

Design of Garbage Truck for Indian Cities

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M. Des. – Transportation Design

(2013-15)



School of Design Studies

University of Petroleum and Energy Studies

Dehradun

April 2015

Design of Garbage Truck for Indian Cities

Project submitted in partial fulfilment of the requirements

For the award of the Degree of

MASTER OF DESIGN

IN

TRANSPORTATION DESIGN

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Declaration

I hereby declare that the project work entitled "Design of a garbage collecting truck for India" submitted by me in partial fulfilment of the requirements for the award of the degree of Master of Design (Transportation Design) at School of Design Studies, University of Petroleum and Energy Studies was carried out by me during 15 Jan 2015 to 16 April 2015 under the supervision of "Mr. Jagpreet Singh, Assistan Professor".

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Acknowledgement

First and foremost, I would like to thank my esteemed guide Prof. Jagpreet Singh for providing a big opportunity to work under him. His guidance made me learn and understand things outside my boundary of thought.

I would like to express heartfelt gratitude to the School of Design Studies for providing me the facilities and the assistance required for the project.

I would also like to thank all the NGOs and Organizations who have assisted me in my research.

A big credit to the overall learning process came through my fellow students at SODS. Students from various backgrounds portrayed different skills and I learnt a lot from my fellow colleagues.

Topic

Design of a Garbage Collecting Truck

Initial Design Brief

Design of a garbage collecting truck for use in Indian cities, providing a hassle free operation for the operator as well as the people nearby.

Scope of Project

Garbage collection is an area where India needs to critically stress upon. Being the country with leading population, the waste generated per day is very high. This high amount of garbage needs to be taken care of. India somewhat lacks behind in maintaining a sustainable environment for the masses.

Garbage Trucks right now are just modifications of existing trucks. The task performed is also very minimal. Being diesel powered, it adds to the energy consumption and air pollution. Hence, in a way, Garbage trucks just “transfer” the garbage from one place to another rather than attending to it. So, it can be concluded that the role of garbage trucks in a proper waste management system is limited right now.

A completely exclusive garbage truck would be a mascot for the world for India’s contribution to the waste management. Also, the truck needs to be designed so that it has a positive inspiring image all around rather than a dirty truck that smells near which people are afraid to go.

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Abstract

India is amongst the most highly populated country in the world. More number of people mean more amount of waste generated every day. People throw garbage here and there without being aware of the after effects of it. Many places are provided with garbage bins but people do not use them efficiently. At some places, shortage of dustbins compel the people to throw litter around.

Ever wondered what happens to the garbage once you dispose it off in a dustbin or any other location? The garbage is collected by a collection medium, then moved to a central collection zone (more popular as a dump yard). At these collection zones, the garbage is manually segregated by humans and then appropriate post processing is done. Post processing involves recycling, bio-degradation, Landfilling, Incineration etc. Every kind of waste requires a different kind of post processing.

Segregation of waste is amongst the major issue faced in the waste management system. People are not aware of the different types of waste and end up dumping a pile of mixed garbage, making further processing difficult. Some places are provided with segregated dustbins, but even then they are not effective. The reason being either lack of awareness, or lack of sincerity towards the environment.

The project identifies garbage trucks as an integral part of the total waste management system. Currently it is just a waste transfer vehicle. The projects aims to design a whole new garbage truck keeping the practical Indian scenario in mind. The new concept will have added versatility with much greater contribution to the waste management system. Since, the garbage trucks move around the streets continuously, these could also be utilized someway to create awareness about proper waste management techniques. Hence, educating people and inspiring their roles for environmental protection. In short, the garbage truck can be portrayed as a mascot for the waste management system in India.

Introduction

Garbage trucks play an important role in accounting for the successful implementation of the waste management system everywhere. There is just one task performed by the garbage truck i.e. collection of garbage. But even then, we cannot imagine implementing a proper waste management system without the truck.

The world is developing at an alarming rate. India is amongst the front runners in global development. Population is rising very quickly. More the number of people, more is the consumption and hence, more is the rate at which garbage is generated.

Proper processing of waste is an important clause India lacks behind in. Improper waste management is deadlier than it looks. People in India usually are not very concerned about their role in the waste management. Every garbage dumped here and there without being aware what happens to it next. Landfills, Incineration etc. are practices used for waste disposal which should not be. Such practices harm the ecosystem a lot. There are places in India where people are losing lives, just because the air is not breathable. Incineration involves burning of the waste. But, the residue is even more toxic in the form of ash. Similarly, Landfills degrade the land over time, and if this practice continues, we can predict shortage of usable land in India.

People in India need to understand their role towards waste management. These are minute civic duties, which can lead to a clean and healthy country. The garbage is dumped in a pile, without segregation. The municipal Corporation hires people to manually segregate them, which is very harmful to their health. Even with the safety protection on, they catch illness at regular intervals.

But then, there is a silver lining. Many NGOs have been setup by some responsible citizens carrying out waste management campaigns throughout the country. They understand the public role, and are able to influence people around. They also help educate people about the benefits of waste management, so that they carry out their role effectively.

Garbage Trucks are just commercial trucks converted for the purpose. The prospect of having an exclusive garbage truck comes from the priority of the issue. Garbage trucks have the potential to contribute far more than what they are doing today.

History of Garbage trucks



19th Century
Horse pulling carts for collecting garbage



1920
The Dempster Dumpster
Biggest innovation with rear loading arms



1940
Garwood Load Packer
Garbage compacting technology

Motorized Garbage trucks after introduction of Ford Model T



1910

Front Loading Trucks and Side Loading Trucks



1935

Technological advancement

2015

History of Garbage Trucks

The Garbage Collection began with horse drawn carriages, pulled by men wandering about and manually collecting garbage. This was the lone source of garbage collection till the end of 19th century. The 20th century saw significant developments for the garbage collection techniques.

The Ford Model T was a revolution in the automobile industry. The reliable use of Ford model T inspired the birth of motorized garbage trucks. People threw garbage on the back of a Ford pick-up truck. Being open from the top, garbage flew out sometimes when the truck is in motion. This continued until the introduction of enclosed garbage trucks around 1920.

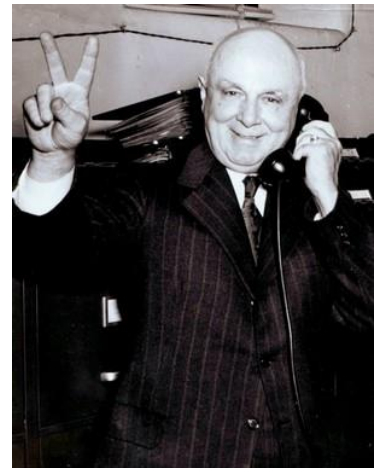
One major issue faced now was the manual lifting of garbage to a height which required great effort. In 1937, George Dempster invented the Dempster-Dumpster system in which wheeled waste containers were mechanically tipped onto the truck. This was the revolutionary invention for the development of garbage trucks.

In 1938, the Garwood Loadpacker brought a big innovation by inventing the garbage compaction system by means of hydraulic systems. This innovation enabled the trucks to carry much more garbage than it used to carry earlier. The system compresses the garbage into a smaller volume, hence creating void spaces for more garbage.

1950s saw the hydraulics of the vehicle develop even more. Compactors with metal panels operated hydraulically came into the scene for making the garbage compact so that more amount of garbage could be carried per trip.

Around 1970s, the need for more number of garbage trucks was rising, leading to development of huge sized trucks. "Godzilla" and the Pack Master were huge trucks with incredible lifting power, picking up containers with hundreds of gallons of waste in them. But Their size was impractical as it was difficult to be used in residential areas. The Pack Master took hydraulics to the next level. A photograph of the truck crushing a Volkswagen was widely circulated in newspapers. The Pack Master was responsible for big waste like furniture etc. which other trucks could not handle.

The refuse truck "Hey Day" developed during the 1990s, when waste management had become amongst the top priorities for the world. It was designed to carry 2-3 times more material than the previous trucks. Even after functionality, it was fast. Its speed gained popularity in residential areas.



Brief History of Waste Management System

Waste management techniques are almost as old as human existence. The early people started burying them under the ground. The Early centuries saw various civilizations develop and hence, a waste management system was adopted by every civilization.

Earlier, people used to dump it at the place of use. But health problems arose. People then started dumping in the outskirts of the city. But it was difficult to dump waste far from the place of use everytime. Hence, the concept of garbage collection started. In this system, hired people would wander around the streets collecting waste in a container and it was their responsibility to dump it out of town.

But then, what after it was dumped outside the city. Some believed in burning it, some collected it in a dump and covered it with earth. Some even exploded the whole garbage pile inside a dump.

As cities grew, Trash started piling up. This caused a stench, harbored rats and other pests, contaminated water supplies and led to transmission of diseases.

In 1340s, "The Black Death" plague spread to western Europe and North Africa, resulting in an estimated 75 million deaths worldwide. Continuous dumping of garbage in the outskirts of the cities began shortage in usable land, and further dumping started in ditches and public waterways

The "Industrial Revolution" saw immense development, but also created significant amount of waste. Savengers started collecting stuff from garbage and selling them.

In 1776, America developed bullets from recycled metal for the first time ever.

The mid 19th century was regarded as the "Age of Sanitization" when several laws, rules and regulations were passed requiring the people to perform their roles.

In 1874, Energy from waste begins its first development in Great Britain as the first "Destructor" is designed and constructed in Nottingham. They burned mixed fuel, producing steam to generate electricity.

Concerns regarding appropriate places for waste disposal begins around the early 20th century. Hence, Early 20th century saw many recycling and incineration plants being developed.

Garbage collecting trucks started being developed, which could assist in adopting a better waste disposal system. They played a major role in waste management. But, practically speaking, they ended up dumping it further than people used to do earlier. In a way, it started damaging more land.

It was late 20th century till people realized the need for waste segregation, which has helped to ease the recycling process to a great extent.

Types of Vehicles used in Waste Management Worldwide

Garbage Truck

Garbage truck, Refuse truck, Dustbin lorry, Rubbish truck, Trash truck etc. are all the names of this very essential truck. Garbage trucks have been around since the past century and have been playing an important role in waste management system.

Garbage truck is a truck specifically designed to collect municipal solid waste and haul the collected waste to a waste treatment facility such as a landfill.

It started with people manually dumping into the lorry. But technological advancements saw automated arms being used to lift the garbage container.

Various types of garbage trucks are :

- Front Loaders
- Rear Loaders
- Side Loaders



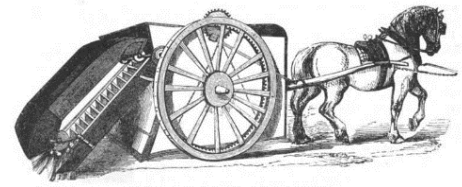
Street Sweeper

A machine that cleans streets, usually in urban areas.

Modern Street Sweepers are mounted on truck bodies and can vacuum debris that accumulate in the streets. Older street sweepers were only effective in removing large particles of road debris, small particles remained behind in large quantities.

Today, small particles are known to carry a substantial portion of the storm water pollutant load.

According to EPA "Street Sweeping, the best management practice in protecting water quality" .



Gully Emptier

Gully emptier or Gully Sucker, is a type of specialized tanker lorry with suction gear, which can suck waste water, mud and sludge out of hollows and carry it to a suitable disposal point. Sometimes, the gully emptier has a flexible hose without solid nozzle.

Possesses the ability to suck out and pump through into its tank, any road grit and miscellaneous solids that have got into the hollow.

Some have a means of squeezing the water out of its load and letting that water run down the drain or keeping it for high pressure cleaning of drain pipes.

Gully emptier are often fit with devices to separate the liquid contents of its tank from solid matter, allowing the liquids to run to storm drain.

Sometimes, the gully emptier has a flexible hose without solid nozzle like a cesspool emptier.



Sand Cleaning Machine

Known as Sand cleaning machine, beach cleaner, sandboni. A vehicle that drags a raking or sifting device over beach sand to remove rubbish and other foreign matter.

Manually self-propelled vehicles on tracks or wheels or pulled by a quad bike or a tractor. Used to combat litter left by beach patrons and other pollution washed up on their shores.

They work by collecting sand by way of a scoop or drag mechanism and then raking or sifting anything large enough to be considered foreign matter including sticks, stones, rubbish, syringes, and other items

Operation technologies include –

- Raking technology
- Sifting Technology
- Combined raking and sifting technology

These sand cleaning machines have been used to clean up after natural disasters apart from beaches.



Motocrotte

Officially called as "Caninette"

A small motorized vehicle designed to vacuum up dog faeces in Paris, France.

Based initially on Yamaha XT 550 and later the XT 600.

A large tank in the rear which housed both water and waste, attached to vacuum powered hose which was placed over the material required to be removed.

Pooper Scoopers being used to rake and scoop the poop into a garbage bag. A metal bin with a rake like edge attached to a wooden stick. It also includes a rake like device to scoop the poop into the scooper and a hatch that can be attached to a garbage bag that fits onto the base.



Garbage Scow

A large watercraft used to transport refuse and garbage across water-ways.

Often in the form of a barge which is towed or moved by means of tug boats, however many are self propelled.

Transport of collected trash to neighboring disposal sites. But many a times used for smuggling practices.



Vacuum Truck

A tank truck with a heavy duty vacuum designed to pneumatically load solids, liquids, sludge or slurry through suction lines.

It uses a Rotary van vacuum pump. The truck can be configured to be direct belt drive, or a hydraulic drive system. There are two ways to mount the pump :

- Directly on the truck with the vacuum drive powered by the truck motor
- On the trailer with an independent motor

When used to transport faecal sludge, then it can also be called " faecal sludge truck" .

All forms of sanitary waste disposal are handled by vacuum trucks. Vacuum trucks discharge the waste to the sewer network to a waste treatment plant in a pit for composting, or (illegally) to the environment.

Used in petroleum industry to clean storage tanks and spills

Manual scavenging is illegal in India. Vacuum trucks is an alternative to such a practice.



Rotopress

A waste collection vehicle, which uses a rotating drum to compact the waste.

