

P3 | Presentation

# Design of Next-Generation AC City Bus for BEST Mumbai Transport

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### Brihanmumbai Electricity Supply and Transport

for several people of Mumbai (Mumbaikers) working or studying, commuting is **slowly shifting to cab or shared taxi**. Opting these alternatives has hit the BEST buses hard. Because of this **privatization in commuting**, 'Mumbaichi BEST' will lose its shine and identity very soon. BEST is another lifeline of Mumbai for public transport.

BEST operates one of India's largest fleets of buses. The bus transport service covers the entire city and also extends its operations into neighboring urban areas. **Around 29 lac people daily in BEST buses in Mumbai**. People want **fast commuting** and **comfort** in travelling. People are ready to pay for quality services.

# Introduction - Brihanmumbai Electricity Supply and Transport



thermal power station in 1905

In 1947, the BEST became an **undertaking of the Municipal Corporation**

**1995 as Bombay being renamed to Mumbai**

1873 as a tramway company called "Bombay Tramway Company Limited".

1905 as Bombay Electric Supply & Tramways (BEST)" Company.

1926 BEST also becomes operator of motor buses.

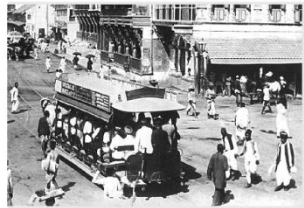
Bombay Electric Supply & Transport (BEST)

Brihanmumbai Electric Supply & Transport (BEST)".



**BEST** Bus Evolution

1874-2019



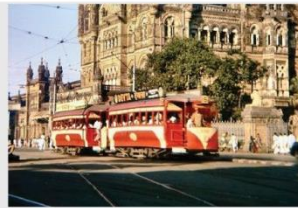
First tram service (horse-pulled):  
May 9, 1874



horse tram services becomes popular in bombay



In 1907, Bombay Electric Supply and Transport Company (BEST) took over and introduced electric trams.



because of high demands of trams, BEST started tram trailer service in 1908 in Bombay



in 1911 american tram was introduced to BEST



Double-decker trams made their debut on Mumbai's streets in 1920



in September 1920, double-decker trams were introduced to deal with the passenger numbers.



in 1924, BEST had its first luxury class double decker tram for upper class people



In 1926, BEST also became an operator of motor buses.



after the trams discontinued by BEST, the cables were still there. so first time Skoda buses were introduced



first motor operated BEST bus started in 15th July 1926.



In 1936, Albion started its first limited stop service for fast service.



In 1937, first single decker bus by Diamler.



In 1939, world war affected automobile too. motor operated double decker bus with open/canvas roof



In 1946, AEC introduced its single decker bus



again in 1946, AEC added double decker bus to BEST bus fleet.



In 1950, GUY introduced its first bus which gave its service till 1954.



In 1954, leyland tiger cub was a lightweight underfloor-engined chassis manufactured by Leyland



in 1955, The Leyland Royal Tiger introduced underfloor-engined heavyweight single deck bus



In 1956, The Leyland Titan introduced a heavy-engined double-decker bus manufactured by Leyland



The Leyland Comet was a long running badge used by Leyland for a series of trucks and buses.



tata mercedes benz bus in 1960



The Leyland Atlantean is a double-decker bus chassis manufactured by Leyland Motors. It pioneered the design of rear-engined, front entrance double deck buses



Leyland Motors Limited was a British vehicle manufacturer of lorries, buses and trolleybuses and introduced double decker with Beaver company.



Semi Articulated double decker trailer bus (1967-1976) bus is a bus formed out of a bus bodied semi-trailer pulled by a conventional tractor unit



articulated bus introduced in 1980s in BEST fleet



ashok leyland titan double decker bus in 1986



1992, single decker TATA BEST bus



ashok leyland titan double decker bus in 1998



in 2003, TATA introduced its first low floor starbus to BEST fleet



in 2004, Ashok leyland added its first low floor bus to BEST



in 2007, Ashok leyland bus added bus to BEST fleet collaboration with MUTP



in 2007, CERITA king long size low floor AC bus.



in 2008, GOLDSTONE low floor AC bus



in 2010, VOLVO added its first AC low floor bus to BEST fleet.



in 2017, CERITA AC bus converted into non AC buses



in 2017, TATA Hi - Tech low floor Starbus of BEST



in Nov 2017, TATA low floor hybrid AC starbus added to BEST fleet collaboration with MMRDA

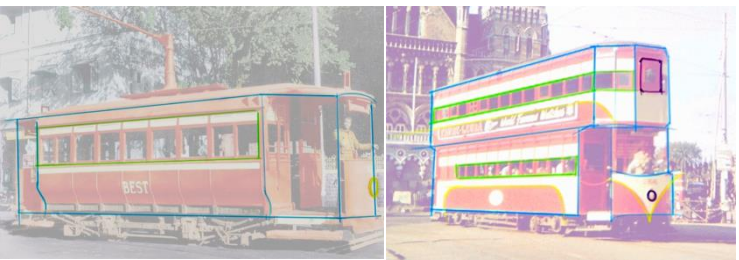


in Sept 2019, BYD introduced its compact low floor AC bus to BEST



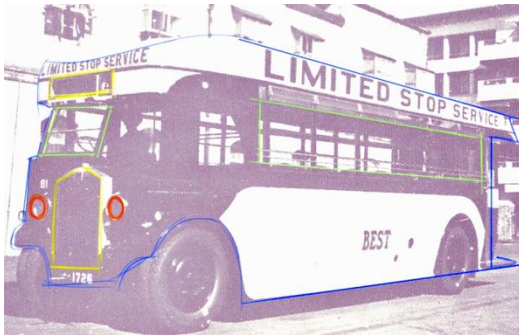
## **DNA study of BEST**

in starting designs, it was more geometric shapes inspired designs. front end seems bending down and seems like lines are concentrating on a single point. overall design seems well crafted work.



1907-20

1926



When Leyland came into role, a new kind of bus design was introduced where graphics were also a part of design. white strip of BEST was introduced birds feather like shapes. front part seems like chopped one while rear part was focused on curvy shape.



1954

when IC engines were introduced there was drastic change in designs. like bowl shape headlamps, curvy fenders on wheels, windshield for

TITAN is one the most Iconic BEST bus in its fleet. BEST's those iconic features were carried as legacy. Grille and Forehead in this bus were designed like bending back or like slantly chopped.



