UNIT 3 TRANSPORT SYSTEM MANAGEMENT

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3.2 Classification of Transport System
3.3 Transport System Indicators
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3.5 Transport Systems as per Modes
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3.1 INTRODUCTION

You are well aware that transport is very important element of urban infrastructure. The transport system and management can be broadly categorized into three aspects: (i) Transportation system- A facility consisting of the means and equipment necessary for the movement of passengers or goods; (ii) The Transportation Systems Sector- a sector that comprises all modes of transportation (Aviation, Air, Mass Transit, Highway, Freight, Rail, and Pipeline), is a vast, open, interdependent Network system that moves millions of passengers and millions of tons of goods; and (iii) The Transportation network- is critical to the Nation’s economic progress. Every day, the transportation network connects cities, provided mobility requirement at a desired accessibility levels and particular level of service. This unit discusses urban transport system and its management. After reading this unit, you will be able to:

- Classify transport system
- Identify indicators of transport system
- Narrate the characteristics of urban transport system
- Describe transport system as per mode used
- Analyse the best practices in transport system
- Describe transport system management
- Discuss human resource component of urban transport
- Record best practices of traffic management

3.2 CLASSIFICATION OF TRANSPORT SYSTEM

The Transport system is broadly divided into three major divisions as shown in the figure below.
These Transport Systems can be classified as follows according to flexibility and time:

<table>
<thead>
<tr>
<th>Time</th>
<th>Fixed</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space/Route/Fare</td>
<td></td>
<td>Fixed Rail Rapid, Transit Light Rail, Fixed Route Bus, Jitney / RTV</td>
</tr>
<tr>
<td></td>
<td>Variable Van Pool, Subscription Bus, Car Pool, Taxi, Auto rickshaws, Cycle Rickshaw, Dial-a-ride, Auto Rental</td>
<td></td>
</tr>
</tbody>
</table>

**Private Transport**

Private transport has flexible route, space, timings. Road based private transport can further be classified as Fast, Slow. Fast is the mechanised mode that includes Car, 2 Wheeler, etc. Slow mode is also called as non-mechanised modes such as cycles, animal drawn private vehicles.

**Public Transport**

Public Transportation includes all multiple occupancy vehicle services designed to transport customers on local and regional routes. It is transportation by van, bus, or rail or other conveyance, either privately or publicly owned, providing to the public general or special service. Any form of transportation that charge set fares, run fixed routes, and are available to the public. For Example: Bus, Metro, Commuter Rail, Trams, etc.

**Intermediate public transport/para transit**

Para-Transit can be further be classified as (i) IPT (Para Transit) Fast; and (ii) IPT (Para Transit) Slow.

i) **IPT Fast**: It is mechanised mode that can be hired and used on any flexible route, with flexible timings. IPT in certain part of the city or in some of the cities also run on fixed route. In that case IPT become the substitute of Public Transport System. Some of the examples of IPT-fast are auto rickshaw, Jugad (Modified form of large size auto which is used in Northern part of India), Taxis, Cabs, e-Rickshaw, etc.

ii) **IPT Slow**: It is non-mechanised mode that can be hired and used on any flexible route, flexible timings, i.e. Cycle Rickshaw, Hand-pull Rickshaw, Camel Cart, etc.
IPT plays a greater role in small and medium size cities. It meets the mobility requirements even on network where Bus cannot run due to non-availability of required Road Space or transport demand may not justify bus transport.

### 3.3 TRANSPORT SYSTEM INDICATORS

The following indicators are used to evaluate or assess performance of transport systems in a city.

1. Average Speed
2. Public Transit Share
3. Walkability
4. Cycle-ability
5. Fatality Index
6. On Street parking Index
7. Non-Motorized Travel Index
8. Emission/hr.

### 3.4 CHARACTERISTICS OF URBAN MASS TRANSIT SYSTEM

The Characteristics of different urban mass transport system are given in the Table below. The various types of urban transit modes used in Metropolis and Cities are broadly commuter rail, metro, monorail, light rail, and bus rapid transits.

