

Product Design Two  
Final Presentation

# REDESIGN OF SEATING FOR INDIAN RAILWAYS - AC CHAIR CAR

FOCUSING ON INDIAN PASSENGERS NEED FOR RELAXING AND WORKING  
DURING TRAVEL

Project Guide  
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## Introduction

User study and analysis

Industry feedback

Product brief

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- Idea Cluster
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# INTRODUCTION



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).

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.



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# USER STUDY AND ANALYSIS



## ACTIVE PEOPLE WATCHING

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

## USERS STUDIED

User 1	35 M	Software consultant
User 2	23 M	MBA student
User 3	30 M	Sales personnel



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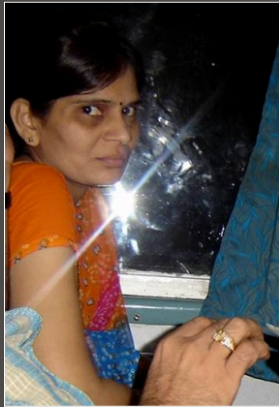
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## USER STUDY AND ANALYSIS



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

### STRATA OF SOCIETY:

High income professionals (management personnel, businessmen, doctors)

Upper class individuals who are concerned about luxury & safety

### AGE GROUP OF USERS

### PURPOSE OF TRAVEL

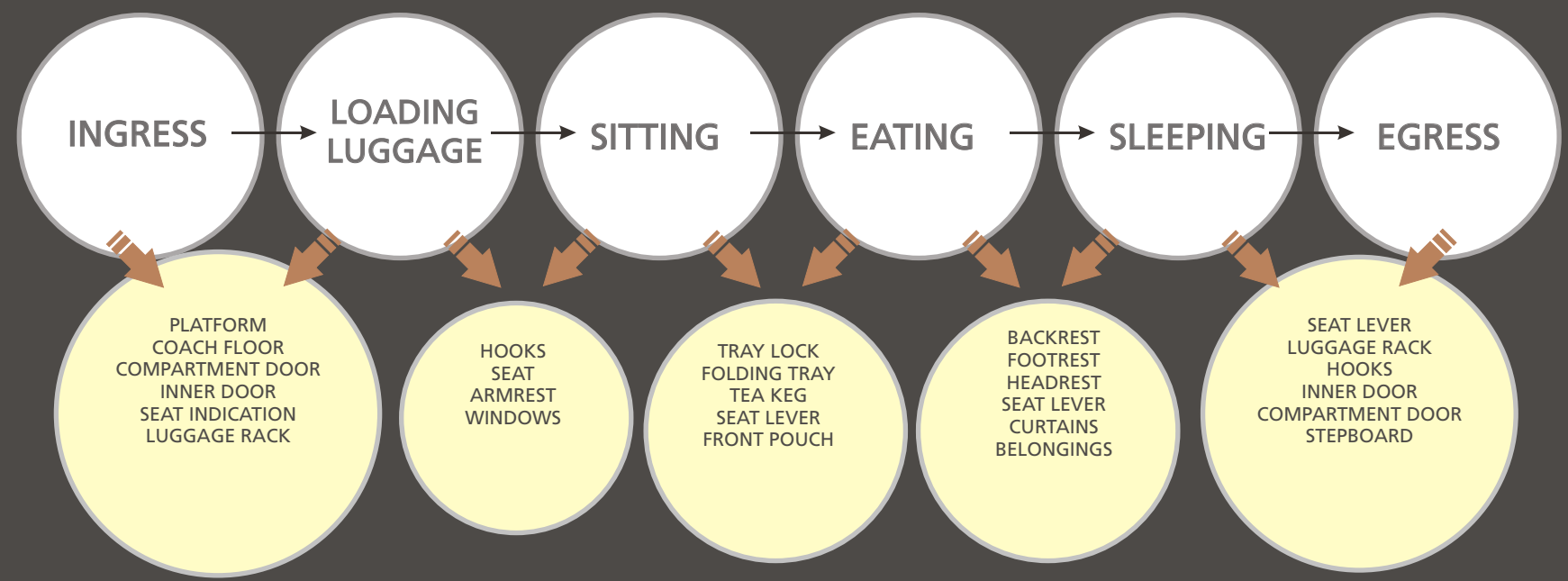
### REASONS FOR CHOICE OF AC CHAIR CAR

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# USER STUDY AND ANALYSIS

## ACTIVITY AND ERROR ANALYSIS

### ACTIVITY FLOW DIAGRAM



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# USER STUDY AND ANALYSIS

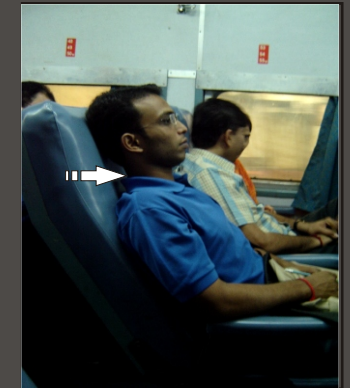
## SITTING



Footrest operation is hard



Footrest accessibility is low



Absence of neck support for shorter individuals



Armrest is shared by two users



Users respond differently with interesting postures for sitting.

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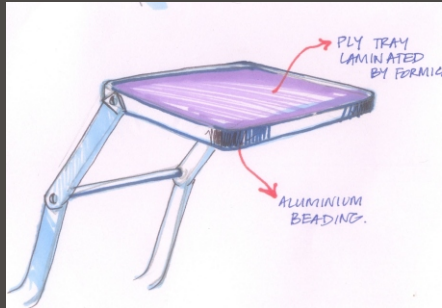
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# USER STUDY AND ANALYSIS

## EATING



Tray is too small and vibrates too much – hot drinks spill  
The metal tray gives the factor of cold touch in the AC Compartment



Once the tray is down, the inner passengers cannot egress easily



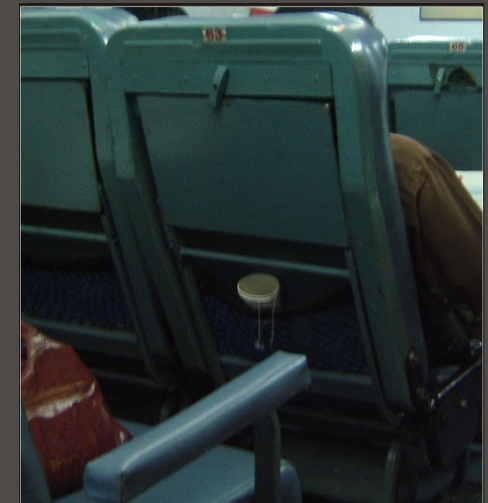
The tray is used for eating, sleeping and working



Passenger has to remove the wallet to pay the pantry server



The tray is used for working during travel



Waste disposal systems are not provided

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# USER STUDY AND ANALYSIS

## SLEEPING



Need to support legs at higher position



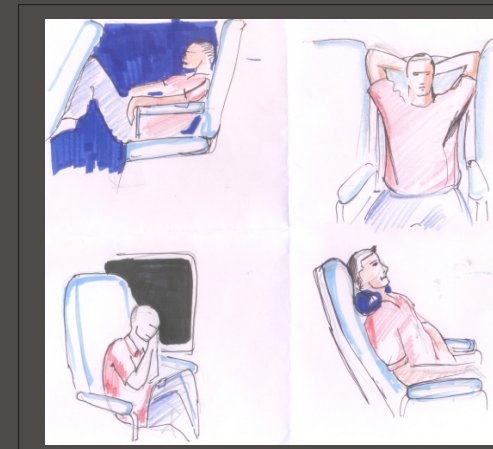
Seeks for head support in different ways



Change in Backrest position is a hindrance to user sitting behind



User sleeps lying flat using adjacent unoccupied seats



Acquires different postures for comfortable sleep

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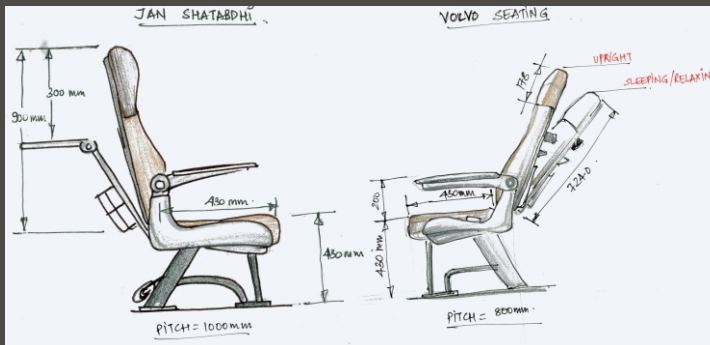
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# USER STUDY AND ANALYSIS

## OTHER CHAIR STUDY



Study of Volvo Bus Seating



Study of Executive Office Chair

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# USER STUDY AND ANALYSIS

## SURVEY

Asking a series of targeted questions in order to ascertain particular characteristics and perceptions of users.

## USERS INTERVIEWED

Total 10 users were directly interviewed to get their requirement and understand problems faced by them.

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

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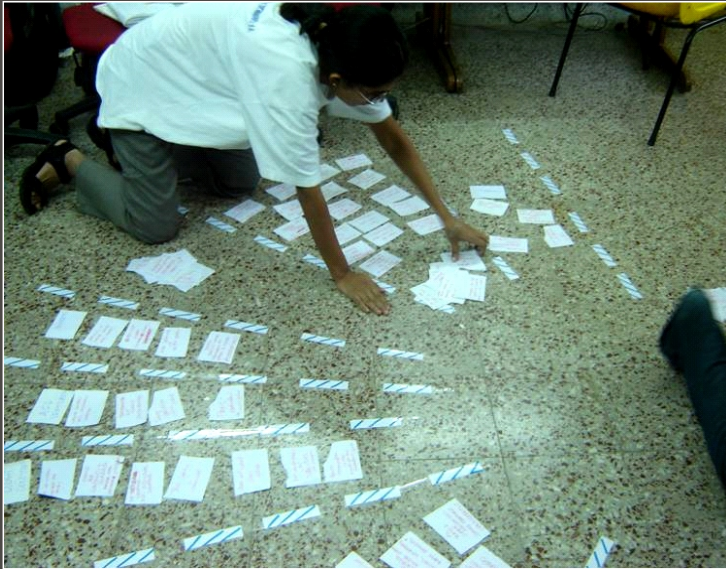
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# USER STUDY AND ANALYSIS



## ANALYSIS OF USER STUDY

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

## METHOD

Rapidly group ideas that seem to belong together.  
Clarify any ideas in question.