1956

1957



further TITAN has some design changes like Curvy ventured out forehead and straight grille with round corners.



1967

by 1957, BEST had some iconic features like split windshield, iconic graphical curve for BEST. rounded headlamp. depot no. and bus no. area split into two. in this design windshield had irregular shape. but it was openable

one of the most surviving iconic double decker BEST bus. complete boxy design with ventured out trapezoidal forehead. curvy roof edge. entry gates shifted to rear and fully covered engine.



1986

Cerita bus was loved by people for AC bus. But the bus design was not followed by iconic BEST design. graphics were forcefully imposed on body. so overall it was a paint work to represent it as a BEST bus rather than following BEST design DNA.

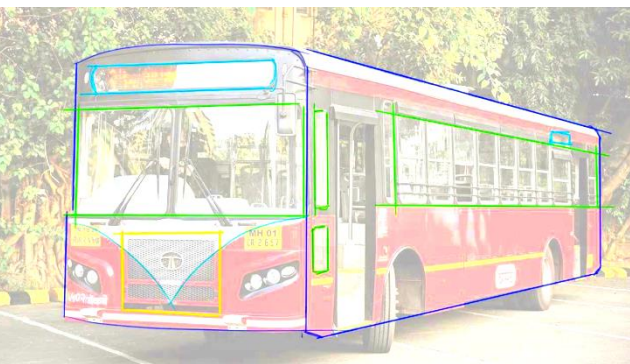
1992



2007



This Bus design become identity for Iconic BEST. Boxy but curved rooftop. round headlamp and iconic BEST graphics, split windshield made it identity for BEST bus.



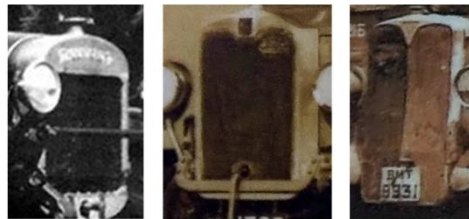
2017

Latest Starcity bus non ac BEST bus by TATA Motors. This BEST bus body works is done by **Antony garages pvt ltd** who is serving for BEST past many years. this bus design has continued its DNA legacy with appropriate aspect ratio. In this low floor bus, bigger LED display was also introduced. doors are comparable more wider. it has bigger windshield and windows but aspect ratio of windshield and windows are same as in earlier bus.



2019

In 2019 BEST hired compact AC buses from BYD. These buses were based on electric platform. These buses are painted RED and WHITE and some graphics to represent BEST.



## Evolution of grille in BEST



When IC engine came into role then grille has played important role in design. In 1946 AEC represented grille with a graphic character which became iconic character for BEST. Initially, vertical patterns were there on grille later it changes into horizontal lines



## Evolution of headlamps in BEST

Round shape headlamp played vital role in BEST buses.

Initially, headlamps were ventured out and in bowl shape. Then meshed with body and then fitted into a scooped in areas.

# Inferences

From the study of the design DNA of BEST, it is inferred that Mumbai needs next-generation BEST bus to continue the legacy of BEST. because these buses are a part heritage of Mumbai. Hiring new buses and painted them red does not fulfill the identity of BEST. Otherwise Mumbai will lose its one of the iconic elements of its heritage. Although electric bus has come into the role in the automobile sector. so there is sudden change in design features too. BEST bus needs to upgrade to stay into the competition.





## **Case Study** | The London Taxi

## Case Study - Iconic London Taxi



The London Cab had always been **an integral part of London's public transportation system**, along with the Double Decker bus. **Loved and respected by people** all around the world. It belongs in a special place in passengers' hearts, relied on and used by millions of residents and tourists every year.



roof mounted turn indicators, nicknamed "bunny ears"

Typical Curved 'C' pillar

Splined shoulder line which converted into steep curve at rear gives essence of muscles in rear

FX4



Notch removed from screen

Splined shoulder line with smooth curve which represents the same emotions as in FX4

elliptical headlamp (seems rounded from front view)

Bumper integrated with the body and indicators are added into it.

TX4



The LEVC TX, the electric London Taxi.

The electric London taxi has all iconic design character inherited from past iconic London taxi like:

Typical Curved 'C' pillar

Splined shoulder line

Round headlamp

Oval shape screen on roof

Inverted trapezoidal grille which is inherited from TX4



Austin FX4 taxi

The London Taxi had always been an **unmistakable symbol** of Britain since the 17th century. **Its iconic shape stands out from the rest of the crowd**, easily identifiable from a mile away in a crowded street.

it is **the oldest forms of road public transport to date**, and has always been the **Londoner's go-to choice** when it comes to public road transport.

The London Taxi has always been a **driver's favorite** because of its **heritage and reliability, especially with the iconic FX4**, spanning production for over 39 years, with some even still on the road today. Its smooth ride, practicality and usefulness and iconic shape had found its way to a special place on every cab driver's hearts.



Preliminary research

# Contribution of Brands in BEST Bus Service in Mumbai



THORNYCROFT (1926)



ALBION (1936)



DIAMLER (1938-55)



AEC (1946)



GUY (1950-54)



TATA  
MERCEDES  
BENZ  
(1960-66)



LEYLAND TIGER CUB  
(1954-57)



LEYLAND  
TITAN  
(1956-66)



LEYLAND ROYAL TIGER (1955-58)



ASHOK  
LEYLAND  
COMET  
(1958-76)



LEYLAND VIKING  
(1968-76)



LEYLAND BEAVER (1968)



ASHOK  
LEYLAND  
TITAN  
(1970-78)



TATA ENGINEERING  
(1986)



ASHOK LEYLAND

ASHOK LEYLAND  
(2004-present)



CERITA (2007-2017) AC

CERITA (2007-PRESENT) NON AC



GOLDSTONE (2009-17)



VOLVO (2010-17)



TATA Motors  
2017-present



BYD OLECTRA – 2019

## Iconic Brand for BEST

Ashok Leyland has been serving BEST since 1958. Earlier the **Leyland Comet** badge was used by Leyland manufacturer.

**Mumbai's iconic double-decker bus has completed its 80 years in 2018.** These buses are **plying on Mumbai's road since 1937.** Since then, Victoria Terminus has become Chhatrapati Shivaji Terminus and Bombay has become Mumbai. But the double-decker remains a symbol of the city.

