

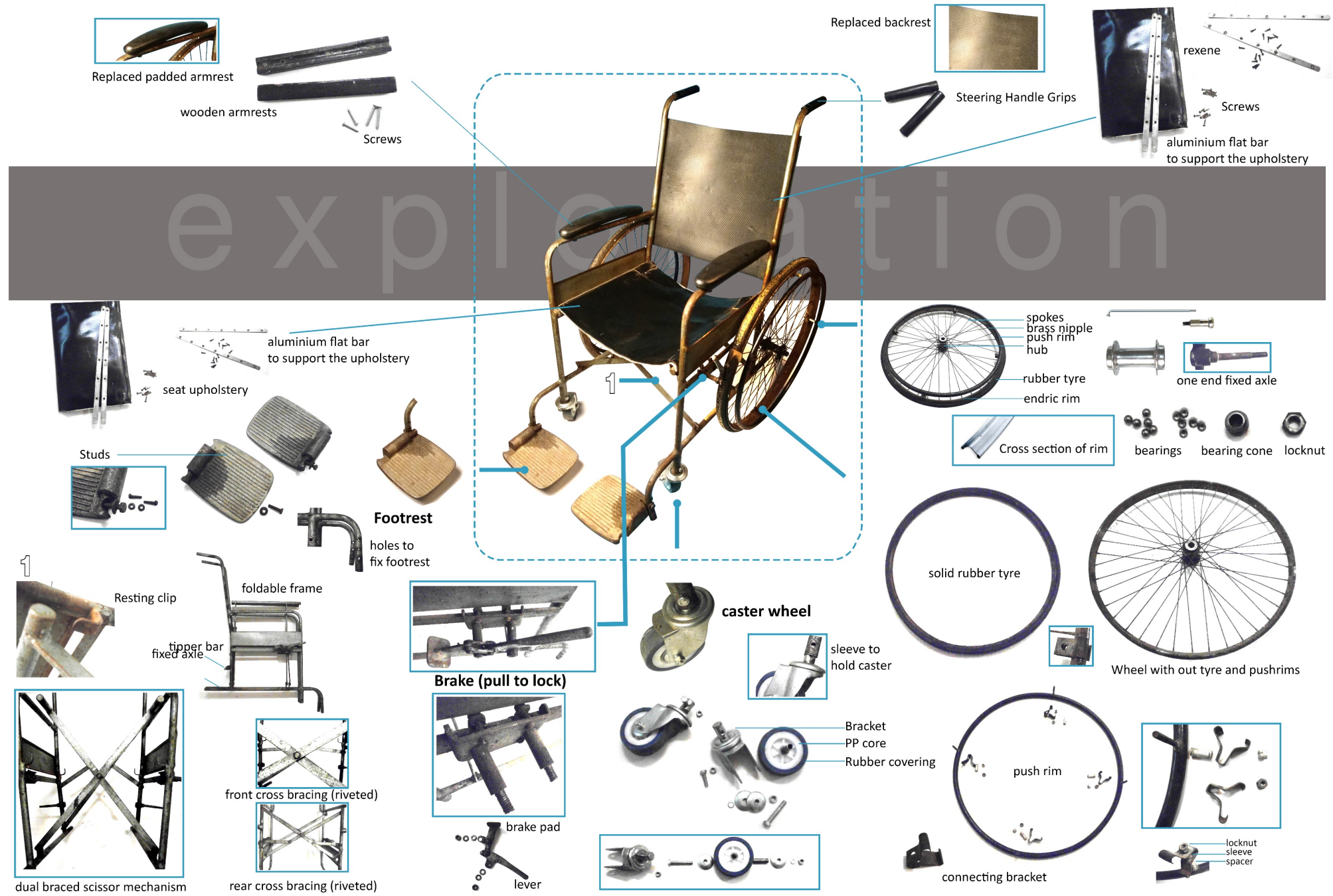
# REDESIGNING OF WHEELCHAIR FOR INDIAN CONTEXT

A LIGHTWEIGHT MOBILITY FOR PHYSICALLY CHALLENGED PERSON

# Disassembling wheelchair



# Redesigning of Wheelchair for Indian Context



## Product comparison



## Redesigning of Wheelchair for Indian Context

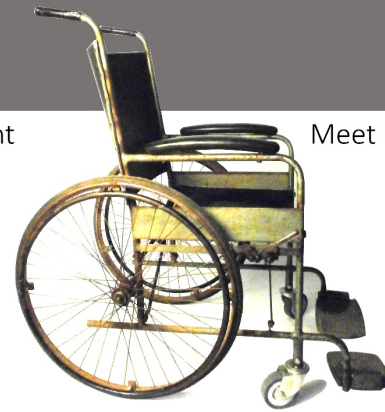
Product Image  
&  
Manufacturers

IDC department

Meet Importers

Mahavir Surgicals

Components  
&  
Specifications



M.R.P.=5800 Rs.



M.R.P.=6800 Rs.

Carbon steel grade -304  
:good resistance to corrosion  
:good malleability and weldability

|                            |                                                                                     |                                                                             |                                                                                       |                                                                                        |                                                                                       |                                                                                        |
|----------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Castor wheels              |    | 3" Bracket type With PP core                                                |    | 8" Bracket type solid rubber With PP core                                              |    | 8" Bracket type solid rubber With PP core                                              |
| Pushrims/Handrims          |    | painted tubular section                                                     |    | Plastic coated solid bar                                                               |    | Chrome plated Carbon steel tubular section                                             |
| Footplates                 |    | Foldable aluminium stud                                                     |    | Swingaway PP Footrests                                                                 |    | Swingaway Aluminium studs                                                              |
| Upholstery                 |    | Black Rexene                                                                |    | Padded Black nylon                                                                     |    | Tartan pattern padded fabrics                                                          |
| Wheel locks<br>Side panels |   | Pull to lock MS assembly<br>Powder coated MS plate                          |   | Pull to lock Chrome finish assembly<br>Moulded PP panel                                |   | Pull to lock Chrome finish assembly<br>Riveted SS panel                                |
| Folding Assembly<br>Frame  |  | Dual Crossbraced Flat Bars (Riveted)<br>MS Powder coated                    |  | Crossbraced Powder coated Steel<br>tube (Bolted)<br>Chrome-plated carbon steel         |  | Crossbraced SS tube (Bolted)<br>Chrome-plated carbon steel                             |
| Armrests<br>Steering Grip  |  | Padded arms<br>Wrap-around Nylon strap                                      |  | Full-length Padded arms<br>PP Grips                                                    |  | Full-length Padded arms<br>PP Grips                                                    |
| Safety Features            |  | N/A                                                                         |  | Safety belt (Nylon)<br>Carry pocket on back                                            |  | Safety belt(Fabric)<br>Carry pocket on back                                            |
| Wheels<br>Tippers<br>Tyres |  | Endric Type Bicycle Rims<br>MS tube without grip<br>24" Molded solid Rubber |  | Endric Type Bicycle Rims<br>Chrome plated tube with grip<br>24" Molded urethane Rubber |  | Endric Type Bicycle Rims<br>Chrome plated tube with grip<br>24" Molded urethane Rubber |



## Examples:



# Redesigning of Wheelchair for Indian Context

Which Are **Capable**  
of Carrying Much More than Their **Own Weight**

### 3 Skateboard

: plywood has omnidirectional strength due to its layered structure  
plywood divides rider's weight between front and rear wheels.



:A Skateboard is a type of sports equipment used primarily for the activity of skateboarding.  
:Skateboard weighs 1.8 kg

### 6 Hammock

: tensile strength  
due to flexible webbing strap-cords.



:A hammock is a sling made of fabric, rope, or netting, suspended between two points, used for swinging or resting.  
:The entire assembly of One hammock weighs 400-600 grams.

### 9 Cup Nest of Sparrow (Gauraiya)

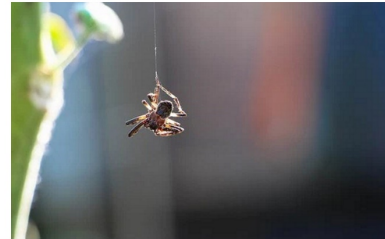
: interlocking in straws  
nest weave density  
shape of the nest



:House sparrow (weight -30-40 grams)  
:Sparrow's egg (weight -3-4 grams).

### 1 Cobweb

:clustering and radial connectivity  
tensile strength of segmented silk



:One weave of Cobweb silk can hold the Weight of One House Spider. (weight 2 to 3 grams)  
:It is up to 6 times stronger than high-grade steel per weight.

### 4 Mushroom

:cantilevered UDL of cap  
concentrated at free end.



:The weight of the cap of a mushroom is 2-3 times heavier than the stem or stalk.

### 7 Parachute

:principle of 'air resistance'  
zero-porosity fabrics that are meant to slow down the fall of people.  
(linen, canvas, or nylon)



:The entire assembly of One Parachute weighs 14 kg-20 kg.  
:It can carry one person (average weight -65kg).

### 10 Dung beetles (also known as gubrella in India)

: Rolling  
due to continuous rolling the  
dung reforms into spherical shape.



:A dung beetle can bury dung 250 times heavier than itself in one night.

### 2 Tiger

:strong physical characteristics  
the bones of the tiger's front legs are strong and dense to support the large musculature.



the bones in each of the tiger's feet are tightly connected by ligaments enabling them to buffer the impact of landing from running, pouncing and leaping.

