

Vehicle for Elderly :

Interior Layout and Support System

Project Guide:
Prof. G.G RAY

Dipesh Parmar
(07613009)



RESEARCH & DATA COLLECTION

Vehicle: Vehicles are means of transport.
Most often they are manufactured
(e.g. *bicycles, cars, motorcycles, trains, ships, boats, and aircraft*)

History:
Palki can be considered as a first vehicle for elderly.



PALKI AND KAAWAR

In older days Palki was used by raja and maharajas. It was also used for Bidai in marriage. Now a days it is used for elderly during Tirth yatra. In the history, it was used by Shravan kumar , who carried his parents on his shoulders for Tirth yatra in a kaawar.

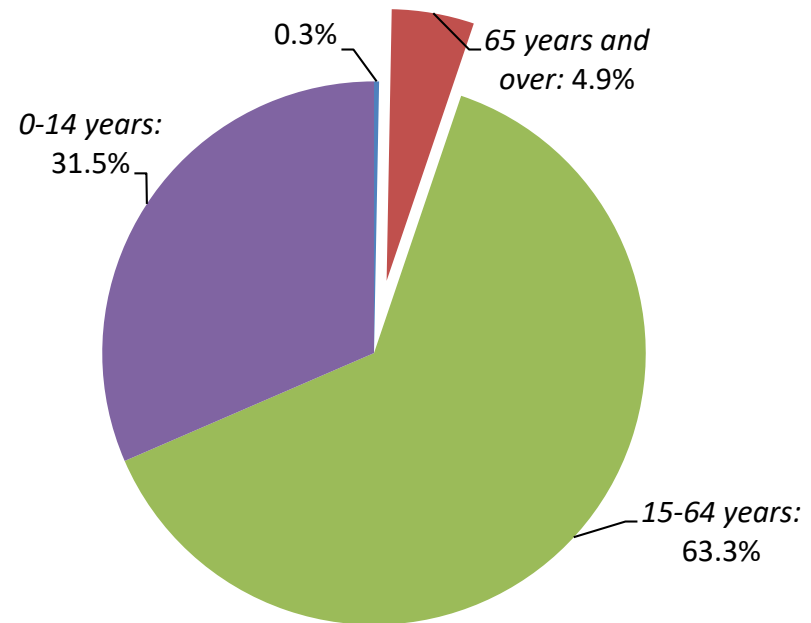


INDIA STATISITICAL DATA

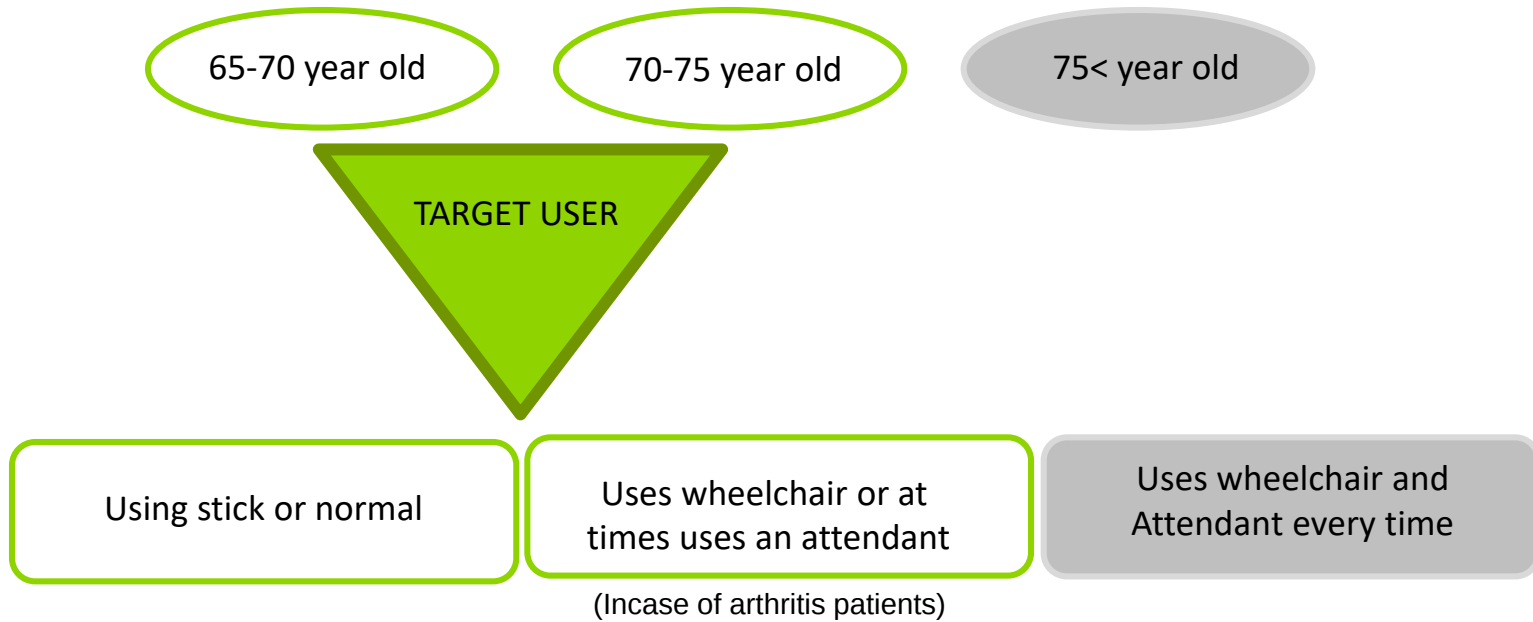
Total Population of India: 1,147,995,904 (July 2008 est.)

Age wise distribution of Indian population as mentioned below: structure:

- 0-14 years: 31.5% (male 189,238,487/female 172,168,306)
- 15-64 years: 63.3% (male 374,157,581/female 352,868,003)
- 65 years and over: 5.2% (male 28,285,796/female 31,277,725) (2008 est.)
- 65< years: 4.9% (urban area population)



TARGET USER





As a part of initial research, the user study was conducted to understand the requirements, disabilities and difficulty in travelling



EXTRACTS FROM INTERVIEW

Mr. Dennis Carpenter

- 70 yrs Old.
- Approximately, he goes 4 times outside in a month.
 - 2 days in a month for shopping.
 - 2 days in a month for a picnics.
 - Once in every 2 month for routine check up.

Medical Problems:

- Visual Problem (*20% visibility in right eye*).
- Other Problem (*Asthma, breathing problem*).

Walking Problems:

- Steps - Comfortable.
- Ramp or Slope - walking Problem (*Breathing Problem*).



Mr.Dennis Carpenter



EXTRACTS FROM INTERVIEW

Luggage Carrying

- Walking Stick
- Umbrella
- Bags

Ingress and egress problems while using vehicles provided by dignity town ship

- Golf Car
- Dignity Auto
- Local Auto
- Dignity Qualis
- Local Bus



Mr.Dennis Carpenter



EXTRACTS FROM INTERVIEW

Mr. M.J.Ropani

- 96 yrs old.
- Approximately, he goes 5 times outside in a month.
 - 1 day in a month for shopping.
 - 2 days in a month for a picnic.
 - 2 days in a month for routine check up.

Medical Problems:

- Visual Problem
- Arthritis (*joint pain- knee join*)
- Other Problems (*Back pain*).

Walking Problems:

- Steps – Little Problem.
- Ramp or Slope – Less Problem.



Mr.M.J. Ropani



EXTRACTS FROM INTERVIEW

Luggage Carrying :

- Walking Stick.
- Umbrella.
- Bags.

Ingress and egress problems while using vehicles provided by Dignity town ship

- Golf Car
- Dignity Auto
- Local Auto
- Dignity Qualis
- Local Bus



Mr.M.J. Ropani



EXTRACTS FROM INTERVIEW

Mrs. Khanna

- 65 yrs old.
- Approximately, she goes 3 times outside in a month.
 - 1 day in a month for shopping.
 - 2 days in a month for a routine check up.

Medical Problems:

- Visual Problem.
- *Arthritis (Advance Stage- hand and leg).*
- Other Problem (*One Attendant's Help*) supported by attendant while.

Walking Problems:

- Steps – Big Problem.
- Ramp or Slope – Less Problem.



Mrs. khanna



EXTRACTS FROM INTERVIEW

Luggage Carrying :

- Walking Stick.

Ingress and egress problems while using vehicles provided by Dignity town ship

- Golf Car
- Dignity Auto
- Local Auto
- Dignity Qualis
- Local Bus



Mrs. khanna



DIGNITY AUTO

- Only for Members.
- Works Outside the Colonies.

Problem identification:

	Name	Score	Reason
	Mr. Dennis Carpenter	OK (no problem in climbing) ★★	High floor height
	Mr. M.J. Ropani	Bad (Difficulty in climbing) ★★	High floor height
	Mrs. Khanna	Very bad (other person help) ★	Too high floor height



DIGNITY QUALIS

- Only for members.
- Works outside the Dignity Colonies.
- Used for picnics or shopping.



Problem identification:

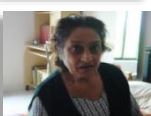
	Name	Score	Reason
	Mr. Dennis Carpenter	OK (no problem in climbing) 	High floor height
	Mr. M.J. Ropani	Bad (Difficulty in climbing) 	High floor height
	Mrs. Khanna	Very bad (other person help) 	Too high floor height



DIGNITY GOLF CAR

- Only for Members.
- Only inside Colonies.

Problem identification:

	Name	Score	Reason
	Mr. Dennis Carpenter	Good (no problem in climbing) ★★	High floor height
	Mr. M.J. Ropani	Bad (Difficulty in climbing) ★★	High floor height
	Mrs. Khanna	Very bad (Extra table used) ★	High floor height



DIGNITY FOLLOWING

In addition to the vehicle ingress/egress attempts were also made to study the local steps or ramps in terms of ease in climbing or walking. This will lead to determine the step height / ramp slope to be provided in the vehicle

Problem identification:

	Name	Step Score	Slope Score
	Mr. Dennis Carpenter	Good 	OK 
	Mr. M.J. Ropani	OK 	OK (Using stick) 
	Mrs. Khanna	Very bad 	Ok(Using stick) 



PROBLEM ANALYSIS

Personal problem

- Everyone prefers front seat.
- Long journey is painful (40-60 min)
- All cannot go out together.
- Person on a wheel chair, cannot accompany them.

Vehicle problem

- Handle problem.
- Roof handle
- Handle bar thickness problem.
- Seating arrangement.
- Pitch of a seat.
- Luggage problem.
- First step in the vehicle is high (ingress and egress)..
- Getting up and getting down problem from the seat



REQUIREMENTS

- Wheel chair should go inside.
- Group travel (13-elderly person, 2-wheel chair person, 2 attainer)
- Playful environment for Long journey.
- Steps height should be 7-8" (ingress and egress).
- Slope angle should be 10-12* degree for wheelchair, 16-25* degree for walking
- Comfortable Handle.
- Layout of vehicle (Seating arrangement).
- Space for luggage.
- Getting up and getting down from the seat.



FOCUS AREA

- Wheel chair should go inside.
- Group travel (13-elderly person, 2-wheel chair person, 2 attainer)
- Playful environment for Long journey.
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- Comfortable Handle.
- Layout of vehicle (Seating arrangement).
- Space for luggage.
- Getting up and getting down from the seat.



FOCUSED VEHICLE

After user study , analyzing the user demands and needs, which is basically for a vehicle for group travelling and also keeping in mind the demands of the physically challenged people, to travel along with others for picnics and for shopping, I selected **Bus** as the target vehicle for modifying it to suite the needs of elderly and provide them with a vehicle for group travelling.



PRODUCT BRIEF

From user study point, the area which need for major improvement was ingress ,egress and step height . Knee pain started during egress and wheelchair person also join a group, for which layout used is of maximum usability and comfortable support system for inside of bus

Thus this was the main focus for improvement

PRODUCT BRIEF STATEMENT.

To design an support system for elderly to get in and out with minimum afford, comfortable and walk inside a bus easily. It is component decided by considering the ergonomic principals of human comfort ability.

Entrance step should be effective than existing bus

By providing slope initially to reduce space between level of bus and ground for the comfort of elderly



LOW FLOOR BUS

Low Floor Buses manufacturing company's

- Ashok Lyland
- Tata Motors ltd
- Tata marcopolo motors
- Tata Hispono
- Marcopolo corporation –brazil

Small Buses manufacturing company's

- Ashok Leyland.
- Tata Motors Ltd.
- Force Motors Ltd.
- Hindustan Motors Ltd.
- Eicher Motors Ltd.
- Mahindra & Mahindra Ltd.



SMALL BUS MANUFACTURING COMPANYS

Force Motors Ltd.

- Force Citiline
- Force luxury
- Force Traveller

Eicher Motors Ltd.

- Eicher Skyline Bus

Hindustan Motors Ltd.

- RTV Passenger

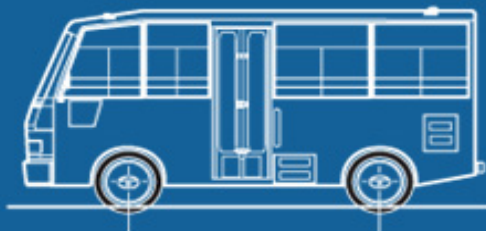
Tata Motors Ltd.(Starbus Standard)

- Starbus 16
- Starbus 18 CNG
- Starbus 20
- Starbus Dlx 18
- Starbus Dlx 20
- Globus18
- Globus 20



TATA STARBUS 18 CNG

Starbus 18 CNG



Side View

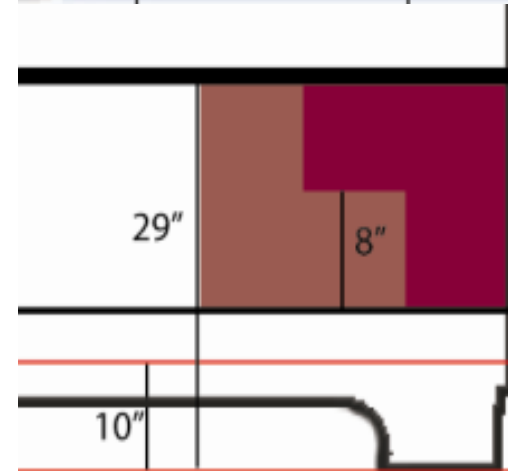
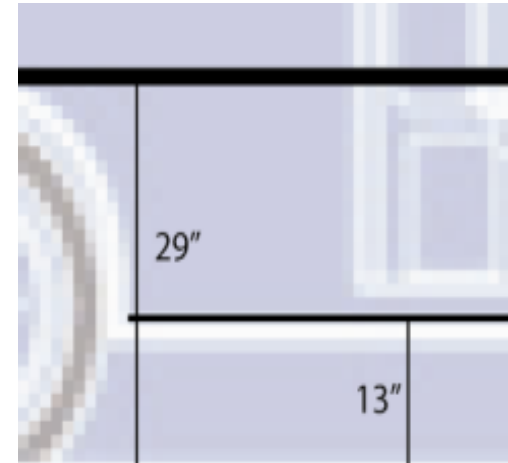
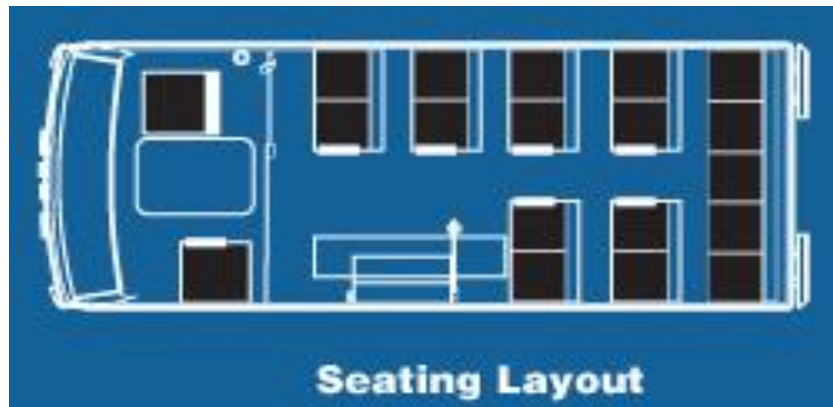
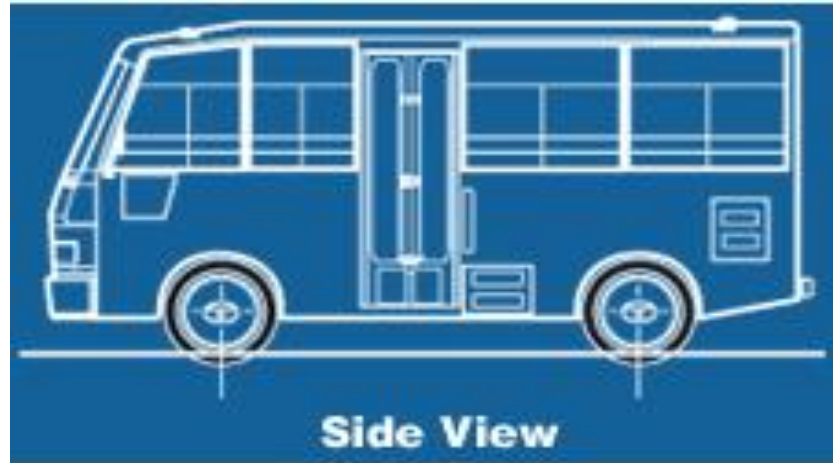


Seating Layout

Door Type	Single door
Chassis Platform	LP 407/31 CNG
Engine Power (Kw)	49.5 Kw @ 3200 RPM
Engine Torque (Nm)	190 Nm @ 1200 - 1700 RPM
Clutch Diameter (mm)	240
Gear Box Type	GBS 18
Rear Axle Ratio	37/8
Steering	Mechanical
No. of Tyre Size	4 +1
Tyre Size	7.5 X 16, 16 PR
Fuel Tank Capacity (litres)	3 cylinders 47 kgs gas @ 200 bar
Gross Vehicle Weight (kg)	5560
Basic Dimensions (mm)	Wheel Base - 3100 Front Over Hang - 1315 Rear Over Hang - 1290 Overall Length - 5705 Width - 2100
Seat Pitch	720
Gangway	350
Internal height	1815
Overall height (in laden condition)	2620



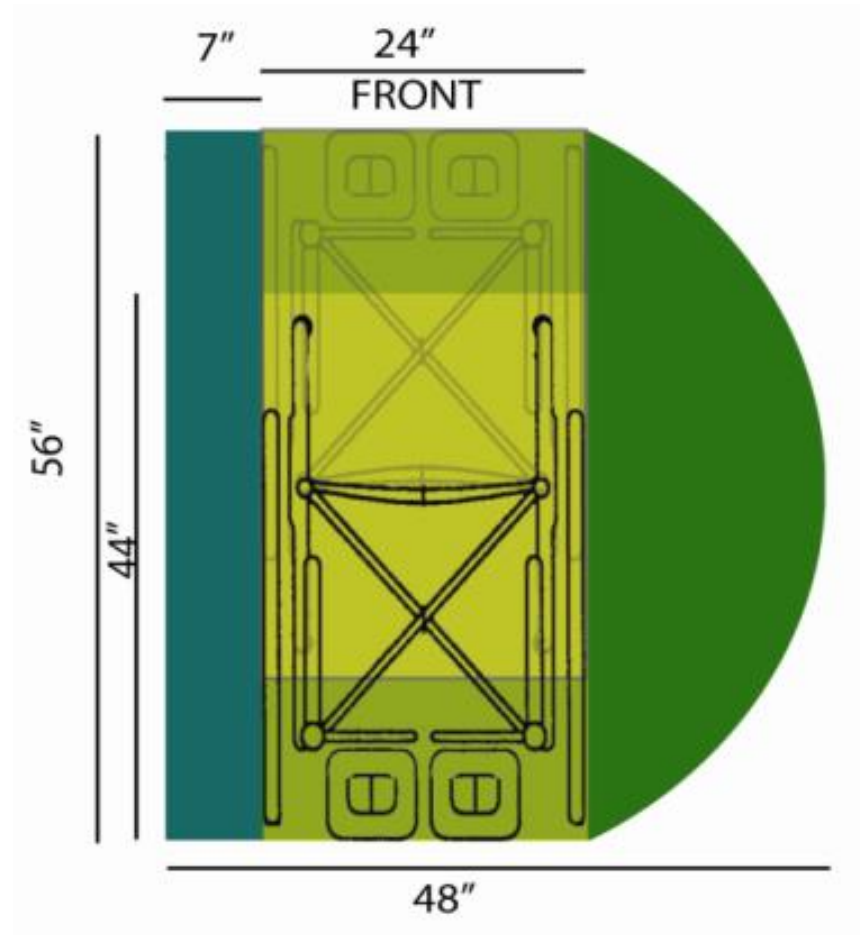
DETAILS OF VEHICLE CHOSEN FOR THE PROJECT



SPACE CONSUMED BY WHEELCHAIR

Wheelchair dimension are 24 x 44".

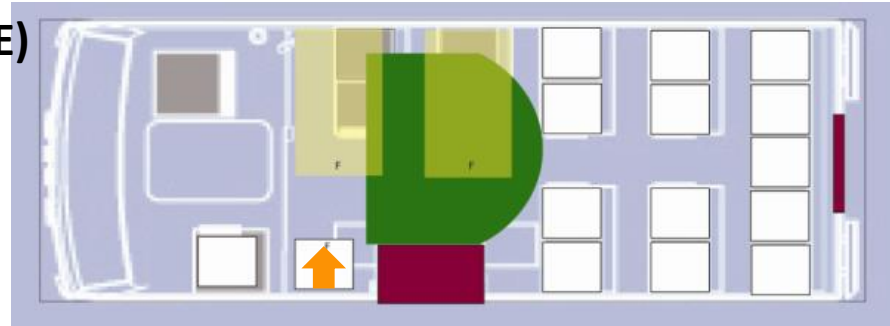
If wheelchair is rotated to 180 degree or given a U-turn then space consumed is 56 X 48" with an attendant consider (width is 7" for the attendant)



SEATING LAYOUT (COMMON ENTRANCE)

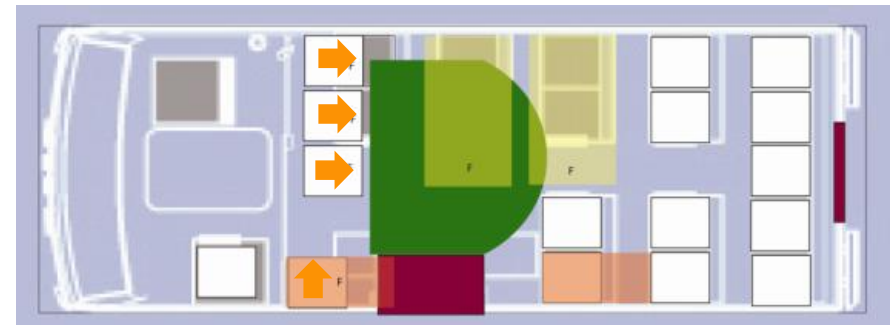
Layout 1 :

- 11+ 2
- Direction problem for 3 persons



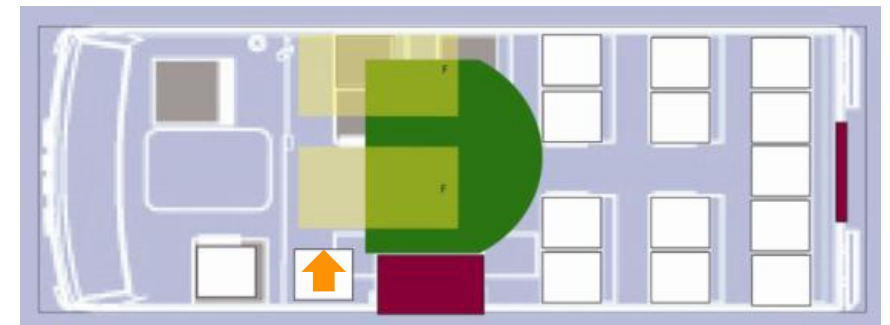
Layout 2 :

- 14+ 2
- Direction problem for 6 persons
- Entrance is blocked



Layout 3 :

- 11+ 2
- Direction problem for 1 persons
- Entrance is blocked



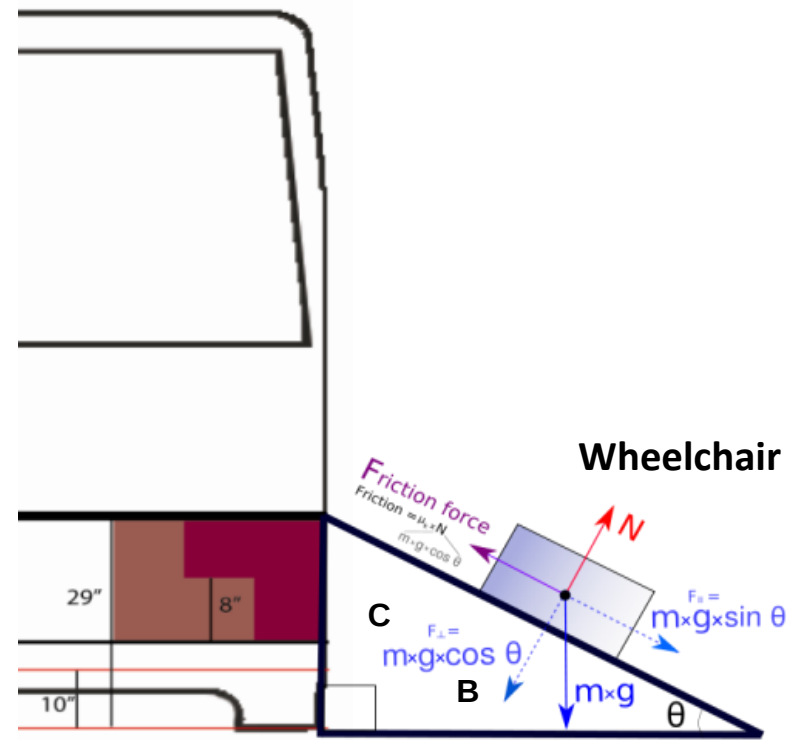
LOAD CARRYING CALCULATION

The standard slope angle for carrying wheelchair is 10 to 12 degree.

In case of 12 degree slope, the attendant carrying the wheelchair, have to apply force of 16 kg.

- In this case 70kg is considered as the weight of the person and 10 kg is considered as the weight of the wheelchair and 10 N is considered as the force of gravity.

