

PD4043 - MATERIALS

PROCESS BOOK

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Timeline

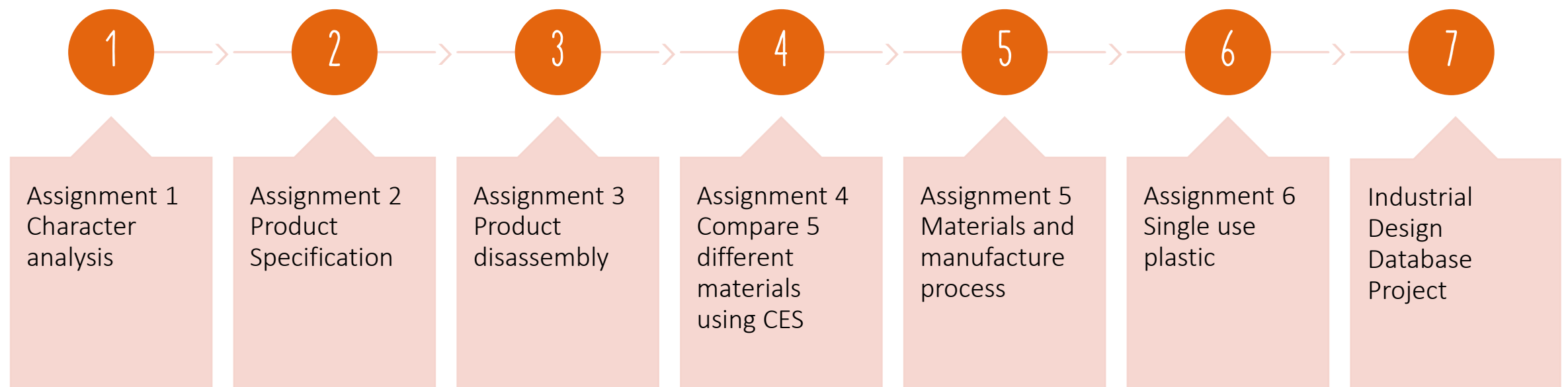


TABLE OF CONTENT

Assignment 1: Character Analysis Pg 4-8

Assignment 2: Product Specification Pg 9-14

Assignment 3: Product Disassembly Pg 15-19

Assignment 4: CES Material selection Pg 20-34

Assignment 5: Materials and Manufacturing Processes
Pg 35-37

Assignment 6: Single-use Plastic Pg 38-41

Industrial Design Database Project: Brief Pg 43

Industrial Design Database Project: Step 1 Pg 44-49

Industrial Design Database Project: Step 2 Pg 50-57

Industrial Design Database Project: Step 3 Pg 58-65

Industrial Design Database Project: Conclusion Pg 66

Assignment 1 Character analysis



- Conduct a character analysis of three similar products expressed through different material characteristics.
- Step 1 photograph each product.
- Step 2 Characterize as follows:

Character analysis:

Context.

Materials and processes.

Usability and personality.

- Aesthetics.

Form, colour, feel.

- Associations.

- Perceptions.

Character analysis of photo frames

You'll find photo frames in all sorts of materials, each with its own special look and qualities.

Glass photo frame



Metal and synthetic crystals photo frame



Wooden collage photo frame



Character analysis – Glass photo frame by Addison Ross

Context	Displaying formal occasions for example wedding photos or studio shots
Materials and processes	Glass which has went through an angled surface cut (bevel) around the entire periphery, silver bezel, black velvet backing, glass insertion Simple removal for photos with clips
Usability and personality	Able to stand both Landscape and Portrait Colour: transparent Feel: Cold, light, smooth Aesthetics: hard, abrasion resistant, permanence of colour Associations of culture, luxury, sophistication Perceptions of refinement, quality

Character analysis – Metal and synthetic crystal photo frame by Sixteen

Context	A feminine touch used to enhance the photos, a luxuries and elegant setting
Materials and processes	Metal base-sheets cut and shaped in style, fake diamond finish placed in desired style, glass insertion. Simple removal for photos with clips
Usability and personality	Standing usually in main bedroom Colour: Mainly fake diamonds with are shiny and transparent Feel: Rough, cold, light Aesthetics: cold, clean, hard, stiff, strong, often ages well, mosaic Associations of machinery, precision instruments, weapons Perceptions of strength, precision, durability, quality

Character analysis – Wooden collage photo frame by Lasercuts

Context	Displaying happy moments in a cozy environment, pictures of family
Materials and processes	Wood selection (rosewood), Cutting-pieces cut into individual shapes, Joinery (collage), sanding for smooth edges, staining (protective), glass insertion Simple removal for photos with clips however multiple for each photo
Usability and personality	Wall hanging for living room, to present the family. Colour: Dark brown Feel: Smooth, heavy Aesthetics: tactile, warm, textured, it ages well Associations of fine furniture, musical instruments Perceptions of craftsmanship, tradition, heritage, quality

Assignment 2 Product specification



Compare 2 products for material properties.

Select which properties are important for that product to function and state why

- Young's modulus
- Tensile strength
- Yield strength
- Compressive strength
- Hardness
- Density
- Electrical resistivity
- Thermal conductivity
- Cost
- Etc.... (select more properties from the slides)

Product Specification

Wind turbine



Radiator



Product specification – Wind turbine

Young's Modulus	It is essential for wind turbine blades to bend with the force of the wind while maintaining structural integrity. To avoid excessive deformation.
Tensile Strength	High tensile strength is necessary to prevent blade failure or damage because wind loads exert significant tensile stresses on wind turbine blades.
Yield Strength	To avoid permanent deformations or breakdowns, it is imperative that materials used in wind turbines remain within their elastic range.
Compressive Strength	The tower can bear the weight and structural stresses put on it because to its high compressive strength.
Hardness	it's still important for the longevity and maintenance of components like gears and bearings within the wind turbine.
Density	To minimize the weight of the turbine overall, which may have an impact on shipping, installation, and overall effectiveness, lower-density materials are chosen.
Electrical resistivity	Components of wind turbines like generators and wires must have low electrical resistivity in order to minimize energy losses due to electrical resistance.

Product specification – Wind turbine

Thermal conductivity	-
Cost	In the design of wind turbines, cost is crucial since materials with exceptional mechanical qualities need to be affordable for broad use in production
Corrosion	Corrosion must be avoided in wind turbines. Small corrosion damage might cause considerable corrosion damage and possibly jeopardize the tower's stability. Some, though, continue to rust.
Wear Resistance	Because of continual spinning and hostile conditions, bearings, gearboxes, gears, and blade leading edges are prone to wear. Effectiveness and lifespan depend on wear resistance.

Product specification – Radiator

Young's Modulus	-
Tensile Strength	-
Yield Strength	-
Compressive Strength	-
Hardness	-
Density	The total weight and structural stability of a radiator can be impacted by the density of the materials used in it. The less weight, the easier it will be to install.
Electrical resistivity	In some specialized appliances, they are often not common home appliances. The electrical resistance of building materials may be important for safety.

Product specification – Radiator

Thermal conductivity	Important component for effective heat transmission to the surroundings.
Cost	Customers must be able to afford it
Corrosion	Essential to maintain long-term performance and prevent harm
Wear Resistance	Guarantees resilience against the consequences of ongoing usage and flow

Assignment 3 Product disassembly



Find 2 products (can be related) that are made up of at least two different materials.

1. Dis-assemble the products.
2. Photograph each component and identify the materials and manufacturing process of each.
(use the CES software to help.

Product disassembly – Computer mouse



Product disassembly – Computer mouse

Materials	Manufacturing process
The Body - Acrylonitrile butadiene styrene (ABS)	<p><u>Injection Moulding</u></p> <ul style="list-style-type: none"> • A mold, often made of steel or aluminum, is created based on the design. The mold consists of two halves, and each half represents the shape of one side of the mouse part. • The mold is mounted onto an injection molding machine. The machine is equipped with a heating unit to melt the plastic material, and a system to inject the molten plastic into the mold. • Plastic pellets, usually made of polymers such as ABS (acrylonitrile butadiene styrene) or other suitable materials, are fed into the injection molding machine. • The plastic pellets are heated until they melt into a molten state. The molten plastic is then injected into the mold under high pressure. The mold is kept closed until the plastic solidifies. • The molded part is allowed to cool and harden within the mold. Cooling times can vary depending on the size and complexity of the part. • Once the plastic has solidified, the mold is opened, and the newly formed mouse part is ejected from the mold. • The ejected part may undergo additional processes such as trimming, deburring, or surface finishing to achieve the desired final appearance and dimensions.
Scroll Wheel - Rubber	<p><u>Injection molding</u></p> <ul style="list-style-type: none"> • A mold is created with cavities in the shape of the desired rubber parts. This mold is usually made of metal and is designed to withstand the pressure and heat of the injection molding process. • The rubber compound is preheated to make it more malleable before injection. The preheated rubber compound is injected into the mold under high pressure. The mold is closed, and the rubber fills the mold cavities, taking the shape of the desired parts. • The injected rubber is then cured or vulcanized. This process involves applying heat to the rubber to promote cross-linking of polymer chains, resulting in improved strength, elasticity, and other desirable properties. • After curing, the molded rubber parts are cooled within the mold before being ejected. The mold is opened, and the finished rubber parts are removed.
Electronic Components - Metal (aluminum, steel, and various alloys)	<p><u>Sheet Metal Fabrication</u></p> <ul style="list-style-type: none"> • Metal sheets are often used to create the outer shell and structural components of a mouse. Sheet metal fabrication techniques include cutting, bending, and stamping. • Laser cutting or water jet cutting may be used to precisely cut metal sheets into the desired shapes. <p><u>CNC Machining:</u></p> <ul style="list-style-type: none"> • Computer Numerical Control (CNC) machining is a process where metal components are cut, drilled, and shaped using computer-controlled machines. This is often used for creating precise and intricate parts. <p><u>Die Casting</u></p> <ul style="list-style-type: none"> • For certain metal components with complex shapes, die casting may be employed. This involves injecting molten metal into a mold to produce the desired part. • Metal components may undergo surface treatments for aesthetic and functional purposes. Processes like anodizing (for aluminum) or coating help improve corrosion resistance and provide a finished appearance. <ul style="list-style-type: none"> • Metal components are assembled with other parts, such as plastic components, electronic circuits, and sensors, to form the complete mouse.

Product disassembly – Hair straightener



Product disassembly – Hair straightener

Materials	Manufacturing process
Heating Plates - Ceramic	<ul style="list-style-type: none"> • Preparation of the ceramic powder, which consists of milling dispersants and adding solvents, mixing with a binding agent and a plasticizer, and controlling the viscosity of the result. • Moulding and drying of the ceramic powder to form thin plates. • Cutting the plates and screen printing the resistor on one of them. • Laminating the two plates by pressure and then cutting them again to fit the size and shape of the iron. • Burning the binding agent and performing a sintering process to fuse the ceramic material and the resistor. • Welding the contact terminals and applying a polished layer for coating purposes.
Handle – Heat Resistant Thermoplastic (polypropylene)	<p><u>Injection Moulding</u></p> <ul style="list-style-type: none"> • A mold is created based on the design. This mold consists of two halves (cavities and cores) that fit together. The mold is typically made of metal, such as steel or aluminum. • Polypropylene (PP) is chosen as the material for injection molding due to its properties, including durability, heat resistance, and ease of molding. • Polypropylene pellets are loaded into the injection molding machine's hopper. • The injection molding machine heats the polypropylene pellets until they melt into a liquid form. • The molten polypropylene is injected into the mold under high pressure. It fills the cavities of the mold, taking its shape. • The mold is cooled to solidify the molten polypropylene and set the shape of the hair straightener parts. • Once the plastic has solidified, the mold is opened, and the newly formed hair straightener parts are ejected.
Power Cord - Rubber	<ul style="list-style-type: none"> • The chosen rubber is mixed with other ingredients in a process called compounding. This involves blending the rubber with additives such as curing agents, accelerators, antioxidants, plasticizers, and reinforcing agents to achieve the desired properties, including flexibility, durability, and resistance to environmental factors. • The rubber compound undergoes milling and mixing processes to ensure a homogeneous mixture. This is typically done using specialized machinery, such as two-roll mills or internal mixers. • The mixed rubber compound is then fed into an extruder, which is a machine that processes the rubber through a shaped die. In the case of cords, the extrusion process forms a continuous rubber cover or insulation around the conductive wires or cable cores. • The extruded rubber is then vulcanized to enhance its strength and stability. Vulcanization involves exposing the rubber to heat and pressure. This process forms cross-links between the polymer chains, making the rubber more durable and heat-resistant. • After vulcanization, the rubber is cooled to room temperature to set the shape and structure of the rubber insulation. • The extruded and vulcanized rubber is cut into specific lengths, depending on the intended use of the cord. The finished rubber cords are often wound onto spools for storage and transportation.

Assignment 4 CES Material selection



- Complete all following exercises;

Exercise 1: Browse material records

Exercise 2: Browse process records

Exercise 3: Searching

Exercise 4: Creating property charts

Exercise 5: Creating bubble charts

Exercise 6: Filtering and Screening -Selection using a Chart Stage

Exercise 7: Selection using a Limit Stage/Tree stage

Exercise 8: Combining filtering and charting tools

Exercise 1: Browse material records

Stainless steel

Description

Image

Caption

1. Siemens toaster in brushed austenitic stainless steel (by Porsche Design) © ANSYS, Inc. 2. Scissors in ferritic stainless steel; it is magnetic, austenitic stainless is not. © ANSYS, Inc.

The material

Stainless steels are alloys of iron with chromium, nickel, and - often - four or five other elements. The alloying transmutes plain carbon steel that rusts and is prone to brittleness below room temperature into a material that does neither. Indeed, most stainless steels resist corrosion in most normal environments, and they remain ductile to the lowest of temperatures.