:A tiger can carry something 550kg, twice its own body weight.

### 5 Director's chair

:scissors action (foldability)  
braced frame gives more strength to it



:A director's chair is a lightweight chair, weighs 4-5 kg.  
It is sufficient for 100-120 kg live load.

### 8 Seesaw swing

: A lever that hinges on a pivot point  
called a fulcrum.  
equilibrium mechanics



:A see saw is a kind of swing, weighs 40-60kg.  
It can hold 100-150 kg live load.

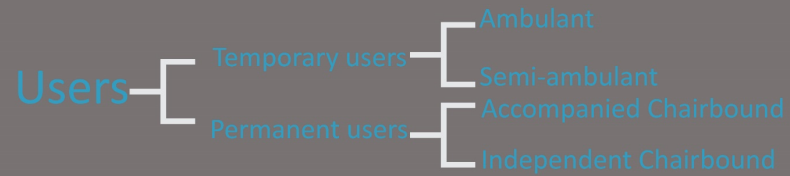
### 11 Bicycles

:diamond shape frame  
frame divides rider's weight between  
front and back wheels.



:Bicycle are used for transportation of peoples.  
:The entire assembly of Bicycle weighs 18 kg -20kg.  
:It is suitable for 1-2 persons (average weight -65kg).





## Wheelchair: Assistance to Disabled Persons

### Man

#### Physiological

Malformation  
Posture issues  
Acceptance

#### Comfort

Seat  
Back Rest  
Arm Rest  
Foot Rest

#### Convenience

Ingress/Egress  
Transferability  
Relaxing Posture  
Handling  
Propelling  
Maintenance

#### Social

Dignity

#### Aesthetics

Look

### Machine

#### Dimensions

Seat depth  
Seat Width  
Armrest Width  
Armrest Height  
Backrest Height

#### Weight

Light in Weight

#### Stability

Performance  
Adjustment

#### Strength

Load bearing capacity

#### Materials

Durability

#### Process Of Manufacturing

### Environment

#### Built Infrastructure

Parks/Gardens  
Railway Station  
Multiplex  
Shopping mall

#### Indoor Places

Bathroom  
Using WC  
Going to Bed  
Using Table

#### Outdoor Places

Elevators  
Staircase  
Ramp  
pathways



H14-IDC --- H14-Mess --- H14-IIT Hospital --- IDC-SJM SOM --- H14-H15 --- SOM-IIT Hospital --- H15-Central library

Wheel Chair is a mobility device designed for shifting patients, moving physically challenged people from one place to another with the help of attendee or by means of self-propelling.

The wheel chair is divided into two categories-  
Battery powered wheelchairs

Manual wheelchairs

:Foldable

:Rigid or non-foldable

I had conducted two weeks user study within the IIT campus.

:For better learning and experience I have used wheelchair in my day to day life.

:To get a hands on feelings it was a great idea.

:By this I could understand the problems very well.



:hectic in holding push rims (due to distributed force applied by hands)



:Stress in hand while steering the wheelchair due to this kind of handle

: stress injuries



:problem in reaching the table and non adjustable height of table for ease of work which increases repetitive stress injuries like wrist, back and shoulder injuries.



:Height of side panels and arm rest creates obstruction while shifting the patient from wheel chair to another transportation medium.



:width of wheelchair create trouble while accessing elevator



## Voice of users:

:Light in Weight.

Cost effective.

:Highly visible frame colour.

:Correlation between disability and poverty.

:Facing problem while defecating.

:No ramp for wheelchair in Best Buses.

:Unfortunately, India is not disabled friendly Country.

:There is difficulty in shifting the patient from wheel chair to auto rickshaw and other vehicles.

:Dignity of the user-Aesthetically it should not look like hospital equipment.

:NGO and Govt distributed wheelchairs are not up to standards.

:many of them dont know-is it a good or bad design.





## Foot rest

It is too low in the current wheelchair, it hits door thresholds when traversing. (Image 1)

Footrest contact occurs most often during starting to go up a ramp or when transitioning between the ramp and flat ground when descending. (Image 2) (Image 3)

The danger lies in the fact that a moving wheelchair can tip forward if the footrests suddenly hit an obstacle.

## Seat Pan

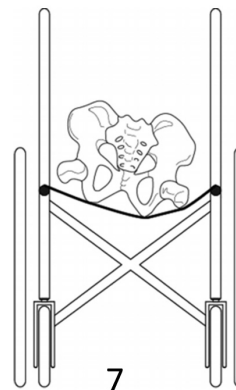
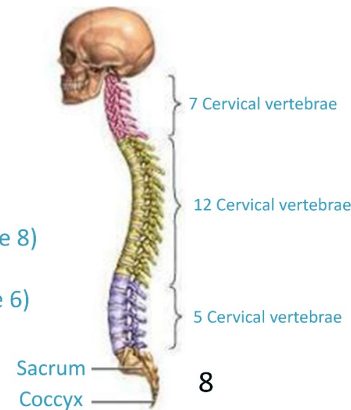
One of the most common problems with wheelchairs can be attributed to sling seat upholstery. (Figure 7)

## Backrest

The height of the backrest does not fulfill the lumbar support.

Due to the long use of wheelchair this creates the pain near the sacrum. (Image 8)

Sitting with a backrest with short height can lead to postural instability. (Image 6)

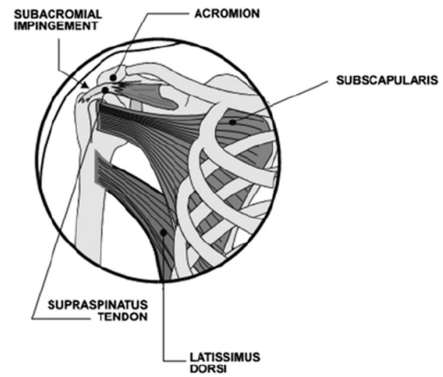


## Arm rest

Armrests serve a valuable postural support role for users. They have different body structure.

The armrests are too high so it forces the user to elevate his/her shoulders, leading to discomfort. (Image 4, 5)

Due to the lack of adjustability, the armrest does not allow the user to go underneath the table or desk. (Image 6)



## Armrest Height

Resting of arm is obstructed by a armrest This will result in postural instability. Due to this the armrest force the shoulder towards up that generates the stress to shoulders. (Image 9)



## Backrest Inclination

Wheelchair users tend to do a lot of functional activity from a seated position. After a long time sitting This will result in postural instability, and the user will respond by leaning forward on the seat into a slouched posture. It causes the back pain. (Image 10)

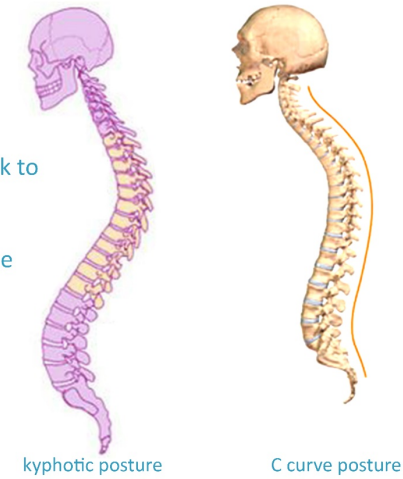




## Vibrations and jerks

When the foot rest hits door thresholds when traversing .It gives a sudden jerk to the whole body.(Image 11)

The vibrations which are generated While using ramp creates unstability to the whole body posture.It happens on the rough terrain.(Image12)

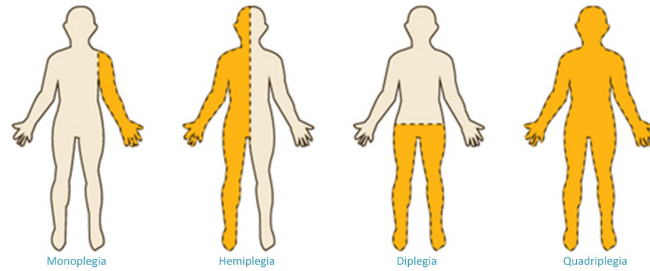


stretching of muscles is caused by the sudden jerks and vibrations which creates stress to the users having the kyphotic posture and C curve posture.