Copy an idea into in 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

# USER STUDY AND ANALYSIS

## DESIGN ISSUES

All the observations were tabulated in a format. The corresponding insight for each observation was noted against them. These insight helped to develop first stage design ideas

### 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
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

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## 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.

Further light was shed on design for ease of manufacture and durability in design by Mr. Ritesh Gohil at Harita Seating, Bangalore.

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

### HARITA SEATING, BANGALORE - MR. RITESH GOHIL

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

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# PRODUCT BRIEF

## PRODUCT BRIEF STATEMENT

**Design of Seating for AC Chair Car**  
**- which caters to Indian passenger needs of relaxing/working during travel**  
**Between cities.**

## DESIGN REQUIREMENTS

### Sitting

- Footrest to be provided addressing to Indian seating /Sleeping Postures.
- Footrest Should be easy to access and operate
- Head support should be provided for resting head
- Should cater to different postures that the passenger takes when s/he is alert or Relaxing
- Better utilization of space

### Sleeping

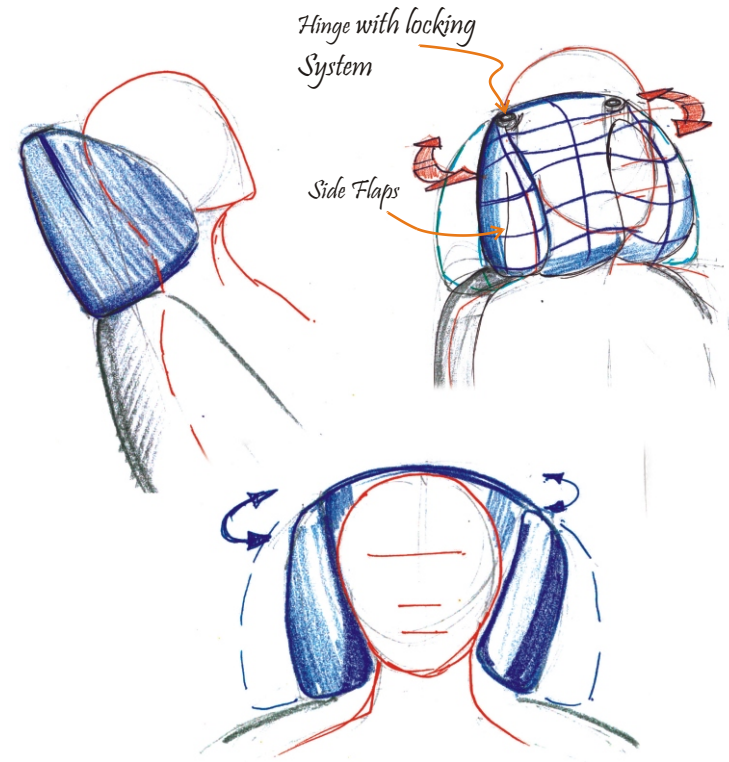
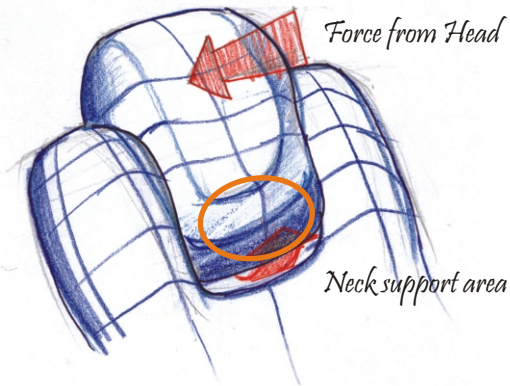
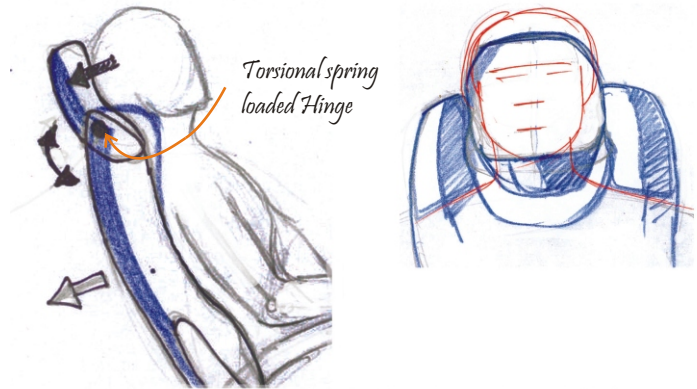
- Reclining the backrest should cause minimum hindrance to the passenger occupying the rear seats.
- Adjustability for the user to support head in different ways
- Allow the user to get his/her comfortable sleeping posture

### Safety & Maintenance

- should be safe in case of accident, have good serviceability and reliability with robust detailing.

# IDEA GENERATION

## IDEA LOG:



### Idea 1

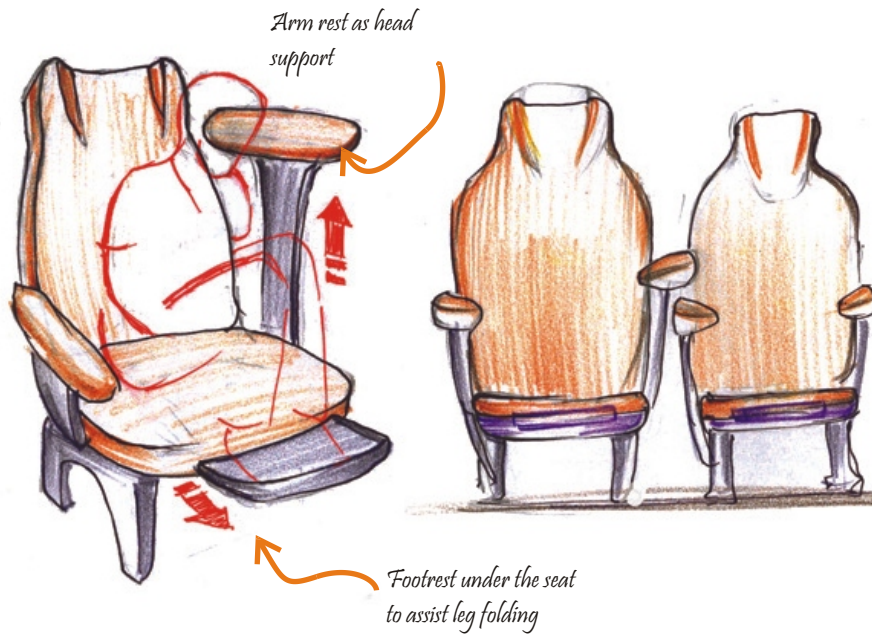
The Head rest is hinged just below the head contact area and above the neck. The hinge has a torsional spring. As the user rests his head on the head rest the area below the hinge moves forward and supports the neck.

### Idea 2

This has two hinged side flaps which can be locked at the desired position. Each flap can be individually controlled, so it allows the user to decide the side where he wants to rest his head. The flaps are cushioned with breathing material.

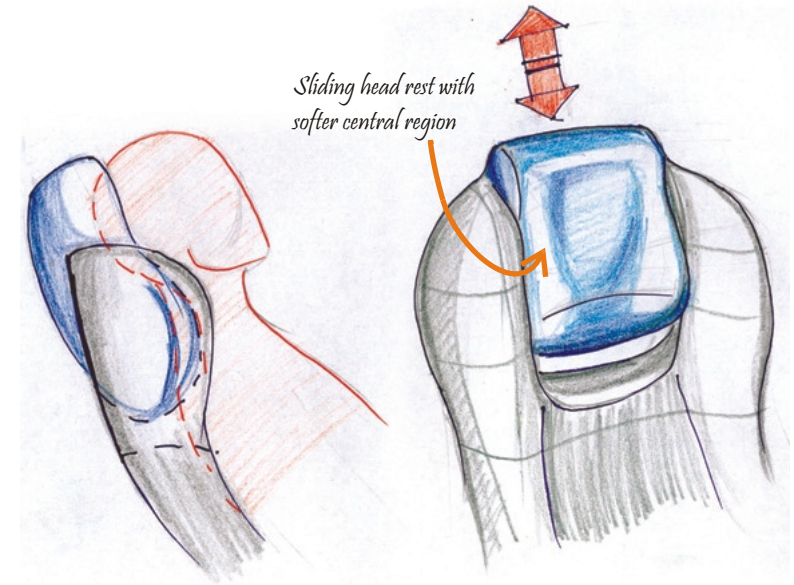
# IDEA GENERATION

## IDEA LOG:



### Idea 3

In this the armrest of the chair slides to desired height to support the head when sleeping. It also has a sliding footrest just under the seat which can be used to support legs in folding.

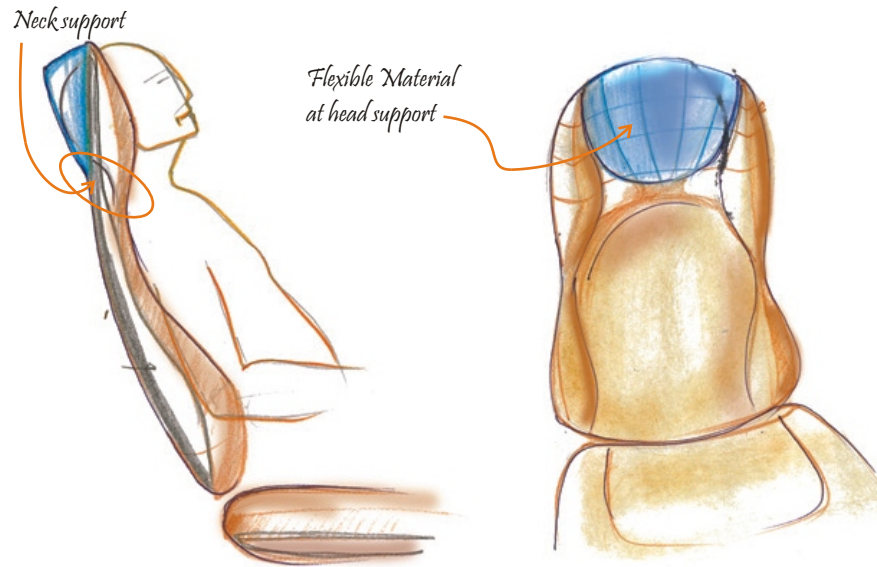


### Idea 4

The head rest can slide within a certain range to consider the variation in user heights. The softer central area sinks in with the head pressure and the harder region below supports the neck.