<table>
<thead>
<tr>
<th>Transit Mode</th>
<th>Commuter Rail Options</th>
<th>Station Spacing (Km)</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROW Options</td>
<td>Exclusive ROW General Railroad, mixed Traffic</td>
<td>3 to 15</td>
<td>Locomotive with set of Passenger coaches</td>
</tr>
<tr>
<td>Commuter</td>
<td>Exclusive ROW Grade Separated</td>
<td>1.5</td>
<td>High Platform Cars operating in multiple car trains set</td>
</tr>
<tr>
<td>Rail</td>
<td>Exclusive ROW Grade Separated</td>
<td>0.75 to 1.5</td>
<td>High Platform Cars operating in multiple car trains set, electric propulsion</td>
</tr>
<tr>
<td>Metro</td>
<td>Exclusive ROW Grade Separated</td>
<td>0.75 to 1.5</td>
<td>Articulated double articulated low floor, can operate in multiple car sets, electric propulsion</td>
</tr>
<tr>
<td>Monorail</td>
<td>Exclusive ROW Semi Separated</td>
<td>0.75 to 1.5</td>
<td>Standard articulated or double articulated, low floor or high platform, diesel, hybrid Propulsion of ETB</td>
</tr>
<tr>
<td>Light Rail</td>
<td>Exclusive Mixed traffic Lanes</td>
<td>0.4 to 1.5</td>
<td>65-85 per car</td>
</tr>
</tbody>
</table>
### 3.5 TRANSPORT SYSTEM AS PER MODES

There are broadly five types of transportation modes. The user select the various modes based on (i) various level of price and (ii) various levels of service such as convenience, speed, safety and availability. Broadly, the various types of the transport system are used for Freight and Passenger movement from one place to another. Now a days, various new modes of transportation are also used for the transportation such as ropeway, etc.

<table>
<thead>
<tr>
<th>Seats</th>
<th>Seated Capacity</th>
<th>Average Speed</th>
<th>Minimum Curve Radius</th>
<th>Approx. Operation and Management Cost</th>
<th>Approx. Capital Cost Per Km (2008 Km)</th>
<th>Implemented Cities - India</th>
<th>Implemented Cities - International</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>90-185 per car</td>
<td>40 - 70 kmph</td>
<td>50 m</td>
<td>40-60 lakh</td>
<td>40-60 Lakh</td>
<td>Mumbai, Chennai, Kolkata, Hydrabad</td>
<td>Moscow, Jakarta, Johannesburg</td>
</tr>
<tr>
<td>Car</td>
<td>60-80 per car</td>
<td>25-55 kmph</td>
<td>40 m</td>
<td>100-200 Lakh</td>
<td>100 crore</td>
<td>Delhi, Kolkata</td>
<td>Bangkok, Kuala Lampur, Mexico City, Cairo</td>
</tr>
<tr>
<td>Car</td>
<td>30-75 per car</td>
<td>25-40 kmph</td>
<td>75 m</td>
<td>40-60 Lakh</td>
<td>100 crore</td>
<td></td>
<td>Tokyo, Sydney, Kuala Lumpur, Seattle</td>
</tr>
<tr>
<td>Car</td>
<td>25-50 kmph</td>
<td>Up to 20000 PPHPD</td>
<td>50-60 Lakh</td>
<td></td>
<td>15 crore</td>
<td></td>
<td>Hong Kong, Shanghai, Kuala Lumpur, Instanbul, Taipie, Bagota</td>
</tr>
</tbody>
</table>

- **Air Transportation**
- **Rail Transportation**
- **Road Transportation**
- **Water Transportation**
- **Pipeline Transportation**

- **International**
- **Domestic**
- **Regional**
- **Urban (Commuter, LRT, PRT, Monorail)**
- **Rural**
- **Urban**
- **Inland Water Transport**
- **Shipping**
Let us describe these transport system one by one.

