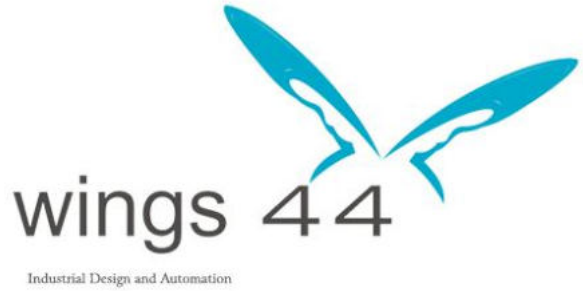


Project 1

Report Book

Shashank Nilesh Sawant

126130012

(2012-14)

acknowledgements

I wish to express my deep gratitude towards Mr.Amey R. Ghatge (proprietor, Wings 44) without whom none of this would have been possible.

Humble, soft-spoken and wise, I have learnt a lot from him.

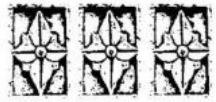
Further I must acknowledge the support, technical and otherwise, from the entire team of Wings 44. The acknowledgement, and consecutively the report, would be incomplete without thanking Mr.Satish Waghmare, Mr.Santosh Khot, Mr.Rupesh Dhanawade, and Mr.Avdhut Kashid.

I also express my thanks to Prof R. Sandesh, and Prof.Purba Joshi for encouraging me to embark upon this internship and their constant support.

-Shashank Nilesh Sawant

126130012

CONTENTS



...to the city of Kolhapur

"Please come, I am in Kolhapur"

Amey R. Ghatge

Tuesday, May 7, 2013 at 11:07 AM


wings44

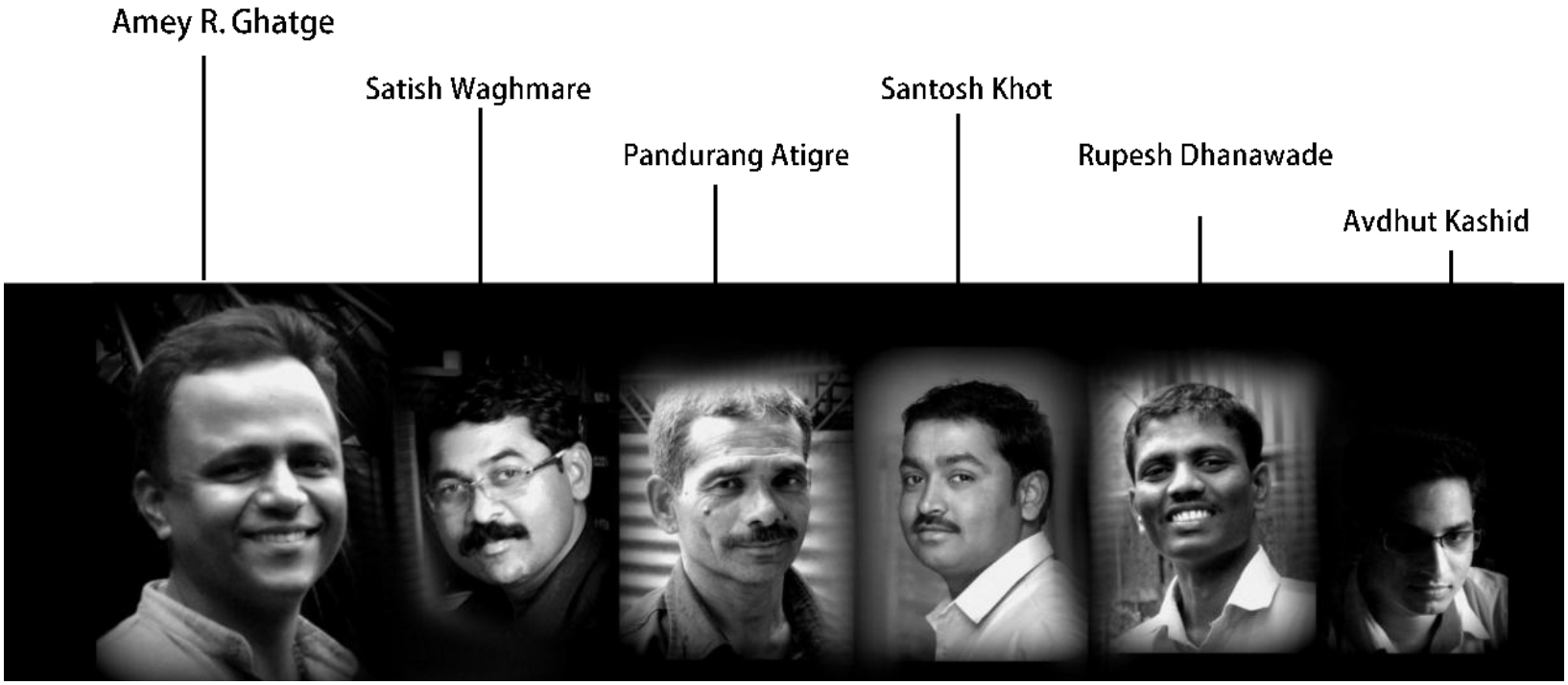
wings 44: the company

Overview

Wings 44 is an industrial design firm that operates from Shiroli MIDC, outside Kolhapur city. It was founded by Amey R. Ghatge, an IDC alumnus. Wings 44 specialises in Material handling and storage, Industrial furniture and Automation. It strives to keep 'man' as the main element around which the design process revolves including machine, environment, manufacturability and economics.

Their products include:

- Industrial cabinets and lockers
- Conveyors
- Mesh bins and pallets
- VMC/HMC Adapter storage
- Assembly inspection stations
- Hand tools stations
- FIFO racks
- Industrial washing machines
- Trolleys


Amey R. Ghatge
Satish Waghmare
Pandurang Atigre
Santosh Khot
Rupesh Dhanawade
Avdhut Kashid


Design & Development
Manufacturing
Purchase

Setup

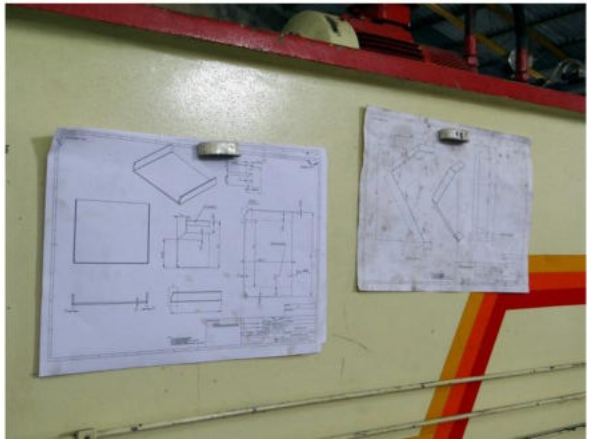
Wings 44 is very well organised into two prominent divisions, both in constant consultation with Mr.Amey R. Ghatge.

- Design & Development team: Brainstorming, ideation, concept generation, market study, CAD modelling
- Manufacturing team: Fabrication, materials and process selection, advising design team on manufacturing constraints

Apart from this, a small team also handles the purchases, stock and dispatch details. There are around 20-25 skilled workers, each specialising in different metal fabrication processes. The shopfloor is categorised accordingly into the following sections:

- Sheet metal work (including shears and bending machines)
- Powder coating setup (including treatment tanks, a spray-cabin and a diesel-powered kiln)
- Gas welding machines
- Presses
- Tool corner
- Automation lines and inspection area
- Storage for stock, sheet metal and other inventory (Pipe and channel storage and processes in an adjacent shed)
- Dispatch counter

Shearing



Images (clockwise from top right): *1.The hydraulic variable rake-angle shearing machine (loading side) 2. Details of job 3.The hydraulic variable rake-angle shearing machine (backside) 4. Control Panel 5. Hold-down cylinders*

Bending

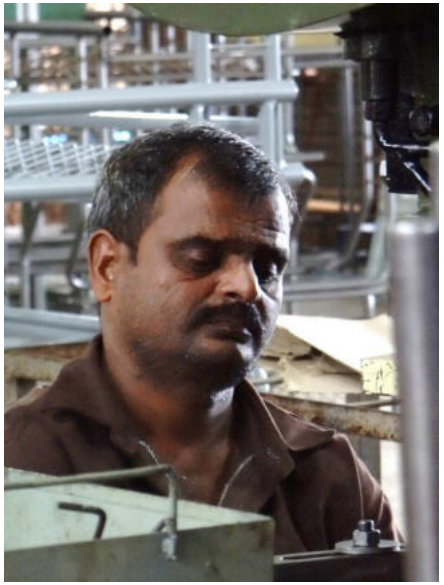
Images (clockwise from top right): 1.Hydraulic Press Brake 2. Punch & die details 3. Manual bending machine

Mechanical press

Images: 1.Eccentric press 2. Details of punch & die (type 1) 3. Details of punch and die (type 2)

Powder-coating

Images (clockwise from top right): 1.Spraying the resin powder 2.Processing tanks 3.Mixture controller 4.Tray for heating in kiln



Images (clockwise from top right): 1.Working on the press 2.Grinding 3.Welding

Wings 44 clientele

- Kirloskar Oil engines (Pune, Kagal, Rajkot)
- Kirloskar brothers (Kirloskarwadi)
- Advik Hi-tech (Pune, Manesar, Bangalore)
- Hindustan Coca-Cola
- Mahindra two-wheelers
- DSK automobiles
- Volkswagen India
- Bajaj Auto
- JCB India
- Emerson climate technologies


MOTOR
HARLEY-DAVIDSON
CYCLES

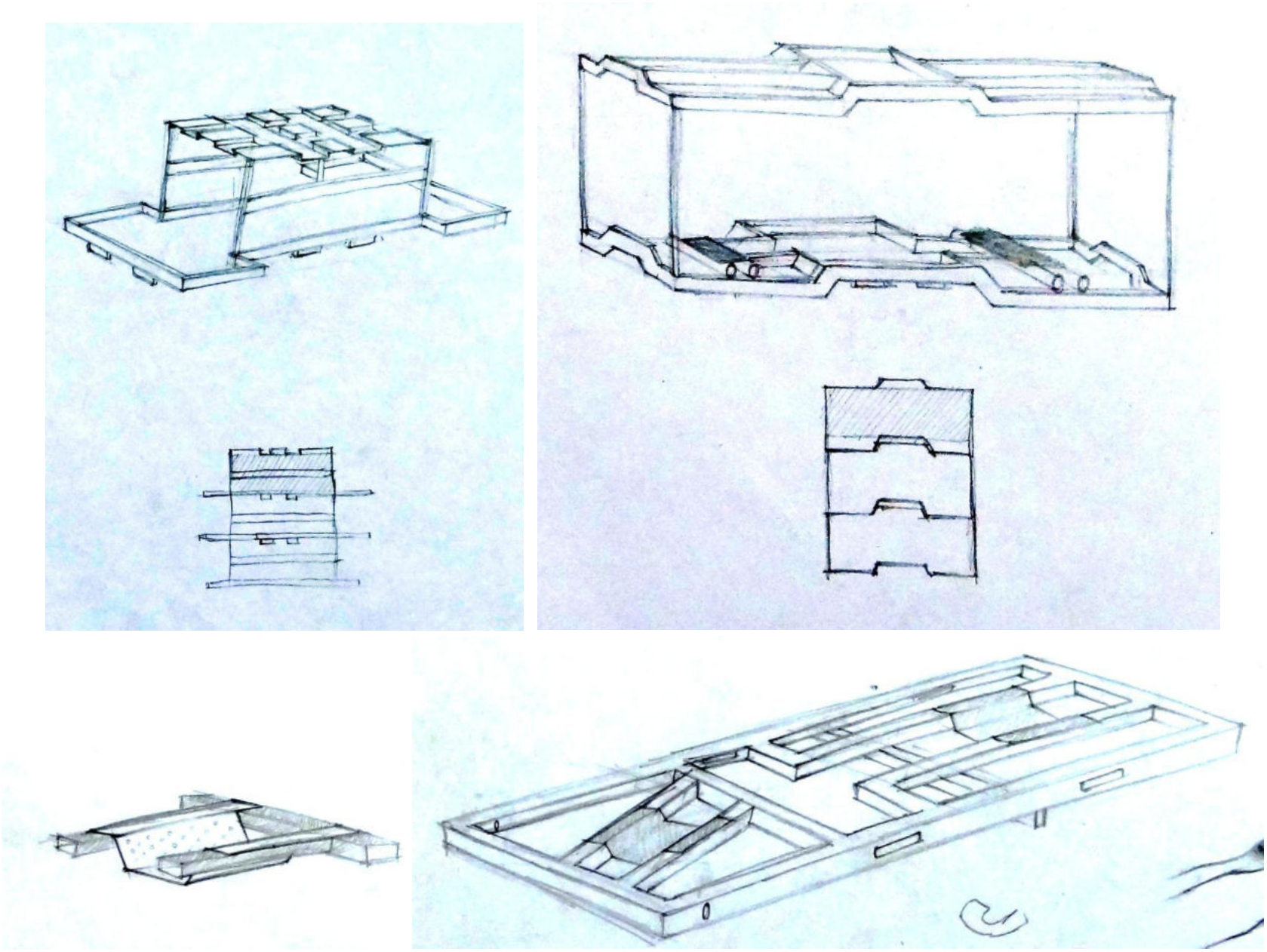
Motorcycle delivery system for Harley Davison India

Problem: Harley Davidson Motorcycles are premium motorbikes, originating from the USA. H-D India has a knock-down assembly plant in Bawal, Haryana and only 6 dealerships across the country. They manage to sell one of these premium bikes per month. Current shipping solutions for Harley Davidson bikes in India are the same as the standard solutions in the U.S. However the shipping costs may go upto as high as $375. In India, these are to be met in $125 i.e. within Rs.7500. The original designs for the shipping crates is imported from Wright firm.

Design Statement: Achieve effective delivery system (crate) for transporting Harley Davidson bikes within India and for importing. There should be considerable reduction in weight (upto 40kgs from existing 73kgs) and in price.

As per given drawings, a trial crate was built. Due to unavailability of 45mm square pipes for the vertical frame, 40 mm square pipes were used with packing in it. Accordingly an inspection report was created. It accounted for the deviations and the adjustments, in terms of weight and overall dimensions. Sample sheet shown below.