A type of a continuously compacting truck. A massive rotating drum compacts and stores the garbage. The outer edge of the drum acts as the loading hopper, and paddles on the drum convey the waste around an auger of decreasing pitch until it is small enough to be forced through a small ring shaped gap between the drum and the auger, where it then enters the main section of the drum, which has helically shaped internal paddles, which move the now crushed waste towards the front of the vehicle.

When emptying, the direction of rotation of the drum is reversed



Primary Research

Primary Research Locations

A primary survey lays the foundation for further development in the project. Hence, intense research related to the topic is necessary. Being in Dehradun, all the concerned offices related to my project were contacted.

It started with creating a list of stakeholders who could contribute to my project by providing some insights related to the topic. Then concerned people were identified and I contacted them. Being in touch with many of the NGOs provided great insights. I was able to grasp some of the problems faced by the people, the waste workers, the Organizations etc.

Listed below are the names of the organizations which provided great insights. This is just a brief list of the total number of places contacted.

Office	Address
Environment Protection and Pollution Control Board	29/20, Nemi Road, Dehradun, Uttarakhand - 248001
Swach Foundation	Kothrud Kachra Depot, Paud Road, Kothrud, Pune - 411038
Dehradun Municipal Corporation	Near Doon Hospital, New Road, Dehradun, Uttarakhand - 248001
Waste Warriors	24, Pritam Road, Dalanwala, Dehradun, Uttarakhand - 248001
Dehradun Municipal Corporation Workshop	Sahastradhara Road, Dehradun - 248001
University of Petroleum and Energy Studies	Energy Acres, P.O. Bidholi via Prem Nagar, Dehradun, Uttarakhand - 248001

Primary research in pictures





Primary Research Insights

The primary research was carried out as a field survey involving meeting with the concerned people. Analyzing the different stakeholders and getting to know about their contribution and needs.

A volunteering was carried out with waste warriors to get the feel of the actual condition being in the waste picker's job.

EPA and Dehradun Municipal Corporation provided with the government related insights.

Dehradun Municipal Corporation workshop provided with the insights for the different types of vehicles used for the waste management around Dehradun.

Swach foundation, Pune is amongst the biggest NGOs for the purpose and it provided great insights being in touch with them.

According to the Indian Govt.

- Waste has to be transported under covered conditions, to prevent harm to the environment.
- Disposal of wastes on roads is prohibited, but still it is practiced in many parts of the country.
- Waste Segregation is desirable, but it is only effective when there are proper treatment facilities for the segregated waste
- Shortage of lands for dumping of waste
- Throwing away of garbage on the streets is an offence and the person will be charged with a fine accordingly.

These are some of the insights provided by the government, which are practically, rarely followed by people. There are Govt. norms prepared for the betterment of the waste management system. But, practically it is not implemented. It has remained on papers.

General insights through the research :

- The Dehradun Municipal Corporation possess 6 different types of vehicles for the purpose ranging from hand pulled to automated rear loaders.
- The rear loader truck is used widely with different capacities of 10-15 ton and 22-25 ton respectively.
- The small truck (10-15 ton) makes 6-7 rounds per day through the city, while the 25 ton truck makes one round.
- The Tata magic converted garbage truck is used for door-to-door collection at several places.
- Besides these, there are lorry trucks, tractor-trailers, manually pulled carts, etc.
- Cranes and Bobcats are used to load waste into such trucks

- According to the Nagar Nigam staff, at least two people (usually 3) are required when a garbage truck is in operation.
- These basic truck chassis has no modifications, all the modifications have been done in the rear equipment.
- The only function of these trucks is to collect the waste from the city, and dump it in the dump yard ("khatta") situated in the outskirts of the city in Sahastradhara road.
- No post processing of the waste is done by the truck.
- No Compacting done in the trucks used
- Waste Segregation is a big problem
- UPES is situated in Bidholi village which falls under the rural sector.
- DMC Workshop is only registered for urban use.
- A privately owned foundation working on contract basis is responsible for the garbage collection.
- They use a Tata Magic Ace pick-up truck for the purpose.
- 3 people accompany the vehicle and manually load the garbage drums onto the vehicle, replacing them with the empty ones.
- Garbage trucks are necessary.
- Their operation is very noisy.
- Most of the trucks do not have a covered loader, which sometimes causes the litter to fly off the truck.
- Low frequency of operation. They feel that garbage bins at busy areas like Ghantaghar, Rajpur Road must be cleaned multiple times a day.
- People do not find sufficient Garbage bins in the city.
- The bigger bins are so dirty, that people do not want to go near them. Hence, they end up dumping waste somewhere else.
- Street dogs and insects hovering around the trash bin.
- There have been cases in Dehradun, where serious accidents have taken place due to the movement of dogs around the bin.

These insights lay the foundation to defining the actual problem areas around which the new concept will be developed.

Types of Waste and their treatment

Types of Waste

Broadly speaking, the waste is classified as under. This classification is based on the post processing of the waste, as different types of waste have to be handled differently.



It is clear from the representation above, that there are four basic types of waste

- Municipal waste
- Hazardous waste
- Biomedical waste
- Special Hazardous waste

Municipal Waste

Municipal waste includes :

- Household waste
- Commercial waste
- Demolition waste

Treatment of Municipal waste :

Open Dumps

Landfills : The garbage is dumped and the pit is covered

Sanitary Landfills : These are lined with materials that are impermeable such as plastics or clay, and are also built over impermeable soil

Incineration Plants : The process of burning waste in large furnaces is known as incineration. Recyclable material is segregated and the rest is burned

Hazardous waste

Hazardous waste include :

- Industrial waste
- Liquid waste

Treatment of hazardous waste

- Landfills
- Surface impoundment : natural topographic depressions, man-made excavations, or diked areas, formed primarily of earthen materials used for temporary storage or treatment of liquid hazardous waste.
- Waste pile: Non-containerized piles of solid, non-liquid hazardous waste that are used for temporary storage and treatment.
- Land treatment unit : use of naturally occurring soil microbes and sunlight to treat hazardous waste i.e. to degrade, transform, or immobilize the hazardous constituents.
 - Injection well
 - Salt dome formation
 - Salt bed formation
 - Underground mine
 - Underground cave
- Recycling
- Portland Cement : Cement based solidification and stabilization
- Pyrolysis : Some hazardous waste types may be eliminated using pyrolysis in an ultra high temperature electrical arc, in inert conditions to avoid combustion

Special Hazardous Waste

It includes :

- Radioactive waste
- Electronic waste
- Explosion waste

Treatment of special hazardous waste

- Incineration plants
- Autoclave : Use of steam and pressure to sterilize the waste or reduce its microbiological load to a level at which it may be safely disposed off
- Bleaching : For liquids and small quantities, a 1-10% solution of bleach can be used to disinfect biomedical waste
- Heat
- Alkaline Digesters
- Use of microwaves

Treatment of Radioactive waste

- Initial treatment of waste
 - Vitrification : Long term storage of radioactive waste requires the stabilization of the waste into a form which will neither react nor degrade for extended periods of time. In vitrification, waste is mixed with sugar and then calcined (passing the waste through a heated rotating tube)
 - Ion Exchange : Concentrating the radioactivity into small volumes, which is often discharged
 - Syncroc : Synthetic rock, a sophisticated way to immobilize radioactive waste

- Long term Treatment
 - Dry cask storage : Taking waste and sealing it along with inert gas in a steel cylinder, which is placed in a concrete cylinder which acts as a radiation shield.
 - Geologic disposal : deep final repositories
 - Ocean floor disposal : deep water floor disposing
 - Transmutation : Use of reactors that consume the waste and transmute it into less harmful nuclear waste
 - Re-use of Radioactive waste

Treatment of Electronic Waste :

- Recycling : Parts of the whole waste can be recycled.
- Refurbishment : so that they can be sold again at a lower price

Problem Areas

Defining problems is as important as solving one. Hence, it is essential to list down the major problem areas, related to the project, explored during the research.

- Garbage Trucks are usually open, causing garbage to fly off.
- Great manual labor is required for the waste collection.
- More hands are required to perform the task of waste collection
- Segregated waste is not available in India.
- The operation of garbage trucks is noisy.
- The Garbage trucks are aesthetically unpleasant and people do not want to look at them, creating a negative image for the vehicle.
- The garbage truck, right now plays a role of “garbage transfer” rather than a vehicle that assists in maintaining a sustainable environment.
- People are either unaware or ignorant of their role towards waste management.
- Automatic systems used globally cannot be applied in India, because segregated waste is not available.
- Compacting is not carried out by Indian Garbage Trucks.
- Huge size and slow speed is irritating for people riding just behind them.
- Efficient signaling system is required due to its large size.
- At some places, the truck is big enough to block the traffic while collecting garbage.
- Garbage Collecting staff have to pick the garbage even from outside the dustbins.
- The area near the garbage bin is very dirty, where garbage is usually thrown outside the bin as people hesitate to go near the bin and throw trash inside.

Brand Selection : Bharat Benz



It is now long time since Tata has played the monopoly for trucks in India. New players have entered the game. Bharat Benz is among the new members and seems very promising in the long run.

Bharat Benz is looking to make its mark in the Indian truck industry. A step into an unexplored area in India could prove to be a vital step for the Company' s stake.

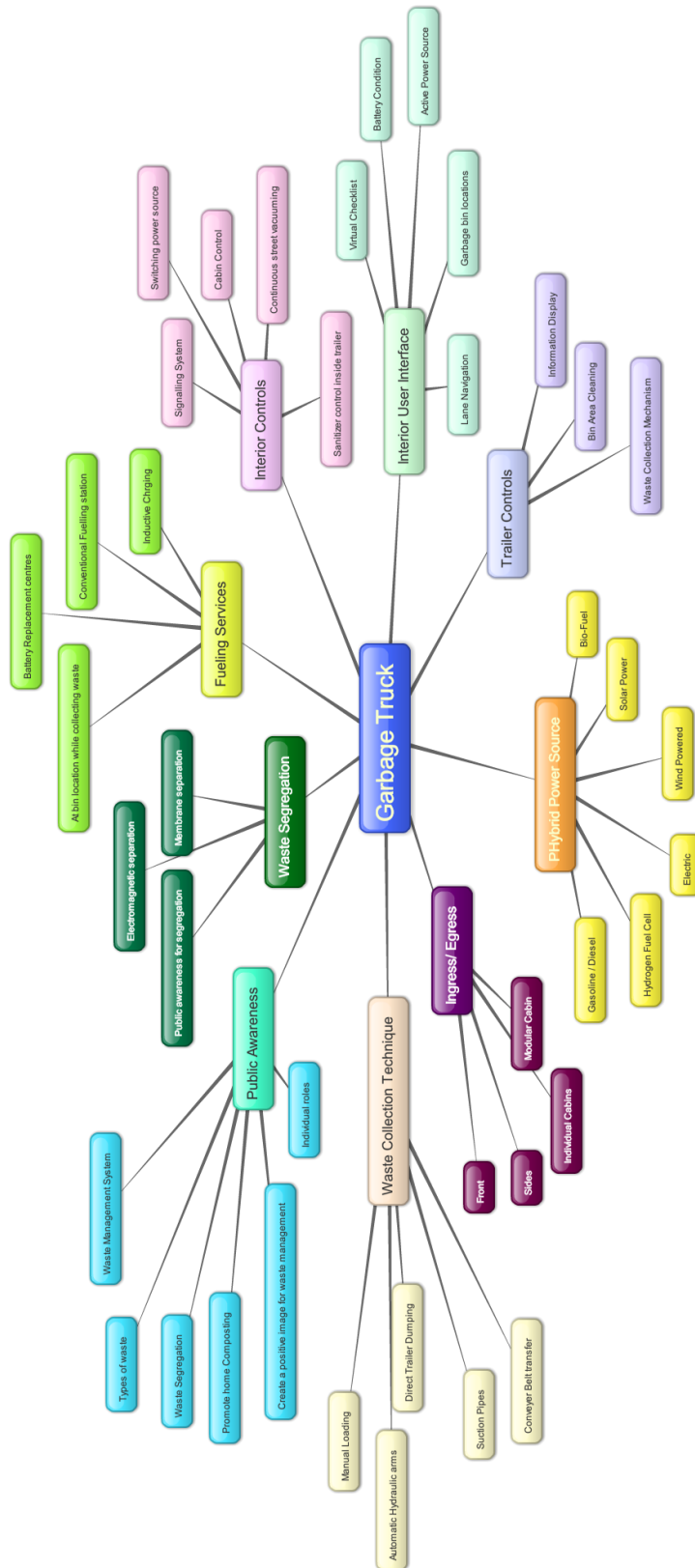
The trucks used currently for collecting garbage are modified versions of commercial trucks. An exclusive garbage truck could prove to be a great step both for the brand as well as for maintaining a sustainable ecosystem

Final Design Brief

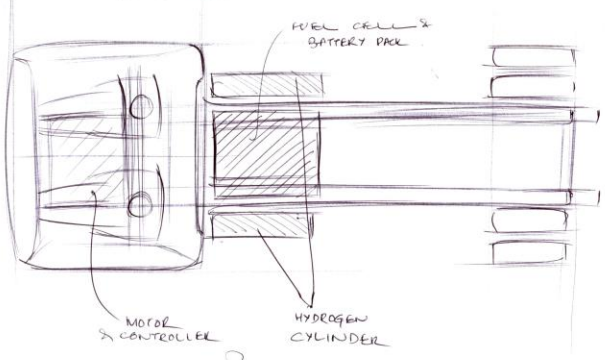
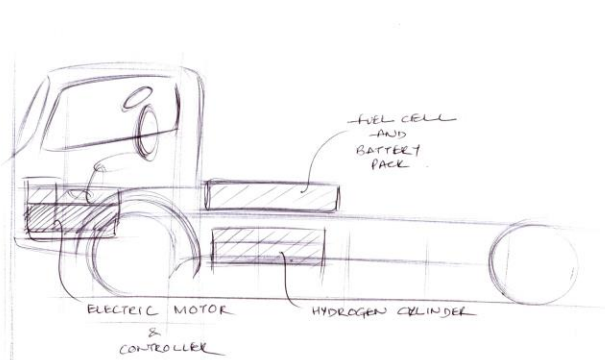
Design of a garbage collecting truck for Bharat Benz to be used in Indian cities, providing a hassle-free operation for the operator as well as the people nearby, stressing on the functionality and styling of the truck, and most importantly, its role in the overall waste management system