### 3.5.1 Air Based Transport

Air based transport involves the Air Plane. Air transport by nature provides the speediest mode of transport service. This mode of transport does not encounter the geographical barriers of earth’s surface like mountains, hills, deserts, rivers, etc. and this allows the air transport to provide gradually faster services. It has also the advantages of linking remote and inaccessible areas across the mountains, oceans, deserts and dense forests.

There are three elements in air transport i.e.

i) Airway

ii) Aircraft service

iii) Airport.

### 3.5.2 Rail Based Transport

Railways are composed of a traced path on which vehicles are bound. They have an average level of physical constrains linked to the types of locomotives and a low gradient is required, particularly for freight. Heavy industries are traditionally linked with rail transport systems, although, containerization has improved the flexibility of rail transportation by linking it with road and maritime modes. Rail is by far the land transportation mode offering the highest capacity.

Rail Based Transportation is of two types

i) Regional Rail Transportation

ii) Urban rail Transport

The urban rail transpiration is broadly of following categories:

a) Commuter Rail

b) Metro Rail

c) LRT (Light Rail Transit)

d) Mono Rail

e) PRT (Personalised rapid Transit)
3.5.3 Road Based Transportation

India has a network of National Highways connecting all the major cities and state capitals, forming the economic backbone of the country. As of 2010, India has a total of 70,934 km of National Highways, of which 200 km are classified as expressways. Under National Highways Development Project (NHDP), work is under progress to equip some of the important national highways with four lanes; also there is a plan to convert some stretches of these roads to six lanes.

As per the National Highways Authority of India (NHAI), about 65% of freight and 80% passenger traffic is carried by the roads. The National Highways carry about 40% of total road traffic, though only about 2% of the road network is covered by these roads. Average growth of the number of vehicles has been around 10.16% per annum over recent years.
The road based transportation can be broadly classified as (i) Urban road hierarchy; (ii) Urban road intersection.

i) Road Hierarchy

An efficient urban road network follows a hierarchy. The hierarchy is based on the function that the road is expected to perform, and the type of traffic and the road users present on the road. The design, speeds, road widths and other geometric features are adapted to suit the road function. These guidelines are based on the following classification of urban road:

- Arterial Road
- Sub-Arterial Road
- Collector Road
- Access streets/Local streets

Let us explain these types one by one.

a) Arterial Roads

They are the primary roads for ensuring mobility function. They carry the largest volumes of traffic and longest trips in a city. These roads are characterized by mobility and cater through traffic with restricted access from carriageway to the side. In such cases, special provisions should be introduced to reduce conflict with the through traffic. These roads also have the maximum right of way (ROW) amongst all categories. However, roads of lower width also function as arterial roads. Functional classification supersedes the geometric classification.
b) **Sub Arterial Roads**

Their basic functions are similar to that of Arterial. It is a street primarily through traffic usually on a continuous route but offering somewhat lower level of traffic mobility than the arterial.

c) **Collector Roads**

As the name suggests, these are connector roads which collects and distributes the traffic from and to the local streets. They are characterized by mobility and access equally. It carries moderate traffic volumes compared to the arterial roads.

d) **Access Streets or Local Street**

This is a street primarily aimed for access to residents, business or other abutting properties. Majority of trips in urban areas usually originate or terminate on these streets. They carry relatively lower volumes of traffic at low speeds. They are characterized by high accessibility among all the categories of roads.
Based on the standard cross sections as per the guidelines, all the roads should be designed in a particular manner with given ROW. The types are as follows:

a) Pedestrian Paths (accessible footpaths)

b) Infrastructure of non-motorized vehicles (Bus lanes)

c) Bus lanes

d) Carriageway (Motorized vehicles)

e) Median

f) Unpaved: Curb and segregators

g) Service Roads

h) Parking

i) Tree belts/Green belts/Landscaped area

j) Bus shelters

k) Other facilities – Street furniture and other facilities

l) Grade separator facilities

ii) Urban Road Intersection

The Road Intersections are the critical elements of the road sections and the function of a designed intersection is to control conflicting and merging streams of traffic, to minimize the delay including pedestrian and bicycle traffic.

