Redesign of car interior for elderly people

Industrial Design project II

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1. Abstract

The project deals with the making / adapting the personnel car interior more suitable/ acceptable by senior citizens. The objective is to make the travel experience a bit comfortable and less offending.

Observation was made to understand the entire issue of car adaptability including issues pertaining to long distance commuting. Different methods used like video documentation and questionnaire direst to the issues like ingress, egress, orientation on the seat, support to body etc. in relation to the age factor. Reduced joint motion and force development are the prime factors towards mobility and easy change of posture.

Considering the above observation, this project is an attempt in the process where understanding of the needs and requirements of senior citizens is made regarding passenger seating of personal car.

Introduction

One of the hazards of the aging is the increasingly failing health. On whole the health and stamina of an individual declines with age. This sometimes requires need of encouraging which could be either in form of design suitability.

Aged are more preoccupied with their inner lives, more introverts, less willing to deal with new complicated situations/ systems and are more conformist.

Body degeneration is one of the most troubling parts which affect their dealing with every activity.
The modern society is organized in a way as suited to the majority population distribution

But reality is going to be different as elderly would comprise a greater degree of population some time from now. From the demographic data the percentage of younger population is decreasing and older population is increasing. And this shift is going to be different this time, as these are the people who will be better informed, more mobile, economically more stable and thus more demanding.

A fact is that, in many situations, car is the easiest [2] travel mode for older people facing declining physical skills. The studies also support the argument that the best mode of transport for elderly is not the public transport but the personal vehicle (car). And at this stage there is a need to put some effort, considering the basic physical and psychological disabilities due to aging.

Socially it also becomes the responsibility to look out for the system which makes any task more unobtrusive for this segment taking in account of the thought that more suitable the system for elderly would normally be comfortable for younger population also.

3. Problem Definition

The area of concern is to be addressed by the effective solution, by making the commuting experience of elderly people to be more comfortable; there by decreasing the stress physically and psychologically.

“Daily interaction with the mode of transport (car in this case) having a crunch of space, along their physical limitations like joint movement restriction makes a combination, which is difficult to deal by them.”

4. Present condition

The population of India stands at more than 1 billion owing 7% of its composition of elderly people and which is project to grow to 10% till 2020.

So, this segment is still under-served. With the consideration given to this, same model could be well applicable to younger group. As of now the extra effort to address those concerns is lacking.

Age distribution of population (%)			
	1992	**1997**	**2007**
0—4	12.8	11.7	10.0
5—14	22.9	22.1	19.5
15—59	57.7	59.1	62.3
60 & above	6.6	7.1	8.3

1. *Source - Population is as per 1991 Census, IRS*

Senior citizens Projection : 78million by 2020

5. Aim of study:

5.1 Study was done to get a hold of the present usage scenario and user aspirations based on the users lifestyle and daily routine.

5.2 In this project the upper stratum of society is taken as the target group because of the fact, that they are the people who actually have more freedom to indulge in their own idea of life. Disability and illness are declining among older people in upper level of society even as they live longer and substantially more likely to use personal vehicles to meet their mobility needs.

5.3 Study is concerned with the people from age group 60-90 yrs of the age group who are still active in their daily routine. They engage themselves in some form of activity for maintaining social obligations. This study is also to find out the characteristics and behavior as related to their vehicle use while using the rear seat.

6. Approach

Beneficiary -

- People Alone living 60+
- Status Upper middleclass
- Usage Daily (short duration)

Age related problems affect these people and as daily encounter with the vehicles is imminent.

Problem area -

- Ingress
- Sitting
- Egress
- Miscellaneous

were selected as core areas to work upon. The afore shown areas were taken as to improve upon, after taking in account of how the user deals with the vehicle. These are not to be dealt as separate issues but interrelated with one another.

These people were quiet active of their age and generally travel alone either for socializing or other commitments in their own car.

This time spent in the rear seat of the car may vary from 2 hrs to 4 hrs, not necessarily at a stretch.

7. Design way

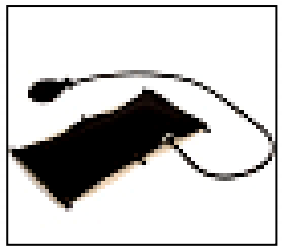
The flow of events in progressing though the project as

- Situation analysis- understanding and evaluating need for a new product concept
- Product proposal- lacunae area
- Data collection and analysis
- Idea generation
- Concept development and exploratory modeling
- Product detailing
- Evaluation and improvement
- Final Prototype development

8. Market Survey:

Storage space

Lumbar support



Grab bar

Elbow support

The market survey included studying the different vehicle's interiors to understand the basic setting and correlation of different units which constitute together for interiors and to identify the problem area some clues also.

The people have a certain intuitive adaptability which is developed over a period, due to indulgence in some particular activity. So, understanding of that is also important to make the transition from current usage to the desired usage smooth and without any trouble. Because the user group is elderly it makes more as a necessity.

An effort was also made to understand the interiors along with the positioning of components and different mechanisms employed to operate the various units e.g. door opening, seat backrest controls. Here the point was made to examine all the associated dimensions.

Existing accessories used for interiors were also taken into account.

9. User Study:

This includes the user profile, habits, lifestyle, preferences, current usage and aspirations. The problems faced by these people were listed and also some connection was made to the real requirements. Here the classification was made into 4 broad categories of the various responses and proposals viz.

- Ingress
- Stay
- Egress
- Miscellaneous

A total of 9 people were observed varying from 76- 86 yrs of age.

9.1 Ingress:

1. A degree of freedom in door openings
2. Type of mechanism in door handles like rotate or press
3. Support during moving in the vehicle, near door and also at seat
4. Locking of door
5. Personal needs vary

9.2 Stay:

1. Min. 1 hr is the time spent in car rear seat
2. A/C preferred
3. Music/No music
4. More leg space required
5. Foot rest is must
6. Extra customizable cushioning is requisite
7. Accessories - Water bottle, Suitcase, Bag
8. Safety issues like door handles , arm rest's cushioning
9. Personal needs vary

9.3 Egress:

1. A degree of freedom in door openings
2. Type of mechanism in door handles like rotate or press
3. Support during moving out of the vehicle, near door, at back of front seat or at seat
4. Opening of door
5. Personal needs vary

9.4 Miscellaneous:

9.4.1 Psychological –

- Sense of well being i.e. in spite of problems they demand acceptance as perfectly healthy .
- Having certain notions, like sitting on the diagonal opposite to the driver
- Adamant about hygiene

9.4.2 Security -

- Less trust on the person driving the vehicle
- Fear from being hurt

Thus, normally all the problems and requirements were distributed well accordingly and pattern noted. The scope of redesign was not thought to be constricted by any of the limits as some of the subjects were sharing a bond with their cars.

10. Analysis

10.1 Method: The analysis method used were

- **Biomechanics –**

  Joint motion study during ingress, stay and egress. In this method the movement of different parts of the body was studied in relation with car in real time.

- **Video analysis –**

  Movement analysis using video documentation. As it is possible that some of the important points may be missed in real time study, so the method of video analysis was then adopted to carry out the posture observation.

- **Questionnaire –**

  Questionnaire was prepared to find out the realization among the elderly people of their own problems and to get some inputs regarding their level of comfort desired.

Thus, the different methods were studied to arrive at the problems and their probable solutions. The locus of points, where the hands are moving either for support or control was analyzed to determine the

placement and type of adjustment required for body comfort. Same applies for the whole body including legs and head.

The movement analysis was done in relation with the specific portion of the car body. Simulation in software and video observation was done to understand it further.

10.2 Representation: The data generated is explained further as the sequence of events in the pictures shown next.

10.2.1 Video Depiction

10.2.2 Software simulation

10.2.1 Video Depiction

Fig 10.2.1a Sitting in to the seat

Fig 10.2.1b Opening of door latch

Fig 10.2.1c Stepping out of the car door

Fig 10.2.1d

Fig 10.2.1e

Fig 10.2.1f

Shown are some of the movements captured during whole of the action during ingress and egress.

Egress sequence from the opening of latch to moving out of the car as depicted in the adjoining images

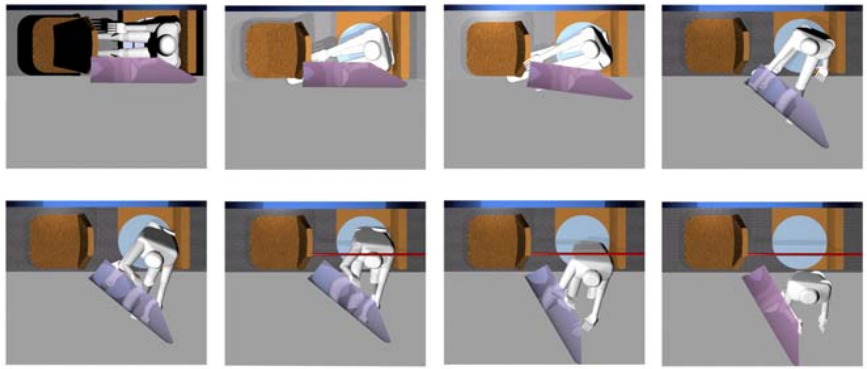


Fig 10.2.2a

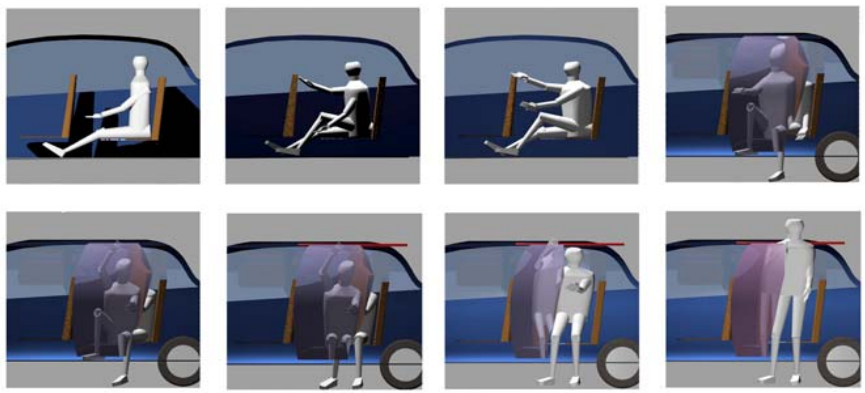


Fig 10.2.2b

10.2.2 Software simulation of body movements

By breaking of the every movement of body action into slots the deficiencies were chalked out

Ingress – Movement sequence

- Reach out for the latch
- Turn it up with fingers and thumb
- Pull out the door with one hand and hold car body with other
- Put one foot on the car floor
- Slide your body in
- Pull the car door in

Sit – Movement sequence

- *Adjusting:*
  - Shifting backwards for lumbar support
  - Push using legs/ hands
  - Hands grip on seat cushion for pushing
  - Seatbelt strapping
- Resting arms on the armrest of door side
- Adjusting the personal belongings to proper place
- Extending/ retracting legs under front seat

Movement Analysis contd.

Egress – Movement sequence

- Moving forward by pulling body using legs/ hands on seat
- Twisting slightly
- Opening door latch
- Jerking the door out
- Meanwhile also grabbing seats
- Turning outwards the door
- Coming to edge of seat for moving out
- Grabbing door with one hand and seat with other
- Pulling the body out
- Holding door for complete support
- Turning and closing the door using knob

11. Product Brief

The priority of working was finalized from the analysis as –

- Seating:
    - Bottom rotation
    - Backrest inclination
- Hand grip
- Head support
- Foot Rest
- Hand rest

Seating:

It is one of the important part of interiors. The main cause of strain for the elderly people is that they have to really push hard for coming out of the vehicle since the exit is at 90 degree to the seating position. So, the twisting and then simultaneously pulling out the body becomes a task too complicated thus, it also relates to comfortable ingress and in the same way to egress also.

Another matter is the lack of adjustment to the rear seat back rest. Due to which the back muscles get strained.

Hand grip:

The elderly specially require some gripping object to come out and move into the vehicle thus the need for it. Due to the age related body joint problems this action demands support for their hands, to be done comfortably.

Head support:

Their pattern of spending time as either sleeping or reading and need to help them in keeping with the correct body posture, the provision of adjustable head support is proposed. Adjustment is needed to cater to the different body percentiles.

Foot Rest:

The elderly people face numbness in legs due to maintaining of same position and lack of movement when they are traveling. Thus to eliminate this and to provide some form of exercise the foot rest is introduced.

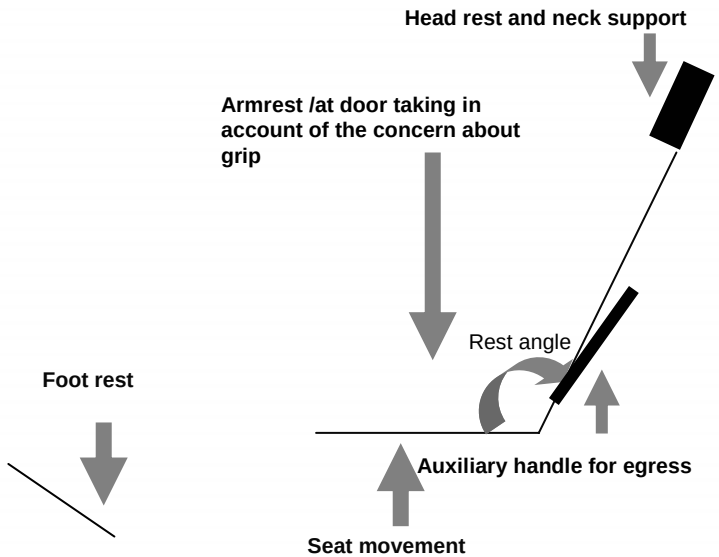


Fig. 11.1

Specification of scope

Hand rest:

It is already an established concept which is made mandatory for providing more comfort and security by doubling as a gripping object.

In addition to all of the above the system has to be unobtrusive since at this stage there are some process which are taken for granted i.e. due to prolonged use of the vehicle there are some intuitive movements which are difficult to change.