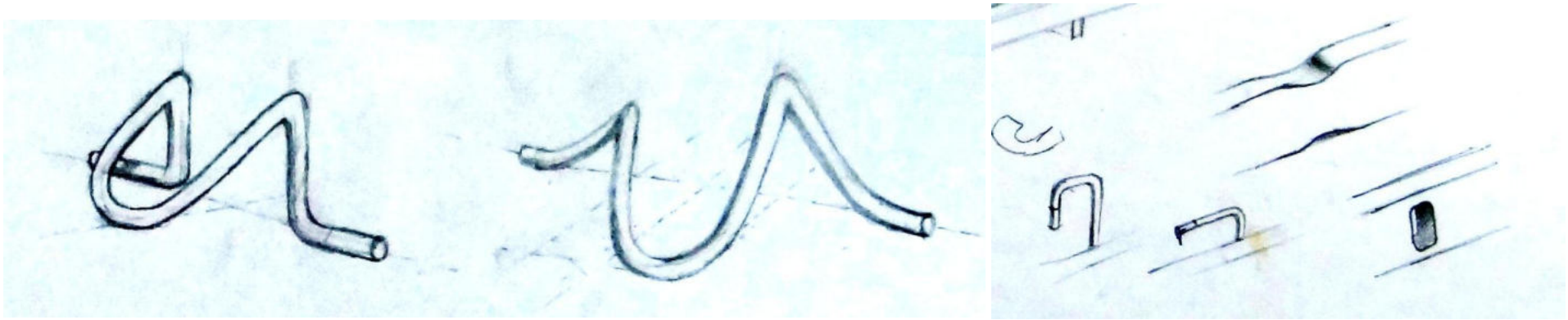
Item No.	Part No.	Qty.	Material	Dimension		Welding	Grinding	Weight	
				Design	Actual			Design	Actual
Base components									
Top components									
Assembly components									



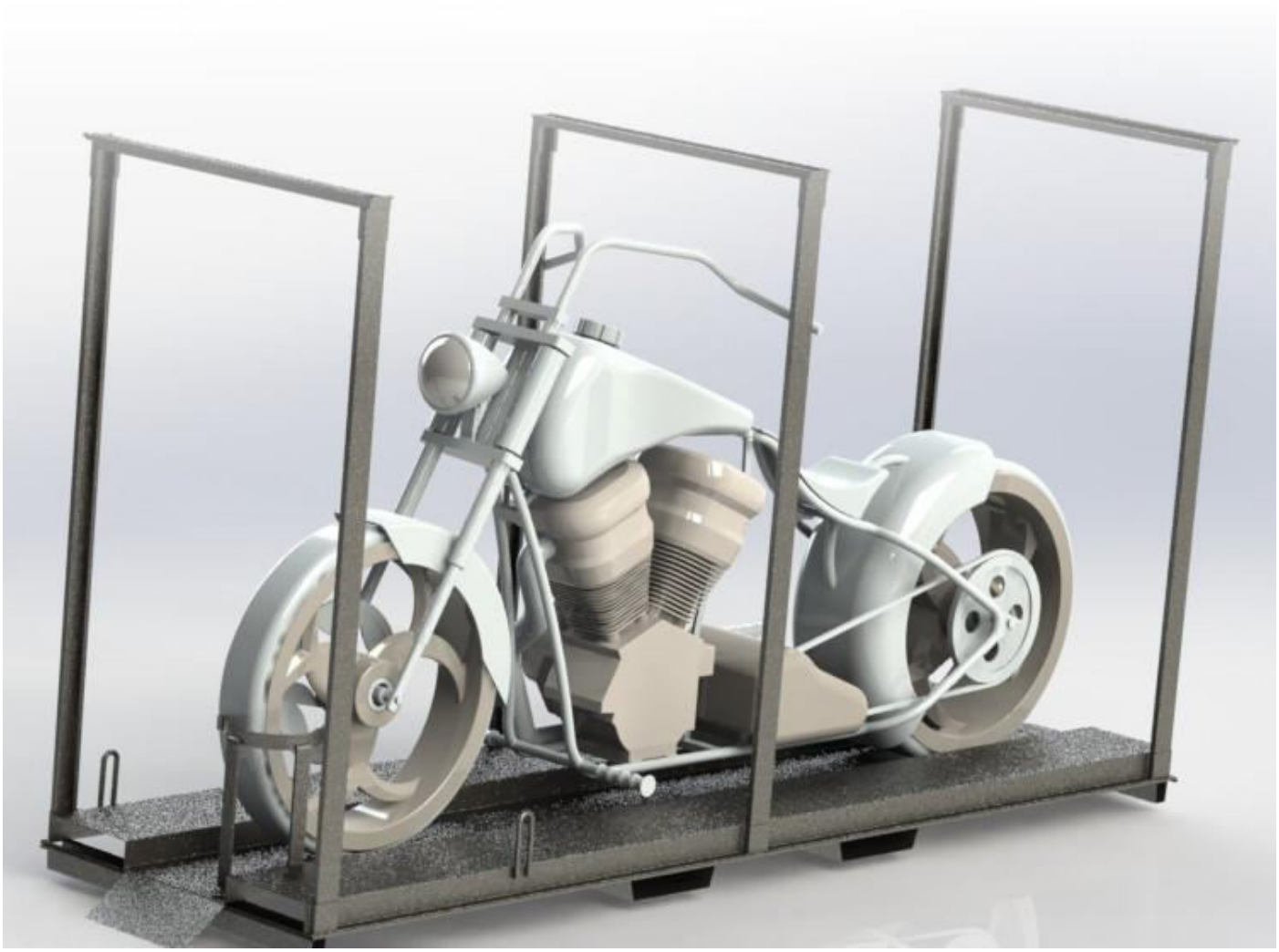
Images (clockwise from top right): *1. Stacking option1 2. Crate with front tyre support at an angle 3. Typical front tyre support 4. Stacking option2*

Suggestions made by design team

- 110cm Length for forklift support can be reduced
- Use of slightly thinner frames
- Redesign of front wheel support
- Remove/redesign top frame (thus reducing weight by ~12kgs)
- Redesign hook for front handle
- Redesign shopfloor for loading/unloading
- Relook at stackability options, redesign stacking cups



Images: *1. Redesigned front tyre support 2. Concepts for tying rope attachment*

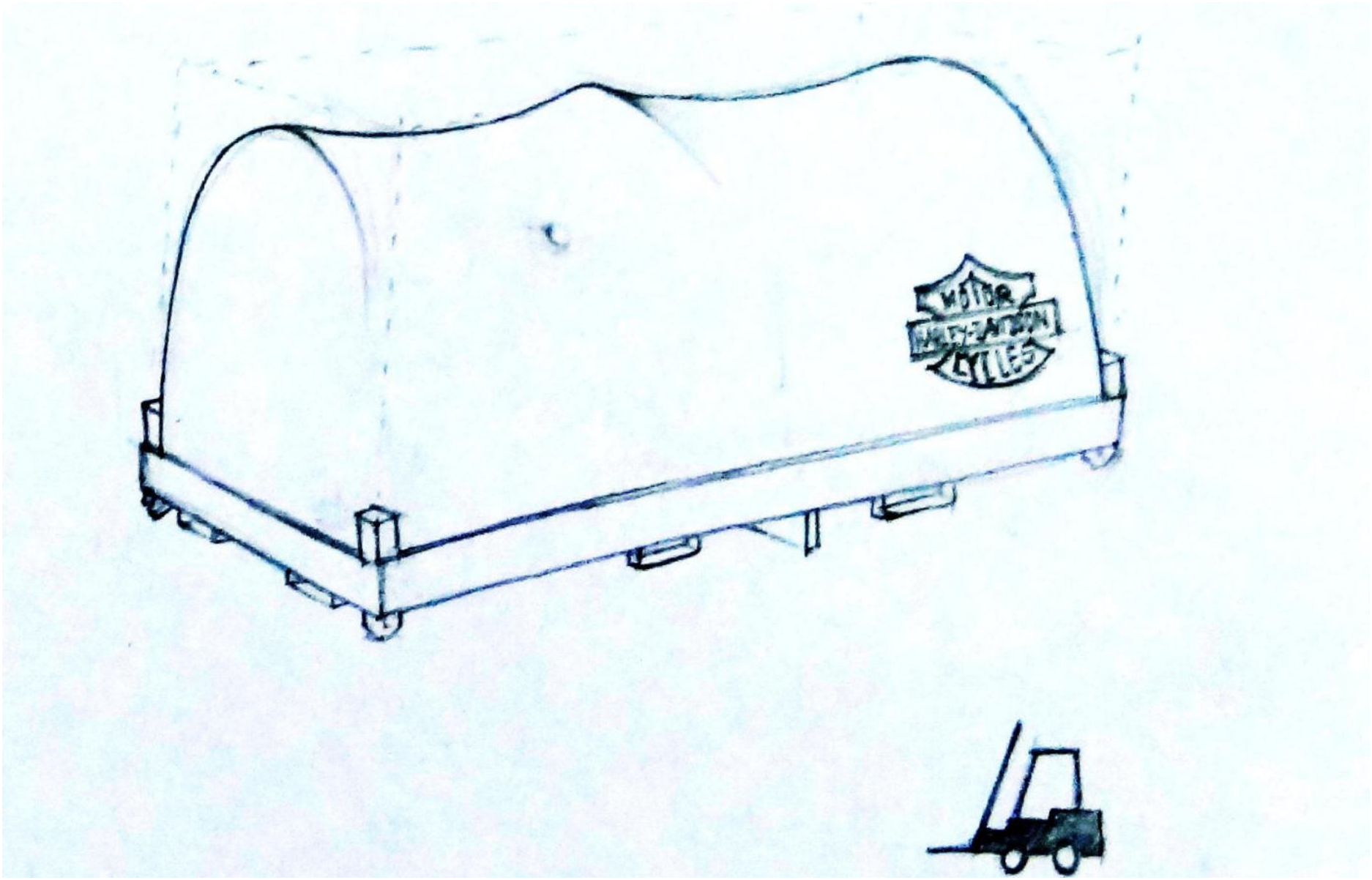


Proposed concepts

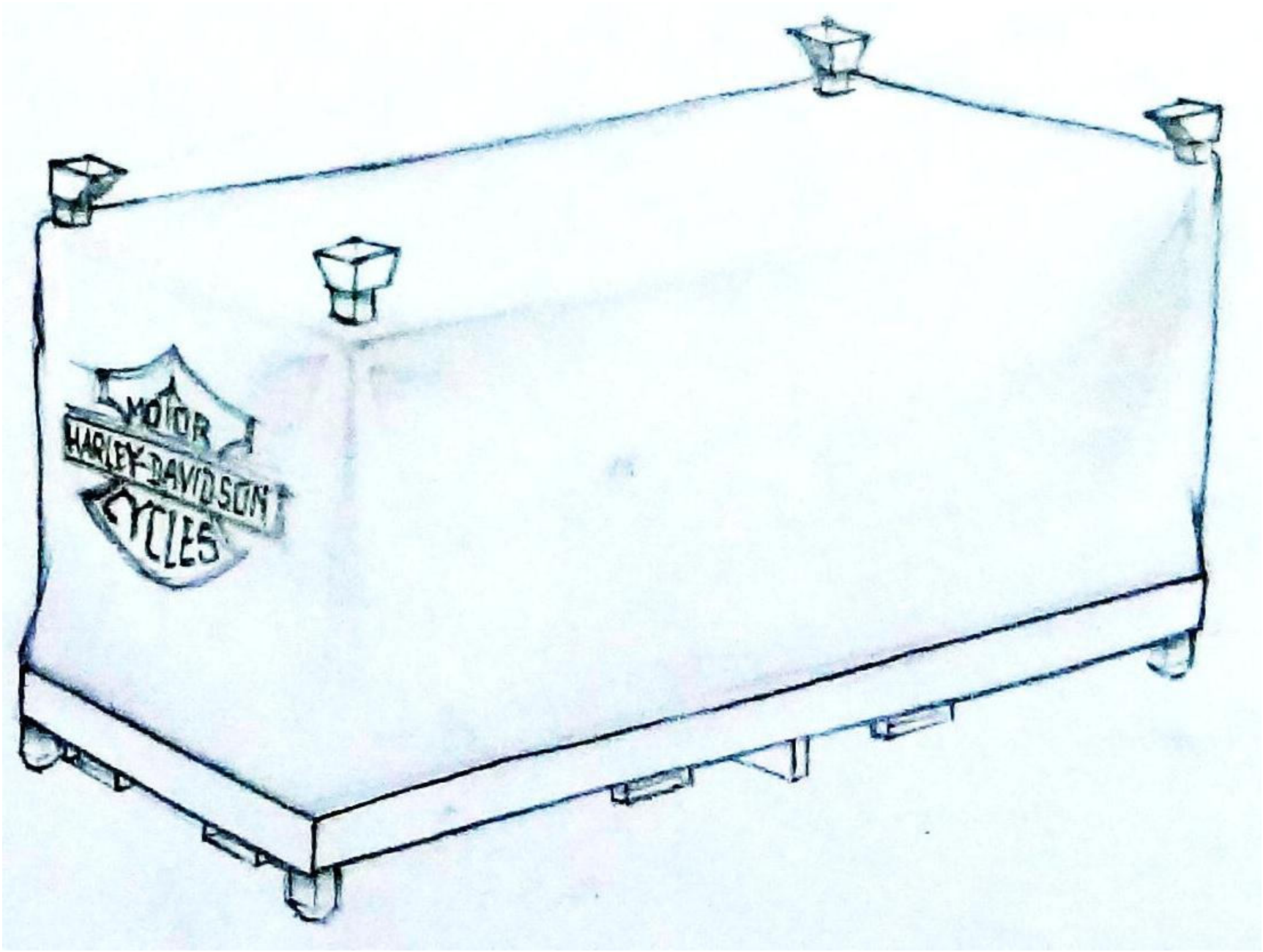
Before taking the trial crate to Harley Davidson's knock-down plant in Bawal, Haryana some concepts were shortlisted. It was decided to eliminate the top frame from stacking point of view. Also, the cardboard box that was to cover the crate was done away with. The bike was now to be wrapped in a thin film. Some more covering options were suggested by Amey Sir.

- Sliding corrugated plastic frames on all sides
- Flex cloth covering for entire crate
- Tent-like covering of flex cloth
- Collapsible flex cloth covering
- Paper pulp mould for bike body
- Covering inspired by fuel tank of the bike

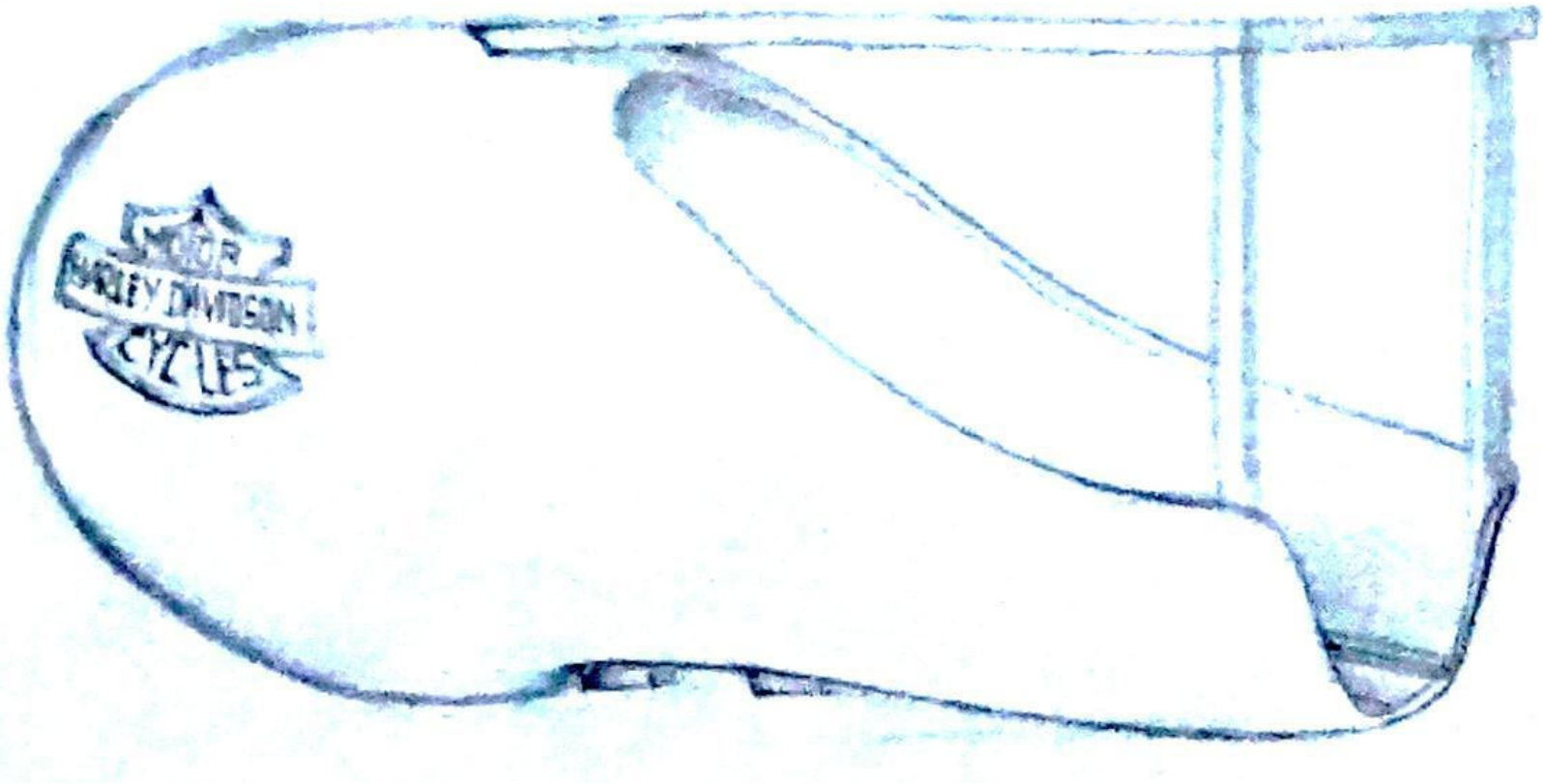
The selection of these materials allowed inclusion of Harley Davidson's logo on the packing. The digital models were worked upon by Avdhut Sir and Rupesh Sir, while I worked on pencil sketches.



