

APPLICATION DEVELOPMENT WITH GE PLASTICS: REDESIGN OF INTERIORS OF AC CHAIR CAR FOR INDIAN RAILWAYS

Industrial Design Project 2

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APPROVAL SHEET

The Industrial Design project titled

“Application development with GE Plastics:
Redesign of the Interiors of the AC Chair Car coach”,

by Tabitha Purathur (05613001)

is approved for the partial fulfilment of the requirement for the
post graduate degree in Industrial Design.

PROJECT GUIDE:

EXTERNAL EXAMINER:

INTERNAL EXAMINER:

CHAIRPERSON:

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1.ABSTRACT

The project aims at enhancing the comfort level of the passengers traveling by Second Class AC Chair Car coach. Most of the Budget Airlines offer very affordable rates, connecting most of the major cities in India and are providing stiff competition to the Indian Railways in this concern. With extra comfort and luxury offered for a slightly higher price, air travel has become more feasible in a developing country, like India, today.

Hence, the need to enrich the experience of traveling by the AC Chair Car was identified and developed by the design team.

1.1 CONCERNS OF THE INDIAN RAILWAYS (IR):

- Increasing the capacity of the coaches - even one extra passenger per coach would generate more revenue on all the AC Chair Car routes
- Using the existing skeletal frame of the coach produced by either the RCF(Kapurtala) or ICF (Perambur)
- Adhering to the safety standards employed by the IR
- Creating fire-resistant, wear-resistant design that is vandalism proof

1.ABSTRACT

1.2 PROJECT BRIEF

Designing the interiors of the AC Chair Car coach for the Indian Railways, focusing on user amenities around the seat.

1.3 DESIGN OBJECTIVES

- Responding to the Indian user's needs for different user amenities
- Addressing the **lighting and ventilation** solution within the coach
- Developing ideal **luggage storage solutions** for every passenger

2. INTRODUCTION



Fig.2.1



Fig.2.2



Fig.2.3

The Indian Railways have a fairly large number of AC Chair Car coaches plying on many Inter-city routes all over India, particularly in the northern and western sectors. Most of these journeys are short-term ones ranging from 3 hours (Mumbai - Surat Shatabdi route) to maximum 9 hours duration (Mumbai- Goa Jan Shatabdi route).

A brief study of the existing system and experience of traveling on these routes not only reiterated the need for a re-design of the environment to provide a more comfortable journey for all travelers on these routes, but also demanded a radical solution for attracting more travelers.

A few of the typical routes are listed below:

SOURCE STATION	DESTINATION	TRAVEL TIME	TRAIN NAME
MUMBAI	PUNE	4 HRS	INTERCITY EXPRESS
MUMBAI	AHMEDABAD	7 HRS	SHATABDI EXPRESS
MUMBAI	MARGAON	9 HRS	JAN SHATABDI EXP.
DELHI	BHOPAL	8 HRS	NDLS SHATABDI EXP
DELHI	LUCKNOW	6.5 HRS	LUCKNOW SHATABDI EXP
DELHI	AMRITSAR	6 HRS	SWARNA SHATABDI
BANGALORE	CHENNAI	5 HRS	SHATABDI EXPRESS
ERNAKULAM	TRIVANDRUM	4 HRS	ERNAKULAM SHATABDI EXP

The Indian Railways faces stiff competition from the Budget Airlines with discounted *APEX* airfares along with faster time travel and added comfort and service. Most of the traveling business professionals prefer air travel for the very reason that more comfort and time saving journeys are viable on most flights connecting important destinations.

Hence, the need to enrich the experience of traveling by the AC Chair Car was identified and developed by the design team.

3. USER STUDY AND ANALYSIS



Fig.3.1
Jyoti Prakash



Fig.3.2
Sanket Shelve



Fig.3.3
Arun Shinde

3.1 ACTIVE PEOPLEWATCHING

For the User Study, we observed and recorded behavioral responses within the given context, without interfering with the user's activities

3.1.1 SET UP FOR OBSERVING USERS

A mini-DV was placed incognito on the folding tray and was used to record minute by minute change in responses of the user to his immediate environment.

This was useful to see what people actually do within real contexts and time frames, rather than accept what they say they did after the fact.

3.1.2 USERS STUDIED

Jyoti Prakash	35 M	Software consultant
Sanket Shelve	23 M	MBA student
Arun Shinde	30 M	Sales personnel

3.1.3 ROUTES STUDIED

A study of four typical routes were carried out initially to understand the user's needs and behavioural patterns within the given context.

- Mumbai- Pune Intercity Express,
- Mumbai - Ahmedabad Shatabdi Express,
- Mumbai- Margaon Jan Shatabdi Express and
- Chennai - Bangalore Shatabdi Express

3.2 SURVEY

Asking a series of targeted questions in order to ascertain particular characteristics and perceptions of users. Users were also asked to prioritize the following factors for design considerations:

COMFORT SPACE ~~PER~~ PASSENGER
LUGGAGE STORAGE ~~SPACE~~
ACCESSIBILITY ~~OF~~ STORAGE
SECURITY ~~OF~~ LUGGAGE STORED
INDIVIDUAL USER ~~CONTROLS~~
CAPACITY OF PASSENGER ~~PER~~ COACH
MAINTENANCE AND SERVICING
MODULARITY IN DESIGN
ADAPTABILITY TO INDIAN RAILWAYS

3.2.1 USER ~~S~~INTERVIEWED

Mr. Hasmukh Jain, 40, M, business man
Mr. Sanket Sadanand Shetve, 23, M, MBA student
Mr. Shaji Thomas, 37, M, IT professional
Mr. Gurdeep Singh Matreja, 46, M, Interior designer
Mrs. Chaitali Shah, 25, F, Housewife
Mr. Nikihil Karwall, 25, M, Design Student
Mr. Jyoti Prakash, 51, M, Management personnel
Mr. Kale, 54, M, Businessman
Mrs. Neeta Jain, 37, F, Housewife
Mr. Patel, 45, M, Ticket collector

The evaluation of different criteria for design of interiors were also carried out by 30 other individuals from different backgrounds and professions.

3.2.2 ADVANTAGE

This was a quick way to elicit answers from a large number of people

3. USER STUDY AND ANALYSIS



Users of different ages & different strata of society

The following observations were recorded as part of the user study:

3.3 STRATA OF SOCIETY

High income professionals (management personnel, businessmen, doctors)
Upper class individuals who are concerned about luxury & safety

3.4 AGE GROUP OF USERS:

AGE GROUP	PERCENTAGE OF TRAVELERS
0 - 17 years	9%
18 - 30 years	22%
31 - 45 years	40%
46 - 60 years	14%
Above 60 years	15%

3.5 PURPOSE OF TRAVEL:

Business trips	Company sponsored trips
Leisure	One- day trips (short trips)
Tours (foreigners, NRIs)	Vacation trips
Reservation for National Awardees	

3.5.1 REASONS FOR CHOICE OF AC CHAIR CAR:

Safety (especially for women traveling alone)
Comfort & luxury
Psychological aspects of comfort like less crowd, no beggars or other disturbances
Can work during travel hours and still feel fresh.

3. USER STUDY AND ANALYSIS

3.6 LUGGAGE



3.6.1 TYPES OF LUGGAGE:

Air bags & duffel bags
Rucksacks
Trolley bags
Briefcases
Laptop bags
Cardboard cartons
Plastic bags

3.6.2 PERSONAL LUGGAGE CARRIED BY PASSENGERS

Personal handbags
Laptops
I-pods
Mobile phones
Walkman
Foodstuff apart from their heavy luggage

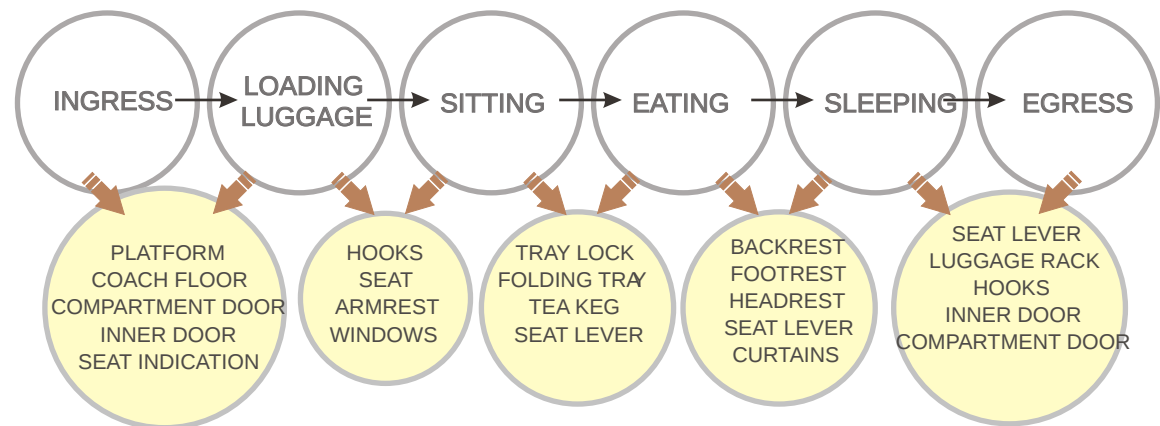
3.6.3 ISSUES FOR LUGGAGE SPACE:

- Safety of luggage storage
- Accessibility of luggage stored
- Every passenger carries at least 2-3 bags.

3.7 ACTIVITY AND ERROR ANALYSIS

Listing/ representing in detail, all tasks, actions, objects, performers and interactions involved in the process.
Listing all things that can go wrong when using a product and determine the various possible causes

3.7.1 ACTIVITY FLOW DIAGRAM



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3.7.2 ADVANTAGE

Understanding how human features mitigate or contribute to inevitable human errors and other failures and to identify what issues to address

3. USER STUDY AND ANALYSIS

3.7.3 INGRESS



Fig.3.5

1) Steps to board the train are vertical and height of platform varies



Fig.3.6

2) AC compartment door shuts immediately because of hydraulic hinge



Fig.3.7

3) Passenger carrying lots of luggage cannot enter at one time and the door width is insufficient



Fig.3.8

4) Elderly people find it difficult to board the train and the heavy door shuts halfway

3. USER STUDY AND ANALYSIS

3.7.3 INGRESS

5) Rush between people boarding and alighting



7) No uniform, legible signage system for locating

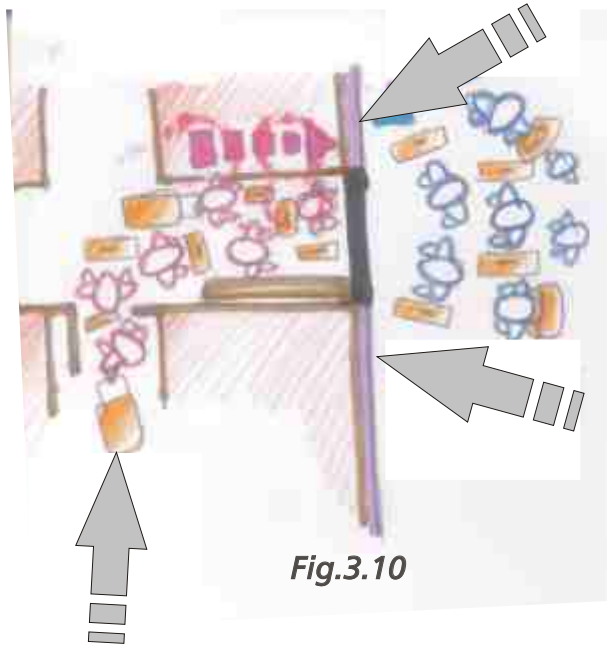


Fig.3.10

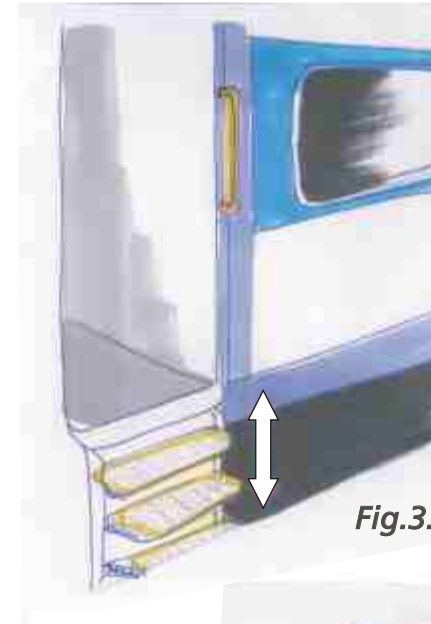


Fig.3.11

6) Steps to board the train are vertical

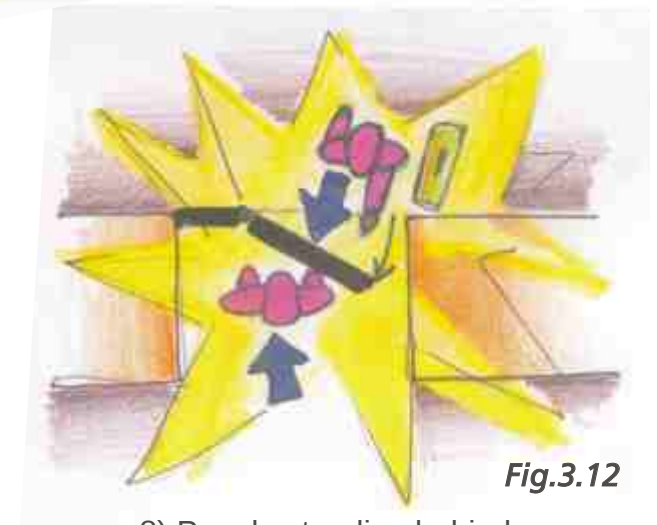


Fig.3.12

8) People standing behind door creates obstacles

3. USER STUDY AND ANALYSIS

3.7.4 LOADING LUGGAGE



- 1) Users prefer keeping the luggage close to them and female passengers do not like to place their handbag on the hook



- 2) Need to access luggage during journey



- 3) The front pouch does not easily accommodate newspapers with magazines and water bottles



- 4) 2 hooks for 3 passengers



- 5) Difficult to haul heavy luggage onto top rack; not accessible to short users

- 6) In absence of space, the user keeps his bags on the floor near his seat

3. USER STUDY AND ANALYSIS

3.7.5 SITTING



- 1) Footrest operation is hard
- 2) Footrest accessibility is low
- 3) Middle passenger has problems in movement



- 4) Armrests are shared by two users each



- 5) Users respond differently with interesting postures for sitting



- 6) Absence of neck support for short people

3. USER STUDY AND ANALYSIS

3.7.6 EATING



Fig.3.25



Fig.3.27



Fig.3.26

1) The tray is used for eating, sleeping, working and storing small bags at times

2) Once the tray is down, the inner passengers cannot egress easily;



Fig.3.28

3) Waste disposal systems are not provided

Very often the trash (paper cups, paper plates and plastic wrappers) are stuffed into the nylon pouch in front



Fig.3.29

4) Passenger has to remove the wallet to pay the pantry server

Passengers sitting on the aisle find this easier - middle passengers find it hard to manoeuvre in this process



5) Tray is too small and vibrates too much – hot drinks spill which can cause accidents and be messy



6) The metal tray gives the factor of cold touch in the AC Compartment



7) The pantry server carries a tea-keg which drips and is difficult to handle



Fig.3.33

- 1) Need to support legs at higher position



Fig.3.34

- 2) Acquires different postures for comfortable sleep

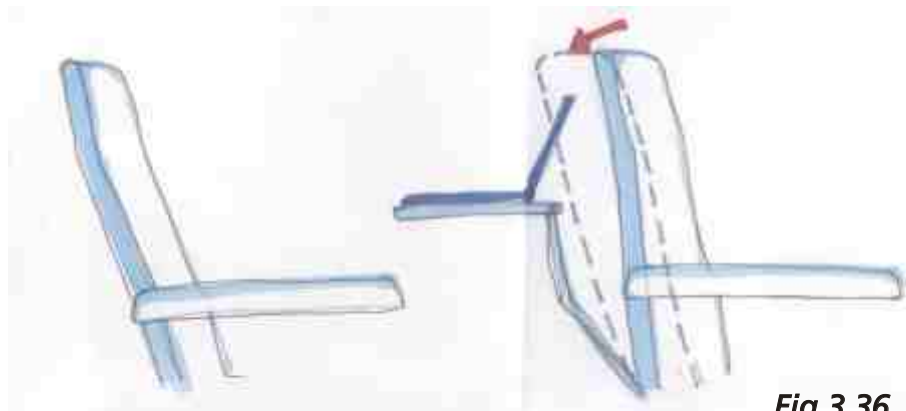


Fig.3.36

- 3) Change in Backrest position is a hindrance to user sitting behind

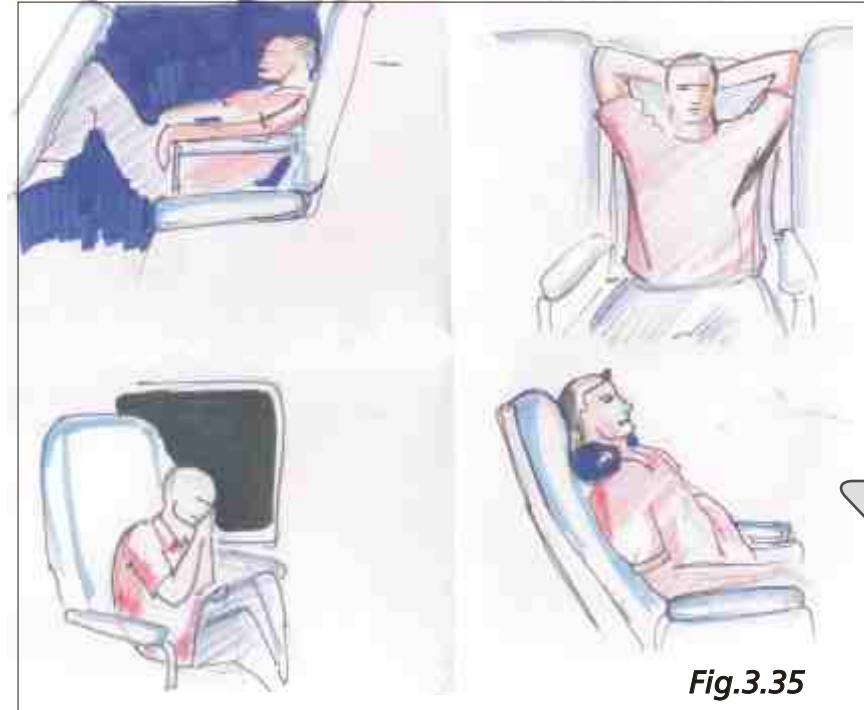


Fig.3.35

- 4) Seeks for head support in different ways
- Using a towel near the neck
 - Supports head on hands after reclining the seat
 - Folds hands and tilts to the side for supporting head
 - Slides down to get full back support and rests head on backrest



Fig.3.37



Fig.3.38



Fig.3.39

- 1) People tend to groom themselves before leaving
- 2) Space in the aisle is inadequate
- 3) Passengers look around to see if they have left any of their personal belongings behind
- 4) Difficulty with exiting through the door with luggage

3.8 SECONDARY RESEARCH

The design team had reviewed published articles, papers and other pertinent documents to develop an informed point of view on the design issue of 'sitting in the direction opposite to that of travel'.

3.8.1 MOTION SICKNESS CAUSES & STIMULI

"Results indicate that horizontal linear acceleration in a car, such as experienced during multiple braking maneuvers, is an effective motion sickness provoking stimulus. **Negative X-axis stimulation is more nauseogenic.**"

- *Article on Dependence of motion sickness in automobiles on the direction of linear acceleration* - [Springer Link](#)

~~"The cause of motion sickness is generally considered to be a mismatch of vestibular and visual sensations. However, actual movement of the body is not necessary to produce symptoms. Purely visual stimuli, such as those from flight simulators, panoramic movies, or even the movement of slides under a microscope, can produce symptoms more effectively than does actual physical motion. The degree of motion sickness appears to be directly related to how well the visual stimulus simulates motion."~~

- *Post-graduate Medicine Online*

3.8.2 ADVANTAGE

This was a useful way to ground observations and to develop a point of view on the product in study - suggesting a scope for flip-type seats in design

3.9 ANALYSIS OF USER STUDY



Clustering the design elements according to intuitive relationships such as Similarity, Dependence, Proximity, etc.

3.9.1 METHOD

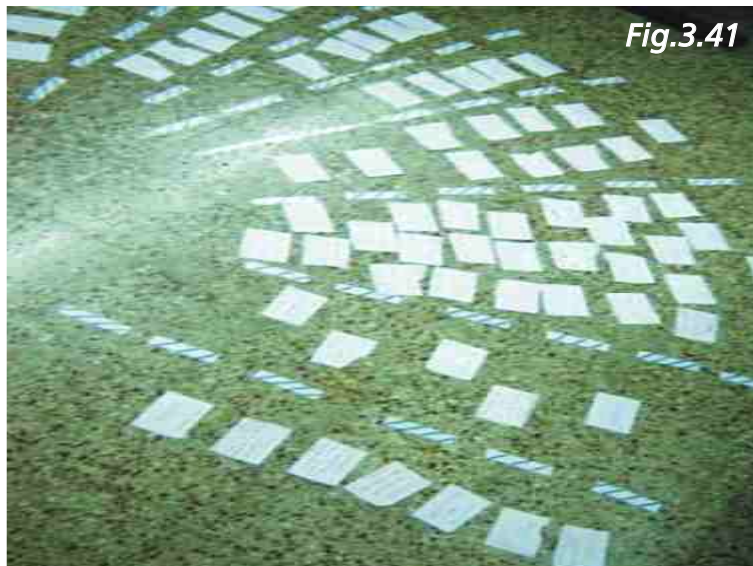
Rapidly group ideas that seem to belong together .

Clarify any ideas in question.

Copy an idea into more than one affinity set if appropriate.

Look for small sets. Should they belong in a larger group?

When most of the ideas have been sorted, you can start to enter titles for each affinity set



Hierarchy of issues to be addressed in design concerns

3.9.2 ADVANTAGE

This method was useful to identify connections between issues and reveal INNOVATION OPPORTUNITIES

3.9.3.1 INGRESS

OBSERVATION	INSIGHT	DESIGN IDEA
Movement of luggage in and out of the inner door is very inconvenient	- Width of the door is too small - No space for a hinged door at the end of the aisle	- Door should be sliding - Door could have sensors at entry
Opening the door with luggage in hand is tough	- Poor detailing in door hinge design - Delayed shutting of door creates a problem for AC environment	Designed for ergonomic considerations for easy opening
Difficulty of loading luggage onto train	- Platform heights vary from station to station - Bogey floor height is too high from the platform	- Platforms could be built up to uniform height all over India - Sloping ramps could ease in the luggage into bogey
Entry area is not clean with the stench of the lavatories	- Close proximity of lavatories to the entry area is not a good solution - Cleaning facilities for maintenance of toilets is absent in the current coaches	- More hygienic facilities provided in toilets and wash areas - Entry could be provided from the middle of the coach just like in the EMU Mumbai local trains

SUMMARY:

Owing to the fact that the inner compartment has to be air-conditioned, the entry doors will have to avoid leakage of cold air to the external area. Hence, the system should allow for passengers to move in easily with luggage in hand and yet provide a full-proof solution for maintaining the air-conditioned environment within the internal compartment.

3. USER STUDY AND ANALYSIS

3.9.3.2 LOADING LUGGAGE

OBSERVATION	INSIGHT	DESIGN IDEA
Luggage on top rack is inaccessible	Height of most of the Indian users is not considered in existing design	- Rack could be lowered for access - Floor could be stepped up from aisle level
Passengers prefer to keep luggage close to them, even hand luggage is kept close to the body	- Security of luggage is of utmost importance - Passengers prefer luggage visibility while seated during the journey hours for assurance	- Cubby holes can be provided for personal luggage storage - Luggage could be stored at floor level for better visibility & access
Fights for luggage space occur between passengers, specially those traveling on longer journeys	- No demarcations are provided for individual luggage storage per passenger - Bigger luggage cannot be stowed away for longer journey hours	- Individual allotment for luggage storage like in airplanes - Big suitcases could be stowed away under the attendant's supervision at the entry areas.
Barely any luggage fits under the seat; small luggage is placed in front of the seat	- People hesitate to store bags under the seat owing to unhygienic conditions - Clearances below the seat are cut by the support structure of the seating onto the floor	- More hygienic storage spaces could be provided on the floor level - Seats could be suspended from above support structure to allow for luggage to be stored under the seat
The top rack is too small for most suitcases, worry of falling down during journey	- For lack of hygiene on the floor surface, passengers insist on storing all their big luggage on the top rack - Top rack depth is not efficient for storage capacity of luggage.	- Even 4" increase in rack depth could make storage safer & efficient - Overhead enclosed luggage cabins could be provided for safer storage

SUMMARY:

Users need to keep luggage visibly close to them for assurance of security and at the same time, the bags should be easily accessible, sometimes even during the time of the journey. Secure storage solutions are a must to avoid accidents

3. USER STUDY AND ANALYSIS

3.9.3.3 SEATING

OBSERVATION	INSIGHT	DESIGN IDEA
Lack of freedom for middle passengers	When the tray is down, the middle passengers have restricted movement	- Tray should be detachable - Tray could pivot around to allow passenger sitting on the inside to exit
Hates sharing armrests - too small for two users	- Passengers demand for privacy in their individual comfort zones - Unforeseen areas of comfort zones overlapping	- Split level armrests should be provided - Inverse seating could be introduced for middle passengers
Water Bottle stored in front pouch hits the knee	- Risk of hurting oneself in times of sudden impacts with bottle hitting the knee - Bottle storage should be accessible and yet placed in a safe proximity to the body	- Bottles could be stored horizontally on sides of passengers - Depth of Back rest could accommodate for depth of bottle storage
Headrest cover is a good solution	- People with oily hair leave stains on the cloth covers - Maintenance personnel do not replace the head covers too often	- use and throw suggestion for head covers - Use of plastic covers that can be wiped easily
All mechanisms used in the interiors should perform consistently	- Hinges wear out over time and excess use - Locks do not hold trays in place, reclining seats stop working, armrests get jammed	- Durable and simple hinges can avoid problems - Easily replaceable hinges can suffice for smooth & better functioning

SUMMARY:

Chairs are where the passenger spends most of the travel time and should be comfortable enough to accommodate a multitude of postures like sitting, squatting, sleeping, eating, etc. The mechanisms used for reclining features and amenities should work consistently, because the repair cycle time of the Railways is slow. Privacy is a main issue to be addressed in the seating elements - for sharing armrests and using amenities

3. USER STUDY AND ANALYSIS

3.9.3.4 EATING

OBSERVATION	INSIGHT	DESIGN IDEA
No proper cup holder in the tray	No opening or depression in tray to hold cup firmly during journey	- Tray has hole to fit in cups of all sizes - Cup holder not attached to tray - independent fixture
Tray vibrates so much; hot drinks spill	- Hinges of tray are weak - Serious accidents could occur if child is seated on mother's lap when hot drinks spill	- Hinges should be sturdy - Tray could stop spillage by use of smaller depressions around the cup area to hold spilled drink
Tray obstructs movement while in use for both passenger and co-passenger	- Need to exit out of coupe for visit to lavatory - Tray is fixed in position, once unlocked and brought down	- Detachable tray design - Pivoted tray for easy movement into aisle without disturbance
More space required on tray for thermos flask, food tray and cutlery	- Too much food is provided on these routes - All food is served together in one time	- Food service could be broken up into two or three sessions - Tray size could increase by an inch on either side for better placing.

