DESIGNING OF WHEELCHAIR FOR CEREBRAL PALSY PATIENTS

MOBILITY & VEHICLE DESIGN PROJECT III

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CEREBRAL + PALSY *(AFFECTED PART OF BRAIN +LACK OF MUSCLE CONTROL)*

Cerebral palsy (CP) is a group of permanent movement disorders that appear in early childhood. Signs and symptoms vary among people. Often, symptoms include poor coordination, stiff muscles, weak muscles, and tremors. There may be problems like:

sensation
vision
hearing
swallowing
and speaking



SPASTIC

- The most common form of CP
- Muscles feel stiff and tight



DYSKINETIC

- Characterised by involuntary movements (i.e. out of a person's control)

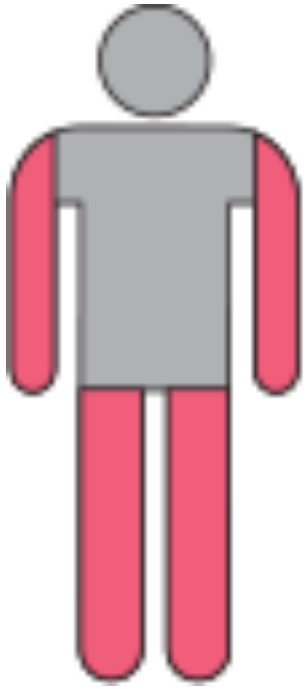


ATAXIC

- Characterised by shaky movements
- Affects balance and sense of positioning in space

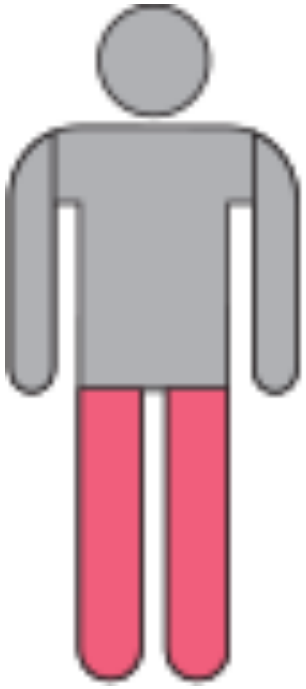


MIXED TYPE



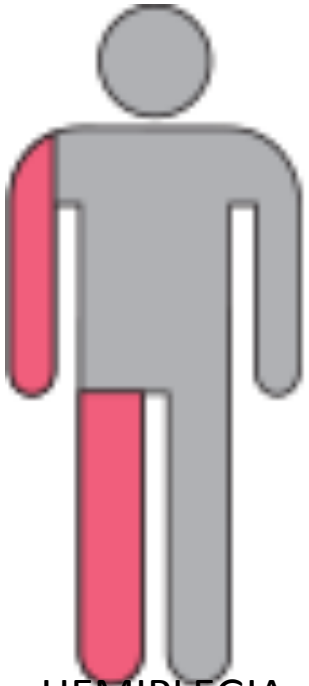
QUADRIPLEGIA

Both arms and legs are affected.
The muscles of the trunk, face and mouth are often also affected.



DIPLEGIA

Both legs are affected.
The arms may be affected to a lesser extent.



HEMIPLEGIA

One side of the body (one arm and one leg) is affected.

ORGANIZATION: at a glance

संज्ञा संबर्धन संस्था

SANDNYA SANWARDHAN SANSTHA

[A Research Institute For The Development and Rehabilitation of Mentally Handicapped]
Registered Office-Near Orange City Hospital,Sawarkar Nagar Bus Stop Khamla Road,Nagpur-440015
Sandnya Srushti,P-14,M.I.D.C. Butibori-441122,Ph.-07103-262174
E-mail:sss_mr@rediffmail.com Web:www.sandnya.org

Kalpataru special school:

Staff: 48 (teaching and non-teaching)
Number of Children: 93
Timing: Monday to Saturday 10:00 am to 4:00 pm

Sections:

Care Group
Pre-Primary
Primary
Secondary
Custodial-Less IQ (severe)
Autistic-Less Social Interaction , Repetitive Behaviour

ACTIVITIES : Kalpataru Special School









Alighting from buses: 10:00 am to 10:30 am
Morning prayer(Ground): 10:30 am to 11:00 am
Classroom activities: 11:30 am to 12:30 pm









Lunch (For mild CP): : 12:30 pm to 01:00 pm
Lunch (For severe CP): : 12:30 pm to 01:10 pm
Physiotherapy: 01:10 pm to 02:30 pm
Yoga: 02:30 pm to 03:30 pm
Evening prayer(Ground): 03:30 pm to 04:00 pm

OBSERVATION : At Kalptaru Special School





Due to the absence of neck support the patient is not able to sit properly in the ideal posture.





All the times in day time activities they need help of escorting member.



Lack of torso support, to make the patient stable and for being in the normal posture they tied the patient with a piece of cloth.



Each and every patient need the escorting member to ensure that they could able to sit properly.



In all day time class activities they need the special treatments. Even for the standing posture some of them need proper and all time support to stand properly.



In class activities, Proper surveillance is needed to happen each and every activities according to the schedule.



Classroom activities





Attendee with the patient while going to the toilet.



The supports for the leg so that legs can not be deformed.





The supports for the leg so that legs can not be deformed. But the adjustability to the foot plates are not built as per need.



Even adult size wheelchair are used there for the child patient. It is so disastrous for the child. It is not meant for these patients. There can be more issues regarding ergonomics.





If we talk about issues generated because of lack in ergonomics considerations. The chairs of classrooms are not properly manufactured.

NECESSARY SUPPORTS:







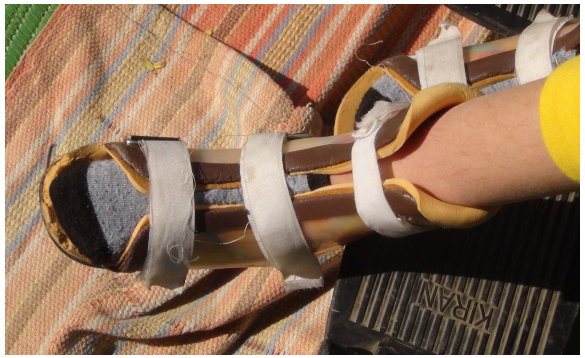




Condition of necessary supports which are not designed as per standard specifications.