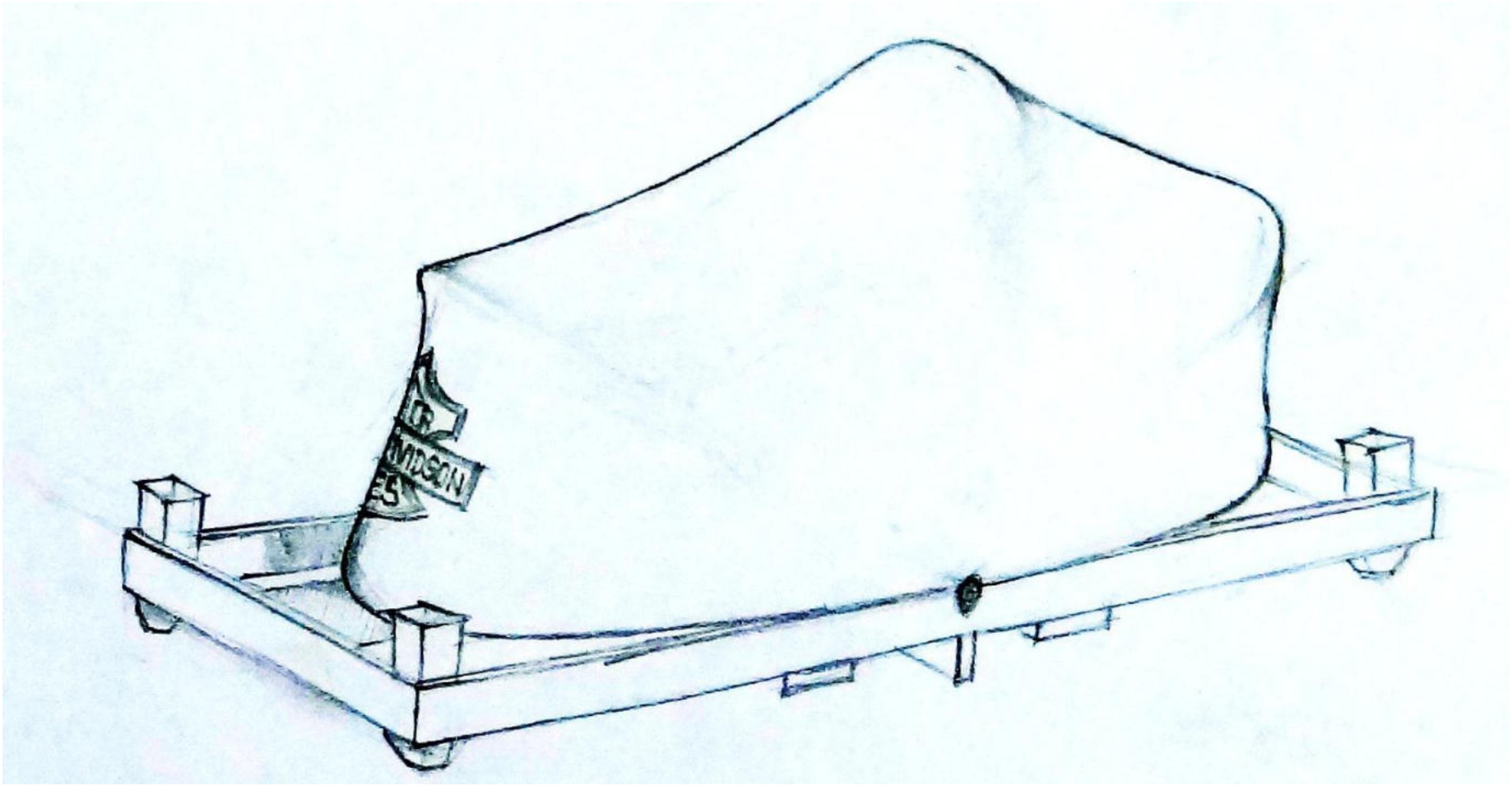
Crate with a dome shaped flex cover



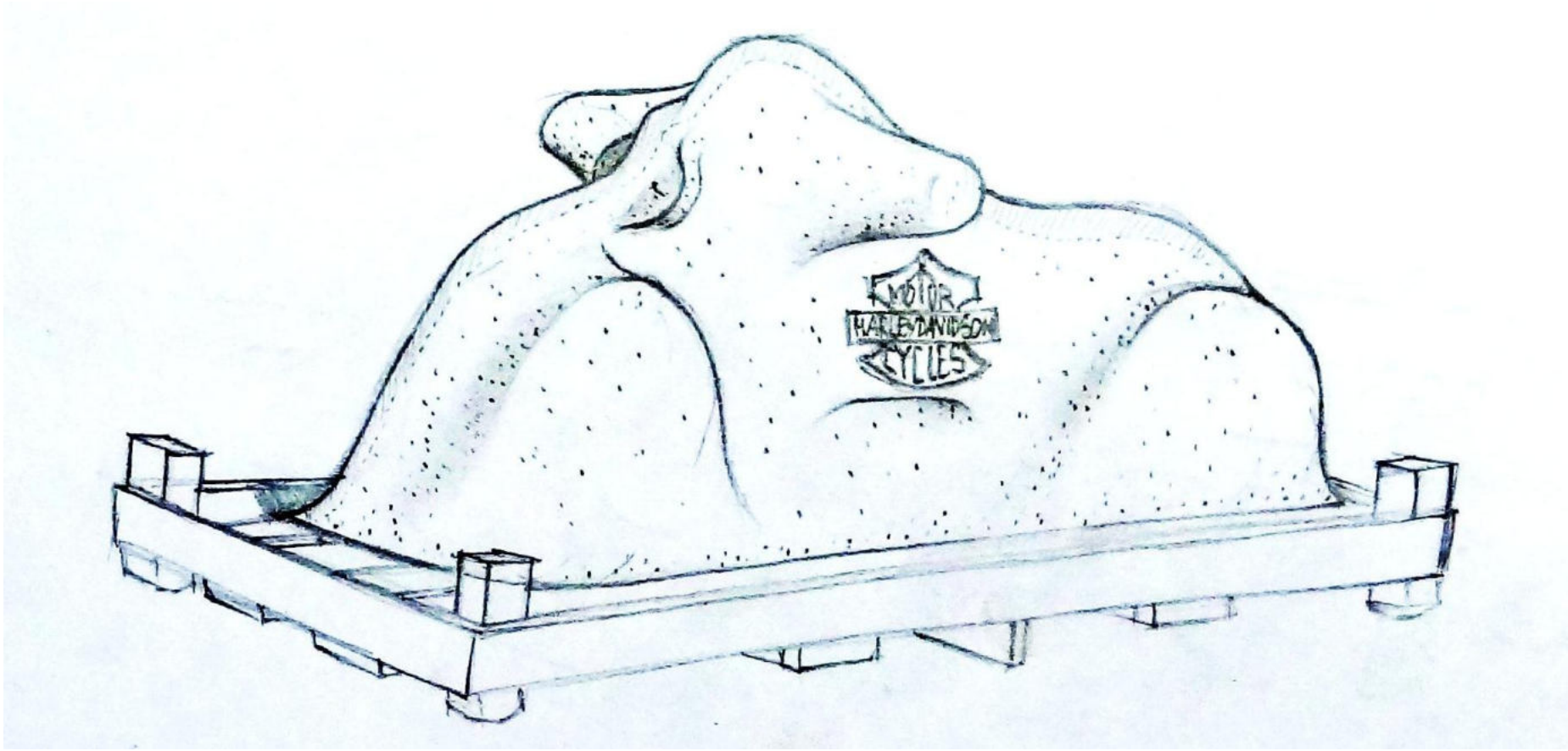
Crate with flex covering on all sides



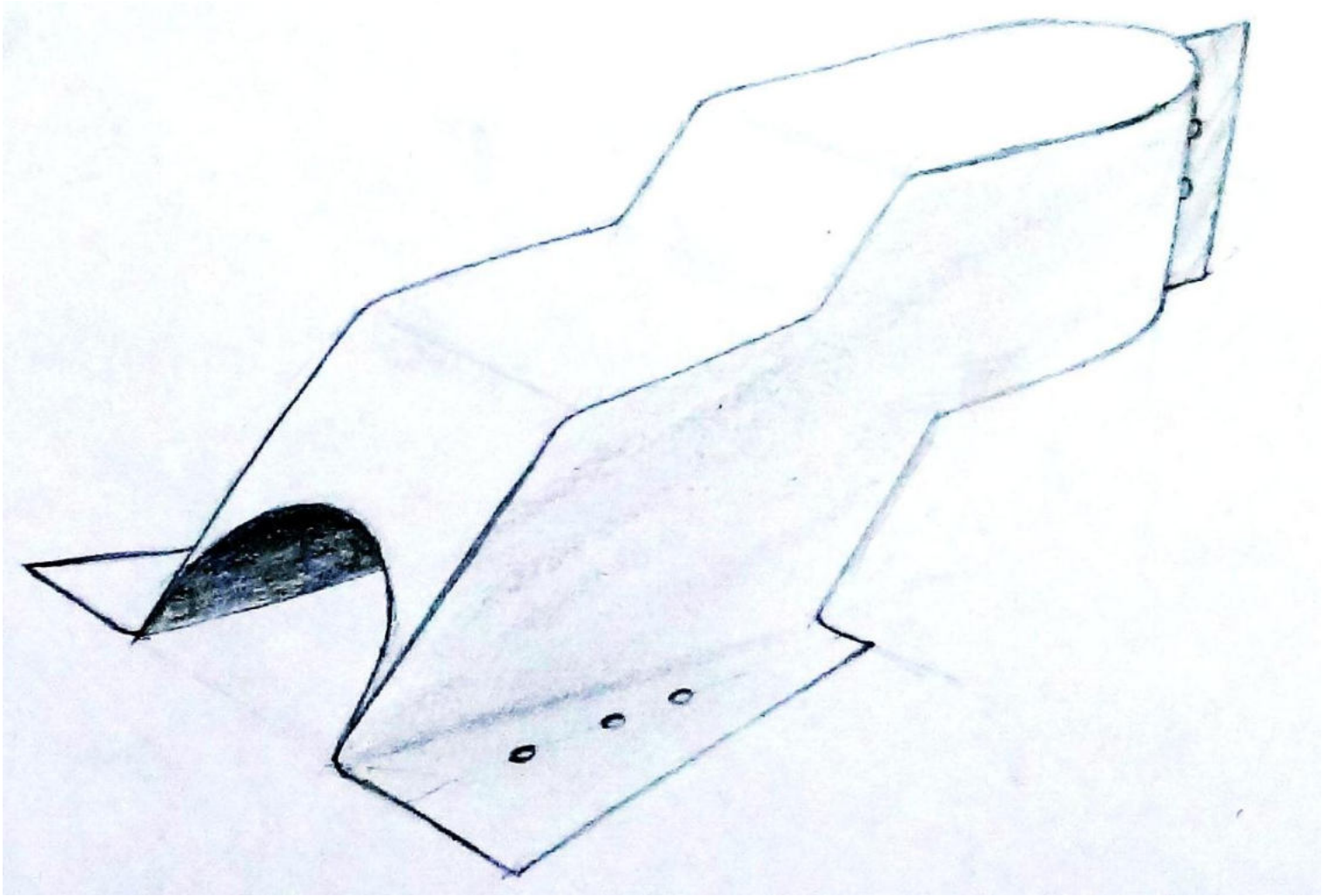
Crate with FRP mould in shape of fuel tank



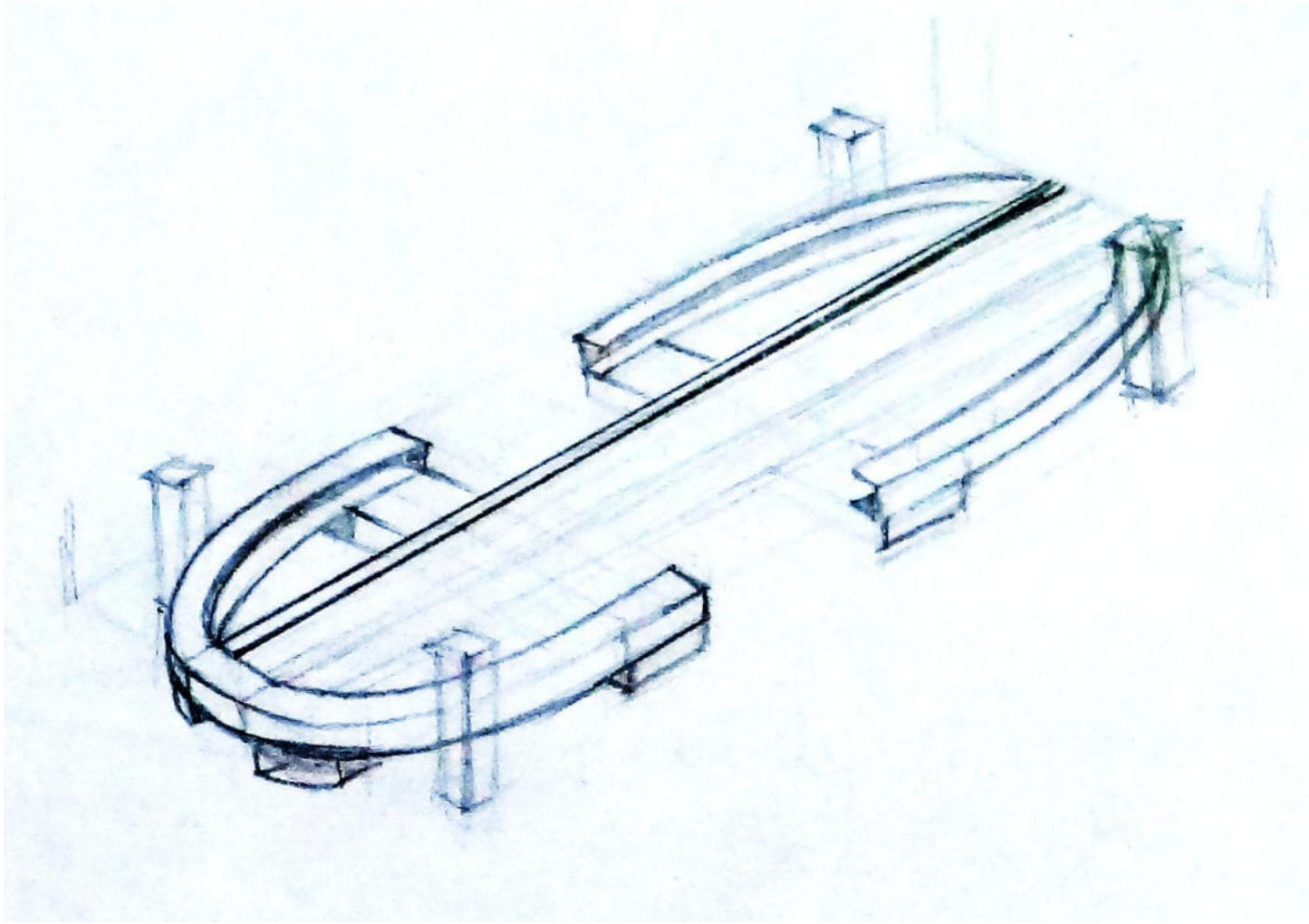
Crate with collapsible flex material tent



Crate with bike covered in an approximate Paper pulp mould



Sheet metal shell for the bike

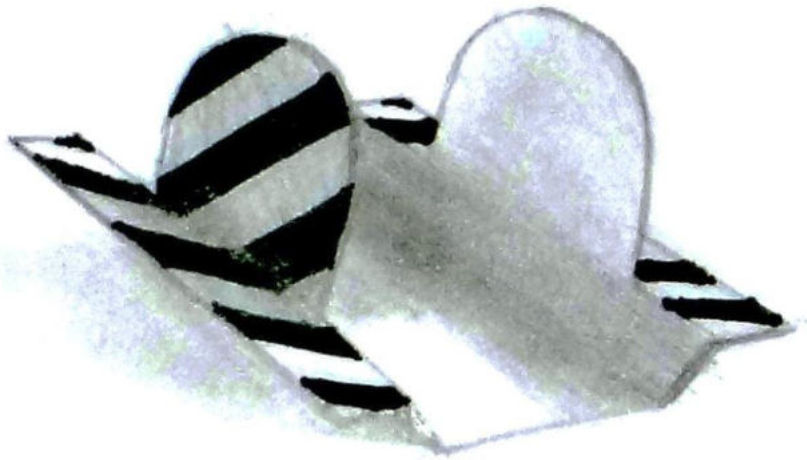


Elliptical crate concept

Status

After several communications with the team at Bawal, the design process was still evolving even as June came to an end. More sample crates were sent from various Harley Davidson dealers across the country. More cost cutting options were explored. It was decided to do away with powder-coating also, as these crates are eventually discarded after use.

