EXPERIENCING MATERIALS

CONCRETE

INDUSTRIAL DESIGN PROJECT III
IDP603

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DECLARATION

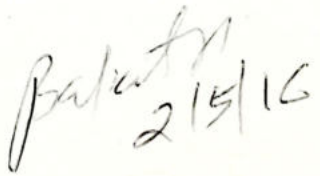
I hereby declare that this written submission represents my idea in my own words and where others' ideas have been included; it has been adequately cited and referenced the original source. I declare that I have adhered to all principles of academic honesty and integrity and have not misinterpreted or fabricated or falsified any data/idea/facts/sources in our submission. I understand that any violation of the above entitles the institute to take disciplinary action against us to which I shall be answerable to.

APPROVAL SHEET

The project titled as "Experiencing Materials - Concrete" by Shreelekha Lakshmipathy
fulfilment of the requirement for the degree of 'Master of Design' in Industrial Design.

Guide: 

Chairman: 

Internal Examiner: 

External Examiner 

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PROJECT ABSTRACT

We like to define historic eras based on the materials that were prevalent at the time, as in 'Stone Age', 'Bronze Age', 'Iron Age' and so on, because they define our relationship with the physical world.

This project, at the outset, states the importance of materials in our world and identifies the softer aspect of the materials - its Character, its Personality, its Association, its Story and continues to showcase the material and design innovations that drive us to the future.

The project then moves into choosing a particular material - CONCRETE, the second most used material on the earth after water. The project identifies the image of the material and continues into exploring the possibilities of the material in the area of Product Design.

BRIEF

Concrete is the second most used material in the earth after water, predominantly for a single application - Building Construction - for 100 years.

This project aims to explore the possibilities of Concrete in Product design scenario, identify its Aesthetic Versatility and reposition concrete
from a “functionalist, modern, tower block”
to “minimal serene art”,
from Public Outdoors to Domestic Indoors,
from Underpass to Exhibitions,
from Pavements to Jewellery,
from Walls to Centre pieces,
from Utility to Luxury.

CONTENT

CONTENT

A1

The BIG attraction

////////////////////

01

The Parthenon,
The Eiffel Tower,
The Golden Gate
all great symbols of their age, are unique expression of what is possible with a particular material.

PERSONAL RATIONALE

Throughout the course I have been involved with materials within my reach - plastics, metal, wood, bamboo. This projects gives an opportunity the explore the fields outside these materials, understand the magnitude of change a material brings to design and manufacture.

THE PROJECT AS PRODUCT DESIGN EXERCISE

The process of design usually starts with the context/concern that we address, design and decide the material suitable for the design. By taking this alternate route of designing ‘for’ a material than ‘with’ a material, we can understand the possibilities, the extents and ‘limits’ of a particular material.

A2

Why Material Innovation is important

The evolution of culture and society has meant that the function of materials has taken on a role that is not just about basic physical and engineering properties. Materials now perform a role that is in a sense invisible. No longer do we use objects to perform essential functions in our lives: their roles are based more on an emotional level. This factor has provided the translators – the design and architecture community – with entirely new ways to exploit the properties of materials. In turn, this has provided a new romance, with new materials to create new products, buildings and environments. Romance because within this association there is a spirit of excitement and adventure, for the palette of new materials will take us to an even more sophisticated level of interaction with the physical world.

Advances in material enable advances in Industrial design - together these advances allow new behaviours, new experiences, new architecture.

A3

Material Personality

A product has perceived attributes and associations, it might be seen as “robust”, or “classical”, or “avant-garde”, It is these, in part, that give it its personality, something designers work hard to create. Similarly, a material could have perceived attributes or indisputable associations - a personality.

Wood is a natural material with a grain, a surface texture, color, and feel that other materials do not have. It is tactile it is perceived as warmer than many other materials, and seemingly softer. It is associated with characteristic sounds and smells. It has a tradition; it carries associations of craftsmanship. And it ages well, acquiring additional character with time. Objects crafted from wood are valued more highly when they are old than when they are new. There is more to this than just aesthetics; these are the makings of a PERSONALITY.

A3

Metals seem cold, clean, precise. They ring when struck. They reflect particularly when polished. They are accepted and trusted; machined metal looks strong, its very nature suggests it has been engineered. The strength of metals allows slender structures the cathedral-like space of railway stations or the span of bridges. Metals can be worked into flowing forms like intricate lace or cast into solid shapes with integral detail and complexity. And like wood metals can age well, acquiring a patina that makes them more attractive than when newly polished think of the bronze of sculptures, the pewter of mugs, the lead and copper of roofs.

Ceramics and Glass have a long tradition(Greek pottery and Roman glass). They accept almost any color; this and their total resistance to scratching, abrasion, discolouration, and corrosion gives them a certain immortality, threatened only by their brittleness. They are or were the materials of great craft-based industries: Venetian glass, Meissen porcelain, and Wedgwood pottery, valued, sometimes, as highly as silver. And ceramic today has an additional association that of advanced technology: kitchen stove tops, high-pressure/high-temperature valves, space shuttle tiles. materials for extreme conditions.

"A cheap, plastic imitation" used to be a common phrase for polymers and that is a hard reputation to live down. It derives from an early use of plastics, to simulate the colour and gloss of Japanese handmade pottery. Commodity polymers are easily coloured and moulded, making imitation easy. Unlike ceramics, their gloss is easily scratched, and their colours fade they do not age gracefully. No other class of material can take on as many characters as polymers: coloured, they look like ceramics; printed, they can look like wood or textile; metallic, they look exactly like metal. They can be as transparent as glass or as opaque as lead, as flexible as rubber or as stiff when reinforced as aluminium. They also have a certain personality: they feel warm much warmer than metal or glass; they are adaptable that is part of their special character; and they lend themselves, particularly, to brightly coloured, lighthearted, even humorous, design.

There is a character hidden in a material even before it has been made into a recognisable form, sort of embedded personality, not always visible, easily concealed or disguised, but one that, when appropriately manipulated, can contribute to good design.

A4

Material Stories

Alongside the evolution of new technologies and grades of materials, something else is happening that is changing the value they have in our lives. This is not linked to the science of new materials but concerns the role they play in contemporary life. Materials are increasingly becoming central characters in consumer focussed stories : anti-bacterial surfaces to improve hygiene; advanced composites that define luxury in consumer electronics; authentic 'real' materials in interiors like stone, glass and stainless steel; the use of 'eco' materials to alleviate our guilt and make us feel like more caring customers.

So, as innovations in materials continues to take place, this is a good time to consider materials and their unique application in design.

A5

Material Association

If we aim to design a particular user experience, the material properties of the object may play a decisive role in being successful. A lightweight car door may not give the proper impression of a luxury car and a perfectly polished doorknob may not feel natural. From a distance, a plastic drinking glass can be visually indistinguishable from one made of glass, but when picked up and it feels lighter, warmer, less rigid. The impression it leaves is so different from glass that, in an expensive restaurant, it would be completely unacceptable. Materials can feel artificial, sound reliable, and can make a product look 'cool', they can be just pleasant to touch or look at, and cause us to experience disgust, admiration or surprise.

The key word 'experiences', marks a point of departure from our old notions about the function of materials. It liberates design from the science of materials, and is also without doubt one of the driving forces behind innovation in buildings and products. It is also testament to the fact that we love not only new materials, but also what they can do. Within many materials there is a potential experience that is disguised by something we think of as a physical substance. **It's a little like a precious metal: sure, its pretty, but we love it not just for its aesthetic beauty but also for the association it brings. As with many aspects of our modern psyche, it is not so much that we admire the object, but how it makes us feel.**

B

Material Innovation and Product design

Innovation in Application :

Paper Pulp Helmets

A group of Royal College of Art graduates has used the pulp from mulched newspapers to form helmets for London's cycle hire scheme. The pulp was mixed with adhesive and pigment then vacuum-formed into shape, before being heated to dry it out. The surface inside the helmet is also bevelled so air can flow through and keep the head cool. Each helmet would cost around £1 and could be sold in a vending machine or nearby shops, offering low-cost safety equipment for London's Barclays "Boris Bike" cycle sharing scheme.

B2

Innovation in Sustainability

Mushroom Materials

Material science company Ecovative has developed Mushroom Materials to provide a natural alternative to traditional plastics and synthetic packaging. The product contains mycelium, the vegetative part of a mushroom fungus, which is a natural glue. This material binds with crop waste like seed husks and corn stalks to form a bioplastic.

The latest development of the product – a Grow it Yourself kit – allows artists and designers the opportunity to grow their own modelling material. Mushroom Materials has also been used to design a biodegradable surfboard, providing an alternative to the popular fibreglass and styrofoam models.

Innovation in Manufacturing time

Fabrican

In 2000 Fabrican patented an instant, sprayable, non-woven fabric. The fabric is formed by the cross-linking of fibres, which adhere to one another, to create an instant non-woven fabric that can be easily sprayed on to any surface. Its properties can be tailored to meet the needs of each user. The initial idea for Spray-on fabric came from Manel Torres' experience in the fashion industry where he nvestigated novel ways to speed up the process of making garments. These photos capture the essence of science and fashion in collaboration. In addition to fashion, the technology provides new horizons, offering sprayable material for any application requiring a fabric coating.

C

Material Options for Design

NATURAL

SOFT WOOD

Red Cedar
Pine
Douglas Fir
Poplar
Yew

FIBRE

Coconut Fibres
Tree Bark
Horsehair
Cellulose
Silk
Bacterial Cellulose

HARDWOOD

European Lime
Oak
European Beech
Rock Maple
Teak
European Walnut
European Birch
European Ash
Aspen
Willow
Boxwood
Balsa
Hickory

PLANT

Algae
Cork
Bamboo
Rattan
Hemp
Wheat Straw
Carrot Fibres
Mycelium
Sugarcane
Orange peel
PLA (Polylactic acid)
Castor oil
Latex

ANIMAL

Bovine Leather
Fish Leather
Fish Scales
Protein

C

MAN MADE POLYMERS

ABS
(Acrylonitrile Butadine Styrene)
ASA
(Acrylonitrile Styrene Acrylate)
CA
(Cellulose Acetate)
EVA
(Ethylene Vinyl Acetate)
Ionomer resins
Melamine Formaldehyde
PA
(Polyamide)
PBT
(Polybutylene Terephthalate)
PC
(Polycarbonate)
PEEK
(Polyetheretherktone)
PF
(Phenol Formaldehyde)
PCL
(Polycaprolactones)
POM
(Polyoxymethylene)
PPSU
(Polyphenylsulphone)
PS
(Polystyrene)
PTFE
(Polytetrafluroethylene)
Silicone
SMMA
(Styrene Methyl Methacrylate)
TPE
(Thermoplastic Elastomers)
UF
(Urea Formaldehyde)
EPP
(Expanded Popypropylene Foam)
EPS
(Expanded Polystyrene)
PE
(Polyethylene)
PET
(Polyethylene Terephthalate)
PMMA
(Polymethyl Methacrylate)
PP
(Polypropylene)
PUR
(Polyurethanes)
PVA
(Polyvinyle Alcohol)
PVC
(Polyvinyl Chloride)
Liquid crystal polymers

