-holder
The 'gear' wheel component will be, just like the platforms, cut from steel. The roll-holder however will be made from foam due to its size, its shape and the long hole inside of it. Connecting these two parts will therefore be rather difficult. The simplest option would be to glue the two parts together, but in this case that won't work. They however need to be connected in some way because the wheel needs to be directly connected to the roll of bags. Therefore the two components will have a form-closed connection. This idea for the connection can be seen on image P.8 below.

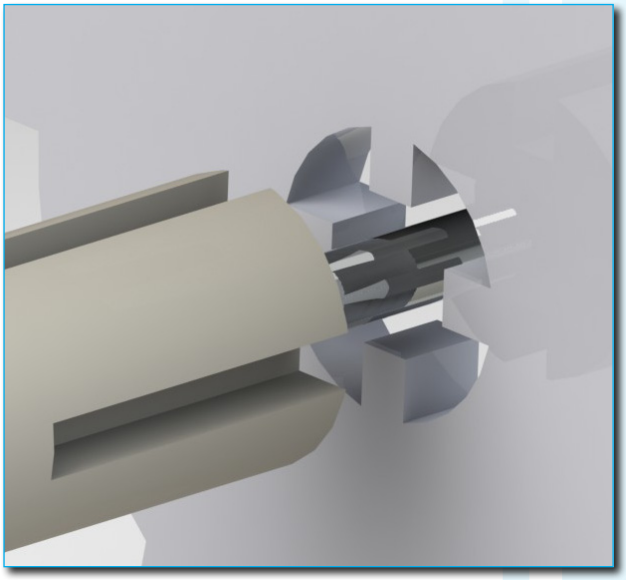


***Image P.8** - Connection between wheel & roll-holder*

The connection in the prototype is not exactly the same; instead of 4 teeth only 1 has been used to connect the two. To make sure that the wheel wouldn't slide off from the holder a pin has been used to block the opening. This result can be seen in image P.9 below; this is the (combined) component that can only be found inside the prototype.

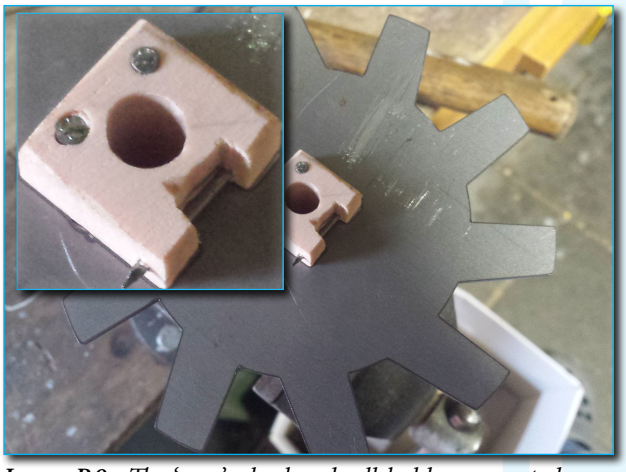


***Image P.9** - The 'gear' wheel and roll-holder connected*

What else can be noticed on the picture above are the 2 nails that have been hammered into the foam. This is done so that the foam expands a little and puts more friction and pressure on the edge of the wheel around it. This will also lower the chances of the wheel sliding off of the holder, although the nail, which blocks the path, eliminates this chance fully.

3.3 -- Realization and prototype try-out

The images below represent the final prototype.

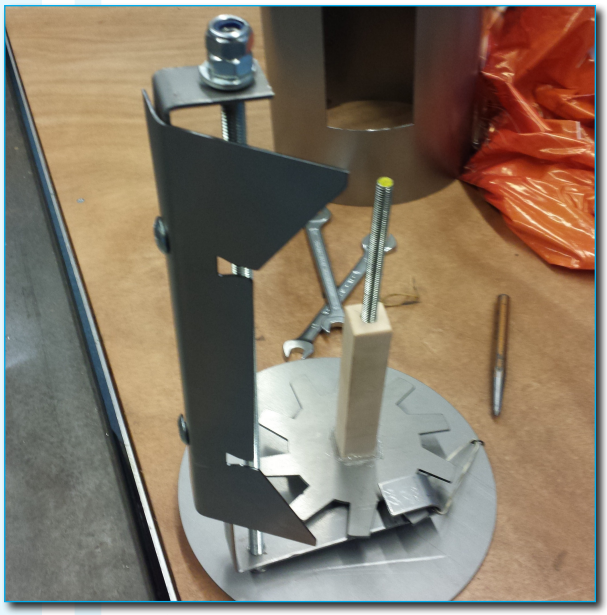


Image P.10 *- The components of the dispenser.*

Image P.11 *- The use of an elastic to replace the spring.*

Image P.12 *- The upper-part of the dispenser.*

Image P.13 *- An inner view; the dispenser is locked.*

Image P.14 *- The dispenser during usage; unlocked.*

Now that the prototype is realized it can be tested. The results of the observations will be listed and eventual problems will be solved. This will lead to a list of improvements that need to be applied to the product when it will be taken to production.

Observation results
Trying out the prototype led to the following observations;

- The connection between the roll holder and wheel is sufficient. It can hold the forces that are being exerted on it. The connection was strong enough to withstand a strong pull while the mechanism was blocked; shortly after the bag ripped itself from the rest.

- The roll-holder works flawlessly and as intended. The roll won't slip on the holder; this means that the 4 edges (the square shape) are strong enough to hold the roll from slipping. Besides that, putting a roll of bags on the holder is rather easy, so is taking it off again.

- The new position of the platform is good enough to limit the user from reaching the inner mechanics, while still retaining its full functionality.

- The contact area between the blocker and the wheel wore off rather quick. Blockage didn't work as intended after a while. Both components make contact in the form of a short line, which causes both to wear off. This needs a strong solution because the blockage is an important aspect of the dispenser.

- All three of the platforms have been tried but not each of them was as useful as the other. Each had its own positive, but also its negative side. These sides will be listed below;

Platform 1 was strong in holding the bags in its openings (triangle shape), however some bags were able to bypass the grappling area in the middle due to its short range.

Platform 2 didn't clamp the bags well in its horizontally shaped openings, however it did a good job in grappling into the opening between two bags. The grappler's range is therefore perfect.

The third platform held the bags extremely well with its round openings, however taking the bags out of it cost too much effort and usually led to torn bags. The grappler works fine though.

All three of the platforms shared one habit though; they tend to tear the bags apart sometimes during the dispense. It had been tried to avoid sharp and cutting edges, however this seemed not be enough.

- The bottom plate is thick enough to hold the components and the axes from swinging, except for the platform-axis. This axis however gets a shock after ripping of the bag from the platform which causes it to vibrate a little.

- As last, the blocking pin that stops the arm from swinging outside the needful range makes too much noise. When the arm bumps into the pin a rather loud noise can be heard each time. A simple and easy solution is to cover the pin in a soft material. This had already been stated before in the concept development, however that reason was to reduce impact force on the pin.

3.4 -- Resulting adaptions

The necessary adjustments as a result
First of all a new platform needs to be made with not only a different and more optimal shape, but also with rounded edges. These edges will need to be softened to make sure the previous issues about the tearing bags won't occur again.

The axis holding the platform shakes after the user splits a bag from the dispenser. This shock will need to be reduced so the axis will stop vibrating. The solution is to fix the axis from the top so that it's impossible to swing. The shell can be used to provide an opening for the axis to get stuck in.

The roll-holding component works great, but doesn't have to be this solid. Only the edges of the holder suffice to hold the roll in it's place. Therefore the material between them can be removed. The new roll-holder will then look like a plus sign from the top.

The blocker-head got worn out too fast. This is the result of the small area/line/point of contact that it makes with the wheel-teeth. This needs some major adjustment because this is the most essential part of the dispenser in general. The most valid solution would be to enlargen the area of contact. However, this would also lead to a larger surface that catches the same frictional force. Therefore a different kind of solution will be needed here. The shape of the blocker-head should be changed.

The wheel thats used to block the rotation of the roll can be made smaller. There is no essential reason for it to keep it this size. Since the blocker also needs to be adapted a new contact-area in general needs to be thought out. This will also affect the sizes of the wheel teeth. This should be tried to make as compact as possible.

Conclusion
Creating the prototype helped out with bringing forth the unforeseen issues. The necessary adaptions are, except for the point-of-contact issue, small changes which can be simply applied. These small changes will however lead to great results; a dispenser that works flawlessly and is durable!

The adjustments to the components can be found in the next chapter where the creation of the mass-product will be covered. These components which will be produced in larger series will be different than the ones used for the prototype.

4 Mass-product

Introduction

In this chapter the realization of the mass product will be explained. Aspects such as material choice, manufacturing and assembly will be covered. First however the new components will need to be defined. The provided solutions to the issues with the prototype need yet to be turned into solid parts. After this has been done the material choice for each component will be made. When the materials are also defined the production of these components will be covered. As last the reader will be enlightened on the assemblage of the dispenser. The main dimensions of the dispenser can be found in appendix part 4.

4.1 -- Product components

The platform will be the first component to adapt. As stated before, the problems are the short ranged grappling area and the edges that cause the bags to tear apart. These edges refer to the edges on both side of the grappling area. A strong point was the triangular-shaped incision that held the bags well in their spot. The image M.1 below illustrates these points.

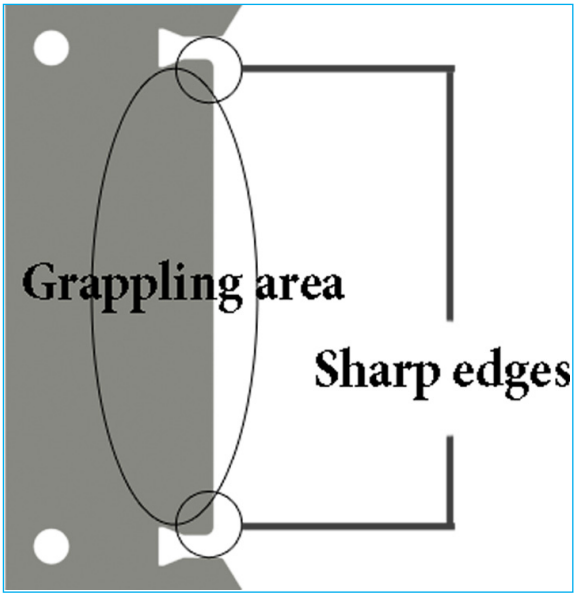


***Image M.1** - Locations of the grappler and sharp edges.*

The needed adjustment is an increase in the grappler's range and the elimination of the two edges that tear the bags. The result can be seen in the image (M.2) below.

