CONSULTANCY SERVICE FOR PHYSICAL PLANNING OF TRANSIT INTERCHANGES IN AHMEDABAD (INDIA)

Task 3 : General guidelines and Concept Plan

Final Deliverable

AFD AGENCE FRANÇAISE DE DÉVELOPPEMENT

ARTELIA AREP urbz

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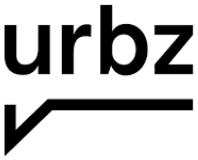
SUB-CONTRACTORS		URBZ ROOM NO.7, PASCO PATIL CHAWL KOLIWADA, DHARAVI MUMBAI 400 017

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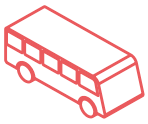
INTRODUCTION

From station analysis to general guidelines

OPEN SPACE DESIGN

- There is a lack of open space, or space is not available for specific activities



- BRT stations are poorly connected to the neighbourhoods they serve

- There is very little vegetation or shaded places that could polarized the areas

TRAFFIC MANAGEMENT

- There is little pedestrian infrastructure, and the major axis are hardly crossable

- Transport modes are competing rather than interconnecting

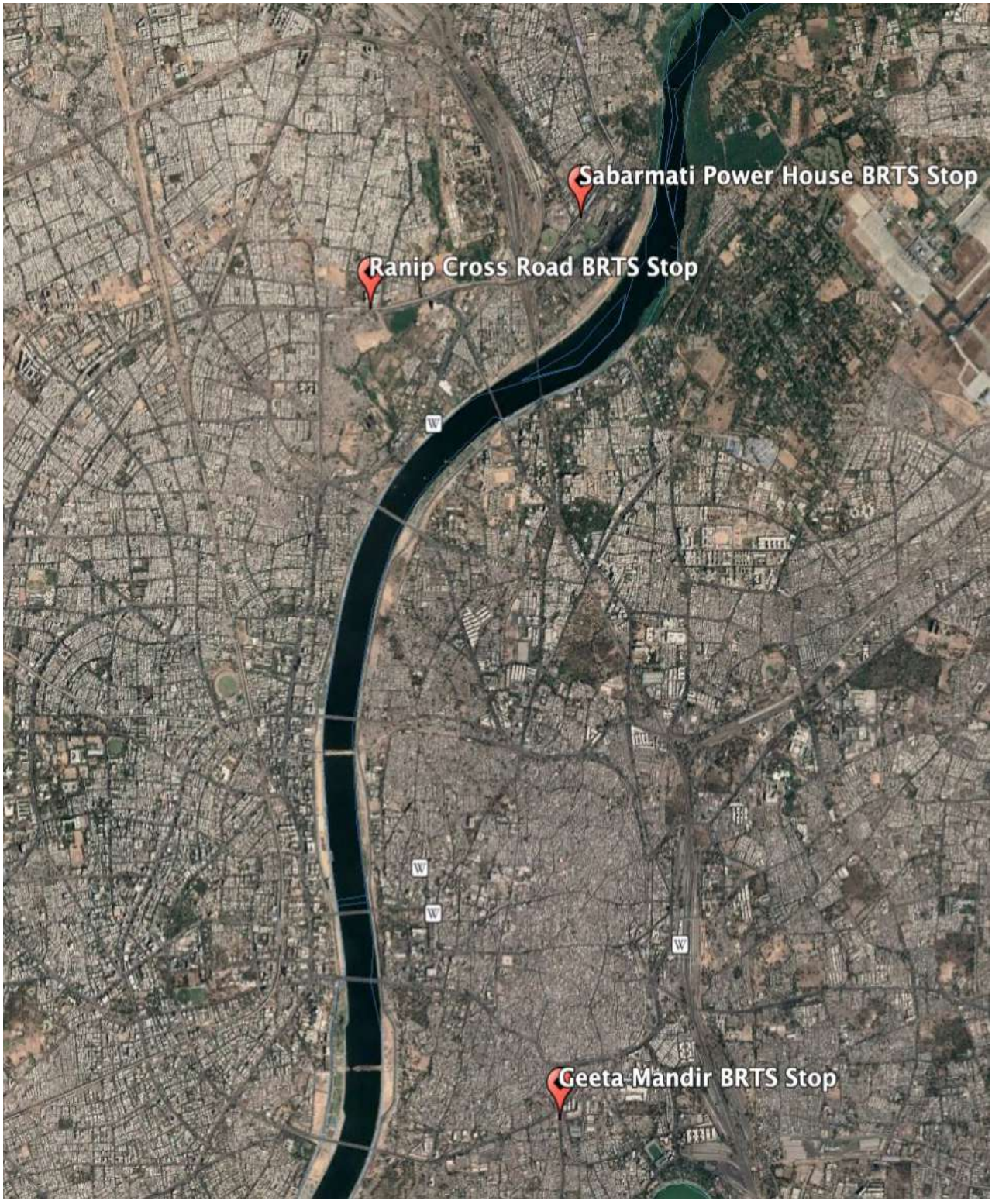
- The exchanges between the different transport modes are not planned

Based on the station analysis report, and the main challenges for public transport interconnections, we propose a list of guidelines to improve station design and access, roads and network organisation, and urban context design.

Improvement of these 3 types of spaces is crucial to increase pedestrian comfort. It is about station visibility, crossing safety, public space design to make pedestrian access to public transport and public transport journey quick, safe and comfortable, and thus increase public transport ridership.

The guidelines provide general directions, applicable to all sites, and specific directions, applicable to one typology of station or specific situations.

All guidelines are developed in concept plans, which should be considered as example to illustrate the application of guidelines in real contexte.