12. Niche areas:

Some of the problems which are taken for working on are as -

- Seat position is static
- Variable support at the door as locus of point where hand moves
- Force required to move, in and out.
- Adjusting the body after moving in
- Gripping on to someplace while close the door
- Back pain due to posture
- Twisting of body during ingress and egress
- Provision for foot resting / movement during travel

13 Idea generation :

13.1 Hand Grip

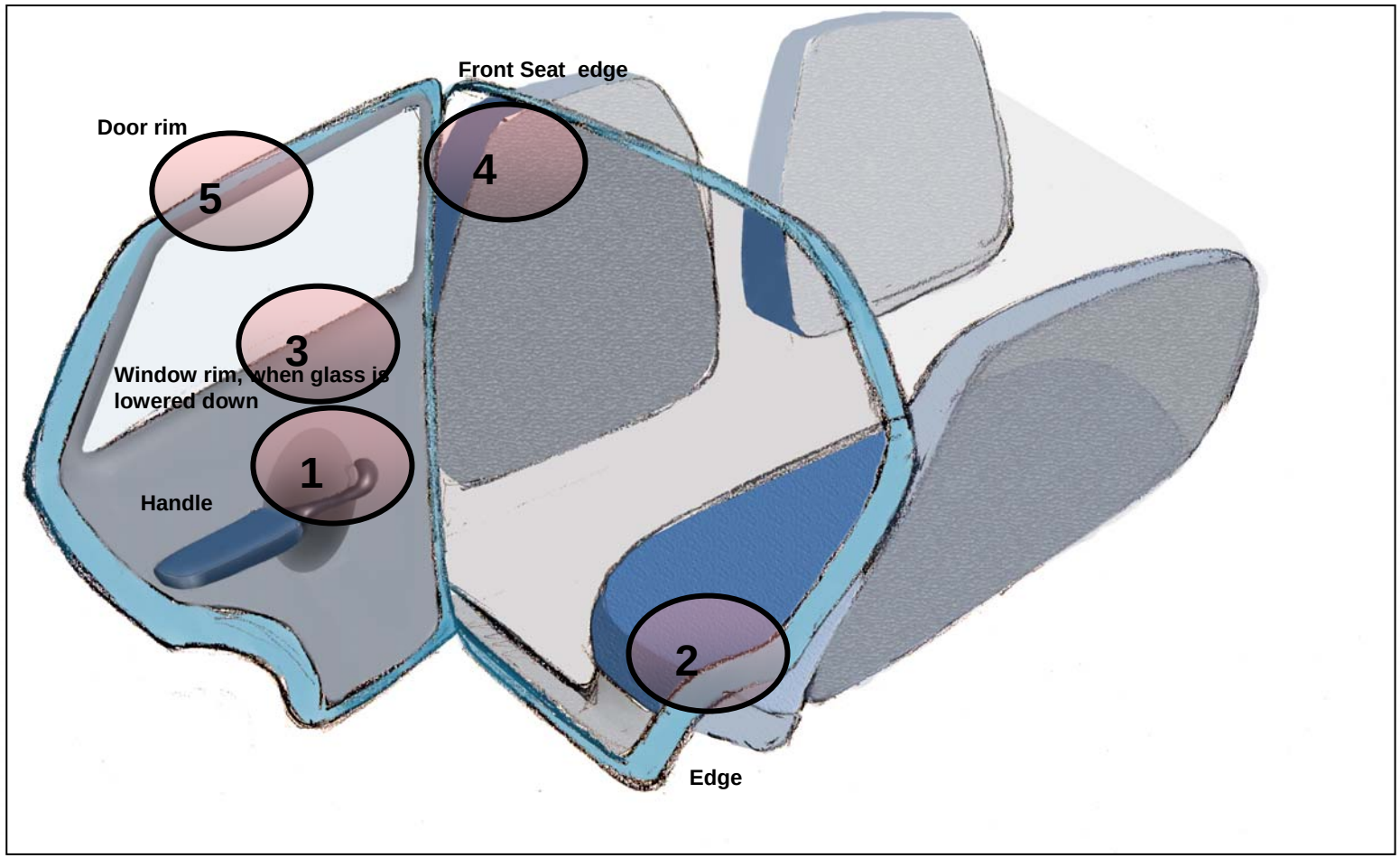


Fig 13.1
Different supporting areas concerned with process of ingress and egress

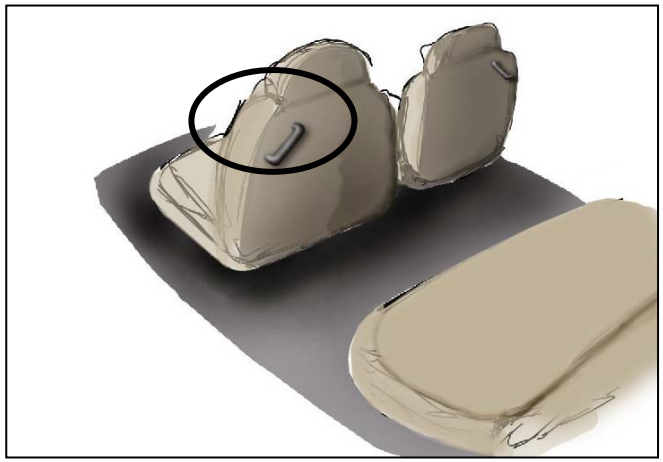


Fig 13.1.1
Grab bar

13. Idea generation : Hand grip -

13.1.1

The generation of idea sketches started with keeping in mind about providing the new provision for solving the aforementioned problems.

During the ingress/ egress there is a need to have a support for pushing pulling the body some time for alignment to the door or with the seat. Hence the need for grabbing was taken care by the provision of a grab bar on the back of the front seat.

So that, when the person wants to come forward as for ejecting himself out, the action is supported by this proper accessory

Fig 13.1.2
Auxiliary handle and grab noose

Fig 13.1.3
Grab bar extended

Idea generation: Hand grip

13.1.2 Auxiliary handle and grab noose

13.1.3 Grab bar extended

Here the ideation was done to have look at new ways for providing support during ingress and egress when hands search for some object to grab on.

Either the door rim or side lining of the car body are the most probable areas for leaning on to.

Idea generation: Hand grip

13.1.4

Here the ideation was done to have look at new ways for providing support during ingress and egress when hands search for some object to grab on. The movement of person and how this bar could help to support the body for stability was looked upon.

Mechanism of operation by the person was explored to find out the effectiveness of this solution.

Fig 13.1.4a

Support by the turning rod

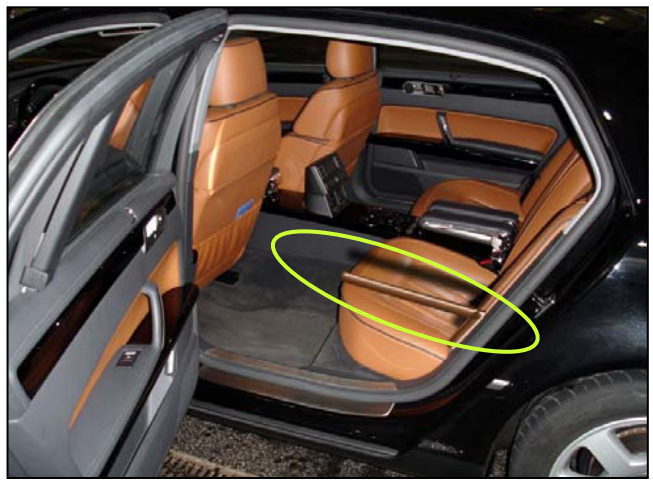


Fig 13.1.4b

Fig 13.1.4c

Fig 13.2.1a

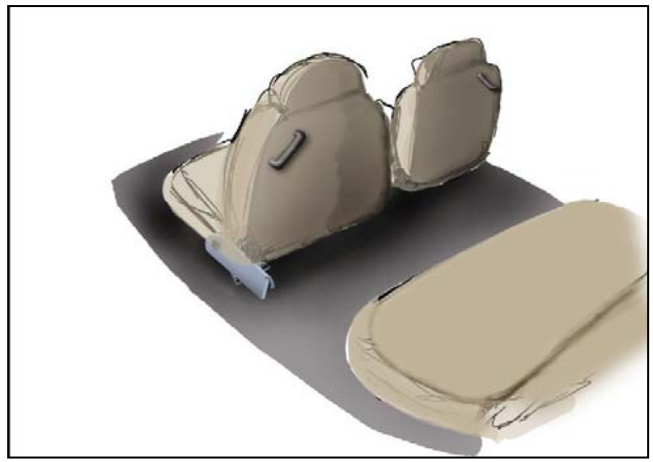


Fig 13.2.1b

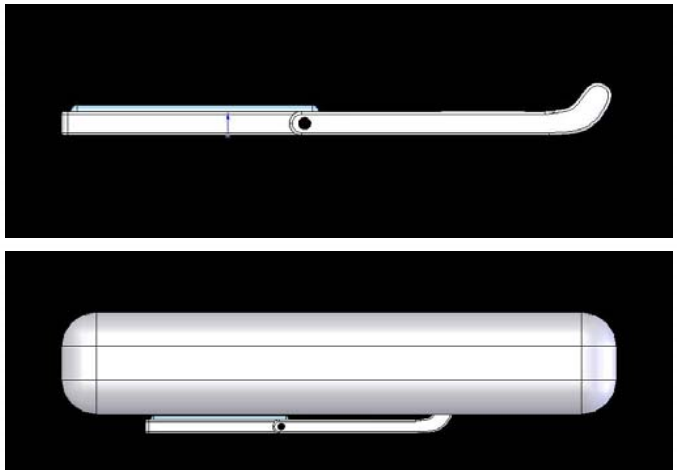
13.2 Idea generation : Foot rest

13.2.1

Here, the provision of providing support to the feet was explored. During travel, the numbness of feet is experienced by these elderly travelers. This happens due to the lack of proper blood circulation when the legs are kept in the same position for a period of time.

Cramping is also noted in some cases due to the prolonged stay in the vehicle but less duration is enough for the elderly people to experience the same problem.

In form of retractable foot attached under the front driver/ co-driver seat provision for support is made so as the strain on the calf muscles and knee joint is lessened. And since the foot rest is retractable it could be used depending upon the requirement.
The foot rest is supported on chassis floor underneath.



13.2 Idea generation : Foot rest

13.2.2

Here the foot rest was made attached under the front driver/ co-driver seat bottom so that the space requirement for the legs is not tampered with.

Also, this arrangement provides for the maximum of the flexion of the legs under the front seat for a taller person.

Fig 13.2.2a

Retractable underneath footrest

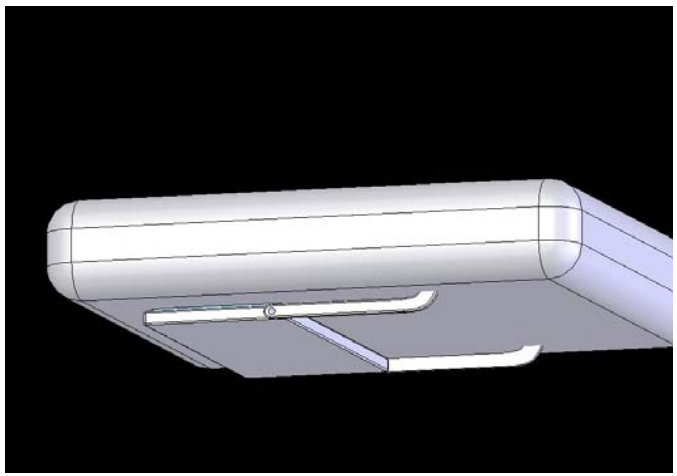


Fig 13.2.2b

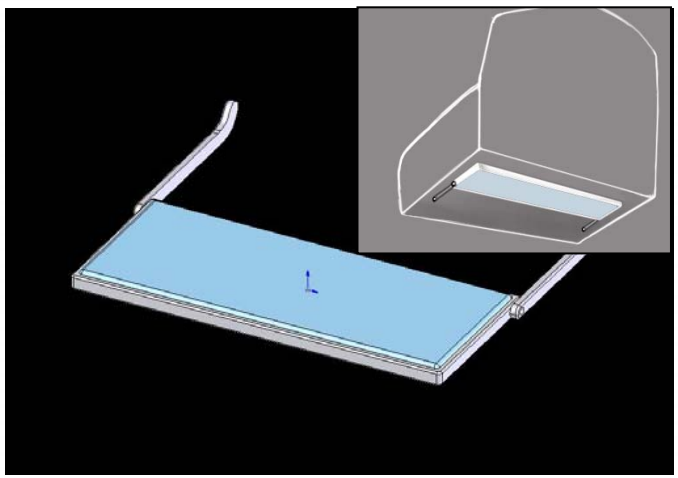


Fig 13.2.2c

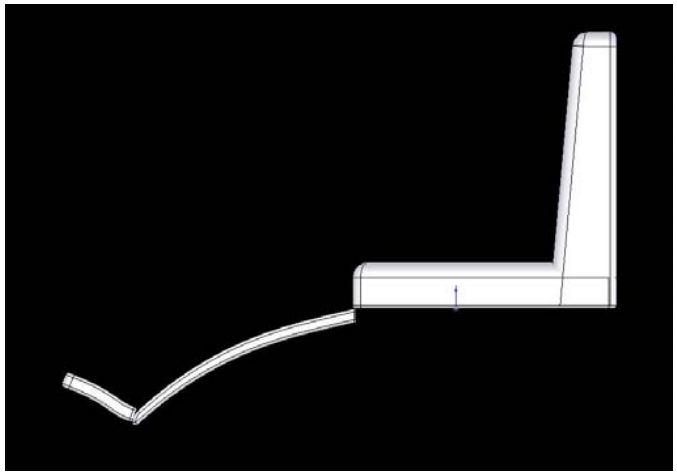


Fig 13.2.3a
The combination of footrest and calf rest

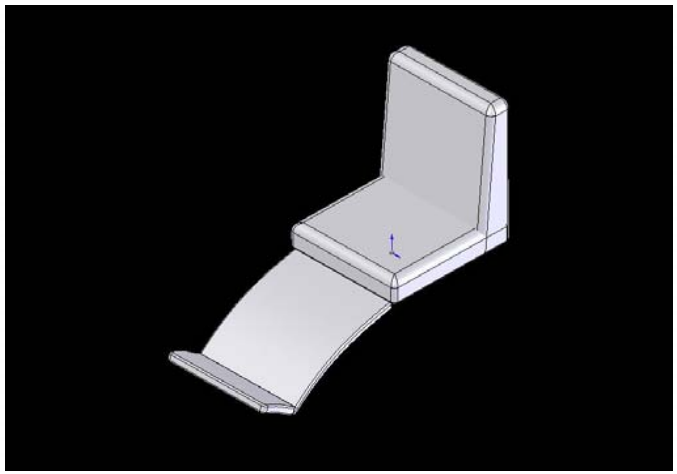


Fig 13.2.3b

13.2 Idea generation : Foot rest

13.2.3

Now one of the concern was making for the rest for leg as a whole not only the feet. So, the foot rest was extended as calf rest also which was to be retracted under the rear seat itself when not in use.