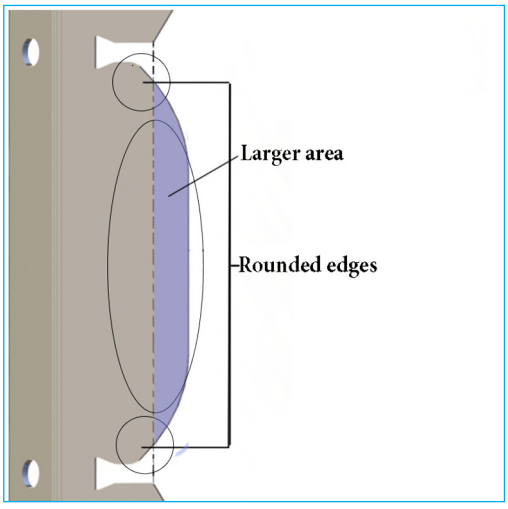


***Image M.2** - The new platform design.*

The next component to improve is the axis that holds the platform. The aftershock of ripping off a bag from the dispenser makes it swing too much. To reduce this swing the axis can be fixed from the top. The top area of the upper-shell however has to stay open because the bag rolls should be able to put it or taken out. Therefore it's necessary to find a, literally, small solution which won't take much room inside the shell, or integrate the solution into the lid on top of the dispenser. Image M.3 below shows the second possibility; a minimal adaption to the lid suffices to solve the issue. A little extra material is added to the left side with a hole in the middle of it. This hole is where the axis can be stuck in to fix it.

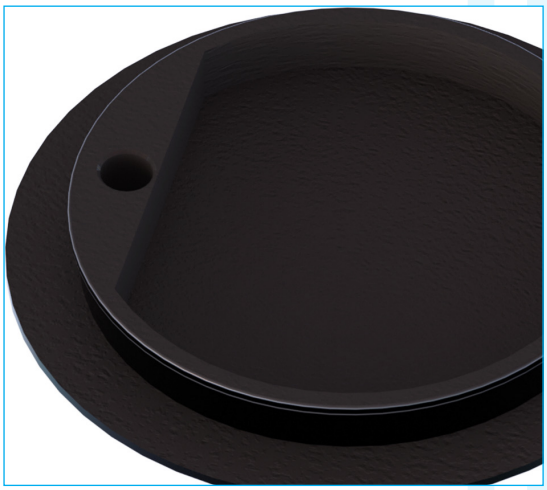


***Image M.3** - A bottom-view of the lid.*

The image M.4 below shows a cross-sectional view of the whole. The thick headpiece of the axis fits into the opening. With just 1 mm room the axis won't be able to swing in any direction anymore.

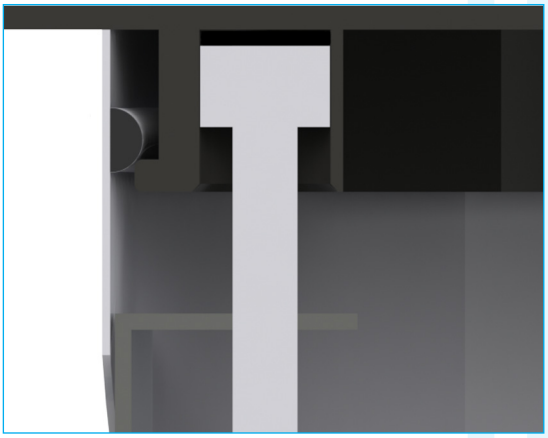


***Image M.4** - A cross-sectional view of the lid and axis.*

The third component that can be adjusted is the roll-holder. Its original shape is a square beam with the same length as a roll. This shape can however be made smaller and still serve its purpose. Therefore a new shape could be introduced which is less solid and so costs and weights less. This shape would represent the four edges of the square beam without all the redundant material in between. An example of this kind of shape would be the plus sign.

However, the issue here is whether it's worth the extra treatments just to lose a minimal amount of weight. Instead of moulding a specific shape or cutting a basic shape it's better to use a standard extruded square shape. This shape has already been tested in the prototype and worked perfectly. The only changes that need to be made are the two incisions for the wheel plate component and the hole in the middle to push the axis through.

Image M.4 shows this new part. On the side view it can be noticed that the diameter of the holder is slightly smaller at the head. The reason for this is to easen the roll placement.

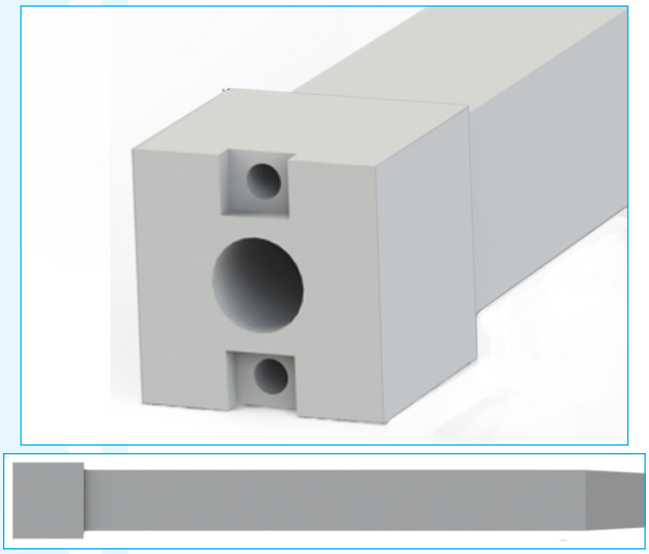


Image M.4 *- The new rol-holder.*

The fourth component is the headpiece of the blocking-arm. Its contactpoint with the teeth of the wheel weared out too fast. A new connection type needs to be applied here, because enlarging the contact area won't solve the issue. The frictional force is simply too much for the material to bear. Therefore the grinding-parts method as it is now should be eliminated completely. Instead, a rolling component can be used to fulfill the same function. In this way the same motion can still be realized, however there will be no more friction between parts. The image M.5 on the right shows the alternative blocker. The first image shows a side view of the new blocker. As it can be seen the rotating component has little room to translate up and down. The 'gear wheel component will also be adjusted to equate the sizes of the teeth and the blocker-wheel with each other.

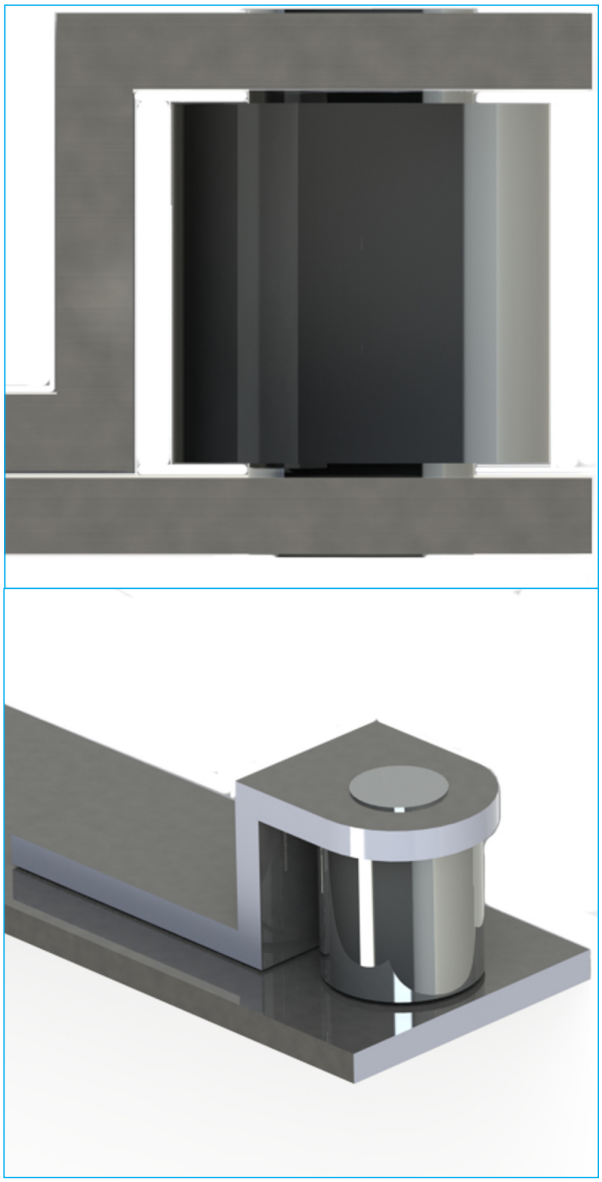


Image M.5*- The adapted blocker-head.*

The last component to change is the wheel attached to the roll-holder. Its size can be significantly reduced, however this will not lead to a more compact dispenser. The size of a full roll will still require the second axis (platform) to stay at the same distance. Not only can the size of the wheel be reduced, but also the size of its teeth. These can be adjusted to match with the new blocking-wheel.

However, doing this would would require the blocker-arm to increase in length to keep the contact area intact. The direction of the blocker arm and the lining of the teeth should be perpendicular to each other to make the blocking mechanism work. If this were not to be the case it would mean that either the rotator-head (image M.5 above) would glide out from between the teeth as soon as the teeth would push against it, or that it would get locked completely and impossible for the user to unlock again. This situation is illustrated on the image M.6 on the next page. Instead of changing the wheel it has therefore been chosen to just adapt the length of the blocker arm.