SUMMARY:

The design of the tray should accommodate for larger trays and cater to a variety of functions apart from eating. With the amount of vibration from the movement of the train, the vibration of the tray should be dampened in the new design to avoid serious accidents of spilling of hot drinks. The tray should also be designed to take sudden impacts from accidents or emergency situations.

3. USER STUDY AND ANALYSIS

3.9.3.5 SLEEPING

OBSERVATION

Footrest is not always accessible - needs to be higher

INSIGHT

Indian anthropometric data is not considered in the existing design

DESIGN IDEA

-Adjustable footrest to suit user's height
- Provision of slumberitt to eliminate foot rest completely

Uncomfortable to sleep with the tube lights on

- Ambient lighting levels are too high
- No cover for the eyes while sleeping

- Ambient lighting could be diffused
- Task lighting is to be provided for reading purposes which can be individually controlled

SUMMARY:

For sleeping, the head and neck support are crucial, since passengers spend most of the travel time relaxing and sleeping. The passengers tends to draw his legs close to the body while sleeping and adequate footrest support should be provided. Lighting should not interfere with the sleeping activity.

3. USER STUDY AND ANALYSIS

3.9.3.6 HVAC & VENTILATION

OBSERVATION

Temperature variations within the coach - not evenly distributed

INSIGHT

- Cold Air is fed into the bogey from the two extreme ends
- Air outlets are placed in close proximity to the RMPU's and are not circulating air within interior

DESIGN IDEA

- Centralised HVAC system can be introduced with air outlets all along the aisle length of the bogey

Cooling controls are not individually operated

- Overall temperature cannot be controlled
- Air draft in vents can be channelised and controlled individually

- Provide individual air-blowing jets for every passenger
- Air outlets can then be controlled individually to set the airflow.

SUMMARY:

The air-conditioning provided should be uniformly distributed along the entire length of the compartment. The temperature cannot be controlled individually, however, personal controls for air-draft pressure should be provided. Heaters could be provided for use during cold seasons in colder places.

3. USER STUDY AND ANALYSIS

3.9.3.7 LIGHTING

OBSERVATION	INSIGHT	DESIGN IDEA
Task lighting is required	Ambient lighting too bright for sleeping and yet too dim for reading purposes	- Task lights should be provided for every user - Ambient lights can be diffused
Film on windows is required for privacy	- Cuts down dependence on natural lighting - intensity of light filtering in keeps changing; can be a disturbance for reading purposes	- natural light can be filtered in to provide ambient light through other openings - Use polychromatic filters on windows
Some seats do not have access to windows	- Seats are not placed on basis of window positions - Modularity in design of side panels for windows and user amenities is not addressed	- Continuous strip of day-light openings - Modular design introduced in side panels for regularized seat layout
Power consumption is too much for lighting	- Lights are not replaced soon as they stop working - No concern of conserving energy with the Indian Railways, all CFL lamps are employed	- LED lamps can be used for lamps - more long lasting and energy consuming - LED lamps will have to be replaced less frequently

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SUMMARY:

Ambient lighting and task lighting should be handled differently in the compartment. The ambient lighting levels should be diffused and should not interfere with the sleeping activity. At the same time, individual task lighting should cater to more intense functions of reading, working, etc. Energy conservation is a key issue to be addressed, considering the fact that the lights are lit all through the journey time.

3. USER STUDY AND ANALYSIS

3.9.3.8 USER AMENITIES

OBSERVATION	INSIGHT	DESIGN IDEA
No proper provision for waste disposal	Waste is thrown into the nylon wire pouch in the front	- Waste disposal systems could be incorporated under each seat with disposable bags
No place for storing mobile phones while charging	- Charging sockets are only at either end of the bogey - Most passengers are unaware of the provision of charging facility	- Mobile charging sockets could be repeated in the side panels for every passenger - Signs must indicate charging facility
No PA systems informing about station arrival or stoppage time	- Passengers are anxious to know about the details before approaching the destination - Sometimes, the systems are installed but do not function regularly	- PA systems could provide information regarding - Stoppage time in next station - Train speed - Warning not to leave luggage - Time to arrive at next station
Seat number indication is very poor	- Stickers are very often replaced by passengers - Too many signs in different places can confuse the passenger (both on the side panel and on the seat front face)	- More legible system for seat signs is required - Digital display of seat numbers so that it can be changed depending on capacity of train compartment.
No provision for storing small items like wallet and walkman	- Personal luggage storage is required with security - People prefer to keep the wallet to the side especially before sleeping	- Cubby holes with secure openings can be provided on the side

SUMMARY:

Integration of all amenities into common units which can be individually controlled for maximum comfort and ease of use. The amenities provided should be intuitively used and should not create confusions. The amenities could also provide for changes with advancements in technology.

3. USER STUDY AND ANALYSIS

3.9.3.9 EMOTIONAL / PSYCHOLOGICAL ASPECTS

OBSERVATION	INSIGHT	DESIGN IDEA
Factor of cold touch in most elements used	Too much use of metal in design of elements creates problem of cold touch	- Need to introduce plastic in design - Self colored plastics are easy to maintain and break visual monotony
Passengers are unaware of amenities provided or just don't know how to use them	- Visual positioning of user amenities is lacking - Passengers may feel hesitant to use unknown or alien features in a new surrounding.	- Design of amenities should be intuitive - user amenities should be visually coded to identify position and use
When person in front reclines, the passenger sitting behind feels uncomfortable	- No indication or warning of reclining position - Passengers using laptops on the tray for work are at risk of damage to equipment	- Glowing signs to indicate slow change in reclining angle - Tray could move back with the seat to avoid damage to laptops
Unhygienic conditions - floor is dirty , curtains stink	- Indian Railways invests little time in maintaining the coaches - Minimal maintenance design is invited by both the Railways and the end user	- Plastic is ideal for easy maintenance and serviceability - Lesser the number of surfaces to be cleaned, the better the travel experience
Noise level from trains to be reduced	- Silence /minimal noise is required during sleep hours on train and is constantly disrupted by external / ambient noises - Too much vibration from use of metal parts creates lot of noise inside compartment	- Use of plastic parts and dampeners to reduce vibrations - Acoustic materials on cladding of interior elements can cut down the noise levels

SUMMARY:

The passenger, being the end user, should be given utmost importance in addressing the design issues, be it hygiene or noise levels or even psychological comfort. Most of the current design caters to the Railways priorities of easy maintenance, but does not address the user's requirements. Care should be taken to create a balance between the two factors.

4. INDUSTRY FEEDBACK

Meetings were held with the design team at GE Plastics in Gurgaon to discuss the user study and design concerns that would be taken up for study basis during conceptualization.

The design team helped in redefining the product brief in accordance with understanding the process of design employed by the Indian Railways. Further light was shed on design for ease of manufacture and durability in design by Mr. Ritesh Gohil at Harita Seating, Bangalore.

4.1 GE PLASTICS, GURGAON - MR. ANAND HINGNE & DESIGN TEAM FEEDBACK

HIERARCHY OF PARTIES INVOLVED IN THE DESIGN PROJECT

RAW MATERIAL SUPPLIERS



TIER 1 AGENCIES



OEM's



END USERS

With the Application Development activity, GE Plastics was already involved with the Indian Railways and are well acquainted with the aspects of implementation revolving around cost angle. The Indian Railways however, does not have ideas of costing and tendering with the notion of tooling and component cost



Fig.4.1



Bench- marking different transport systems - Aircraft and Metro interiors

4. INDUSTRY FEEDBACK

4.1 GE PLASTICS



*Bench- marking
foreign train systems*



Fig.4.2

2) The data collection should entail benchmarking other modes of travel on parallel lines like

- Aircraft interiors - Boeing aircraft interiors, Airbus interiors
- Luxury bus coaches interiors - Volvo luxury buses, large fleet services operation from Mumbai to Pune
- International Rail systems (TGV designs employed by the SNCF, German metro services in Bonn and Dusseldorf)

The design team must look into more areas of Chair car routes to study the imported LHB railway coaches that are already being employed by the Indian railways

3) The major pain areas of the Indian Railways are:

- Seating elements have to be redesigned - Harita seating and Surat seating are already involved in analyzing the major faults with the existing design, and developing an ideal solution to suit the Indian user's needs.
- Luggage storage solutions are a dire need in the space - Another major pain area , causing so many accidents every year , which could be addressed separately, working with the various OEM' s involved in this area
- Wall paneling in the interior compartment catering to daylight-openings and user amenities integrated within the panel, including lighting solutions and holders, hooks, etc. The design could be independently handled in association with Leers Ltd, Pune, for further development

4.2 HARITA SEATING



Fig.4.3

*Bus seat designs developed by Harita Seatings - providing the SLUMBERITT eliminates the need for a footrest for long distance journeys
A typical seat design incorporated in the luxury Volvo bus designs with the slumberitts*

4.2 HARITA SEATING, BANGALORE - MR. RITESH SHIL

- 1) Ease of manufacture for plastic productions and detailing - structural PP (injection molding) was suggested for use in elements owing to the existing huge dependence of the automotive industry on this production process
- 2) Safety issues in case of Fire, Derailing and other Emergency situations
- 3) Durability and Design for Vandalism, owing to the context of use
- 4) Ease of replaceability and repair - on the spot replaceability as well as yard servicing, understanding the attitude towards assembly scheme and fixing.
- 5) Joinery and details ideal for Indian conditions - sliding details do not last as long as the pivoted joints over extreme use and load.
- 6) The use of a "slumberitt", can actually avoid the need for a footrest in the seating element. The slumberitt has been used successfully in the new design for most of the luxury Volvo buses And can be very comfortable especially for long journey hours.

5. IDEA GENERATION

5.1 IDEATION

The process of idea generation was ongoing throughout the data collection phase. Free ideation was done based on the observation, idea sketches were made focusing on specific issues. The intention was to come up with new ideas as and when a problem was identified during the data collection.

5.2 CONCEPT SKETCHING

From this stage on, concepts were developed taking into consideration the basic dimensions of the elements coming into the defined shell structure. Taking cues from existing aircraft interiors and metro rail systems of other countries, (Shiengkansen -Japan, Underground Tube - London and TGV - SNCF -France), concept ideas were generated for individual elements that existed in the user amenities zone. Clusters of ideas were generated based on user's needs and requirements of the Indian Railways

5.3 TARGETED AREAS

Creating sense of privacy for personal spaces
Maximizing the use of space for user amenities

Luggage Storage solutions (heavy & personal luggage)
Natural & Artificial Lighting Solutions

User Amenities (Bottle & Cup holder , Food tray, Mobile charging sockets, magazine rack, lighting controls)

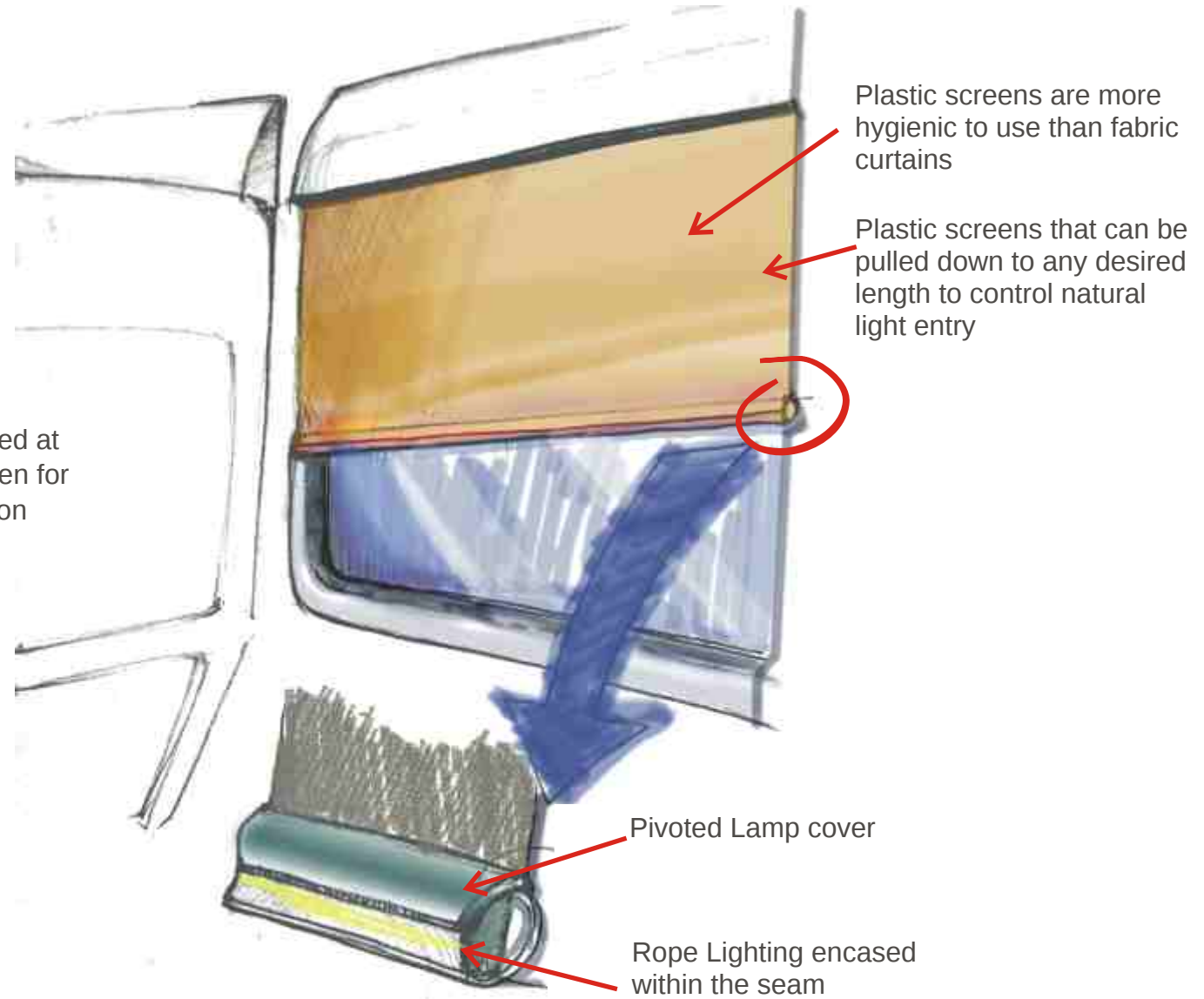
Layouts within the coach - breaking away from existing layout
Using coaches manufactured by the RCF (Kapurtala) or ICF (PERAMBUR) , registered by the Indian Railways only .

5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 1

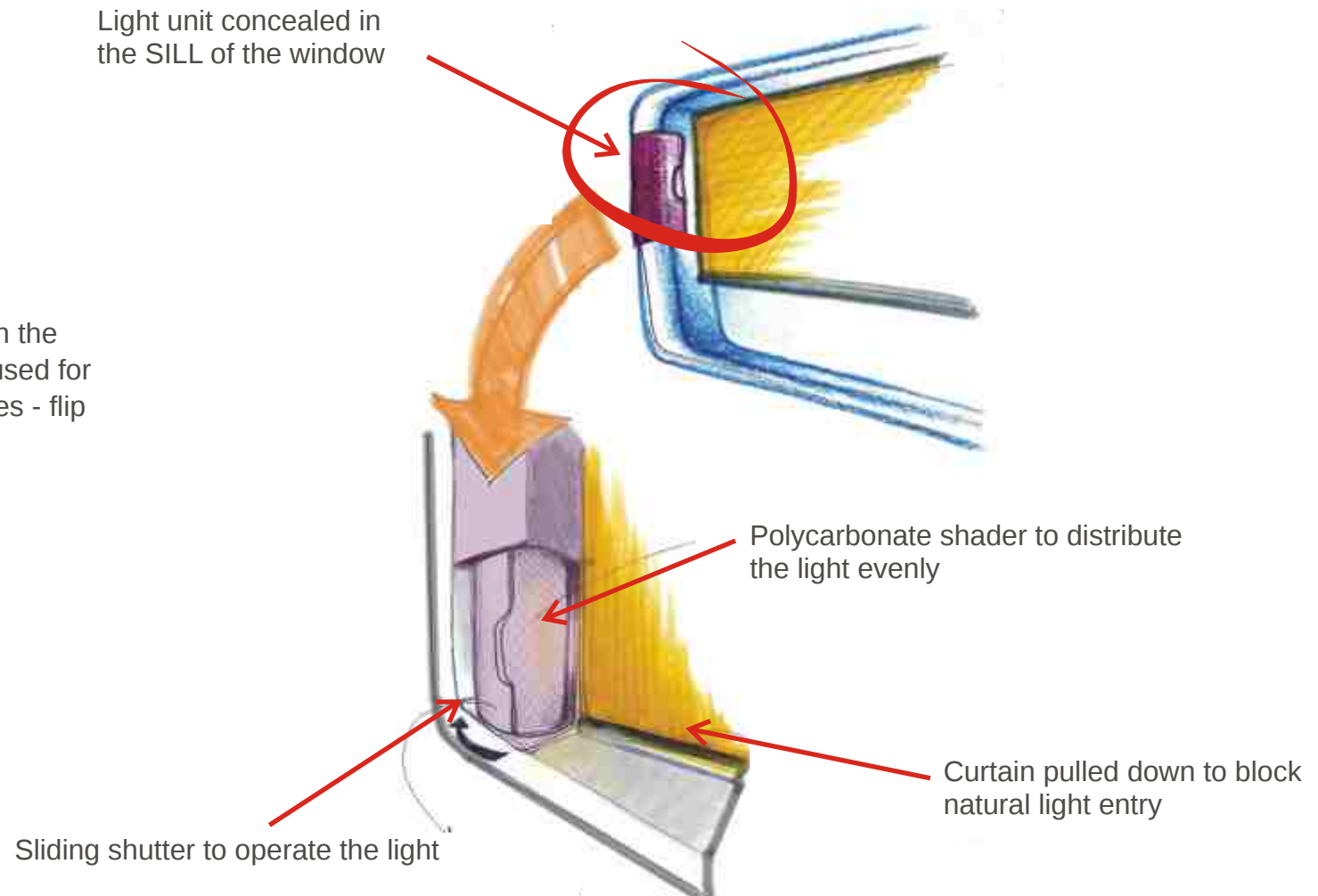
Twist to operate rope lights placed at the end seam of the plastic screen for windows - Task lighting solution



IDEA LOG 2

Light unit concealed in the SILL of the window

Task lighting placed within the window frame - LED lamp used for energy conserving purposes - flip

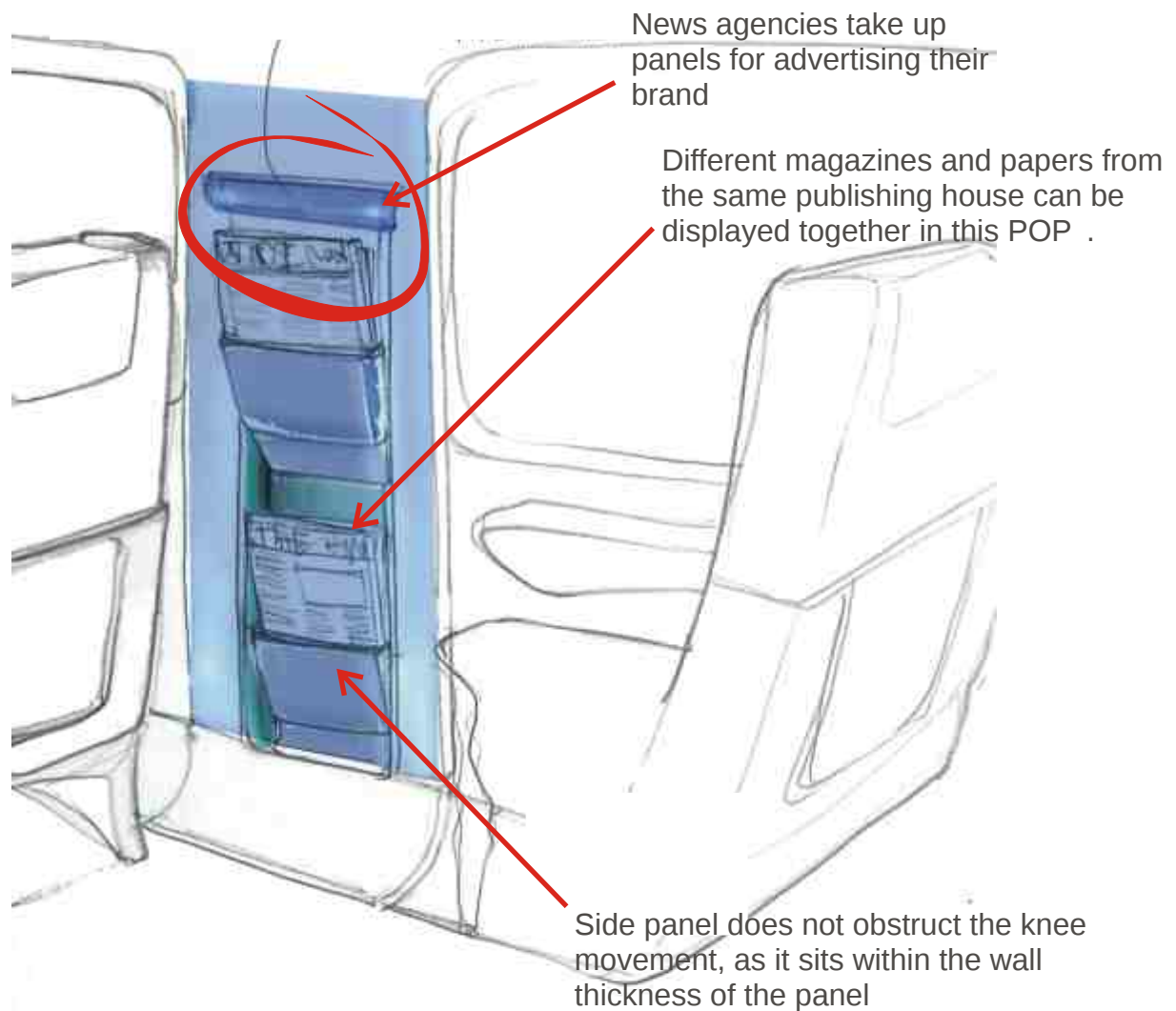


5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 3

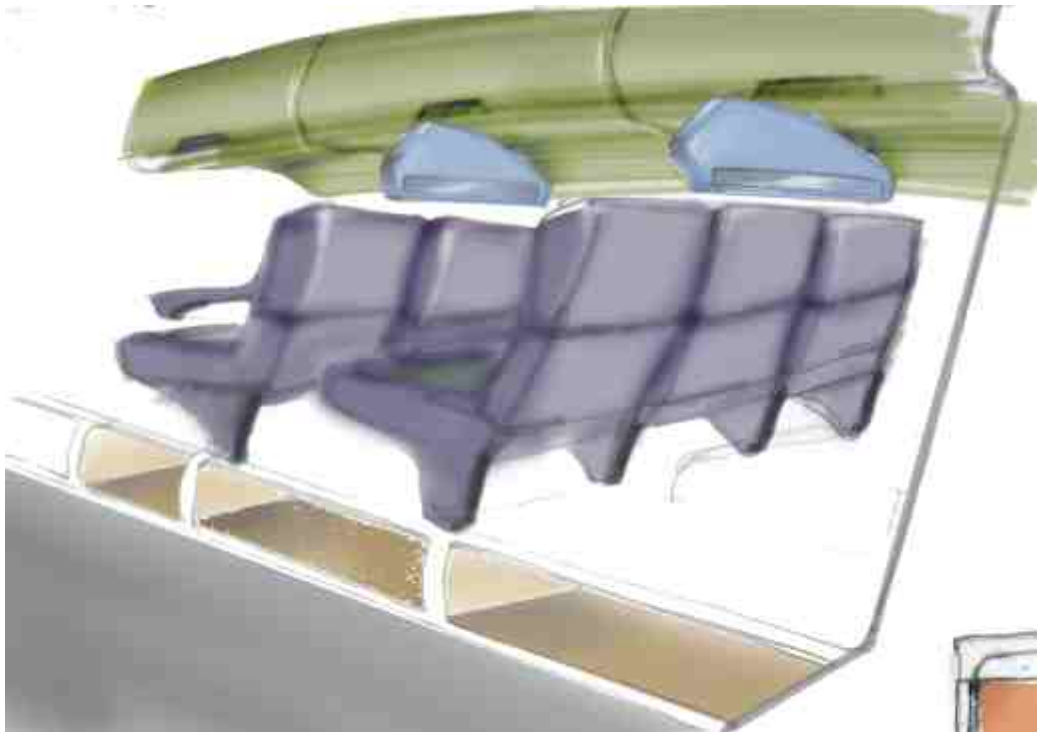
Side panels are employed for Newspaper branding - reputed news agencies can put up their rack to serve as magazine holders as well



5. IDEA GENERATION

5.4 IDEA LOG

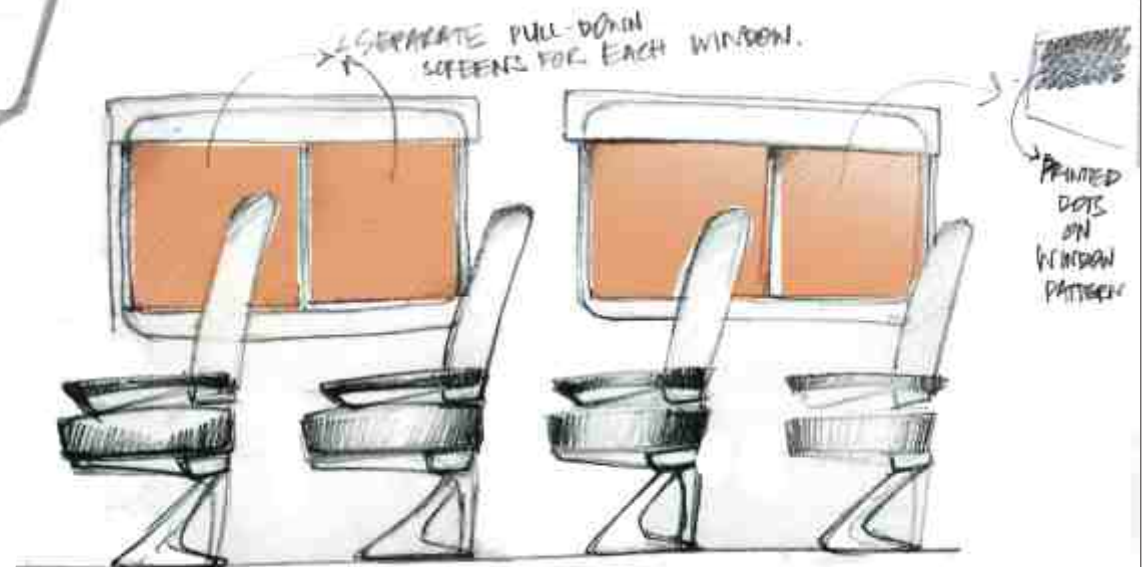
IDEA LOG 4



Roof mounted PA systems to inform about the train timings and arriving stations; overhead luggage storage as inspired from the aircraft interiors

IDEA LOG 5

Individual window screens for the existing layout where most windows are shared by two passengers - so individual access to light filtering in is provided



5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 6

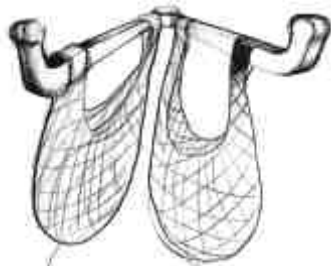


Rack tilts down allowing luggage to slip till RIDGE



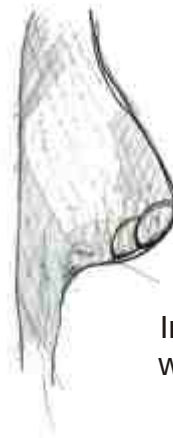
Delayed release load bay using dampeners

IDEA LOG 8



Luggage storage solutions to avoid slipping down into the aisle area; Nylon wire sacks provided below hooks to avoid bags tearing and falling down; Kinks in the end section to create a stopper for luggage slipping down from overhead rack.