New Concept Development

New Concept Development Framework

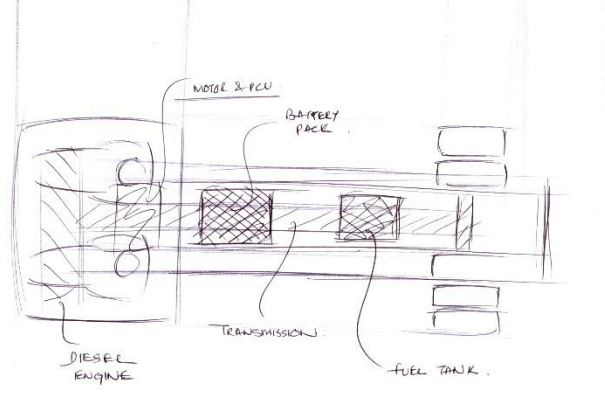
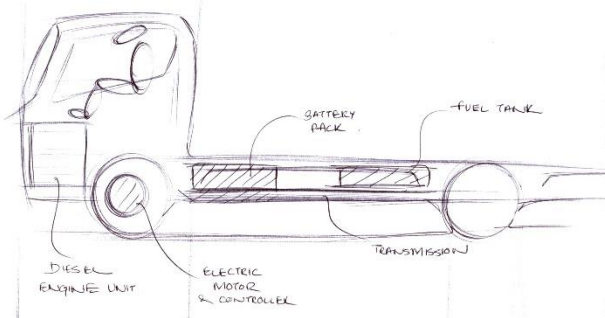


Package Ideation

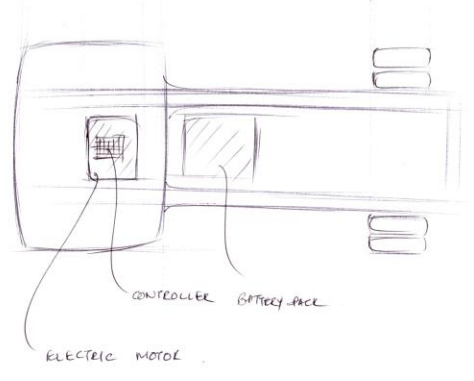
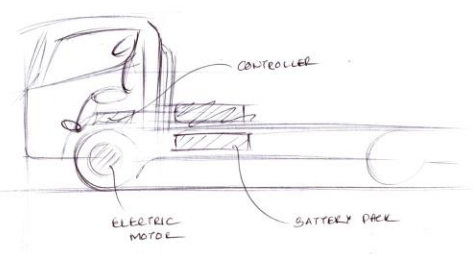


FUEL CELL & ELECTRIC HYBRID POWERTRAIN
2 OCCUPANTS

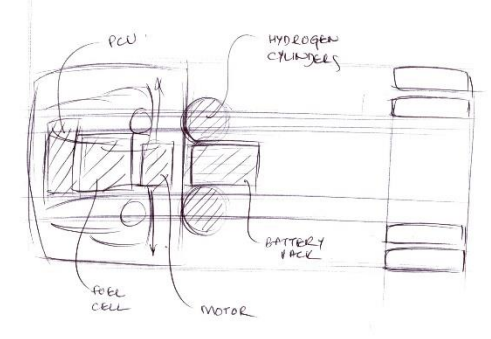
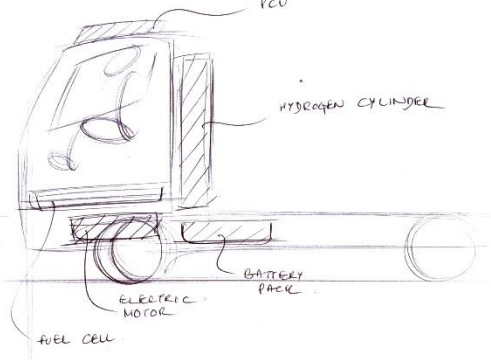
DIESEL-ELECTRIC HYBRID
(2-people)



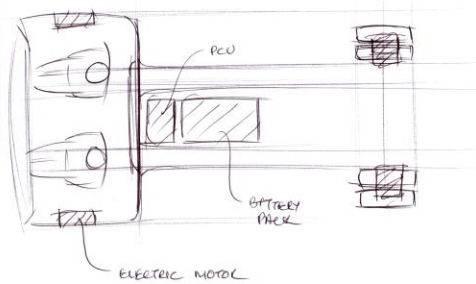
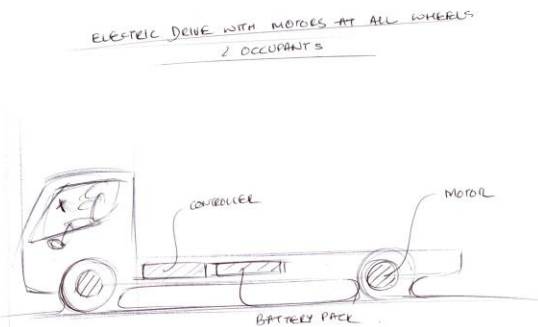
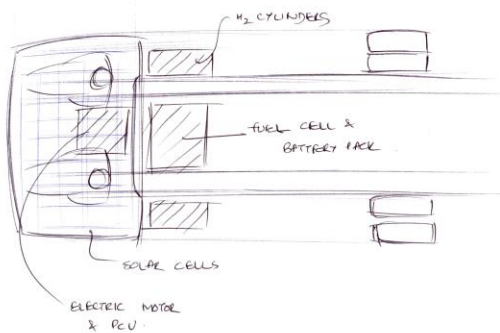
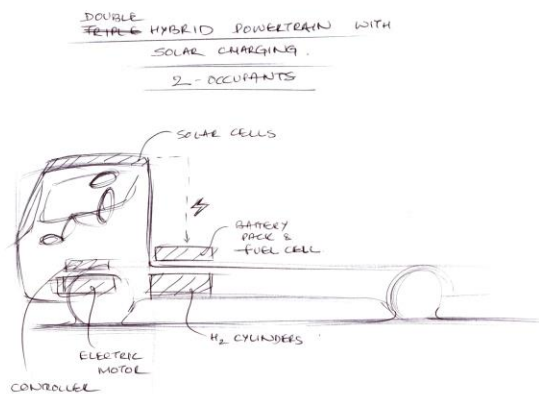
2- OCCUPANTS-
ALL ELECTRIC POWERTRAIN



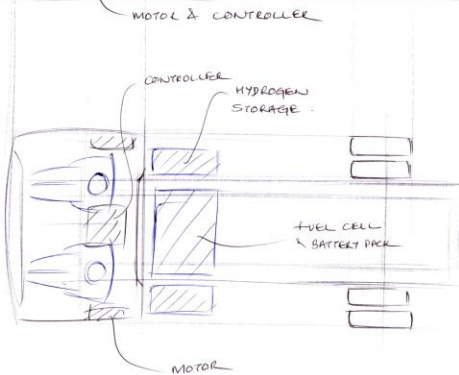
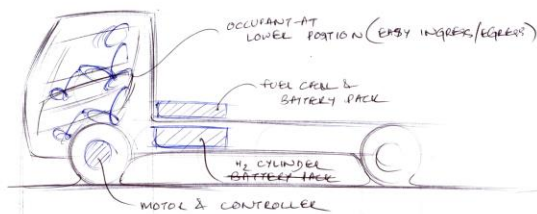
FUEL CELL-ELECTRIC HYBRID (2 PEOPLE)



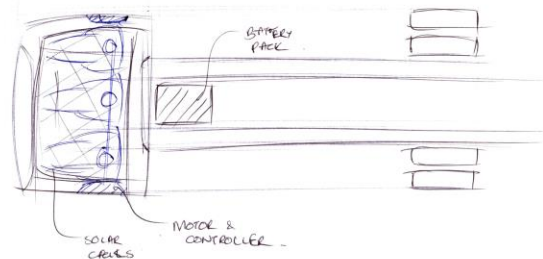
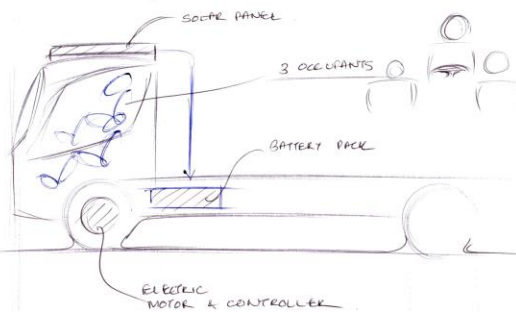
Package Ideation



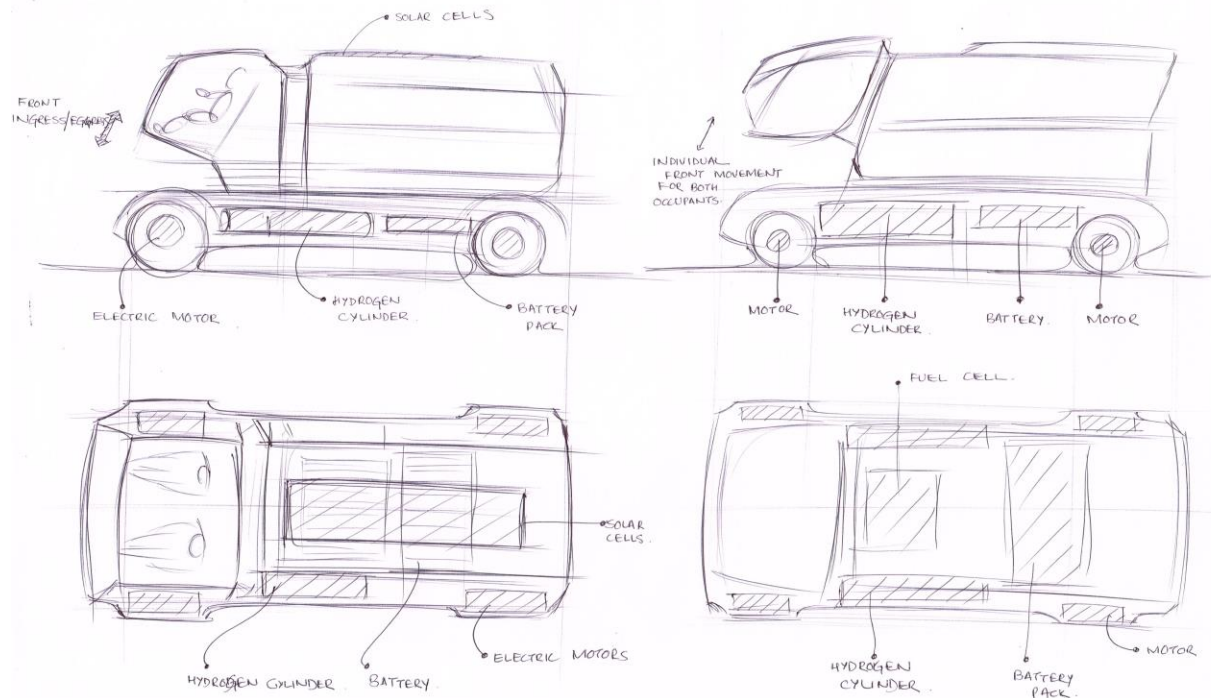
FUEL CELL - ELECTRIC HYBRID TRUCK
2 OCCUPANTS
NAVIGATOR SEATED AT A LOWER POSITION



ELECTRIC - SOLAR HYBRID TRUCK
(3 OCCUPANTS)



Package Ideation



Bharat Benz Trucks study

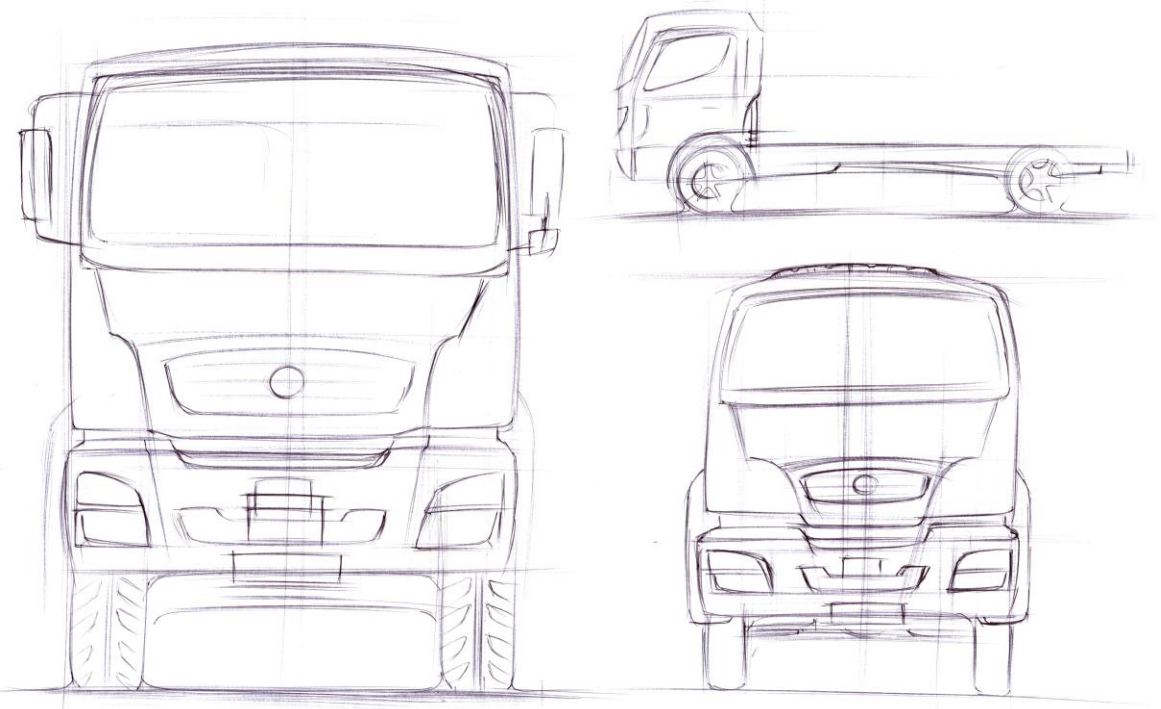
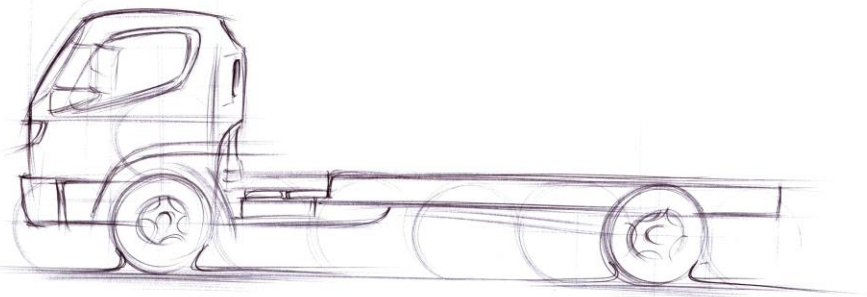
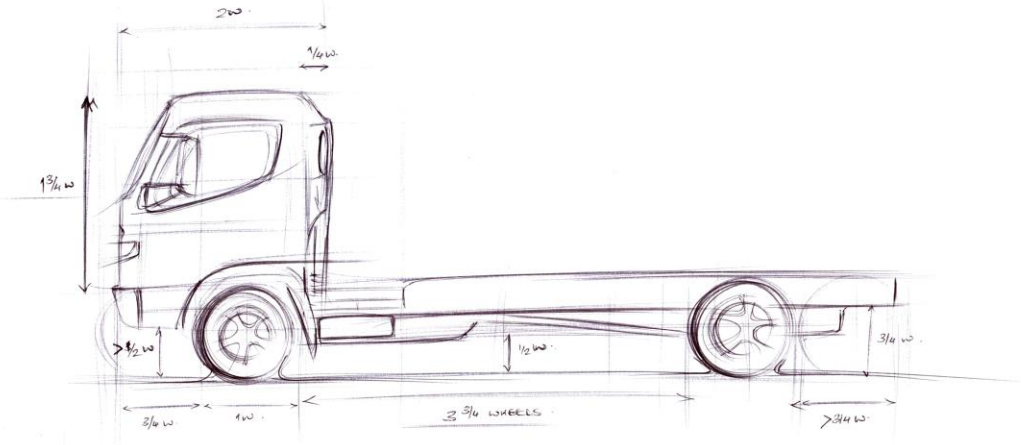