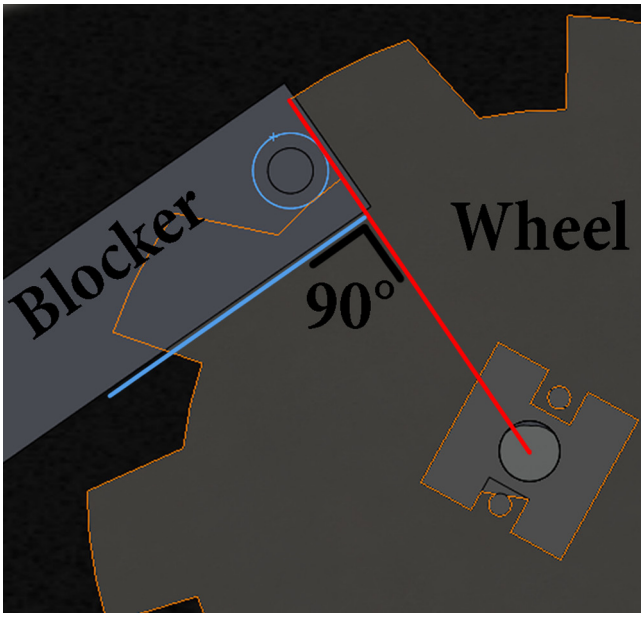


***Image M.6** - The blocker and teeth alignment.*

The 90° angle is the balancing point. This means that in theory the blocker has a 50% chance to immediately shoot up and unlock at the slightest force that the tooth would exert on it. This is due to the round shape of the blocker-head. However, if this angle would be increased by a minimal amount (by shortening the blocker-arm length) it would mean that the wheel would push the blocker-head downwards slightly and, without any interference, would stay blocked. If the user however were to interfere by applying a small amount of force through the platform (so by not just pulling on a bag, but by pulling on it sideways while pushing against the platform) this rotational force would be enough to make the blocker roll upwards and unlock the mechanism. This is the method with which the blocker-arm length is determined.

Now that the components have been adjusted and their final form has been defined they can now be prepared for production. In the upcoming part the production method and material choice for each component will be explained.

4.2 -- Material & manufacturing

The numbers of the parts each represent an image of it which can be found in appendix C. This will make it easier to keep in mind what exact part is being spoken of.

1. Base plate
The first part that will be started off with is the base-plate. This plat will hold both axes, the blocking pin and the pin to attach the spring to. It's important that this plate can hold these weights and the external forces that influence it. Therefore it needs to be rather strong so it won't break that easily. Due to it's shape it has been chosen to cold-mould this part. The need for a strong and shock-absorbing material led to choosing ABS. A test had already been done earlier to assure that ABS could hold these forces.
After the moulding is done there are 2 holes on the plate that need to be threaded. On the side of the plate there are 4 more holes that need to be threaded. These holes will contain bolts that connect the plate with the outer shell and refrain it from rotating inside of it.

2. Axes
On this plate there are 2 axes. These axes hold the components and are subjected to (light) bending forces. These 8-mm steel axes are pretty regular items which can easily be found and bought instead of manufactured. It does have some thread on both tips which will need to be applied. This can easily be done on a lathe machine. However, first they will need to be cut into their right lengths.

3. Blocking pin
The short blocking pin is of the same diameter as the axes. The only difference between both are the lengths of them. Also this pin has some thread on one of its tips to attach it to the base plate. On the other end the pin needs a damping material coat. A thin layer of rubber, which can be glued onto it, such suffice.

4. *Blocker arm*
This refers to the whole arm in general. Including the part where the platform gets attached to, until the part of the blocker-head. This is one long slender part of plate which contains some holes in it and needs to bent on several spots. The arm in its whole is made of stainless steel for its stifness and its ability to be shaped rather easily.

5. *Blocker head*
The head of the blocker exists of a rotator-component and an additional part of plate to fix it from the top. The rotator is a simple shape and can also be made with the use of a lathe machine. The rotator will have to be incised from the top and the bottom to decrease the diameter so that it can be locked in between the two plates. The smaller, upper plate will first have the holes drilled into it, then bent and eventually be spot-welded on the lower plate (blocker-arm). The material for the rotator will have to excel in durability, which in this case means its hardness. This is the component that will make contact and therefore needs to be hard enough so it won't wear out easily. Therefore this component will be manufactured from steel with a high carbon-percentage.

6. *Roll-holder*
The roll holder consists of two components; the long holder which the roll can be placed upon and the smaller part where the wheel and the long holder can be locked into. The long holder is a simple square extrusion which can best be bought like that. The extrusion may not be a profile but rather has to be a solid, because the hole for the 8mm axis still needs to be drilled through it. Also, the far end still needs to be processed to decrease the diameter so the rolls can be placed onto it with less effort. This can be realized with the help of a grinding machine. The dimensions for this aren't important, as long as the diameter of the tip is slighty reduced.

The smaller part can also be cut from a standard, solid, extrusion. On one side some milling is required so that the holder can be fit into it. On the other side two grooves have to be milled and 2 holes have to be drilled. Both these holes have to be threaded. When the metal wheel is fit into both grooves it can then be tightened with two bolts.

7. Platform
The platform is a relatively large shape. The original platform was cut out of steel, which was too sharp-edged and therefore tore the bags apart. Even after grinding these edges it still wasn't soft enough. Therefore it has been decided to cut this platform out of a plastic plate. The platform may now be thicker without gaining too much weight and can still easily be bent in the required angle as the plastic can be heated to easen this process. Making the platform thicker also makes it easier to rounden the edges on it. When these rounded edges are made sure to be smoothened afterwards the tear issues will be fully eliminated. The platform can be attached to its spot on the blocker arm with these use of flat-headed bolts and nuts. Using flat-headed bolts keeps the aesthetic design aspect stronger.

8. *Lid*
The lid to close off the top of the dispenser can also be cold-moulded just like the base plate. Due to it's shape moulding would be the best option. Also this component needs to be shock resistant as the axis holding the platform will be inserted into it. The swings that this axis makes will be caught up by the lid.
After it's moulded the hole on the bottom side needs to be drilled into it. This makes room for the header component that is screwed on top of the axis holding the platform.

9. *Headers on axes*
The headers on both axes are just steel hollow caps. They can be made by drilling a hole partly into a solid bar which has already been cut into the right length. Afterwards thread should be applied inside the hole so that the cap can now be screwed on top of the axe.

10. *Rubber strip*
The rubber strip can be bought and doesn't need to be produced again. Its shape should be half-round so that it can be glued to its spot on the inside of the shell.

11. *Spring attachment pin*
This is a simple pin with a hole through it. The hole will allow to attach one side of the spring to this pin which sits firmly in its place.

12. *Spring*
The spring can be bought. The type of spring needed in this case is an extension spring. The spring should be slightly holding the round blocker-head in between the teeth. It needn't apply much of a force to do this. Therefore a thin and small spring with a small wire diameter should suffice. If such a spring can not be found it can be manually manufactured also.

If it wouldn't be able to apply a spring for some reason, an alternate option would be to use an industrial elastic. These are significatnly stronger than regular elastics and can be used in such a situation.

13. *Housing*
The overall dispenser consists of a thick iron plate on the ground to hold balance, which is welded to the housing. The housing is a simple plate which can be cold rolled into a round shape and spot-welded to close it. The top of the housing is left open as the lid will be used to close it off.

4.3 -- Assembling

The main part that will carry all attachments is the base plate. The axes will be mounted on this plate and rest of the component will be placed onto the axes. The images below will show how the whole is assembled in general. Step by step it will be illustrated how each part fits into another.

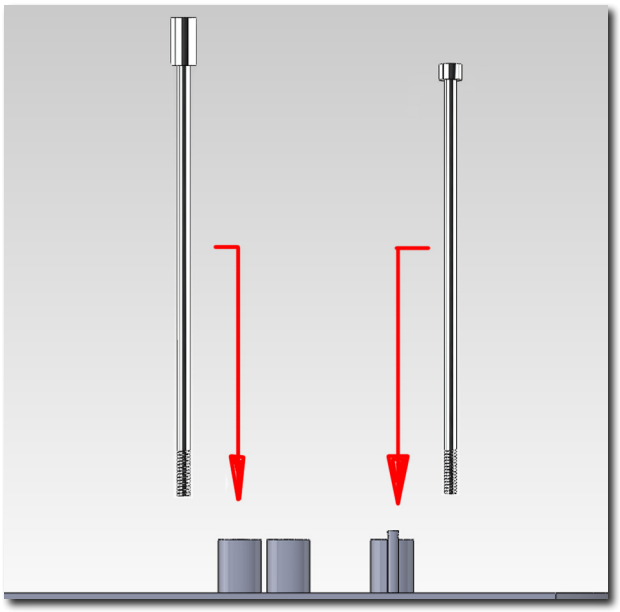


Image M.7*- Inserting the axes into the holders.*

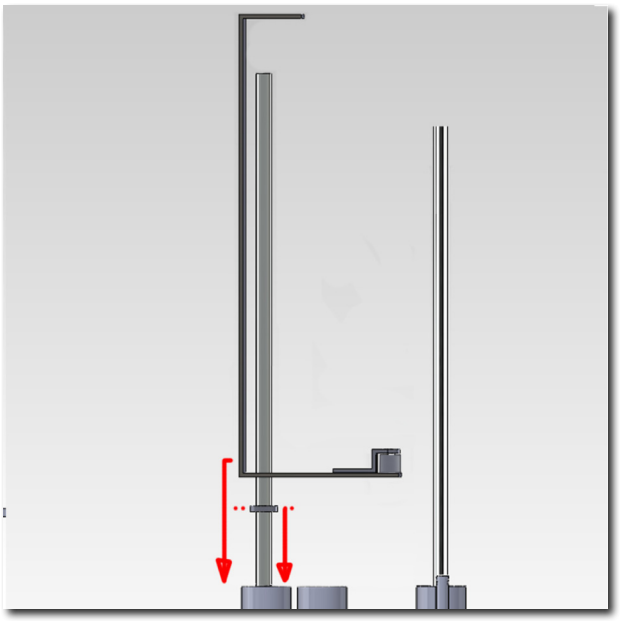


Image M.8*- Placing a ring and blocker onto the left axis.*

On the first image both axes are mounted, then the blocker and its ring are placed. Then the roll-holding component is put together (M.9 & M.10) and placed onto the right axis together with its own ring. These ring make sure both components are on the right height to interact well with each other. Afterwards the blocking pin and the spring are attached (M.12). Then the platerform is positioned (M.13) and the whole mechanism is being placed inside the shell (M.14). As last the two are connected by means of bolts which fit right into the 4 holes inside the sides of the base plate. These 4 bolts can then be covered by glueing a plastic plate around them. The dispenser can be built in this way and will be delivered like this with not further set-up required.