MINED

GLASS

Soda-lime Glass
Borosilicate
Lead Glass
Aluminosilicate Glass
Quartz Piexoelectics

CERAMICS

Bone China
Porcelain
Earthenware
Stoneware
Terracotta
Cement
Granite
Marble
Glass Ceramics

Aluminium oxide
Silicon Carbide
Boron Carbide
Silicon Dioxide

METAL

Gold
Silver
Platinum
Brass and Bronze
Copper
Chromium
Pewter
Aluminium
Magnesium Alloys
Tungsten
Tin
Titanium
Neodymium
Nickel
Zinc

Carbon Fibre
Graphite

Iron
Molybdenum
Stainless steel
Steel

C

Material Timeline


Metals
Wood
Other natural
Ceramics
Glass
Plastics
Composites
Relative importance
Stone tools
Clay
Chalk
Terracotta
Early textiles
Flint tools
Bone hooks
Animal fat
Copper
Brass
Gold
Metal casting
Earthenware
Woodworking
Concrete
Silk
Nickel
Bronze
Vegetable oils
Hemp fibre
Papyrus
Glass
Iron
Natural rubber
Brick
Veneer
Steel
Glass blowing
Parchment
Coal
Lead
Magnets
Paper
Porcelain
Mercury
Petroleum oil
China clay
Platinum
Tungsten
Molybdenum
Plaster
500.000 BC
5000 BC
1000 BC
0
1000
1500
1800
1900
1925
1950
1975
2000
Plywood
Aluminium
Zirconia
Bone china
Graphite
Magnesium
Portland cement
Synthetic plastic
Electromagnets
Vulcanized rubber
Titanium
Bakelite
Synthetic fibre
PVC
Borosilicate glass
Stainless steel
Polyamide
Glass fibre
PMMA
Polyethylene
Synthetic rubber
Polystyrene
PC
Teflon
Bent plywood
Silicones
HDPE
Acrylic
Aramid
Polyesters
PET
Nickel-based super alloys
Silicon crystal
Carbon fibre
Float glass
Polyurethane
Polypropylene
ABS
LEDs
PEEK
Kevlar
Bioglass
Amorphous metal alloys
NiTi alloy
Synthetic skin
Nanotechnology
MDF
Rare earth magnets
Super conductors
Molecular transistor
Starch-based plastics (PLA)
Biodegradable plastics

D

Material Choice

The material was chosen considering the academic framework, the ease in Procurement of Material and the availability of resources and time.

CONCRETE

After water, cement is the most used product on the planet. Over the last 100 years, concrete has had a huge effect on our environment and it is constantly being redefined in both its functions and associations. The biggest application of concrete is in building construction. However various artists and designers have been exploring new possibilities for the material and new applications have been discovered that include jewellery, furniture, kitchen work surfaces and tableware.

Personal Rational

Having used this as a base material for all my architectural designs, the understanding of this material that I had was very less. This project would alter the possibilities that it offers and how it can be translated into architecture.

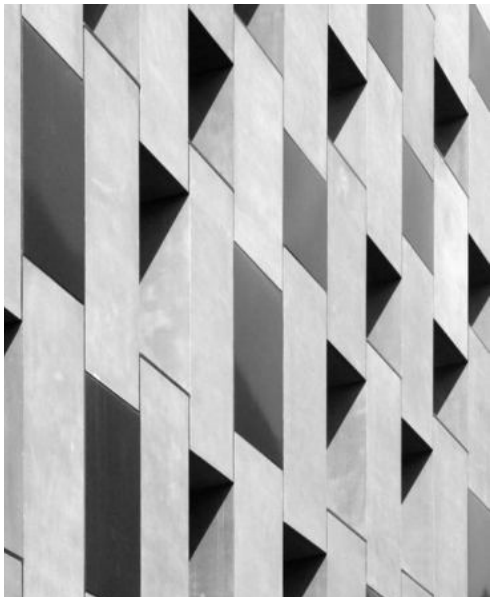
Material and Product Design

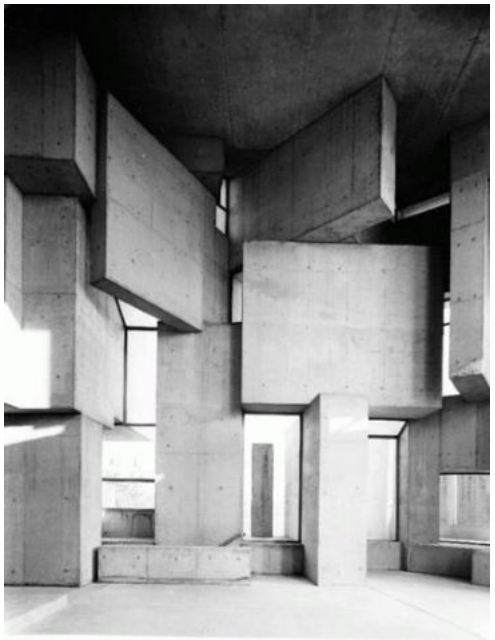
Concrete is in many ways a ceramic but each dwell on vast ends of the spectrum. This project finds the in-between bringing them together by linking their similarities and disparities.

E

CONCRETE

Man has been using concrete as a building material since the rise of the earliest civilisations. The Romans refined its use for construction, laying a concrete foundation for the Colosseum. After the fall of the Roman Empire, the mix of cement, sand, water and rocks fell out of use before being rediscovered in late 18th-century Britain. By the end of the 19th century it was ubiquitous, and 300 years later it is the most commonly used manmade material in the world, according to Robert Courland, the author of the history Concrete Planet.





E

If concrete has long been a foundation for our buildings, bridges, roads and dams, it was 20th-century architects like Frank Lloyd Wright (who constructed textile block houses made from patterned and perforated concrete blocks) and Le Corbusier (who produced monumental buildings) who gave concrete star billing.
In recent years, architects and interior designers have brought concrete into the home once more by laying polished concrete floors in a range of finishes or constructing concrete-based bathrooms and kitchens. And now a set of product designers are taking concrete even further, using it to make furniture, lighting and decorative objects for the home.

E1

THE MATERIAL

E1

There are many types of concrete available, created by varying the proportions of the main ingredients. In this way or by substitution for the cementitious and aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties.

Aggregate consists of large chunks of material in a concrete mix, generally a coarse gravel or crushed rocks such as limestone, or granite, along with finer materials such as sand.

Cement, most commonly Portland cement, is associated with the general term "concrete." A range of materials can be used as the cement in concrete. One of the most familiar of these alternative cements is asphalt concrete. Other cementitious materials such as fly ash and slag cement, are sometimes added as mineral admixtures (see below) - either pre-blended with the cement or directly as a concrete component - and become a part of the binder for the aggregate.

E1

To produce concrete from most cements (excluding asphalt), water is mixed with the dry powder and aggregate, which produces a semi-liquid that workers can shape, typically by pouring it into a form. The concrete solidifies and hardens through a chemical process called hydration. The water reacts with the cement, which bonds the other components together, creating a robust stone-like material.

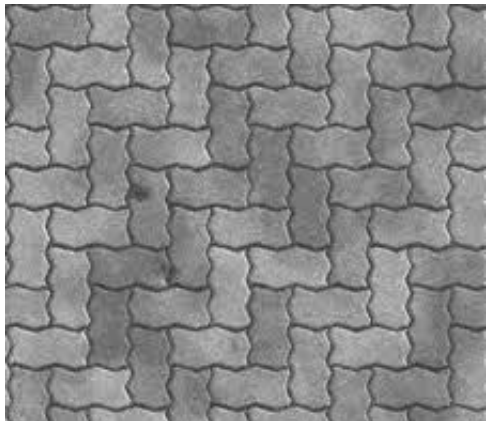
Chemical admixtures are added to achieve varied properties.

These ingredients may accelerate or slow down the rate at which the concrete hardens, and impart many other useful properties including increased tensile strength, entrainment of air, and/or water resistance.

Reinforcement is often included in concrete. Concrete can be formulated with high compressive strength, but always has lower tensile strength. For this reason it is usually reinforced with materials that are strong in tension, often steel.

Mineral admixtures are becoming more popular in recent decades. The use of recycled materials as concrete ingredients has been gaining popularity because of increasingly stringent environmental legislation, and the discovery that such materials often have complementary and valuable properties. The most conspicuous of these are fly ash, a by-product of coal-fired power plants, ground granulated blast furnace slag, and silica fume, a byproduct of industrial electric arc furnaces. The use of these materials in concrete reduces the amount of resources required, as the mineral admixtures act as a partial cement replacement. This displaces some cement production, an energetically expensive and environmentally problematic process, while reducing the amount of industrial waste that must be disposed of. Mineral admixtures can be pre-blended with the cement during its production for sale and use as a blended cement, or mixed directly with other components when the concrete is produced.The mix design depends on the type of structure being built, how the concrete is mixed and delivered, and how it is placed to form the structure.

THE IMAGE OF CONCRETE



INNOVATIONS IN THE AREA

CANVAS

Concrete Canvas (CC) is a flexible, concrete impregnated fabric that hardens when hydrated to form a thin, durable, water proof and fire resistant concrete layer. CC allows concrete construction without the need for plant or mixing equipment. The material can be hydrated either by spraying or by being fully immersed in water. Once set, the fibres reinforce the concrete, preventing crack propagation and providing a safe plastic failure mode.

BIOCONCRETE

Researchers from Delft Technical University in the Netherlands have developed concrete that can heal itself using special bacteria. Concrete is the most widely used building material in the world but is prone to cracks which means that it needs to be reinforced with steel and in some cases fixed or replaced when cracks expand too much. They added a harmless bacteria known as Bacillus genus to the concrete which remained dormant until rainwater entered the cracks which occur naturally inside concrete.

LITRACON

World's first commercially available transparent concrete Litracon is a combination of optical fibres and fine concrete. It can be produced as prefabricated building blocks. Due to the small size of the fibres, they blend into concrete becoming a component of the material like small pieces of aggregate. In this manner, the result is not only two materials - glass in concrete - mixed, but a third, new material, which is homogeneous in its inner structure and on its main surfaces as well.

E4

HARDCORE

The second major application of concrete after building construction is Landscape.
The cost efficiency, manufacturability and durability make it an appropriate material for public infrastructure.
Also, its resistance to heat, rain and corrosion makes it a perfect outdoor material.

