



**MARMARA UNIVERSITY
FACULTY OF ENGINEERING**



Viol Design and Development

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GRADUATION PROJECT REPORT
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**MARMARA UNIVERSITY
FACULTY OF ENGINEERING**



Viol Design and Development

by

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**SUBMITTED TO THE DEPARTMENT OF MECHANICAL
ENGINEERING IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE
OF BACHELOR OF SCIENCE
AT MARMARA UNIVERSITY**

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Viol Design and Development

Aiming to meet the heating, cooling, and electrical energy needs of a four-member family's house on Rabbit Island with solar and wind energy, the intention is to fulfill the energy requirements through an off-grid and hybrid system at the most affordable price while preserving the environment. The system's design, analysis, optimization, and cost analysis were conducted, revealing economic gains observed in the long term compared to a conventional home meeting its energy needs from the grid. Moreover, our hybrid system, with its environmentally friendly structure, will provide a healthier atmosphere for future generations. The simulation utilized the Homer Pro program, a preferred tool in renewable energy system design. Optimization is performed to design the optimal number of solar panels, wind turbines, batteries, and inverters at the most favorable cost. These values are input manually based on pricing and energy quantities. For our hybrid system, we considered the average wind speed, sunlight durations, and the average solar energy on Rabbit Island. If there is an energy input above the average, we opted for a battery to store the excess energy. In cases where the energy input is below average, our goal is to use energy from the storage

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1 INTRODUCTION

The growing obsolescence of single-use plastics in contemporary society can largely be attributed to certain advantageous features such as low cost, lightweight, superior performance, and ease of production. This ubiquitous use, however, eventually proved to be a magnitude reduction in the environmental crisis. Most plastics made from non-renewable fossil fuels are resistant to biodegradation, resulting in plastic pollution that remains suspended in the ecosystem and disallows aquatic life, creating a potential health hazard for humans. Such environmental awareness and growing concern for the negative impacts of plastic pollution have steered the search for eco-friendly alternatives on a sustainable path.

Interestingly, molded pulp packaging (MPP) provides a sustainable answer to the challenge of plastic waste. MPP is renewable, recyclable, and biodegradable, thus an MPP presents an environmentally friendly alternative. A growing market is seeking packaged products using sustainable options. Molded pulp products, generally made from recycled paper and other cellulose materials, are widely used for various three-dimensional goods' packaging. MPP was historically used mainly for egg trays, due to its limitations in form and visual appeal; however, its sustainable benefits, and a growing market for environmentally responsible packaging solutions, have led to an expansion into the packaging of electronics and specialty products.

Therefore, for full utilization of molded pulp packaging, it calls for a greater R&D effort directed to the standardization of design and testing protocols. This report aims to investigate the manufacturing processes and properties of MPP.

Molded pulp comprises a green-processing technology through which recycled papers or fibers derived from agricultural waste are formed into shapes now molded into three-dimensional products. The passive construction could define the idea as:

"In creating molded pulp design, the natural fibers are shaped into specific forms through the molding process. The natural fibers are selected for being sustainable, and the molded products are intended to be biodegradable and ecologically sound."

LITERATURE REVIEW

These days, worldwide expansion of single-use plastics has become an ever-more-important concern for the environment. The adverse impacts of plastic pollution on ecosystems and human health have evidently led to the call for immediate sustainable packaging options. This literature review analyses sustainable packaging materials, focusing on molded pulp products (MPP). MPP emerges here as a noteworthy alternative due to renewable, recyclable, and biodegradable properties. The present study will consolidate research work done to date on MPP, including a definition of MPP, a historical background, and some manufacturing techniques and materials used. The paper will also present MPP's environmental and economic advantages, with applications of MPP across several industries. These design and testing standards are significant in measuring the performance and durability of MPP. This review also highlights the work being carried out in research and development and future possible innovations in this area. A life cycle assessment of the MPP will analyze the entire product life cycle, from production to disposal, in light of its significance and its positioning as a frontrunner among sustainable packaging solutions.

1.1.1 Definition

The defining feature of molding pulp constructions is that they are packaging components molded or formed with the production of molded fiber material, which is normally derived from recycled newspapers, cardboard, or any other fiber after processing. This process has broader environmental significance and is considered an alternative to plastic use for packaging purposes

Types of Molded Pulp:

1. Thick-Wall Molded Pulp
2. Transfer Molded Pul
3. Thermoformed Molded Pulp
4. Processed Molded Pulp

1.1.1.1 Thick-Wall Molded Pulp:

It is made using a single tooling layout; thick-walled is often known as "Slush mold". Its products surfaces moderately smooth on one side and very rough on the other side and are of the type of cardboard or corrugated pulp, newspaper, and inexpensive materials. The range of wall thickness is between 2.5mm and 6.0mm. Products are used for edge protector, large home appliance packaging, and other heavy-duty .



Figure 1 - Molded Pulp Packaging

1.1.1.2 Transfer Molded Thin-walled

Molding provides that molded products are set to be transferred to sunlight drying, as should be very clear these days. The products have one side smooth but not so smooth as type 1, the other side is rough, and the wall thickness is in the range of 1.5mm to 3.0mm. The products mainly serve areas including electronics as well as household hardware, wine shipper, egg cartons, cup carrier, fruit trays, medical care; for example, bedpan liners and urinals. It is actually a case of dry pressing.

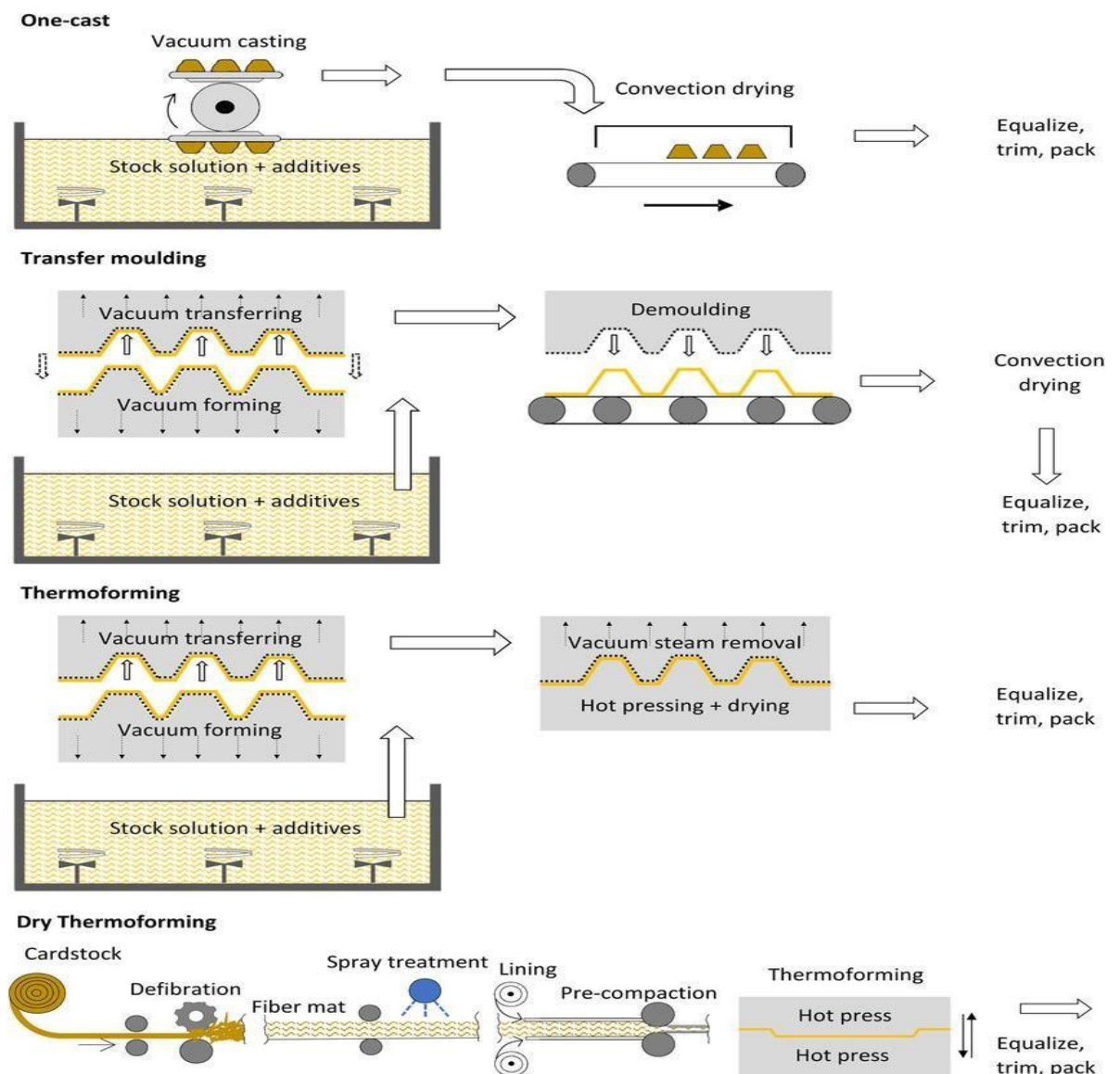


Figure 2 - Comparative schematic representations of moulded pulp processing methods:

Molding implies that molded products will have to be taken out for sunlight drying, as should be very clear these days. The surface features of the products have one side smooth, but not so much smooth, as type1, the other side is rough, the wall thickness is between 1.5mm and 3.0mm. The major uses of the products include the electronics and household hardware, wine shipper, egg cartons, cup carrier, fruit trays, medical care: bedpan liners, to urinal, and so on. It is considered to be dry pressing.

1.1.1.3 Thermoformed fiber thin-walled

This technology uses Cure In The Mold modern technology, has very good definition, smooth texture on one side and grid texture on the other side. With wall thickness ranging from 0.7 mm to 1.2 mm, we refer to it as wet pressing in molded pulp industry. The product types of molded pulp trays include but are not limited to those for cellphone/mobilephone, molded fiber trays for various cosmetic products, and paper pulp trays for packaging wine bottles.