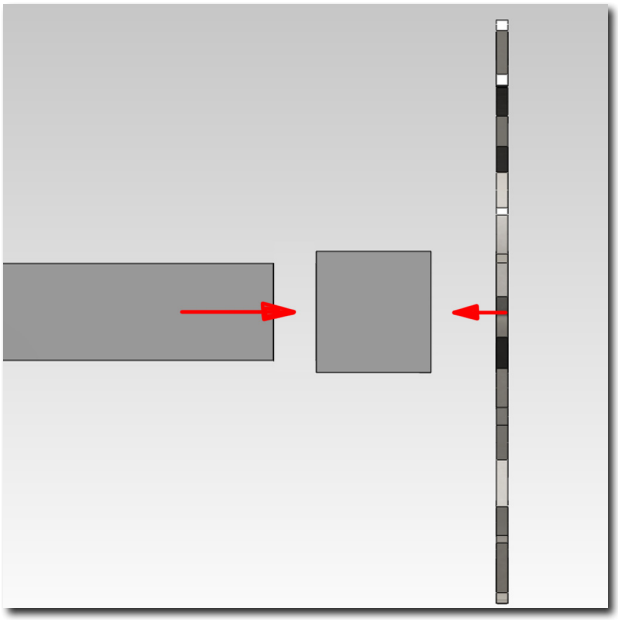


***Image M.9**- Rollholder & wheel attached to the connector.*

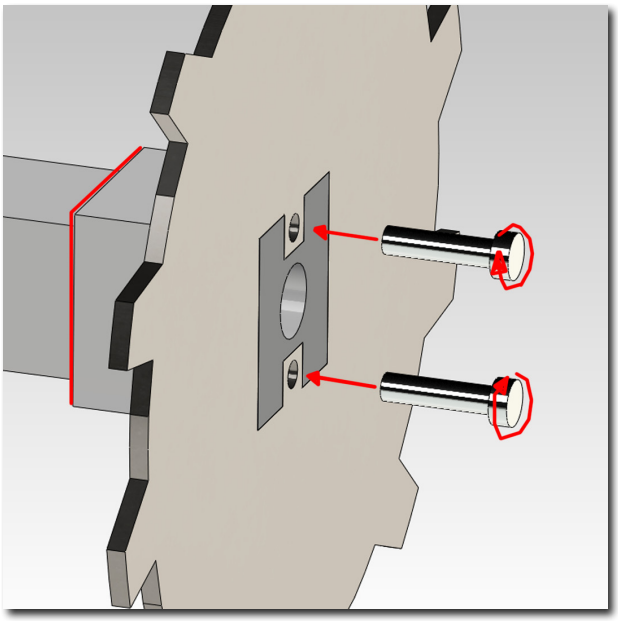


***Image M.10**- Rollholder glued & wheel screwed to it.*

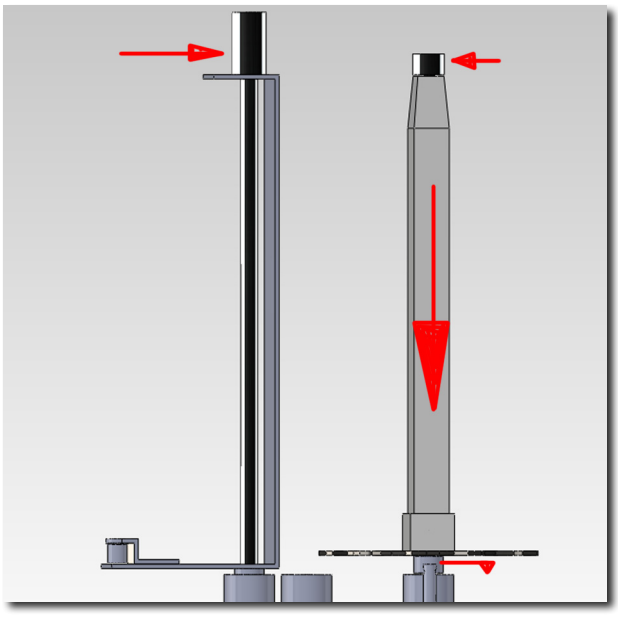


***Image M.11**- Rollholder put on the right axis, screwed tops.*

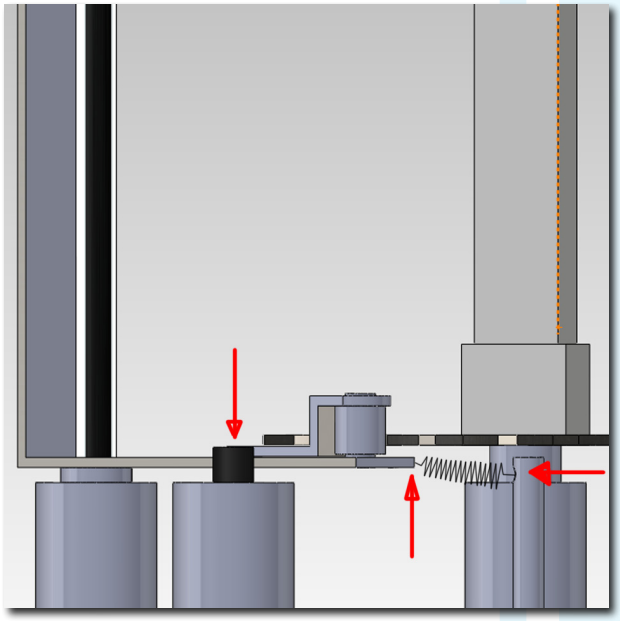


***Image M.12**- Placed blocking ping & attached the spring.*

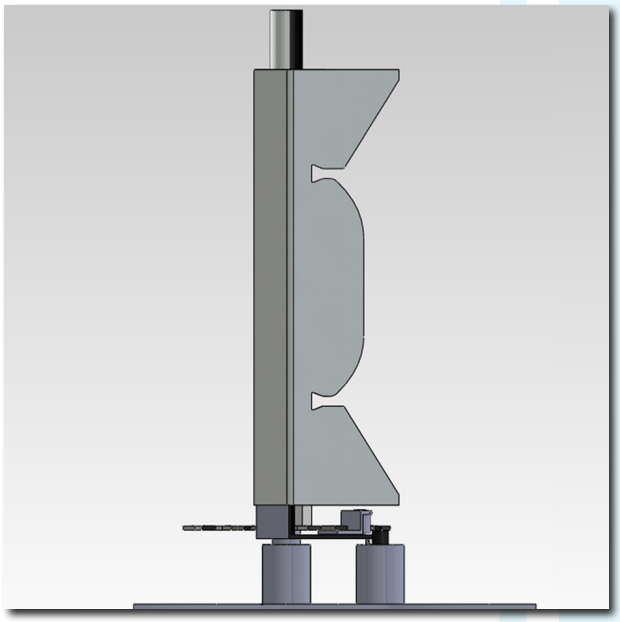


***Image M.13**- Positioned and glued the platform.*

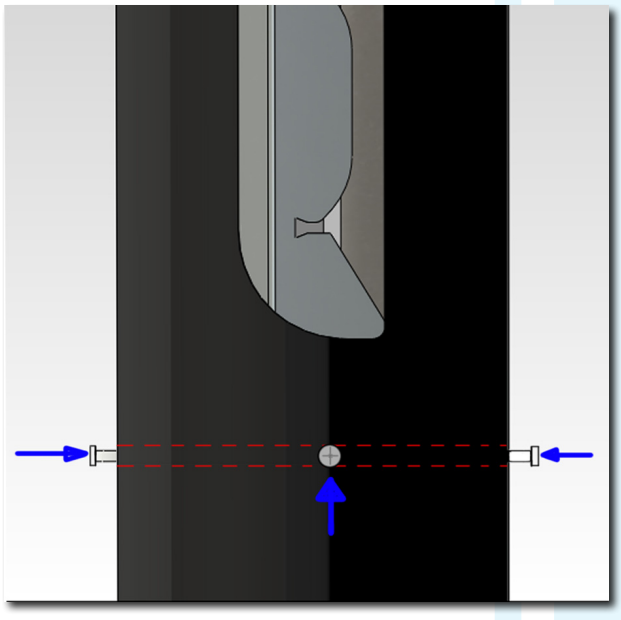


***Image M.14**- The whole mechanism put into the shell. Screwed from the outside into the base-plate holes.*

Evaluation

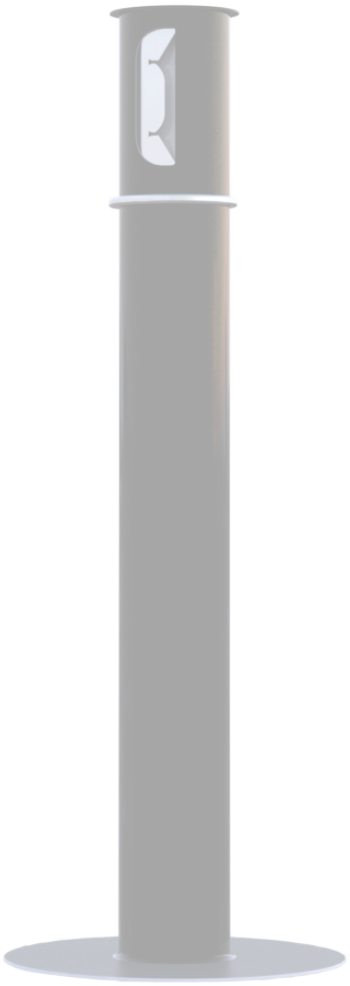
This is the end of the dispenser project.

The goal of the retailer was to create a better future environment by deciding to take the first step amongst his competitors to limit the waste that plastic bags caused. The dispenser that has been created will help to reach this goal by limiting the users in taking more bags than needed. It's fully mechanical and replaces the present way of taking plastic bags where the user rips them off the roll by himself. For the fact that the dispenser replaces a fairly simple task it was important that the task was still kept easy to execute. It seemed to be simple to design such a dispenser, but it was harder than expected. It is extremely difficult to make a task, which already doesn't take lots of effort, even more easy. The solutions that were comen up with in the concept generation were pretty complex and risky to use. Almost days worth of thinking have been spent to come up with a working solution that wasn't complex, didn't take much time to use, didn't have a significant chance of failing and would be understood by the users. It has definitely not been an easy task, but it seems like this dispenser suffices to the important aspect of keeping it easy.