Attendant with the patients during morning prayer.



Necessary support for leg which are not designed as per standard specifications.

OBSERVATION STUDY : kosmocare junior wheelchair



The calf support is not supporting the calf muscles properly.



Lack of support to the arms and palms.

OBSERVATION STUDY : kosmocare junior wheelchair









Too many operations to manage the patient on this wheelchair.

The supports are not designed or placed according to the ergonomic considerations.

Neck rest and head rest are not suitable for the neck of patient.

The dimensions of footrests are not matched with the patients need.

The height adjustability in wheelchair is not functional.

EXISTING WHEELCHAIR : At Kalpataru special school









Castor wheels and the hand grips are not designed according to the ergonomic considerations.

There is a lack of maintenance.

Locally Manufactured.

EXISTING WHEELCHAIR : At Kalpataru special school





Condition of wheelchairs at the school is not so good.

Because of foldability it needs a extra support which can be cushioned pillow.

INFRENCES :

Consuming to much time while boarding and deboarding

Problems in transferring the patient

Lack of necessary supports in existing wheelchairs

Much efforts to handle patient

Non Availability of Proper Wheelchair according to need

Lack of maintenance to existing wheelchair

Unfulfillment of needs for Individuals

Locally manufactured Wheelchairs without any ergonomic considerations.

DESIGN AUDITING :

