Medical First Responder Vehicle for Chennai

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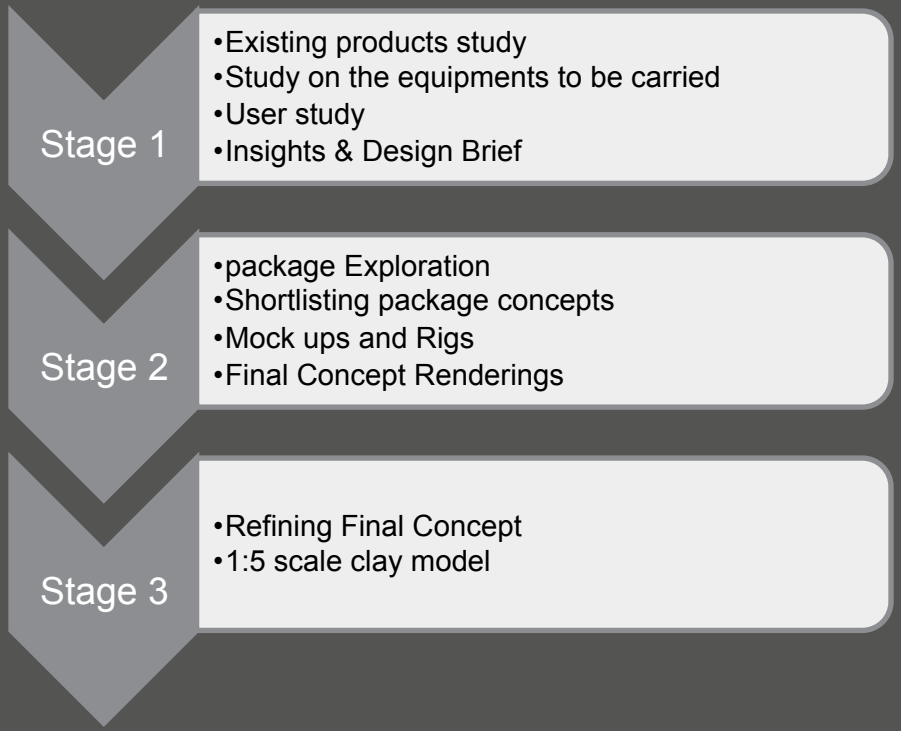
MD 126390004
Design Project 3
Guide : prof. B. Bhaumik

Overview

- Understanding First responder vehicle
- First Aid – Who does it? ; how it is done?
- The scenario – Why Chennai?
- Which Vehicle to choose?
- Insights and Design Brief
- Explorations
- Packaging
- Concepts
- Model


Stage 1
•Existing products study
•Study on the equipments to be carried
•User study
•Insights & Design Brief
Stage 2
•package Exploration
•Shortlisting package concepts
•Mock ups and Rigs
•Final Concept Renderings
Stage 3
•Refining Final Concept
•1:5 scale clay model

Understanding the First Responder Vehicle

Medical First Responder vehicles

"Vehicles that can carry all necessary equipment and paramedics to reach the destination as quickly as possible and give pre-medical care for medical emergencies"

Difference between ambulance and First Responder Vehicle

Ambulance	First Responder Vehicle
Gives Treatment on the way	On the spot pre-medical care
Can Carry patients	Does not Carry patients
More than two attenders	Maximum two attenders
Almost all important Equipment	Only First Aid Equipment
Usually large	Compact is the keyword

Existing First Responder Vehicles

- Assessing an incident's severity
- First Aid
- Resource saving
- Improve response times
- Supervisor vehicle

Four Wheeled FRV

Czech Republic

Austria

Sweden

Belgium

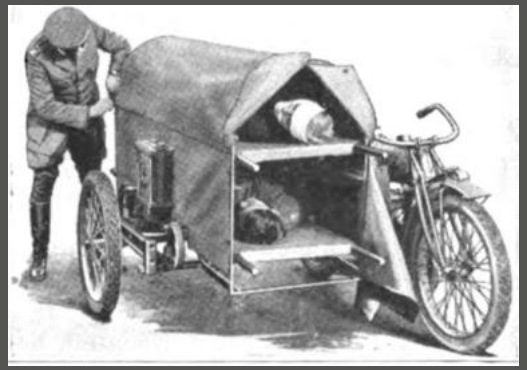
Frankfurt

Italy

Toronto

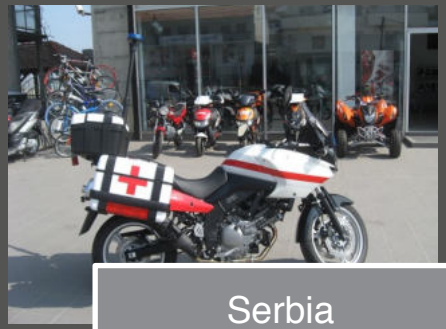
Germany

Motorcycle Ambulance



- Built During world war 1 by British, French & Americans
- Lightweight, Speed and Mobility
- Used Side cars to carry a injured soldiers

Motorcycle Responder



Serbia

South Sudan

Birmingham

Hong Kong

London

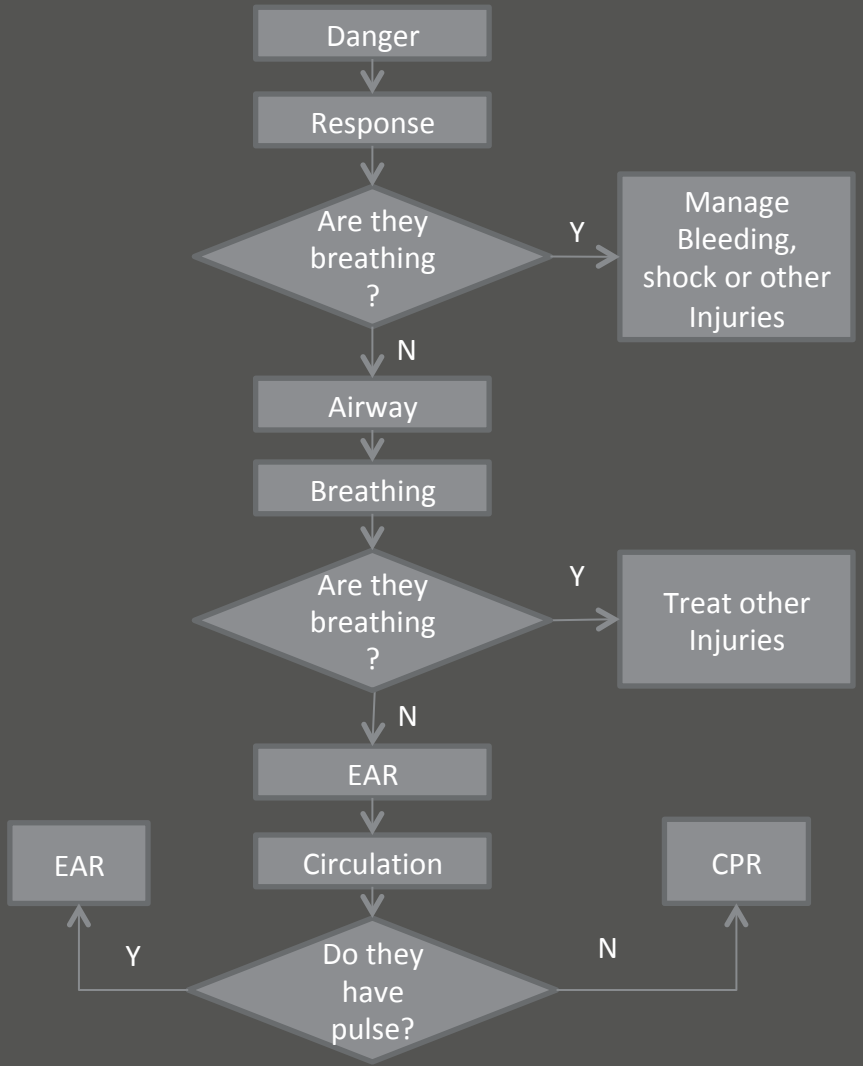
Japan

Compact is the keyword

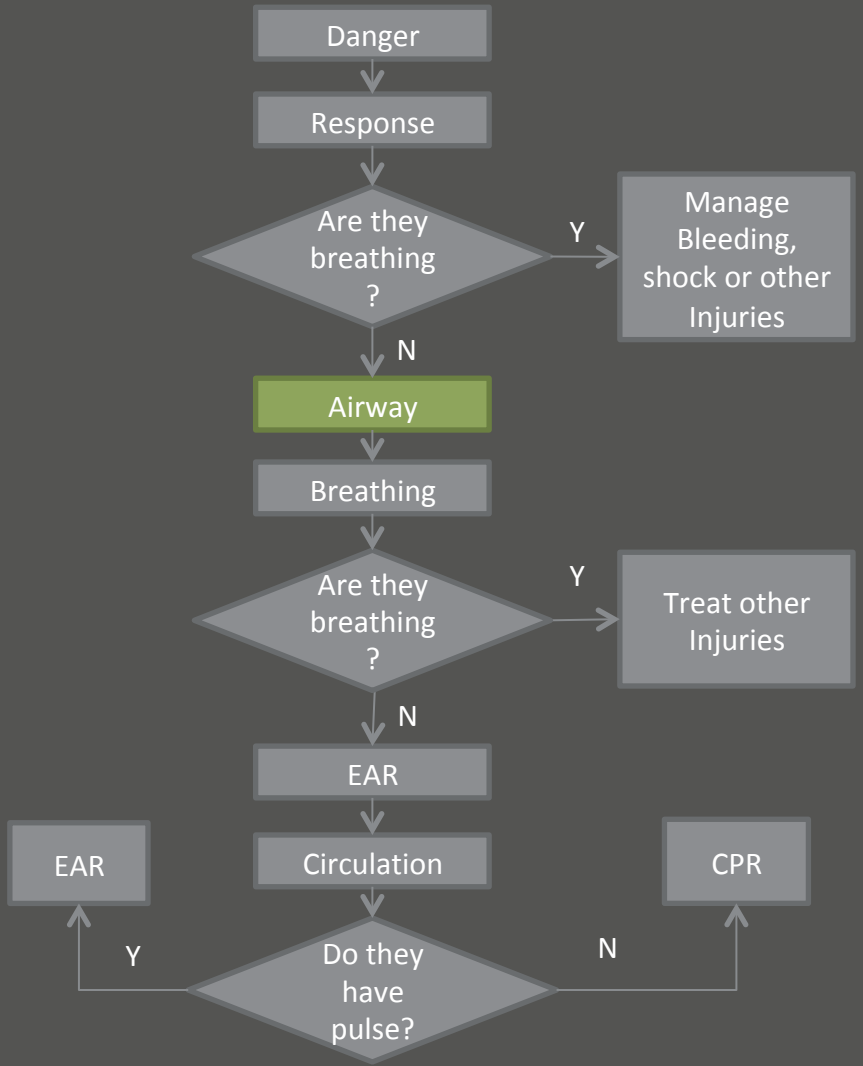
Renault Twizy

First Aid

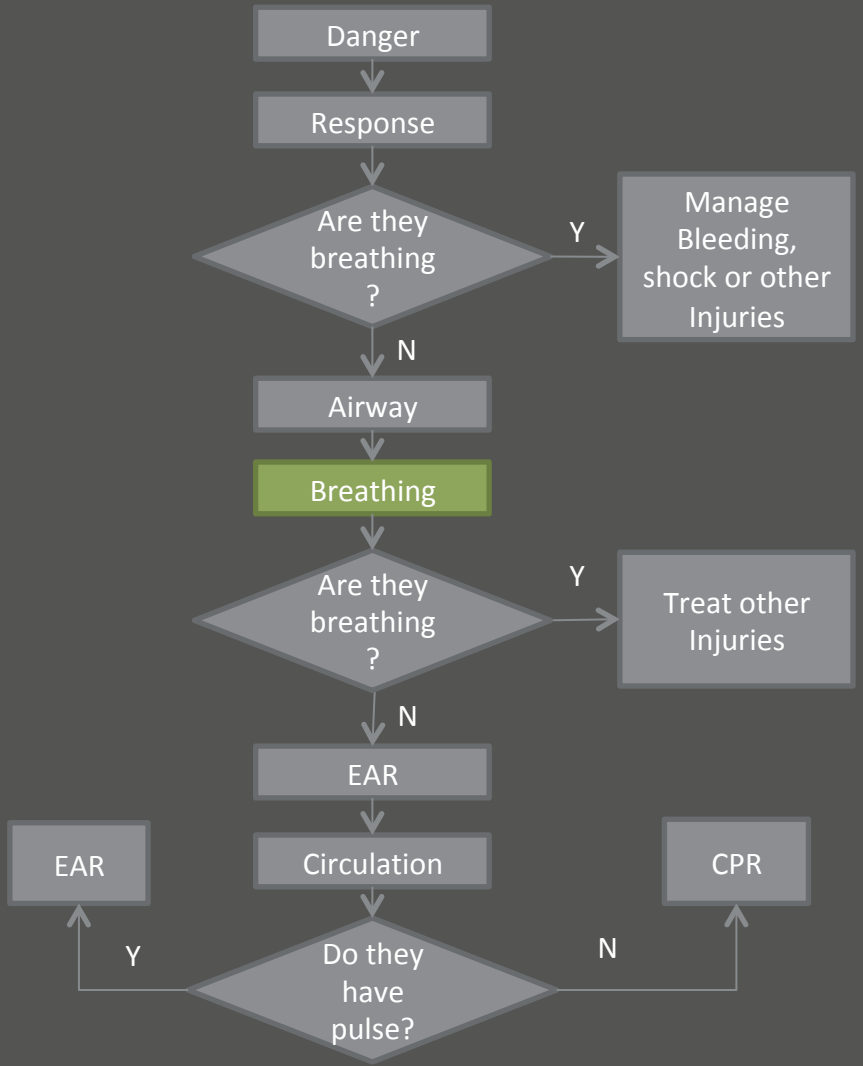
How It is done?



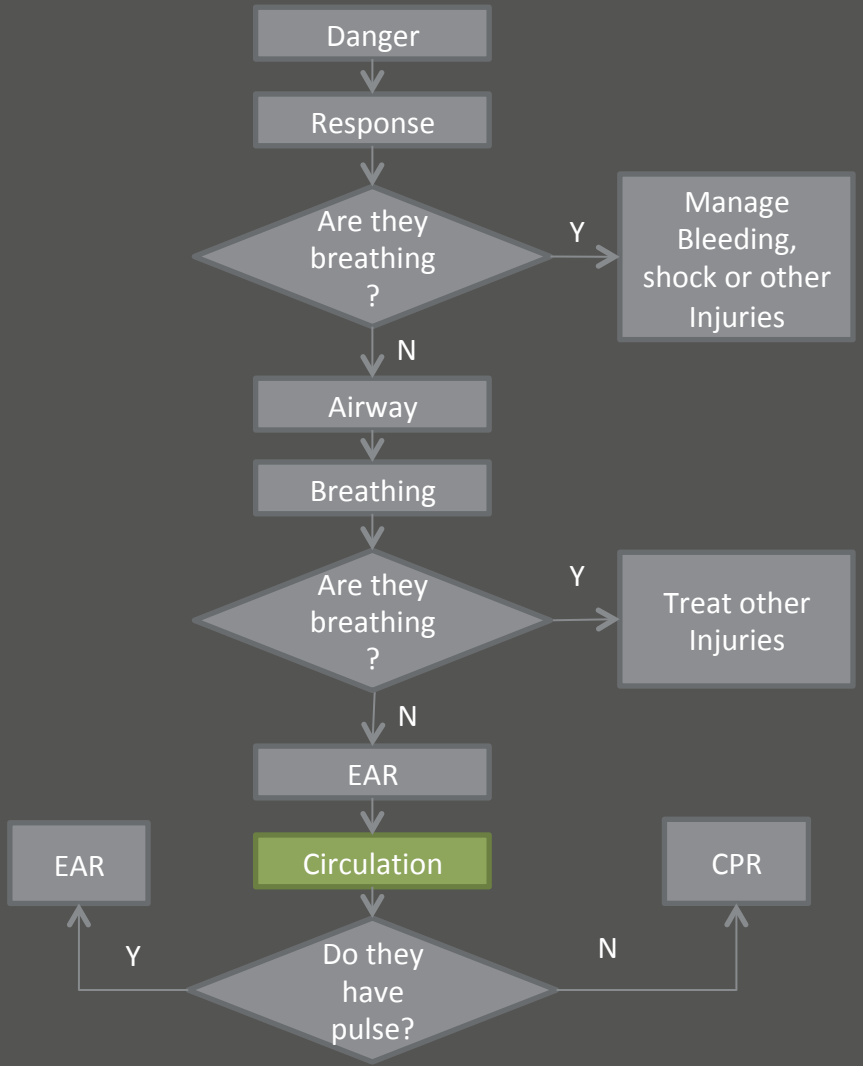
How it is done?



How it is done?



How it is done?



Who does it?

Mr. Ramadoss
Ambulance Coordinator

- There is a plan of making a first responder vehicle
- Tamil Nadu government not cooperating
- Male nurses – B.Sc., M.Sc.
- Drivers with paramedic training – Ambulance orderly, pilot
- Response time is ~ 20 mins.
- “Apollo First” project.

Case example

Feb 5, 2005

- India's first fully-equipped two-wheeler ambulance service called 'Apollo First' in Chennai.
- "Irrespective of all that we do with the siren, still there is a lot of time that is being wasted because of traffic block. So, for that we have created this two-wheeler ambulance 'Apollo First', so that two-wheeler can negotiate itself and go to patient care almost immediately and attend to his urgent need. The ambulance will follow if it is necessary for him to be shifted to the hospital. So the two-wheeler ambulance to beat the traffic and to reach the patient at the earliest is the first. We are launching it across the country," said PC Reddy, Apollo chairman.

Case example

Feb 5, 2005

- TVS Centra Bike
- Carried Basic Life Support equipment
- Two Paramedics
- They used backpack also
- Lasted for only a few months

Case example- Why it failed?

Feb 5, 2005

- People did not accept this idea, not cooperating
- Paramedics were not comfortable to ride it on Chennai traffic and weather
- Vehicle is not designed to carry more than two persons
- Its not safe for the paramedics too

Mr. Sudhakar
Sr. Nursing Officer

- BLS, ACLS ambulance
- No clear curriculum
- Male nurses are the paramedics
- Male because it involves lot of physical work
- Male nurses need almost one year of field experience to handle cases
- They work on 12 hours shift basis

THE HINDU

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CITIES » CHENNAI

Updated: August 26, 2013 09:04 IST

CHENNAI, August 26, 2013

In Chennai, '108' most used for road accident cases

SERENA JOSEPHINE M.

SHARE COMMENT (1) PRINT T+

On an average, 108 caters to 3,500 emergencies a month in the city. The number of cases has increased from last year – Photo: M. Vedhan THE HINDU

The city may well be the road accident capital of the country going by the emergency calls made to the 108 ambulance service.

The city's utilisation of 108 has been increasing but emergency care managers say the ambulances were mostly sought for accident cases as against pregnancies and other emergencies like chest pain.

On an average, 108 caters to 3,500 emergencies a month in the city. The number of cases has increased from last year – in April 2012, 108 handled 2,299 cases, whereas, this July, the number of cases stood at 3,776.