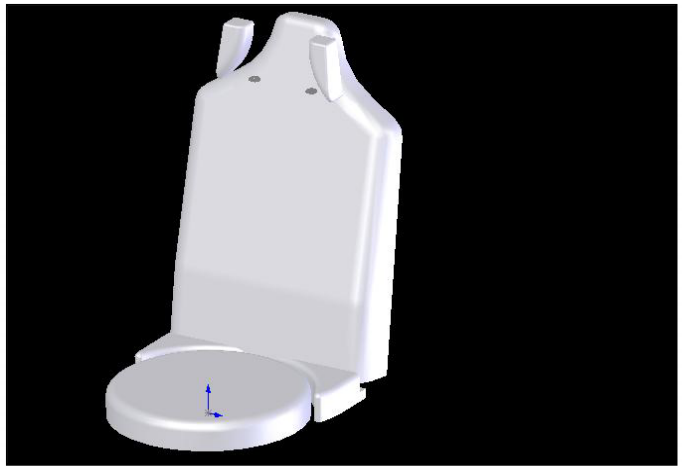


Fig 13.3.1a
Head rest fused with movable back rest, sleep support is static

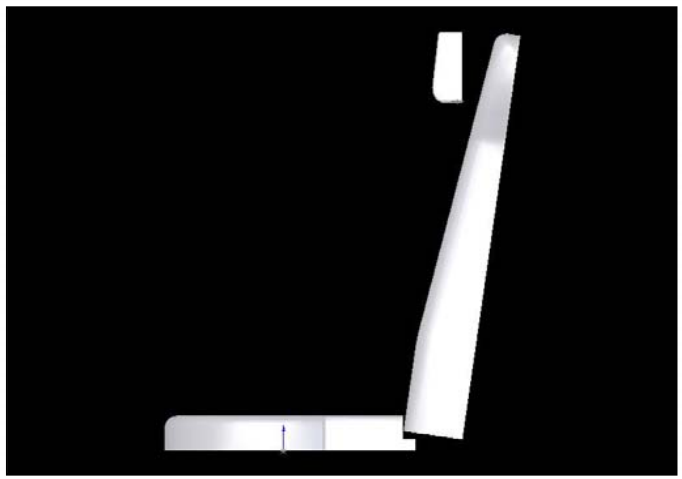


Fig 13.3.1b

13.3 Idea generation : Head rest/ neck support

13.3.1

Now, the focus was for the provision of head support which should also provide stability to neck during sleeping. Thus side are extended to make up for the support for that purpose

But to take into account the different percentiles of the population adjustment in height is required to be introduced along with it.

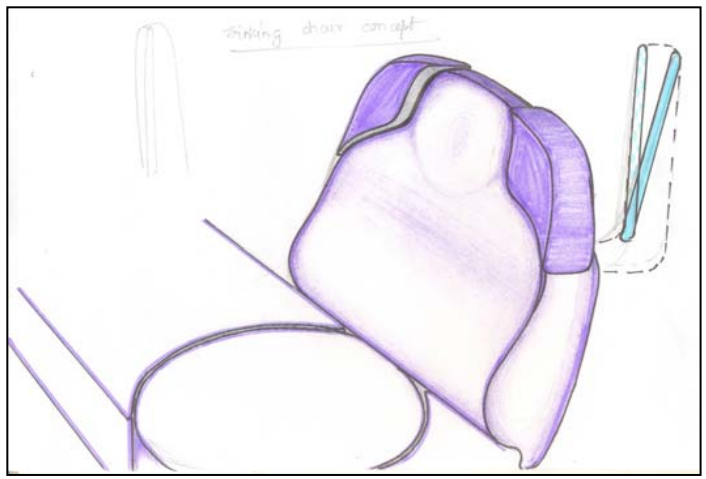


Fig 13.3.1c
Back rest movable, head support elevated

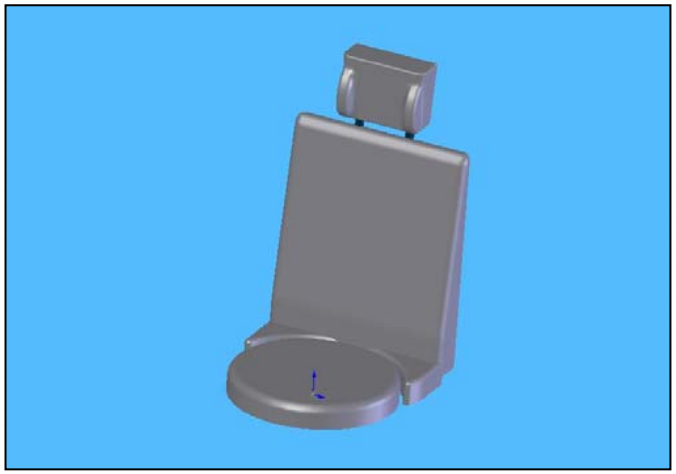


Fig 13.3.2

Head rest adjustable in height along with side support

13.3 Idea generation : Head rest/ neck support

13.3.2

Now the same idea of head support which provides stability to neck during sleeping was explored further in form of inflatable balloons, strapped side constraints and one was to make provide height adjustability to compensate for different body structures 3.

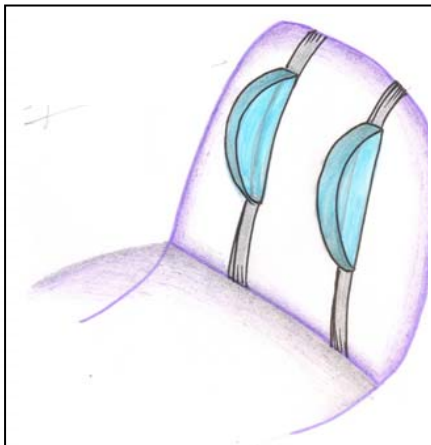


Fig 13.3.3

Strapped neck support

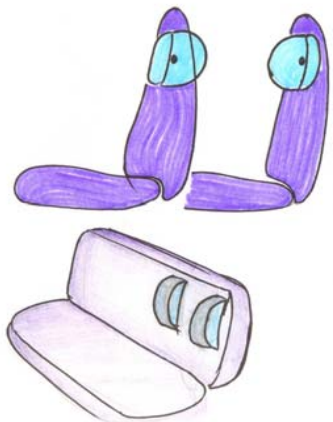


Fig 13.3.4

Rotating disc

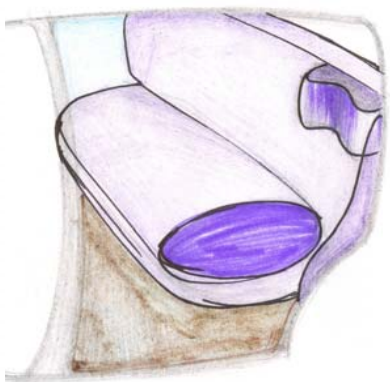


Fig 13.3.5

Cushioned head rest

Fig 13.3.6

Inflatable balloon

Fig 13.4.1a
Back rest at relaxed position

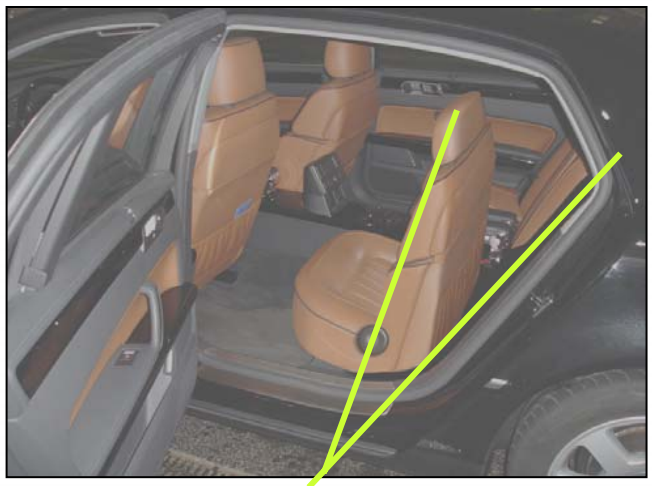


Fig 13.4.1b
Back rest at erect position

13.4 Idea generation : Seat

13.4.1 Linear and angular motion

Here the area of focus was the rear seat movement where the back rest moves forward as well as rotates at pivot point thus helping in pushing forward while going out or sitting in. So that the unnecessary effort on back muscles is reduced.

When in relaxed posture the back rest is inclined at obtuse angle to the horizontal but when the user wants to move out the backrest rotates to make it come perpendicular as depicted in the image.

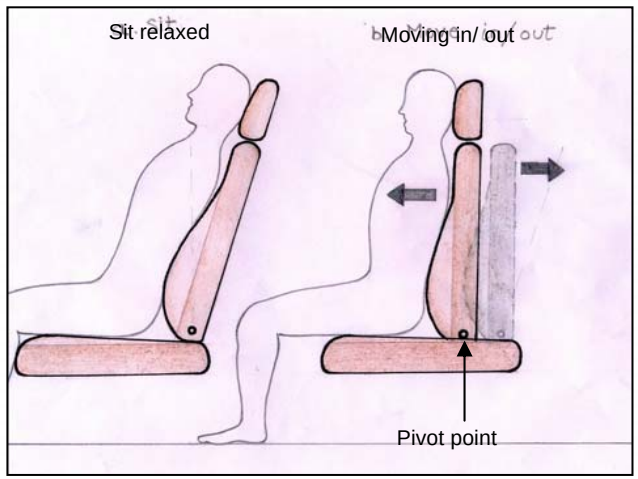


Fig 13.4.1c
Representation of backrest motion

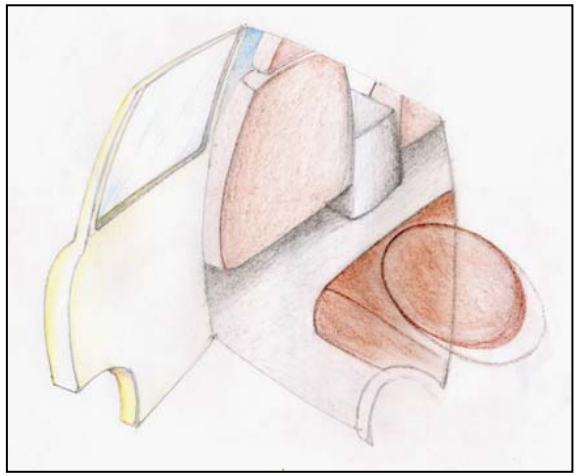


Fig 13.4.2a
The positioning of rotating disc

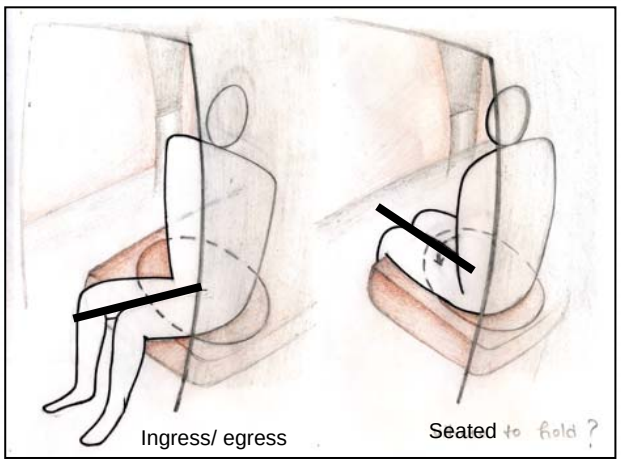


Fig 13.4.2b
Usage pattern of the seat

13.4 Idea generation: Seat

13.4.2 Rotatory motion

In this proposal, the bottom seat i.e. the area which remains in contact with the buttocks is used to enhance the comfort level at the time of ingress and egress by reducing frictional force between legs and seat cushion.

This system reduces the effort on back, leg as well as arm muscles during twisting, as required while ingress and egress.

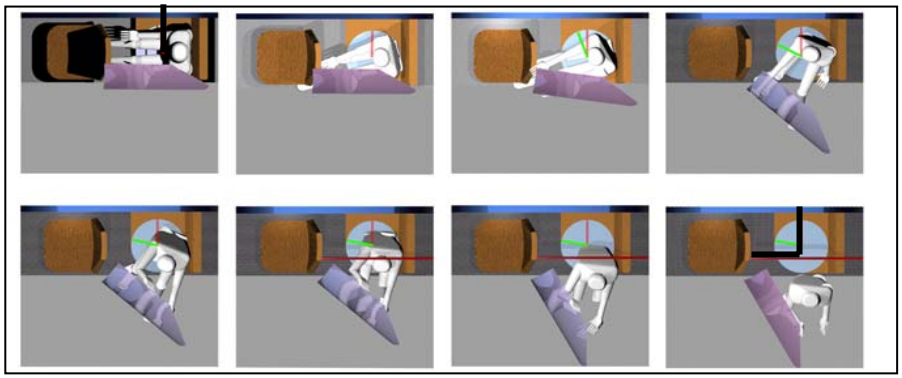


Fig 13.4.2c
The angular rotation of the disc

The extent of rotation is tried to analyzed with the help of simulation of motion during egress.

As depicted the rotation varies from extremes of 0 to 90 degrees in between the normal seating and egress.

14 Concepts:

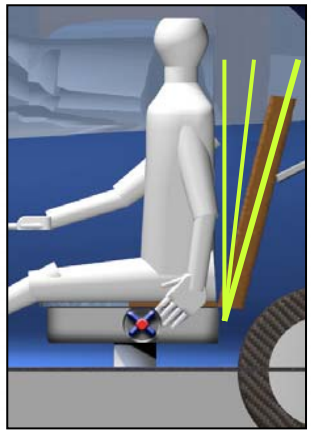


Fig 14.1.1a
Back rest at relaxed position

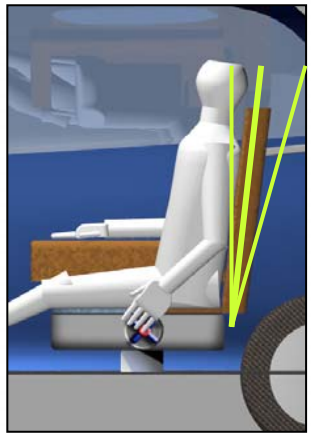


Fig 14.1.1b
Back rest at erect position

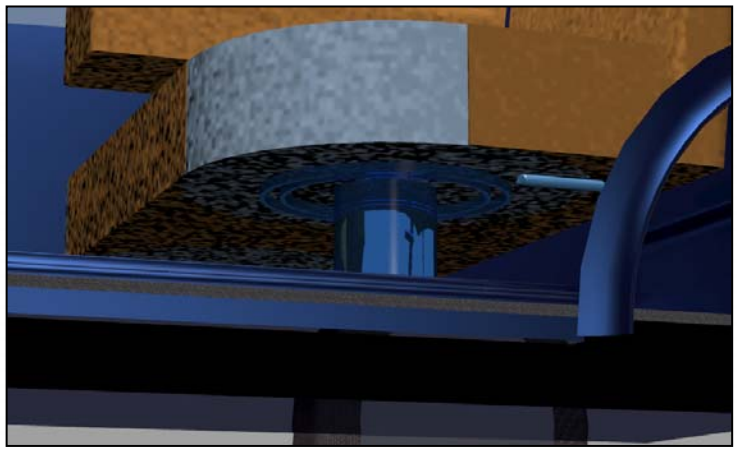


Fig 14.1.1c
Rotating pivot mechanism as on the underside

The concept developed were not as standalone type but differentiated from each other in case of

14.1 Rotating Seat

14.1.1 Rotating seat along with slotted adjustable backrest

- Bottom support desired rotating angle 90 deg.
- Locked when door is closed
- Becomes free to rotate when door latch opened
- Rotates on the central pivot pillar
- Back rest is adjustable from 90- 110 deg.
- Control for that is provided at the lower door side of the rear seat
- Slotted motion is given to rotated it backward and forward both for controlled force
- Similar mechanism used for this backrest rotation as of used in co-driver/ driver seat

14.1.2 Concept Evaluation User feedback

Fig 14.1.2a
Going to be seated

Fig 14.1.2b
Just started to move out

Fig 14.1.3c
Holding on the pillar to support moving out

Fig 14.1.4d
Getting up from the seat

Fig 14.1.5e
Moving one leg forward to get up

Fig 14.1.6f
Bending out to make egress

14.1.2 Concept Evaluation User feedback contd.

During the testing with the working rig, two users were requested to simulate the sitting as in the car. Pillar support was provided in form of the wire frame. Dimension of the various components were reference form the Indica car like entrance spacing, leg space and head room.