To understand-

Specifications

Performance standards

User requirements

Ergonomic Considerations

Number Of Operations

Safety measures

Kosmocare Junior Wheelchair



SIDE

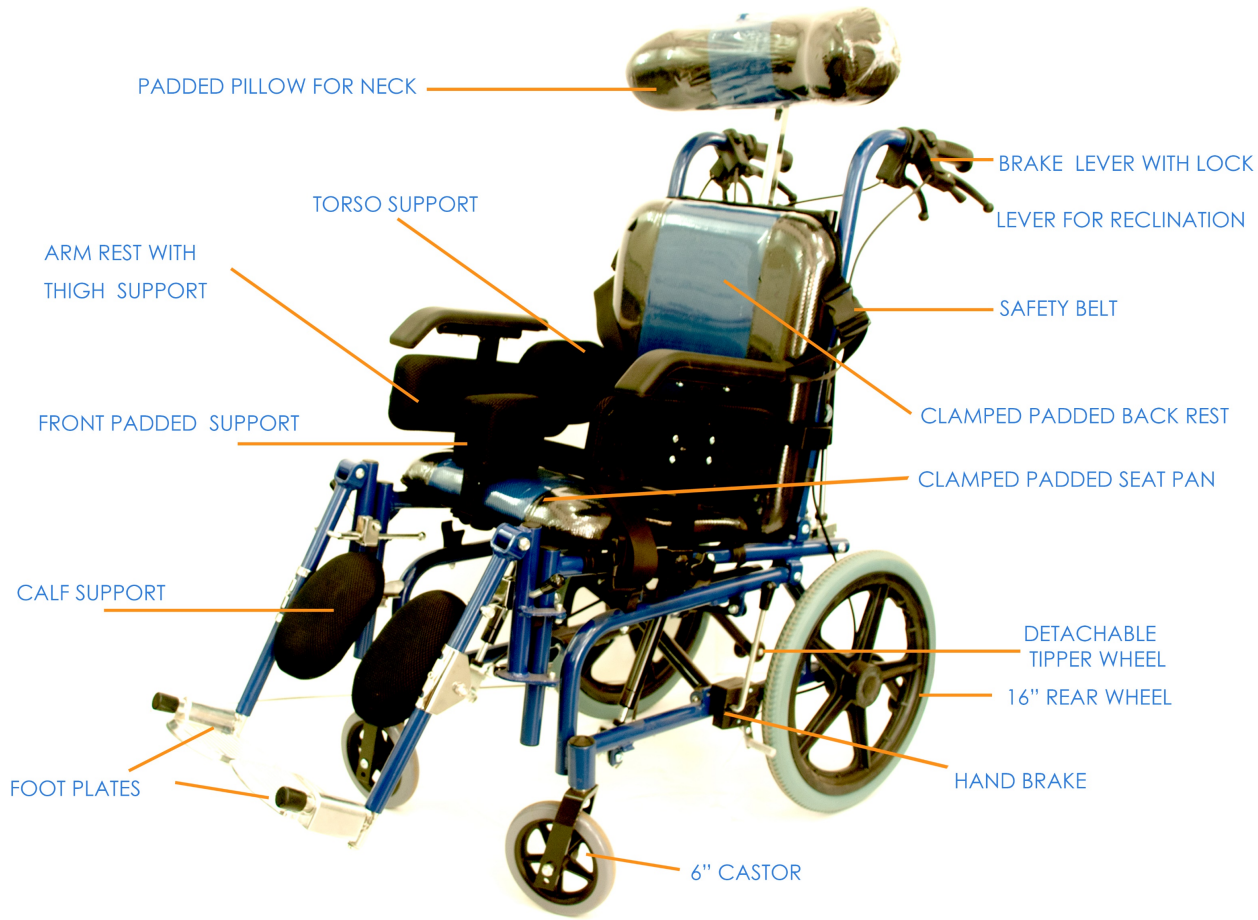


REAR

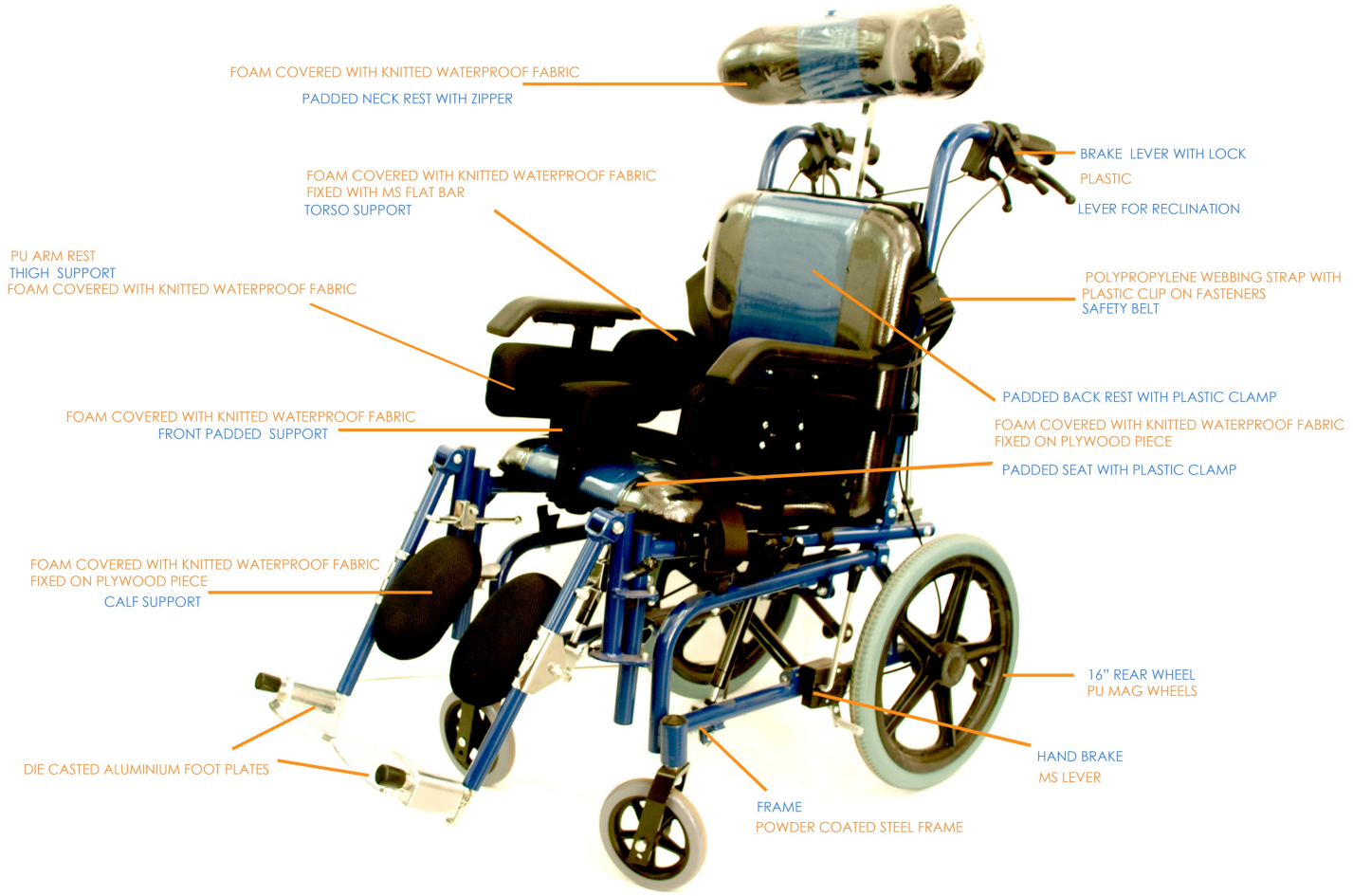


KOSMOCARE RECLINER JUNIOR

ANATOMY :


PADDED PILLOW FOR NECK
BRAKE LEVER WITH LOCK
LEVER FOR RECLINATION
TORSO SUPPORT
ARM REST WITH
THIGH SUPPORT
SAFETY BELT
CLAMPED PADDED BACK REST
FRONT PADDED SUPPORT
CLAMPED PADDED SEAT PAN
CALF SUPPORT
DETACHABLE
TIPPER WHEEL
16" REAR WHEEL
HAND BRAKE
FOOT PLATES
6" CASTOR

MATERIALS :


FOAM COVERED WITH KNITTED WATERPROOF FABRIC
PADDED NECK REST WITH ZIPPER
FOAM COVERED WITH KNITTED WATERPROOF FABRIC
FIXED WITH MS FLAT BAR
TORSO SUPPORT
PU ARM REST
THIGH SUPPORT
FOAM COVERED WITH KNITTED WATERPROOF FABRIC
FOAM COVERED WITH KNITTED WATERPROOF FABRIC
FRONT PADDED SUPPORT
FOAM COVERED WITH KNITTED WATERPROOF FABRIC
FIXED ON PLYWOOD PIECE
CALF SUPPORT
DIE CASTED ALUMINIUM FOOT PLATES
BRAKE LEVER WITH LOCK
PLASTIC
LEVER FOR RECLINATION
POLYPROPYLENE WEBBING STRAP WITH
PLASTIC CLIP ON FASTENERS
SAFETY BELT
PADDED BACK REST WITH PLASTIC CLAMP
FOAM COVERED WITH KNITTED WATERPROOF FABRIC
FIXED ON PLYWOOD PIECE
PADDED SEAT WITH PLASTIC CLAMP
16" REAR WHEEL
PU MAG WHEELS
HAND BRAKE
MS LEVER
FRAME
POWDER COATED STEEL FRAME

FUNCTIONS :