Sabarmati Power House BRTS Stop
Ranip Cross Road BRTS Stop
Geeta Mandir BRTS Stop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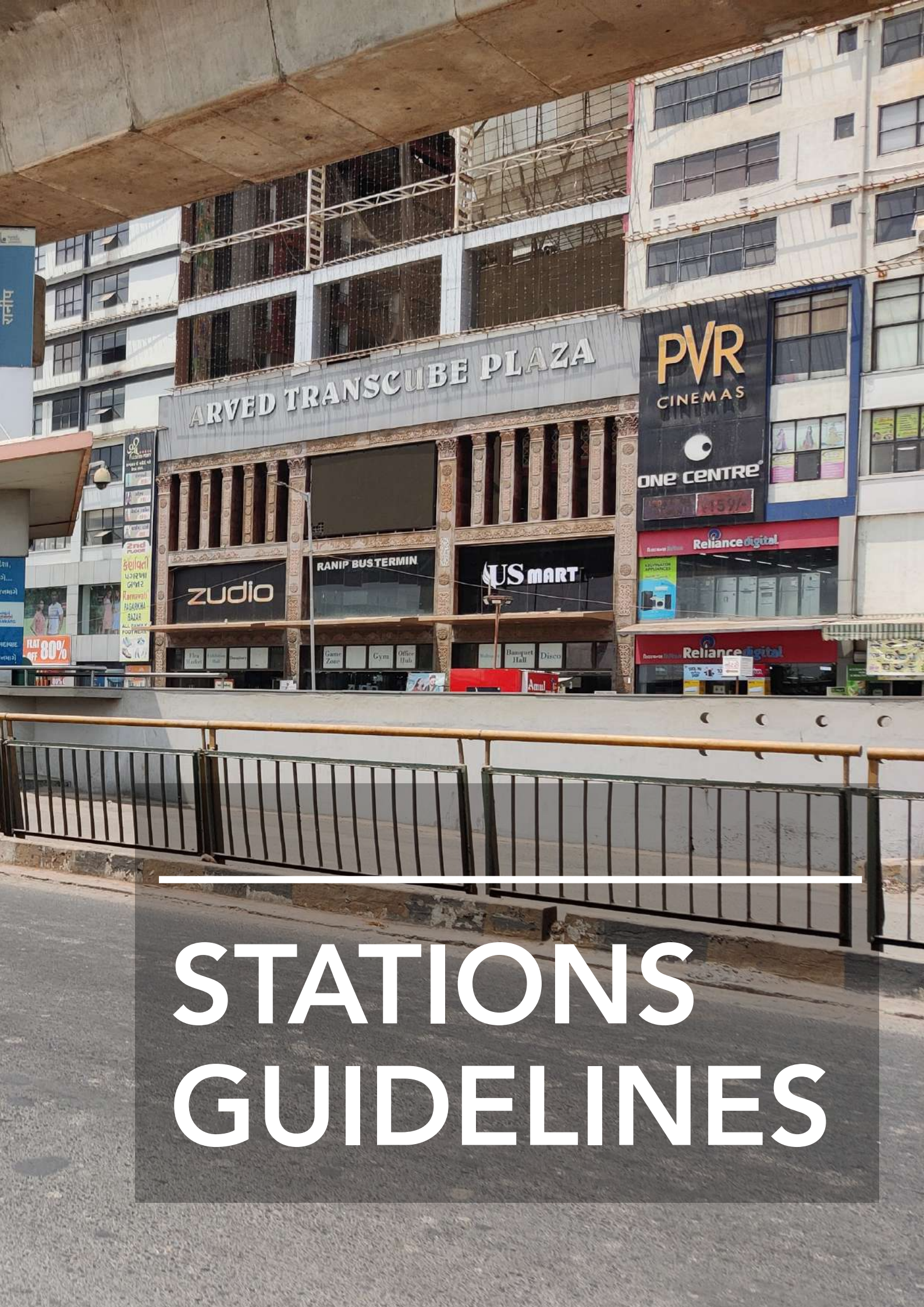
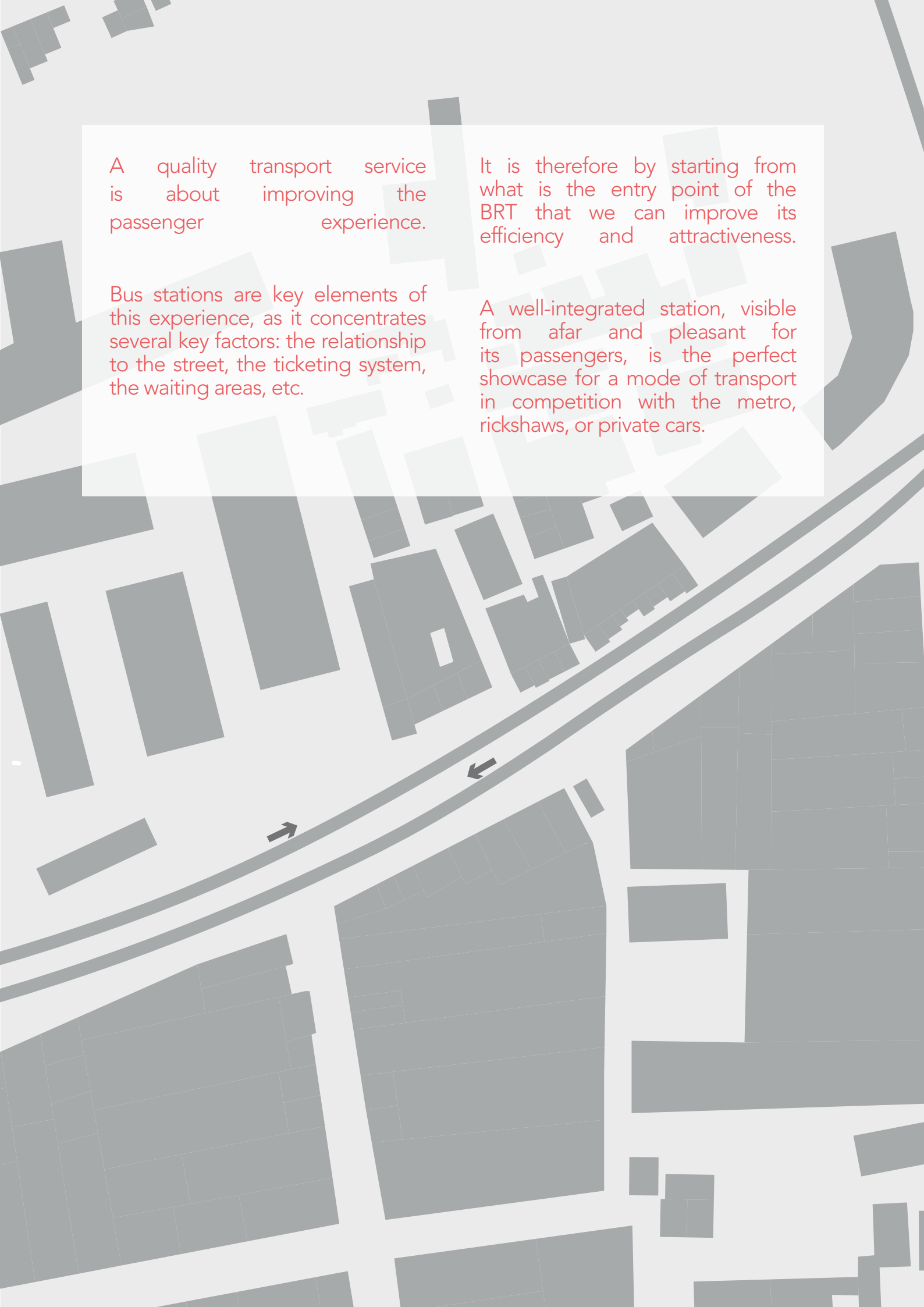


STATIONS GUIDELINES



A quality transport service is about improving the passenger experience.

Bus stations are key elements of this experience, as it concentrates several key factors: the relationship to the street, the ticketing system, the waiting areas, etc.

It is therefore by starting from what is the entry point of the BRT that we can improve its efficiency and attractiveness.

A well-integrated station, visible from afar and pleasant for its passengers, is the perfect showcase for a mode of transport in competition with the metro, rickshaws, or private cars.

1 | STATION URBAN INTEGRATION AND ACCESS

■ Global intents

The three different BRT stations we're dealing with all have the same design: the closure, the lack of crossroads and connection with the sidewalks break the street design. We need to tackle this geographical isolation by enhancing connections between the station and the street.

The few meters around the station and the platform are crucial for the passenger experience. Integrate the station in its urban context requires visibility and practice, so that users follow a path previously established for them and that they do not waste time.

Guidelines

1 Enhance station visibility from the neighboring areas:

- Introduce signages within a 300m area (if the BRT station isn't visible from the neighborhood)
- Define a visible and unique signage to signal the entrance and exit

2 Implement continuous, direct, and all-accessible pedestrian routes from the BRT station from and to the key destinations:

- The access path to the station should be briefly visible with a fully signposted route, on the ground and on the walls
- The approximate radius around the station within which the improved pedestrian access is a must is 500m. Pedestrian access should also be improved along connections between different public transport modes and to/ from main destinations entry points
- Implement crosswalks directly at the stations' exits and entrances

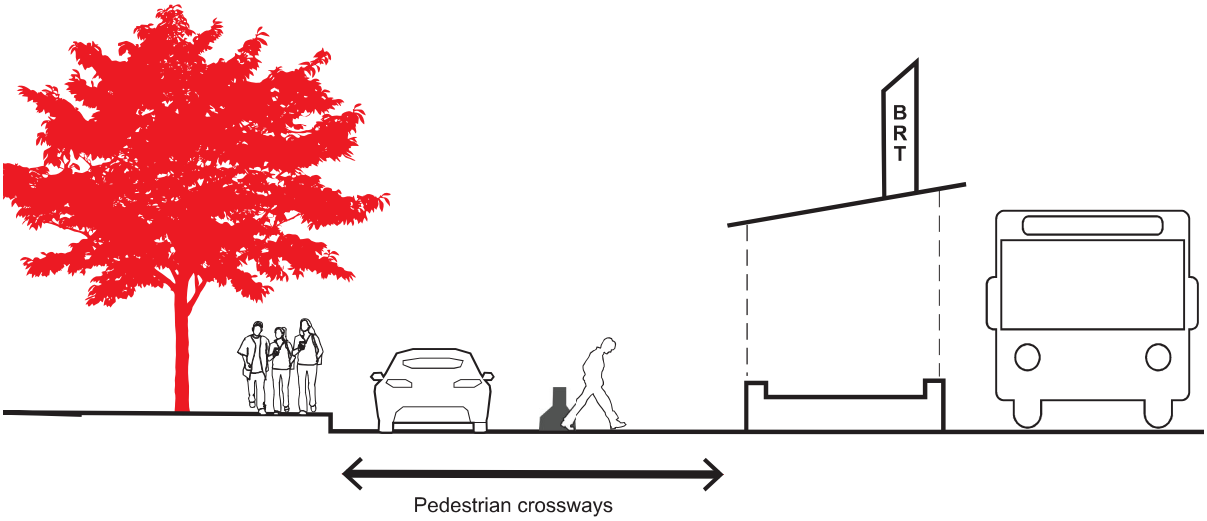
1

2

Signs should be posted at least 500 m from the station to indicate the entrance and exit of the station

Pedestrian movements must be made more fluid at the direct exit of the station

2



Design secure public spaces in the direct vicinity of the station

3

- Enlarge public spaces around station exit and entrance . Entrances and exits widths are dependent of the volume of passengers entering/exiting the station within 1 minute. It should be considered 1m every 70 passengers/min (free of obstacle) with a minimum of 2 meters.
- The number of gates is defined by the volume of passengers entering/exiting the station and the type of gate (in France, gates' average flowrate considered is 35 person per gate per minute), with a minimum of 2 gates. A large gate (accessible for wheelchairs or passengers with luggages) should be implemented at each access of the station.
- Set-up new sidewalks to secure the direct vicinity of the stations

4

Provide all-accessible, safe and comfort waiting areas provided with:

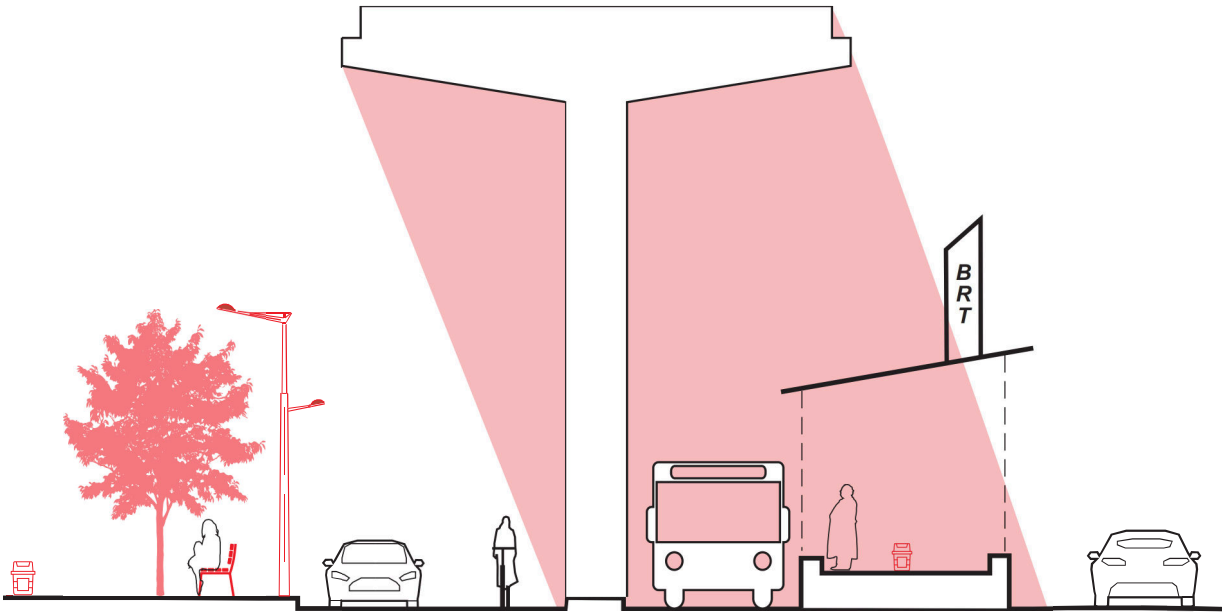
- shade and shelter (trees, overhead metro lines): 80% of waiting areas should be shaded
- furniture: waste bins, drinking fountains, banks
- In the case of a Linear platform, the width of the lane should be around 7 m with 3 m between two busses, in the case of Parallel platform, 4 m is necessary between the left side of two busses,in case of Sloped platform, the width of the lane should be around 8,24 m with 1,76 m for the sloth and 18,41 m for each bus

Planted trees, overhead metro lines or urban properties provide shelter and freshness to the passengers

3

All three stations areas dispose of considerable plazas that could be use to the benefit of the various transports modes

4



2 | Design

Global intents

By reconnecting the station to the very street it's implemented in, we can leverage new ways of organizing passenger flows and taking advantage of the opportunities they offer. A station redesigned to be more open to the street would allow it to become a place of services.

Guidelines

1

Enhance stations and line identity:

- Define a common design chart for all BRT stations and if possible for all other public transport modes in accordance with the entire public transport system
- The platform should be part of the street, recognizable, visible and integrated
- The width of the platform is defined by the volume of passengers boarding/alighting during peak hours. It is commonly considered in France than the density on a platform should be lower than 0,7 person per m² during peak hours for the passengers to move in comfortable conditions (based on Fruin scale). The surface used to implement equipments of the platform should be taking off of the surface dedicated to passengers.
- BRT stations should be more visible and welcoming to attract passenger flows. This could be achieved by designing a more transparent enclosure system for instance
- Use a continuous design (colour, material, textures) between the street and the stations

2 Secure access to the station by BRT and other public transport mode users

- Position pedestrian crossings before and after the BRT accesses to the station to avoid conflicts between pedestrians and buses
- Reduce the speed of vehicles to 30km/h in front of the station
- Set up appropriate signage to warn of entry into a pedestrian priority zone
- Add traffic islands, particularly where crossings are longer than 25m
- Facilitate the exit of the BRT, particularly in the case of re-insertion of the BRT into traffic or into a crossroads

1

Level of service	m^2/pers ($pers/m^2$)	Circulation conditions	Graphic illustration
A	> 3,2 (< 0,3)	Free circulation.	
B	2,3 à 3,2 (0,3 à 0,43)	Uni-directional flows and free circulation. Reverse and cross-flows with only minor conflicts.	
C	1,4 à 2,3 (0,43 à 0,71)	Slightly restricted circulation due to difficulty in passing others. Reverse and cross-flows with difficulty.	
D	0,9 à 1,4 (0,71 à 1,1)	Restricted circulation for most pedestrians. Significant difficulty for reverse and cross-flows.	
E	0,4 à 0,9 (1,1 à 2,5)	Restricted circulation for all pedestrians. Significant difficulty for reverse and cross-flows.	
F	< 0,4 (> 2,5)	Complete breakdown in traffic flow with many stoppages.	

Fruin scale is commonly used to qualify the level of comfort of passengers based on the density of passengers per square meter. Levels A to C are considered to be comfortable, while comfort is deteriorated in levels D to F.

1

Example of a continuously designed station : the roadway and the tramway waiting area have the same surface texture (Saint-Etienne, France)

Sabarmati Station : an elevator will form a direct jonction between the BRT and the Metro Stations.

2

Accessible bus stop, France

Flow management with separate entry/exit, Paris, France

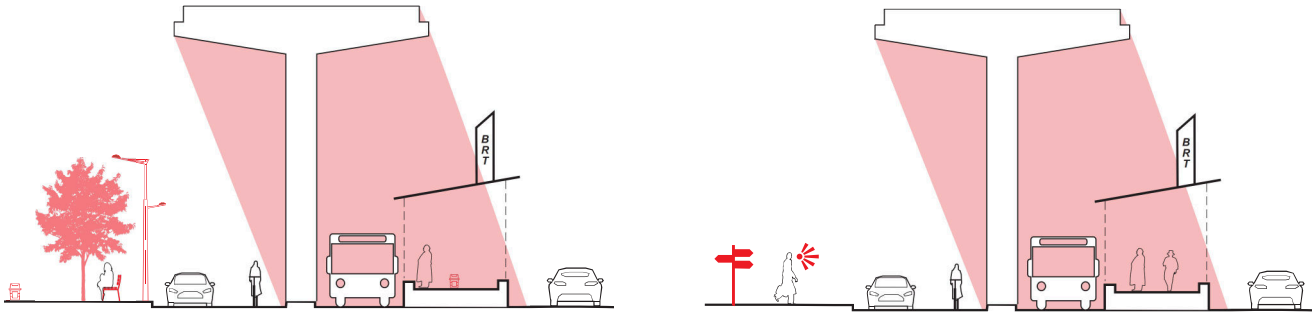
3 Ensure readable design for the station:

- Design separate entries and exits to dissociate incoming and outgoing pedestrians flows , and avoid conflicts. Unidirectional flow is generally more comfortable (or need less space), easier to signalise but can generate longer routes. Therefore, comfortable routes with large pathway and no waiting periods (ie. road crossing) should be considered.
- Enough space should be considered just after the exit to ensure safety for lost passengers. Good information/ signage should be displayed to ensure a quick action.
- Design all-accessible for reduced mobility persons with disabilities (physical disabilities, blindness, etc.)
- At least one elevator should also be implemented to ensure the accessibility of the station

4 Design waiting spaces accessible for all, safe and comfortable provided with:

- Passenger's information (real-time travel information, city and network's' maps)
- Pedestrian itineraries maps and interchange information for transport modes which are not located close or visible from the station
- Waiting spaces, entries and exists should be designed according to the space standards for physically challenged people.
- Entry and exist ramps shall have handrails on at least one side, that are 90 cm high, measured from the surface of the ramp, the handrails should be smooth, and extend 30 cm beyond the top and bottom of the ramp.
- The platform at the top of the ramp should be at least 1.80 m long, if a door swings out onto the platform or towards the ramp.

3 4



BRT Stations should be provided with furnitures and direct signages

3

Different sign patterns: freestanding, ceiling mour, wall-mounted

Ceiling-mounted Sign

Freestanding Sign


Ranip
રાણીપ
Ticket
Entry
No Entry
કોરોનાથી બચવા
માસ્ક પહેરો
સોશ્યલ ડિસ્ટન્સ જાળવો
રાણીપ ક્રોસ રોડ

MULTI-MODAL INTEGRATON

Issues related to BRT stations are most often related to other transport modes. BRT itself plays a role as an intermediate link between larger infrastructure such as the metro, inter- and intra-regional bus stations or railway stations.

It is on the basis of this observation that the second phase of the guidelines was designed. How can inter-modality be organized in the three studied stations and, more broadly, for all the stations?

The proximity of the transport infrastructure and their complementarity are thus major assets on which these guidelines constantly seek to rely.

1 | A transit Plaza

Global intents

BRT stations are in direct contact with other transport infrastructure (metro stations, bus stations, fast train stations, etc.). The three stations studied are therefore inter-modal hubs that should be developed as such, so that passengers can move as easily as possible from one transport mode to another.