The project was a good learning experience in cost cutting techniques, material reduction and optimisation. I learnt the basics of dimensioning, which was done on micrometer level(10^-6) in this project. The project being associated with a prestigious brand, was worked upon with fervour and extensive discussions with everyone and a wide market study.

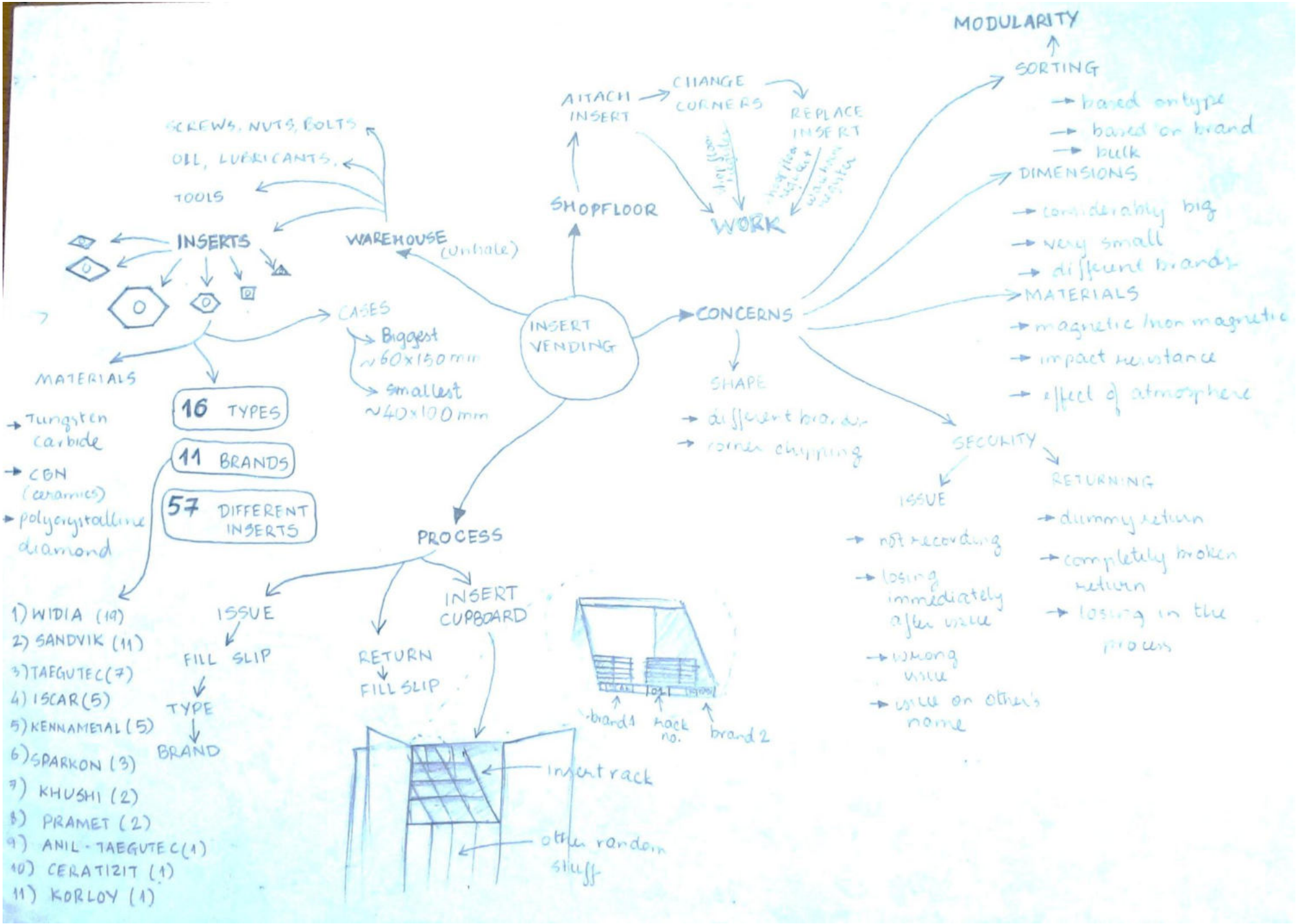


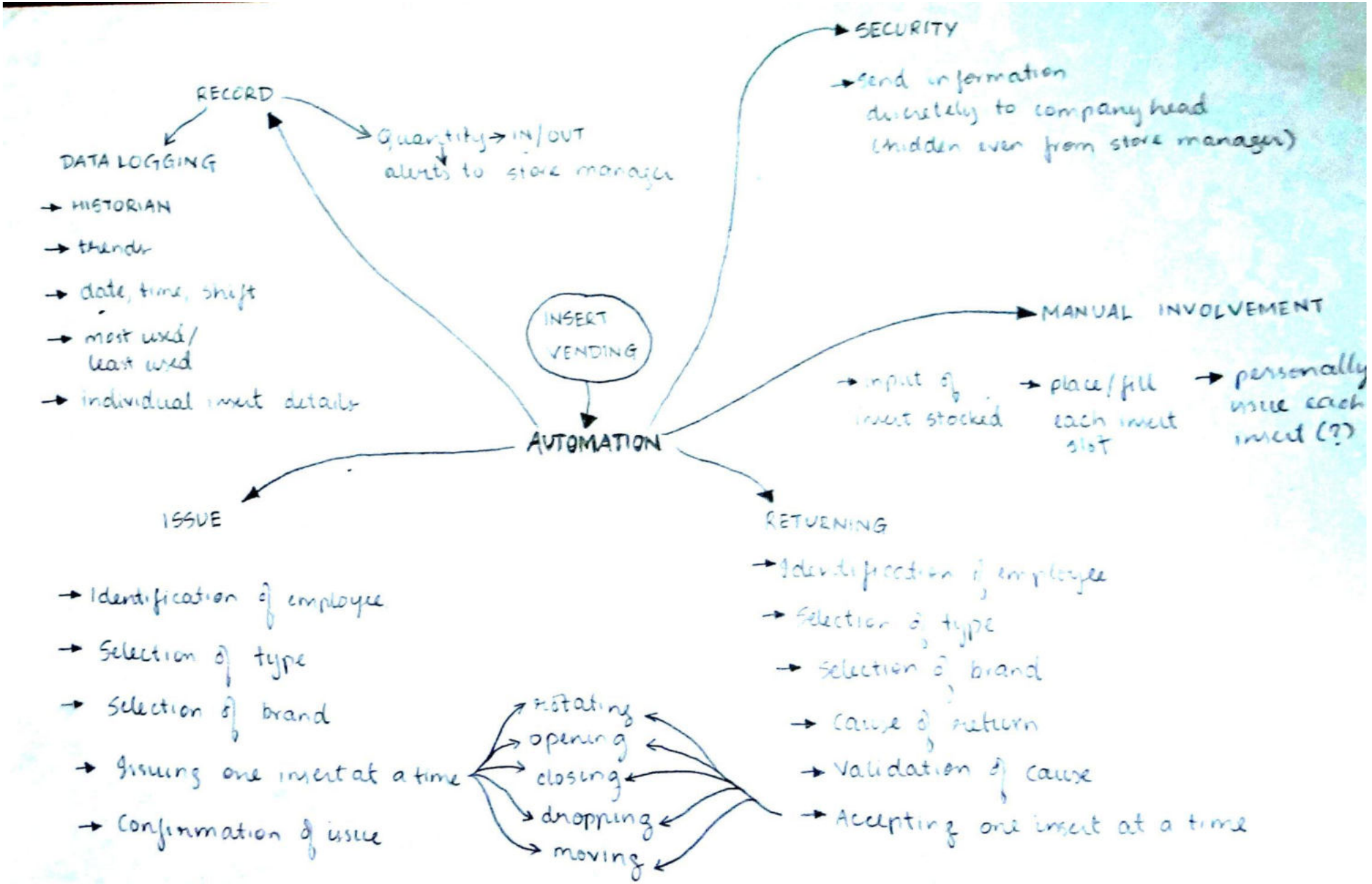
Insert Vending Machine

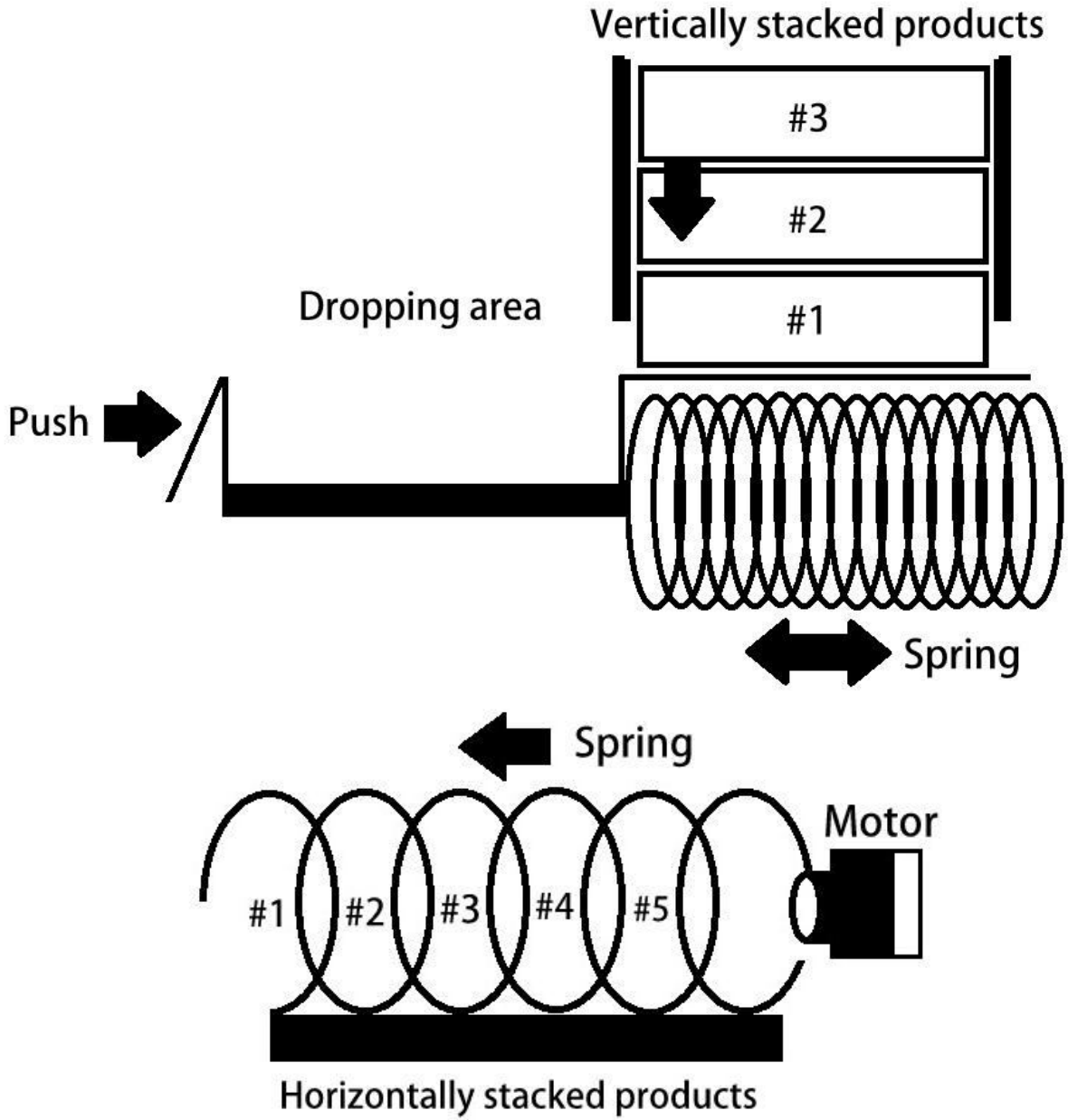
Problem: CNC inserts are small cutting tools attached on the spindle of VMC/HMC used for machining complex shapes from metal blocks. Though these components are small, they are made of special materials (viz. tungsten carbide, CBN, polycrystalline diamond) and hence costly. They are often stored in a secure locker in the inventory store. The issue is done with the only with the consent of the store manager and the shift supervisor. Once the tool wears out, the workers replace them with new ones only after the damage has been confirmed by the authorities. The worn-out insert is returned to the store manager who, in most cases, returns it to the company owner. This is a very time consuming procedure both for the worker and the store manager. It is complicated by workers allegedly sneaking off these inserts and selling them in the scrap market at a good price. It is also rumoured that leading insert-manufacturing companies buy them off the scrap market, repackage them and re-sell .

Design Statement: An insert vending machine should be a product that secures and supervises the process of issue and return of CNC inserts, while speeding up the process thus leading to increased efficiency of shopfloor work. It should have a feel that is rigid, strong, rugged and yet futuristic. Additionally it can be used to store other shopfloor inventory (like gloves, goggles, drill bits, bigger tools, etc.). It should consume least power whilst using technology on par with the ones used elsewhere in the company. Further, its main aim is to reduce the workload on the store manager, while providing easy, secured access to the workers to the desired insert. Lastly, the housing should be tamper-proof, the issue/return should be fail-proof and the technology unimitable.

User study: Since, the owners of Ratna Udyog, a neighbouring company came up with the need for a secure issue/return system, they also gave access to their store for us to clear our doubts and understand the whole procedure. An extensive market study told us that there were none or very few Indian companies that catered to the given problem, thus giving us ample lead for possible innovation. Overseas, however there are a few companies that offer entire inventory management solutions. All these were studied and mind maps were made.


MODULARITY
SORTING
→ based on type
→ based on brand
→ bulk
DIMENSIONS
→ considerably big
→ very small
→ different brands
MATERIALS
→ magnetic / non magnetic
→ impact resistance
→ effect of atmosphere
SECURITY
ISSUE
→ not recording
→ losing immediately after issue
→ wrong issue
→ issue on other's name
RETURNING
→ dummy return
→ completely broken return
→ losing in the process
ATTACH INSERT
CHANGE CORNERS
REPLACE INSERT
SHOPFLOOR
WORK
SCREWS, NUTS, BOLTS
OIL, LUBRICANTS,
TOOLS
INSERTS
WAREHOUSE (Unhale)
INSERT VENDING
CASES
Biggest ~60×150 mm
Smallest ~40×100 mm
MATERIALS
→ Tungsten carbide
→ CBN (ceramics)
→ polycrystalline diamond
16 TYPES
11 BRANDS
57 DIFFERENT INSERTS
1) WIDIA (19)
2) SANDVIK (11)
3) TAEGUTEC (7)
4) ISCAR (5)
5) KENNAMETAL (5)
6) SPARKON (3)
7) KHUSHI (2)
8) PRAMET (2)
9) ANIL - TAEGUTEC (1)
10) CERATIZIT (1)
11) KORLOY (1)
CONCERNS
SHAPE
→ different brands
→ corner chipping
PROCESS
ISSUE
FILL SLIP
TYPE
BRAND
RETURN
FILL SLIP
INSERT CUPBOARD
brand 1
rack no.
brand 2
insert rack
other random stuff


RECORD
DATA LOGGING
→ HISTORIAN
→ thandu
→ date, time, shift
→ most used/ least used
→ individual insert details
Quantity → IN/OUT
alerts to store manager
SECURITY
→ send information directely to company head (hidden even from store manager)
INSERT VENDING
AUTOMATION
MANUAL INVOLVEMENT
→ input of insert stocked
→ place/fill each insert slot
→ personally issue each insert (?)
ISSUE
→ Identification of employee
→ Selection of type
→ Selection of brand
→ Issuing one insert at a time
→ Confirmation of issue
rotating
opening
closing
dropping
moving
RETUENING
→ Identification of employee
→ Selection of type
→ Selection of brand
→ Cause of return
→ Validation of cause
→ Accepting one insert at a time


Vertically stacked products
#3
#2
#1
Dropping area
Push
Spring
Spring
Motor
#1
#2
#3
#4
#5
Horizontally stacked products

Vending Technologies

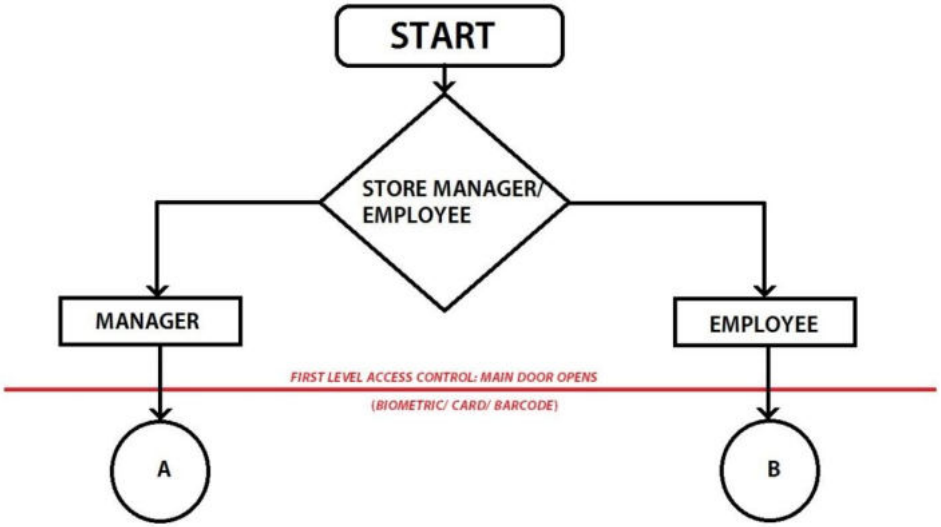
The concept of vending something i.e. accepting money and giving a product/service in return while eliminating a human seller can be traced as back as to ancient Greece, where a machine accepted coins to dispense holy water. Modern vending machines were developed in the USA, where today they have become common place. Japan, especially uses vending machines extensively and leads innovation in this sector. Vending is now applied to productas and services as diverse as soft drinks, fruits, fast food, snacks, cars and car washing, phones and other devices, etc.