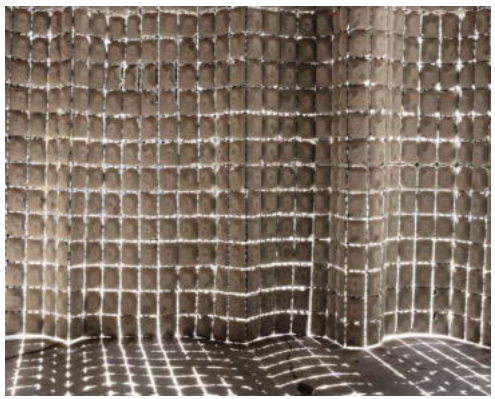
E5

CONCRETE BUT DIFFERENT

Cementipede

FORM

Cementipede is a seat-concrete sculpture, the agile stretches across the room. Shaped As cloud 10m large surface space for all body sizes / postures / body language - without predefined seating positions. The viewer is the user and is prompted to seek any piece of the space-filling object intersect. August Kocher Scheidt & Rupert Zallmann experimenting for 10 years with concrete show that concrete in its malleable state is a liquid and will be forced not only in rectangular molds. The result are monoliths as snapshots of dynamic forces that obtained by the material concrete contained a different shape. Furniture was made with the aid of Concrete canvas.



Concrete Curtain

Context

The austrian design company Memux created a concrete curtain working as a decorative room divider or facade decoration - a new context for this building material.
The unusual employment of concrete lends this object : the apparent contrast between materiality and variability has been translated into a piece of textile architecture. The colour and form of the concrete cushions are adaptable to the respective function. The concrete curtain may be installed indoors and outdoors. It serves as a sun- and wind screen, privacy screen, façade element or heat-accumulating room partition.

Konkrete

PROCESS

7

This project by Tjiang Supertini of started as experimentation on concrete's properties and analysis of its history. Instead of manipulating this material to not look like itself, the research brought her to take advantage of the synergy between its hydraulic property and fabric forming as an alternative to solve weight matters. This design arrangement allows the user to carry the dry-concrete stool like a bag and has interaction with the stool in water immersing phase. By doing so, it creates unique language for each stool that corresponds as ownership.

E6

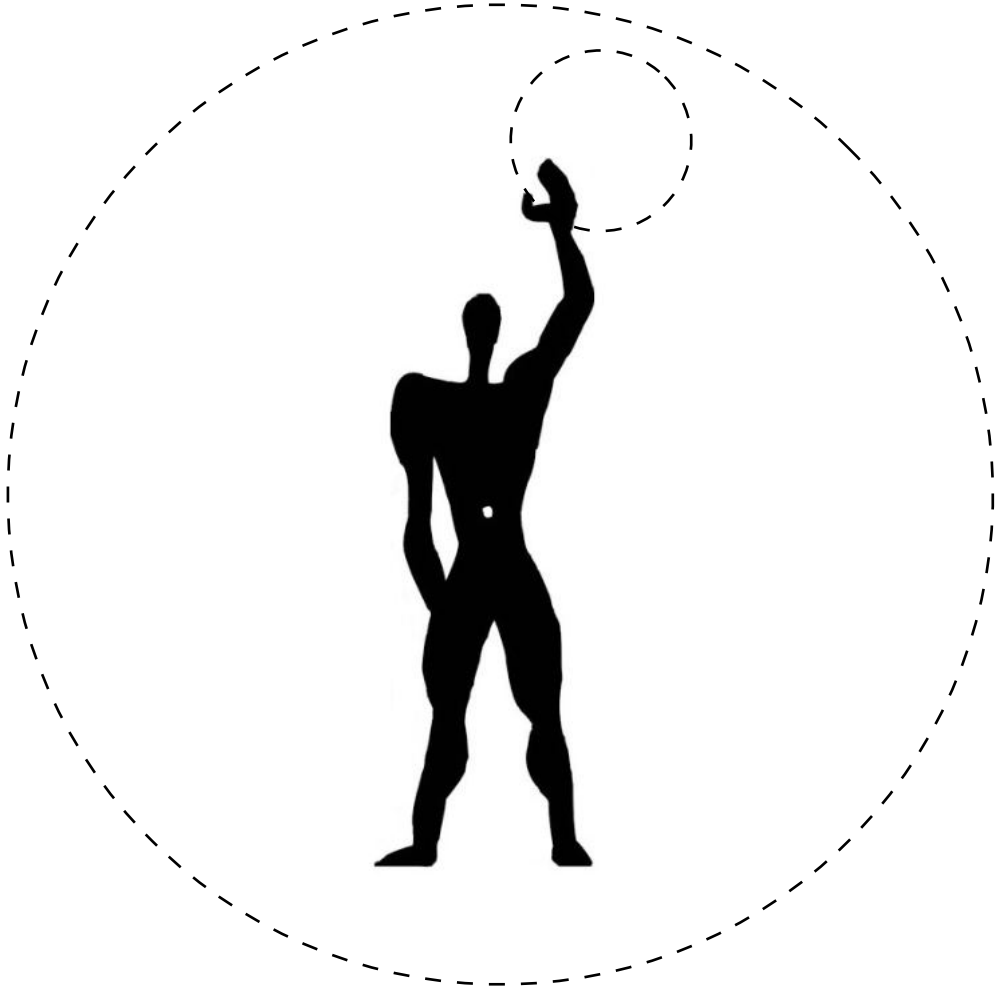
THE CHANGING TREND

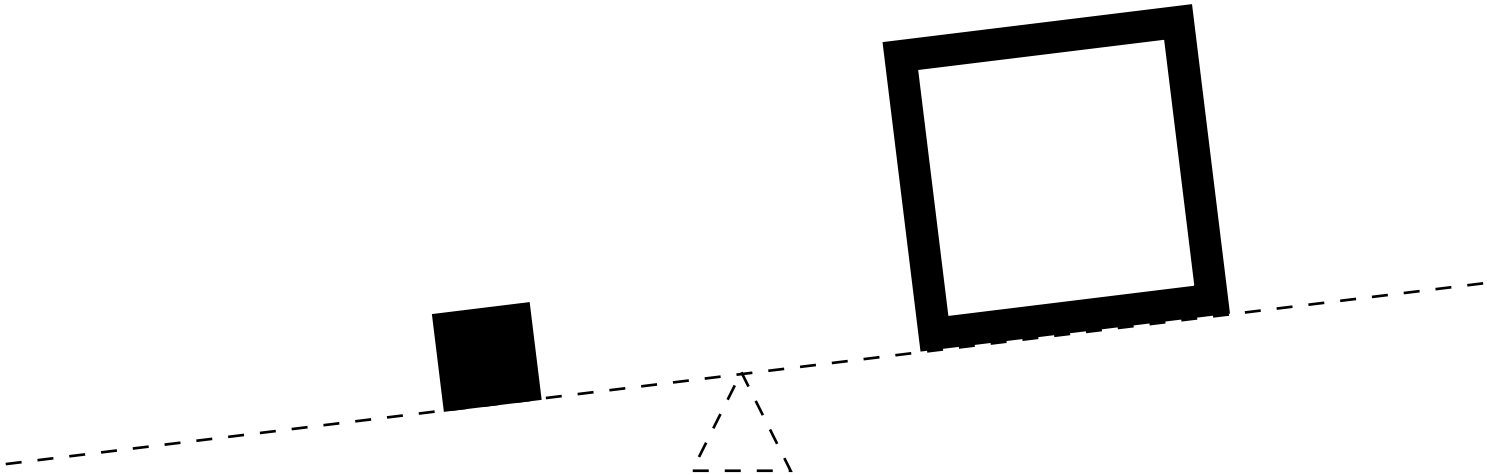
Boiacca table [1] by Kristalia Five-inch potted desert flowers [2] by Crate and Barrel. Small recycled glass bell jar [3] by Crate and Barrel.Nairobi oval planter [4] by Crate and Barrel. Aplomb suspension lights [5] by Foscarini. Pencil succulent potted plant [6] by Crate and Barrel. Tall stone stool [7] by Crate and Barrel. V2 square planter [8] by Kevin Wood. Small vase [9] by Ferm. Concrete seven-inch crust planter [10] by 18Karat. Aside table [11] by Kevin Wood. Grey square side table [12] by CB2. Tapered square planter set [13] by 18Karat .

E7

SCALE

The change in scale from being enclosed within the material to being able to hold the material, alters the way, concrete is perceived. The latter is noticed with a greater detail - the pores form the texture.





FORM vs WEIGHT

The smallest piece could be made heavy and the largest one light. This control over weight that is regulated by the form of the object makes an interesting aspect of working with this material.

E8

MATERIAL UNDERSTANDING

As an attempt to understand the material and the work that has already been done in the area, I visited some construction sites within the campus and the Concrete lab of Civil Engineering department.

The process of concrete work, the propositions, composites, and machines used for larger quantities were noted. This also led to a meeting with Prof Prakash Nanthagopalan, Department of Civil Engineering where the initial idea of creating a material that would be apt for Product design was dismissed and working with the context of construction waste and moulds were considered

The Conversation -

Me : …..I want to develop a newer category of concrete for indoor applications. Start with composites with Paper, Foam, Thermocol.

Prof Prakash : But we have already done that. **We don't need you for that**. You give us the mould and ask for a concrete that has a consistency of honey, we will give you that.

F

POSSIBLE CONTEXT

Building materials	Percentage N	Contribution	Mean	Rank
Concrete	56	31-40	3.0	1
Mortar from plastering /rendering	56	31-40	2.6	2
Sandcrete blocks	56	31-40	2.5	3
Timber formwork	56	31-40	2.5	3
Iron bars	56	21-30	2.4	5
Ceramic/Vitrified tiles	56	21-30	2.3	6
Clay tiles	56	21-30	2.1	7
Fibre- cement roofing sheets	56	21-30	2.1	7
Wood used for flooring	56	21-30	2.1	7
Bricks	56	21-30	2.1	7
PVC	56	21-30	1.0	11
Paints	56	21-30	1.9	12
Long span aluminum roofing sheets	56	21-30	1.9	13
Steel formworks	56	21-30	1.7	14

Building materials	N	Mean response	Rank
Mortar from plastering /rendering	56	3.32	1
Timber formworks	56	3.23	2
Sandcrete blocks	56	3.16	3
Concrete	56	2.79	4
Ceramic/Vitrified tiles	56	2.70	5
Clay tiles	56	2.66	6
Wood used for flooring	56	2.52	7
PVC tiles	56	2.36	8
Bricks	56	2.27	9
Fibre- cement roofing sheets	56	2.21	10
Paints	56	2.16	11
Iron bars	56	2.14	12
Long span aluminum roofing sheets	56	1.88	13
Steel formworks	56	1.50	14

The Tables provide information on Percentage Contributions of material wastage to cost overrun and material wastage on construction site respectively.

DOI 10.5592/otmcj.2013.1.11
Research paper

Products from Concrete Wastes

Urban building sites produce a lot of different waste materials. Concrete, being a big part of the waste is also a difficult material to recycle. After every concreting step there are concrete leftovers that can not be used on the building site. They are mostly spilled on the floor and the next day - when dryed out - put away with other waste material. With the simple intervention of installing a small co-production on building sites, the leftover concrete can be poured into moulds while still liquid, so this engineered material can be turned into a functional product instead of waste.