"When we look at the State figures for utilisation of 108 ambulances in the city, nearly 26 per cent of cases are pregnancy-related emergencies followed by road traffic accidents at 24 per cent. In Chennai, 25 per cent cases comprise accidents and just 10 per cent are pregnancies. Other emergencies such as chest pain and acute abdominal pain are single digit contributors to the overall utilisation percentage," said B. Prabhudoss, regional manager of GVK-Emergency Management and Research Institute (EMRI).

TOPICS
Tamil Nadu
Chennai

disaster and accident
road safety

transport accident
road accident

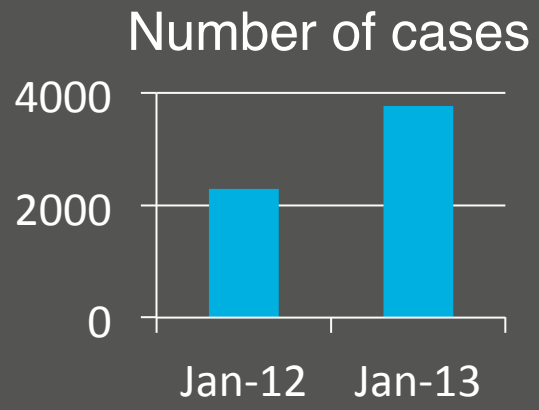
People should understand they can use 108 for any kind of trauma and medical emergency including respiratory problems, oral poisoning, and insect, snake and animal bites, he said.

The Tamil Nadu Health Systems Project is the nodal agency that sponsors the 108 emergency response service along with GVK-EMRI, which is a private partner. There are 629 ambulances in the State, of which 35 operate in the city. "The ambulances are fully equipped with medicines, equipment and oxygen. It is available free of cost to patients. They can choose the hospital they want to go to. In an emergency situation, it should be the nearest medical facility," he said.

V. Kanagasabai, dean of Government General Hospital, said more than 60 per cent of cases brought to the GH were of trauma. "Two-wheeler accidents constitute a major share," he said.

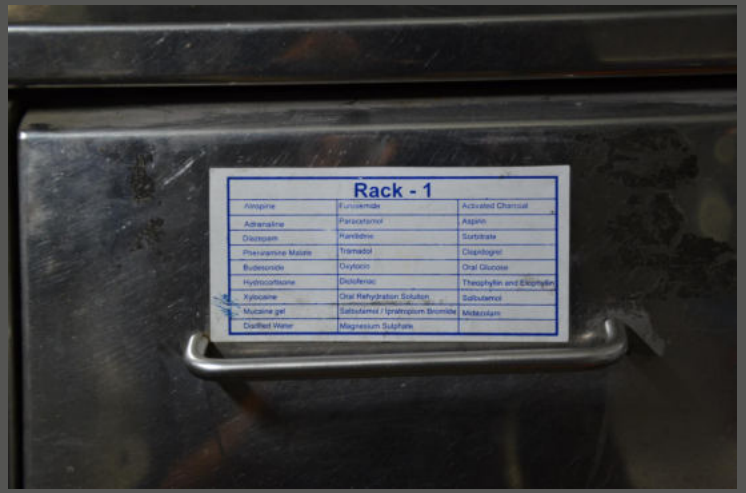
108 Ambulance

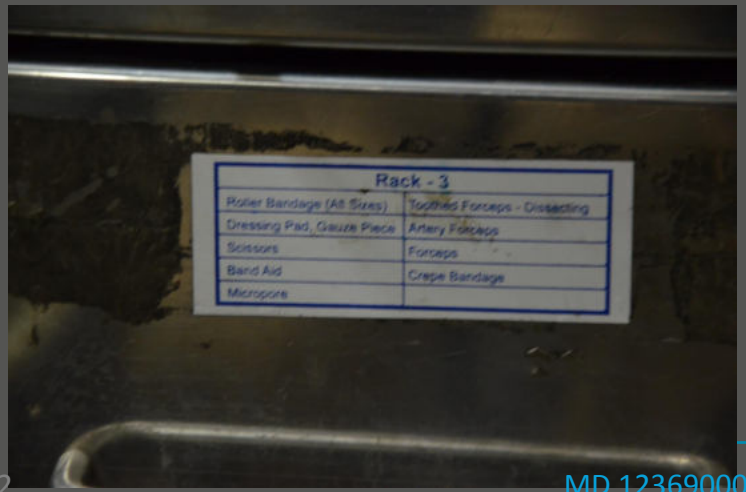
- On an average, 3500 emergencies a month in the city (Aug 2013)
- Chennai is the road accident capital of the country
- 25 % emergencies are accidents
- 10% are pregnancies
- Rest of them are acute abdominal pain, chest pain, poisoning , insect, snake, animal bites, respiratory problems.



Mr. Rajan
108 Ambulance paramedic

- Will be called at any time, works more than 12 hours a day
- Usually road accidents cases
- Because of unavailability of other ambulances, at times response time goes more than 40 minutes
- Did not worry much about the sanity of the vehicle.


Rack - 1
Atropine
Furosemide
Activated Charcoal
Adrenaline
Paracetamol
Aspirin
Diazepam
Ranitidine
Sorbitrate
Pheniramine Maleate
Tramadol
Clopidogrel
Budesonide
Oxytocin
Oral Glucose
Hydrocortisone
Diclofenac
Theophyllin and Ekophyllin
Xylocaine
Oral Rehydration Solution
Salbutamol
Mupirocin gel
Salbutamol / Ipratropium Bromide
Metoclopramide
Distilled Water
Magnesium Sulphate


Rack - 3
Roller Bandage (All Sizes)
Toothed Forceps - Dissecting
Dressing Pad, Gauze Piece
Artery Forceps
Scissors
Forceps
Band Aid
Crepe Bandage
Micropore

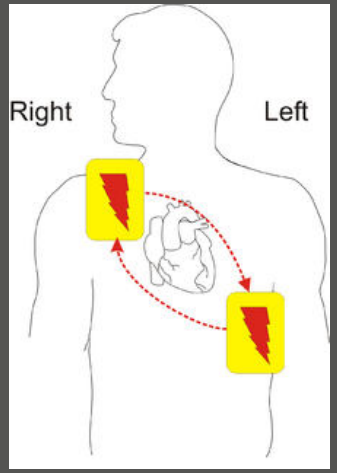

Rack - 4
Glucometer
BP - Cuff (Pediatric)
Glucostrip
Nebulizer Machine
Gluco Lancet
Nebulizer Mask
Pupillary Torch
Pulse Oxymeter
Digital Thermometer
Stethoscope
Dig BP Apparatus
BP Apparatus Manual

User

- Male Nurse (paramedics) – 2nos
- Age – 20 + years
- Trained in BLS and have good field experience
- Knows to drive well
- Need to communicate before, during and after the trip
- Records all events, vital stats
- Works fast and knows to use all equipment
- Trip sheet

Equipment

- Defibrillator
- Suction Apparatus
- Immobilization Equipment
- Breathing Apparatus
- Bandages and Splints
- Drugs



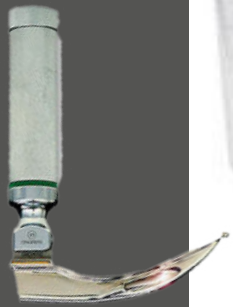
Defibrillator

- Used in treating for life threatening cardiac problems
- produces therapeutic electrical energy
- The charges target the critical heart muscles and stops the dysrhythmia and makes normal sinus rhythm


BP
Manu.
HF
79
SPM
EKG
12 ABL.
x 1
SpO2
97 %
Signal OK
Pleth
Atmung
Aus
Keine Tmp
Sonde
200 J
Energie
Intub.
IV
EPI
Lido
Atrop
Löschen
Weiter

Defibrillator

- Manual External Defibrillator
- Automatic External Defibrillator
- Semi Automated External Defibrillator

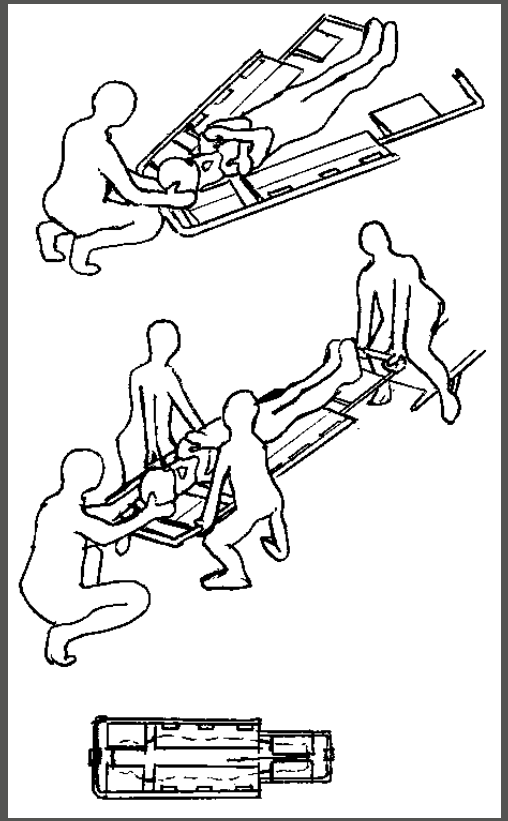


Suction apparatus

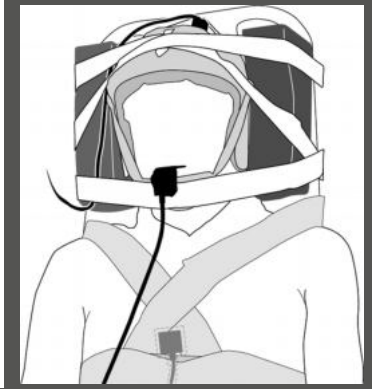
- aspirating fluids and vomit from the mouth and airways
- sucks the material through a catheter into a bottle.
- Laryngoscope to easily use the catheter

Immobilization

Scoop stretcher



Spine Board with straps



Spine Immobilization

Foldable stretcher

Breathing Apparatus

AMBU Bag - Artificial Manual Breathing Unit

Bandages and Splints

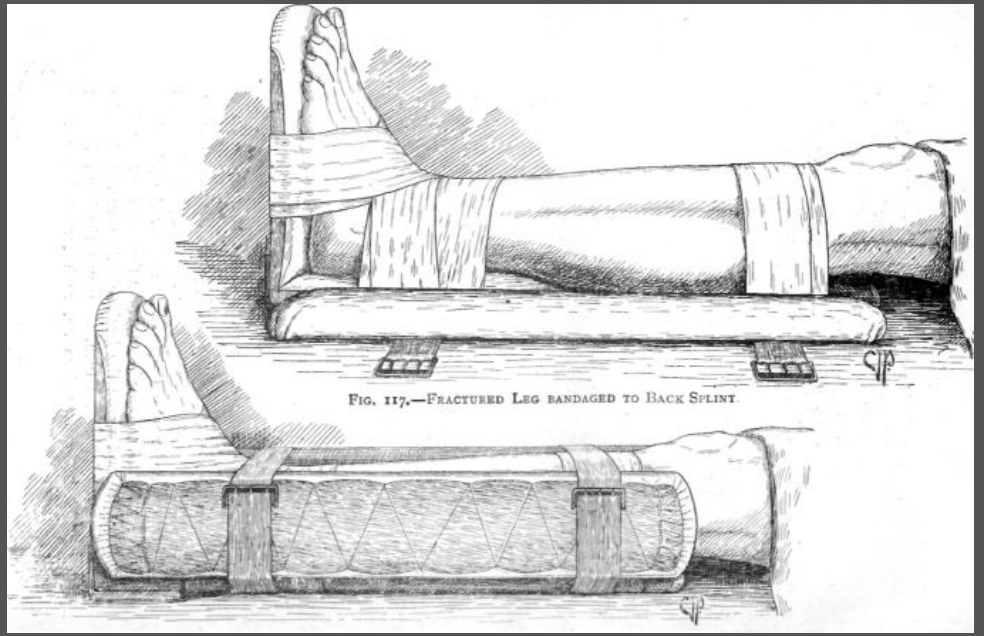


Fig. 117.—Fractured Leg bandaged to Back Splint.

Drugs

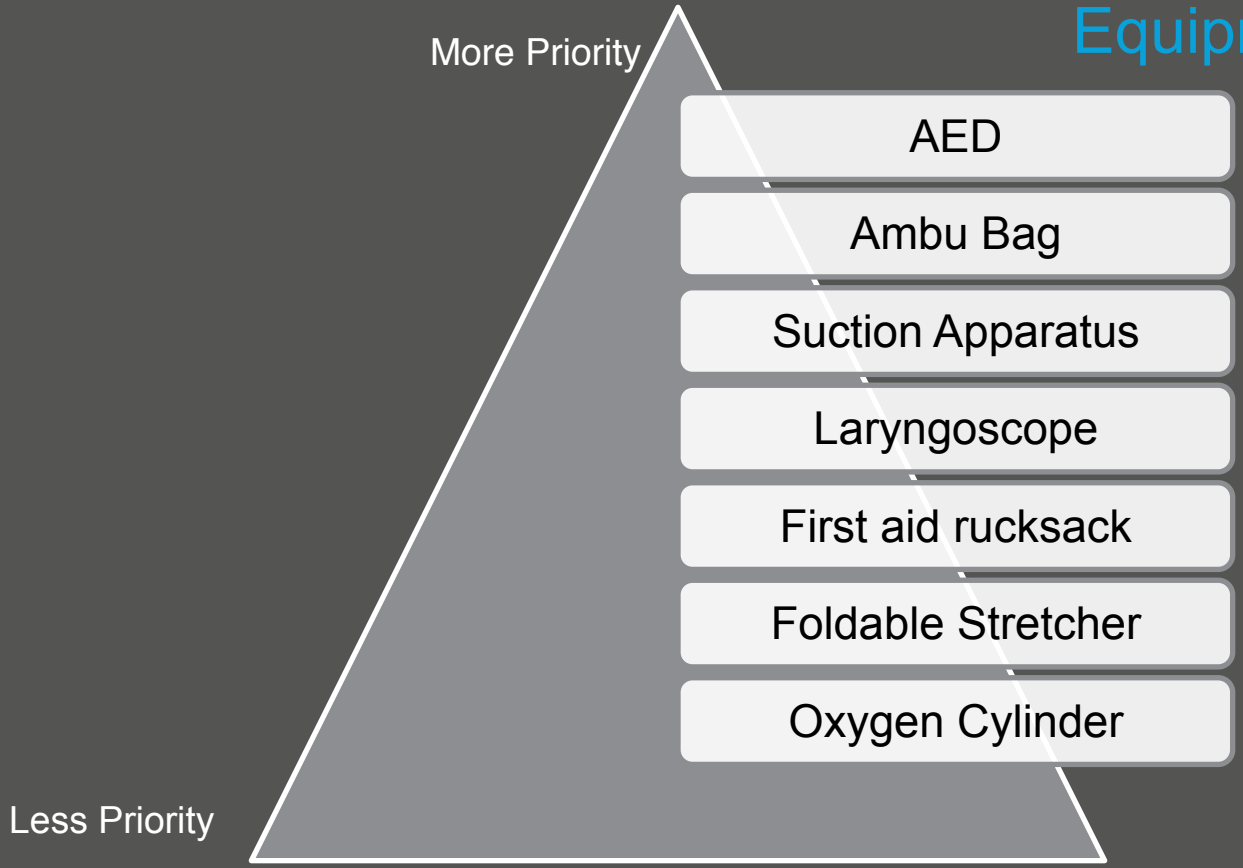
Some of the more common medical emergencies that require drugs are

- cardiac arrests/arrhythmias
- strokes
- Seizures
- allergic reactions
- Overdoses
- traumatic injuries.

Dimensions

Product	Dimensions	weights
Zoll X Series AED	260mmx200mmx226mm	6 Kgs
Portable Suction apparatus	450mm× 200mm× 320mm	6.2 Kgs
Rucksack for the First Aider	400mm x 300mm x 140mm	1 kg
Ambu Bag	400mm x 120mm(dia)	415 g
Foldable Stretcher	960mm x 180mm x 540mm	8 kgs
Laryngoscope	140mmx 200 mm(dia)	100 g
Oxygen Cylinder	300 X 80 mm (dia)	1.4 kgs

Equipment priority

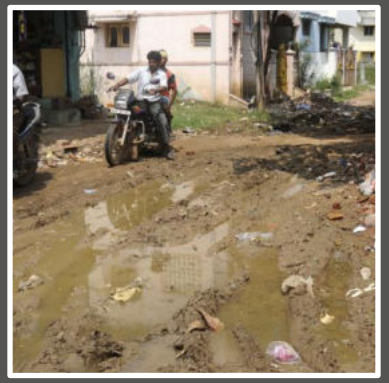


Why Chennai?

- Maximum number of road accidents
- Slow moving traffic
- Hot and humid weather conditions
- Bad road conditions







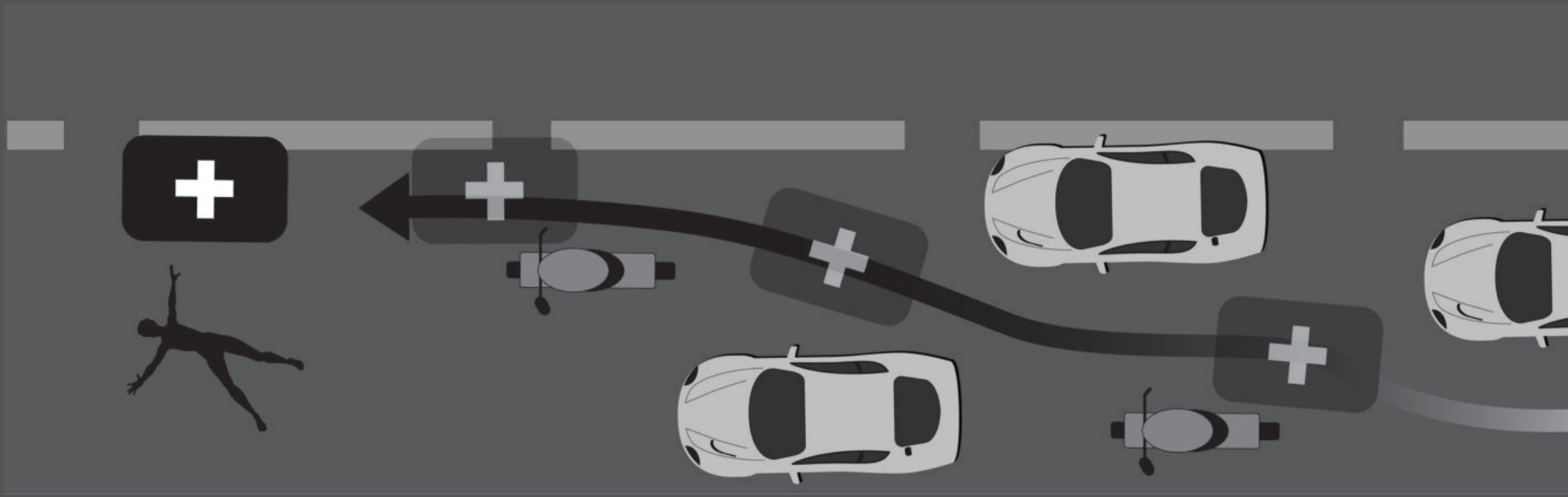

Inferences

- Male nurses are looking for comfort as they work for 12 hours a day.
- Ambulances take more than 20 minutes response time.
- Chennai traffic is not controllable.
- Hot sun in Chennai is a big problem, both for the male nurse and the patient.
- The male nurse must remember all the events happening during the trip.
- Two wheelers are not a good option in Chennai.
- people look for the image that will make them feel confident that the first response will be effective.
- There is no communication happening between the ambulance and the hospital to the doctor during the trip. It is happening only after the trip.
- Sanitation is a big issue.
- Sirens are not helping in a big way.
- The male nurses are not feeling comfortable with the current facilities provided to them.
- There is no assurance that the male nurses will be safe on roads when they are giving the first aid.

