

An Approach Towards Redesign and Modernization of Puducherry Bus Terminus

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Abstract

Pondicherry is one among the 8 Union Territories in India and it lies in Southern part of Indian Peninsula. For any nation or state Public transportation plays an integral part in ease of living and economic growth and hence it was decided to conduct a study on the present status of Puducherry Transport facility alongside the future expansion and growth plans of the city. On survey it was found that due to growing population, development of the city and traffic congestion there is serious need to look in to modernization of Puducherry Bus terminal. A state of art Bus terminal needs to consider all aspects pertaining to cost, mobilization of goods and human across, energy utilization, accessibility, availability of consumables and medicines and parking space. Main objective of our project is to develop the infrastructure of Pondicherry Bus Terminal as part of Smart City Plan. The entrance and exit of the Bus count is analysed and maintained using Radio Frequency Identification Tag sensor. Further considering human need for Medical clinic, Restaurants, ATM, Toilet, Waiting room, Led Display etc., provision had been made in the plan. In this study the main motive is to provide improved design from infrastructure point of view, proper space utilization, new required elements can be introduced. Suitable measures for efficient handling of buses have been suggested. Essential features under Pondicherry Smart City Proposal with emphasis on energy conservation through PV Solar cell system thereby contributing to reduction in carbon footprint efforts are implemented, thus based on the design standards for planning the bus terminus, infrastructure has be developed.

Keywords: Public Transportation, Modernization, Infrastructure, Smart city plan, RFID sensor, Energy conservation, PV Solar cell system.

1. INTRODUCTION

Transportation is an integral part of the functioning of the society. Transport system improves social, economic, industrial and commercial progress and transfers the society in an organized one. Efficiency of a transport system in any urban area enhances general growth and the quality of life of its people. Cities all over the world work towards achieving the most efficient transport system that meets the demand all the time. As transportation is concerned with the movement origin and destination involves the movement of peoples and goods. Transportation is one of the most vital services for every small or big city. An interstate/city bus terminal is a landmark in the city and nevertheless “the gateway of the city”. This can be considered as an indicator of development of any city/town. To achieve a desired transportation system, it is essential to provide an adequately planned and organized accessibility in the system, most widely used one such facility is the “Bus Terminal”. Bus terminals are predominantly used for inter-city and intra-city movements. This chapter contains an introduction of master thesis. The topic bus terminal has been chosen as the society is developing at a faster rate and hence the need for infrastructure up-gradation based on density of population and expectations of the customers. Buses are the most popular means of transport catering to more than 2 lakh average daily passengers using public transport. The success of public transport is largely depending on its supportive infrastructure such as terminals, depots, etc. To understand the effects of infrastructure on bus operations and services, this study focuses on terminal infrastructure.

2. GENERAL DISCRIPTON OF BUS TERMINUS

Pondicherry Tourism Development Corporation Limited (PTDC) was incorporated during February 1986 to promote tourism in the union territory of Puducherry. With the introduction of transport service from March 1988, the corporation was converted into Pondicherry Tourism and Transport Development Corporation Limited (PT&TDC) with effect from December 1992. The corporation operates inter-state buses on 55 routes throughout the territory, providing direct services to important tourist destinations in all the southern states of India. PT&TDC has paid up capital of about Rs.28.42 Crore, and was incurring substantial annual losses in the tourism sector, hence the corporation was bifurcated with effect from 1 April 2005 into the Puducherry Road Transport Corporation (PRTC) and Pondicherry Tourism Development Corporation (PTDC), in order to focus on diversification and expansion projects.

2.1 Location Map

The site is located at Northern part of Puducherry City. This site is situated at the middle of Pondicherry, thus very accessible from other part of the city.

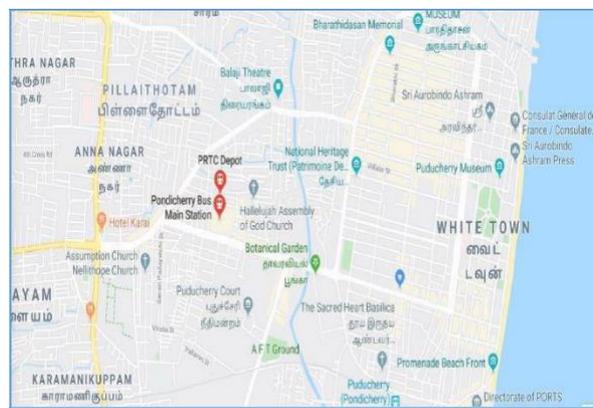


Fig: 1 Site Location Map

2.2 Environmental Consideration

The site has some issues related to environmental conditions. As it is located at the middle of the city, huge traffic moves around the site and has a great impact on the site. The right, left side and back side of the site is mostly residential along with some commercial and mixed used development, which has to be considered while designing.

