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The Sustainable Development Goals (SDGs) are a bold, universal agreement to end poverty in all its dimensions and craft an equal, just and secure world – for people, planet and prosperity by 2030 - by UNITED NATIONS

The 17 SDGs comprise of 169 targets to be achieved by 2030

The Government of India has played a leadership role in defining the SDGs.
**01 Introduction**

### WHY WAS THE GUIDELINE DEVELOPED?

In 2015, the United Nations announced Agenda 2030, a mandate of development aimed at ending all forms of poverty in all countries, and to promote prosperity while protecting the planet. This Agenda, popularly known as Sustainable Development Goals, is a call to action for people, prosperity and planet.

Since 2017, TRIPP, IIT Delhi has been working on SDG Oriented Planning and Design in Small cities and Community Participation to develop approaches for Tier II and Tier III cities to adopt transport related SDGs in their city. One of these cities, the city of Patiala has one of the highest number of vehicles per capita in the country; a rate of 5 deaths every month due to road accidents.

Indian Road Congress (IRC) provides various guidelines to road making agencies and engineers, to plan, design, and construct streets based on standards. Table 1 shows a list of multiple guidelines to be referred by planning authorities and engineers for multiple details. Some of these guidelines have been updated. However, there are no city specific guidelines that support planning and design integrated with the Sustainable Development Goals.

SDG Oriented Street Design Guideline (PART A & B) for Patiala, Punjab aligns the planning and design approach to road safety and transport in Patiala with Global Goals. It supports Patiala in developing a local agenda and vision oriented to the SDG framework. It delivers high quality planning and design of sustainable urban mobility roadmap (and related SDG targets) and street design according to international best practices and national policies and guidelines assisting the decision makers to develop SDG sound urban transport policies.

### WHO ARE THE INTENDED USERS?

Patiala city is the administrative headquarters of Patiala district of Punjab and is located in the south eastern part of the state. The guideline supports the city agencies to develop a planning and design approach for implementing SDG oriented streets.

The agencies primarily include Patiala Urban Development Authority (PDA) established in 2002, which has the responsibility for balanced development including the areas in and around the Patiala’s Municipal limits.

Patiala Municipal Corporation is responsible for governing, developing and managing the city and related urban services. All road making agencies such as Public Works Department, Water and Utilities, Electricity Department report to the Hon. Commissioner of Patiala Municipal Corporation.

The guideline can also be used by other government and non-government organizations, consultants working on streets, transport and road safety. This can also be useful to students from design, engineering and planning institutions.

### HOW WAS THE GUIDELINE DEVELOPED?

As part of the project, the guideline aligns the Master Plan of Patiala 2009-2031; one year after the targeted completion of Sustainable Development Goals in 2030.

First Information Report (FIR) data was collected from respective police stations of the city. Based on the fatality data, high crash locations were determined and audited with the ‘Urban Road Safety Audit’ toolkit. The audit results indicated deficiencies in pedestrian infrastructure, a complete neglect of bicycle infrastructure and poor signage on the streets.

Over discussion with local authorities, Street Design Guideline was developed to support PUDA and MC Patiala, mainly responsible for planning and design of the road network of the city. A draft guideline was presented in a city level workshop in Feb 2019 and all stakeholders shared inputs and scope of improvement.

Proposed design were exhibited in a six week long public exhibition at 4 different locations in the city. Based on the inputs by IATSS and city authorities, the draft guideline was revised & presented to the city authorities in September 2019.

### STRUCTURE & CONTENT

The guideline has been developed in two parts. Part A covers planning guidance and focuses on the importance of integrating SDG in the master plan process.

This guideline provides a summary of Patiala street network and its road safety statistics followed by other design issues faced by various user groups in the city. Localization of the transport SDGs in city of Patiala - SDG 3.6 (Reduce road injuries and death), SDG 3.9 (Urban air pollution PM10 & PM2.5) and SDG 11.2 (Affordable & sustainable transport systems) has been covered in this study.

SDG Integrated Master Planning assists local governments and urban development authorities like PUDA to integrate their upcoming master plan with a strategy and road map to integrate SDG comprehensive mobility vision that leaves no one behind. It offers a course correction to development trajectory of cities so that they can grow with sustainable mobility choices and projects.

Part B covers design guidance and offers support to develop SDG oriented street design.
<table>
<thead>
<tr>
<th>IRC Code</th>
<th>Name</th>
<th>Details for city engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRC:11-2015</td>
<td>Recommended Practice for the Design and Layout of Cycle Tracks. (First Revision)</td>
<td>Road cross sections; Dimensions for cycle tracks (width, slope); Design details (pavements, edges, lighting, street furniture, traffic calming, signage etc.); Services and Utilities</td>
</tr>
<tr>
<td>IRC:35-2015</td>
<td>Code of Practice for Road Markings (Second Revision)</td>
<td>Material, Colour classification, Classification of markings (carriageway, edges, intersections etc.), Dimensions</td>
</tr>
<tr>
<td>IRC:65-2017</td>
<td>Guidelines for Planning and Design of Roundabouts (First Revision)</td>
<td>Planning and design of roundabouts</td>
</tr>
<tr>
<td>IRC:67-2012</td>
<td>Code of Practice for Road Signs (Third Revision)</td>
<td>Material, Placement, Dimensions and colour, Maintenance etc. of signs</td>
</tr>
<tr>
<td>IRC:69-1977</td>
<td>Space Standards for Roads in Urban Areas</td>
<td>Typical cross sections for various category of urban streets</td>
</tr>
<tr>
<td>IRC:70-2017</td>
<td>Regulation and Control of Mixed Traffic in Urban Areas (First Revision)</td>
<td>Traffic capacity on roads, Segregation of traffic, One way traffic streets, Bus bays, Loading/Unloading bays, Bicycle and pedestrian infrastructure requirements</td>
</tr>
<tr>
<td>IRC:79-1981</td>
<td>Recommended Practice for Road Delineators</td>
<td>Design standards for road delineators, reflectors and hazard markers</td>
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<tr>
<td>IRC:86-1983</td>
<td>Geometric Design Standards for Urban Roads in Plains</td>
<td>Cross sectional elements; Design of medians, kerbs and camber; alignment details, curve designs</td>
</tr>
<tr>
<td>IRC:92-2017</td>
<td>Guidelines for Design of Interchanges in Urban Areas (First Revision)</td>
<td>Planning interchanges</td>
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<tr>
<td>IRC:93-1985</td>
<td>Guidelines on Design and Installation of Road Traffic Signals</td>
<td>Technical aspects of signals, Height, Foundation, Maintenance</td>
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<tr>
<td>IRC Code</td>
<td>Name</td>
<td>Details for city engineers</td>
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<tr>
<td>IRC:99-2018</td>
<td>Guidelines for Traffic Calming Measures in Urban and Rural Areas (First Revision)</td>
<td>Traffic calming techniques, Dimensions and arrangement of various traffic calming measures, traffic calming at junctions,</td>
</tr>
<tr>
<td>IRC:103-2012</td>
<td>Guidelines for Pedestrian Facilities (First Revision)</td>
<td>Design standards for pedestrian facilities (width, height, pavement type, kerbs, kerb ramps etc.); disabled friendly requirements; maintenance of footpaths, pedestrian crossing types and design; subway and footover bridge specifications; Street furniture details)</td>
</tr>
<tr>
<td>IRC:106-1990</td>
<td>Guidelines for Capacity of Urban Roads in Plain Areas</td>
<td>Level of Service for urban roads, recommended design service volumes for urban roads, measures to improve capacity of urban roads</td>
</tr>
<tr>
<td>IRC:124-2017</td>
<td>Bus Rapid Transit (BRT) Design Guidelines for Indian Cities</td>
<td>Planning, design of Bus rapid transit system</td>
</tr>
<tr>
<td>IRC:SP:43-1994</td>
<td>Guidelines on Low-Cost Traffic Management Technique for Urban Areas</td>
<td>Techniques for regulating traffic, Details of traffic control devices (signs, markings, signals, barricades, cones, drums etc.)</td>
</tr>
<tr>
<td>IRC:SP:41-1994</td>
<td>Guidelines on Design of At-Grade Intersections in Rural &amp; Urban Areas</td>
<td>Intersection design (Capacity assessments, rotary/signalized, islands specifications, traffic control devices requirement and specifications)</td>
</tr>
</tbody>
</table>