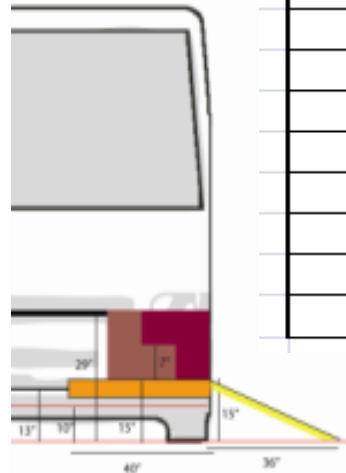
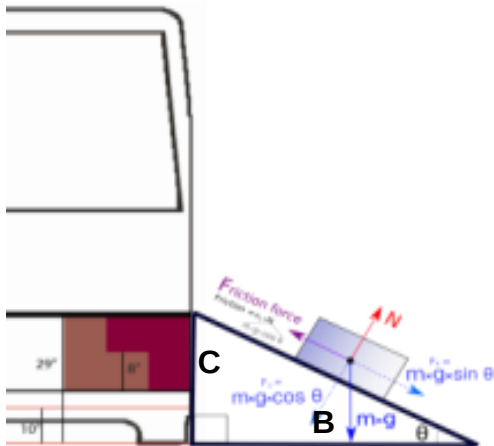
Angle	Load carrnying .= $m \times g \times \sin A / 10$	m= Mass g= Gravity	70+10 10
12	16		
15	20		
17	23.5		
20	27.2		
22	29.6		
24	32		
25	33.6		
30	40		



SLOPE ANGLE CALCULATION

According to ergonomic standard
10 to 12 degree is for perfect angle
for wheelchair and 16 to 25 degree
slope angle for walking

Step Height	Step Depth	Step Width	Ground Clearance	Slope angle	Slope base
H	D	W	C	Ang*	B
7"	9"	28"	15"	15*	57"
8"	9"	28"	13"	15*	50"
7"	9"	28"	15"	17*	50"
8"	9"	28"	13"	17*	43"
7"	9"	28"	15"	20*	41.5"
8"	9"	28"	13"	20*	36"
7"	9"	28"	15"	22*	37.5"
8"	9"	28"	13"	22*	32.5"
7"	9"	28"	15"	24*	34"
8"	9"	28"	13"	24*	29.5"
7"	9"	28"	15"	25*	32"
8"	9"	28"	13"	25*	22.8"
7"	9"	28"	15"	30*	22"
8"	9"	28"	13"	30*	18.4"
29"	0	28"	0	15*	111"
29"	0	28"	0	17*	96"
29"	0	28"	0	20*	80.5"
29"	0	28"	0	22*	72"
29"	0	28"	0	24*	65.5"
29"	0	28"	0	25*	63"
29"	0	28"	0	30*	46.5"



LIFTING MECHANISM USED

There are many Wheelchair lifting mechanisms available in the market, so the one which selected one out of them, which suites. the best according to the bus selected

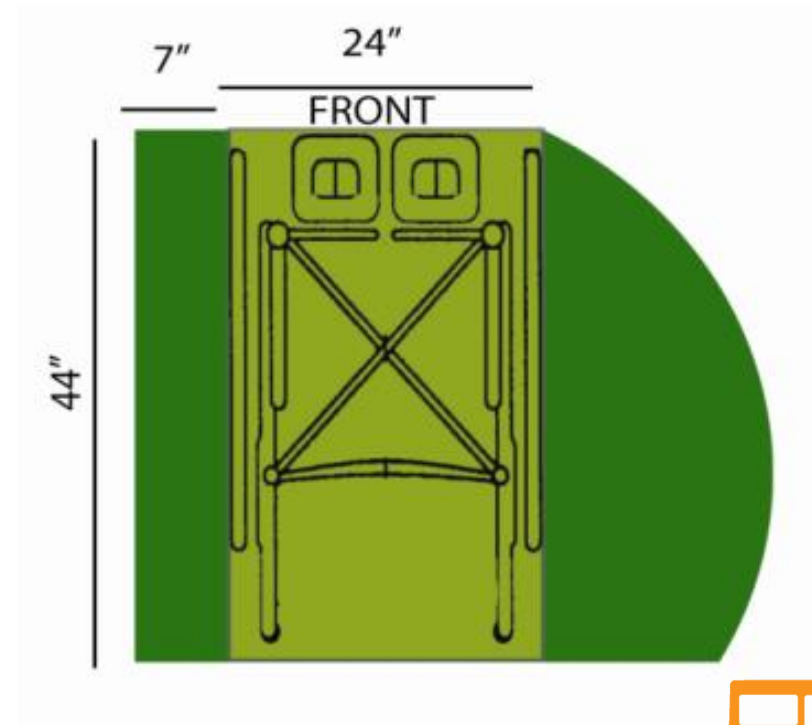
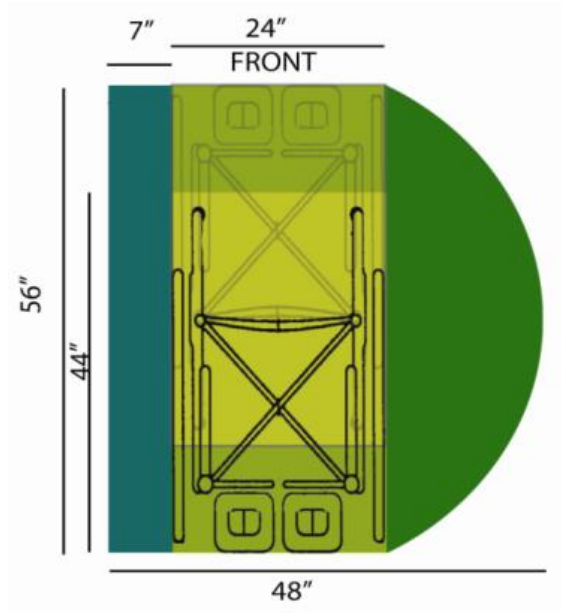
arm and lever mechanism. It is consumed lots space it is using for big or high floor buses in used.

In these mechanism is special for two hydraulic cylinder and foldable base, and base guide in guiding slide ways.



SPACE REQUIRED FOR WHEELCHAIR (LIFTING MECHANISM USED)

Dimension of wheelchair is 24 x 44". Space consumed by wheelchair when rotated 90 degree is 44 X 48" including attendant. Width of the attendant considered is 7".



EXTRA GATE POSITION

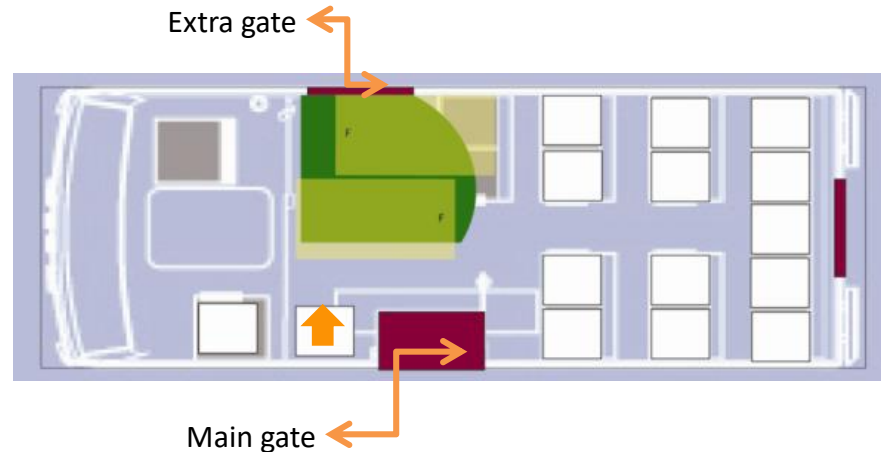
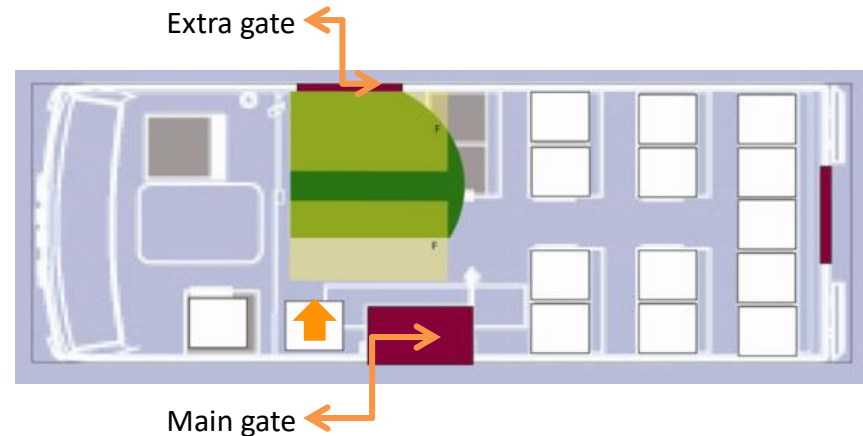
Entrance for wheel chair using lifting mechanism

Layout 4 :

- 15 + 2 person
- Direction problem for one person
- Door area remain block because of the wheelchair
- According to Indian standard door position is always in the left hand side.

Layout 5 :

- 15 + 2 person
- Direction problem for 2
- According to Indian standard door position is always in the left hand side.

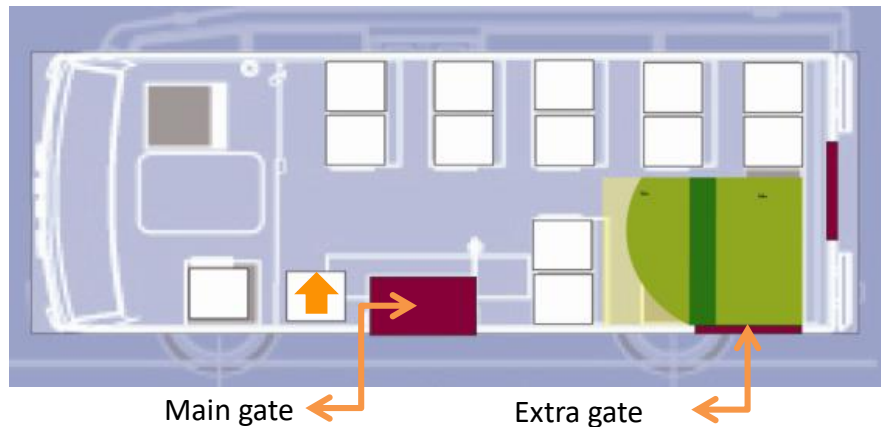
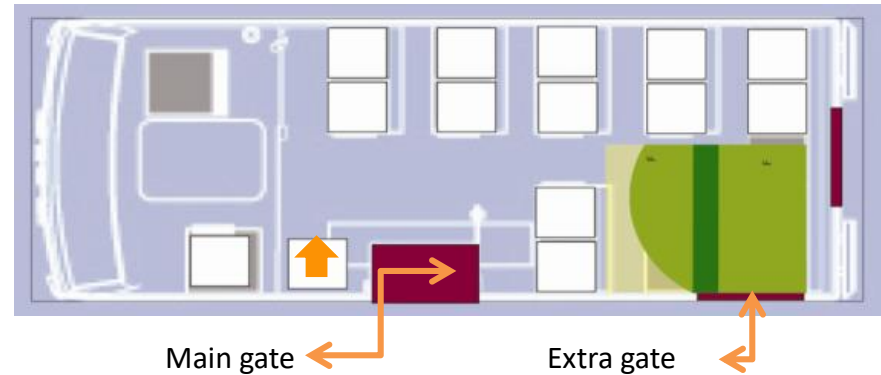


EXTRA GATE POSITION

Layout 6 :

- **14 + 2** persons
- Direction problem for 3 persons
- Door area remain block and there will be a problem for 4 persons to move inside and outside the bus without moving the wheelchair

Layout 6(A) : Another issue with this layout is that the Lifting mechanism touches the tires.

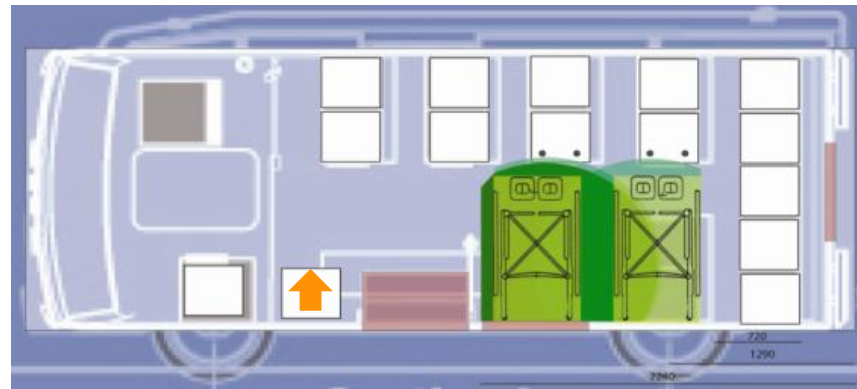
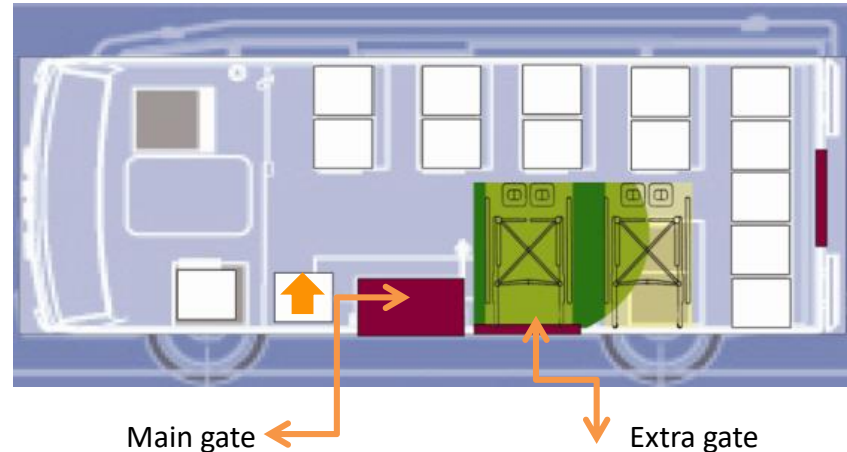


EXTRA GATE POSITION

Layout 7 :

- 15 + 2 persons
- Direction problem for 3 persons
- Door area will remain block and there will be a problem for 9 persons to move inside and outside the bus without moving the wheelchair.

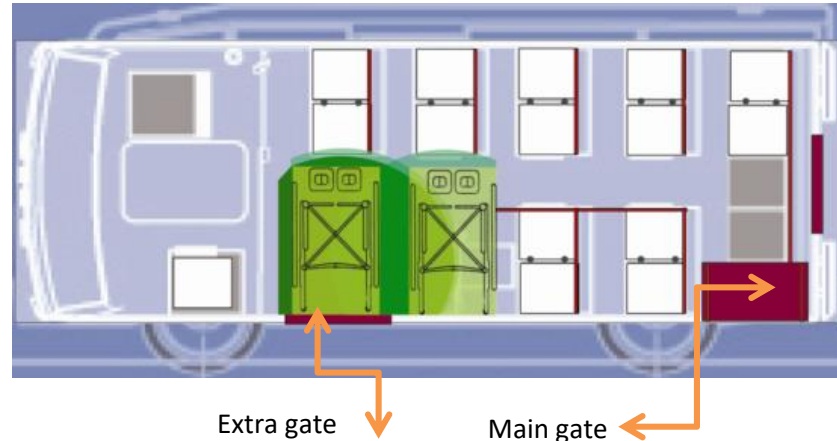
Layout 7(A) : With this layout Lifting mechanism does not touch the tires.



EXTRA GATE (MAIN GATE NEW POSITION)

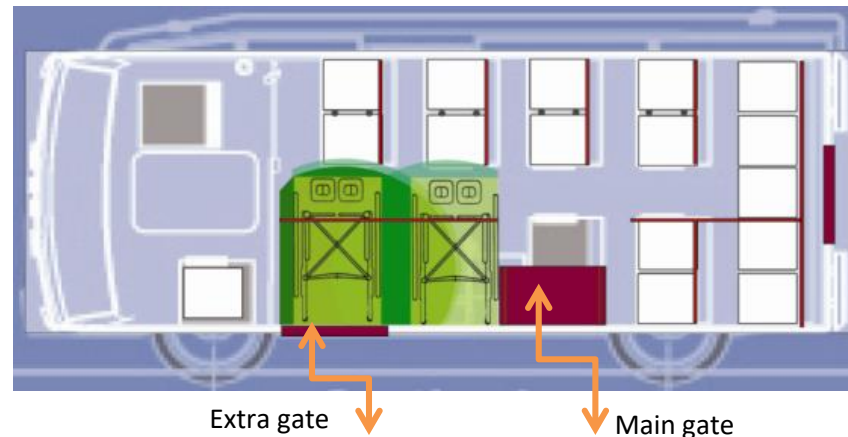
Layout 8 : Now the position of the staircase is also changed

- **15 + 2** persons
- Direction problem for 2 persons, two on the wheelchair
- Door area will remain block and there will be a problem for 5 persons to move inside and outside the bus without moving the wheelchair.
- Staircase mechanism touches tires.



Layout 9 :

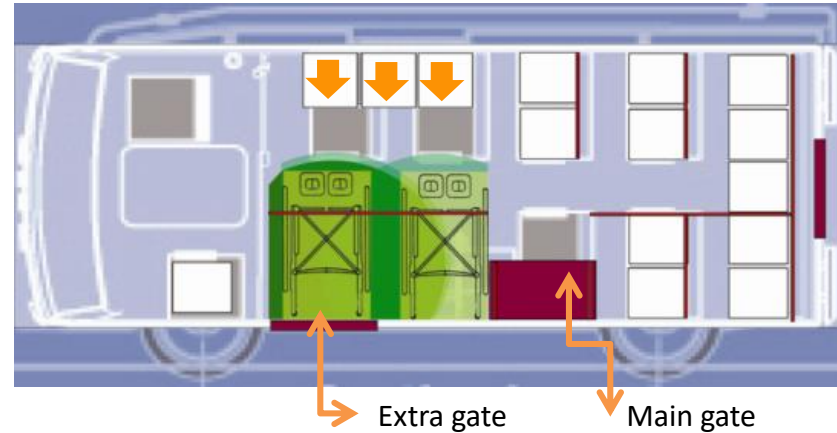
- **16 + 2** persons
- Direction problem for 2 persons
- Door area remain block and there will be a problem for 5 persons to move inside and outside the bus without moving the wheelchair.



EXTRA GATE (MAIN GATE NEW POSITION)

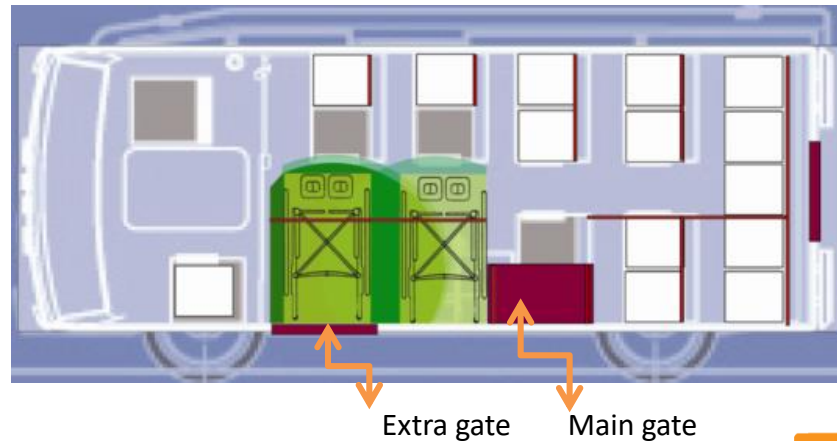
Layout 9(A) :

- **15 + 2** persons
- Direction problem for 5 persons, 3 person seating on front of wheelchair and the two on the wheelchair.
- **Door** area will **not blocked** in this case.



Layout 9(B) :

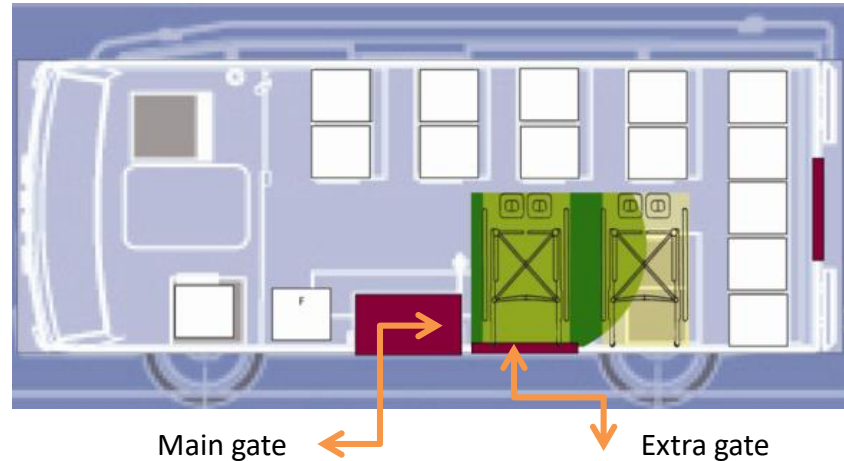
- **14 + 2** persons
- Direction problem for 2 persons, the two on the wheelchair.
- **Door** area will **not blocked** in this case.



FINAL LAYOUT PERPOSE

Concept Layout 1 :

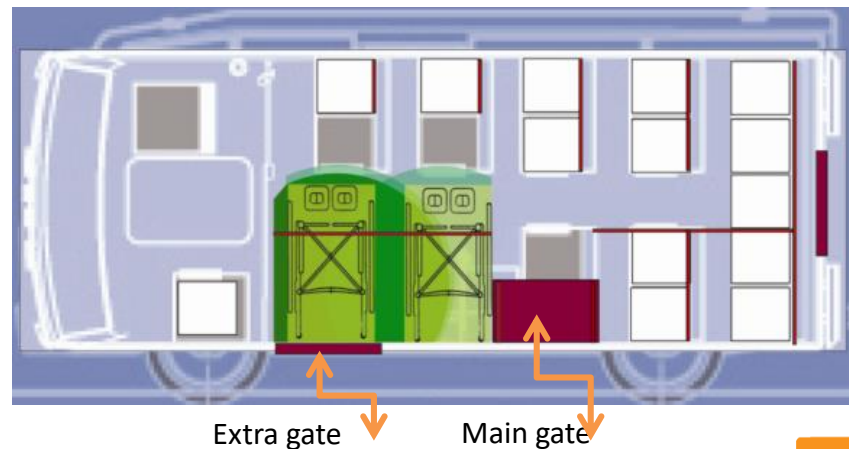
- **15 + 2** persons
- Direction problem for 3 persons, one person seating on the side and the two on the wheelchair
- Door area will remain block for 9 person (Moving problem)



✓ **Concept Layout 2:** Now the position of the staircase is also changed

- **14 + 2** persons
- Direction problem for 2 persons, the two on the wheelchair
- **Door** area will **not blocked** in this case.

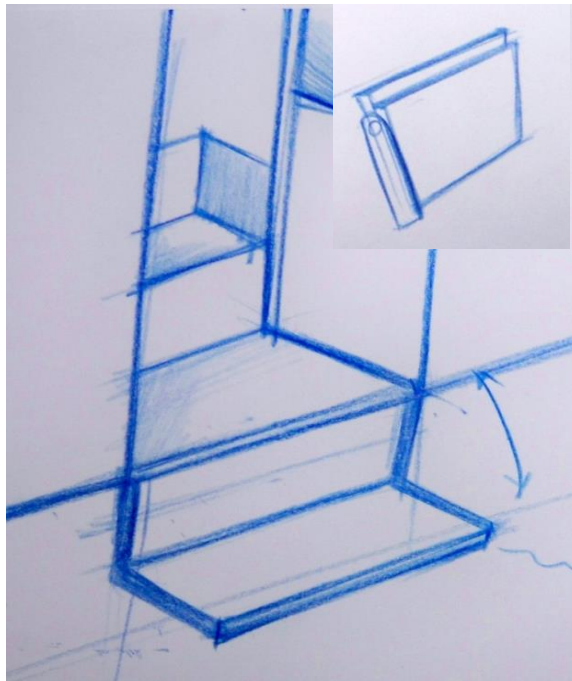
Concept 2 is the most suitable and fulfilling all requirements



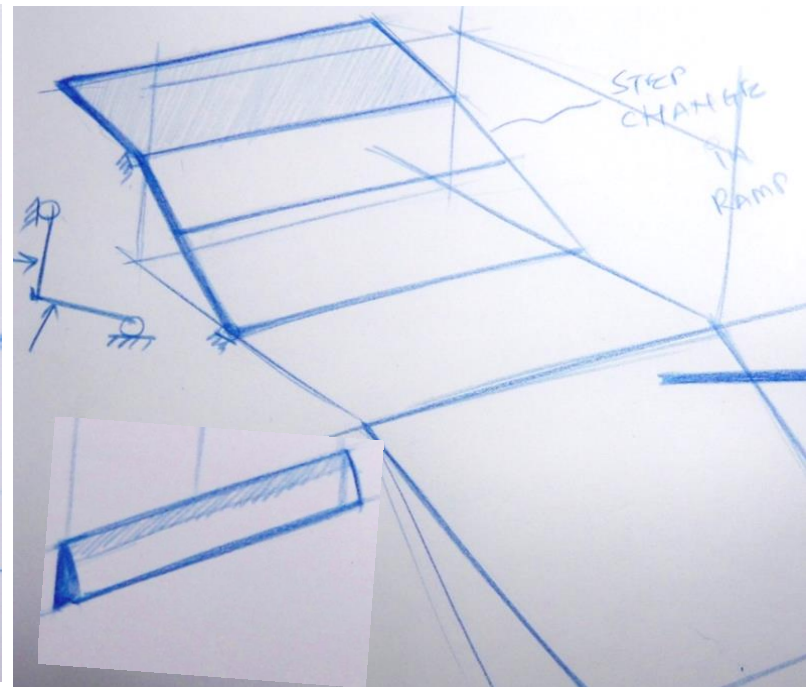
IDEATION FOR INGRESS PROBLEM

The height of the first step while entering the bus is 13" is really high for elderly. According to ergonomic standard step height should be 7" for elderly.