Figure 3 - wet pressing molded pulp

1.1.1.4 Processed

This type of molded pulp packaging is not as extensively used compared to other three antique forms of packaging; it is produced with a secondary or specific treatment processing process, secondary processing can be green printing, hot pressing, coating, trimming or make color by adding special slurry additives to custom color.



Figure 4 - example of processed molded pulp production

1.1.2 Types of Molded Pulp Press Technologies

1.1.2.1 Dry Press Technology

To impart molding another technique known as dry press technology; it can form and dry its molded pulp products under ambient conditions or heat with an external source after molding in the die. It's simpler and cheaper but offers a rougher texture with a less refined appearance.

Example Applications:

Egg Cartons: Are rough surface-lightweight and protective? Economical and largely in use for eggs that use the thickness of the rougher structure for cushioning.



Figure 5 - Egg cartons

Fruit Trays: Used for apples, pears, or other produce, providing cushioning during transport and storage. The surface texture doesn't need refinement as functionality is the priority.



Figure 6 - Fruit Tray

Protective Packaging for Heavy Items: For furniture, industrial components, and appliances. Provides strong protection for little production cost and environment. are the most common wind turbines. These types of turbines consist of three main components: rotor (blades), generator and body.

The rotor consists of many blades stacked on top of each other and generates mechanical energy by rotating around the wind. This mechanical energy is transferred to the generator through a transmission.

1.1.2.2 Wet Press Technology

Wet press technology compresses the wet pulp under high pressure and heat to get a smooth, dense, and refined product. It is a thinner, stronger, and better-looking finish; however, it is also very energy-intensive and expensive.

Example Applications:

Electronics Packaging: With its smooth yet premium finish, it shines even for the highest-end products, such as tablets and laptops. Protects-and-is-beautiful-as-well, then believes in the eco-conscious values of the brand.



Figure 7 - Electronic Molded Wet Pressed Packaging Product

Cosmetic Packaging: Luxury items extravagantly graced with perfume bottles or skincare products. Thin and precise designs are achieved with sharp edges and fine details.

Medical and Food Containers: High precision and hygiene are usually synonymous with the storage of medical devices or take-out food. Most times, they are coated for added moisture or oil resistance.



Figure 8 - Medical and Food Containers pulp

1.1.2.3 **Manufacturing Pulp Packaging**

Most pulp packaging processes usually have similarities in their general mode of manufacturing. The only major variations between them are automation, raw materials and the complexity of machines & tooling involved.

Step 1 - Mixing

Coarse raw materials are soaked in water and mixed, which eventually leads to the formation of the pulp at the appropriate consistency. The making of the pulp does not carry away any waste water from the process, but all excess water is either evaporated in the course of manufacturing or returned into circulation.



figure 9: Raw materials

Step 2 - Forming

The pulp part has to be formed into shape with the custom designed tools. They are lowered into the pulp mixture into a puddle with the hollow meshes and then vacuumed from above to withdraw the water. Then the upper tools press into the lower tools to help shape the pieces. Suction through the vacuum binds the fibers. The parts are still wet and should be dried after forming.



figure 10 : Pattern of Mold

Step 3 – Drying

Conventional molded pulp packaging is dried in open air drying racks, whereas thermoformed thin walled molded pulp packages are dried by automated, high temperature and pressure drying machines.

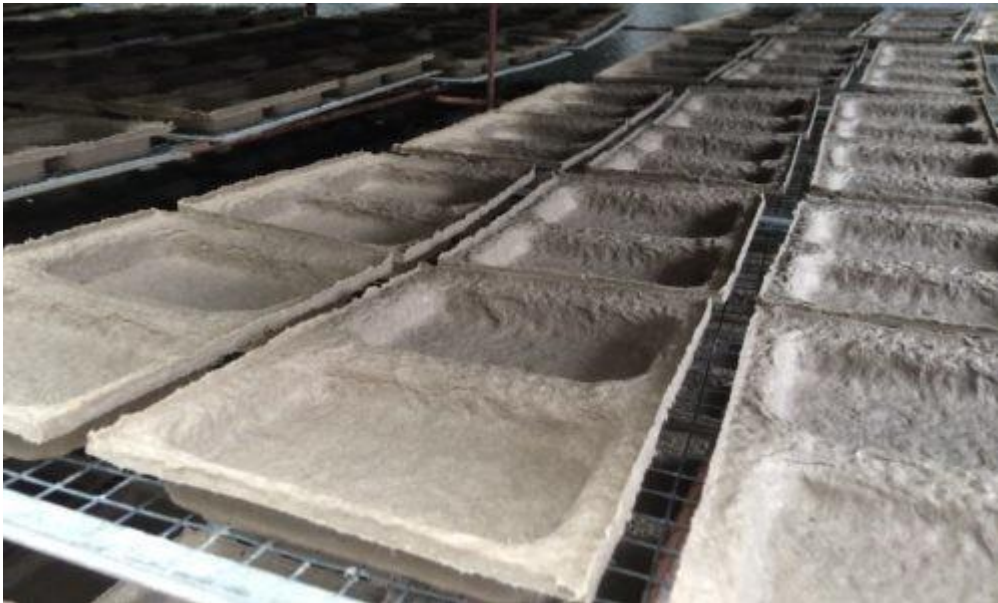


figure 11 : Drying machine

Step 4 - Pressing

As the pulp parts dry the surface can become uneven; each product is pressed onto solid metal tools to smooth the surface. The other benefit of pressing is that an improvement is made on stacking and nesting for more efficient shipping and storage of parts.

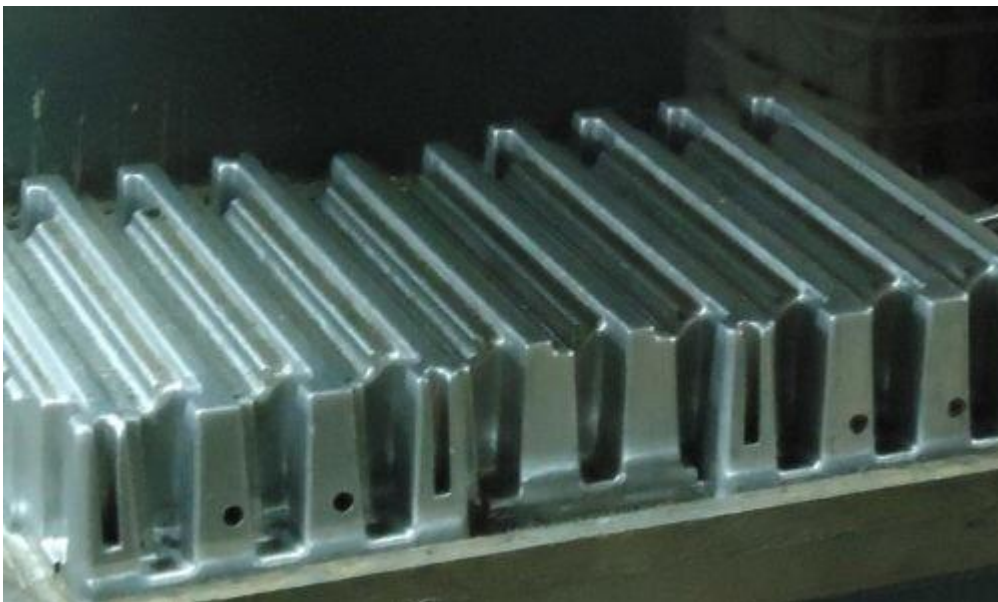


figure 12 : Pattern of pressing

Step 5 – Trimming:

The edges of the parts are trimmed. Completely No material wasted including all scraps (cut-off) goes back in same pulp mixture for reuse. For specialty and high quality products, these parts are subjected to different post pressing debossing or special treatments.



figure 12 : After trimming

Step 6 - Quality inspection before packing

Quality Inspection Last inspection of the finished products before they are packaged is done for the items under manufacturing. Those spoiled items would be returned back into the raw material supply and reused.



figure 13 : Last shape of molded pulp

WORKING PARTS

In our viol design and development project, we designed a four-compartment box, Male Urinal Bulbous, Kidney Tub, Maxi Bedpan, Snack Plate. Below are the views of the designed.