2.3 Surrounding site in satellite view

The site is located at the prime location of Puducherry in the vicinity of prominent trade establishments and government buildings.

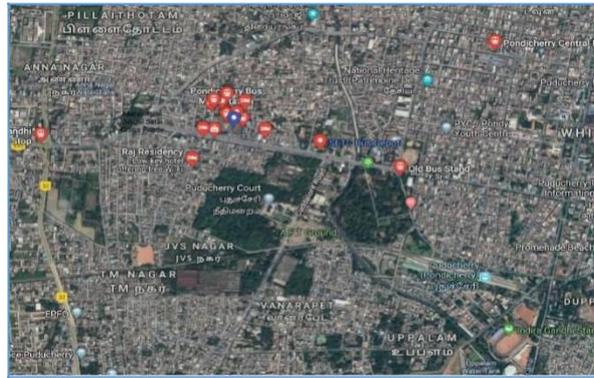


Fig: 2 Satellite View of Bus Terminus Road Network

2.4

As the site is located at the center of the city, it connects to many places like Villupuram, Cuddalore, Chennai, Bangalore, Mahe, Yanam, Karaikal etc.

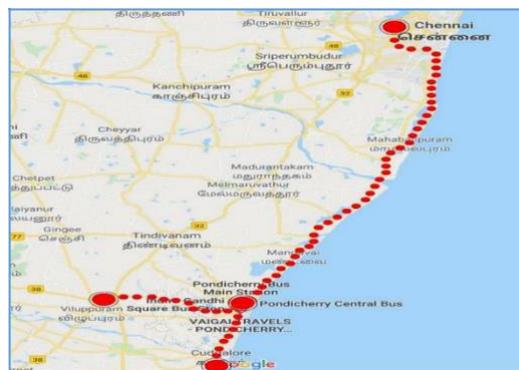


Fig: 3 Major Road Route

3. MATERIALS

3.1 RFID sensor

3.1.1 Objective

This is a system which aims to provide real time bus tracking and display of the estimated time of arrival of buses at various destinations.

3.1.2 Principle

Radio-Frequency Identification (**RFID**) is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the **reader** to be tracked.

3.1.3 Radiation effect on Human

A passive **RFID** tag does not pose any health risk as it does not emit any waves when outside of the field of a reader. Readers do emit waves, but they have only a short range. The same goes for active tags, which are relatively rare and similar to sensor networks

3.1.4 Operational Frequency

These can operate either in low (LF), high (HF) or ultra-high frequencies (UHF). Lower the frequency the shorter the read range and slower the data read rate. The frequency band between 125-134.2 KHz and 140-148.5 KHz is termed as low frequency and operates within ½ metre. High frequency operates between 13.553 – 13.567 MHz within 1 metre. UHF operates between 858 – 930 MHz and effective up to 10 metres. For our study we recommend use of UHF due to the purpose it needs to serve.

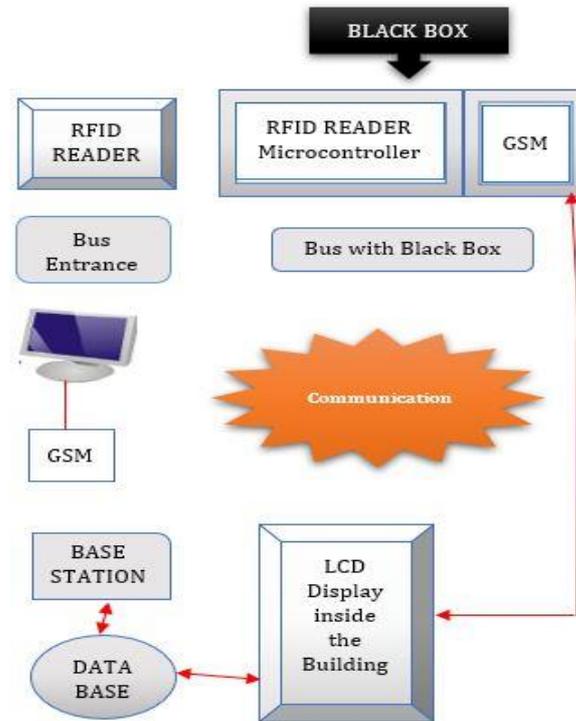


Fig: 4 Block Diagram of RFID sensor

3.2 Bio-toilet

3.2.1 Objective

Bio-toilet is designed with the aim of accelerating decomposition of human excreta, optimizing efficiency and minimizing any potential environmental or nuisance problems (odour).