Table 1: List of IRC guidelines for street design
Figure 1: Local Planning Area (2009 - 2031), PUDA
Source: http://www.pdpatala.in/master-plans/
Patiala city is the administrative headquarters of Patiala district of Punjab and is located in the south eastern part of the state. It is the fourth largest city of Punjab.

The city extends from 30°12’N to 30°27’N latitude and 76°11’E to 76°32’E longitude. Patiala is located 233 km from Delhi and 67 km from the state capital of Chandigarh. Patiala is well connected by a network of National, State and District roads.

The first urban local body, Municipal Committee of Patiala was established in 1904. The Office of Divisional Town Planner was set up in 1967 to develop the city in a planned manner. The first Master Plan of Patiala was prepared in 1971. The population of Patiala city, as per Census of 2011, is 406,192 and the Patiala Metropolitan Region is 446,246.

Patiala is a land locked city with an area of 50.11 square kilometres. The average density of Patiala city is 8106 per square kilometres. The ward densities vary between 420 persons to 900 persons per kilometre. The municipality is divided into 60 wards. Patiala Municipal Corporation is responsible for governing, developing and managing the city and related urban services.

The Patiala Urban Development Authority (PDA) was established in 2002. The authority has the responsibility for balanced development including the areas in and around Patiala’s Municipal limits. According to the Punjab Regional and Town Planning Development Act (2006), the Local Planning Area (L.P.A.) was notified in 2008 and the first Master Plan of Patiala was prepared for 2009-2031. This L.P.A. includes Patiala’s municipal limits, nearby Sanaur town, and 155 villages.

Figure 2 : Street in Patiala, India.

Figure 3: Patiala Road Network. Source : TRIPP, IIT Delhi

Figure 4: Population Source: Census 2011

Figure 5 : Population Projection for 2030
HOW DOES PATIALA TRAVEL?

Almost half of the population in Patiala walks or cycles to work. Based on the modal share for work trips in Patiala (census 2011), this constitutes 46% of the total trips.

The city has one of the highest number of vehicles per capita in the country and private modes of transport have a 40% modal share in Patiala. There is mere 11% share of people travelling in buses. These trips are probably of the buses connecting the peripheral areas of the city i.e. the nearby villages.

Most small cities and towns in India with a population less than 5 lakh, informal public transport (IPT) or para transit plays a major role as public transport system. Such systems exist in Patiala in the form of 7-seater and 3-seater auto rickshaws along with some cycle rickshaws and e rickshaws.

People face overcrowding and poor quality of vehicles. The absence of proper infrastructure for such systems also lowers their efficiency. The lack of any industries or manufacturing units near Patiala may also be considered a reason for an underdeveloped transport system (MC Patiala, 2013).

Figure 6: Modal Share for work trips in Patiala (Census 2011)

Figure 7: Mixed traffic on streets in Patiala

Figure 8: Feeder Services in Patiala
ROAD FATALITIES IN PATIALA

Road traffic injuries are the eighth leading cause of death and ninth leading cause of overall health loss in India. There is an urgent need to study the characteristics of traffic crash patterns so that remedial treatments can be adopted to improve the overall safety scenario. SDG Target 3.6 requires reducing road traffic cash deaths by 50% by 2030.

TRIPP collected the fatality data for the city of Patiala from the office of Senior Superintendent of Police in Patiala, where monthly records are available in the form of FIR’s. The data was collected for 2013, 2014, 2015 and 2016. All the FIR’s lodged under section 304A, which included cases in which at least one person died, were collected. From 2013 to 2016, 249 road traffic fatalities were recorded in Patiala. This means that every month 5 lives are lost in Patiala in road accidents.

The locations of all the recorded accidents in the city were marked on Google maps on the basis of description provided in each of the FIR’s. The Kernel Density method was used to calculate the density of fatal crashes in Patiala from 2013 to 2016 with a search radius of 150m.

The assessment of the FIR’s revealed that almost 80% of street users who die in road accidents are pedestrians, cyclists and motorcyclists.

- Motorised four wheelers (cars) are the most common striking vehicles in fatal road traffic crashes of Patiala, with more than one third share amongst the striking vehicles followed by trucks and buses.

- The motorised two wheeler users are the majority victims during the fatal road traffic crashes followed by pedestrians and bicyclists, thus being the vulnerable groups.

Figure 9 : Lack of pedestrian and cyclist infrastructure

Figure 10 : Road Accidents in Patiala
Figure 11: Road Fatalities Accident Map, (2013-16)

Figure 12: Striking Vehicle Type, TRIPP 2017

Figure 13: Victims, TRIPP 2017
- Motorised two wheeler users and pedestrians are mostly hit by motorised four wheelers (cars).

**Factors Contributing to Road Traffic Crashes are:**

- Vehicles move at a high speed increasing the risk of accidents. Non segregation of traffic leads to high risk to VRUs
- Cyclist accessibility and signage is neglected in the design of street infrastructure
- Lack of proper lighting
- Footpath lack continuity and the design does not follow national/international design guidelines.
- Pedestrian infrastructure is not maintained well. The footpaths are not disabled friendly. In the newer areas of Patiala, there is a near fatal lack of pedestrian infrastructure is absent.
- Pedestrian signals are missing at junctions
- Standard median design is lacking. This increases the risk for motorised vehicles.
- Lack of well designed parking spaces for para-transit vehicles such as e-rickshaw.
- Encroachments on pedestrian infrastructure by parked vehicles and structures. Lot of obstructions on footpath adds to the difficulty of pedestrians.
- Highways close to the city with high speed, heavy vehicles and motorised two wheelers sharing the carriageway.