Scenarios

On the Road

Heavy traffic conditions

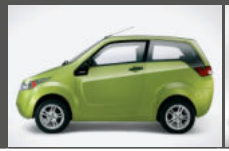


Inside any building

- Package all the equipment
- As compact as possible
- good acceleration
- good ground clearance

Choosing the base vehicle

Vehicles considered

						
	Nano	Reva	Wagon R	Indica v2	i10 Era	Eon
Turning radius	4 m	3.9 M	4.6 m	4.9 m	4.75 m	4.6 m
width	1495 mm	1514 mm	1475mm	1,665 mm	1595mm	1550mm
length	3099 mm	3280 mm	3599mm	3,675 mm	3585mm	3495mm
Acceleration (0-60 kmph)	8 sec	11 sec	8.03 sec	7.3 sec	6 sec	6.41 sec
Ground clearance	180 mm	180 mm	165mm	170 mm	165mm	170 mm

Weighted matrix

	Weights	Nano	Reva	Indica v2	Wagon R	i10 Era	Eon
Turning radius	5	4	5	2	3	3	3
width	4	5	4	2	5	3	3
length	3	5	5	2	3	3	3
Acceleration	2	4	3	4	4	5	5
Ground clearance	3	5	5	4	3	3	4
		78	77	44	61	55	58

Why Reva E2O over Tata Nano?

- Reva E2O has a linear torque curve, good for quick pick up
- Range is not an issue since one charge gives 90 Kms
- Quick charging (1 hours gives 20 kms)
- Speed and acceleration can be increased just by tuning ECU
- Better turning radius (very vital)
- Battery provides 10 units of power
- Good for two passengers

Mahindra Reva E2O

VEHICLE SPECIFICATION

Type	Two door hatchback
Seating Capacity	Four adults
Motor	3 Phase Induction Motor
Power	19 kW @ 3750 rpm
Torque	53 N-m @ (0-3400 rpm)
Battery	48V maintenance-free Lithium-ion
Steering Mechanism	Rack & Pinion
Transmission	Fully Automatic
Suspension: Front	MacPherson strut - Gas filled
Suspension: Rear	Gas filled shock absorber with coil springs
Brake: Front	Disc: 215 mm
Brake: Rear	Drum: 180mm
Tyre (Front & Rear)	155 / 70 R 13, Tubeless Low Resistance

DIMENSIONS

Length x Width x Height	3280 mm x 1514 mm x 1560 mm
Wheelbase	1958 mm
Ground Clearance	180 mm
Turning Radius	3.9 m
Kerb Weight	830 kg

Design Brief

Technical Specifications

The base vehicle is Mahindra Reva E2O

wheelbase - 1958 mm
width - 1514 mm
Height - 1560 mm
ground clearance - 180 mm
Turning Radius - 3.9 m
Transmission - automatic

Vital Needs

- Carry all equipment
- Carry two paramedics
- Access to equipment must be easy (prioritize)
- Secure the equipment from shock

Essential

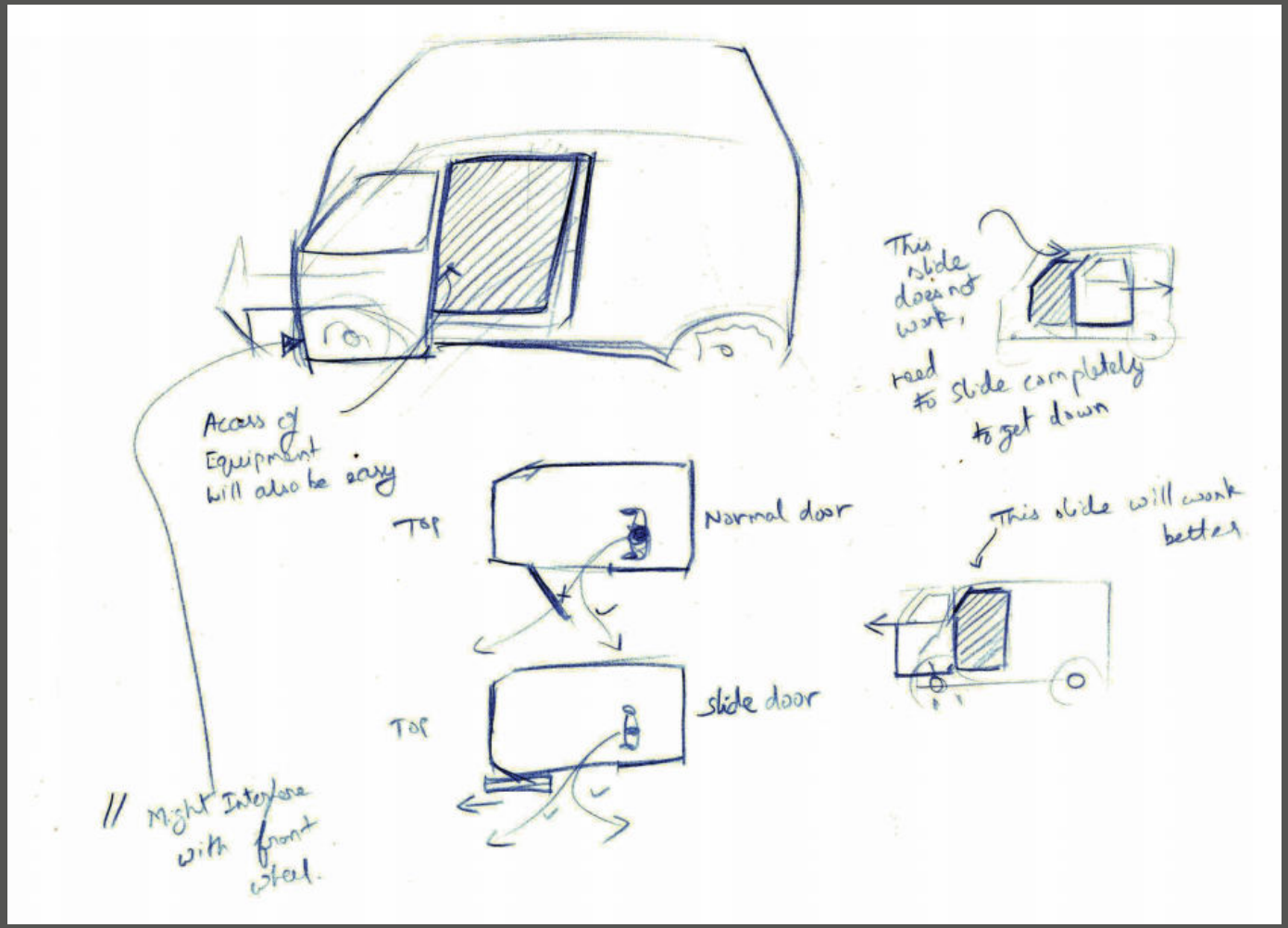
- Sun & rain protection for treatment
- Night time visibility for treatment
- Provision to discard waste after treatment
- Easy to clean
- Communication devices

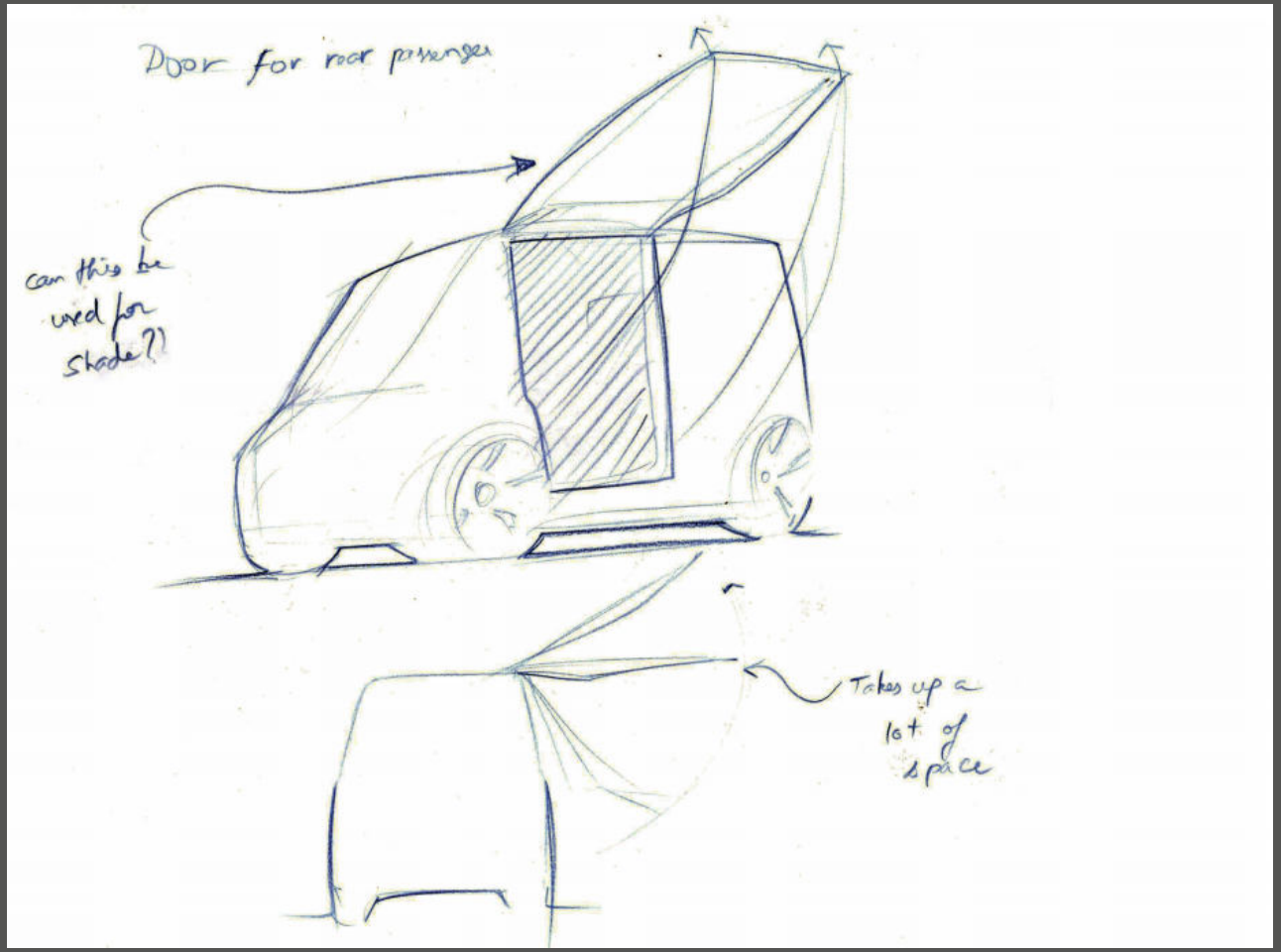
Nice to have

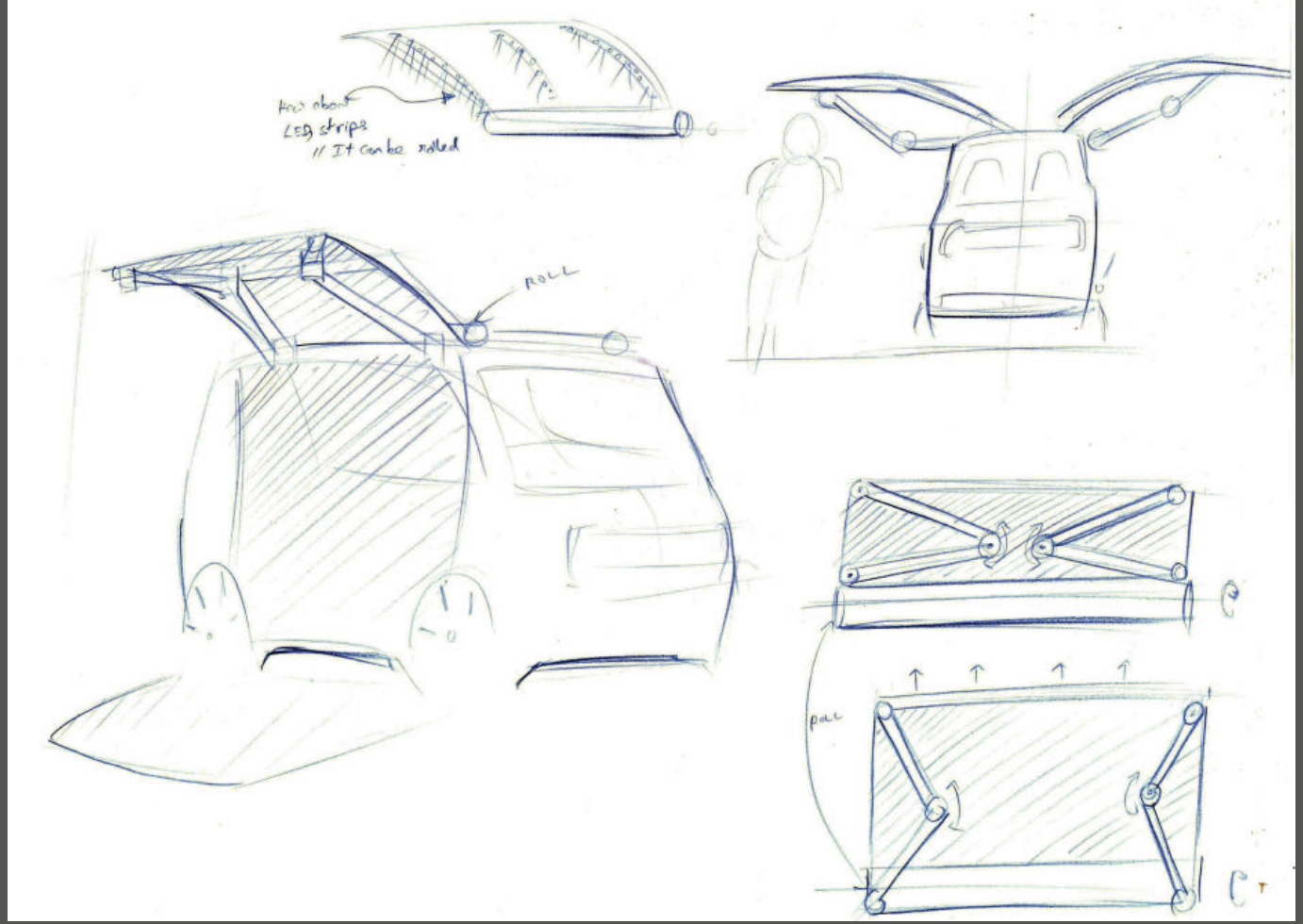
- Additional storage for more equipment
- Better way of incoming alert