3.2.2 Principle

The Bio-toilet system utilizes anaerobic digestion by bacteria which consume the waste material and convert it into water and gas. The water is passed through a chlorine tank and is discharged as clean water on the tracks, while the gas evaporates. Hence no solid waste is released to the environment.

3.2.3 Specification

Size of Bio-toilet-

- Length(l) = 5.4m to 5.7m
- Width (w) = 3m (with both side pathways)
- Height from ground level (h) = 3.15m to 3.5m.

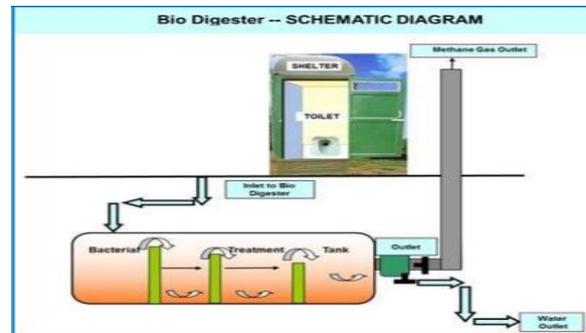


Fig.5 Bio-toilet

3.3 Solar PV Panel

3.3.1 Introduction

Among types of renewable energy / clean energy, solar energy from sun is available abundantly in India. Solar radiation in Pondicherry is estimated on an average around 6KWH/Sq. M/Day (RE Department, Pondicherry). The term Solar Panel is used colloquially for a photo-voltaic (PV) module. A PV module is an assembly of photo-voltaic cells in series mounted in a frame work for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity

3.3.2 Working

In **off grid solar** applications, a battery bank, charge controller, and in most cases, an inverter are necessary components. The solar array sends direct current (DC) electricity through the charge controller to the battery bank. The power is then drawn from the battery bank to the inverter, which converts the DC current into alternating current AC that can be used for non-DC appliances. Assisted by an inverter, solar panel arrays can be sized to meet the most demanding electrical load requirements. The AC current can be used to power loads in homes or commercial buildings, recreational vehicles and boats, remote cabins, cottages, or homes, remote traffic controls, telecommunications equipment, oil and gas flow monitoring, RTU, SCADA.

3.3.3 Solar Panel Estimation

- Current Consumption of Electrical energy =12439 KWH
- Total electricity consumption as calculated per day based on our proposal = 301.51 KWH
- Total electricity consumption per month = 9045.3 KWH
- Total Electricity bill = Rs.54,272/- (@ Rs 6/- per unit approx.)
- Total Savings as on date approx. = Rs 20365 per month

The standard dimension of Solar panel is 65*39*1.6 inch (for Monocrystalline Type) and this can generate up to 1.476 KWH / day with irradiance intensity in Pondicherry.

To generate 9045 KWH per month we need 204 Panels.

Cost of Solar System per KW is around Rs 70000.

Hence, to generate 9500 KWH we need 214 Panels and the total system can be bought at a capital outlay of Rs 37,80,000 .

The above decision will yield an ROI in around 6 years keeping in view subsidy from MNRE and IRR calculations. Life of Solar Panel is normally 25 years.

3.4 Bio septic tank

3.4.1 Introduction

The Bio Septic wastewater treatment system is a compact sewage treatment plant that safely processes all household wastewater and recycles it as clear odourless water to irrigate the garden. This means that the wastewater is treated and recycled to the property where it is produced rather than moving the waste problem to a town sewage treatment plant.

3.4.2 Process

The Bio Septic process begins when all the wastewater from the kitchen, toilets, bathroom, and laundry drains into the septic tank. The solid waste settles in the septic tank and naturally occurring anaerobic bacteria slowly break it down. The wastewater overflows into the aeration tank where the air is diffused into two separate aeration chambers to create aerobic bacteria. These quick acting bacteria reduce the sewage to carbon dioxide and water. Because aerobic bacteria breathe oxygen there is no odor. Finally a small amount of chlorine is added to kill any pathogens that have survived the aeration process. The treated water is then suitable to irrigate the garden.