IDEA LOG 7



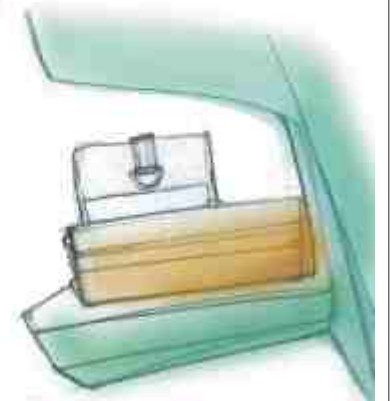
Inspired from the Weaver bird's nest, which does not allow the eggs to fall out, luggage can safely be stored



IDEA LOG 9



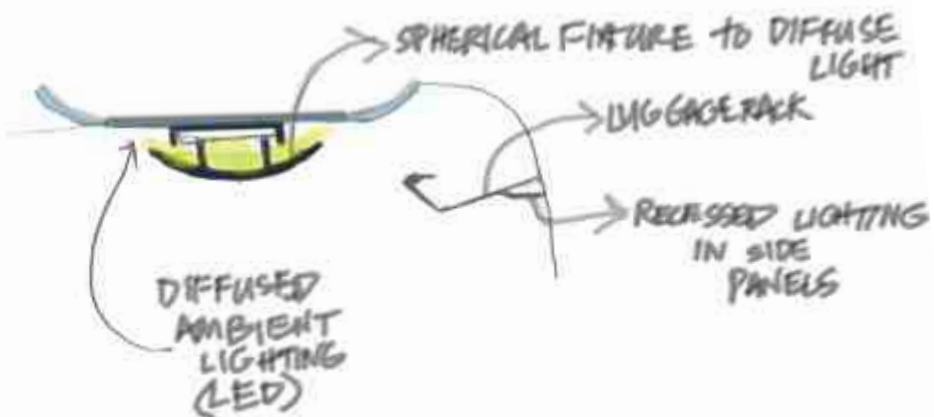
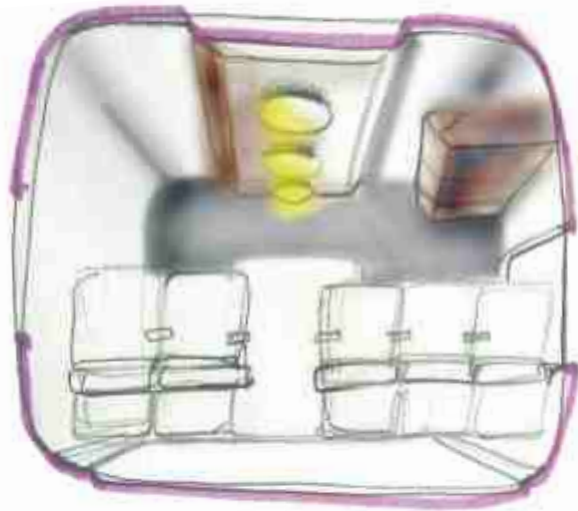
INDIVIDUAL RACK UNITS FOR STORING LUGGAGE



5. IDEA GENERATION

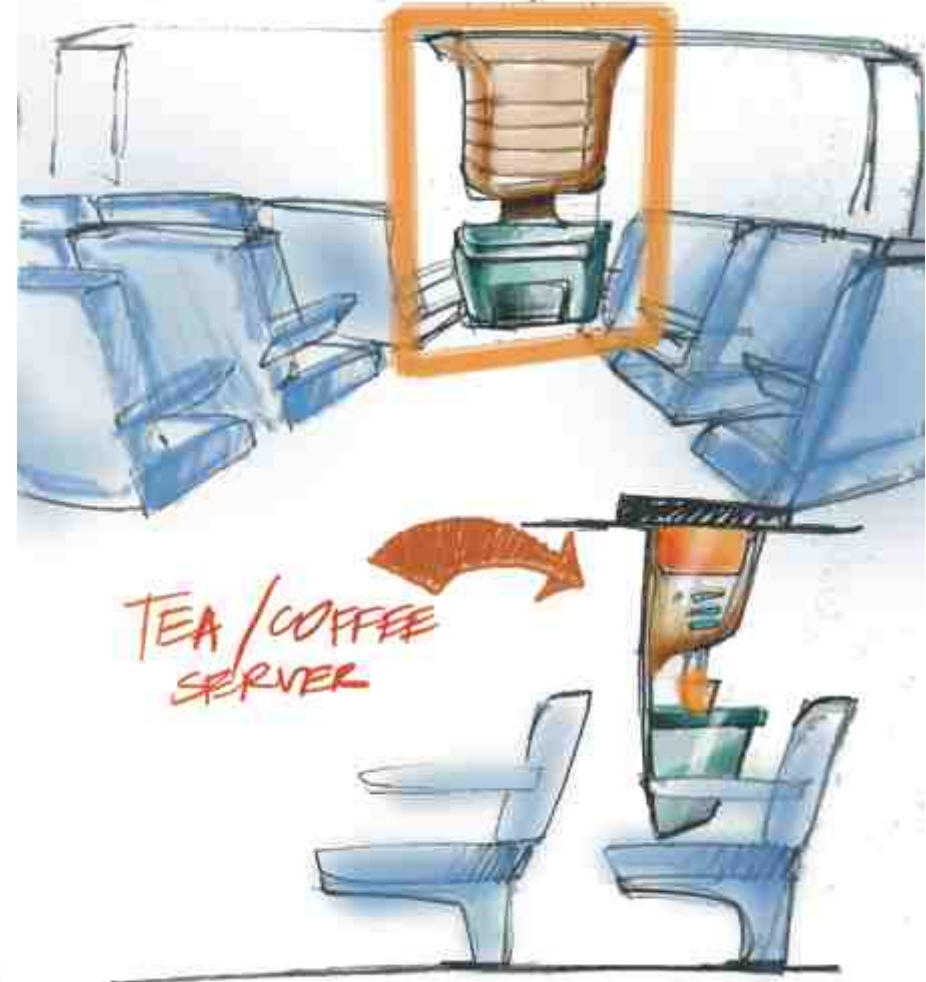
5.4 IDEA LOG

IDEA LOG 10



Ambient lighting solutions - LED lamps placed along the central aisle in spherical fixtures to provide diffused light quality

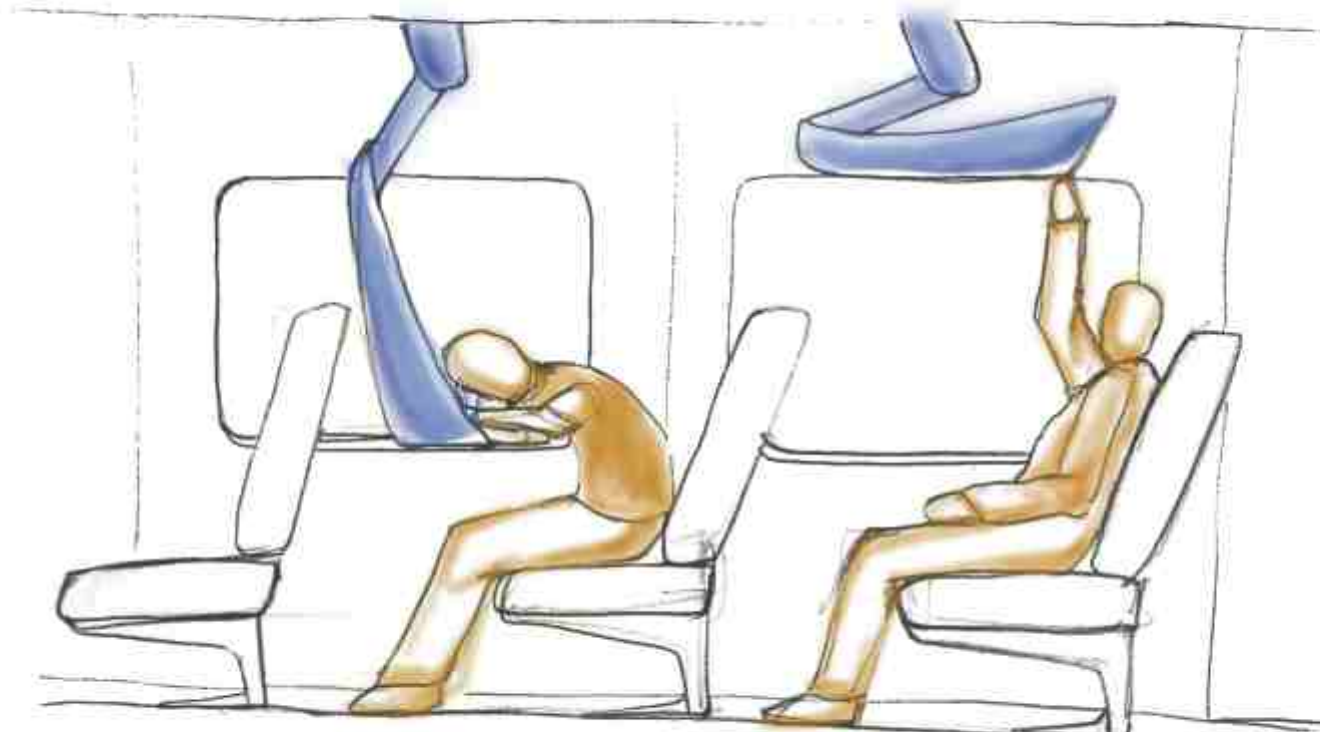
IDEA LOG 11



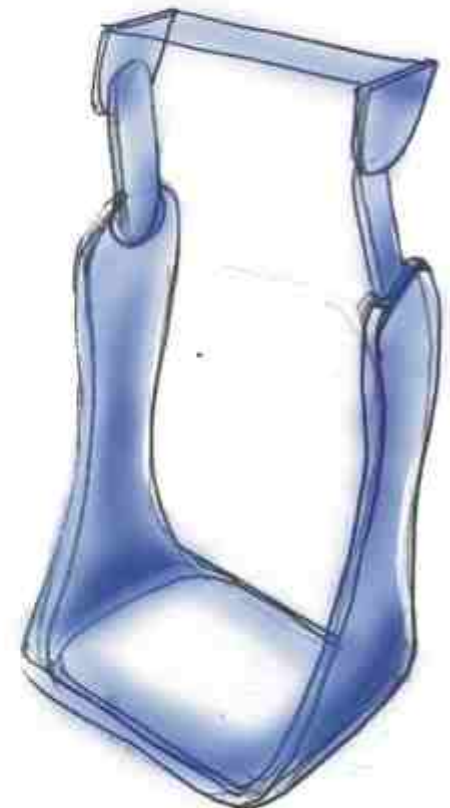
Hot drink service by robotic machine that marches up and down the aisle as and when required - eliminated the mess created by the pantry servers in the compartment

IDEA LOG 12

SLEEPING CONSOLES



Creates a private niche for every passenger

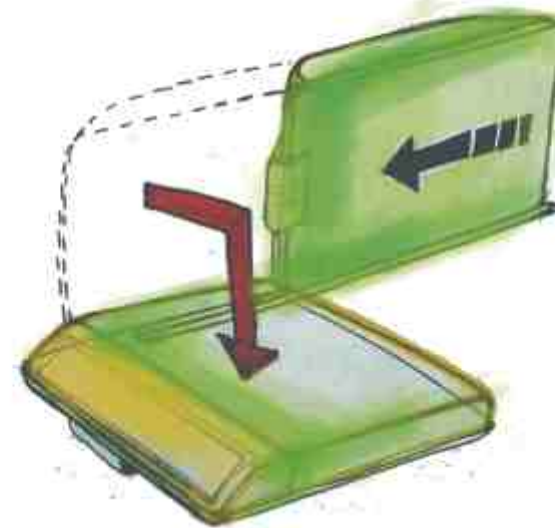
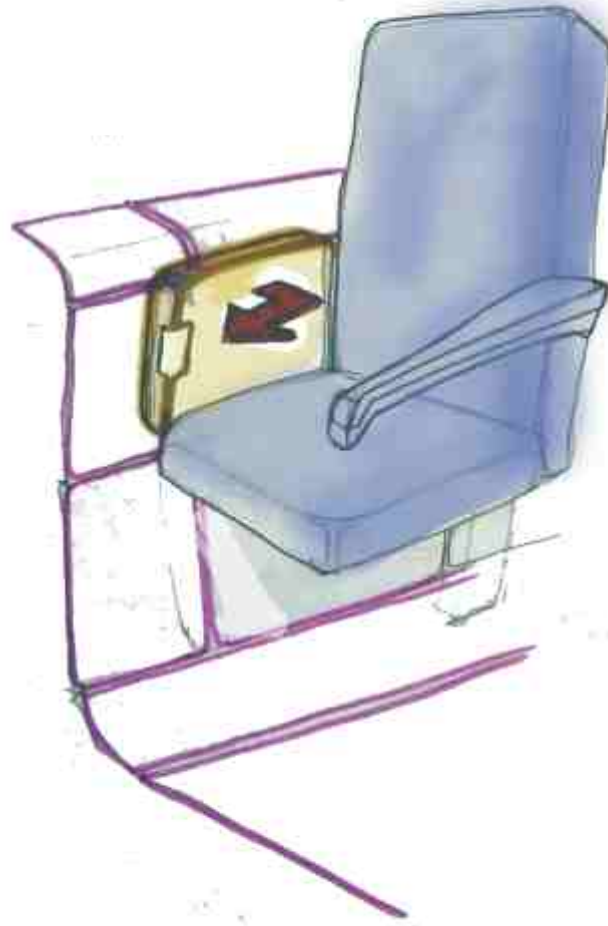


Providing a separate niche for privacy when sleeping - CONSOLES can be folded down from the roof and used with access to amenities like music, lighting for reading purposes, etc.

"private niche"

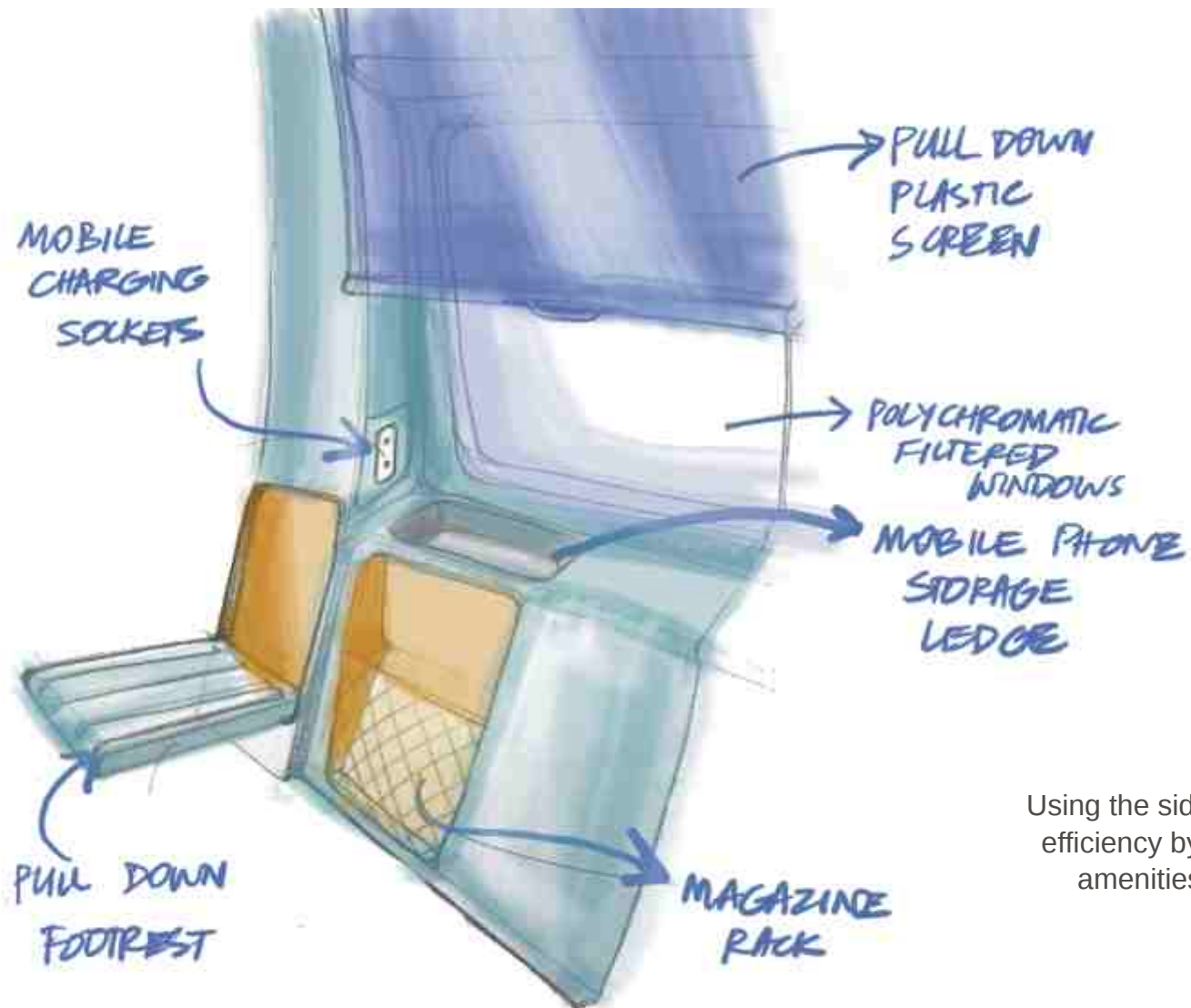
up into ceiling

IDEA LOG 13



Side panels from the wall fold down to form the footrest and is very viable for passengers who choose to adapt to Indian postures of squatting for extra comfort

IDEA LOG 14



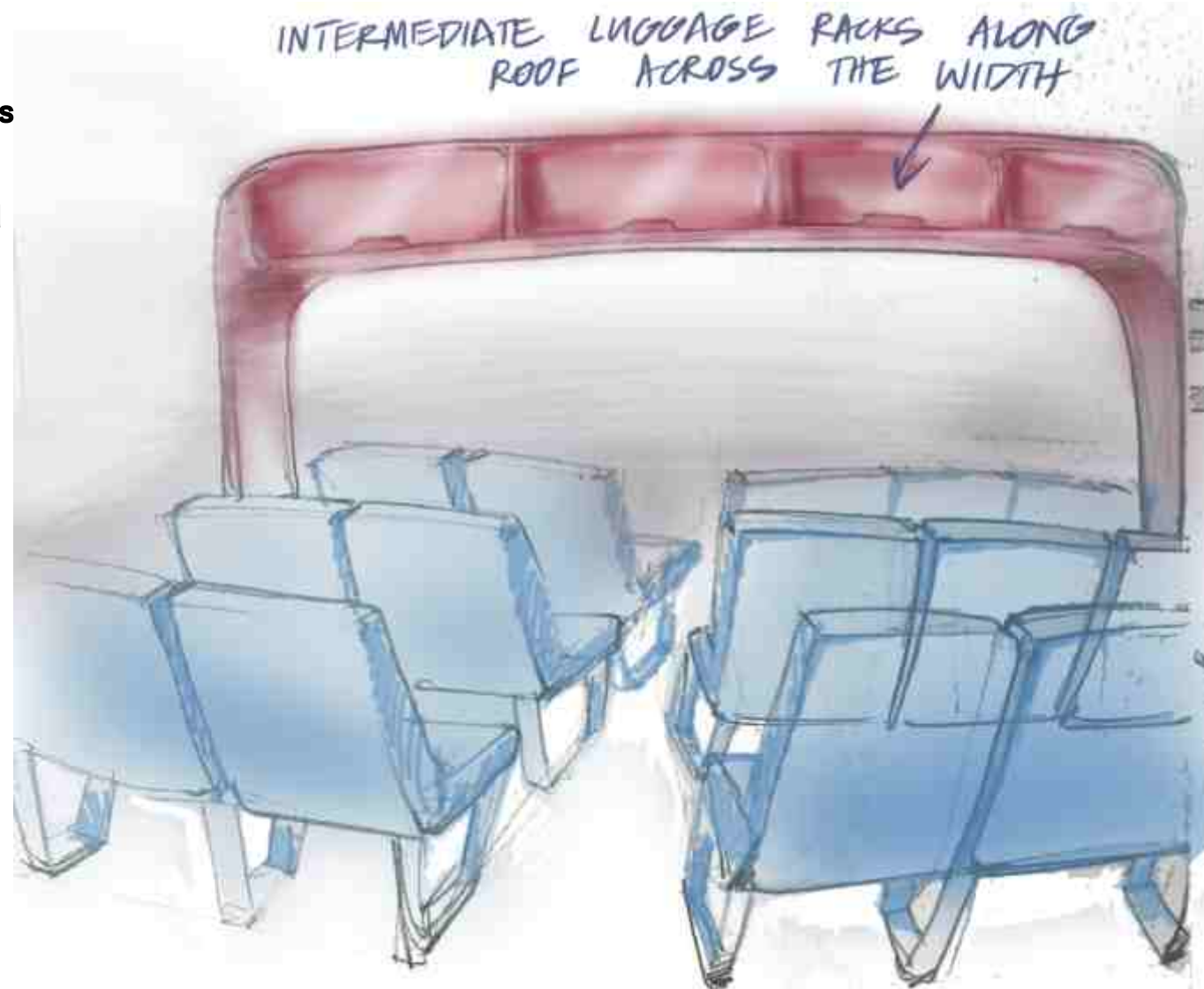
Using the side panel for maximum efficiency by integrating all user amenities within the panel

5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 15

**Intermediate luggage storage across the width of the compartment on the roof -
Provides extra storage space and breaks the monotony of the visual clutter**



advantages:-

5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 16

Armrest with user controls and speakers are integrated into the side panel moulding



5. IDEA GENERATION

5.4 IDEA LOG

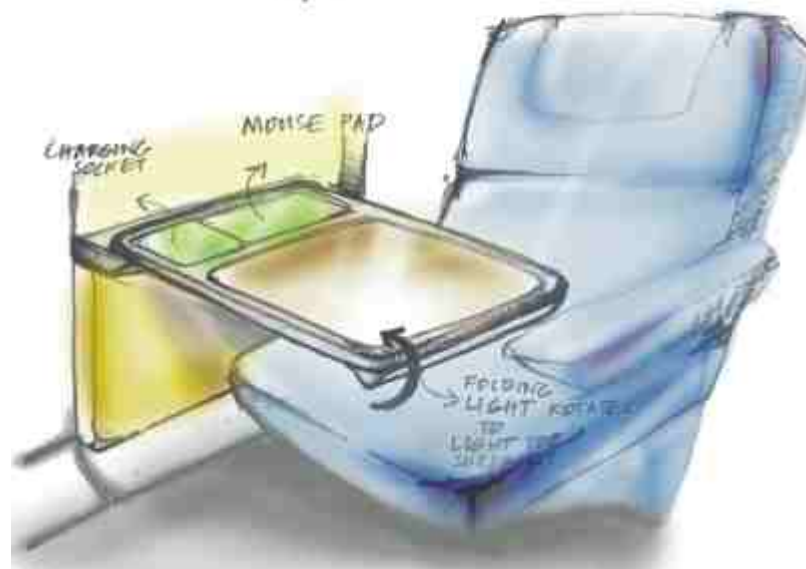
IDEA LOG 17

WORK PLATFORM FOR TRAVELLING BUSINESSMEN:

Indian Railways
creates a separate "CLASS"
or
charges a slightly higher FARE for
"WINDOW SEATS"

ADDED COMFORTS:-

15" X 12" WORK SURFACE divided into separate
areas



Working surface where laptop and mobile
phone can be plugged in for charging;

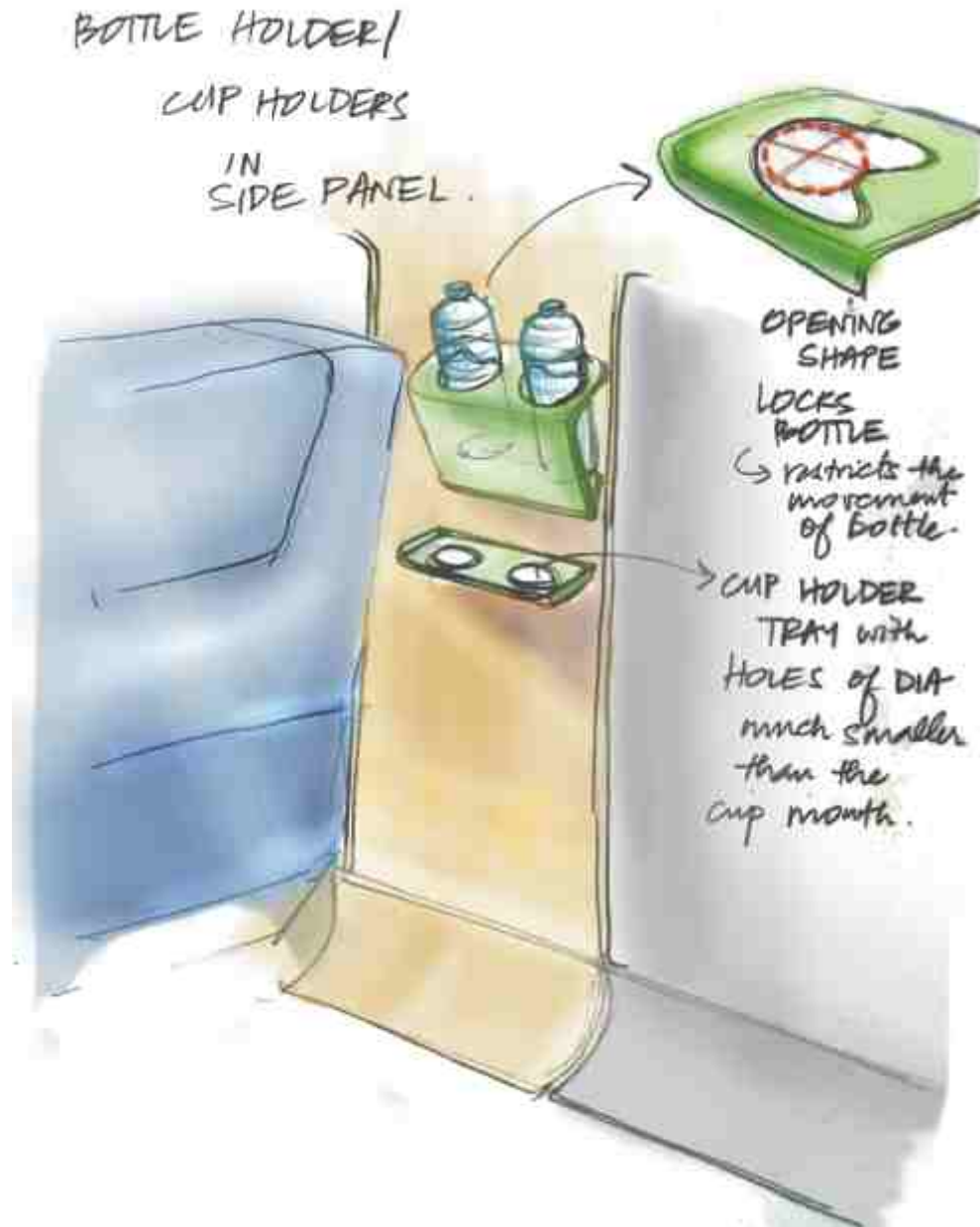
Surface level task lighting is also provided
for;