Image Boards

Inspiration and characteristics

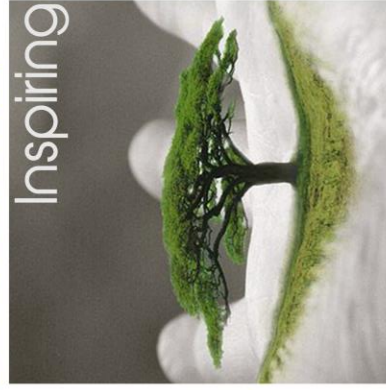
The Inspiration



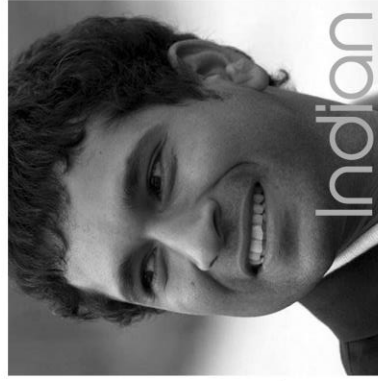
The Gulmohor tree



Peaceful



Protective



Dependable

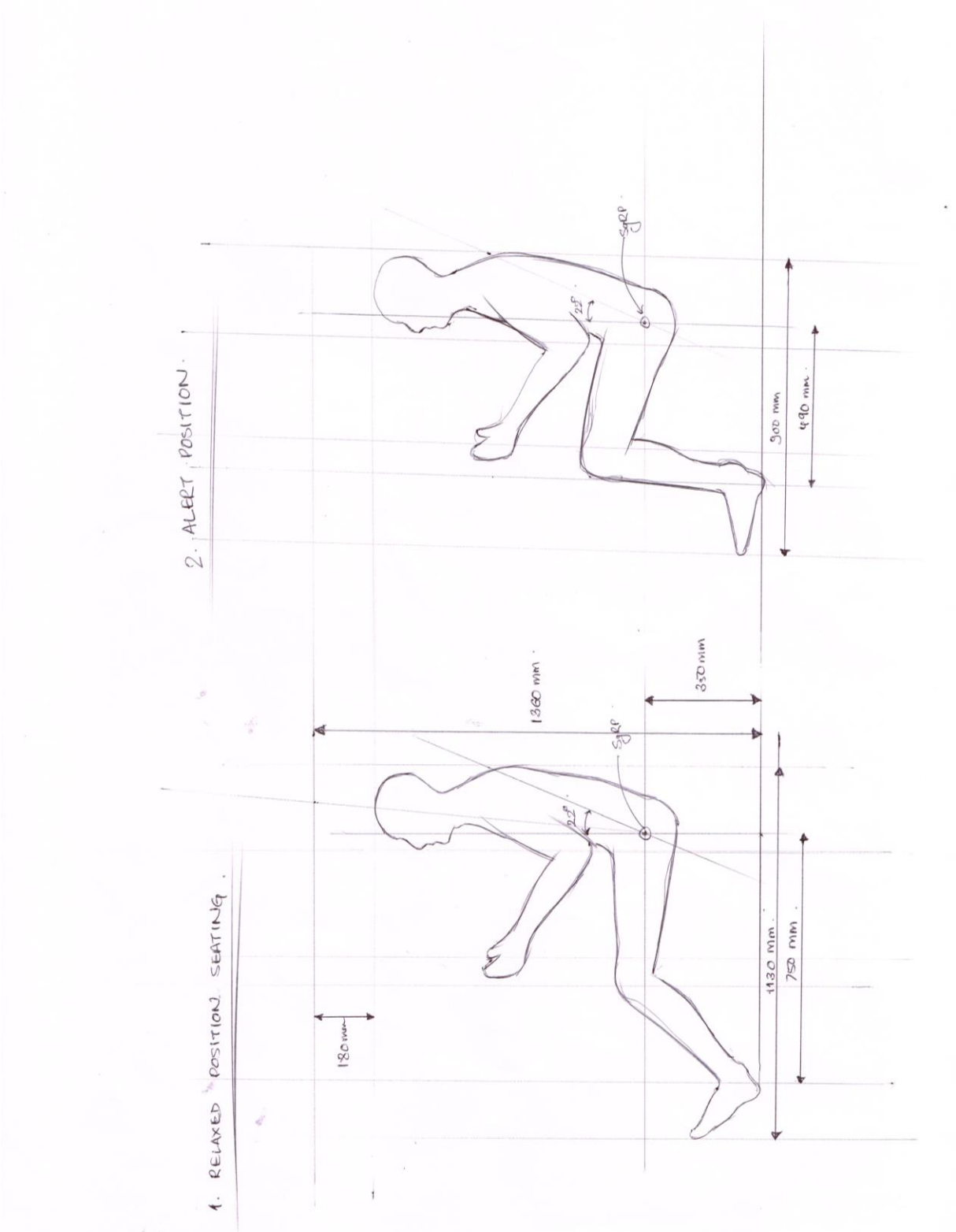
Overall Dimensions for the new concept

Based on the package ideation and brand study the overall dimensions of the truck have been decided which are as follows :

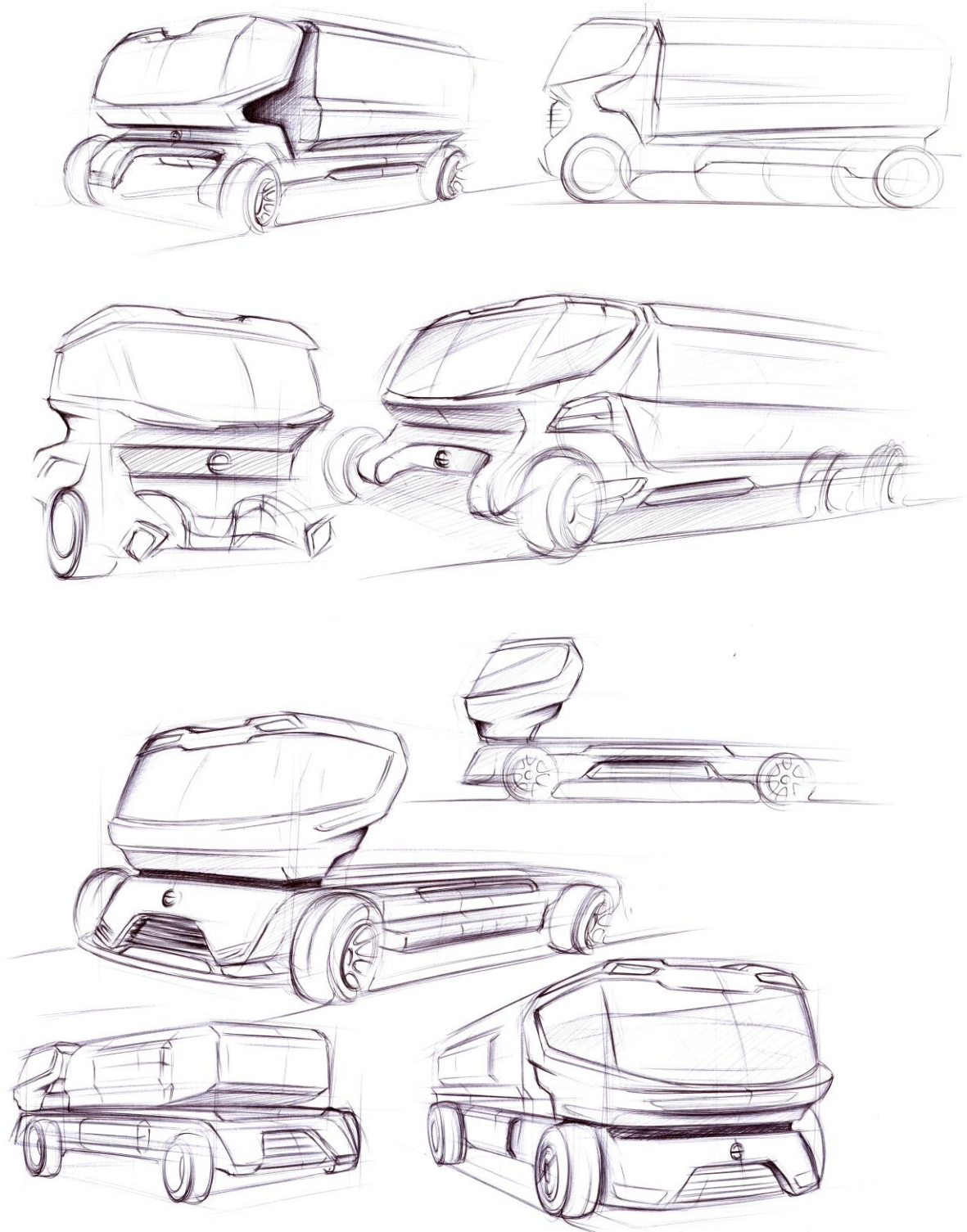
- Overall Length : 7585 mm
- Overall Width : 2135 mm
- Overall Height : 2420 mm