G

MATERIAL EXPLORATIONS

POINT OF VIEW

There have been numerous experiments with concrete but for the particular application - Building systems. Each exploration addresses a different question. Permeable concrete - Can the concrete be made permeable so it can drain rain waters and prevent flooding? Biocrete - Can it be self healing so it could save repair and maintenance costs? Litracon - Can the concrete be made translucent? Concrete Canvas - Can the concrete be made flexible and easy for transportation and assembly? While looking at the material from the point of view of a product, structural strength is no more a primary criteria. The change in scale creates a dramatic change in the way we see the material. Each and every pore and crack gets noticed. The use of this material for a particular product issues a statement to that product which is an expression of the material. The questions thereby alter to: Can concrete be crafted? Can it be made visually appealing? Can they fit in a regular home environment? How different are they from ceramics? Can they be made lightweight? This section attempts to answer the questions above.

G

COMPOSITION

Concrete comprises of the following - Cement, Sand and Aggregates. These elements are varied in proportion and relative changes in weight, finish and workability is explored.

The following compositions were attempted :

1:1

1:1:2

1:2:4

FORMWORK

Concrete is primarily a semisolid. It requires a formwork to mould the material to the requisite form. Hence the formwork defines the form and its properties are thereby transferred to the material.

The following materials are used for making formwork:

Rusted Iron

Fabric (Plain)

Fabric (Textured)

Silicone/Rubber

Wood

Plastic

COMPOSITIES

Other materials can also be added to the concrete powder mix which contribute a change in the concrete property. The change depend on the characteristic of the material.

The following fillers were added to the mix :

Thermocol

Paper

Grated Fabric

Saw dust

Silica gel / Marbles

METHOD

The method of working with concrete and altering its process or sequence can lead to an alternate possibility of application in the field of concrete.

The following methods were attempted :

Wet

Dry

WORKABILITY

Concrete once moulded has very little room for alteration. Its important to understand the extent to which the material can be altered after setting. This is explored along multiple compositions of concrete.

The following techniques were attempted :
Drilling
Sanding
Cutting
Carving

MATERIAL COMBINATIONS

Unlike fillers and composites, layering and embedding materials do not alter the primary property of material but offer additional properties and finishes. Using other materials can alter the product experience.

The following materials are fused with concrete:
Silicone
Fabric
Foam
Paper
Wiremesh
Brass and Copper
Marble and Granite

TEXTURE

Concrete has a plain dull grey look. This can be modified by using appropriately textured materials as lining in the formwork.

The following textures were attempted :
Stripes
Weaves
Lace
Dimples

FINISHES

Concrete has a very characteristic hard and industrial finish which can be altered appropriately to provide a alternate statement and expression to the product.

The following finishes were attempted :
Exposed
Cement
Resin
Paint
Pigments
Effects

G1

MATERIAL EXPLORATION COMPOSITION

1:1

One portion of cement is mixed with one portion of sand. The resultant mixture is consistent and smooth.

Adv:
Good Workability after setting ; Clean grey finish

Disadv:
Uses large quantity of cement ; Heavy

Application:
Jewellery (Products small in size with detailing) and Finish.

1:1:2

One portion of cement is mixed with one portion of sand and two portions of aggregate - fine / coarse

Adv:
Clean Finish; Lighter than previous

Disadv:
Poor Workability

Applications:
Building systems, Tiles, All casted non altered products.

1:2:4

One portion of cement is mixed with two portion of sand and four portions of aggregate - fine / coarse

Adv:
Lighter than previous, Better Strength, Mosaic Finish

Disadv:
Very Poor Workability

Applications:
Building systems (areas that require better strength); All casted non altered products.

G2

MATERIAL EXPLORATION FORMWORK

G2

Polythene packets

Fabric

Two part Styrene moulds. One with two faces and base. The other with two faces

Hollow Plastic balls cut for a hemispherical form

Silicone moulds for baking used as a mould

Disposable cups and bowls - Use and throw formwork

Two part wooden mould without base. The were held to the table using plaster of paris.

RUSTED IRON / WOOD

Rusted Iron sheets are bent and welded to hold a particular form.
Wood is cut and joined to hold a specific form.

Adv:
Formwork can be used multiple times; Sharp Forms;Durable Transferred textures
Disadv:
Restricted number of forms; Comparatively expensive
Applications:
Basic available Formwork for all applications and Finish

FABRIC

Plain/Textured fabric are stitched to contain the liquid concrete in a required form.

Adv:
Can be Flatpacked; Soft Forms
Disadv:
Single use only; Holder required to hold the fabric in position(not self stable)
Application:
DIY products and as a Concept.

SILICONE/RUBBER

The required form is made is Wood/metal/Plastic and the liquid silicone is poured around the form to create the negative (mould) that can hold the liquid concrete.

Adv:
Complex forms; Visible Details; Multiple uses Easily removable formwork-Flexibility
Disadv:
Comparatively more expensive than regular formwork
Applications:
Small Products with details - Jewellery

PAPER/CARDBOARD

Thick Paper / Cardboard could be folded to hold the required concrete form.

Adv:
Can be Flatpacked; Cost effective; Can be folded to be self-stable.
Disadv:
Single use only;
Application:
DIY products and as a Concept.

THERMOCOL

Thermacol is used as a replacement to wood/Iron

Adv:
Formwork can be used a couple times, Transferred textures
Disadv:
Not durable;
Less number of moulds only
Applications:
Mainly as a formwork for Products that have sharp and soft form

OTHER PLASTICS

Similar to Silicone, Plastic moulds could be formed. The liquid concrete then is poured in the formwork and left to set. The formwork could also be 3D printed.

Adv:
Complex forms;
Visible Details;
Multiple uses
Disadv:
Comparatively more expensive than regular formwork
Applications:
Products with textures and complex forms

DESIGNING THE FORMWORK

1. The Formwork must allow itself to be disassembled.
2. The edges must not leaves gaps for the liquid concrete to seep out.
3. The mould have a base so the formwork could be manoeuvred for better flow into edges for the formwork
4. Grease/Oil/Soap must be used as a coating to avoid the concrete from sticking to the formwork
5. The formwork should allow the air to pass through for the concrete to set
6. Major part of designing with concrete is actually designing the appropriate formwork to receive the required form : DESIGNING THE NEGATIVE.

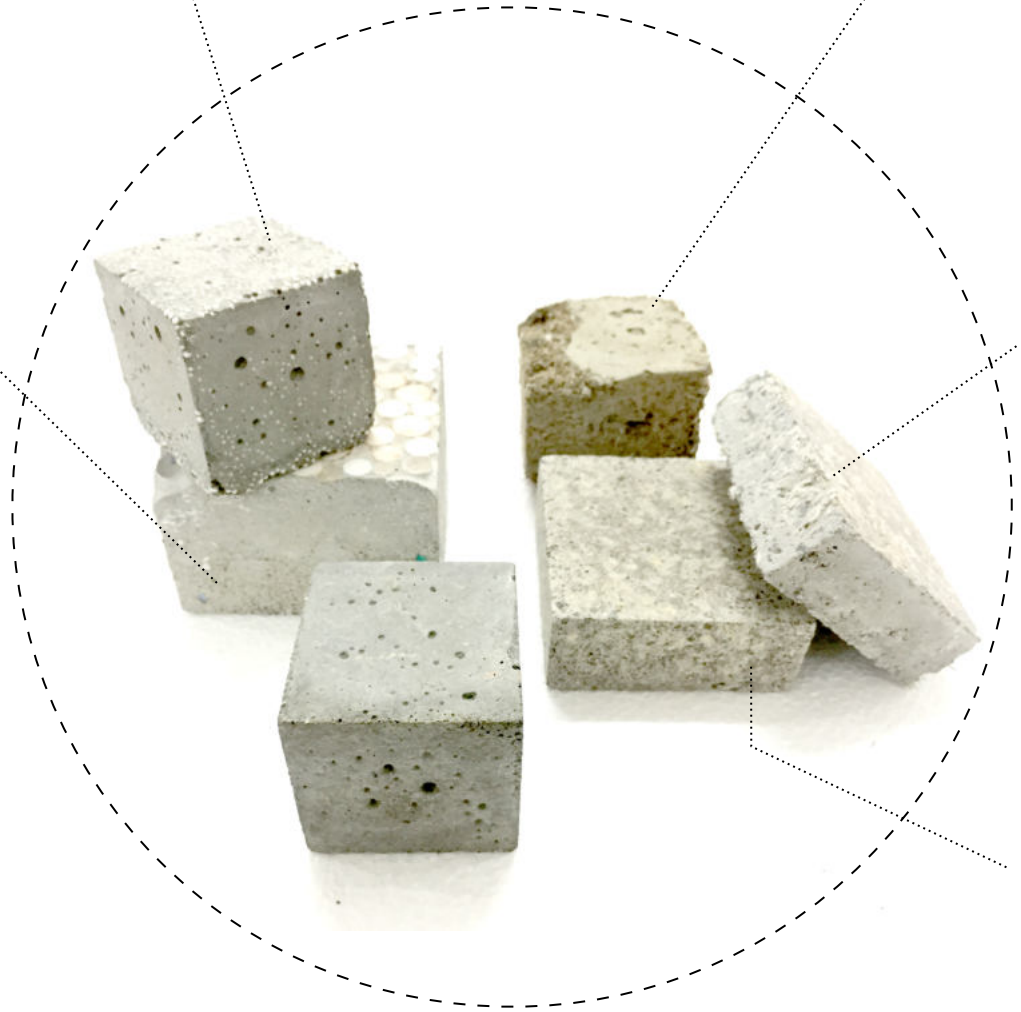
G3

MATERIAL EXPLORATION COMPOSITES

G3

Two portions of small polystyrene(Thermocol) balls mixed with one portion of cement and one portion of sand

One portion of sawdust with One portion of cement and one portion of sand



One portion of large polystyrene (Thermocol) balls mixed with three portions of cement and three portions of sand

One portion of grated fabric with one portion of cement and one portion of sand

Two portions of paper with one portion of cement and one portion of sand

G3

THERMOCOL

Polystyrene(Thermocol) balls are mixed along with cement and sand. The balls act as air gaps occupying volume.

Adv:
light weight

Disadv:
jaggered edges

Applications:
as a concept, non load bearing structures, doors,Homewares and Furnitures

PAPER

Paper is mixed with cement, sand and aggregates.

Adv:
weight - lighter than normal, Visual texture

Disadv:
not water proof

Applications:
Replacement for regular concrete.

GRATED FABRIC

Fabric prices are cut and mixed with cement, sand and aggregates.

Adv:
visual texture

Disadv:
jaggered edges

Application:
Homewares and Statement walls as a finish.

SAWDUST

Sawdust is mixed with cement, sand and aggregates.

Adv:
Better workability

Disadv:
Longer setting time

Application:
Replacement to regular concrete

METHOD

WET

The contents are mixed thoroughly with water and then poured into the mould.

Adv:
no possibility of failure

Application:
All Concreting works are done using this method.

DRY

One portion of cement is mixed with one portion of sand. The resultant mixture is consistent and smooth.

Disadv:
Possibility for failure

Application:
DIY possibilities and onsite manufacturing possible with this approach.