It is necessary to build a single platform for all modes of transport in order to :

- *channel and secure pedestrian flows*
- *harmonize competition between modes of transport*
- *organize additional activities without hindering the smooth running of services*

Guidelines

1 Design a space for pedestrians:

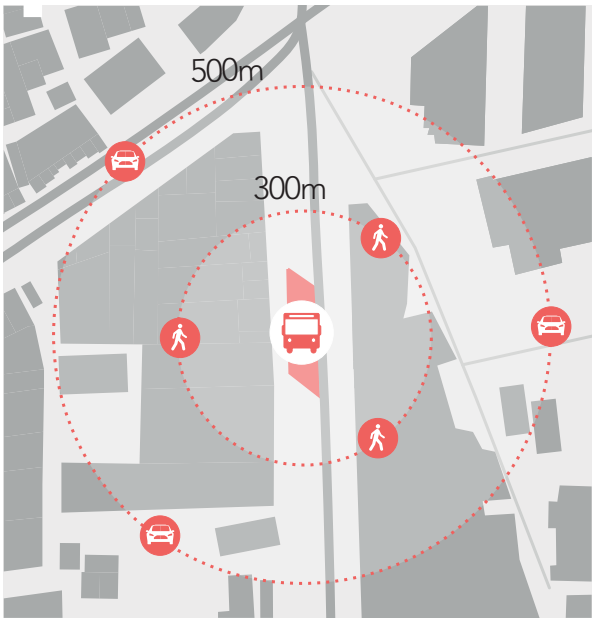
- Pedestrian flow management strategy should be defined prior to interchange plaza design, the factors to be considered in pedestrian flow management of interchange plaza are:
  - > direct paths (to reduce transfer time),
  - > clear directions (the ways towards different modes should be clearly indicated),
  - > comfortable spaces (large enough based on the number of passengers, high enough ceiling and lights if underground, shaded if outside, ...)
- Interchange corridors width is designed based on the number of passengers transferring through it. It should be considered 1m every 70 passengers/min (free of obstacle) with a minimum of 2 meters.
- Transfer signage should be implemented every 100m and at each intersection to guide passengers.
- Secure large pedestrian areas including major public transport points with highly restricted traffic
- Anticipate main direct pedestrian flow directions from and to each public transport mode and main attraction point

- Ensure main pedestrian flows routes are free from other functions (traffic and amenities), except information devices
- Implement shaded and comfortable waiting areas

2 Enhance information device to facilitate public transport journeys and interchanges

- Display travel times by mode for the most popular destinations for passengers: intelligent display and directional aid
- Highlight modes of transport according to their capacity (e.g. BRT can be highlighted at peak metro times)
- Prioritise signage according to the desired orientation for each flow
- Ensure visibility and readability of all information

1

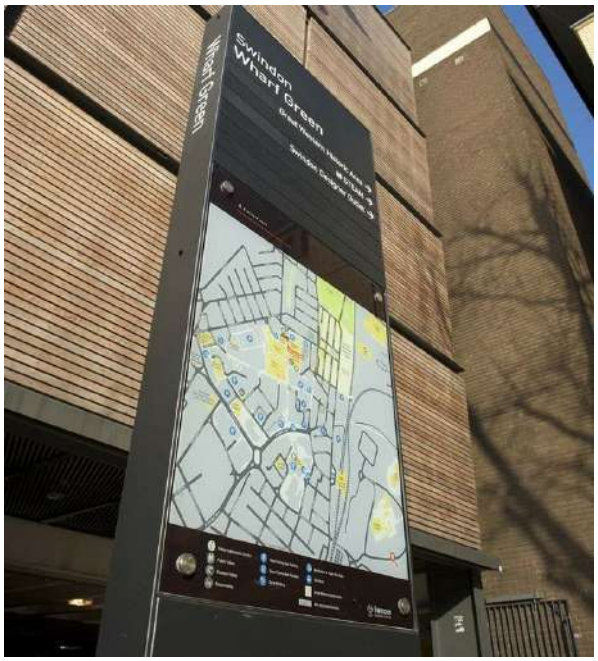


A shared zone for pedestrians and drivers

This is the example of the common graphic design for the signage of the different modes of transport in Ile de France region in FRANCE. The metro is symbolized by the letter M, the Regional Express train Netwrok is symbolized by RER while the tramway is symbolized by T. The letters and numbers define each metro or tramway line. This clear and simple graphic design simplifies communication with users and facilitates daily mobility. (Sources: SNCF/ RATP)

2

Well-designed signs panels will help passengers decisions (Sources : London City Council)



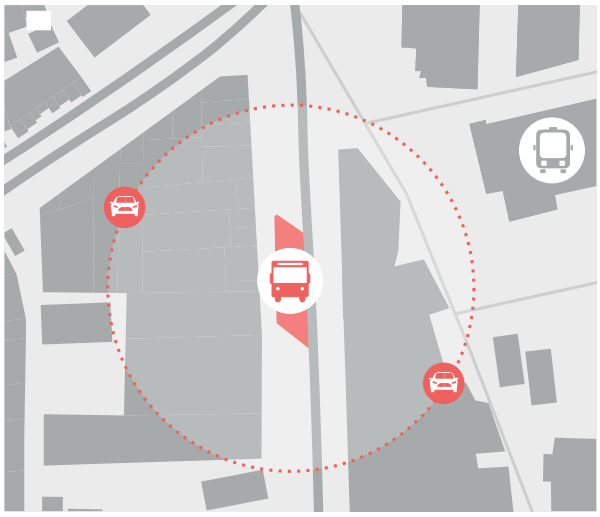
3 Integrate secondary functions on the transit plaza :

- Essential transit lane (bus, cars, …) on the plaza should be reduce to the minimum functions
- Develop mitigation measure to reduce the speed and ensure pedestrian security crossing these lanes:
- When busy pedestrian routes are crossing secondary traffic lanes, soft measures such as 20km/h roads or speed bumps can be implemented.
- When medium to small pedestrian routes are crossing secondary traffic lanes, medium measure such as pedestrian push button to secure crossing
- At busy traffic lanes, pedestrian crossing should be integrated to the junction traffic lights
- Design dedicated space for each mode to avoid conflicts over parking, encroachment, etc. to limit conflict between transport modes
- Introduce cars and rickshaws drop-off and pick-up area close to pedestrian flow, in a dedicated space
- Drop off and parking areas spot shouldn't be located on the main pedestrian flow coming in/ out the stations (min. 10 meter wide)
- Drop-off and parking should allow station visibility from other transportation and amenities spots
- 12 meter-square parking slots for each rickshaws and a number of parking slots equals to 20% of the maximum number of rickshaws during peak hour, with a minimum of 10 slots (either in one parking or multiple parkings).
- Introduce regulation device to control a Maximum of 10 min parking time
- Locate long-term parking within a minimum of 100m distance of the station

4 Integrate additional functions if the public space is large enough

- Organize non-transport activities (food-corners, street vendors, etc.) on the sides of the traffic routes to prevent congestion
- Define precise location for amenities and facilities
- Define planted area to provide comfortable and shaded waiting and socialization spaces

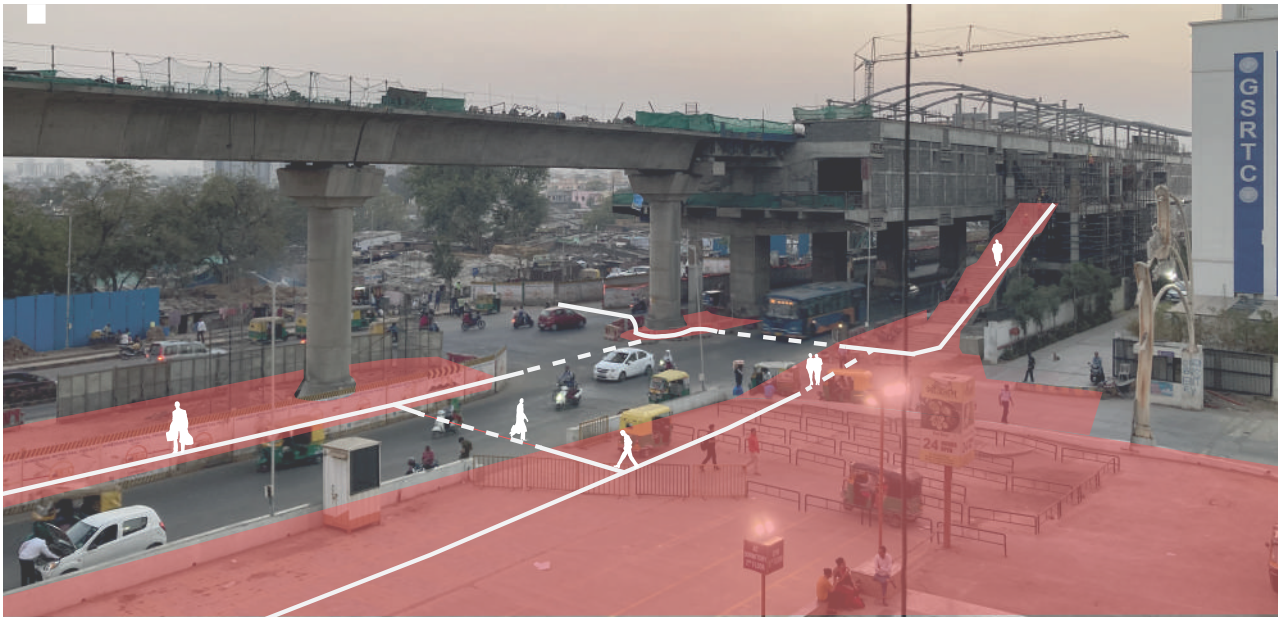
3



Individual vehicles should be moved away from the BRT stations' entrances

Drop-off points at existing signages should be provided to ease the flow of rickshaw traffic and speed up their turnaround

1



Pedestrian flows from Ranip metro to BRT and GRSTC station should be directed by clearly marked crossings on the ground or on the walls

2 | Intregrate the various transport modes

For the common hub to work, each mode of transport must find an advantage. Now, some transport, especially auto-rickshaws, do not follow the current sharing because it is not clear or interesting enough.