Foldable step

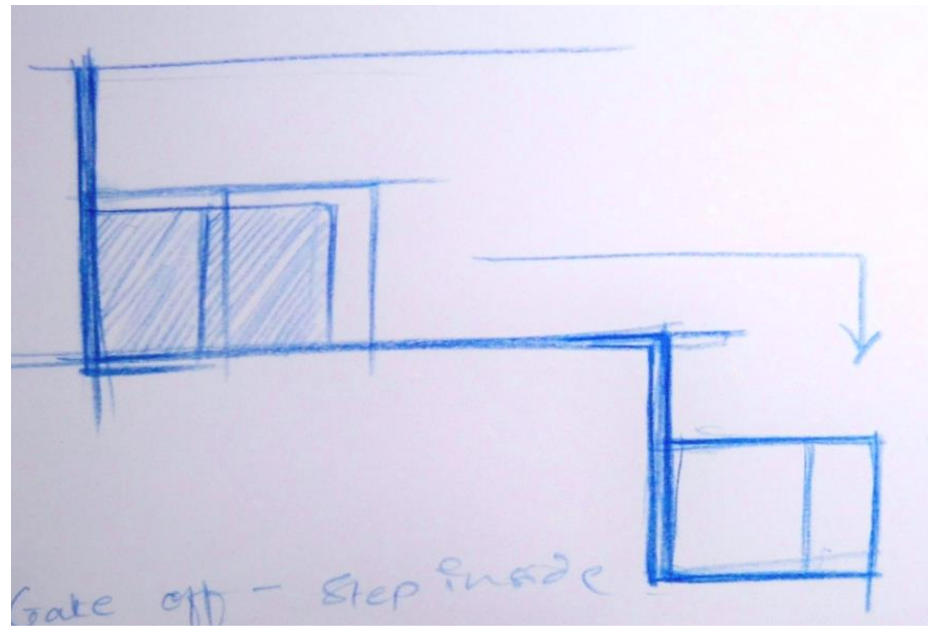
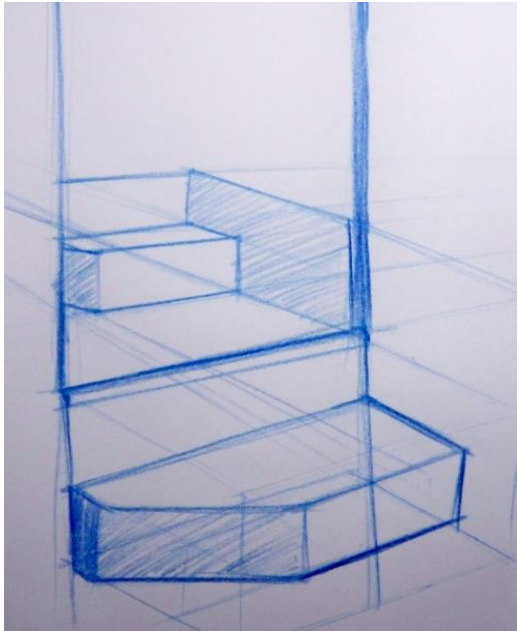


Step convert in to slope



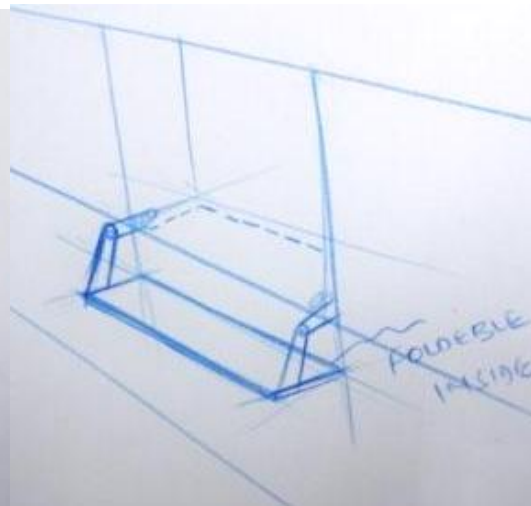
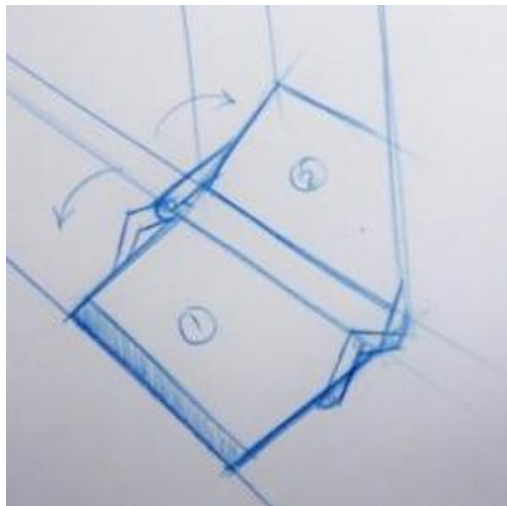
IDEATION FOR INGRESS PROBLEM

Step move mechanism

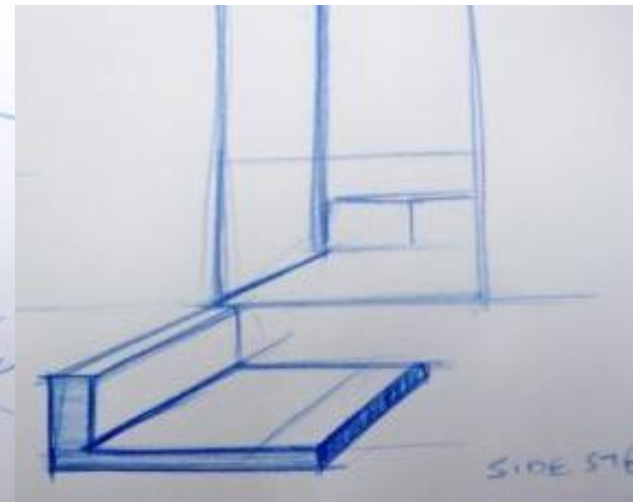


IDEATION FOR INGRESS PROBLEM

Foldable step



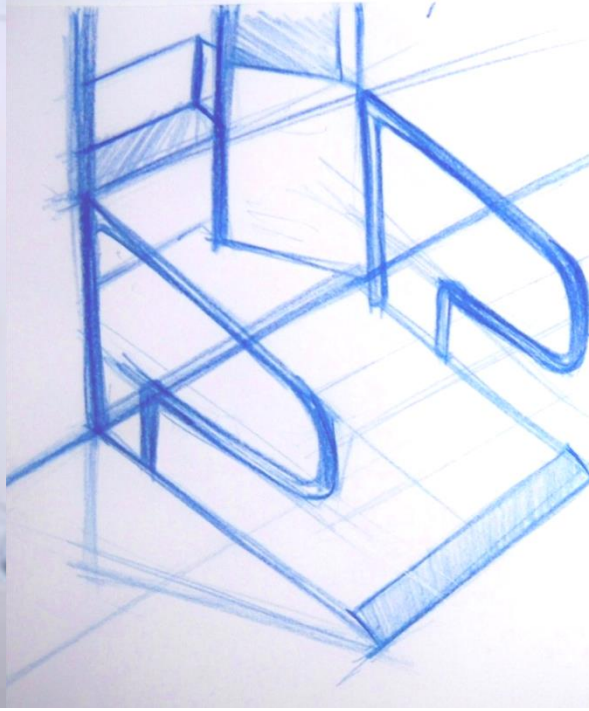
Side step



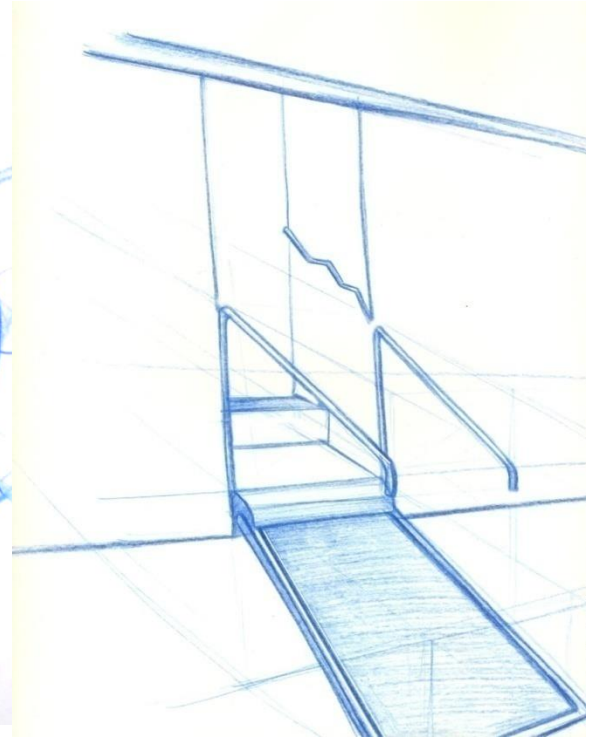
FINAL CONCEPT FOR INGRESS PROBLEM



Door convert into ramp



Ramp with foldable handle

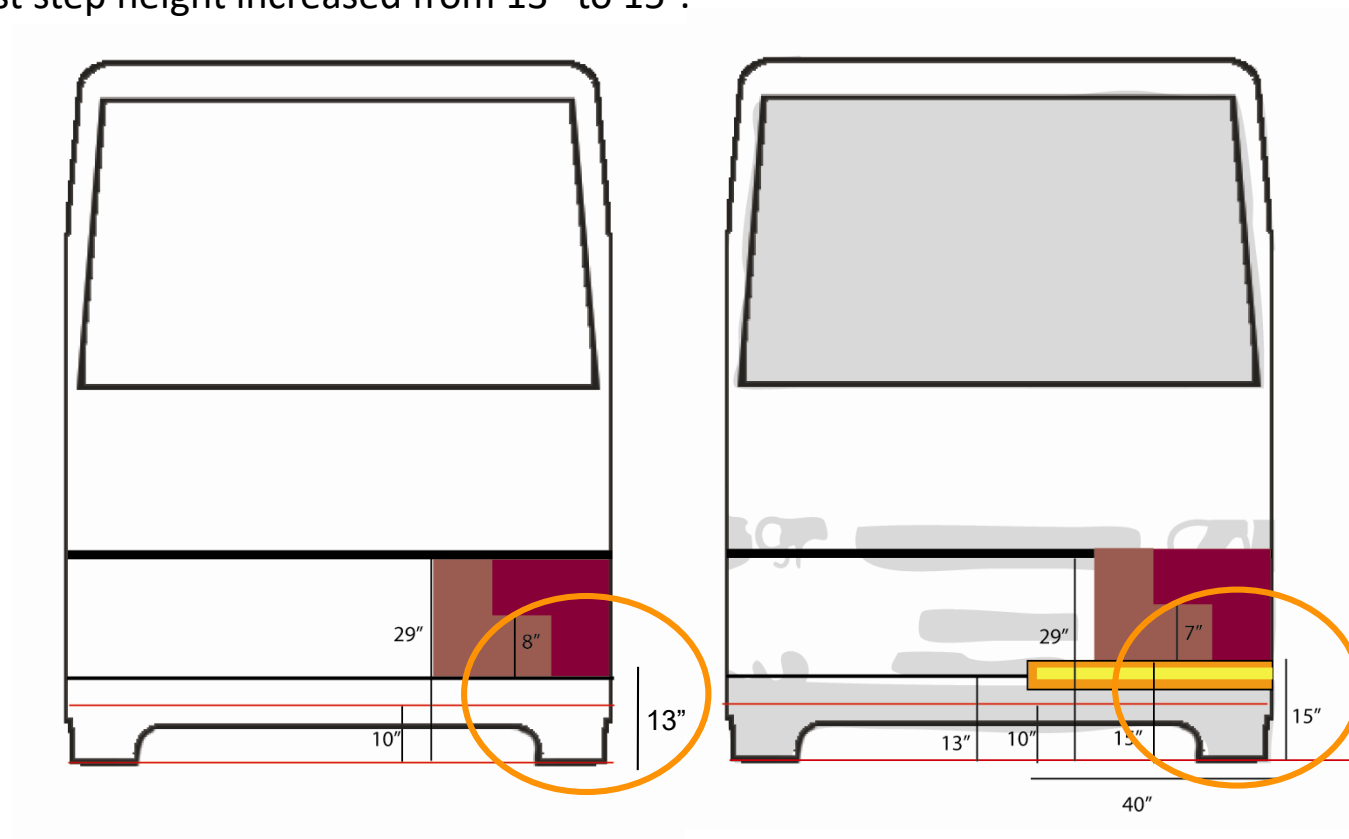


Ramp with external handle

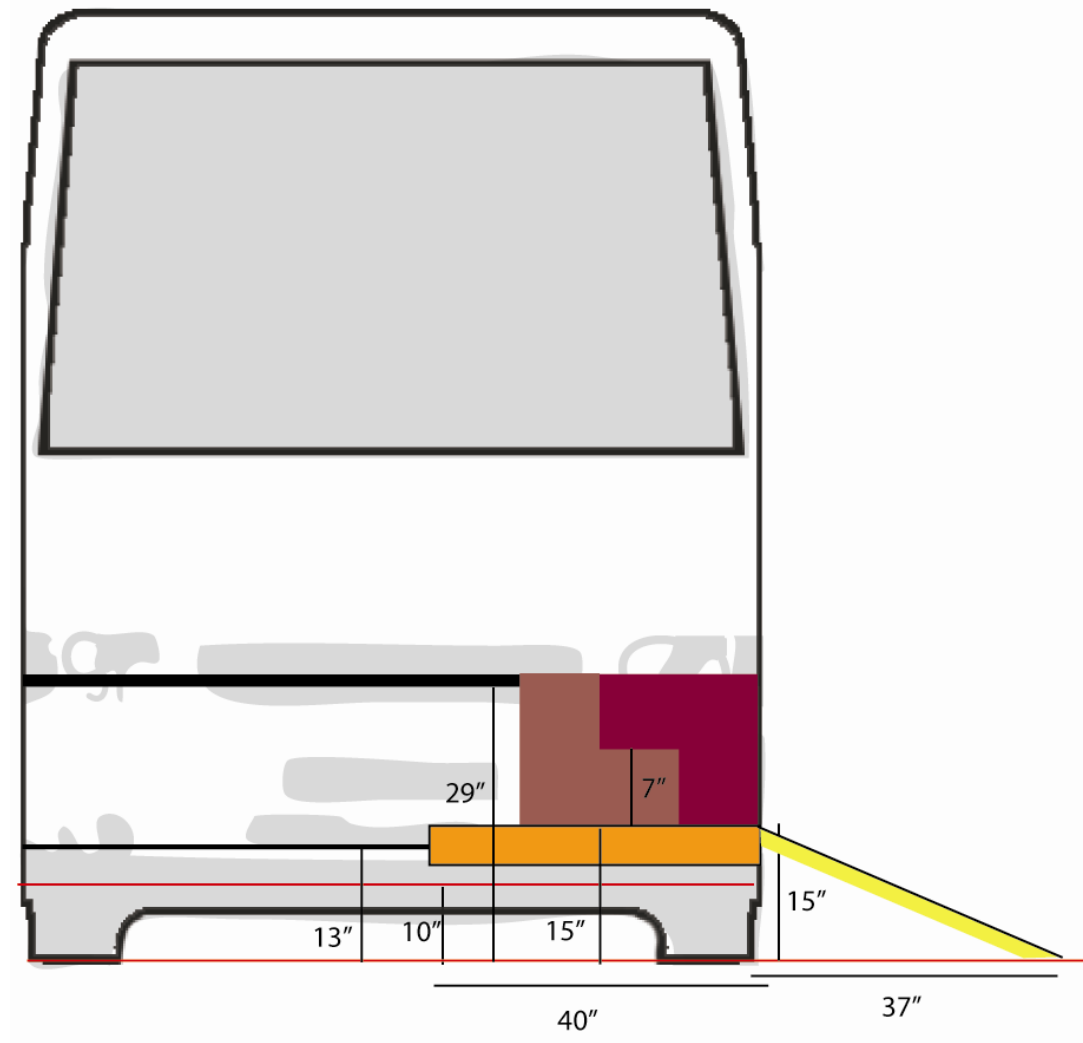


SLOPE MECHANISM

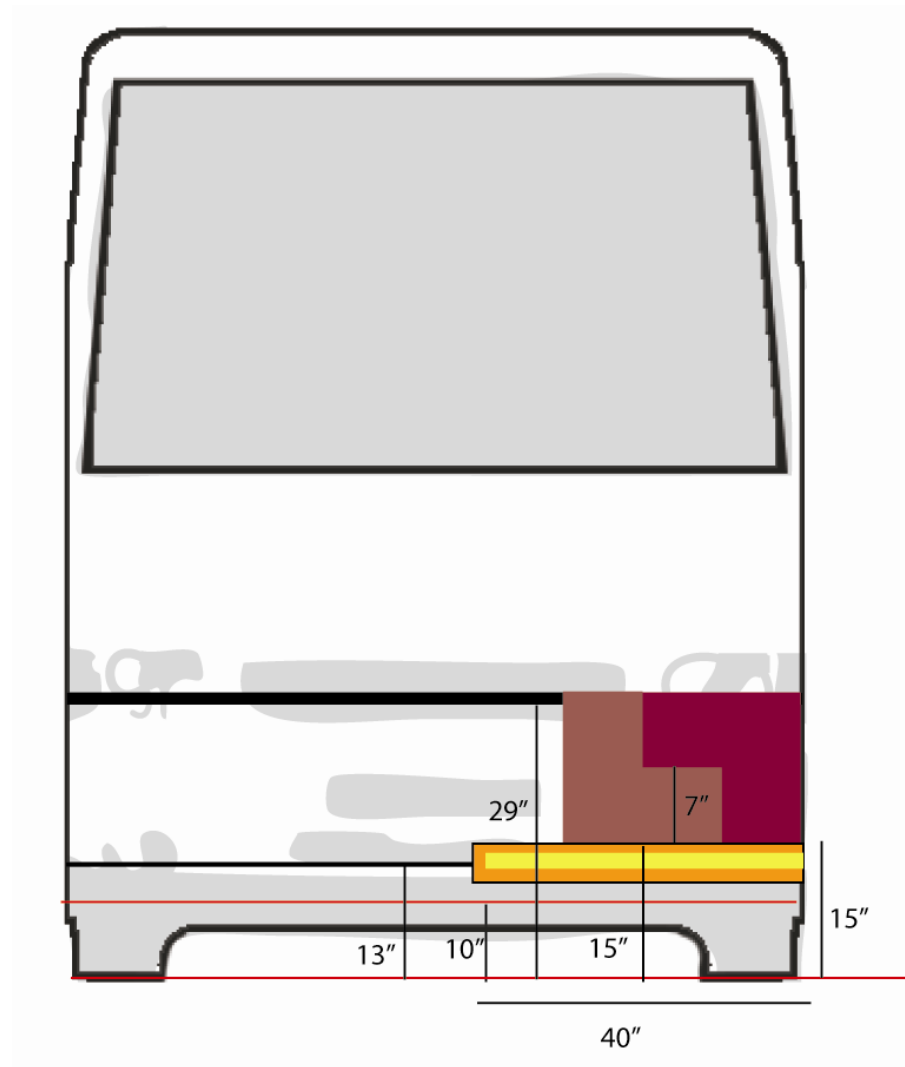
The height of the step was 8" and the aim was to bring it down to 7", and by bringing step height down, the first step height increased from 13" to 15".



SLOPE MECHANISM (OPEN CONDITION)

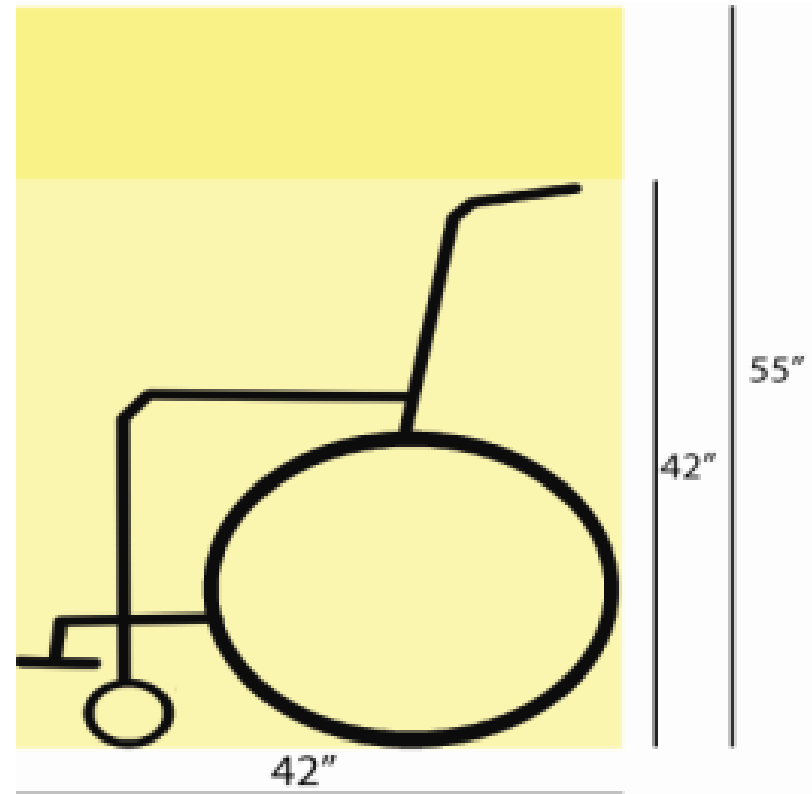


SLOPE MECHANISM (CLOSED CONDITION)



WHEELCHAIR DIMENSION

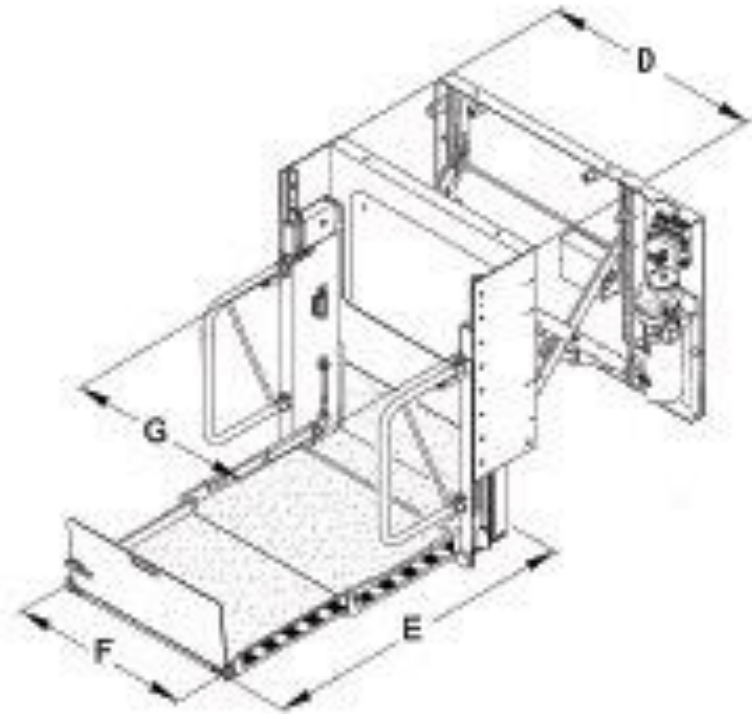
Dimensions the wheelchair is 24 X 42" and height is considered as 55", considering the clearance of the height of the person sitting on the wheelchair, thus the final considered dimension is 24 x 42 x 55.



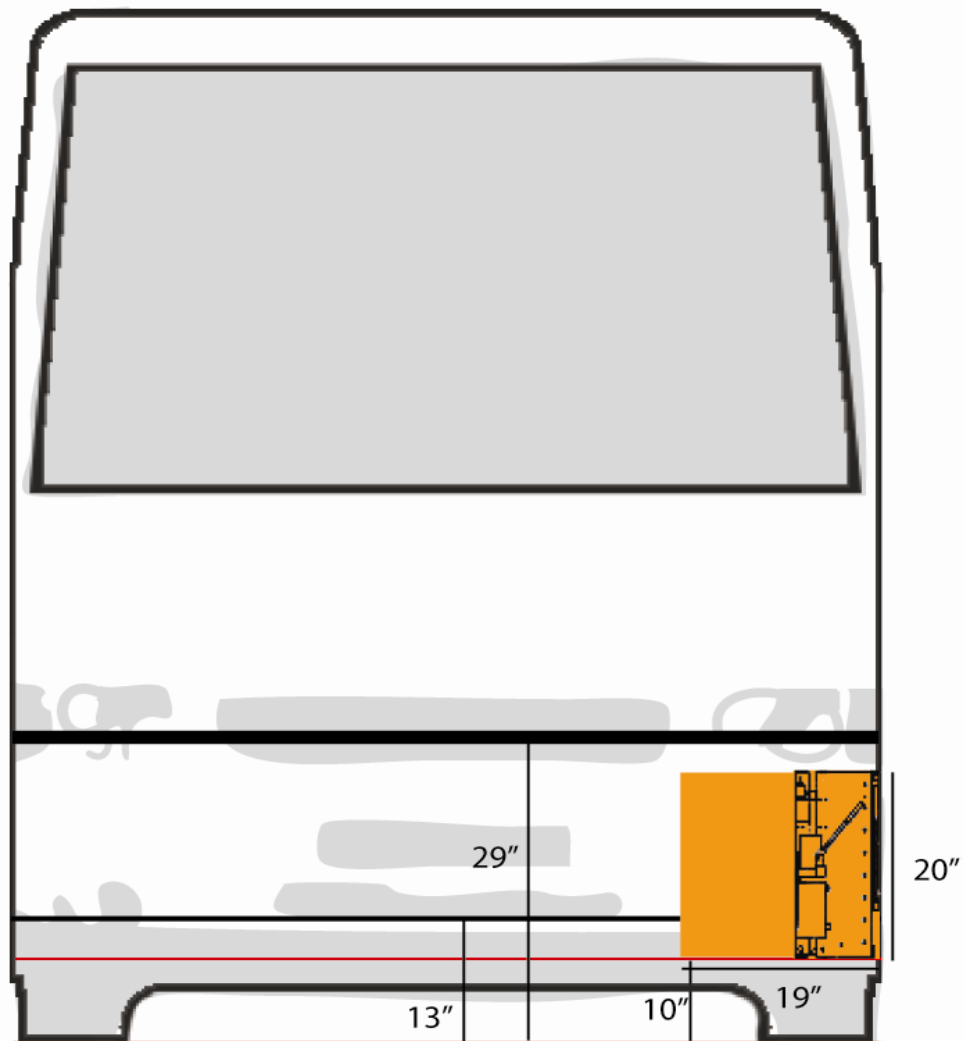
LIFTING MECHANISM DETAILS

Mechanism details

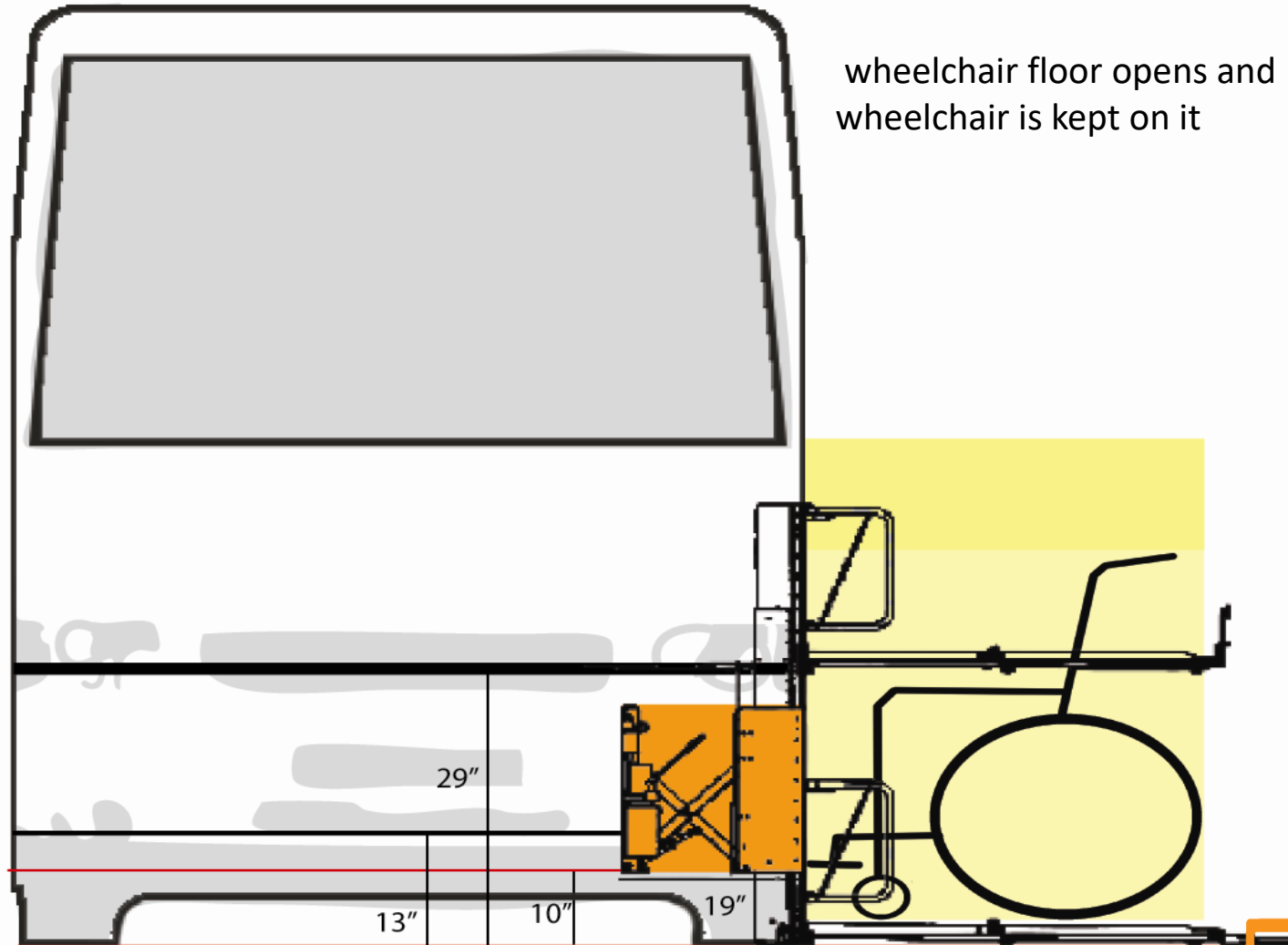
- Load carrying capacity- 275kg
- Lifting weight - 268kg
- Power - Electro- Hydraulic
- Hydraulic Cylinder -(2)diameter 1.75"
Single-Acting/gravity down
- Power rating @24V DC-65amp / Cycle 1800 psi
- Manual Backup(up) - Hand pump
- Manual Backup(down)- Pressure Release Valve
- Overall dimension - 19 X 20 X 35"