The tray is folded down into the side panel

5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 18



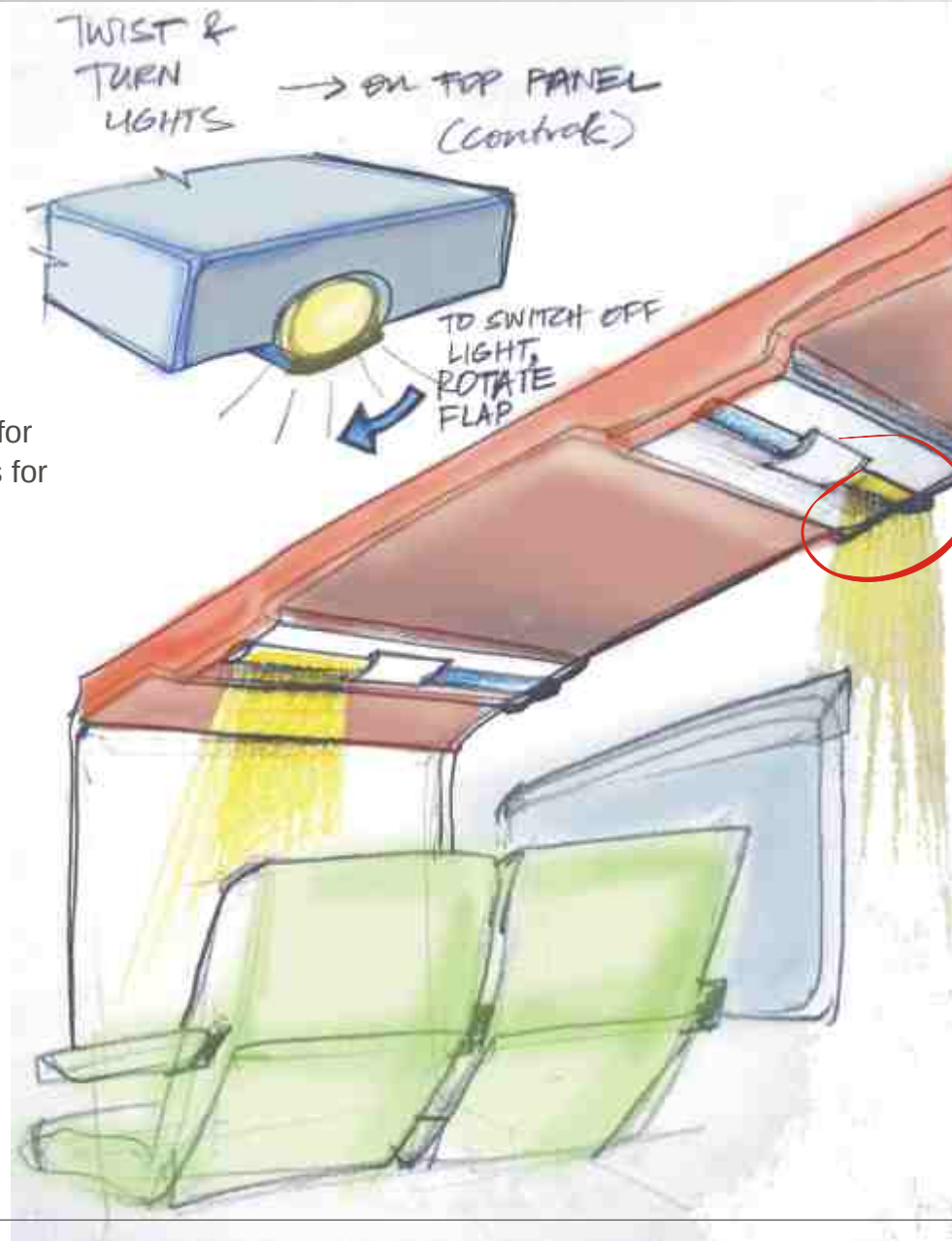
Side panels holds the bottle holder and cup holder for easy access;

5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 19

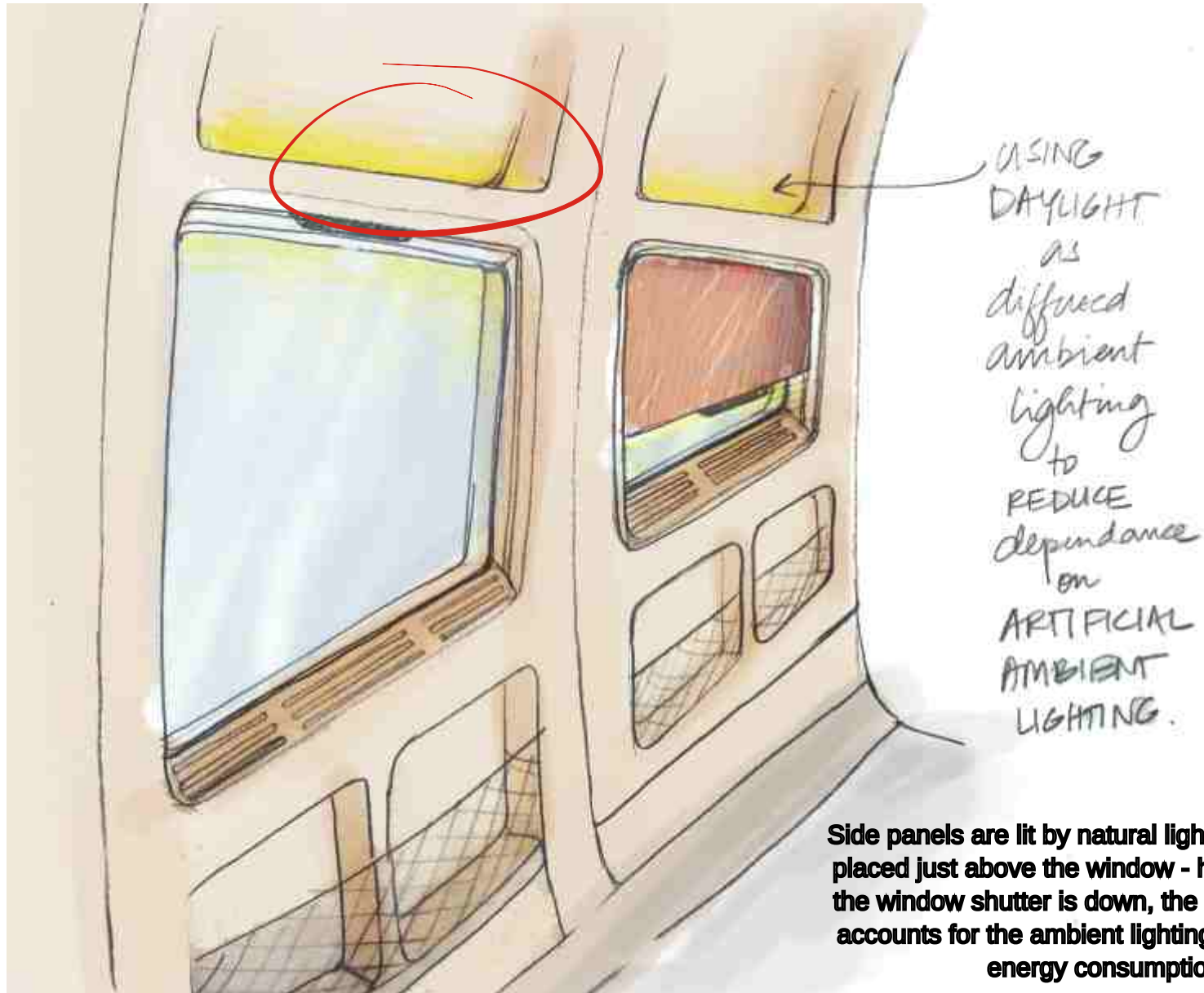
Twist to operate roof lights for overhead reading purposes for individual passengers



5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 20

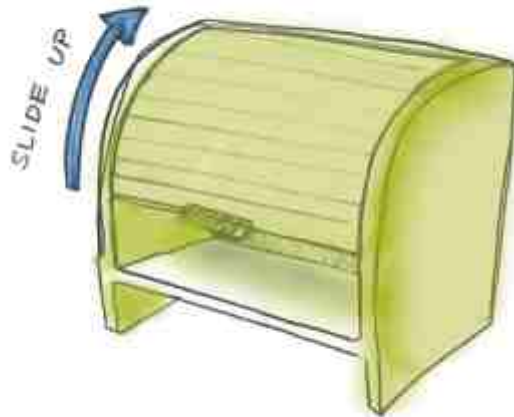


5. IDEA GENERATION

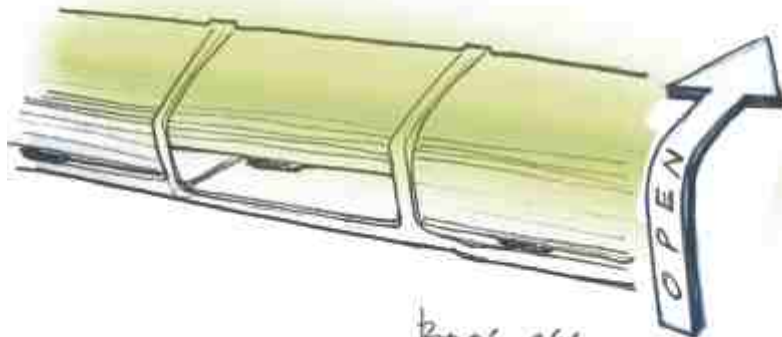
5.4 IDEA LOG

IDEA LOG 21

CHEST OF DRAWERS/CABINET
opening mechanism

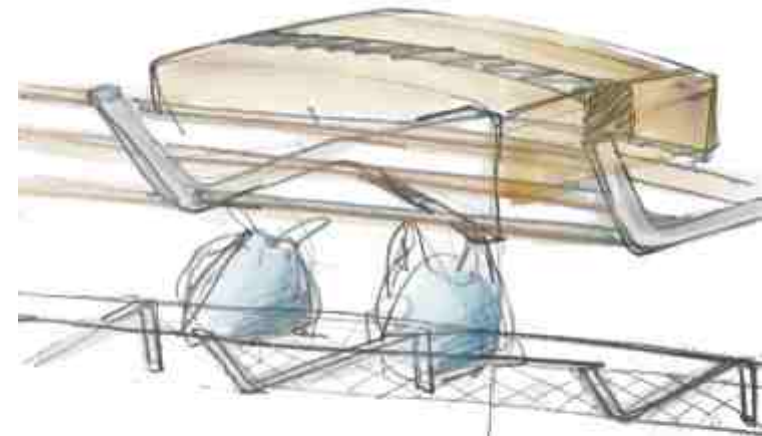


Cabinet style luggage rack
with front covers that slide
open and self-lock using
the dead weight
mechanism behind



Bags are
secure &
do not fall off

IDEA LOG 22



TO AVOID HOOKS
Sub-level storage
to put bags (smaller
bags)

* — shelf could be made of
plastic
or
WIRE RACK.

Luggage storage for smaller bags at the
lower intermediate level to avoid the use
of hooks

5. IDEA GENERATION

5.4 IDEA LOG

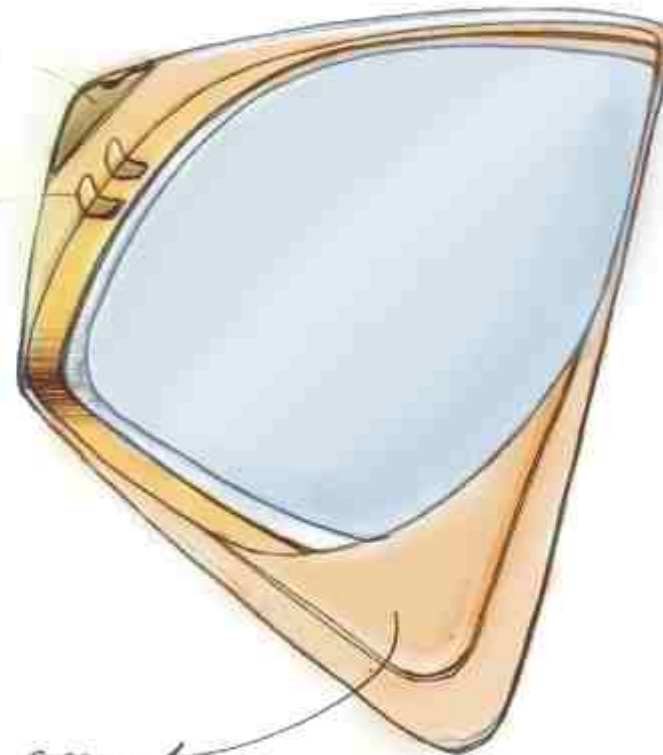
IDEA LOG 23

Aperture Openings
for TRAIN:



PUSH <
OPEN
LIGHTING

USER <
CONTROLS
FOR
LIGHTING



WINDOWS:
imitate "EYES"
negative space used
for • STORAGE
• USER CONTROLS

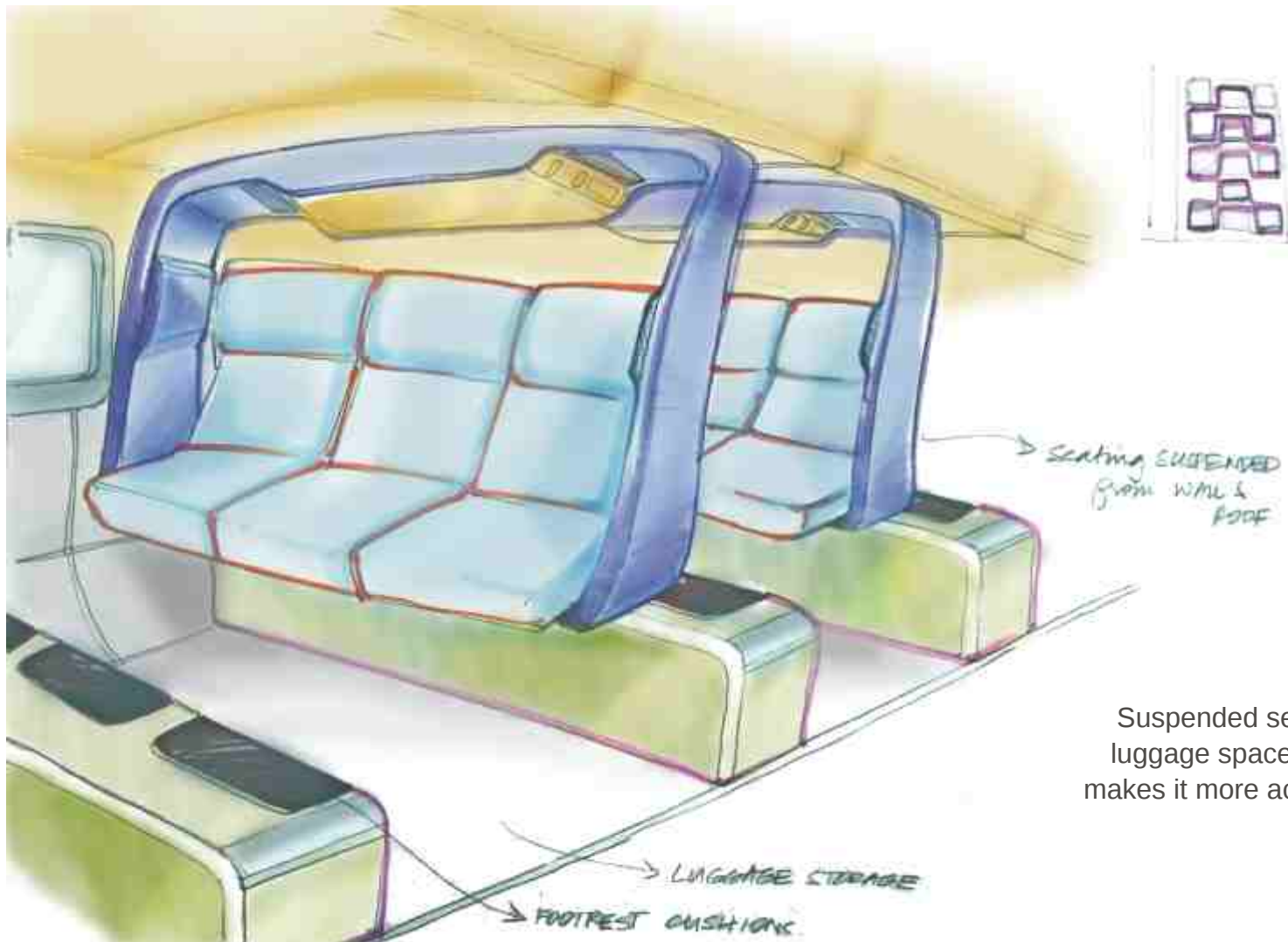
STORAGE
FOR
SMALL
PERSONAL
ITEMS

Windows are shaped apertures from the inside, using the blocked spaces for mini-storage and user controls for lighting

5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 24



Suspended seats to allow for more luggage space on the floor and this makes it more accessible than overhead racks

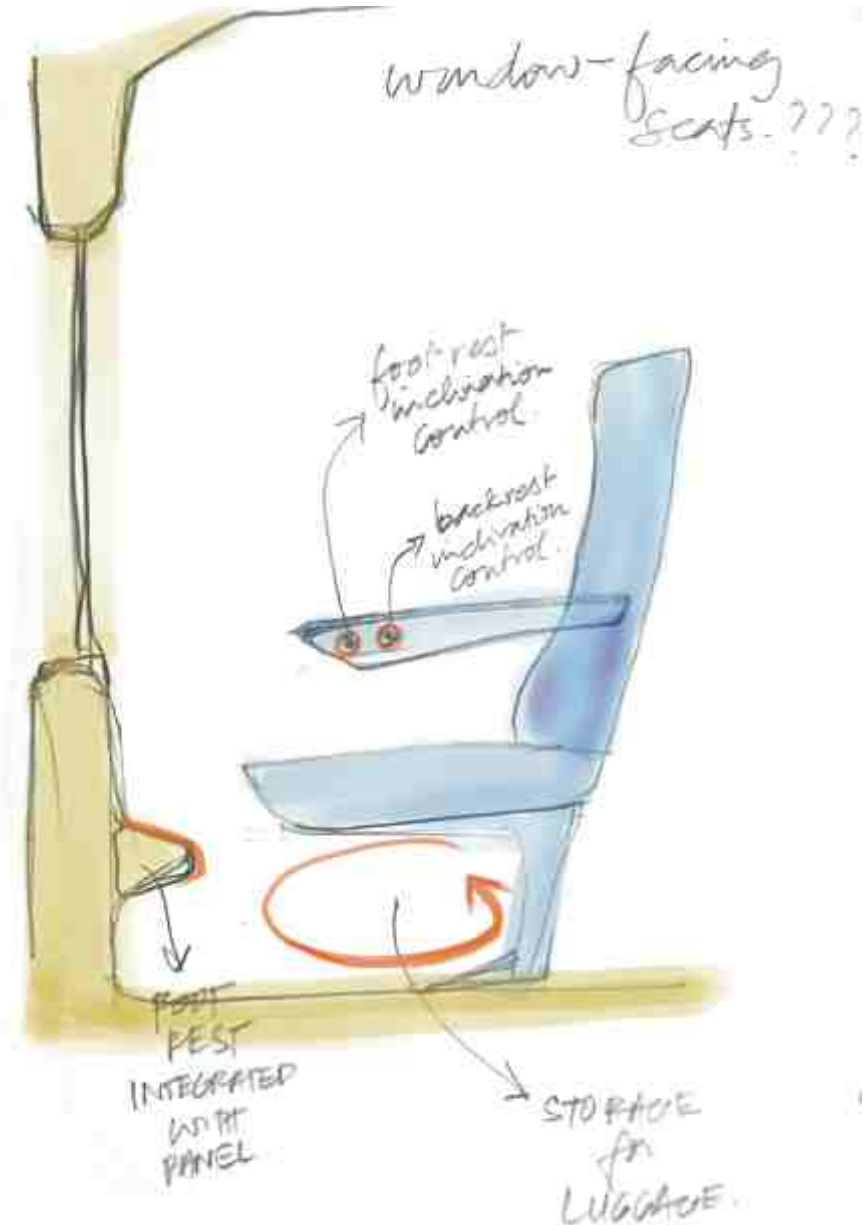
5. IDEA GENERATION

5.4 IDEA LOG

IDEA LOG 25

Seats could face the window with the footrest incorporated into the side panel for more comfort.

Each window could accommodate for two passengers?



6. CONCEPT GENERATION

3 CLUSTERS
FORMED



6.1 IDEA CLUSTERS:

The idea sketches were then clustered according to the core functions they addressed. This was done to facilitate extraction of key attributes that would help in building complete concepts. Different concepts evolved as they addressed different attributes of the product brief to varying degrees of importance. Three clusters were made by using this approach

CONCEPTUAL IDEATION

Evolution of the cluster representative using the nuances from the design ideas in each cluster, keeping in mind the broad variations in each cluster. The concepts were then derived as wholistic solutions catering to all aspects of user-centered design.

All issues of spatial comfort, luggage storage, amenities and manufacturing ease were addressed at this stage to concertize the cluster ideas.

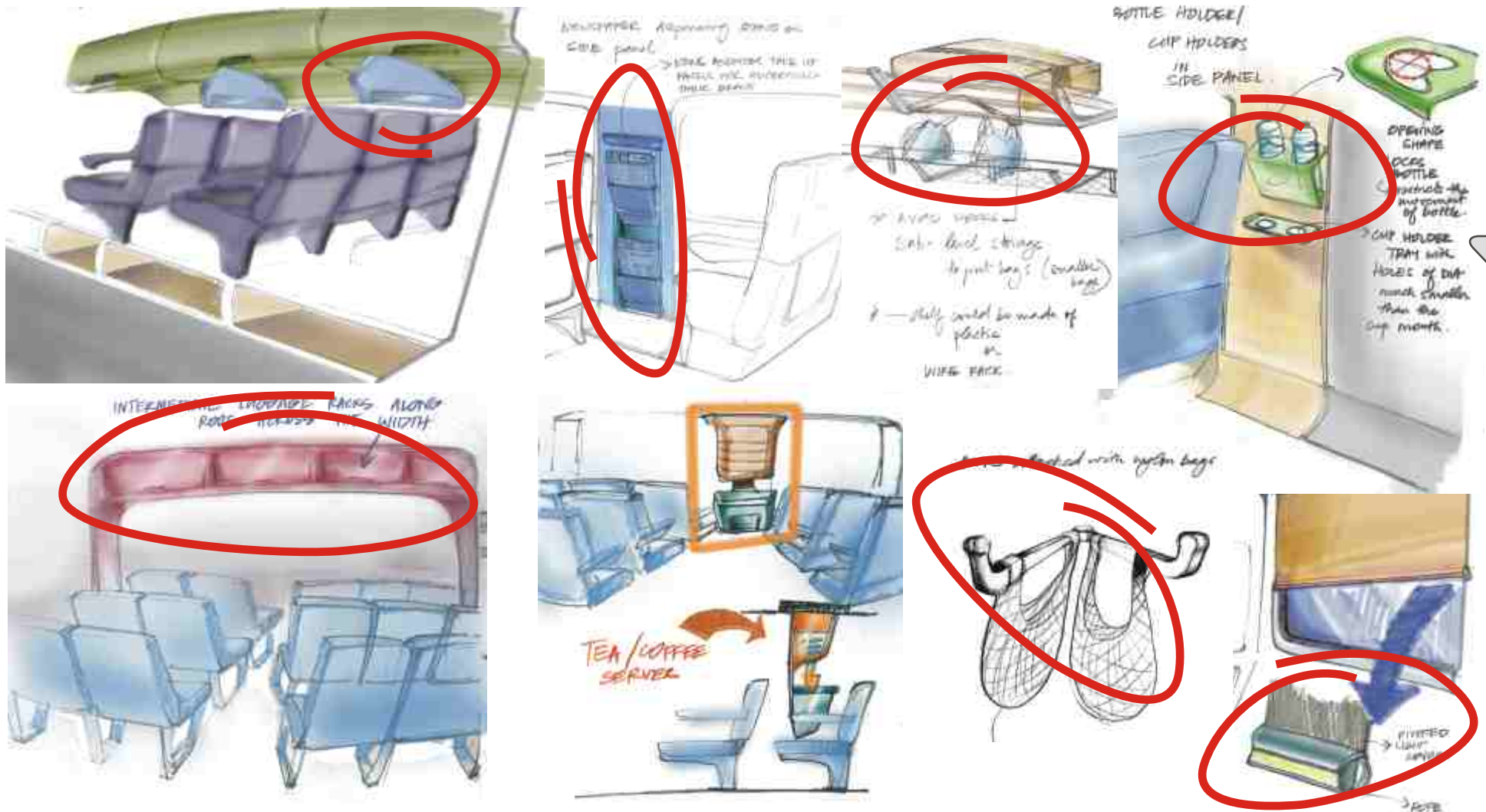
The concepts also had to be made feasible within the existing shell structure specifications used by the Indian Railways

The use of more plastics, especially injection moulded parts in the interiors of automotive industries served as an inspiration to back the production processes of most of the large-span elements in the interiors, This would also serve the interest of modulating the design, with units that could repeat intermittently .

6. CONCEPT GENERATION

6.2 SIMILAR ORGANIZATION

The idea was to maintain the existing configuration (2 + 3 seating arrangement) and make the basic changes with the user amenities which would also be incorporated by the Indian Railways in the easiest manner.



6. CONCEPT GENERATION

6.2 SIMILAR ORGANIZATION

CONCEPT 1 - SIMILAR ORGANIZATION

Keeping the same layout of the existing AC Chair car, (2 + 3 seating arrangement), one has attempted to bring down the luggage rack and create a step in the seating area, making the luggage more accessible to most users. This option however, cuts out the headroom in the seating area.