Based on these proportions, the further concept will be worked out

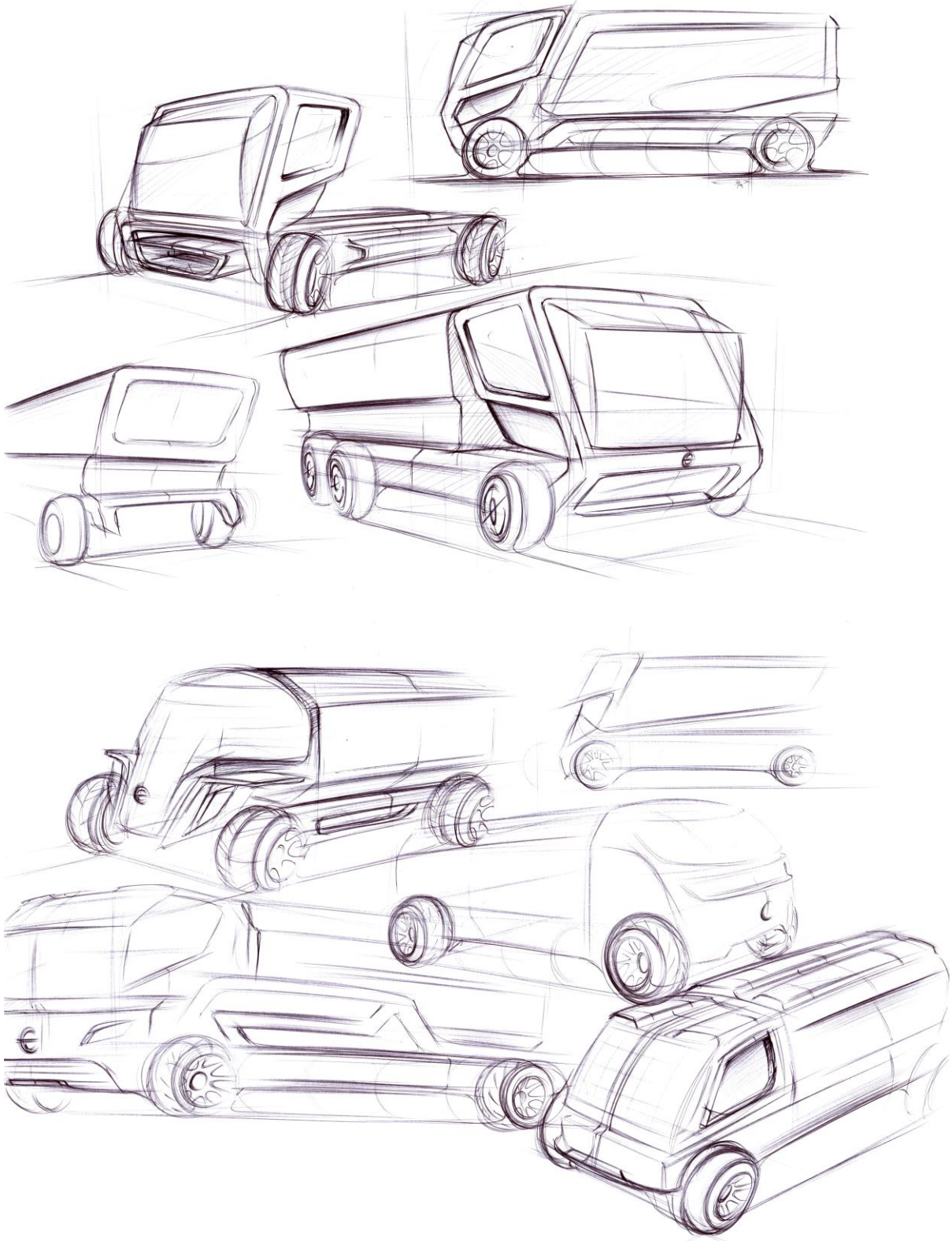
Driver Manikin Posture



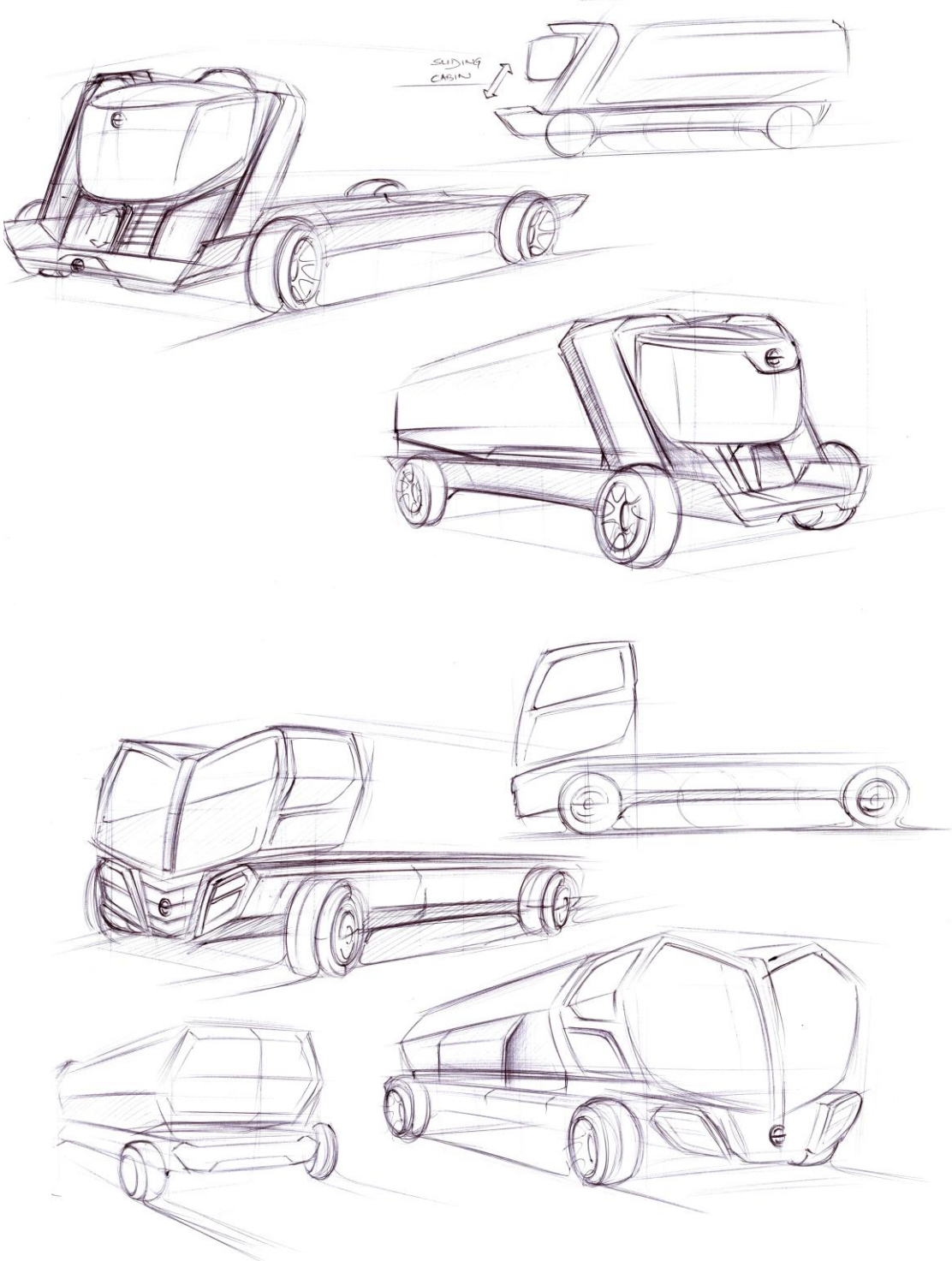
Initial concept brainstorm sketching



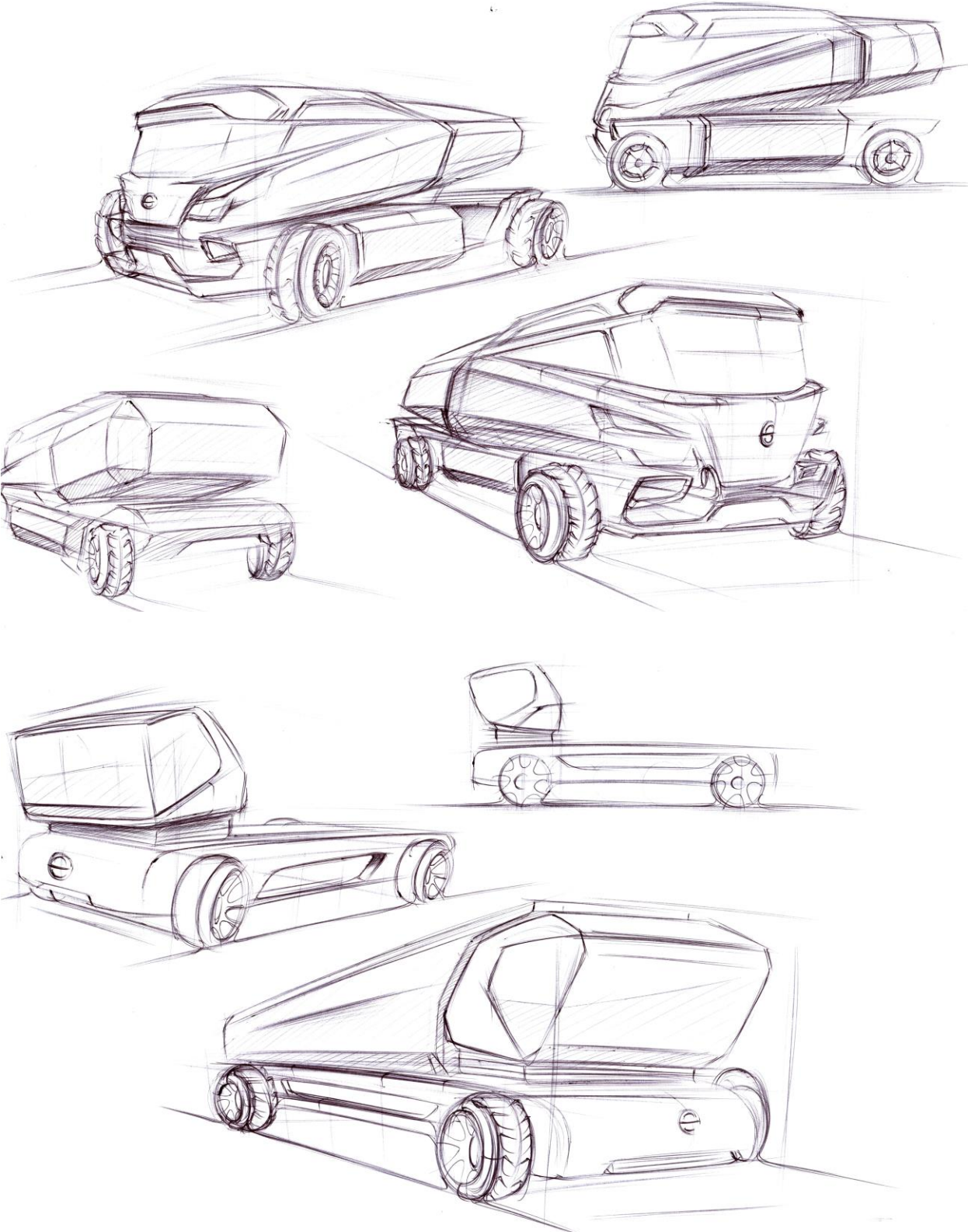
Initial Brainstorm Concept Sketching



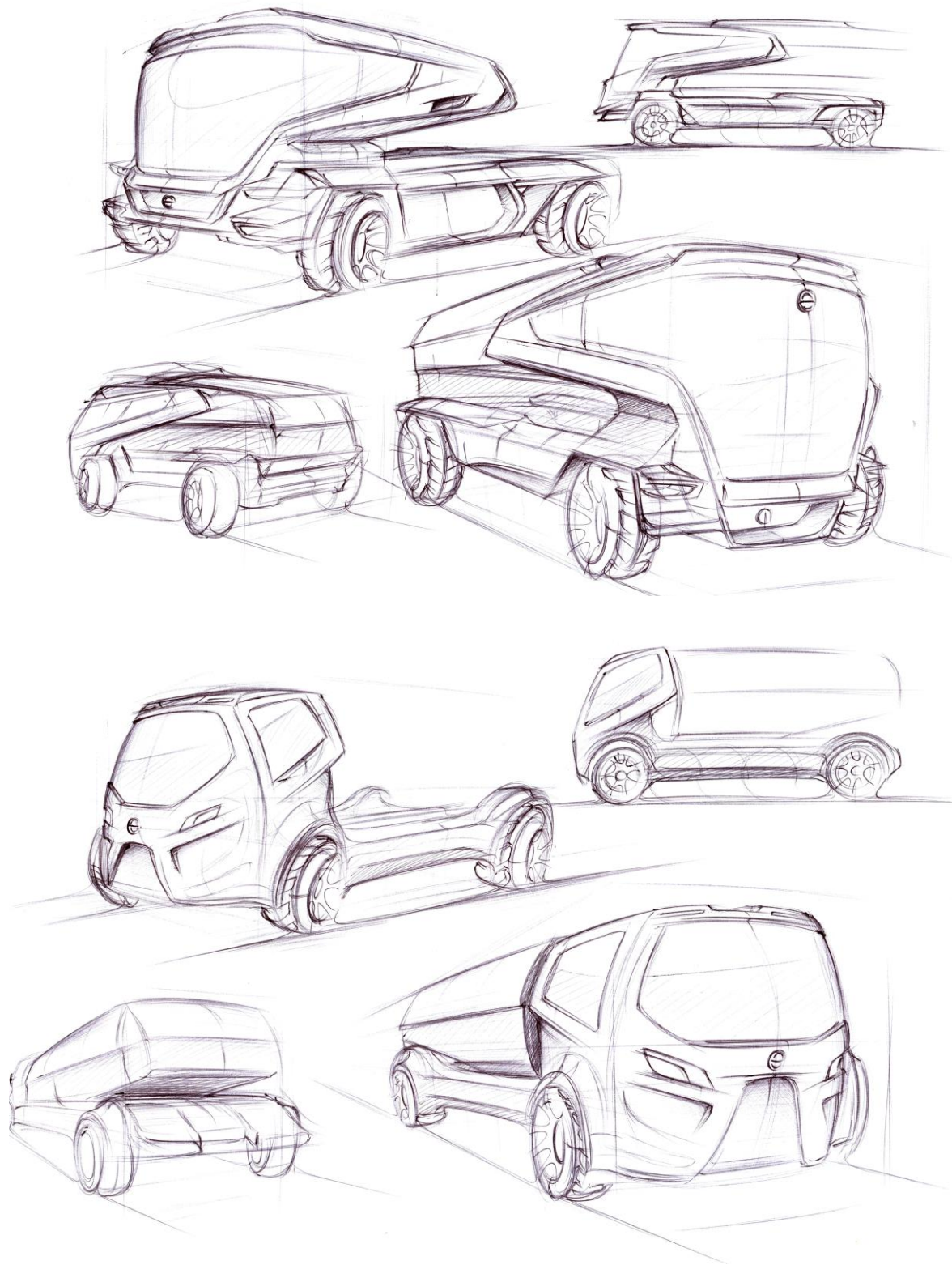
Initial Concept Brainstorm Sketches



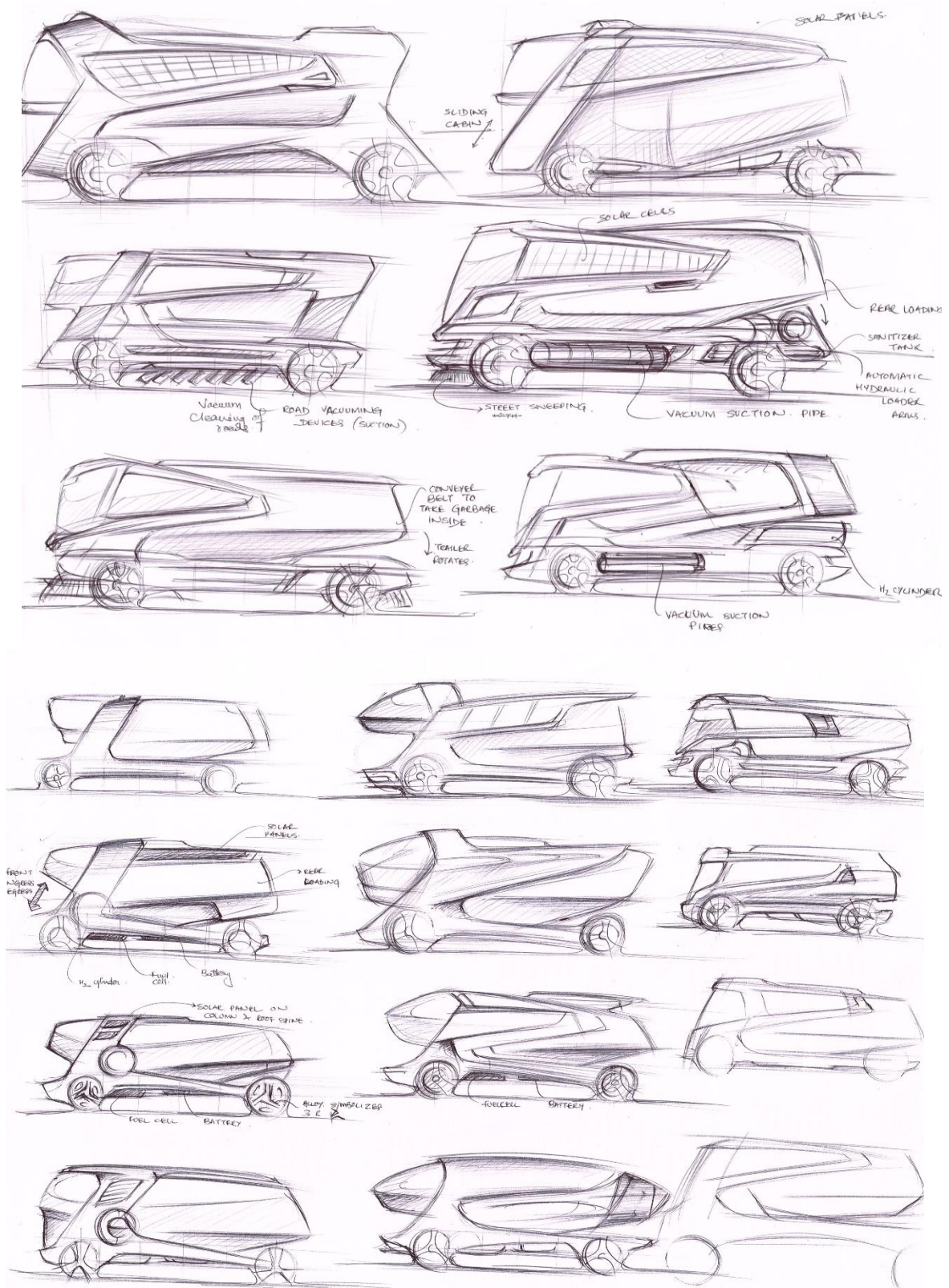
Initial Concept Brainstorm Sketching



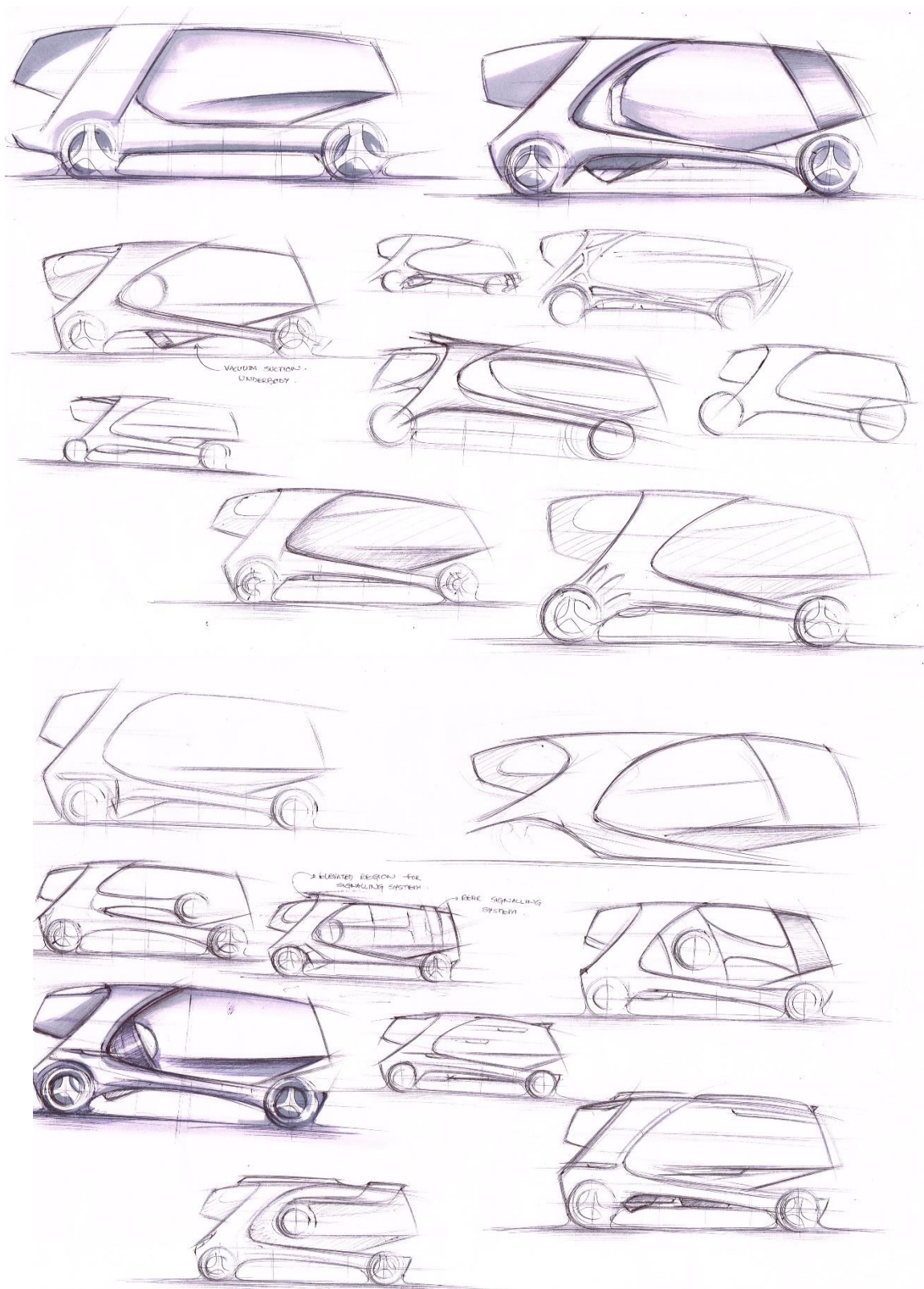
Initial Concepts Brainstorm Sketching



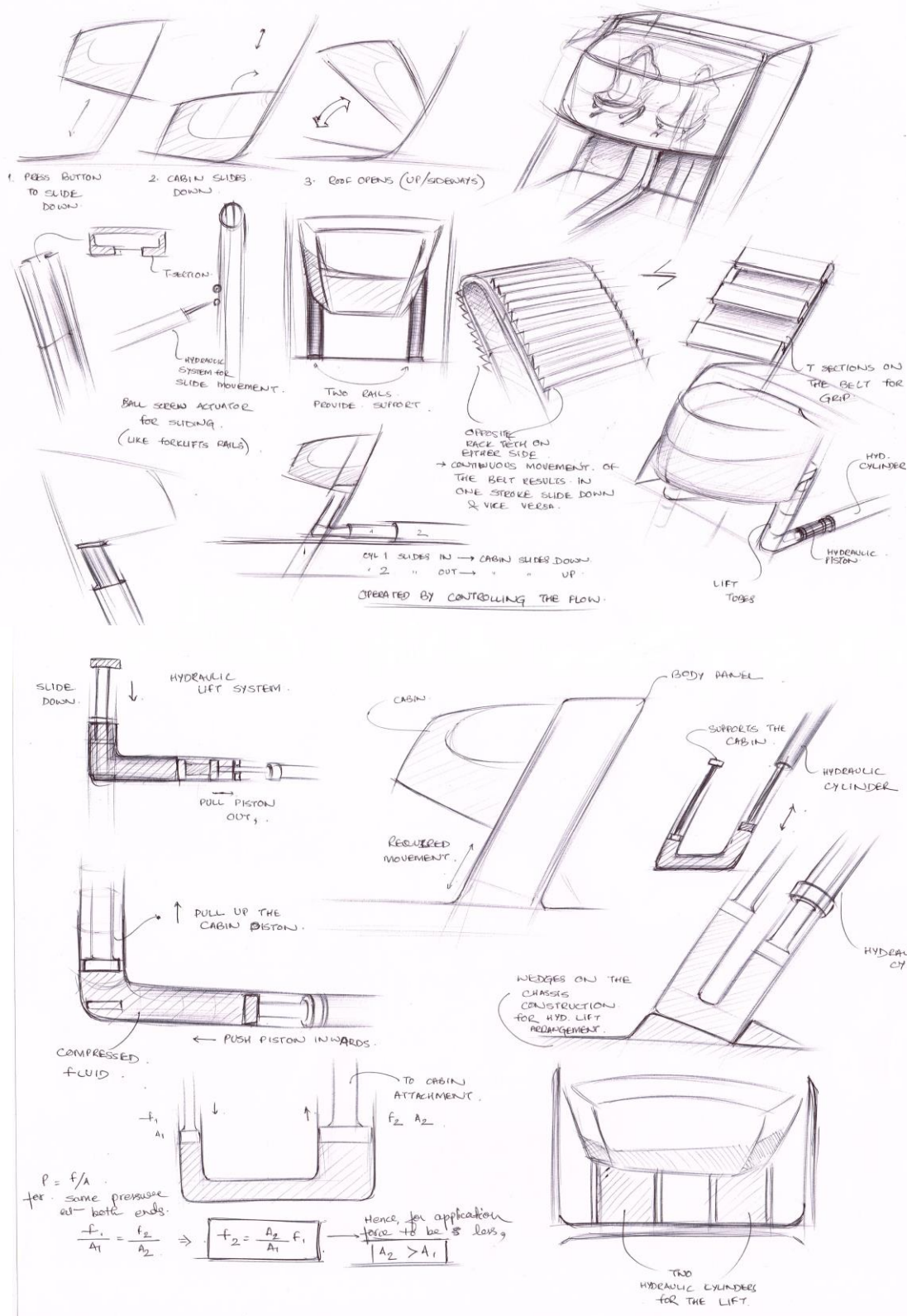