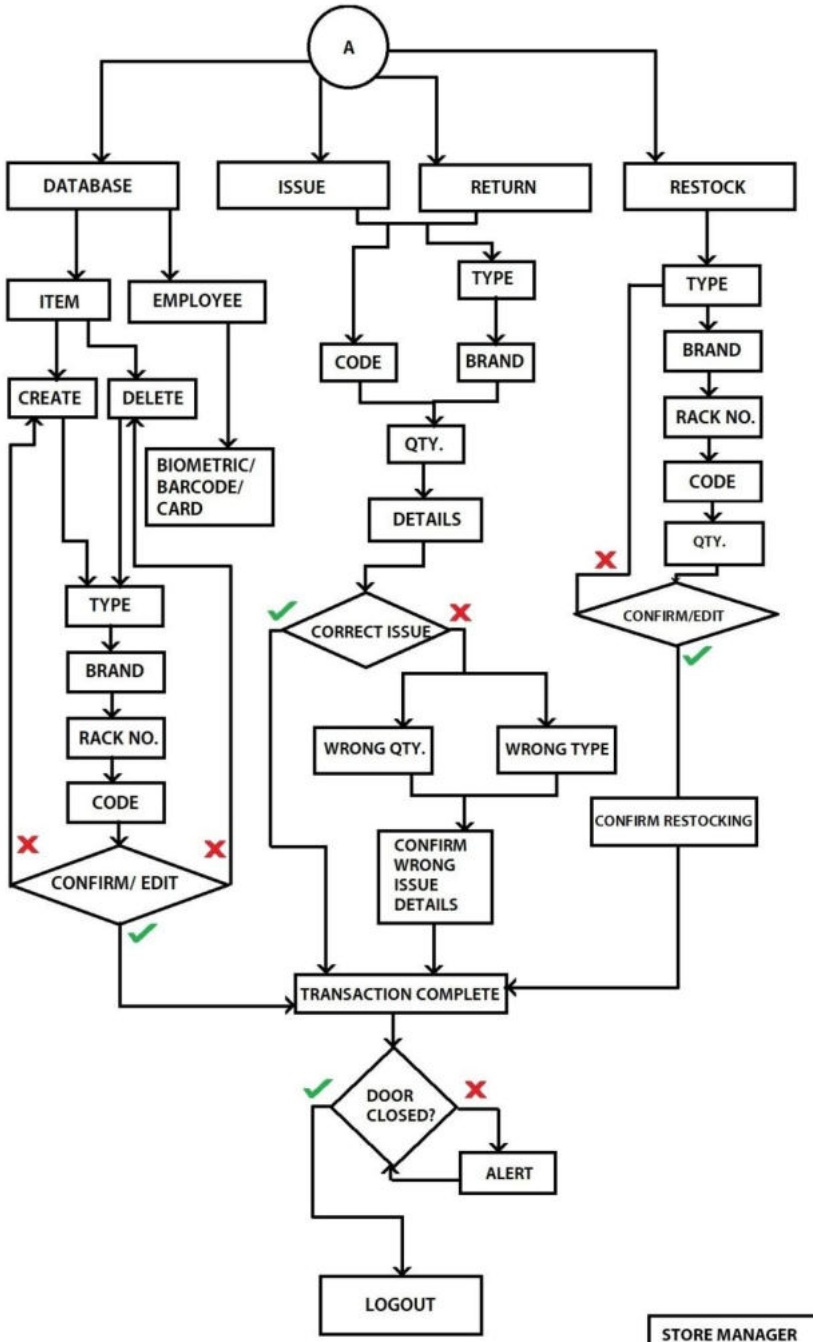
Most of these machines include a simple motor-driven spring (auger), wherein products are stocked in the pitch of the spring and with each rotation, one product falls off the shelf while the one behind it automatically shifts ahead to the front position. This is almost like a standard operation for vending machines. The feasibility of this technology was explored and found suitable enough. The problem of inserts being small was solved by placing them in small plastic cases. But this raised the issue of sourcing aptly sized cases.

Another option explored and developed was that of vertical stacking of cases. The drawer itself acts as a stopper for the column of cases. When pushed behind, only one case falls into the drawer and it springs back to its normal position by spring-action. However, this would demand very crucial designing and smooth guides for vending action.

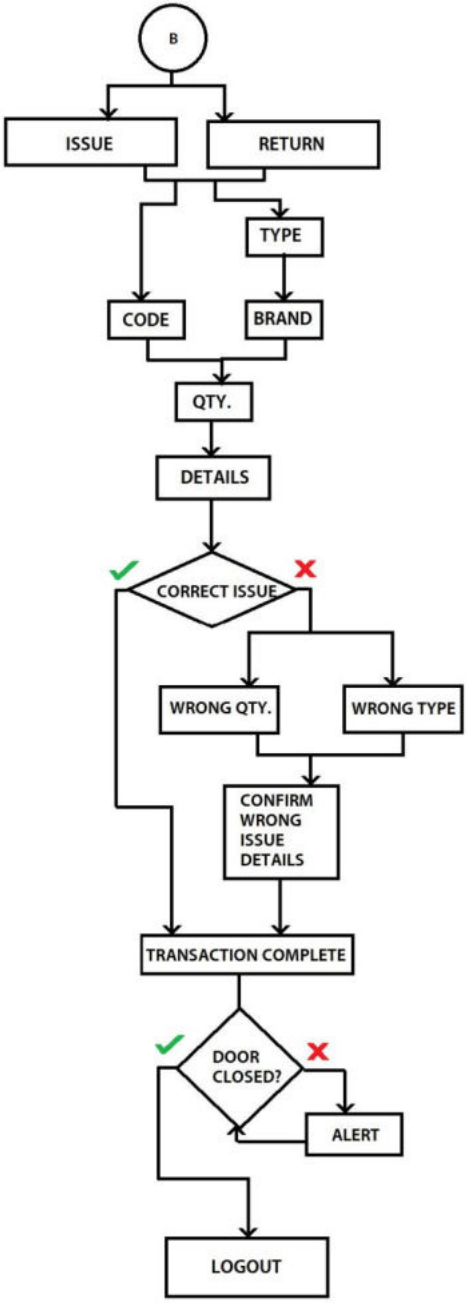
The access control part was finalised to be controlled by a Mitsubishi MS-61 HMI. Its specifications are as follows:
Screen: 5.7" 256 color TFT LCD; 320X240 resolution
Memory: Application Flash ROM - 2 MB; Data/Recipe - 256 KB
Ports: COM1 9-pin female (RS232/RS485) / RS422 without RTS / CTC)
COM2 9-pin female (RS232 / RS422/ RS485)

The access control was basically divided into store manager and employee with the latter having deeper access. The employee only had permissions to issue/return that too only after proper identification. The store manager was given permission to add new employee/item, restocking, while also being able to issue/return himself. Corresponding logic and HMI screens were developed to control the PLC action.