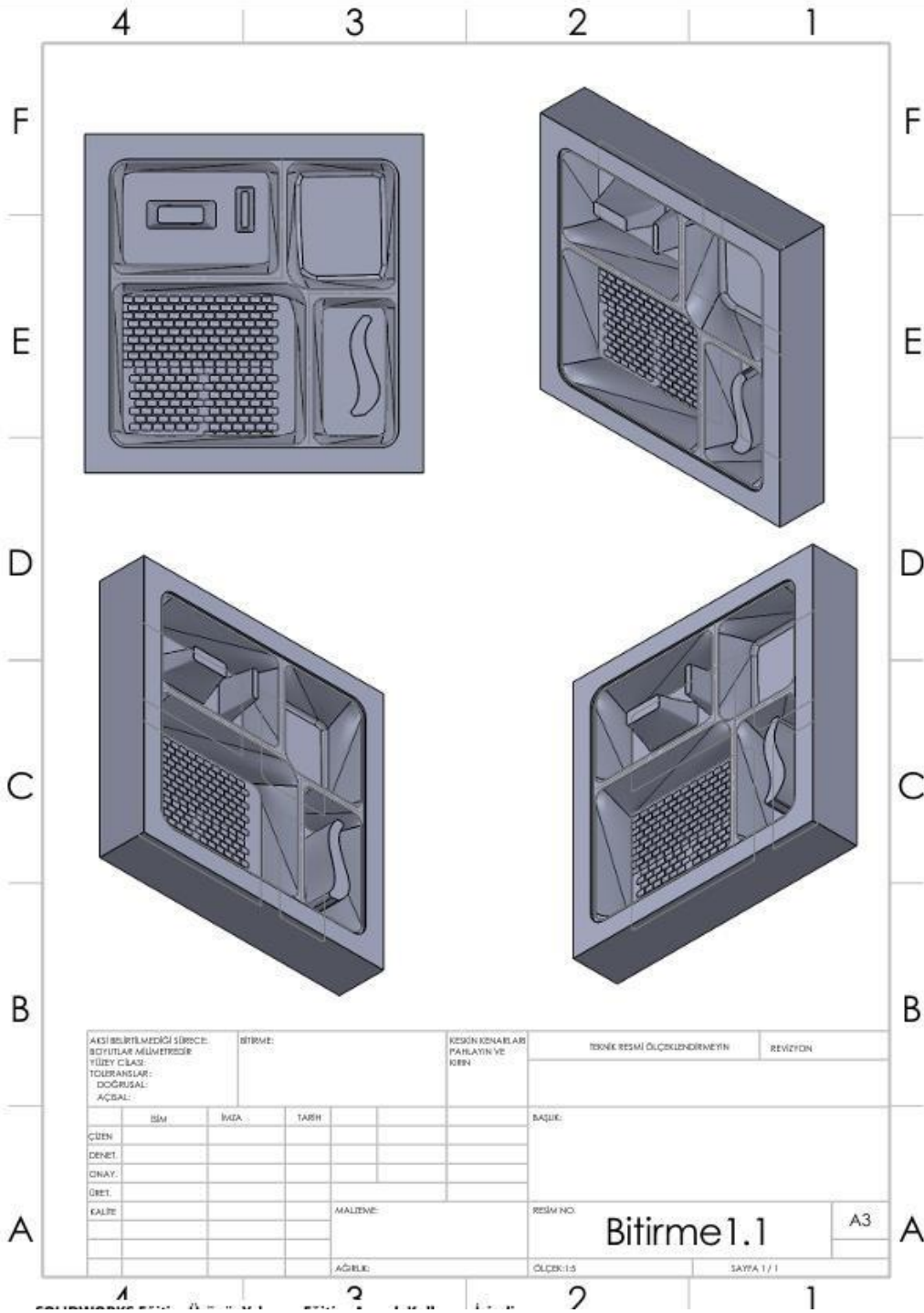


Figure 14 : Technical Drawing 3D

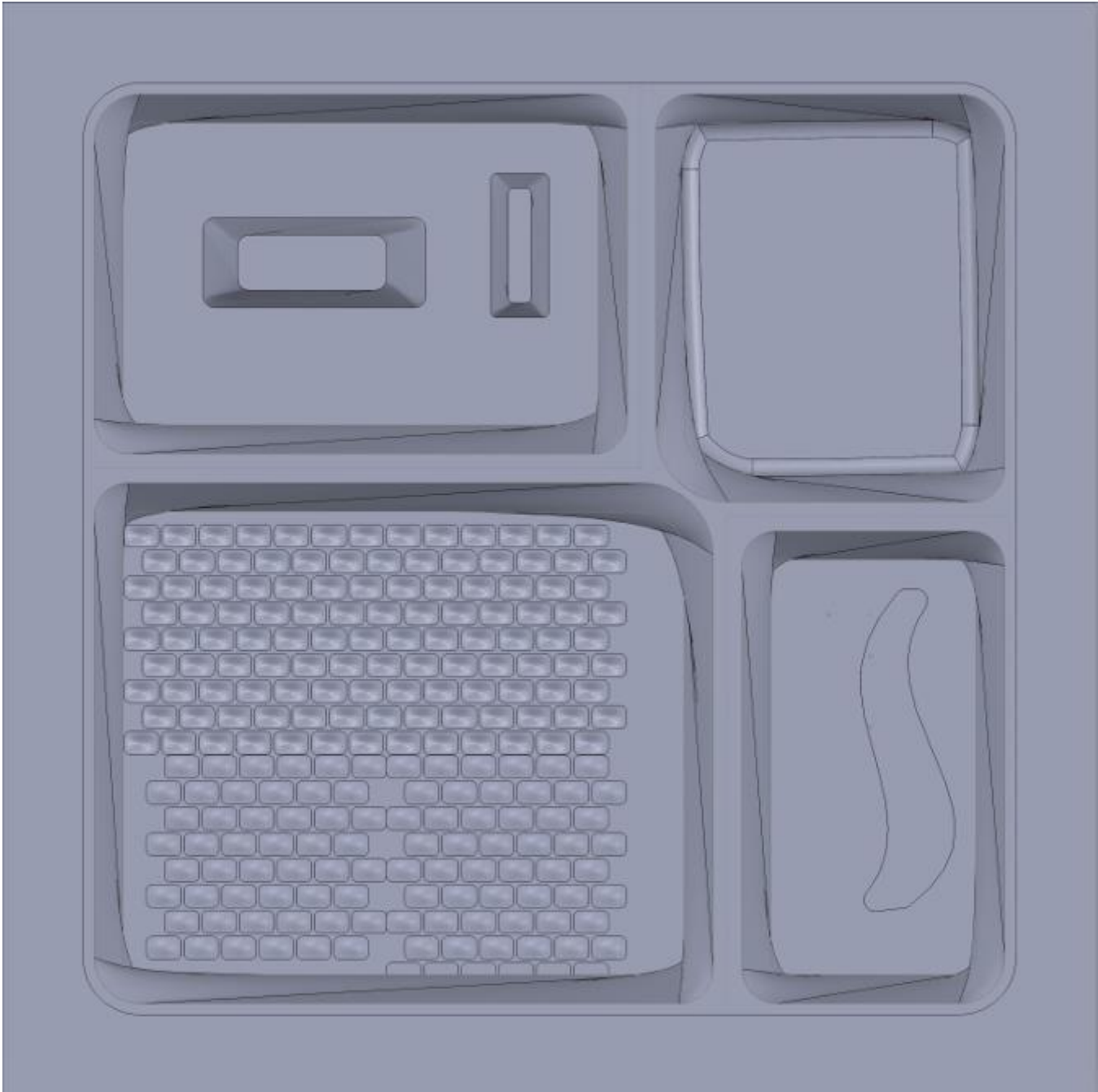


Figure 15 : 3D top view

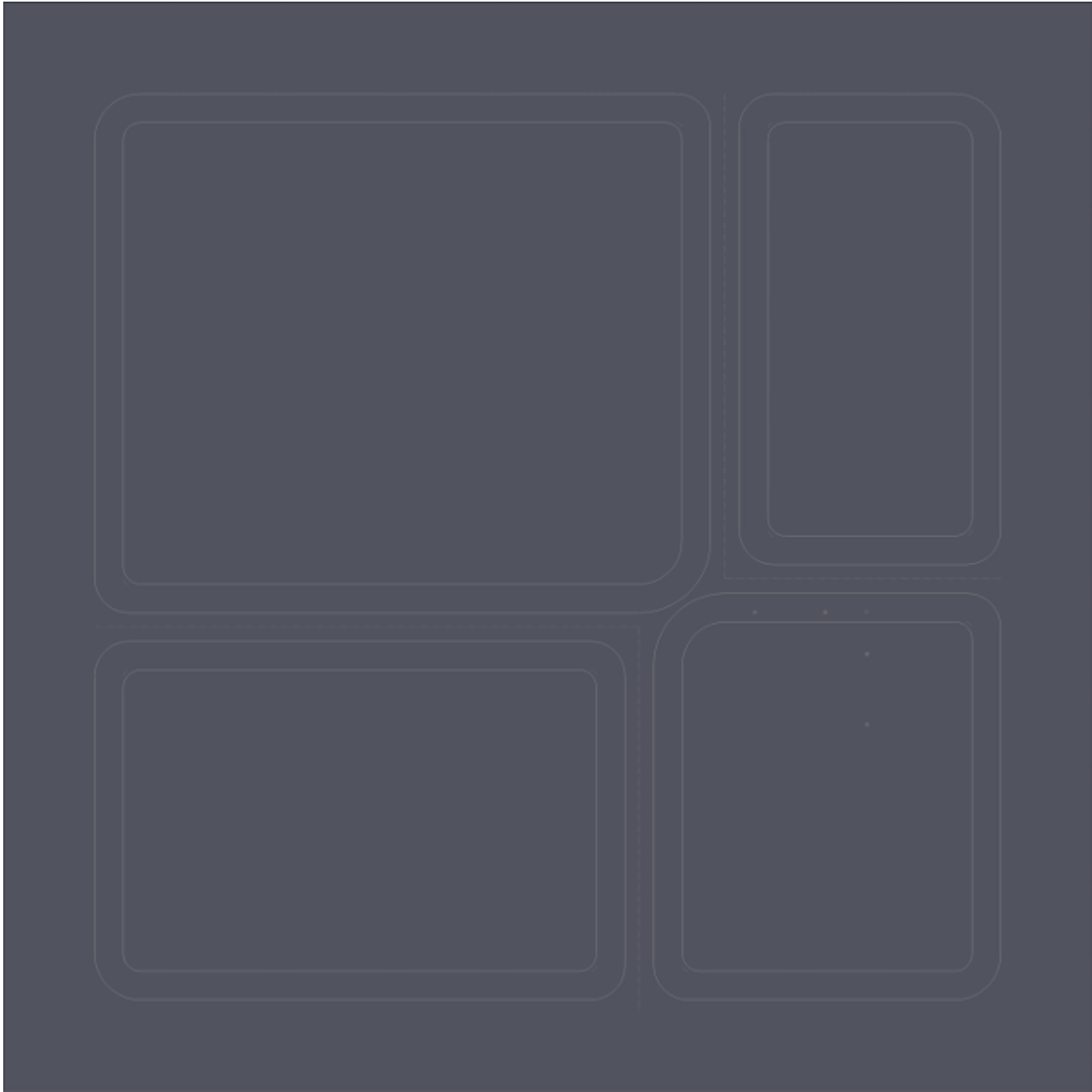
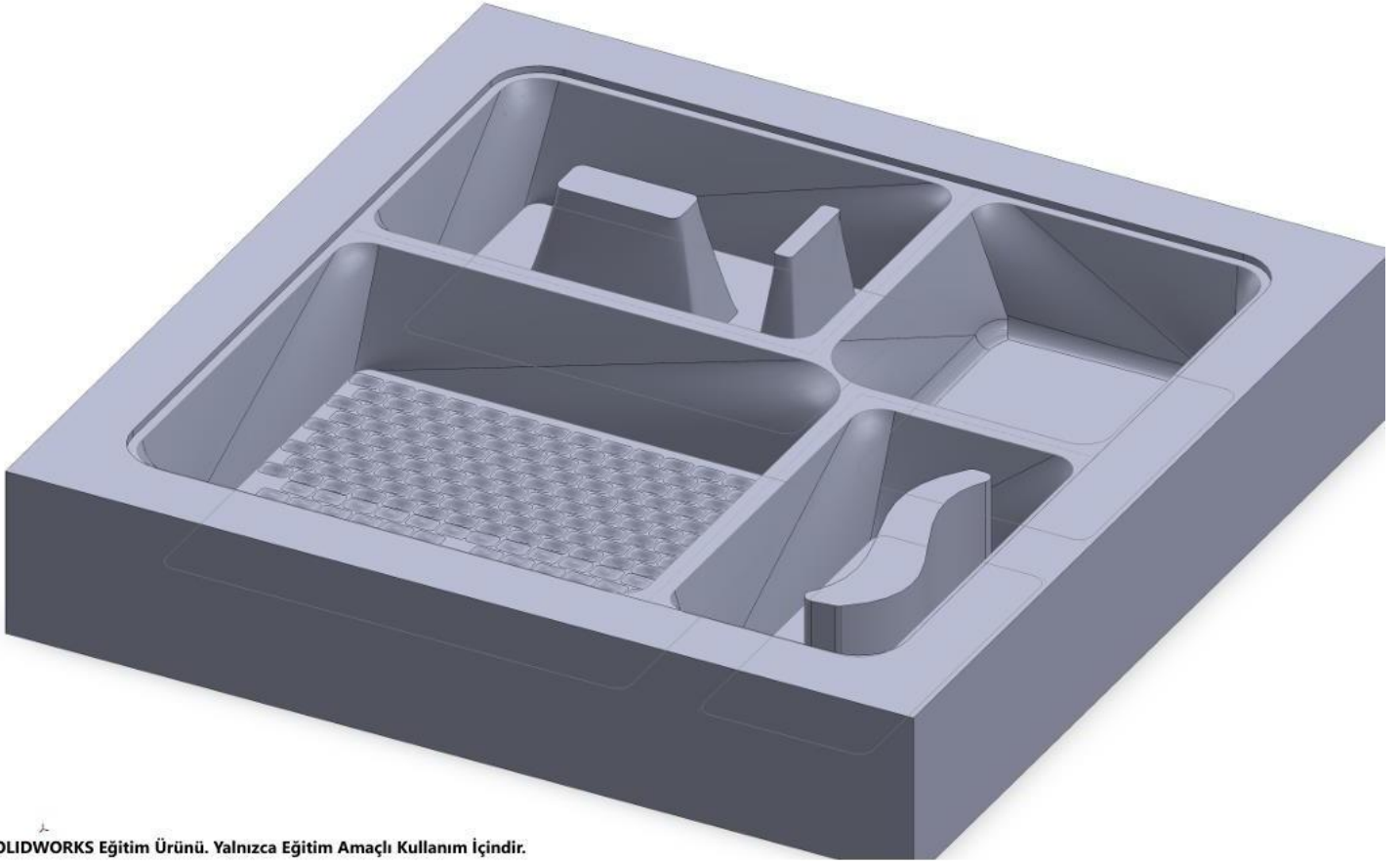