Ashok Leyland has played a vital role in a double-decker bus. **The chassis is made by Ashok Leyland as is the Hino series engine,** both of which are designed specifically for the double-decker bus. The body or the **coachwork is done by Antony Motors.**

In 1997, **Ashok Leyland launched India's first CNG bus** which was a major step in developing alternate fuel for mass transportation. These buses were handover to the BEST



Ashok Leyland TITAN bus BEST

## What makes the BEST bus – ICONIC?

One of the most iconic elements of Mumbai is the BEST bus. People also called it “ **Red Box**”, in a derogatory way. But these Red-and-White buses giving their services to Mumbai since 1947.

The **Red color** of BEST bus is inspired by the **British** as the buses in London were colored in RED. So this Red and white color of BEST bus becomes an identity and iconic element of BEST.

Even these BEST buses have played a vital role in **Bollywood movies** like in the movie “**CHHOTI SI BAAT**” many scenes were filmed inside the BEST bus and at the BEST bus stop.

### Core values of BEST

**‘BEST’ travels, ‘SAFE’ travel** : it is one of the safest mode of city transport in BEST bus. BEST has achieved award in 1994, 95, 96 for passenger safety.

**“BEST deserve the BEST”** : it is one of the core values for BEST which is said in the sense of best service given to the passengers by BEST.



“CHHOTI SI BAAT” movie scene

# Public Transport Buses in India

**Ahmedabad Municipal Transport Service (AMTS)** runs the public bus service in the city of Ahmedabad in India. AMTS has 1072 buses serving the city in which 848 runs under AMTS & 224 under Janmarg.



**BEST** operates one of India's largest fleets of buses. Around 29 lac travel daily in BEST buses.



**Bangalore Metropolitan Transport Corporation (BMTC)** has the highest number of Volvo buses operated by a public transport company in India. BMTC is having a fleet of 6448 buses.



**Delhi Transport Corporation (DTC)** is one of the largest CNG-powered bus service operator in the world. DTC is having a fleet of 3900 buses.



The **Metropolitan Transport Corporation** operates the public bus service in Chennai. On a daily basis around 6.0 million passengers travel to and from, which is half the population of Chennai





**Research** | Mumbai

# Visual Study

## BEST Bus Museum Mumbai

BEST Museum is a one of a kind museum that houses miniatures of the BEST company's buses and trams, and a collection of old bus tickets and old photographs of buses from when they were introduced to Mumbai. The center of attraction is a classic Daimler double-decker bus chassis exhibited right in the middle of the museum.





The objective of this study is to observe and experience the BEST buses in day to day life. it also helps to understand the design language of the BEST bus when observing these buses very closely and using them as a mode of public transport. I also preferred to go to Wadala depot where no. of buses can be seen at a single place.

## BEST Buses parked in Wadala depot

Lower windshield is opened for air intake for driver and passengers. Bus no. & destination is written (in Marathi above windshield area) and (in English on right side of Bus)

Mechanical driver side indicator



Bus no. and depot (Marathi)



Safety barrier grille

51 seats & 18 standees



**Destination LED screen**

Its hard to see screen while standing in rear but while seating, one can easily see screen. Since speakers are mounted on left and right inside panels of bus so announcement can be heard easily.



## AC buses converted into NON AC buses



CERITA AC bus converted into  
NON AC bus



BEST bought 266 CERITA AC buses in 2007-08. around 20,000 commuters used to travel in these AC buses. But from May 2017, BEST's AC buses went off Mumbai roads frequent break down, heavy maintenance and some Cerita buses caught fire on road.

### **5 CERITA AC buses converted into NON AC buses.**

Fuel efficiency get affected because of more powerful engine which was not essential for a NON AC bus.





Advertisement is another kind of source of income for BEST. Companies use this bus body as a medium for their advertisement. BEST buses travel throughout Mumbai city .

### **Advertisement ( Exterior ) [ Rate: 34,500 ]**

Ad will be placed on the exterior or interior part of the bus as wrap.

### **Single Decker:**

Driver Side - 48.5 W x 11.5 H ft, Passenger Side - 48.5 W x 11.5 H Ft, Back - 8 W x 10 H Ft

**Lead Time :** 1 Week for 10 buses

### **Advertisement ( Interior ) [ Rate: 15,000 ]**

Ad will be displayed on 23 to 32 seat back and 9 interior panels.