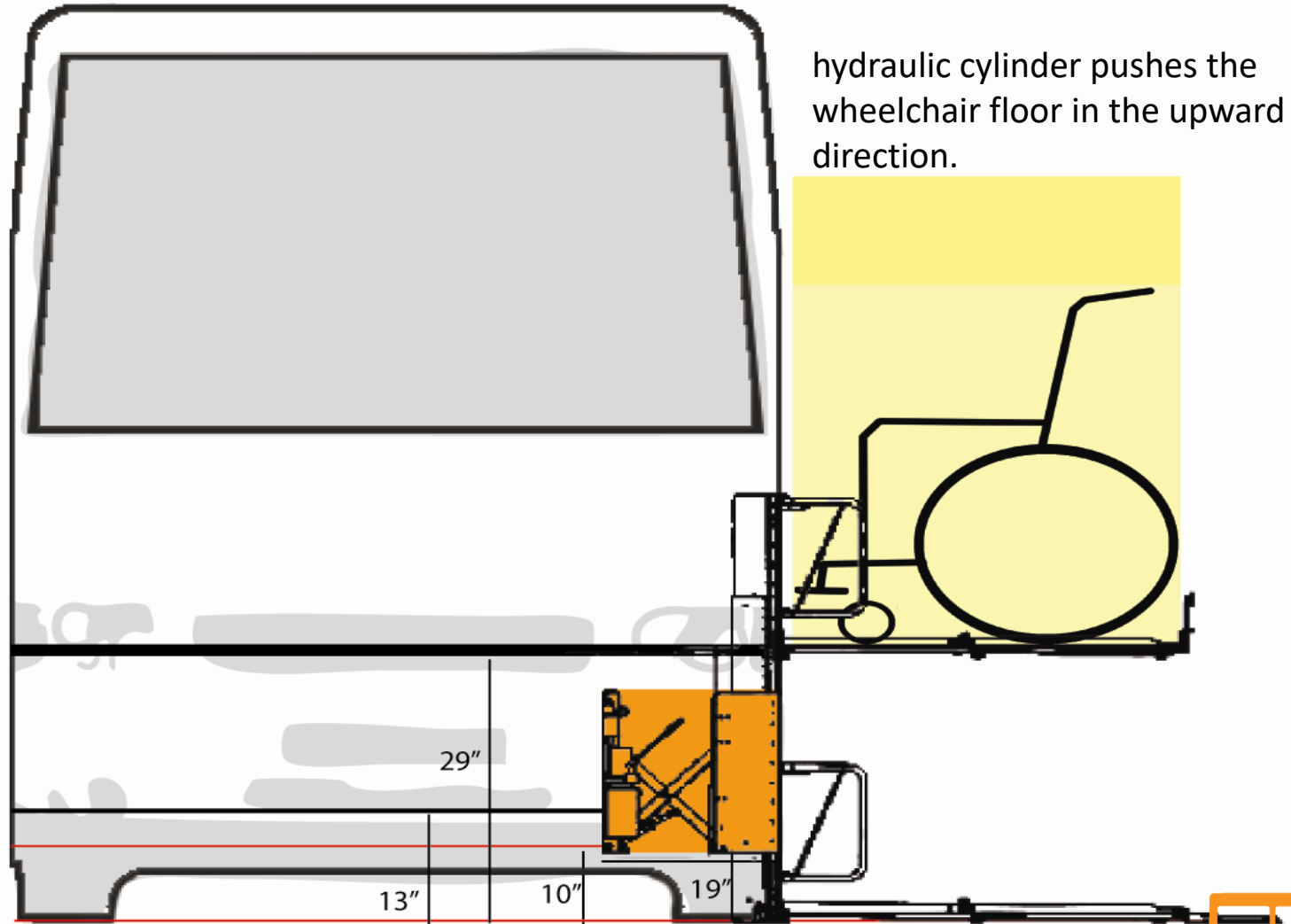
LIFTING MECHANISM DETAILS



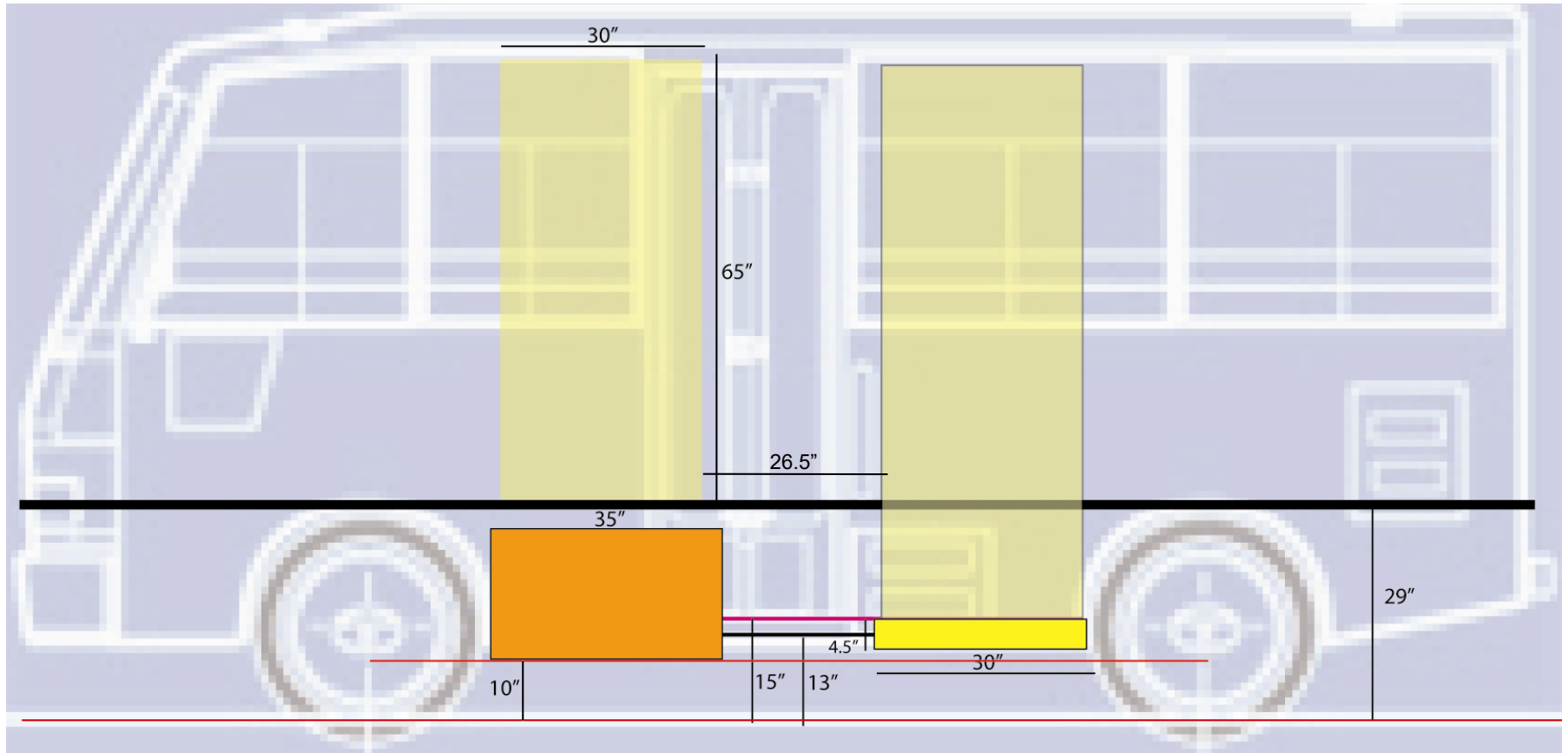
LIFTING MECHANISM DETAILS



LIFTING MECHANISM DETAILS



SLOPE & LIFTING MECHANISM DIMENSION

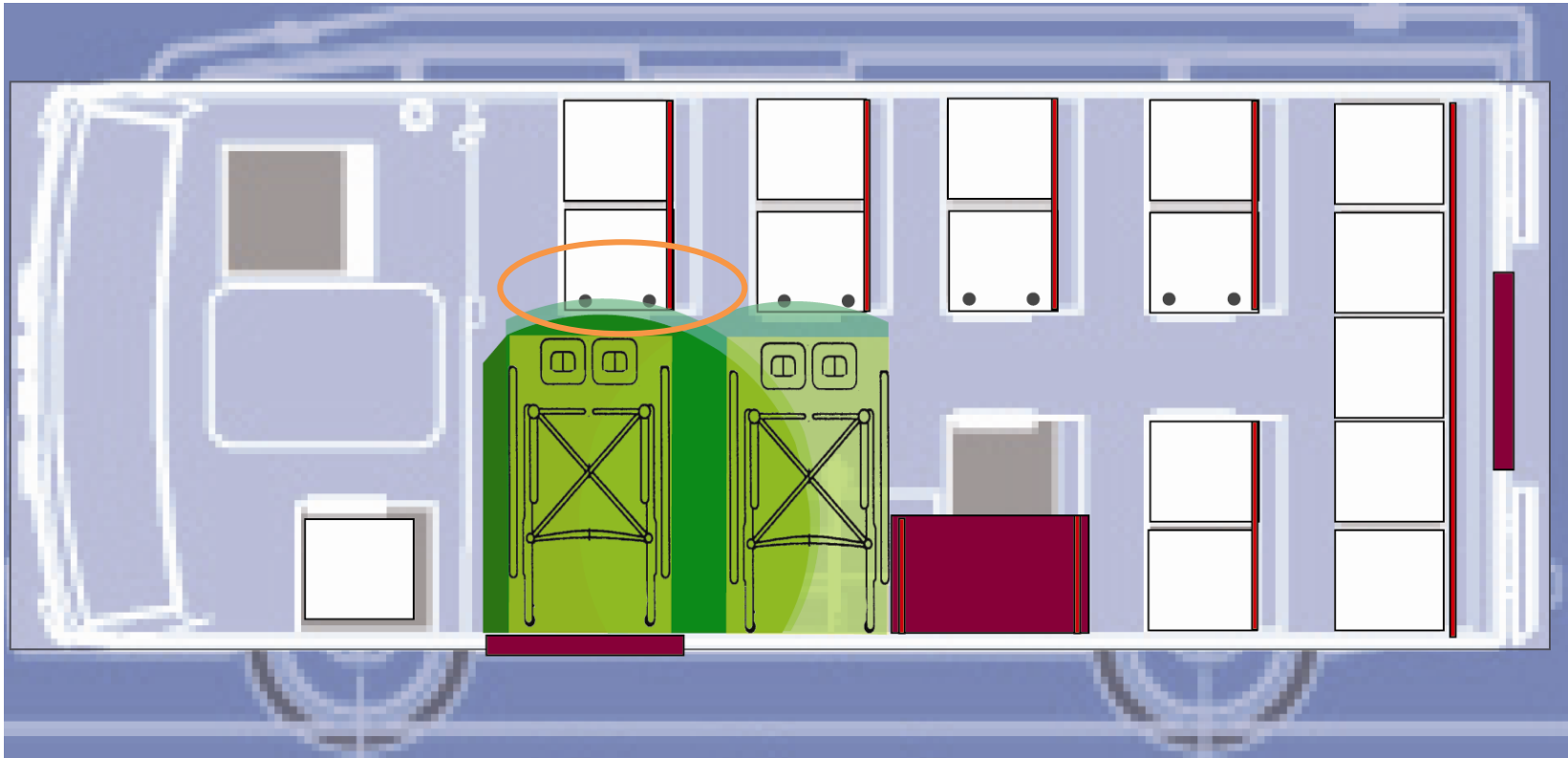


SIMULATION OF WHEELCHAIR MOVEMENT TO UNDERSTAND THE SPACE



SIMULATION OF WHEELCHAIR MOVEMENT TO UNDERSTAND THE SPACE

CONCEPT 1

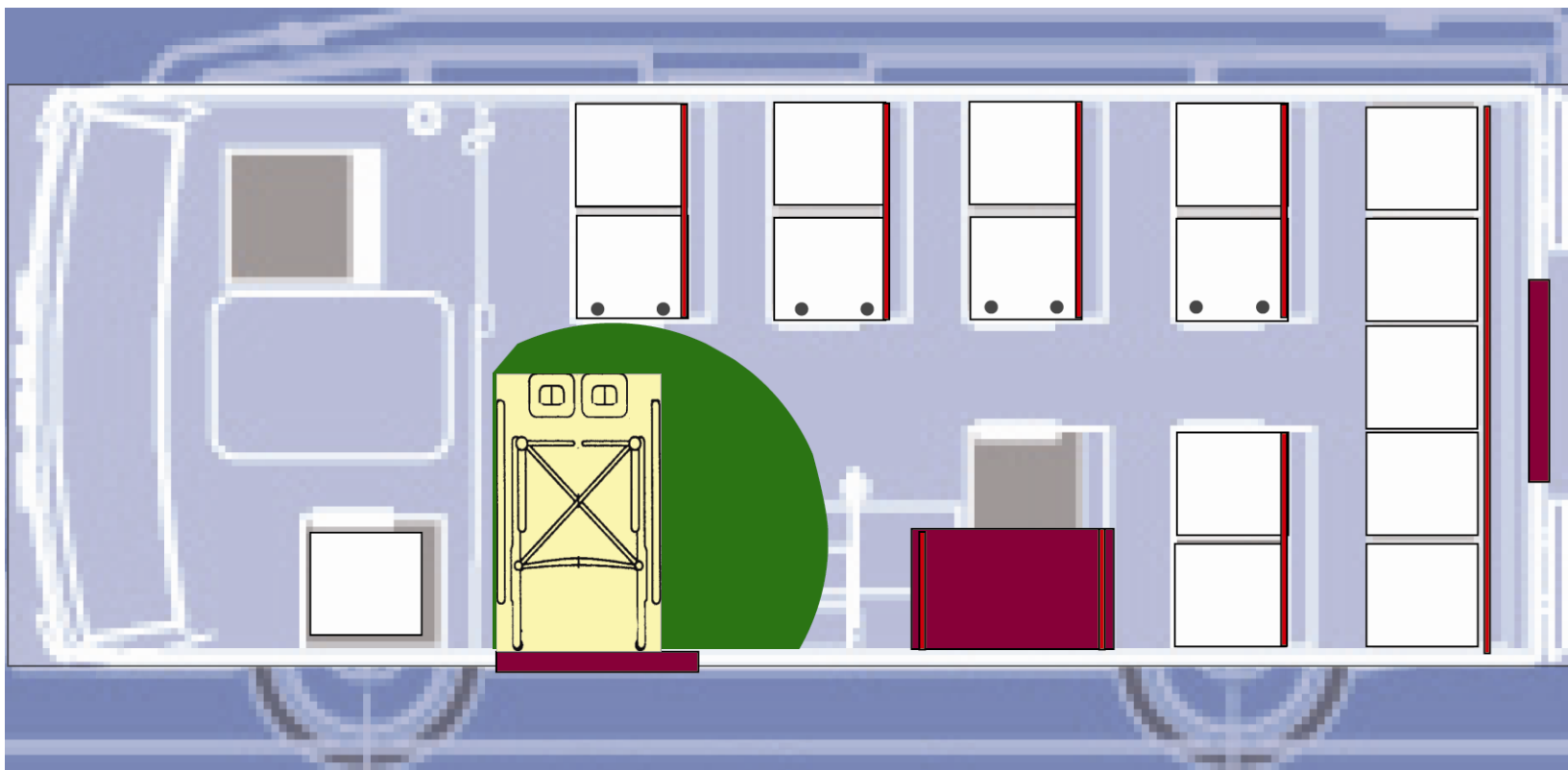


Legs supporting the seat can be shifted inside, thus solving the problem of moving the wheelchair.



SIMULATION OF WHEELCHAIR MOVEMENT TO UNDERSTAND THE SPACE

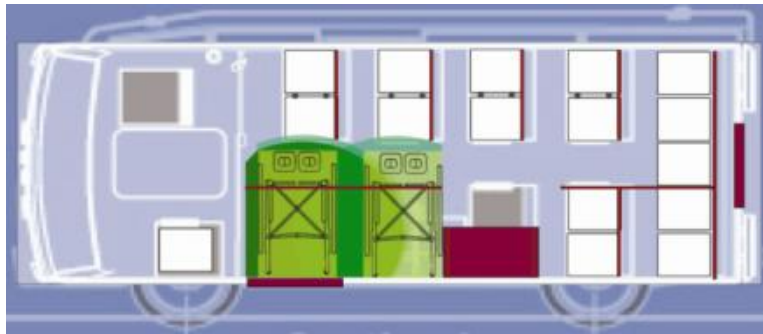
CONCEPT 2



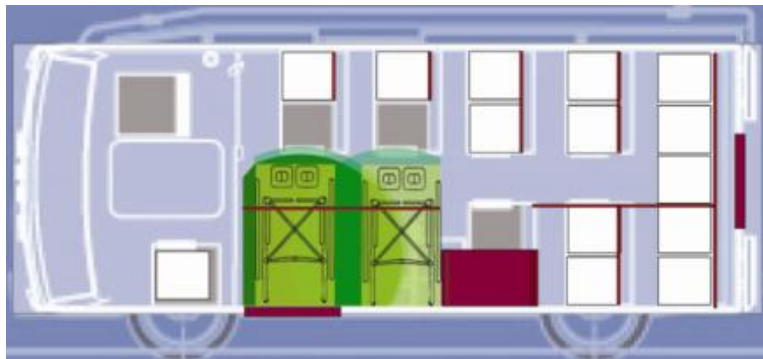
- Wheelchair locking
- Height difference



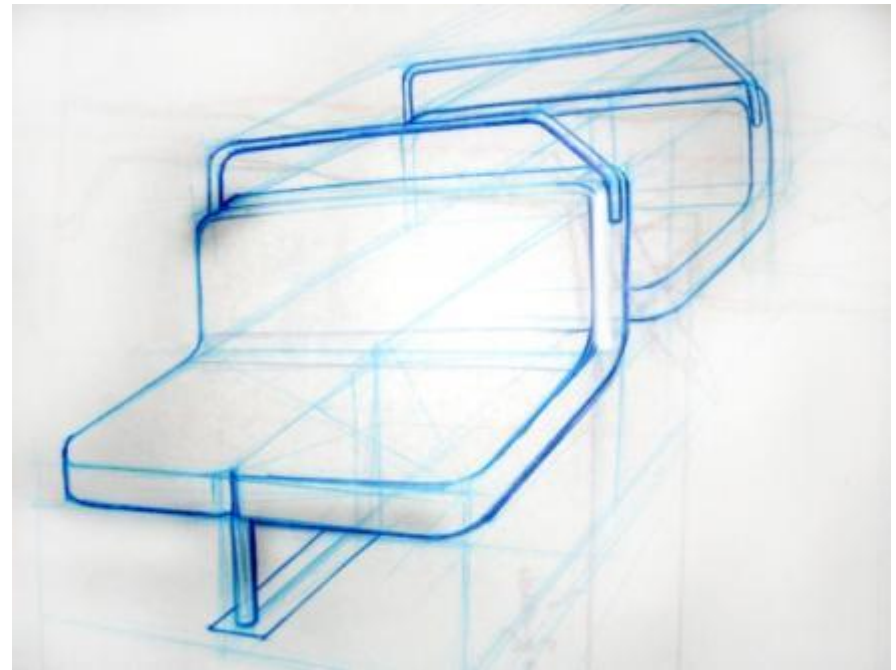
FINAL CONCEPT



layout propose



Final layout concept



Centre support seat



ANTHROPOMETRIC DETAILS

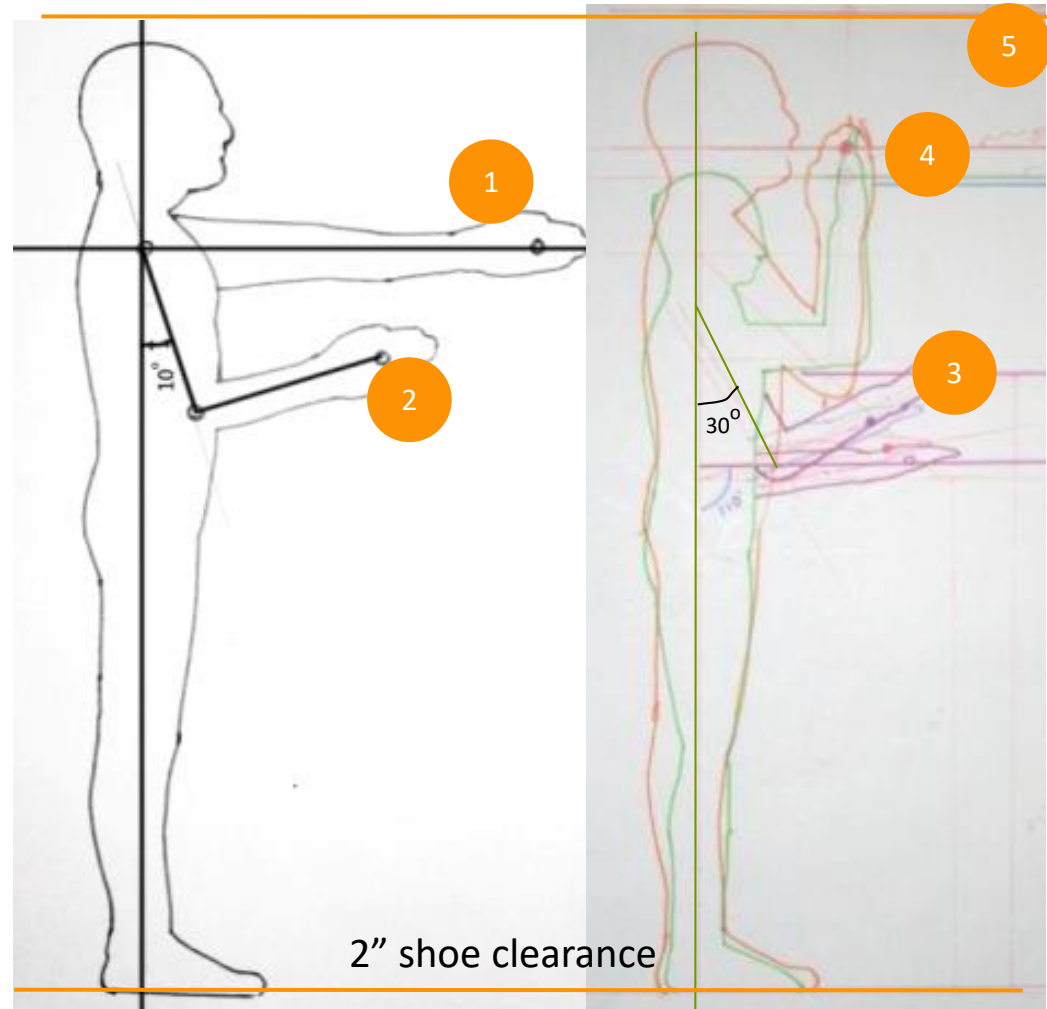
Hand position 1- Straight hand for pulling muscle force activity.

Hand position 2- Folding hand for climbing the staircase.

Hand position 3- It is position better for horizontal surface condition with below shoulder height handle grip.

Hand position 4- It is position better for horizontal surface condition with upper shoulder height handle grip.

Hand position 5- In this position persons doesn't hit each other. 2" for shoe clearance of the user.