**Figure 14: Road Traffic Crashes: Victim Vs. Impacting Vehicle Type**
Figure 15: An online, interactive mock-up of the Patiala mobility indicators dashboard. Developed for TRIPP by OpenCities Institute, Community Systems Foundation.
02 Issues

DESIGN ISSUES ON STREETS

• **Absence of Pedestrian Paths**: Streets are mostly devoid of any safe infrastructure like footpaths or refuge space. Streets have been asphalted to allow for movement of motorised vehicles.

• **Parking Encroachments**: Heavy encroachment of two wheelers and car parking on pedestrian infrastructure. This makes the pedestrian infrastructure unusable and forces the pedestrians to use the carriageway alongside motorised traffic.

• **Insufficient widths**: Many footpaths are not wide enough to ensure smooth and comfortable walking.

• **Obstructions**: The other obstructions apart from vehicular parking, include encroachments due to extension of abutting property, trees, bus stops and signages on the walking path.

  - Lack of amenities like toilets, kiosks, etc. A few toilets have been built but they are not enough. The toilets itself are built on footpath, causing abrupt discontinuation of pedestrian path. The design of the toilets and making them accessible for all needs to be re-looked into.

  - Lack of designated parking spaces: There are limited designated parking spaces. Most of the on-street parking is unmarked and free of charge.

• **No integration of feeder service**: Auto rickshaws, e-rickshaws, cycle rickshaws ply on streets. However, there is no provision of integrating bus stations for commuter convenience.

• **No provision for safe cycling**: There is a presence of cyclists, passenger cycle rickshaws and goods cycle rickshaws. However, all the above three modes are moving in unsafe conditions in a high speed corridor. With no provision of bicycle infrastructure, cyclists travel with motorised vehicles, risking their lives.

• **Unsafe and inaccessible pedestrian crossing**: Crossing facilities in the city are abysmal. Pedestrians and cyclists then need to cross 4-6 lanes of traffic. The medians lacks refuge island spaces.

• **Lack of universally access infrastructure**: All of
street infrastructure needs to be universally accessible. The existing bus shelters have been built without any consideration for people with disabilities. Signages, proper lighting, accessible ramps, use of tactile paving, easy boarding and alighting, route informations, etc., should be part of state of the art bus stations.

- **Design of integrated spaces for hawkers/vendors:** A lot of informal activity is present on the streets. The vendors stand along the street providing service to bus commuters, cyclists and pedestrians. Though they are generally seen as encroacher's by authorities, their presence also provides security on our streets. The need to integrate them in street design is critical.

- **Lack of planning to integrate service and utilities:** Light poles and power poles come in front of the pedestrian path and street edges. These are obstructions but also indicate a lack of planning so that they can be easily maintained in future without disturbing pedestrians and cyclists. Proper drainage has been not provided. This leads to water-logging and puddling, adding to inconvenience to people on the footpath and street edges.

- **Missing street infrastructure, signs and street marking:** There is a lack of resting places like seats and benches. These not only provide comfort but make the street attractive. Adding street furniture will add to the attractiveness of already existing formal and informal commercial stretches. Signages and marking play a critical role to inform street users.

- **Need for Safe Intersection design:** The current intersections comprise of signalised crossings, un-signalised crossings and roundabouts. However, there are basic flaws in the current geometry. They do not slow the traffic slow down and are not able to assist in safe crossings by pedestrians and cyclists.

- **Missing traffic signals:** The junctions are also unsafe since a lot of traffic signals are absent or are not in a working condition.

- **Signages:** There is lack of street signs for each street user. Also, lack of standardization of signs and non-compliance with signs recommended by Indian Road Congress was observed.

- **Marking:** Only a few pedestrian crossings were painted. There are other types of markings that complement signages and inform street users of the street environment. This is absent.
Air Quality has become a serious health issue in many Indian cities. Based on the PM10 measurements from 2016, the World Health Organisation (WHO) had estimated the annual PM 2.5 levels and Patiala was classified as the 13th most polluted city in the world.

With continuous exposure to such levels, it is very harmful for citizens living in Patiala and can lead to health hazards such as cancer, heart problems and asthma etc.

The particulate matter (PM10) pollution is above the WHO as well as the Indian Standards limit, throughout the year.
Agenda 2030 is a plan of action for people, planet and prosperity...determined to take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path. ...we pledge that no one will be left behind.

The 17 Sustainable Development Goals and 169 targets ... demonstrate the scale and ambition of this new universal Agenda ... seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls.

They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental

People: ... to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment.

Planet: ... to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.

Prosperity: ... to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature.

Peace: ... to foster peaceful, just and inclusive societies which are free from fear and violence. There can be no sustainable development without peace and no peace without sustainable development.

Partnership: ... to mobilize the means required to implement this Agenda through a revitalised Global Partnership for Sustainable Development, based on a spirit of strengthened global solidarity, focussed in particular on the needs of the poorest and most vulnerable and with the participation of all countries, all stakeholders and all people.

- Preamble, Transforming our world: the 2030 Agenda for Sustainable Development
In 2015, UN General Assembly adopted the Sustainable Development Goals to foster action oriented development towards people, peace and prosperity.

The Sustainable Development Goals are 17 bold yet achievable goals to end extreme poverty, fight inequality and build peaceful societies on a healthy planet; they provide a guiding framework to all countries, developing and developed, to enable national and sub-national governments orient planning, design and implementation to eliminate poverty in all forms and empower communities to become active agents to develop a safe, sustainable and resilient future by 2030.

5 billion people are projected to live in cities by 2030. All cities aim to increase prosperity, promote social inclusion, and enhance resilience and environmental sustainability. The SDGs can strengthen short and long term city planning objectives and outcomes, when aligned with existing planning frameworks and development priorities. They act as a rich tool to support local governments to bridge the gaps between the present scenario and the ambitious target for 2030.

Building on the principle of ‘leaving no one behind’, Agenda 2030 emphasizes on a holistic approach to achieve sustainable development for all.

SDGs are a **local agenda**, where targets need to be prioritised and adapted at the community level.

SDGs are a **collective agenda** – implementing the goals will require global cooperation on a scale and intensity that transcends traditional concepts of ‘partnership’.

SDGs are a **people’s agenda** – civil society is more than NGOs. People must be involved in the design, delivery, monitoring and evaluation of the SDGs on an ongoing basis and will improve effectiveness as well as accountability.

SDGs are **universal in nature**; they apply to all countries. They are integrated and mutually reinforcing. There are multiple goals that are cross cutting in nature such as SDG 13: Climate Action or SDG 11: Sustainable Cities and Communities, supporting low carbon and people centric approach to development.

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**UN SUSTAINABLE DEVELOPMENT GOALS**

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The genius loci of Indian cities is its vibrancy and diversity, visible in all aspects of urbanity, but especially so within its street life.

The present structure of our cities is predominantly high density and mixed land use. This results in short trip lengths and dependence on walking, bicycles and para-transit use such as non-motorised rickshaws, shared auto’s and e-rickshaws.

Street vendors bring vibrancy and life to our city streets, in their quest for earning a livelihood through hawking, street merchandise and informal trade. They are also the ones who contribute to sustainable soft mobility modes - walking and cycling.