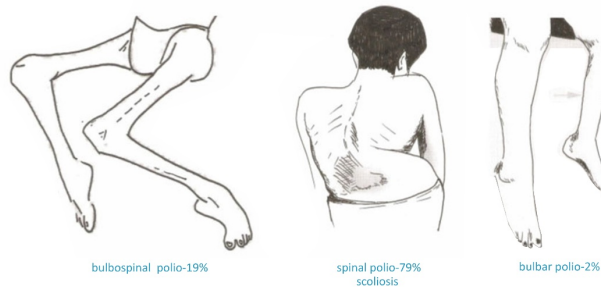




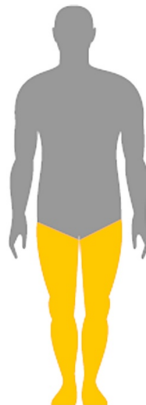
## Cerebral palsy



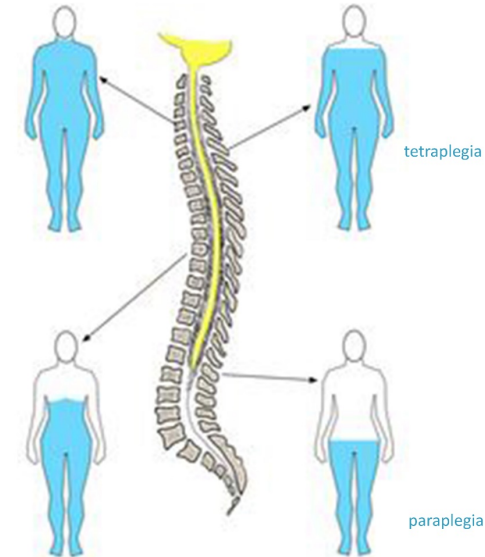
## Poliomyelitis(Paralytic)



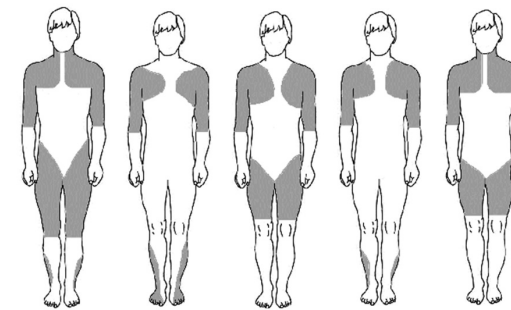
## Lower limb amputation (bilateral)



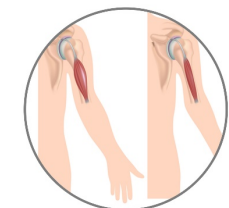
## Paraplegia/Tetraplegia



## Muscular dystrophy



main areas of muscle weakness in different types of dystrophy

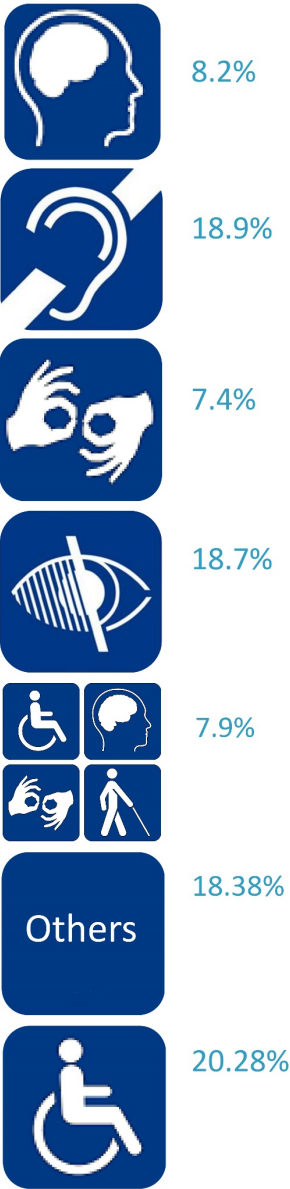
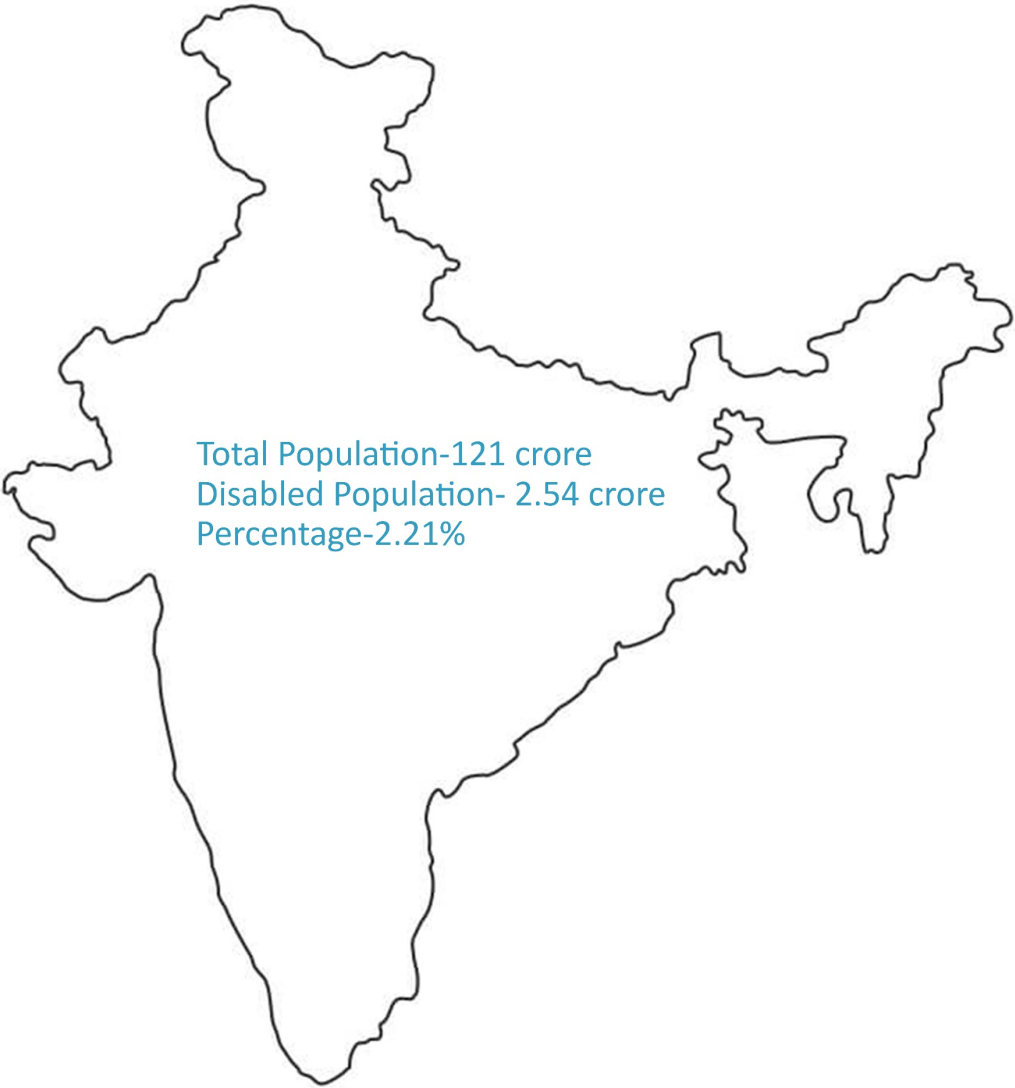


normal biceps muscular dystrophy





Source: Census 2011





### Poliomyelitis(Paralytic)



bulbospinal polio-19%

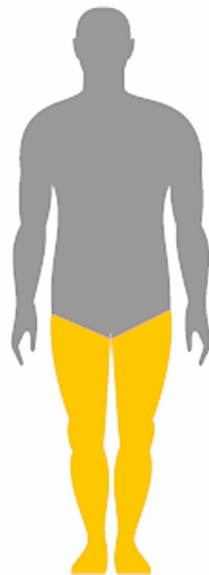


spinal polio-79%  
scoliosis



bulbar polio-2%

### Lower limb amputation (bilateral)



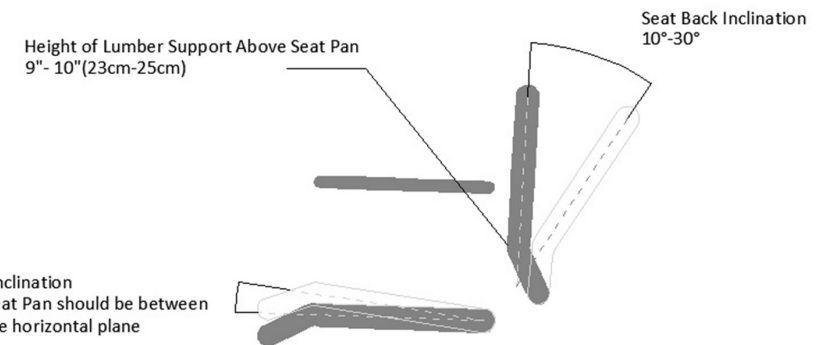
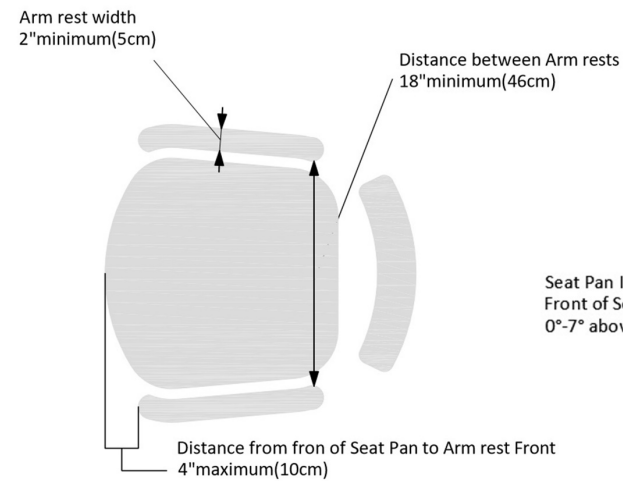
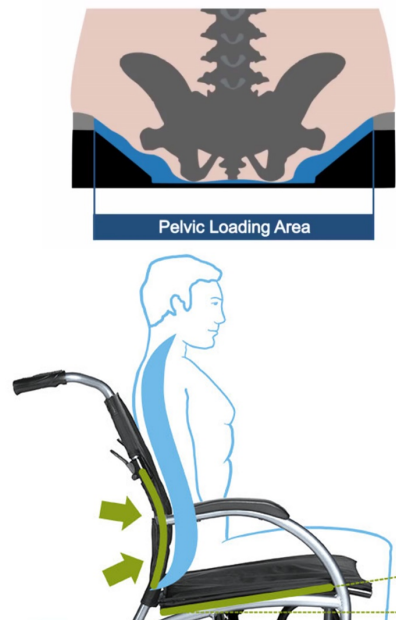
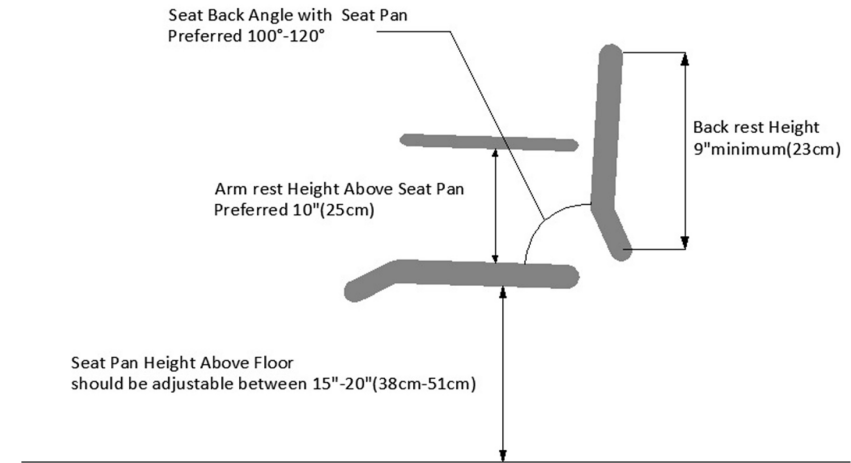
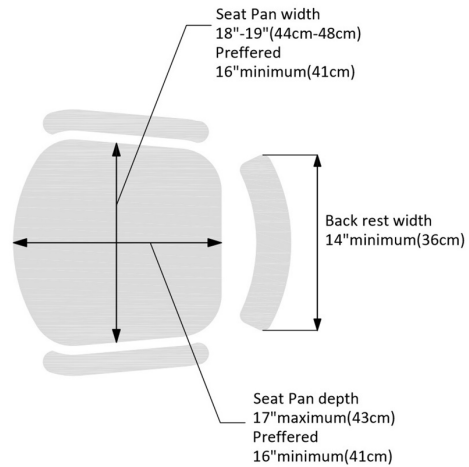
### Elderly people