Composition (summary)

Fe/<0.25C/16 - 30Cr/3.5 - 37Ni/<10Mn + Si,P,S (+N for 200 series)

General properties

Density	7.61e3 - 7.87e3	kg/m ³
Price	* 3.87 - 4.28	EUR/kg
Date first used	1915	

Mechanical properties

Young's modulus	190 - 210	GPa
Shear modulus	74 - 82	GPa
Bulk modulus	140 - 160	GPa
Poisson's ratio	0.27 - 0.28	
Yield strength (elastic limit)	257 - 1.14e3	MPa
Tensile strength	515 - 1.3e3	MPa
Compressive strength	* 252 - 1.2e3	MPa

Exercise 1: Browse material records

Granta EduPack 2023 R2 - [MaterialUniverse\Metals and alloys\Ferrous]

File Edit View Select Tools Window Help

Home Browse Search Chart/Select Solver Eco Audit Synthesizer Learn Tools Settings Help

Browse Database: Level 2 Change... Table: MaterialUniverse Subset: All materials

- MaterialUniverse
 - Ceramics and glasses
 - Hybrids: composites, foams, natural materials
 - Metals and alloys
 - Ferrous
 - Cast iron, ductile
 - Cast iron, gray
 - High carbon steel
 - Low alloy steel
 - Low carbon steel
 - Medium carbon steel
 - Stainless steel
 - Non-ferrous
 - Polymers and elastomers
 - Elastomers
 - Polymers
 - Thermoplastics
 - Acrylonitrile butadiene styrene (ABS)
 - Cellulose polymers (CA)
 - Ionomer (I)
 - Polyamides (Nylons, PA)
 - Polycarbonate (PC)
 - Polyetheretherketone (PEEK)
 - Polyethylene (PE)
 - Polyethylene terephthalate (PET)
 - Polyhydroxyalkanoates (PHA, PHB)
 - Poly lactide (PLA)
 - Polymethyl methacrylate (Acrylic, PMMA)
 - Polyoxymethylene (Acetal, POM)
 - Polypropylene (PP)
 - Polystyrene (PS)
 - Polytetrafluoroethylene (Teflon, PTFE)
 - Polyurethane (tpPUR)
 - Polyvinylchloride (tpPVC)
 - Starch-based thermoplastics (TPS)
 - Thermosets


Stainless steel

Datasheet view: All properties Show/Hide Find Similar

Metals and alloys > Ferrous >

Description

Image



Caption

1. Siemens toaster in brushed austenitic stainless steel (by Porsche Design) © ANSYS, Inc. 2. Scissors in ferritic stainless steel; it is magnetic, austenitic stainless is not. © ANSYS, Inc.

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Tensile strength	515 - 1.3e3	MPa
Compressive strength	* 252 - 1.2e3	MPa

Exercise 1: Browse material records

The screenshot displays the Granta EduPack 2023 R2 interface for browsing material records. The main window is titled "Polypropylene (PP)" and shows the following content:

Description

Image

Caption

1. Polypropylene samples showing texture and transparency. © Chris Lefteri 2. Polypropylene glasses. © Thinkstock

The material

Polypropylene, PP, first produced commercially in 1958, is the younger brother of polyethylene - a very similar molecule with similar price, processing methods and application. Like PE it is produced in very large quantities (more than 30 million tons per year in 2000), growing at nearly 10% per year, and like PE its molecule-lengths and side-branches can be tailored by clever catalysis, giving precise control of impact strength, and of the properties that influence molding and drawing. In its pure form polypropylene is flammable and degrades in sunlight. Fire retardants make it slow to burn and stabilizers give it extreme stability, both to UV radiation and to fresh and salt water and most aqueous solutions.

Composition (summary)

(CH₂-CH(CH₃))_n

General properties

Density	895	-	909	kg/m ³
Price	* 1.51	-	1.73	EUR/kg
Date first used	1957			

Mechanical properties

Young's modulus	0.824	-	1.02	GPa
Shear modulus	* 0.327	-	0.36	GPa
Bulk modulus	* 0.872	-	0.961	GPa
Poisson's ratio	* 0.422	-	0.465	
Yield strength (elastic limit)	24.1	-	28.4	MPa

The right-hand pane shows a hierarchical tree of material categories under "ProcessUniverse":

- ProcessUniverse
 - Joining
 - Adhesives
 - Flexible adhesives
 - Rigid adhesives
 - Fasteners
 - Mechanical welding
 - Thermal welding
 - Shaping
 - Surface treatment

Exercise 2: Browse process records

Granta EduPack 2023 R2 - [ProcessUniverse\Shaping\Molding\Thermoplastic molding]

File Edit View Select Tools Window Help

Home Browse Search Chart/Select Solver Eco Audit Synthesizer Learn Tools Settings Help

Database: Level 2
Table: ProcessUniverse
Subset: All Processes

ProcessUniverse

- Joining
 - Adhesives
 - Flexible adhesives
 - Rigid adhesives
 - Brazing and Soldering
 - Brazing (>450°C)
 - Soldering (<450°C)
 - Fasteners
 - Mechanical welding
 - Friction welding (metals)
 - Friction-stir weld
 - Ultrasonic welding
 - Thermal welding
 - Ceramics
 - Metals
 - Polymers
- Shaping
 - Additive manufacturing
 - Casting
 - Composite forming
 - Deformation
 - Machining
 - Molding
 - Ceramic molding
 - Thermoplastic molding
 - Blow molding
 - Compression molding
 - Expanded foam molding
 - Injection molding, thermoplastics
 - Polymer extrusion
 - Rotational molding
 - Thermoforming
 - Thermoset molding
 - Powder methods
 - Surface treatment

Injection molding, thermoplastics

Datasheet view: All Processes Show/Hide Find Similar

Shaping > Molding > Thermoplastic molding >

Description

Image




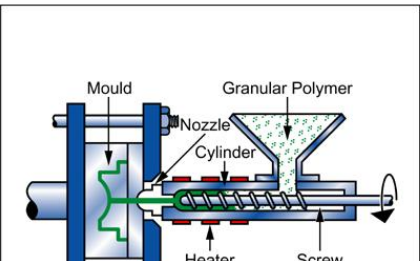
Image caption

(1) Plastic granules © ANSYS, Inc. (2) Injester duroplast © Arburg GmbH (3) Lego building blocks © Alexas_Fotos at Pixabay [Public domain]

The process

Injection molding of thermoplastics is the equivalent of pressure die casting of metals. Molten polymer is injected under high pressure into a cold steel mold. The polymer solidifies under pressure and the molding is then ejected. Various types of injection molding machines exist, but the most common in use today is the reciprocating screw machine (shown schematically). Capital and tooling costs are very high. Production rate can be high particularly for small moldings. Multicavity molds are often used. The process is used almost exclusively for large volume production. Prototype moldings can be made using cheaper single cavity molds of cheaper materials. Quality can be high but may be traded off against production rate. Process may also be used with thermosets and rubbers. Some modifications are required - this is dealt with separately (see Injection Molding - thermosets). Complex shapes are possible, though some features (e.g. undercuts, screw threads, inserts) may result in increased tooling costs.

Process schematic



Granta EduPack 2023 R2 - [ProcessUniverse\Surface treatment\Surface coatings]

File Edit View Select Tools Window Help

Home Browse Search Chart/Select Solver Eco Audit Synthesizer Learn Tools Settings Help

Database: Level 2
Table: ProcessUniverse
Subset: All Processes

ProcessUniverse

- Joining
- Shaping
- Surface treatment
 - Heat treatments
 - Painting and printing
 - Polishing / etching / working / texturing
 - Surface coatings
 - Anodizing
 - Electroless plating
 - Electroplating
 - Hot dip coating (Galvanizing)
 - Metal flame spray
 - Polymer powder coating
 - Vapor metallizing (PVD)

Vapor metallizing (PVD)

Datasheet view: All Processes Show/Hide Find Similar

Surface treatment > Surface coatings >

Description

Image

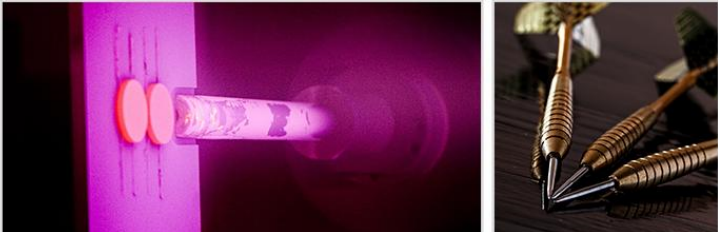


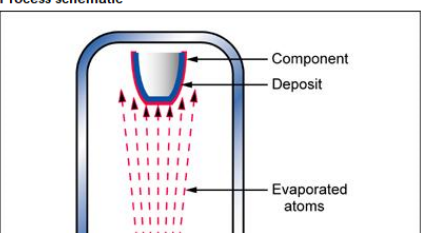
Image caption

(1) Inside the Plasma Spray-Physical Vapor Deposition, or PS-PVD, ceramic powder is introduced into the plasma flame, which vaporizes it and then condenses it on the (cooler) workpiece to form the ceramic coating © NASA/Marvin G. Smith at Wikimedia Commons [Public domain] (2) Physical vapor deposition used in darts © Stevpeb at Pixabay [Public domain]

The process

Mirrors used to be made by a complex process involving silver dissolved in mercury. Today they are made by PVD metallizing, a process in which a thin coating of metal - usually aluminum - is deposited from a vapor onto a component. The vapor is created in a vacuum chamber by direct heating or electron beam heating of the metal, from which it condenses onto the cold component, much like steam from a hot bath condensing on a bathroom mirror. In PVD metallizing there is no potential difference between bath and component. In ion plating the vapor is ionized and accelerated by an electric field (the component is the cathode, and the metallizing source material is the anode). In sputtering, argon ions are accelerated by the electric field onto a metal target, ejecting metal ions onto the component surface. By introducing a reactive gas, compounds can be formed (Ti sputtering in an atmosphere of nitrogen, to give a hard coating of TiN, for instance).

Process schematic



Exercise 2: Browse process records

The screenshot displays the Granta EduPack 2023 R2 software interface, showing two windows side-by-side. The left window is titled ':PROJECT MATERIALS - Granta EduPack 2023 R2 - [ProcessUniverse:Joining\Mechanical welding]'. The right window is titled ':PROJECT MATERIALS - Granta EduPack 2023 R2 - [Gravity die casting - Links]'. Both windows show a 'Browse' panel on the left with a tree view of process categories. The main area of the left window displays 'Friction welding (metals)' with a description, three images, and a process schematic. The right window displays 'Gravity die casting - Links' with a list of material categories.

Friction welding (metals)

Description

Image

Image caption

(1) A rotatory friction welding machine © Thompson Friction Welding (2) Friction welding process in action © TWI Ltd at flickr (3) Linear friction welded blisk © TWI Ltd at flickr

The process

In friction welding, one component is rotated or vibrated at high speed, forced into contact with the other, generating frictional heat at the interface, and - when hot - the two are forged together. In direct drive friction welding, the motor is connected to the work piece and starts and stops with each operation. In inertial friction welding, the motor drives a fly wheel that is disconnected from the motor to make the weld. In friction stir welding a non-consumable rotating tool is pushed onto the materials to be welded. The central pin and shoulder compact the two parts to be joined, heating and plasticizing the materials. As the tool moves along the joint line, material from the front of the tool is swept around to the rear, eliminating the interface. The weld quality is excellent (as good as the best fusion welds), and the process is environmentally friendly.

Process schematic

Gravity die casting - Links

MaterialUniverse

- Brass
- Bronze
- Cast Al-alloys
- Cast magnesium alloys
- Metals and alloys

Exercise 3: Searching

Granta EduPack 2023 R2 - [MaterialUniverse\Polymers and elastomers\Polymers\Thermoplastics]

Search: polylactide

Database: Level 2

MaterialUniverse (1)

- Polylactide (PLA)

Producers (1)

- NatureWorks LLC


Poly lactide (PLA)

Datasheet view: All properties

Polymers and elastomers > Polymers > Thermoplastics >

Description

Image



Caption

- Shopping Bag made of PLA-Blend Bio-Flex © F. Kesselring, FKUR Willich at Wikimedia Commons (CC BY-SA 3.0)
- Mulch Film made of PLA-Blend Bio-Flex © F. Kesselring, FKUR Willich at Wikimedia Commons (CC BY-SA 3.0)
- Blow film PLA-Blend Bio-Flex © F. Kesselring, FKUR Willich at Wikimedia Commons (CC BY-SA 3.0)

The material

Poly lactide, PLA, is a biodegradable thermoplastic derived from natural lactic acid from corn, maize or milk. It resembles clear polystyrene, provides good aesthetics (gloss and clarity), but it is stiff and brittle and needs modification using plasticizers for most practical applications. It can be processed like most thermoplastics into fibers, films, thermoformed or injection molded.

Composition (summary)

$(CH(CH_3)CO_2)_n$. The lactic acid is produced from sugar (dextrose) with plant starch origins e.g. corn, wheat, sugar beets and sugar cane.