G5

MATERIAL EXPLORATION WORKABILITY

CUTTING

Excess material after setting can be cut of by a sharp saw, It must however be noted that chipping might occur in the edges.

CARVING

Information/Patterns can be carved within one hour from pouring the concrete. After this amount of time, the concrete starts to set and carving becomes disheveled.

DRILLING

Concrete can be drilled easily. It must however be noted that chipping might occur in the rear face and hence the process must be slow.

SANDING

The set concrete can be sanded for a flatter cleaner finish. A better procedure is to coat the set concrete with cement plaster and then sand to even.

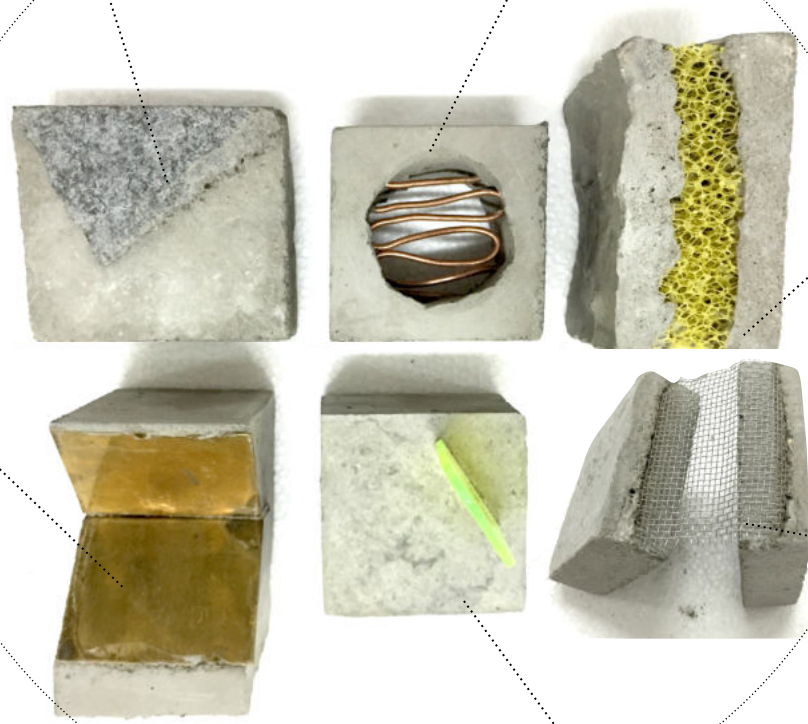
G6

MATERIAL EXPLORATION
MATERIAL COMBINATIONS

G6

Concrete and copper wires

Concrete and Granite



Concrete and sponge

Concrete and Brass Plate

Concrete and wire mesh

Concrete and acrylic

GRANITE/MARBLE

These stones can be casted along with concrete or later combined with an appropriate joinery.

Adv:
Texture addition
Disadv:
Weight
Cost

BRASS/COPPER

Brass/Copper in the form of rods, wire or sheets are casted along with the concrete or inserted after pouring.

Adv:
Addition of polish and color
Disadv:
Cost

PLASTIC

Plastic, acrylic sheets are casted along with the concrete or inserted after pouring.

Adv:
Transparency, Translucency, Color
Disadv:
Low value addition to the product

FOAM/SPONGE

Foam/sponge is embedded with the liquid concrete in the formwork.

Adv:
Flexibility, Filler material, Weight reduction
Disadv:
possibility for failure

FABRIC/WIREMESH

Fabric/wiremesh is embedded with the liquid concrete in the formwork.

Adv:
Flexibility
Disadv:
Embedding technique

INTERACTION ADVANTAGE

- Commonly available materials
- Sense of Familiarity
- Transfer of property to the combination
- Addition of qualities that is absent in concrete

DESIGNING THE POINT OF INTERACTION

- The materials must be a value addition and not overpower concrete.
- While casting, there is a chance for the material to sink within concrete. The dimensions and weight must take this aspect into consideration.

MATERIAL EXPLORATION FINISHES

Marbled concrete

Concrete with Sprinkled color

Concrete with dimples casted in vacuum formed LDPE

Concrete with coloured aggregate

Concrete with bamboo weave

Concrete with corrugated sheet

MARBLED FINISH

Ink droplets along the side of the formwork leaves concrete with a marbled effect.

Adv:
Texture addition
Disadv:
Careful Positioning

PIGMENT

Iron oxides mixed with concrete fills it with colour.

Adv:
Addition Color
Disadv:
Availability of a large color range

SPRINKLE

Oxides are sprinkled after pouring and before setting. The material take colour in those areas alone.

Adv:
Effect
Disadv:
Careful Positioning

PAINT

Concrete can then be spray painted or painted with brush after a even application of putty/mortar

Adv:
Colors, Material Illusion
Disadv:
Common Finish

DIMPLES

Pimples on the formwork create dimples on the material

Adv:
Tactile texture
Disadv:
Only Plastic formwork

CORRUGATION

Texture are created with lining corrugated sheet in the formwork

Adv:
Tactile Texture, Strips
Disadv:
Not very sharp and neat.

WEAVE

Bamboo/Plastic weaves can be used as lining or as formwork.

Adv:
Transfered texture
Disadv:
Alteres the material texture.

IDEATIONS

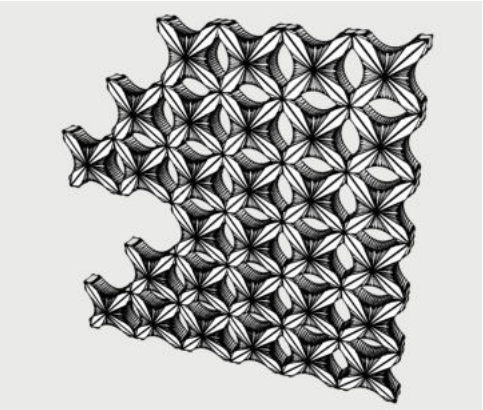
While materials such as glass, acrylic, copper, brass etc are commonly used in Lifestyle products, concrete has a rugged Industrial appearance. Combination of these materials provides a consumer with a sense of familiarity thereby easing the entry of concrete into the lifestyle scenario. Copper and Brass have a sense of polish and elegance which define 'lifestyle' and concrete as a material lacks this. Hence these materials and this contrast of character is predominantly used in the following ideations. **The ideations have been spread acrid various fields - Structures, Furnitures and Lifestyle Products. The design ideas are shown in their multiple stages - Sketches, 3D models and Renders.**

H1

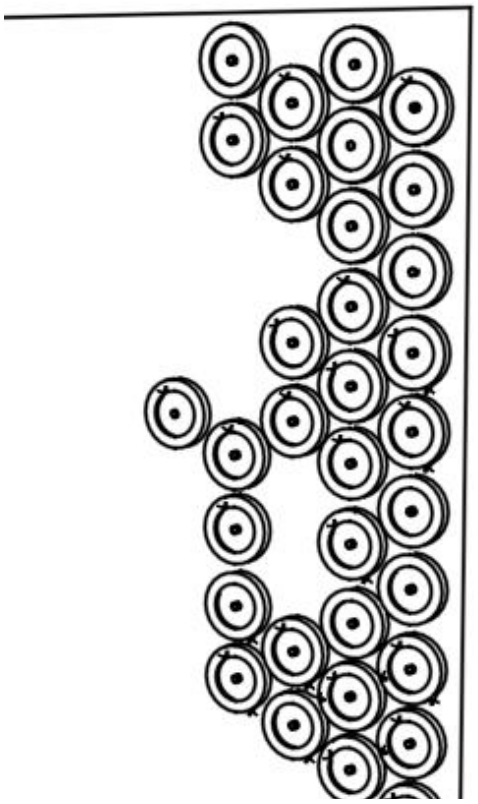
ARCHITECTURE INFRASTRUCTURE

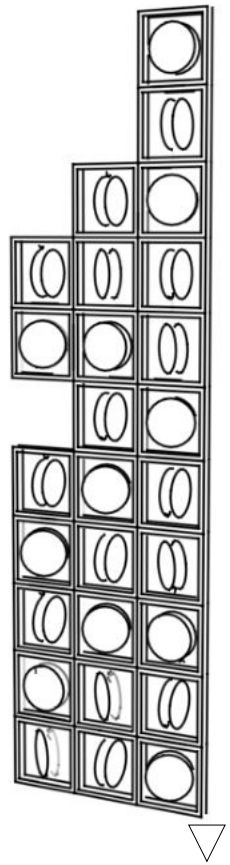
MATERIAL ADVANTAGE : Mould-ability, durability and fit for outdoors
DESIGN SCOPE : Form and Formwork, Modularity and connections.

MODULAR PARTITION BLOCKS
Each of the casted block has embedded poles and rod that could be inserted and interlocked to form the partition lattice.



CLADDING TILES
Casted concrete pieces can be individually attached to the wall to form a respective pattern. Metal bolts hold the concrete in place and add a feature to the design.

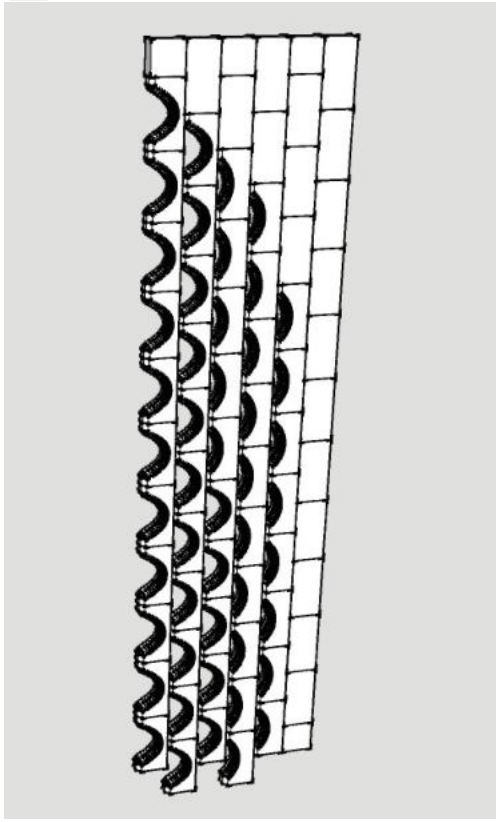


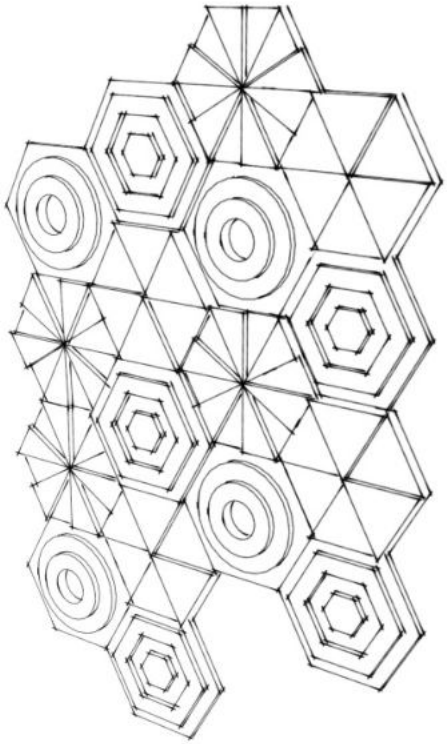


INTERACTIVE PARTITIONS
Casted concrete blocks with independently moving centres (wood/ polycarbonate) that rotate with wind or by hand.