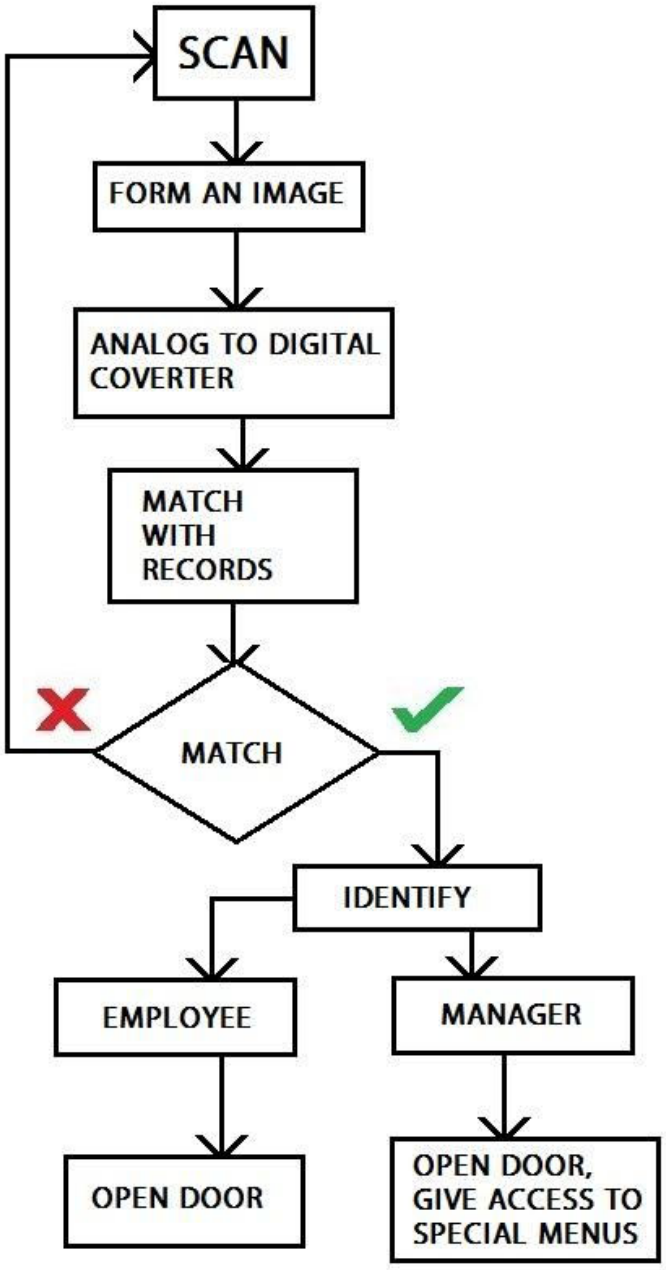




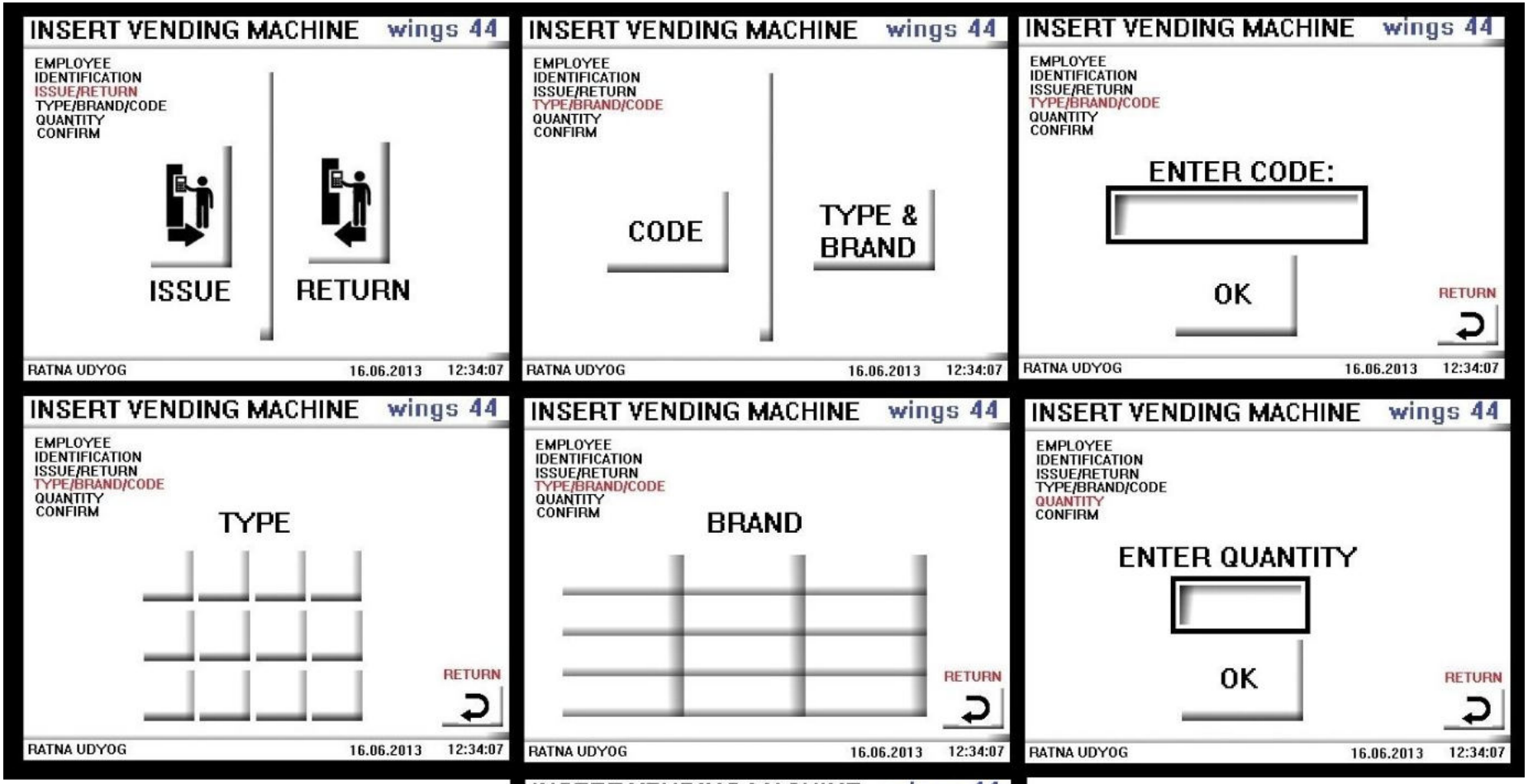
STORE MANAGER FLOWCHART



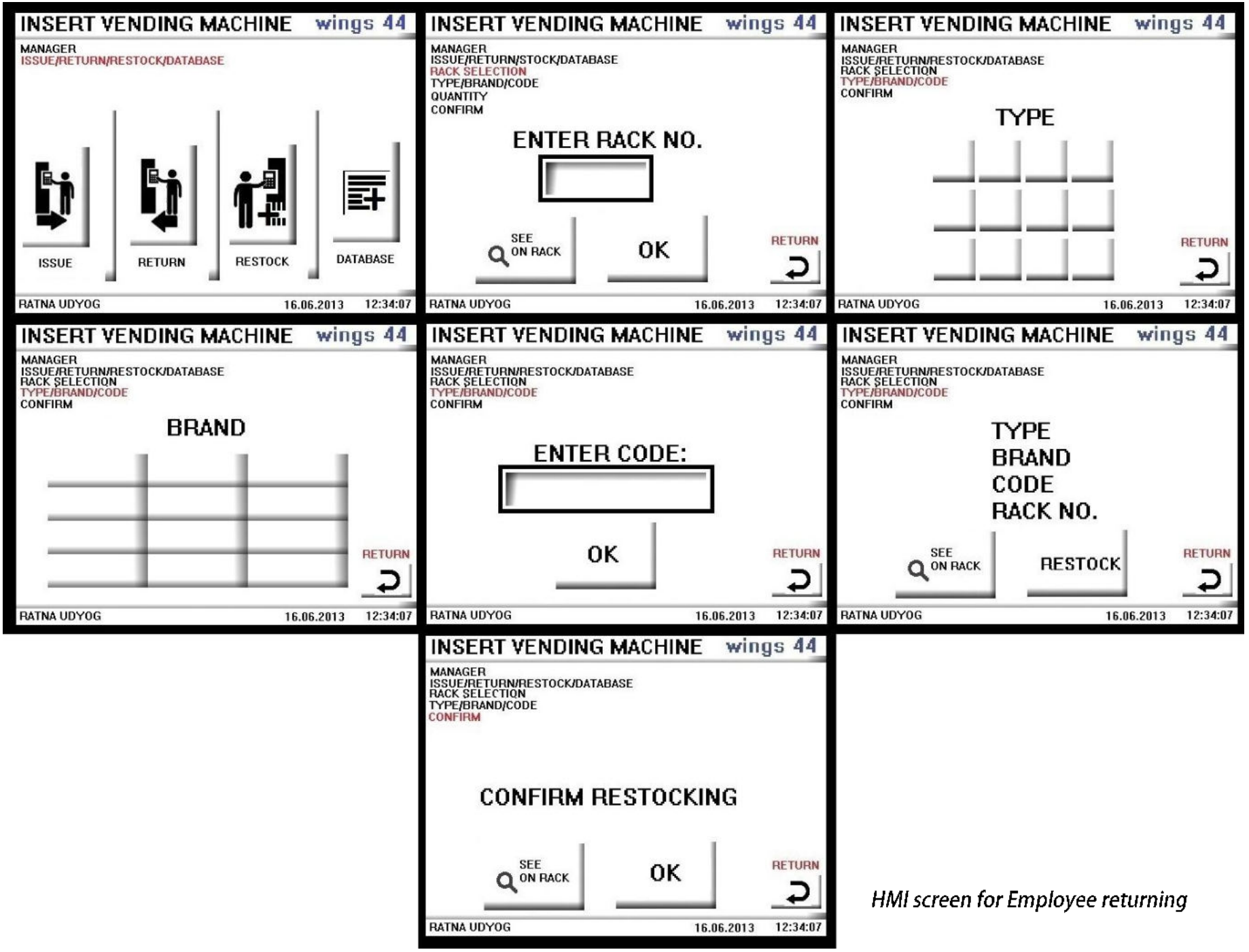
EMPLOYEE FLOWCHART



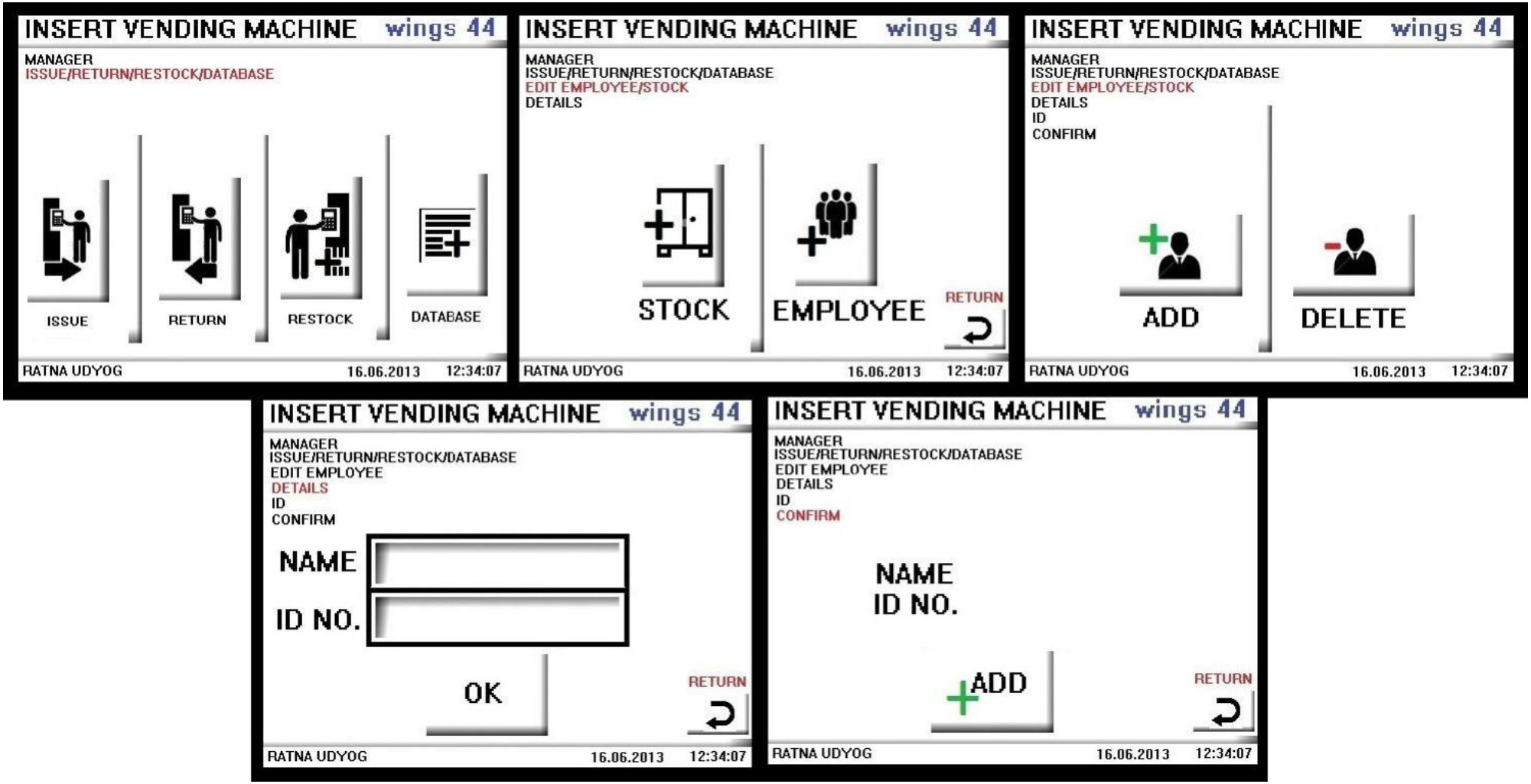
Biometric Access Control Flowchart



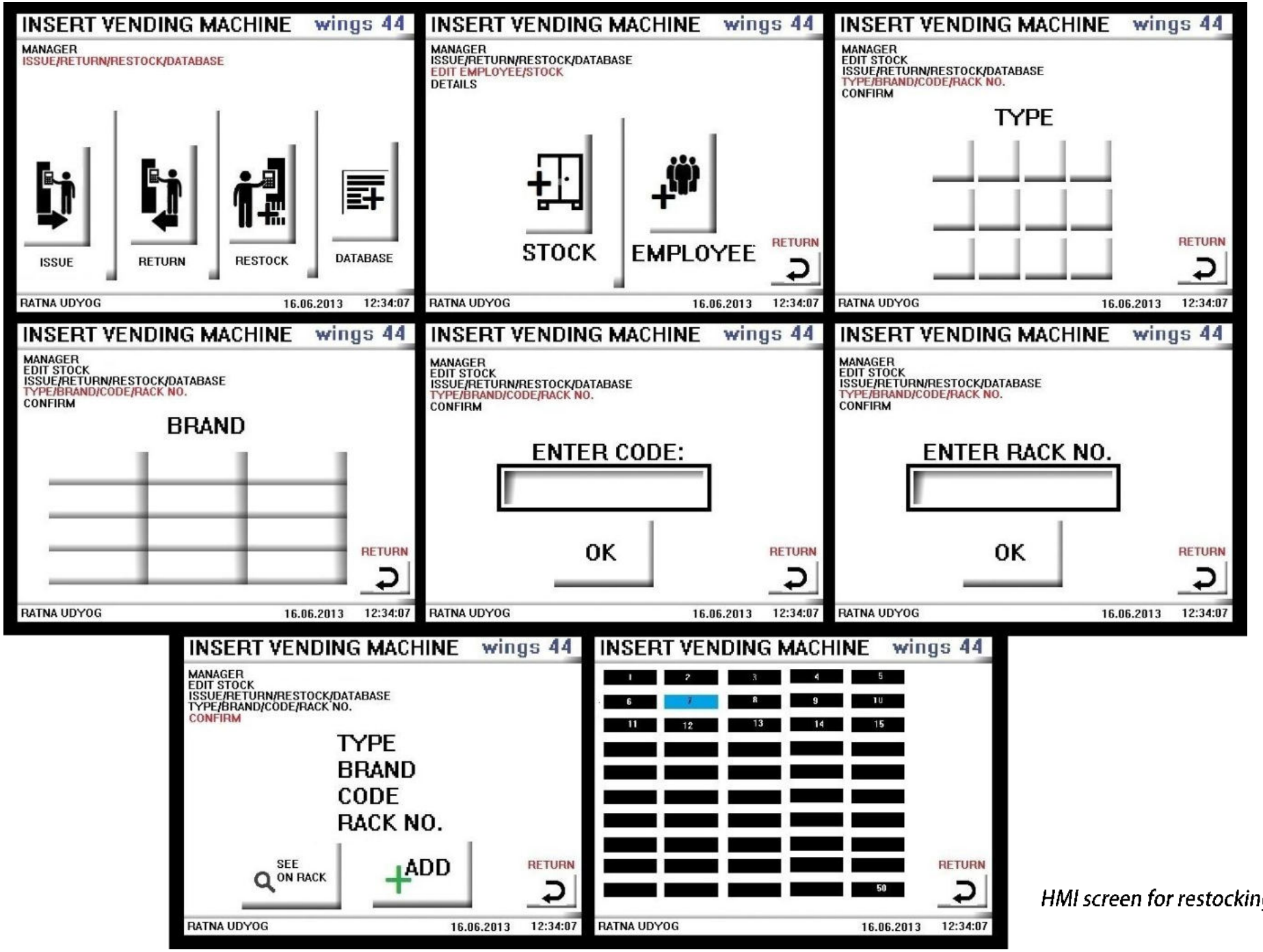
HMI screen for Employee issuing



HMI screen for Employee returning



HMI screen for adding new employee



HMI screen for restocking

Some cabinet concepts

Cabinet design

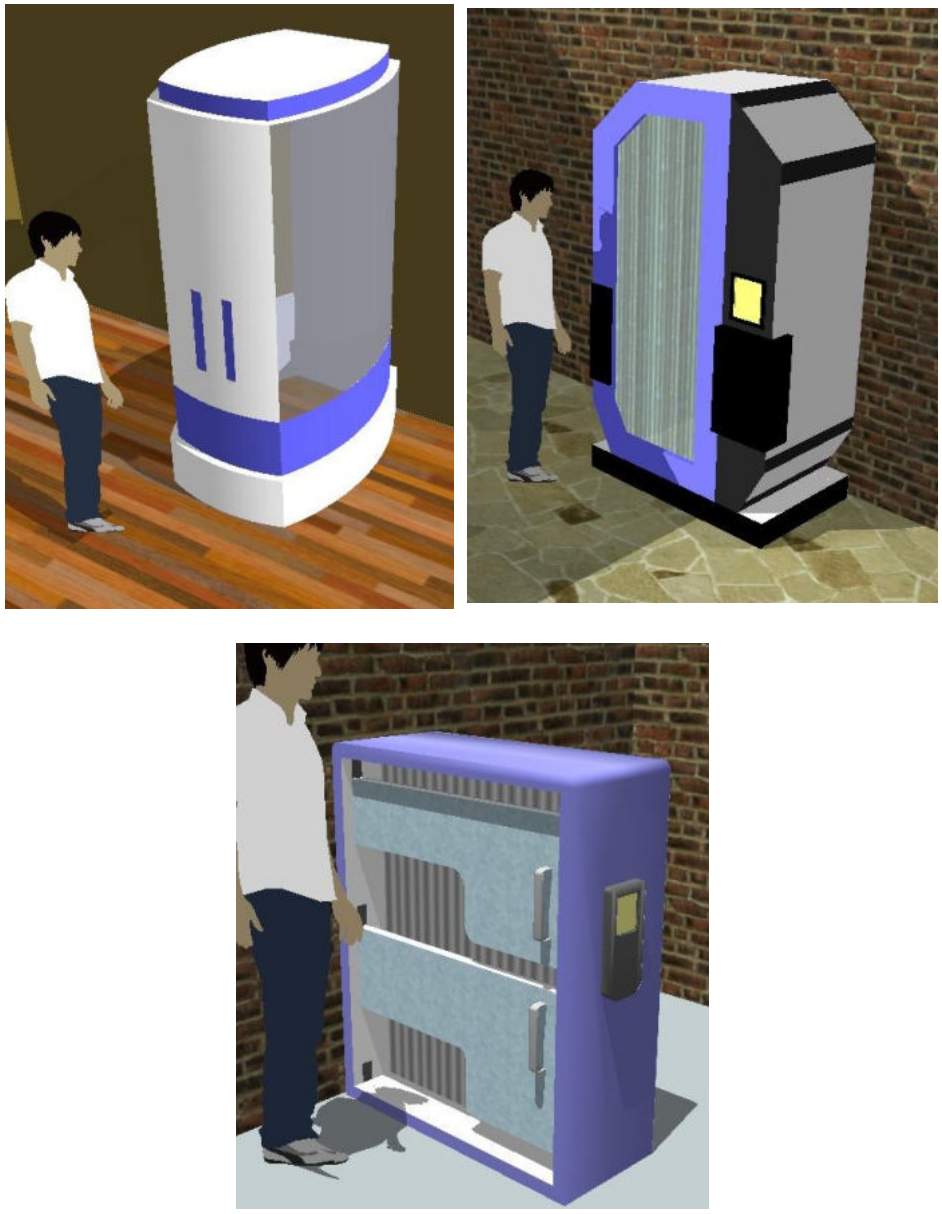
Once the inner mechanism was being finalised, in parallel work was also directed towards the housing for the mechanism. This stage would involve consultation with the manufacturing team for their inputs on possibilities and constraints. The cabinet had to look futuristic and yet be possible to manufacture at Kolhapur. Many modern cabinets were studied, often discussing on what makes futuristic look 'futuristic'. Often ideas were scrapped at sketch level itself due to non-feasibility of manufacturing. But I was instructed to continue sketching and exploring options limited to sheet metal.

Many ergonomic calculations were made and often scrapped. About two-three dimensions were finalised and the design then proceeded vertically, often again going back one stage to another dimensions. In the initial stages I used Google SketchUp 3D for CAD modelling owing to my comfort-level on it. In the later ideations, each stage involved a unique method, suggested by Amey Sir. For each given dimension, a grid/box was exactly sketched on the computer and a perspective printout was sketched. I was then asked to fit my designs into this grid. Thus, I was still sketching but more accurately.