General properties

Density	1.2e3	- 1.29e3	kg/m ³
Price	* 2.66	- 3.38	EUR/kg
Date first used	1993		

Mechanical properties

Young's modulus	3.3	- 3.6	GPa
Shear modulus	* 0.902	- 1.35	GPa
Bulk modulus	* 2.35	- 3.53	GPa
Poisson's ratio	* 0.38	- 0.4	
Yield strength (elastic limit)	45	- 72	MPa

Granta EduPack 2023 R2 - [ProcessUniverse\Shaping\Composite forming\Advanced composite forming processes]

Search: Vacuum Assisted RTM

Database: Level 2

ProcessUniverse (1)

- Vacuum assisted resin transfer molding (VARTM)

Vacuum assisted resin transfer molding (VARTM)

Datasheet view: All Processes

Shaping > Composite forming > Advanced composite forming processes >

Description

Image

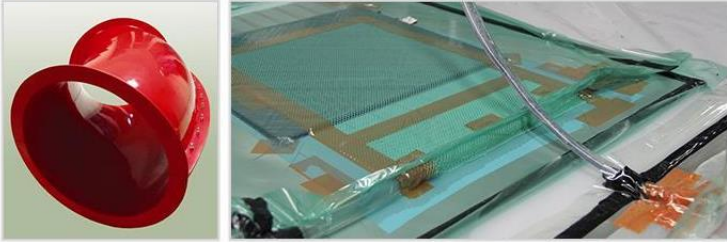


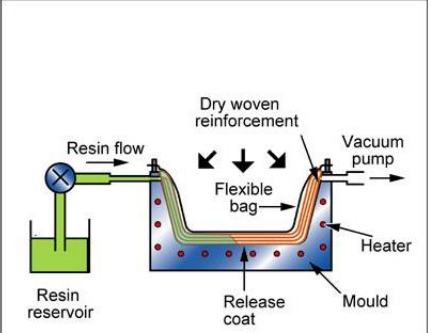
Image caption

- Water slide part produced by Resin Transfer Molding (RTM) © Brittany Hagen at Wikimedia Commons (CC BY 3.0)
- Vacuum assisted composite © ANSYS, Inc. at TU Delft University

The process

Vacuum Assisted Resin Transfer Molding (VARTM) is a low-cost tooling way of manufacturing large complex shapes of composite materials. Reinforcement is placed in the mold in the form of layers of dry, woven fabric. This is covered by a peel ply and the whole lot is vacuum bagged. Resin is released and sucked into the bag by the vacuum, flowing through and impregnating the fabric, which is then cured.

Process schematic



Exercise 3: Searching

Tungsten carbides

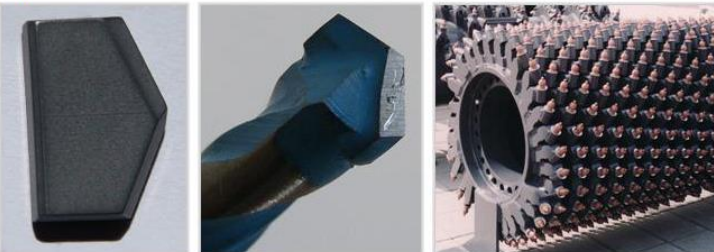
Database: Level 2

cutting tools

- MaterialUniverse (9)
 - Tungsten carbides
 - Technical ceramics
 - High carbon steel
 - Zirconia
 - Alumina
 - Stainless steel
 - Epoxies (EP)
 - Silicon nitride
 - Cellulose polymers (CA)
- ProcessUniverse (19)
- Producers (3)
- Reference (1)

Description

Image



Caption

1. Tungsten carbide **tool** tip © Hi-Res Images of Chemical Elements at Wikimedia Commons (CC BY 3.0) 2. C Masonry © Byrev at Pixabay [Public domain] 3. Tungsten Carbide tipped cutter drum of a road recycler © Dw1 Wikimedia Commons (CC BY-SA 3.0)

The material

Tungsten carbide (WC) is most commonly used in the form of a 'cemented' carbide, or cermet: particles of WC by a small amount (5-20%) of metallic binder, usually cobalt. Its exceptional hardness and stability make it an attractive material when wear resistance is essential. Properties depend on grain size and shape and the prop carbide to metal. Cermets are expensive but, as **cutting tools**, they survive **cutting** speeds 10 times those of the **tool** steel. Shaping is usually done by pressing, sintering and then grinding; the **tool** bit is brazed to a shank or made from a cheaper steel. Cermets can be vapor-coated with titanium nitride to improve wear resistance even further.

Composition (summary)

WC/ 2 - 10%Co

General properties

Density	①	1.53e4	-	1.59e4	kg/m ³
Price	①	* 17.4	-	27.1	EUR/kg
Date first used	①	1923			

Mechanical properties

Young's modulus	①	600	-	670	GPa
Shear modulus	①	* 243	-	271	GPa
Bulk modulus	①	* 350	-	400	GPa
Poisson's ratio	①	0.2	-	0.22	

concrete

Database: Level 2

- MaterialUniverse (12)
 - Concrete
 - Cement
 - Plaster of Paris
 - Non-technical ceramics
 - Low carbon steel
 - Granite
 - Bamboo
 - Polyester (UP)
 - Hardwood: oak, across grain
 - Hardwood: oak, along grain
 - Softwood: pine, across grain
 - Softwood: pine, along grain
- ProcessUniverse (1)
- Producers (3)
- Reference (8)

Concrete

Database: Level 2


Concrete

Database: Level 2

ceramics and glasses > Non-technical ceramics > Cement and **concrete**

Description

Image



Caption

1. **Concrete** texture. © Dave Morris at Flickr - (CC BY 2.0) 2. **Concrete** blocks. © iStockphoto 3. Reinforced **concrete**, Sydney opera house. © John Fernandez

The material

Concrete is a composite, and a complex one. The matrix is cement; the reinforcement, a mixture of sand and gravel ('aggregate') occupying 60-80% of the volume. The aggregate increases the stiffness and strength and reduces the cost (aggregate is cheap). **Concrete** is strong in compression but cracks easily in tension. This is countered by adding steel reinforcement in the form of wire, mesh or bars (rebar), often with surface contours to key it into the **concrete**; reinforced **concrete** can carry useful loads even when the **concrete** is cracked. Still higher performance is gained by using steel wire reinforcement that is pre-tensioned before the **concrete** sets. On relaxing the tension, the wires pull the **concrete** into compression; the **concrete** does not crack until the loads applied to it overcome this compression stress (pre-stressed **concrete**).

Composition (summary)

6:1:2:4 Water:Portland cement:Fine aggregate:Coarse aggregate

General properties

Density	①	2.2e3	-	2.6e3	kg/m ³
Price	①	* 0.0373	-	0.056	EUR/kg
Date first used	①	1756			

Mechanical properties

Young's modulus	①	15	-	25	GPa
Shear modulus	①	* 6.5	-	10.9	GPa
Bulk modulus	①	* 7.1	-	11.9	GPa
Poisson's ratio	①	0.4	-	0.2	

Exercise 3: Searching

Granta EduPack 2023 R2 - [MaterialUniverse\Ceramics and glasses\Technical ceramics]

File Edit View Select Tools Window Help

Home Browse Search Chart/Select Solver Eco Audit Synthesizer Learn Tools Settings Help

Search Database: Level 2 alum*

MaterialUniverse (36)

- Alumina
- Aluminum/Silicon carbide composite
- Aluminum nitride
- Non age-hardening wrought Al-alloys
- Age-hardening wrought Al-alloys
- Cast Al-alloys
- Sandstone
- Granite
- Slate
- Metal foam
- Ceramic foam
- Printed wiring board (for desktop)
- Foams
- Printed wiring board (for laptop)
- Brick
- Wrought magnesium alloys
- Cast magnesium alloys
- Cement
- Bronze
- Titanium alloys
- Technical ceramics
- Nickel-based superalloys
- Sheet molding compound, SMC, polyester matrix
- Glass ceramic
- Silver
- Non-technical ceramics
- Silicon
- Dough (Bulk) molding compound, DMC (BMC), polyester matrix
- Brass
- Commercially pure titanium
- Commercially pure zinc
- Zinc die-casting alloys
- Silicon nitride
- Copper
- Cellulose polymers (CA)
- Polytetrafluoroethylene (Teflon, PTFE)


Alumina

Datasheet view: All properties Show/Hide Find Similar

Ceramics and glasses > Technical ceramics >

Description

Image



Caption

- Alumina components for wear resistance and for high temperature use. © Kyocera Industrial Ceramics Corp.
- Alumina spark plug insulator. © Norris Wong at Flickr - (CC BY 2.0)
- Alumina insulator of a spark plug broken open. © Industry_shill at en.wikipedia - Public domain

The material

Alumina (Al₂O₃) is to technical ceramics what mild steel is to metals - cheap, easy to process, the workhorse of the industry. It is the material of spark plugs, electrical insulators and ceramic substrates for microcircuits. In single crystal form it is sapphire, used for watch faces and cockpit windows of high-speed aircraft. More usually it is made by pressing and sintering powder, giving grades ranging from 80 to 99.9% alumina - the rest is porosity, glassy impurities or deliberately added components. Pure aluminas are white; impurities make them pink or green. The maximum operating temperature increases with increasing alumina content. Alumina has a low cost and a useful and broad set of properties: electrical insulation, high mechanical strength, good abrasion and temperature resistance up to 1650 C, excellent chemical stability and moderately high thermal conductivity, but it has limited thermal shock and impact resistance. Chromium oxide is added to improve abrasion resistance; sodium silicate, to improve processability but with some loss of electrical resistance. Competing materials are magnesia, silica and borosilicate glass.

Composition (summary)

Al₂O₃ (97% purity), often with some porosity and some glassy phase.

General properties

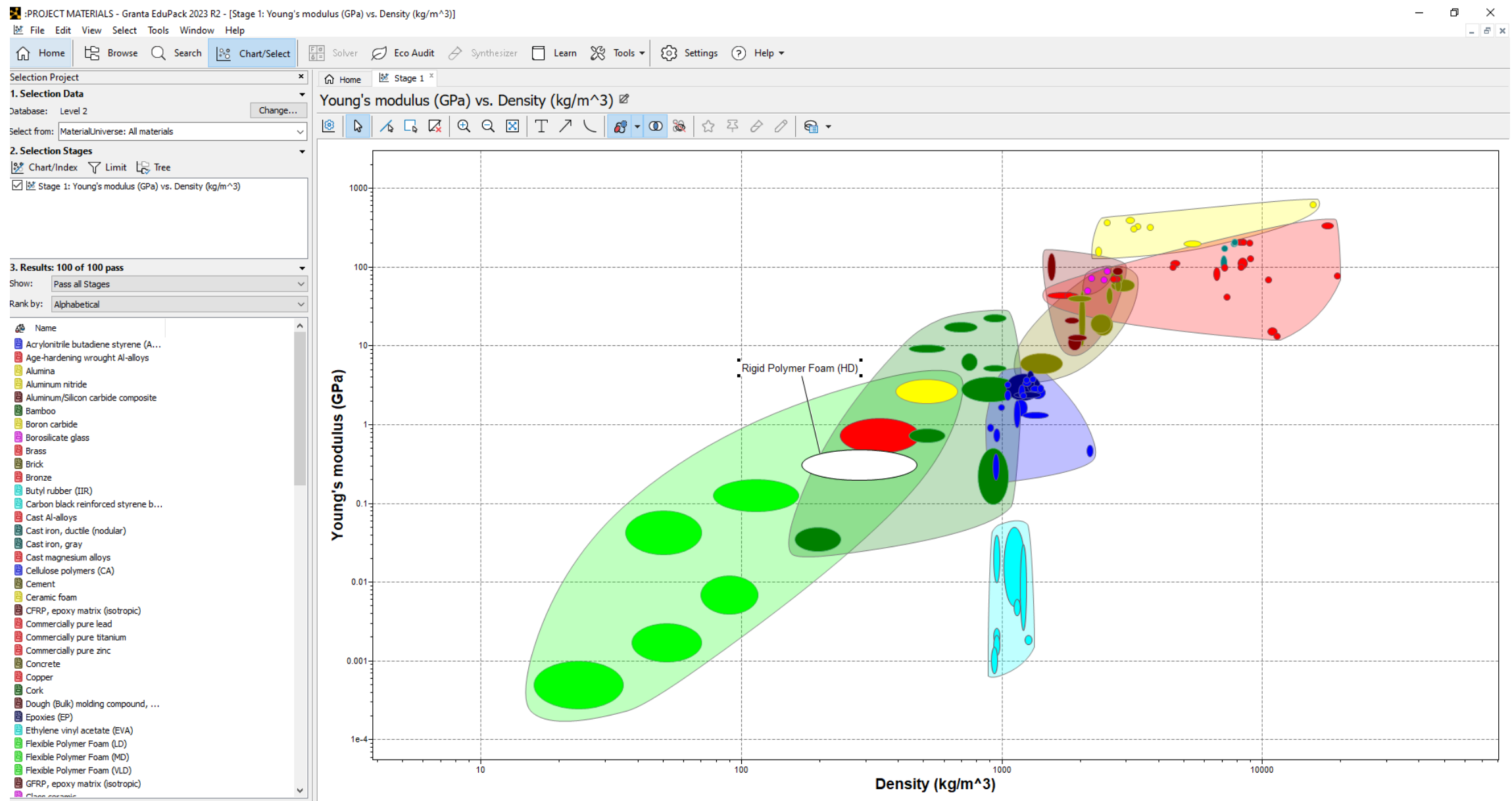
Density	3.66e3 - 3.74e3	kg/m ³
Price	* 17 - 25.5	EUR/kg
Date first used	1914	