GREEN WALL
Hollow blocks can be casted which can be added as a planter box for compound walls or as green wall partitions.

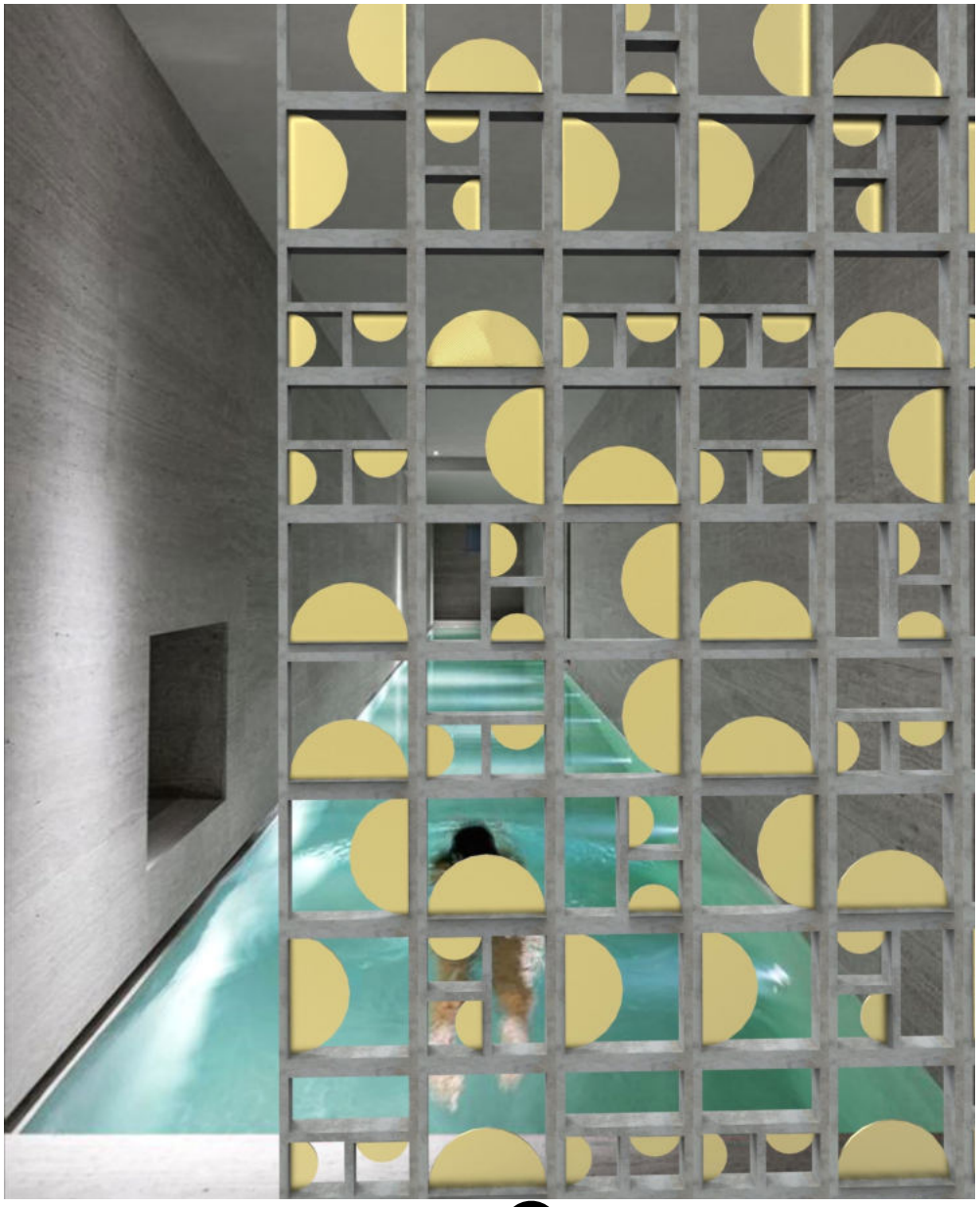
PARTITION BLOCKS
A set of three moulds that offer a pattern within the partition





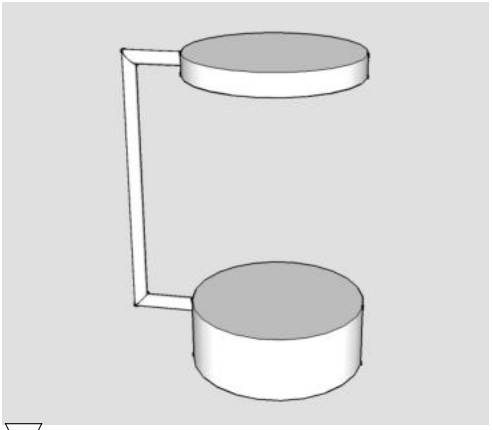
RELIEF TILES
Similar to ceramic tiles, 3D tiles can be casted

SPACE DIVIDERS
Cut Brass plates are casted with the square concrete outlines.

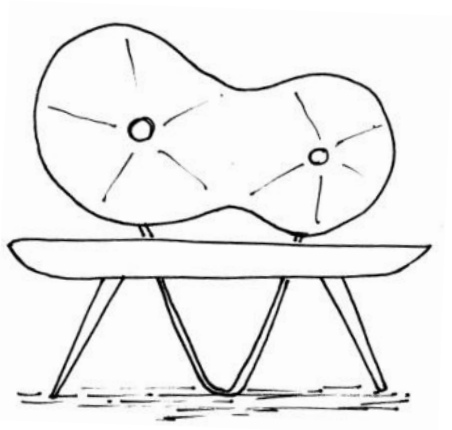


LANDSCAPE ELEMENTS

MATERIAL ADVANTAGE : Mould-ability, durability and fit for outdoors
DESIGN SCOPE : Form and Formwork, Function and Environment

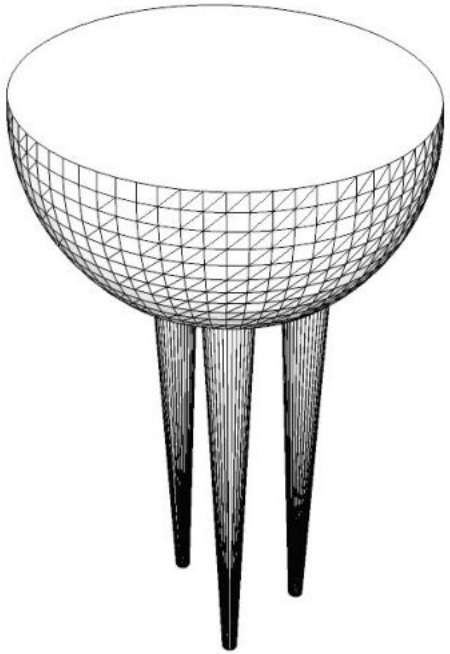


SEATER I
Cantilevered concrete flats held with heavy bottom holding a light or a planter.

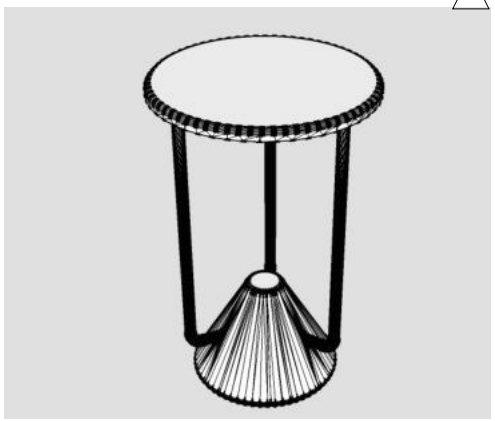


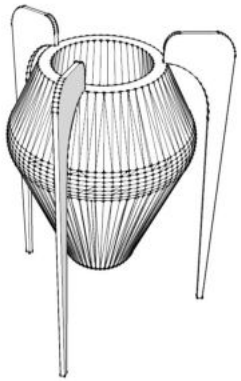
DILEMMA | OUTDOOR SOFA
Concrete casted in flex/ fabric takes the form of a cushion to give an impression of softness and comfort in the outdoors.

TABLES
Metal Legs casted with concrete hemisphere



SEATER II
Concrete flats held with heavy bottom holding a light or a planter.

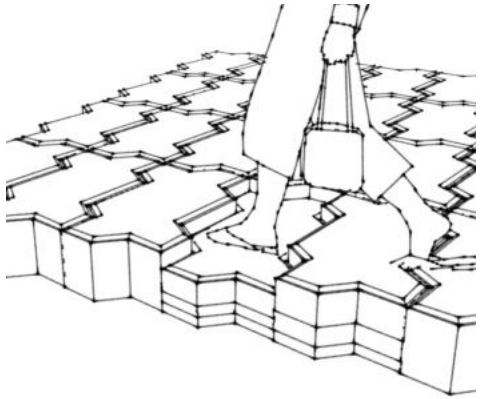




GARDEN LIGHTS
Concrete light holders with sharp metal legs can be created that can be dug into the ground. The spider lamps can be focussed to either light the grass or the area.

SEATERS III
Cantilevered concrete flats held with heavy bottom holding a light or a planter. Can be used for Bus stops and other areas with moving crowd

SOFT PAVERS | URBAN INSTALLATION
A few paver blocks can be casted with a layer of foam and blended with the regular blocks. They add a spring to the regular walkway.



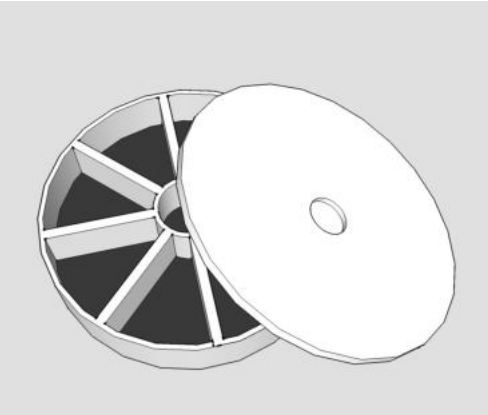
SEATERS IV
Concrete cylinder held with metal flats.

CONCRETE CUSHIONS
Concrete casted in flex/ fabric takes the form of a cushion to give an impression of softness. They are held in place with metal legs.