The rotating mechanism was found to be feasible and more helpful in reduction of physical stress to the users.
As it provided some relief to the turning movement.

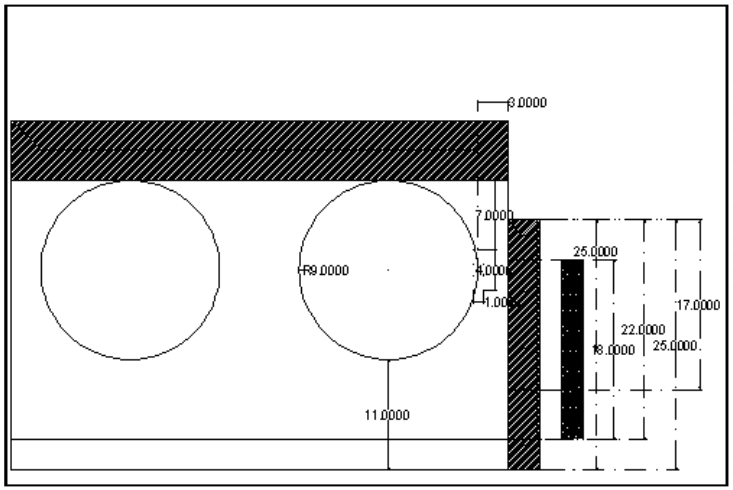


Fig 14.1.3a
Top view seat and door dimensions

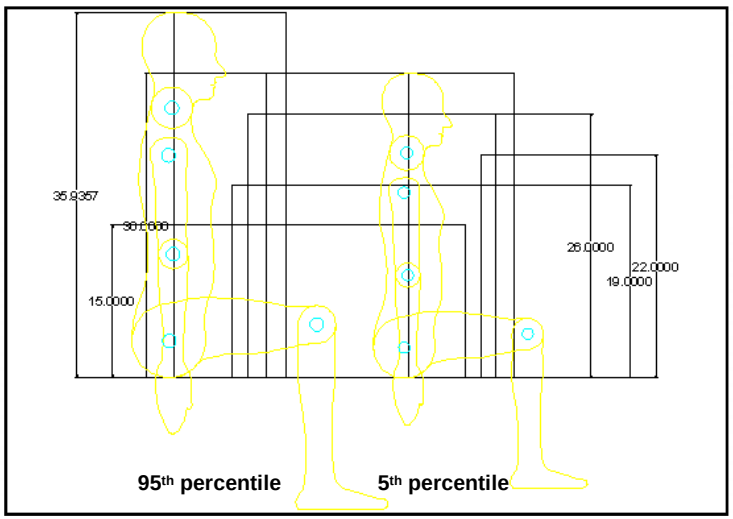


Fig 14.1.3b
Backrest height requirement

14.1.3 Concept refinement

After evaluation the concept was further developed regarding dimensioning clarity, positioning and settlement along with various components

The height for back rest is taken to be equivalent to the cervical height of 95th percentile population.* So that the 5th percentile height person may also be able to use the same comfortably. Compensation regarding the head support is made in the subsequent stages.

*All dimensions are in inches

14.1.3 Concept refinement

The basic chassis was required for reference to the concepts, in this case Indica was kept for reference. And further details were worked out accordingly.
Some basic dimensions as measured and used are

- Leg room – 13”
- Back support – 26”
- Bottom seating – 18”
- Seat width – 50”
- Door height – 45”
- Door width – 35” (max.)
- Door width – 25” (min.)
- Seat height – 13-16” (varies with cushion thickness)
- Wheel diam. – 15”

All the units for the dimension were taken in inches due to the preference of manufacturers and suppliers in the market

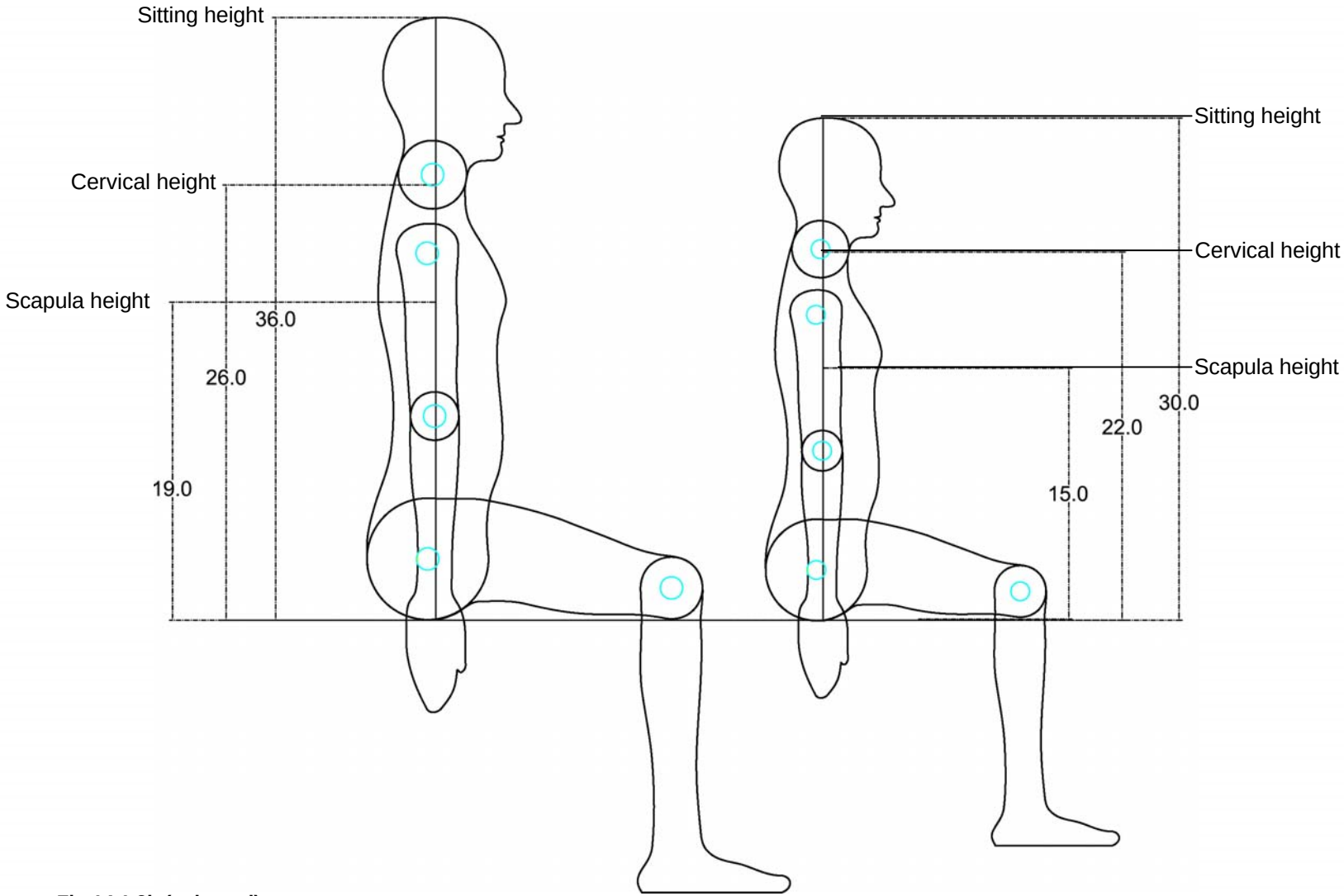


Fig 14.1.3b (enlarged)
Backrest height requirement

*All dimensions are in inches

Location of seat in the car

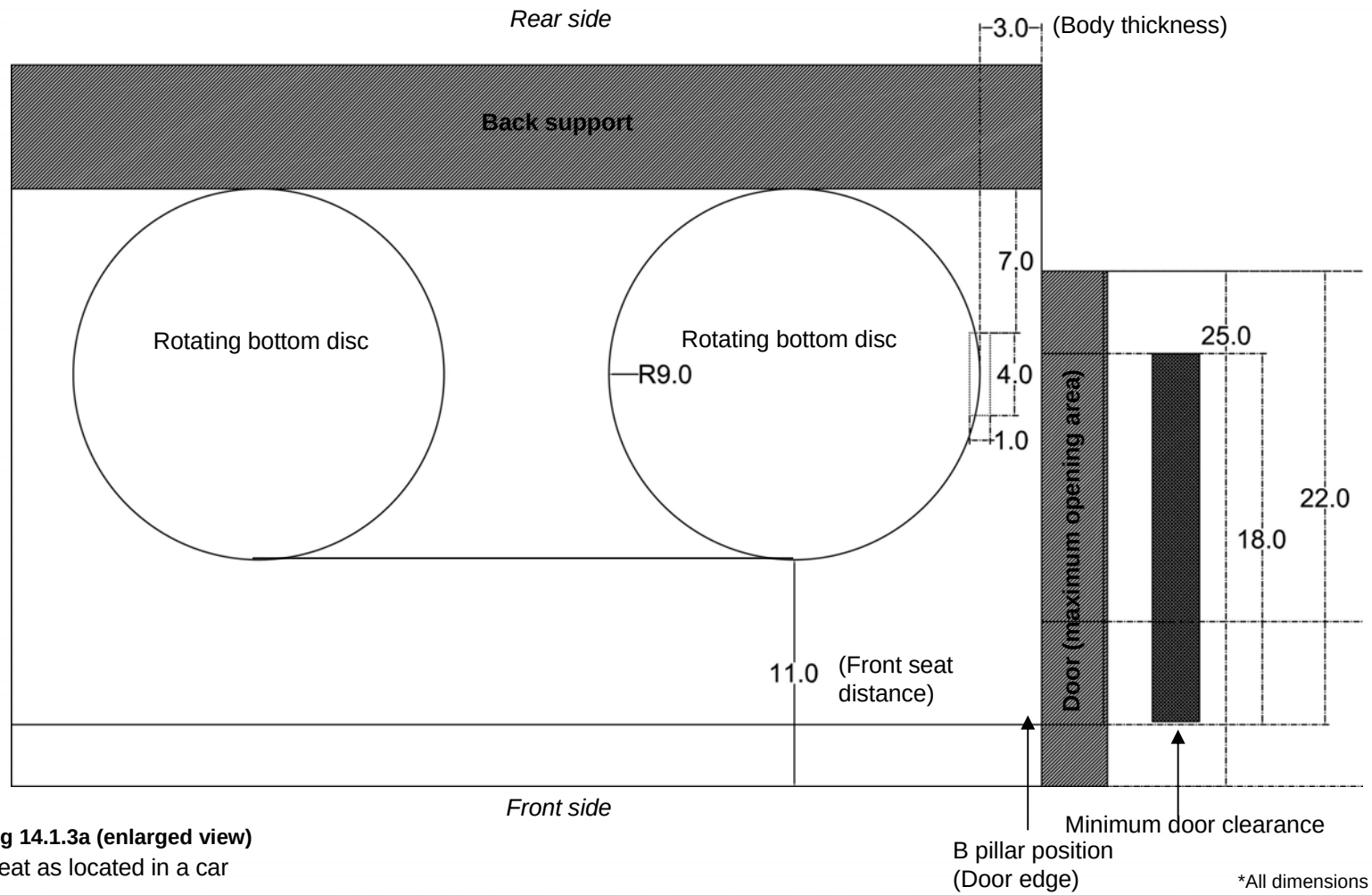


Fig 14.1.3a (enlarged view)
Seat as located in a car

*All dimensions are in inches

14.1.3 Concept refinement:

Location of seat in the car

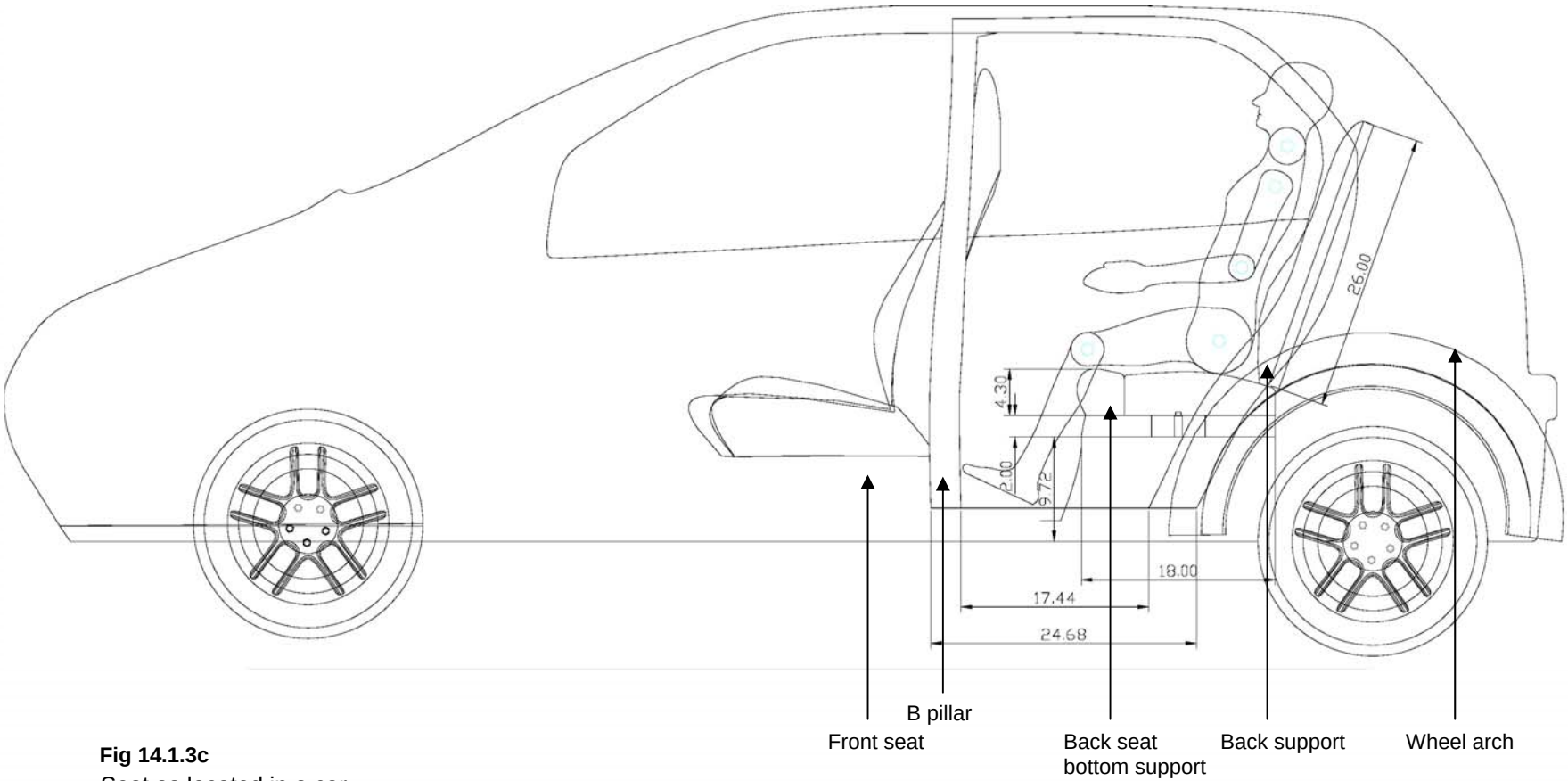


Fig 14.1.3c
Seat as located in a car

*All dimensions are in inches

14.2 Concepts:

14.2.1 Foot Rest

Here, the functioning of foot rest was explored

- One time adjustment regarding horizontal distance from the rear seat, slides on the guide rail
- Switch pressing for making it lift up in working position