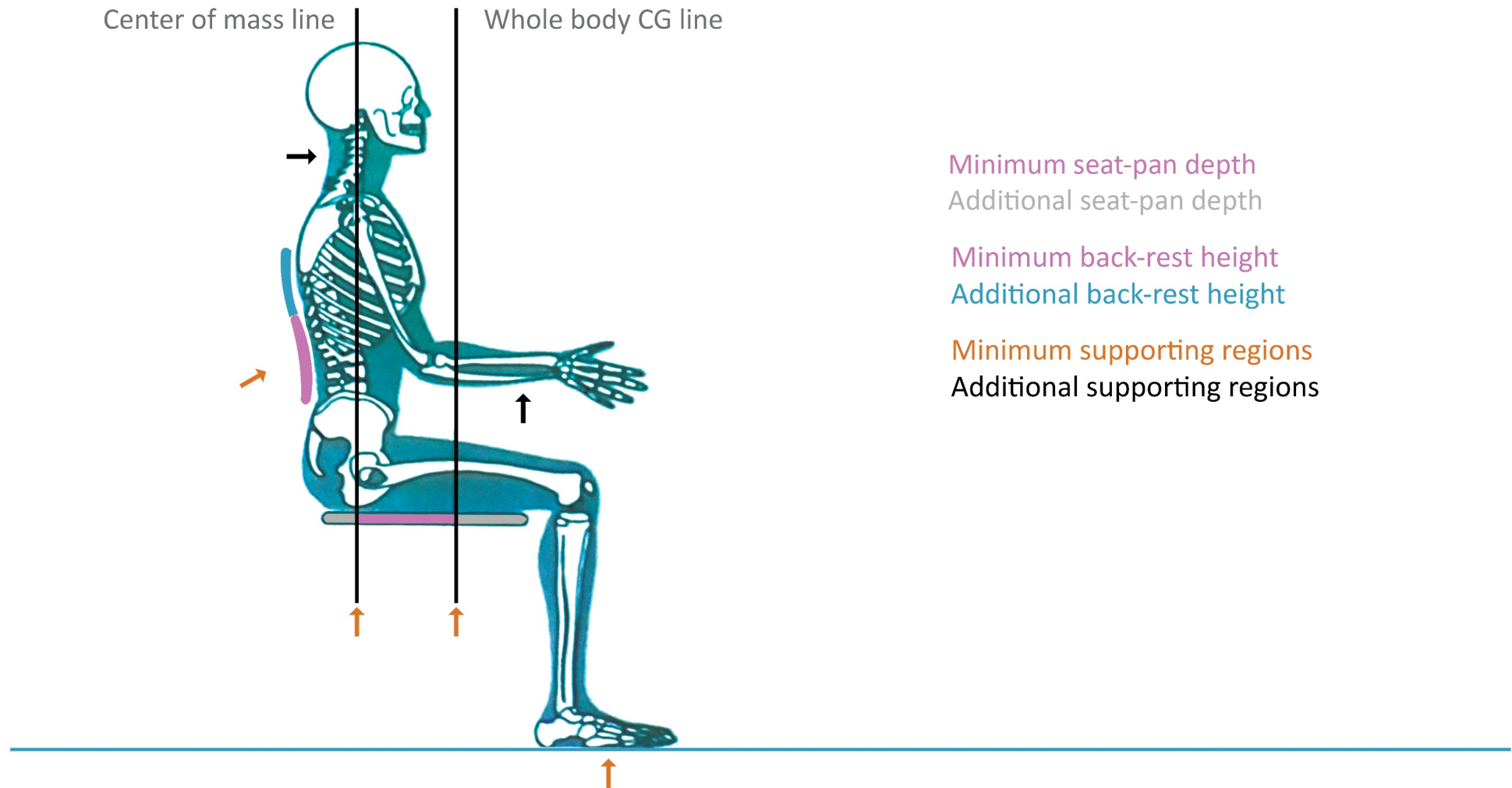




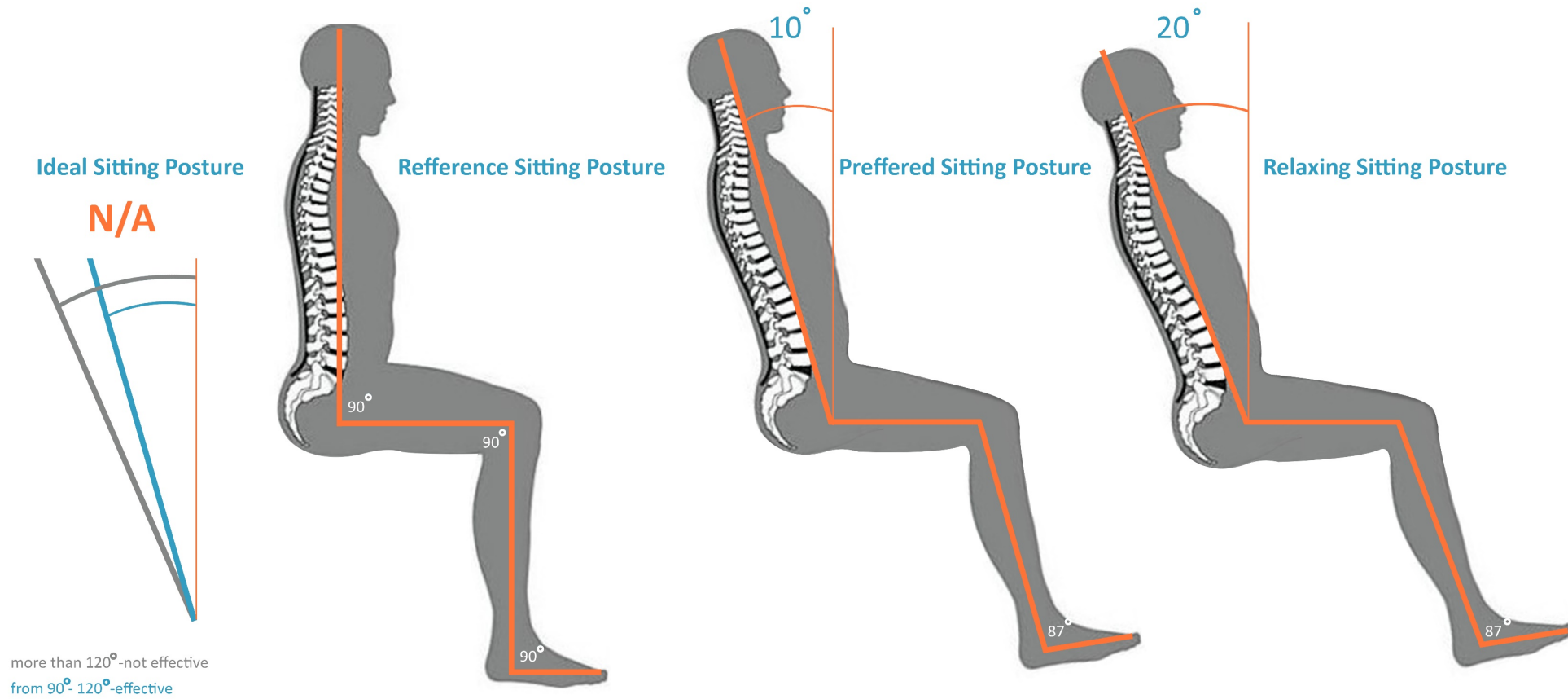


| Selected Structural Body Dimensions (cm) |                    |                     |
|------------------------------------------|--------------------|---------------------|
| Body Features                            | 95 Percentile Male | 5 Percentile Female |
| Height                                   | 185                | 150                 |
| Sitting Height, erect                    | 97                 | 79                  |
| Sitting Height, normal                   | 93                 | 75                  |
| Knee Height                              | 59                 | 46                  |
| Elbow-Rest Height                        | 49                 | 36                  |
| Thigh-Clearance Height                   | 30                 | 18                  |
| Buttock-Knee Length                      | 18                 | 10                  |
| Buttock-Knee Length                      | 64                 | 52                  |
| Buttock-Popliteal Length                 | 55                 | 43                  |
| Elbow to Elbow Width                     | 51                 | 31                  |
| Seat Width                               | 40                 | 31                  |