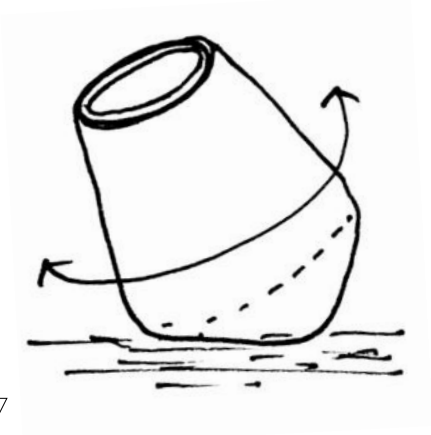
H3

HOUSEWARES A

MATERIAL ADVANTAGE :
Mould-ability, durability, weight and material image
DESIGN SCOPE : Form and Formwork, Detail

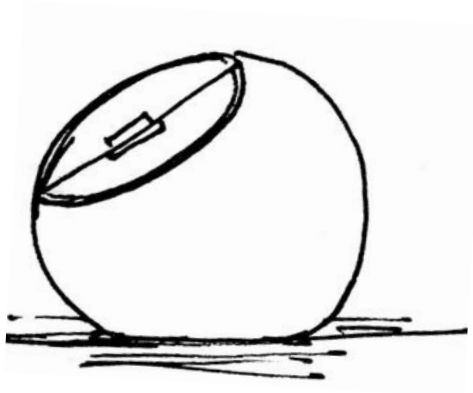


CONTAINERS
Concrete is primarily a ceramic and this property allows its use as containers such as spice boxes in houses or restaurants



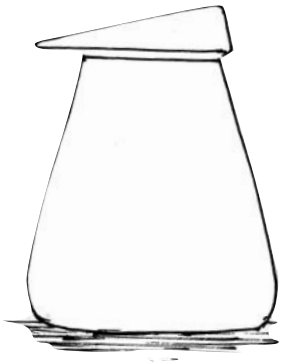
TABLEWARES
Salt and Pepper shakers could also be made in concrete. The form allows them to becomes more dynamic both visually and playfully, primary for restaurants.

SINKS
The durability combined with its industrial look when combined aptly leads to its use as outdoor sanitary wares and vessels.

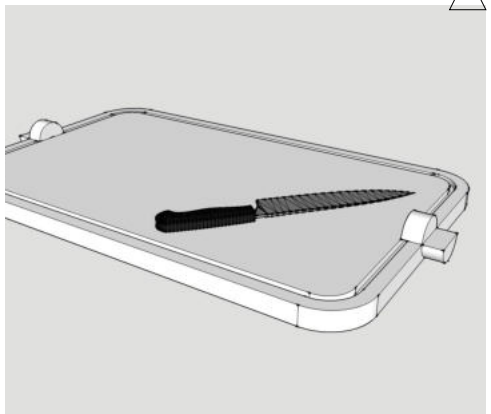


CENTREPIECES
Concrete fruit bowls and containers work as tablewares that are rarely displaced.

TABLE WARMERS
The fire resistant quality could make concrete a material to be used as table warmers for teapots, mugs and small utensils. The central niche holds the candle/ camphor while the slits allow the air for the fire when the crockery is placed on the coaster.



BOARDS n TRAYS
Concrete flats with appropriate details could be made as serving trays and cutting boards

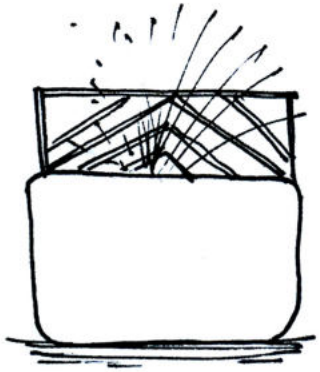


CONTAINERS
Concrete is primarily a ceramic and this property allows its use as storage containers in houses and restaurants.

H4

HOUSEWARES B

MATERIAL ADVANTAGE : Mould-ability, weight and material image
DESIGN SCOPE : Form and Formwork, Material combination, detail



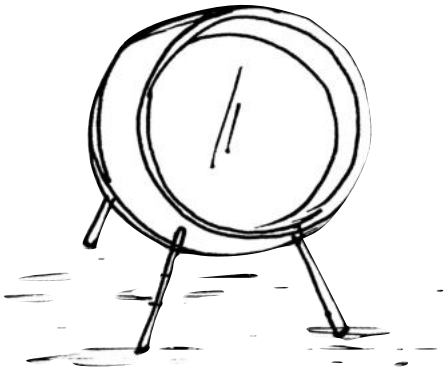
PLANTERS
Table top planters fused with brass intricacy.

CLOCKS
These get rarely displayed and the weight of concrete gets acceptable in this area of products.

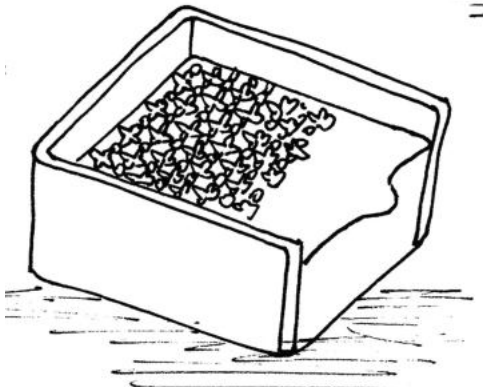
BOOKENDS
Concrete's characteristic weight puts it for this obvious use. Minimalistic animals can be themed with the combination of laser cut metal pieces for head and and newspaper holder as body

TABLELAMPS
The base form serves as the holder for the bulb and neck. Balance in weight could be a playful attribute in such products.

MIRRORS
Concrete casted with mirrors held at an angle with sleek metal legs



BOX
Concrete box with brass laser cut intricacy as sliders

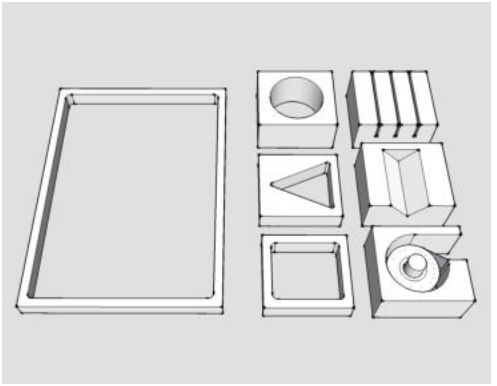


MANTLE PIECES
The combination of aesthetics, weight and material make them apt mantle pieces - coin banks, mirrors, clocks, lights etc.

H5

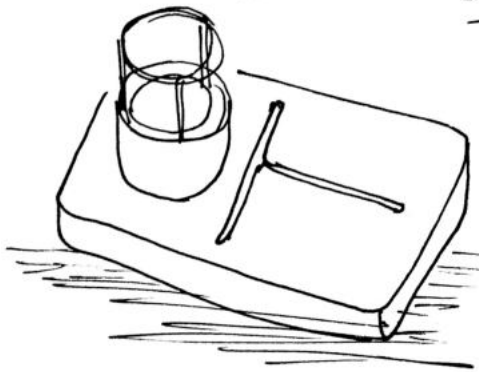
OFFICE PRODUCTS

MATERIAL ADVANTAGE : Mould-ability, weight and material image
DESIGN SCOPE : Form and Formwork, Material combination, detail

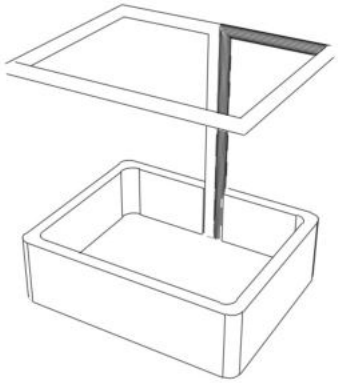


OUTLINES
The concrete set the outline on the desk to mark the area for loose papers and clips

BATH
The holder with the tray and cylinder fits as an accessory for bath

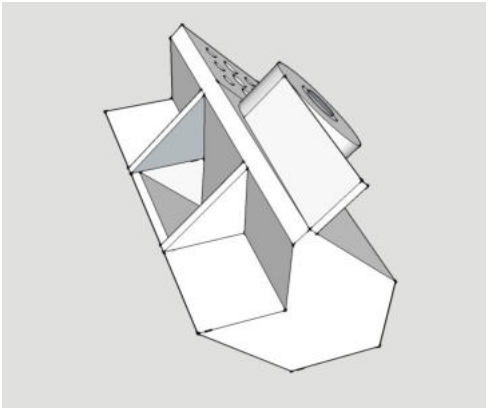


WIRE n BLOCK
The heavy concrete holds the wireframe at planes that create volumes to hold pens and tapes while the slits hold memos. Niches are provided within the concrete solid to hold the little things

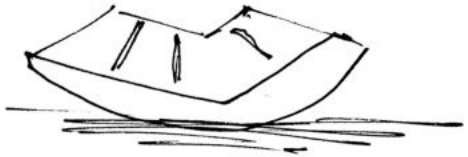


HOLDER
Concrete base casted to hold the clean bent wire creating enough volume accompany the wash basin.

BLOCK
Solid block of concrete with appropriately sized niches and pores



SOAP
Concrete form casted to hold soap



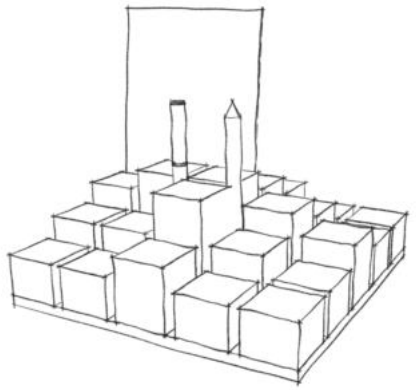
TRAY
Concrete tray casted to hold stationary. The brass poles helps the concrete base with organisation and elegance

H6

SMALL OBJECTS

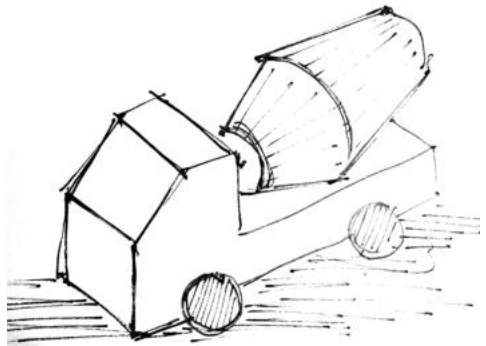
MATERIAL ADVANTAGE :
Mould-ability and material image
DESIGN SCOPE : Form and Formwork, concept and detail

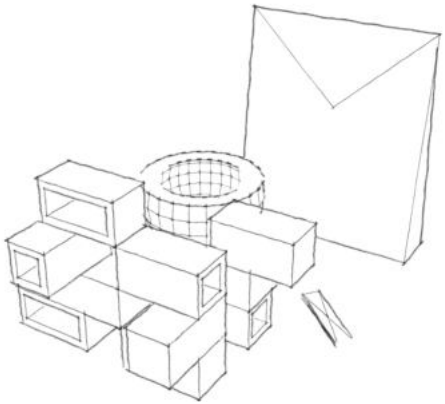
REPRESENTATION
Objects inspired from architecture, here, the holocaust memorial is transversed to a desk accessory



PEN'DRIVE
USB chips casted with concrete in the dimensions of a pen.

COLLECTIBLE
Toys in concrete that relate to the use of material, here, a concrete mixer vehicle.