HAND BRAKES OPERATION WITH LEVER MANUALLY



LEVER WITH BRAKE LOCK ASSEMBLY





CASTOR WHEEL



REVOLVING CASTER WHEEL



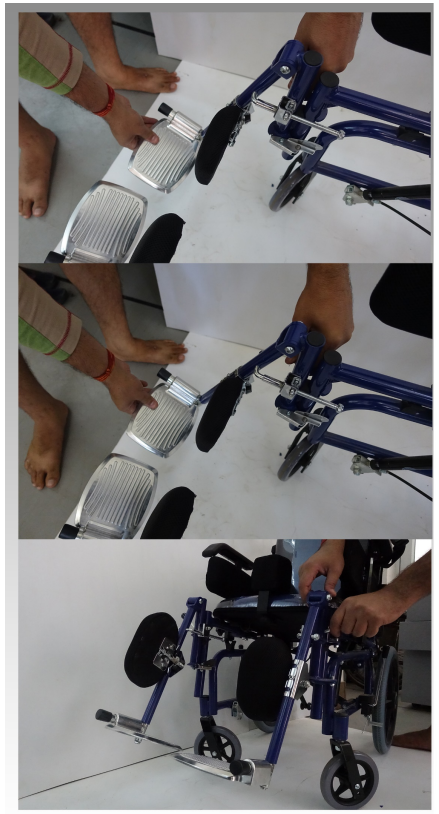


DETACHABLE TIPPER WHEEL





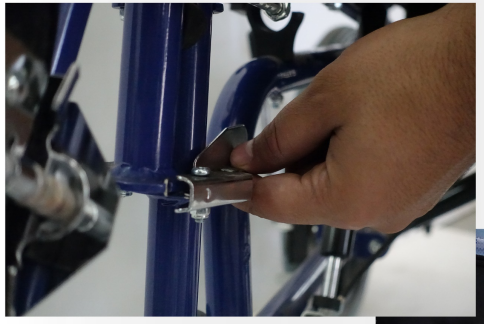
FUNCTIONS



ADJUSTABLE FOOT PLATES



ADJUSTABLE LEG SUPPORT





FUNCTIONS



HIGHT ADJUSTABLE ARM RESTS



ADJUSTABLE NECK SUPPORT

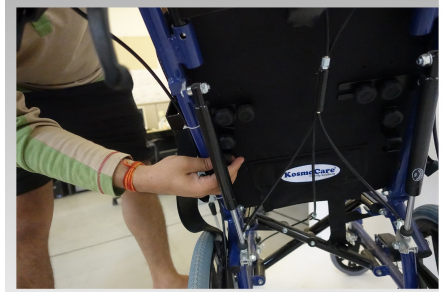




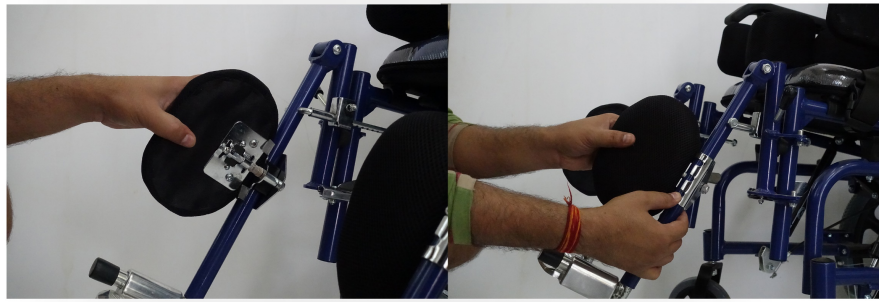
FUNCTIONS



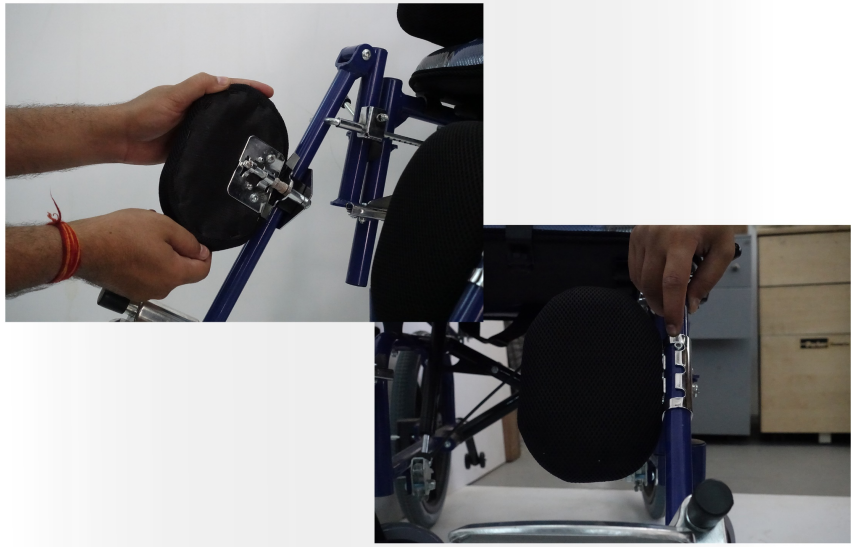
16" PU MAG WHEELS



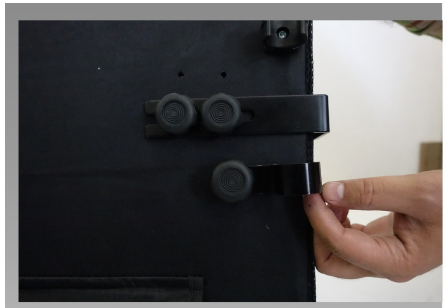
POCKET AT BACK FOR STORAGE



6 WAY ADJUSTABLE CALF SUPPORT



FUNCTIONS



WIDTH ADJUSTABILITY OF TORSO SUPPORT



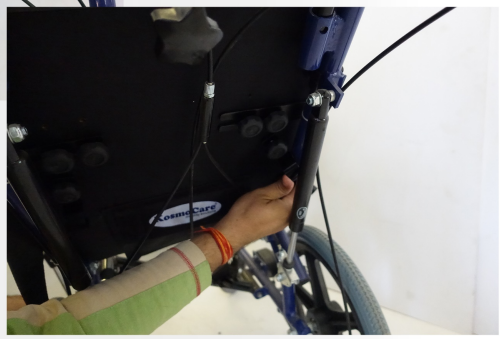
ARM REST WITH ADJUSTABILITY





CLAMP TO HOLD SEAT PAN TO THE FRAME





FUNCTIONS



30 DEGREE BACK REST RECLINATION



30 DEGREE SEAT RECLINATION





SAFETY STRAPS





FUNCTIONS



PNEUMATIC CYLINDERS



SAFETY STRAPS





FUNCTIONS

FOLDABILITY :SCISSOR MECHANISM



FOLDING FRAME



RECLINING CUM ELEVATED VIEW OF FRAME



RECLINING CUM ELEVATED FRAME WITH ELEVATED CALF SUPPORT

FUNCTIONS

OUTCOMES FROM DESIGN AUDITING :

Overdone design

To much operations-not satisfactory

Lack of necessary supports (Footrest, Armrest, Headrest)

Affordability(current wheelchair costs around 20 thousand INR)

Improper placing of calf supports

Neck support needs to be rectified

Balancing of Wheelchair while reclined position

Problems in going back to the normal sitting form reclined positions

Unfulfillment of needs for Individuals

Transportability (weight-19 KGs)