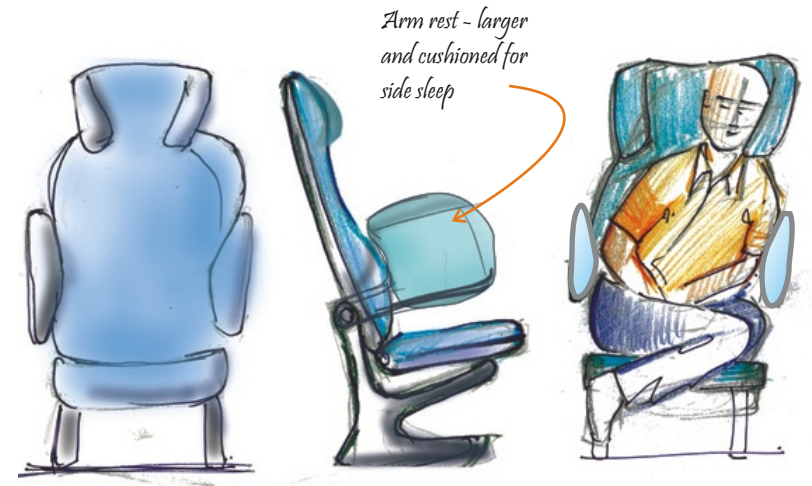
# IDEA GENERATION

## IDEA LOG:



### Idea 7

The thin flexible material provided at the head resting area stretches and sinks in to accommodate the head like a bucket. The lower region below the flexible material is harder and would support the neck.

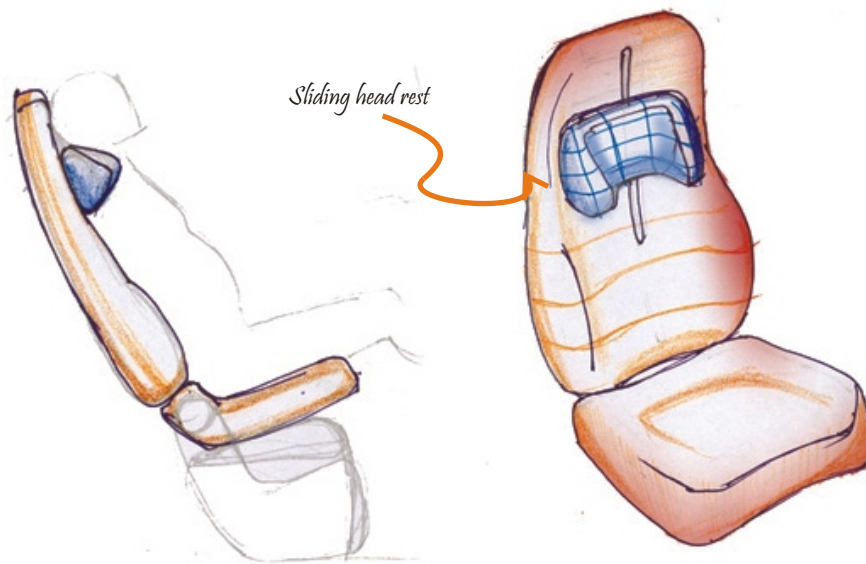


### Idea 8

This has two fixed side flaps which act as cocooning of the head. The arm rests are larger and cushioned which acts to support the body in side sleeping.

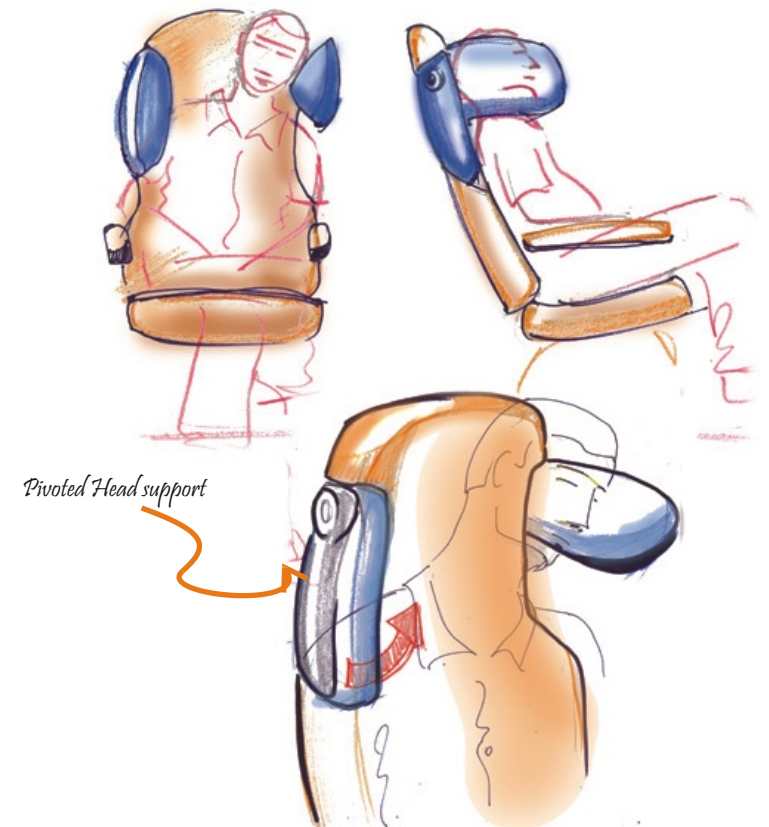
## IDEA GENERATION

### IDEA LOG:



#### Idea 5

The Head rest has is a movable unit and has side supports. This head rest slides on the back rest. It can be adjusted and locked at the desired height by the user. It can also be cleared off from the head region if the user wants to have a different sleeping posture.



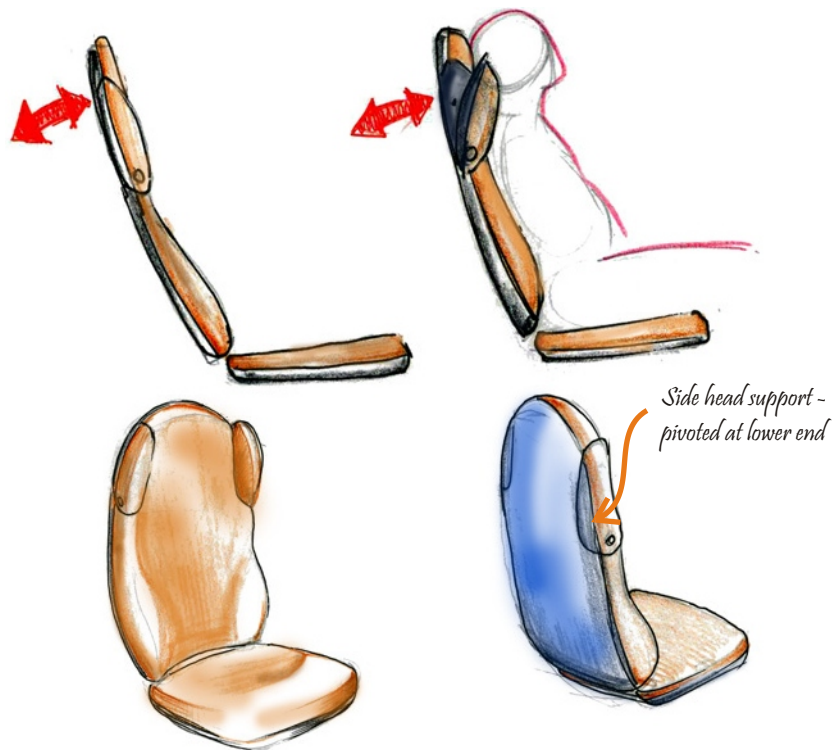
#### Idea 6

In this there are two side flaps which are pivoted just above the shoulder. The flaps can be individually rotated about their pivot and locked at desired heights. These can be used as head supports while sleeping.

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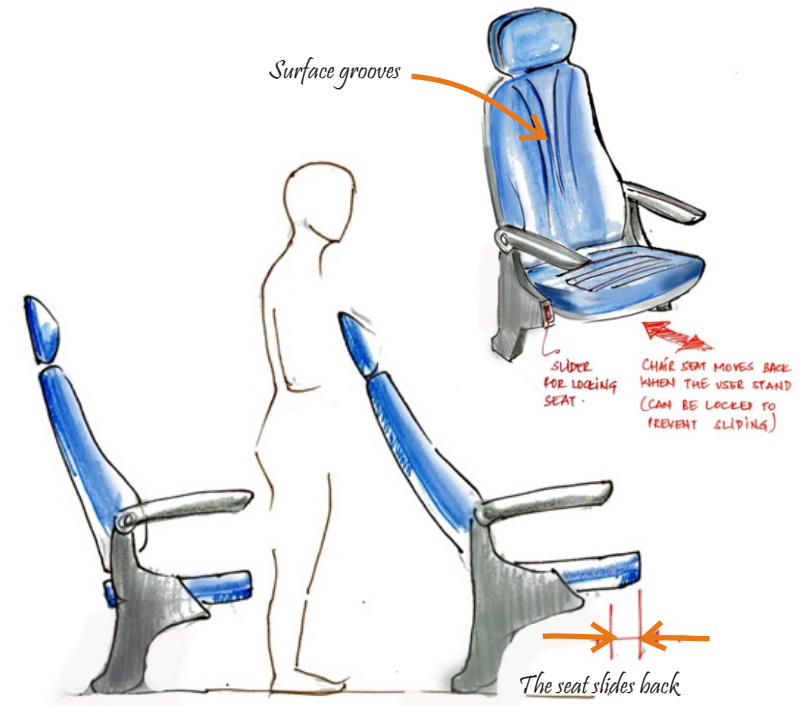
## IDEA GENERATION

### IDEA LOG:



#### Idea 9

In this the head support is pivoted at the lower end. This support flaps can be swivelled to support the head.