Dimensions: 150 Sq Ft

# Advertisement by BEST buses



center body part is wrapped for advertisement



Full body wrapped



# A Visit to **Antony Garages (Navi Mumbai)**

BEST Bus Body Works

**BEST buses under repairing**





Sheet metal works under progress



I section cut out for windows fixing



Aluminum sheets are used for sheet metal works



GI 14 gauge Z section



GI 14 gauge U section



GI 14 gauge top plate

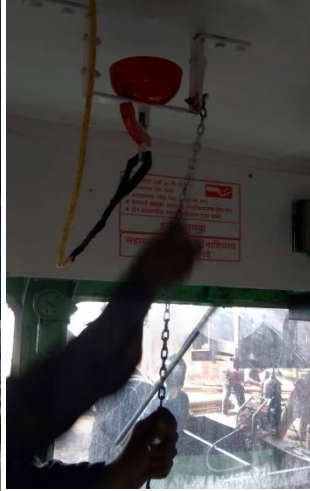


Working on Windows





Painted Red to the Bus



## PAINTING and ASSEMBLY PROCESS



Adding accessories



MH.01  
AP.0092

Exterior and Interior BEST bus



# User Study

# People boarding BEST Buses

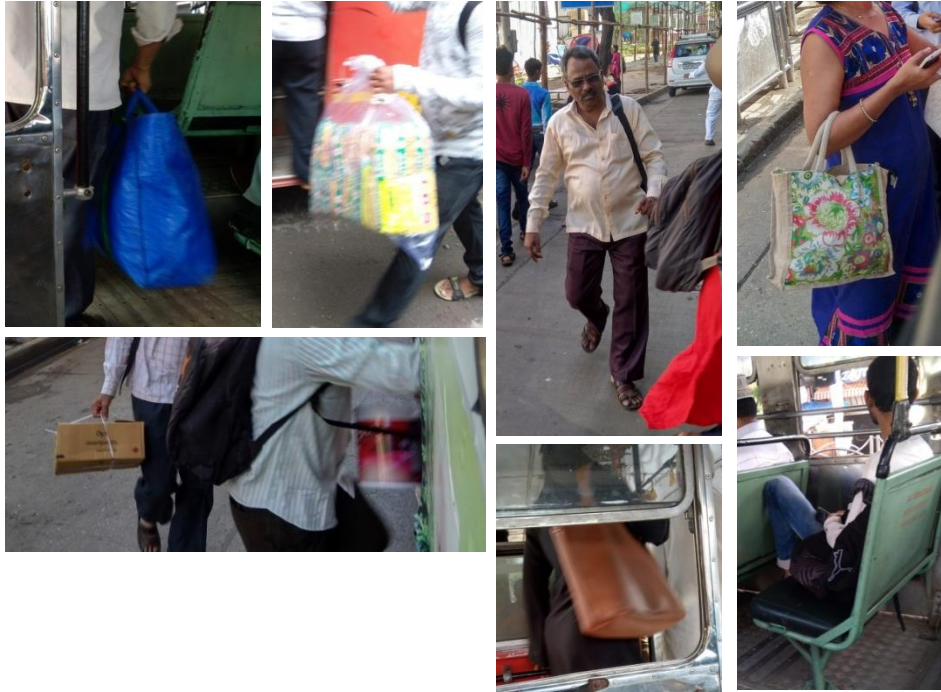


**Colaba to Powai via Wadala depot**

Passenger category: Students, employees, workers

Rush hours: 6AM to 10AM and then 4PM to 10PM

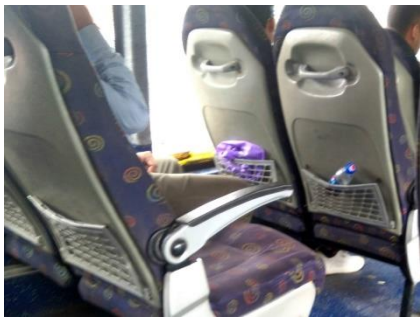
## Luggage carried by passengers in BEST Buses



Backpack, sling bag, hand bag, shopping bags etc.

Heavy luggage not allowed in BEST buses.

Inside AC bus



**From the understanding of the BEST bus, the following inferences have been made:**

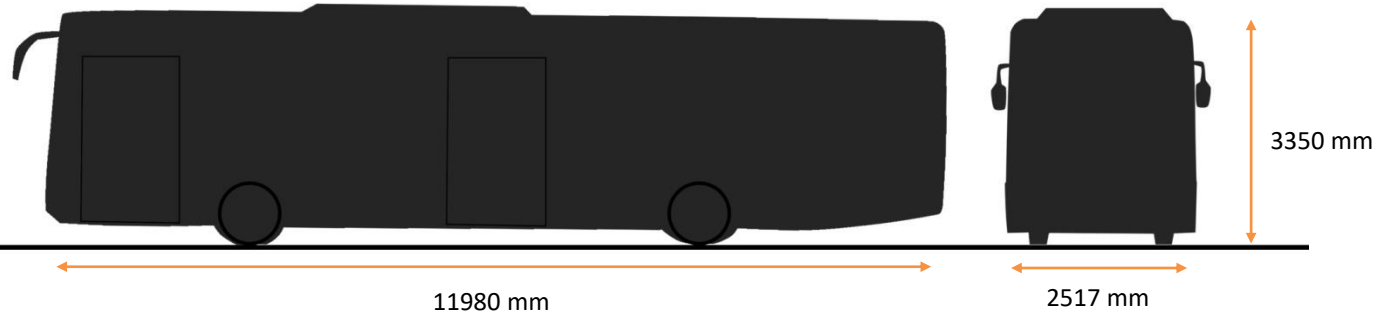
- The Red color of BEST has better visual identification for users even from a long distance but identifying bus no. from a distance is still difficult for many users.
- Low floor buses made it easier to get in or exit by one step only.
- Advertisement is source of income for BEST but it spoils the beauty of BEST and it is a visual distraction.
- In the rainy season, people have to face a lot of difficulty in getting on board the bus Because they have to close the umbrella before boarding the bus and have to open the umbrella immediately after getting off the bus so that they does not get wet.
- Traveling in BEST is one of the safest modes of transportation.
- Traveling in AC buses is more comfortable, noise-free and pleasant.
- AC bus is the first priority for working women for commuting by public transport.
- Some people don't use AC buses for daily commuting due to high bus fare.
- There is need of proper seating layout in such a way that people traveling short or long distance can use those seats accordingly.

# Dimensions and Packaging

Comparison of buses for the dimensions

Segment	Diesel Buses		CNG	Hybrid Electric Bus	Pure Electric Bus
Model	Volvo 8400 (AC)	Tata STARBUS SLF (AC/non-AC)	Tata STARBUS LE CNG (AC/non-AC)	Tata Starbus Hybrid (AC/non-AC)	BYD K9 (AC)
Seats	32	44	41	32	31
Length	12.3 m	12 m	12 m	12 m	12 m
Width	2.5 m	2.5 m	2.55 m	2.55 m	2.55 m
Height	3.2 m	3.2 m	3.35 m	3.35 m	3.49 m
Gross weight	16,200 kg	16,200 kg	16,000 kg	16,200 kg	18,500 kg
Costs (INR)	88 lakhs	33 lakhs	30 lakhs	1.2–1.4 crores	2–3 crores
Fuel efficiency	2.2 km/L	3.5 km/L	2–3 km/kg	2.2–4km/kg	1.5 kWh/km
Fuel cost	INR 23/km	INR 15/km	INR 13–19/km	INR 10–17/km	INR 10/km
Range (km)	484	560	260–390	286–520	249
Fuel tank size	220 L	160 L	720 L	720 L	-
Charging time	-	-	-	-	3–6 h
Max power	290 BHP	177 BHP	230 BHP	230 BHP engine 44 kW battery	180 kW
Max torque	1,200 Nm	685 Nm	687 Nm	678 Nm	700 Nm
Battery type	-	-	-	Li-ion batteries	Li-ion Iron (300 kWh)
Emission standard	EURO III	BS III	BS IV	EURO III	Zero tail pipe emission