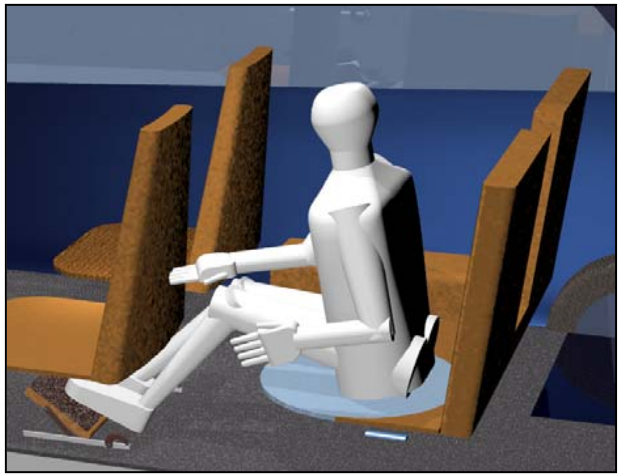


Fig 14.2.1a
Location in car

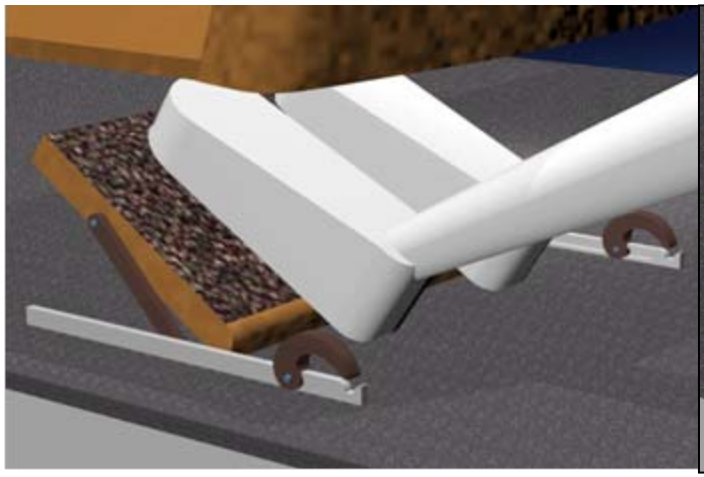


Fig 14.2.1b
Feet position on the rest

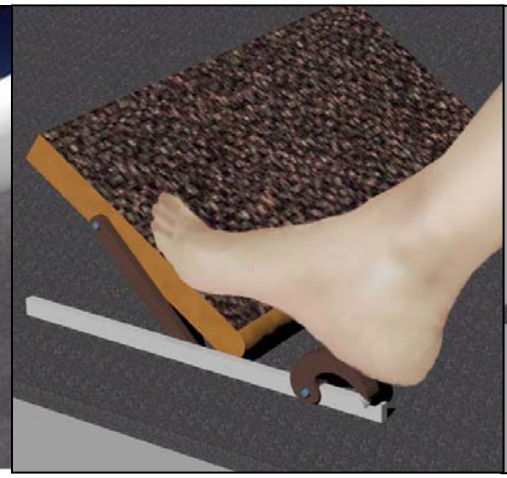


Fig 14.2.1c
Moving one foot to operate

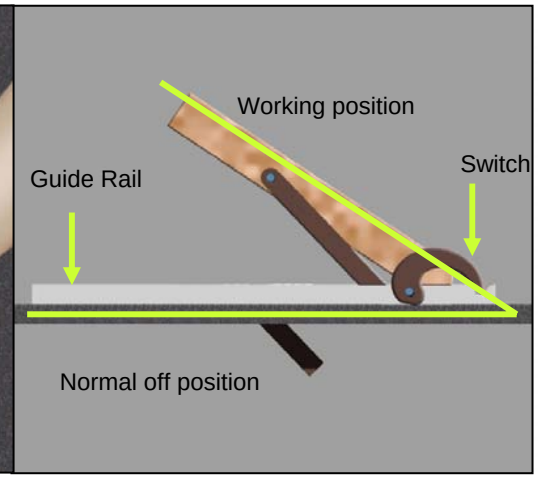


Fig 14.2.1d
Detailing out

Fig 14.2.2a
Location in car

14.2.2 Concept Evaluation User feedback

The plywood footrest was made and kept in the interior of Indica itself at different angles and position. Then study was carried to find out the extent of comfort achieved through it.

Fig 14.2.2b
Feet position on the rest

Fig 14.2.2c
Exploration best suitable position

Fig 14.2.2d
Joints position in the car with foot rest

14.2.2 Concept Evaluation User feedback

During the testing with the working rig, user was required to sit with foot rest put underneath the co-driver seat and it was found that –

- It provided some rest to the sole with optimum angle of 15 deg.
- Space reduction was occurring due to it,
- Along with reduction in the knee angle thus increasing stress
- Variation in front seat movement was hindering the use of foot rest
- Thus, creating a degree of dependency on the front seat occupant

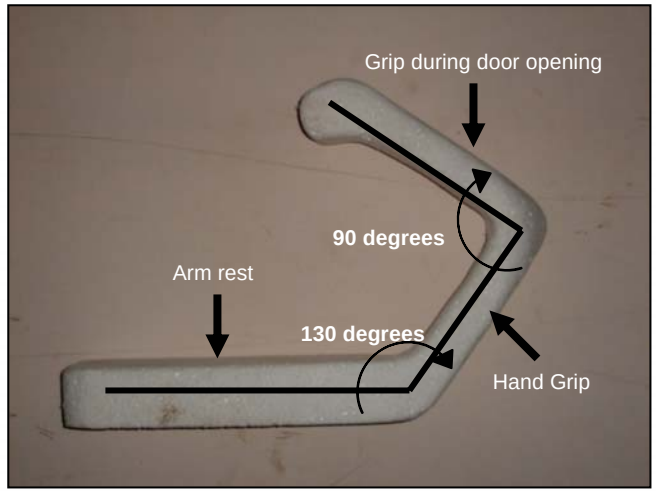


Fig 14.3.1a Location in car

14.3 Concept

Hand support

- It provides rest to the forearm
- Provision of holding in natural position of the wrist
- Gripping for opening the door and during emergency
- Support during opening of the door

14.3.1

This concept was to get the elderly have a comfort level as well as the security feeling; as it also provide a support during sudden brakes

The natural wrist position during grip has to be maintained without causing unnecessary twisting or bending.

Upper bar is provided to make up for the force required during egress when some sort of support is needed to grip for standing up from the seat level.

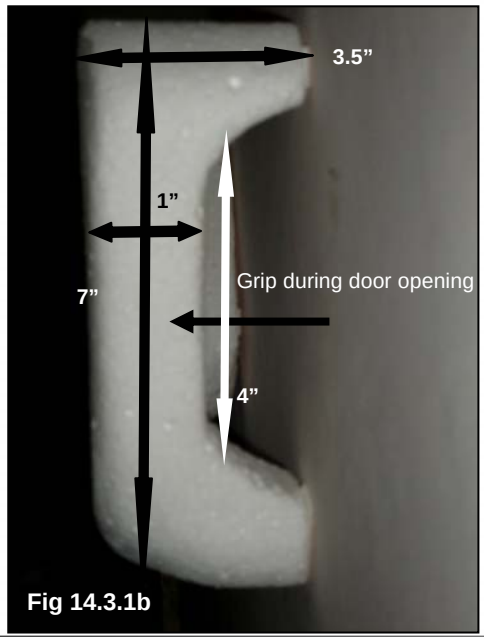


Fig 14.3.1b

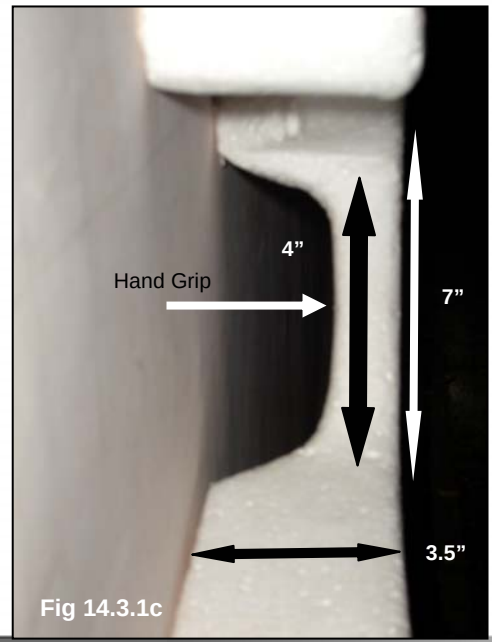


Fig 14.3.1c

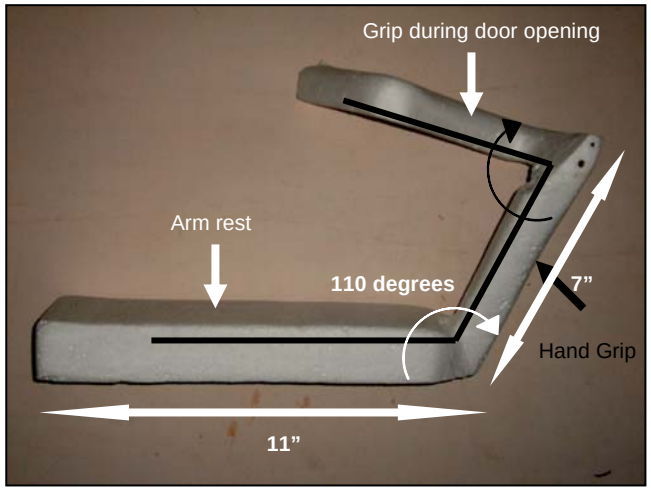


Fig 14.3.2a

Concept

14.3.2 Hand support

- Here the angle of middle and upper bar was changed to know the change in comfort level provided by it.
- Also the upper bar is rotated at an angle with horizontal to provide a better grip at the moment the pulling force is exerted by commuter to come out of the car body rim level.

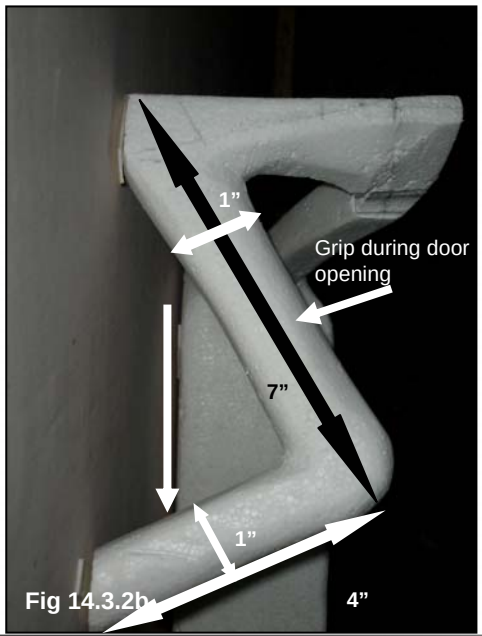


Fig 14.3.2b

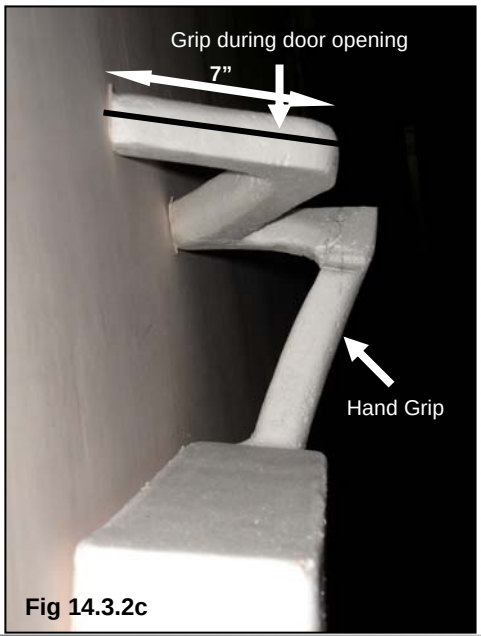


Fig 14.3.2c

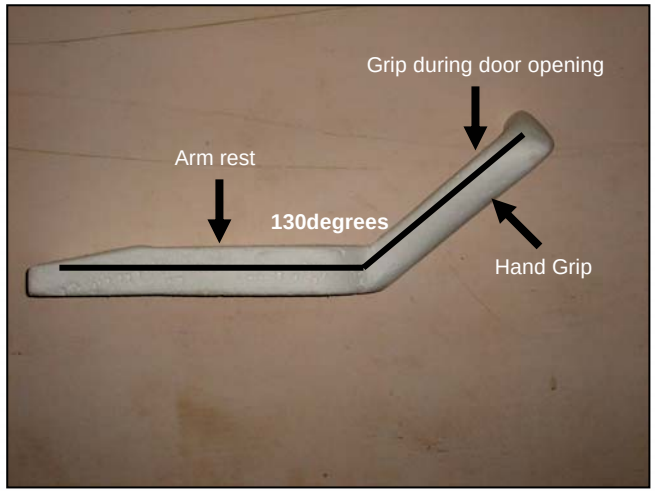


Fig 14.3.3a

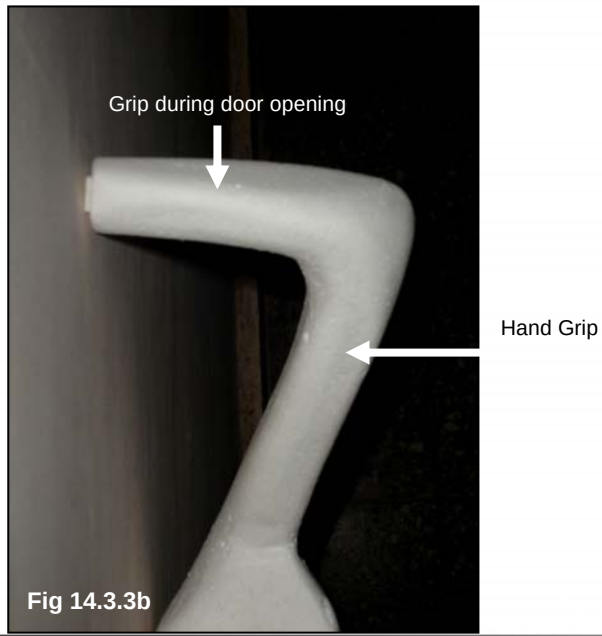


Fig 14.3.3b

Concept

14.3.3 Hand support

- In this concept the main focus shifted to provide maximum comfort during the egress part.
- The upper bar is fused with the middle bar so as to create a cavity for grip itself