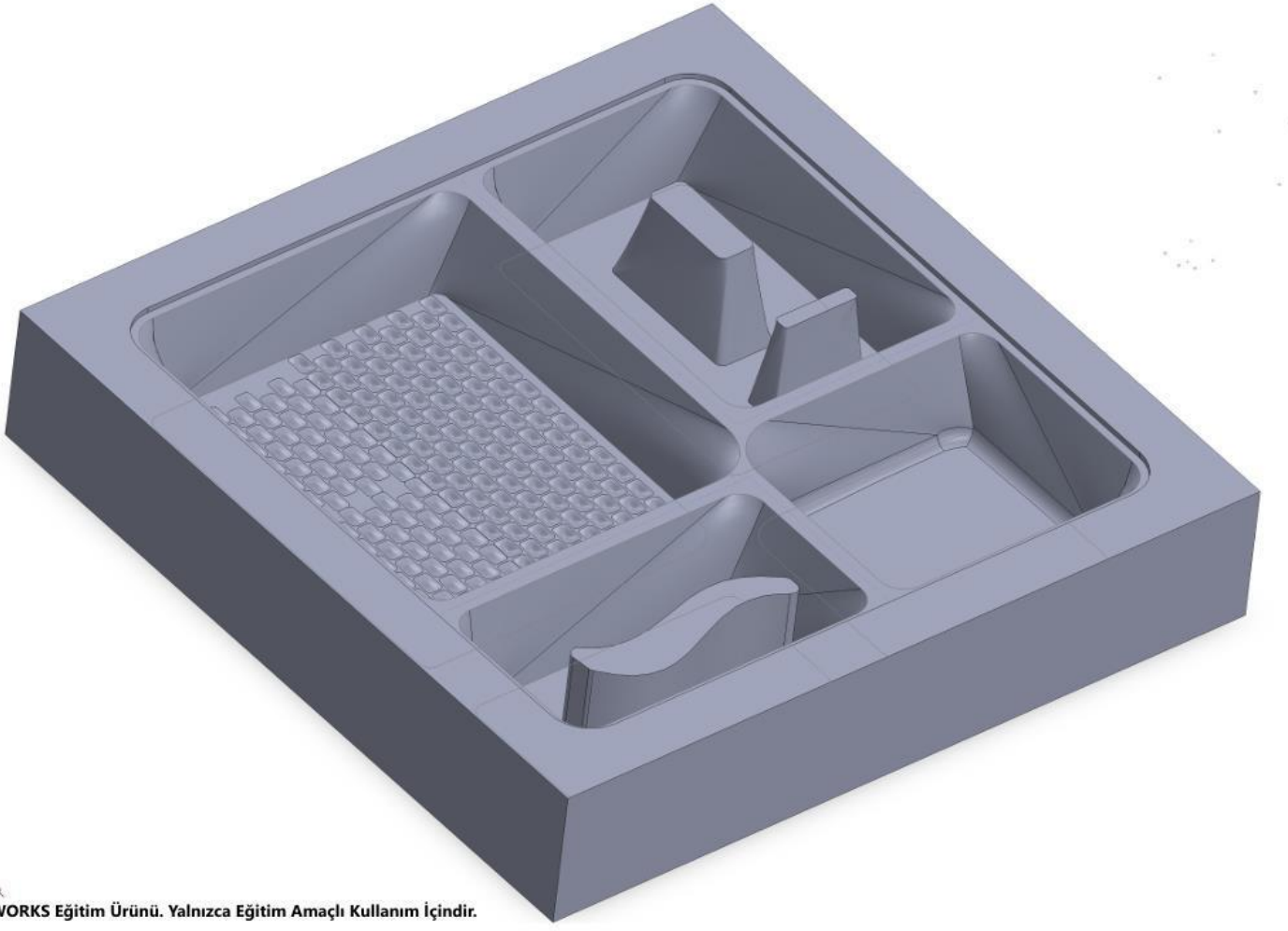


Figure 16: 3D bottom view



SOLIDWORKS Eğitim Ürünü. Yalnızca Eğitim Amaçlı Kullanım İçindir.

Figure 17: triometric view



SOLIDWORKS Eğitim Ürünü. Yalnızca Eğitim Amaçlı Kullanım İçindir.