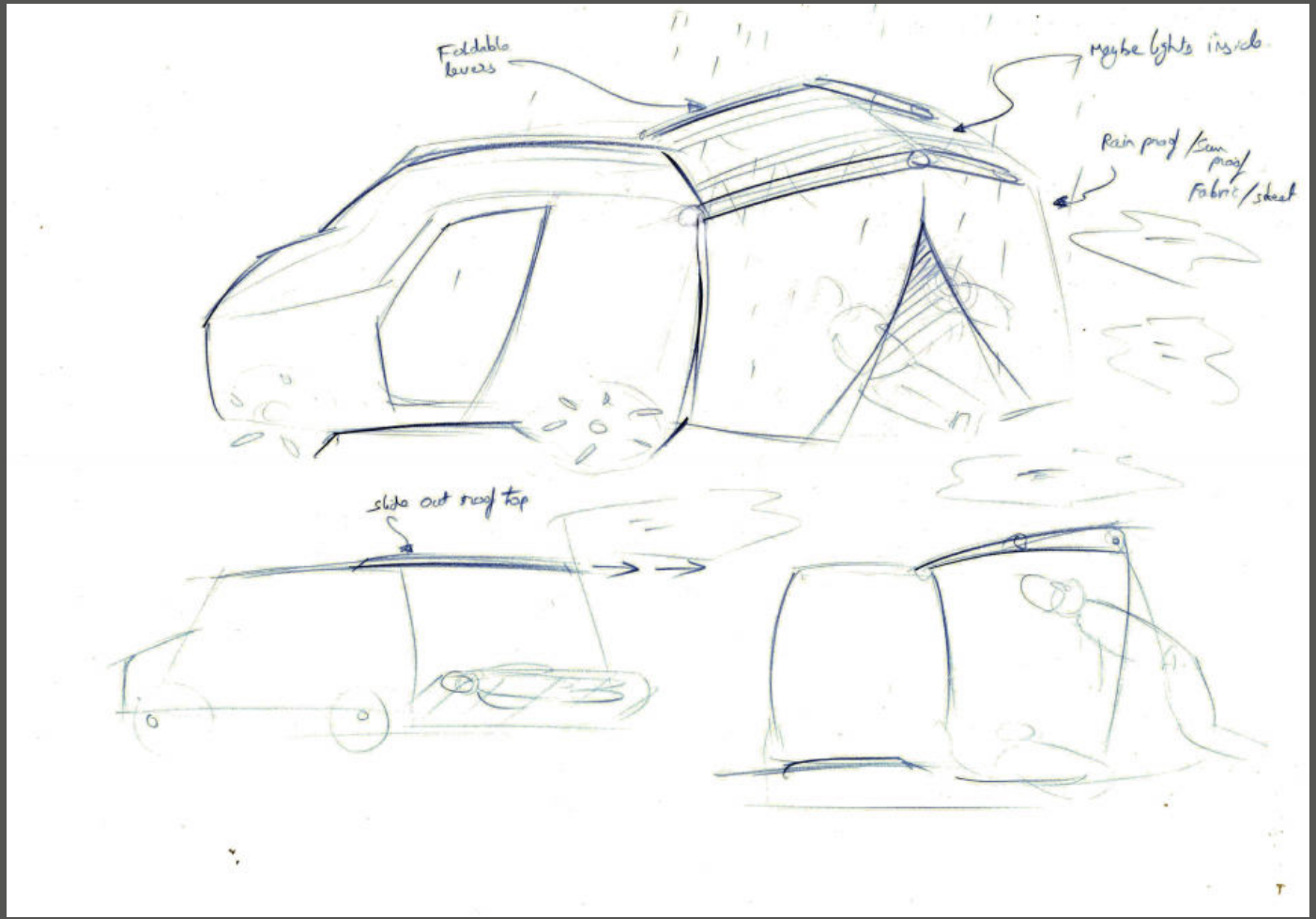
Explorations

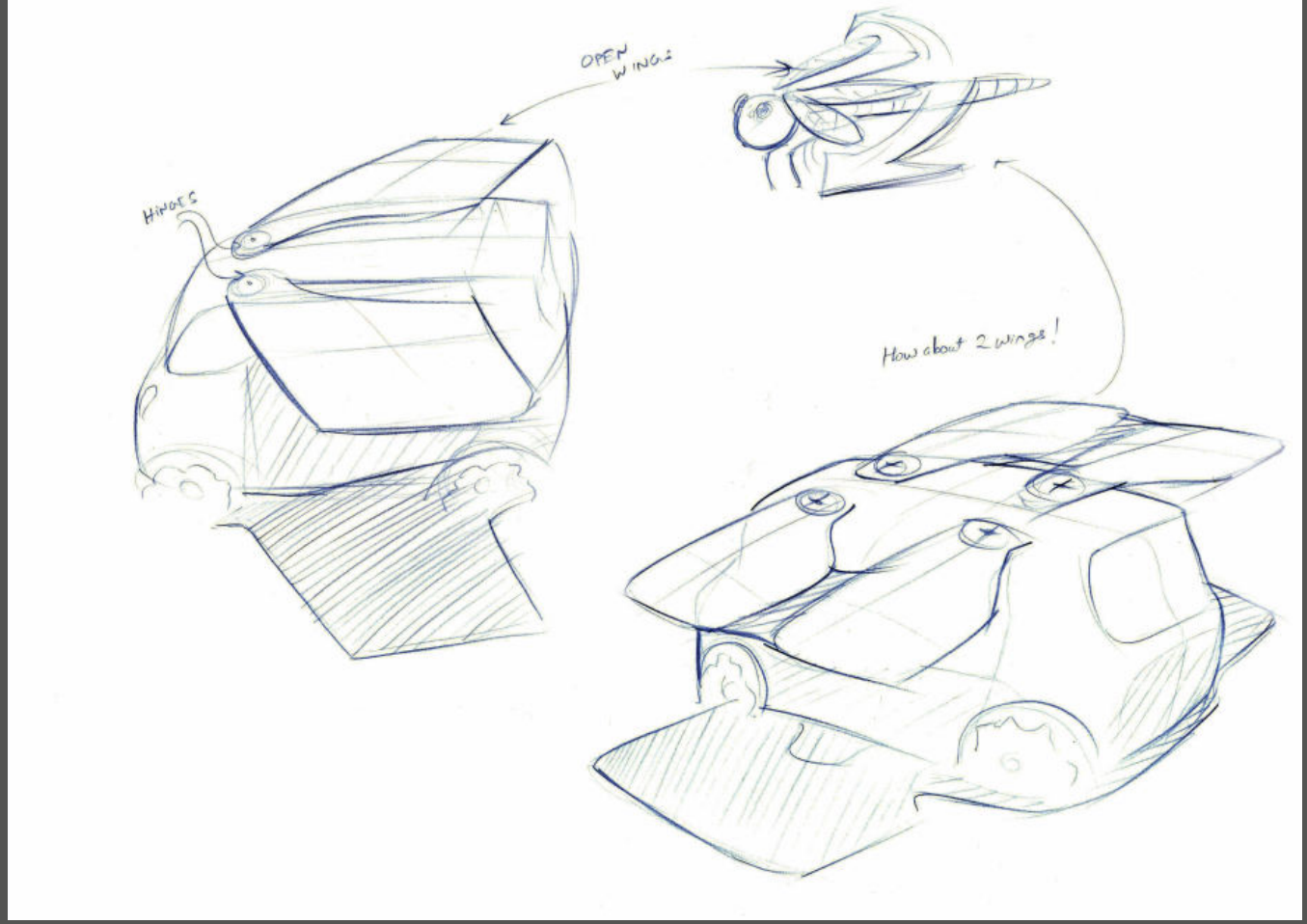
Refer report page 49

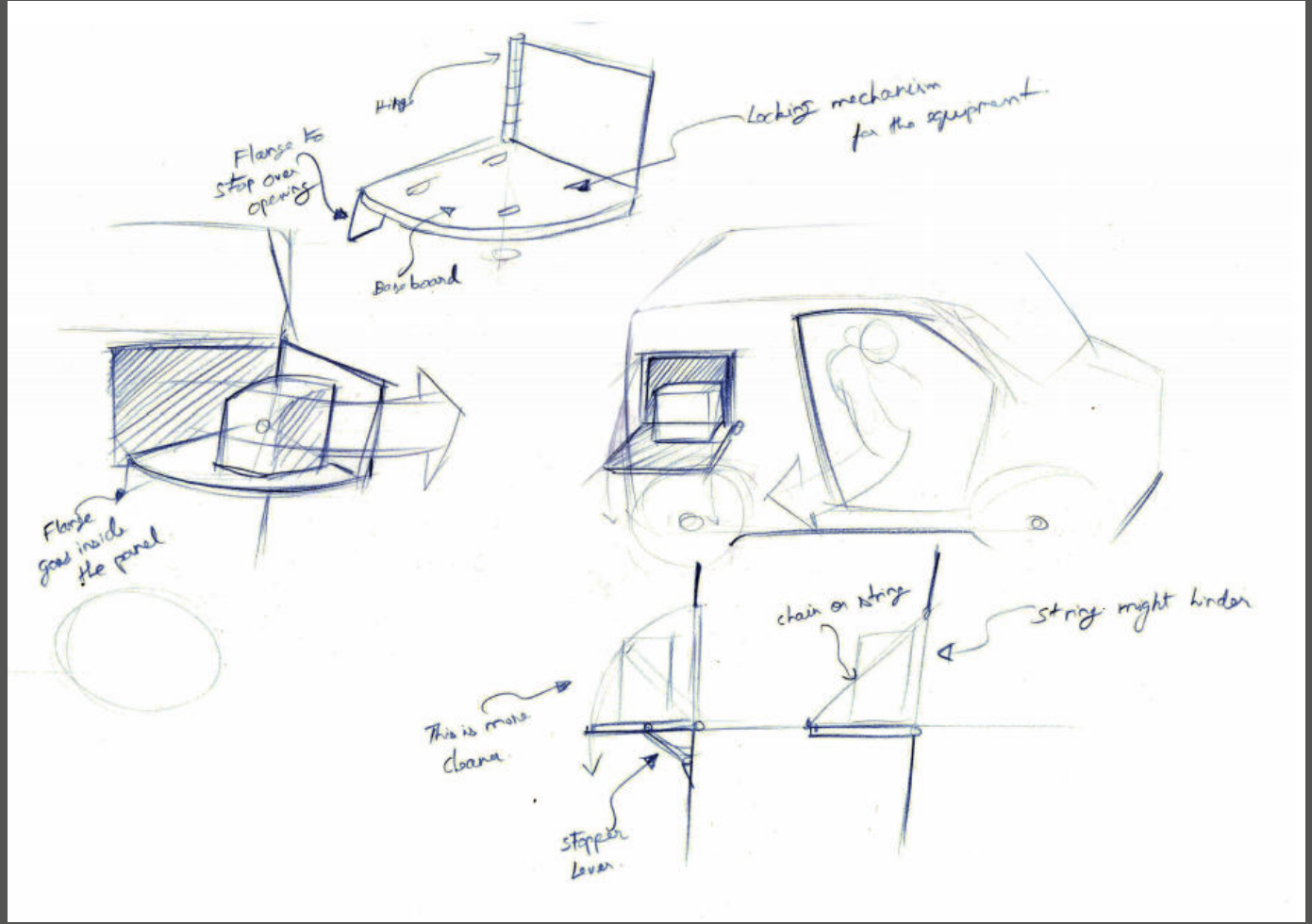

This slide doesn't work,
need to slide completely to get down
Access of Equipment will also be easy
Top
Normal door
This slide will work better
Top
slide door
// Might Interfere with front steel.

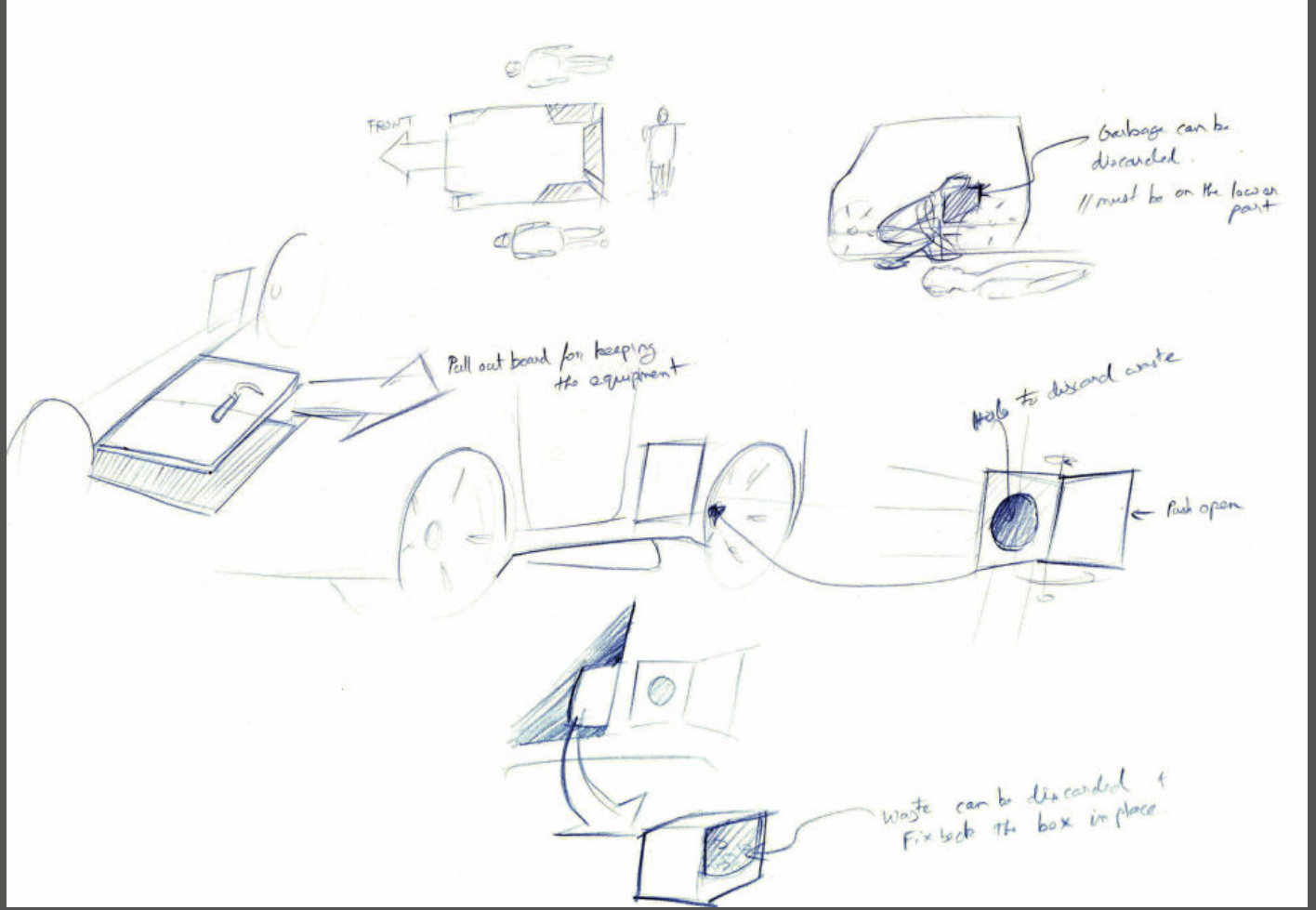

Door for rear passenger
can this be used for shade??
Takes up a lot of space

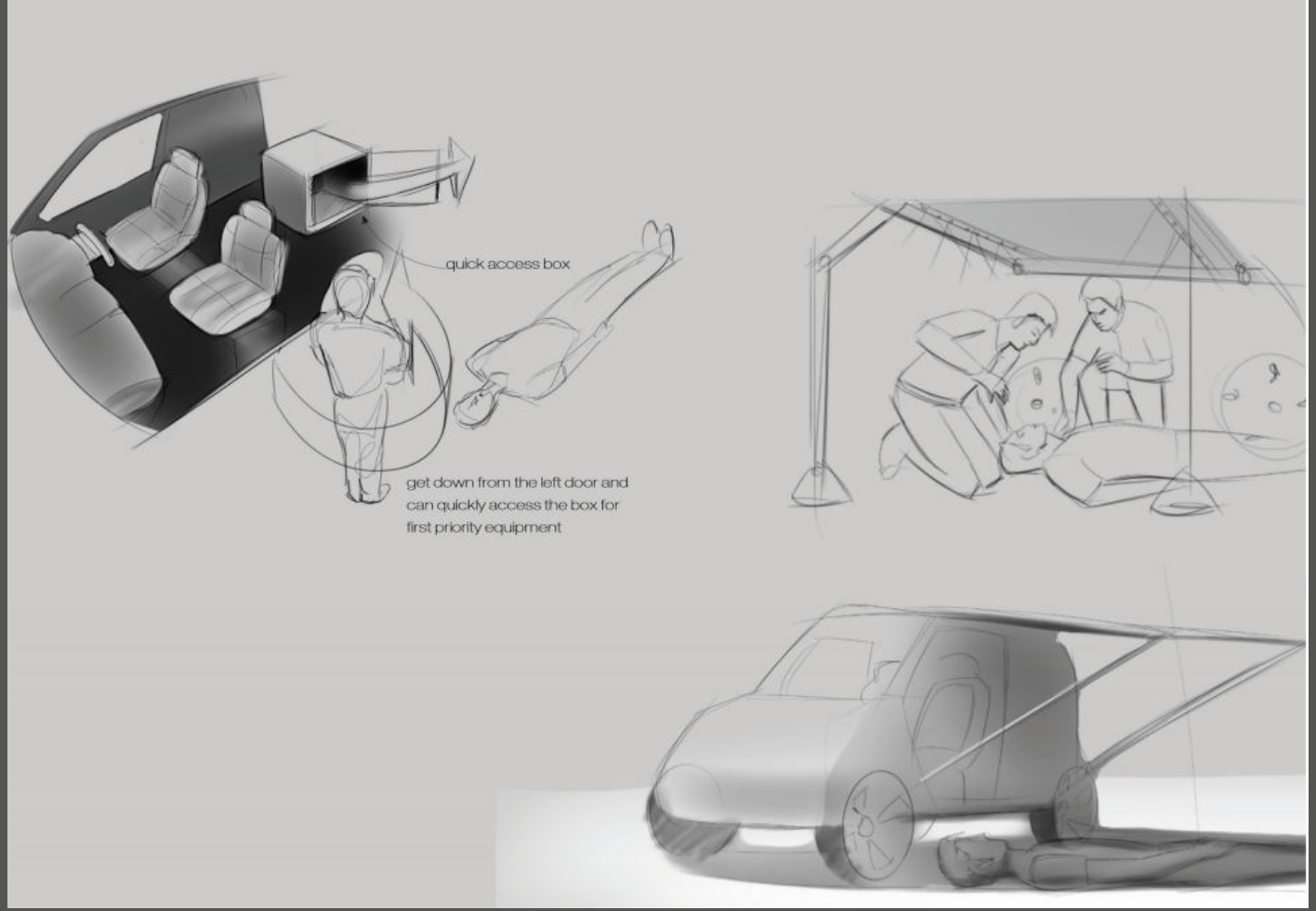

LED strips
ROLL
pull

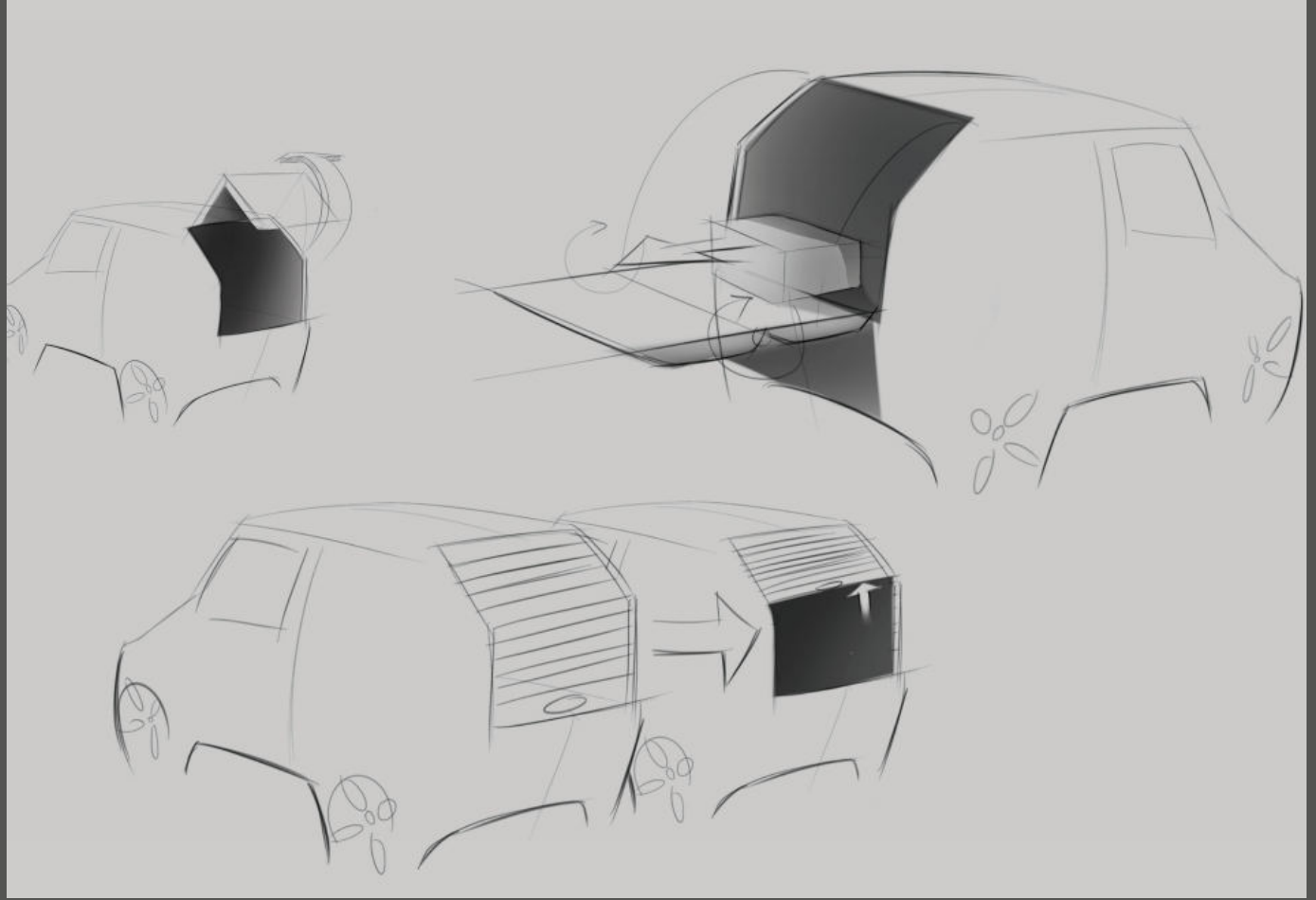

Foldable
buses
Maybe lights inside
Rain proof / Sun
proof
Fabric / sheet
slide out roof top