This design will now be taken to the retailer to present them with the solution for their issue. If they can be convinced that it is indeed this dispenser that they need to apply to their supermarkets, then the product can be taken to production. The amount of dispensers that will be produced depends on the amount of stores thay they're planning to introduce the dispenser in. This amount will also determine whether the costs of the dispenser will be rather high or low. If an agreement can be reached upon the price, then the production can be started.

Thanks for reading, hopefully the paper has been enjoyable.

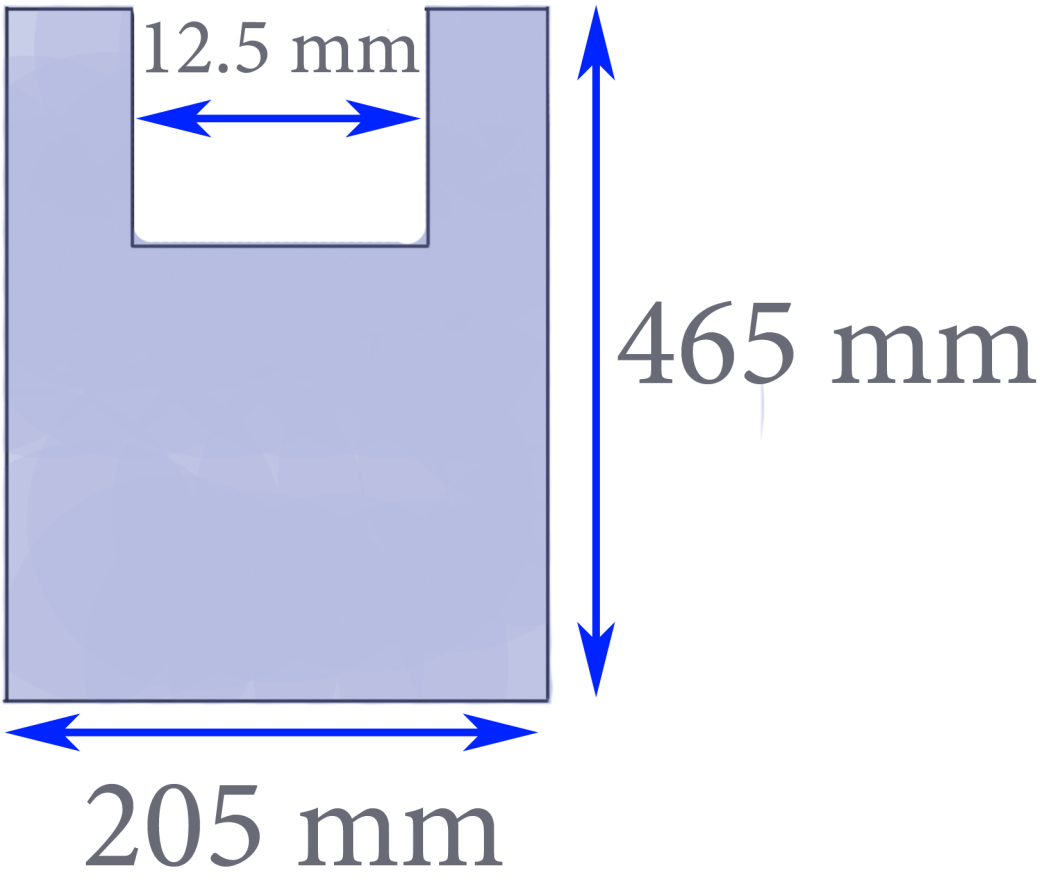
Project Cyligros

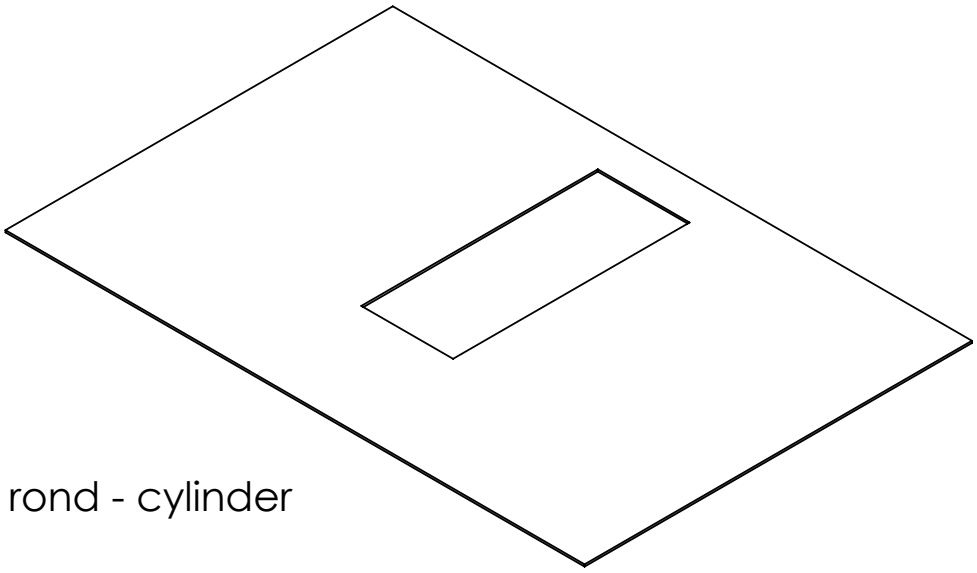


Appendix

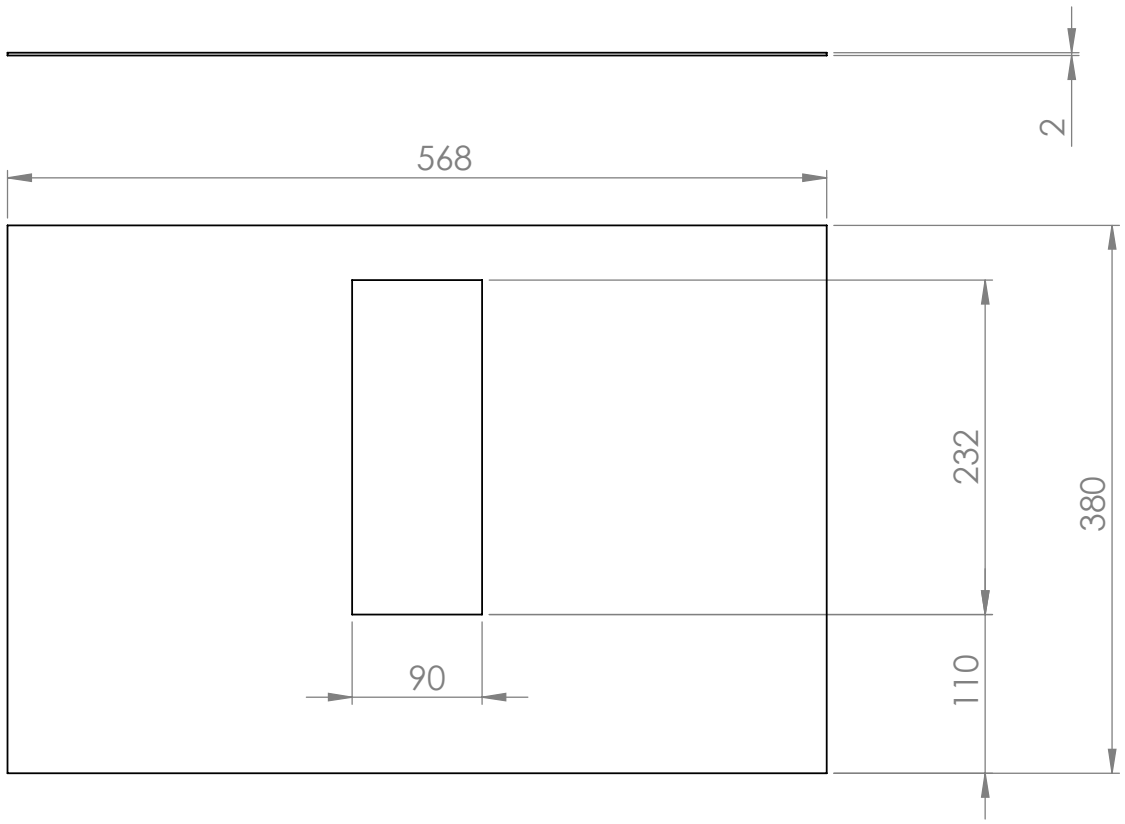
rayka

Defining bag size

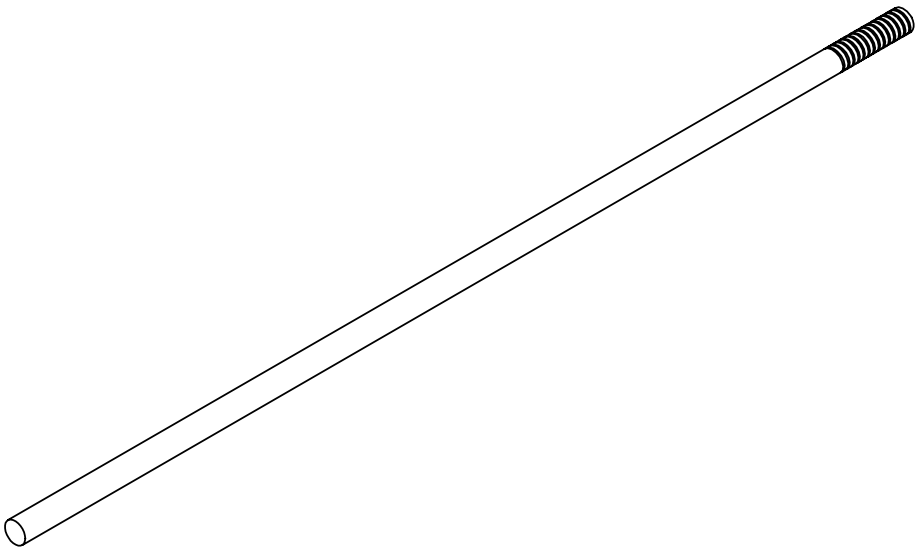




Wals 360 graden rond - cylinder

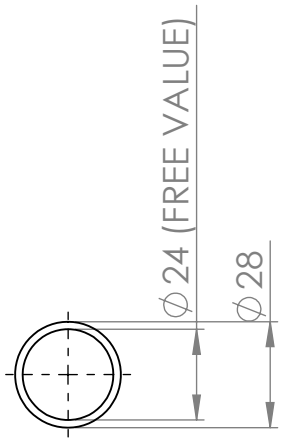


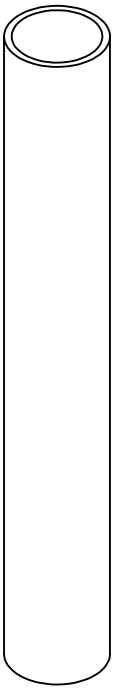
Upper-shell

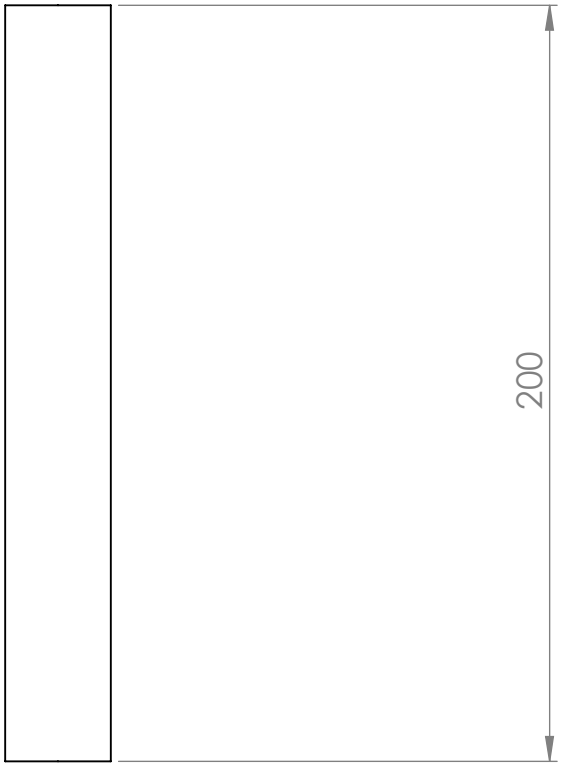


TWO UNITS NEEDED (2 X)