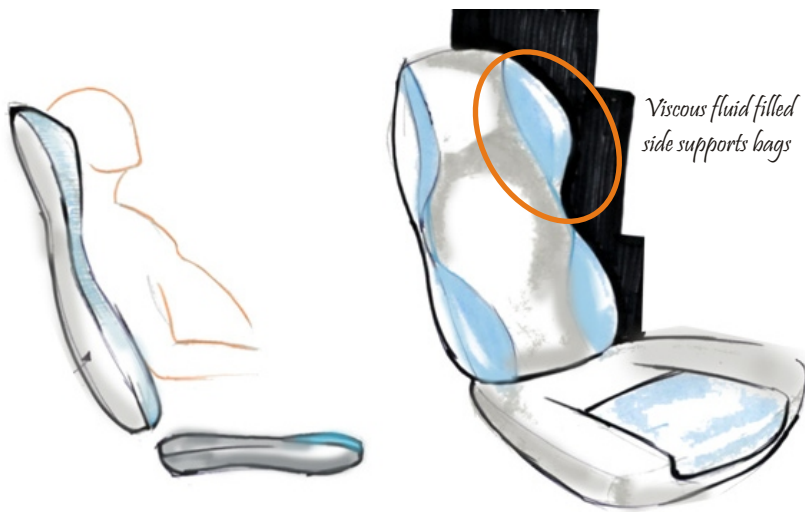


#### Idea 10

Here the seat would slide back when the user stands and pushes it. This would increase the space for the user to stand and move about the place. The chair surface are provided with grooves for better air circulation over the user skin.

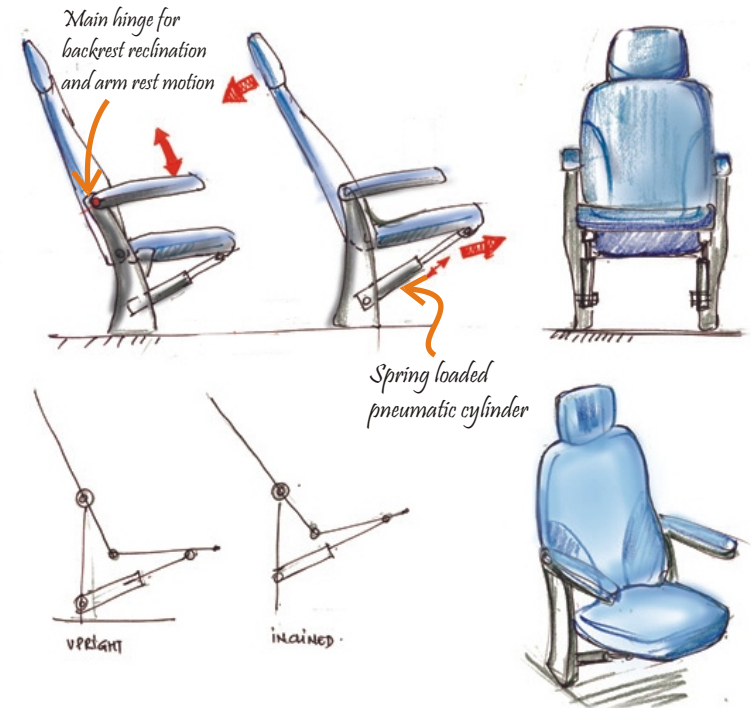
# IDEA GENERATION

## IDEA LOG:



### Idea 11

In this the back rest and side support bags are filled in with a viscous fluid which adjust according to the user body type.



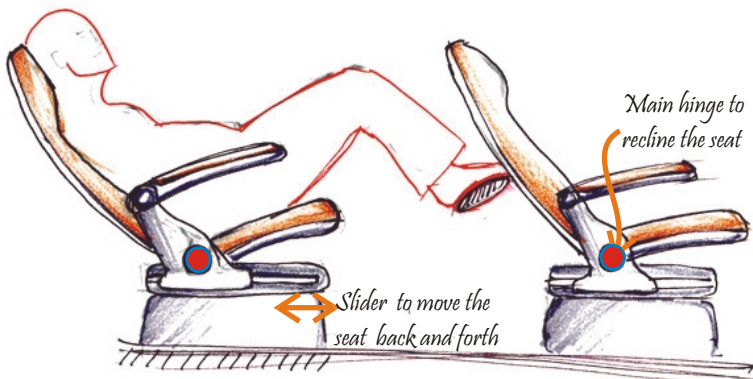
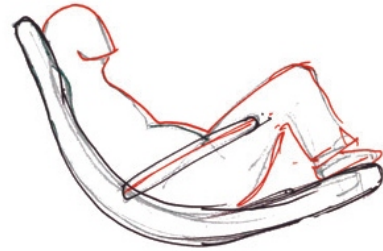
### Idea 12

This seat is based on different mechanism for reclination. The linkage diagram is shown in the above sketch. This would give a kind of stressless back angle.

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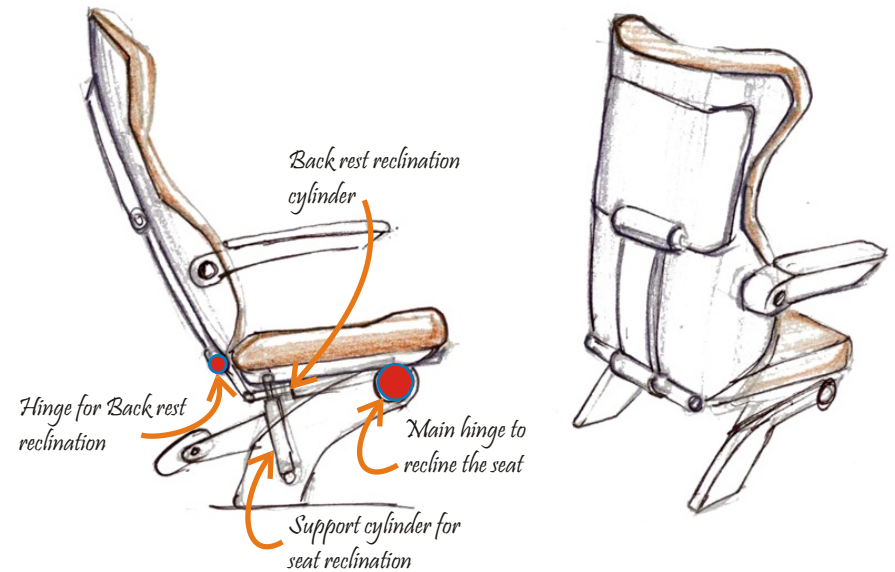
# IDEA GENERATION

## IDEA LOG:



### Idea 13

In this the back rest reclines along with the seat moving up. Here the whole seat slides back with the reclination of the backrest. This combined motion of the back reclination and



### Idea 14

This seat has two hinges. About the main hinge the back rest and the seat recline together. The back rest reclination can be further controlled by the second hinge. This

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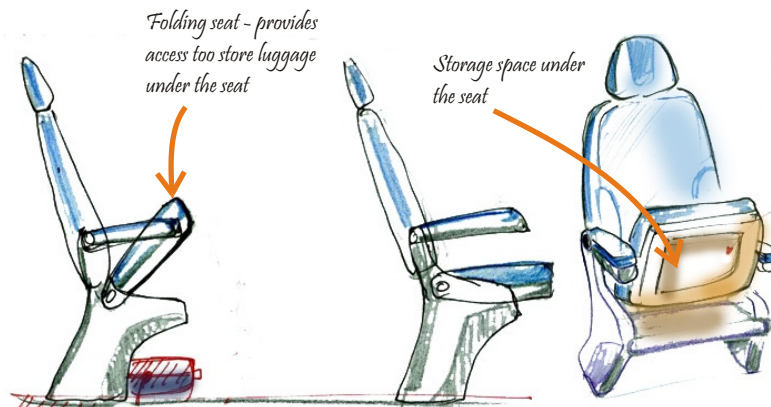
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## IDEA GENERATION

### IDEA LOG:

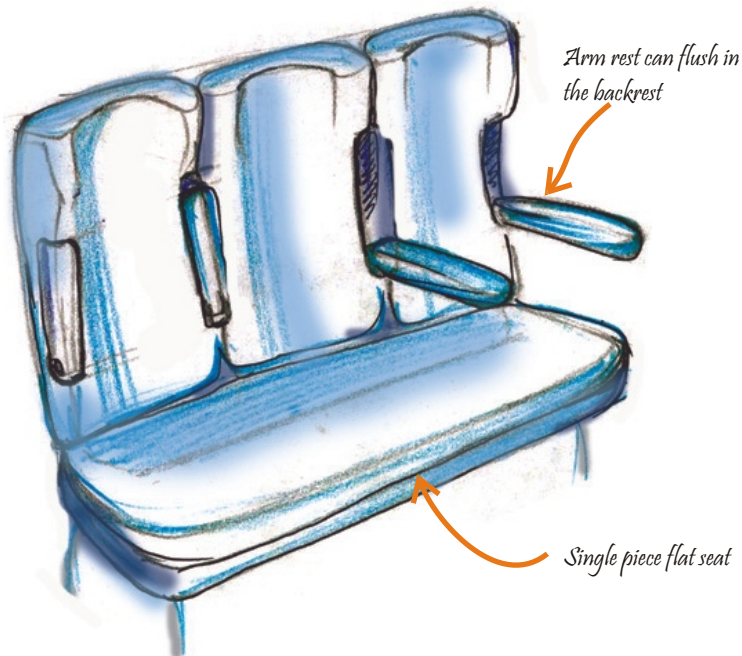


### Idea 15

Here the seat folds up when the user moves out from it. This will provide more area for the user to move about the seat area. Storage space may be provided for small luggage below the seat.