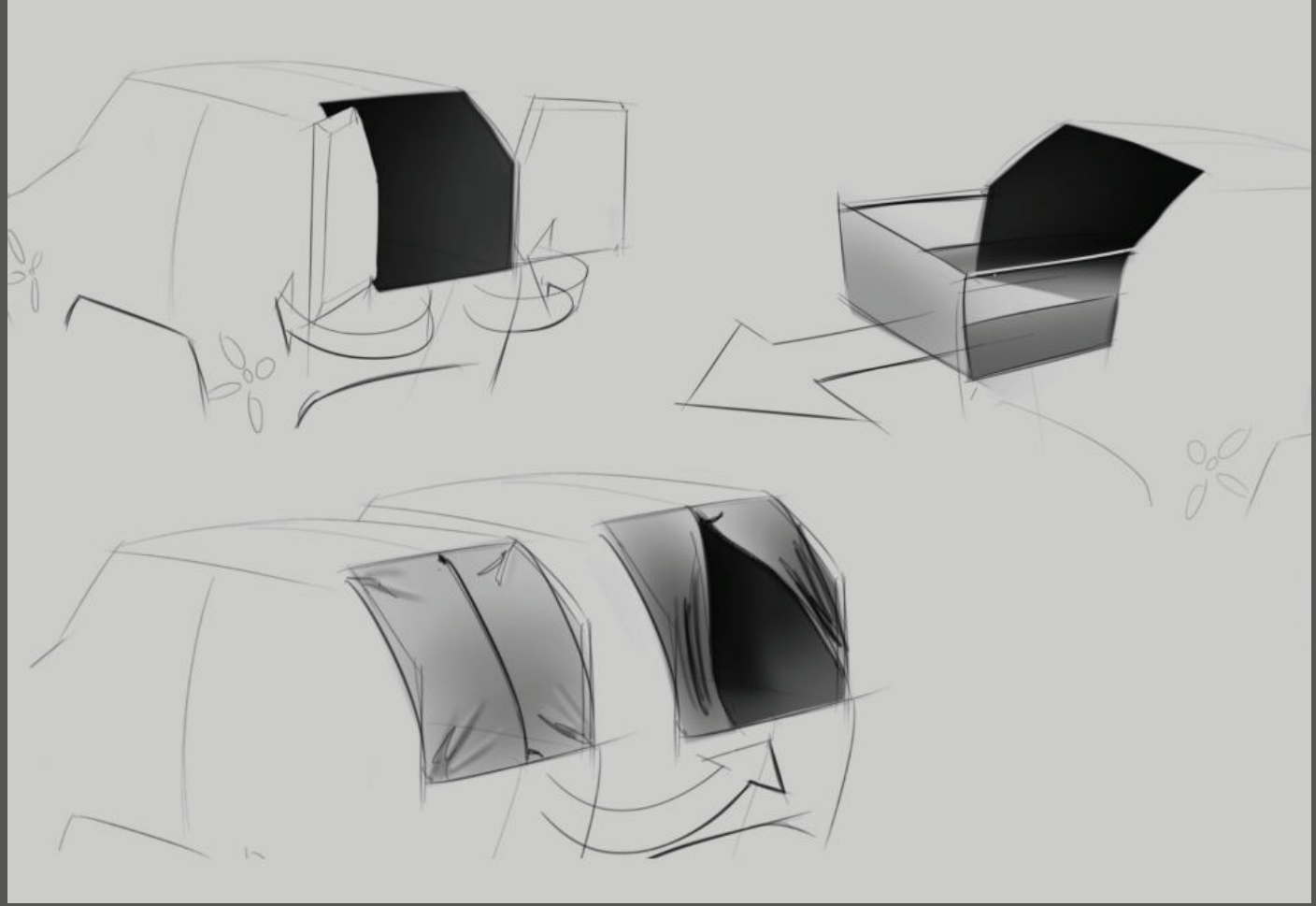

OPEN WINGS
HINGES
How about 2 wings!


Hinge
Flange to stop over opening
Locking mechanism for the equipment
Base board
Flange goes inside the panel
chair on string
string might hinder
This is more clearer
stopper lever

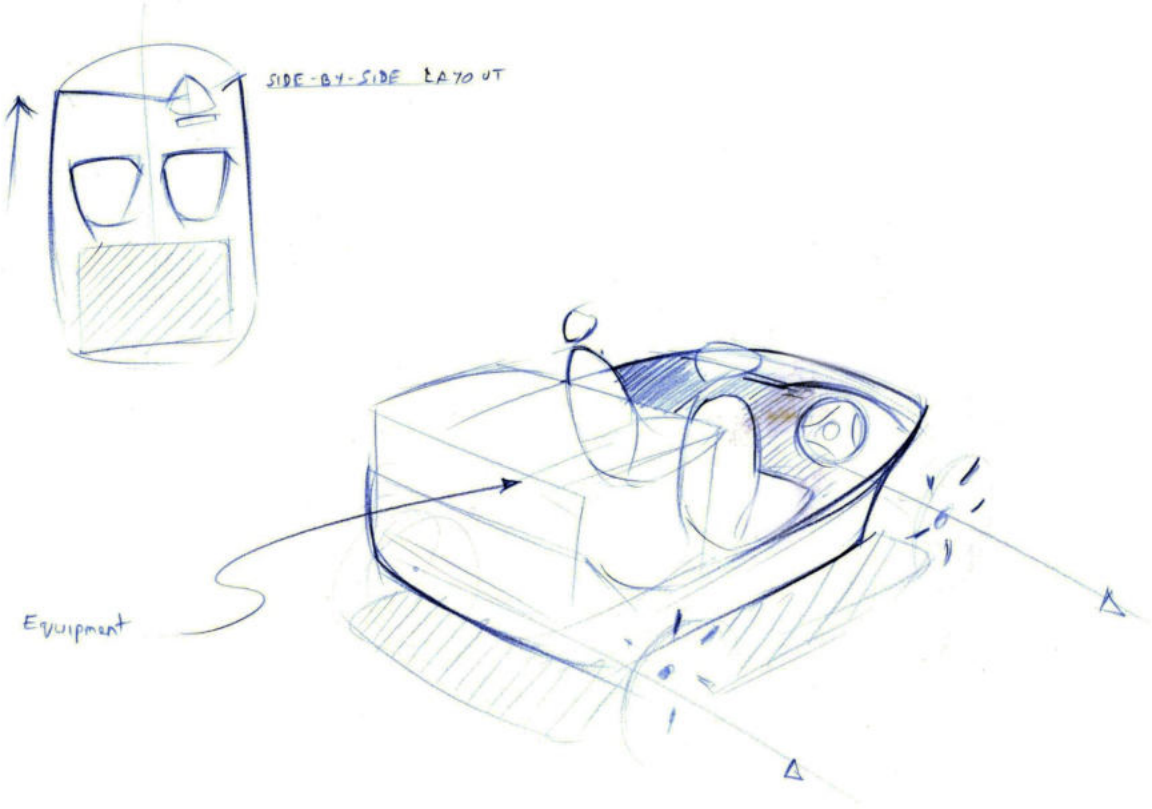

FRONT
Garbage can be discarded
// must be on the lower part
Pull out board for keeping the equipment
Push to discard waste
Push open
Waste can be discarded
Fix back the box in place

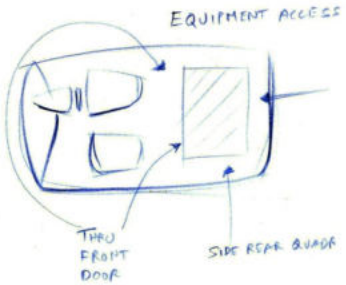

quick access box
get down from the left door and
can quickly access the box for
first priority equipment

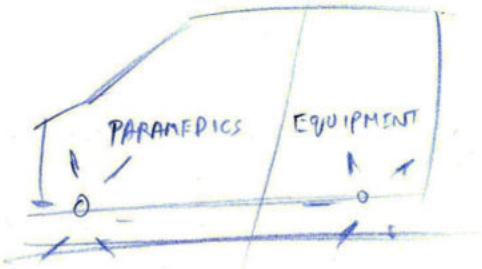




Vehicle packaging


SIDE-BY-SIDE LAYOUT
Equipment

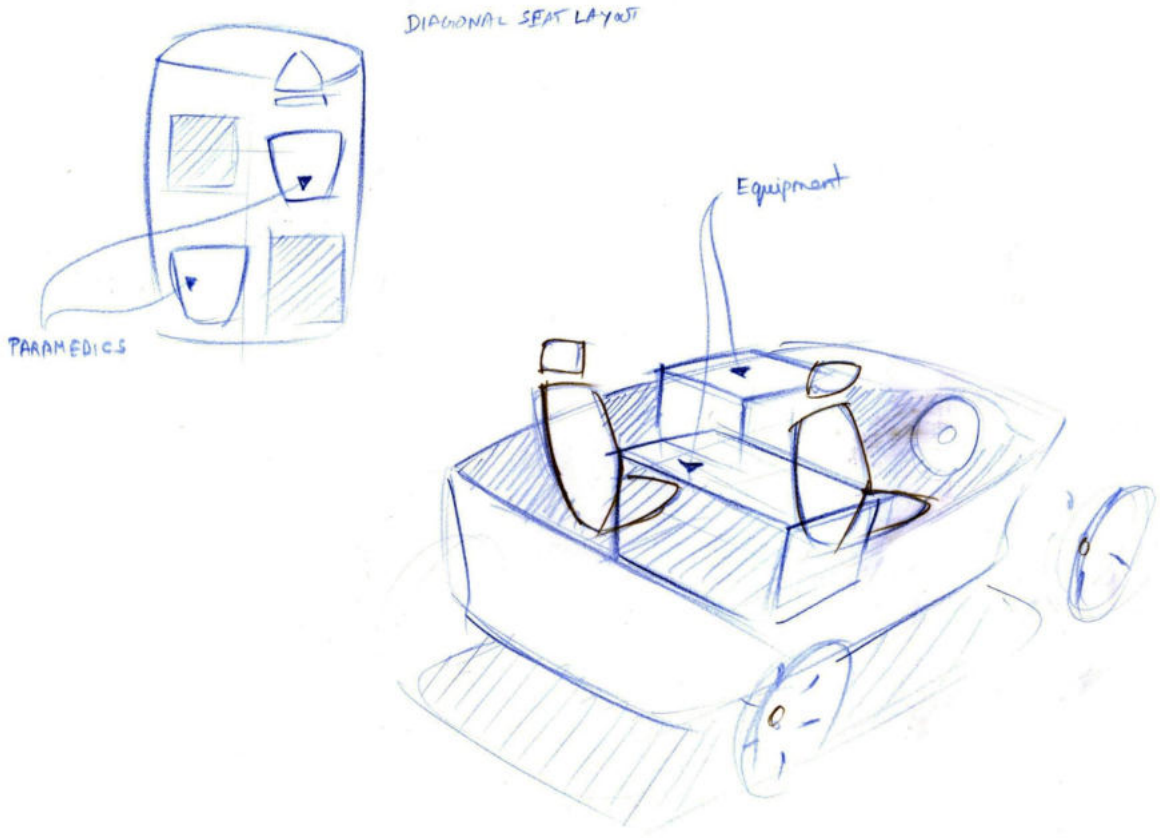




- ALL access from rear
- No immediate access
- Needs to step, get down and then take the equipment out
- Ingress / Egress is easy

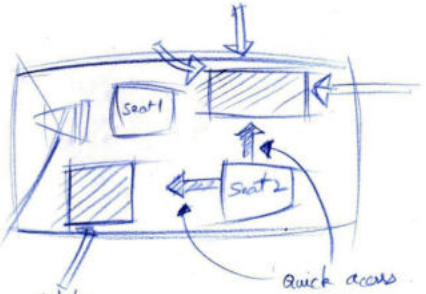
Easy to communicate with the other paramedic

- All Equipment are stored behind the paramedics

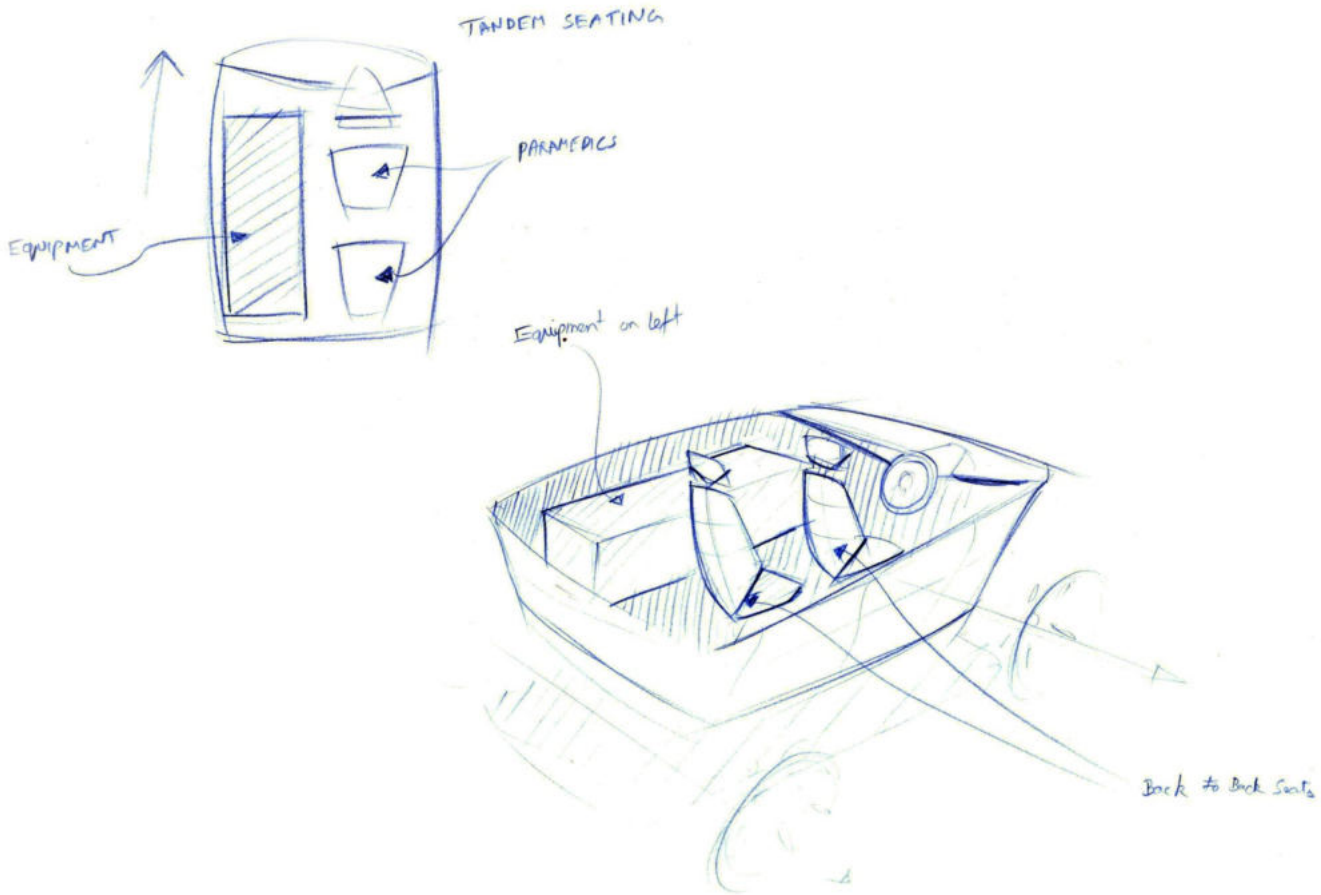

DIAGONAL SEAT LAYOUT
PARAMEDICS
Equipment

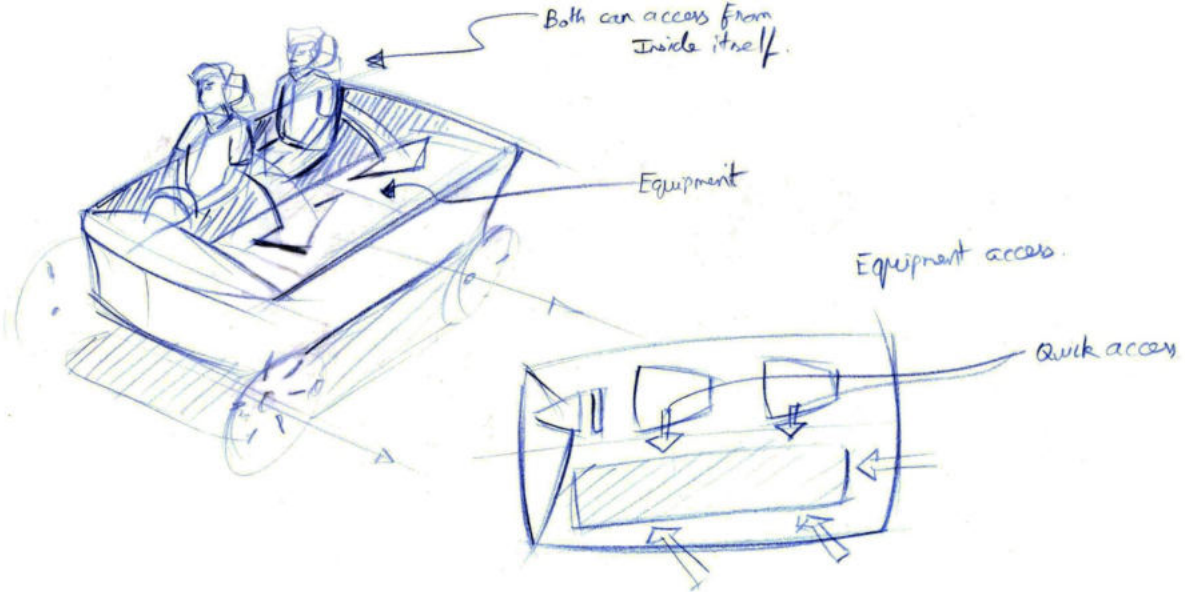
Allows paramedic to get down with the equipment

Equipment access

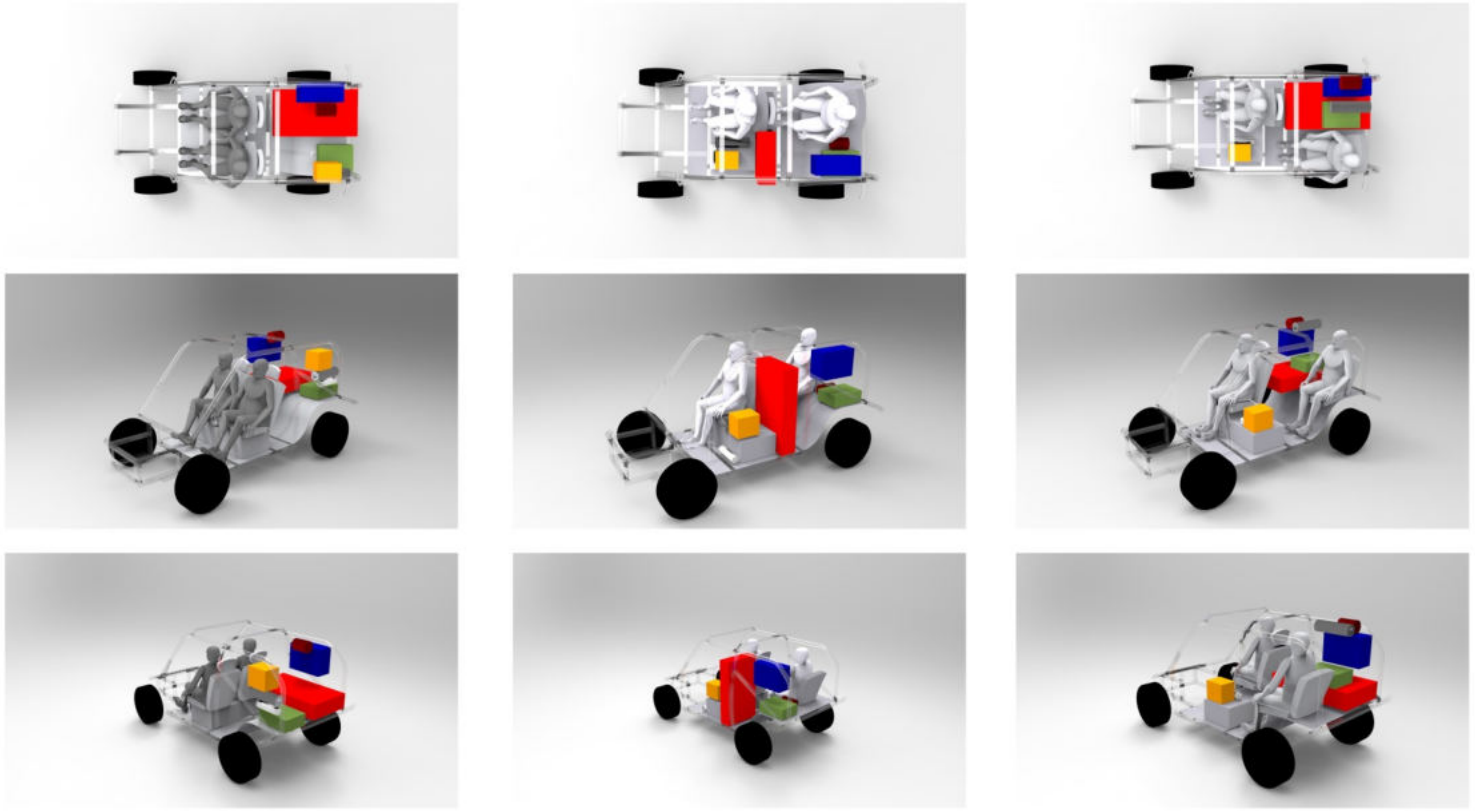


+ Ingress / Egress is a bit hindered as there is no rear seat
+ Quick access is very useful, can prepare the equipment before getting down
// very useful if it is very hurry outside or raining.