Figure 18 : isometric view

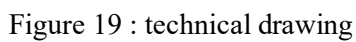
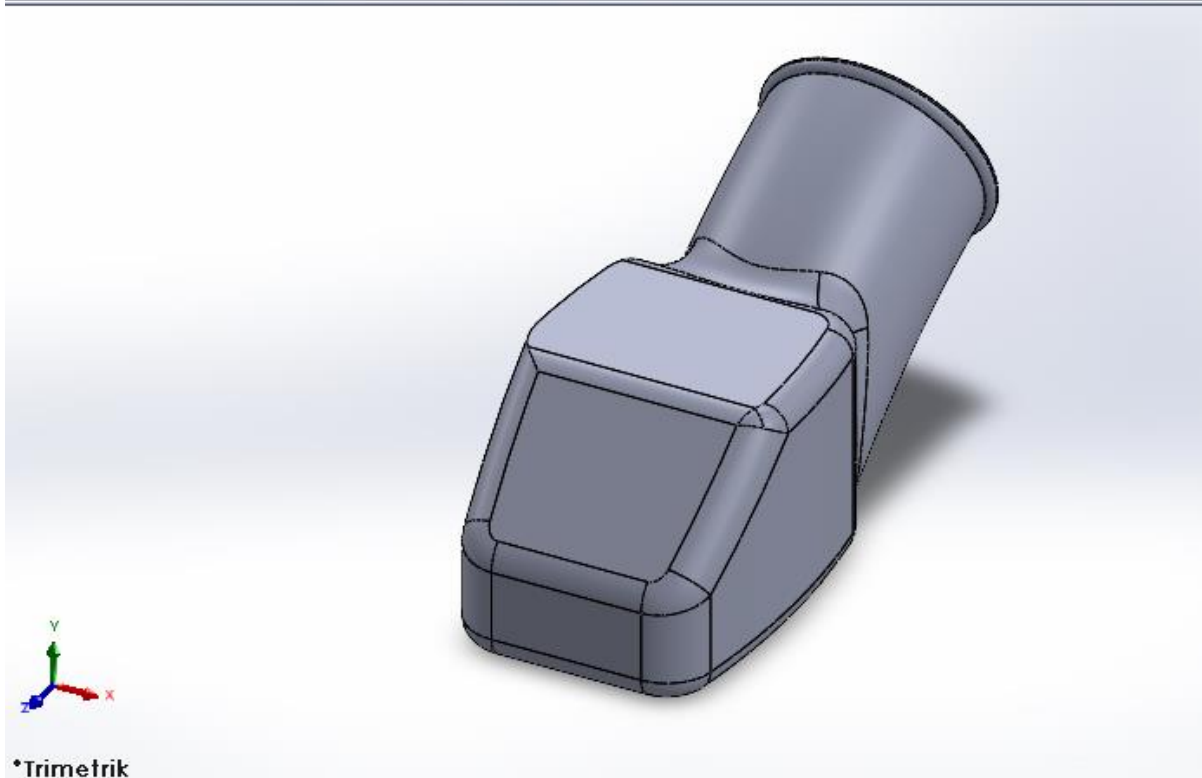
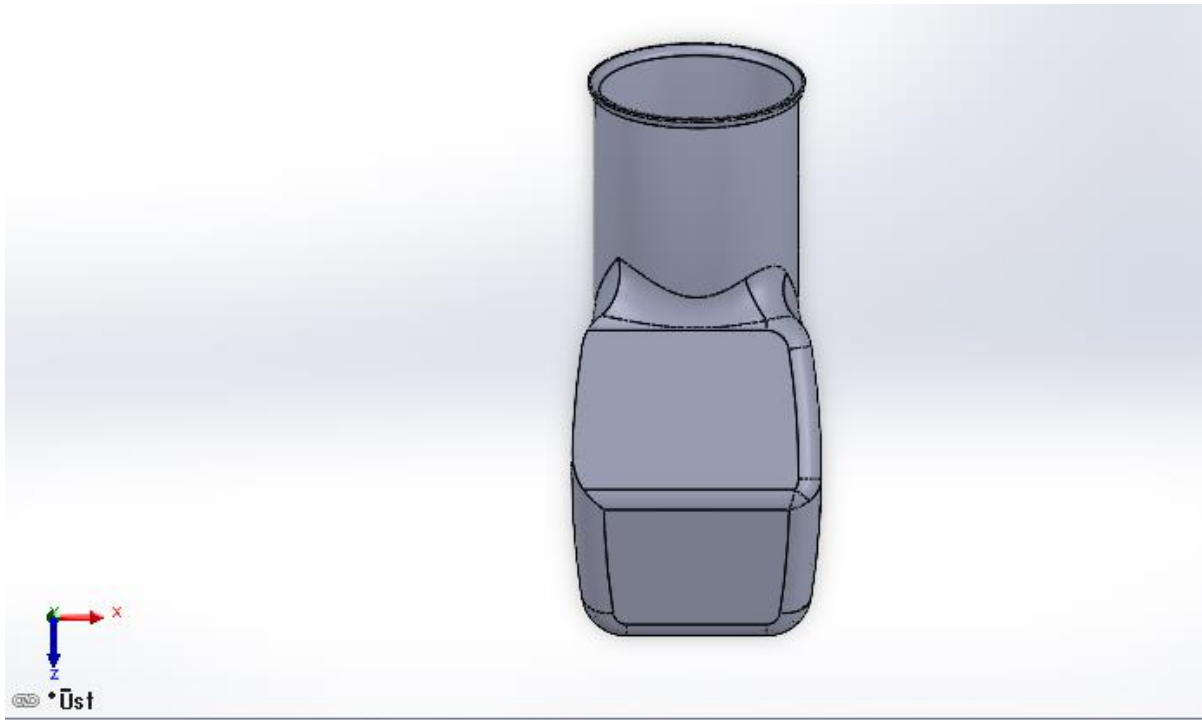