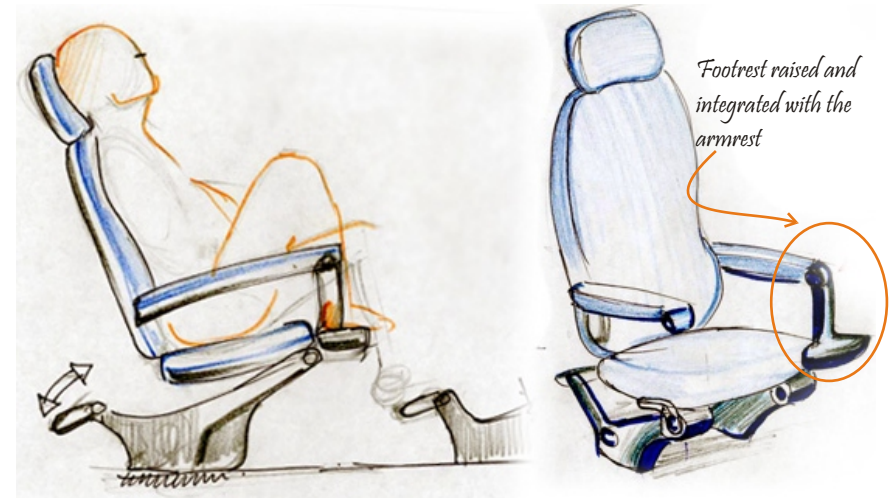
## IDEA GENERATION

### IDEA LOG:



#### Idea 16

This is a bench kind of seating. Here the armrest flushes into the back rest, and the seat is a single flat surface. So when the users are traveling with family members they can seat comfortably without the armrest obstructing them. Also the single flat seat would permit the user to lye on it flat when the adjacent two seats are unoccupied.

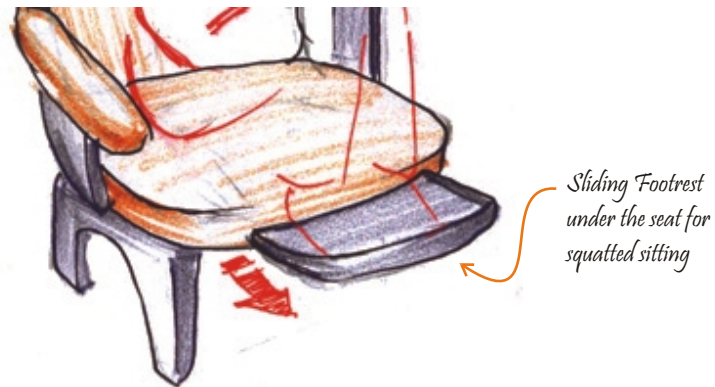


#### Idea 17

The footrest is integrated in the arm rest. This footrest is closer to the seat so that the user can rest his legs at raised height. It can be folded back when not in use. The lower footrest can be rotated about its hinge so that user positions it as per his/her requirements.

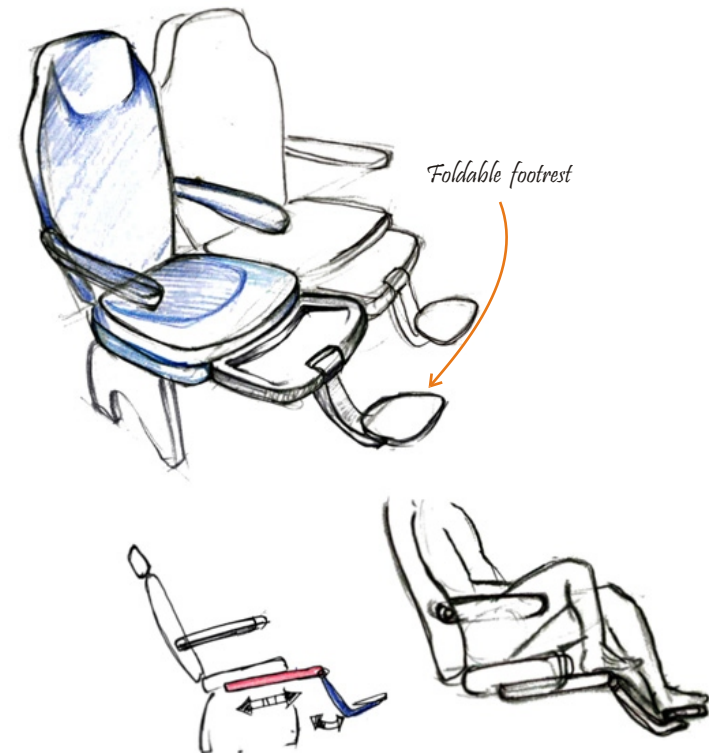
## IDEA GENERATION

### IDEA LOG:



#### Idea 18

In this seat a sliding footrest is provided just below the seat. This permits the user to seat/sleep in folded leg posture or keep his legs at raised position.



#### Idea 19

This seat has two footrest at two positions. the sliding footrest can be used without having to use the foldable footrest. The user can open up the foldable footrest and use as shown in sketch.

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# CONCEPTUALISATION

## IDEA CLUSTERS

The idea sketches were then clustered according to the core functions they addressed. Different concepts evolved as they addressed different attributes of the product brief to varying degrees of importance. Three clusters were made out of the numerous ideas generated:

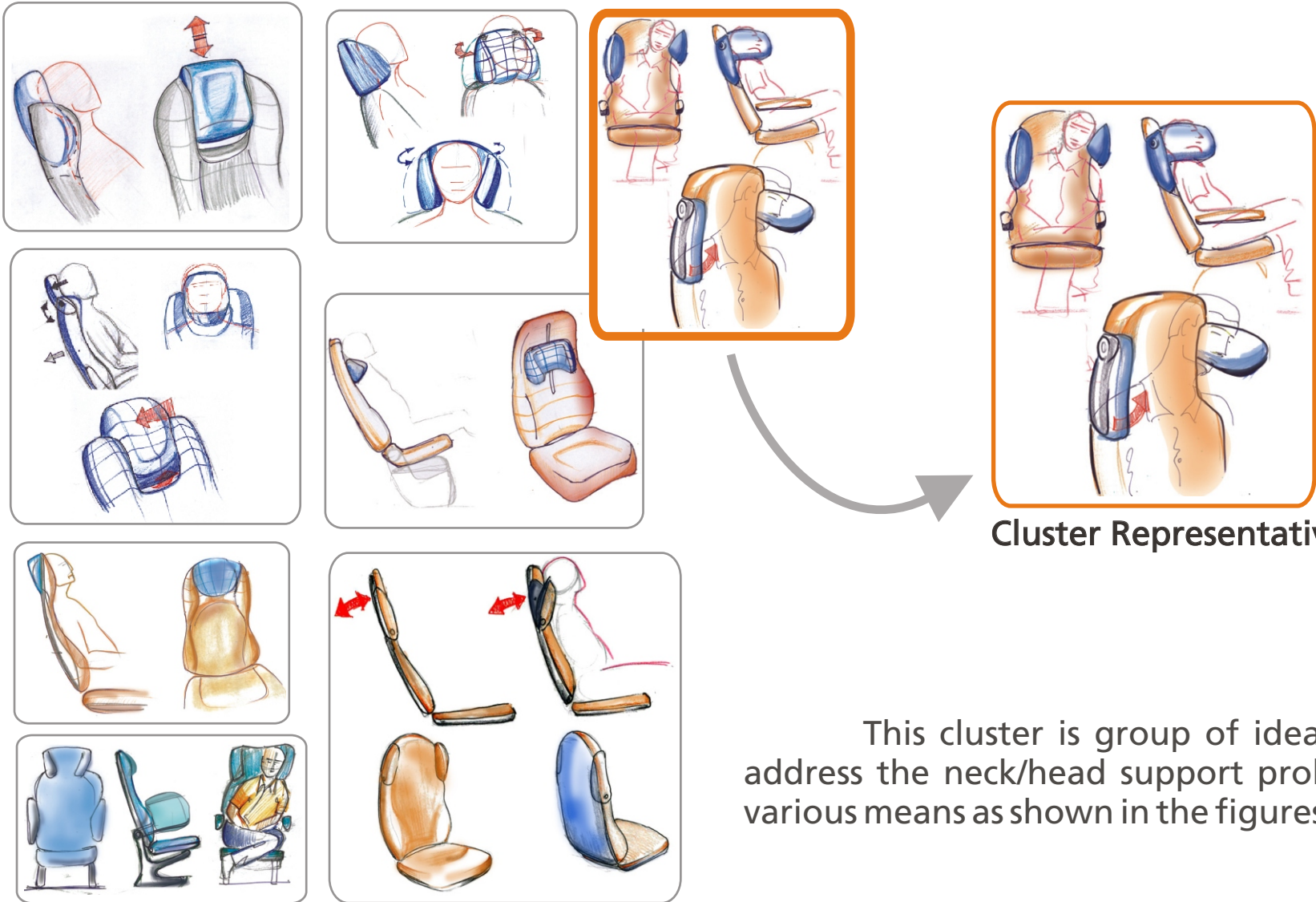
**HEAD/NECK SUPPORT** - Cluster One

**FOOTREST ARRANGEMENT** - Cluster Two

**SEAT RECLINATION SYSTEM** - Cluster Three

# CONCEPTUALISATION

## HEAD/NECK SUPPORT CLUSTER



**Cluster Representative**

This cluster is group of ideas which address the neck/head support problem by various means as shown in the figures.

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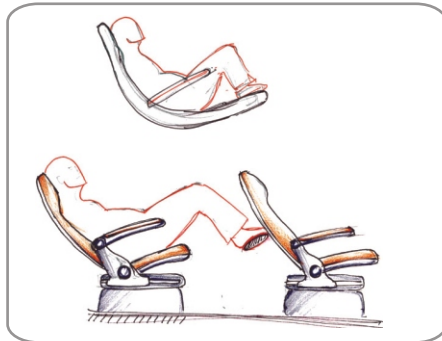
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# CONCEPTUALISATION

## FOOTREST ARRANGEMENT



**Cluster Representative**

This cluster is group of ideas which address the footrest and seating posture problem by various means. The main concern was to take into account the Indian way of sitting which was observed during the user study.