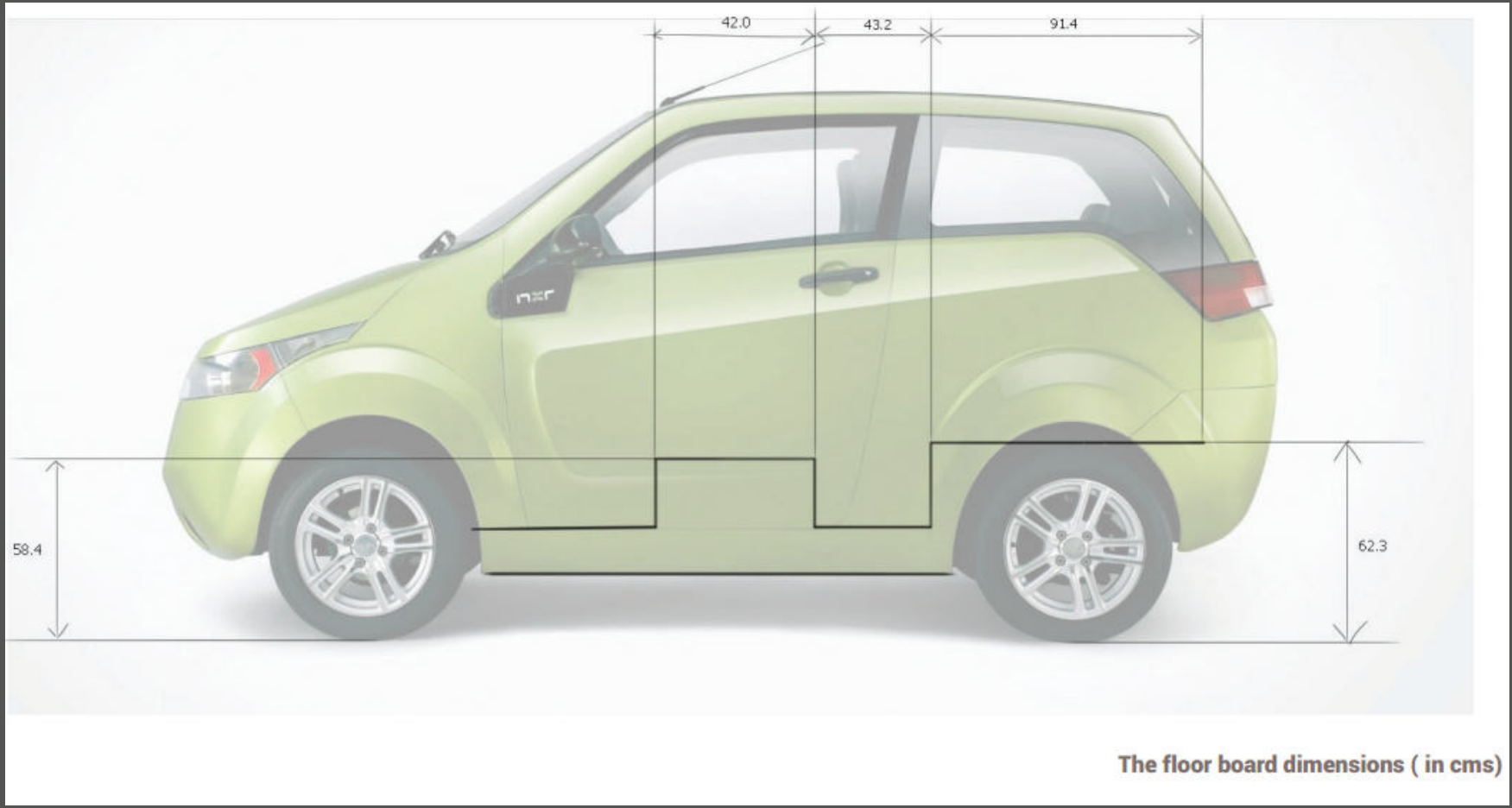

TANDEM SEATING
PARAMEDICS
EQUIPMENT
Equipment on left
Back to Back Seats



* Ingress/Egress for rear passenger will be hard
* Paramedics can't see both the sides while riding
* Not so good for communication

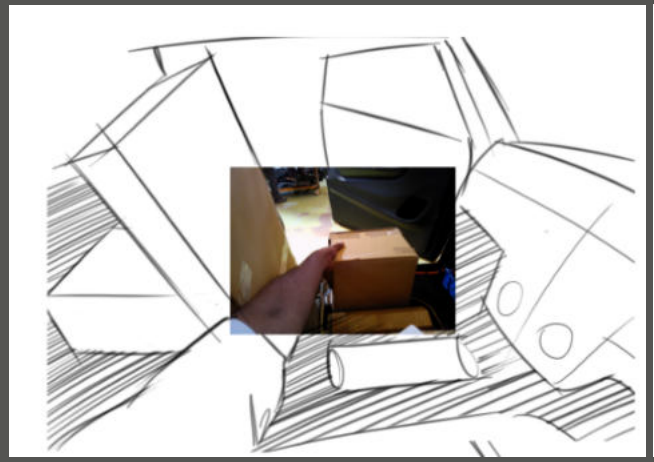

Foldable stretcher
Rucksack
Oxygen cylinder
Laryngoscope
AED
Suction apparatus
Ambu Bag

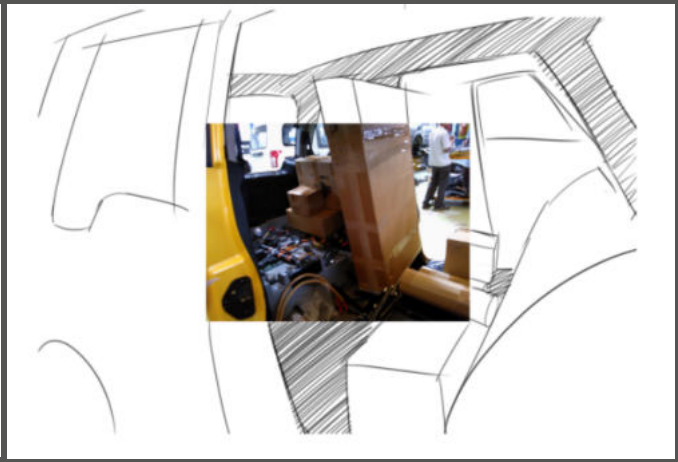
Equipment mockup



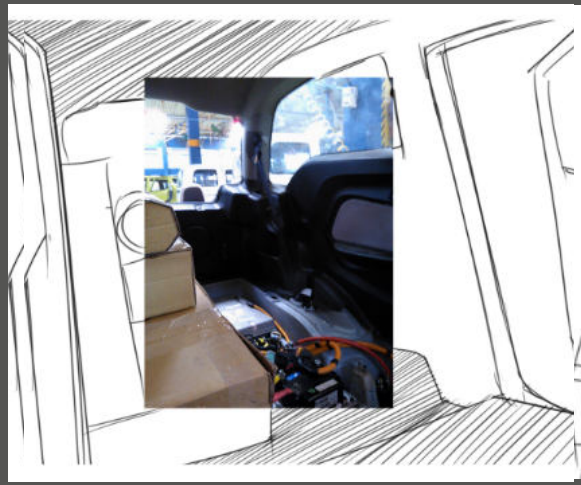
The floor board dimensions (in cms)

Back to back layout

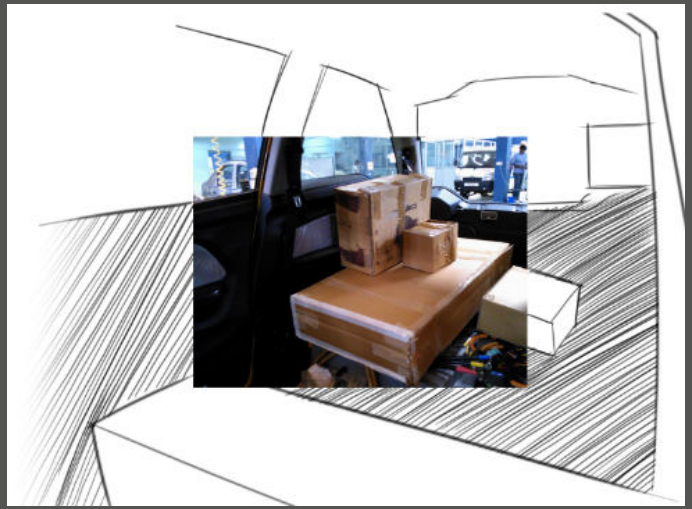


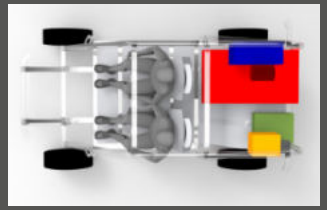
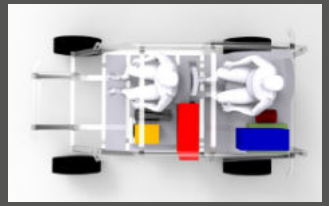
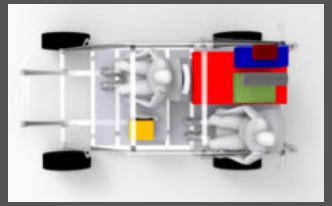


Diagonal layout



Side by side layout

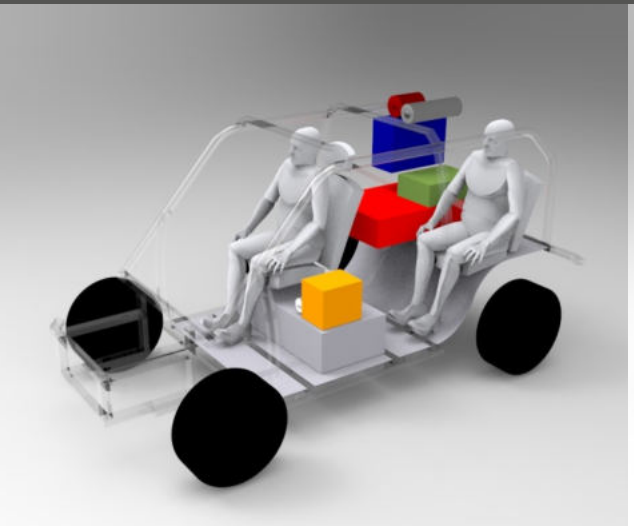


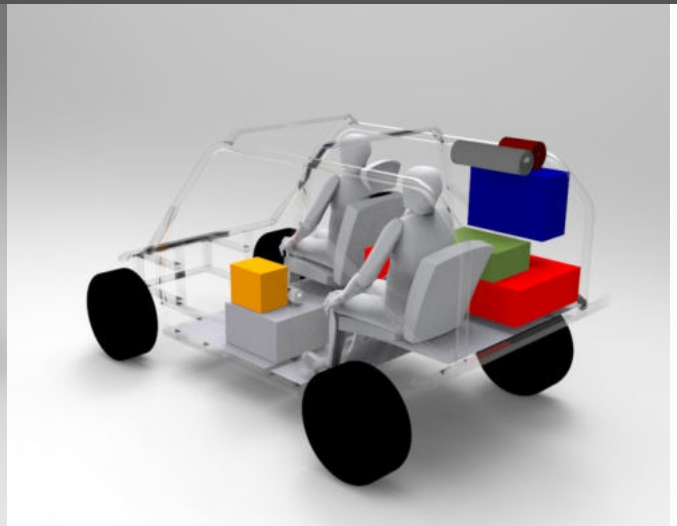




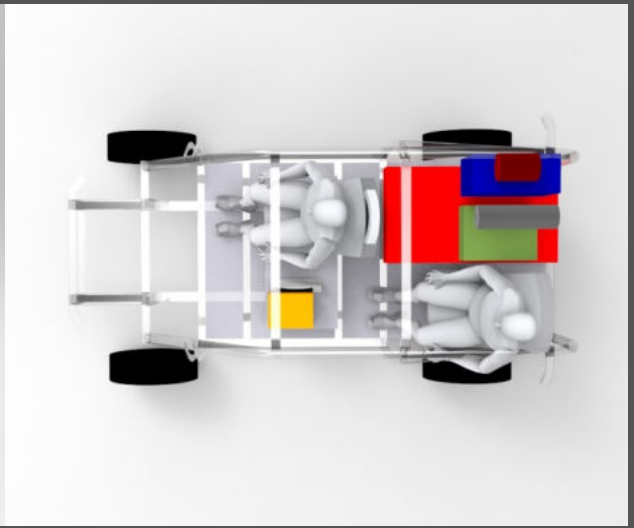
Criteria	weightage	Package 1 (side by side)	Package 2 (back to back)	Package 3 (diagonal)
Ingress/egress	5	5	2	4
Equipment accessibility	5	3	4	5
not claustrophobic	4	5	2	5
Communication between paramedics	3	5	2	4
Visibility (for both paramedics)	2	4	3	4
Total		83	47	85

Package 3 – Diagonal layout

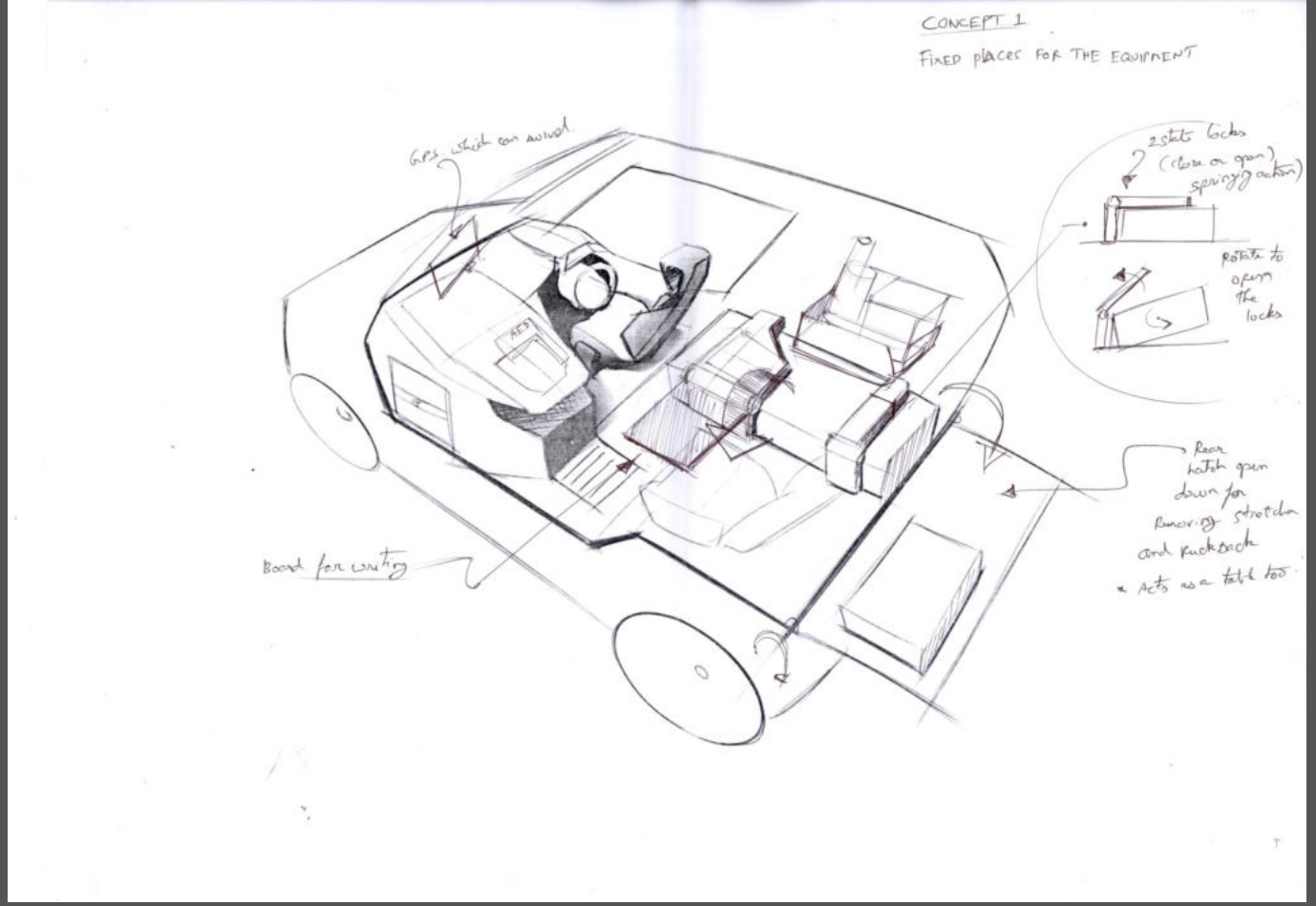
- Allows the paramedic to prepare even before he gets down
- Both paramedics can access the equipment
- Not safe to have AED on dashboard since it is heavy (6kgs) and expensive