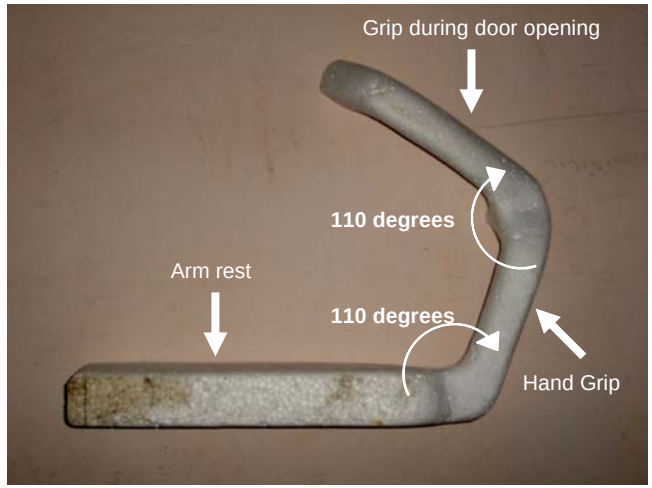


Fig 14.3.4a

Concept

14.3.4 Hand support

- In this concept the middle bar was tilted at the increased vertical angle as compared to 1st one so as to coincide with the natural posture of wrist .
- Upper bar was tilted with horizontal to amalgamate the provision for pulling for and load bearing during lifting up from the seat

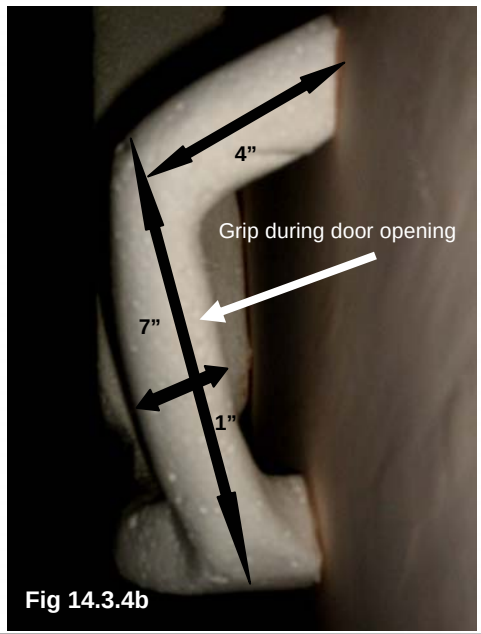


Fig 14.3.4b

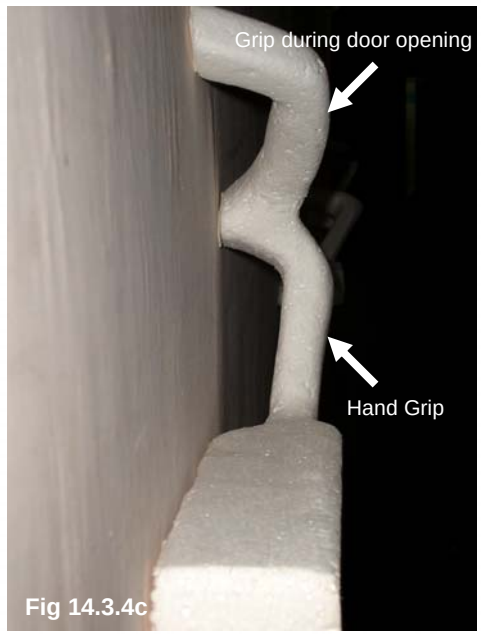


Fig 14.3.4c

Concept

14.3.7 Arm rest finalized

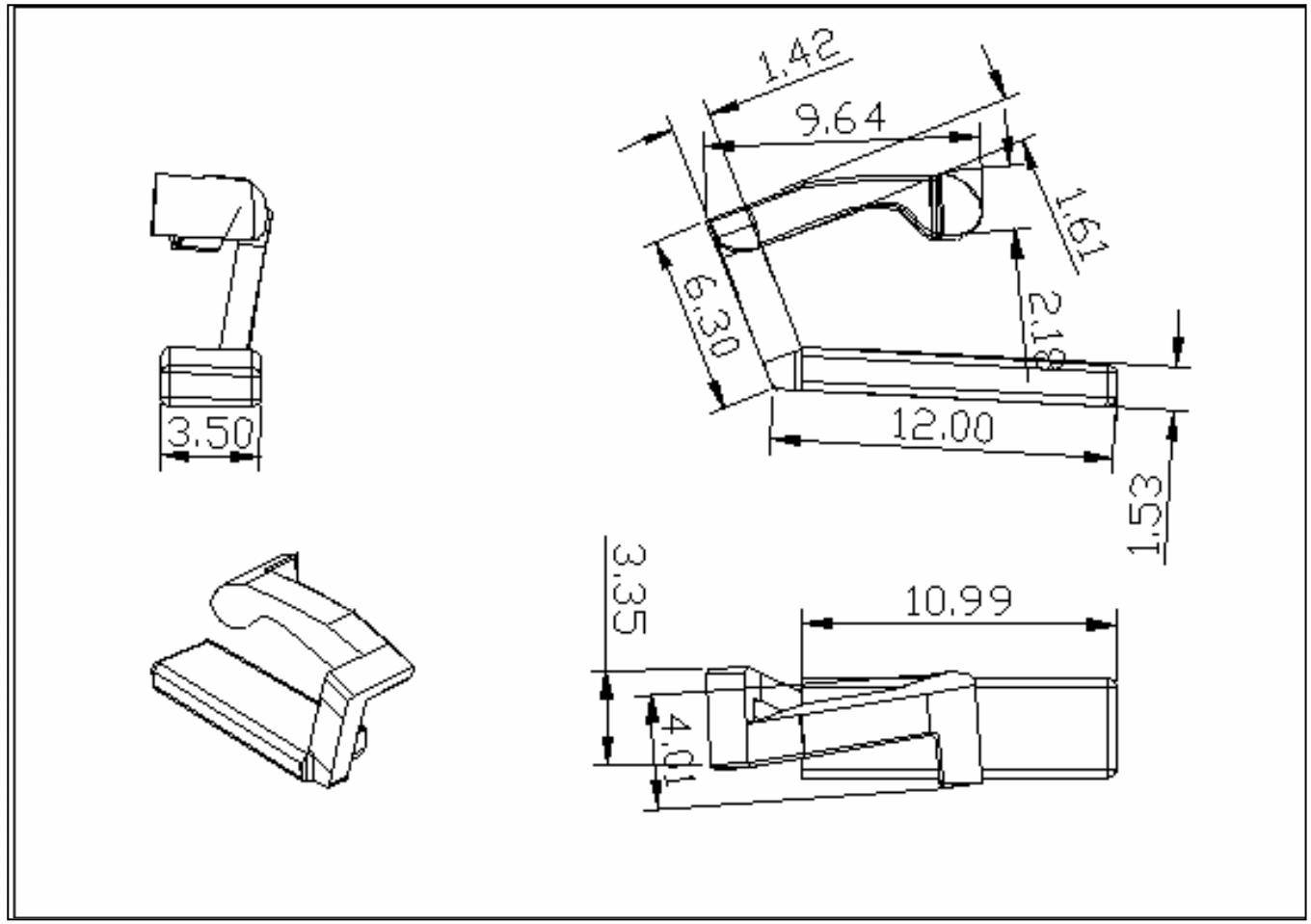


Fig 14.3.5

*All dimensions are in inches

Fig 14.3.7a

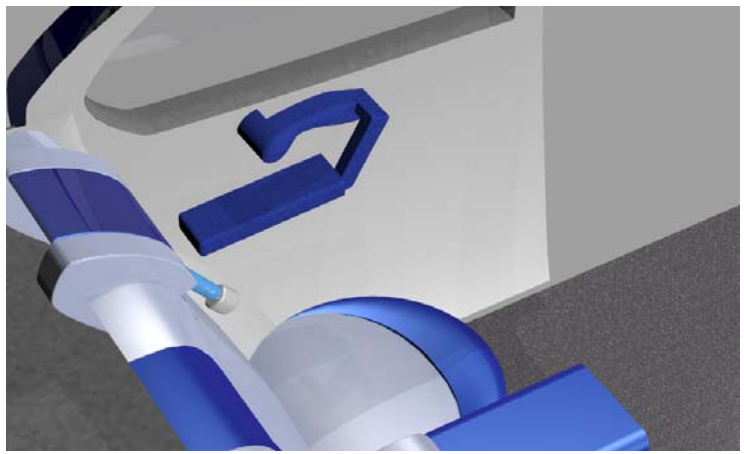


Fig 14.3.7b

Concept

14.3.8 Arm rest

- It provides rest to the forearm
- Provision of holding in natural position of the wrist
- Gripping for opening the door and during emergency
- Support during opening of the door

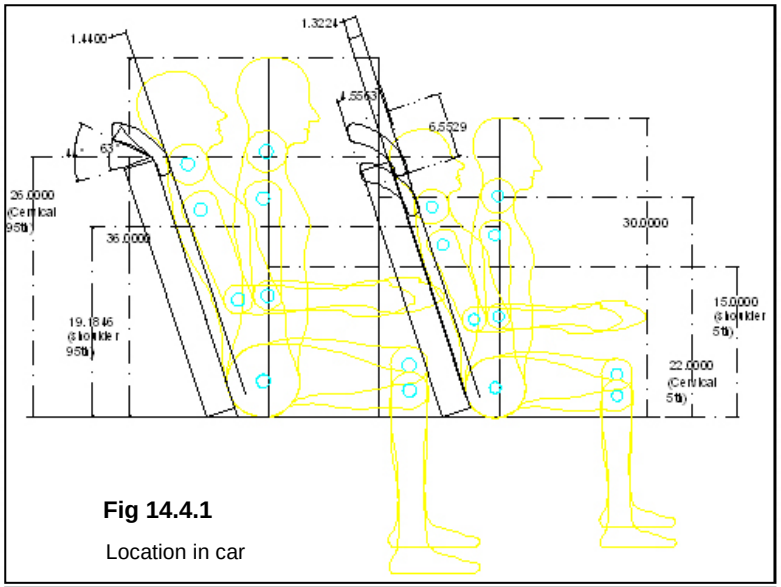


Fig 14.4.1

Location in car

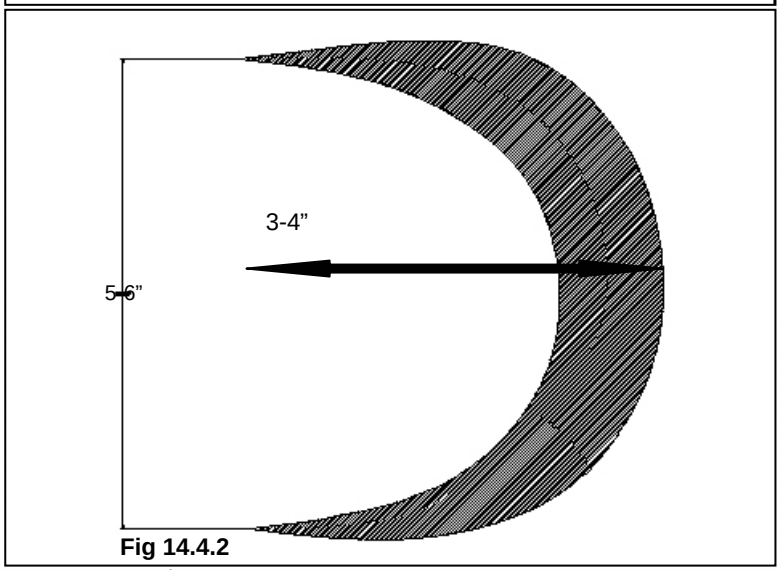


Fig 14.4.2

Head measurements

14.4 Concept

14.4.1 Head rest

- It provides rest to the cervical region
- Provision of keeping the neck in natural curved posture
- Since, sleeping is the activity which occurs most of the elderly people when they are traveling in their vehicle provision of some support inducted
- Normal indexing mechanism as is prevalent, employed for height adjustability
- Fig. 14.4.1 shows the adjustability required for the head support and also the angle arrived for providing the natural posture for head resting
- Regarding the variation in sizes of head fig. 14 4 2 conveys the shaded area as the difference in 5^{th} and 95^{th} of the sample.