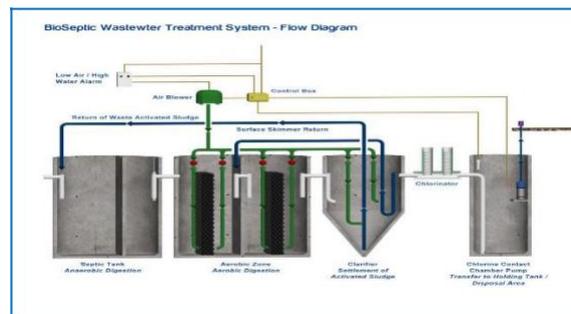


Fig: 6 Bio-Septic Tank Process

4. METHODOLOGY

- Assessment of our prevailing system
- Collection of literature
- Analysis of the existing bus terminus for assessing of existing bus route networks
- Layout of the existing bus terminus through AutoCAD
- People survey
- Identifying terminal gaps in the study area
- Options to incorporate terminal infrastructure
- Collection of sensors
- Solar panel system estimation
- Plan and design of the terminal using AutoCAD

5. SURVEY ANALYSIS

As part of the data analysis exercise we decided to go on ground on a primary data collection effort and hence visited the Pondicherry Bus Terminus for 7 days intermittently after preparing a valid questionnaire designed to understand the commuters frame of mind which will support our project work in understanding the ease of operation of the Bus terminus in relation to the logistics and commercials avoiding crossover in process flow.

5.1 Internal Space Facility

- We find from the analysis that 69% of the people feel that the present internal spacing is comfortable
- On the contrary 31% of the data sample have disagreed with the internal arrangements and suggested that due to overcrowding and increase of population especially in week end being a tourist destination it is a dire need to consider for a re-modification to accommodate the need of the commuters relevant to today's context.

5.2 Usage of Bus transportation

- It is observed that 35% of the total Population is using the public transport on daily basis.
- We find that 26% of people are using the public transport on a weekly basis while observe that only 21% of the population are using the public transport on monthly basis.
- Finally just 18% of the Population is using the Public Transport occasionally and rarely for commuting within Puducherry. We thus conclude that people of Pondicherry most likely prefer public transportation to any other due to frequency and timeliness of bus service in Puducherry.

5.3 Problem Experienced in Bus Terminal

- Majority of the people interviewed (39%) have expressed their dissatisfaction on cleanliness while 35% have quoted that traffic problem is very painful which creates too much disturbance and delays coupled with commotion.
- Considerably very less number of people, around 26% ostensibly stated that safety is not adequate especially for weaker section of the Population due to heavy crowd especially in peak hours. Thus we conclude that people of Pondicherry have expressed great concern on the cleanliness of the Bus terminal.

5.4 Routes covered by PRTC

- Majority of the people are satisfied with all routes covered by PRTC buses as this amounts to a share of 70% as per the study.
- Roughly 1/3rd of the population are not satisfied with the routes covered and they have suggested many additional routes such as Nalavadu, Vembukiraipalayam, Thirukanur, Thellaru etc., due to spread and density of population.
- By this we can conclude that people of Pondicherry are highly satisfied with routes being covered currently.

5.5 Overcrowding of Bus Terminus

- Observed that 55 % of the people agreed that the buses are always crowded and hence we can say that people of Puducherry believe that the buses are mostly populated.
- Very less number of people disagree with the statement that buses are not overcrowded. 19% of people responded saying that the buses are running with minimum passengers.

- We find 26% of the respondents have given a neutral reply. We thus conclude that the people of Puducherry believe that buses belonging to PRTC and Private Owners are always crowded

5.6 Mobile Application for Express Time Table

- Majority of the people ie.,around 74% are satisfied with the service of providing PRTC’s mobile app for booking seats.
- Very less number of people, around 26% do not like the service of booking through Mobile App due to reasons of literacy and affordability. Hence we conclude that people of Pondicherry feel satisfied with the service of providing PRTC’s mobile application for booking

5.7 Location of Bus Terminus

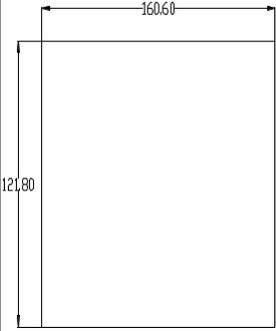
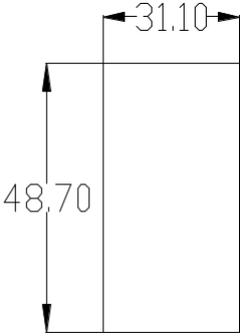
- Few respondents to the extent of 27% are not satisfied due to the space constraint / area within which the Bus terminal is planned and hence could have been placed little outside, centrally located bigger area for Bus terminal.
- We could understand from above that the present location is acceptable to most people who utilize the bus services to commute from Puducherry.