Secondary level of storage is provided for smaller bags. Wall surfaces are used more efficiently with the use of modular panels

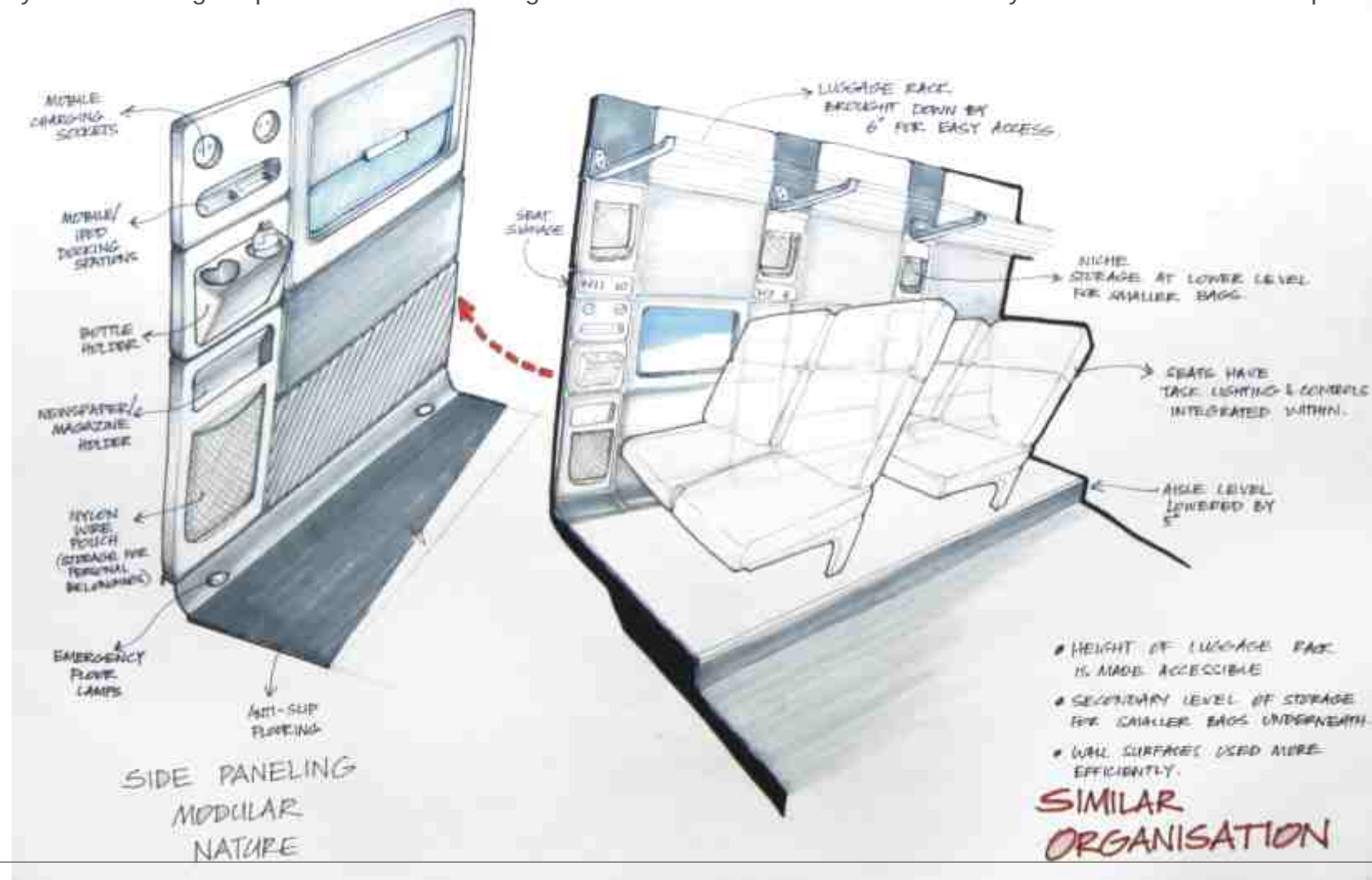
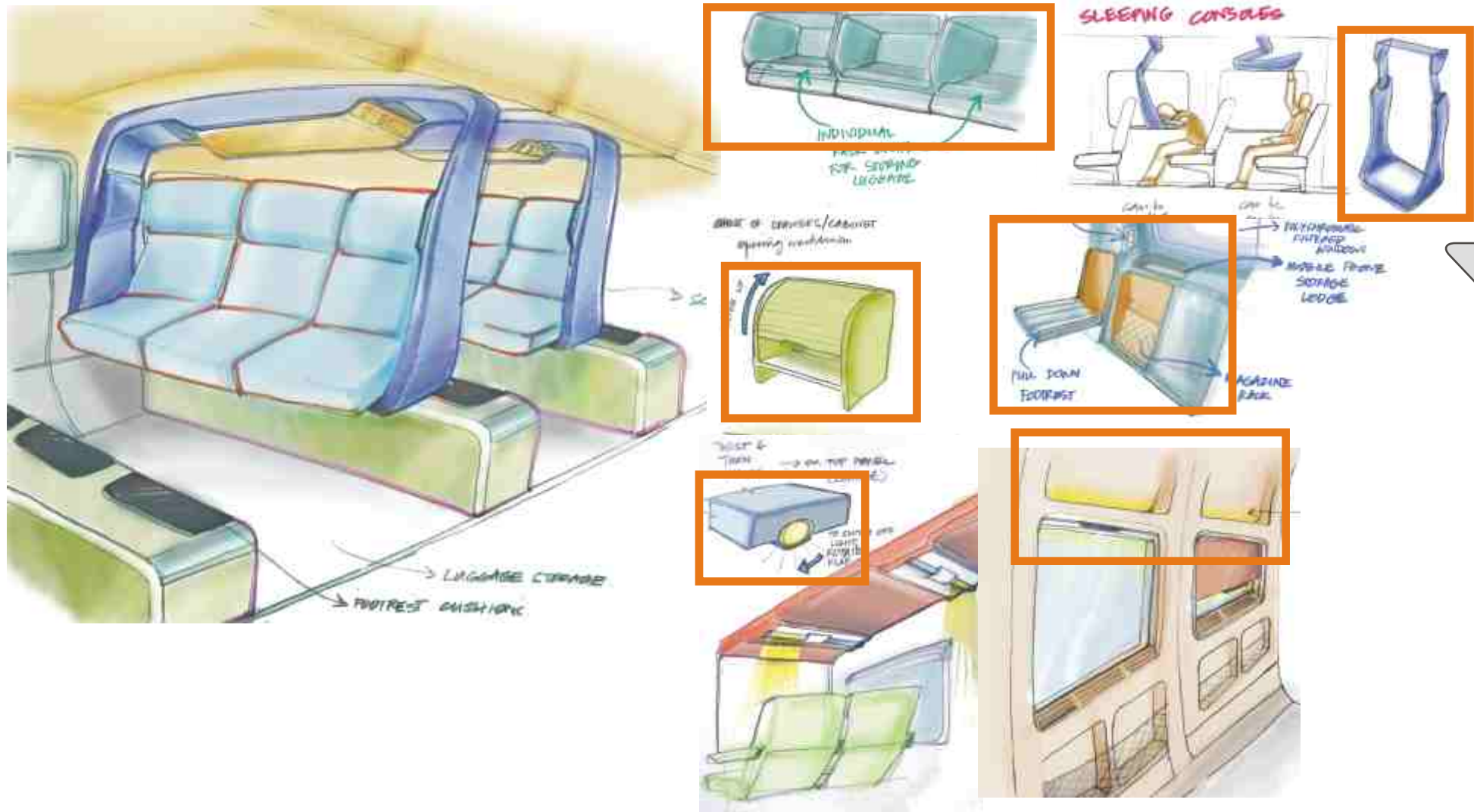


Fig.6.1

6. CONCEPT GENERATION

6.3. SUSPENDED SEATING ARRANGEMENT

The cluster was formed on basis of the idea of better luggage accessibility and directing the storage space towards the floor space, thereby placing the seats at a higher position from the ground and addressing the user amenities accordingly.

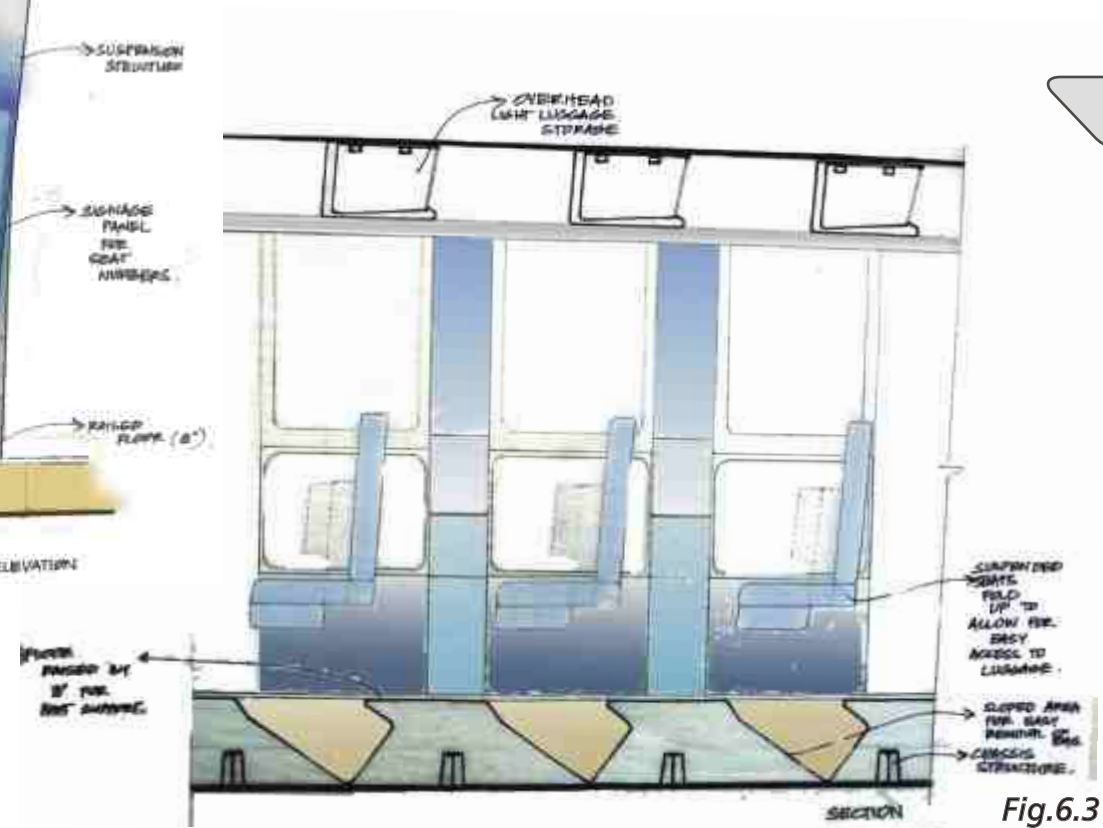
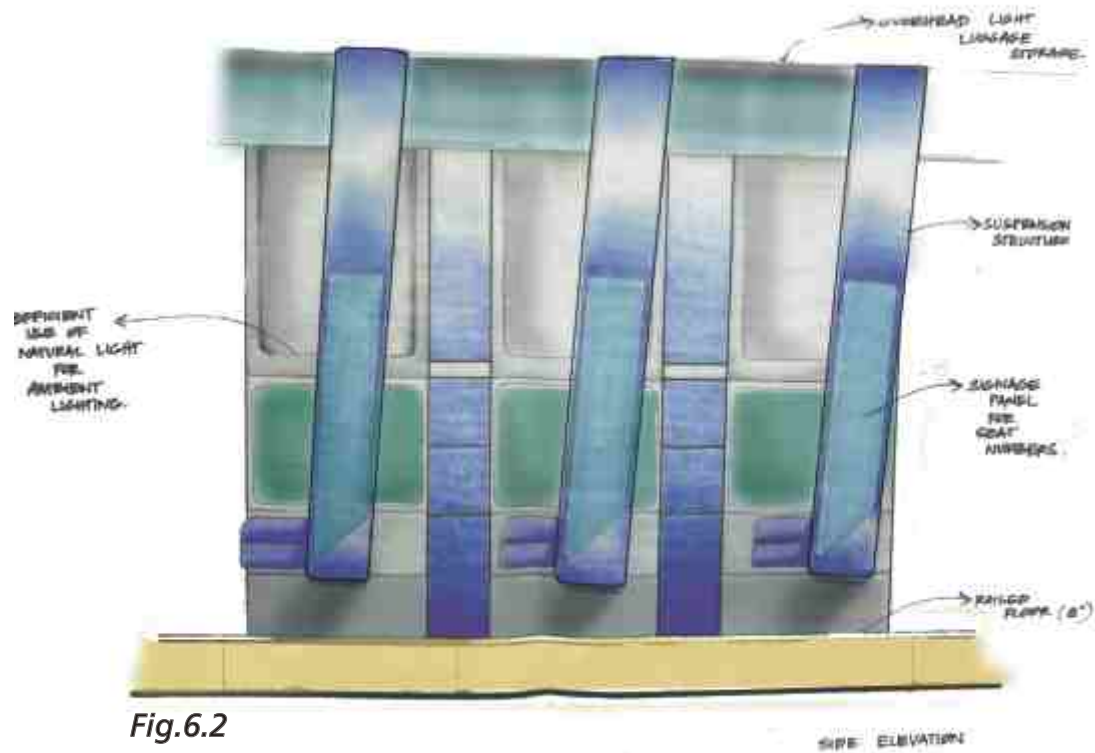


6. CONCEPT GENERATION

6.3. SUSPENDED SEATING ARRANGEMENT

CONCEPT 2 - SUSPENDED SEATING ARRANGEMENT

Using the 2+2 seating arrangement, the floor space is raised to 8" above the actual floor level for user comfort. This allows for more accessible luggage space, further the seats fold up to make the luggage more accessible. User controls are integrated within the suspended system. Natural lighting is used to provide ambient lighting, even when shutters are pulled down. Side panels provide for user amenities.



6. CONCEPT GENERATION

6.3. SUSPENDED SEATING ARRANGEMENT

CONCEPT 2 - SUSPENDED SEATING ARRANGEMENT

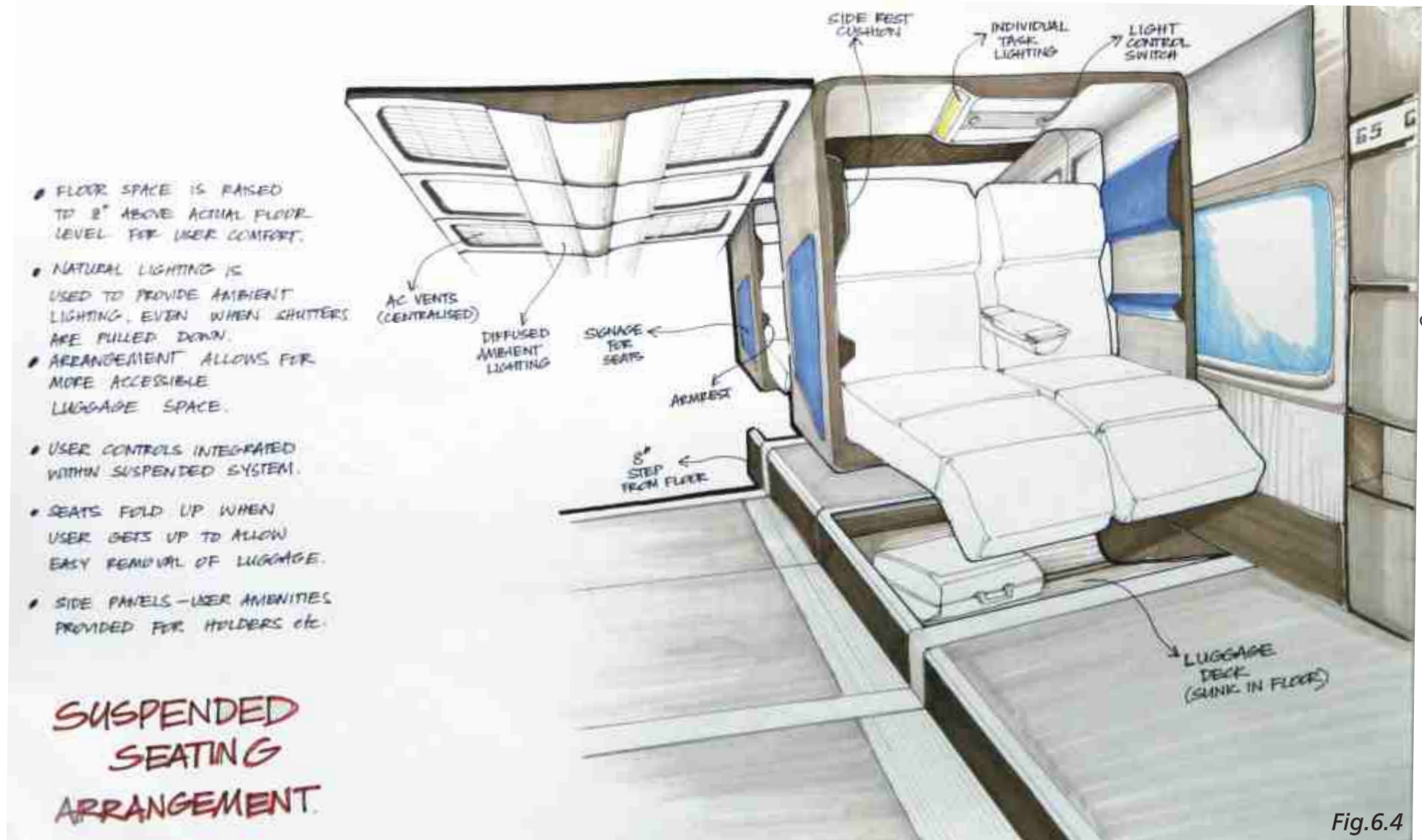
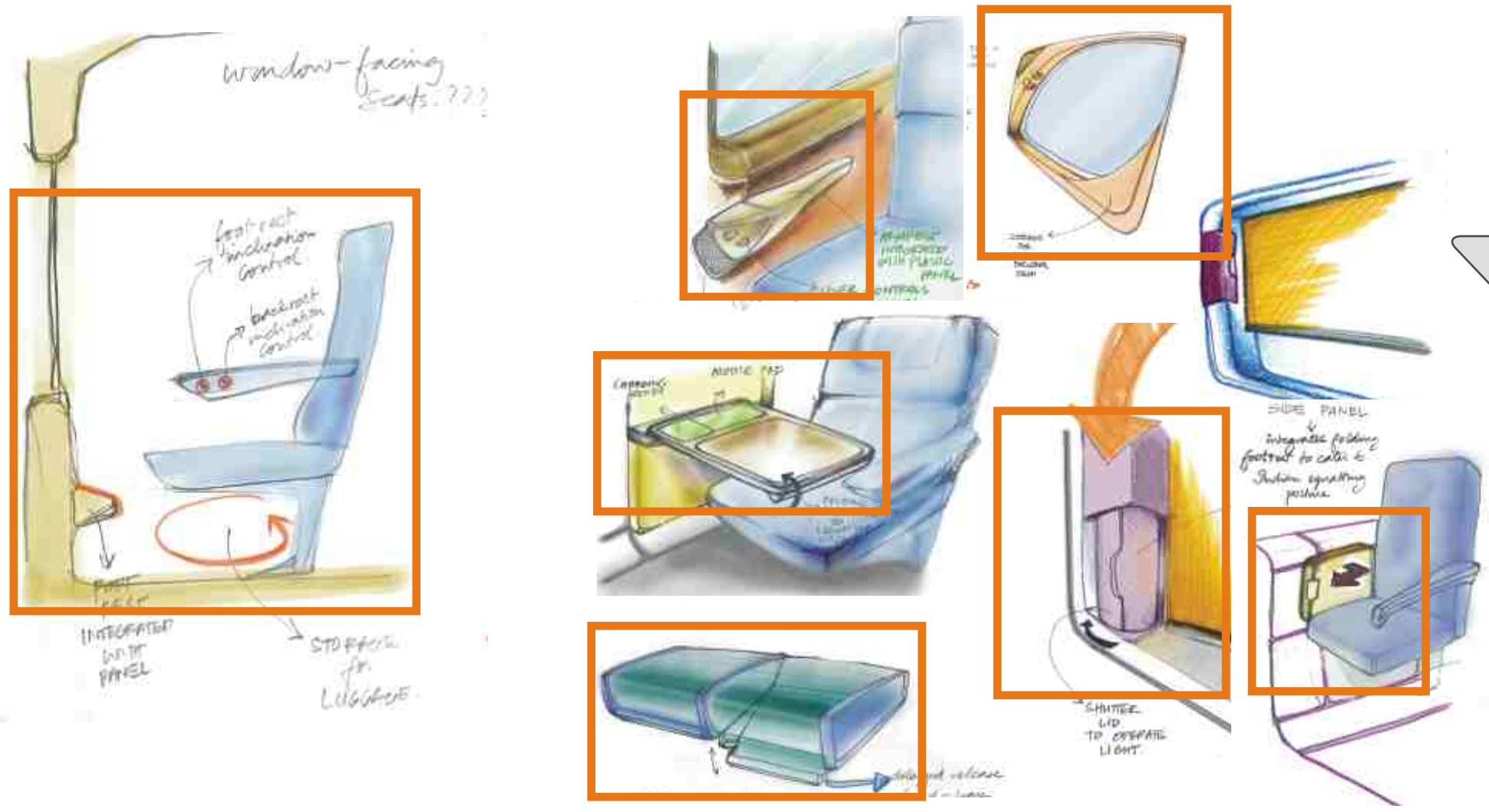


Fig.6.4

6. CONCEPT GENERATION

6.4 SINGLE SEATING ARRANGEMENT

This cluster started from the idea of providing the passenger utmost luxury and comfort with maximum space. Further, all amenities were re-directed towards the side panel and integrating all facilities including foot rest into the side wall mould. The issue of capacity of passengers in this cluster was not addressed for the time being.



6. CONCEPT GENERATION

6.4 SINGLE SEATING ARRANGEMENT

CONCEPT B - DOUBLE DECKER ARRANGEMENT

Employing the coaches already manufactured by the tier-one agencies [RCF(Kapurtala) and ICF (Perambur)], the double decker coach could be converted into an AC Chair Car and can accommodate more passengers than the standard AC Chair Car coach, providing more luxury and space per passenger. Air conditioning units are placed as RMPU's (Roof-mounted Power Units) above the lavatories at either ends. *(Please refer to appendix for more details on existing double decker coaches)*

DOUBLE DECKER ARRANGEMENT

- COACHES ALREADY MANUFACTURED BY TIER 1 AGENCIES
- CONVERTED TO AC BODIES & CAN ACCOMMODATE EITHER 70 PASSENGERS — SINGLE SEATER 180 PASSENGERS — DOUBLE SEATER
- COMPARTMENTS FOR STORING HEAVY LUGGAGE PROVIDED AT INTERMEDIATE LEVEL
- AIR-CONDITIONING UNITS & COMPRESSORS PLACED AT ENDS OF COMPARTMENT.

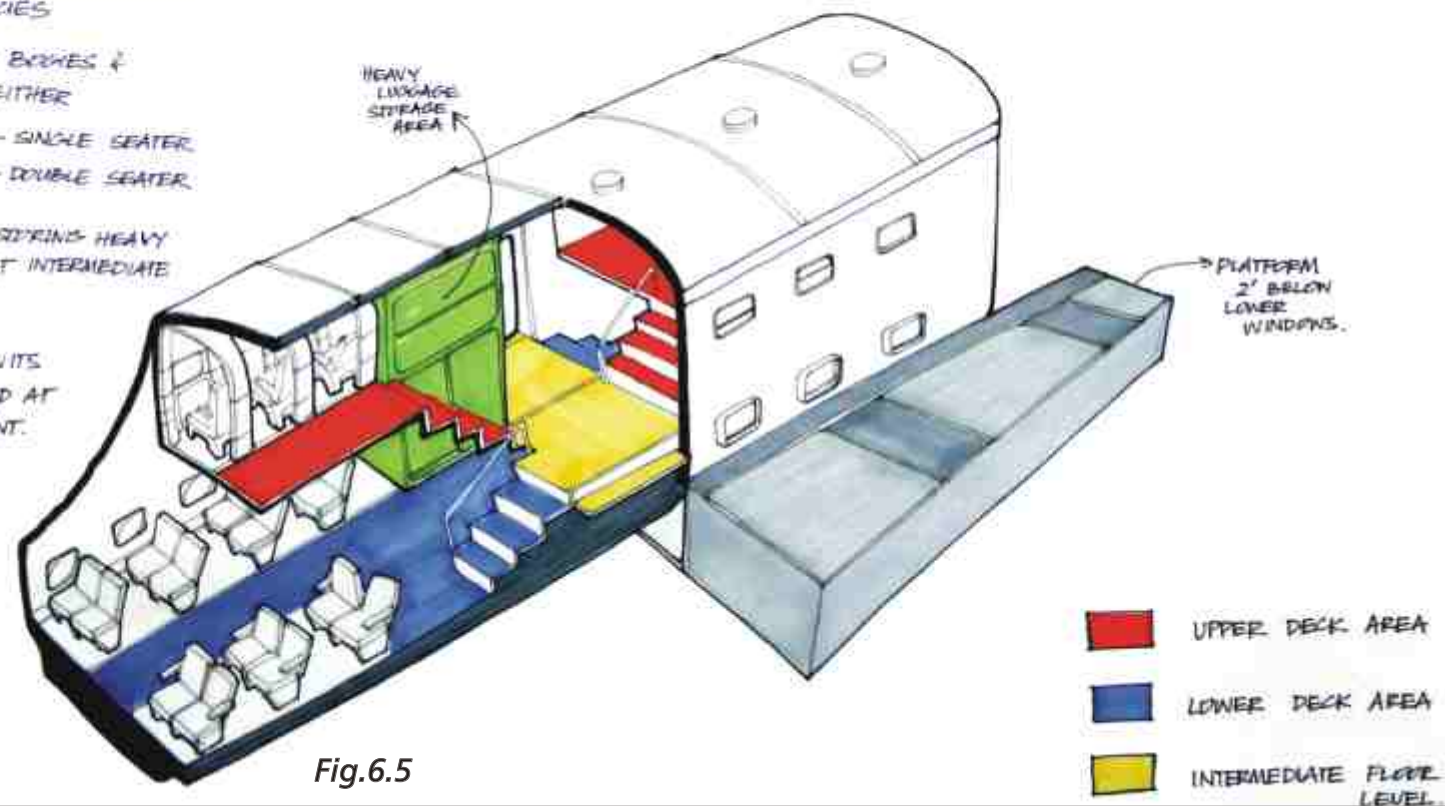


Fig.6.5

6. CONCEPT GENERATION

6.4 SINGLE SEATING ARRANGEMENT

CONCEPT B

6.4.1 DOUBLE DECKER ARRANGEMENT- SINGLE SEATING

Two concepts for seating within the double decker coach were arrived at. The first concept was a single seating arrangement which would be afforded by people who wouldn't mind spending for extra luxury and comfort. The single seat would have individual user-centered controls, private luggage space and extra provisions for the working professional to suit his needs. Ample luggage space would also be provided for.