Apart from the streets of the old and historic parts of most Indian cities, the human-scale of our urban environments has progressively decreased since the 1960’s. Enabling the viability and liveability factor in our cities, means creating a sensitive communication between the “built - enclosed; built - open; semi-built - open” urban spaces.

The current structure of our street planning focuses solely on moving vehicles. It ignores the spaces for walking, cycling and affordable public transit infrastructures. People first rather than vehicles will foster safe and accessible mobility for all users.

Key to the people first approach is recognizing that walking is the most universal form of transport. All cyclists, public transit riders and motorists begin their journey as pedestrians and therefore the transit and automobile network can only be as good as the pedestrian network that brings them to other modes of transit (Jeff Risom, in Mohan, D. 2012)

Cross-cutting across other goals, SDG 11 focuses on making cities inclusive, safe, resilient and sustainable. Each of the targets within this goal aims to:

- Ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums;
- Provide access to safe, affordable, accessible and sustainable transport systems for all;
- Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management;
- Protect and safeguard the world’s cultural and natural heritage;
- Reduce the number of deaths and the number of people affected due to disasters;
- Reduce the adverse per capita environmental impact of cities, due to air quality and municipal and other waste management;
- Provide universal access to safe, inclusive and accessible, green and public spaces to all;
- Strengthen national and regional development planning;
- Implement integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change;
- Build sustainable and resilient buildings utilizing local materials.
The transportation system and the way street spaces are allocated in the cities, is a clear indication of a societal attitude and mind-set. Transport planning is clearly car-oriented, with cars having priority on the high speed street stretches, at the intersections which minimize their waiting time, at flyovers that allow them to avoid the congestion, at market places that give them large parking spaces, and the list goes on.

While the authorities may apologize for badly maintained roads, they would never think of apologizing for the broken pedestrian paths, non-existent bicycle lanes and dilapidated bus shelters and the inefficient public transport now in place. Ravi, R. TRIPP Bulletin 2005

Figure 28: 5 advantages if people centric streets
SAFE STREETS ARE COMPLETE STREETS

Sustainable transport needs inclusive streets. Inclusive streets ensure not only safe mobility – reduced risks of traffic crashes – but also reduced street crimes and better social cohesion, and makes public transport, bicycling and walking attractive, and the preferred choice for commuting. Hence, Safe streets are complete streets. They ensure door to door mobility for all street users in a safe and seamless manner. They foster a community spirit since residents use streets to meet, access public spaces and socialize. There is strong evidence that sustainable urban mobility planning raises the quality of life in an urban area (Wefering, et al., 2014).

Safe Streets put pedestrians first. They prioritize vulnerable user groups like pedestrians and cyclists. Any type of streets, any width of streets needs to address the prerequisites of a pedestrian and a cycle. The approach is people centric and not car centric. The multi-dimensional experiences of the pedestrian, cyclist and passenger must all be considered as one, at the ‘eye-level’ of humans in the city.

Safe streets are forgiving in nature. The street environment allows the users to make ‘mistakes’.

Safe streets are more secure street. Newly emerging research confirms that the presence or fear of violence impedes activity levels and the ability to move outside freely, especially among populations that are more vulnerable to violence such as children, women, people with disabilities, and older adults,(Cohen, et al., 2013). Safe streets are inclusive and provide ‘eyes on street’. Integrating spaces for hawkers and vendors not only provide

Safe streets are for ALL: Design of inclusive streets gives a safe environment to all age groups and segregates population from high speeds and prevents injuries. Safe streets do not discriminate the elderly and the differently-abled.

Safe streets give clean air. The increased dependence on personal transport leads to high emissions. The more people use public transport or just walk and cycle, the cleaner the air.

A complete system of mobility within a city encourages a sense of equality among its citizens. People First Mobility fosters democracy as well as a sense of individual importance (Gehl 2010)
PRINCIPLES

1 Sustainable Safe Traffic System

Congestion continues to get worse as more and more people give up walking, cycling, and using public transport, which are better for the environment. A well functioning street infrastructure must meet the needs of all street users (Tiwari, 2002). The sustainable safe traffic system is based on the five principles on which the vision is based: functionality, homogeneity, predictability, forgivingness, and state awareness (Wegman, et al., 2008).

It focuses on three main points:

• a street environment with an infrastructure adapted to the limitations of the user. Designing a forgiving environment is key. The guideline focuses predominantly on this factor.

• Vehicles equipped with technology to simplify the driving task and provided with features that protect vulnerable and other users

• Street users that are well informed and adequately educated.

2 Social Usability

Streets are not only important for mobility but are vital public spaces of the city. As mentioned earlier, streets are tools for social cohesion. Streets are used by people to meet each other, do outdoor activities and access other public spaces of the city. This is an important component which separates a street from a road. This is where the ‘human factor’ influences. Detailing such as continuity, traffic calming, street furniture, lighting, shade, etc make the street more attractive and encourage usage.

3 Universal Accessibility

The integration of the concept of universal design has been completely missing from our streets. Street design has to be responsive to inclusiveness and accessibility for ALL. Pedestrians, therefore includes everybody i.e. differently-abled people, hawkers and street vendors, people carrying luggage, pregnant women, children, people travelling with infants either in hand or in stroller, etc. Invariably, the physical profile of a pedestrian covers all age groups and gender.
4 Captive Users

Indian cities, with their high population densities, mixed land use and short trips have an environment which naturally encourages walking. Added to that, high rates of poverty make the ownership of any type of vehicle, often even a bicycle, unaffordable.

Even if a vehicle is owned by a household of 4-5 persons, it may typically only be used by one person and the others may resort to other, less expensive means of transport like walking or IPT or Public transport, depending on their trip length. Very few people, who walk in the Indian cities, do so out of choice.

Streets must be returned to pedestrians, not only because pedestrians make up the majority of road users, but also because the efficiency of the overall system, including the performance of motorised vehicles, depends on meeting the demand of “captive pedestrians.”

Travel patterns of people living in informal housing or slums are very different from residents in formal housing. Generally, bicycles and walking account for 50-75% of the commuting trips for those in the informal sector. The formal sector is dependent on buses, cars and two wheelers. This implies that despite high risks and a hostile infrastructure, low cost modes exist because users of these modes do not have any other choice. They are captive users of these modes.

Figure 33: Captive users

Figure 34: Different design components of the Street for different users
Source: Code of Practice -I (Institute of Urban Transport, 2013)
5 Equitable Allocation of Street Space

Urban streets in India have a heterogeneous mix of traffic. These include the pedestrians, slow moving vehicles like bicycles, rickshaws both for passenger and freight movement and fast motorized vehicles like motorcycles, scooters, three wheelers, cars and public transport vehicles. The space occupied by each of these vehicles, accelerations and deceleration characteristics and possible maximum speeds by each user is variable. Therefore space allocation to different vehicles has to be carefully ensured according to their design speed to achieve a smooth and safe flow of traffic.

6 Modal Hierarchy

Pedestrians, non motorized users and the public transport users in urban areas form the basis of sustainable transport systems. Therefore designing a street space for these three user groups in priority is of utmost importance.