Form Explorations



Form Explorations

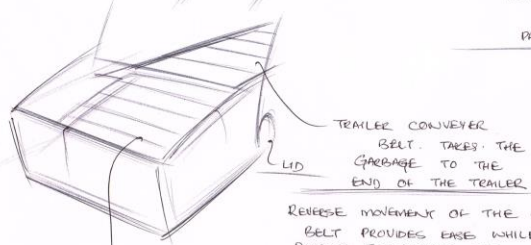
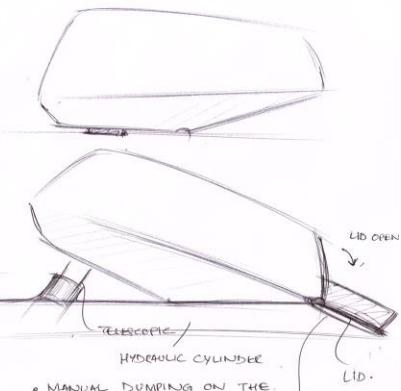
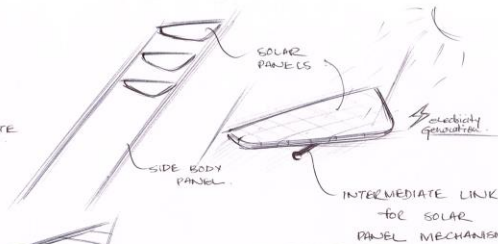


Ideation Phase : Ingress / Egress

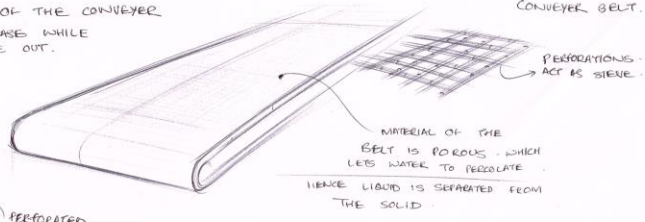
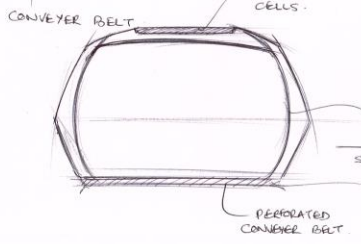


Ideation Phase : Trailer

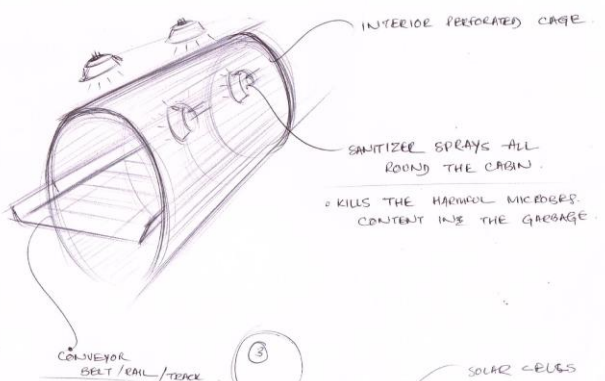
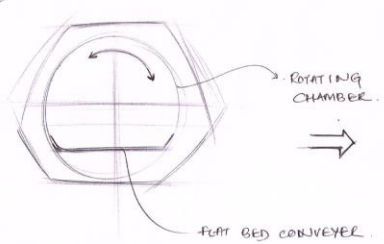
UMBRELLA MECHANISM



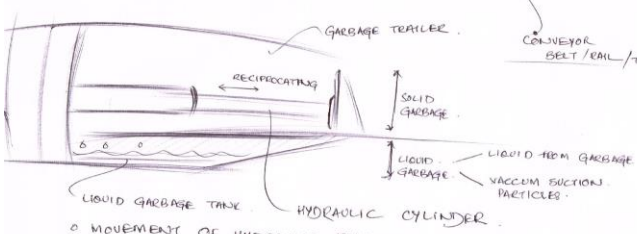
REVERSE MOVEMENT OF THE CONVEYER BELT PROVIDES EASE WHILE POURING THE GARBAGE OUT.