Intersection design influences the capacity of the corridor and the safe movement of conflicting directions. The pattern of the traffic movements at the intersection and the volume of traffic on each approach, during one peak period of the day determine the lane widths required including the auxiliary lanes, traffic control devices and channelization, wherever necessary. The arrangement of the islands and shape, length of the auxiliary lanes also differ based upon the type of intersection.
Different combinations of the intersection type is determined primarily by the number of intersecting legs, the topography, the character of the intersecting roads, the traffic volumes, patterns, and speeds, and the desired type of operation.

Intersection has merging, diverging, cross conflict points. Four Arm Intersection of Two Way Roads has 16 cross, 8 merging, 8 diverging conflict points. In total, there are 32 conflict points.

Types of intersection depending on the geometric forms are as follows

1) 3- Leg Junction
2) 4- Leg Junction
3) Multi-Leg Junction

The function of an intersection is to enable safe interchange between two directions or two modes.

The design of an intersection must be comprehensible to road users. This aim is best achieved with a well-organized situation with a minimum number of conflict points. The basic principle is to limit the number of conflict points.

Different types of intersections are as follows:

1) Channelized intersection
2) Roundabout
3) Signalized Intersection
4) Grade Separated Intersection (Flyover)
5) Grade Separated Interchange

1) **Channelized Intersections**

Channelized intersections use pavement markings or raised islands to designate the intended vehicle paths. The most frequent use is for left-turns,
particularly when accompanied by an auxiliary left-turn lane. At skewed intersections, channelization islands are often used to delineate left turns. At large intersections, short median islands can be used effectively for pedestrian refuge. The design of channelized intersections needs to ensure that the needs of pedestrians are considered. In this type of Intersection, Merging and Diverging type conflict points are reduced.

2) **Roundabouts**

A Roundabout is a type of Circular intersection with a specific design and traffic control features. Roundabouts can be tailor designed to suit most site conditions, traffic volumes, speeds, and all road users’ requirements. This is one versatile solution, which combines the benefits of safety and efficiency in an attractive package. Safety is achieved by reduced speed (less than 40 km/hr.) within the roundabout and efficiency by high directness in time and distance or minimal delays for all users.

Roundabouts, on higher traffic intensity junctions, requiring complex crossing decisions by cyclists would require segregated bicycle infrastructure along with safer crossing provisions for pedestrians, whereas lower intensity junctions may rely more on mixed conditions and traffic calming techniques.

In Roundabout, cross conflict points are converted to angular type conflict points which are less dangerous. Roundabout can carry around 3000 pcu/hr. However Capacity can be increased by changing Geometrics.
3) **Signalized Intersection**

A signalized intersection is the junction of road which is controlled by traffic signals. Signalised Intersection generally comes after Roundabout, however, sometimes Signalised Intersection is preferred over Roundabout due to space consideration or Roundabout is not able to handle the required traffic. It encourages:

- a) Orderly movement
- b) Reduce right angle accidents
- c) Increase capacity
- d) Allow crossing
- e) Coordination
- f) Driver’s confidence
- g) Cost effective

4) **Grade Separated Intersection (Flyover)**

It is a road junction in which the direct flow of traffic on one or more of the roads is not disrupted. Instead of a direct connection, traffic must use on and off ramps (United States, Australia, New Zealand) or slip roads (United Kingdom, Ireland) to access the other roads at the junction.

Grade Separated Intersection is planned and designed when average delay to vehicle increase at the intersection as per IRC, when total approaching traffic in peak hour increases 10,000 pcu/hr, we generally go for flyover.

5) **Grade Separated Interchange**

In the field of road transport, an interchange is a road junction that typically uses grade separation, and one or more ramps, to permit traffic on at least one highway to pass through the junction without directly crossing any other traffic stream. It differs from a standard intersection, at which roads cross at grade.

Trumpet Interchange at 3 arm Road and (b) Clover leaf Interchange at 4 arm road.
In these sessions you read about the various transport system and also best practices in transport system, now you would be able to answer the questions given in Check Your Progress 1

**Check Your Progress 1**

**Note:**

a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit

1) What do you mean by Transport Systems?