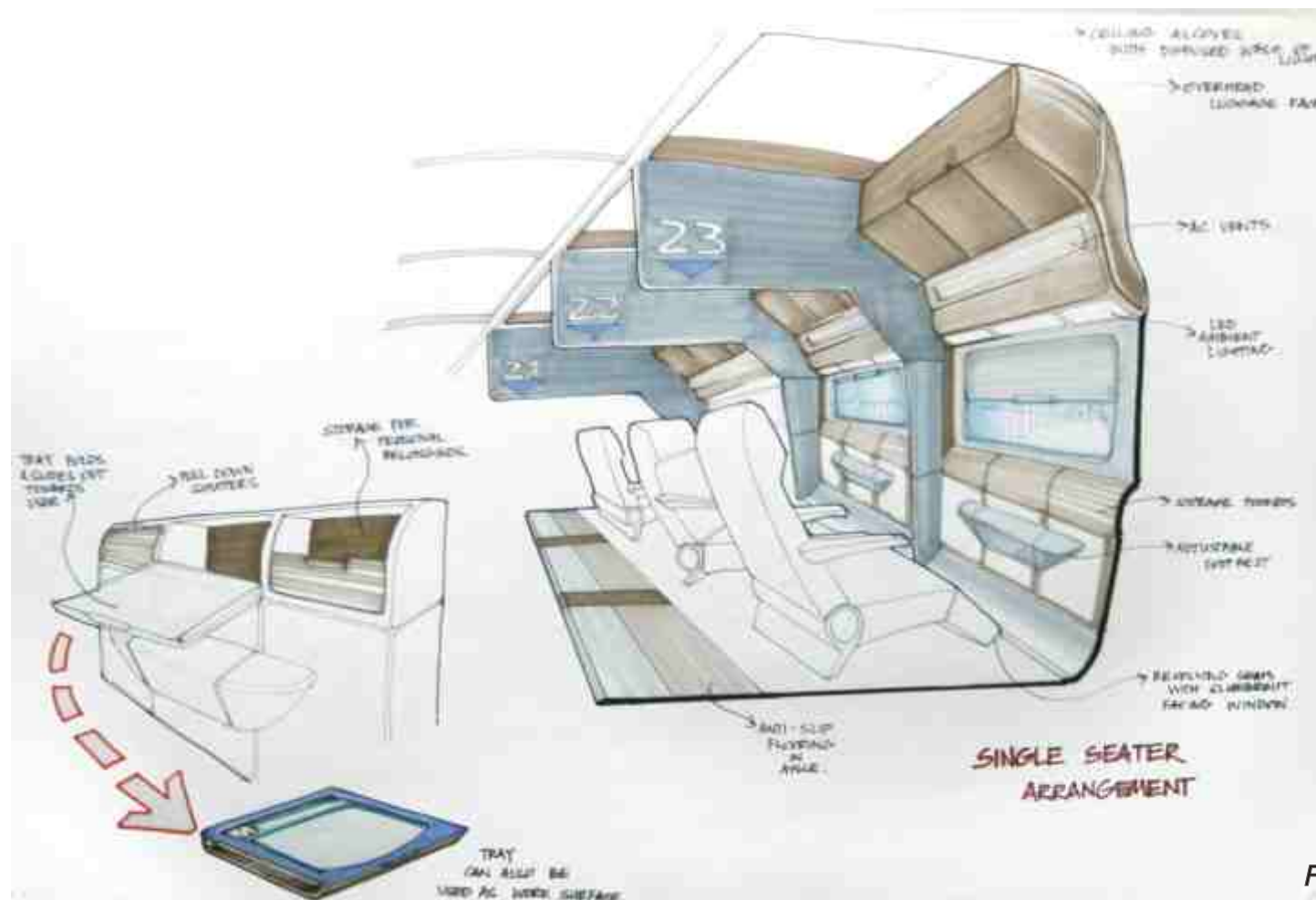


Fig.6.6

6. CONCEPT GENERATION

6.4 SINGLE SEATING ARRANGEMENT

CONCEPT B

6.4.2 DOUBLE DECK ARRANGEMENT- DOUBLE SEATING

The second concept deals with the 2 +2 seating arrangement, with overhead storage space for smaller luggage. User amenities are provided for on the side panels. The space provided per passenger is a lot more than the existing configuration. Using this configuration on both the floor decks can accommodate a total of 88 passengers. With a combination of this configuration on the upper deck and the double seating arrangement on the lower deck, the total capacity increases to 80.



Fig.6.7

7. CONCEPT EVALUATION

Each concept was then evaluated based on the product brief and the criteria of evaluation determined during the user study.

7.1 CRITERIA FOR EVALUATION

7.1.1 COMFORT SPACE PER PASSENGER

The area provided to each passenger is a major criteria for evaluation and is rated on a scale of 1 to 10, 1 being less comfortable with cramped spaces and 10 being luxurious. The volume in terms of headroom is also considered in this condition.

1 (less comfortable)  9 (more comfortable)

7.1.2 LUGGAGE STORAGE SPACE

The volume allotted for luggage storage is evaluated on a scale of 1 to 10, 1 being very tight and 10 providing for all types and sizes of luggage carried by each passenger.

1 (tight space)  9 (ample storage space)

7.1.3 ACCESSIBILITY OF STORAGE

How far the Indian user will be able to access the luggage stored is evaluated here on a scale of 1 to 10, 1 referring to reduced accessibility and 10 corresponding to easily accessible luggage at close reach.

1 (less accessible)  9 (easily accessible)

7.1.4 SECURITY OF LUGGAGE STORED

Sense of security of luggage stored is another important criteria for the psychological benefit of the passenger during journey time. Evaluated on a scale of 1 to 10, 1 refers to scenarios where luggage is stored in least secure situations, most probably away from the passenger; while 10 refers to the situation in which luggage is in close proximity to the passenger and is visible for maximum assurance.

1 (less secure)  9 (more secure)

7. CONCEPT EVALUATION

7.1 CRITERIA FOR EVALUATION

7.1.5 INDIVIDUAL USER CONTROLS

The provision for user-centered controls for task lighting, mobile charging sockets, air-vent controls are evaluated on a scale of 1 to 10, 1 referring to the existing condition in the AC Chair Car coaches, where not many user amenities are operated by individual passengers; and 10 refers to each passenger having access to controlling all features of lighting levels and air vent flows to even individual mobile charging sockets.

1 (less no. of controls)  9 (more controls)

7.1.6 CAPACITY OF PASSENGER COACH

The number of passengers that can be accommodated in the coach is another major factor that needs to be addressed from the interest of the Indian Railways in revenue generation per coach

1 (more dense)  9 (less dense)

7.1.7 ADAPTABILITY TO INDIAN RAILWAYS

How far can the Indian Railways go towards developing the chair car coach? How many changes would have to be incorporated keeping in mind that the existing shell would remain untouched?

1 (more changes)  9 (less no. of changes)

7.1.8 MAINTENANCE & SERVICING

Seeing that servicing is not done frequently except once in 5 years, the solution should be a durable and easily serviceable design. Further maintenance issues should also be considered as a criterion, as passengers are particular about hygiene conditions within the coach.

1 (hard to maintain)  9 (easy maintenance)

7.1.9 MODULARITY

Modular panels should be introduced into design for easy manufacturing and cost effectiveness in design

1 (less modular)  9 (more modular)

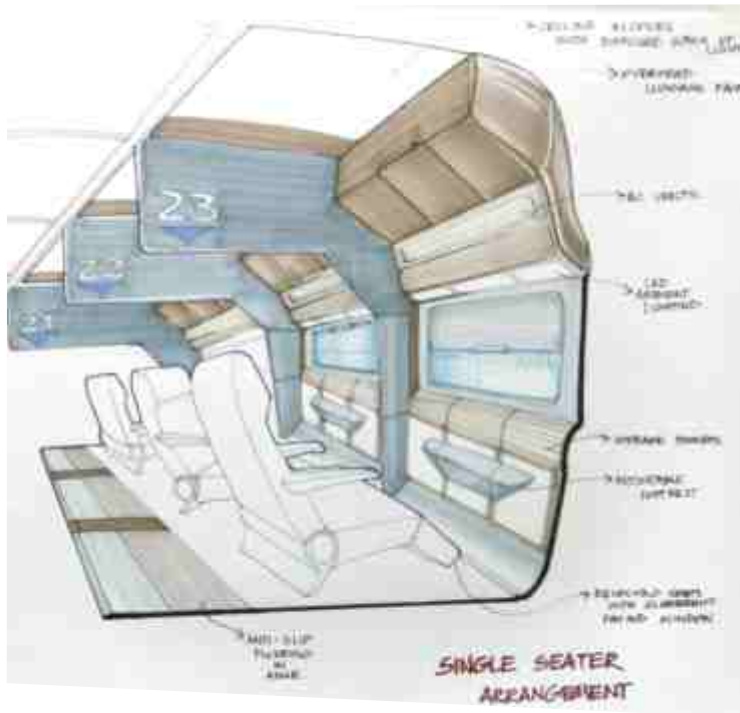
7. CONCEPT EVALUATION

7.2 EVALUATION TABLE

CRITERIA FOR EVALUATION*	EXISTING AC CHAIR CAR COACH	CONCEPT 1 SIMILAR ORG.	CONCEPT 2 SUSPENDED SEATING	CONCEPT 3 DOUBLE DECKER ARR
COMFORT SPACE PER PASSENGER	4	4	6	8
LUGGAGE STORAGE SPACE	2	2	7	7
ACCESSIBILITY OF STORAGE	2	2	6	9
SECURITY OF LUGGAGE STORED	4	5	5	8
INDIVIDUAL USER CONTROLS	2	3	5	8
CAPACITY OF PASSENGERS PER COACH	5	5	2	7
MAINTENANCE AND SERVICING	9	8	2	4
MODULARITY IN DESIGN	6	8	4	5
ADAPTABILITY TO INDIAN RAILWAYS	9	8	5	6
TOTAL	43	45	42	62

* The evaluation was carried out on a scale of 1 to 9, the criteria for which were explained in the earlier pages

8. FINAL PROPOSAL



8.1 REFINEMENT OF FINAL CONCEPT

Having done the initial analysis, formal variations were explored keeping in mind the keywords thrown up by the investigations. After selecting the final concept, the final design embodies all aspects of the product brief and was detailed out keeping in mind the use of plastics in the elements

Passengers today are willing to spend for the right service and comfort, and the final concept now addressed for these key issues. Luggage storage for most big suitcases are also catered to, with the inclusion of different user amenities in close proximity to the passenger

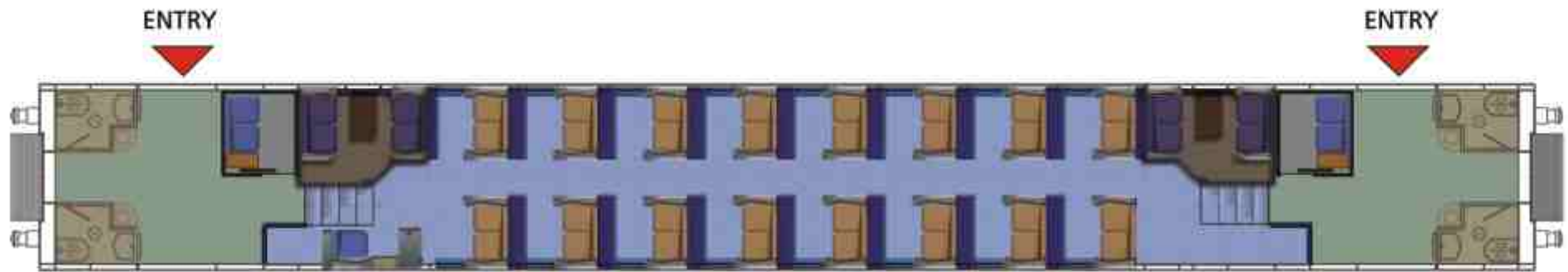
Comfort space provided per passenger : 1570 mm x 650 mm

The decision to use both types of seating arrangements was finalized to provide different classes for traveling in the AC Chair Car coach. The total capacity now increases to 80 passengers, from the 72 that the normal Chair Car coach would accommodate.

8. FINAL PROPOSAL

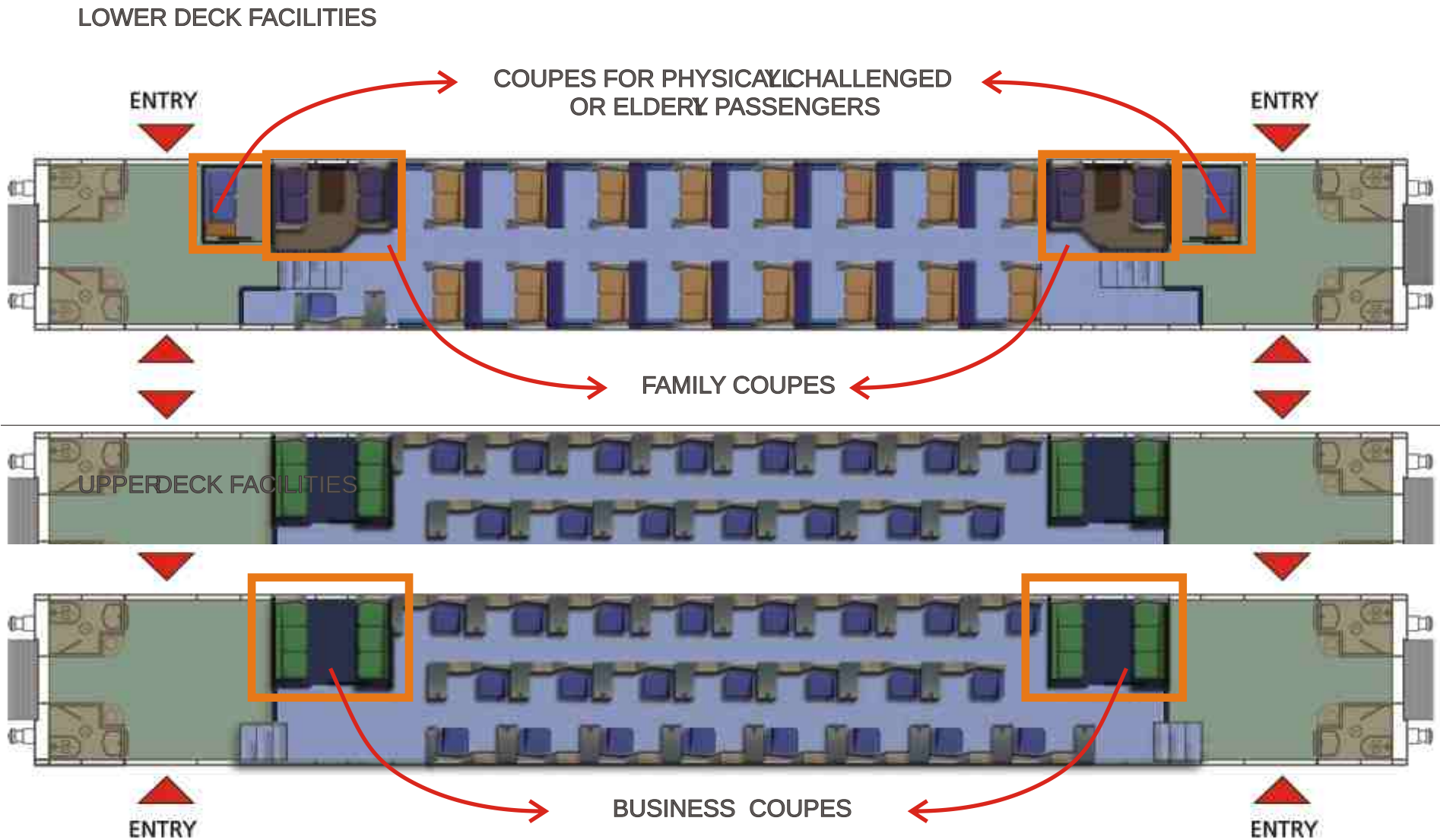
8.2 LAYOUTS

8.2.1 LOWER DECK LAYOUT



8.2.2 UPPER DECK LAYOUT

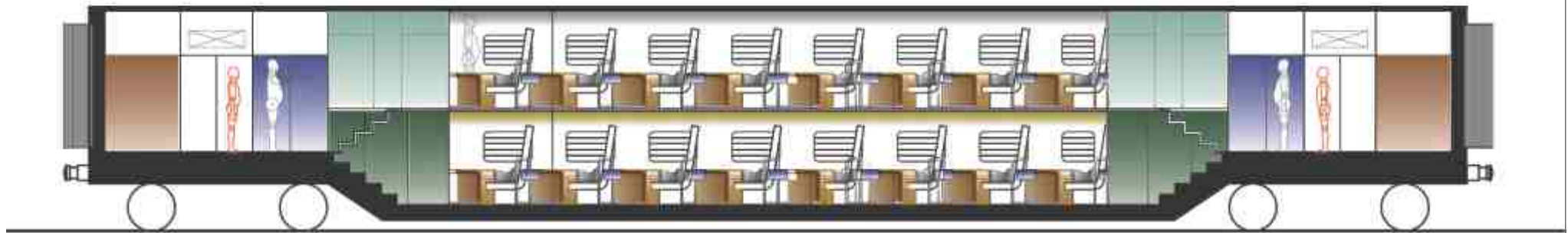




8. FINAL PROPOSAL

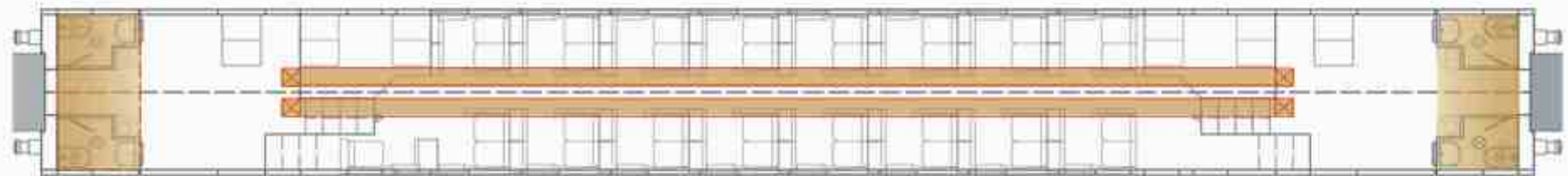
8.2 LAYOUTS

8.2.3 SECTION



67

8.2.4 HVAC LAYOUT



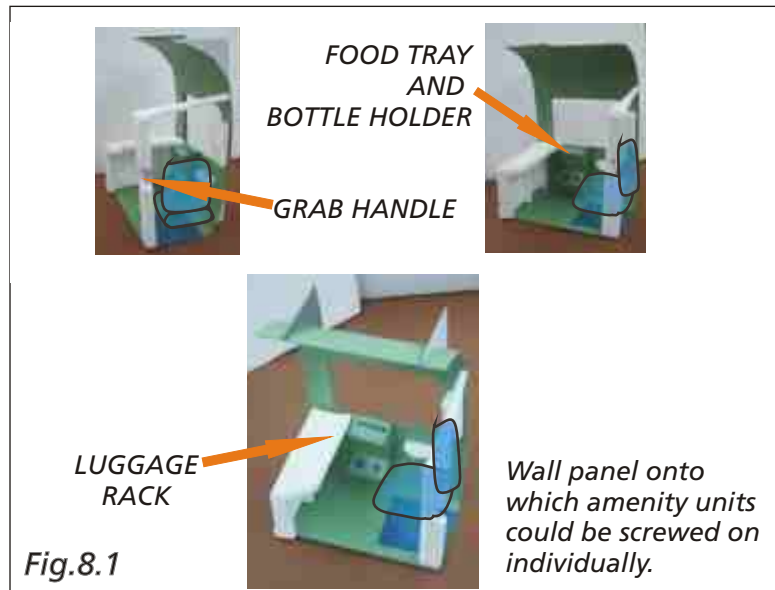
LOWER DECK



UPPER DECK

8. FINAL PROPOSAL

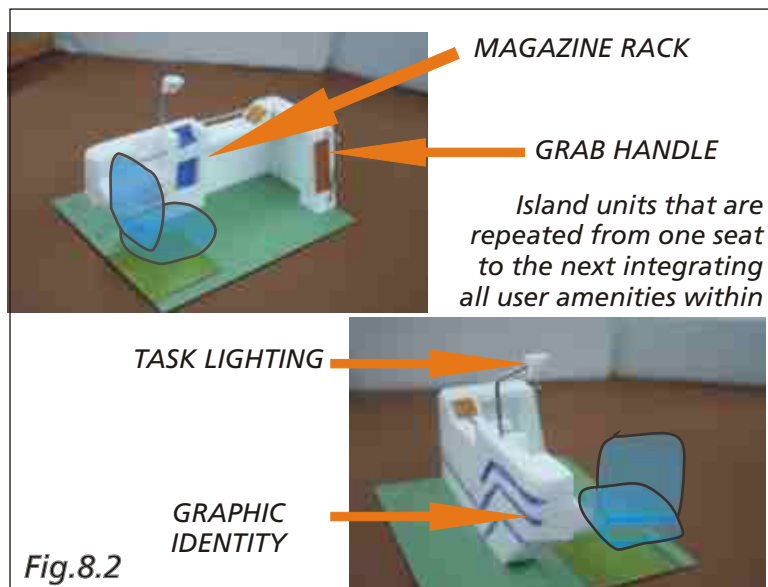
8.3 DESIGN EXPLORATION



Exploratory models were made to understand the attitude towards designing the wall panels integrated with the user amenities.

The first exploration delved on integrating units within large wall panels that ran from floor to ceiling. Using structural polypropylene panels that could withstand impacts from use, the user amenities units would then be assembled onto the panel. This method was however, too tedious in assembly process and not easy to maintain either.

The second option was to design island units that could house all the user amenities in different zones depending on the percentage of use of each function. User amenities were then categorized and placed in proximity to the passenger depending on the frequency of use.



Primary amenities:

Mini- luggage storage
Task Lighting
Mobile phone charging facility

Secondary amenities:

Food tray
Working surface
Magazine rack
Shawl and pillow storage

Tertiary amenities:

Heavy luggage storage
Grab handles
Seat number indication

8. FINAL PROPOSAL

8.3 DESIGN EXPLORATION



*Main structure of T-angles
on sides*

*Curtain steel used in
spanning members (3.15 mm
thick)*

*L-angles used as tie
members*

*Corrugated trough floors at
both levels*

Fig.8.3



Fig.8.4

Assembly methods were established by use of exploratory models and the final sequence of assembly was decided as:

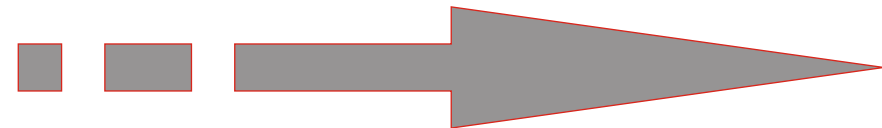
Basic structure

Windows

Mid panel

Roof panel

Consoles



BASIC STRUCTURE



1

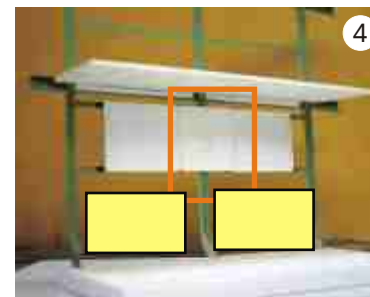
WINDOW UNIT



2

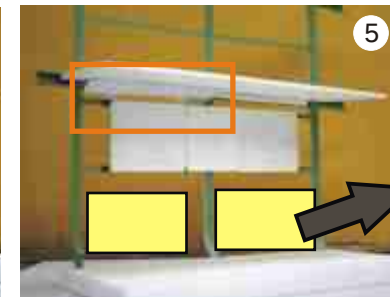


3



4

MID PANEL



5

ROOF PANEL

CONSOLES

8. FINAL PROPOSAL

8.4 DESIGNFOR PLASTICS



Internal panels used in automobiles are also made of structural polypropylene and are fit onto the inner metal body using plastic lugs.



PLASTIC LUGS

Fig.8.8

With the use of more injection moulded parts in the automotive industry, the detailing of the plastic elements assembled together was decided along the same lines and is discussed in this chapter. Acoustically treated wall panels and floor mats are three-dimensionally formed in structural polypropylene by injection moulding or if required can also be SMC parts. These technologies make it possible to integrate more functionality in the same parts.

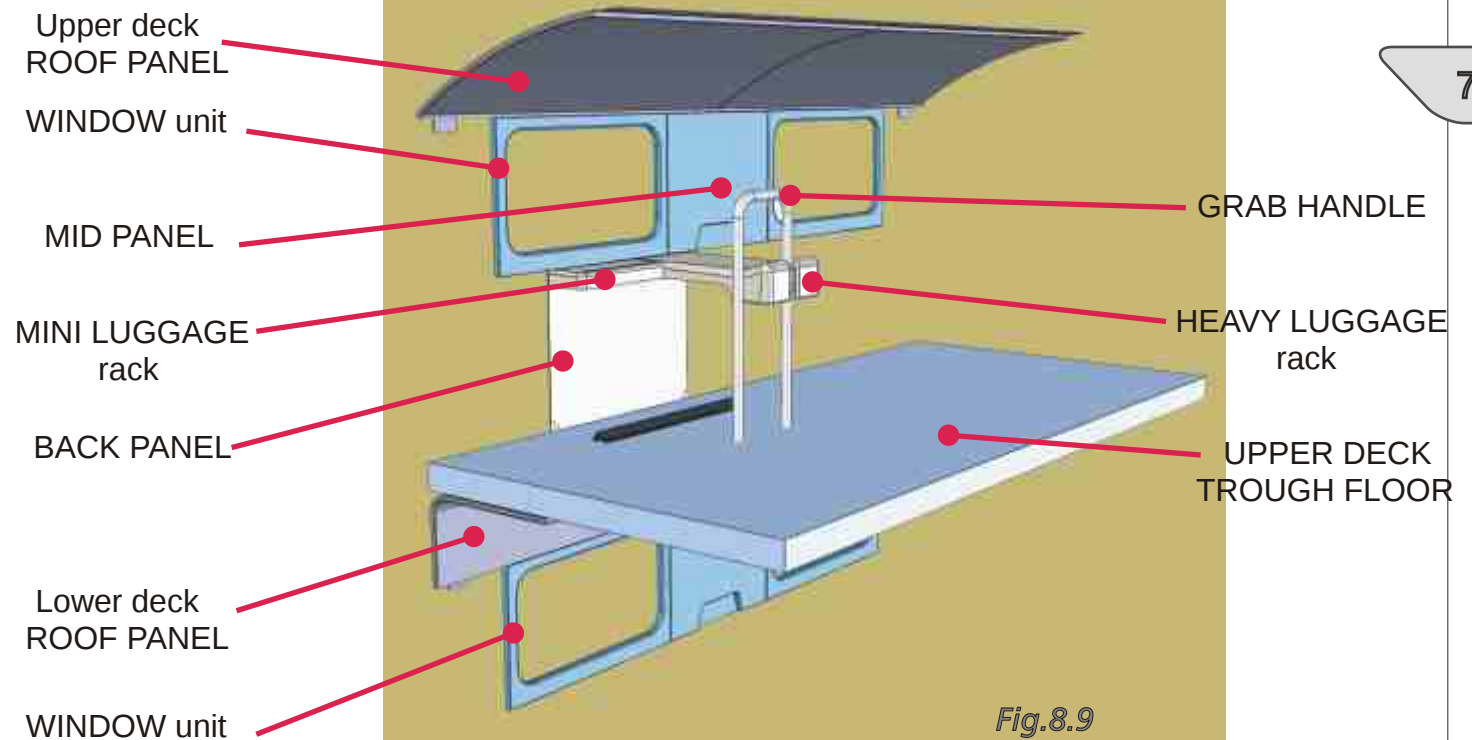
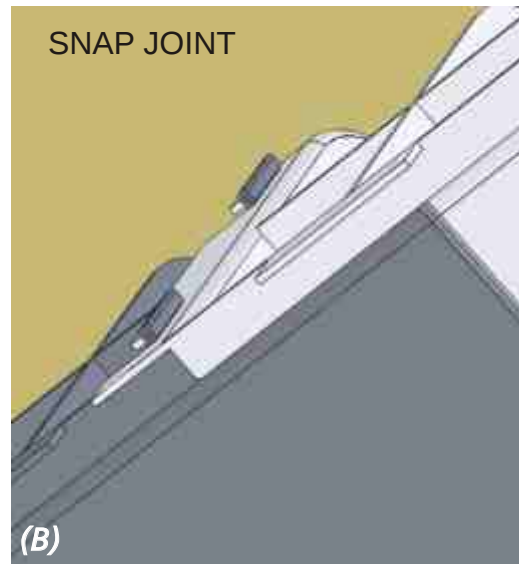
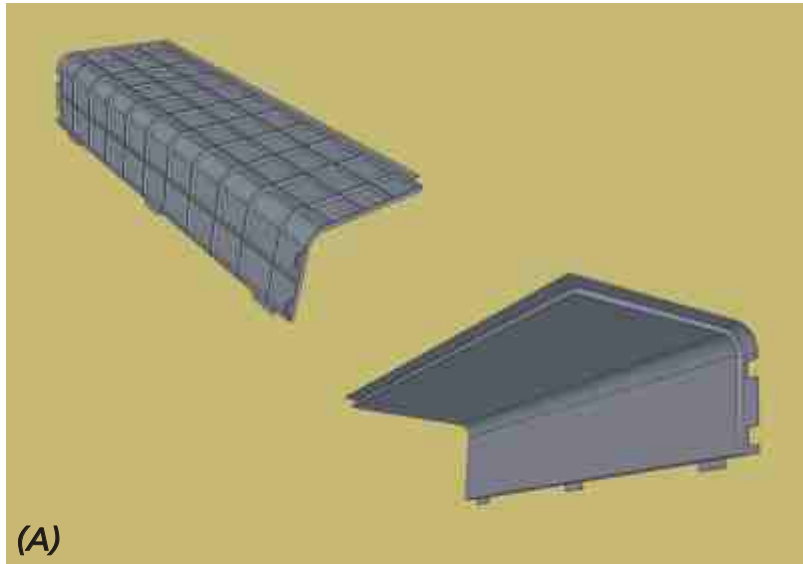