①

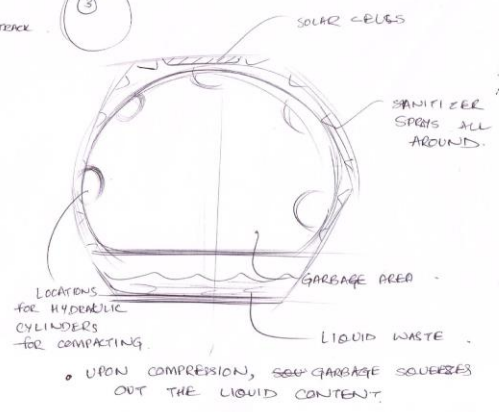


②

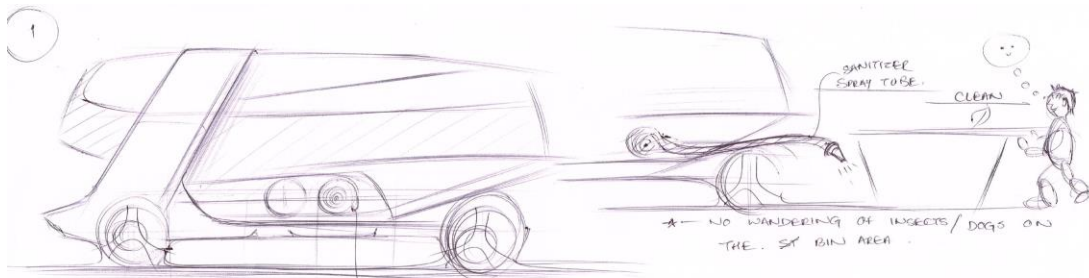


MOVEMENT OF HYDRAULIC CYLINDERS AID IN COMPACTING THE GARBAGE
LIQUID GARBAGE SEPARATES MORE BETTER BY COMPOSTING PROCESS.

③



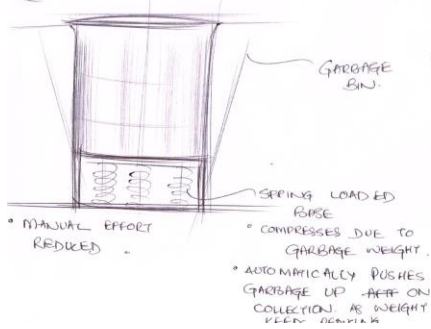
Ideation Phase : BIn Concepts



- SANITIZER SPRAY COULD BE USED ON GARBAGE BIN LOCATIONS - FOR KEEPING AREA CLEAN - AFTER GARBAGE COLLECTION.

SANITIZER SPRAYING PIPE.

2

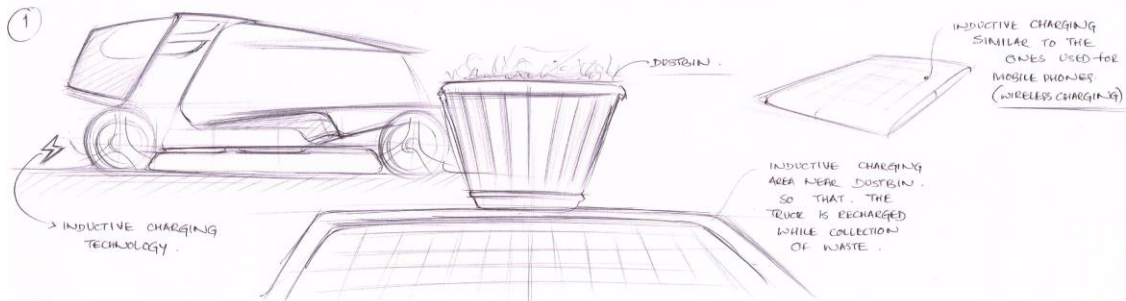


★ AS SOON AS THE SPRING COMPRESSES, SOME AMOUNT OF SANITIZER IS SPRAYED AROUND.

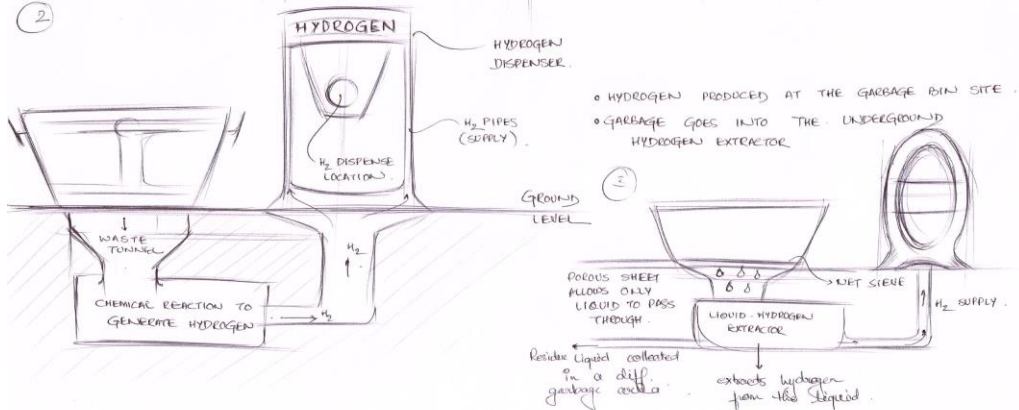
- MANUAL EFFORT REDUCED.

- COMPRESSES DUE TO GARBAGE WEIGHT.
- AUTOMATICALLY PUSHES GARBAGE UP - AFF ON COLLECTION. AS WEIGHT VERY HEAVY.

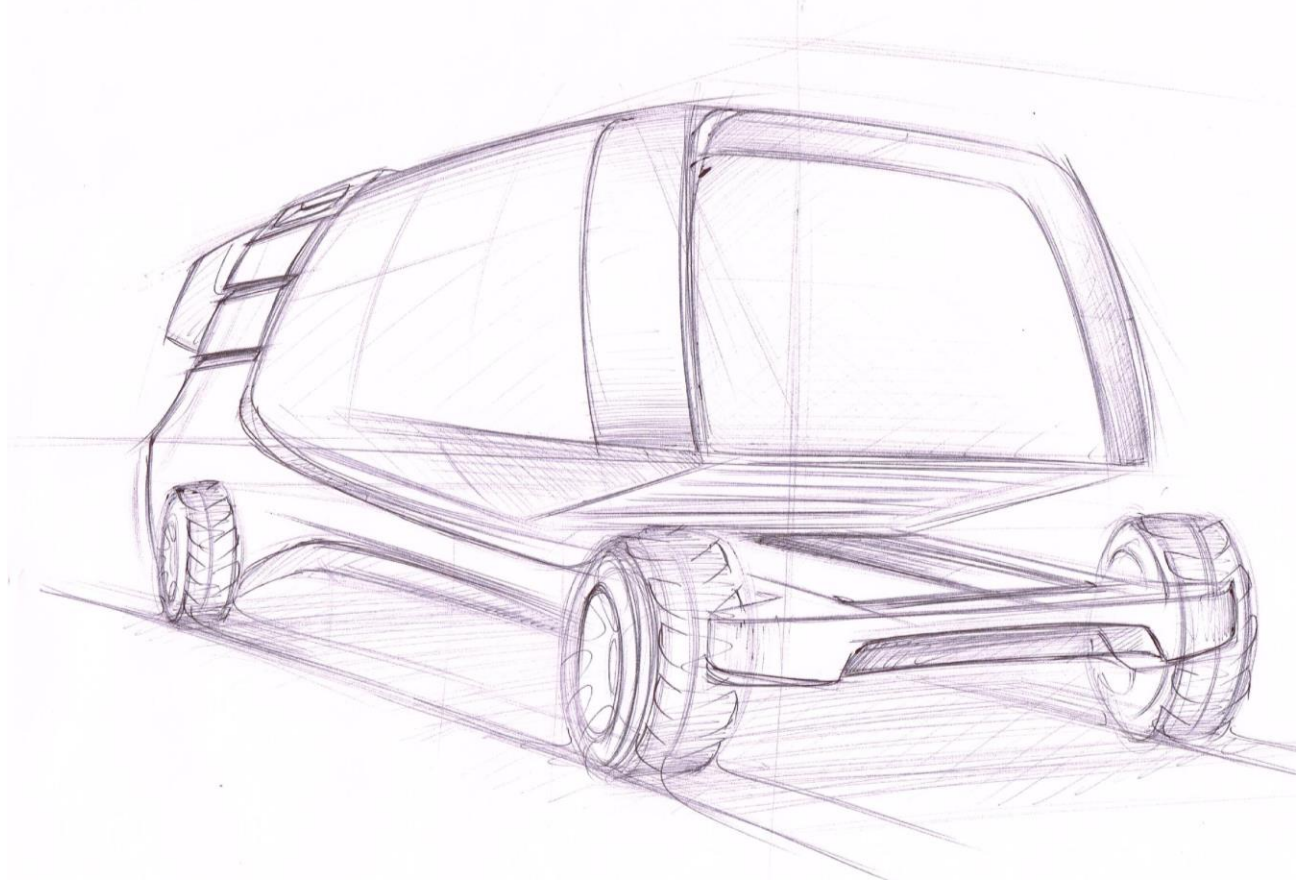
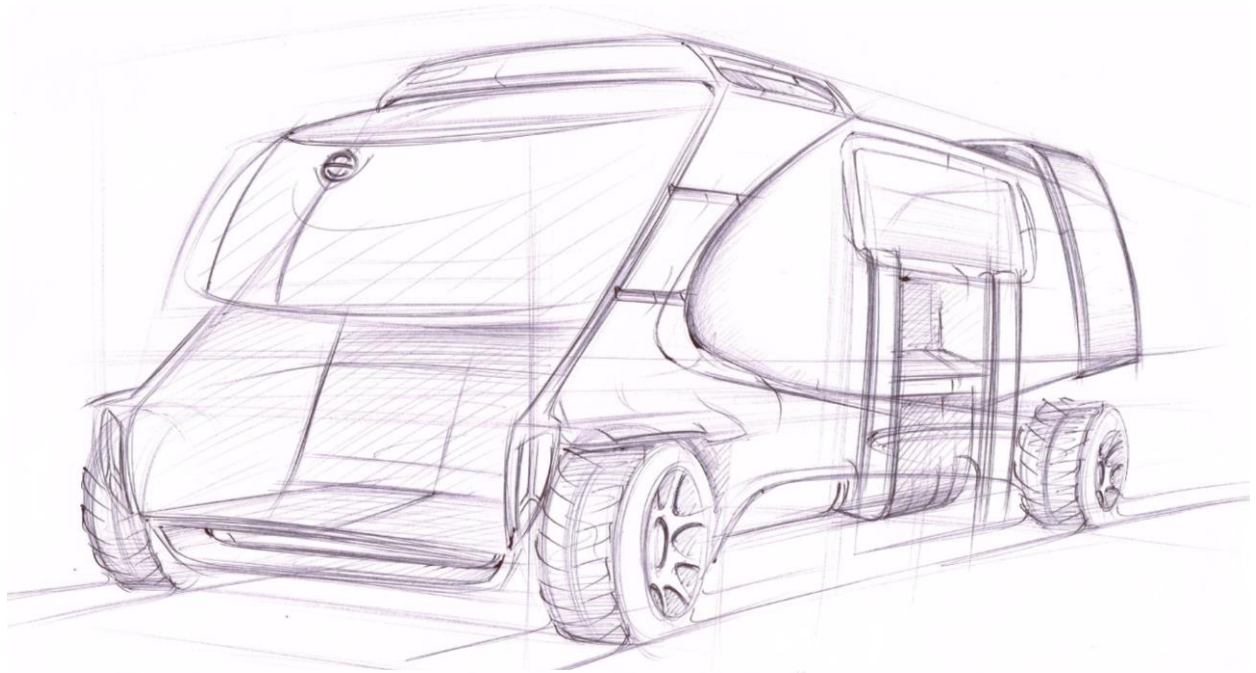
1