Some parts are designed without ergonomic considerations

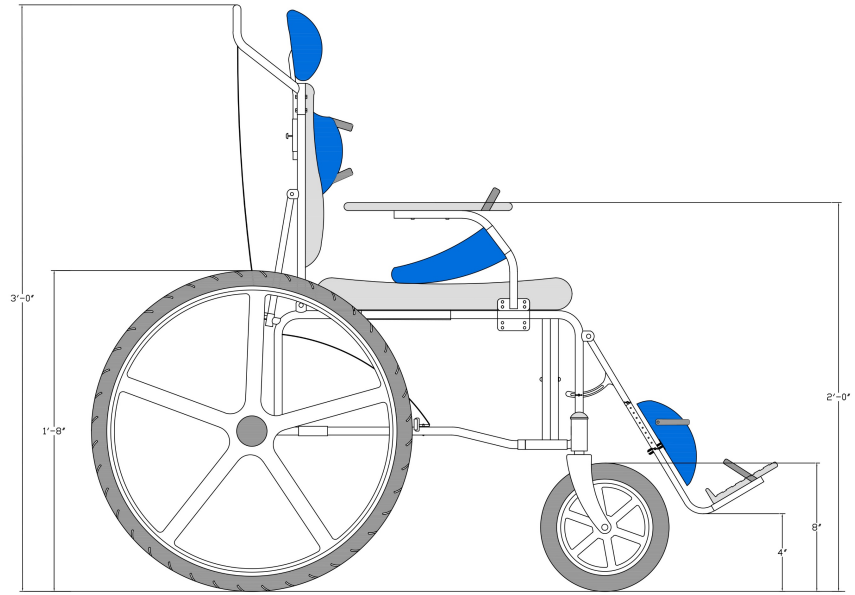
DESIGN BRIEF :

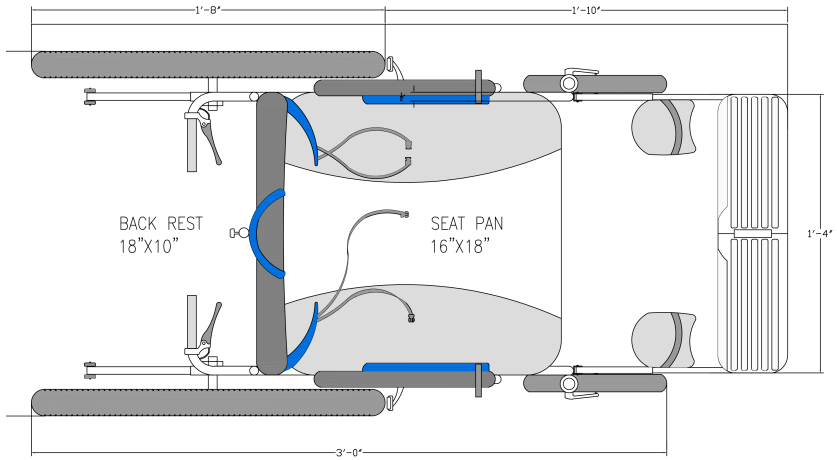
Design a wheelchair for younger CP patients which is sturdy, affordable and light in weight.

The wheelchair design has to fulfil the following requirements:
Foldability with minimum effort.
Less maintenance.

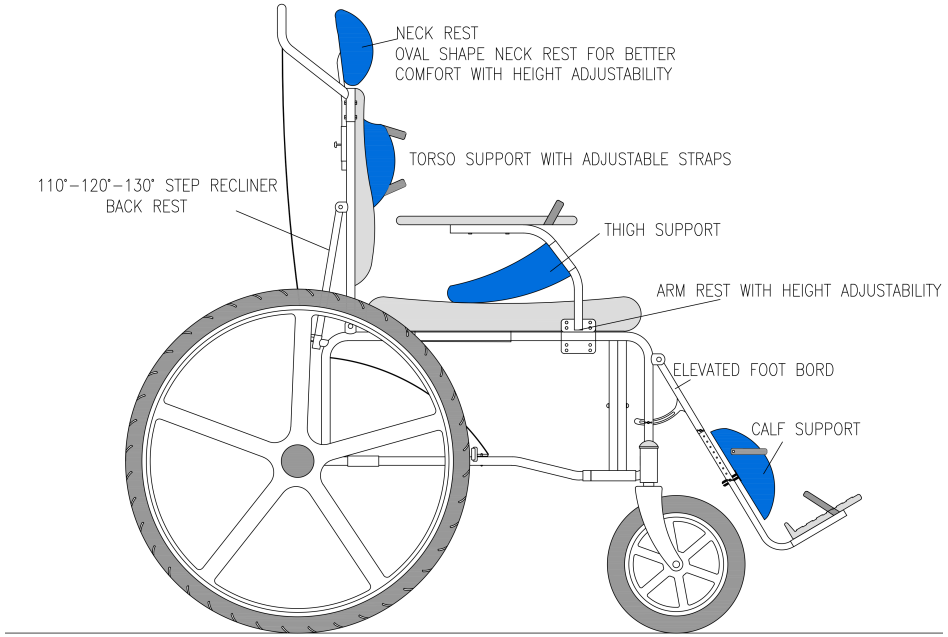
DESIGN APPROACH : By Prototyping

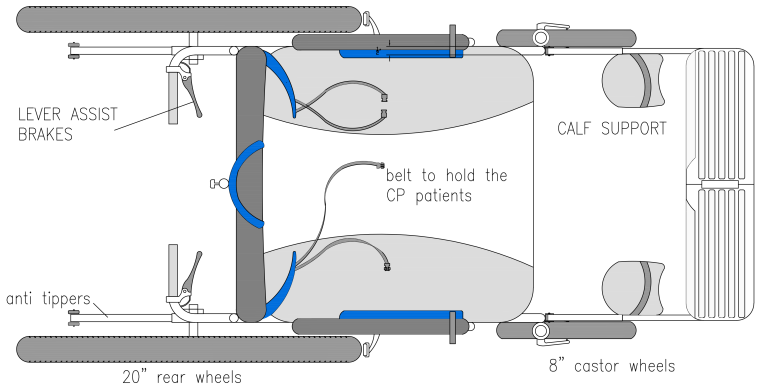
DIMENSIONS BENCHMARKING :