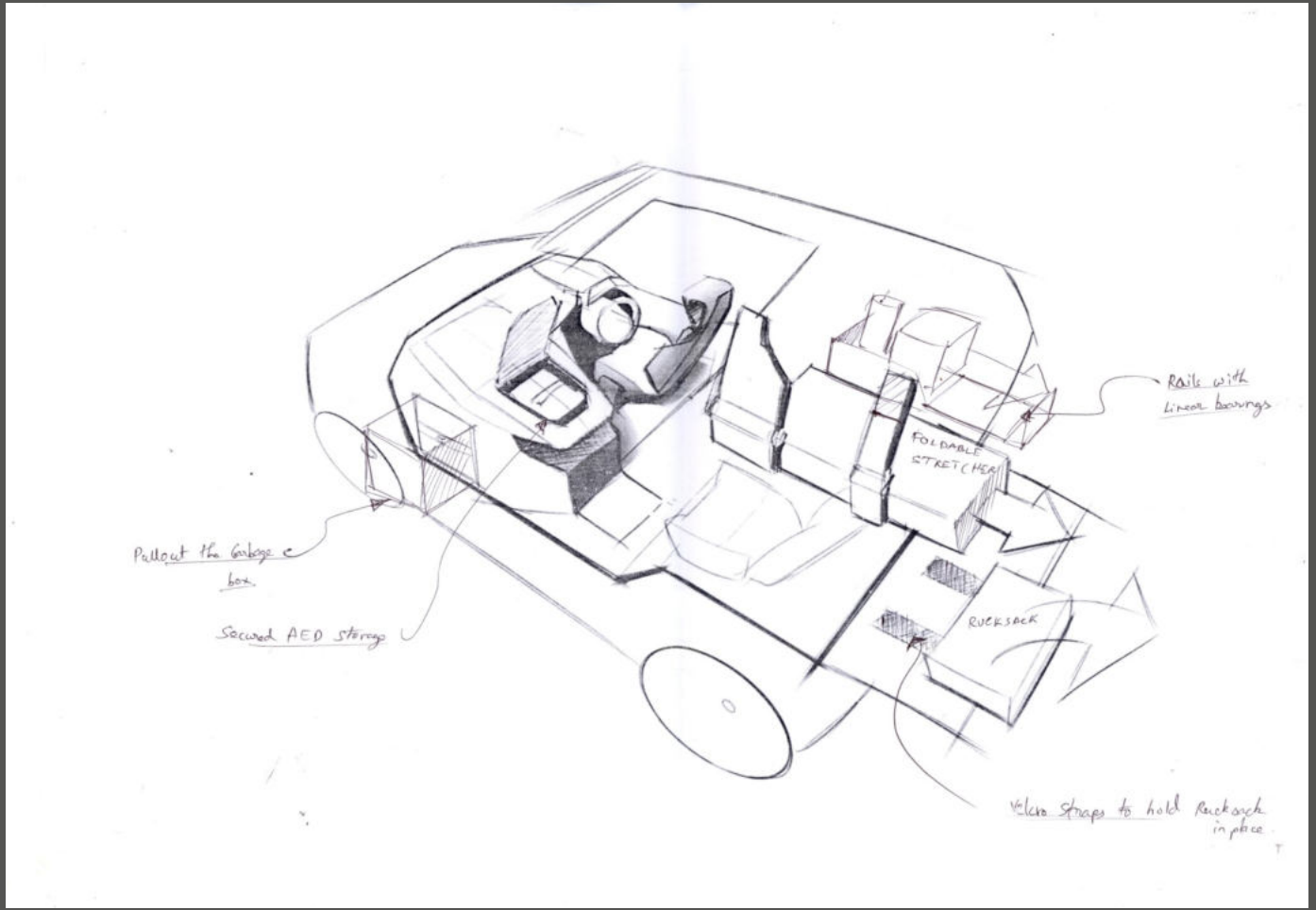






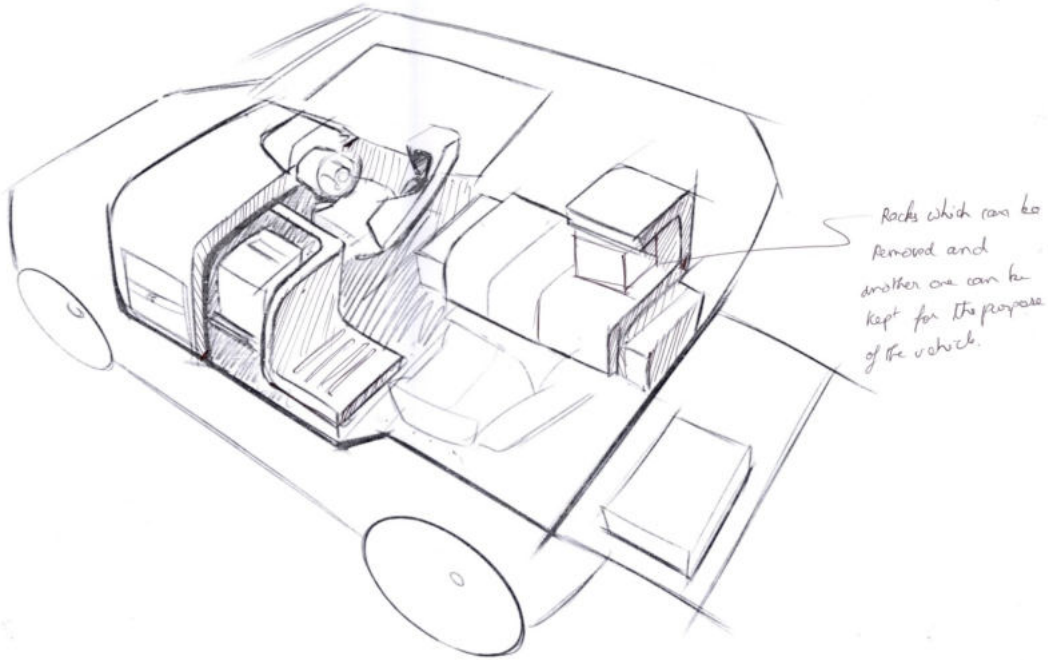
Concepts

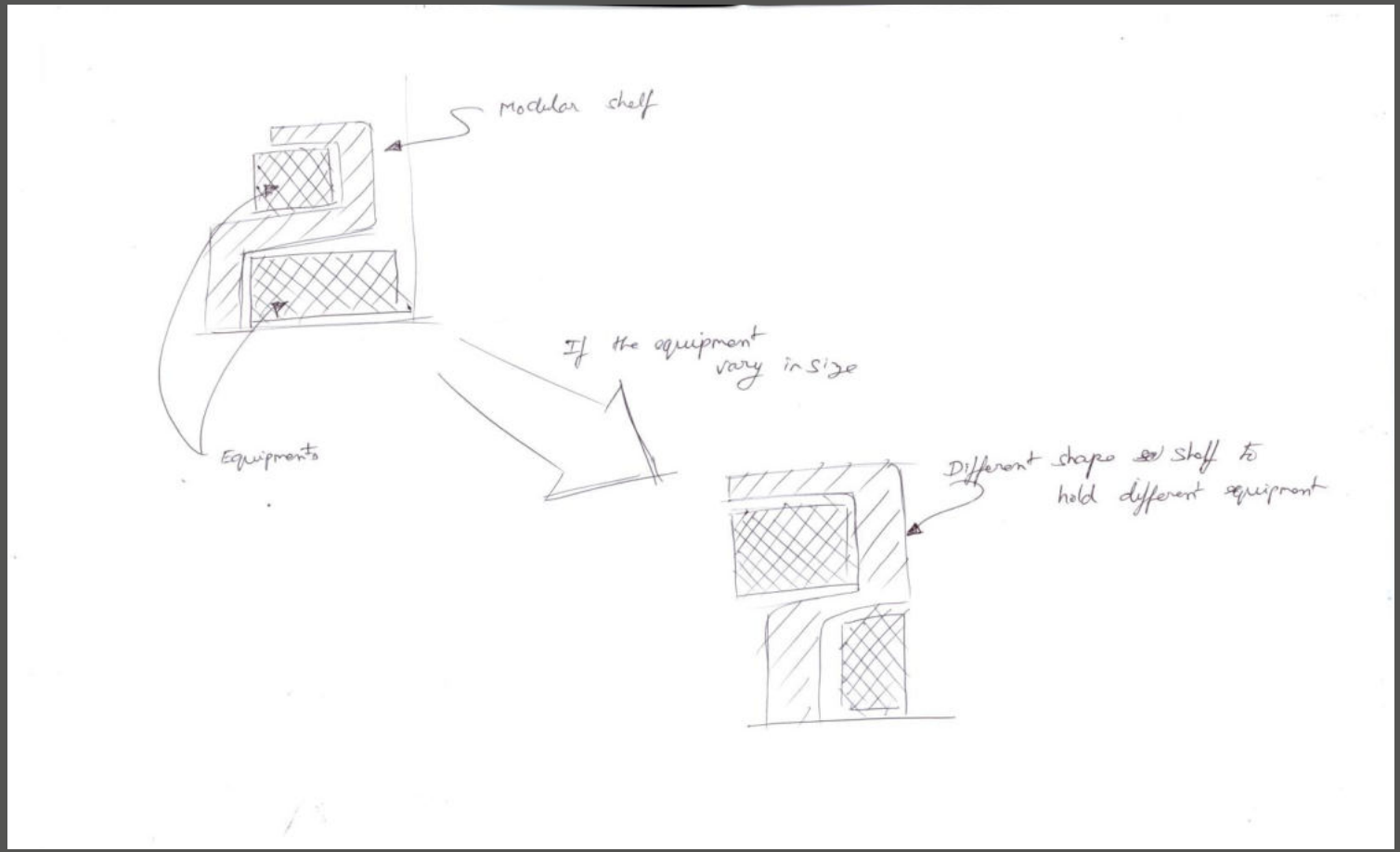

CONCEPT 1
FIXED PLACES FOR THE EQUIPMENT
GPS which can swivel
2 static locks
(close or open)
spring action
rotate to
open
the
locks
Rear
hatch open
down for
removing stretcher
and rucksack
* Acts as a table too
Board for writing


Rails with
Linear bearings
FOLDABLE
STRETCHER
Pullout the Garbage
box
Secured AED storage
RUCKSACK
Velcro straps to hold Rucksack
in place

CONCEPT 2

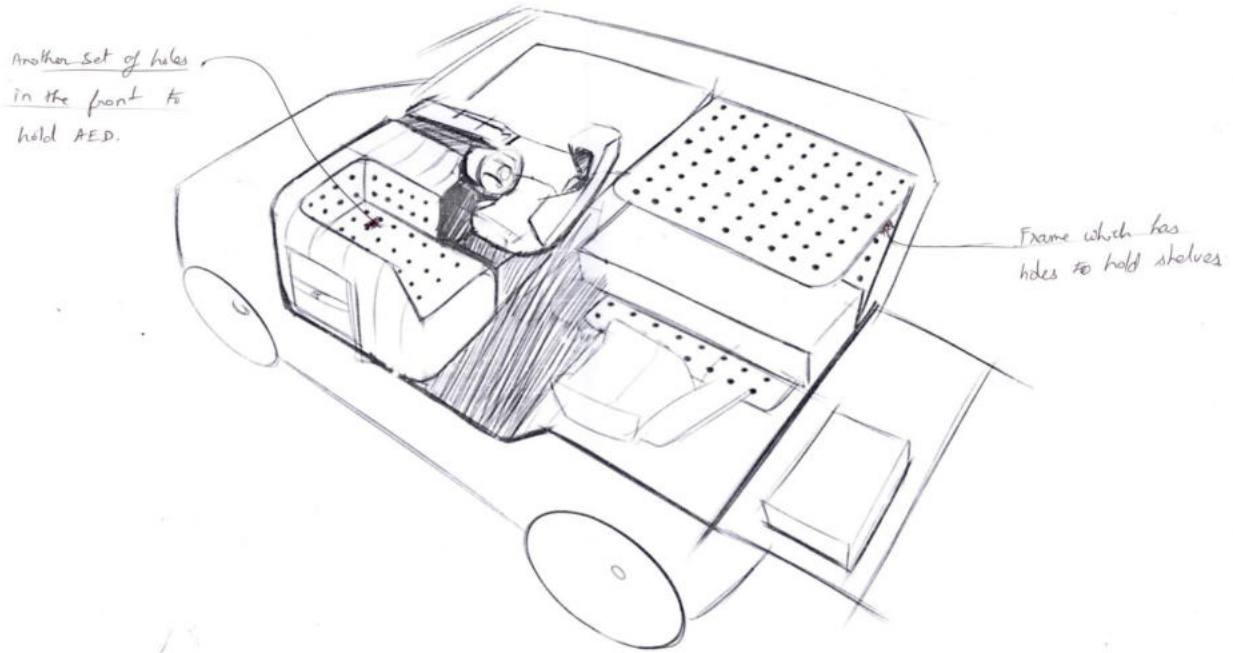
MODULAR RACKS

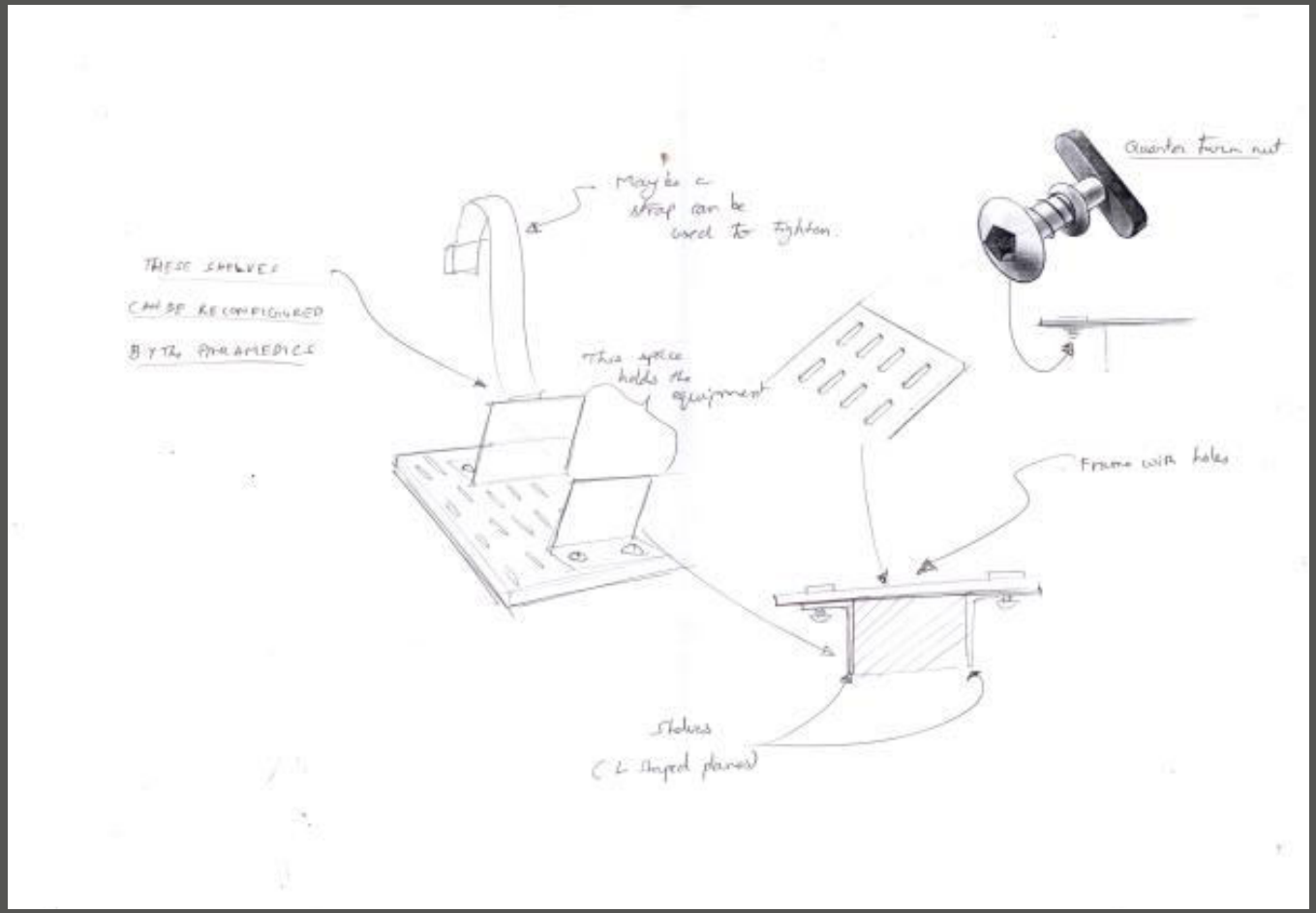


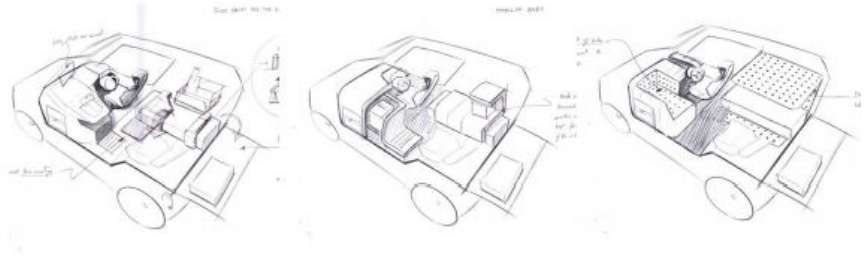

Modular shelf
Equipments
If the equipment vary in size
Different shape of shelf to hold different equipment

CONCEPT 3

LEGO CONCEPT




Maybe a strap can be used to tighten
Quarter turn nut
THESE SHELVES CAN BE RECONFIGURED BY THE PARAMEDICS
This space holds the equipment
Frame with holes
Slotted
(L shaped plates)



Criteria	weightage	Concept 1	Concept 2	Concept 3
Speed of retrieval	5	25	15	15
Securing equipment	5	25	15	10
Cleanability	4	12	16	8
Flexibility	3	3	9	15
Aesthetics	2	10	8	4
Total		75	63	52