Fig.8.9

8. FINAL PROPOSAL

8.4 DESIGN FOR PLASTICS

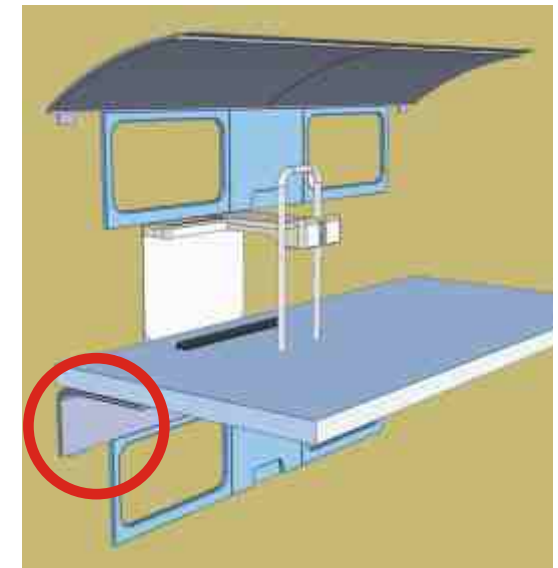
A log of all the parts assembled together are listed below:

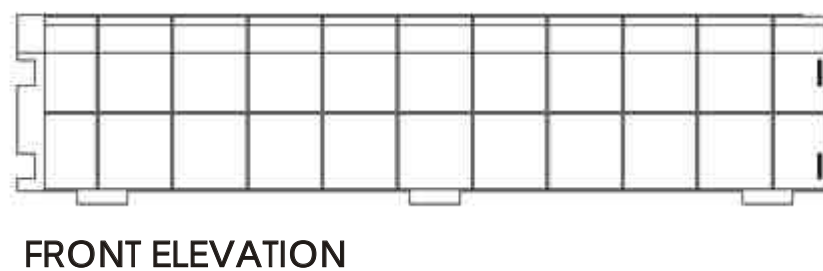
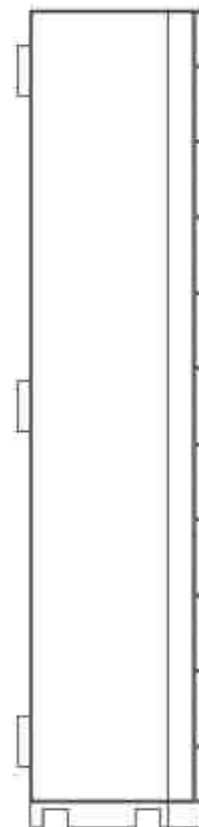
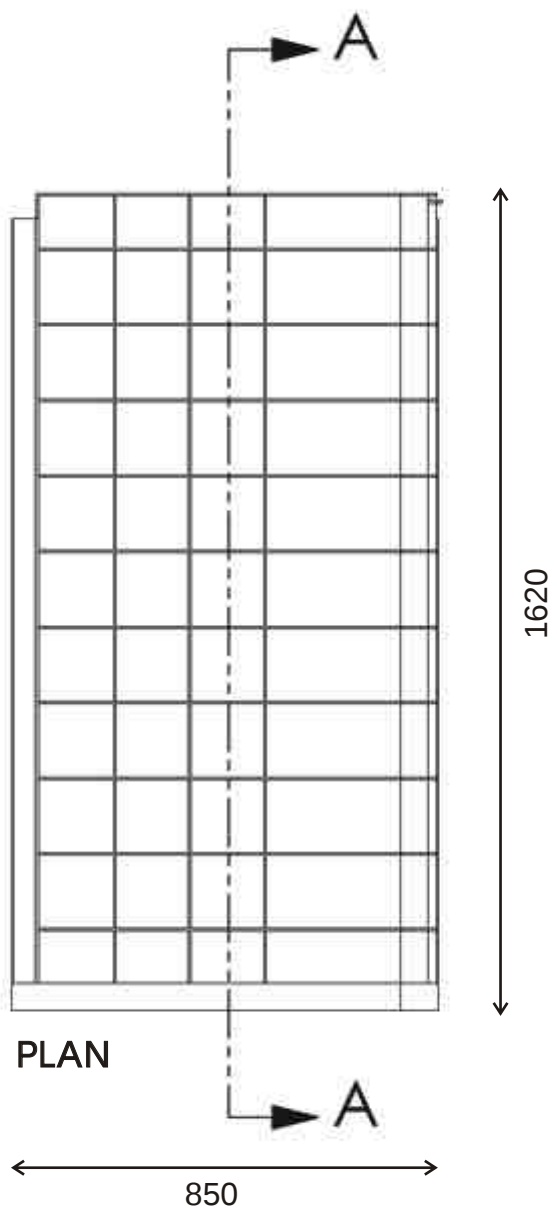


LOWER DECK ROOF PANEL

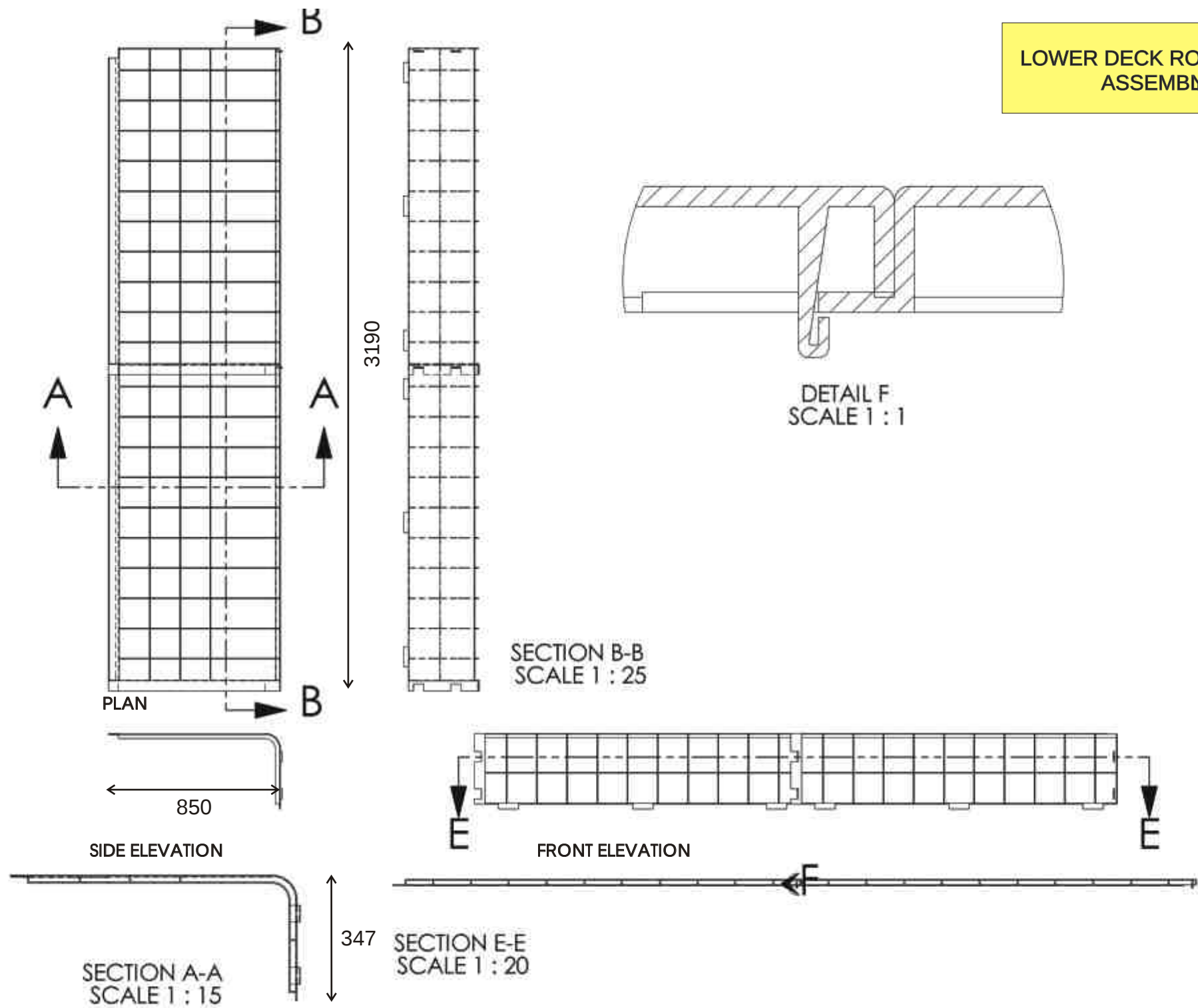
FEATURES:

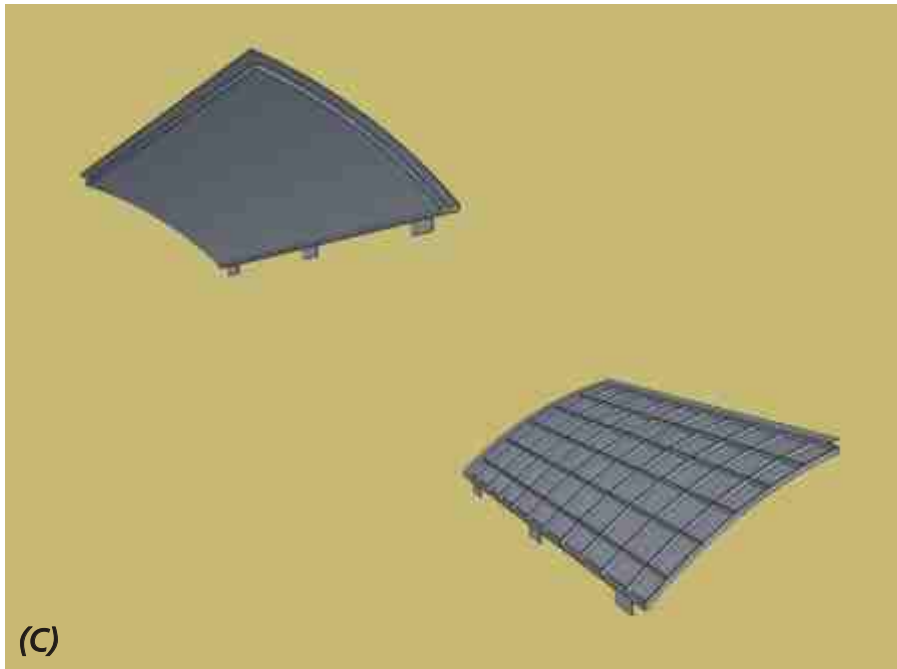
Structural polypropylene member used for spanning 1.5 m
Roof panel will hold ambient lighting units.
Checkered grid is provided on the back side for strengthening
The panels will be snapped together on the sides for locking
Panels will be screwed on the top to the roof structure





LOWER DECK ROOF PANEL
ASSEMBLY

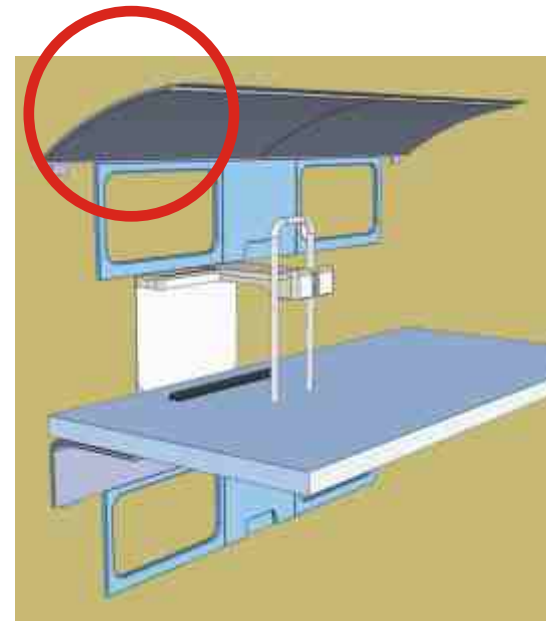


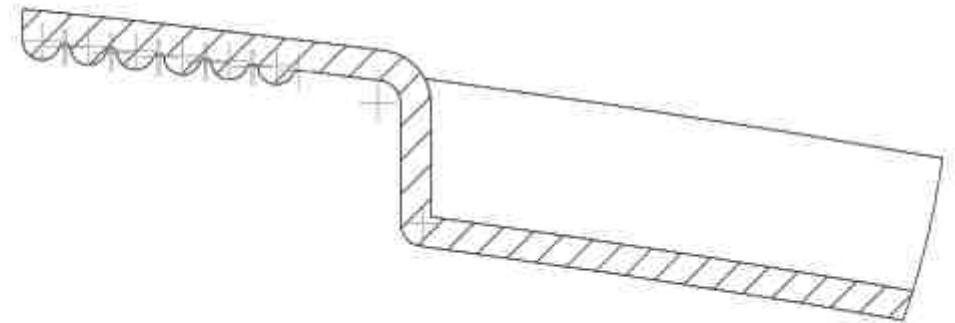
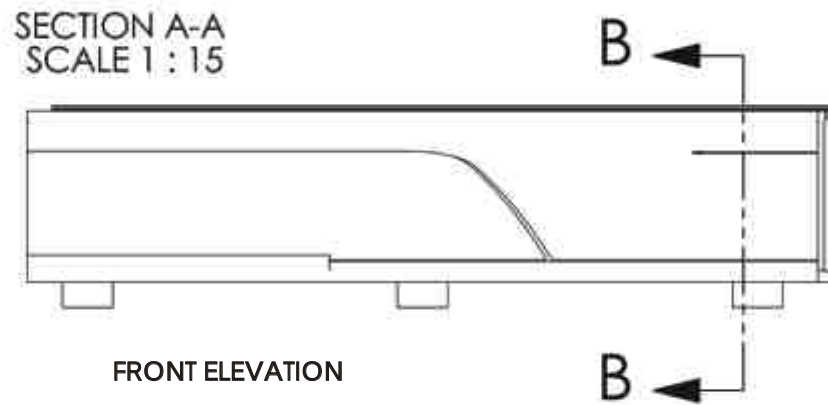
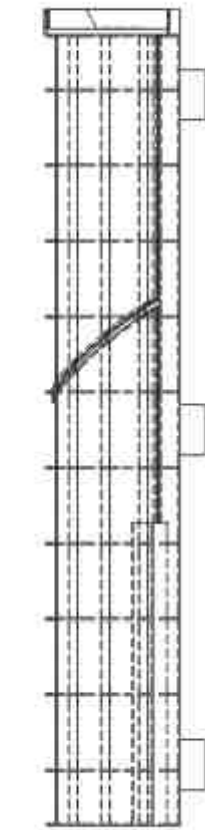
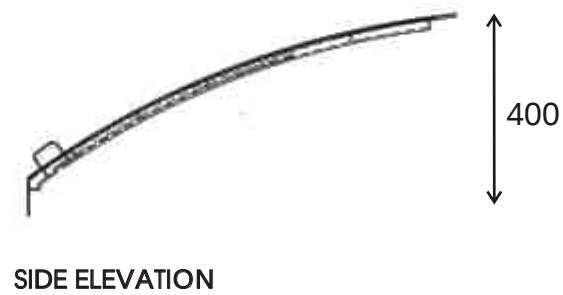
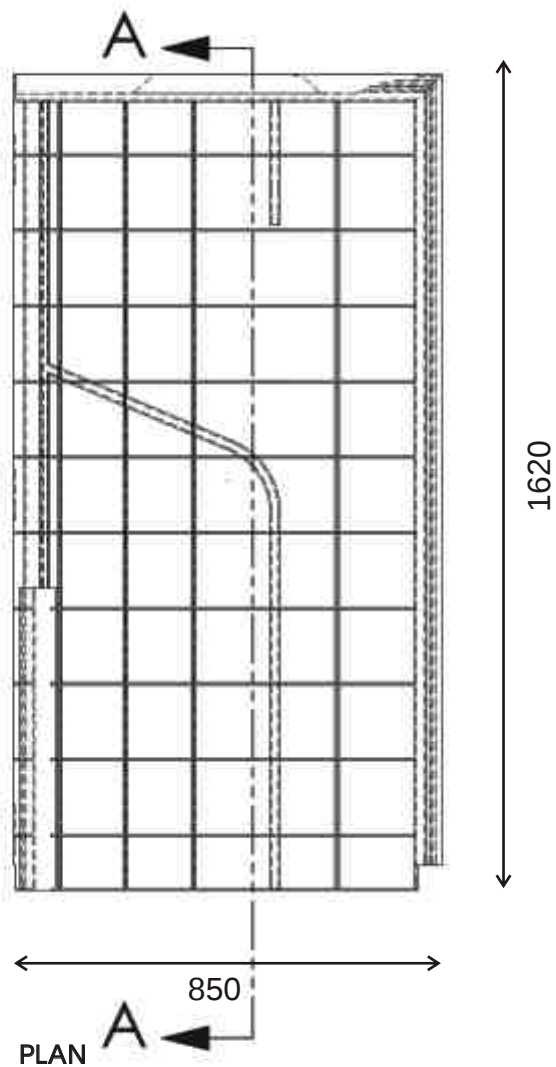


FEATURES:

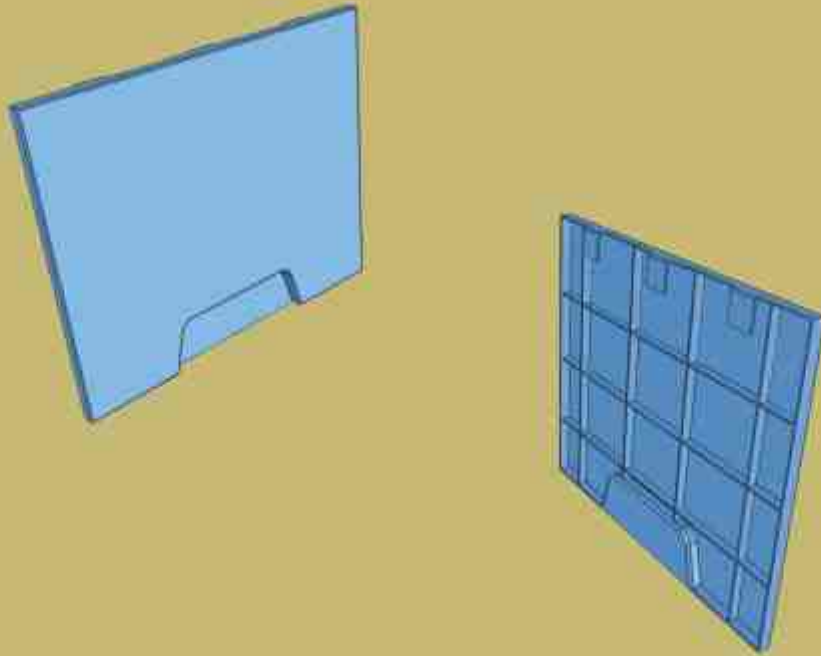
Structural polypropylene member used for spanning 1.5 m
Roof panel will hold ambient lighting units and AC vents.
Checkered grid is provided on the back side for strengthening
The panels will be snapped together on the sides for locking
Panels will be screwed on the top to the roof structure

UPPER DECK ROOF PANEL

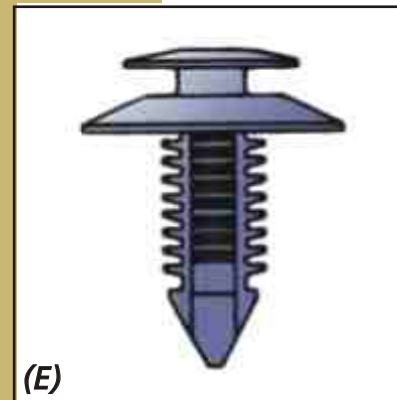




UPPER DECK ROOF PANEL



(D)



(E)

PLASTIC LUG using
Christmas tree detail

MID-PANEL

77

FEATURES:

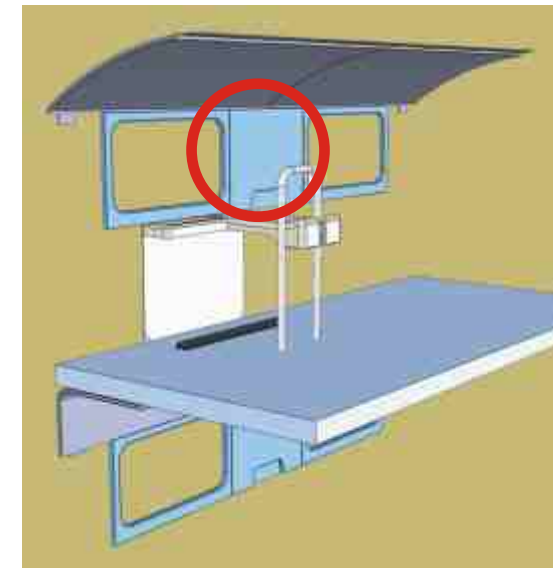
Structural polypropylene member used for mid panel

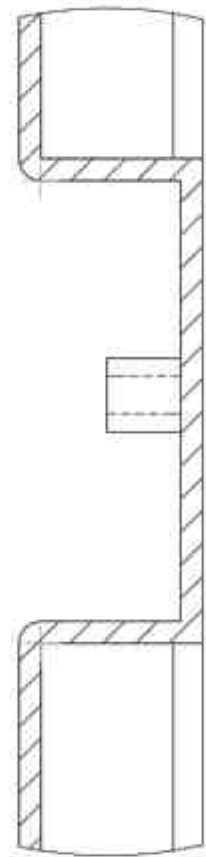
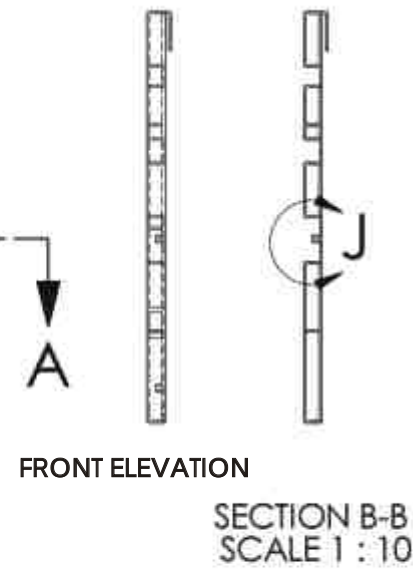
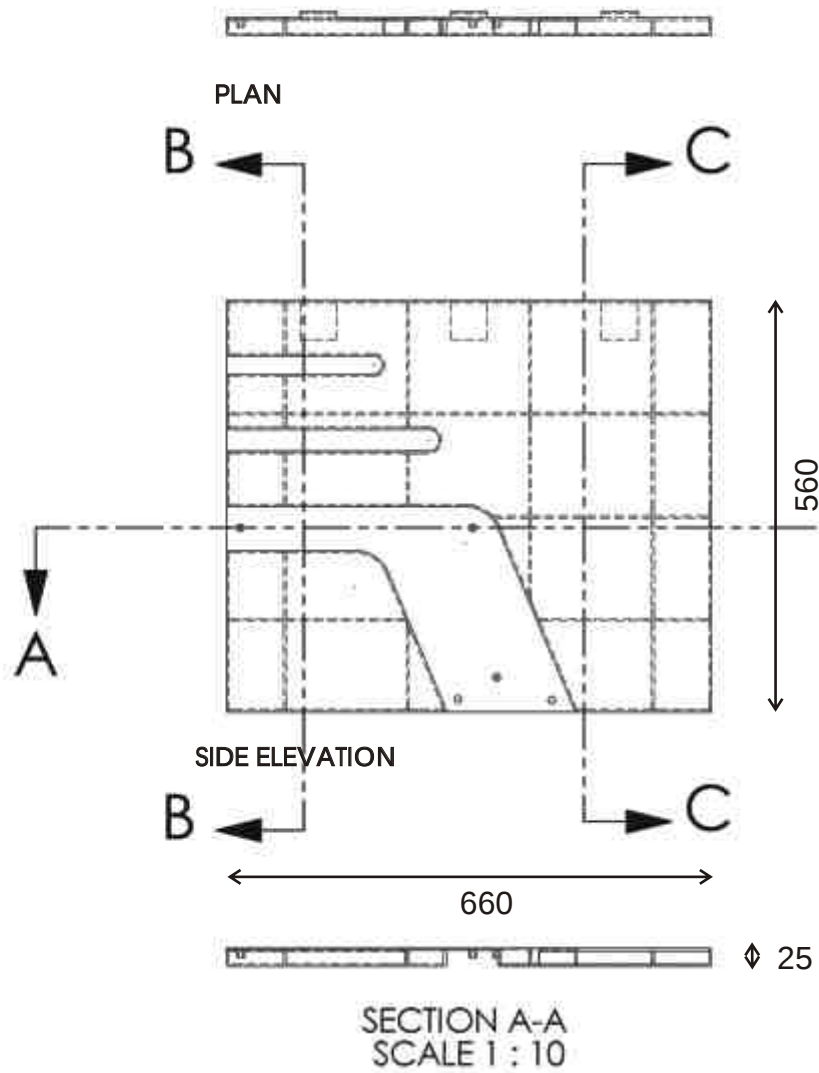
Mid-panel will have seat number indication.