Figure 19 : technical drawing



•Trimetrik
Figure 20: Male Urinal Bulbous

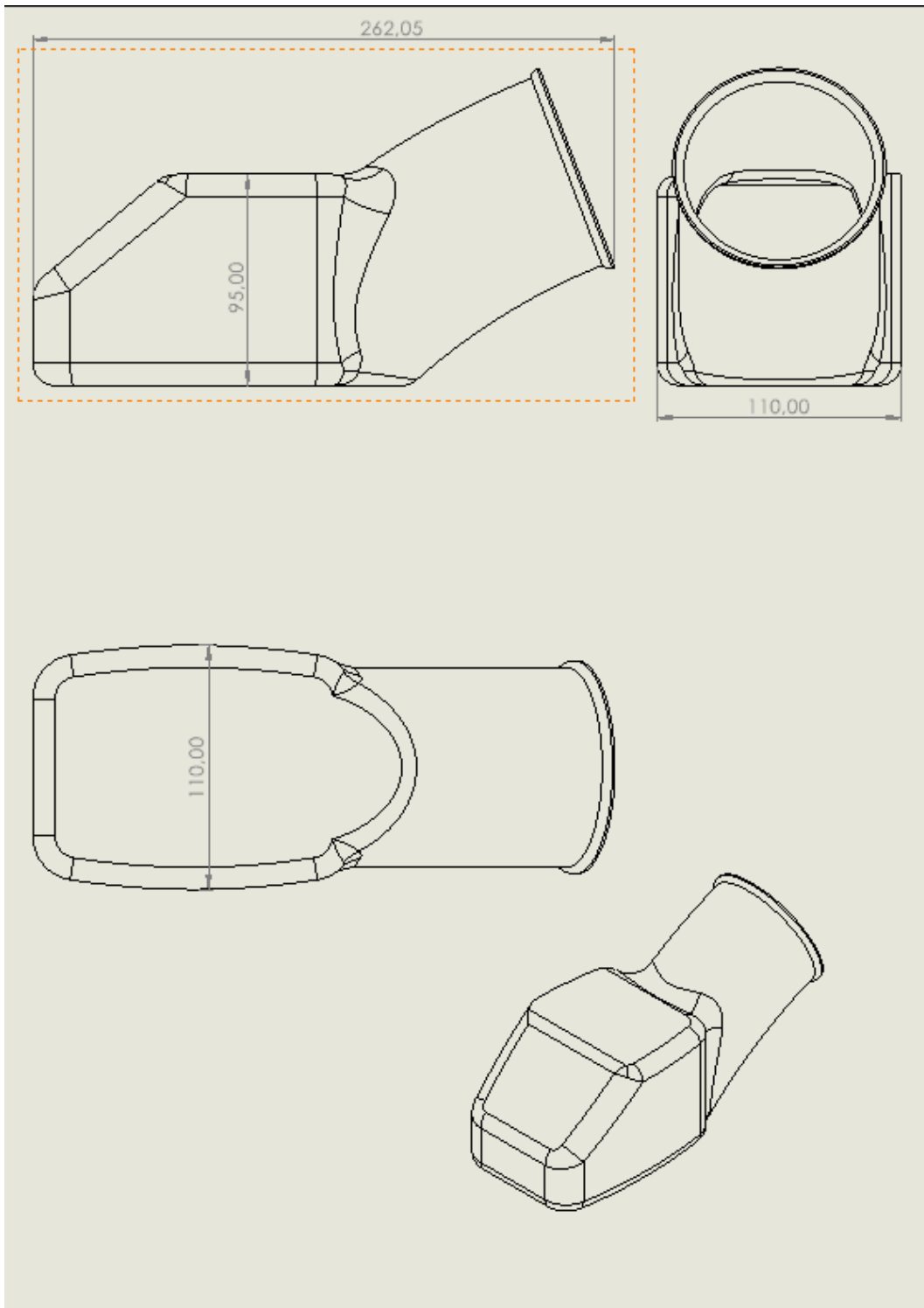


Figure 21: Male Urinal Bulbous

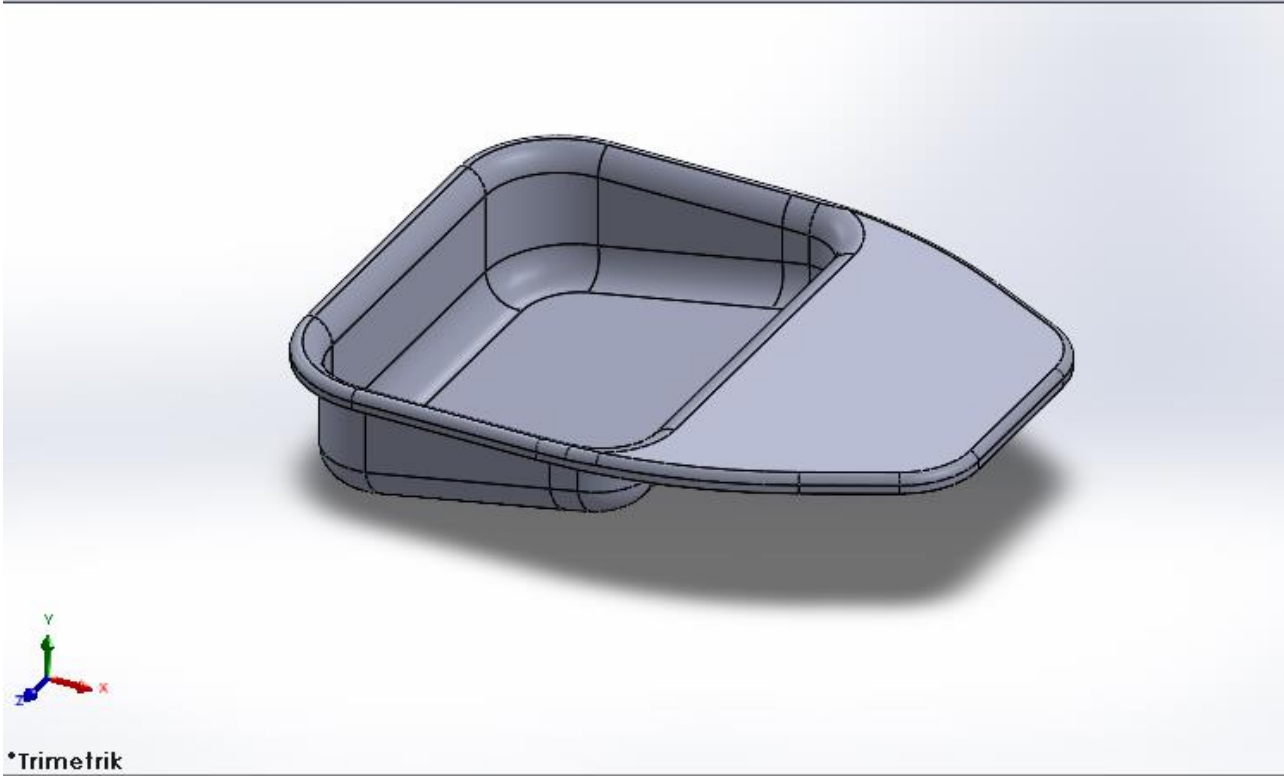