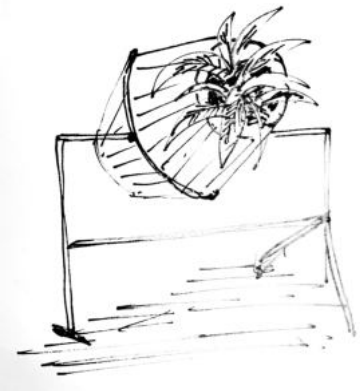




MASONRY
A mix of solid and hollow scaled sized bricks with a packet of cement and mixing bowl - A DIY brick set along the lines of lego reflecting the actual masonry

SMALL BOOK
The small book is a book end that uses its weight for the purpose and blends itself with the stack

MIXER
The characteristic form of the mixer bowl used as a holder



MAGNET
Fridge magnets of classic architectural styles - columns, facades, etc

J

DIRECTIONS

Designing
WITH
a material

Designing
FOR
a material

Using the material in ways that expose its strengths, its natural appearance, and its intrinsic qualities

A material has two overlapping roles : that of providing technical functionality and that of creating product personality. This direction bridges this gap and explores methods and ultimately design tools that weave the two strands of thinking into a single integrated fabric.

Create objects, each exploiting the unique qualities of the materials with which they work - an integrity to product and material.

Using the material in unfamiliar ways offering the potential for a novel design

Design integrity is a quality that consumers value, but they also value other qualities " humour, sympathy, surprise, provocation, even shock and often it is achieved by using materials in ways that deceive or inspire. Honesty and authenticity are an important part of design, but so is invention and expression.

Create objects that counteract those characteristics that are usually ascribed to the material

DIRECTION {+}

CHARACTER

ARCHITECTURE and INFRASTRUCTURE

Modular Blocks
Space Dividers
Partitions
Relief Tiles
Cladding

LANDSCAPE ELEMENTS

Outdoor seating
Pathway lights
Paver Blocks
Planters
Garden accessories

HOUSE and SANITARY WARES

Cutting boards
Table warmers
Servers
Tableware
Sinks
Basins
Bath

DIRECTION {X}

HOUSEWARES

Lamps
Containers
Mantle pieces
- Bookends
- Mirrors
- Piggybanks

OFFICE PRODUCTS

Table lamp
Desk accessories
- Pen holder
- Card holder
- Memo holder
- Pins and staple storage
- Tape dispenser
- Paper weight

SMALL OBJECTS

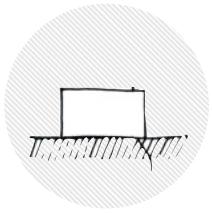
Knobs
Magnets
Toys
Jewellery

IMAGE

Concrete since its invention has been primarily used as a product of utility and function. This projects and this direction{X} aims at bringing it to a forefront in the lifestyle scenario.

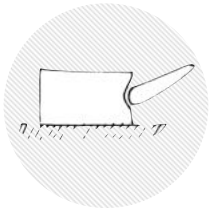
K

MATERIAL INTERPRETATION

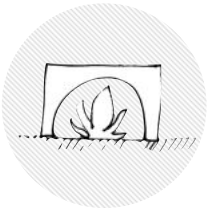


1. HEAVY
To use this attribute of concrete into an appropriate product of everyday use.

2. LIGHT
To project this attribute as a possibility for the material for an appropriate product that can celebrate the difference in weight.



3. SOFT
To utilise the mould ability of the material to display the attribute that is not not its inherent material quality, in a product befitting this dilemma.



4. CHARACTER
To showcase the primary characteristics of the material in the product

5. DIY
To convey this feature as a potential opportune area. within the material

DESIGN
THE COLLECTION

CONCRETE REFERENCE

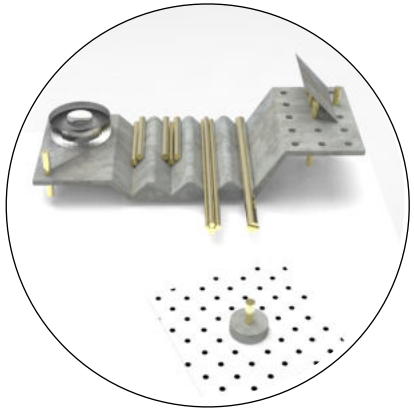
The collection exemplifies the material with its interpretation in use. Each of the products have a link that connect and remind of the existing common that is translated by the material, making it a novelty.

L

HEAVY | BOOKEND

1.CONCRETE XXS

Bookends are products that accept weight as a feature. Concrete being inherently heavy is made to pose as one of the books - a Concrete book Bookend.



LIGHT | DESK ACCESSORY

2.OVERHANG

This desk accessory made of concrete is lighter than one imagines the material to be and the paper weight with the same material questions the difference.

CHARACTER | WARMER

3.HEARTH

Hearth, the table warmer showcases three properties of concrete - water resistance, heat resistance and weight, a take on the table coasters.

DIY | TOY BRICKS

4.MASONRY

Concrete blocks are primarily used as construction blocks. 'Masonry' is a scaled version where the user gets to build their own sculptures/buildings with cement mortar.

SOFT | OUTDOOR SEATER

5. DILEMMA

Softness is generally attributed to cushion and comfort, concrete takes that shape, literally. The indoor cushioned seater is translated to an outdoor item with the hard concrete imitating the softness leaving the user with the dilemma between soft and hard.

L

CONCRETE XXS

SIZE:
145 x 105 x 70mm

PROTOTYPE MOULD:
Laser cut acrylic layers
POP

PRODUCTION MOULD :
Cast Iron

COMPOSITION:
1:2:4 , Blue Iron Oxide

DESIGN SCOPE:
Detail

FUTURE SCOPE:
Mantle Pieces
Souvenirs

OVERHANG

SIZE:
100 x 350 x 75

PROTOTYPE MOULD:
Laser cut acrylic layers
Wood

PRODUCTION MOULD :
Silicon

COMPOSITION:
1:2:2 , Thermocol

DESIGN SCOPE:
Slopes and Form

FUTURE SCOPE:
Office Products
Souvenirs

HEARTH

SIZE:
120mm dia x 60mm

PROTOTYPE MOULD:
Laser cut acrylic layers
Thermocol

PRODUCTION MOULD :
Silicon vessel with Thermocol insert

COMPOSITION:
1:2:2

DESIGN SCOPE:
Slits and Slope

FUTURE SCOPE:
Size variations for various utensils

MASONRY

SIZE:
50 x 25 x 25mm solid
25 x 25 x 25mm color
50 x 25 x 25mm hollow
Paper Packets, Bowl and Spoon

PROTOTYPE MOULD:
Lasercut Acrylic layers
Styrene

PRODUCTION MOULD :
Silicon

COMPOSITION:
1:2:2

DESIGN SCOPE:
Manual and Variation options

FUTURE SCOPE:
Other DIY products painting kits, Relief moulds.

DILEMMA

SIZE:
600 x 400 seat
700 height

PROTOTYPE MOULD:
Plastic Bag and Rope

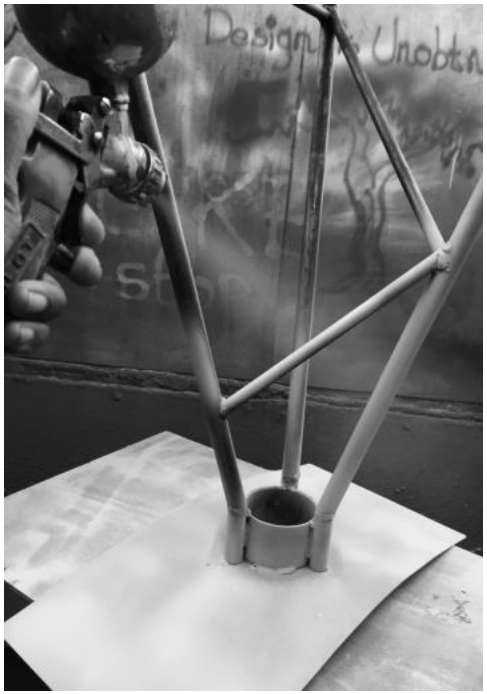
PRODUCTION MOULD :
In Situ Plastic bag with marking for ropes with stand as moulds

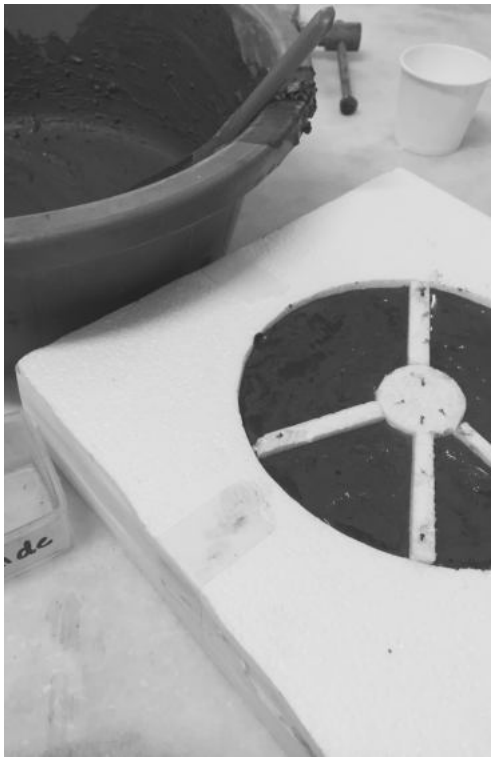
COMPOSITION:
1:2:4, Thermocol

DESIGN SCOPE:
Metal Stand variations

FUTURE SCOPE:
Fabric Forming
Offsite Production and Transport

L





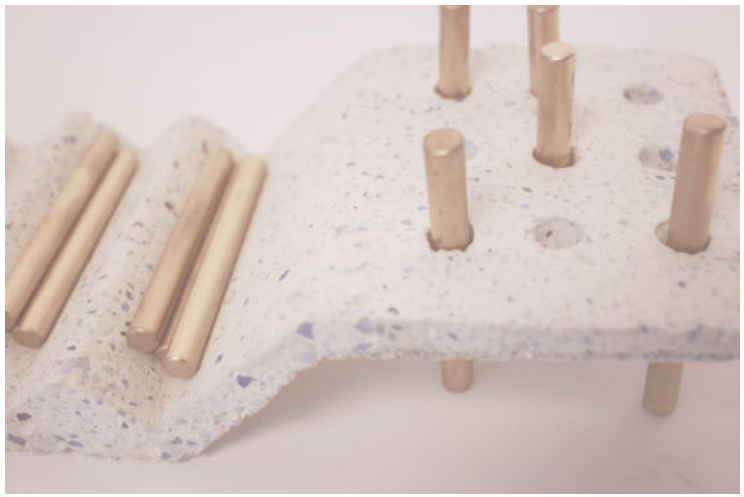

CONCRETE


CONCRETE


MASONRY
INSIDE
MOULD
MASONRY

L


CONCRETE REFERENCE




CONCRETE REFERENCE
MASONRY
OVERHANG
HEARTH

M

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Books

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Concrete - Phaidon
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