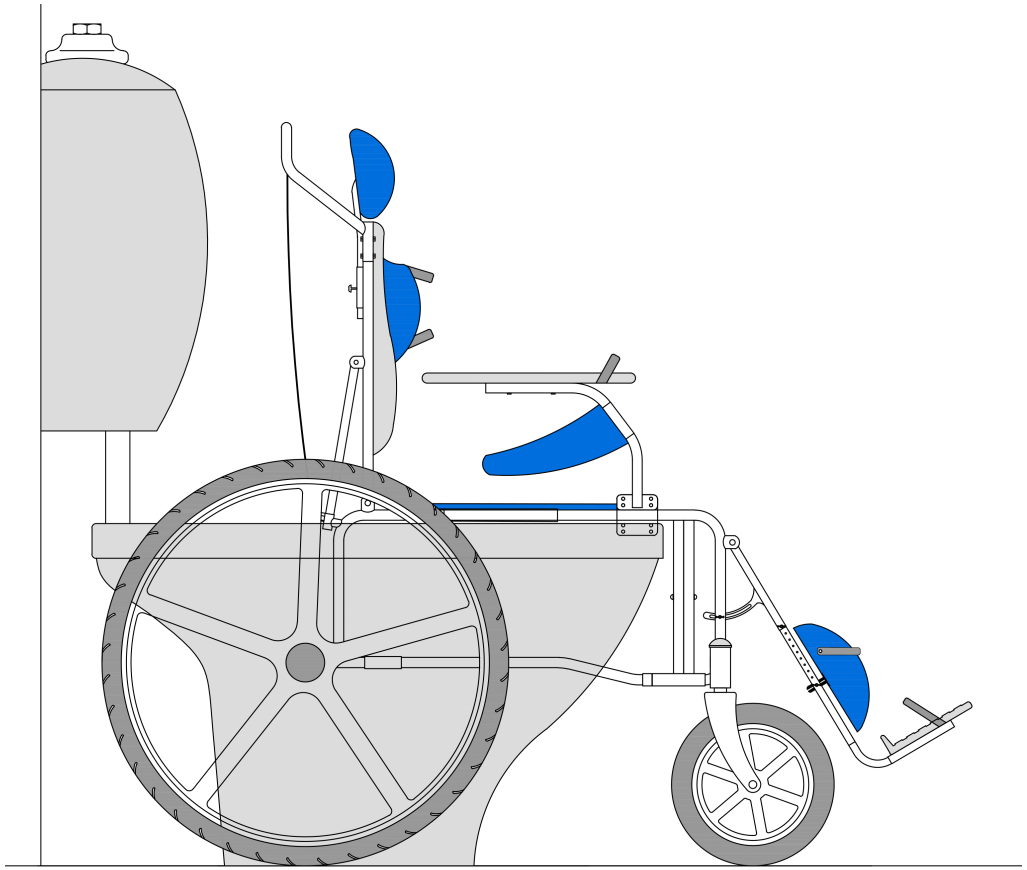


SPECIFICATIONS :





USP :



ACCESSIBILITY

CONCEPT RENDERS:





ALFA PROTOTYPE :







Tilted push handle

Big size main wheels

Adjustable rounded Neck support

HARNESS AND SUPPORTS :



Support for wrist.

Velcro for foot

Front support strap

STEPS TO INGRESS





USP OF THIS PRODUCT :



FOLDABILITY :





After folding it will occupy less space in comparison to the traditional one.

INSIGHTS FROM ALFA PROTOTYPE :

In current design we have to remove the seat pan and back rest away from the main structure which is difficult to handle.

The design of head rest is nor proper. It has to be in oval shape which could provide better comfort and support to the neck as well as head.

The built-in pot for defecation will create hygiene issue.

Need of mudguards on both the rear wheel for safety of patient and the escorting member.

Reclining of back rest is necessary.

BEETA PROTOTYPE :





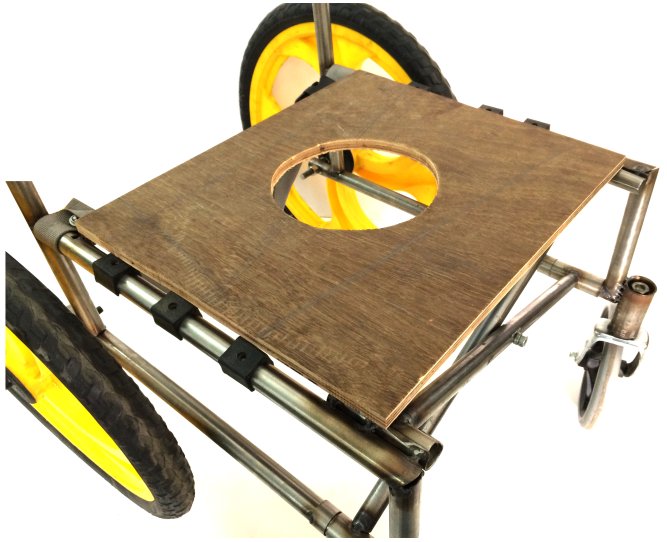
EASY TO FOLD :





Scissor mechanism at the most front part of the structure to make the wheelchair accessible for the Indian seat and WC.





FOLDABILITY :







INSIGHTS FROM BETA PROTOTYPE :

It is better then the first one but there are some issues with the easiness of folding the wheelchair.

There are some issues regarding the aesthetics on which I have to work for final prototype.

The design of head rest is nor proper. It has to be in oval shape which could provide better comfort and support to the neck as well as head.

I have to add all the supports and harnesses to it for the final user testing.