Ergonomic data considered:

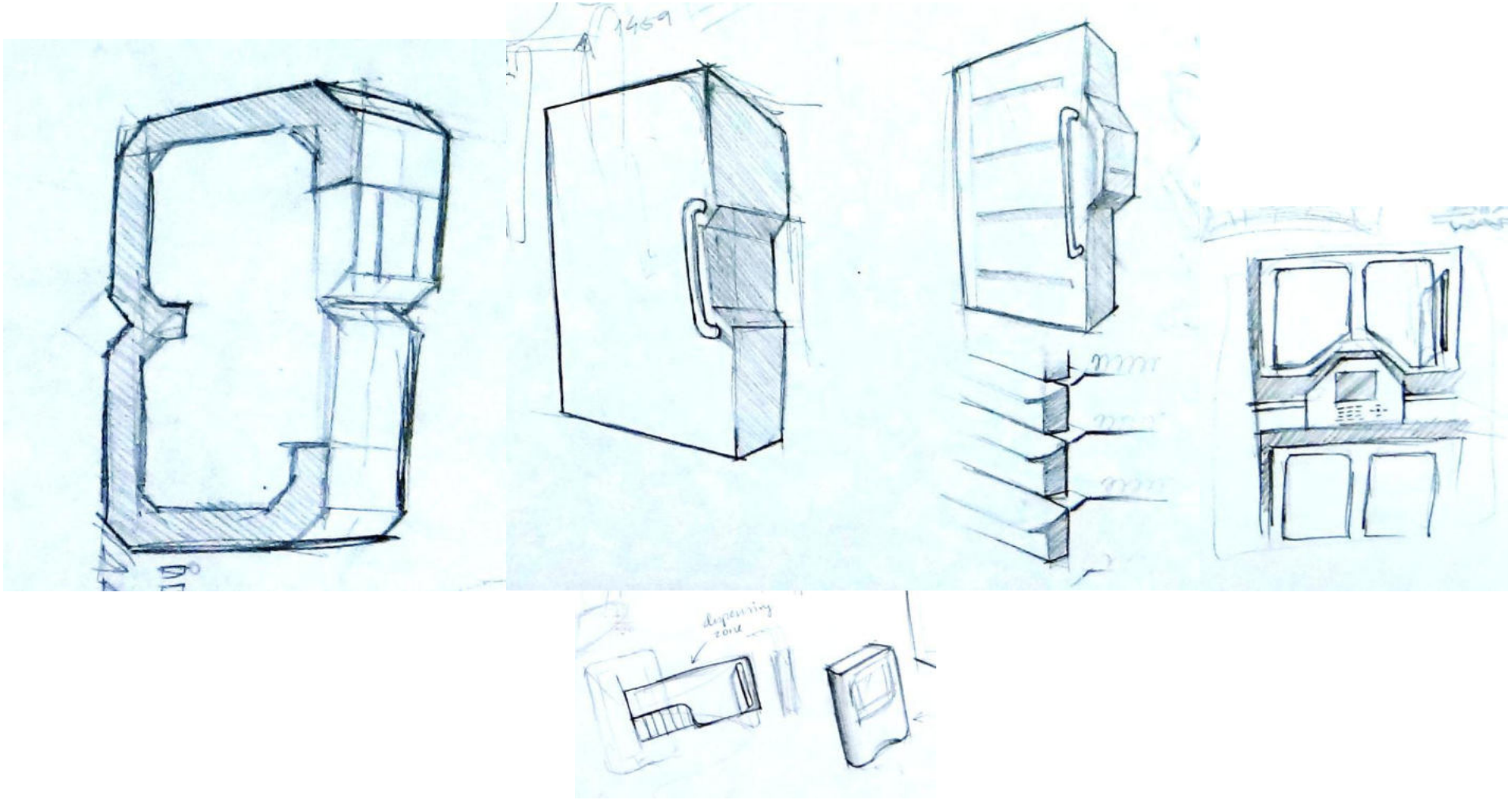
Parameter	Anthropometric parameter considered	Value (in mm)
Height	Maximum arm reach (5^{th} %ile)	1659
Length	Span (95^{th} %ile)	1829
Keypad height	Acromion height (5^{th} %ile)	1235
Screen height	Eye level height (5^{th} %ile)	1419
Issue box height	Bending (95^{th} %ile)	419

Source: *Indian Anthropometric Dimensions for Ergonomic Design Practice* by Debkumar Chakrabarti



Some cabinet concepts

Some cabinet concepts



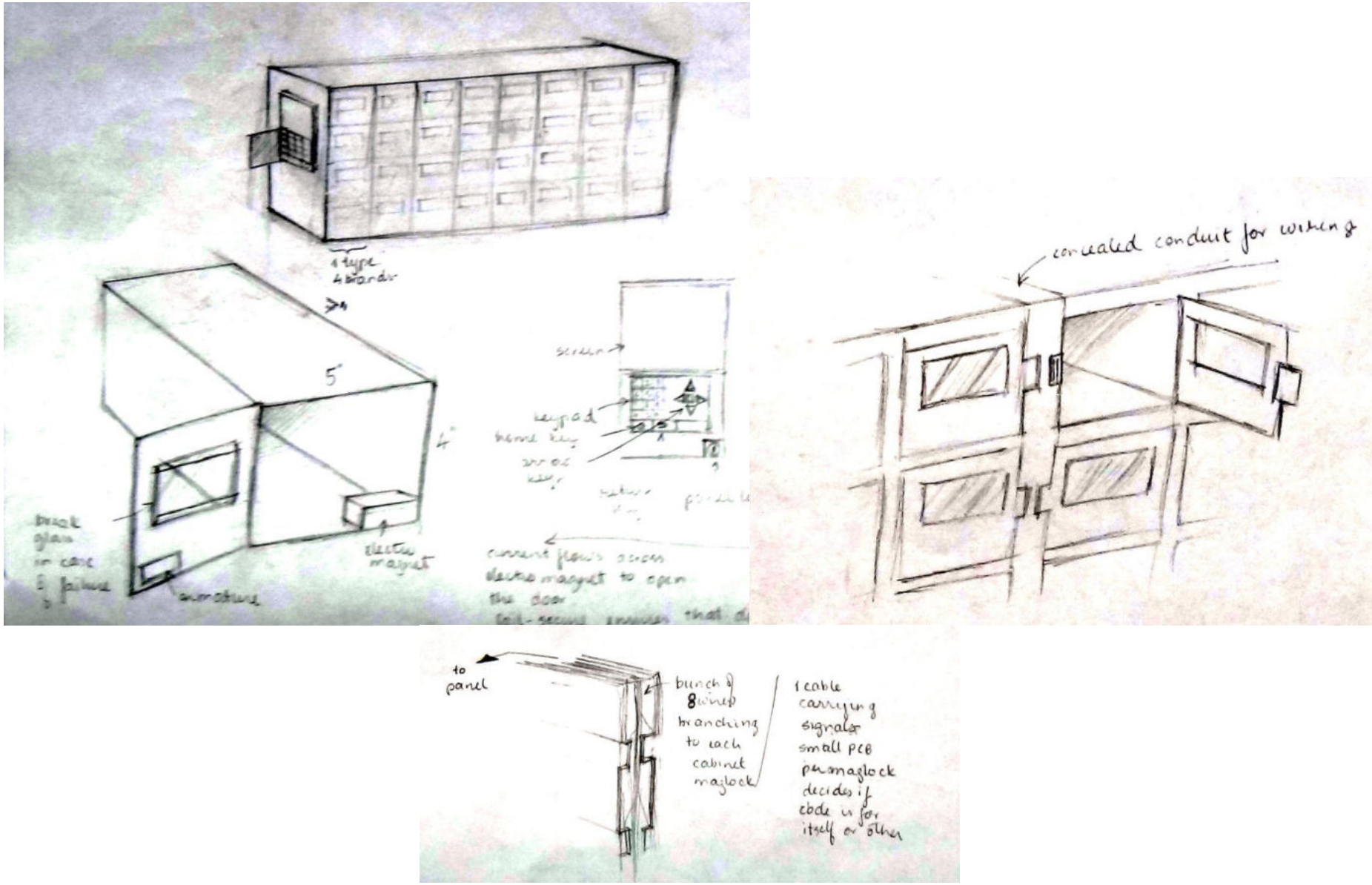
Some rough sketches

The cabinet design had certain aspects to be taken into account.

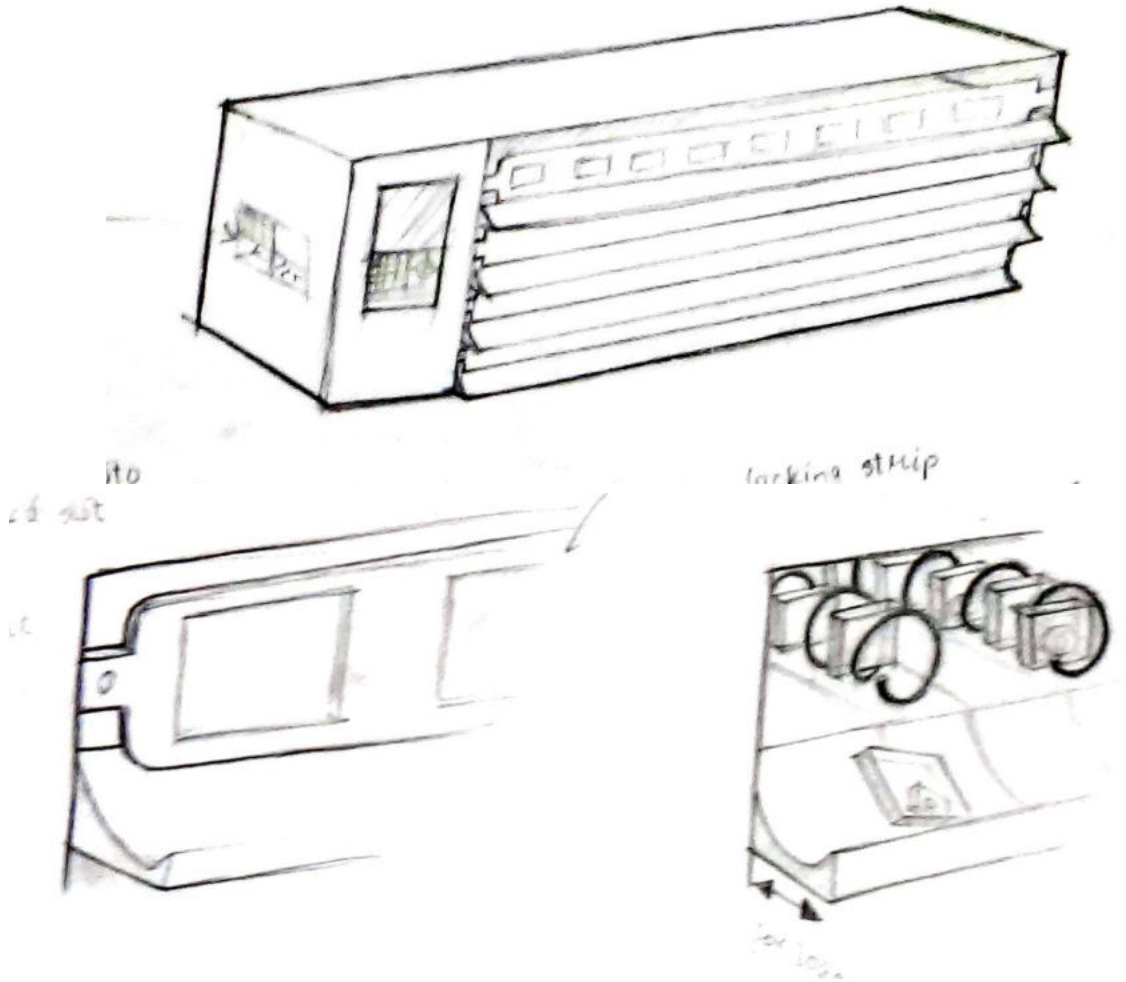
- The door
- The handle
- The location and resulting wiring of the HMI
- The hinges
- The drawer/racks for the insert vending mechanism
- The tamper-proof yet manufacturable housing
- The issue box (and the noise made while dropping)
- The return box

All these were thought upon with respect to company's prior experience in industrial storage. The company already makes industrial cabinets, sliding drawers, automation lines with HMI etc. But the biggest challenge was to control the vending action. If the product dropped from a height, it was ejected equally fast from the issue box. If it was tried to slow down using barriers, it was creating noise.

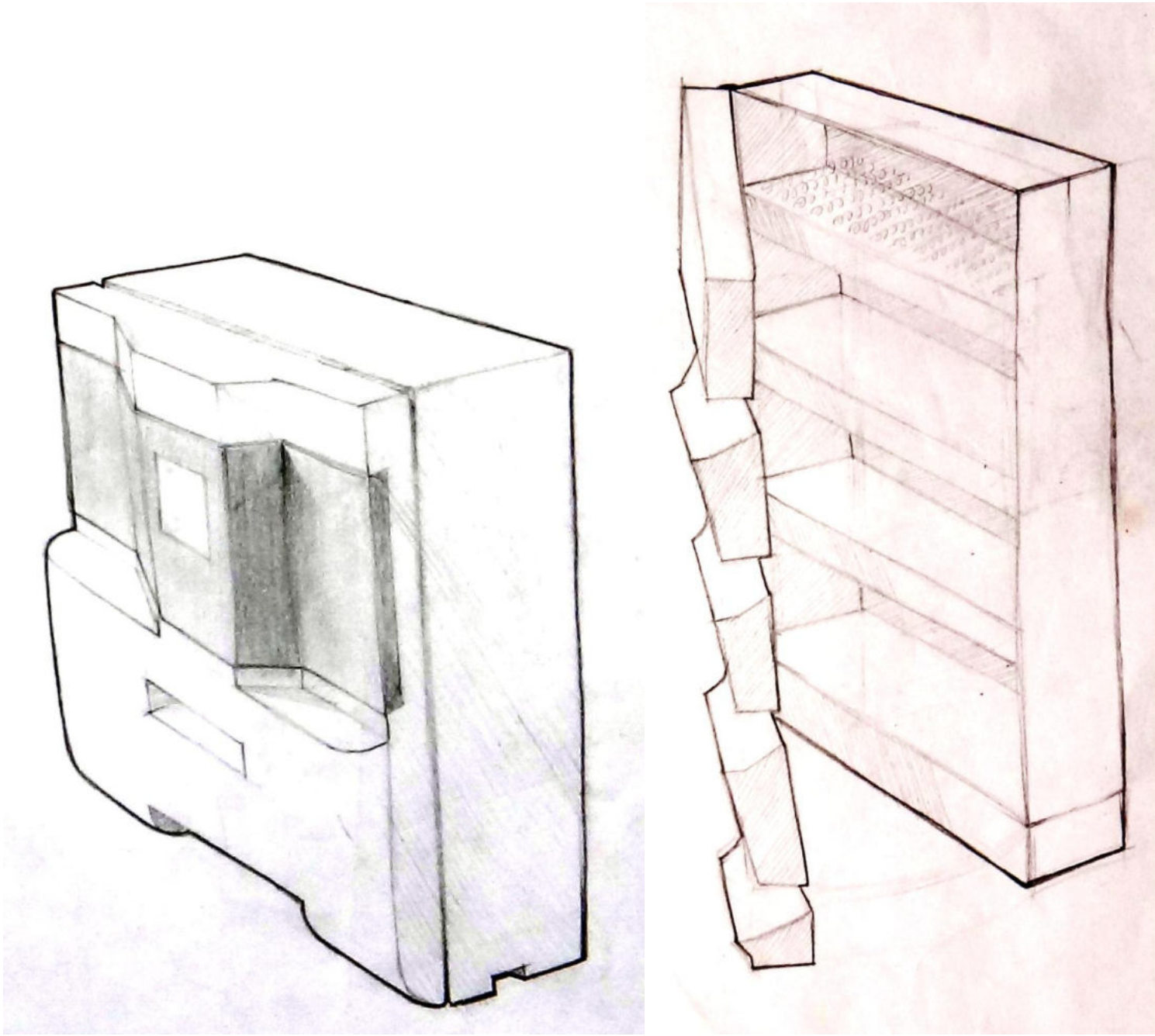
Another issue was how many and what types of inserts were to be stored.Ratna Udyog, the company that had approached, had an inventory list of 58 insert of 11 different brands so currently we had decided to stock 60 different types of inserts. The dimensions were then played with with respect to issue/return and restocking procedures being kept in mind.