## Existing Bus Dimensions : BYD K9



## Tata Starbus Diesel Series Hybrid Bus Dimensions

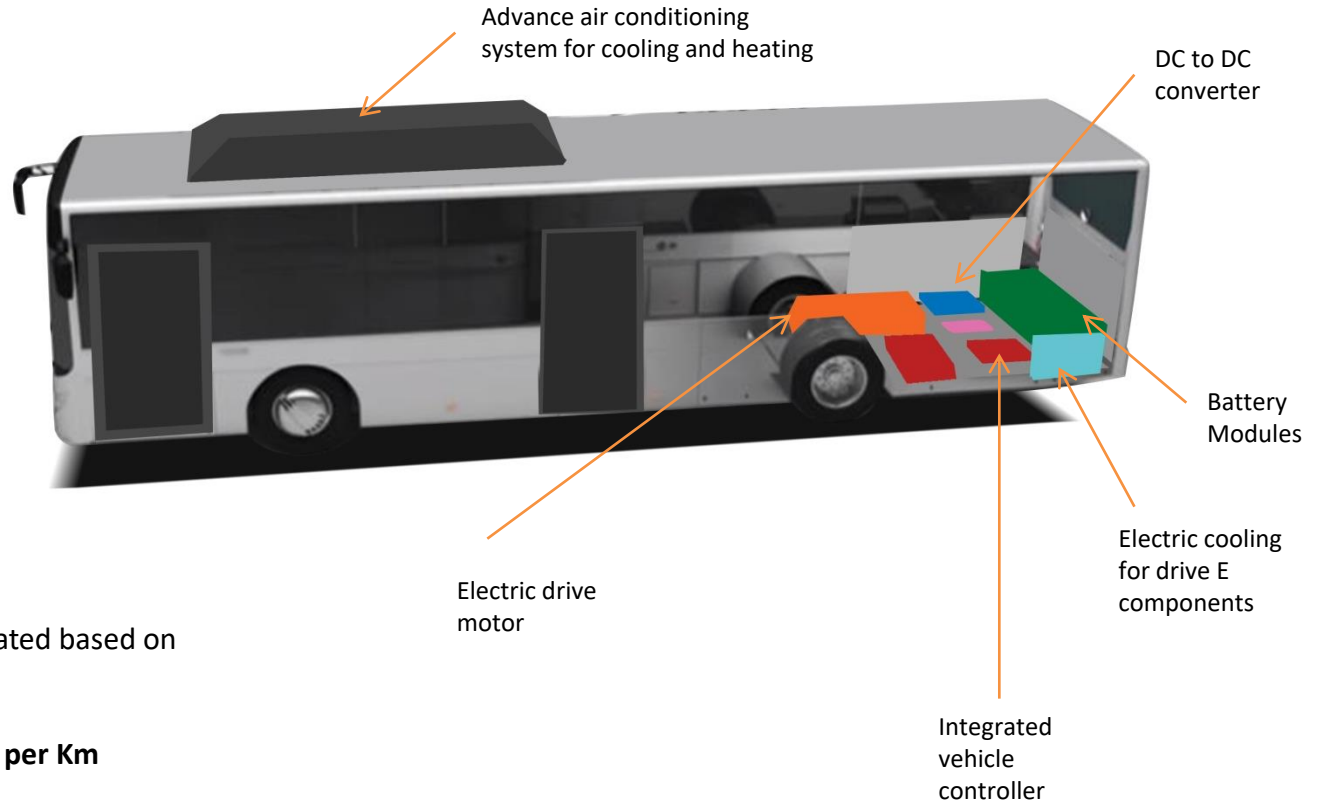
L x B x H : 11980 mm x 2517 mm x 3350 mm  
Floor height: 250 mm  
Wheelbase 6100mm

**Seats** (31 +1D)

**Standees** 28

## Key points

- broad width of doors for easy ingress and regress.
- all electric & battery operated bus.
- zero carbon emission and ecofriendly.
- avoid noise and pollution.



## Technical specifications:

### Pure Electric Bus: BYD (K9D)

Charging System:- Battery operated based on single charge at night.

**Energy Consumption-1.61 units per Km**

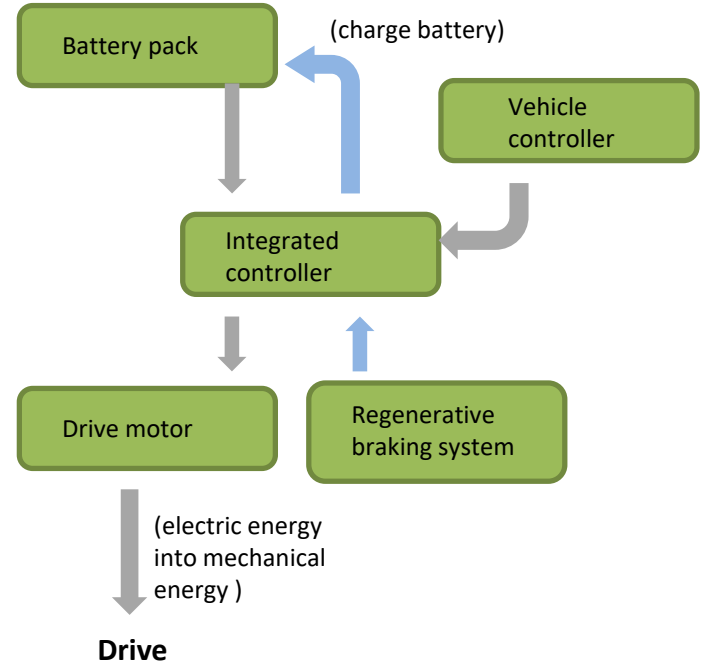
**Motor:** Permanent Magnet  
Synchromesh Motor-2X90KW  
Battery Pack-300KWH

# Principle of Electric bus



- 1) Roof mounted battery modules
- 2) Advanced inverter air conditioning for heating and cooling
- 3) Rear mounted battery modules
- 4) Integrated vehicle controller
- 5) Electric drive motor

- 6) Regenerative braking technology recovers energy from coasting and braking to recharge the batteries
- 7) Light-weight aluminium body
- 8) Electric hydraulic steering



# User Profile



Name : Munish Gupta  
Age : 28 years  
Occupation: Employee at IT Company

Munish Gupta works in an IT company. Munish is a very enthusiastic person. He works for the company 5 days a week. He spends his weekends time with his friends. Whenever he gets time from his busy schedule, he goes out with the camera and captures those moments in the camera. He is down to earth person and also loves nature photography.



# Design Brief

Design a next generation aesthetically appealing AC city bus for BEST that satisfy following needs of Mumbai people:

- The design should be able to capture the essence of iconic design DNA of BEST
- The design should give the essence of Mumbai.
- A beautiful form with better functionality.
- The design by which Mumbai people can relate their emotions to the BEST bus.