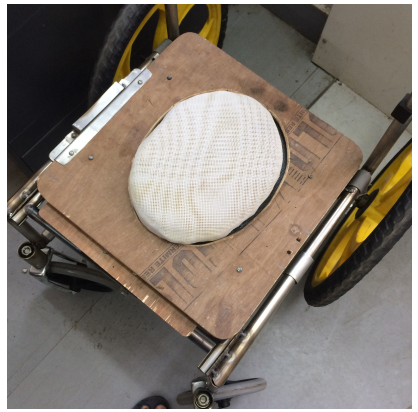
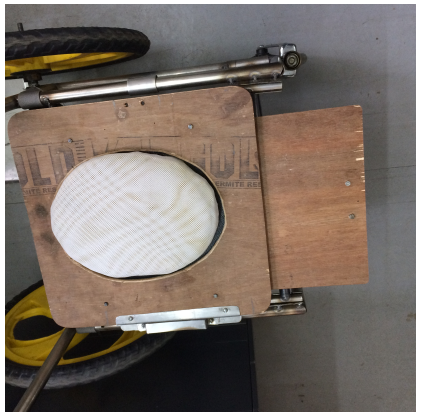
Reclining of back rest is necessary.

In current design we have to remove the seat pan and back rest away from the main structure which is difficult to handle. Now for final product I have to design the seat pan and back rest in such a way so that it can be with the frame after folding.

FINAL PROTOTYPE :






FINAL PROTOTYPE :









FINAL PROTOTYPE :





NEED OF SPECIAL WHEELCHAIR ACCESSIBLE BUS :

The concept of special bus is for the students with multiple disabilities who can not use wheelchair by themselves. They get in to the wheelchair in their home. Their parent carries him to the nearest pick up point. At pick up point their wheelchair itself get hoisted in to the bus. This wheelchair then taken to the specific slot by the bus attendant and gets locked on to the floor of the bus. On reaching the Sandnya Srushti School campus, the wheelchair is taken out with the student seated in it. The student further goes to his class on the same wheelchair and attends the school for the whole day and is back coming back in the evening on the same wheelchair. This whole drill is meant to eliminate the need of physically handling the disabled student. This is to give due dignity to these less fortunate students who are not self advocates.

There are four distinct parts of this special bus to be designed:

Body of the bus
Wheelchair
Floor of the bus with locking device
Wheelchair hoisting in built device(Provision of Ramp/Hydraulically operated)

REQUIREMENTS FOR BUS :

Proposed number of wheelchairs to be accommodated is 14 to 15 nos.

2 seats for attendants

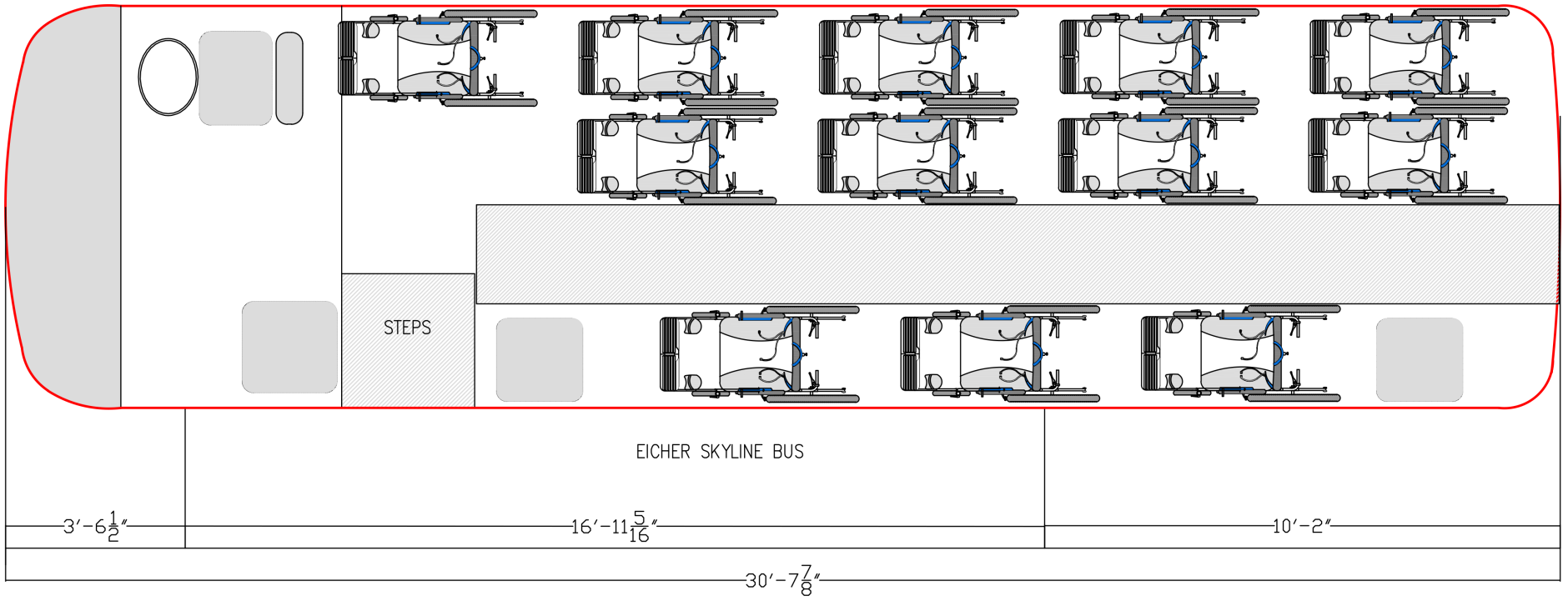
Hydraulic built in platform lowering and lifting arrangement