*All dimensions are in inches

Concept

14.4.2 Head rest position

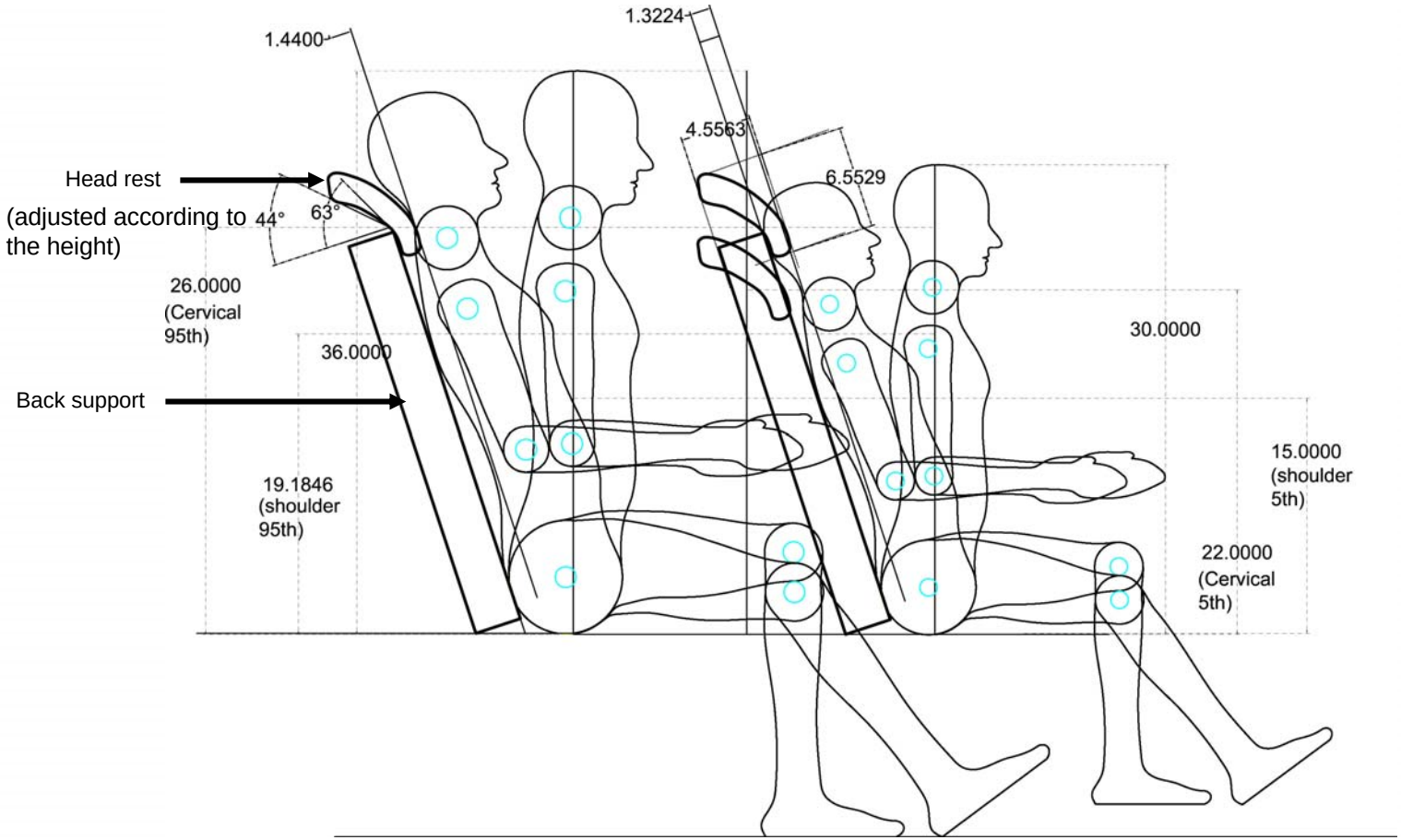


Fig 14.4.1 95th percentile for height 5th percentile for height

Location in car (enlarged)

*All dimensions are in inches

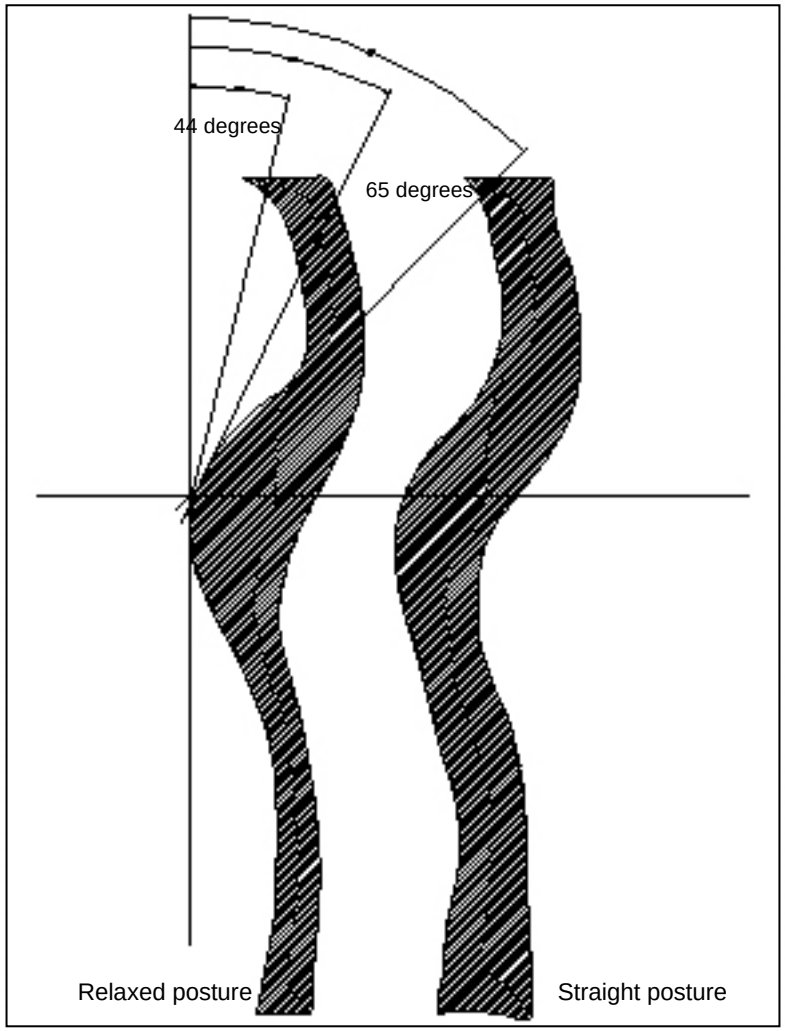


Fig 14.4.3

Neck/ head profile measurement

Concept

14.4.3 Head rest profile

- The adjoining figure shows the variation in spinal curves (at neck)of different people.

•The variation in angle may be in between 44 deg to 65 deg. Under relaxed and straight posture

*All dimensions are in inches

Fig 14.4.4a

Testing of mechanism

Concept

14.4.4 Head rest mock model

- The adjoining figure shows the simulating of the head support
- The flapping mechanism pivoted at a point is done with fixed number of slots

Fig 14.4.4b

Fig 14.4.4c

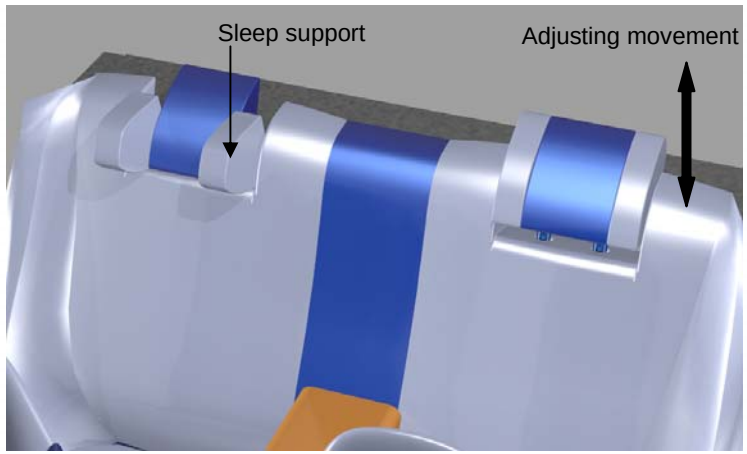


Fig 14.4.6a
One of the seat's head arresting panels moved forward

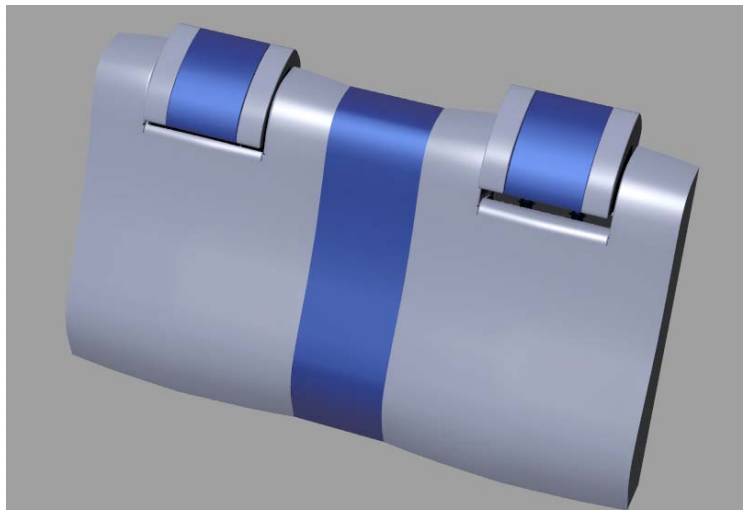


Fig 14.4.6b
One of the head support moved for upward adjustment

Concept

14.4.5 Head rest renderings

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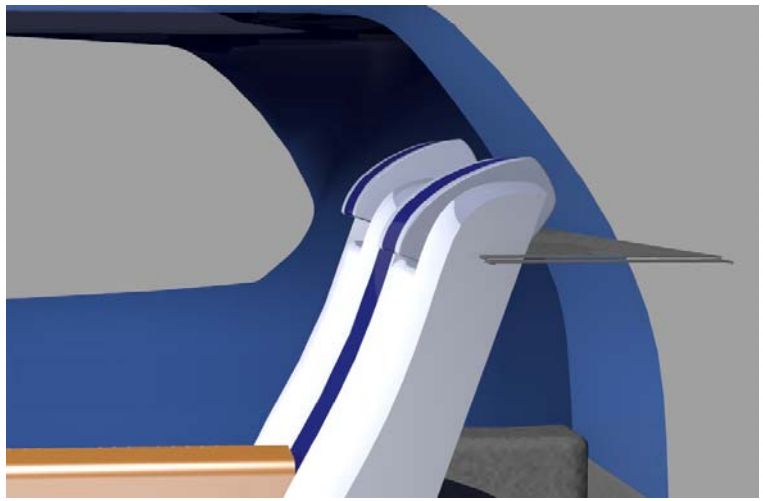


Fig 14.4.7c

Concept

14.4.6 Head rest renderings contd.

- It provides rest to the cervical region
- Provision of keeping the neck in natural curved posture
- Since, sleeping is the activity which occurs most of the elderly people when they are traveling in their vehicle provision of some support inducted
- Normal indexing mechanism as is prevalent employed in height adjustability

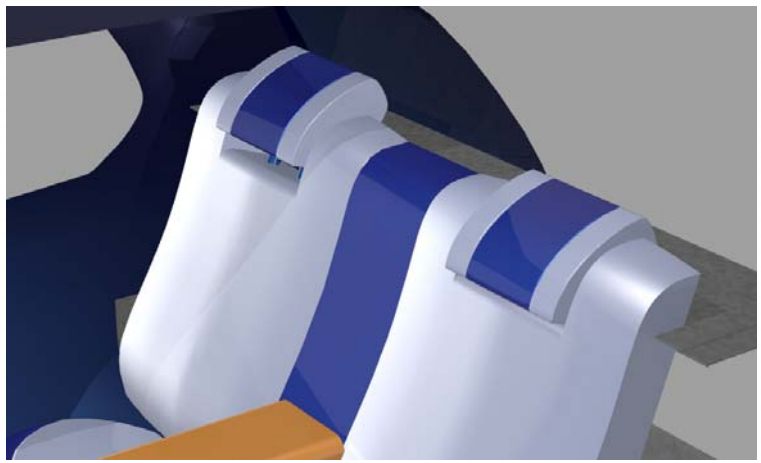


Fig 14.4.7d

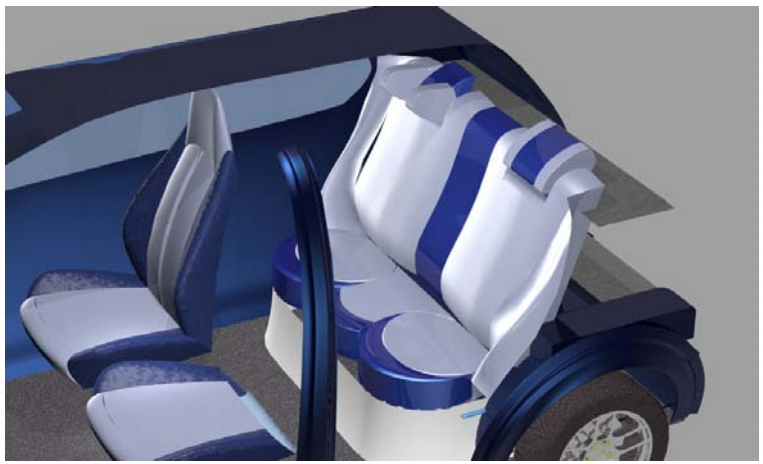


Fig 14.4.7e

Concept

14.4.7 Head rest final dimensions

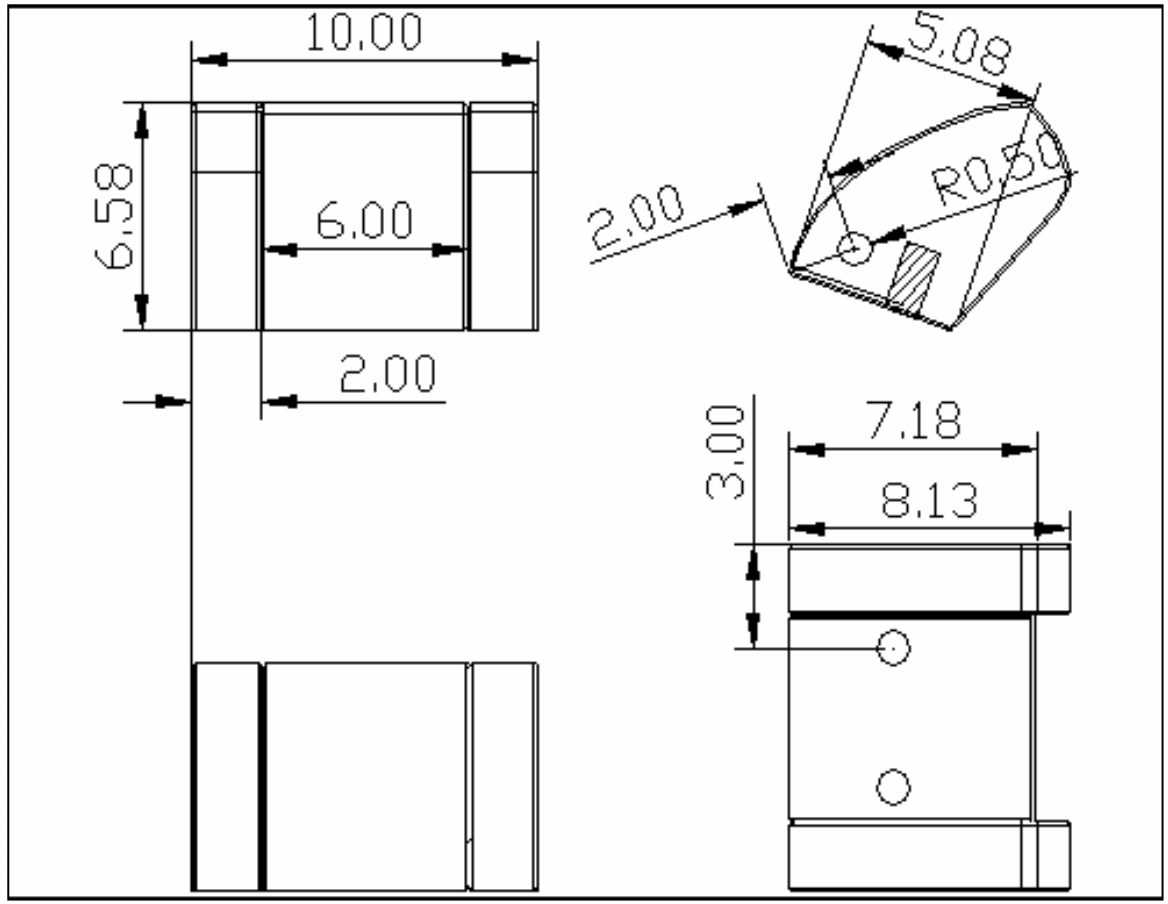


Fig 14.4.5

Neck/ head support dimensions

All dimensions are in inches

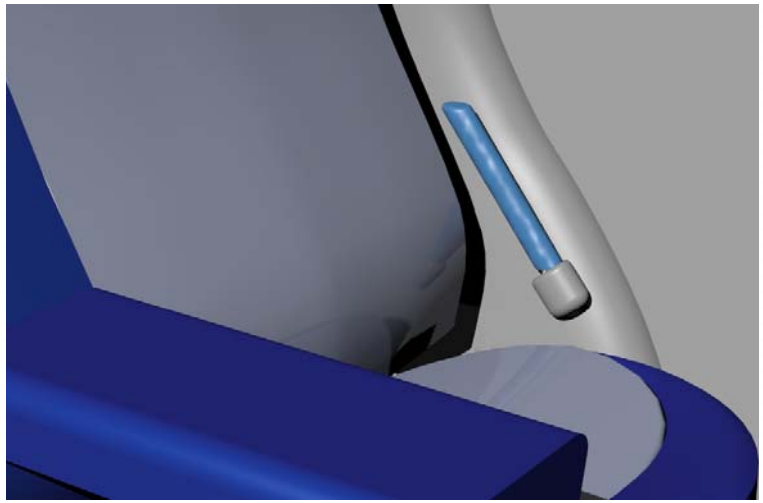


Fig 14.5a

Concept

14.5 Auxiliary handle

- It provides support during egress
- In the normal position it remains rested with the car body
- At the time of egress the user pushes it up, so that it rotates and becomes vertical and self locks
- Then it does an outward rotation for serving the purpose of support
- i.e. it has tri axial motion in x , y and z direction