Therefore, we need to clearly delimit the areas dedicated to one or more transport modes according to the imperatives of each.

Public transports

■ Global intents

Public transport is a priority and forms the backbone of the organisation of transit plazas.

Guidelines

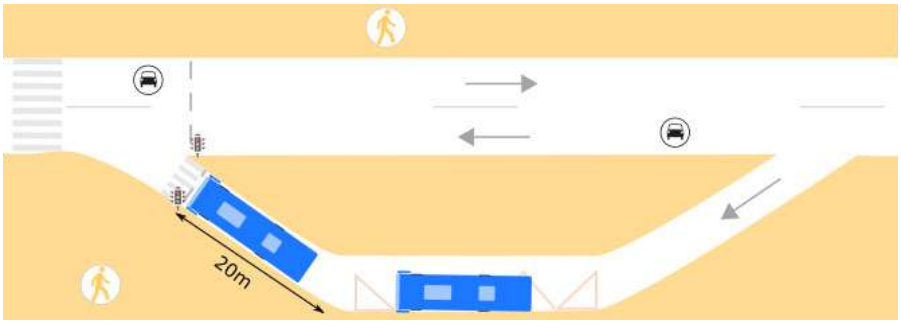
1 Set up a secure and legible bus stop

- Select the type of bus stop according to the location environment from the three possible cases:
  - > *Make on-street stops if traffic density is low and stop times are short (bus routes in transit). They make it easier for the bus to dock and to fit into the traffic.*
    - » *Recommended on the minor roads of the three poles.*
  - > *Make notched stops if traffic is very heavy and stops are long (regulation, terminus, heavy load stops).*
    - » *Recommended on major roads in Geeta Mandir due to lack of space.*

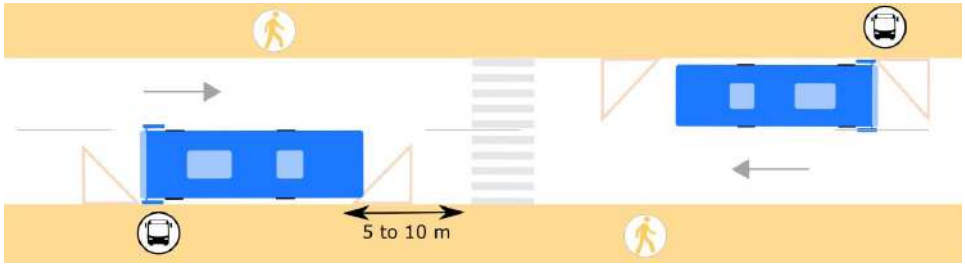
- *Make recessed stops under the same conditions as notched stops. The alleyway provides greater safety for users in the event of large flows and can be associated with other mobility functions (e.g. drop-off, access to the alleyways are associated with the traffic light plans of the intersections), but requires a larger right-of-way.*
  - *Recommended on the major axes of Ranip and Sabarmati to take advantage of the available space and create quality bus hubs.*
- Ensure a safe link to nearby crossroads:
  - *Position the pedestrian crossing behind the public transport vehicle,*
  - *Ensure a distance of at least 5-10m between the pedestrian crossing and the stop,*
  - *Accompany the crossing with a slowing device (e.g. pedestrian platform) if no traffic lights are provided and road traffic is heavy.*

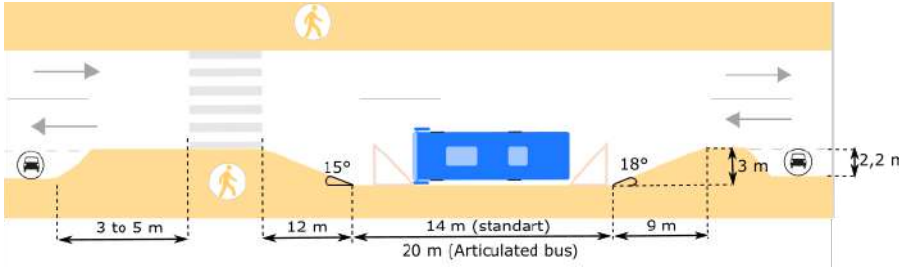
1

Recessed bus stop configuration



On street bus stops configuration





Notched bus stop configuration

2 Adapt bus station to the right size

- Provide a necessary and enough platforms. The number of platforms depends on the number of lines, their function (transit or terminus) and the level of service per line (frequency, range of service). The objective is to determine the number of movements per line during the busiest hour, add waiting and regulation times and group this information into a platform occupancy diagram. Based on the maximum occupancy observed, the number of platforms is adjusted. We recommend adding +10 to +20% of the current number of bus platforms to anticipate changes in bus supply.
- Study optimizations on spatially constrained sites:
  - > *Pooling of a platform for several lines*
  - > *Dissociation of commercial and bus regulation functions*
  - > *Dynamic allocation of platforms*

3 Calculate the area needed to develop the project and define the feasibility of the planned system according to the available land holdings:

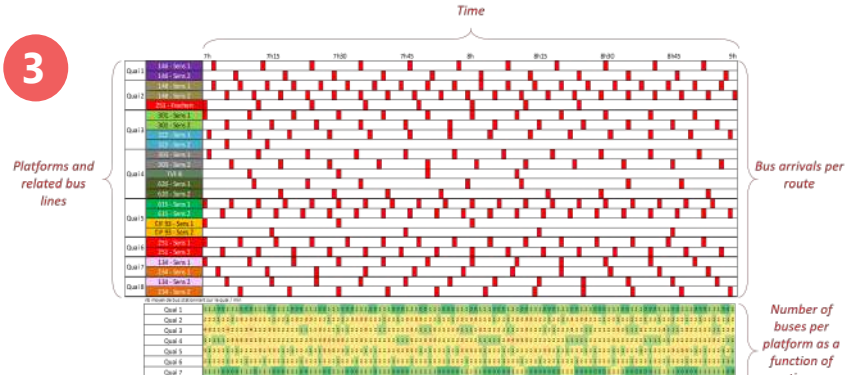
- Apply a ratio from 125m² (herringbone platforms or cell platforms) to 400m² per platform (central platform or side platforms).
- These ratios include circulation spaces and will therefore vary greatly depending on the location of the platforms chosen, the layout of access and circulation spaces, regulation functions, etc.

2

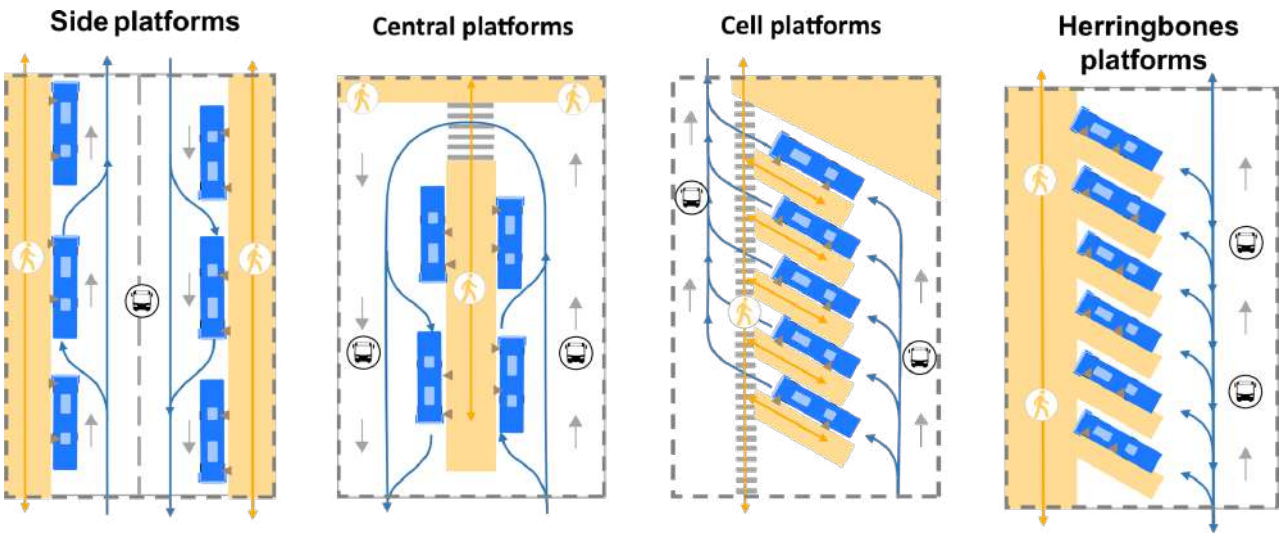
Example of cell platforms – Berlin / ZOB (Germany)

Example of herringbone platforms in a configuration adapted to the site - Christchurch Bus Interchange (New Zealand)