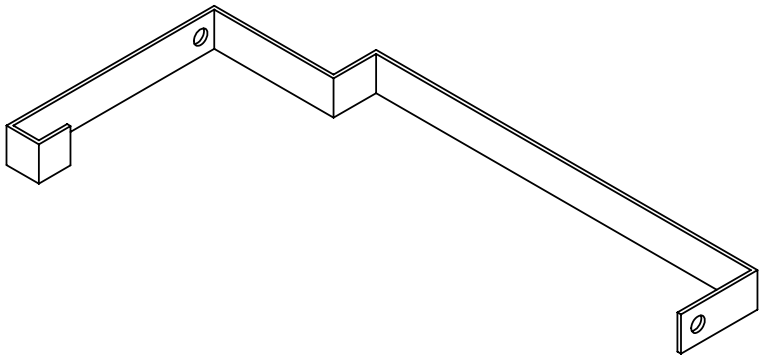
The axis

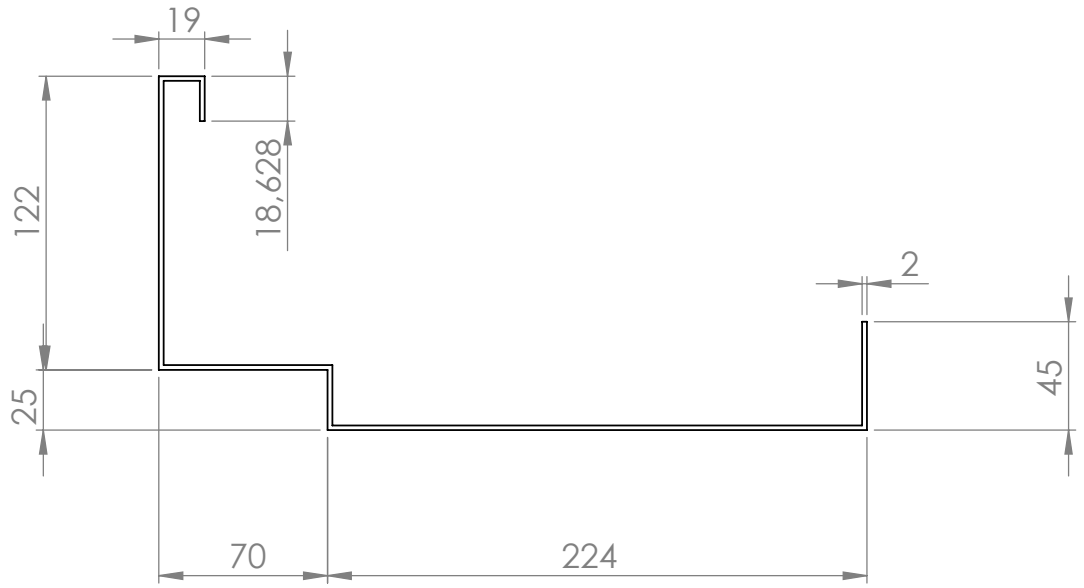


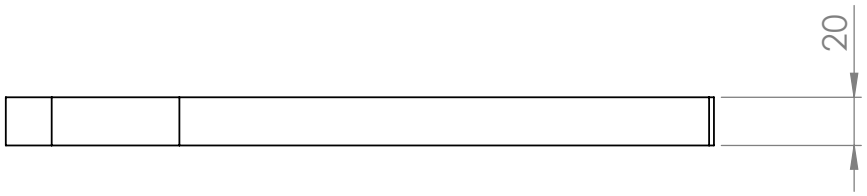




Roll holder

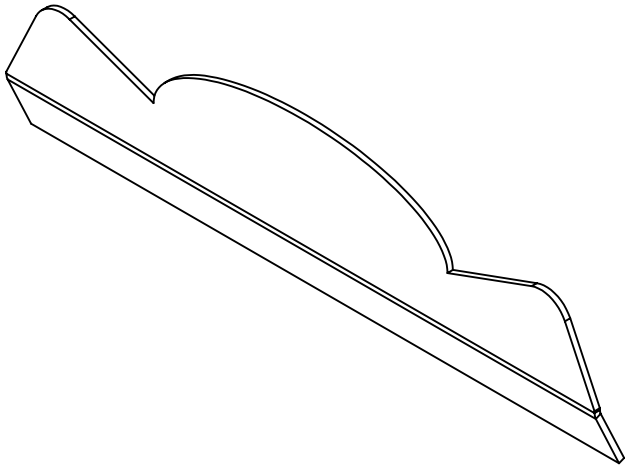


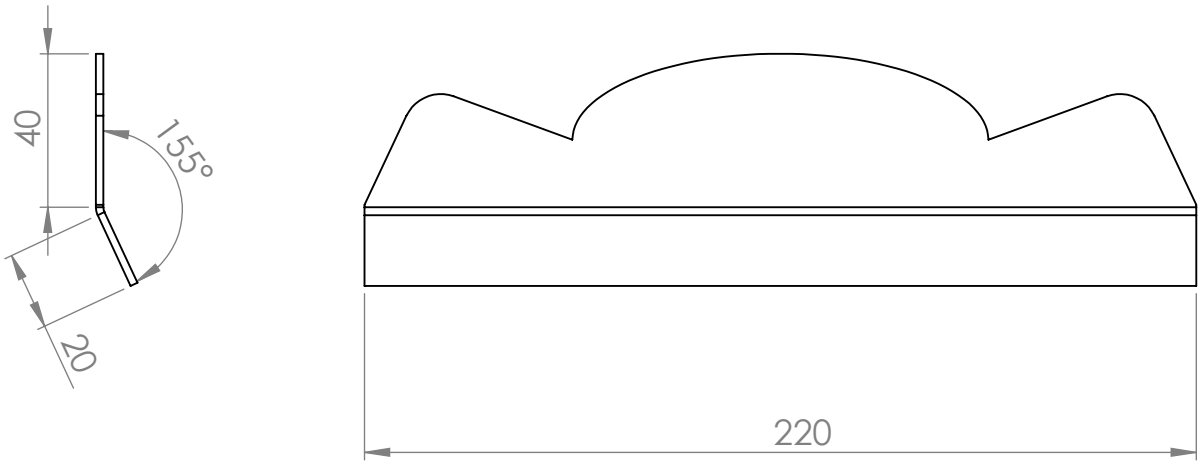




Total (UNFOLDED) length: 52.5 cm

Blocking arm

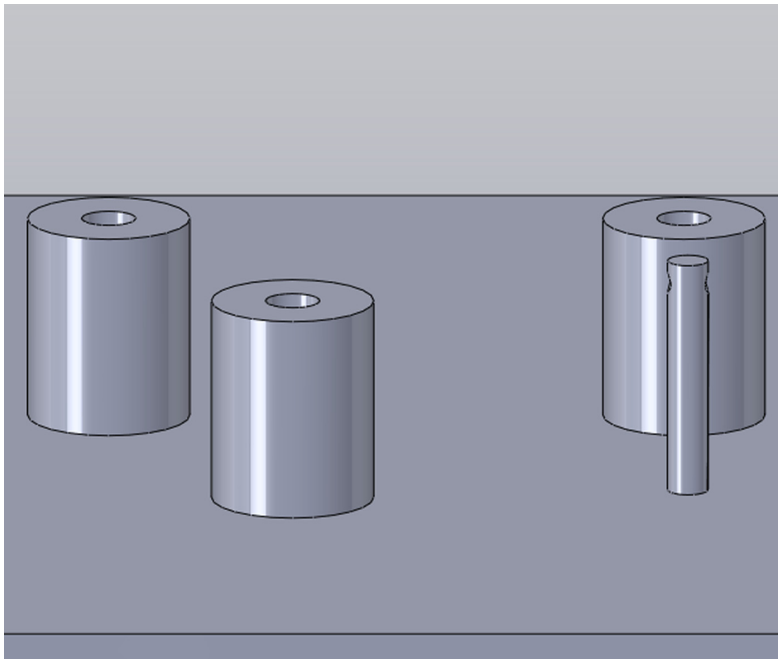




Platform

App. C

1



2

3

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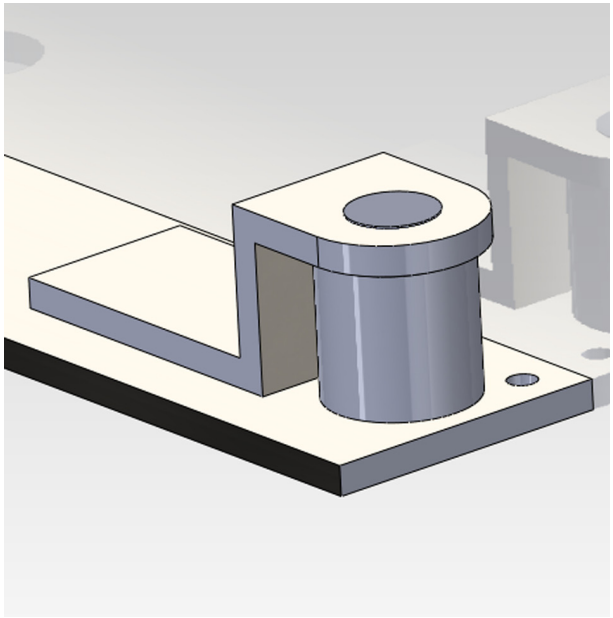

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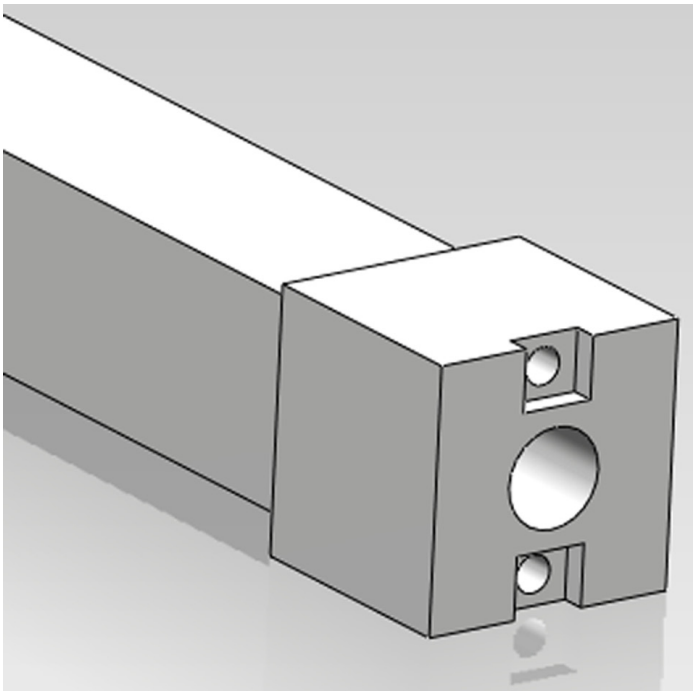