2) Explain Briefly Road Transportation with Example.

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**3.6 TRANSPORT SYSTEM MANAGEMENT**

Transport System Management is the planning, monitoring, and controlling or influencing of traffic modes. It aims to:

- Maximise the effectiveness of the use of existing infrastructure;
- Ensure reliable and safe operation of transport;
- Address environmental goals; and
- Ensure fair allocation of infrastructure space (road space, rail slots, etc.) among competing users.

Transport System Management (TSM) maximises the capacity of the street system and reduces the demand on it. Although some of them may be expensive to implement, TSM measures are typically low cost localized improvements that attempt to take full advantage of the existing street infrastructure thereby increasing the efficiency of the street system.

The spectrum of TSM measures is wide; the measures that are applicable will generally fall into one of six categories listed below:

1) Regulatory Techniques
2) Traffic Control Devices
3) Traffic Segregation Techniques
4) Demand Management Techniques
5) Bus Priority Techniques
6) Self-Enforcing Techniques

3.6.1 Regulatory Techniques

The regulatory techniques are further divided into 5 management techniques listed below:

a) One Way Street
b) Reversible Streets
c) Reversible lanes
d) Turning Moment Restrictions
e) Closing Streets

a) One Way Street

This is a technique where vehicle moments are possible only in one direction. It optimizes the road capacity and minimizes the conflict. It is best suited if the network is Grid Pattern.

Reasons for being one-way:

- The street is too narrow for movement in both directions and the road users unable to co-operate.
- To prevent drivers from cutting through residential streets (rat runs) to bypass traffic lights or other requirements to stop.
- Part of a one-way pair of two parallel one-way streets in opposite directions (a divided highway).
- For a proper functioning of a system of paid parking or other paid access.
- To increase traffic flow and potentially reduce traffic congestion.

b) Reversible Streets

It is a technique adopted on the way where one direction traffic is about twice the other direction. To adopt this technique, another parallel street should be available to accommodate those traffic.
c) **Reversible Lanes**

It is a lane in which traffic may travel in either direction, depending on certain conditions. Additional lane should be provided to the peak flow direction by squeezing the carriage way width of opposite traffic flow. Typically, it is meant to improve traffic flow during rush hours, by having overhead traffic lights and lighted street signs, notify drivers which lanes are open or closed to driving or turning. The presence of lane controls allows authorities to close or reverse lanes when unusual circumstances (such as construction or a traffic mishap) require use of fewer or more lanes to maintain orderly flow of traffic.

- This technique is normally implemented if road is more than 4-lane.
- Traffic cones are generally used to delineate boundary of additional area taken away from opposite carriage way.

![Reversible lane during (a) Morning and (b) Evening Peak hours.](image)

**d) Turning Movement Restrictions**

It is a technique used where the turning movement of the vehicles is restricted or banned to minimise the conflict points. It also helps to minimise the traffic signal phases at crowded intersection.

**e) Closing Streets**

It is a technique adopted to improve the flow on the main street by minimising conflicts. The side street may be used for the parking purposes or the pedestrian purposes according to the requirements.

### 3.6.2 Traffic Control Devices

The various traffic control devices used for the traffic management are:

a) Traffic Signs
b) Traffic Signals
c) Road Markings
d) Computerised Signal Control device
e) Traffic Cone and Drums
f) Speed Breakers
a) **Traffic Signs**

Traffic signs or road signs are signs erected at the side of or above roads to provide information to road users. As per IRC specifications, the road signs can be broadly classified into:

- Informatory Signs (They are Shown in Rectangle)
- Cautionary Signs (Also known as warning Sign, shown in triangle)
- Mandatory Signs

![Examples of (a) Informatory Signs (b) Cautionary Signs (c) Mandatory Signs](image)

b) **Traffic Signals**

These are important for orderly traffic movement and it also helps the pedestrians to cross in heavy traffic stream.

c) **Road Surface Markings**

Road surface marking is any kind of device or material that is used on a road surface in order to convey official information. They can also be applied in other facilities used by vehicles to mark parking spaces or designate areas for other uses. Road surface markings are used on paved roadways to provide guidance and information to drivers and pedestrians. Uniformity of the markings is an important factor in minimizing confusion and uncertainty.