Mechanical properties

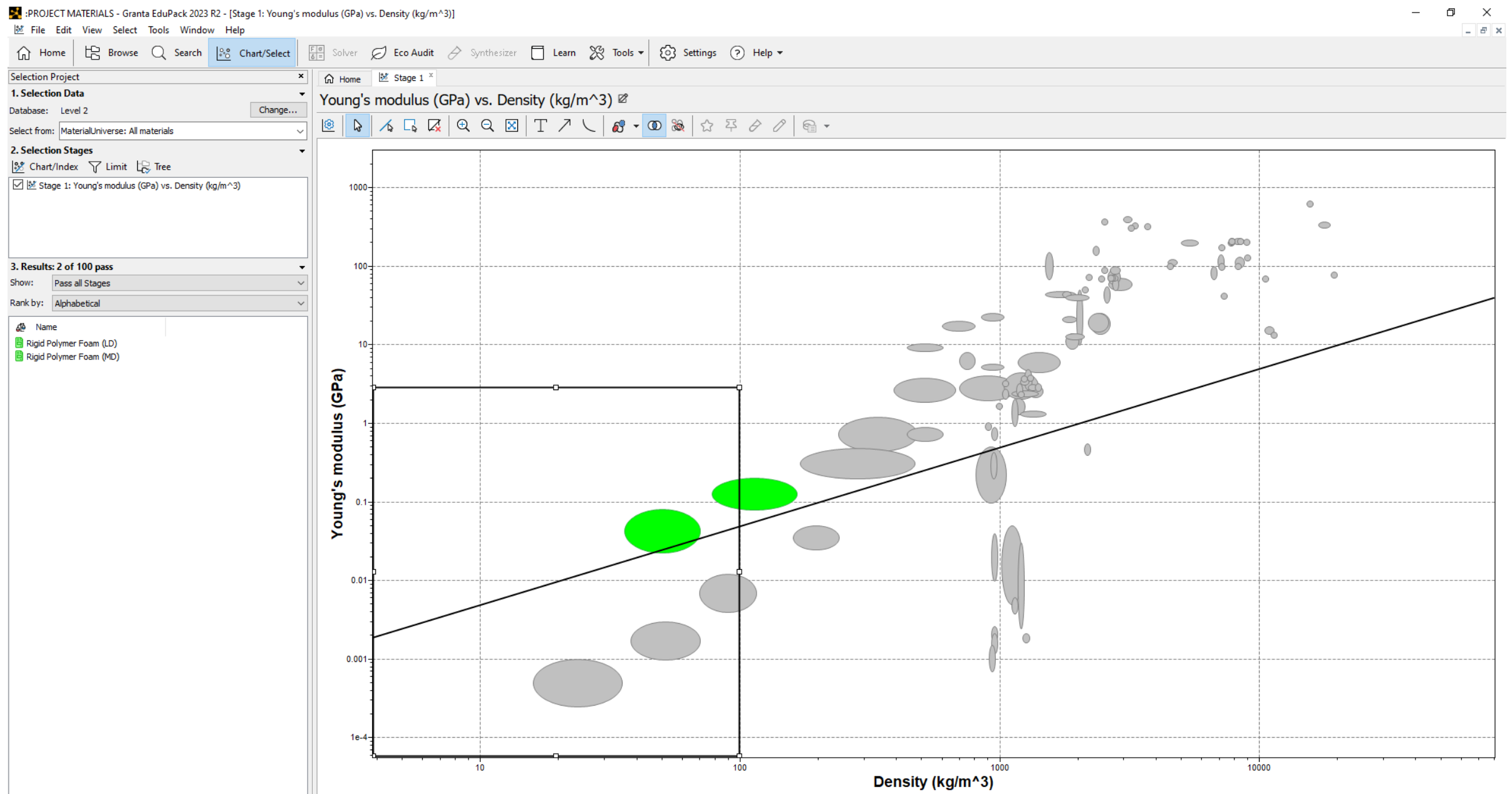
Exercise 4: Creating property charts



Exercise 5: Creating bubble charts



Exercise 6: Filtering and Screening - Selection using a Chart Stage



Exercise 7: Selection using a Limit Stage/Tree stage

The image displays two screenshots of the Granta EduPack 2023 R2 software interface, illustrating the 'Limit' stage configuration and results.

Left Screenshot: Limit Stage Configuration

- Project Name:** :PROJECT MATERIALS - Granta EduPack 2023 R2 - [Stage 1: Maximum service temperature AND Thermal conductivity AND Electrical resistivity]
- Stage 1:** Maximum service temperature AND Thermal conductivity AND Electrical resistivity
- Logic between attributes for this stage:** AND
- Results:** 3 of 100 pass
- Materials List:** Alumina, Aluminum nitride, Silicon nitride

Right Screenshot: Limit Stage Configuration

- Project Name:** :PROJECT MATERIALS - Granta EduPack 2023 R2 - [Stage 1: Limit]
- Stage 1:** Limit
- Logic between attributes for this stage:** AND
- Results:** 100 of 100 pass
- Materials List:** Acrylonitrile butadiene styrene (A...), Age-hardening wrought Al-alloys, Alumina, Aluminum nitride, Aluminum/Silicon carbide composite, Bamboo, Boron carbide, Borosilicate glass, Brass, Brick, Bronze, Butyl rubber (IIR), Carbon black reinforced styrene b..., Cast Al-alloys, Cast iron, ductile (nodular), Cast iron, gray, Cast magnesium alloys, Cellulose polymers (CA), Cement, Ceramic foam, CFRP, epoxy matrix (isotropic), Commercially pure lead, Commercially pure titanium, Commercially pure zinc, Concrete, Copper, Cork, Dough (Bulk molding compound, ...), Epoxies (EP), Ethylene vinyl acetate (EVA), Flexible Polymer Foam (LD), Flexible Polymer Foam (MD), Flexible Polymer Foam (VLD), GFRP, epoxy matrix (isotropic)

Durability: acids Table (from right screenshot):

Acid	Acceptable	Excellent
Acetic acid (10%)		
Acetic acid (glacial)		
Citric acid (10%)		
Hydrochloric acid (10%)		
Hydrochloric acid (36%)		
Hydrofluoric acid (40%)		
Nitric acid (10%)		
Nitric acid (70%)		
Phosphoric acid (10%)		
Phosphoric acid (85%)		
Sulfuric acid (10%)		
Sulfuric acid (70%)		

Exercise 7: Selection using a Limit Stage/Tree stage

The screenshot displays the Granta EduPack 2023 R2 interface for a selection project. The main window is titled ':PROJECT MATERIALS - Granta EduPack 2023 R2 - [Stage -1: Ferrous alloys, Joining]'. The interface is divided into several panes:

- Selection Project:** Shows the current stage as 'Stage 1' and the project name 'Ferrous alloys, Joining'.
- 1. Selection Data:** Database: Level 2, Select from: MaterialUniverse: All materials.
- 2. Selection Stages:** Includes 'Chart/Index', 'Limit', and 'Tree' options. 'Stage 1: Ferrous alloys, Joining' is selected.
- 3. Results: 99 of 100 pass:** Shows 'Pass all Stages' and 'Rank by: Alphabetical'. A list of materials is visible, including Acrylonitrile butadiene styrene (A...), Age-hardening wrought Al-alloys, Alumina, Aluminum nitride, Aluminum/Silicon carbide composite, Bamboo, Boron carbide, Borosilicate glass, Brass, Brick, Bronze, Butyl rubber (IIR), Carbon black reinforced styrene b..., Cast Al-alloys, Cast iron, ductile (nodular), Cast iron, gray, Cast magnesium alloys, Cellulose polymers (CA), Cement, Ceramic foam, CFRP, epoxy matrix (isotropic), Commercially pure lead, Commercially pure titanium, Commercially pure zinc, Concrete, Copper, Cork, Dough (Bulk) molding compound, ..., Epoxies (EP), Ethylene vinyl acetate (EVA), Flexible Polymer Foam (LD), Flexible Polymer Foam (MD), Flexible Polymer Foam (VLD), GFRP, epoxy matrix (isotropic), and Glass ceramic.
- Link Record:** A table showing the number of records that passed each stage:

Link Record	Number Passed
MaterialUniverse: \ Metals and alloys \ Ferrous 7	Show
ProcessUniverse: \ Joining	99 Show

The second window, titled ':PROJECT MATERIALS - Granta EduPack 2023 R2 - [Stage -1: Ferrous alloys]', shows the next stage:

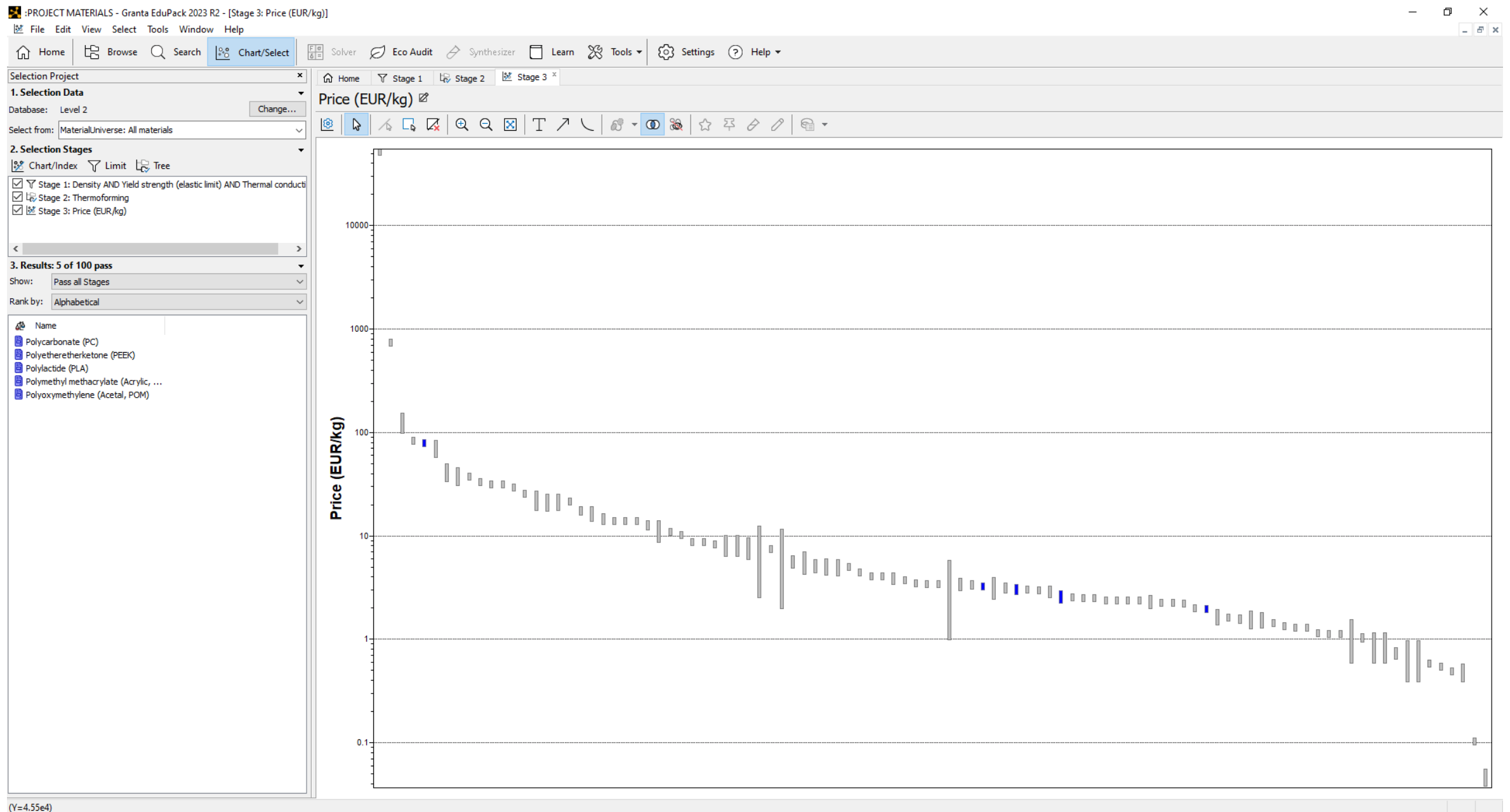
- Selection Project:** Shows the current stage as 'Stage 2' and the project name 'Ferrous alloys'.
- 1. Selection Data:** Database: Level 2, Select from: MaterialUniverse: All materials.
- 2. Selection Stages:** Includes 'Chart/Index', 'Limit', and 'Tree' options. 'Stage 1: Molding' and 'Stage 2: Ferrous alloys' are selected.
- 3. Results: 0 of 100 pass:** Shows 'Pass all Stages' and 'Rank by: Alphabetical'. The results list is empty.
- Link Record:** A table showing the number of records that passed each stage:

Link Record	Number Passed
MaterialUniverse: \ Metals and alloys \ Ferrous 7	Show

A 'Cell Contents' window is open on the right, showing 7 out of 100 records in a cell. The records are:

- Cast iron, ductile (nodular)
- Cast iron, gray
- High carbon steel
- Low alloy steel
- Low carbon steel
- Medium carbon steel
- Stainless steel

Exercise 8: Combining filtering and charting tools



(Y=4.55e4)

Assignment 5 Materials and manufacturing processes

- Select a product type such as a rubbish bin or a chair that can be placed in different environments
- such as indoor or outdoor.
- Propose 2 different materials and manufacturing process to suit the two different environments.
- Provide a rational for both

Lighting – Material and manufacturing process

Indoor Lighting

Materials	Manufacturing process
<u>Metal</u> (aluminum, steel, and brass) used for frame, different coatings for aesthetic appeals.	<u>Sheet stamping</u> <ul style="list-style-type: none">• Sheets cut into blanks of the desired size and shape.• Design and create dies and tools to shape the metal.• Configure the press machine with the necessary dies and adjust setting.• Place between upper and lower dies• Apply force to the blank to shape it using the dies• Trim excess material. <u>Die casting</u> <u>Cutting</u> <u>Joining</u> <u>Seam welding</u>
<u>Glass</u> clear, frosted, coloured, and textured	<u>Glass blow molding</u> <ul style="list-style-type: none">• Shaped using tools and molds.• Air is blown into pipe to expand and hollow out the glass• Adjust and shape to achieve desired shape• Place the glass in a kiln to cool and strengthen it.

Lighting – Material and manufacturing process

Outdoor Lighting

Materials	Manufacturing process
<p><u>Metal</u> (aluminum, steel, and brass) durable, withstand outdoor conditions, treated with protective finishes, UV-resistant coating.</p>	<p><u>Sheet stamping</u></p> <ul style="list-style-type: none">• Sheets cut into blanks of the desired size and shape.• Design and create dies and tools to shape the metal.• Configure the press machine with the necessary dies and adjust setting.• Place between upper and lower dies• Apply force to the blank to shape it using the dies• Trim excess material. <p><u>Die casting</u></p> <p><u>Cutting</u></p> <p><u>Joining</u></p> <p><u>Seam welding</u></p>
<p><u>Plastic</u> resistant rust and corrosion, not as durable as metal, lightweight and easy to install, affordably.</p>	<p><u>Glass blow molding</u></p> <ul style="list-style-type: none">• Extrusion• Parison formation• Blow molding• Cooling• Mold opening• Ejection• Trimming

Assignment 6 Single use plastic



- Select two 'single use' item from your list.
- Choose an alternative material (with less negative environmental impact)
- Justify your selection 2-5 lines on each.