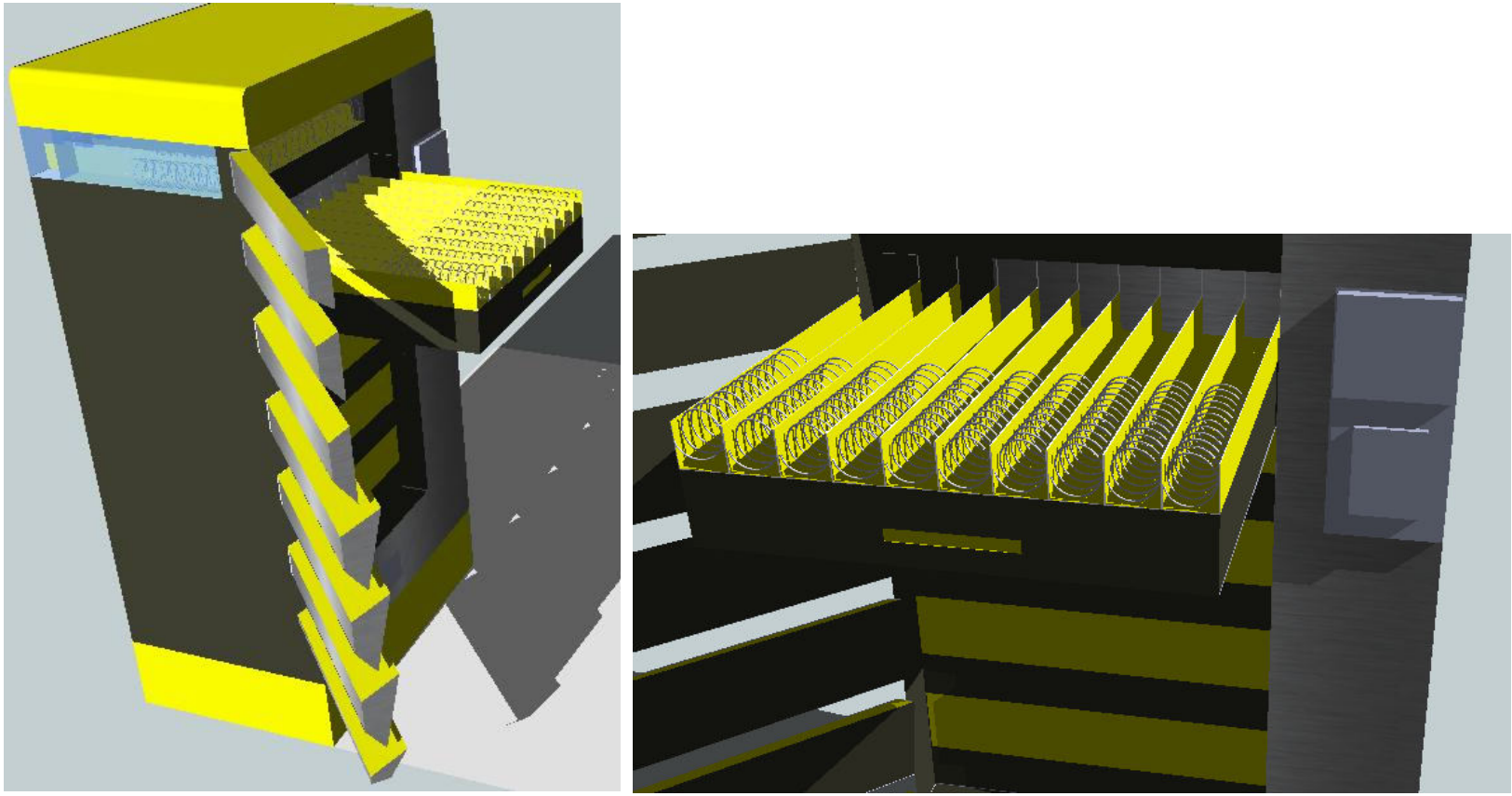
Locker with electronically actuated maglocks concept



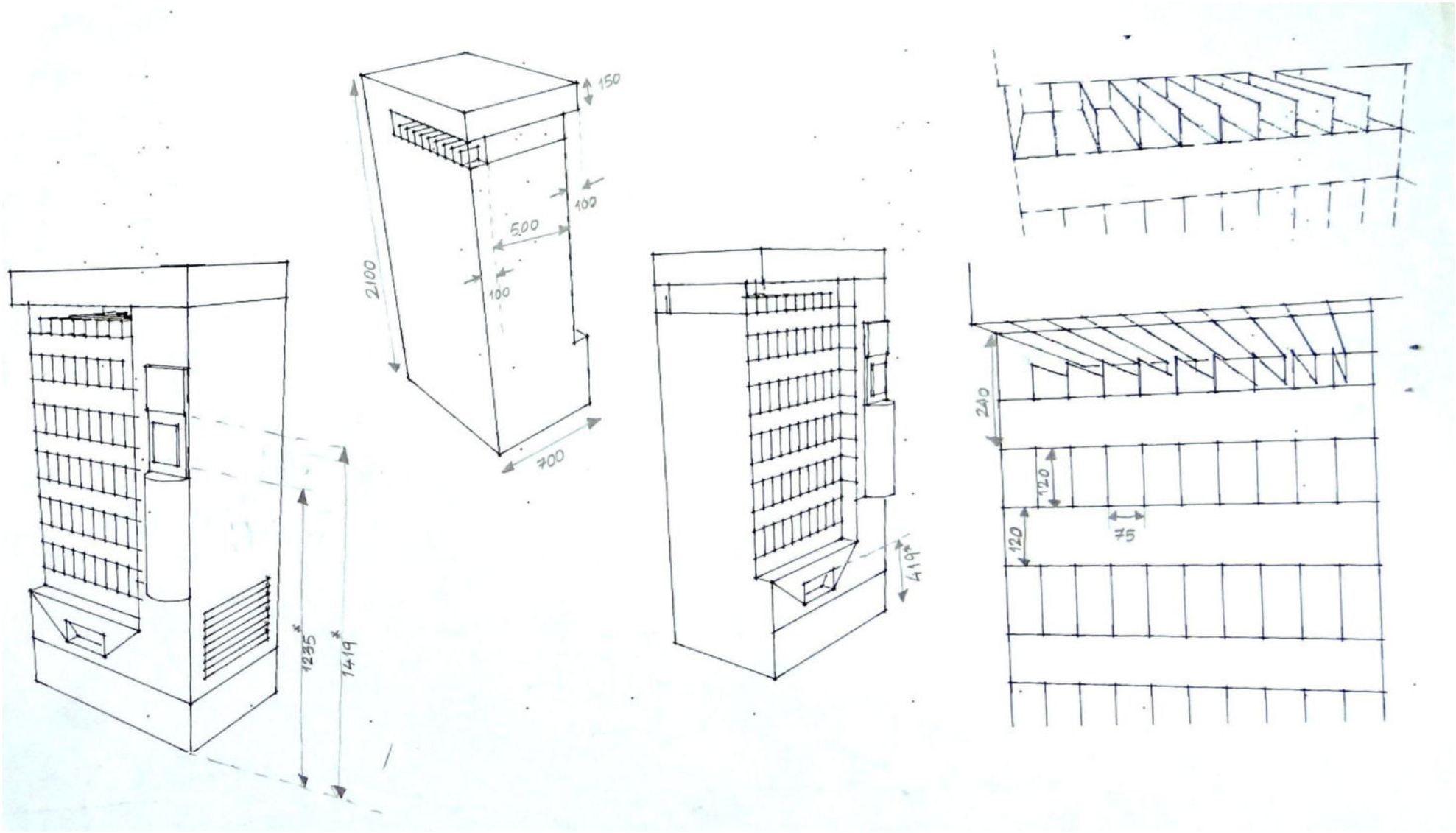
Initial sketches for vending cabinet with auger mechanism



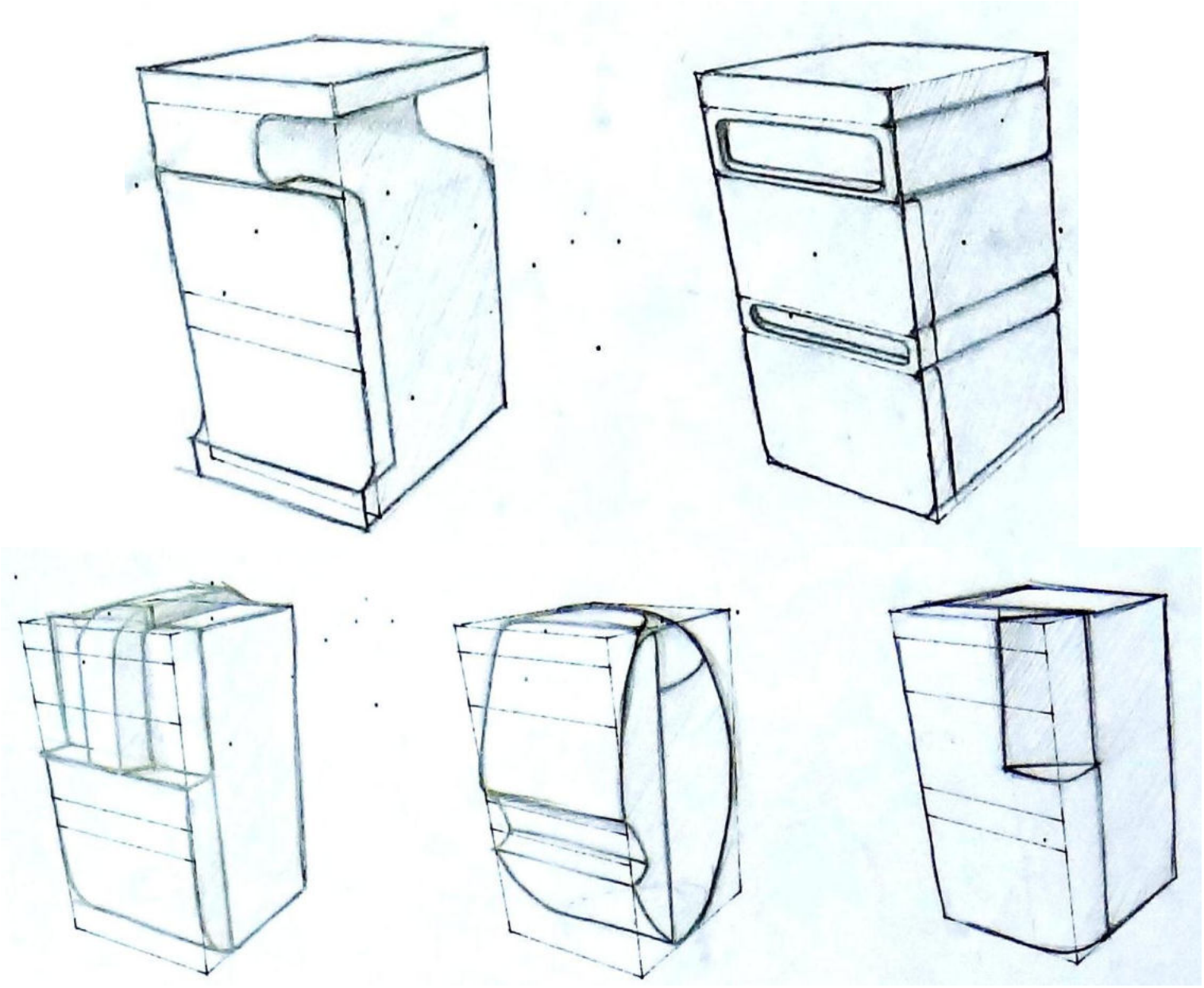
Some well-developed cabinet designs



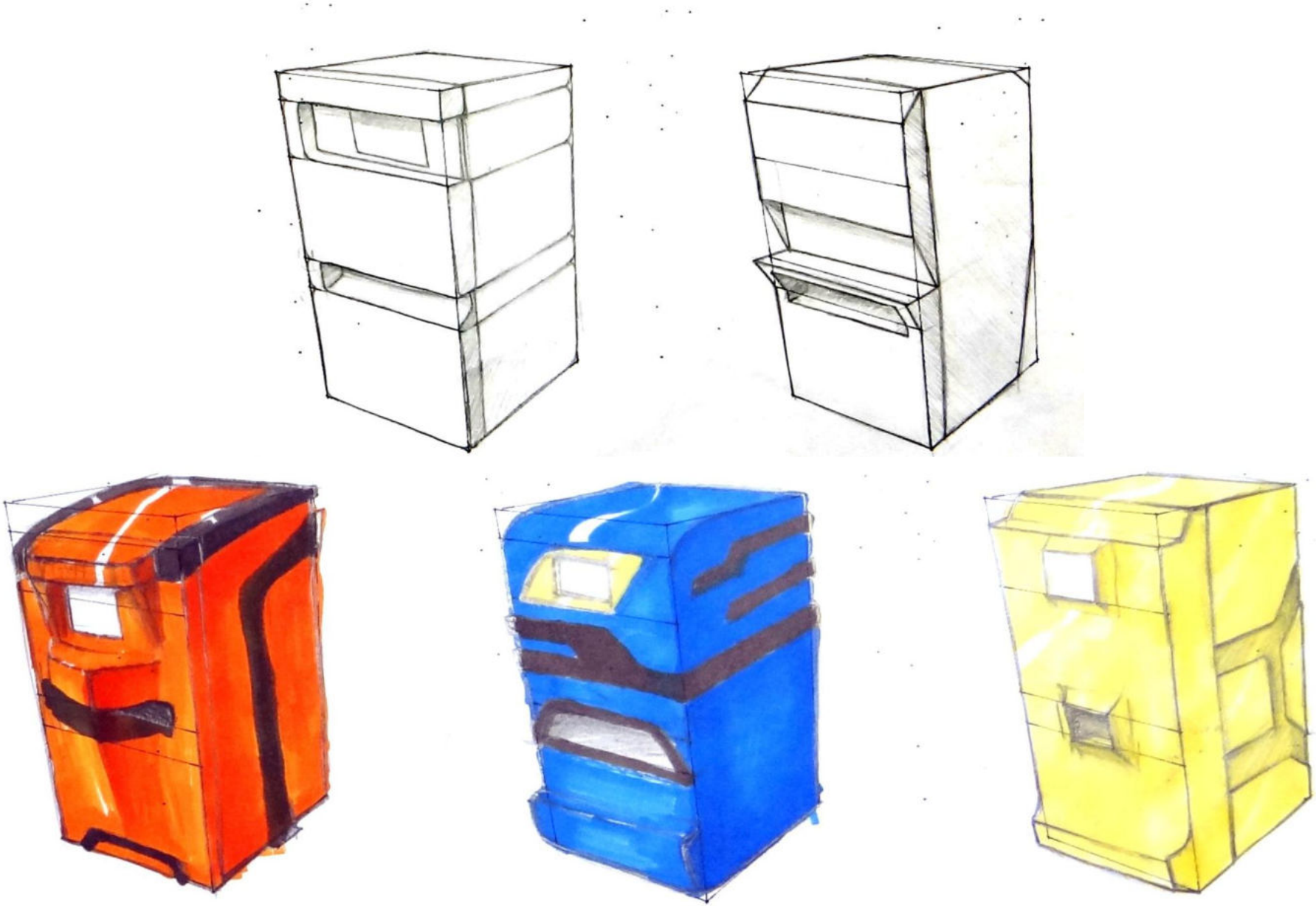
CAD models of a concept (sketched on opposite page)



Finalising grid dimensions



Sketching within grids

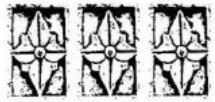


Sketching within grids

Status

The mechanism was finalised to the horizontal stacking with auger spring to perform the vending action. Accordingly some sample 12V DC motors were sourced from a firm in Gujarat. Their dimensions being already known, design had progressed with it. However, the cabinet design remains yet to be finalised.

The project was a learning experience in cabinet designs, realising how a difference of millimeters can lead to door failure. It is referred to as 'तटणे' in local terms, which literally means clashing of components. Also I got to brush up on my knowledge of PLC, HMI and automation which was a great experience. The HMI was designed keeping in mind 5 hat racks, information overload and other design principles.



Bhudargad
Bavda Rajarampuri
Panhala Opal Shivaji putla Zhapaatlela 2 Shahupuri
Bhavani mandap Misal Pav "Kay rao?"
New Palace Ghodake
Circuit house Gokul Kho Kho K.M.T Dasra chowk
Shalini Palace Talkies Lakshmipuri Serial Killer
Tawde hotel Ayodhya Padma
"Kay vishesh?" Rankala Shahu Prabhat Yeh Jawaani Hai Deewani
Gargoti Kagal Go Goa Gone Baburao Painter Loni dosa Narsoba wadi

Kalakruti Saroj Ratna Peth-Vadgaon Khidrapur
Toll Naka Akkha masur Lokmat Aashiqui 2
Shiye phata Nagaon Sakal Pudhari
Shiroli MIDC Tambda-pandhra rassa
Top-Sampbhapur

For someone who has never stayed out of his home, Kolhapur was an adventure. To step out of our comfort zones, into a city where you hardly know anyone was a totally new experience for me. Add to it the pressures of working for an organisation for the first time. The pressure to perform, deliver, stay creative… and yet, I could not have asked for a better city than Kolhapur and a better firm than Wings 44. Wings 44 is just the right size. Big enough to provide the right amount of exposure to materials and processes, especially those related to sheet metal and industrial furniture. It is also small enough to harbour a workforce that cares for each and every detail of the deliverable with amazing love.

Kohapur is a typical city on the vast Deccan plateau- cruel summers, slow monsoons, the countryside peppered with forts and beautiful temples. A visit to Kolhapur is incomplete without visiting Panhala Fort, Jyotiba Temple, and the ancient stone carved temple of Khidrapur, apart from the Mahalakshmi temple complex, the New palace and the Rankala lake. The city is also known for its cuisine, pure and earthy, drawing its origins from true Maharashtrian culture.

I look back and thank the city and the company for hosting me for over a month and wish them all the best for their future.

Wings 44

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"The wide world is all about you; you can fence yourselves in, but you cannot forever fence it out."

- J.R.R. Tolkien