Chicago Department Of Transportation has adopted a pedestrian-first modal hierarchy for complete streets and all transportation projects and programs, from scoping to maintenance, will favor pedestrians first. (CDOT, 2012)
04 Localising Transport SDGs

Sustainable transport has an impact on several other sectors and SDGs. Without substantial achievement of transport targets, many SDGs risk under achievement. Road Safety and Air Pollution are two key areas while looking at an SDG oriented planning and design approach with Patiala. The main target is to decrease the number of traffic fatalities as well as bring down the air pollution. Access to sustainable public transport also remains key. A number of interventions are required that SDG can be used as a guiding light. These are:

- Traffic conflict analysis: Understanding road accident crashes at high crash locations
- Monitor air pollution: Collection and review data on air pollution and particulate matter
- Promote Safe Street Design: Design and implement safety principles in streets for all road users; giving priority to pedestrians and cyclists
- Improve Traffic Management: Improve street geometry and design safer intersection design.

For SDG & mobility in Patiala, Target 3.6 and 3.9 have been selected to report on SDG 3: Good Health and Well Being; Target 11.2, 11.6, 11.7 have been identified from SDG11: Sustainable Cities & Communities.

Figure 37: Identified SDG Targets and Indicators

<table>
<thead>
<tr>
<th>SDG 3: GOOD HEALTH &amp; WELL BEING</th>
<th>SDG 11: SUSTAINABLE CITIES &amp; COMMUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target 3.6</strong></td>
<td><strong>Target 11.2</strong></td>
</tr>
<tr>
<td>By 2030, halve the number of global deaths and injuries from road accidents</td>
<td>By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all</td>
</tr>
<tr>
<td><strong>Target 3.9</strong></td>
<td><strong>Target 11.6</strong></td>
</tr>
<tr>
<td>By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination</td>
<td>By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management</td>
</tr>
<tr>
<td><strong>Target 11.7</strong></td>
<td><strong>Target 11.7</strong></td>
</tr>
<tr>
<td>By 2030 provide universal access to safe, inclusive and accessible green and public spaces</td>
<td>By 2030 provide universal access to safe, inclusive and accessible green and public spaces</td>
</tr>
</tbody>
</table>
Figure 38: An online, interactive mock-up of the SDG Data dashboard. Developed for TRIPP by OpenCities Institute, Community Systems Foundation.
FRAMEWORK FOR ACTION

SDGs provide an umbrella framework and guidance to authorities to monitor progress, effectiveness and sustainability of urban transport in their cities. These may have been lacking in many aspects of development or community change.

Initiating work on Sustainable Development goals so as to ‘leave no one behind’ requires developing a baseline and meeting various user groups. A number of discussions were done with various stakeholders through meetings, workshops and consultations. These included District Administration, Municipal Corporation, Punjab Urban Development Authority (PUDA), Traffic Police, TRIPP IIT Delhi, Researchers, Thapar University, Citizen groups, Local NGO’s, Patiala Foundation with support from IATSS team.

The framework also assists in setting up a local agenda and identifying goals and targets. This weaves into any long term planning that exists or can support in planning one.

INPUTS
• Stake holder consultations and Meetings
• Workshops
• Perception Survey

ACTIVITIES
• Data Collection and Analyses
  FIR Data collection from all the police stations inside the city boundary, coding the FiRs, extracting out the crash detail.
• Hotspot Analyses and Design Solutions
• Stakeholder consultation
• Linkages to SDG 3.6

OUTPUTS
• Exhibition for Community Participation
• SDG Planning and Design Guideline
• Pilot corridor - street design. Data Dashboard.
• Road safety & vehicular technology interventions
• Forecast for 2030
• Future Roadmap to achieve SDG 3.6

OUTCOMES
• Short Term : Reduction of crashes; improved traffic management; Including citizen’s opinions in the local agenda; Enhanced awareness towards equitable allocation of road space; Improving coherence in road design
• Mid Term : Promotion of walkability, connectivity and social cohesion; Integration of street vendors and hawkers, bus shelters, feeder services and utilities
• Long Term : Better Quality of Life; Safer streets and mobility; Better health and well-being; economic vibrancy
Target 3.9  
Reduce illnesses and death from hazardous chemicals and pollution

**INPUTS**
- Stakeholder consultations and Meetings
- Workshops
- Perception Survey

**ACTIVITIES**
- Data Collection - Installation of monitors
- Air pollution monitoring
- Analysis of annual data

**OUTPUTS**
- Exhibition for Community Participation
- Strategies/Recommendations to reduce air pollution

**OUTCOMES**
- Short Term: Monitor air pollution; Including citizen’s opinions in the local agenda; Increased aspiration on why and how to meet SDG goals by 2030
- Mid Term: Improved air quality monitoring and management;
- Long Term: Better Quality of Life; Better health and well-being; Economic vibrancy

Target 11.2  
Affordable and sustainable transport systems

**INPUTS**
- Stakeholder consultations and Meetings
- Workshops
- Perception Survey

**ACTIVITIES**
- Data Collection and Analyses
- Survey and Planning of current IPT network
- Review of city master plans
- Hotspot Analyses and Design Solutions
- Stakeholder consultation
- Linkages to SDG 3.6

**OUTPUTS**
- Exhibition for Community Participation
- SDG Planning and Design Guideline
- Draft Transport Chapter for City Master Plan
- Public Transport Improvement Plan - 2030
- Estimate Ridership Demand & Fleet Requirement
- Finalizing Route Structure and public transport routes

**OUTCOMES**
- Short Term: Introduction of buses; Including citizen’s opinions in the local agenda;
- Mid Term: Promotion of walkability, connectivity and social cohesion
- Long Term: Better Quality of life; Reduced dependency on private transport; Better mobility and accessibility; Better health and well-being; Economic vibrancy
SDG Oriented Street Design Guideline for Patiala, Punjab

05 SDG Integrated Master Plan

In the UN SDSN SDG Cities Guide, four basic steps for getting started with SDG implementation in cities have been proposed. These are:

i. **Initiate an inclusive and participatory process**: Raising awareness of the SDGs and engaging stakeholder collaboration to achieve the goals and targets.

ii. **Set the local SDG agenda**: Translating the global SDGs into an ambitious yet realistic agenda that is tailored to the local development context.

iii. **Planning for SDG implementation**: Deploying goal-based planning principles and mechanisms for more sustainable social, economic and environmental outcomes.

iv. **Monitoring and evaluation**: Ensuring that SDG implementation remains on track, and developing local capacity for more responsive and accountable governance.

It is critical to map the stakeholders and engage them through a participatory process. In Patiala, key government stakeholders working on transport related SDGs were mapped and their duties and responsibility was also reviewed. These include Patiala Urban Planning & Development Authority, Municipal Corporation of Patiala, State Transport Department, Punjab Municipal Development Company, Patiala Police and Public Works Department.