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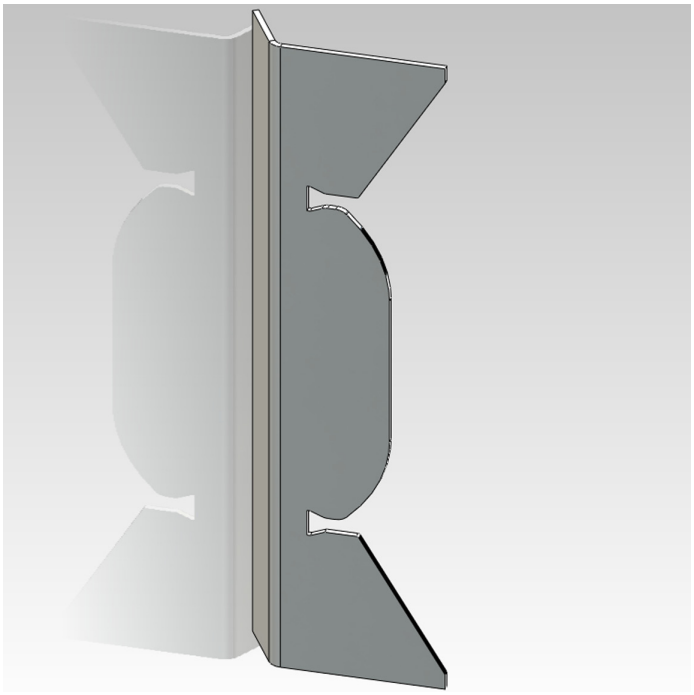

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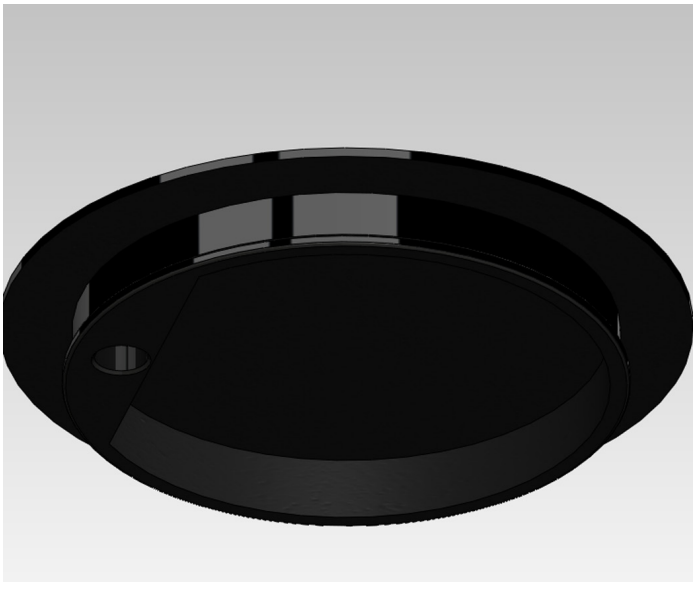

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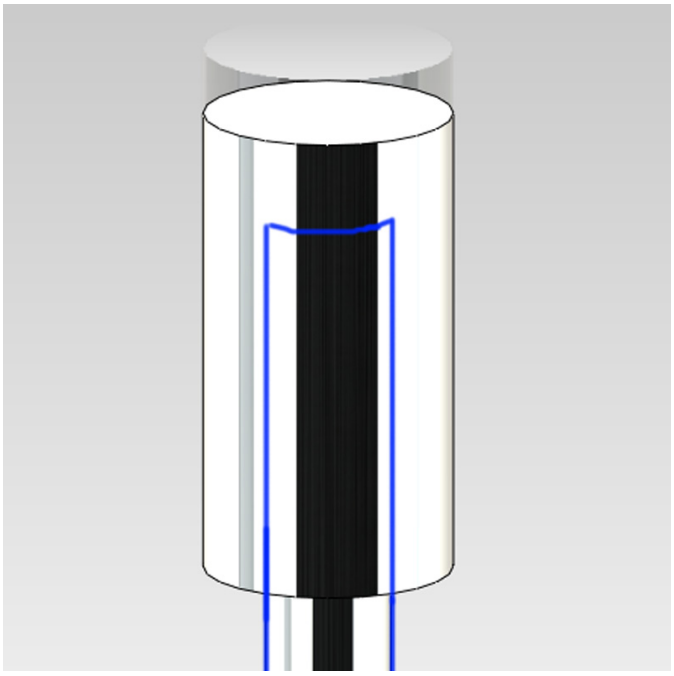

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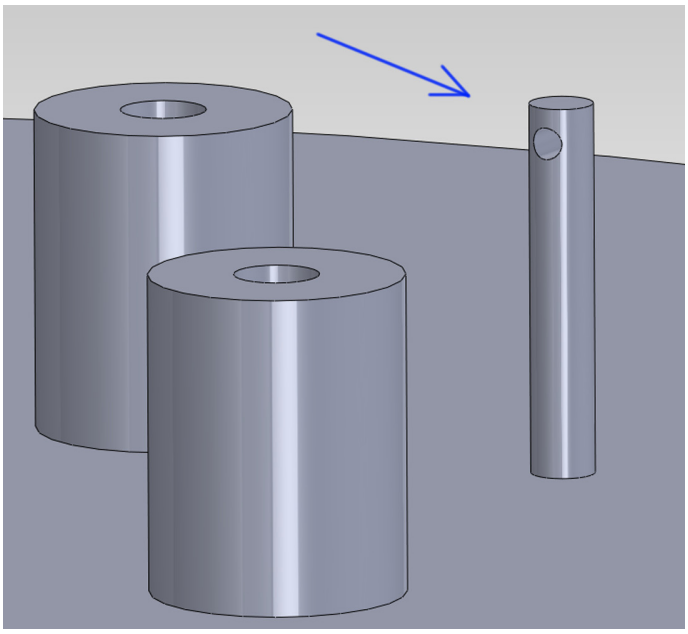

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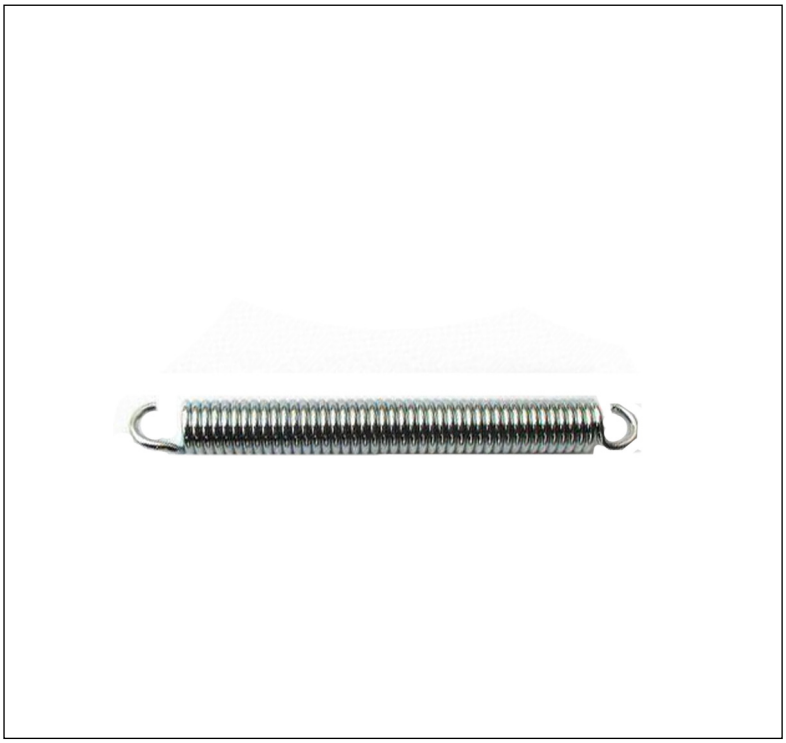