Criteria	weightage	Concept 1	Concept 2	Concept 3
Speed of retrieval	5	25	15	15
Securing equipment	5	25	15	10
Cleanability	4	12	16	8
Flexibility	3	3	9	15
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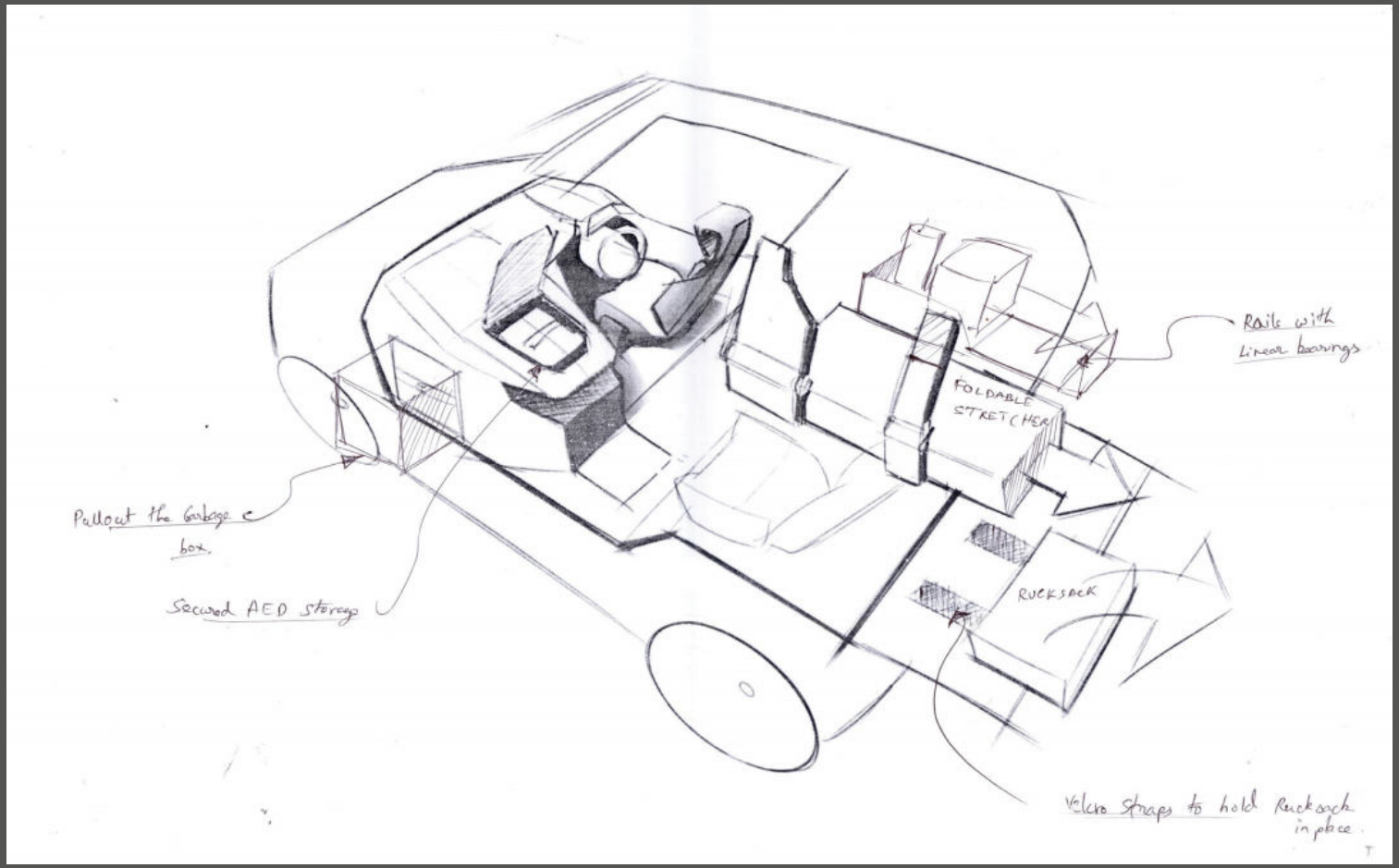
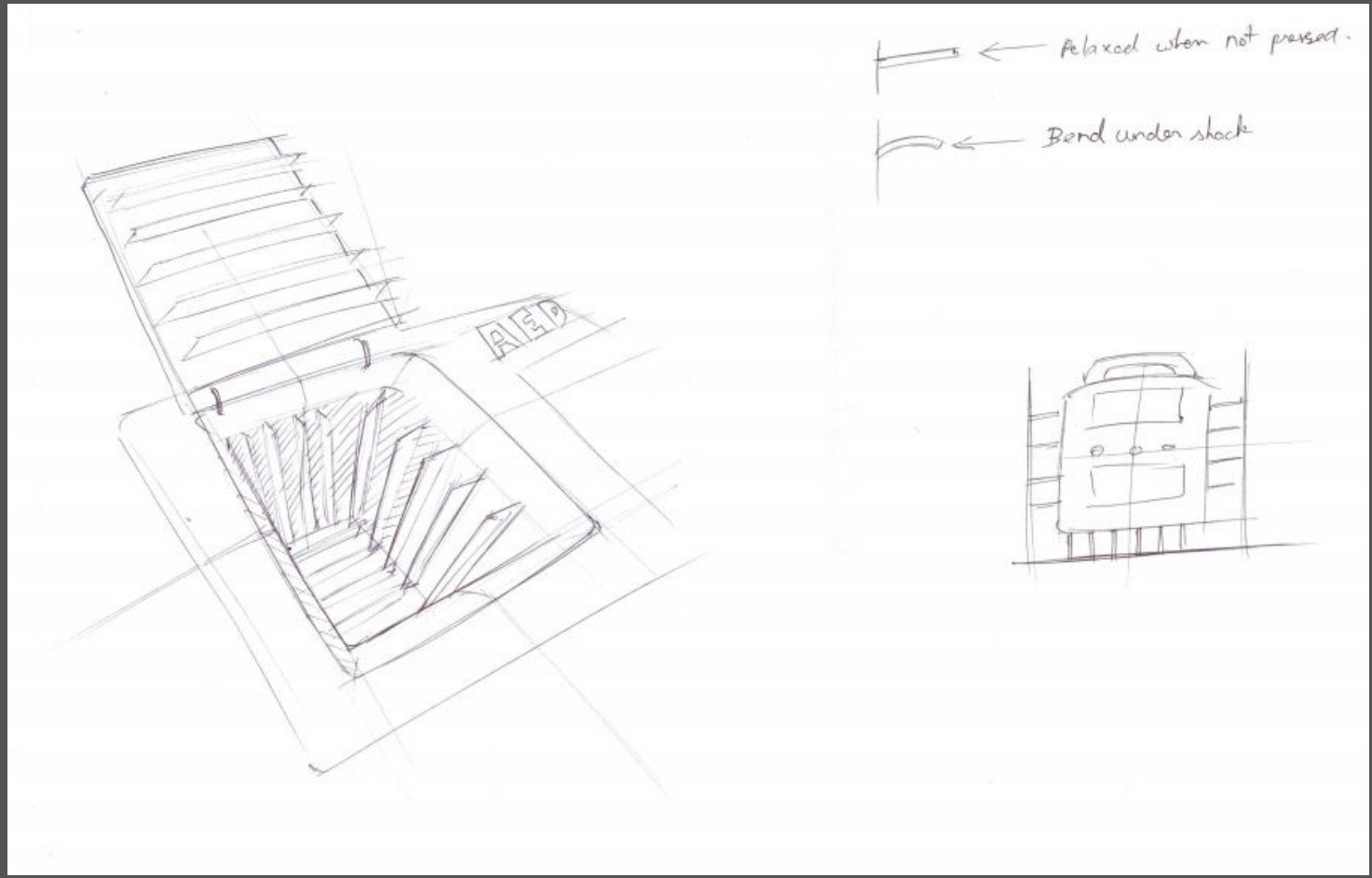
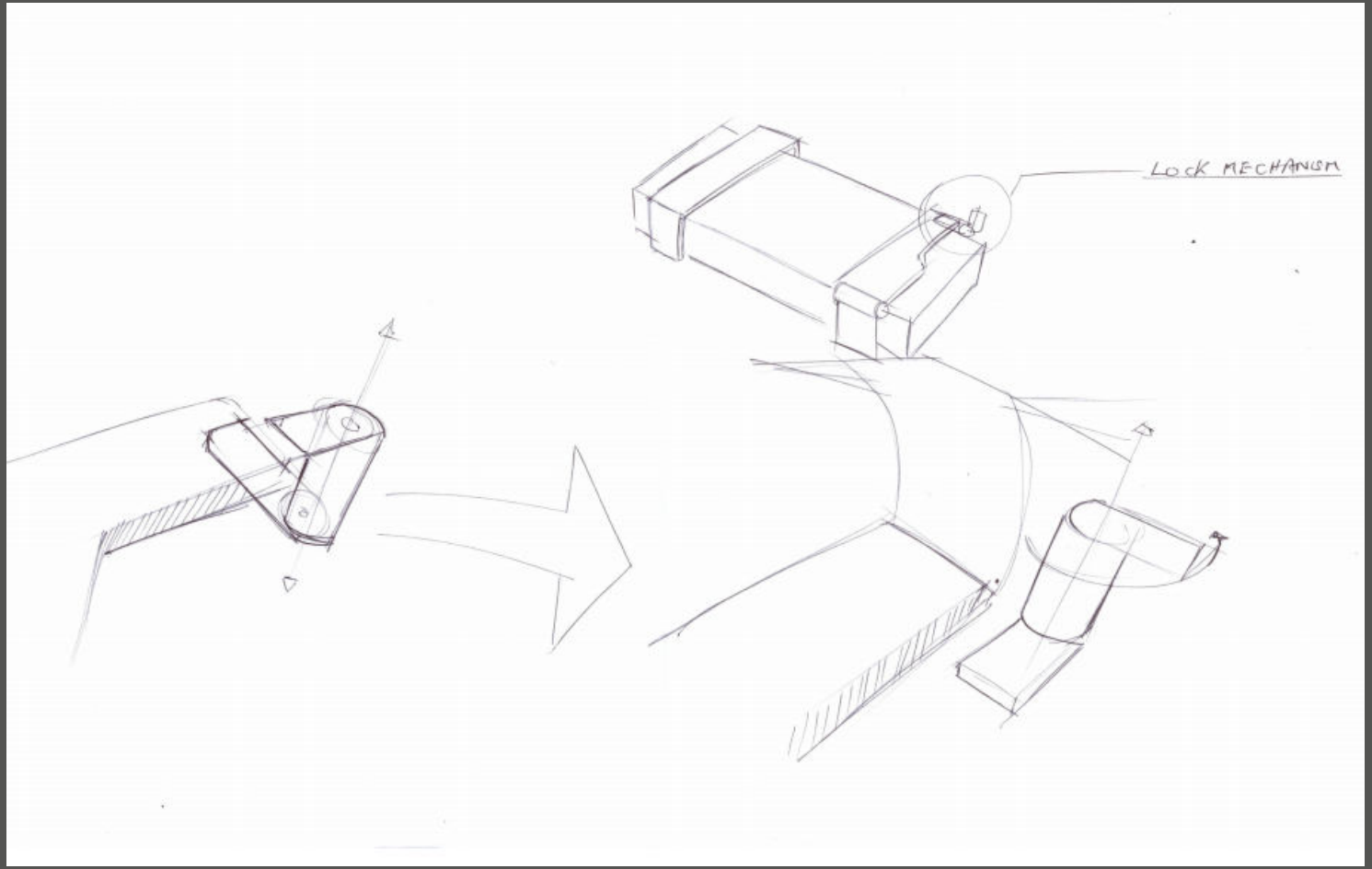
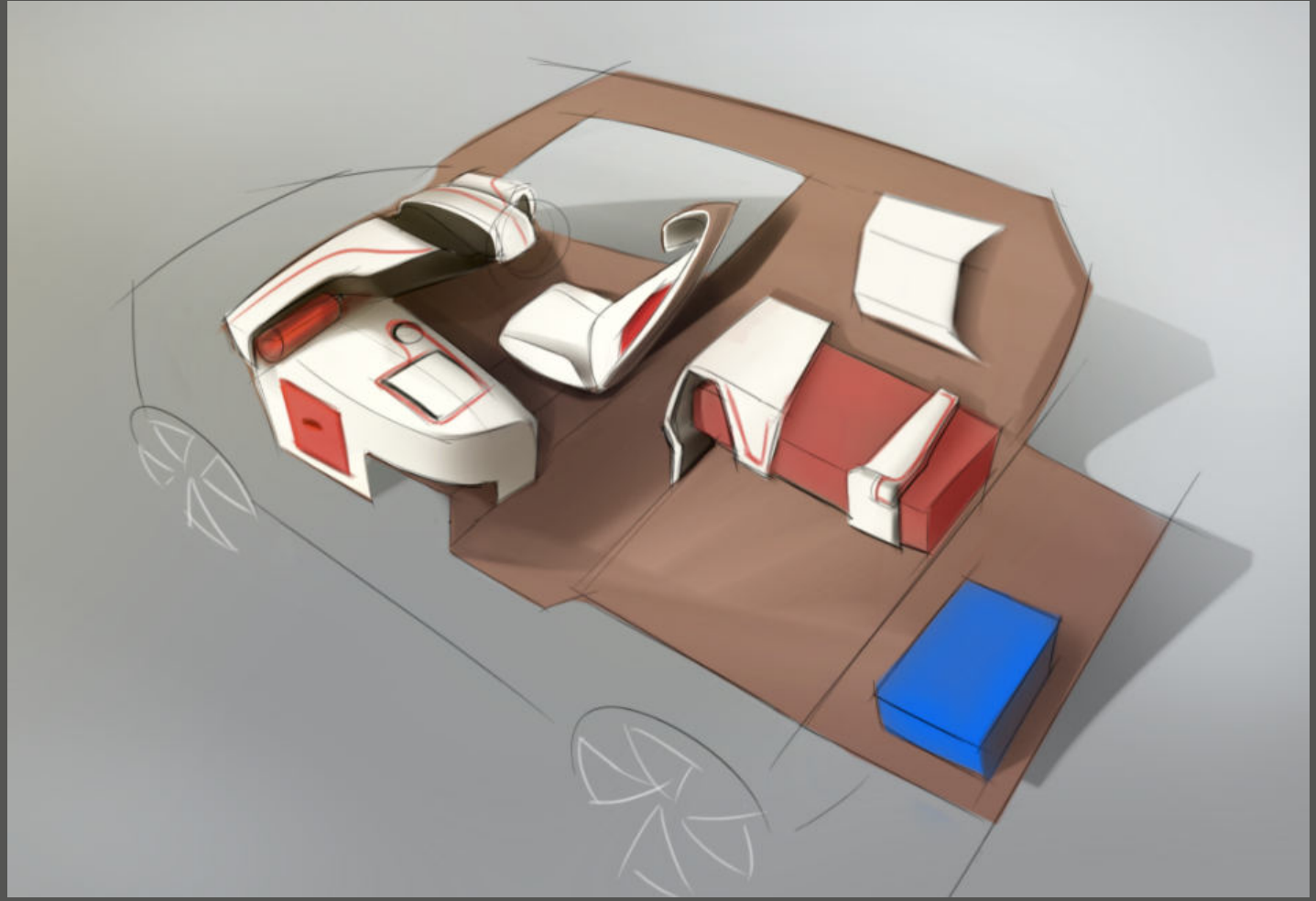
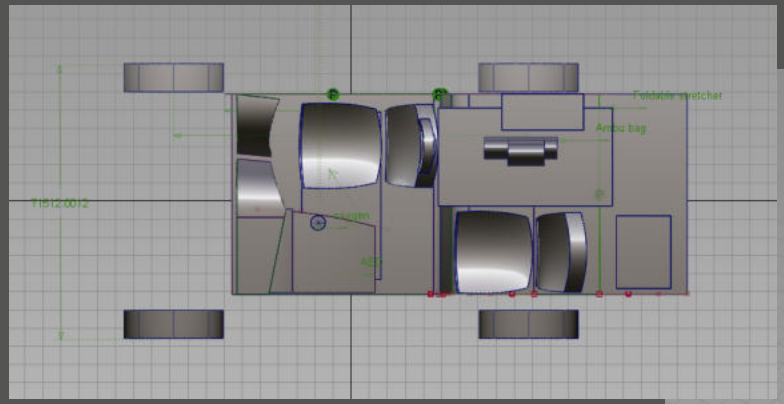
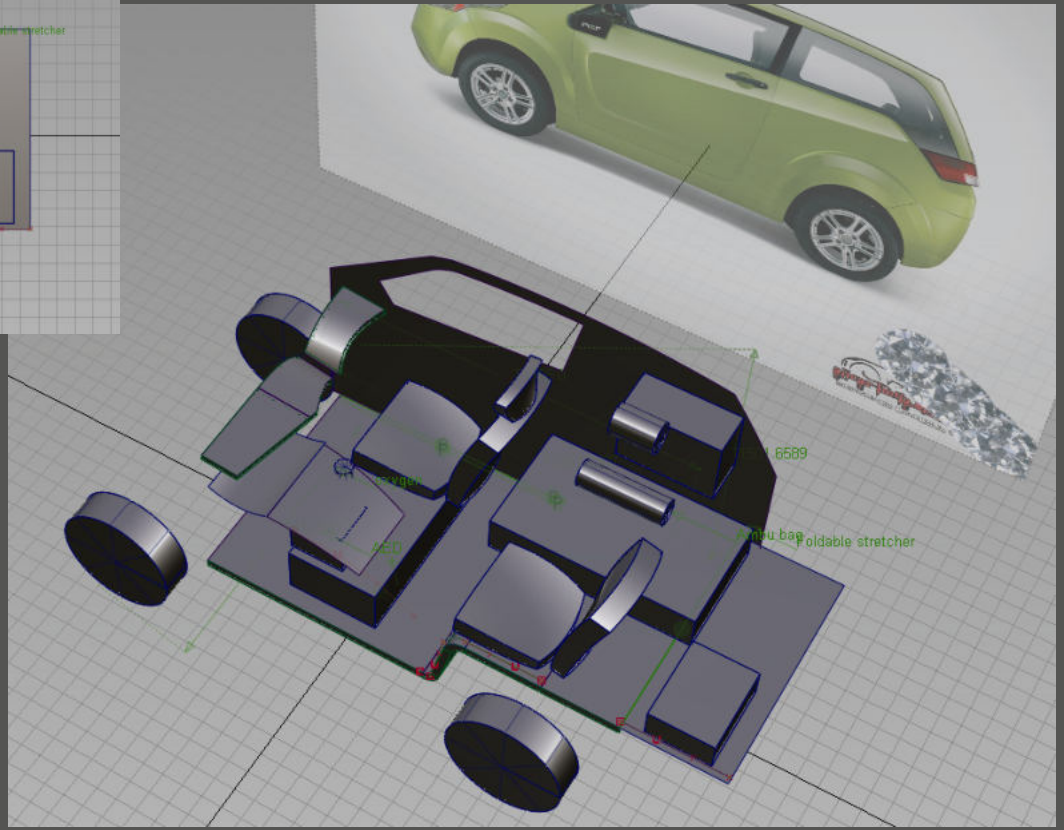

Rails with linear bearings
FOLDABLE STRETCHER
RUCKSACK
Pullout the Garbage box
Secured AED storage
Velcro straps to hold Rucksack in place


Relaxed when not pressed.
Bend under shock
AED


LOCK MECHANISM




Foldable stretcher
Ambu bag
AED


6589
Ambu bag
Foldable stretcher
AED

References

- “Accidents and first aid”. NHS Direct. Retrieved 25-2-2014.
- “A study comparing the usability of fully automatic versus semi-automatic defibrillation by untrained nursing students.” Monsieurs KG1, Vogels C, Bossaert LL, Meert P, Calle PA. Retrieved 26-2-2014.
- “Passage through India is a lifeline to rural poor” . The Sydney Morning Herald. 21 February 2009. Retrieved 28-2-2014