To redesign a lightweight wheelchair (Weight reduced by 30%) so that it can enhance the comfort level of users in day to day life activity with the ease in manoeuvrability. Following points are also taken forward for the user-cantered design:

Foldability-Reduced volume after folding  
Portability-Easy Transportation

**The challenge** lies in making the innovation scalable on a mass manufacturing level.

This is because of the increase in NGOs requirement of low production cost of wheelchairs for their strategic **CSR initiatives**.



After studying the inspirations Following are the keywords for explorations for the best user-centered design of wheelchair.

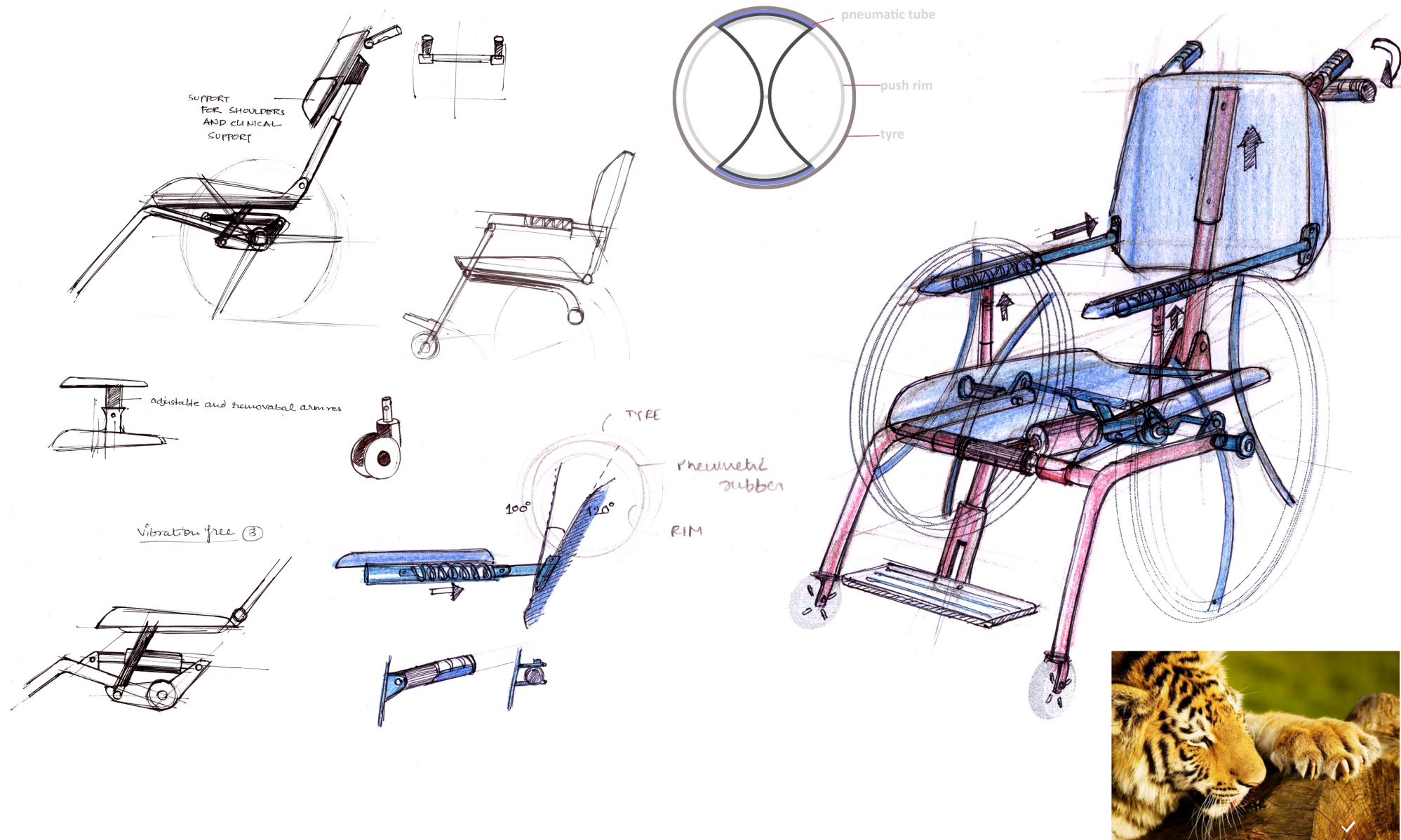
TOUGH  
PORTABLE  
RESILIENT





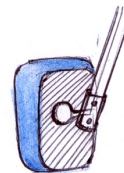
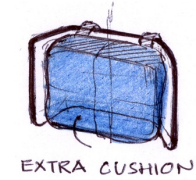
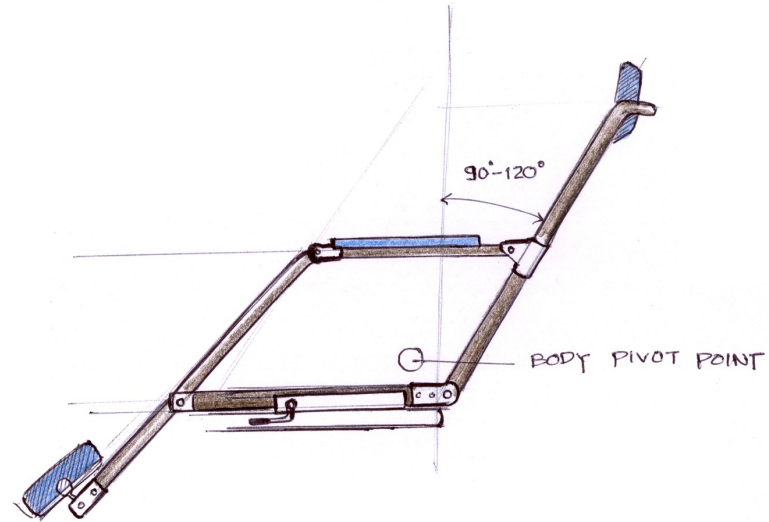
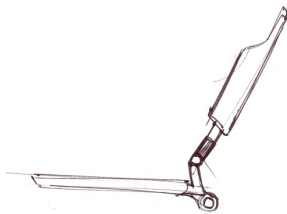
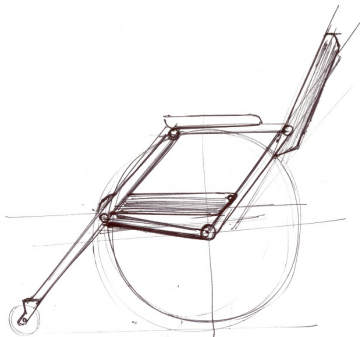
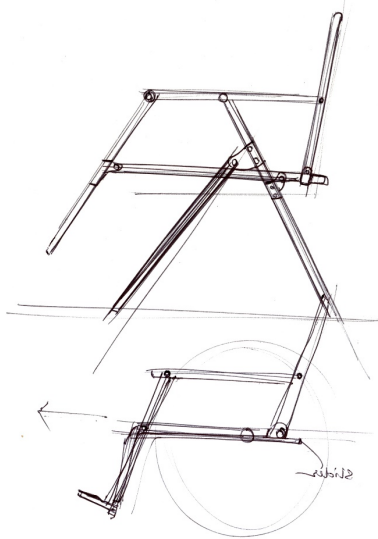