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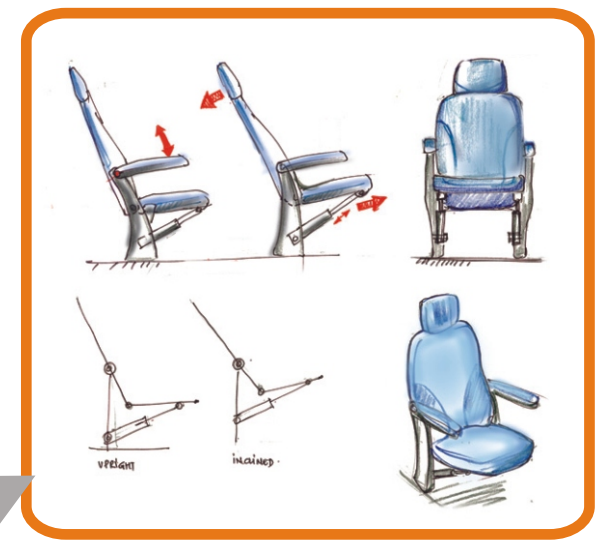
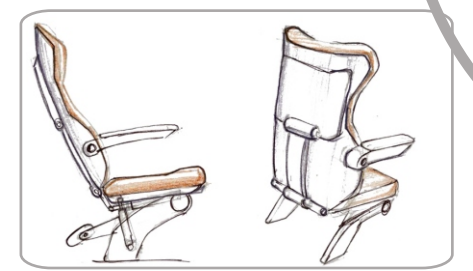
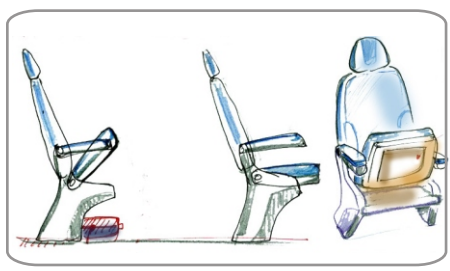
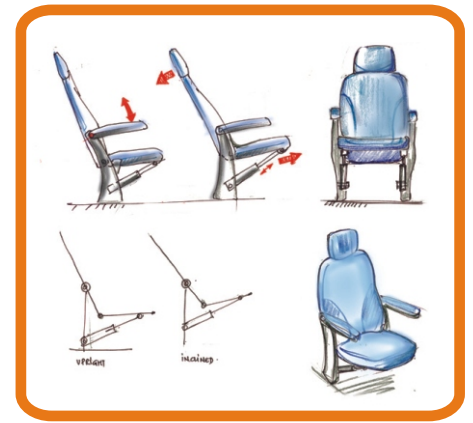
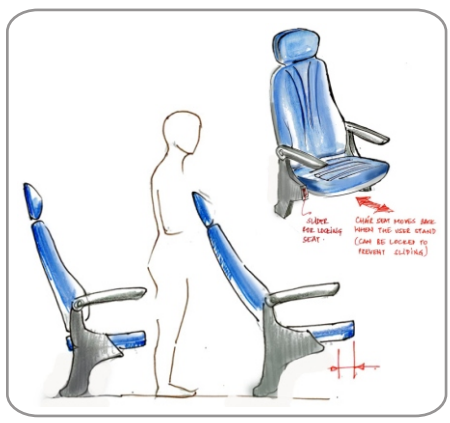
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**Cluster Representative**

This cluster is a group of ideas which address the reclination mechanism that is incorporated in the seat. These ideas also consider the space utilization around the seat.

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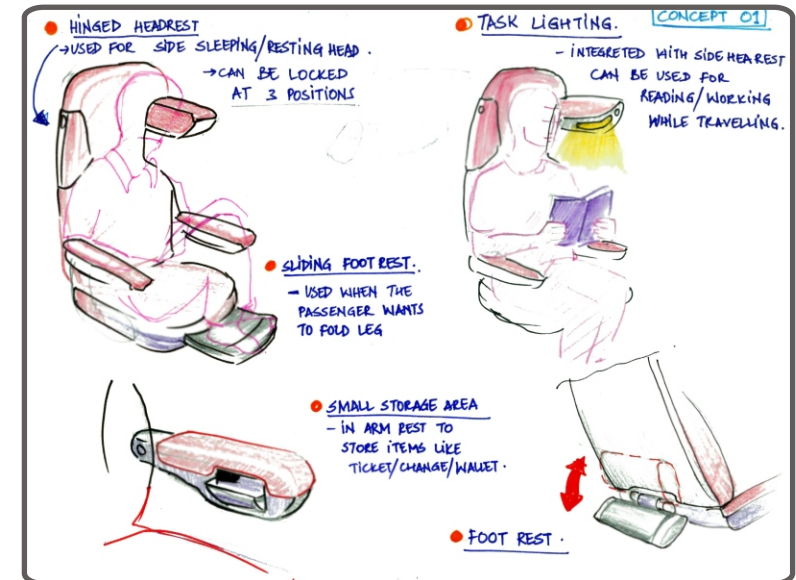
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# CONCEPTUALISATION

## CONCEPT ONE

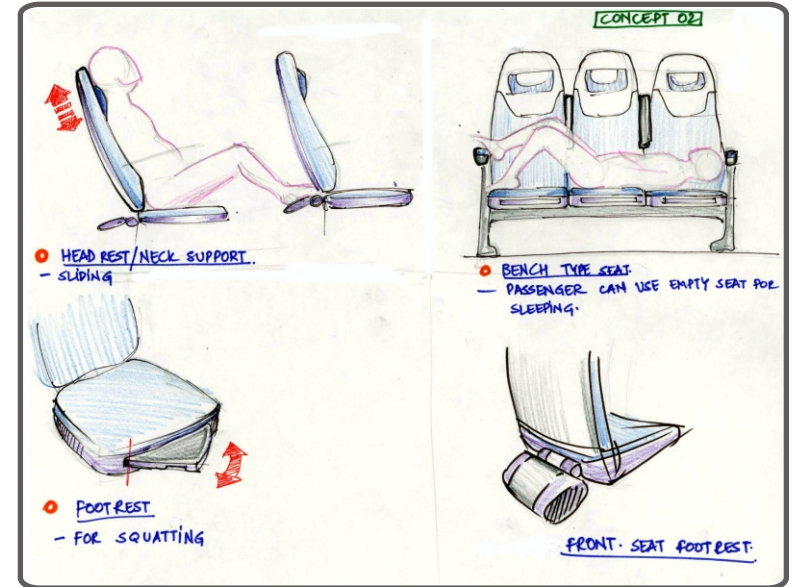


### Concept One:

This concept addresses to the problem of head support during sleeping with the two slide head supports provided. The footrest is just under the seat which addresses the folded/raised leg seating postures of the user. The side head supports has user controlled task lighting. A wider arm rest has provision for storage of small personnel items.

# CONCEPTUALISATION

## CONCEPT TWO



### Concept Two:

This concept has a main feature of bench type sleeping. The seat would be flat so that if the other seats are unoccupied a user can sleep lying flat. Also when the adjacent users are family members they can sit close to each other without the arm rest obstructing them.

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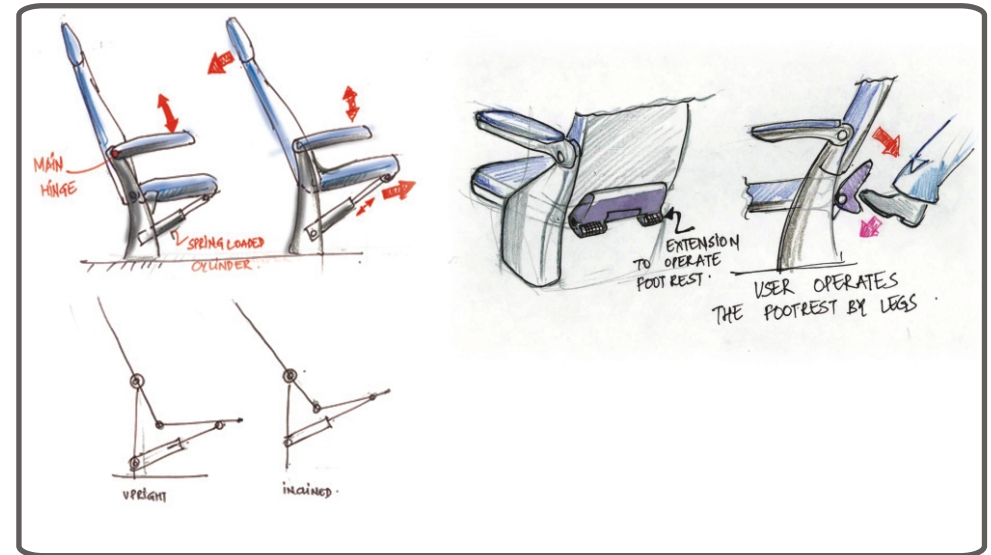
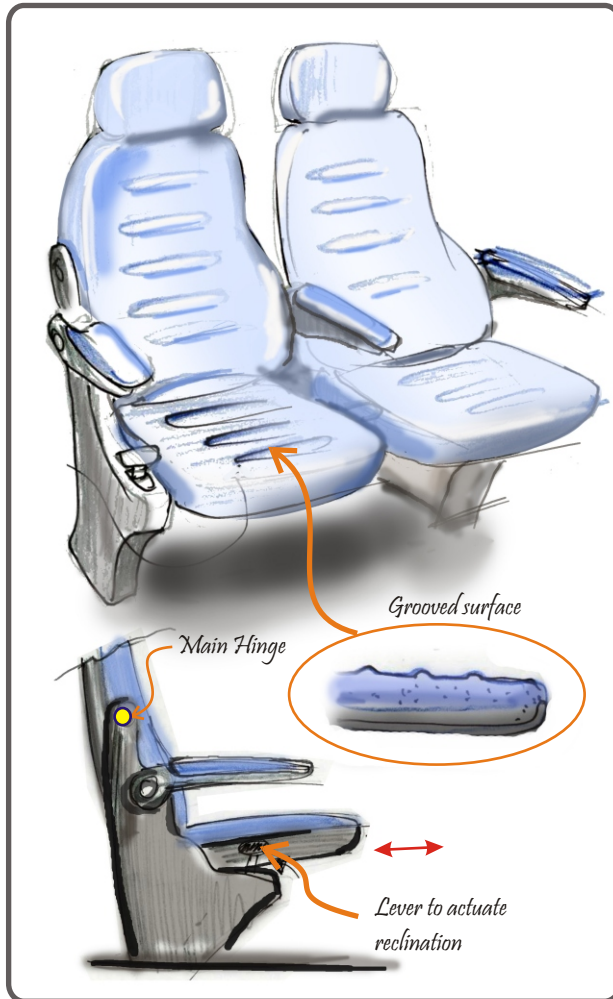
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# CONCEPTUALISATION

## CONCEPT THREE



### Concept Three:

This concept has completely different system of reclination. The back rest would recline along with the seat about the main hinge.