Tampon applicator - Single use plastic

Original – Polypropylene (PP)
contribute to plastic waste



Alternatives – bio-gradable
and renewable sugar cane



- Sugar cane tampon applicators are made from natural and renewable plant-based materials that are biodegradable and eco-friendly.
- Sugar cane tampon applicators have a smooth and rounded tip that allows for easy and comfortable.
- Sugar cane tampon applicators are free of pesticides, dioxins, fragrance, chlorine, and other harmful chemicals that can irritate the sensitive vaginal area.

Tampon applicator - Single use plastic

Original – Polypropylene (PP)
contribute to plastic waste



Alternatives – cardboard



- Cheaper and more accessible than plastic applicators, as they use less materials and are easier to manufacture.
- Cardboard tampon applicators are biodegradable and environmentally friendly.
- Safer and healthier for the vagina, as they do not contain any plastic, chemicals or synthetic materials.

Dental floss - Single use plastic

Original – nylon fibers, which are woven together to form a thin, durable, and flexible thread



Alternatives – pure silk



- Silk dental floss is soft and smooth, making it gentle on the gums. This can be particularly beneficial for individuals with sensitive gums or those prone to gum irritation.
- Silk is a natural fiber, and silk dental floss is often biodegradable
- Silk is known for its strength, and silk dental floss is generally durable - effectively removing plaque and debris from between teeth without easily fraying or breaking.

Materials Design Database Project

Brief

- Choose a product from the design database.
- Step 1: Explain the design and why I picked the material, finish and process.
- Step 2: Change the material and process but keep the same design. Create some sketches and small models to show my ideas. Pick one idea and make a bigger model with card, wire or foam. It should be no bigger than 300mm x 300mm x 300mm.
- Step 3: Change the material, process and design. Show this with sketches and small models to show my ideas. Pick one idea and make a bigger model with card, wire or foam. It should be no bigger than 300mm x 300mm x 300mm.
- Present a character, aesthetics, the function, environment and required material properties for each design.

Part 1

Traffic cone by Swintex

Character Analysis

Context:

A traffic cone by Swintex is a type of road safety device that is used to mark hazards, divert traffic, or create temporary barriers. The context of a traffic cone is that it is a cone-shaped object that is usually red and white or yellow, used to keep vehicles away from an area of road temporarily, usually because repairs are being done to it. Traffic cones are also called pylons, witches' hats, road cones, highway cones, safety cones, channelizing devices, construction cones, or just cones. Traffic cones is made of recycled PVC and have a reflective sleeve for visibility at night.



Usability:

- A traffic cone is a cone-shaped marker that is used to redirect traffic or pedestrians in a safe manner. Traffic cones can have different colors and sizes, depending on their purpose and the speed of the road they are used on. Traffic cones are made of plastic or rubber, and usually have a reflective collar for nighttime visibility.
- Traffic cones are versatile and useful tools for creating safe and efficient environments. However, they should be used properly and according to the rules of the road. Placing traffic cones on the road without authorization or for personal reasons is illegal and dangerous. If you carry traffic cones in your vehicle, you can use them to alert other drivers to keep a distance if your car breaks down, especially if you are changing a tire. However, you should always call for roadside assistance or emergency services if you need help.

Traffic cone by Swintex

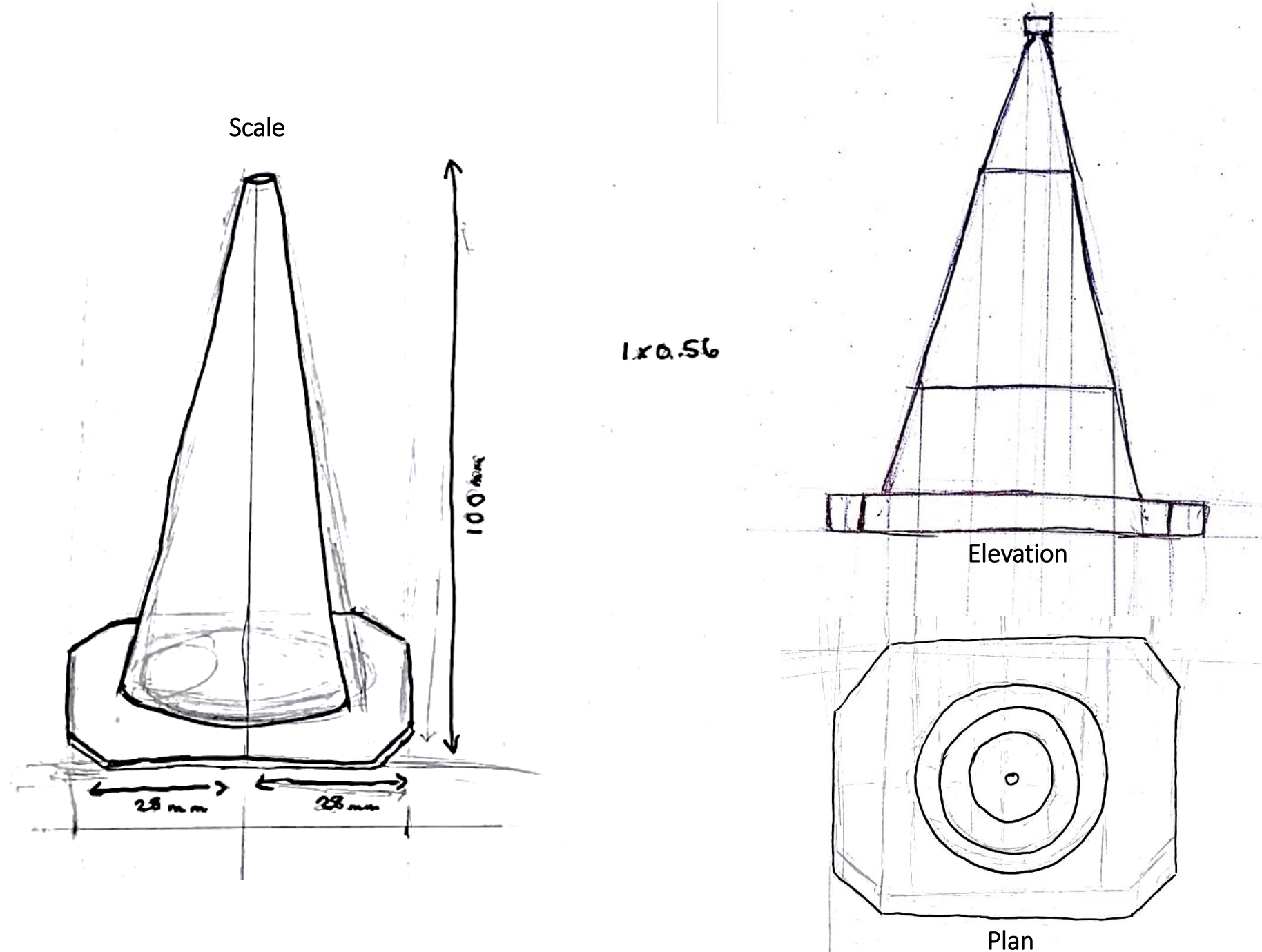
Personality:

- Reflective band – visibility
- Durable construction
- Stackable design
- Weighted base – stability, preventing them to being knocked over
- Various size- specific requirements and requirements
- Withstand various weather conditions
- Lightweight
- Bright colour – easily distinguishable

Materials:

Polyethylene

PVC (recycled)



Material Properties

Polyethylene

Colour: Bright colours for high visibility, easily colouring

Mechanical: Makes them durable withstanding challenging conditions of road use.

Physical: Must be lightweight making easy to transport and set up.

Flexibility: Polyethylene allows traffic cone to bend upon impact and return to its original shape

Weather resistance: Resistant to moisture, which helps cones endure various weather conditions without degrading

Impact resistance: Withstand bumped or run over by vehicles.

UV resistance: Must maintain its colour and structural integrity.



PVC with anti-slip feature

Mechanical: PVC is flexible, durable, and weather-resistant, making it suitable for outdoor use.

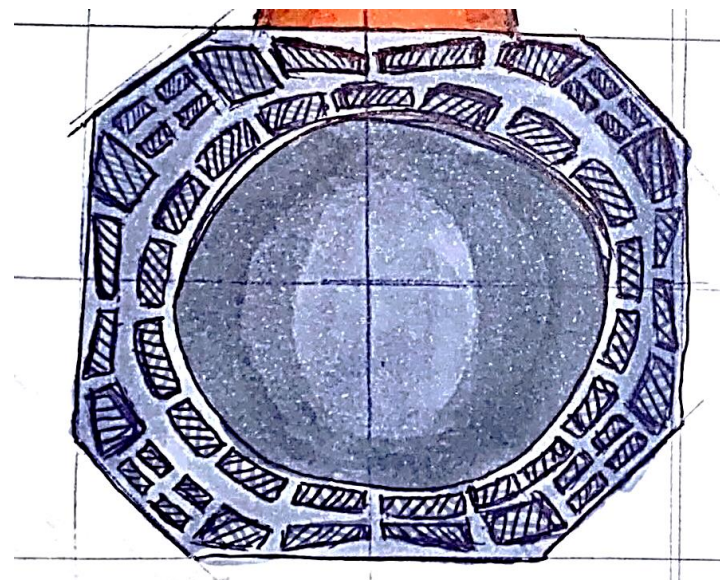
Physical: PVC can be molded into various shapes and sizes and can be colored with pigments or reflective materials. PVC has a low density and a low melting point, which makes it lightweight and easy to carry.

Flexibility: PVC can bend or flex if struck by a vehicle, reducing the risk of damage to the cone or the vehicle.

Environmental: PVC can be recycled and reused, which reduces the environmental impact of waste disposal.

Manufacturing Process

A Swintex traffic cone is a type of traffic cone that is manufactured by Melba Swintex, a UK-based company that specialises in temporary traffic management products. According to their website, the Swintex traffic cone is made through a combination of different moulding techniques. The base of the cone is compression moulded from bits of shredded tyres, which gives it durability and stability. The top of the cone is blow moulded from plastic, which makes it lightweight and flexible. The two parts are then co-injection moulded together, with connector elements gripping apertures in the base. This ensures a strong bond between the base and the top. The cone is also fitted with reflective sleeves for visibility. The Swintex traffic cone is designed to meet the British Standard BS EN 13422:20042



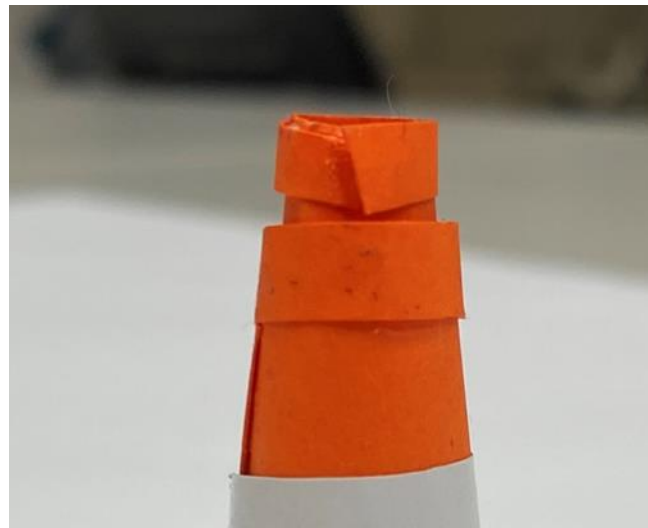
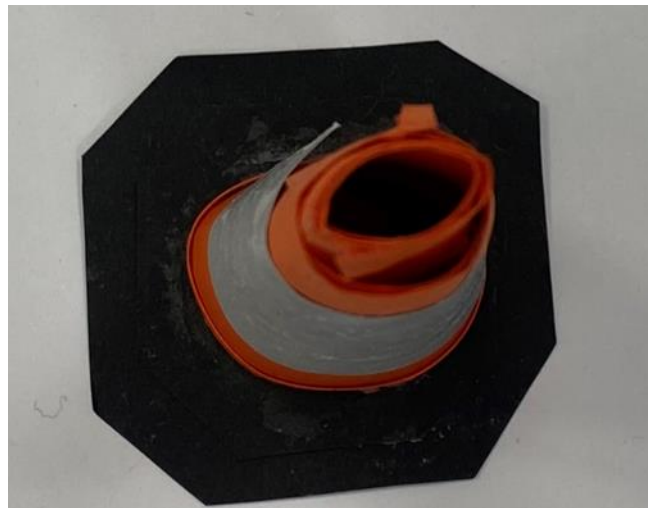
ORIGINAL CONE WITH
GRIPPER PROPERTIES
IMPORTANT TO EXPLORE
AND KEEP DEPENDING ON
MATERIAL

Questions:

- How to make it lightweight?
- How to make it stay in place?
- How will endure weather conditions?



I used colored paper to craft the original traffic cone. The choice of colored paper enhanced the visual appeal, with the body in orange and the base in black. For a white, glossy element of the luminated cover they use. I repurposed an old photocopy cover, with a glossy finish.



Part 2

Picking a New Material

Metal (aluminium)

Sturdy, durable and long lasting

Aluminum has a highly reflective surface, which is an important property for a roadside barrier. This could enhance the visibility of the cones, especially in low light conditions.

Aluminum is known for its durability, which could make the traffic cones more resistant to wear and tear.

Aluminum is easy to fabricate, which could allow for efficient production of traffic cones.

Aluminum increases strength in cold environments, which could be beneficial in colder climates.

Aluminum is non-toxic and recyclable¹, making it an environmentally friendly choice.

Aluminum has a pleasing aesthetic appearance, which could enhance the overall look of the traffic cones.