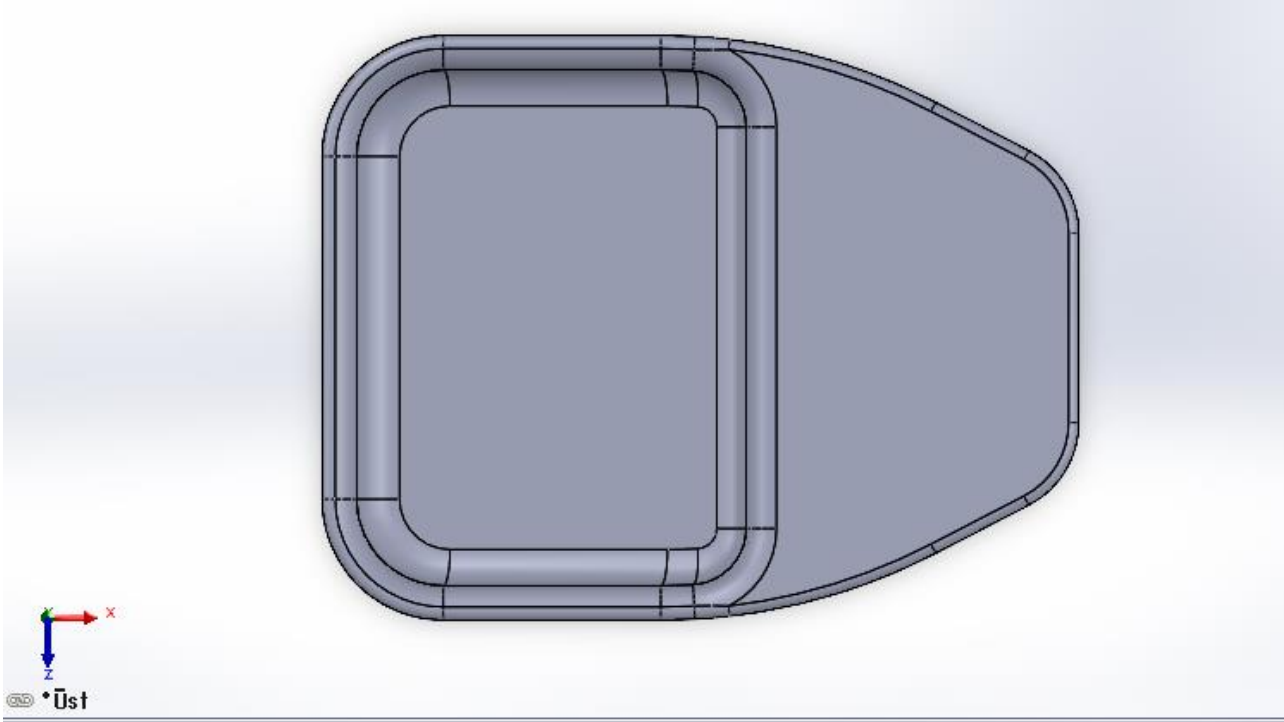


Figure 22: Maxi Bedpan

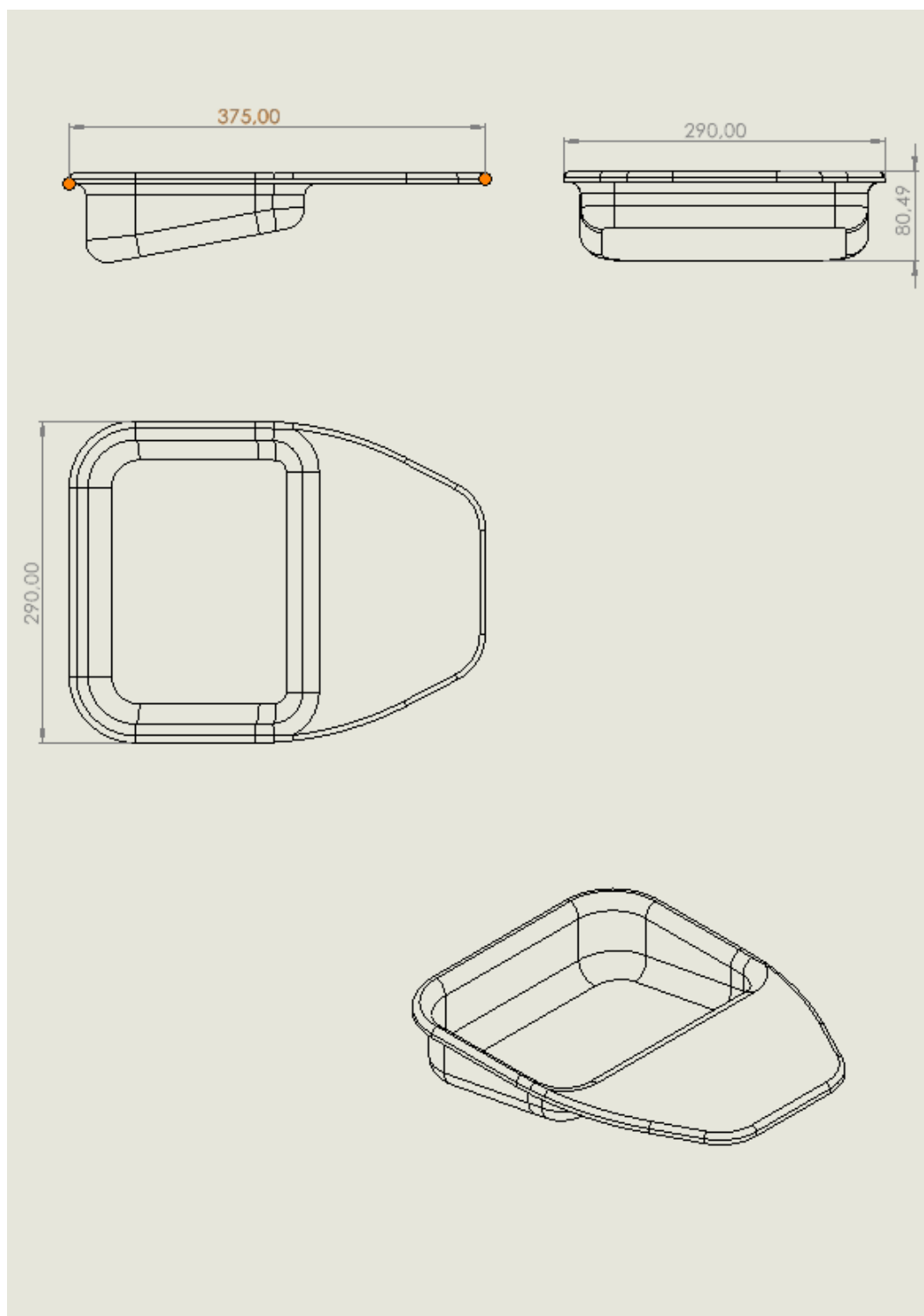
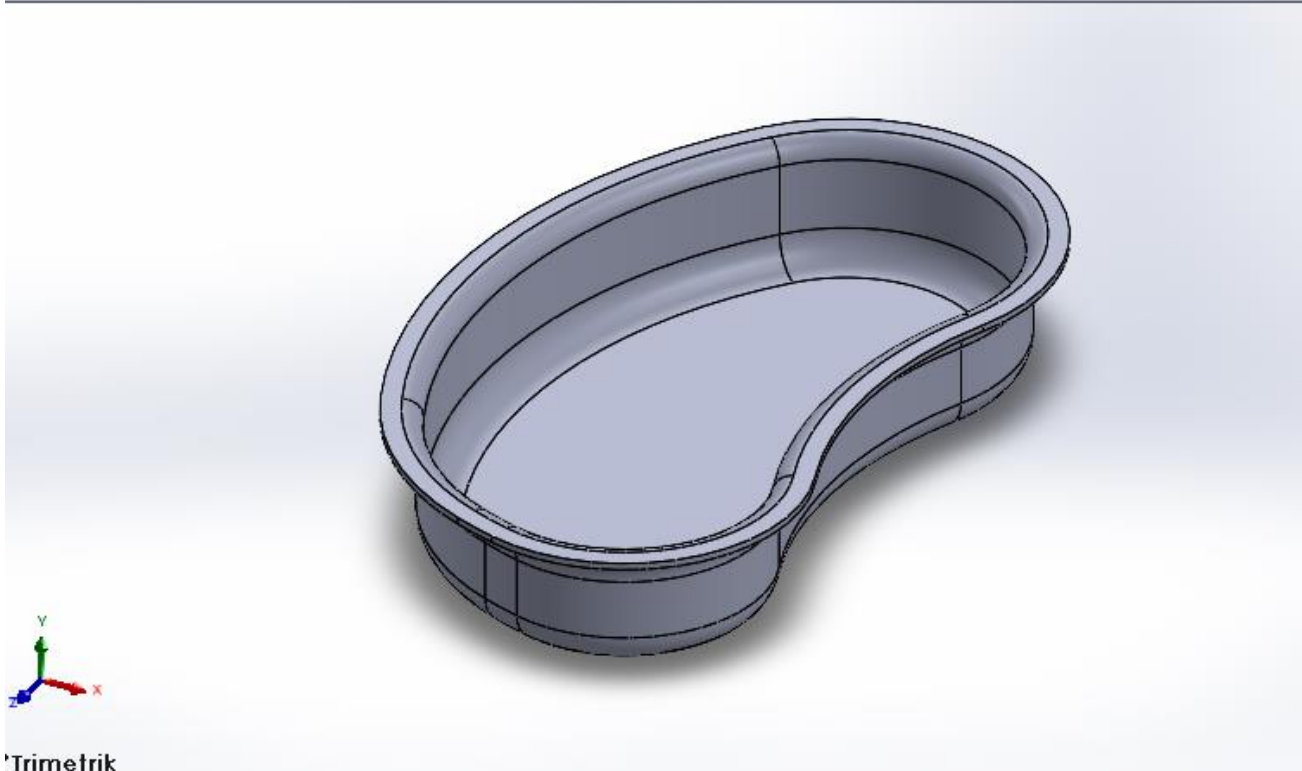
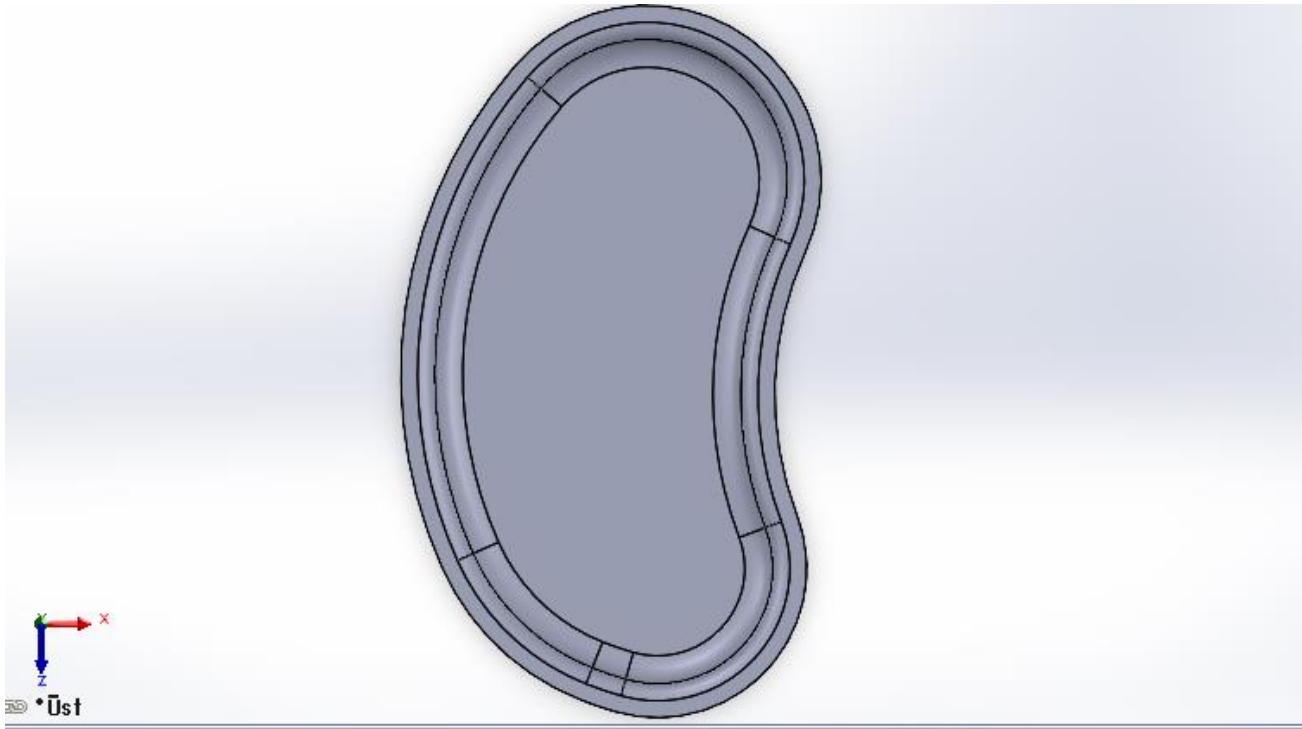