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# CONCEPTUALISATION

## CONCEPT EVALUATION



Evaluation Criteria

	Concept One	Concept Two	Concept Three
Cross leg	8	6	2
Raised leg rest	8	8	2
Head Support	8	6	2
Reclining position	6	2	8
Bench sleeping	6	4	4
	<b>30</b> ✨	26	18

### RESULT:

Concept One has scored above the other concepts and hence it is taken for further development.

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# FINAL CONCEPT

## FINAL CONCEPT PROPOSAL



Having done the evaluation of all the three concepts, concept one was selected for further refinements and development. This concept was cross checked with all the requirements listed from the user study. Further a Mock up model was prepared and studied on different users.

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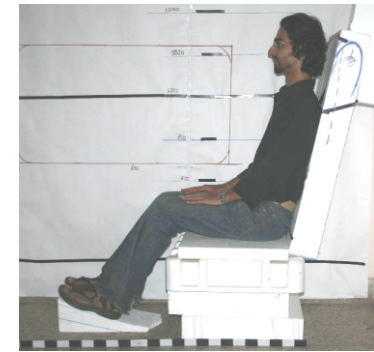
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## RIG STUDY



Upright posture  
at 110 deg.



Relaxing posture  
at 130 deg.

Following aspects were studied:

- seat and back rest dimensions.
- feasibility of the head support and footrest under seat.
- leg room requirements and footrest requirements.
- armrest and seat height.
- reclination angle.

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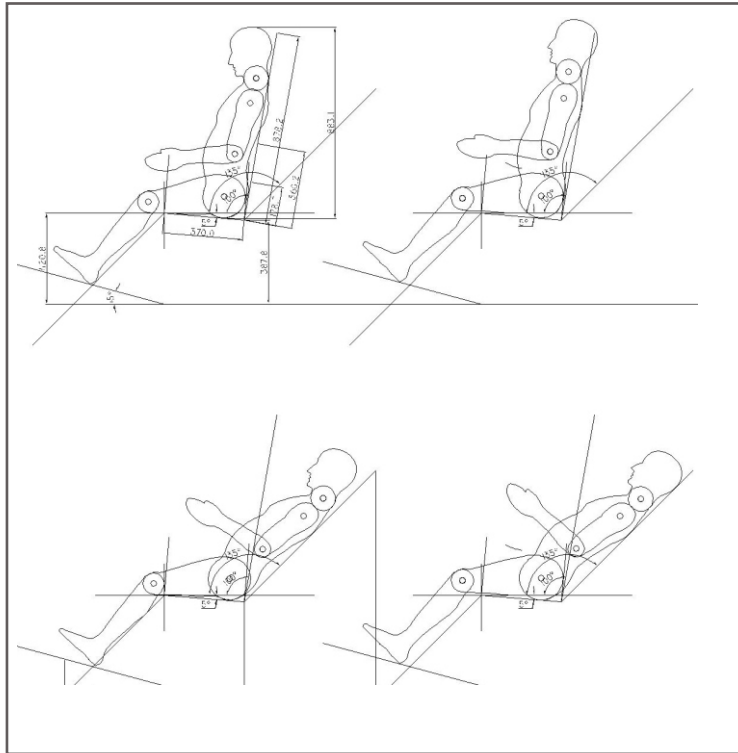
## HEAD SUPPORT STUDY



In another study the option of using a different mechanism of providing the side head support was tried out. During the process the mock rig was adjusted to different users height.

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## MOCK UP MODEL



2D drawing using 50th and 75th percentile mannequin



Mock up model (1:5 scale)



# FINAL CONCEPT

## FINAL DESIGN CONCEPT

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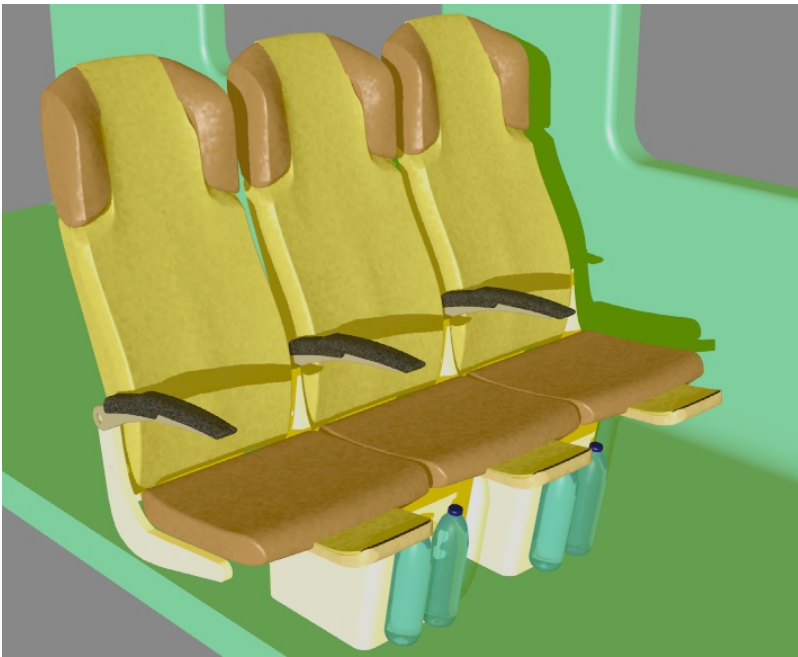
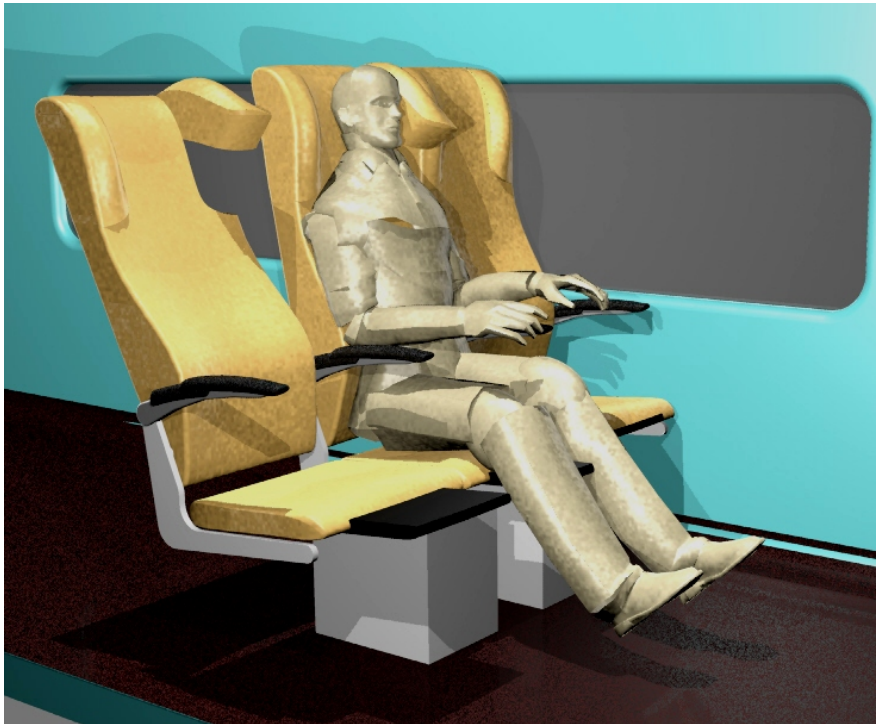
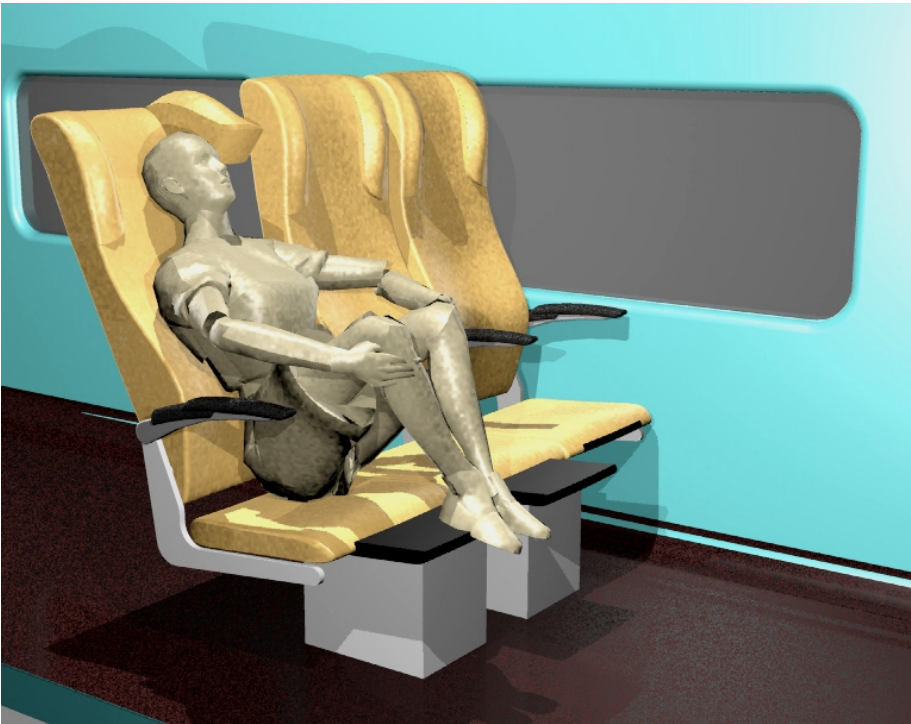
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CAD MODELING



# FINAL DESIGN CONCEPT

## Final Mock Up Model



Scale 1:4

# FINAL DESIGN CONCEPT FEATURES

The features incorporated in the final concept which meets the requirements as stated in the product brief are explained below.