Lightweight Aggregate

Sturdy, durable and long lasting, lightweight

Lightweight concrete has a lower density, ranging between 300 and 1200 kg/m³¹. This could make the traffic cones easier to transport and handle.

Despite its reduced weight, lightweight concrete has a high compressive strength in relation to its density. This could result in traffic cones that are robust and long-lasting.

Pose a lower risk of causing damage to vehicles that encounter them, making them safer in the event of minor accidents.

They can still withstand the rigors of daily use in various weather conditions. They are less prone to cracking or breaking compared to some plastics.

Bamboo

Lightweight, durable, eco-friendly.

Bamboo is one of the fastest-growing plants in the world. This makes it a highly renewable resource.

Bamboo is known as the strongest woody plant in the world due to its high weight-to-strength ratio. This could potentially make bamboo traffic cones sturdy and durable.

Bamboo has good elastic properties, which could help the cones withstand impact without breaking. Bamboo is economical and easy to use compared to other types of construction materials. This could potentially make bamboo traffic cones more cost-effective.

Bamboo is easier for transportation and construction, which could simplify the manufacturing and distribution process.

Picking a New Material

Carbon fibre

Carbon fiber significantly reduces the weight of objects, making it ideal for weight reduction applications. This could make the traffic cones easier to transport and set up.

Carbon fiber offers a lightweight alternative to metal while maintaining superior strength and durability. This could make the traffic cones more robust and long-lasting.

Carbon fiber has superior fatigue properties compared to metal, meaning components made of carbon fiber won't wear out as quickly under the stress of constant use.

Carbon fiber will expand or contract much less in hot or cold conditions than materials like steel and aluminum. This could be beneficial in varying weather conditions.

Wood

Wood is a renewable resource, which could make wooden traffic cones a more environmentally friendly option.

Wooden traffic cones could potentially offer a unique and aesthetically pleasing alternative to traditional traffic cones.

Certain types of wood are very durable and could potentially withstand the elements well.

Unlike plastic or metal, wood is biodegradable, which could reduce environmental impact when the cones are no longer usable.

Wood cones can be lightweight, making them easy to transport and handle, especially for temporary or low-traffic situations.

Silicone

Silicone is known for its flexibility, which could make the traffic cones more resistant to impact and less likely to be damaged by vehicles.

Silicone is resistant to weathering, ozone, radiation, and temperature extremes. These properties could make silicone traffic cones more durable in various environmental conditions.

Silicone can be made in bright colors, which is an important property for a roadside barrier.

Silicone resists high temperatures, which could be beneficial in hot climates.

Non-slip surface.

Environmental benefits.

Phosphorescent Paint

Phosphorescent paints are special types of paints that contain phosphorescent pigments. These pigments absorb and store light energy when exposed to a light source and then slowly release that energy in the form of visible light over an extended period, creating a glow-in-the-dark effect. This is different from fluorescence, which involves immediate emission of light upon exposure to light.

Absorption of Light: When phosphorescent paint is exposed to light, the phosphorescent pigments in the paint absorb photons (light energy).

Emission of Light: When the ambient light diminishes, the stored energy is slowly released in the form of visible light. This is what creates the glowing effect in the dark.

Bamboo Cone

Hot Pressing and Gluing

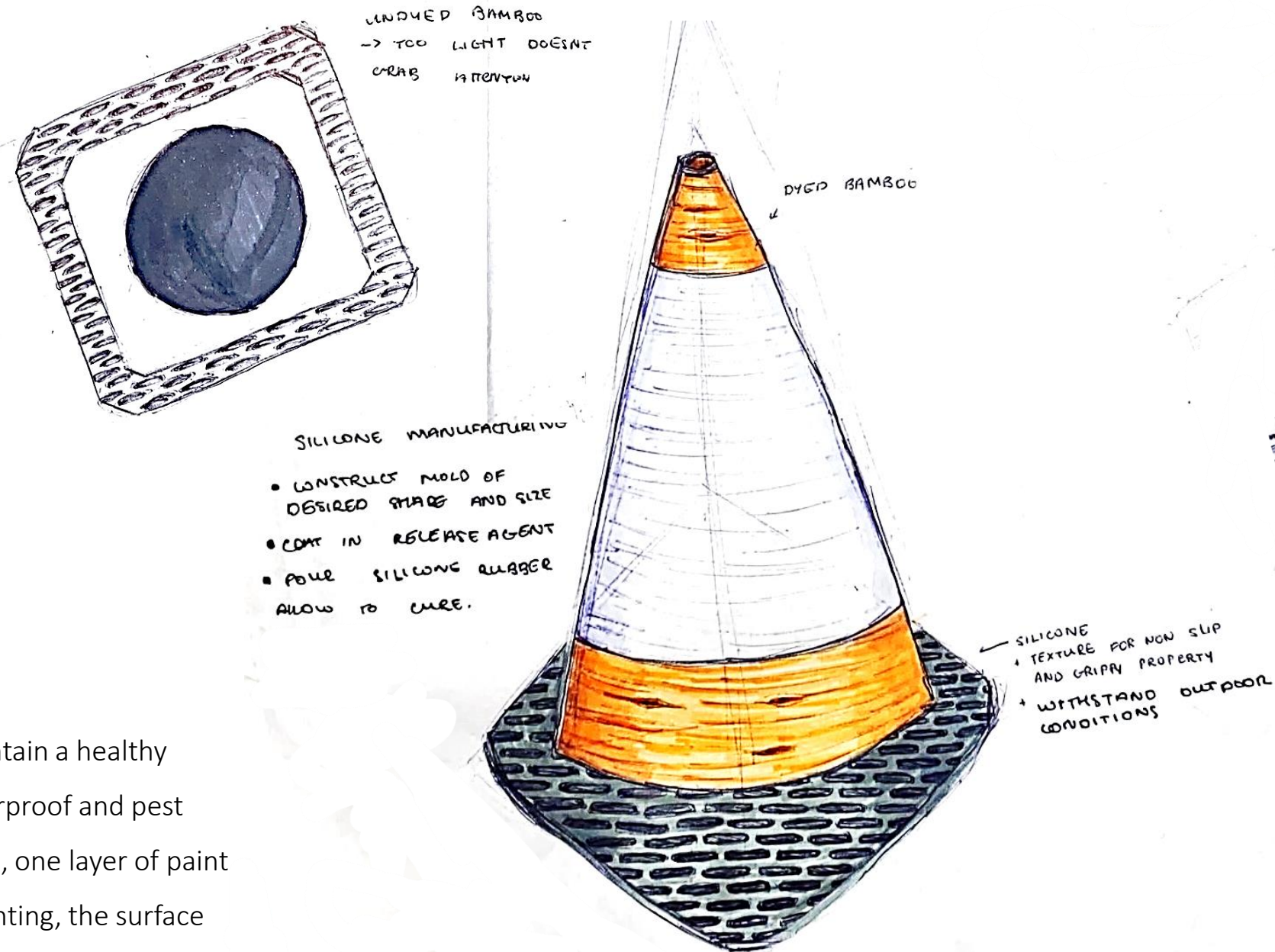
Glue spreading and blank assembling: select high-quality environment-friendly adhesive, glue and evenly spread according to the specified glue spreading amount, and then assemble bamboo strips into cone shapes according to the required specifications.

Sanding

The surface of the blank plate is treated to make the surface smooth, and the plain plate is fixed in thickness.

Painting

High-quality Phosphorescent paint can not only maintain a healthy home environment, but also achieve aesthetic, waterproof and pest corrosion prevention. To ensure good paint adhesion, one layer of paint must be sanded, and after repeated sanding and painting, the surface can be ensured to be smooth, flat and free of bubbles



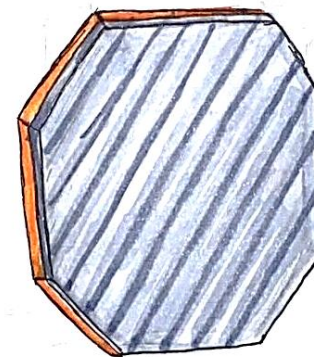
Aggregate cone

To make a cone shape out of concrete, you will need a mold. A mold is a hollow container that is used to give shape to molten to hot liquid material when it cools and hardens.

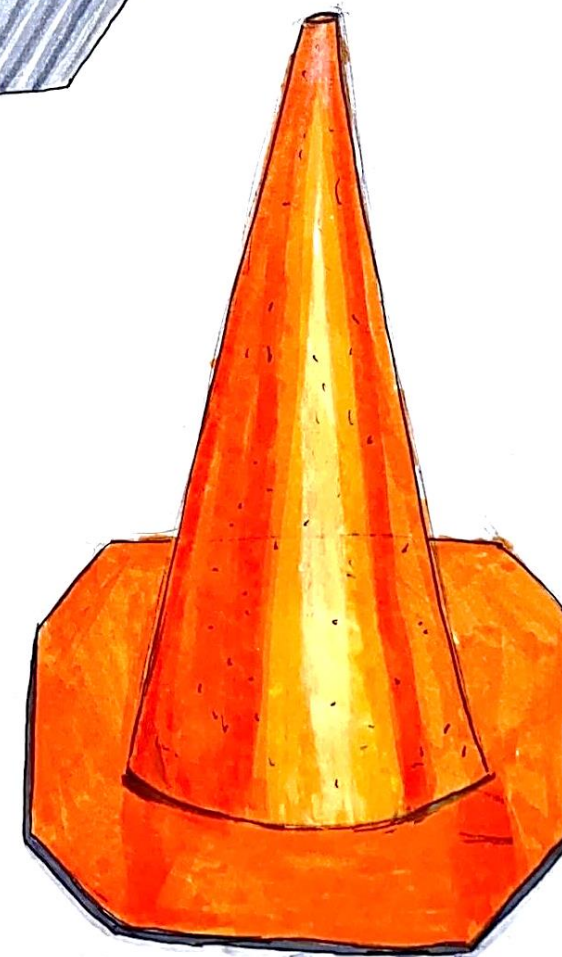
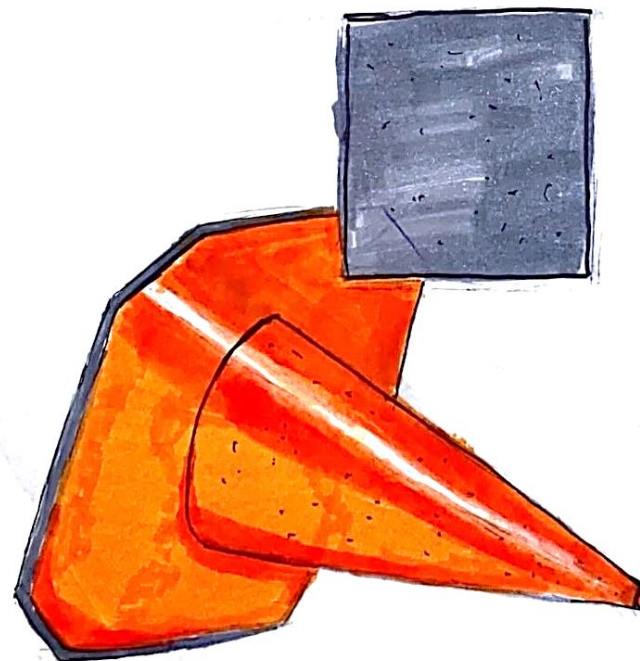
you will need to cut a hole at the tip of the cone to allow the excess aggregate to drain out. You will also need to coat the inside of the cone with a release agent

fill the cone with wet aggregate and tap it gently to remove any air bubbles. Let the concrete cure for at least 24 hours, then remove the mold.

LIGHTWEIGHT YET A HIGH COMPRESSIVE STRENGTH.
ROBUST
LONG-LASTING
DURABLE
LOW RISK OF INFLOSING DAMAGE TO VEHICLE.
WITHSTAND ALL WEATHER CONDITIONS



- AGGREGATE CONE
- MOLD TO GIVE SHAPE
 - THE HOLE AT THE TOP ALLOW EXCESS TO DRAIN OUT
 - USE RELEASE AGENT
 - CURE THE AGGREGATE



Attaching the base and body

Bamboo Cone

1. Some silicones can be heat-bonded. Heat the silicone component slightly and press it onto the bamboo. As it cools, it may form a strong bond.
2. Design the bamboo and silicone parts with complementary grooves or notches that fit together. This can enhance the bond between the two materials.

The different materials used for the original traffic cone would require no shape changes. My intention was to preserve the original forms, and this was achievable even with the change to different materials.