1

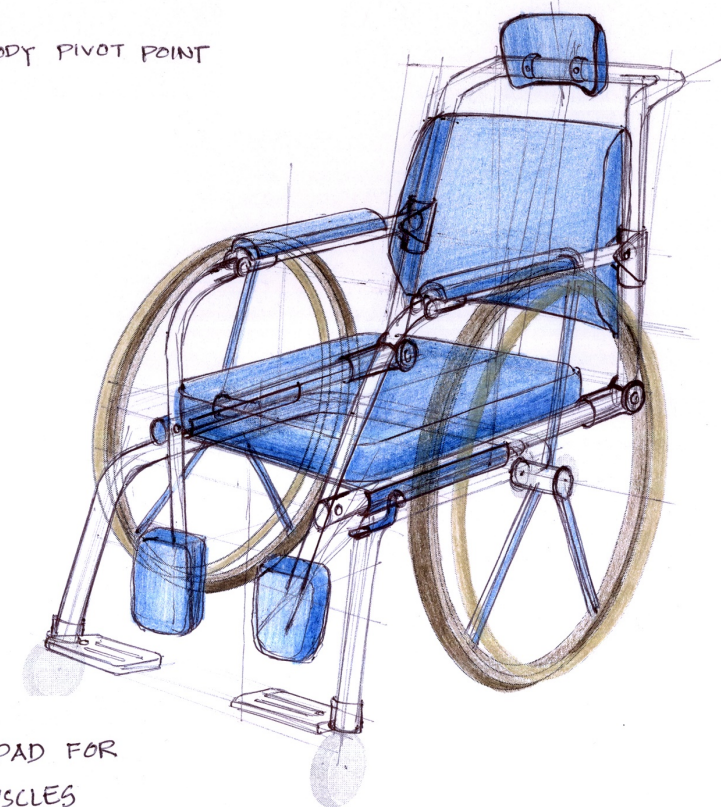




2



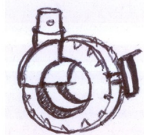
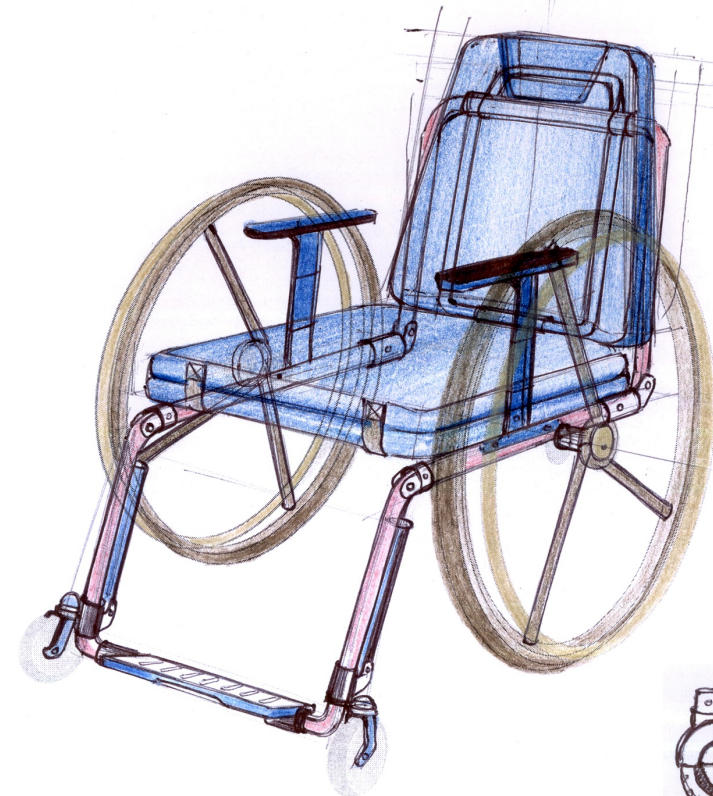
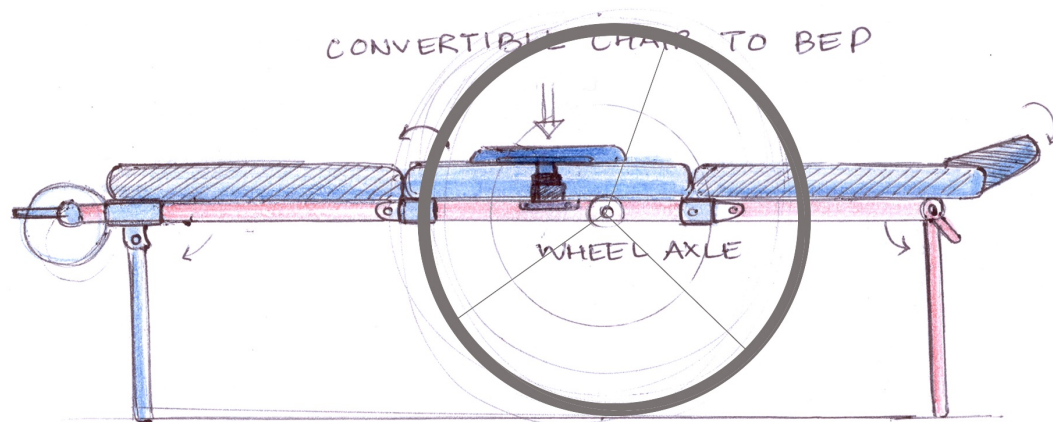
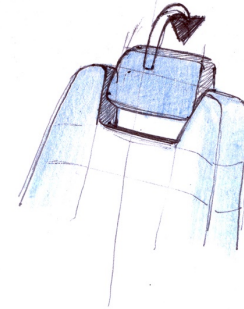
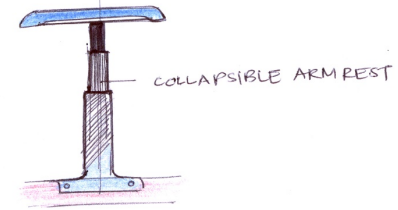
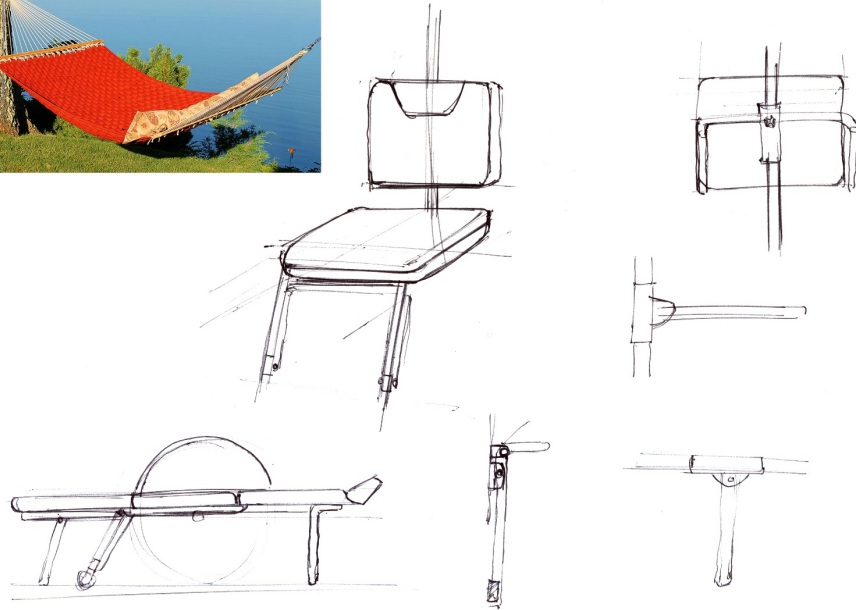
SWIVEL PAD FOR  
CALF MUSCLES