## 1. SIDE SUPPORT WITH INTEGRATED TASK LIGHTING



The side head support is pivoted at the top. This can be swivelled and kept at the desired height for resting the head when sleeping or even when relaxing.

A LED task light could be provided in this head support, so the user can use it for lighting his space by rotating the unit. Each seat has two side head supports so that the user can use either one depending on their habit of sleep.

## 2. FOOTREST BELOW THE SEAT



The movable foot rest below the seat can be used by the user to sit with their legs folded or can be used when they want their legs close to their body. This footrest can be pushed back when not in use.

It is would be made of a suitable polypropylene by injection moulding process. A part of the footrest where the feet rest will be covered with foam.

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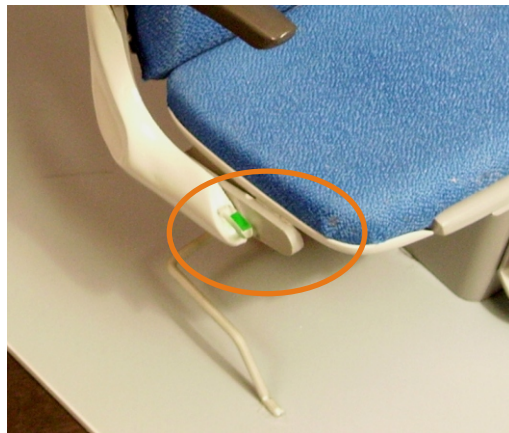
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### 3. EXTENDABLE ARM REST



The Arm rest in this concept can slide out and thus act as a support to the thigh region of the leg when the user is sitting in folded legs posture. This arm rest made of PU foam coated with flexible surface. This foam will be backed by suitable structural plastic.

### 4. RECLINING MECHANISM LEVER



The backrest reclining mechanism is used from the current one available in market. The lever to operate this mechanism is changed for easy access and operation. The surface area of the lever handle is increased to reduce the pressure on palm while being operated.

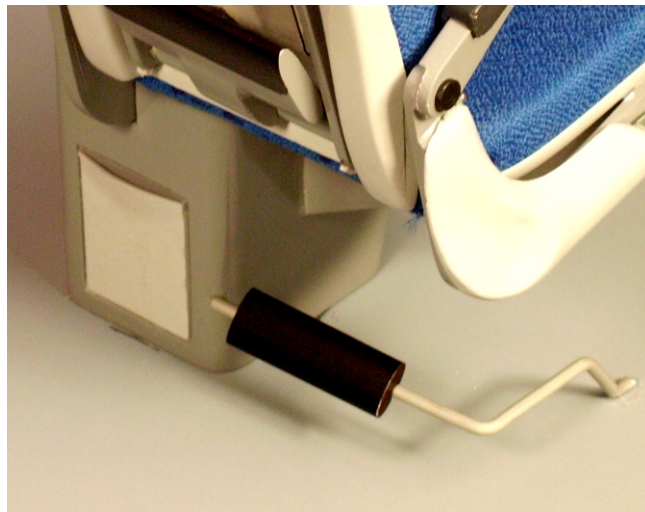
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## 5. FOLDAWAY FOOT REST AT HEIGHT



This concept has a foldaway footrest which can be brought into use by the feet itself. It is loaded with a soft spring so that when the user removes his leg it moves back to its foldaway position. This footrest would give two positions.

## 6. EXTENDED LEG FOOTREST



This footrest would be used when the user is in alert sitting position. The footrest can be swivelled about its hinge so that the user can move his feet and have some kind of exercise for the feet. This exercise would improve the blood circulation and reduce numbness caused in long distance traveling.

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## 7. CANTILEVERED SEAT

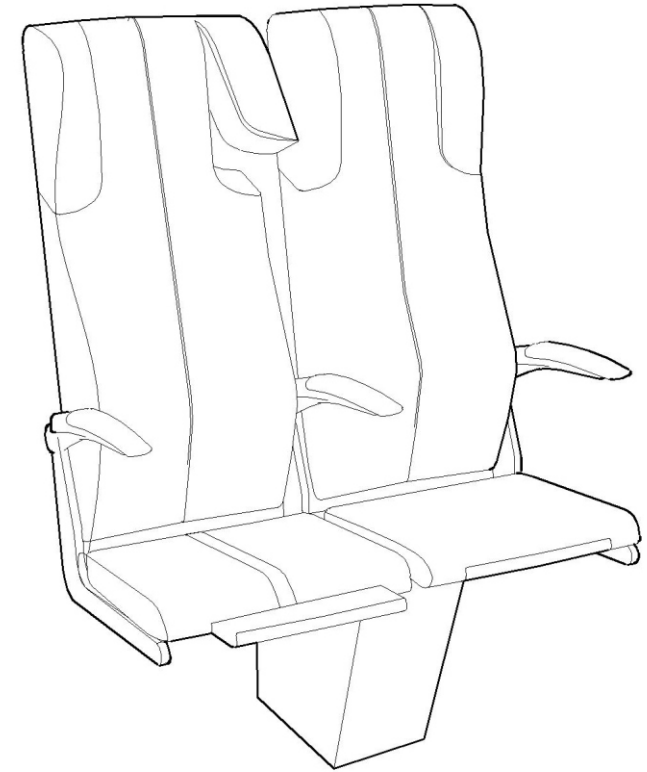
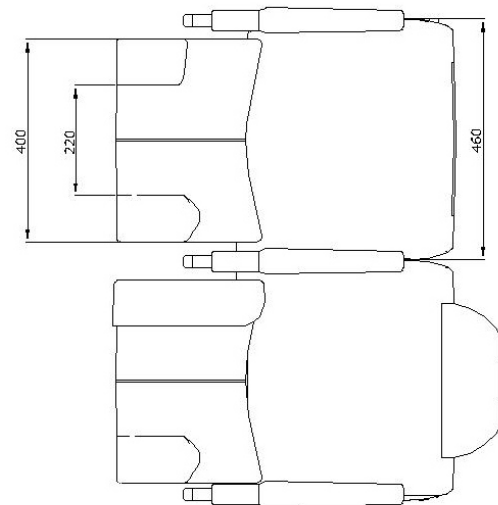
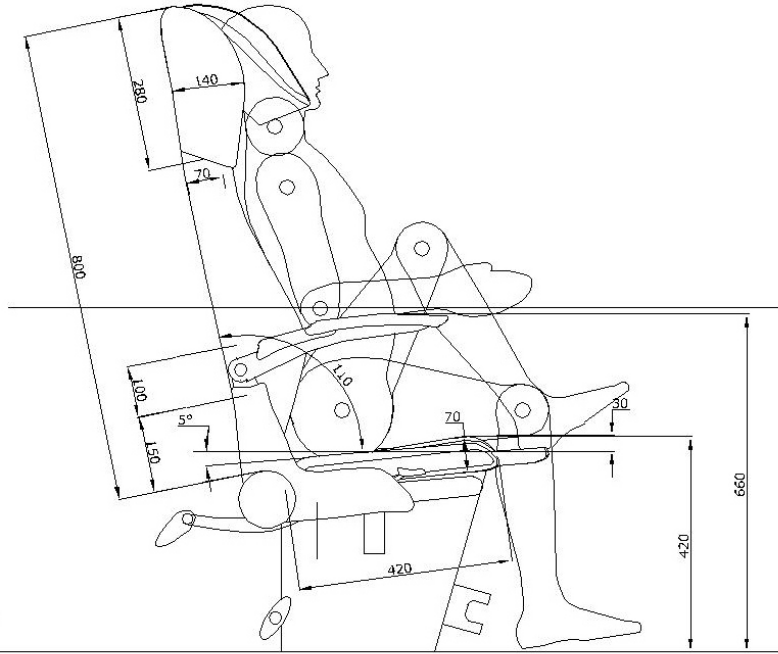
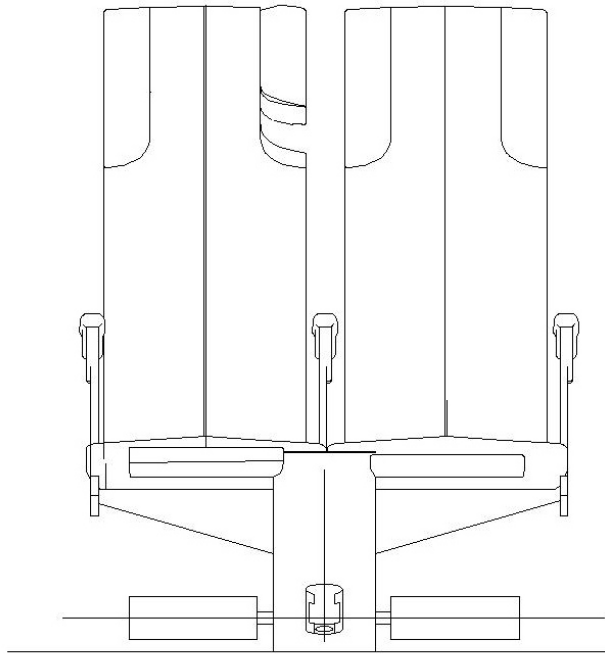


The side seats are cantilevered to the base structure. This provides space for smaller languages.

## 8. BOTTLE HOLDER AND USED CUPS BIN



# OVERALL DIMENSIONS



All dimensions are in mm.

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