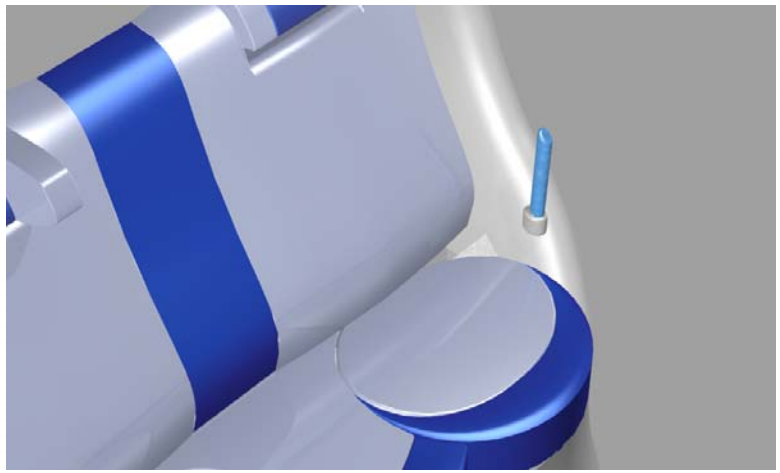


Fig 14.5b

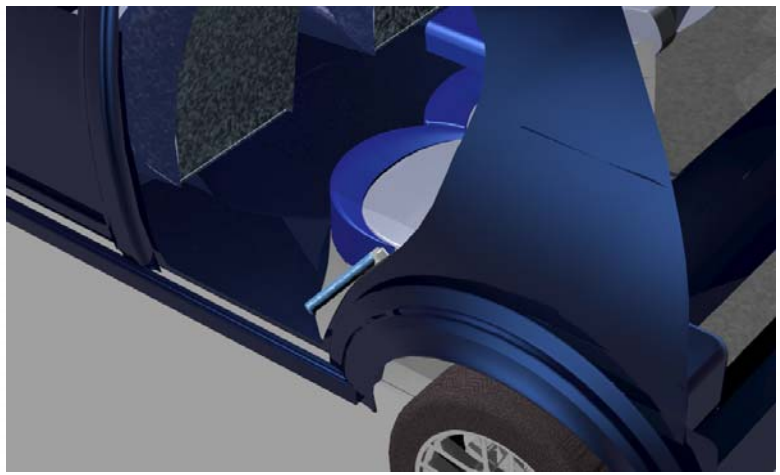


Fig 14.5c

14.5 Auxiliary handle dimensions

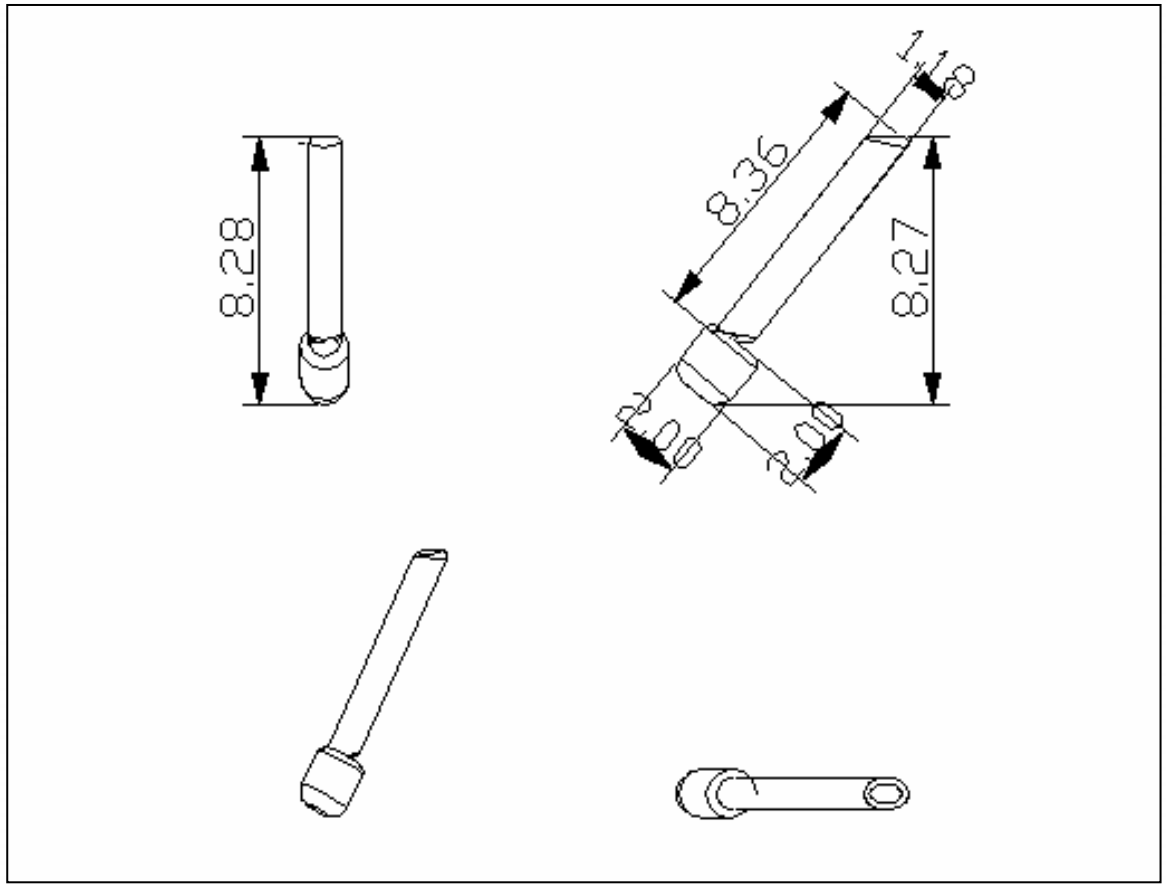


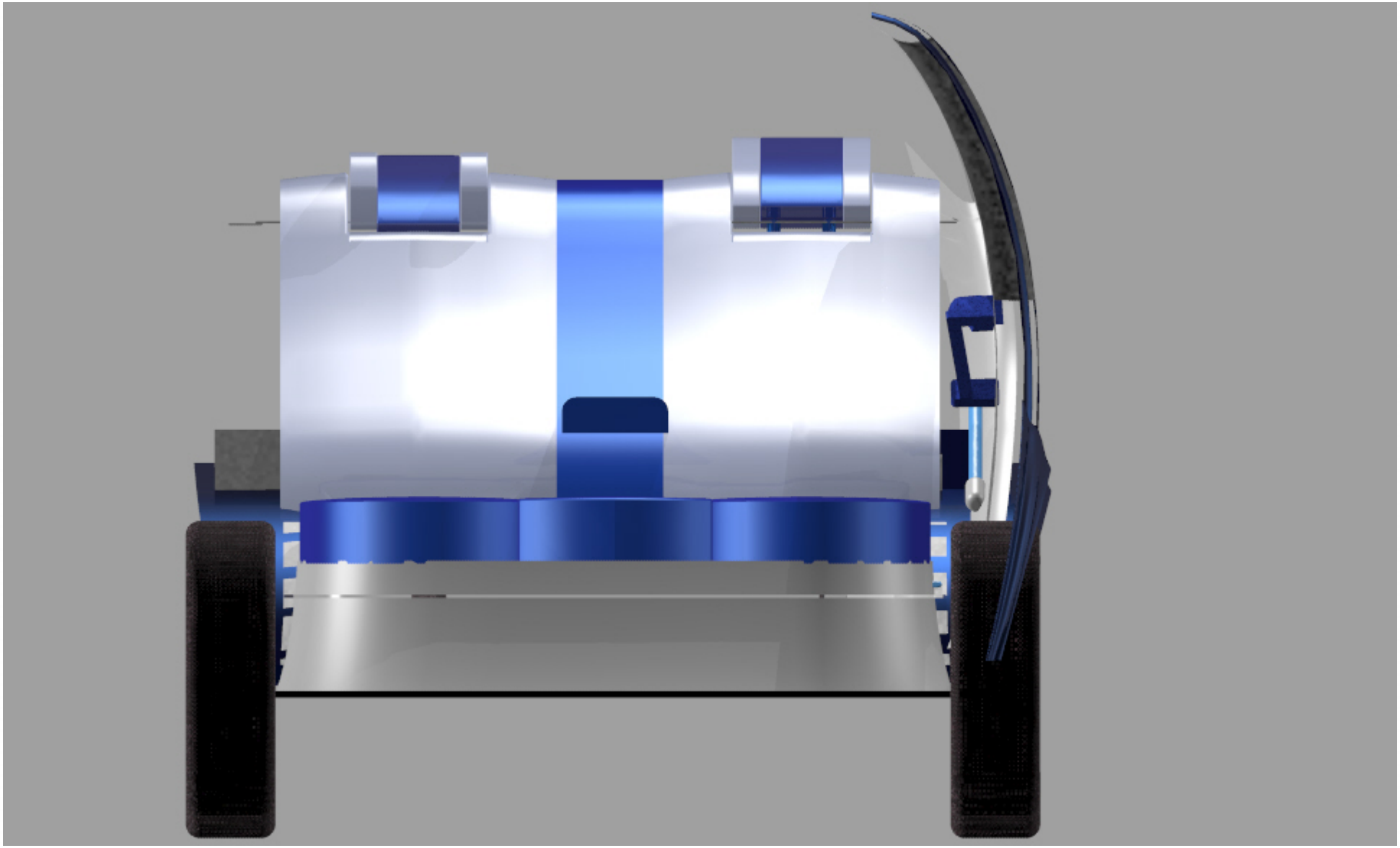
Fig 14.6

Auxiliary handle dimensions

All dimensions are in inches

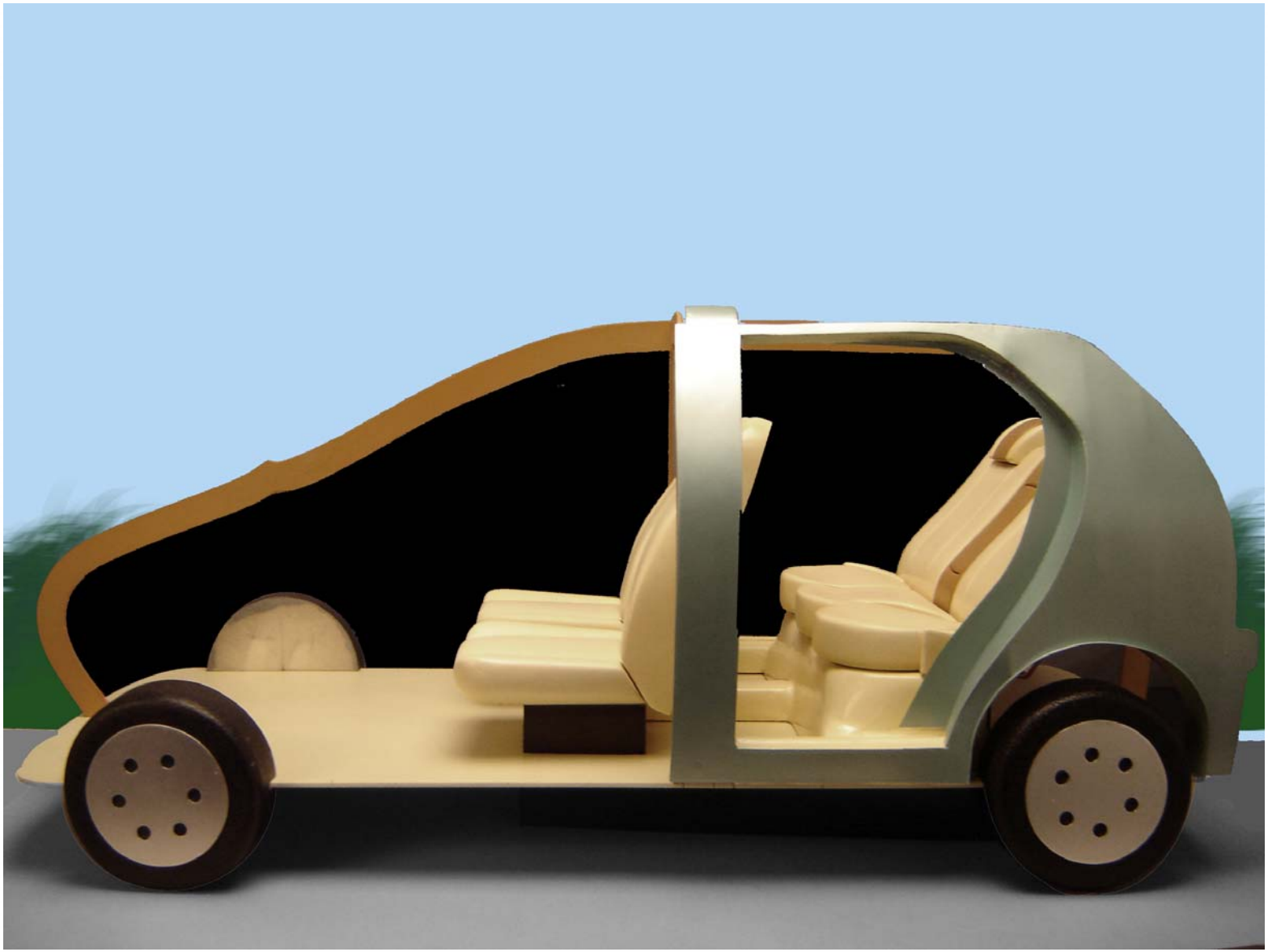
Final concept -

Rendered images



Final concept -

Model images



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