Figure 23: Maxi Bedpan



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Figure 24: Kidney Tub

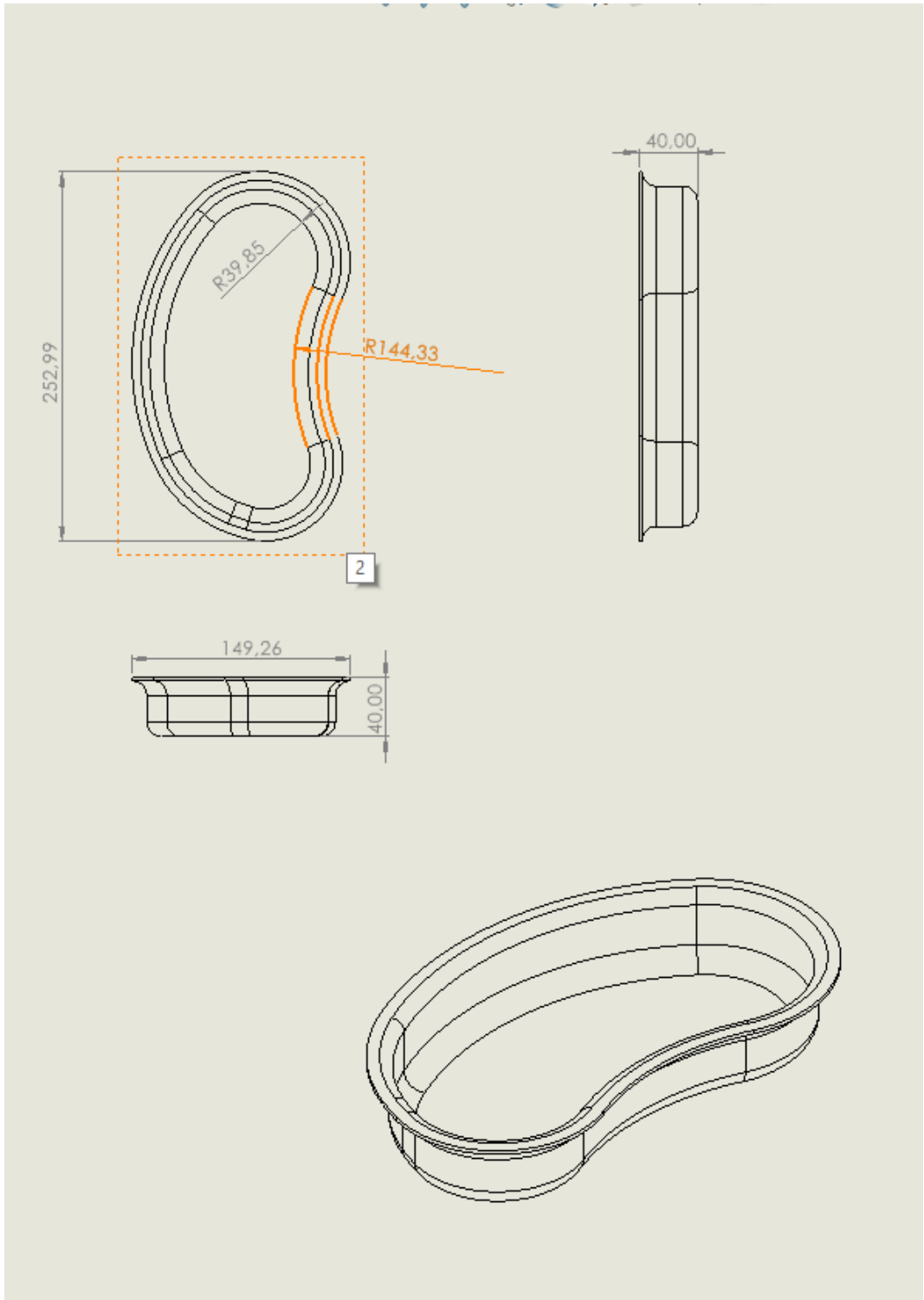


Figure 25: Kidney Tub

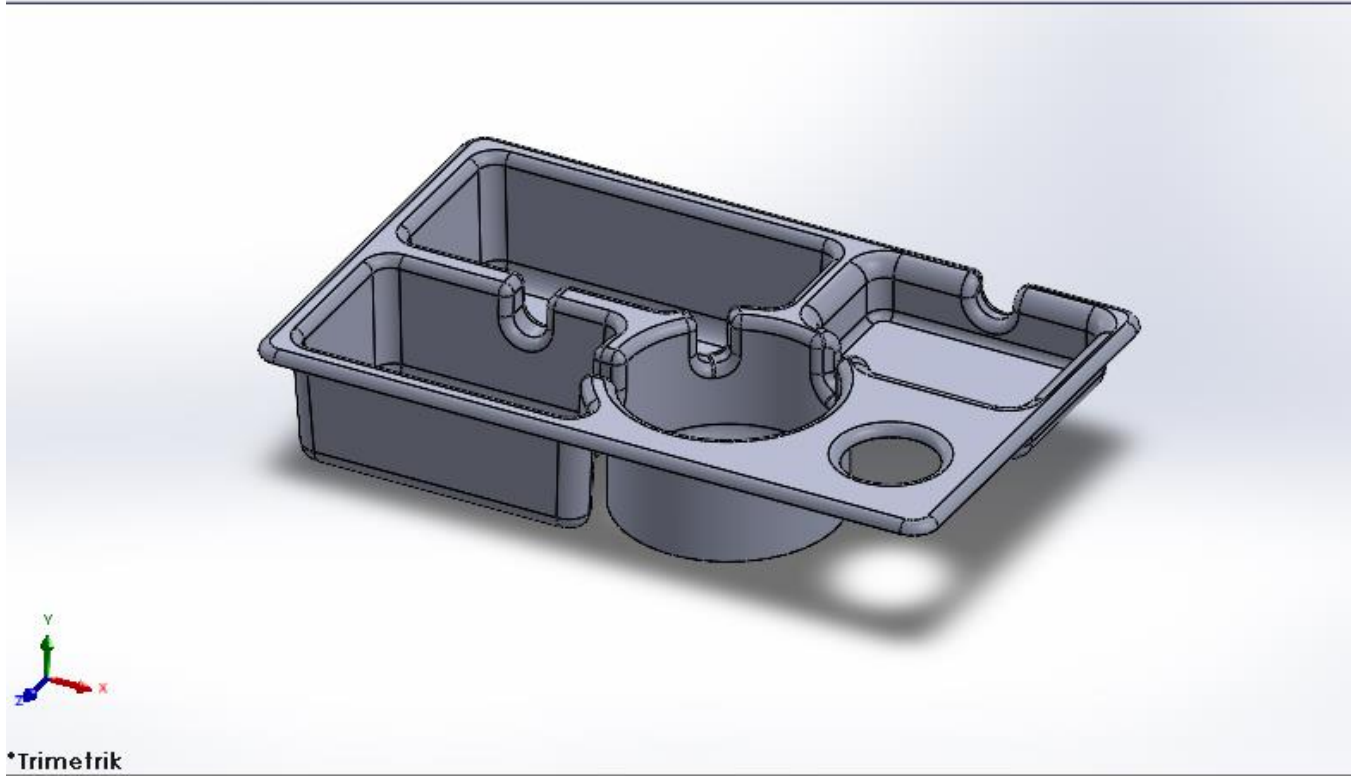
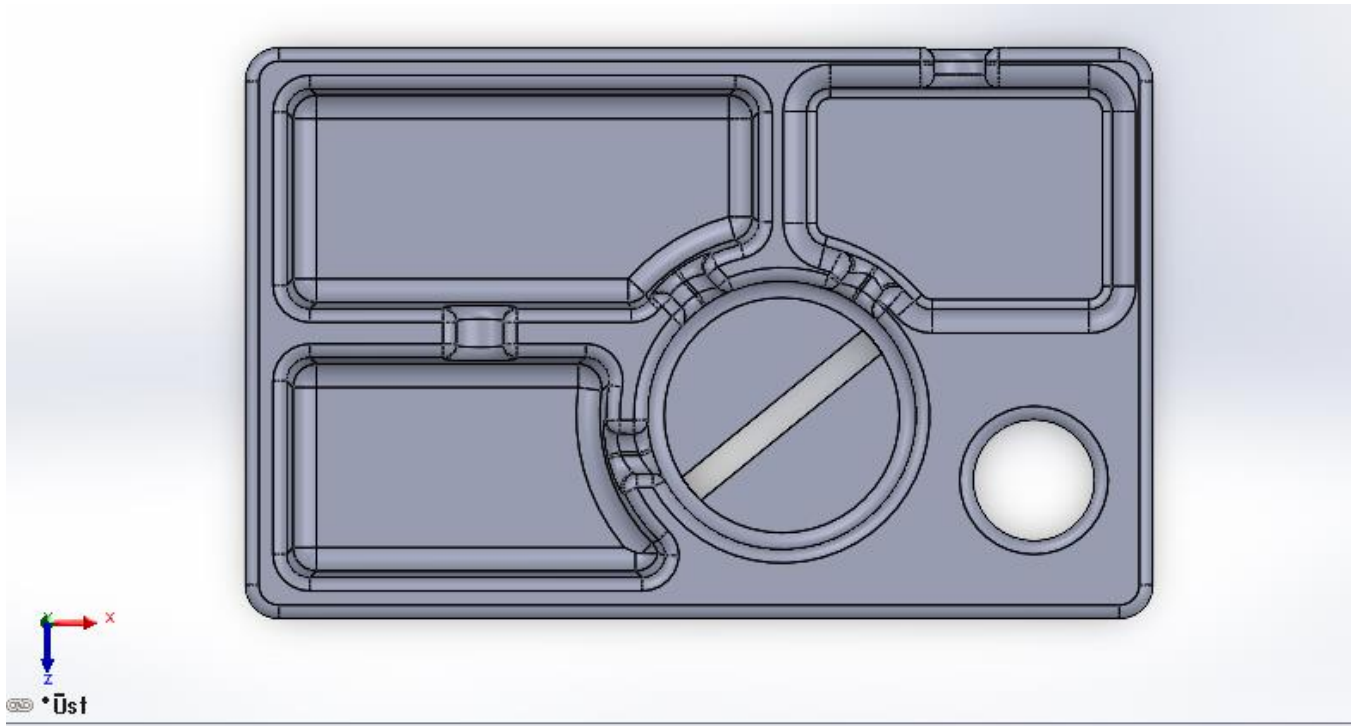


Figure 26 : Snack plate

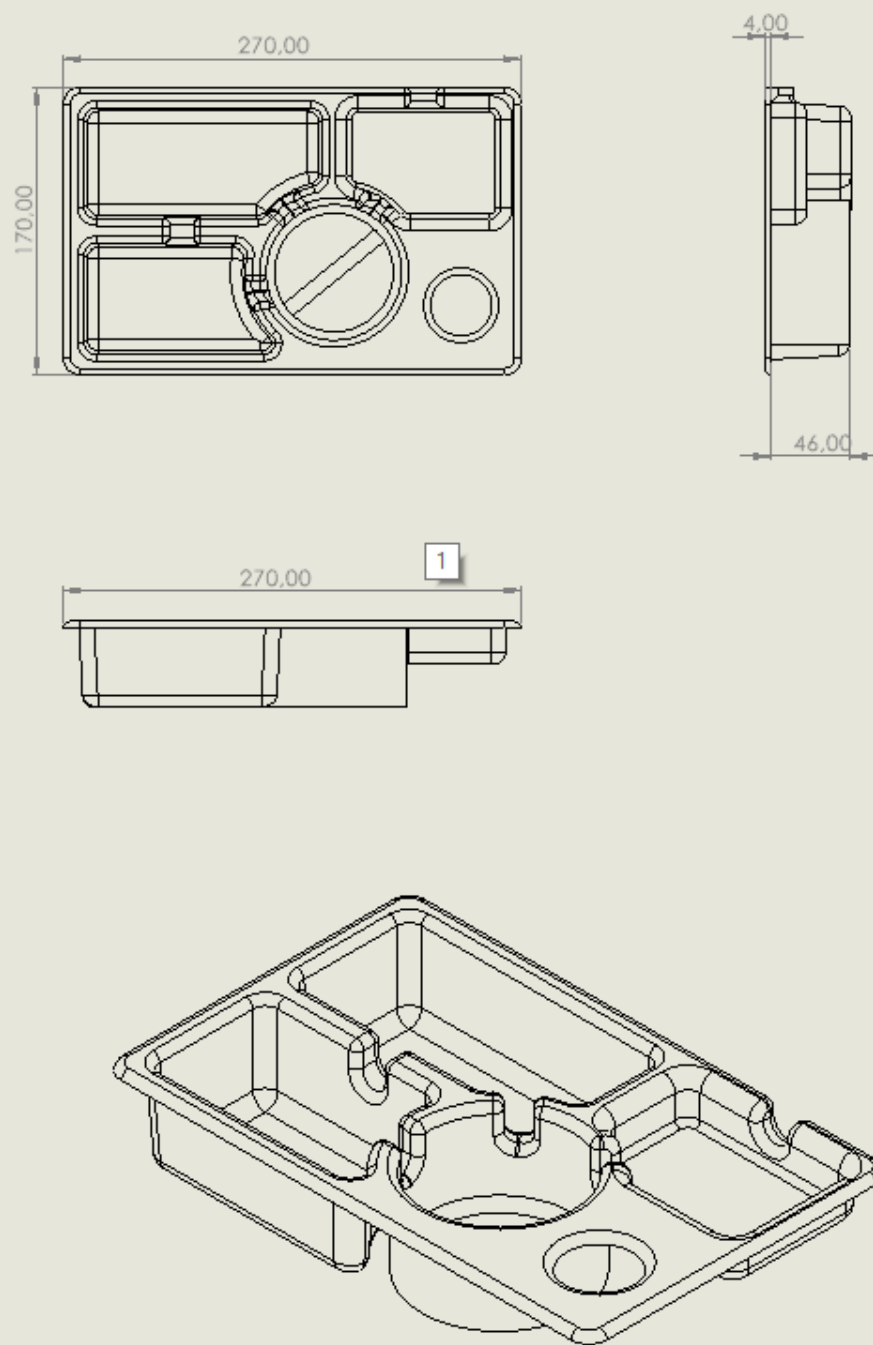


Figure 27 : Snack plate

CONCLUSION

The necessary points for viol design were learned. To give an example. One of these is that since a mold is used in viol production, the viol must be drawn at a small angle. If it was made without an angle, it might have to be removed from the mold by breaking it into pieces. Another gain is that there are tolerance values depending on the use of the designed viol and that these values are important for the product to fit perfectly into the viol.

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