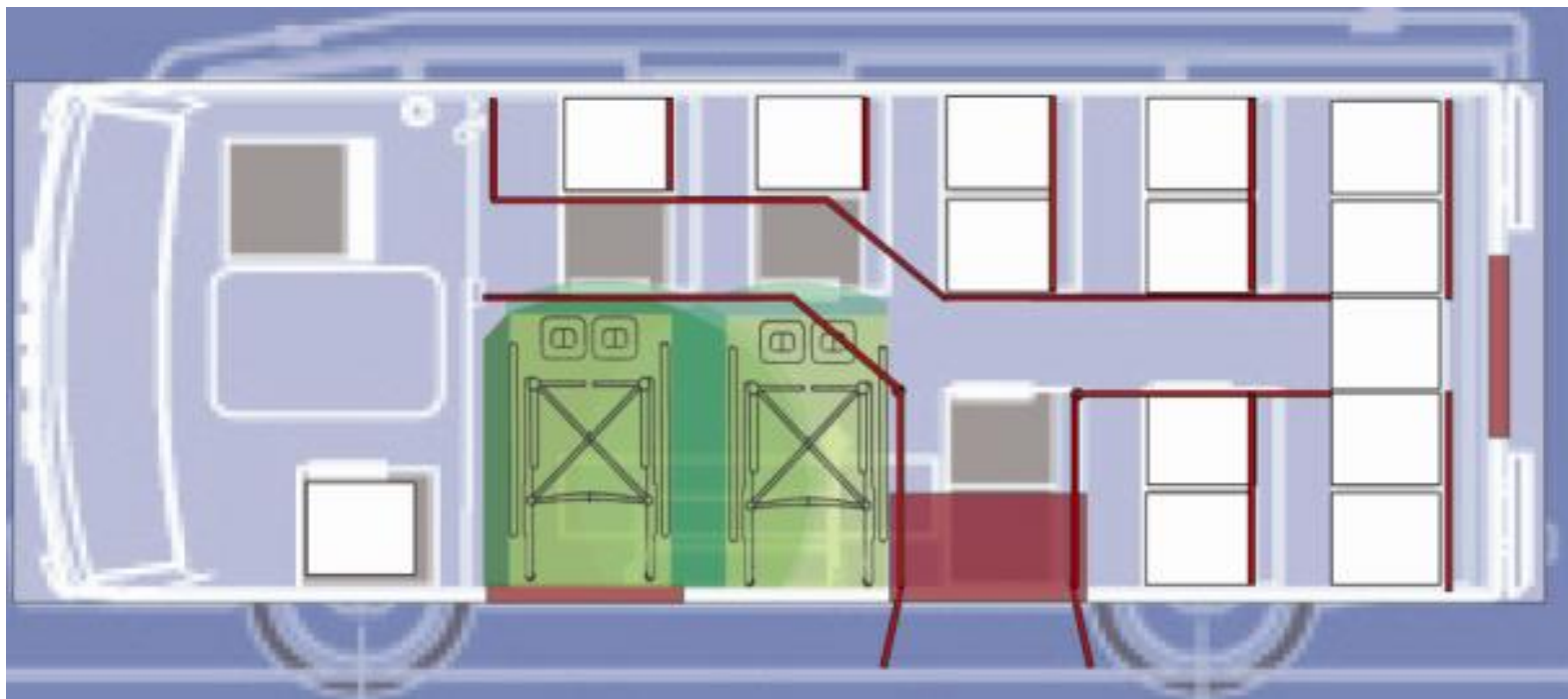
CONSIDERED HANDLES

1

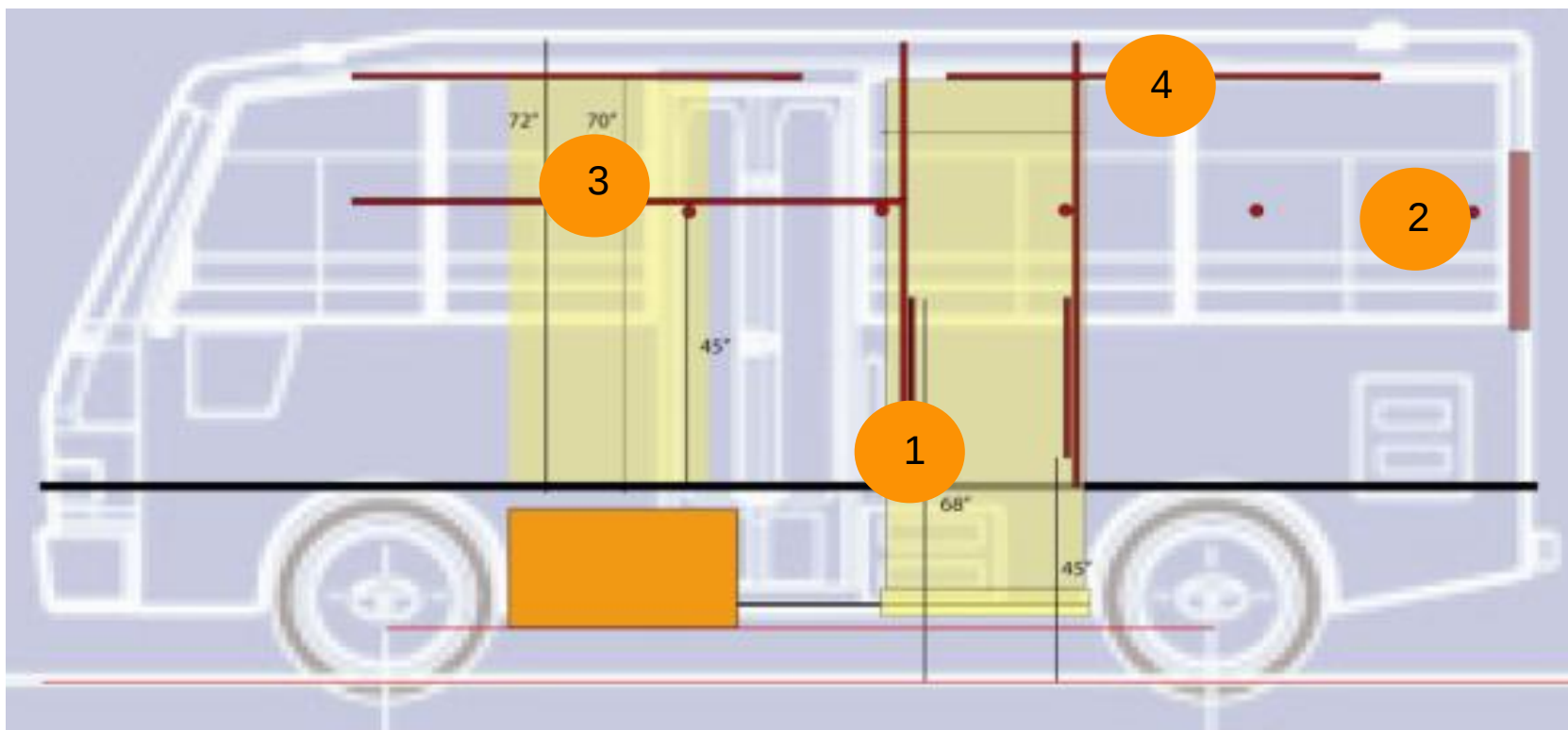
2

3

4

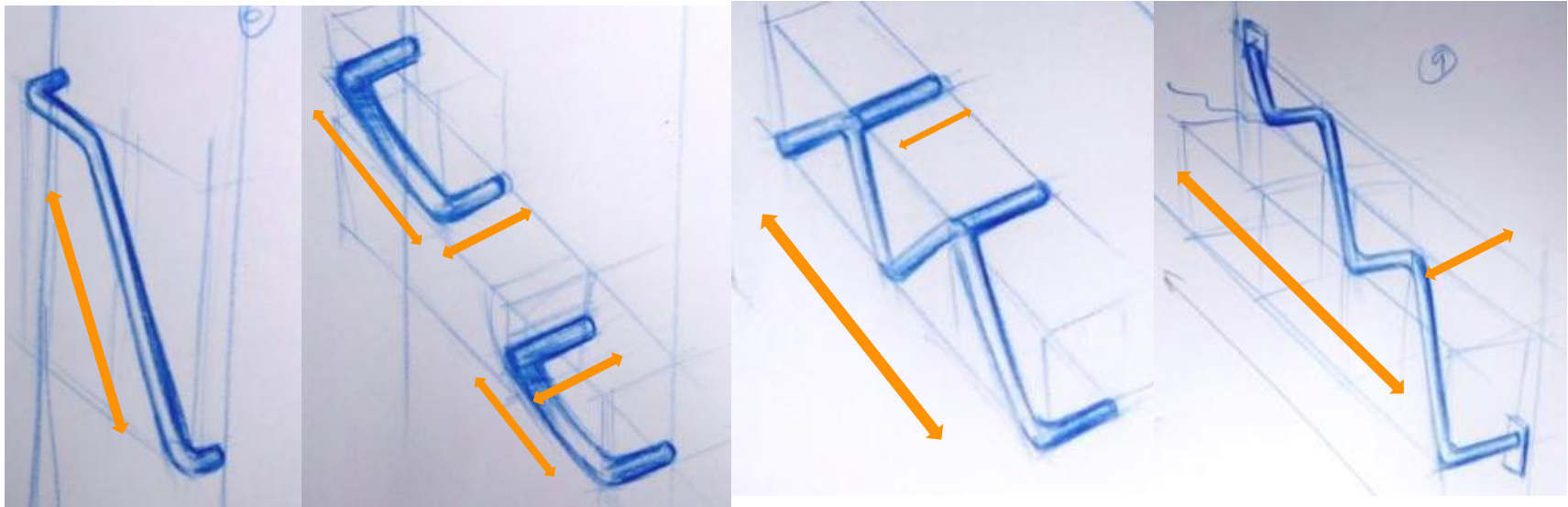


SIDE VIEW OF ALL HANDLES

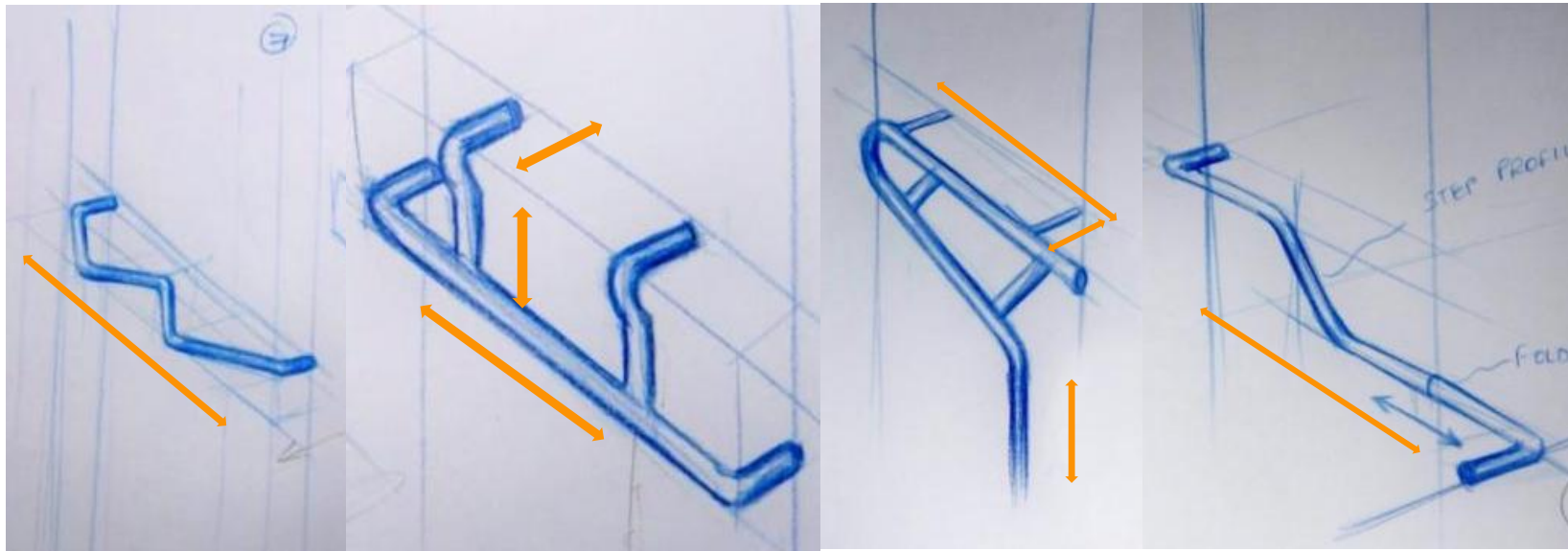




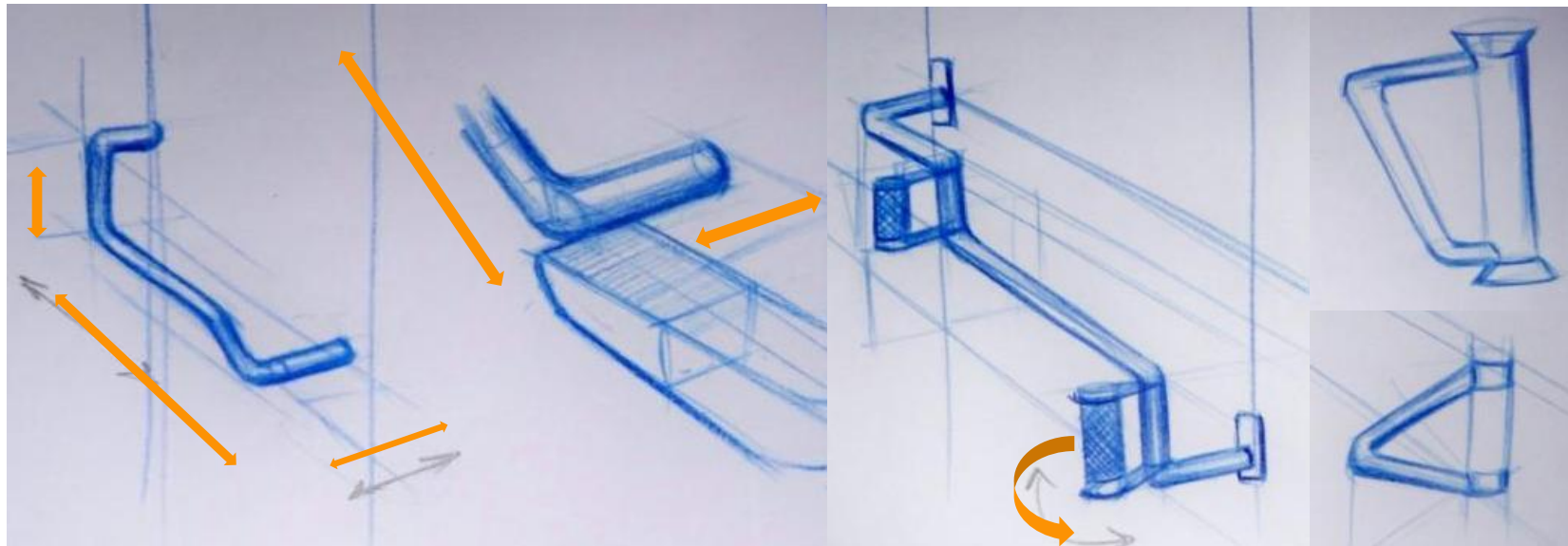
IDEATIONS FOR DOOR HANDLE (HANDLE-1)



IDEATIONS FOR DOOR HANDLE (HANDLE-1)



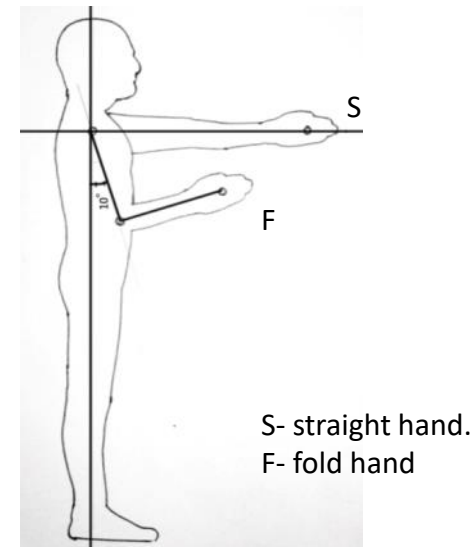
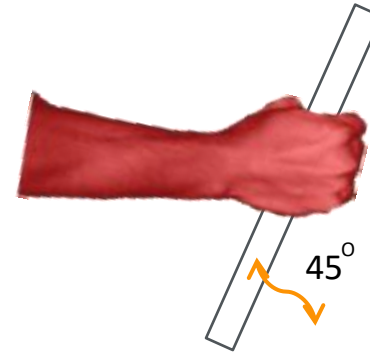
IDEATIONS FOR DOOR HANDLE (HANDLE-1)



ANTHROPOMETRIC DRAWING (DOOR HANDLE-1)

When the hand position is straight wrist angle is approximately 45 degree vertical for comfortable posture

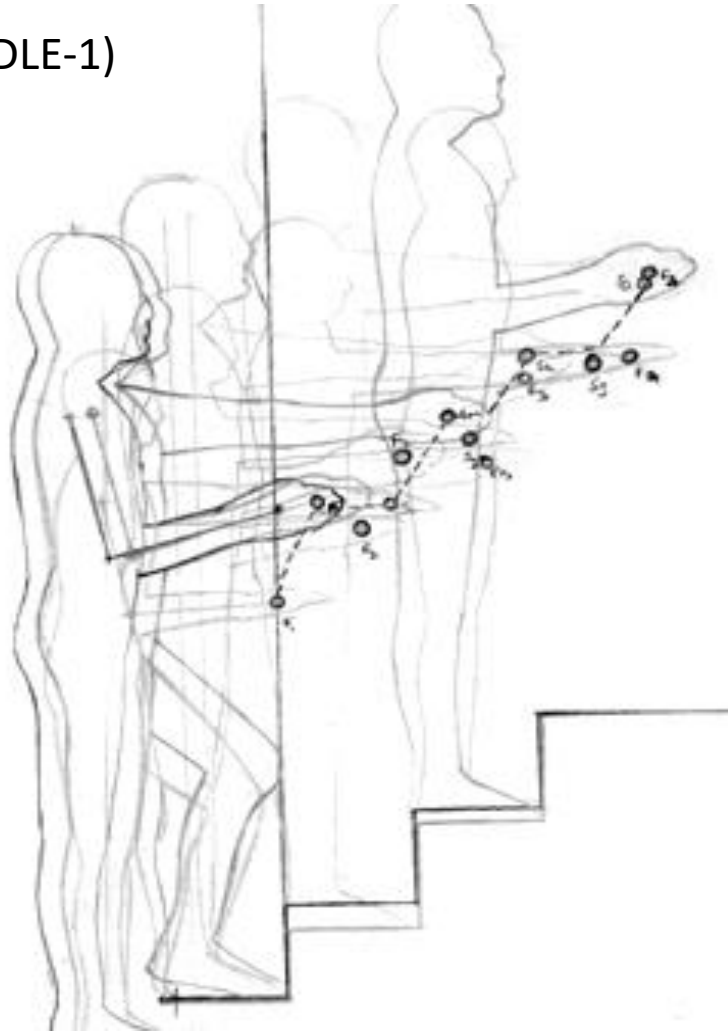
the best fit anthropometric position in which one can apply maximum pulling force is generated by biceps which helps in climbing the staircase .



ANTHROPOMETRIC DRAWING (DOOR HANDLE-1)

Manqué (5 percentile of female, 95percentile of male)

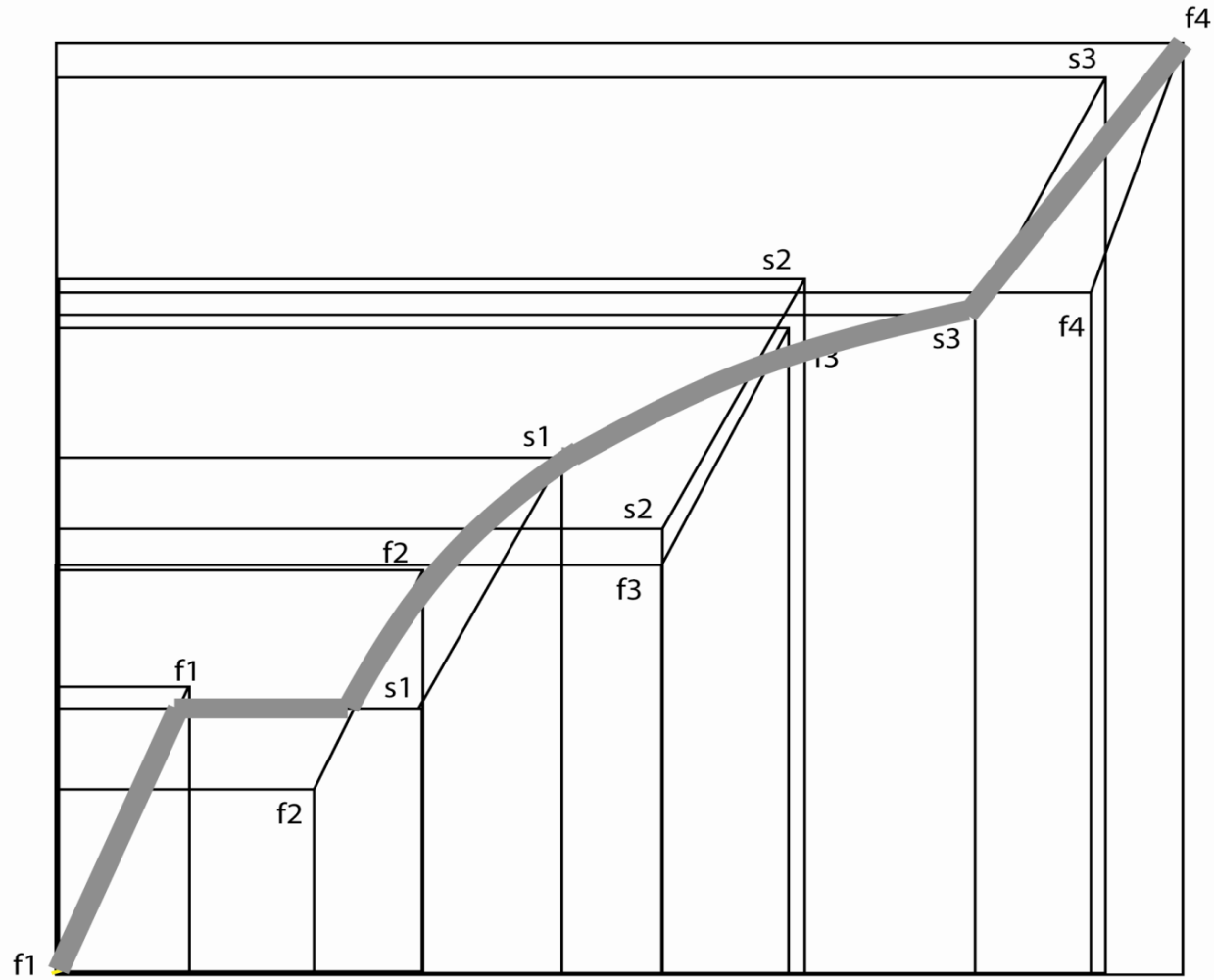
Used for finding upper and Lower limit of the hand position according to movement. All the points are mapped.



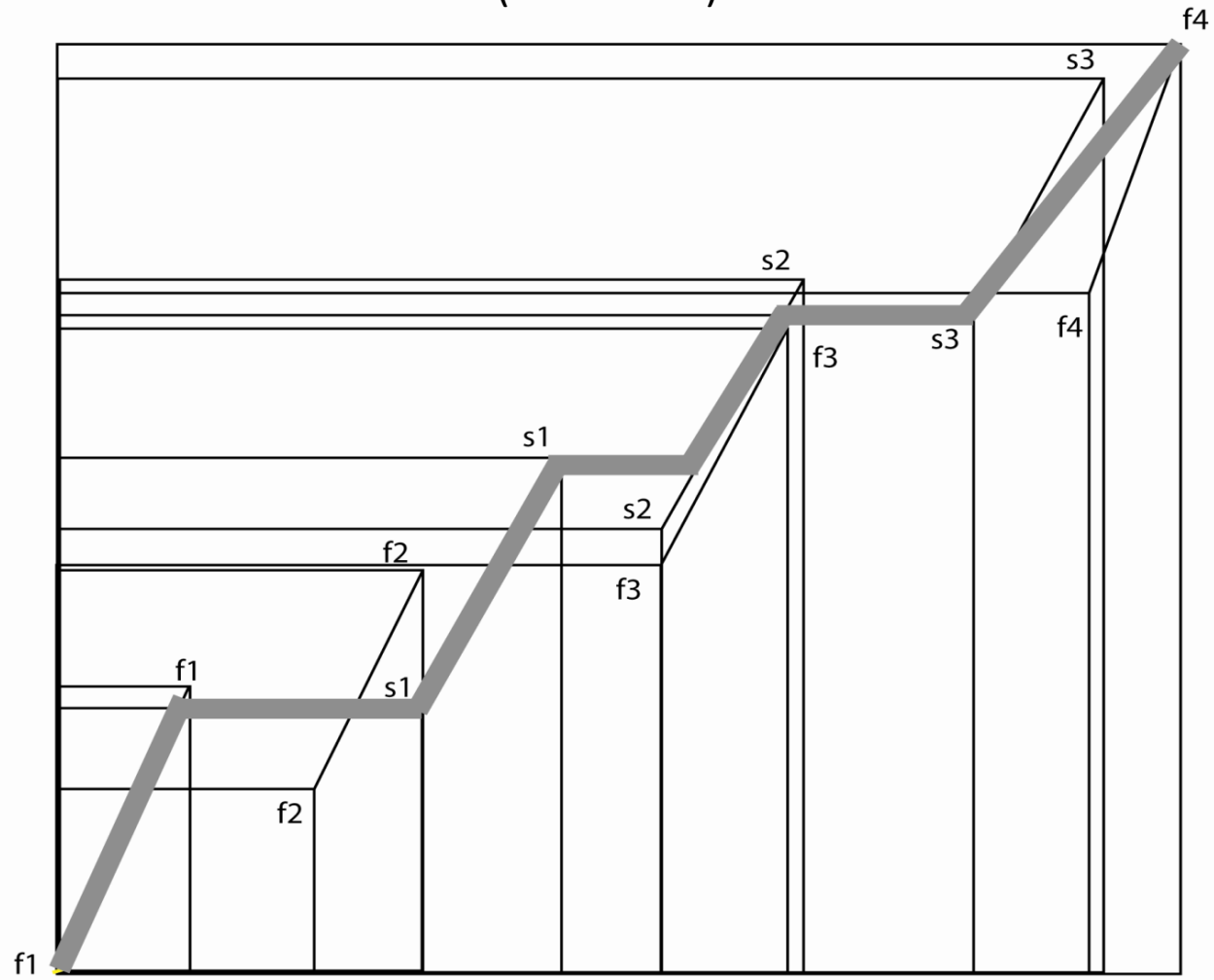
Manqué works profile



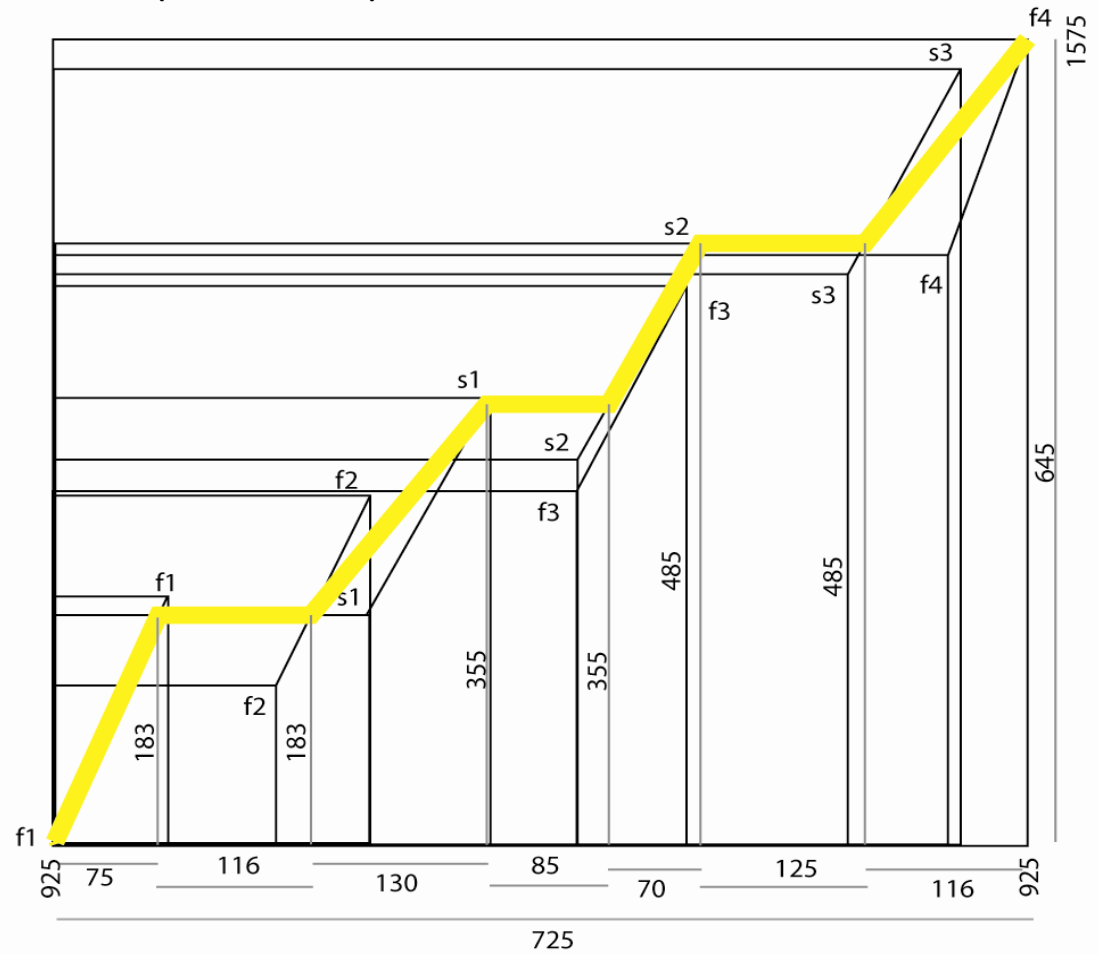
CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)



CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)



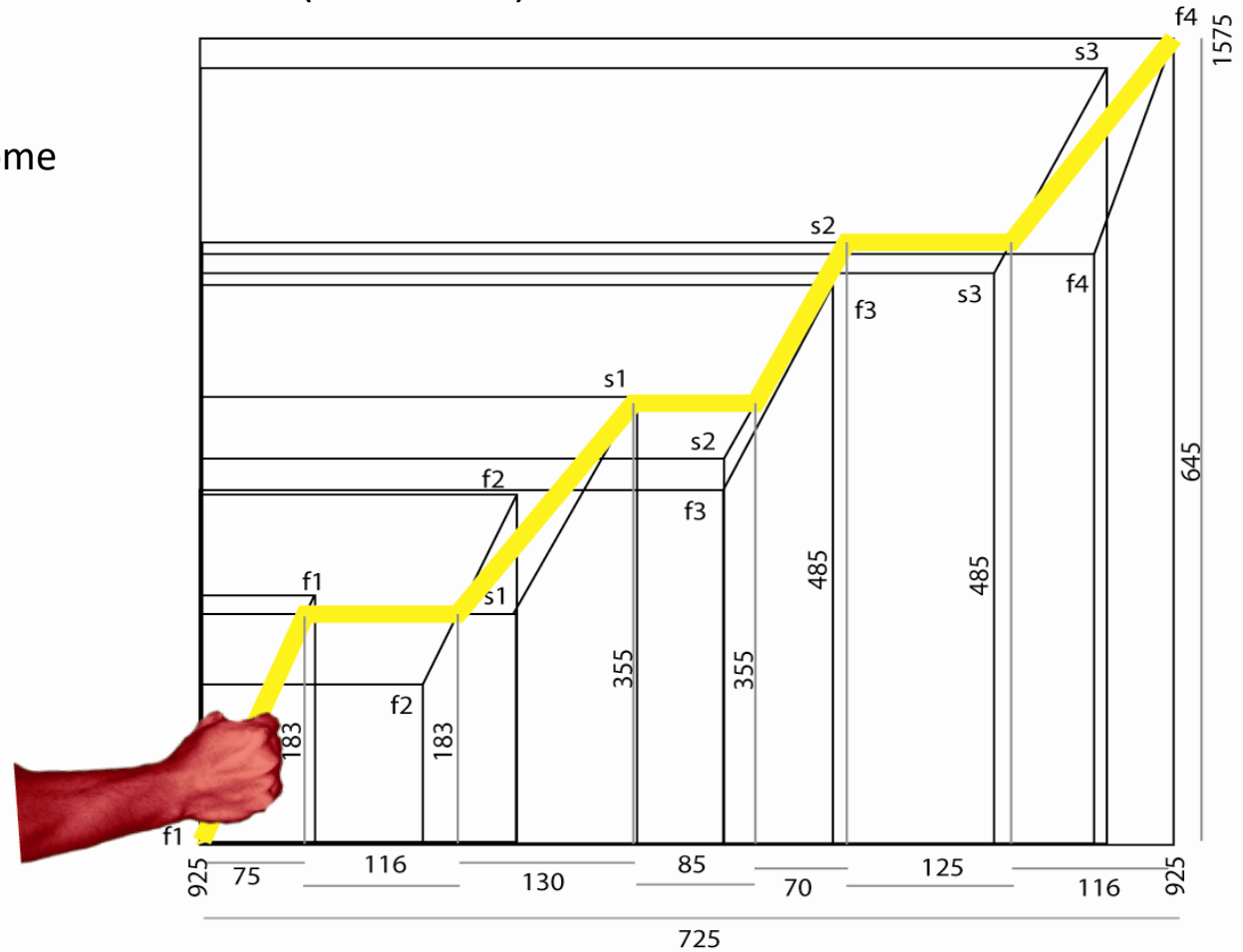
CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)



CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)

 -STRAIGHT HAND
 -FOLD HAND

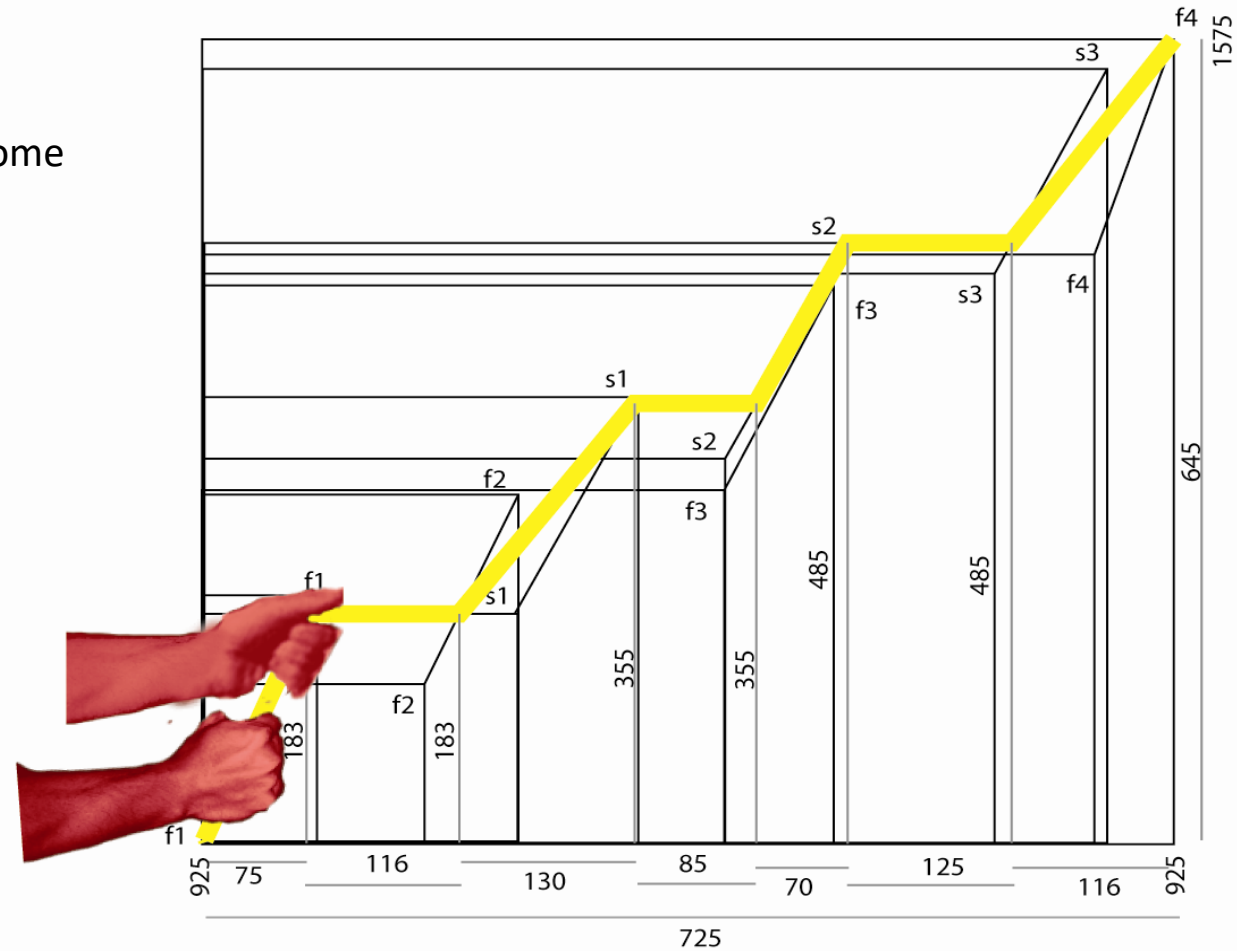
Normal position 1st hand come



CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)

-  -STRAIGHT HAND
-  -FOLD HAND

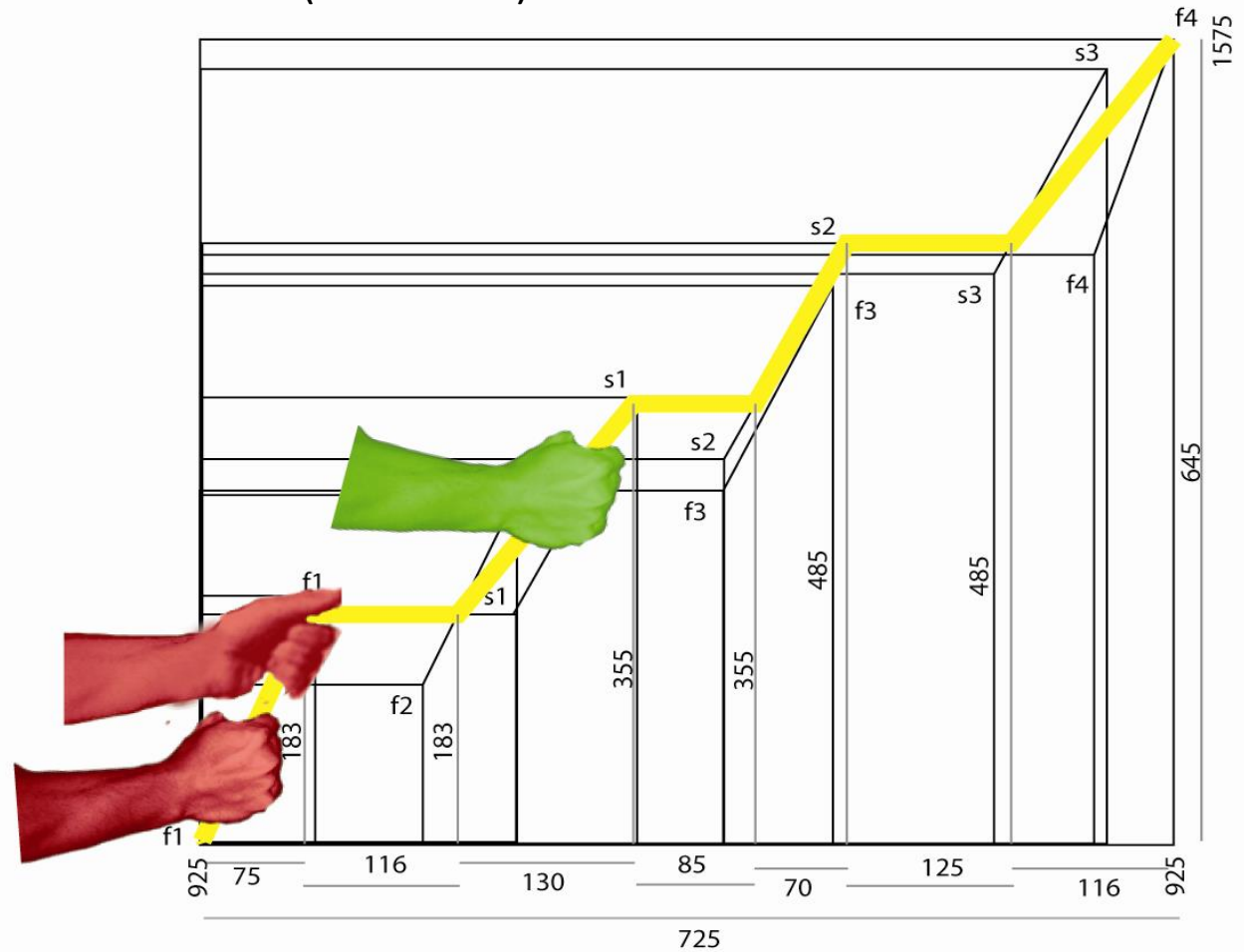
Normal position 2nd hand come



CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)

- STRAIGHT HAND
- FOLD HAND

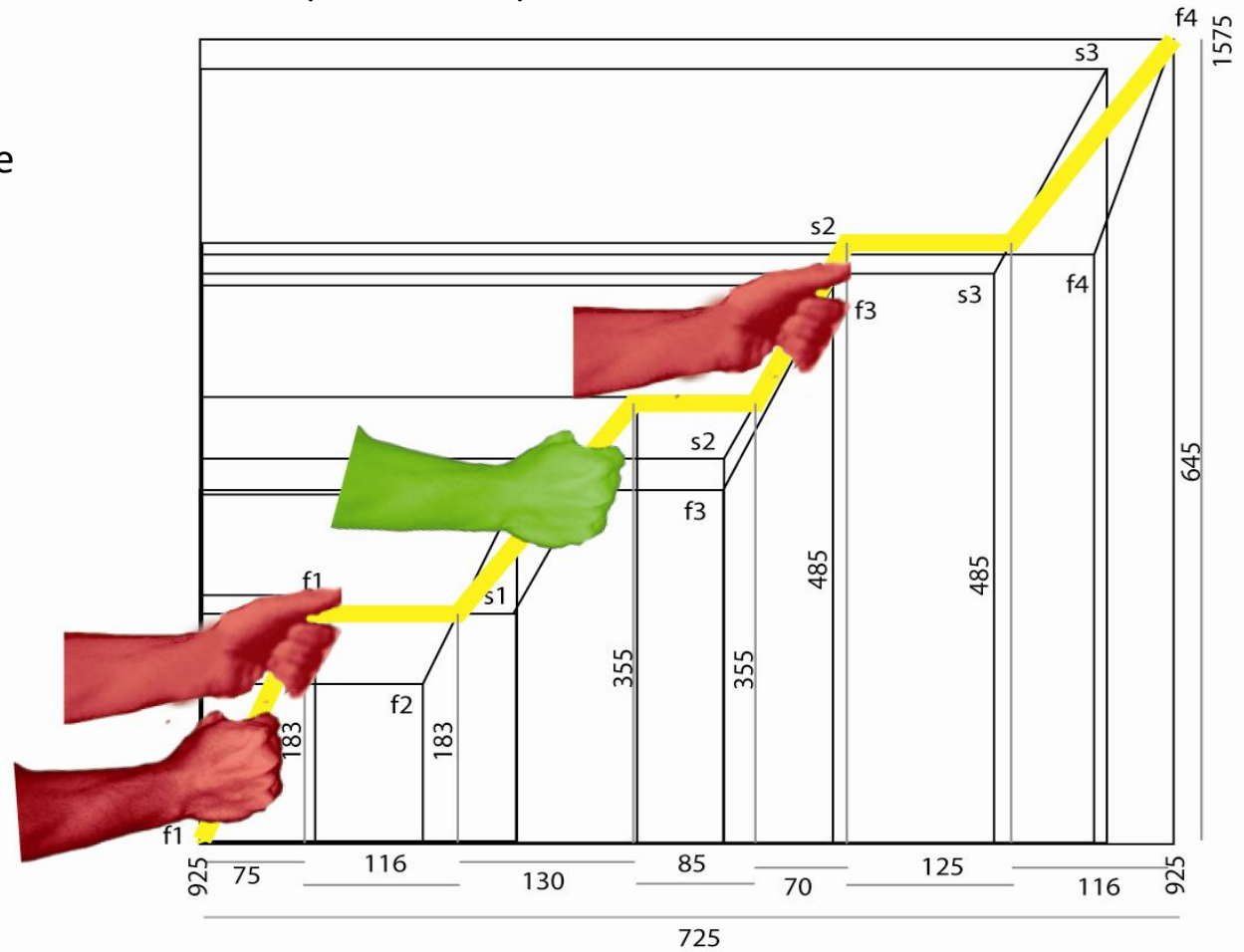
Next step in 1st hand come



CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)

 -STRAIGHT HAND
 -FOLD HAND

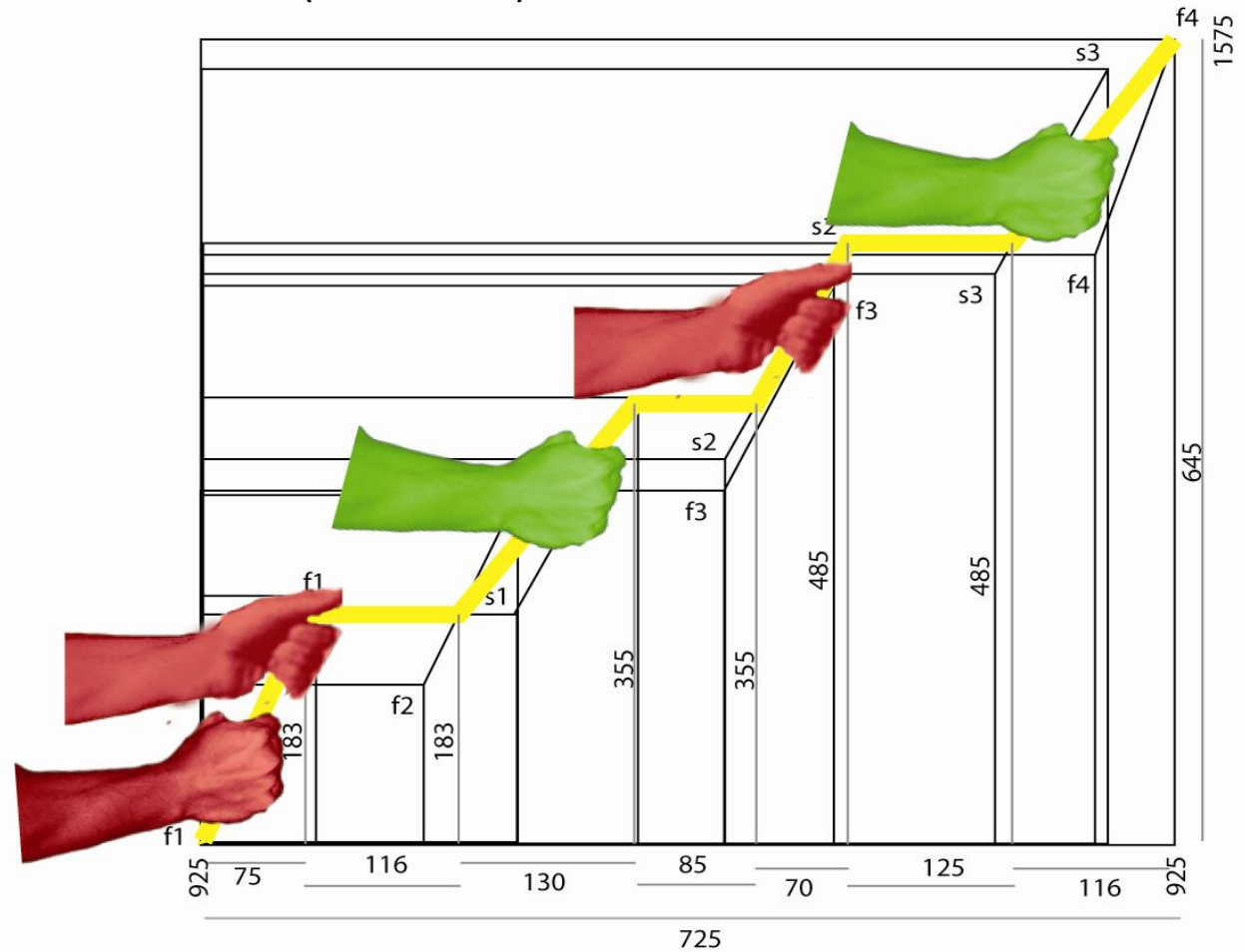
Same step in 2nd hand come



CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)

-STRAIGHT HAND
-FOLD HAND

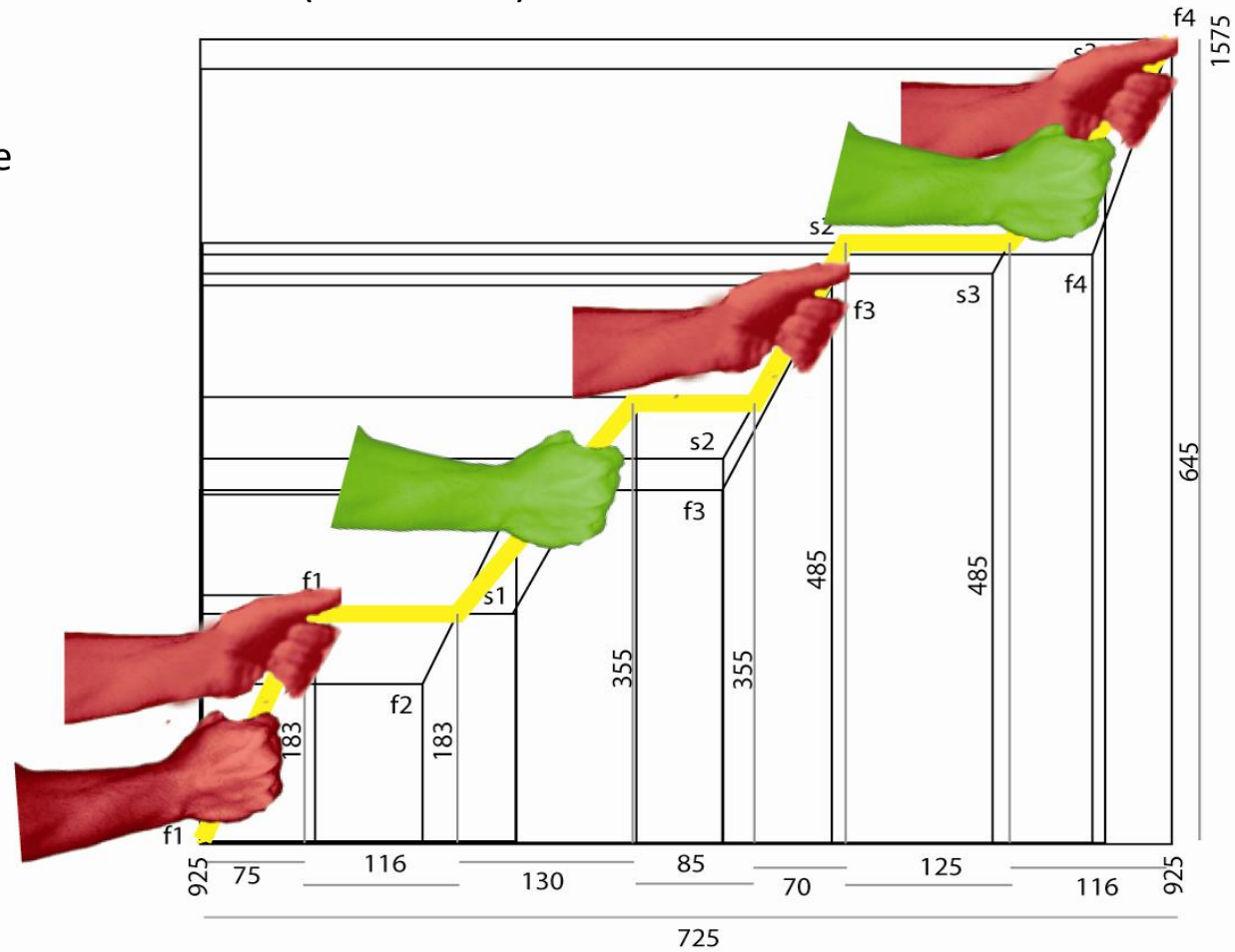
Next step in 1st hand come



CONCEPT FOR DOOR HANDLE PROFILE(HANDLE-1)