## **Specifications:**

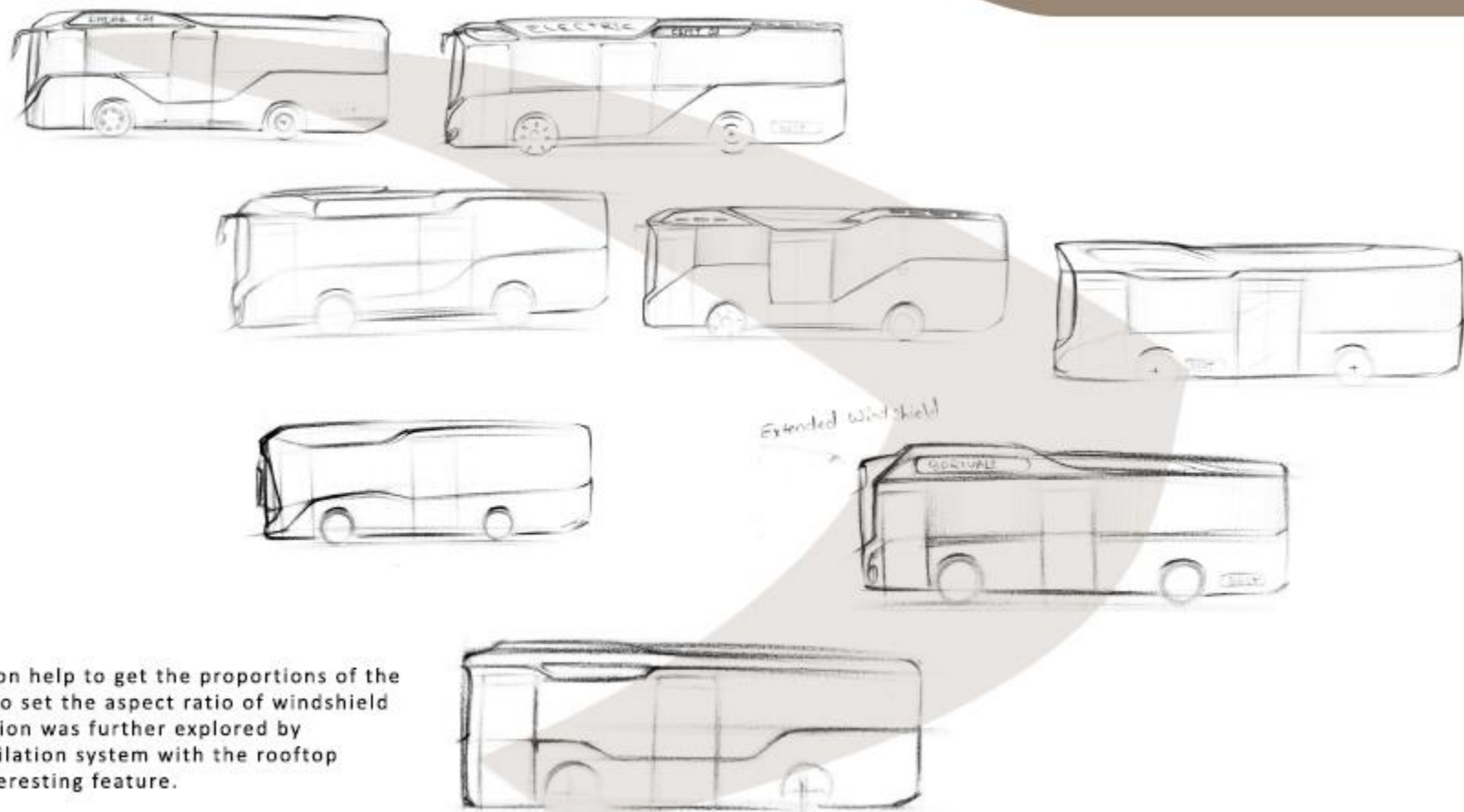
- A 12m long city bus with the capability of 31 seating and sufficient space for 28 standees and an area for physical disable person.
- One step to enter and exit through bus steps.
- An all Electric bus which is ecofriendly and noise-free



## RELIABILITY LEGACY

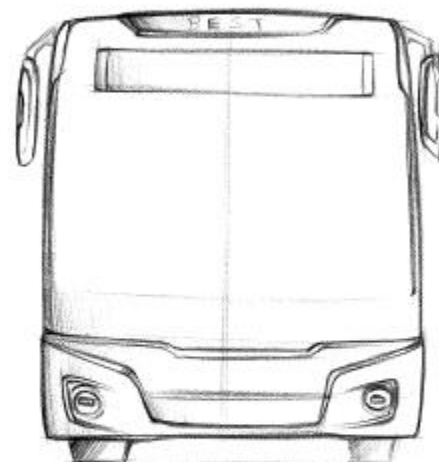
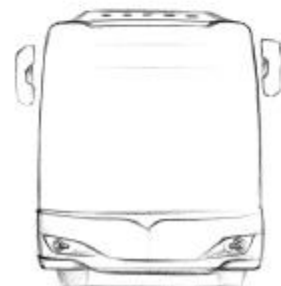
Legacy represents the inheritance of DNA from ancestor to the Next-Generation.

Bonding between two character represents the Reliability which makes strong beliefs and trust.

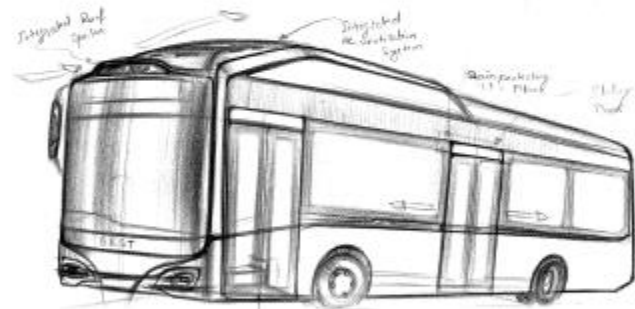
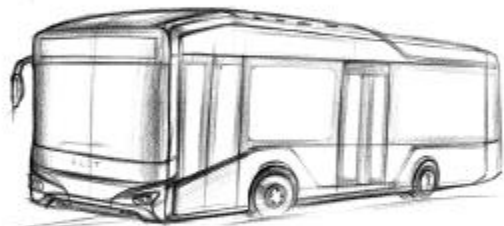
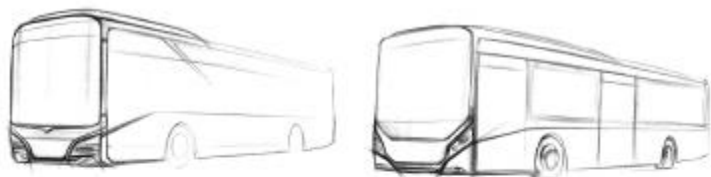


Side view exploration help to get the proportions of the bus. It gives ideas to set the aspect ratio of windshield and windows. ideation was further explored by combining the ventilation system with the rooftop which makes an interesting feature.