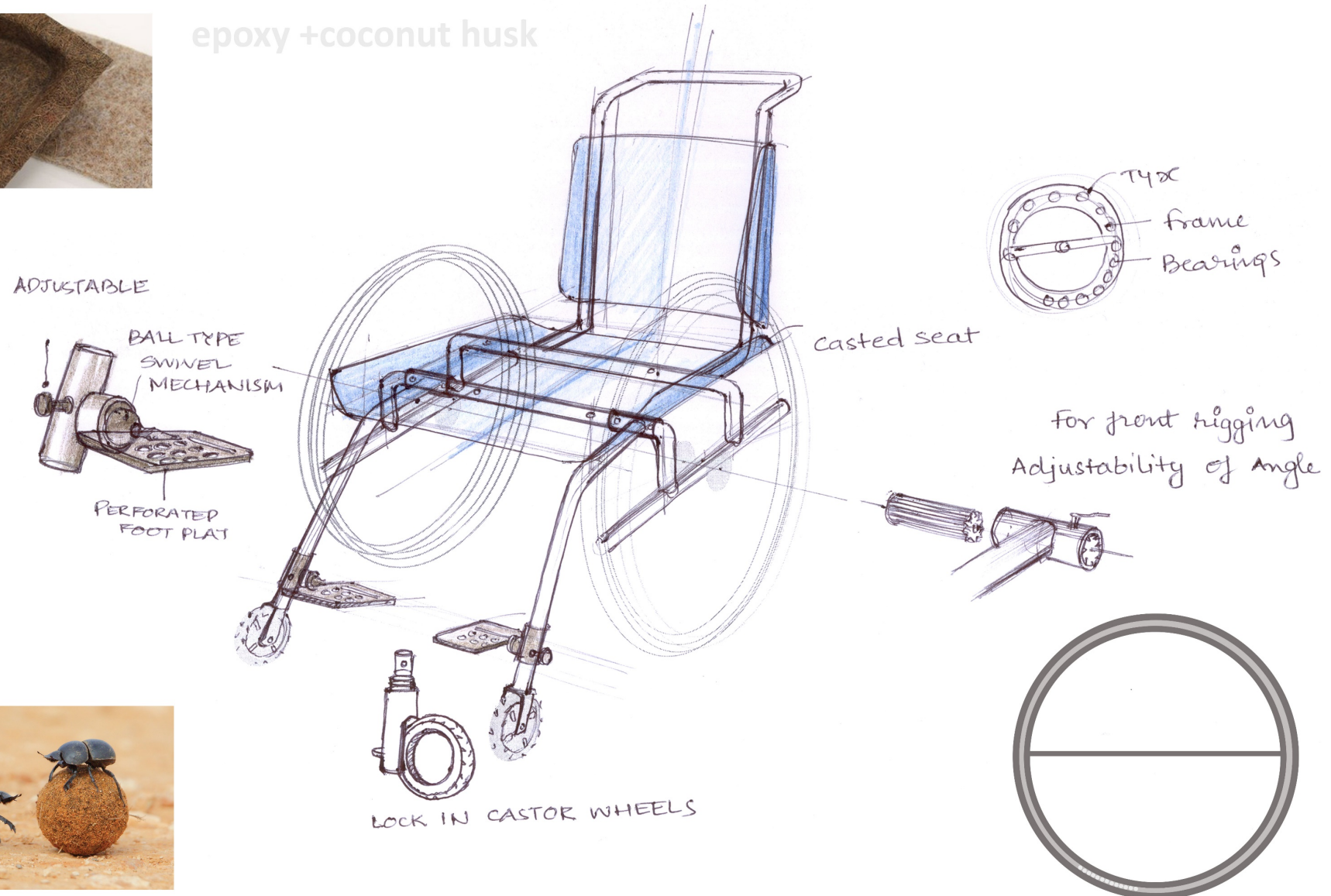
4

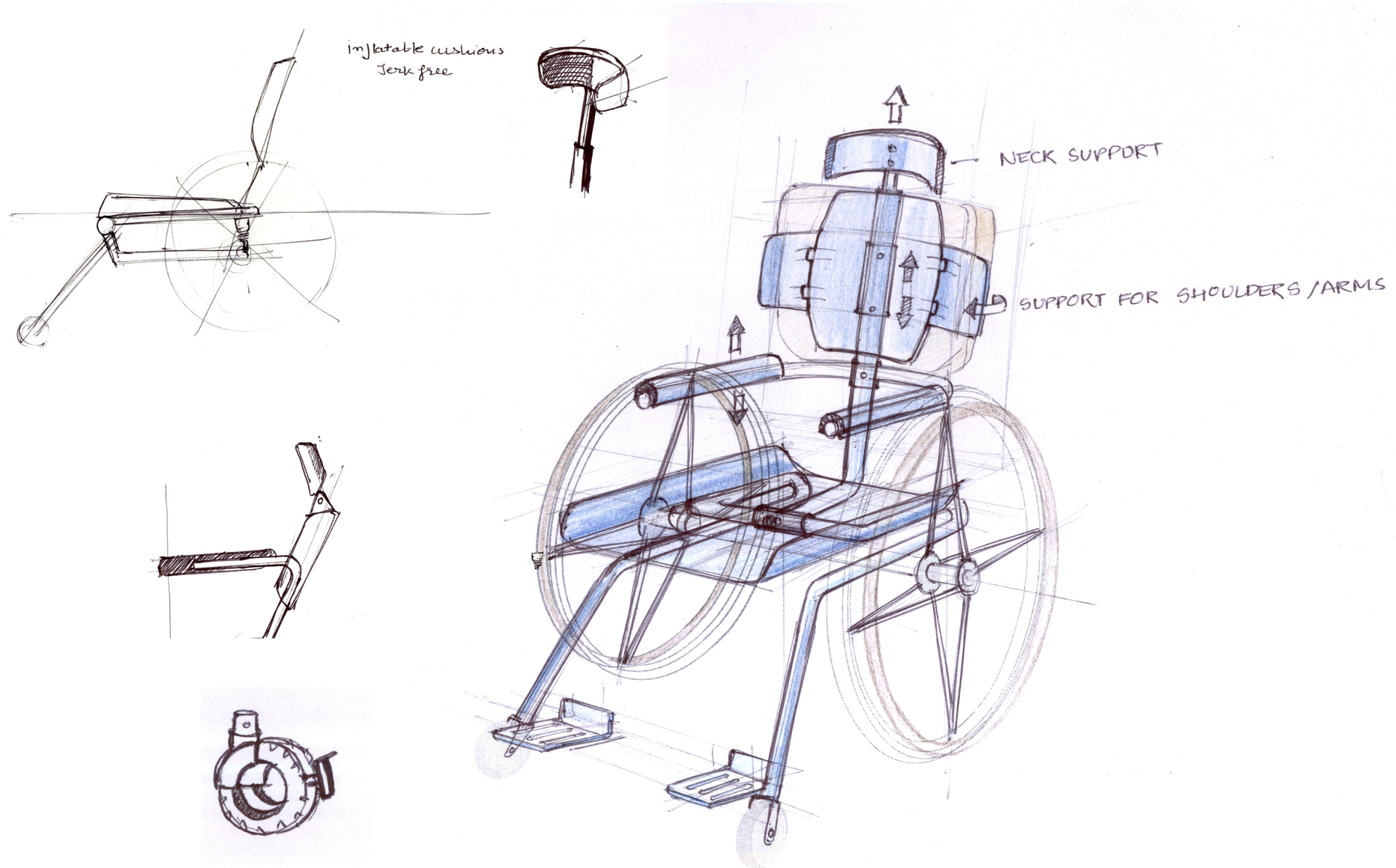
convertible bed



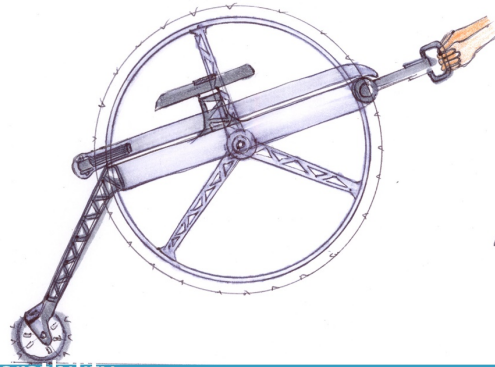


epoxy + coconut husk



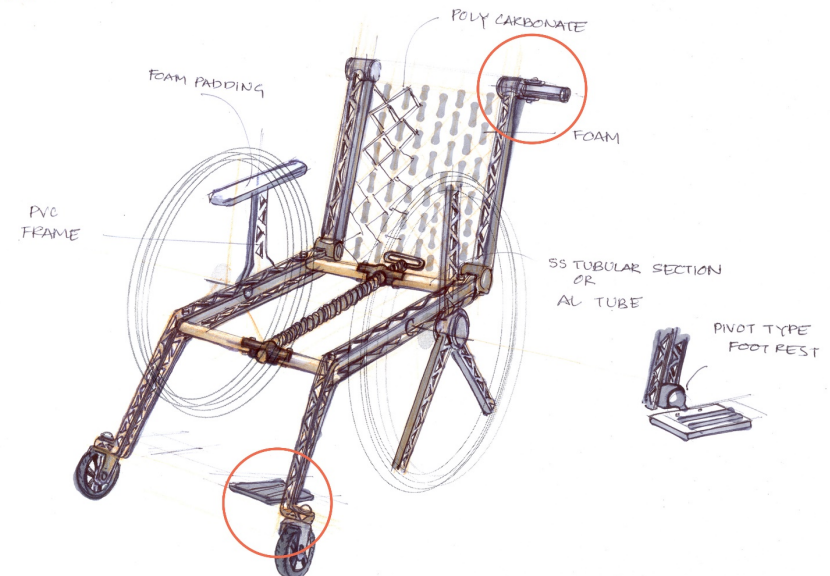
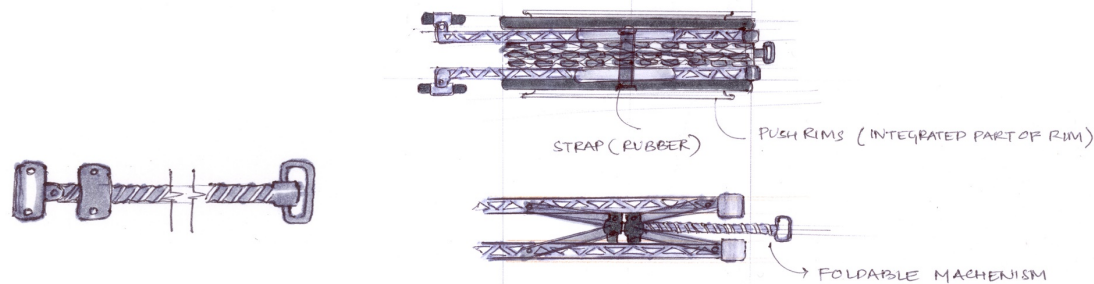
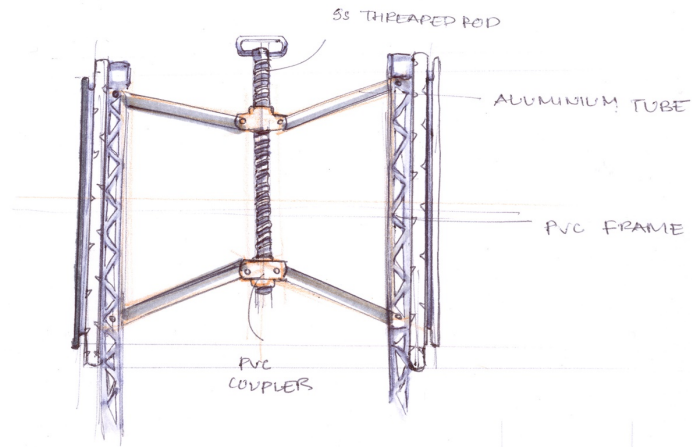
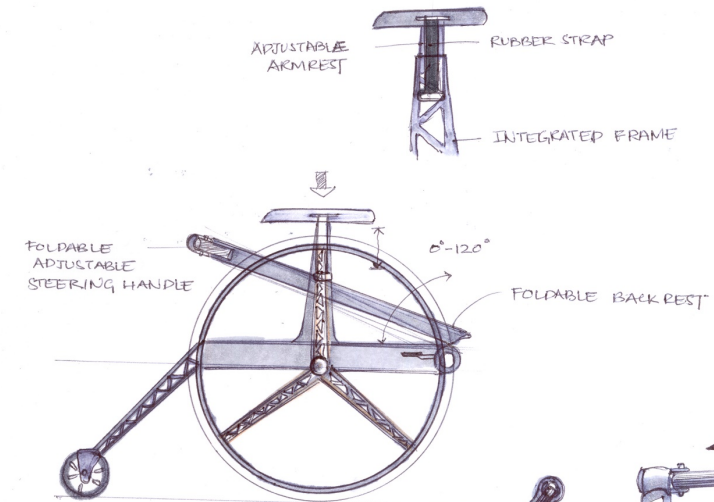
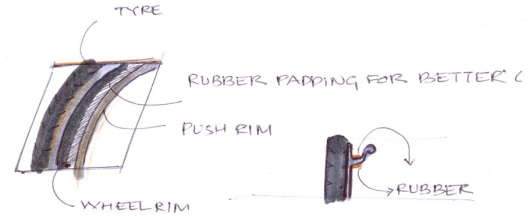