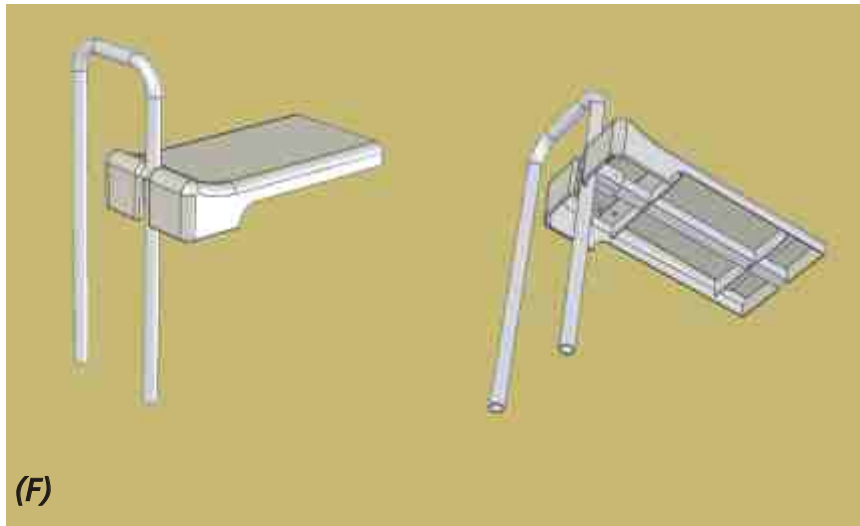
Checkered grid is provided on the back side for strengthening

The panels will be hung from the top onto the structure

Panels will be screwed on the bottom to the structure using plastic lugs/ metal screws







HEAVY LUGGAGE RACK

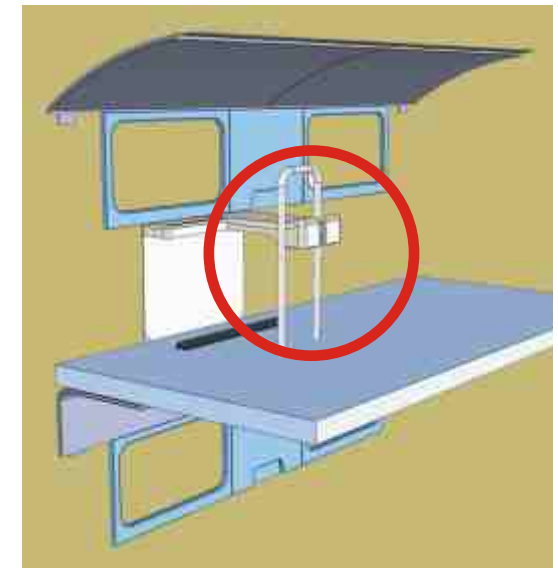
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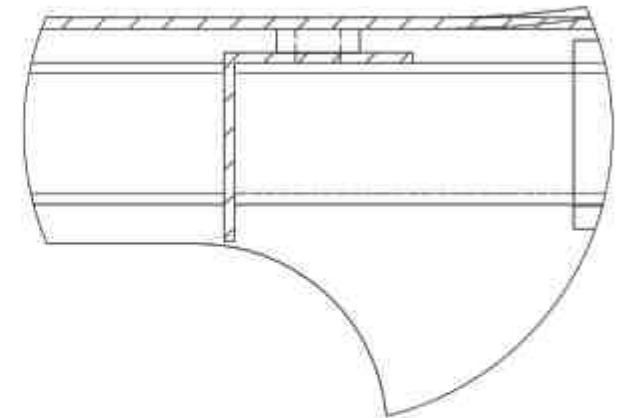
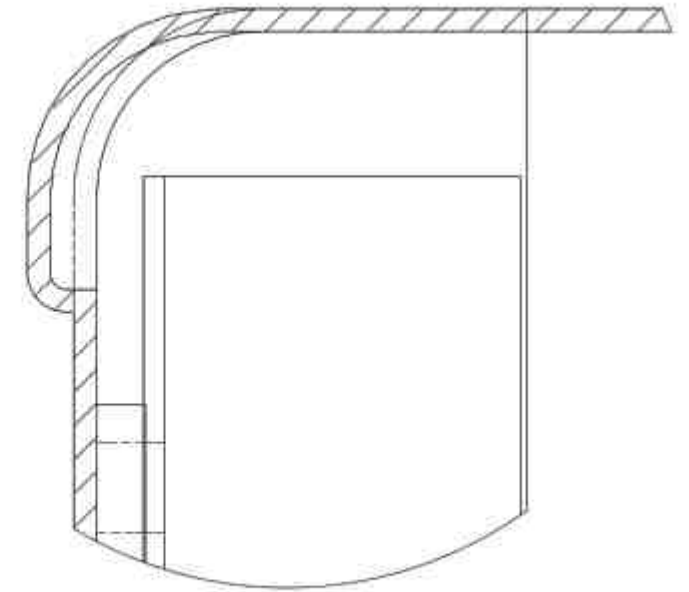
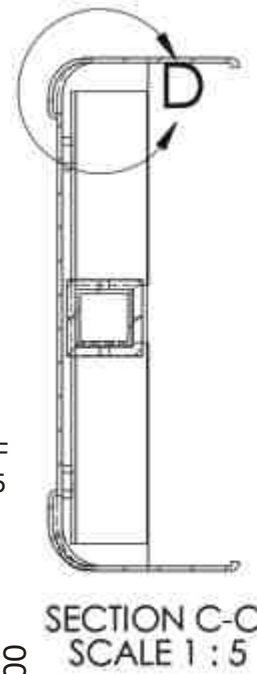
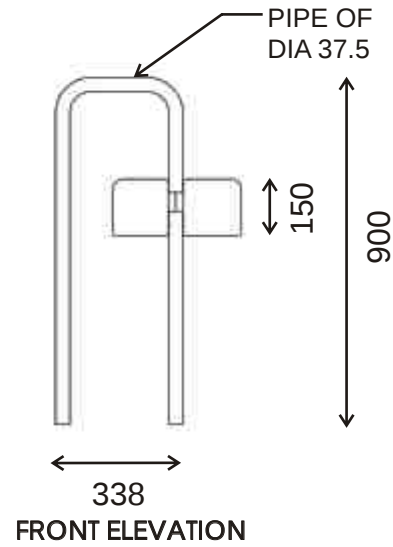
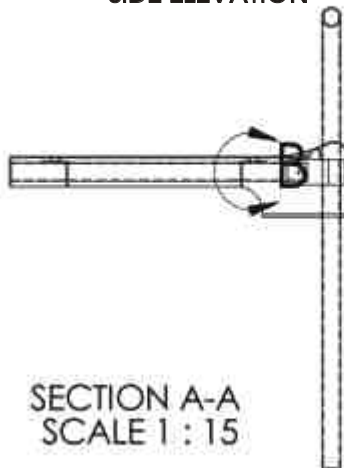
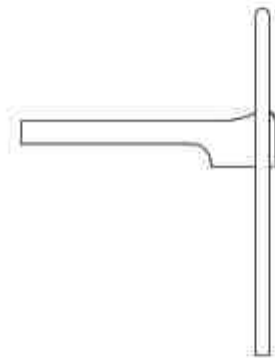
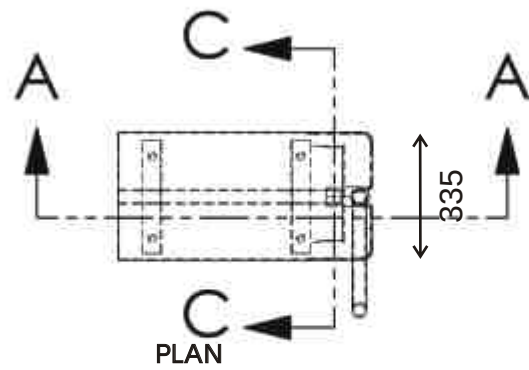
Structural polypropylene member used for heavy luggage rack
Smaller luggage is placed on top and heavy luggage is stored on the ground below the rack, restrained by an elastic strap.

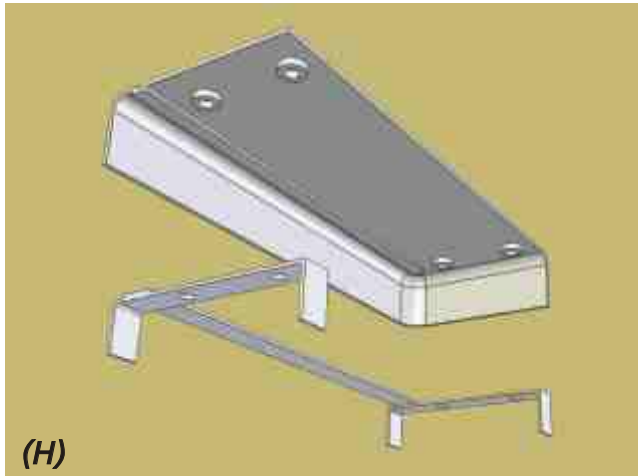
Support structure of MS is welded onto main frame of train structure
The grab handle is made of GI pipe with shrink- wrapped fire-proof coating or with(SS pipe and PU foam grip)

Plastic rack is screwed onto support structure using plastic bosses

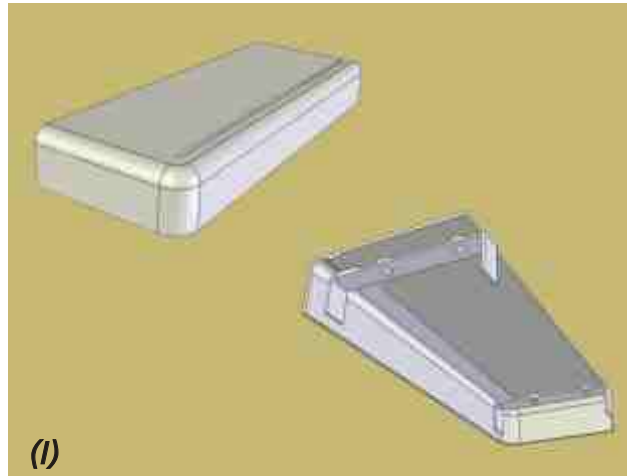
PVC







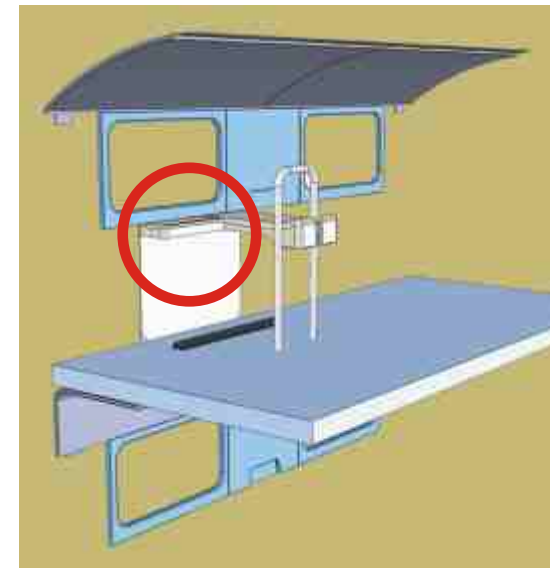
MINI LUGGAGE RACK

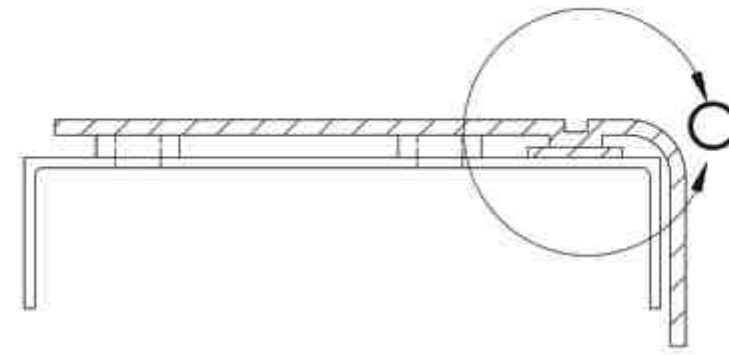
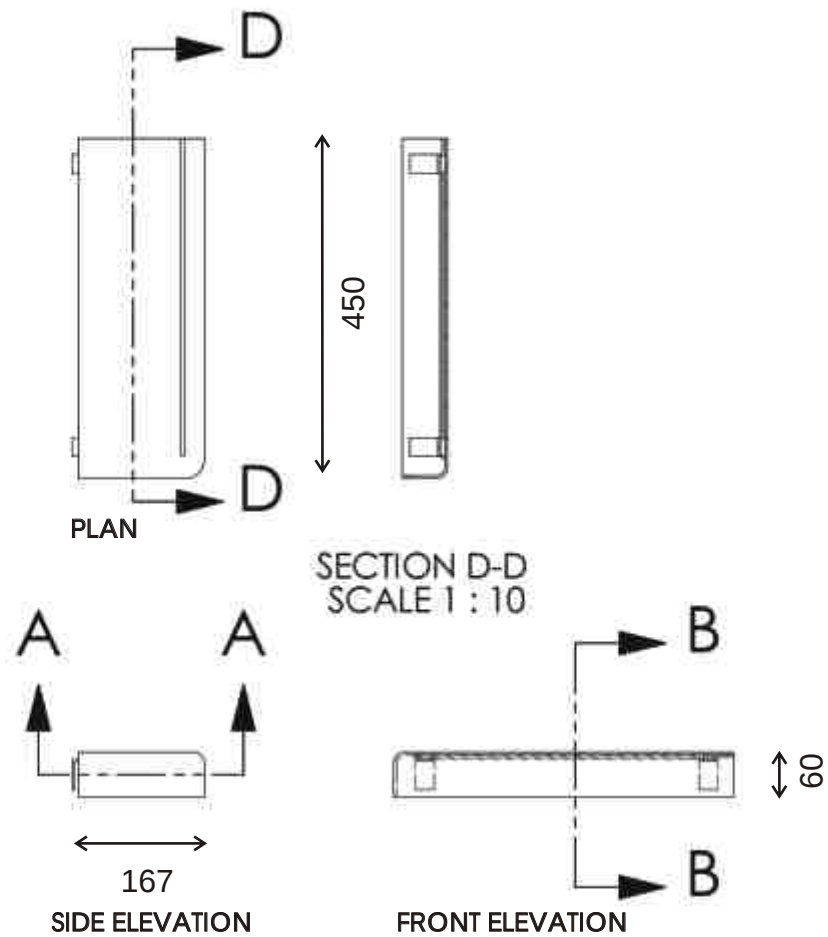


FLOOR STOPPER

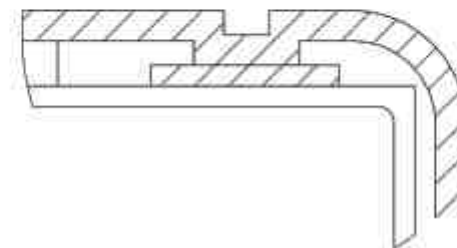
FEATURES:

Structural polypropylene member that sits on metal frame structure
 MS metal frame is welded onto main structure of train.
 PLASTIC BOSSES are screwed to the structure.
 The back panel continues from below this rack to the ground with an elastic restrainer to keep luggage in place.
 Floor stopper prevents the luggage from sliding into the aisle

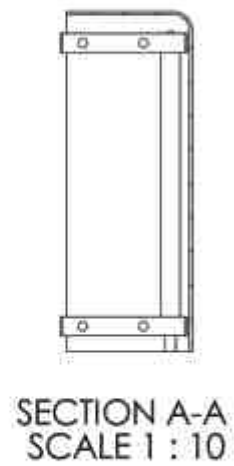


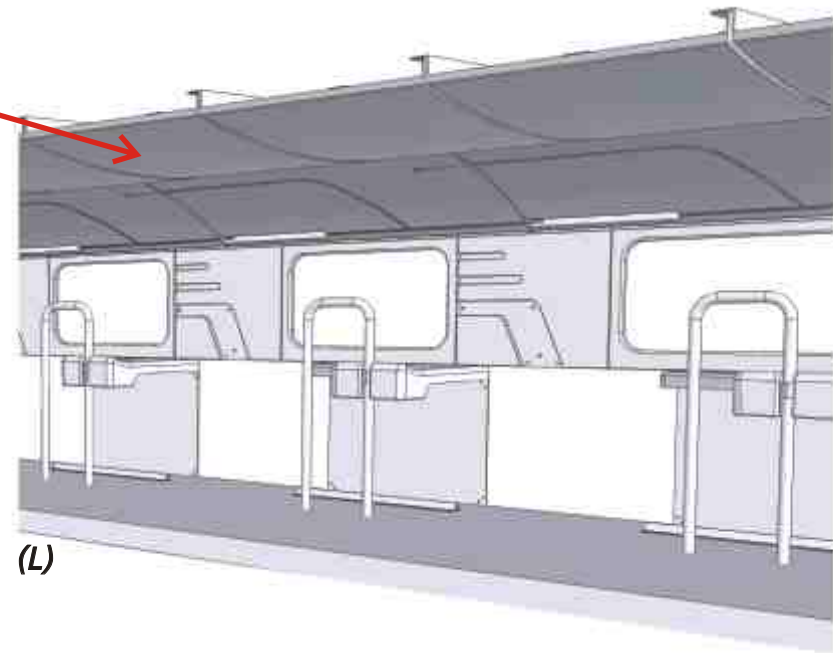
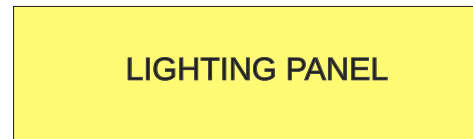


SECTION B-B
SCALE 1 : 2



DETAIL C
SCALE 1 : 1





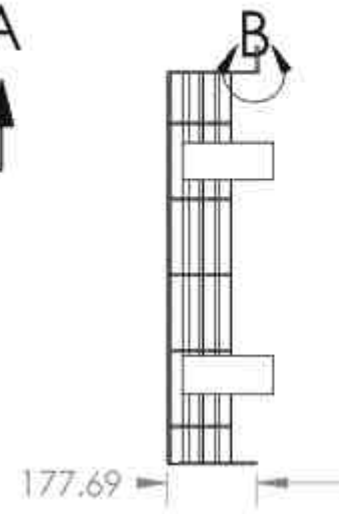
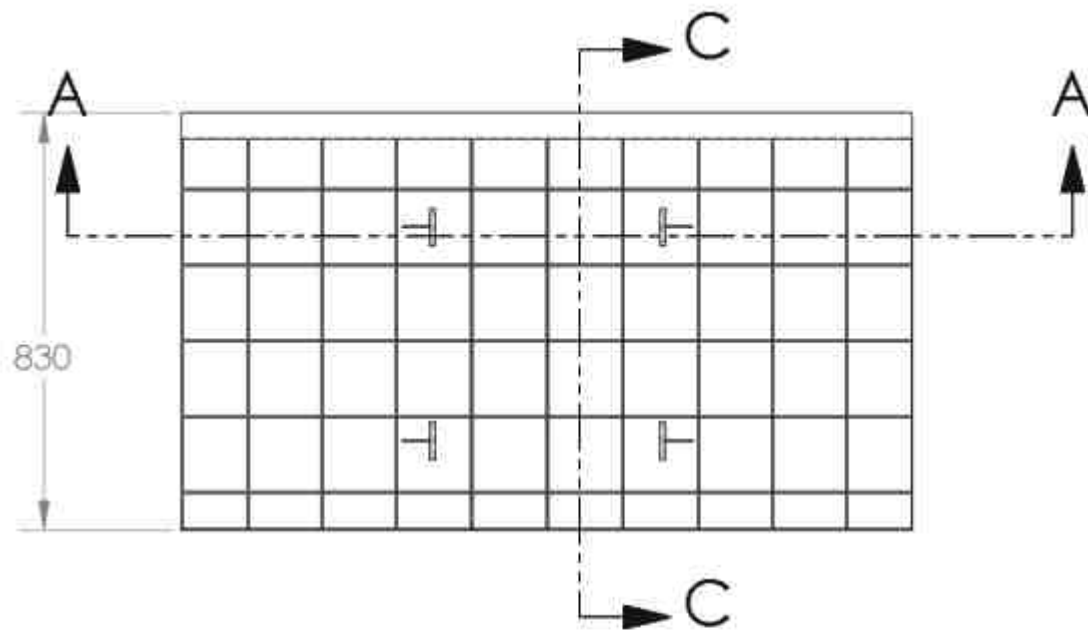
FEATURES:

Structural polypropylene member that hooks onto the aluminium frame above

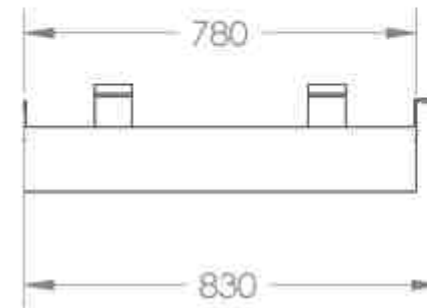
PLASTICSNAPS and tamper-proof screws help in fixing onto overhead supporting frame

Each panel is placed in series with a little offset from the roof panels to allow the diffused light from the LED lamps to filter out.

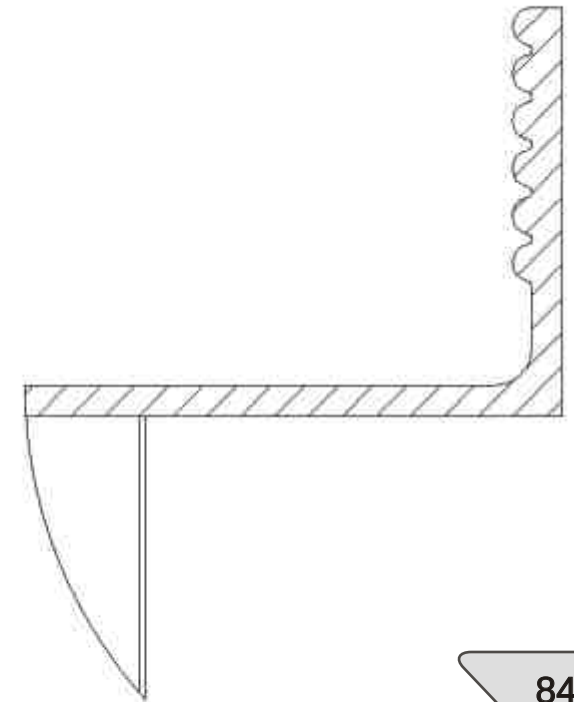
Each panel can be easily replaced in case of bulb fuse or any electrical maintenance.



SECTION C-C
SCALE 1 : 15



SECTION A-A
SCALE 1 : 10

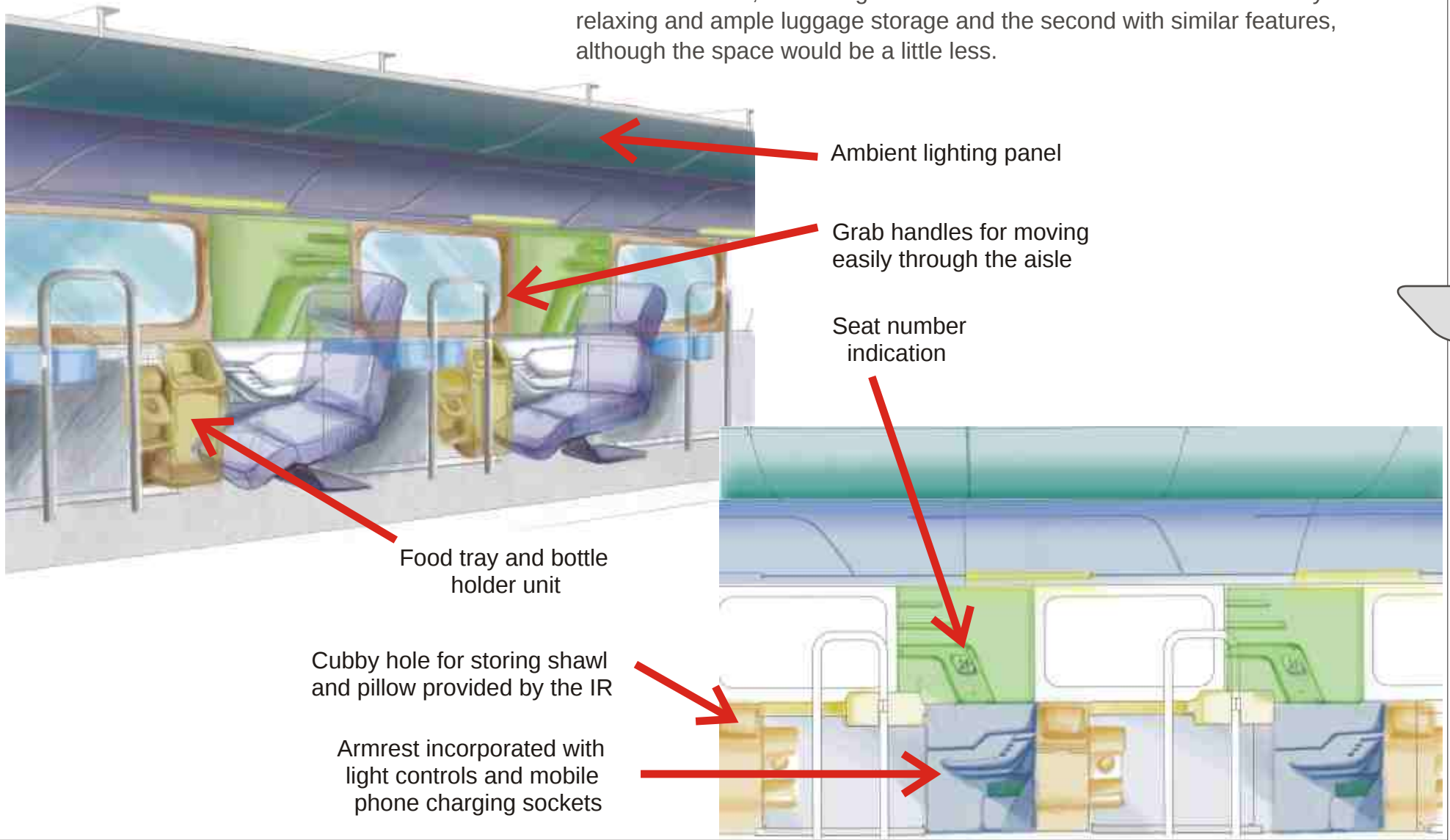


DETAIL B
SCALE 1 : 1

8. FINAL PROPOSAL

8.5 USER AMENITIES

The final concept would cater to two classes of passengers traveling in the AC Chair Car, one being more luxurious with comfort and luxury for relaxing and ample luggage storage and the second with similar features, although the space would be a little less.



9. APPENDIX



DOUBLE DECKER COACHES

These coaches are manufactured by the tier one agencies of the Indian Railways in both RCF(Kapurtala) and ICF (Perambur).

The double decker coach currently accommodates 136 passengers, although the space provided per passenger is less than the bare minimum requirements. It is not an air conditioned coach and has three floor levels. The coach has two double-door entries at the extreme ends of the coach on the intermediate floor level and has not been successfully used owing to the number of people egressing out of the bogey from just two exits.

The Indian Railways currently employs a total of 40 - 45 double decker coaches which are plying on the following routes:

SOURCE STATION	DESTINATION	TRAVEL TIME	TRAIN NAME
MUMBAI	SURAT	5 HRS	FLYING RANEE
MUMBAI	VALSAD	3 HRS	FLYING RANEE
MUMBAI	VADODARA	7 HRS	SWARAJ EXP

9. APPENDIX



The Indian railways is now toying with the idea of employing more double-decker coaches to increase the passenger capacity per route. This would also lead to an increase in revenue generation for the Indian Railways. The new design for double-decker coaches has been commissioned to the RCF, only proving the interest of the Indian Railways in developing this sector of transport.



Deccan Herald » National » Detailed Story

Rlys sets in train its double-decker idea

From B S Arun DH News Service New Delhi

After two-stack containers, it is double-decker passenger trains and triple-stack containers. In a determined bid to meet the passenger rush as well as to achieve a better market share in the cargo sector, the Indian Railways (IR) is chugging ahead with these two proposals in focus.

The idea of having double-decker passenger trains has created excitement in the Rail Bhavan, the headquarters of the railway ministry. The proposal, first mentioned by Railway Minister Lalu Prasad in his 2006-07 budget speech, is now being given shape by the Rail Coach Factory, Kapurthala in Punjab. Currently, the proposal is at design stage at RCF. The IR, it is learnt, has given no time-frame for RCF to make it ready. As the design undergoes serious study at the RCF, the Railway Board is considering how to make the double-decker train a working proposition. Several factors will have to be dealt with: the safety aspects would have to be studied — whether the already weary tracks can take the additional burden; the platforms at railway stations — the height factor as new stations may have to be built to accommodate these trains; the height factor will also make the synergy with electrical wires, if they are to be electrified and not diesel-run, a problem.

One-storey train

As Mr Prasad promised in his budget speech,

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[Http://www.americansofttrim.com](http://www.americansofttrim.com)
[Http://dams.rca.ac.uk](http://dams.rca.ac.uk)
[Http://www.deccanherald.com/deccanherald/sep192006/national1915172006918.asp](http://www.deccanherald.com/deccanherald/sep192006/national1915172006918.asp)
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Design of a passenger cum cargo microbus - P II - George, Thomas