3



The "Garobus" tool can be used to calculate the number of platform required

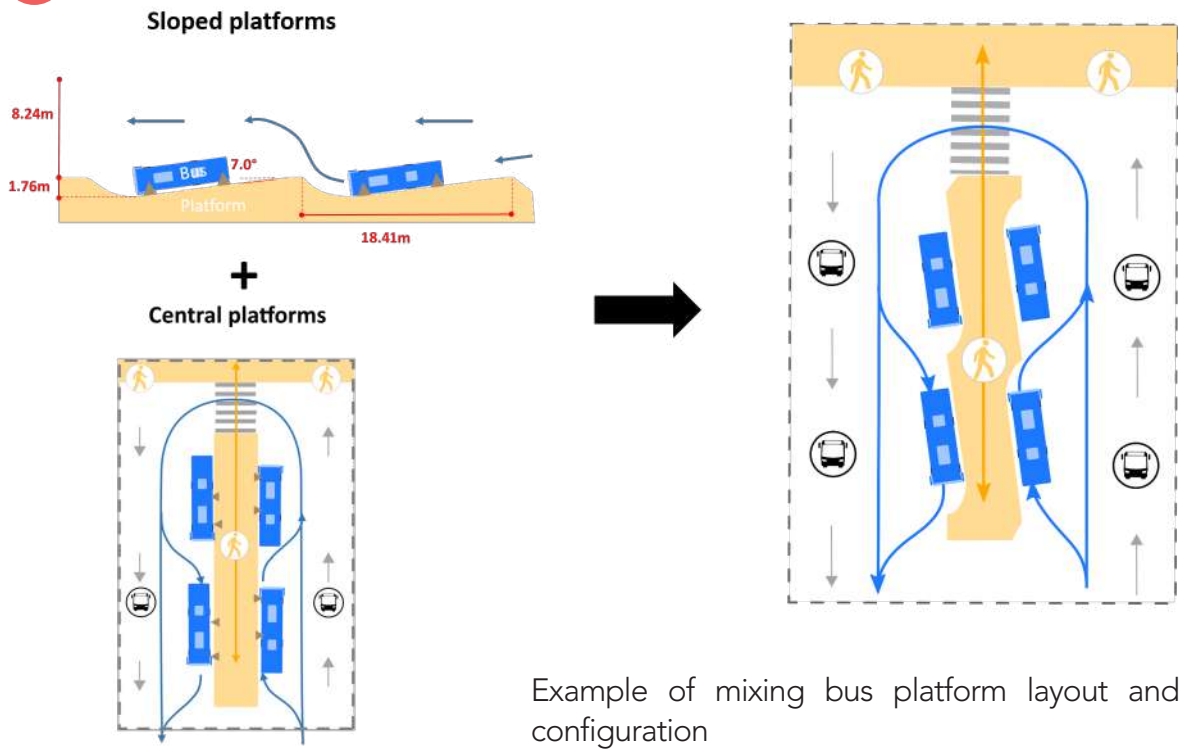


The four main recommended bus platform configuration

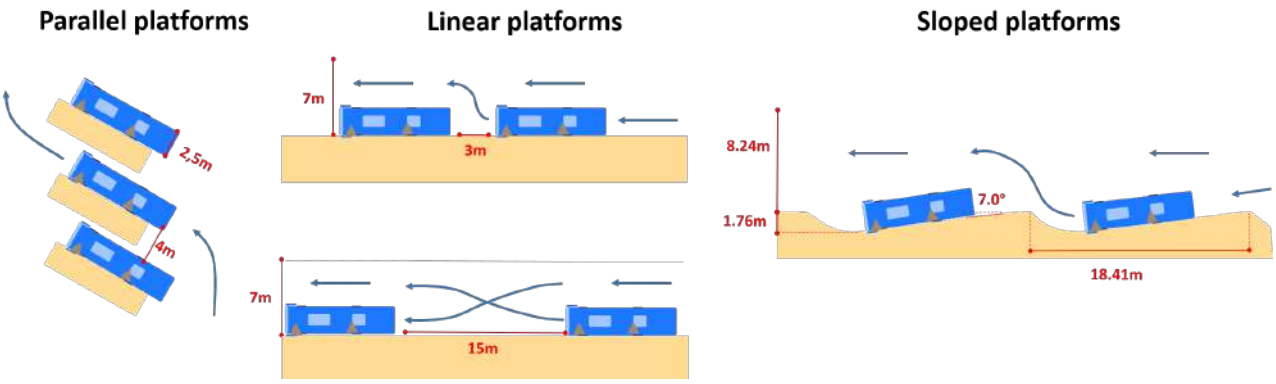
4 Spatially organize bus stations

- Provide for the organisation of bus lines in off-street bus stations based on a need for 5 platform stations
- Ensure that passengers can be dropped off and picked up on the left-hand side of the platform and that all bus services are designed to do this. It should be noted that BRT lines have rolling stock with doors on both sides to allow right-handed drop-off on central platforms.
- Select a platform layout (linear, sloping or parallel) according to the site constraints:
  - > *Prefer parallel platforms on the most spatially constrained sites or those that need to manage a large number of lines (e.g. Geeta Mandir). The space between 2 parallel platforms should be minimum 4m between two buses parked side by side.*
  - > *The platforms should be long enough to reach the rear door of the buses (minimum 8m*
  - > *Prefer linear or sloped layouts on sites with fewer constraints or with large linear layouts (e.g. Sabarmati and Ranip). These layouts limit bus/pedestrian conflicts and reduce bus maneuvers such as reversing.*
  - > *Linear platforms must be accessible by a 7m wide lane to ensure parking and circulation of buses and to allow passing of parked buses. Sloped platforms need a 8,24m lane to ensure bus turns*
- Select an optimal bus platform configuration (central platform, side platforms, herringbone platforms or cell platforms) according to site constraints:
  - > *Prefer herringbone or cell configurations to handle a large number of bus lines with long stopping times (e.g. Ranip and Geeta Mandir intercity bus stations). The herringbone platforms make it easier to maneuver the bus and avoid rear steps, while cell platforms promote pedestrian safety.*
  - > *Prefer central and side platforms when the available space is large and there are few bus lines to manage. These configurations allow good management of pedestrian flows, good readability of the offer and easier bus maneuvers. They could be adapted to manage an increase in the number of classic bus lines at Sabarmati or Ranip while maintaining the side lane logic.*

4



Example of mixing bus platform layout and configuration



The three main recommended bus platform layout

■ Connections management

There is two main ways to ensure connections between bus, BRT, and metro:

- A physical approach via a readability of the paths between modes
- A temporal approach through coherence of the lines timetables

Guidelines

1 Reduce physical distances between modes of transport.

- Reduce transfer times
- Facilitate the co-visibility of modes
- Reduce physical constraints such as urban (railways, major roads) or natural (rivers, slopes) barriers or facilitate their crossing (footbridges, pedestrian platforms, removal of barriers, etc.).
- Respect users' desire path, i.e. the routes that pedestrians would naturally take if there were no obstacles.

Ensure consistency of timetables[1]

- Adapt the timetables of the different modes to ensure the feasibility of connections between the modes
- Limit the average waiting times for connections to 5 minutes on strong lines and 15 minutes on weak lines.

2 Make the connections instinctive. Sometimes reduce the physical distance of the connections is difficult. It is also possible to reduce the «cognitive distance», i.e. the distance perceived by the user, by working on the following points:

- Add services to the user (information on the timetable of connecting lines, fares, shops, newspaper kiosk)
- Propose a design of the space adapted to connections (visibility of stops between modes, treatment of uneven surfaces, limitation of unprotected crossings, intuitive pedestrian paths)
- Provide comfortable waiting areas if waiting time cannot be reduced

1 *This last point should be studied as a priority in the intermediate and minor stations, where supply is weaker and poor coordination of arrivals and departures will be very detrimental.*

An example of a natural user path unaccompanied by a development, which degrades the public space

A design proposal accompanies user's desire path

An open square makes it possible to see all the available modes of transport as soon as you leave the station - Bahnhofplatz , Karlsruhe, Germany

Road Traffic

+ Traffic management

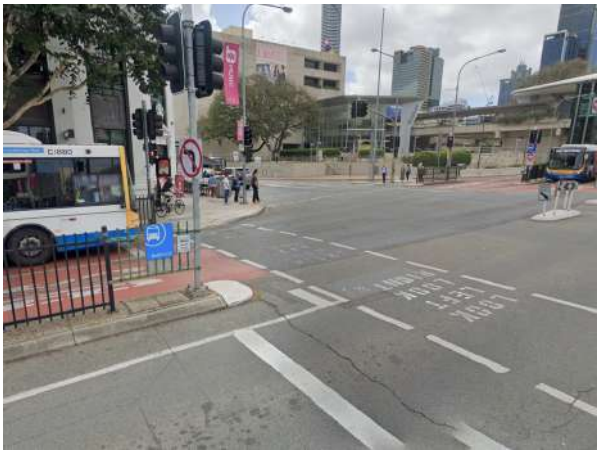
■ Global intents

It is necessary to strengthen road traffic control measures for the transit plaza to work. Too much road traffic and control would undermine decisions made for other modes of transport, and would jeopardize intersections.