Feedback from citizens was collected and some suggestions to prepare the local agenda on transport are as follows:

- Design cycle tracks around the city
- Provide footpaths on every street
- Promote walking and cycling
- Improve Street Infrastructure
- Educate citizens about road safety
- Challans on 3-wheelers for wrong parking
- Upkeep and maintain the existing traffic lights
- Introduce more CNG vehicles on the streets
- Ban cars in market areas from 9am-9pm
- Introduce e-rickshaws
- Increase the use of helmets

A master plan is a blue print for the future. It is intended to guide the long view of development of any city for a period of 10-20 years.

The Patiala Urban Planning and Development Authority had prepared a master plan in 2009 with a long term view of 2031. This almost coincides with

Figure 39: Our Patiala 2030 : Travelling Exhibition in Patiala (Nov 18 - Feb 19)
KEY STAKEHOLDERS: GOVERNMENT

PATIALA URBAN PLANNING & DEVELOPMENT AUTHORITY
Development of Master Plans, Zonal and Layout Plans.
Land acquisition, pooling, township development, colony regulation including local streets.

MUNICIPAL CORPORATION, PATIALA
Implements Central and State level urban schemes such as AMRUT for initiatives in water, sewerage, storm water, drainage, transportation and recreational spaces.
Maintenance of Roads

STATE TRANSPORT DEPARTMENT (Road Transport Authority & District Transport Office)
Vehicle Registration data / issuing and renewing driving license
Members of State Road Safety Council Authorising Driving Schools
Vehicle Fitness Certificate Testing

PUNJAB MUNICIPAL INFRASTRUCTURE DEVELOPMENT COMPANY (PMIDC)
State level Nodal Agency for resource mobilization of AMRUT, Smart City, Swacch Bharat, etc and other central government initiatives

PATIALA POLICE
Traffic Management by Traffic wing
Road accidents data through FIR

PUBLIC WORKS DEPARTMENT (PWD)
State Government agency for construction, upgradation and maintenance of roads, buildings and bridges in the state.

Agenda 2030 and the advent of the new development goals that will follow SDGs.

The Comprehensive Mobility Plan for a city/study area is prepared to develop a transport strategy for the future to cater to the anticipated transport demand. Patiala CMP was developed in 2012.

The mobility plan seeks to “move people, not vehicles”. By emphasizing the pre-eminence of public transport and non-motorized transport and integrating the land use with transport networks, it seeks to achieve the objective of National Urban Transport Policy (NUTP).

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public transport share</td>
<td>0%</td>
<td>45%</td>
</tr>
<tr>
<td>Footpath coverage</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>Number of fatalities per 100,000 population</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>NMT share</td>
<td>35%</td>
<td>45%</td>
</tr>
</tbody>
</table>

Patiala CMP Goals for year 2031 (no supporting data available)

Some observations are listed below:

**Road Network of Patiala:**
- Only Major roads of Patiala listed
- No existing road hierarchy details/map available
- Map/details of the major intersections of the city aren’t available

**NMT Infrastructure**
- Proposed 100% walk-ability i.e. provision of footpaths on all mobility corridors and secondary arterial
- Pedestrian only streets in dense areas of old city (area not specified)
- NMT Infrastructure, including footpaths and bicycle lanes – no inventory or details available
- Regularization or provision of hawking zones near streets
- Pedestrian crossings in front of educational institutions, hospitals, transport terminals

**Freight Movement**
- Restriction of freight movement in city from 9 am
SDG Oriented Street Design Guideline for Patiala, Punjab

Phase I (2010-2020)
Cost – INR 1633 Cr
- Traffic management
- Core city plans (NMT zones, traffic circulation)
- Construction of footpaths, pedestrian crossings
- Junction improvements
- Public Transit augmentation and improvement
- Parking management along with construction of parking plazas at suggested locations

Phase II (2020-2030)
Cost – INR 1622.5 Cr
- Focus on mass transit, feeder services, bus shelters, bus bays etc.
- Construction of bus terminals, intermodal stations
- Development/up gradation of mobility corridors
- Creation of Pedestrian safe environment along all corridors and accessibility to transit corridors
- Missing link roads and new roads to enhance mobility

Proposed Plan, CMP Patiala

- Traffic management
- Core city plans (NMT zones, traffic circulation)
- Construction of footpaths, pedestrian crossings
- Junction improvements
- Public Transit augmentation and improvement
- Parking management along with construction of parking plazas at suggested locations

Planning Roadmap

1. Look at Freight in long term planning - movement of passenger as well as freight.
2. Planning can influence the demand for car parking. The master plan should design and planning of streets that is aligned to ‘moving people. not vehicles’.
3. Planning can develop, enhance and amplify active nodes of transport by integrated public transport and para-transit.
4. Planning can guide the layout of road network that promotes walkability, social cohesion & safety, and make it universally accessible by all.

Total Population 2011: 406192
Total Population 2031: 754000

Patiala 2031

- Reduce the overall parking demand gradually
- To retain the current 46% of NMT share as per Census 2011
- Road Network Development: Pedestrian friendly - Disabled friendly - Bicycle friendly
- Equitable road space allocation

- Bus system can be operated through the city with designated routes/schedules/fares/stops etc.
- Integration of various modes like buses and IPT to improve last mile connectivity
- Mapping future transport needs of the city

Suggestion aligned to SDG and derived from CMP Patiala
PUBLIC TRANSPORT IMPROVEMENT PLAN

According to mode of travel to place of work data (census, 2011), about 65 per cent of the existing trips in Patiala are within five kilometres distance. More than 15 per cent of the trips to work are more than 10 kilometres trip are supported by bus transport system.

For developing road map to improve public transport system in Patiala aligned to SDG 11.2, 10 minutes of headway for the project has been considered instead 20 minutes as mentioned in SDG 11.2 in the view of providing higher level of public transport services. Higher waiting time leads lower attraction towards public transport system and 10 minutes gives satisfactory waiting time for passengers.

The process followed is as follows:

1. **Existing city road network distribution**: The existing street network distribution indicates that 45 percent of collector streets (30km/h) are the majority. The combination of collector streets and access streets cover about 90 percent of the city. Arterial and sub-arterial streets cover only around 10 percent of the city road distribution.

<table>
<thead>
<tr>
<th>Street Type</th>
<th>Total Street Length (in Km.)</th>
<th>Total Street Length (in %)</th>
<th>Street Length in MC Boundary (in Km.)</th>
<th>Street Length in MC Boundary (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Street</td>
<td>41</td>
<td>18%</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>Sub Arterial Street</td>
<td>11</td>
<td>5%</td>
<td>10</td>
<td>8%</td>
</tr>
<tr>
<td>Collector Street</td>
<td>100</td>
<td>43%</td>
<td>59</td>
<td>46%</td>
</tr>
<tr>
<td>Access Street</td>
<td>79</td>
<td>34%</td>
<td>54</td>
<td>42%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>231</td>
<td>100%</td>
<td>129</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2: Street Typology, Patiala
2. **Location of trip attraction centers** - More than 50 percent of the trip attraction centres are located along the collector streets of the city. The trip attraction centres includes commercial activity centres, educational institutions, government organizations, recreational facilities, tourist sites, etc.