6. DESIGN SPECIFICATIONS OF EXISTING BUS

TERMINUS 6.1 Total area

The Pondicherry Bus Terminus covers an area up to 5.2 acres approximately

Table 1 Total Area of Existing Design

AREA – 1	AREA – 2
	
Length = 160.60 m Breadth = 121.80 m Area = 19561.08 m ²	Length = 48.70 m Breadth = 31.10 m Area = 1514.57 m ²
Total Area = 19561.08 + 1514.57 = 21075.65 m ² (or) = 5.2 acres (approximately)	

6.2 Bus Bay

- Inter-state bus bays = 14 bays
- Inter-district bus bays = 6 bays
- Local bus bays = 9 bays
- Total Bus Bays = 29 bays

6.3 Park

Park is situated at the center of the bus terminus and covers an area of 855.27 m²

6.4 Government office:

Number of Government Offices related to Bus terminal functioning is as below:

- Control office
- Power Room
- Puducherry Road Transport Corporation
- Tamilnadu Road Transport Corporation
- Karnataka Road Transport Corporation
- State Express Road Transport Corporation
- Reservation Office
- BSNL Recharge station
- Enquiry Office
- Tourism Information Centre

6.5 Restrooms dimensions

The existing size of restroom in Bus terminus is tabulated below:

Table 2 Restroom size of Existing design

RESTROOM – 1	RESTROOM - 2
<p>The diagram shows an L-shaped restroom with a main horizontal section of 20.6 m and a vertical section of 8.0 m. The total width is 15.5 m, composed of a 6.3 m section and a 9.2 m section (8.0 m + 1.2 m). The vertical section has a height of 7.5 m.</p>	<p>The diagram shows a rectangular restroom with a length of 48.70 m and a width of 31.10 m.</p>
<p>Length = 20.6 m</p> <p>Width = 15.5 m</p>	<p>Length = 48.70 m</p> <p>Width = 31.10 m</p>

Area= 225 m ²	Area= 1514.57 m ²
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6.5 Other specifications

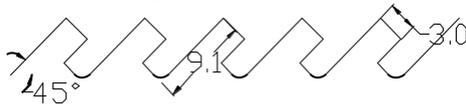
- The length of 'entrance' and 'exit' of the Bus terminus is 18 m
- Bus Terminus has 22 shops and 5 restaurants
- The two wheeler parking space is spread within an area of 1255m², in addition to an Auto stand and Tempo parking with an area of 155.8m² and 253.8m²
- Further a water purification tank with storage capacity of 2 KL / day

7. DESIGN SPECIFICATIONS OF PROPOSED BUS

TERMINUS 7.1 Total Area

As we are not extending Pondicherry Bus terminal, so the area of the Bus Terminal remains the same as 5.2 acres approximately.

7.2 Bus Bay



7.2.1 NUMBER OF BUS BAYS :

- Inter-state bus bays = 21 bays
- Inter-district bus bays = 10 bays
- Local bus bays = 15 bays
- Total Bus Bays = 46 bays

7.3 Footpath

- Walkway for the pedestrian movement to regulate a disciplined movement of people safely.
- Generally design of Walkway is classified into three zones based on the movement of pedestrians.
- According to *IRC 103-2012, Cl.6.1.5.2 standard*, we recommend High-Intensity Commercial Zone with the total width of 5.5m and with the Kerb height of 150mm.

7.4 Entrance

7.4.1 Bus Entrance

As per IRC Specification, we recommend Flexible Pavement with Length of Two-Lane Road with raised Kerb is **7.5m**.

7.4.2 Vehicle Entrance

As per IRC Specification, we recommend Flexible Pavement with Length of Single Lane Road is **3.75m**.

7.5 Main Block

Main Block Consist of two floors (i.e G+2 Building)

- Ground Floor - Two-wheeler and Four-wheeler Parking
- First Floor - Shops and Government Offices
- Second Floor - Maintenance offices

7.5.1 Ground Floor

Ground floor is meant for parking vehicles (Two-wheelers and Four-wheelers). This is separated into two sides one is for Two-wheeler parking and another is for Four-wheeler parking.

- Security check is done at both entrance and exit of the ground floor. This may reduce the difficulty in traffics and conjunction inside the parking lots.
- Here we provide the entrance width of 9.25m and exit width of 7.75m which is more than the width of the two-lane road. So that the vehicle can move inn and out without any obstacles.