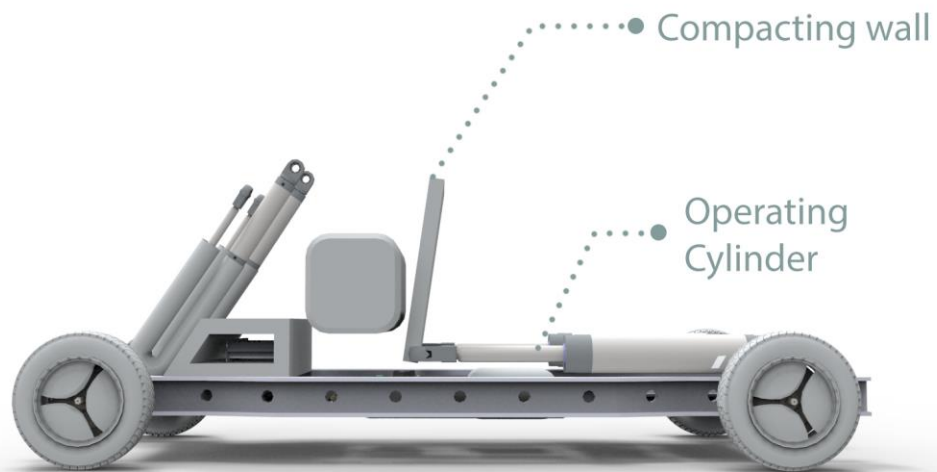
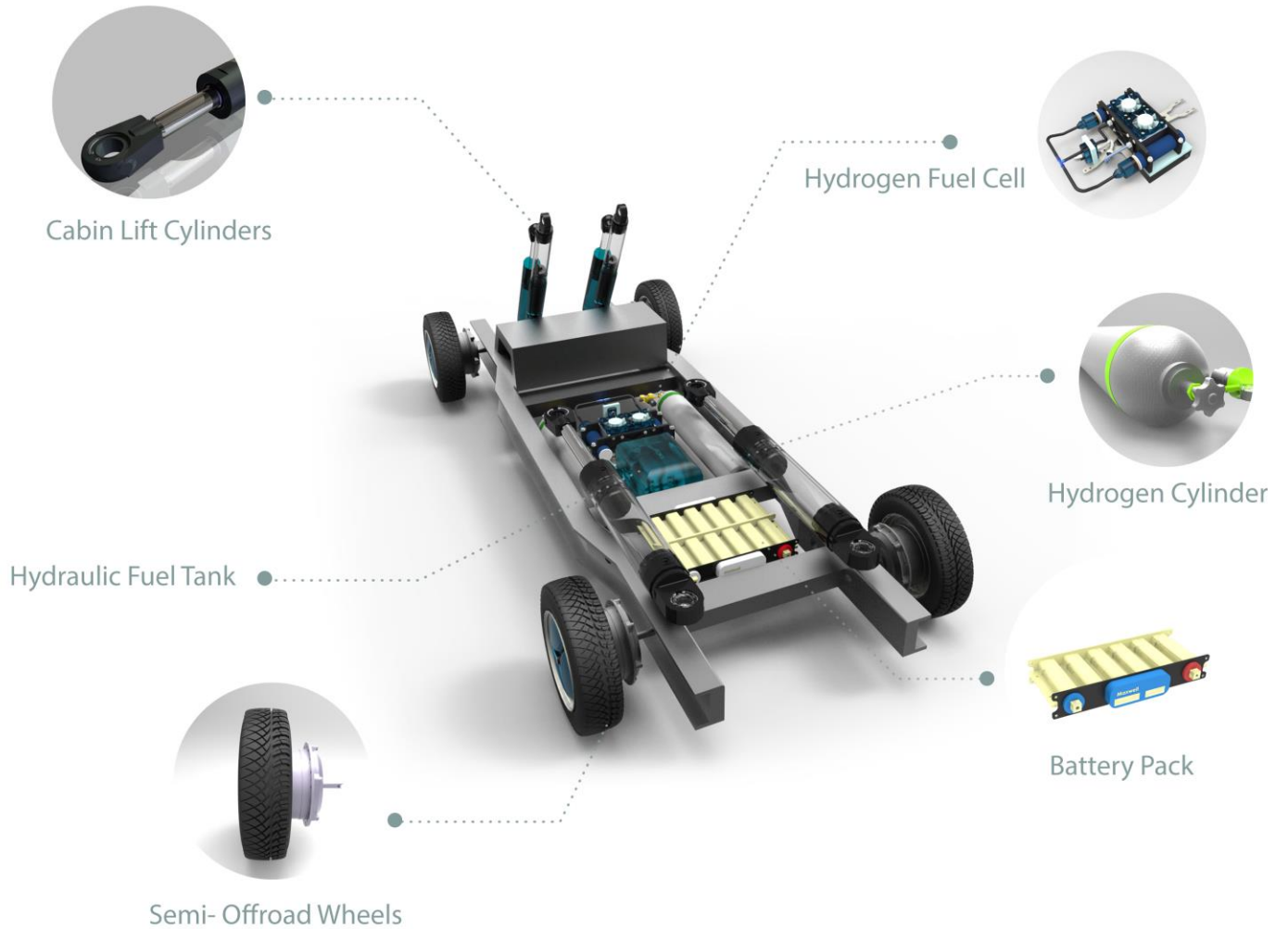
2



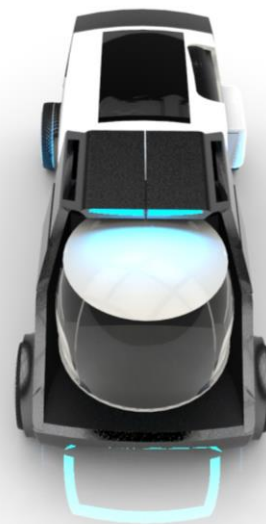
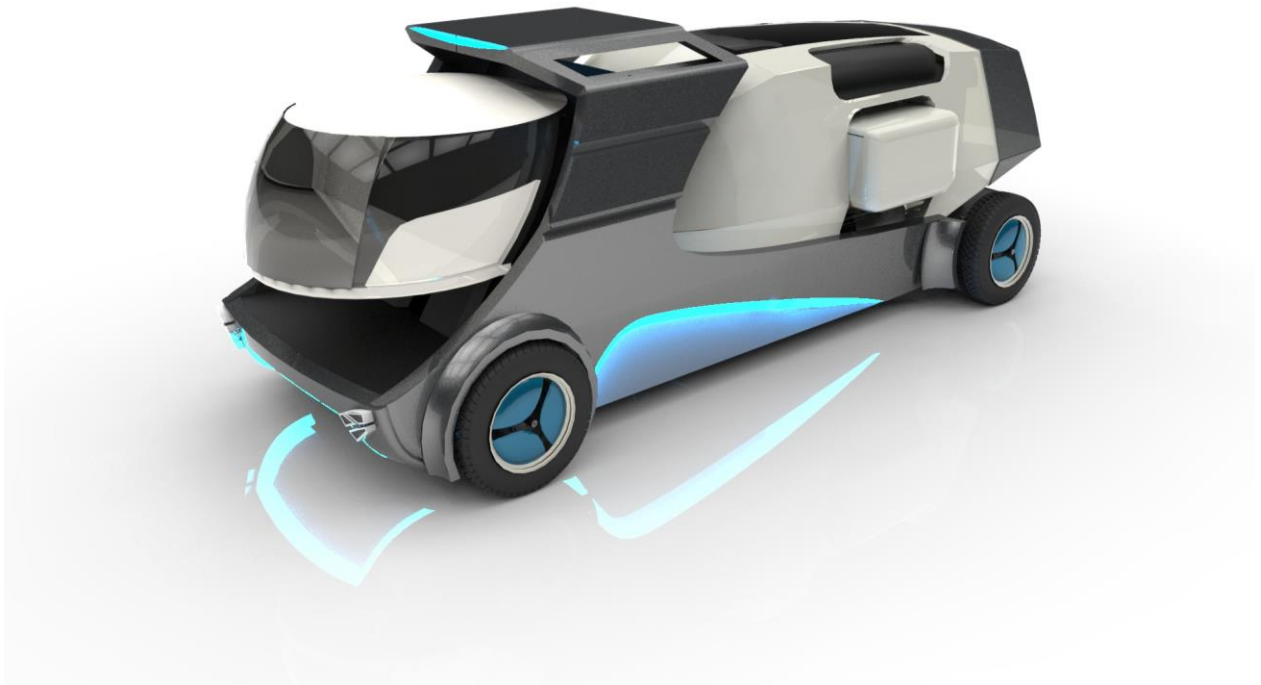
Final Concept Sketches



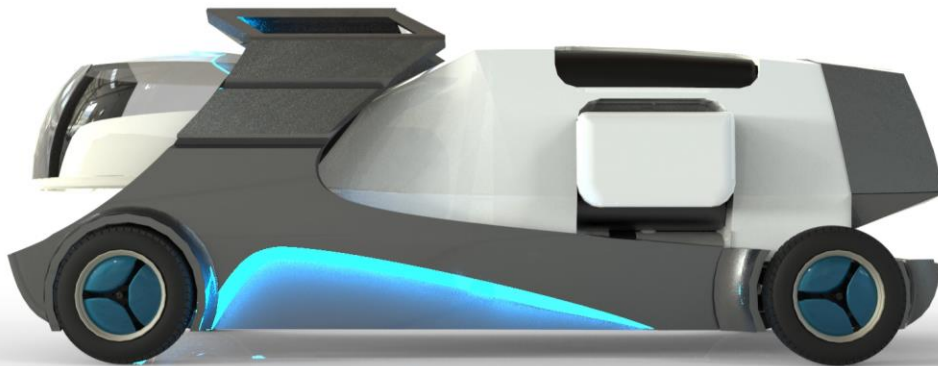
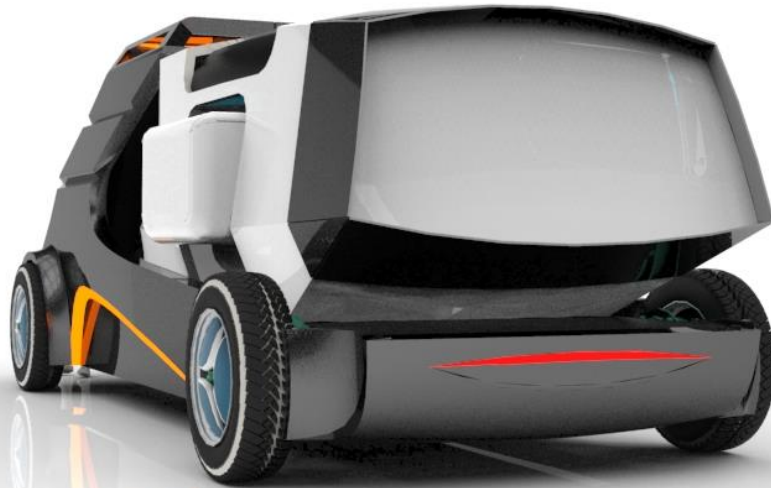
Final Concept Definition



Final Concept Definition



Final Concept Definition



Waste Collection Process



Co-Driver steps out of the truck



Side Loading bucket begins to open

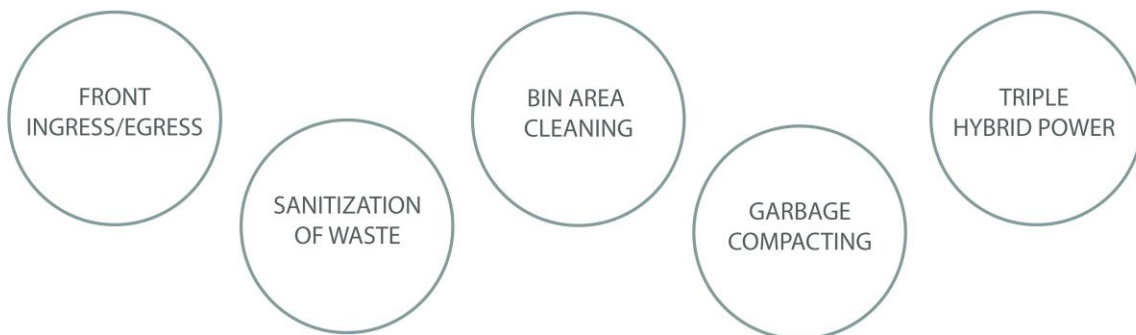
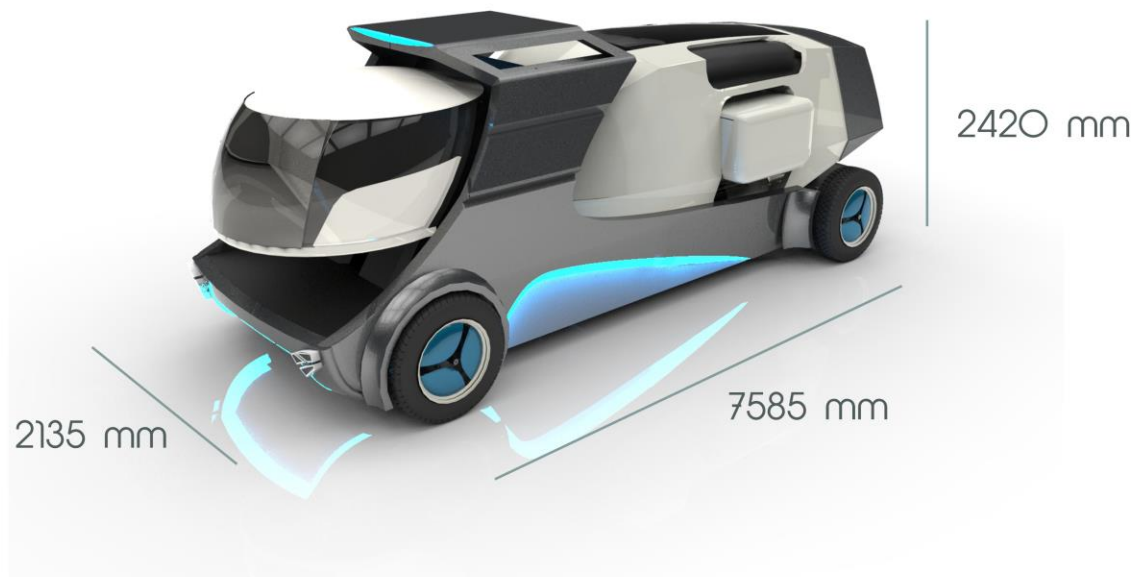


Manual Loading of the garbage



Garbage lifted by hydraulic mechanism

Final Concept Definition : Dimensions and features



Final Concept Definition : Bin and Refueling Centre



Hydrogen is supplied through underground pipelines to the dispenser. This hydrogen is extracted from waste at a plant in the outskirts of the city. Underground pipelines assist in supply of hydrogen at dispenser locations. Posters making people aware of the different types of waste to be segregated.

Contribution to Waste Management

The Bharat Benz Retruck contributes to the waste management in many ways:

- A Triple Hybrid Power Source, between, Solar-Electric-Hydrogen is an innovative emission free power source that can be utilized wisely as per requirement. Unlike Diesel engines, it does not emit toxic fumes into the atmosphere.
- The Hybrid powertrain used, ensures a quiet operation, thereby not disturbing the public.
- Front ingress / egress could be a boon for crowded Indian streets. Being hydraulically controlled, it is resistant from slight accidents and jerks. The hydraulic lift also acts as a hydraulic suspension for the occupant cabin
- Body Panels are equipped with area lights to act as signals for various tasks.
- As soon as the Garbage is dumped into the truck, a sanitizer is sprayed all over so as to kill the harmful content of the garbage even before being disposed. This provides ease of recycling for many materials.
- Compacting of Garbage trucks is carried out by hydraulically operated wall. A simple operation that helps compress the waste when inside. Also, this wall is used to push out the garbage when disposing off in a dumping ground.
- The Sanitizer used to sanitize the garbage inside, is also used to sanitize the bin area after collection. This is done to ensure that the bin area remains clean and healthy, so that people do not hesitate going near them.
- The Waste Collection mechanism is very compact and the operation takes place where it does not disturb the public nearby.
- The Bin-Refueling Center is designed keeping in mind the tight schedule of the garbage trucks. The inductive charging in the area can account for recharging without any extra time spent.
- The Bin-Refueling Center ensures to educate the public about the different types of waste. Also it tells them about the benefits of segregation of waste by having a live example at hand, the hydrogen dispenser, the hydrogen in which is extracted from garbage itself.

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