3. **Current Intermediate Para Transit (IPT) operational routes**: The IPT system existed in the city in the form of seven seated auto rickshaw, two seated cycle rickshaw and four seated e- rickshaws.

4. **Existing and Proposed landuse and Density of the city**: The proposed master plan of Patiala for 2031 observed that the tendency of growth of the city was along the transport corridors. High residential density zone (above 200 persons per acre) are around the walled city of Patiala. Medium density zones (151-200 persons per acre) fall within urban agglomeration (M.C+ Outgrowth) limits. Low density (101-150 & up to 100 net) are proposed along the road between Patiala-Samana road and Patiala-Bhunerheri road upto village boundaries.

   Based on this analysis, a public transport system for 2030 has been proposed. This includes:
   - 71.1 km of 8 standard city bus routes -
   - 25.4km of 2 mini bus routes
   - 40.8 km of 12 IPT routes
   - 6.9km of 1 moffusil route

   By 2030, total public transport system will be available over 143km of overall route length. With proposed route length, around 86% of area and population of city will be able to access public transportation within the distance of 500m. (SDG 11.2).

   However, 99% of the city will be able to access public transport within 1 km radius.
PHASE WISE IMPLEMENTATION

The phase wise implementation of proposed PT is planned in two phases. Each phase scheduled for 5 years of time period - 2025 and 2030.

The public transport system routes being introduced in Phase I is selected on the basis of availability of RoW for introducing public transport systems without much initiative, maximum coverage of trip attraction centres, current IPT Routes and city area & population.

Selection criteria for Phase II routes is based on area and population inaccessible to PT, connecting trip attraction centres left in the Phase I, providing connection to city out growth areas.

Phase I : 2025

During the Phase I, the proposed public transport system network covering around 68.5 kilometres of length includes,

- 38km (approx) of standard city bus route,
- 7km (approx) of mofussil bus route and
- 23km (approx) IPT route.

The implementation of Phase I covers around 65 percent of the city area being covered by 45% of city bus services.

Phase II : 2030

For the Phase II, the proposed public transport system network providing access around 68.5 kilometres of length overall, which includes,

- 30km (approx) of standard city bus service,
- 25km (approx) of mini bus service

<table>
<thead>
<tr>
<th></th>
<th>Total Length (in Km)</th>
<th>Total Length (in %)</th>
<th>In MC Patiala (in Km)</th>
<th>In MC Patiala (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Bus</td>
<td>71.1</td>
<td>49%</td>
<td>46.5</td>
<td>50%</td>
</tr>
<tr>
<td>Mofussil Service</td>
<td>6.9</td>
<td>5%</td>
<td>4.4</td>
<td>5%</td>
</tr>
<tr>
<td>Mini Bus Services</td>
<td>25.4</td>
<td>18%</td>
<td>8.0</td>
<td>9%</td>
</tr>
<tr>
<td>IPT</td>
<td>40.8</td>
<td>29%</td>
<td>33.3</td>
<td>36%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>143.3</td>
<td>100%</td>
<td>92.2</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 3: Proposed Public Transportation Plan 2030

Figure 43 : Proposed Public Transport Coverage (0.5km radius)

Figure 44 : Proposed Public Transport Coverage (1.0km radius)
17km (approx) IPT route.

Large share of the Phase II public transport plan is providing transport facility to the outgrowth areas of the Patiala.

The implementation of Phase II public transport covers around additional 21 percent of the city area increasing to 56% area coverage with additional coverage by 45% of bus transport services.

**HIGHWAY PASSING THROUGH THE CITY**

Based on the hotspots derived from the analysis, three areas were identified:

- **Head Post Office Road (Fountain Chowk to Leela Bhawan Chowk)**: It is a sub arterial street which carries one of the highest traffic volumes in the city of Patiala.

- **Rajpura Road (Near Santoshi Mata Mandir/Hotel Eqbal Inn)**: It is a sub arterial street in the city of Patiala which carries the entry and exit traffic of the city connecting the cities like Rajpura and Chandigarh.

- **Rajpura Road (Near Punjabi University)**: This is a high crash location in the vicinity of a premier educational institution of Patiala and even Punjab. It is a part of highway connecting Patiala to various other parts of Punjab and even other states.

Average Safety Score observed for the three high crash locations is 27 out of 100 (URSA Toolkit). Most of the fatalities in this area is due to high speed that needs to be controlled to achieve the desired safety levels. Any highway entering city boundary should be treated as an urban street and the speed and design should be governed by the typology of the street. The cross-section should be based on the design standards. (Refer SDG Oriented Street Design Guideline - Part B).

Appropriate crossing facilities should be designed. At stretches of high speed and high volume of vehicles, crossing facilities could vary from a half subway, full subway and a foot-over bridge. (Refer SDG Oriented Street Design Guideline - Part B).

Instead of providing “hard separation”, “audible markers” should be provided to define the line between the shoulder, where motorcycles usually go on the highways.
In the future, post agenda 2030, it is possible that a BRT system could be introduced in Patiala’s public transport system.

The Bus Rapid Transit system is a road based system that allows the buses to move separately in their exclusive lanes independent of the rest of the traffic.

In simple terms, the BRT upgrades the performance of the bus systems by providing them with exclusive right of way so they are no longer hampered by the movement of other vehicles. A direct result of this is an increase in their operating speeds leading to greater reliability and dependability. This in turn greatly increases the convenience provided to the users and more and more people are encouraged to use the new system.

OPEN & CLOSED SYSTEM

For instance, a BRT system cannot be considered complete without a lane on a city street being reserved for the exclusive use of buses. The exclusivity of this lane depends on the type of BRT system being used in the city. The two types of systems are: open systems and closed systems.

In an open system, buses are allowed to move out of the exclusive corridors and mix with the general traffic in order to increase the catchment area of the service.

The closed systems, on the other hand, function on the principle of allowing the buses to run only along the exclusive corridors.

Most importantly, implementing a BRT system forces the authorities to realize that bus rapid transit is complemented by pedestrian-oriented transport infrastructure development. So another major feature of this system is the integration of transit planning with pedestrian infrastructure development.

BENEFITS OF BRT

- Unlike the Metro system, the BRT system provides the planners with the flexibility of altering or changing its route as and when required. While this might be a little difficult in the case of closed systems, it is easily managed in an open BRT system.
- the routes of the bus network can also be changed with the city size and structure. This is extremely desirable keeping in mind the dynamic nature of Indian cities.
- BRT holds over any other public transport system is the relatively low capital needed for its planning and implementation.
- An important requirement for public transport use is safety from street crime. The presence of street hawkers and vendors ensures that streets are not lonely and people especially women and children feel safe.

BRTS NETWORK

BRTS network is a network of selected roads along which the buses run. This is also referred to as the route network for the system. As BRTS is a road based system, its efficiency would be influenced by the existing road network of the city. The road network in most Indian cities consists of four types of streets: local streets, collectors, arterial and highways.