Aggregate Cone

1. Cure the silicone base with the aligned already formed aggregate body.
2. Adhesives.

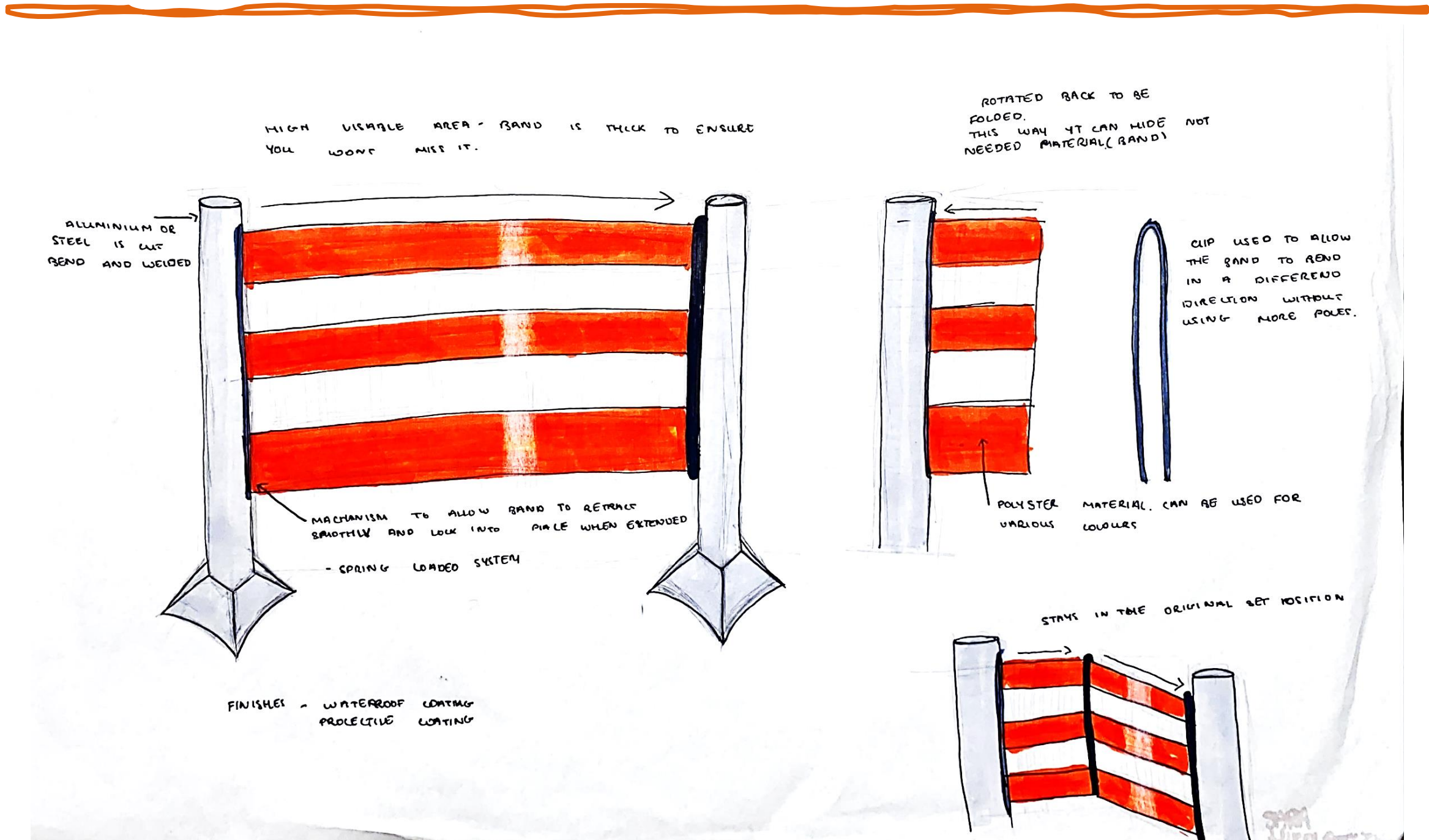


I was able to mold the same shape out of clay as I had previously done with the paper prototype. However, I found that the clay offered a more aggregate feel, making it an interesting choice for prototyping. After achieving the desired shape, I felt it was perfectly suited for the material it was intended to represent. It however lacked the painted element.



Part 3

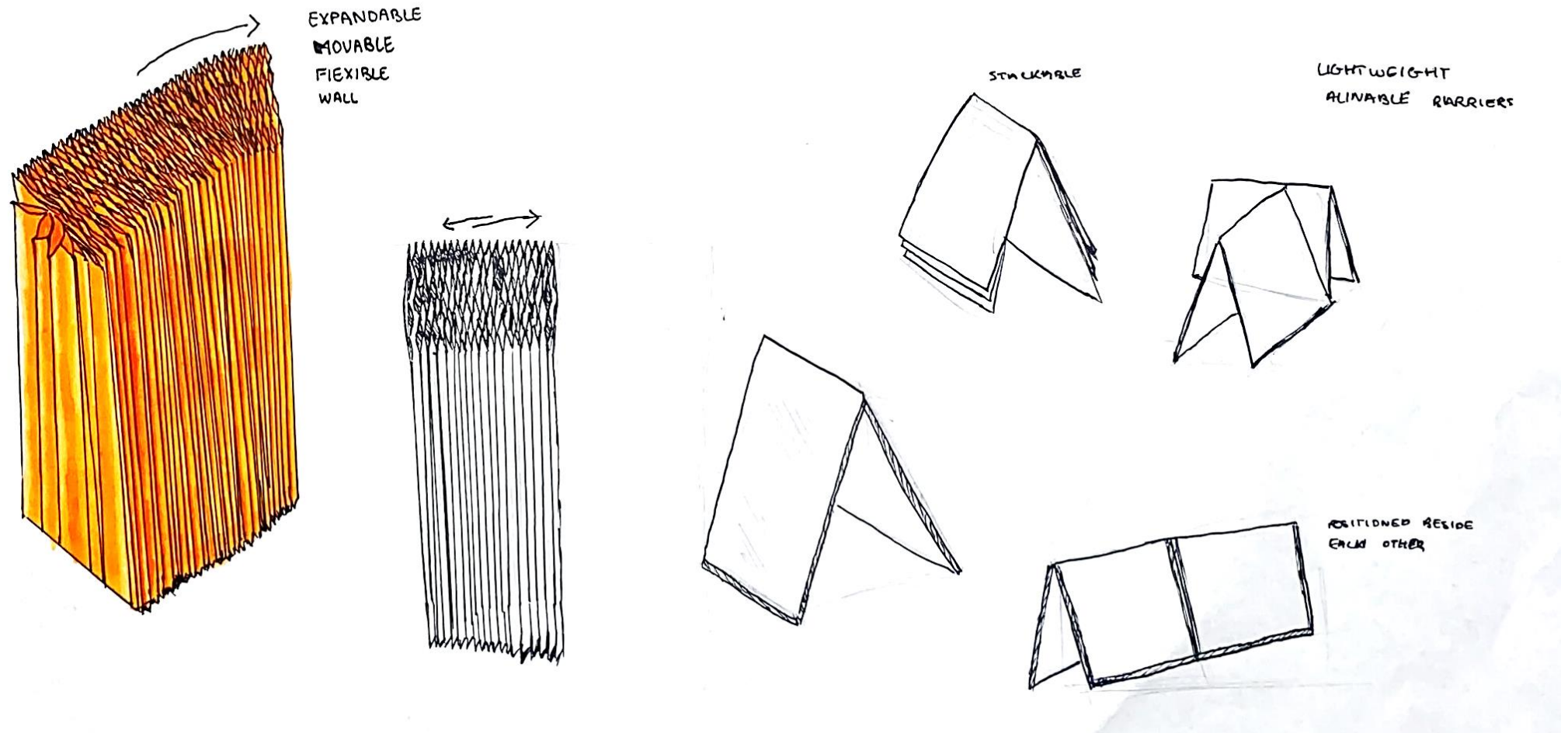
Following my research for the third part of the project, I was determined to create something that would not merely be convenient like the traffic cone. Given that traffic cones are designed to be stackable, I wanted my concept to incorporate a unique feature. Hence, I chose expandability. It was crucial for the design to not be overly complex. An expandable belt seemed to be the optimal choice. Although such belts have been used in barricades before, this one would stand out due to its thickness and colour. The original idea allowed for the position to be altered by adding another pillar. However, I decided to incorporate clips that would keep the belt straight, thereby reducing the number of pillars required.



I decided to utilise concertina folding, keeping expandability in mind. This approach would only require a single component for the entire solution, as the concertina folding provides the necessary mobility. To avoid focusing solely on one particular feature, I also made the decision to restore the stickability of a traffic cone. By designing a roof-like shape, the forms could be arranged side by side while having the ability to stack them.

CONCERTINA FOLDING

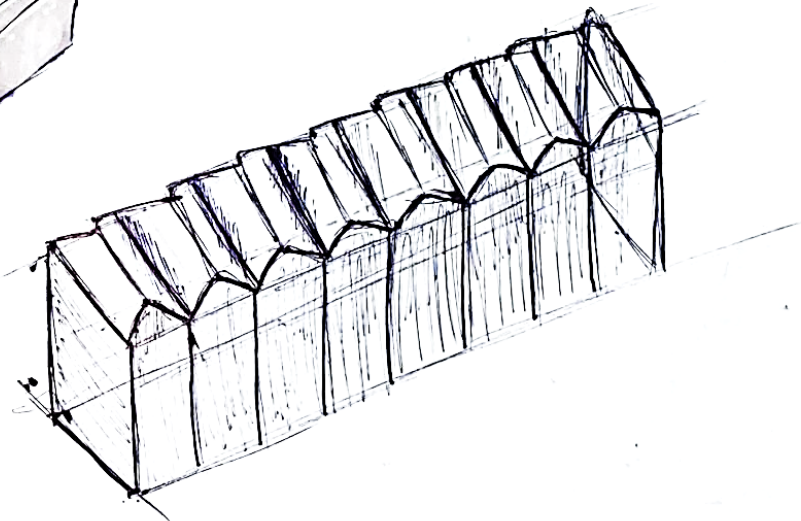
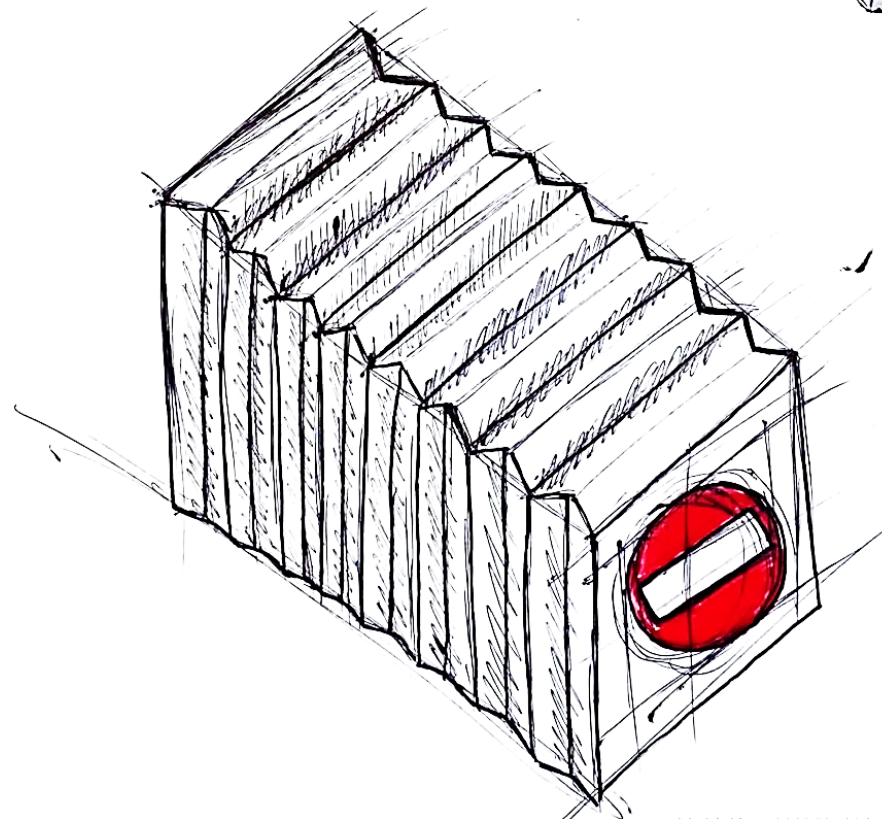
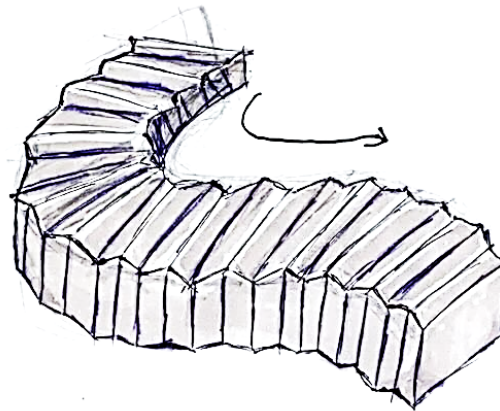
- LARGE SCALE PRINTING PRESSES - FOR DESIRED DESIGN
- CUTTING SHEETS TO SIZE
- FOLDING MACHINES - PRECISE AND RAPID FOLDING AT INDUSTRIAL SCALES



The concept required a material that was both waterproof and durable. Before deciding on an alternative to plastic, I discovered bamboo. Given its versatility in form, bamboo could potentially be used to create a concertina fold. However, the key consideration would be to apply a waterproof finish to this material. Additions like the bamboo cone, such as phosphorescent paint, would also be incorporated into this concept. Compared to other concertina foldings, this one would be much easier to manufacture due to its less complex structure. Its design is similar to an accordion.