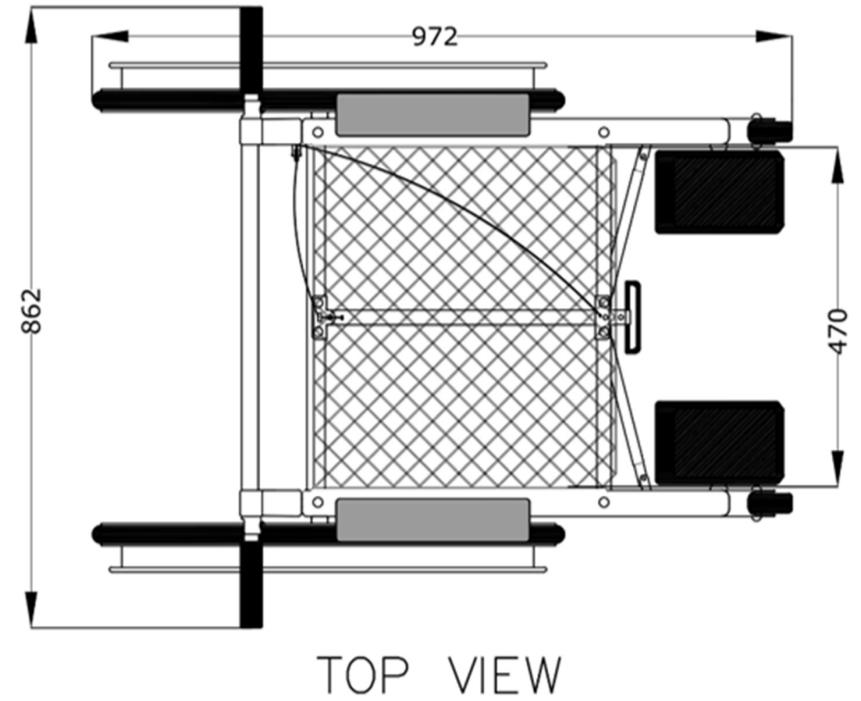
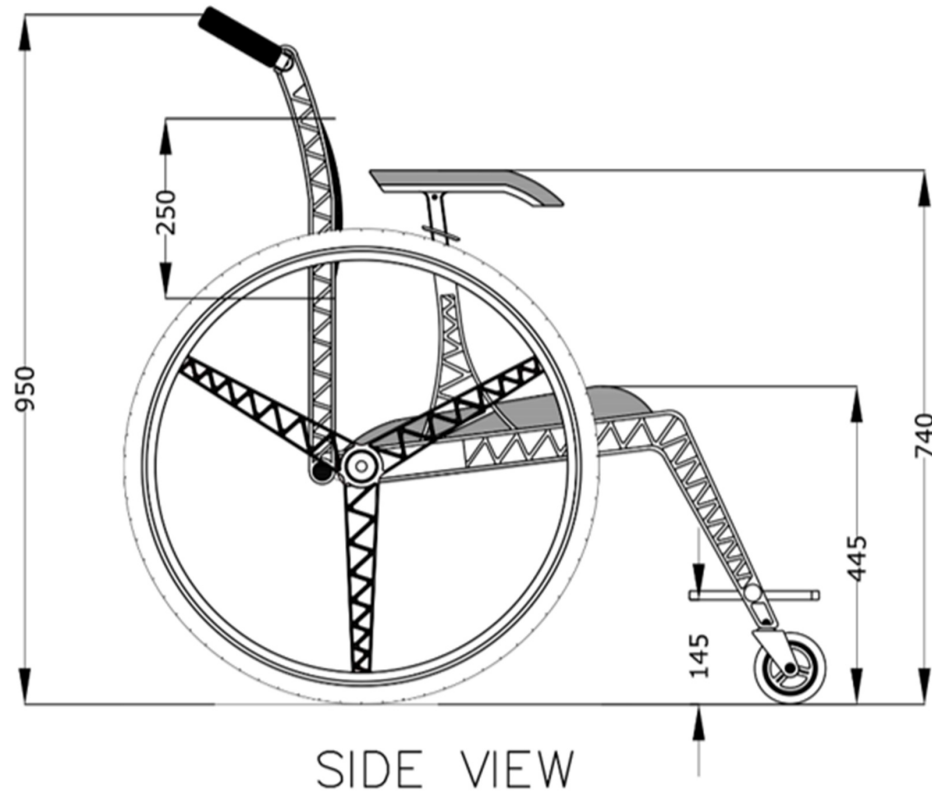


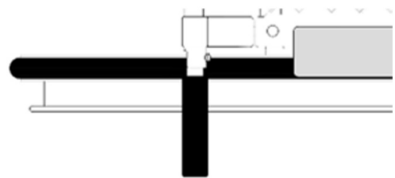
transportability

foldability

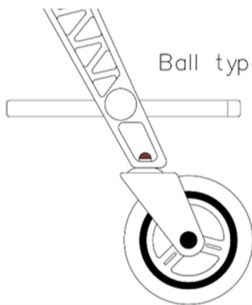
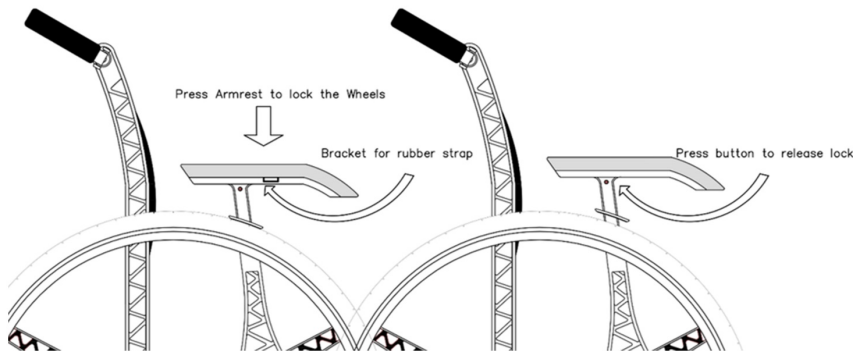




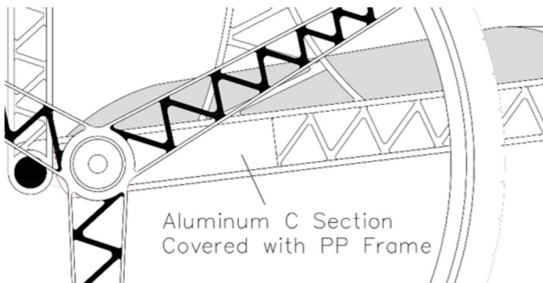




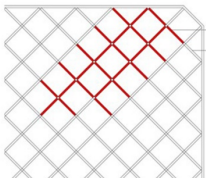
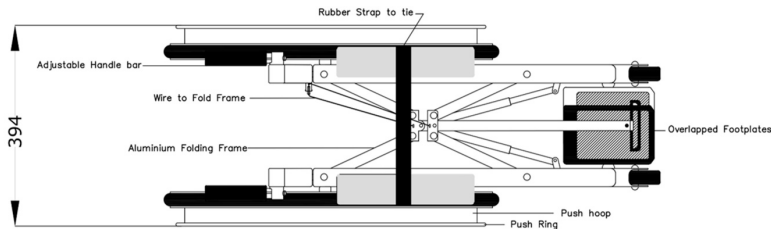
Adjustable Steering Bar



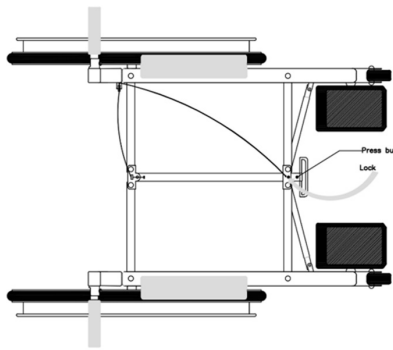
Ball type pivot (swivel type) foot plate



Aluminum C Section Covered with PP Frame



Foam Lining  
Polycarbonate foldable structure



Press button to fold the Wheelchair  
Lock