![Road surface markings to differentiate right and Straight Traffic Movements.](image)

d) **Computerised Signal Control Device**

ITS technology is used to regulate the traffic flow. Cycle time is optimized according to the cycle volume at morning, evening and non-peak hours. A computerised signal control device is placed at intersection whereby the information is transferred to the control room and signal operation is controlled to minimise the delay.
e) **Traffic Cone and Drums**

These are portable temporary devices used to delineate the diverted path.

![Traffic cone and Traffic Drums used to segregate the flow](image)

f) **Speed Breakers**

This is a traffic control device which alerts the driver of the change in condition and to break the speed of the vehicle. Nowadays, rumble strips and sleeping policemen are also used.

![Speed Breaker](image)

### 3.6.3 Traffic Segregation Techniques

The various traffic segregation techniques used are:

a) **Vehicle-Vehicle Segregation**

It is a technique used to separate slow moving vehicles from the fast moving. Basically, it is observed in CBD areas, where slow moving vehicles are confined to outer areas.

b) **Pedestrian-Vehicle Segregation**

It is a technique used to separate pedestrians from the moving vehicles. The various techniques used under this are:
i) **Longitudinal Segregation**
   It includes the separate footpath provided to the pedestrians. It prevents the conflicts between the pedestrians and the vehicles.

ii) **Lateral Segregation**
   These are done for safe crossing of pedestrians across the road, which includes zebra crossing, pedestrian traffic signal, foot over bridge, pedestrian sub way etc.

iii) **Total Segregation**
   If the pedestrian movement is large, then the street is made exclusively for pedestrians only, i.e., pedestrian mall.

iv) **Special Segregation Technique**
   These are the techniques which are meant for cyclist or bushes.

c) **Time Segregation**
   It is a technique meant to regulate the specific traffics at different times of the day. For example, heavy vehicles are not allowed in peak hours in busy areas.

### 3.6.4 Demand Management Techniques

The various demand management techniques used are:

1. **Parking Restriction**
2. **Parking Pricing**
3. **Off Street Parking and Pay Area**
4. **On street parking meters**
5. **Park and ride systems**

i) **Parking Restriction**
   It is a technique where parking may be restricted in the CBD area or the core areas where there is limitation of space for parking. On-street parking avoided if traffic flow is more on the corridor.

ii) **Parking Pricing**
   It is a tool used for enforcing on-street parking policy, usually related to the traffic and mobility management policies in order to reduce the demand for parking in the core areas. Pricing methods are being improved to make pricing more cost-effective, convenient and fair.

   For example, use of electronic pricing systems that accommodate various payment methods and rates, and allow motorists to pay for just the amount of time they will be parked. For short-term parking, it is charged by the minute rather than by the hour, and for long-term parking, it is charged by the hour rather than by the day or month.

iii) **Off street Parking and Pay Area**
   According to land availability and the demand for parking, off-street parking is created with a specific parking tariff.
iv) **On street Parking Meters**
   In this case, a meter may be installed on the on-street parking such that the demand reduces and the traffic flow is not hampered.

v) **Park and Ride Systems**
   Large off street parking is created to enable motorist to park their vehicle and switch to public transport to reach workplace, CBD etc.

### 3.6.5 Bus Priority Techniques

The various bus priority techniques used are:

a) **Bus Priority Maneuvers**

b) **Bus Lanes**

c) **Bus Priority Signal system**

a) **Bus Priority Maneuvers**

It is a technique to give priority to buses by permitting them turning movements which are prohibited to other vehicles.

b) **Bus Lanes**

A bus lane or bus only lane is lane restricted to buses on certain days and times, and generally used to speed up public transport.