Three aspects of geometric design are essential for system efficiency:

- Creating exclusive lanes for buses: This minimizes conflicts with other vehicles and therefore improves bus movements. Exclusive bus lanes can be provided either as curb-side lanes or central lanes, physically segregated from the rest of the traffic.
- Location and design of bus stops
- Non-motorized vehicle lanes

Components of BRT

Bus shelters should be located near the intersection. It will benefit commuters in two ways:

- Commuters can use at grade crossing when intersection traffic stops at red light.
- Commuters can access all approaches with minimum walking distance. This is especially
<table>
<thead>
<tr>
<th>Factor</th>
<th>Trunk-feeder system (closed system)</th>
<th>Convoy technique (Open system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population densities</td>
<td>Most efficient when a significant difference exists between the population densities along the major corridors and residential areas</td>
<td>Efficient when almost the same density exists along the entire route – the main corridor as well as the feeder areas</td>
</tr>
<tr>
<td>Type of system</td>
<td>Supports a closed system as the BRT buses run only along corridors with exclusive bus lanes</td>
<td>Works well in an open system as the buses leave the exclusive corridors at certain points and run along normal roads</td>
</tr>
<tr>
<td>Vehicle types</td>
<td>Employs two kinds of buses – the large ones for the main corridors and the smaller ones for the feeder routes</td>
<td>Same size buses run along both the main corridor as well as the residential areas</td>
</tr>
<tr>
<td>Travel time</td>
<td>Can potentially increase the total travel time as the passengers need to transfer but speed along the major corridors is maximized</td>
<td>Does not involve unnecessary transfers</td>
</tr>
<tr>
<td>Capacity</td>
<td>Higher capacity is available in the trunk lines</td>
<td>Higher capacity along trunk line is available through convoy of buses</td>
</tr>
<tr>
<td>Distance traveled</td>
<td>Works best if the average distance to be traveled is relatively long (10 km or more)</td>
<td>Works best for shorter distances as does not involve transfers unless specifically required by the passenger</td>
</tr>
</tbody>
</table>

Table 4: Open BRT System Vs Closed BRT System

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Central Bus Lane</th>
<th>Curb-Side Bus Lane</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excessive side-entries for vehicles into service lanes or individual plots.</td>
<td>Limited access to service lanes or widely spaced entry points into adjoining area.</td>
</tr>
<tr>
<td></td>
<td>The high volume of turning traffic interferes with the through movement of bus traffic if the bus uses the curb-side lane as the turning vehicles must cross this lane.</td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>Closely placed traffic lights for vehicles may be combined with bus shelters.</td>
<td>Traffic lights at larger intervals.</td>
</tr>
<tr>
<td>2</td>
<td>Buses using the curb-side lane face interference by turning traffic, therefore central bus lanes are preferred. If traffic lights are at larger intervals, distance between two bus shelters may be too long and a mid-block bus stop with pedestrians traffic light may be required.</td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>Higher volume of two-wheeler and three-wheeler vehicles</td>
<td>Lower volume of two-wheeler and three-wheeler vehicles</td>
</tr>
<tr>
<td>3</td>
<td>High volumes of two-wheeler and three-wheeler vehicles interfere with the movement of buses in the curb-side lane especially at the bus-shelters where buses often cannot approach the designated bus-bays due to the three-wheeler vehicles parked there and the two-wheelers trying to overtake from the left-side. Also, the difference in sizes of these vehicles sharing the curb-side lane makes the situation unsafe for the smaller vehicles.</td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: BRT System - Central Lane Vs Side Lane
beneficial for changing bus routes in the perpendicular direction.

Bus shelters can be located in the mid-block, away from intersection if spacing between consecutive intersections is more than 1.5 kms or there is a high demand destination/origin e.g. school or institutional building.

For eg. Patiala could opt for an open system with Bus stop as linear platform without overtaking lanes. This would apply when, areas of application

- Number of passengers : 8,000 – 14,000 people/hr/dir
- Length if platform =56, then the capacity is 3 buses. If the capacity is 4, 5, 6 buses; then the length increases to 68, 80, 92m respectively.

Minimum Right of Way Needed : 33.0m
- Without Service Lanes and with minimum two MV lanes for each direction
- With Cycle Track & Footpath for both direction (2.75m) MV Lane & 0.25m shy away distance)
- Additional M V Lane before junction (turning pocket) (3.0m MV Lane & 0.75m shy way distance)


Figure 50 : Proposed BRT Cross section

Figure 51: Proposed Plan for BRT system
**SDG Oriented Street Design Guideline for Patiala, Punjab**

**MYTHS: ROAD NETWORK**

**Wider the Carriageway - Less the Congestion**

This is a capacity enhancement measure and creating a more attractive infrastructure for motorised users, while creating hostile environment for pedestrians and cyclists.

**MYTHS: MOTORISED VEHICLES**

**Flyovers will be solve bottlenecks and congestion**

Flyovers shift bottlenecks but do not eliminate them. They do not serve the pedestrians, the cyclists and bus users.

**PUBLIC TRANSPORT = BUS**

**E rickshaws, auto’s and cycle rickshaws cater to the population and act as public transport for small-mid sized cities.**

**More parking will solve congestion**

Creating more parking is only a capacity enhancement solution which will serve in the short term. The land used for parking can be designed as quality public spaces that serve everyone.

Plan city for people, not vehicles. Patiala 2018
**MYTHS: DESIGNING FOR CYCLISTS**

**CYCLE SHOULD ONLY BE IN INTERNAL ROADS.**

India has a high share of current users and they will prefer using the road network which is more direct and faster.

NMT = BICYCLE.

NMT also covers tri pedal rickshaws and four wheeled vendor trolleys apart from others used for inclusive mobility.

**SEPARATE TRACKS ARE REQUIRED ONLY WHEN VOLUME OF CYCLISTS IS HIGH**

Separate cycle tracks are required on all high speed roads more than 30 m ROW to prevent conflict.

**THERE IS NO SPACE FOR CYCLE INFRASTRUCTURE.**

There is a lot of wasted space on the road. Equitable road space allocation can be easily done according to the classification of road to provide usable and safe cycle infrastructure.

**CYCLE IS USED PREDOMINANTLY BY MEN.**

A large number of women of all age groups use the bicycle and rickshaw for work and commutation.

**IN METROPOLITAN CITIES TRIP LENGTHS ARE LONGER. PEOPLE HAVE TO TRAVEL LONGER DISTANCES**

Nearly seventy percent of the trips are shorter than 10 kms regardless of city size. There are about a million cyclists in metropolitan cities like Delhi. The average trip length is about 10km.
**MYTHS: PLANNING FOR PEDESTRIANS**

**Disabled persons are taken care of. They do not need to be alone on the street**

**Street Hawkers create unsafe and chaotic environment**

**Person with Disabilities are not able to navigate the streets independently, as footpaths do not comply with universal accessible design standards.**

**There is no space for footpaths due to high volume of cars**

**Street edges lack proper thought and design, thereby wasting a lot of space, which if properly designed can provide ample space for footpaths**

**Foot-Over Bridges are the best way to cross roads**

**At grade crossing is the most comfortable way of crossing for pedestrians.**

**There are no planned spaces for street hawkers. Hawkers and vendors bring safety and vitality on Indian streets. They are essential for public life.**
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