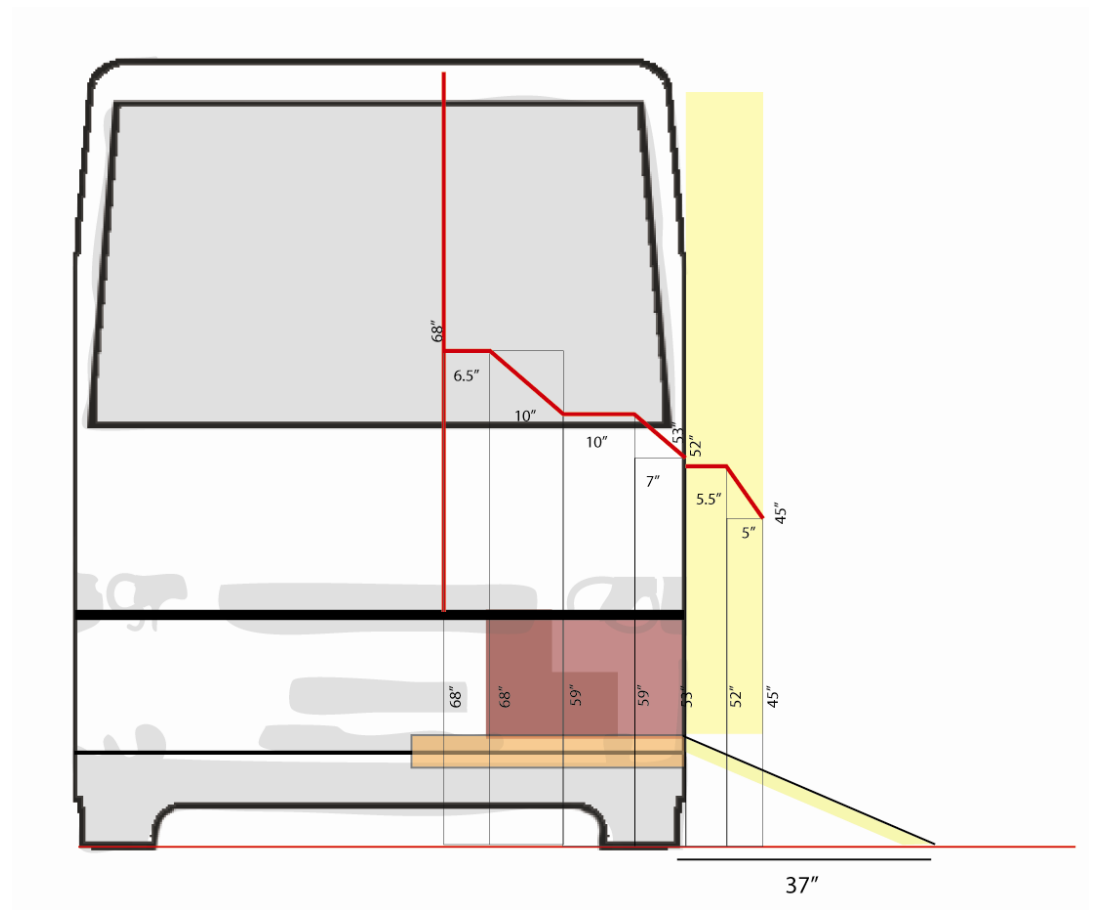
- STRAIGHT HAND
- FOLD HAND

Same step in 2nd hand come

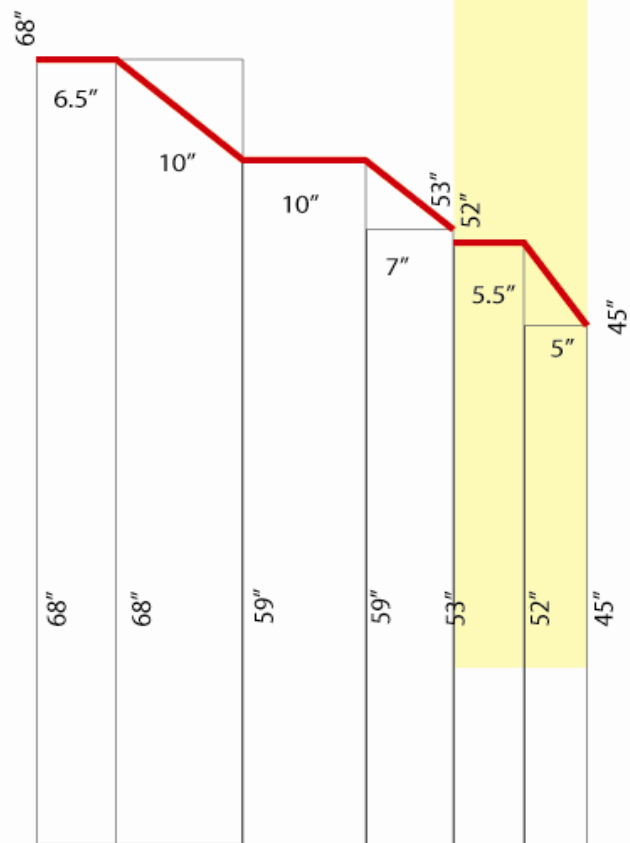


FINAL DOOR HANDLE CONCEPT (HANDLE-1)

The door handle is divided into two parts. The door opens outside so that the handle comes outside providing more grip for comfortable climbing. Normally all doors open inside that condition the handle is so far from the person.



FINAL DOOR HANDLE DIMENSION (HANDLE-1)



SIMULATION OF DOOR HANDLE TO UNDERSTAND IS COMFORTABLE



5%ile Female in 1st step



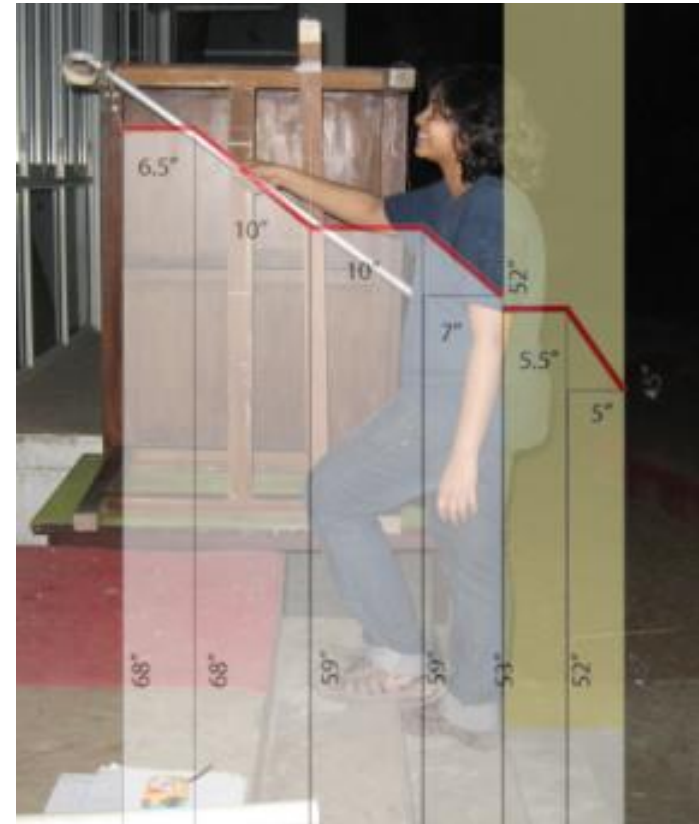
95%ile male in 1st step



SIMULATION OF DOOR HANDLE TO UNDERSTAND IS COMFORTABLE



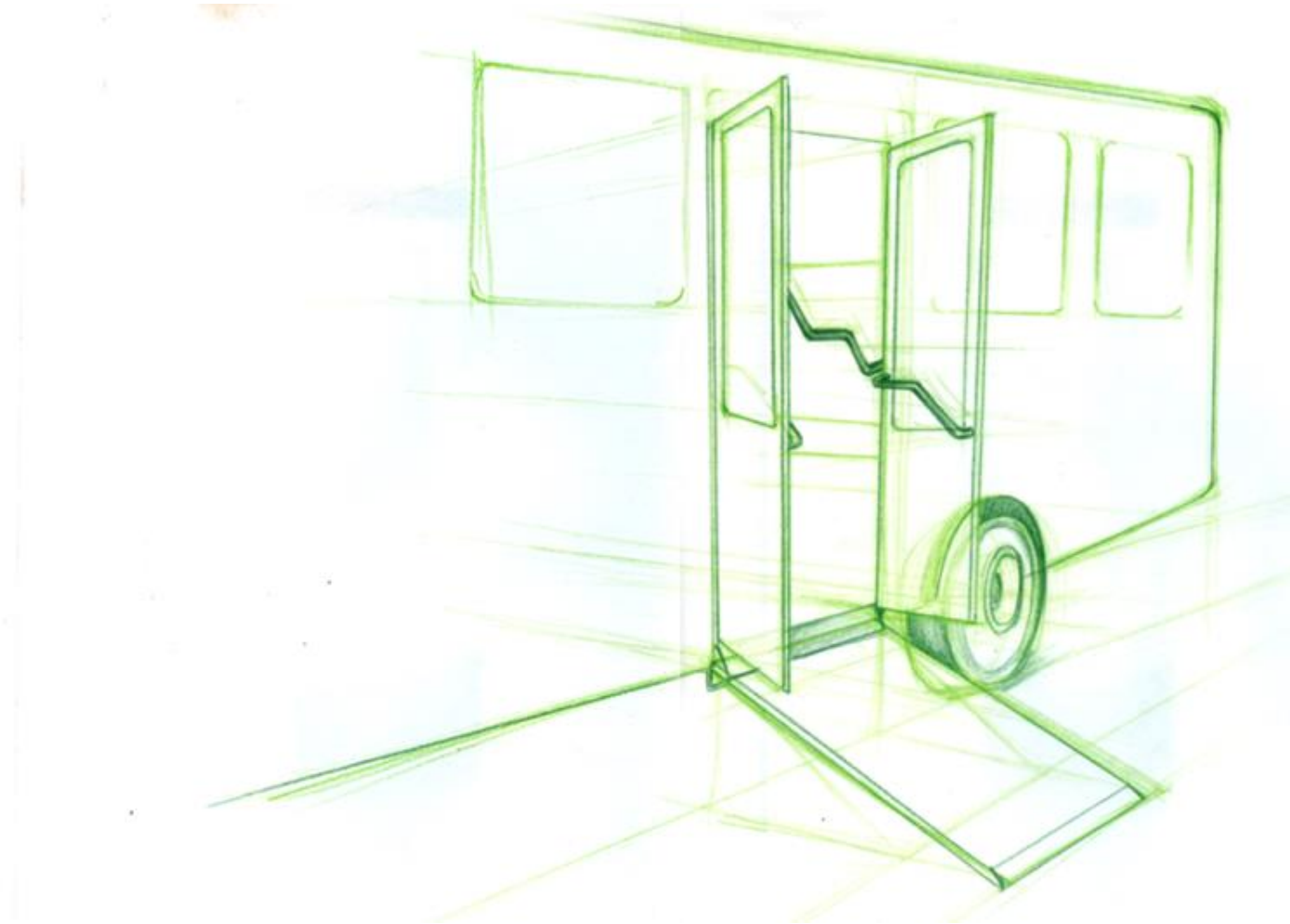
95%ile male in 2nd step



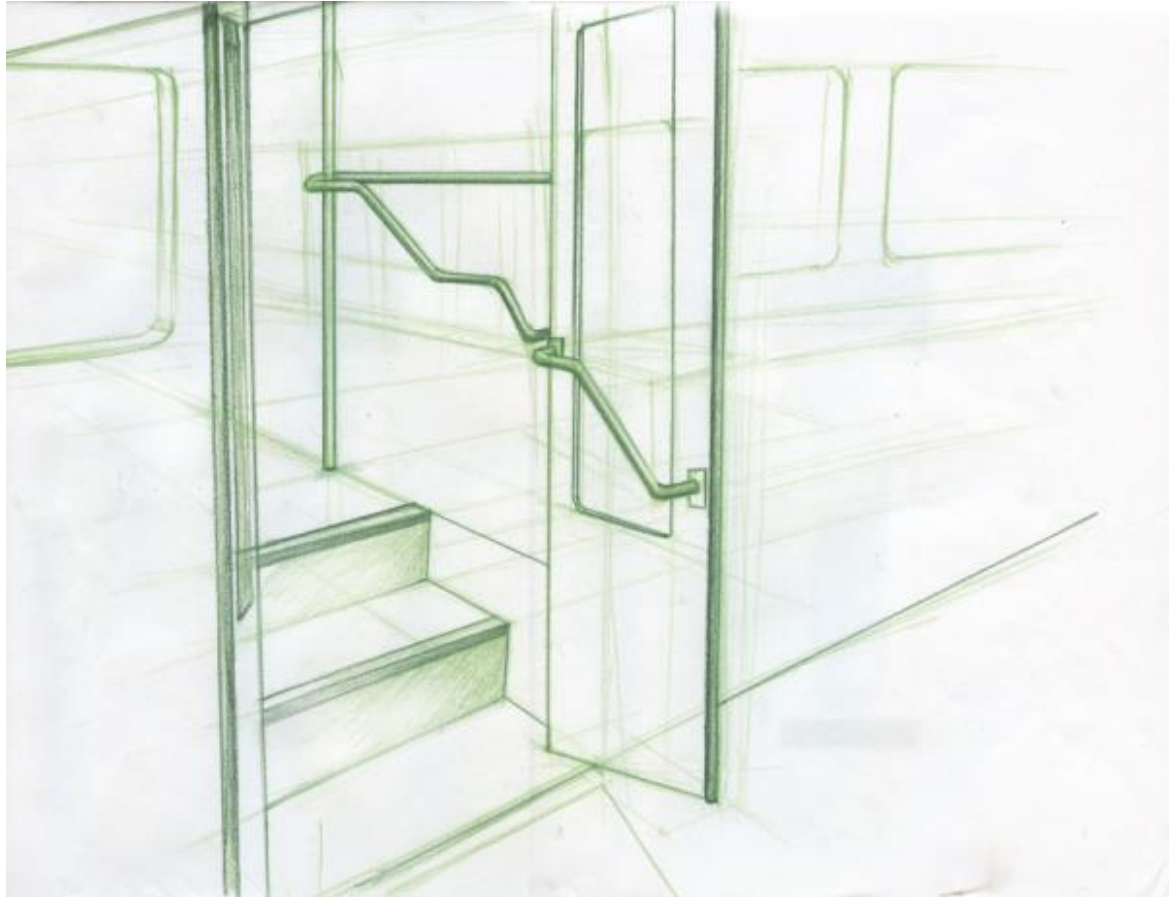
5%ile Female in 4th step



FINAL DOOR HANDLE SKETCH (HANDLE-1)



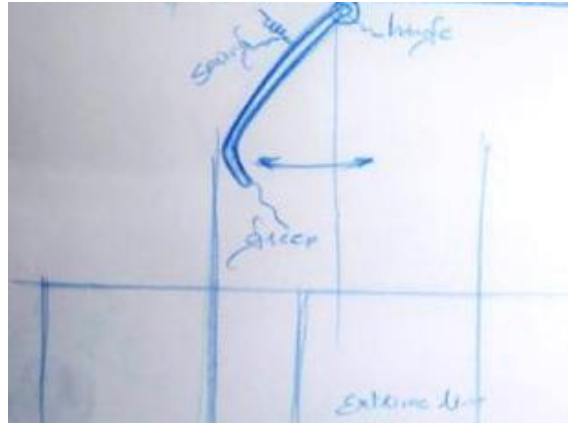
FINAL DOOR HANDLE SKETCH (HANDLE-1)



IDEATIONS FOR SEAT HANDLE (HANDLE-2)

The ideation for Seat handle was based on the ergonomic study for the comfortable posture of elderly. They are as follows:

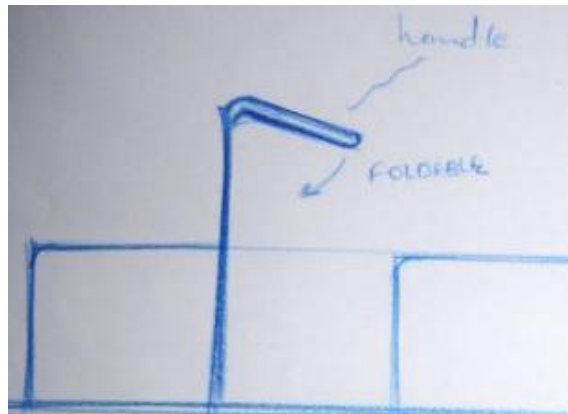
- Grip should be linear in form
- Handle should be help for get up get down
- Grip should be comfortable



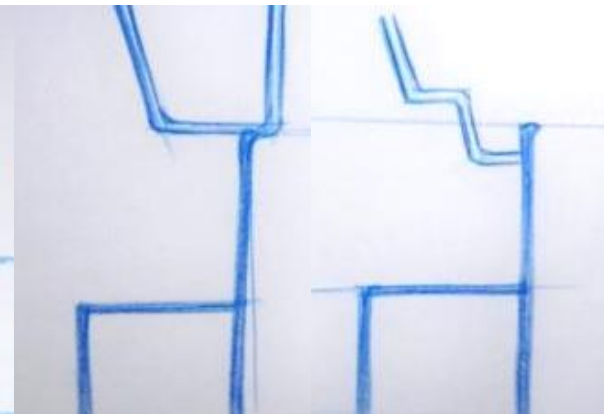
Spring system



Multi step



Foldable handle

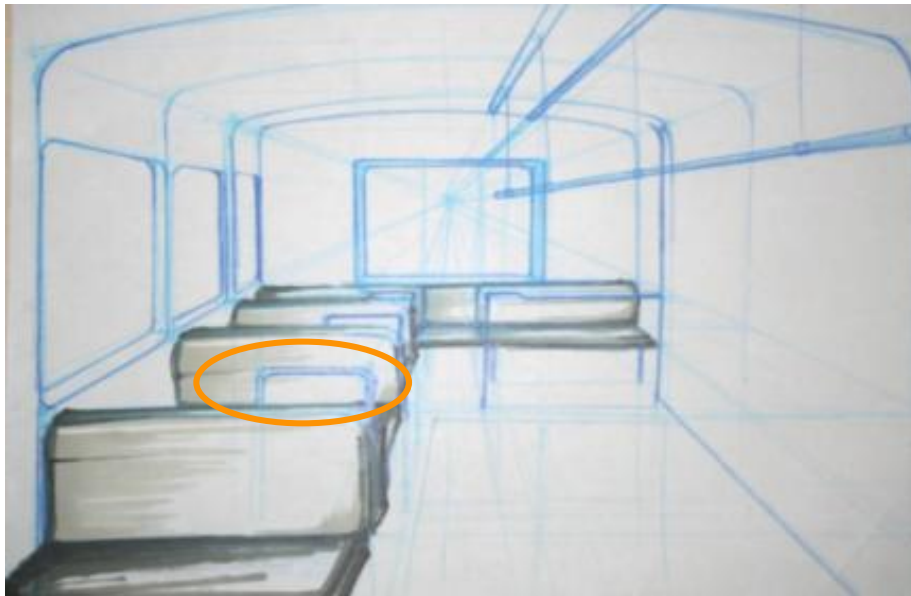


seating and stand person for handle

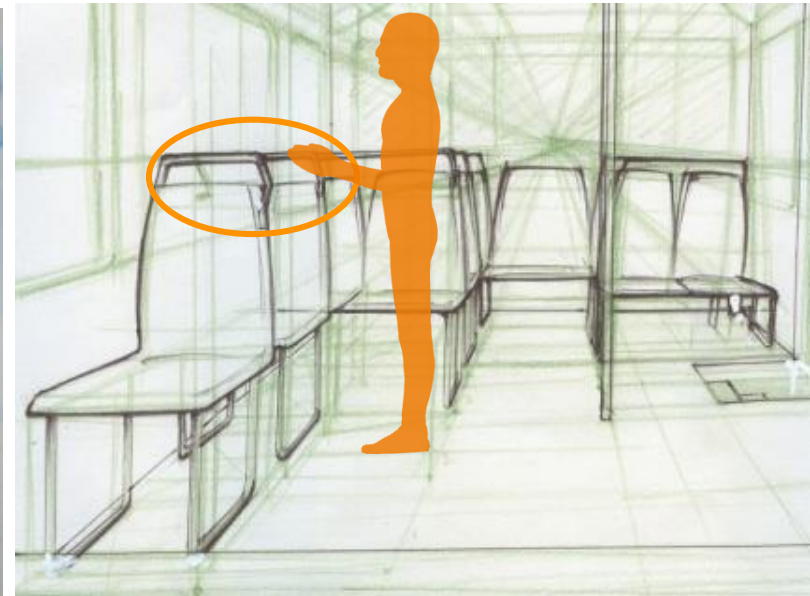


IDEATIONS FOR SEAT HANDLE (HANDLE-2)

After ideation, concluded that handle should be linear and helpful for getting up and down at the seat, for movement inside bus a seat handle must be in ergonomic form, shown in



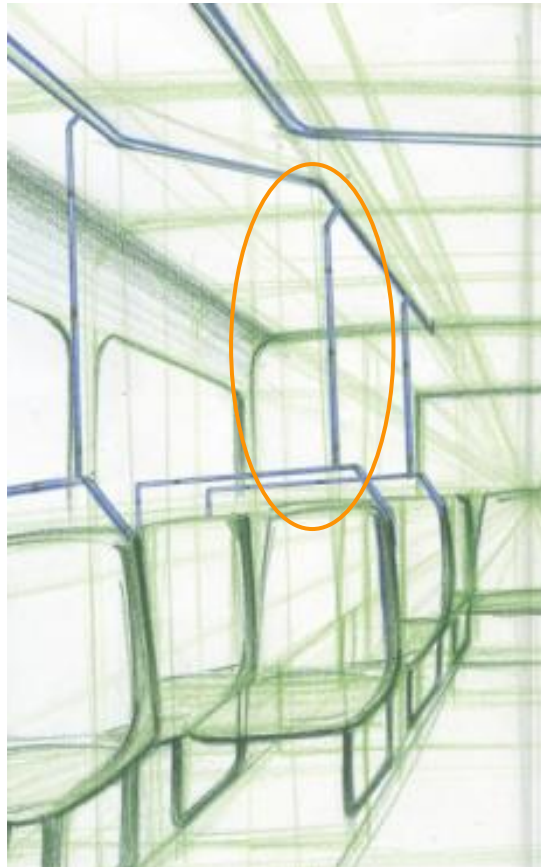
Concept 1



Concept 2



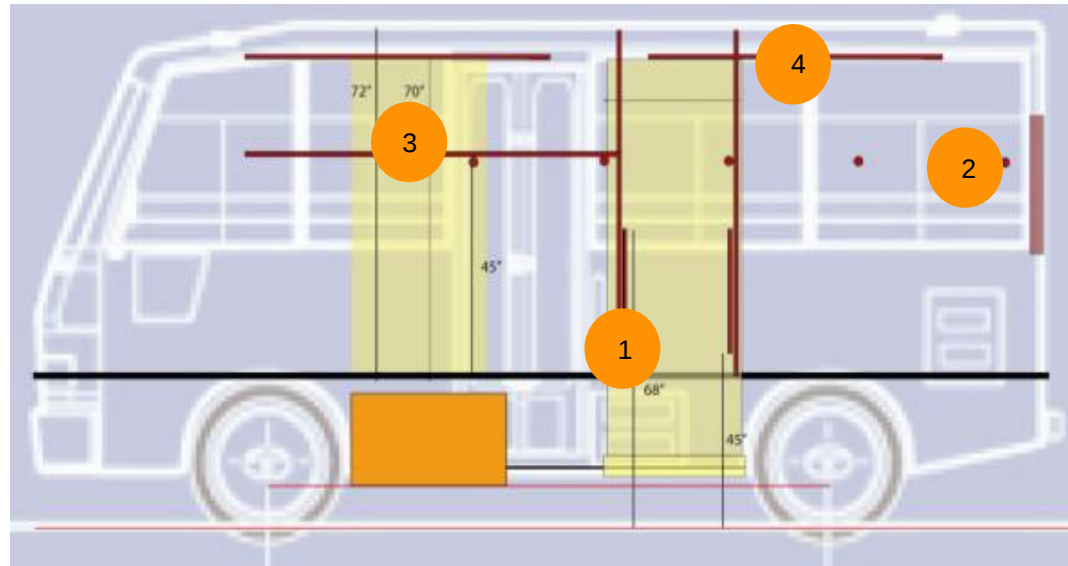
FINAL CONCEPT FOR SEAT HANDLE (HANDLE-2)



FINAL CONCEPT FOR ROOF HANDLE (HANDLE-3)

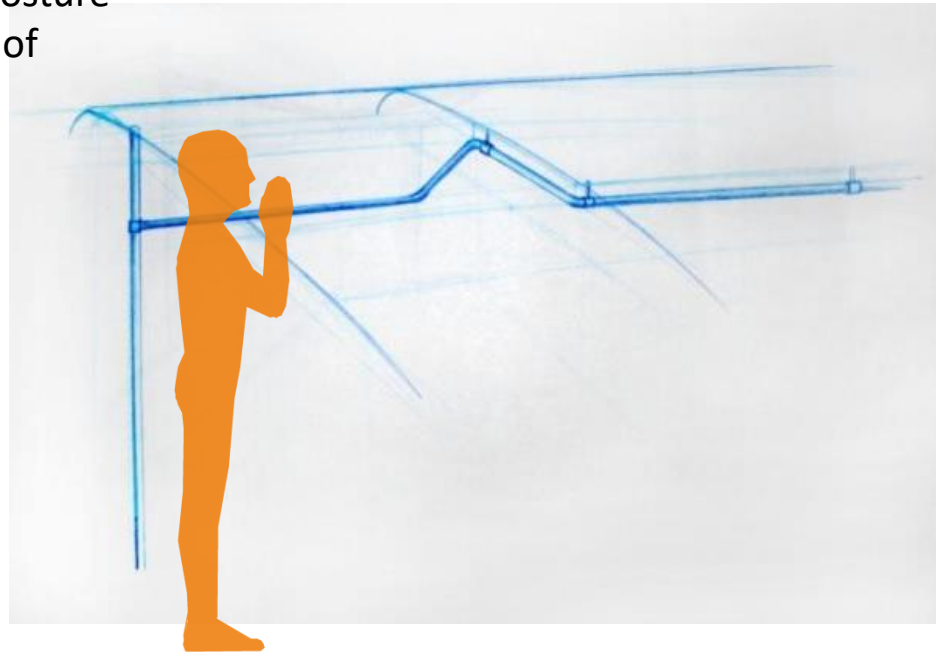
The ideation for Roof handle was based on the ergonomic study . They are as follows:

- Grip should be linear in form
- Handle should be in continues form
- Grip should be comfortable for grip



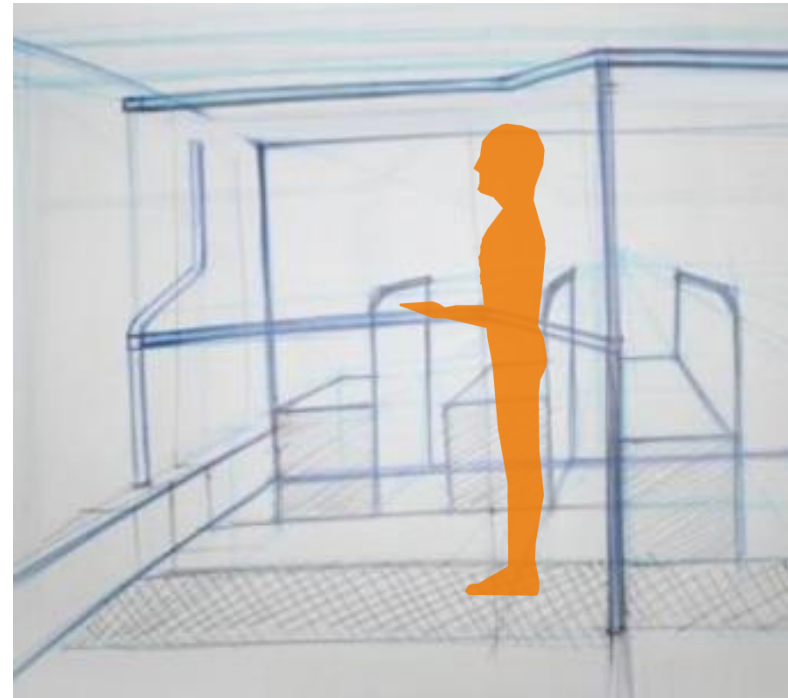
FINAL CONCEPT FOR ROOF HANDLE (HANDLE-3)

CONCEPT 1: Linear roof handle for wheelchair on the left side, bended slight portion just above the shoulder to give space to shoulder for better grip upper side position this posture is more comfortable for elderly but fear of hitting head on handle.