MATERIAL

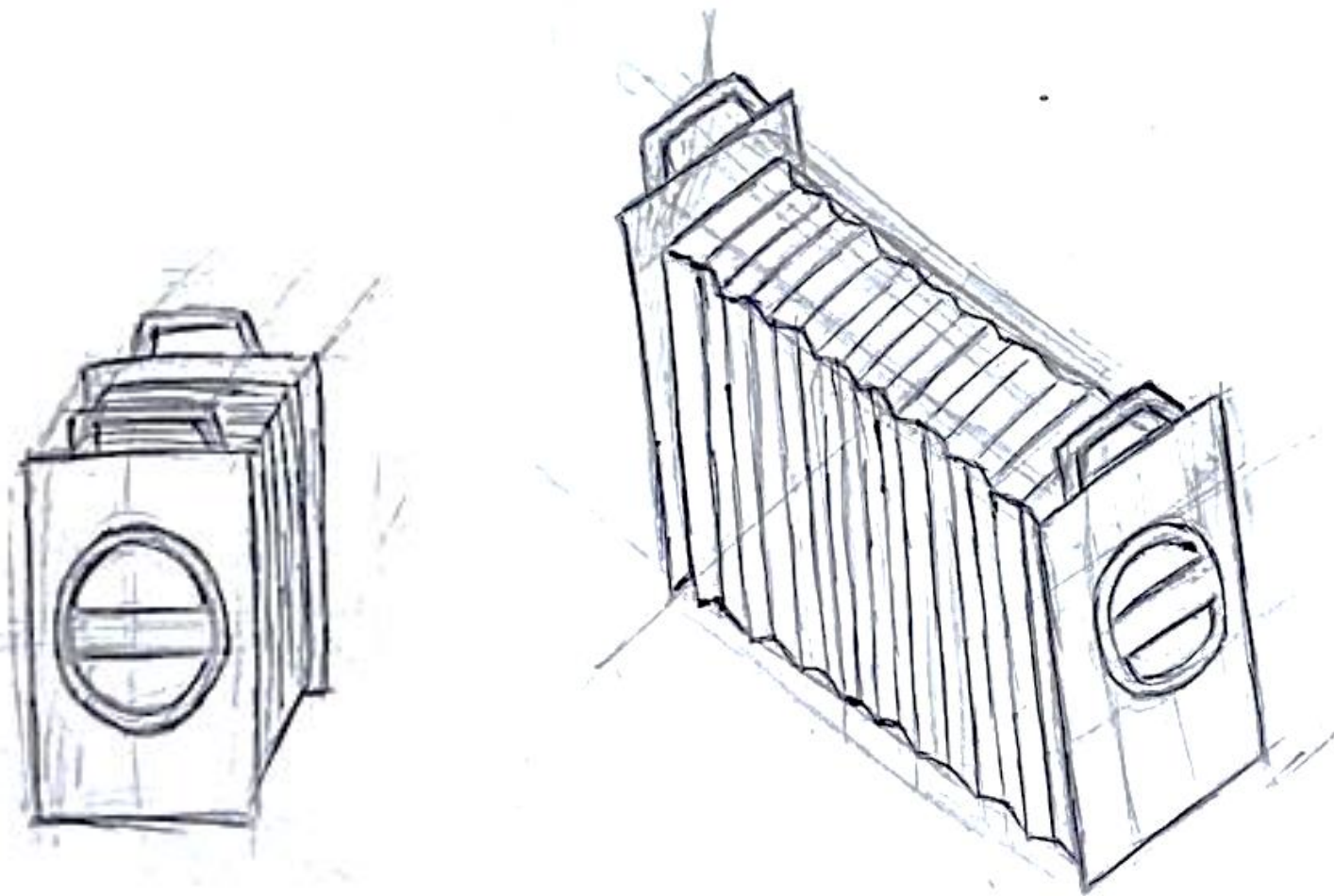
WATERPROOF BAMBOO
 ECO-FRIENDLY ONCE RUN DOWN A LOT
 COMPARE TO ORIGINAL BARRICADES OF
 POLYETHYLENE
 BAMBOO ADDS TO FLEXIBILITY WILL
 BE EASILY FIXED
 STURDY



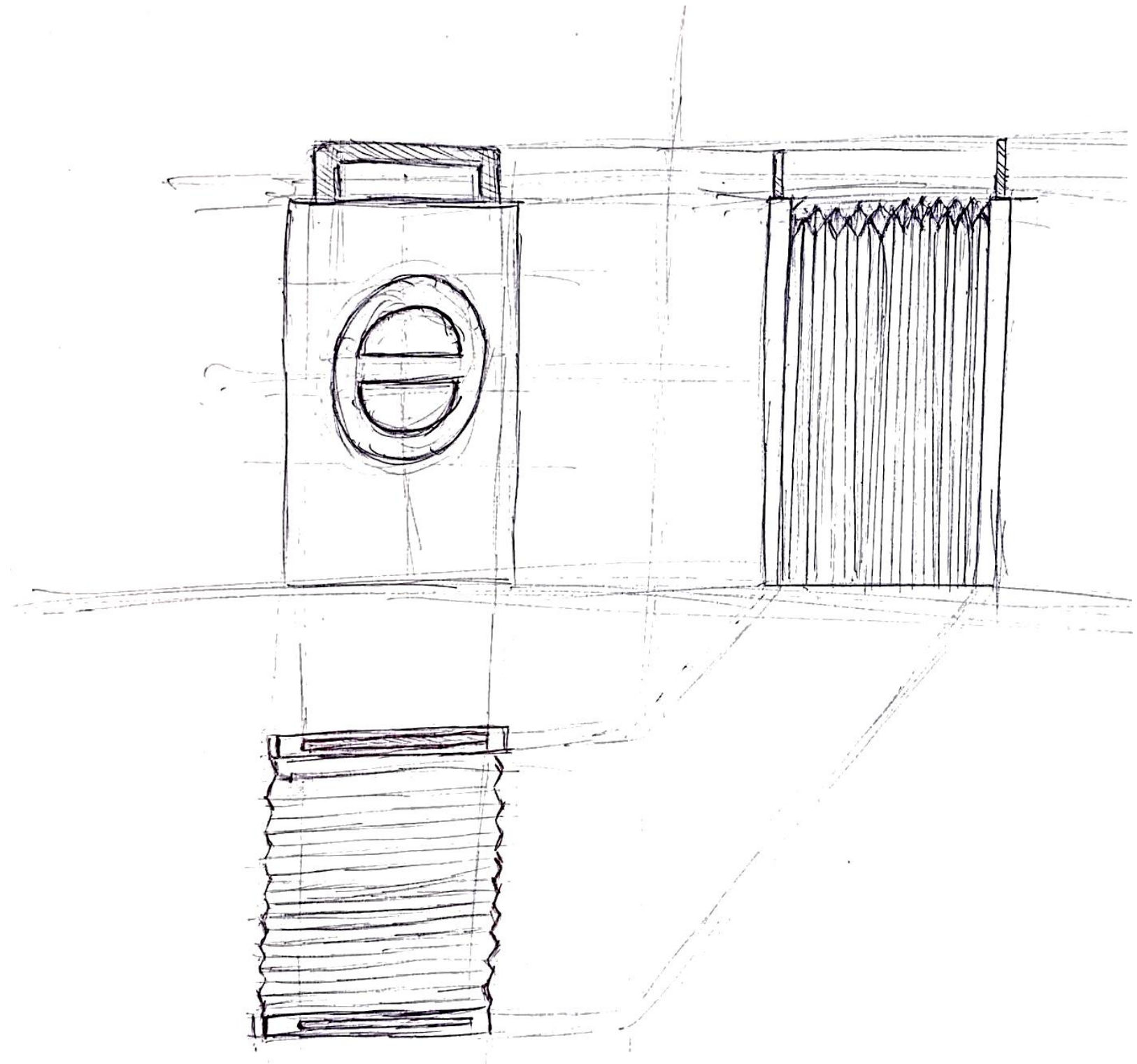
ACCORDIAN DESIGN

FLEXIBLE
 LIGHTWEIGHT
 MOVABLE
 EXPANDABLE TO LIKENESS

To simplify the folding process, I introduced a handle and a base to the design. The addition of a handle provides users with a means to easily extend the accordion folds. The base also allows for a convenient way to fold the item back into its compact form. This functionality does not only enhance the user experience by making the extension and retraction of the accordion folds effortless, but it also adds a portable aspect to the design, as users can now easily carry the folded item.

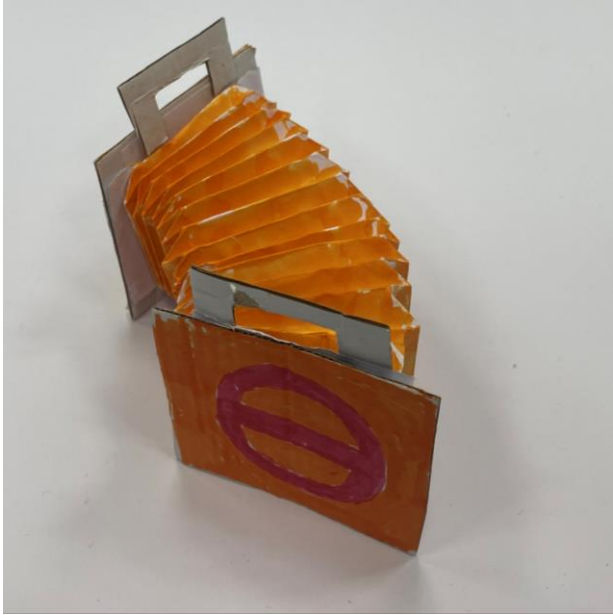


Orthographic view

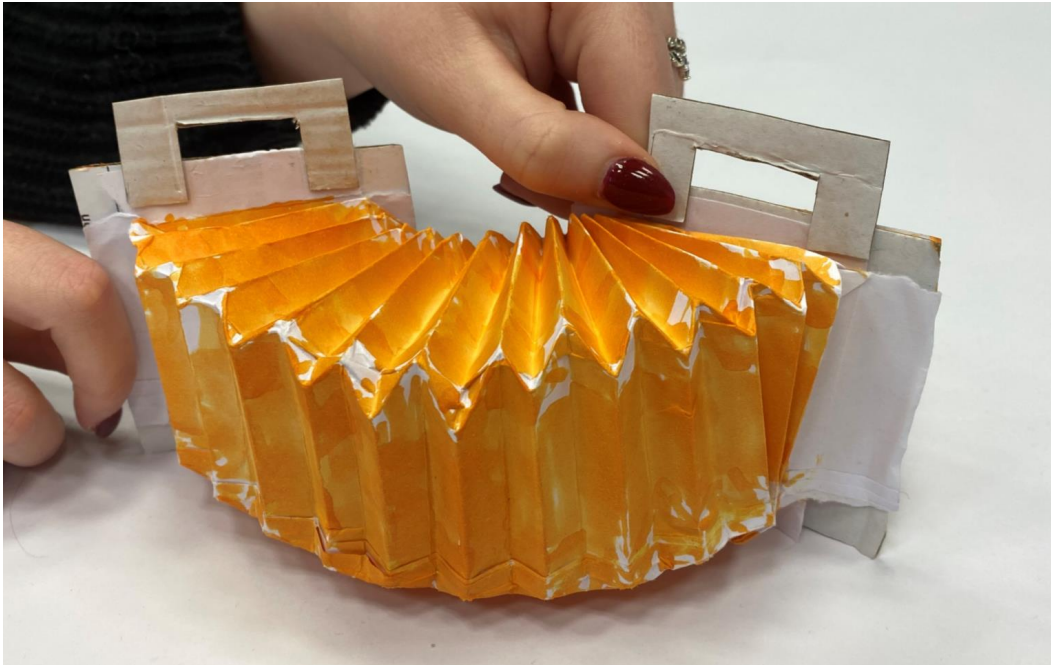
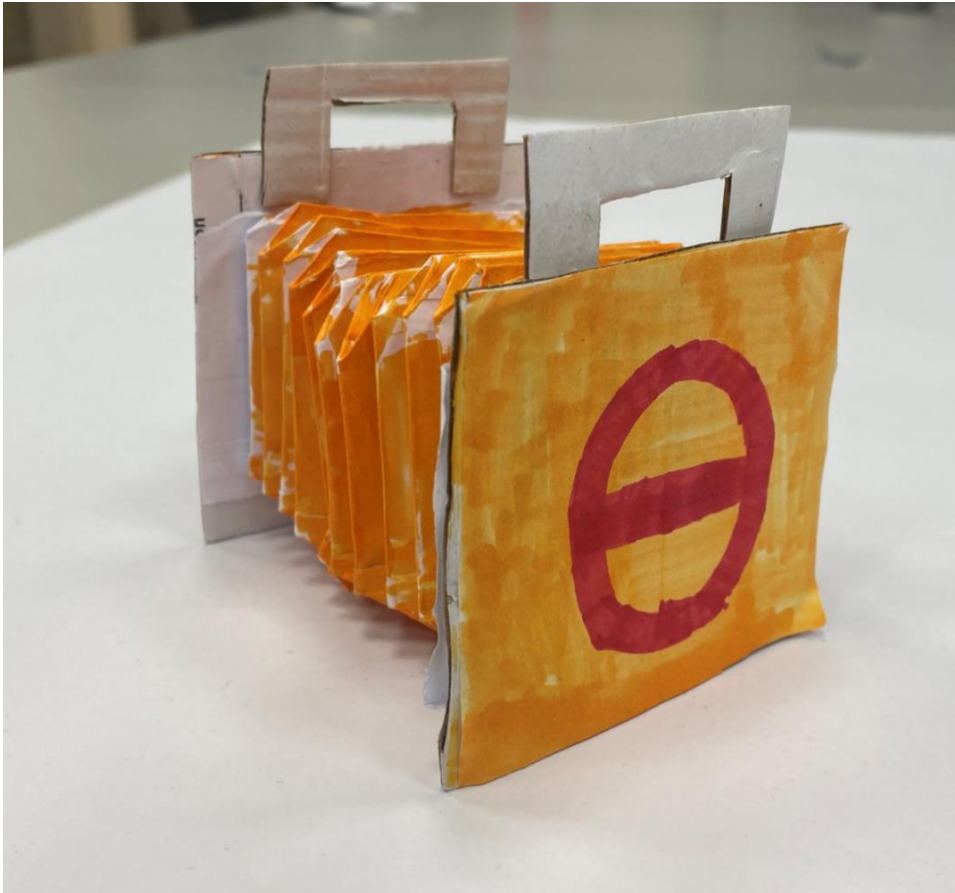


Final Concept





I successfully managed to mimic the accordion fold using paper, although it was a time-consuming process. Following this, I constructed the sides using cardboard. To finalize my concept, I decided to add color that represented the concept I had chosen.



Conclusion

After careful consideration, I decided to choose the traffic cone as a product to work on, which turned out to be an enjoyable challenge. During the second phase, I encountered several difficulties, primarily because I felt that the traffic cone's functionality was optimal with its original material. Despite this, I still believe that its function is best served by the original materials. The materials I selected seemed to align well with the traffic cone's function and offered additional advantages.

Choosing the Swintex traffic cone for the third part was thrilling as it broadened my thought process, considering the already existing (traffic) barriers. I believe my idea was unique, well-developed, functional, lightweight, and capable of protecting traffic in the real world.

This project allowed me to gain my first experience with clay modelling, which will be beneficial for my future projects. I was also able to delve deeper into the manufacturing process of my concepts. This experience will serve as a valuable knowledge for my research in upcoming projects.

Overall, I learned a great deal from this project and will undoubtedly apply these learnings to enhance my future projects.