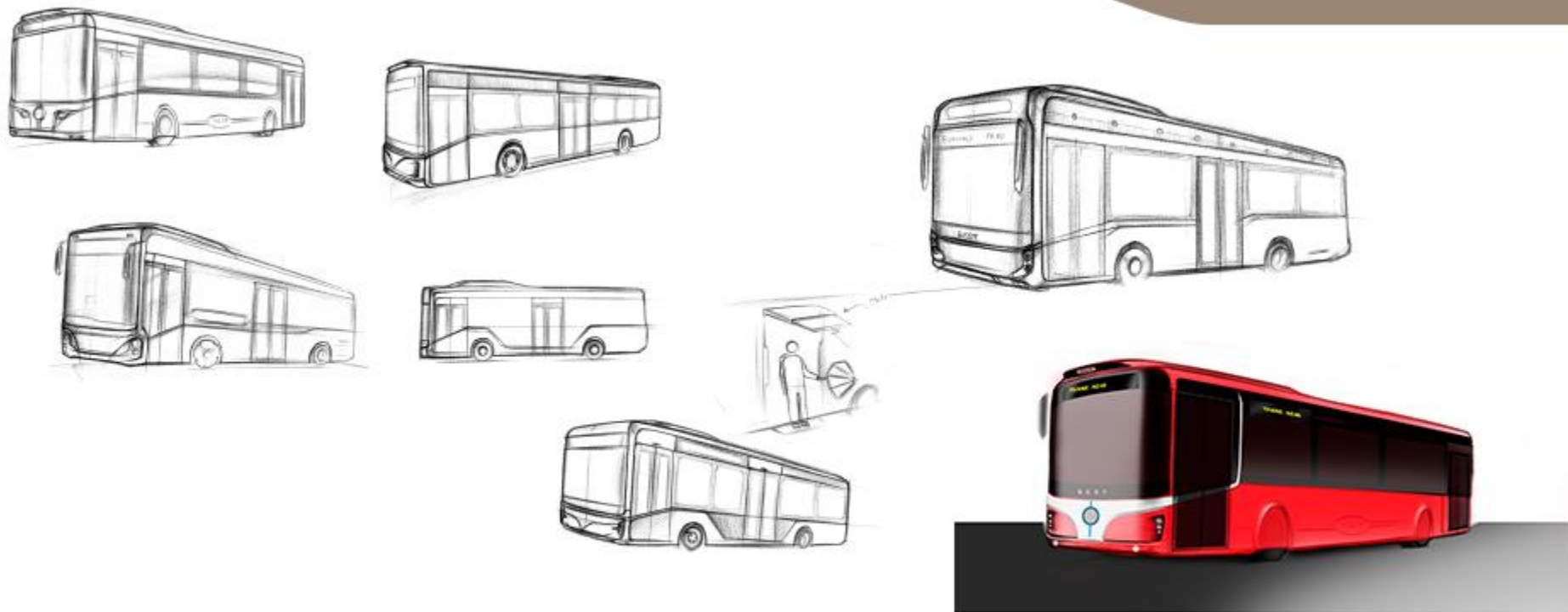




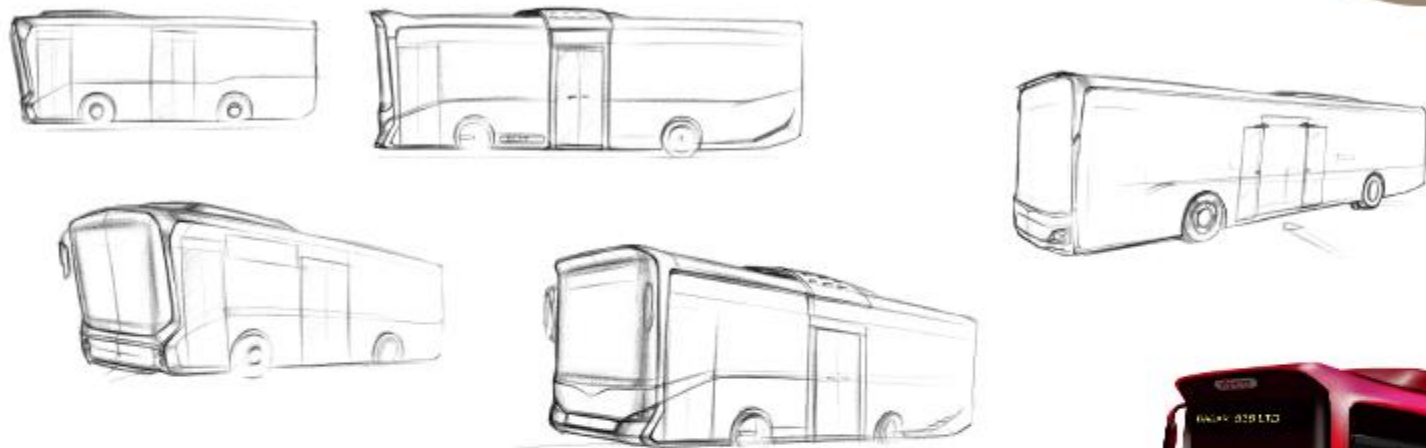
The objective of front theme exploration was to get the aspect ratio of the windshield, rooftop area, grille, and bumper area. These doodles were experimented to create interesting features with the graphics and the fake glasses to show modernism.