FINAL CONCEPT FOR ROOF HANDLE (HANDLE-3)

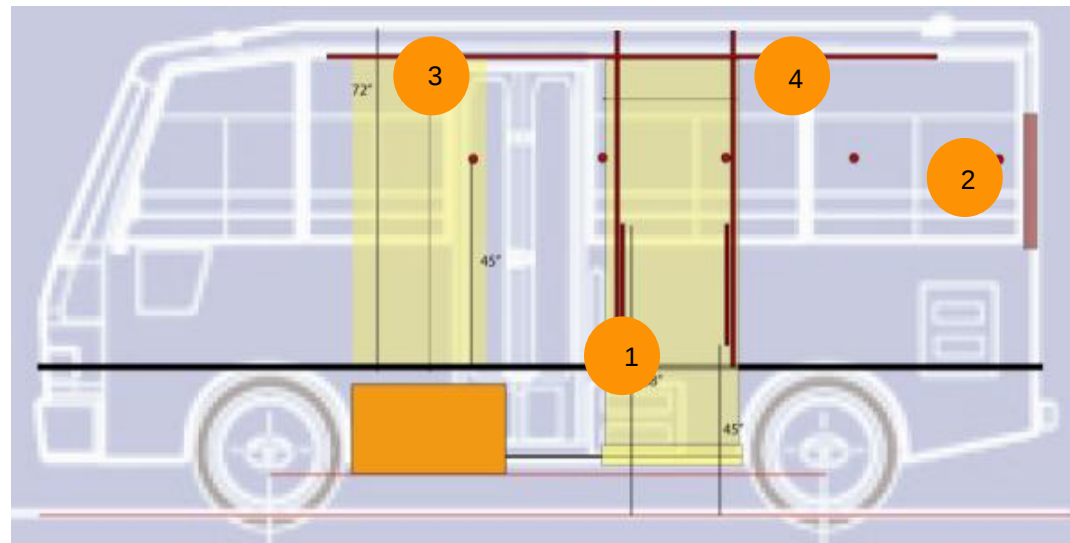
CONCEPT 2: In this case the handle position is lowered down just below shoulder to give proper grip throughout the way for movement . These handle position will hit nobody but aesthetically doesn't look good.



FINAL CONCEPT FOR ROOF HANDLE (HANDLE-3 OR 4)

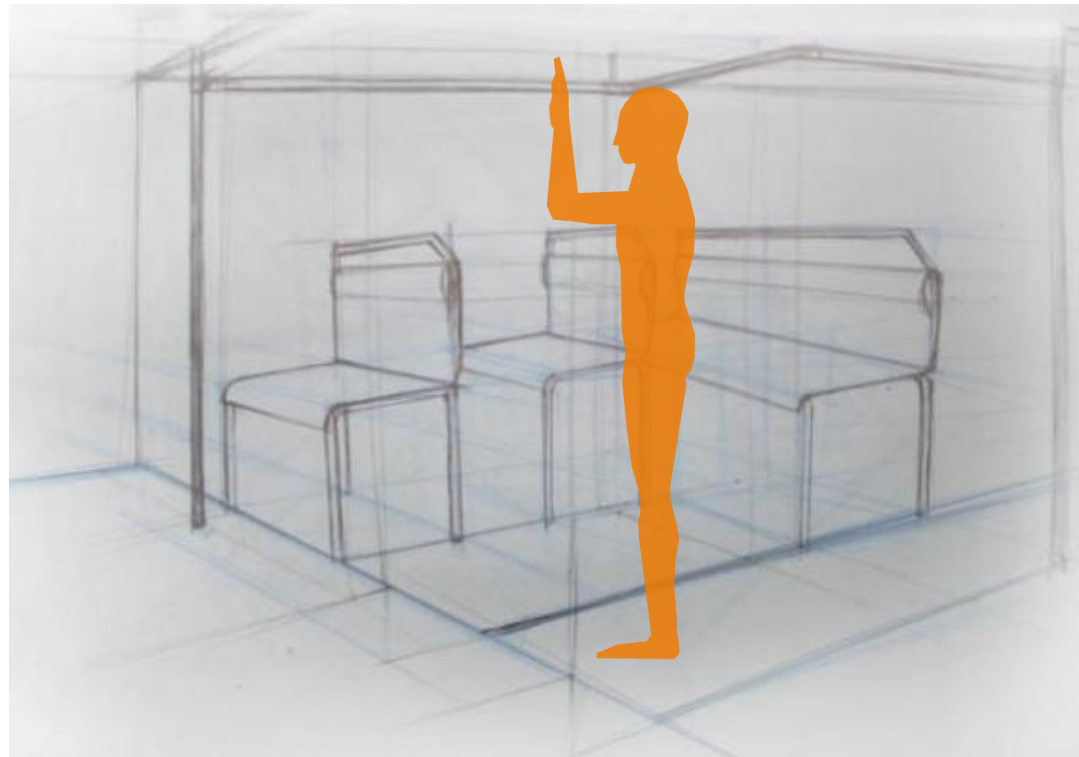
The ideation for Roof handle was based on the ergonomic study . They are as follows:

- Grip should be linear in form
- Handle height should be 95%ile above(no once hit)
- Grip should be comfortable

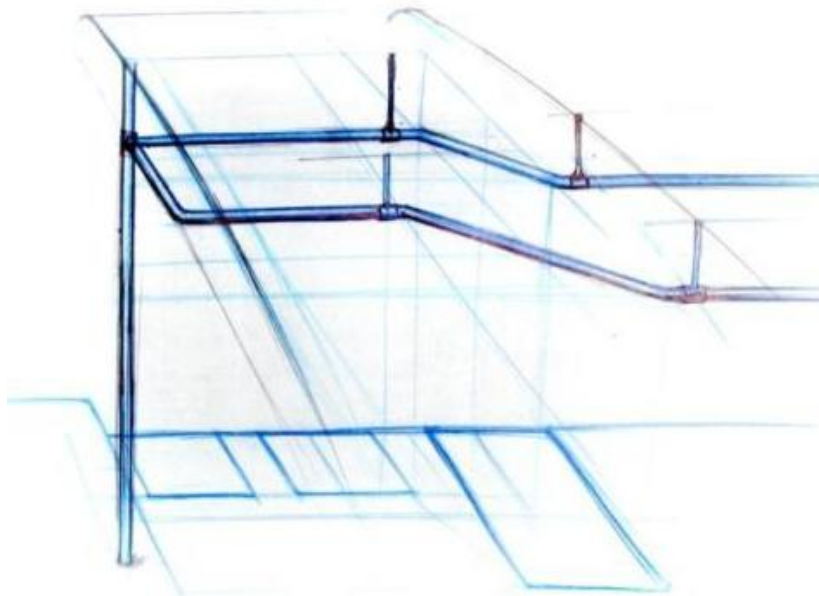


FINAL CONCEPT FOR ROOF HANDLE (HANDLE-3 OR 4)

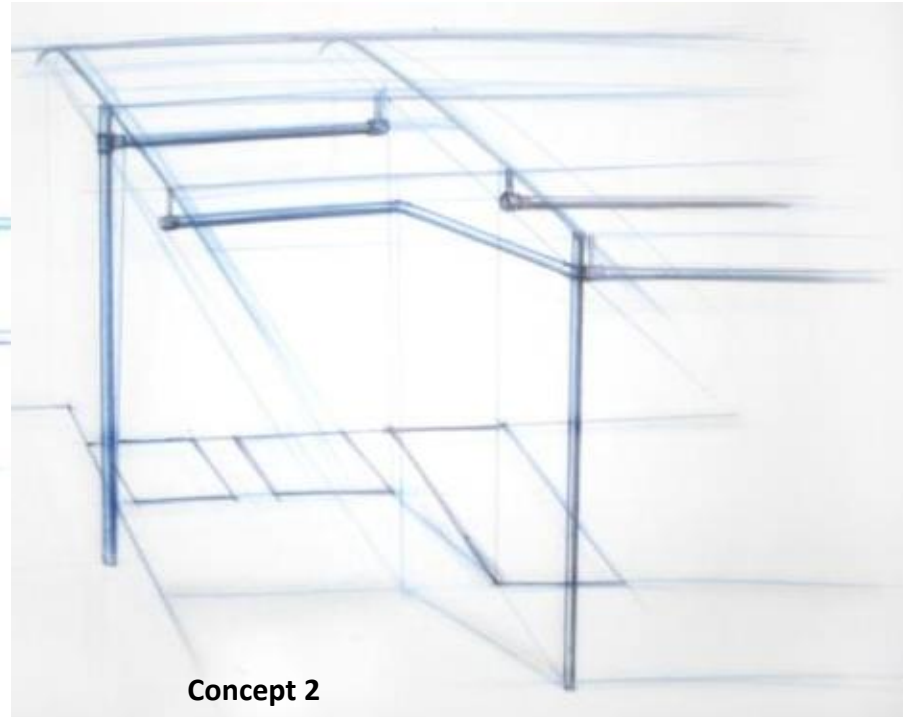
CONCEPT 3: considering roof handle height is above the 95%ile Male with adding of 2" clearance for shoe will not hit anyone. All handle in same height so that it will look like same family.



FINAL CONCEPT FOR ROOF HANDLE (HANDLE-3 OR 4)



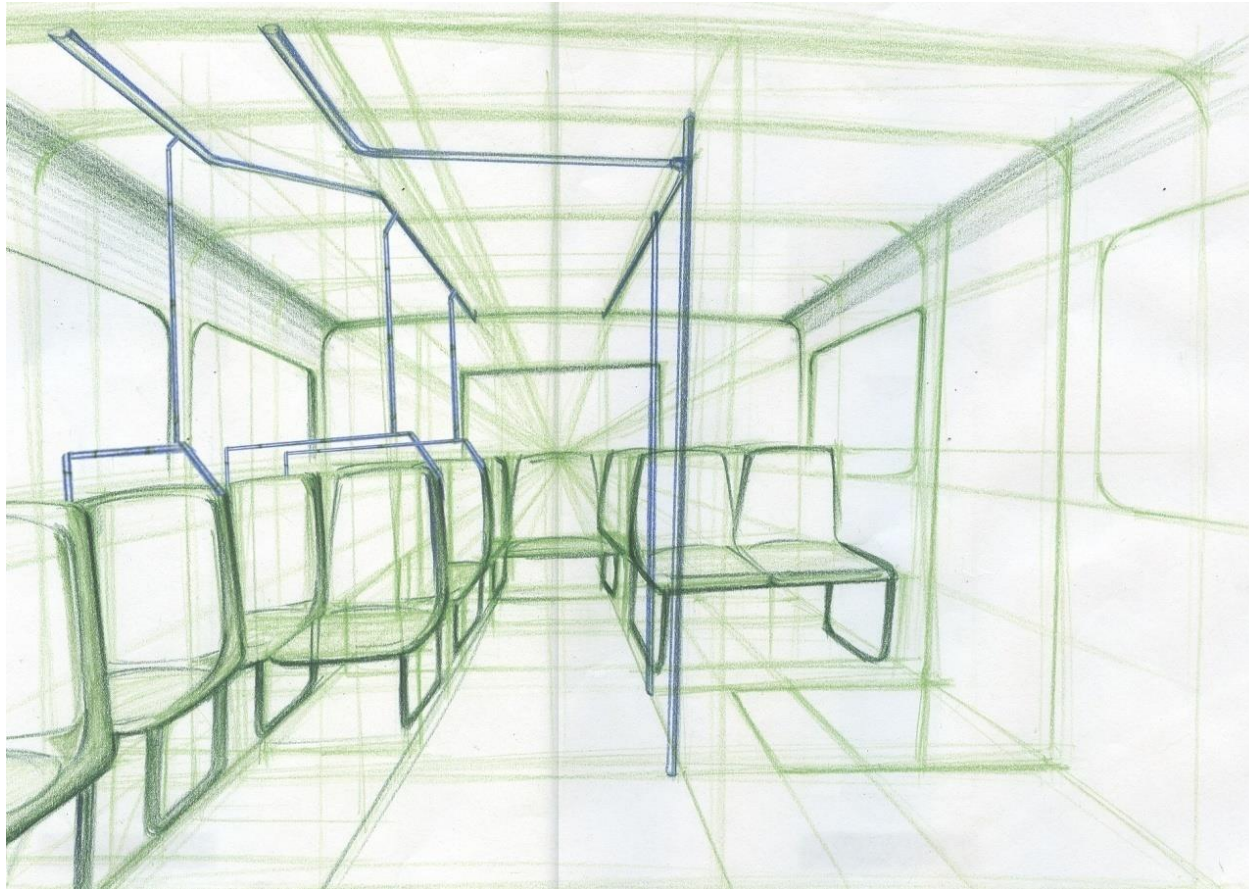
Concept 1:



Concept 2

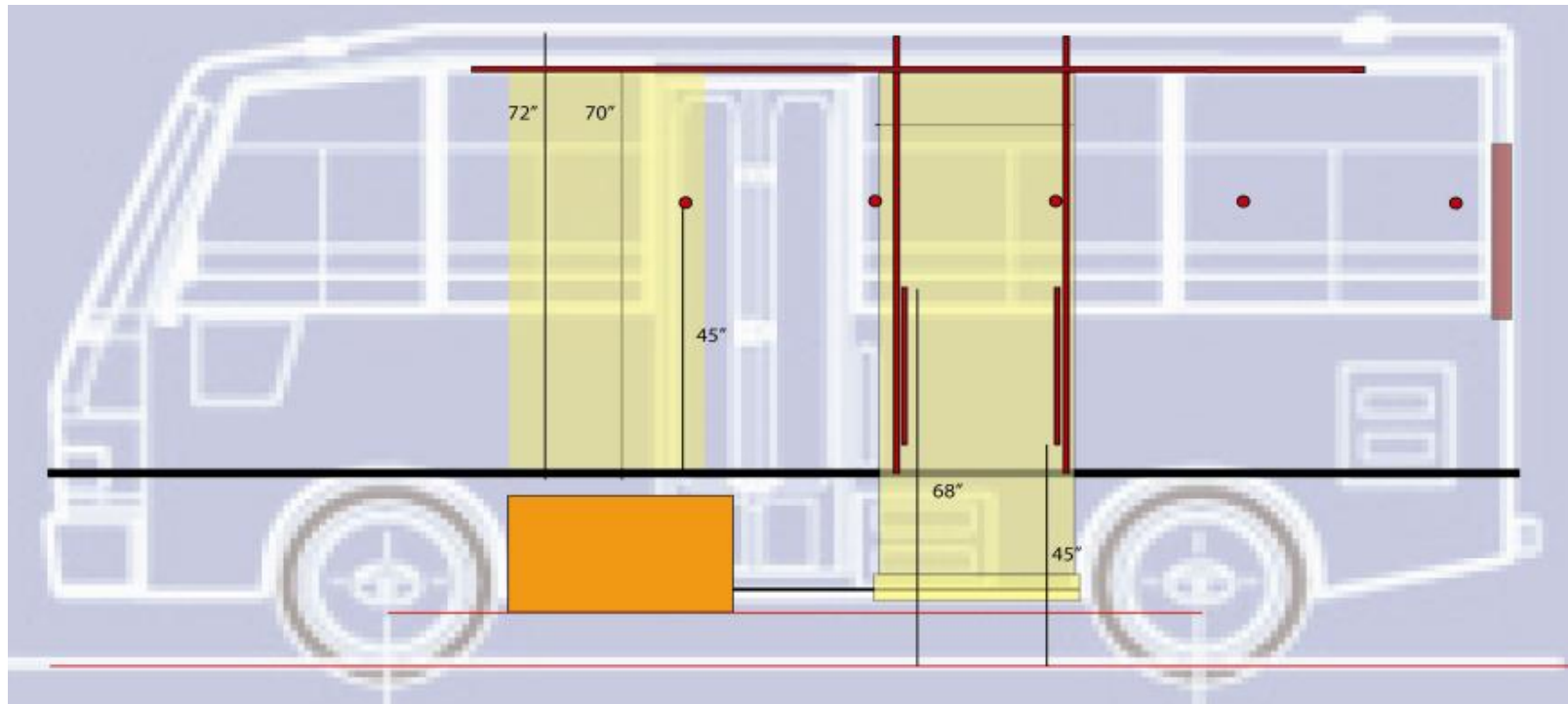


FINAL CONCEPT FOR ALL HANDLE

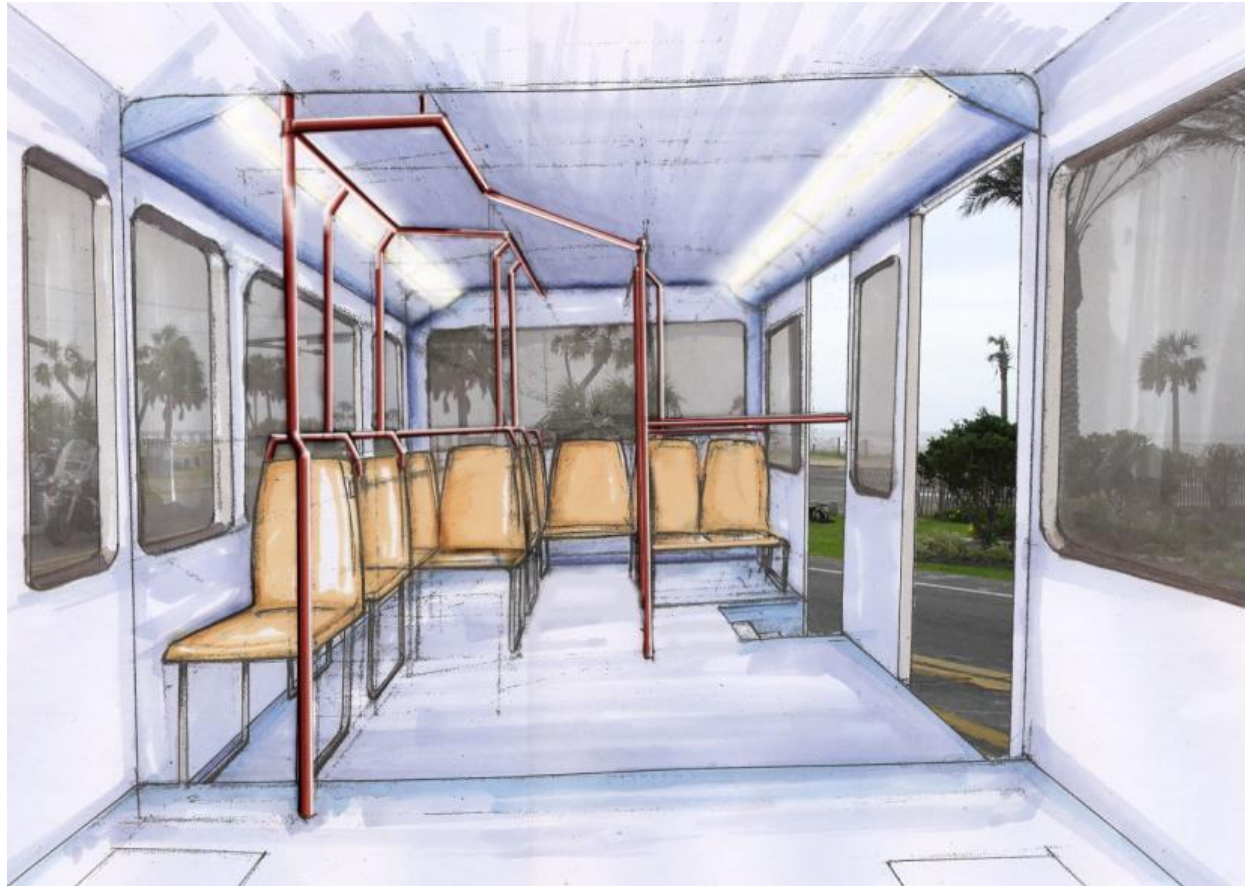


ALL HANDLE DIMENSION HEIGHT

The dimension of all bus handles which we considered according to our requirements. Roof height is 73" , handle height is 70", Seat handle height is 45"



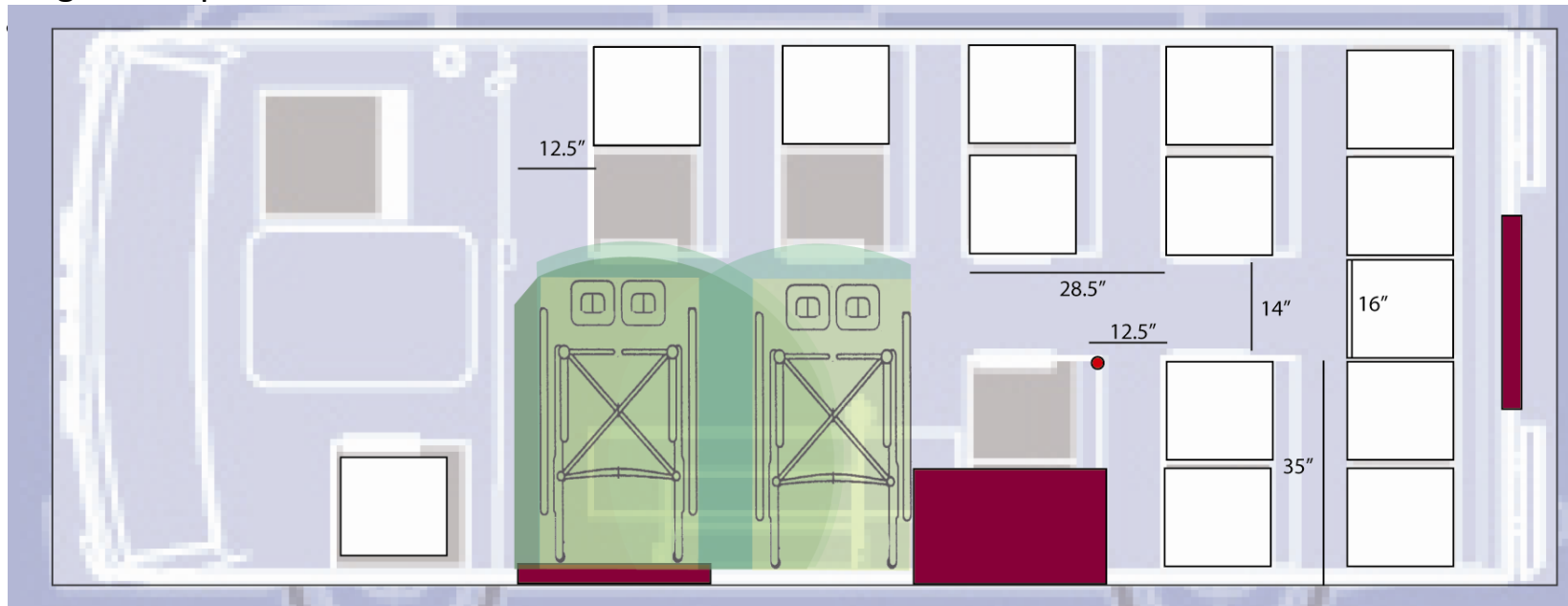
FINAL HAND RENDER VIEW OF ALL HANDLE



SPACE LAYOUT

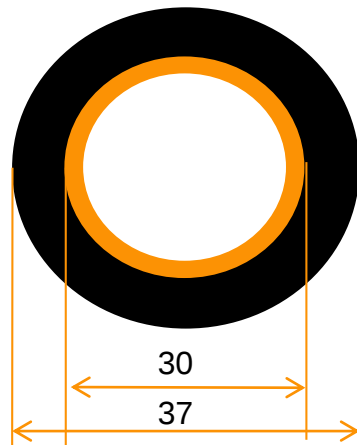
Sitting arrangement of bus

- Door to pillar distance is 35"
- Two seat dimension is 35"
- Single seat dimension is 16X16"
- Pitch distance of seat is 28.5"
- Leg room space is 12.5"



HAND GRIP DIMENSION

Handle grip dimension is given. in table , considering 16 person hand grip dimension data study in 14 Male and 2 Female, average hand grip diameter is 3.9, handle lower limit is 3.7cm



No. of person	M/F	dimension
1	M	3.7
2	M	3.7
3	M	3.7
4	M	3.8
5	M	3.8
6	M	3.8
7	M	3.8
8	M	3.9
9	M	4
10	M	4
11	M	4
12	M	4.1
13	M	4.2
14	M	4.2
15	F	3.8
16	F	3.9
Avg		3.9
SD		0.167332005



HAND GRIP MATERIAL

Market in three types of grip available
Is all are foam types
According to bus handle select

Spkined- An interesting variation on the standard foam tube, splined foam tubes (or sleeves) contain a number of exterior ribs designed to enhance the appearance of the part. They are a cost effective way to add value.



HAND GRIP MATERIAL

Durablend-foam Durablend foam is GripWorks' proprietary material that combines two high-grade rubber compounds to form extremely durable grips with excellent outdoor weathering properties. but were also resistant to oil and gas

NPVC-foam Our workhorse material due to its low cost, NPVC foam grips are available in three standard densities

Splined is make in tube form is good for linear bus handle



REFERENCE

Ref 1: <https://www.cia.gov/library/publications/the-world-factbook/geos/in.html>

12th nov'o8(11:15 PM)

Ref 2: Fitting the task to the Man (E. Grandjean) page no. 77

Ref 3: <http://auto.indiamart.com/bus/>

Ref 4: http://www.riconcorp.com/products_transit.asp

13th nov'08(2:51)

Ref 5: <http://www.gripworks.com/durablend-foam.htm>

14th nov'08(7:51 PM)

Ref 6: <http://www.gripworks.com/splined-foam-tubes.htm>

14th nov'08(7:56 PM)

Ref 7: <http://buses.tatamotors.com/starbus.htm>

13th nov'08(2:51 AM)

Ref 8: http://buses.tatamotors.com/standard_tech.htm

13th nov'08(2:57 AM)

Ref 9: <http://www.gripworks.com/UV-NPVC-foam-tubing.htm>

14th nov'08(7:39 PM)



REFERENCE

Ref 10: <http://www.gripworks.com/foam-grips.htm#foammaterials>
14th nov'o8(8:01 PM)