- Such lane is either with-flow bus lane and contra-flow bus lane.
- The with flow bus lane should be proposed if frequency of the buses is 60 per hour in number or the 1.5 times the passenger moved by other vehicles.

![Image and Plan showing Bus lanes](image)

**Contraflow:** These techniques are generally adopted in one way road; (ii) Minimum no of bus per hour 30; and (iii) here some emergency vehicle and school bus may be allowed.
3.6.6 Self-enforcing Techniques

These are some techniques which ensure traffic discipline automatically. The various techniques used are:

1) Central Divider
2) Railing
3) Parabolic Dividers
4) Channelisers
5) Parking Notches
6) Sleeping Policeman

**c) Bus Priority Signal System**

By providing Bus priority signal, public transport may be promoted.
3.7 RESOURCES COMPONENT OF URBAN TRANSPORT

Delhi Traffic Police established a Road Safety Cell in 1972 to generate awareness among road user. It is an educational wing of the Delhi Traffic Police and its main function is to educate the road users as regards the proper and safe use of roads as well as to develop the human resources who are responsive to public and are technically competent. The training programmer is meant to encompass the whole range of road using citizens, from a common pedestrian to a vehicle driver.
3.7.1 Human Resource Requirement

The ideal number of human resources required for urban transport management is follows:

- Minimum 1600 Police Personals per traffic Police range.
- One Traffic Training park for 10 lakh population. Hence New Delhi requires 19 Traffic training parks.
- Number of Traffic police personnel on every intersection installed with CC TV Cameras should be two.
- Min 6 Traffic Police Personnel should be deployed in each intersection without use of CCTV Camera.
- 100 Traffic police Personnel required per Lakh Population.
- For every 10 Km length of ARTERIAL road 4 Traffic Police personals should be deployed.
- One TRAFFIC MANGEMENT CONTROL CENTER(TMCC) for the whole city and One small traffic control center for each planning zone.

3.7.2 Infrastructure and Vehicle Requirements

The deal quantum of infrastructure and vehicle requirements for traffic management is as follows:

- At least 2 CCTV Cameras for one Arterial interaction
- 1 CCTV camera on 3 legged intersection where Traffic flow is more than 5000 PCUs per hour
- One Motorcycle for HC, ASI rank
- 1 Gypsy each for Senior Inspector rank
- 2 Interceptors per Police districts
- 2 Light cranes per Field inspector
- 3 Heavy Cranes per district
- 1 super heavy crane per Police Range
- 4 Ambulance per district
- 3 Recovery Vans per Police District
- One Toying Van per Field inspector

(a) Training Centre (b) Traffic Police Kiosk (c) Recovery Van (d) Traffic Control Room
Suggested Movement of Traffic System Management around the Sarojani Nagar Market

Projected peak demand: 1800 ECS
Parking at Multi-storeyed parking lot by DLF: 800
Total parking supply in adjoining areas: 580 ECS
Shortage: 420 ECS
Plan of Future Pedestrian Movement

In these sessions you read about the transport management, human resources requirement of transport system and also best practices in transport management, now you would be able to answer the questions given in Check Your Progress 2.

Check Your Progress 2

Note: a) Write your answer in about 50 words.
b) Check your answer with possible answers given at the end of the unit

1) Name various traffic control devices.

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2) What are various techniques used for automatic traffic discipline?

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3.8 LET US SUM UP

Transport system is an important arm of the urban development. In this unit on transport system and management, several of types of transport, transport and traffic management and manpower requirement of the urban transport has been described. This unit also gives a pictorial description of case studies on best practices in traffic management.