Space for Fire Extinguisher

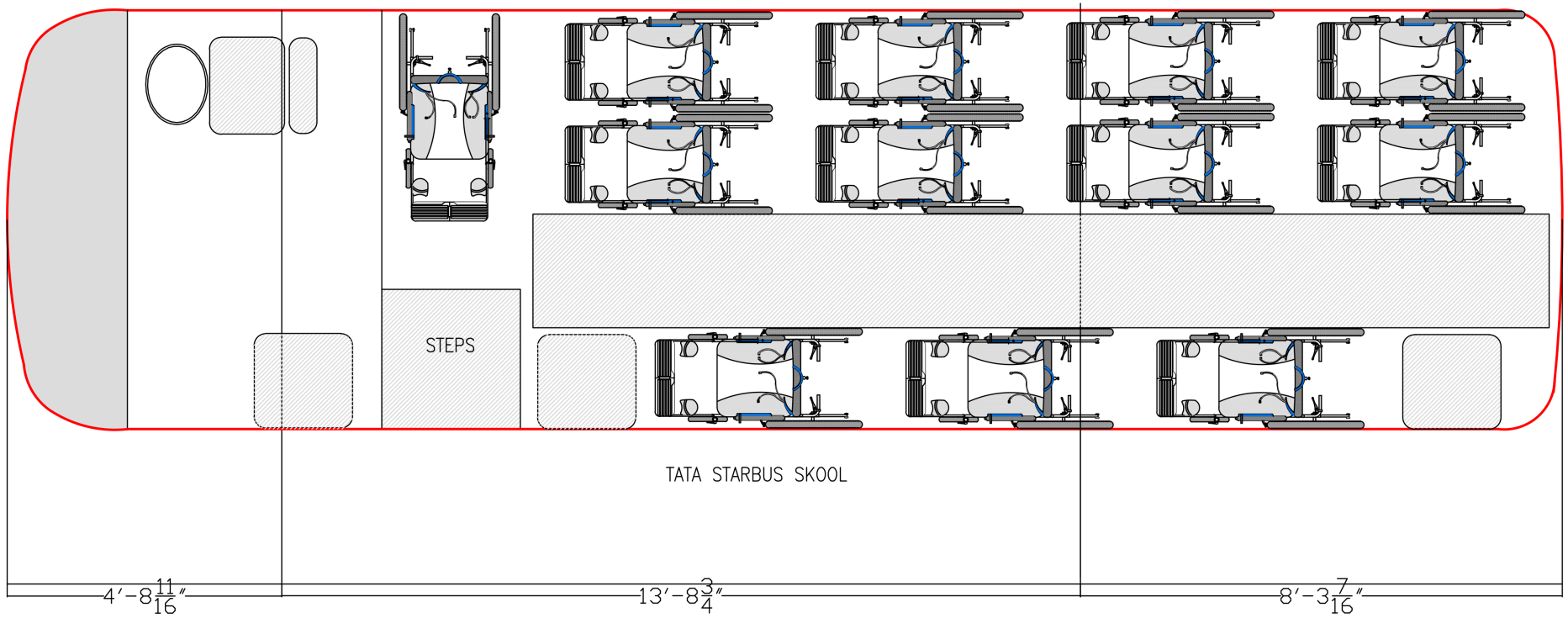
Space for School bags

Emergency Exit door

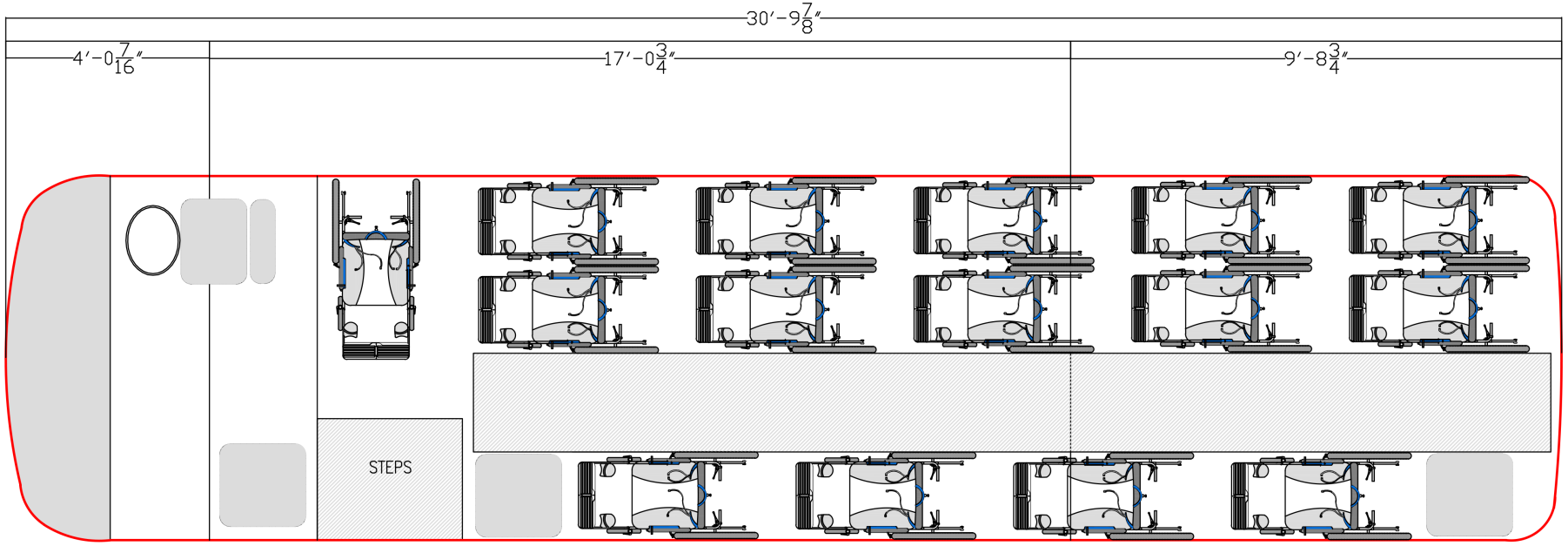
LAYOUT-1 : EICHER SKYLINE BUS



LAYOUT 2 : TATA STARBUS SKOOL



LAYOUT 3 : ASHOK LEYLAND SUNSHINE BUS



ASHOK LEYLAND SHUNSHINE

11.3. EXAMPLES : Fastening devices

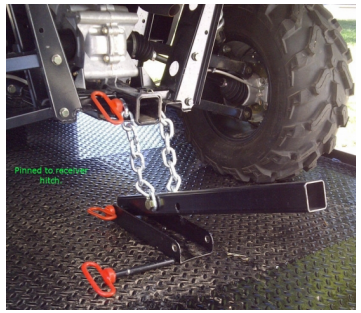


MOBILE PHONE HOLDING DEVICE



PANDROL FASTCLIPS FOR RAILWAY SLEEPER







TRAILER MOUNT REAR HITCH











TRAILER MOUNTED CHOCKS









ADJUSTABLE WHEEL STRAPS



CANTILEVERED ASSEMBLY





FRAME TYPE ASSEMBLY

















STRAP HOLDING ASSEMBLY

EMERGENCY EXIT:





Existing standard type locking device.







Location of Emergency exits in buses in current scenario as per the norms and regulations.