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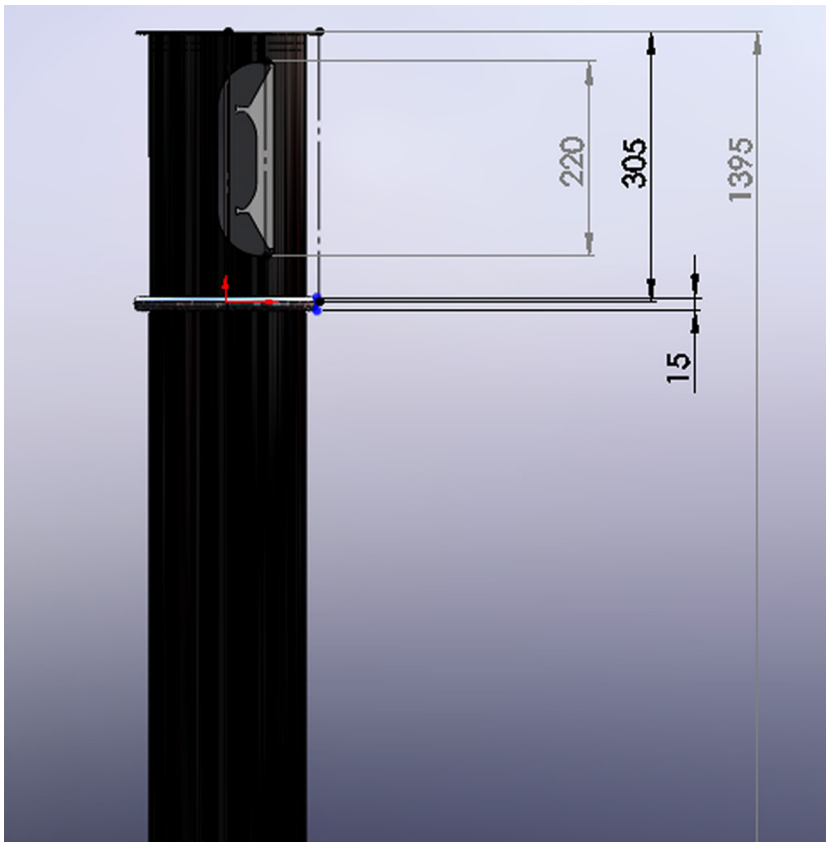
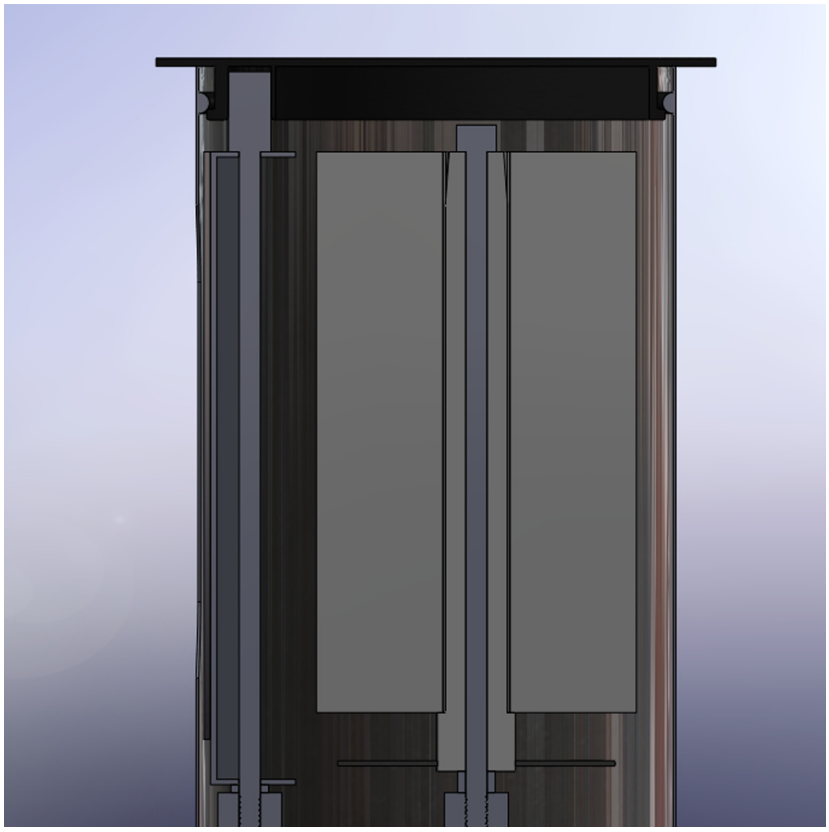
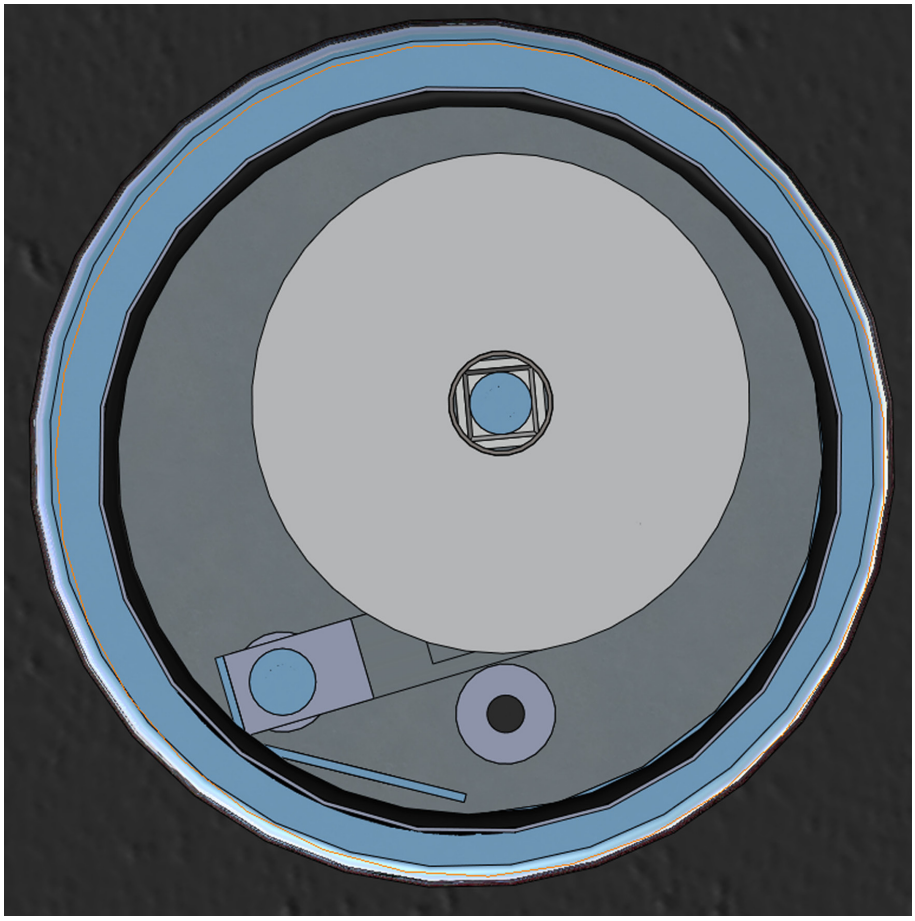


The main dispenser dimensions.



A cross-sectional view of the upper part.



A top view inside the dispenser.

A frontal view of the upper-part.

- (Migros takes the 236th position, having the 12th fastest grow in between 2001-2006)
http://www.perakende.org/marketler/uluslararasi/kocun-son-migros-genel-kurulu-gerceklesti-1209552699h.html

- (Background information about Migros TAS)
http://www.migroskurumsal.com/en/Icerik.aspx?IcerikID=181#

- (The founding of Migros in Switzerland)
http://en.wikipedia.org/wiki/Migros

- (The 3 M market sizes and their differences)
http://en.wikipedia.org/wiki/Migros_T%C3%BCrk

- (Table representing the amount of shops per year)
http://www.ortakalan.com.tr/haberler/zincir-marketlerin-yil-sonu-acilislari-12548#1

- (The largest global retailers of 2013)
http://www.deloitte.com/assets/Dcom-Turkey/Local%20Assets/Documents/Global_Powers_of_Retailing_son_2013.pdf

- (Information about the BIM markets)
http://tr.wikipedia.org/wiki/Bim

- (Information about the A101 markets)
http://tr.wikipedia.org/wiki/A101

- (Information about the Dia Sa Market)
http://tr.wikipedia.org/wiki/DiaSA_Market

(An explanation of Migros being the top retailer and the BIM chain being the second largest)
http://www.patronturk.com/bim-en-buyuk-ikinci-perakende-zinciri

(Ankara university, Table 3 - Height, weight and BMI results.)
https://www.jstage.jst.go.jp/article/ase/116/3/116_061213/_pdf

_____ **All data consulted 15. October, 2013**_____

- (Images of the products used in the 'Analysis - Comparative products' part have been found on google search machine whilst entering "dispenser", "bag dispenser", "napkin dispenser", "tissue boxes", "Foil rolls" and "Plastic bag rollers". No mechanical plastic bag dispenser could be found on the web and the items mentioned above are only used to gain ideas from. They can in no way be seen as a competitive product and therefore no source will be provided on them.) .
https://www.google.nl/imghp