3.9 ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AADT</td>
<td>Annual Average Daily Traffic</td>
</tr>
<tr>
<td>BRT</td>
<td>Bus Rapid Transit</td>
</tr>
<tr>
<td>CPCB</td>
<td>Central Pollution Control Board</td>
</tr>
<tr>
<td>ECS</td>
<td>Equivalent Car Space</td>
</tr>
<tr>
<td>DIMTS</td>
<td>Delhi Integrated Multimodal Company</td>
</tr>
<tr>
<td>DTC</td>
<td>Delhi Transport Corporation</td>
</tr>
<tr>
<td>HCM</td>
<td>Highway Capacity Manual</td>
</tr>
<tr>
<td>IDFC</td>
<td>Infrastructure Development Finance Company</td>
</tr>
<tr>
<td>IPT</td>
<td>Intermediate Public Transport</td>
</tr>
<tr>
<td>IRC</td>
<td>Indian Road Congress</td>
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<tr>
<td>IUT</td>
<td>Institute of Urban Transport</td>
</tr>
<tr>
<td>JNNURM</td>
<td>Jawaharlal Nehru National Urban Renewal Mission</td>
</tr>
<tr>
<td>LOS</td>
<td>Level of Service</td>
</tr>
<tr>
<td>LRT</td>
<td>Light Rail Transit</td>
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<tr>
<td>MoUD</td>
<td>Ministry of Urban Development</td>
</tr>
<tr>
<td>MRTS</td>
<td>Mass Rapid Transit System</td>
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<tr>
<td>MUZ</td>
<td>Multi Utility Zone</td>
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<tr>
<td>NHAI</td>
<td>National Highway Authority of India</td>
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<td>NHDP</td>
<td>National Highways Development Project</td>
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<tr>
<td>NUTP</td>
<td>National Urban Transport Policy</td>
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<tr>
<td>PCU</td>
<td>Passenger car Unit</td>
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<tr>
<td>PMGSY</td>
<td>Pradhan Mantri Gramin Sadak Yojana</td>
</tr>
<tr>
<td>pphpd</td>
<td>Persons Peak Hour per Direction</td>
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<tr>
<td>PRT</td>
<td>Personal Rapid Transit</td>
</tr>
<tr>
<td>ROW</td>
<td>Right of Way</td>
</tr>
<tr>
<td>TSM</td>
<td>Traffic System Management</td>
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</table>

3.10 REFERENCES AND SELECTED READINGS


- ASVV, Recommendations for Traffic Provisions in Built Up areas, 1998 Centre for Research and Contract Standardization ion Civil Engineering (CROW), The Netherlands

- B. Immers- B. Egeter- R.V.Nes, Handbook of Transport Engineering,
3.11 CHECK YOUR PROGRESS: POSSIBLE ANSWERS

Check Your Progress 1

1) What do you mean by Transport Systems?
The transport system and management can be broadly categorized into three aspects: (i) Transportation system: A facility consisting of the means and equipment necessary for the movement of passengers or goods; (ii) The Transportation Systems Sector—a sector that comprises all modes of transportation (Aviation, Air, Mass Transit, Highway, Freight, Rail, and Pipeline), is a vast, open, interdependent network system that moves millions of passengers and millions of tons of goods; and (iii) The Transportation network is critical to the Nation’s economic progress. Every day, the transportation network connects cities, provided mobility requirement at a desired accessibility levels and particular level of service.

2) Explain Briefly Road Transportation with Example.

India has a network of National Highways connecting all the major cities and state capitals, forming the economic backbone of the country. As of 2010, India has a total of 70,934 km of National Highways, of which 200 km are classified as expressways. Under National Highways Development Project (NHDP), work is under progress to equip some of the important national highways with four lanes; also there is a plan to convert some stretches of these roads to six lanes. As per the National Highways Authority of India (NHAI), about 65% of freight and 80% passenger traffic is carried by the roads. The National Highways carry about 40% of total road traffic, though only about 2% of the road network is covered by these roads. Average growth of the number of vehicles has been around 10.16% per annum over recent years.

Check Your Progress 2

1) Name various traffic control devices.

The various traffic control devices used for the traffic management are:

- Traffic Signs
- Traffic Signals
- Road Markings
- Computerised Signal Control device
- Traffic Cone and Drums
- Speed Breakers

2) What are various techniques used for automatic traffic discipline?

There are some techniques which ensure traffic discipline automatically. The various techniques used are:

- Central Divider
- Railing
- Parabolic Dividers
- Channelisers
- Parking Notches
- Sleeping Policeman