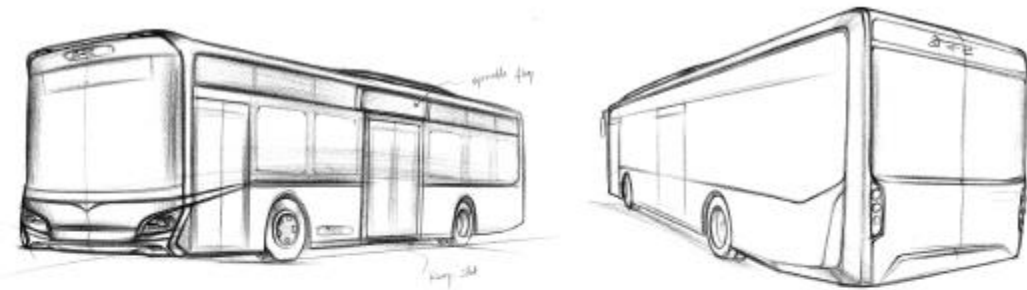
Concept 1 is based on a conservative theme. The concept has a mix flavour of an existing bus design characters and new feature design. The ventilation system is integrated with the rooftop in such a way that the front end looks bending down. It gives a conservative form to the bus but there is twist element. There is continuity of A-pillar from the front fascia to the roofline. This A-pillar merges somewhere in the centre of the rooftop. Overall it is a conservative form and in the same way, it gives a new design



Concept 2 is based on the retro-futuristic theme which is inspired by Bombay Trams. In this concept, sharpness and complexity are avoided. Surfaces are simple, soft and round corners are some highlighted features. It has a retro feel with the taste of futuristic features like advance lights, smart displays etc.



concept 3 is a new form that breaks away the traditional box volume of the bus. It has enhanced the character feature of the BEST bus i.e. Ventured out the forehead. In this concept, A-pillar is gradually narrow down. Because of this there is gradual increasing volume from top to bottom. This feature makes the BEST bus dominant and ruling character.



BEST's own design

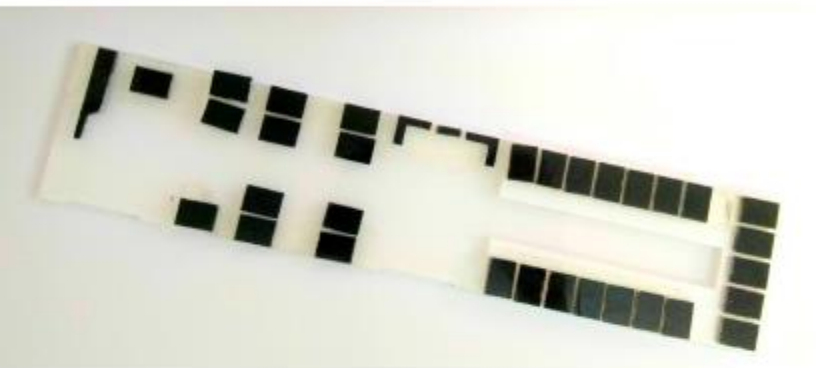


In the final concept there is modernism and carries DNA of Best bus. concept reveals freshness, young and next gen appeal. In this design, smiley character of BEST bus has been carried as a legacy that shows the welcoming character for the users.

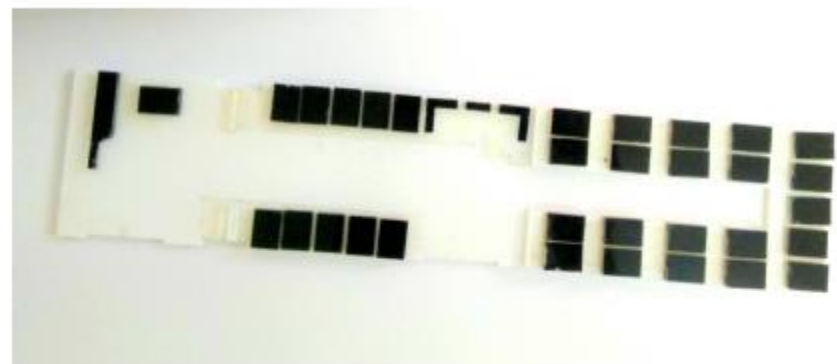


Final design



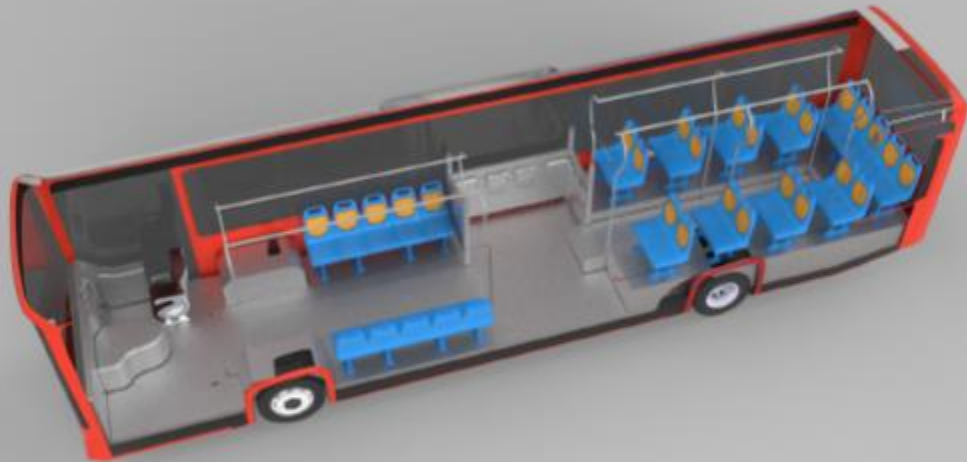


**Layout 1**  
30 seats for the passengers. First half contains 11 seats which are reserved for ladies and elderly. These seats are front facing. Rear seats are organised in the rows and facing each other. Last row contains 5 seats front facing.



**Layout 2**  
31 seats for the passengers. First half seats contains 10 seats and these are like metro seat layout. Rear seats are 21 in count and front facing.

## Interior Layouts



the seat layout is divided into two sections.

The first half-section is reserved for ladies and elderly. Since the seats are organized in a row so sufficient space left for the standees.

rear seats can be used by those passengers who have a long journey.

Centre space can be used for the standees. There is space available for wheelchair passengers.



Openable flaps to protect passengers from rain. once the passenger step out of the bus they can open umbrella and then can leave. In the same way, passenger can close umbrella before step into the bus. This flap will protect them getting wet in the rain.



Sliding ramp at rear door of the bus help wheel chair person to get into the bus.

Emergency exit from rear. there is a ramp with foldable staircase helps passengers to get out of the bus in case of emergency. Rear windshileld is openable. Seats in the last row can be folded to give path to the passengers for the emergency exit.



Foldable staircase attached with ramp





Thank You