7.5.1.1 Two-wheeler Parking

- Dimension of two wheeler parking space is 3m *1.5 m
- (Taken size of Honda active = 1.8m length*0.7m wide *1.1m height)
- It can accommodate more than 100 vehicles.

7.5.1.2 Four-wheeler Parking

- Dimension of four wheeler parking is 5m*2.5 m
- (Taken size of Innova car = 4.7m length*1.8m width *1.7m height)
- Here we provide a special parking allocations for Physically challenged.
- Dimension of four wheeler parking is 4.8m*3m (As per IS 4983 - 1987, Cl.4.3.3)
- The intermediate ramp space between two lanes is 1.2m

7.5.2 First Floor

First floor consist of shops and Government offices. Here the lists are

- Clinic
- Baby feeding room
- Cloak room for Gents
- Cloak room for Ladies
- Dormitories for Gents
- Dormitories for ladies
- Telephone booth
- Shops (6)
- Restaurant
- Canteen
- Railway enquiry office
- BSNL recharge station
- Tourism Information center
- Enquiry room
- Reservation office
- PRTC office
- SERTC office
- KSRTC office
- TNRTC office

- Toilets

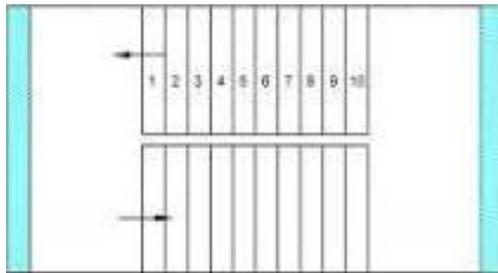
7.5.3 Second Floor

Second floor consist of Various Maintenance offices. This floor is only for the use of government offices not for the Public use.

- Control room
- CCTV room
- Maintenance room
- Power room
- Dormitories for Gents
- Dormitories for Ladies
- Toilets

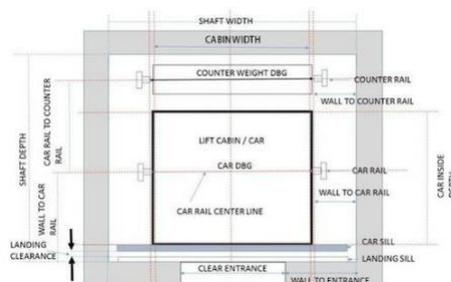
7.6 Staircase

- Dimensions of the staircase provided is 6m*3m (singly reinforced Dog-legged Staircase)
- Floor to Floor height – 3.5m (Height of each flight 1.75m)
- Width of riser and treads are 150mm and 300 mm
- Weight of waist slab is 9.1 KN/m and weight of steps is 1.875KN/m
- Factored load of stairs is 24 KN/m (where DL – 10.975 KN/m & LL – 5 KN/m)
- Factored load for landing is 19.7 KN/m



7.7 Lift

- Dimensions of the lift is 3.75m*3m.
- Lifts can withstand a weighing capacity of 550 kg (8 Persons).
- Shaft size - 1.75m length*1.55m width.
- Cabin size - 1.4m length*1.1m width.



8. CONCLUSION

With the above elaborate study and having spent our valuable time collecting data on the current status of Puducherry Bus terminal, we like to conclude that there is enough scope to upgrade the facility for ease of living of Puducherry people.

- We had put forth the idea of digitalizing the arrival and departure time of the bus using RFID sensor.
- The concept of green energy to consume less energy by using solar panel system and smart energy lighting system replacing the existing outdated lighting
- The idea of Bio-toilet is introduced with the aim of decomposition of human excreta, optimizing the efficiency and minimizing the nuisance problem.
- Introduction of sewage treatment plant for reuse of wash waters.
- New plan for the Pondicherry Bus Terminus has been proposed based on the smart city efforts
- Number of Bus bays has been doubled in order to decrease the traffic congestion.
- To ensure the safety of people, proper surveillance system has been proposed in the plan with automatic fire control system with sensors
- Public address system is introduced for clear communication and emergency
- By redesigning the Pondicherry bus terminal, commercial facilities such as shops, hotels, cafeteria has been considered and layout planned accordingly.
- Emergency medical service and ATM are provided in the modified plan of Pondicherry Bus Terminal
- To avoid cross transportation of people and goods have reengineered flow routes, parking facility for both two and four wheelers and a separate path for physically challenged people for easy access to the desired location.

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