Guidelines

1 Define the spaces for each mode to organize the flow at best.

- Motorized modes (cars, motorized two-wheelers, auto rickshaws) :
  - > *Delineate the traffic lanes and the right-of-way for vehicles, both in standard sections and at crossroads.*
  - > *Adapt the traffic rules and the size of the lanes according to the intensity of the traffic flow (number and width of lanes, authorized speed, and configuration of crossroads).*
  - > *Identify areas that are not used by traffic but are functional by means of signage and clear organisation (drop-off points/ taxis, use of side streets, access to car parks or parking areas).*
- Public transport (bus, BRT, metro):
  - > *Ensure dedicated lanes for public transport, identifiable and forbidden to other vehicles either physically or through clear regulations.*
  - > *Ensure dedicated access and space for buses and technical vehicles within bus stations to facilitate maneuvering and limit conflicts with general traffic.*
- Active modes of transport (pedestrians and bikes) :
  - > *Define areas protected from motorized modes (e.g. pavements with herbs for pedestrians, cycle tracks with physical separators for bicycles on the road).*
  - > *Physically identify meeting points between active and motorized modes with pedestrian crossings on the ground.*



Example of crossroads crossing treatment for BRT – Brisbane (Australia)

Example of crossroads crossing treatment for BRT with a compression – Pau (France)

2 Support the management of a conflict between modes through specific actions:

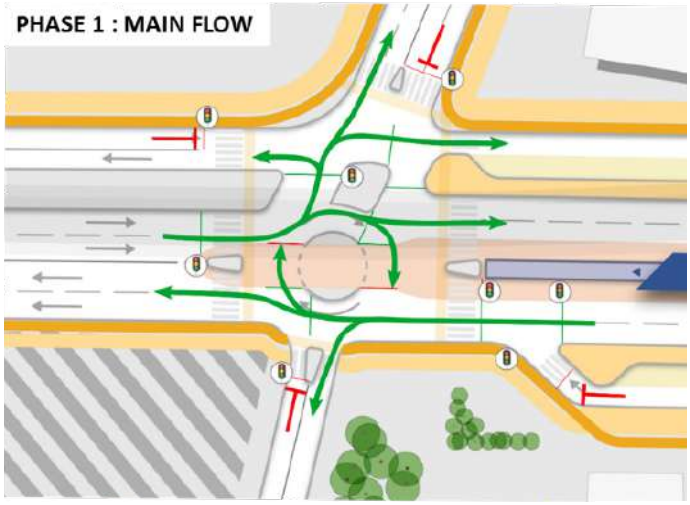
- Implement traffic lights where there are large flows and complex vehicle movements. The traffic lights define the priority rules between pedestrians and motor vehicles and ensure that traffic flows are separated in time.
- Implement a give-way or stop sign priority system when flows are low and crossings are simple.
- Guarantee the safety of users by means of devices to accompany pedestrian or cyclist crossings in addition to managing priority systems. These devices can be:
  - > *speed reduction or hazard warning signs,*
  - > *physical traffic calming devices (succession of turns to reduce speed, speed bumps, raised pedestrian crossings),*
  - > *Lane width reduction,*
  - > *Speed cameras,*
  - > *changing the colour of the pavement to break up the uniformity*

3 Develop functional and secure crossroads

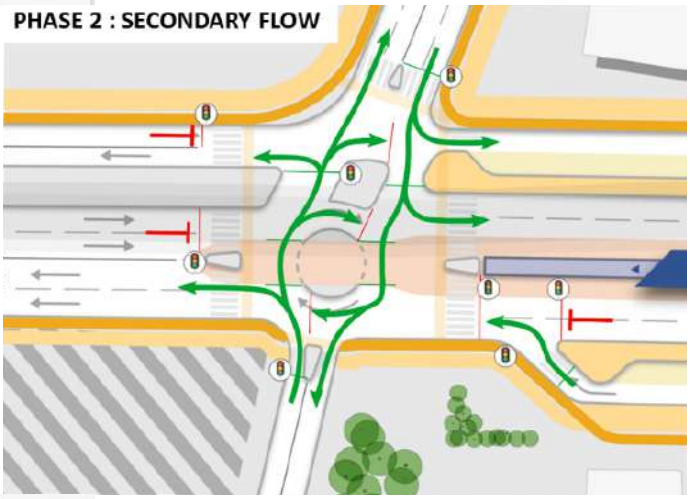
- Allow clear visibility between drivers and soft mode users
- Compact crossroads where possible, reducing the size of the conflict zone
- Design perpendicular, continuous pedestrian crossings on each branch of the intersection
- Provide pedestrian refuge islands when the width of the crossing is greater than 12m
- Adapt the phasing for traffic light crossroads (adapt the phasing to flows; add a dedicated bus phase, etc.)

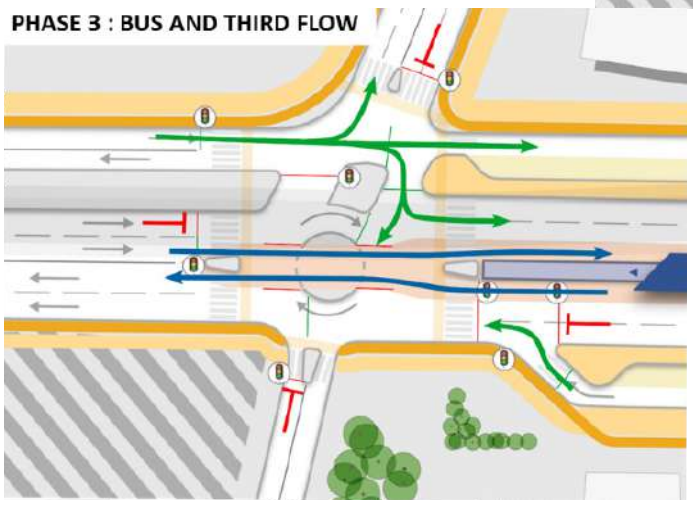
Gradually reduce speed as vehicles approach stations.

- Vehicles must cross the stations at 30km/h, especially at pedestrian crossings.
- If the initial speed is above 50km/h, vehicles must reduce their speed to 50km/h and then gradually to 30km/h as they approach the station. Road signs support the gradual reduction in speed. Refuge islands and pavement projections make pedestrian crossings safer.



If the bus has left the crossroads





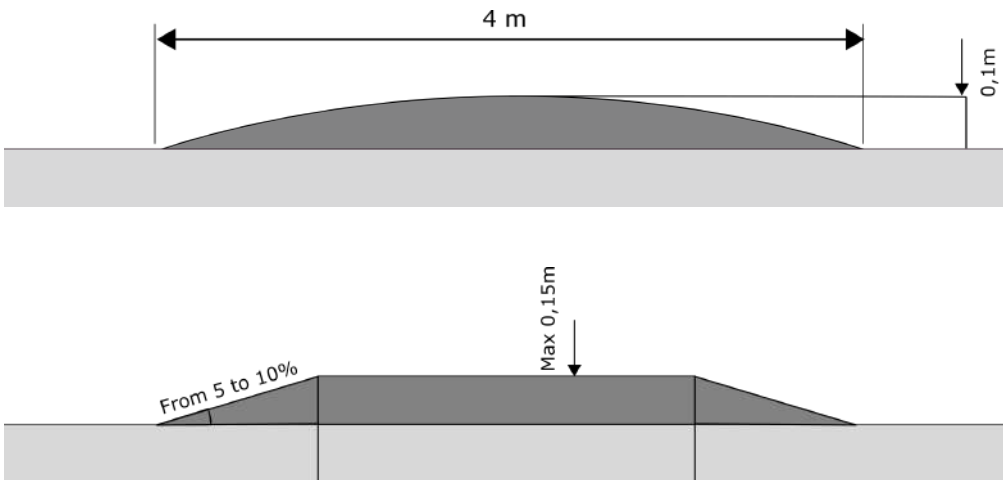
If the bus is detected

1

Type of road	Context	Speed limit (Km/h)	width of a lane (m)
Highway	Out of cities	110 -> 130	3,5 - 3,75
Nationals Roads	Out of cities	80 -> 110	3 - 3,5
Country Road	Out of cities	70 -> 90	2,5 - 3
Main road	Heavy traffic in a very dense area	50 -> 70	2,5 - 3
Secondary road	Moderate traffic in a dense area	30 -> 50	2,5 - 3
Residential road	Low traffic in a low density area	30	2,2-2,5
Dedicated bus lane		30 -> 70	3-3,5
Bike lane			1 - 2 (1.5 m advised)

Example of lane width and speed limits depending on each type of road

2



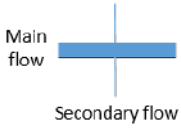
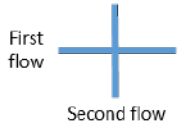
Examples of physical traffic calming devices

4 Adapt the traffic management to the urban context

- In a low-density urban context (e.g. Sabarmati), road traffic is generally low and the traffic flows to be managed remain limited:
  - > *Enhance mobility functions, which are often not very visible.*
  - > *Set up traffic light junctions according to the importance of conflicts on a case-by-case basis.*
- In a denser urban context (e.g. Ranip), within a residential area for example, motorized flows are predominant, and the mobility function often becomes central:
  - > *Secure the area around high-traffic and high-speed roads, at pedestrian crossings. Local speed reduction devices or traffic light junctions can be adapted to this context.*
  - > *Take advantage of wide lanes to build comfortable traffic light crossroads with many lanes if necessary.*
- In a very dense urban context, the flows of all modes of transport are very important and conflicts must be strictly managed to guarantee the safety of users:
  - > *Restrict motorized traffic to favor pedestrians and cycles, which are the most suitable modes of transport in a dense environment.*
  - > *Compact the crossroads as much as possible to ensure that the space is distributed in favor of pedestrians.*
  - > *Ensure the cohabitation of the mobility function with various activities (shops, housing, jobs) in a strict sharing of areas.*

The following help to adapt the number of lanes of a traffic light junction to the traffic:

1. *Collect traffic volumes and directional movements on each leg of the junction in PCU/hr over the morning and evening peak hours*
2. *Identify the number of lanes per leg based on the right-of-way and the average width of a lane (3 to 3.5m)*
3. *From the peak hour count data, calculate the hourly flows per branch by multiplying the vehicle numbers by 1.1 for right-turn movements and 1.7 for left-turn movements.*
4. *Determine the overall capacity per leg, based on the number of lanes and the main flow from the table provided.*
5. *If the capacity obtained per branch is higher than 80% of the hourly flow recorded on the branch, delete one lane and redo the calculation. If the capacity is still higher than 80% of the hourly flow rate recorded, it is possible to delete a lane and you can repeat the test by deleting a lane again. If not, the lane cannot be deleted.*
6. *The aim of this analysis is to reduce the number of lanes in a junction, and therefore to reduce the space allocated to motorised vehicles in order to allocate it to other uses, while ensuring correct operation.*

Type of crossroad	Illustration	Reduction of the capacity depending on green time	Base capacity (pcu/h)	Saturation threshold per lane (pcu/h)
Crossroad with unbalanced flows		Main flow reduction : from -35% to -50%	1800	900 - 1200
		Secondary flow reduction : from -65% to -80%	1800	400 - 650
Crossroad with balanced flows		First flow reduction : -55%	1800	800
		Second flow reduction : -55%	1800	800

Example of different capacities of a lane at crossroads

4

BEFORE CROSSROADS COMPACTION

AFTER CROSSROADS COMPACTION

Type of road	Number of lane	Saturation threshold (pcu/h)	Saturation treshold per lane (pcu/h)
Highway	1 lane	2000	2000
	2 lanes	3600	1800
	3 lanes	4500	1500
Nationals Roads	1 lane	1800	1800
	2 lanes	3200	1600
	3 lanes	4200	1400
Country Road	1 lane	1500	1500
Main road	1 lane	1400	1400
	2 lanes	2400	1200
Secondary road	1 lane	1200	1200
	2 lanes	2000	1000
Residential road	1 lane	800	800

Example of different capacities of a lane without crossing

■ Parking management

Guidelines

1 Size the number of parking spaces to suit the use: on street, drop-off, multi-store or underground parking, taxi rank, etc.

- Build a reliable dimensioning method based on the station's frequenting (study of the station's catchment area, definition of the potential interested parties, survey of vehicles parked in the vicinity and using the station, surveys by questionnaires, etc.)
- Study the possibilities of sharing parking with other uses (housing, shops, jobs). This approach is particularly interesting in dense areas (e.g. Geeta Mandir).
- Study the feasibility of a park-and-ride facility, if the hub meets three conditions:
  - > *Good road accessibility,*
  - > *A high level of use that allows for at least 50 surface parking spaces and 300 underground parking spaces. Below these numbers, the facility is not profitable, and solutions must be found on the road.*
  - > *Guaranteeing proper inter modality between car parks and other modes of transport.*
- Adapt the pricing of the park-and-ride facility and offer combined tickets for access to the car park and transport tickets, to make the offer attractive.

2 Calculate the area needed to develop the park spaces and define the feasibility of the planned system according to the available land holdings[1]:

- Apply a ratio of 25m² per parking space for cars and taxis.
- Apply a ratio of 4m² per parking space for motorized two-wheelers.
- Apply a ratio of 12m² per parking space for auto rickshaws.

1 *These ratios include circulation spaces required for vehicle maneuvering. If necessary, this step allows you to review the number of parking spaces.*

3 Prioritise parking functions (on-street parking, conventional parking or park-and-ride facilities, drop-offs, taxi drop-offs or auto rickshaws) as required, and according to the type of hub:

- Major hubs (Geeta Mandir) :
  - > *Combine as many different functions as possible to handle large passenger flows.*
  - > *Provide a park-and-ride facility if accessibility by car is good (proximity to a major road infrastructure*
- Intermediate hubs (Ranip) :
  - > *Investigate opportunities to share a private car park and park and ride facility with other functions (e.g. Ranip shopping center car park).*

    We recommend avoiding the structure if there is no opportunity, because it will not be profitable.
  - > *Develop and distinguish between classic drop-offs and taxis/auto rickshaws, necessary for this type of hub.*
- Minor hubs (Sabarmati) :
  - > *Offer a classic drop-off point, shared with taxis and rickshaws.*
  - > *Guarantee a minimum supply of on-street parking.*

Drop-off points on both sides of the road – Gatewick airport (UK)

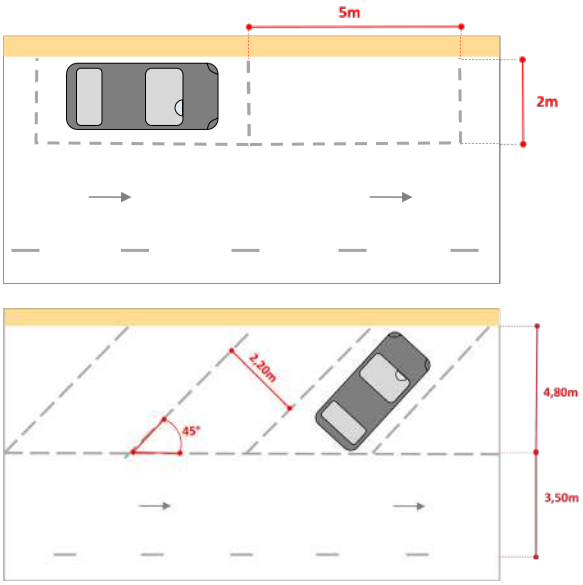
4 Prioritise the different functions and their proximity to the hub :

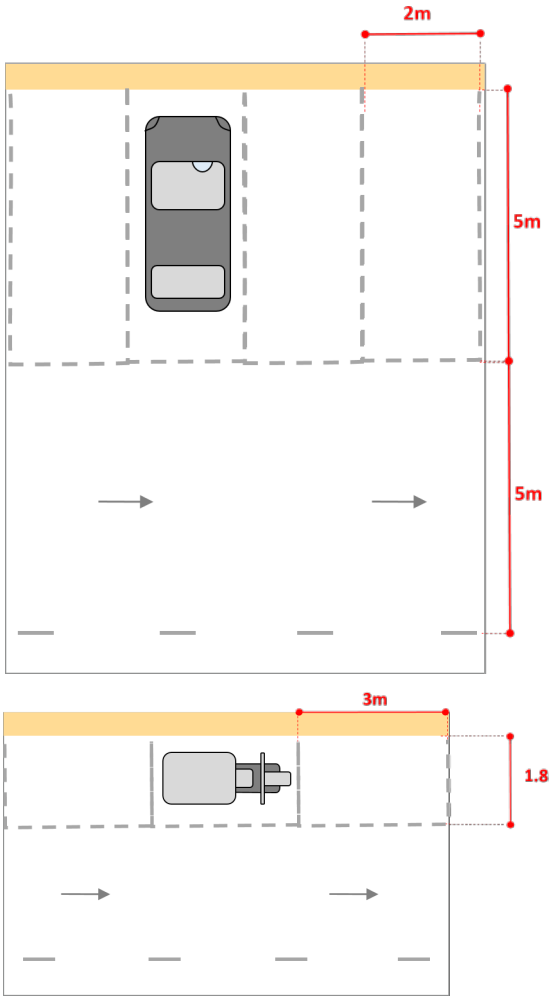
- Firstly, position the drop-off point for professional users (taxis, rickshaws) as close as possible to the accesses to the hub,
- Secondly, position the classic drop-off point and the park-and-ride facility for regular users (car and motorized two-wheelers) near the accesses to the hub,
- Lastly, place on-street parking for occasional users. This last function will be the furthest away from the hub depending on the available land, as it is the lowest priority.

5 Adapt the drop-off point to the site and use

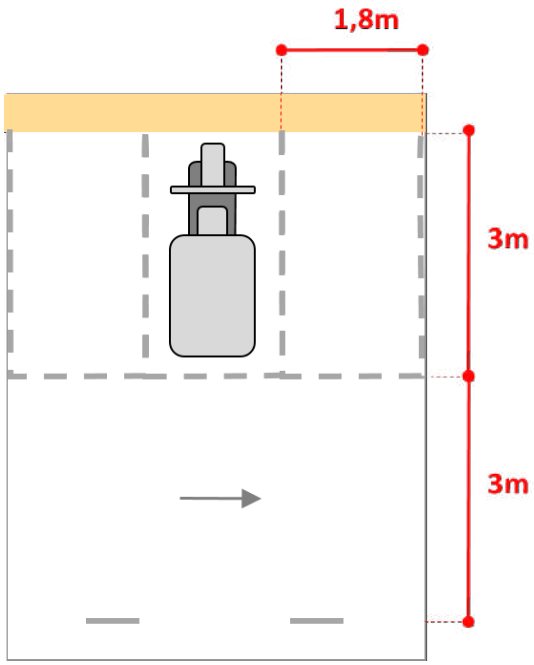
- Provide easy access from and to the main roads. This principle should be extended to all types of hubs.
- Mutualize passenger drop-off and pick-up within the same system on the intermediate and minor hubs (Sabarmati and Ranip).
- Provide a side or on-street walkway to allow clear identification of the function of the area and improve safety (disembarkation of passengers further away from traffic).
- Separate passenger drop-off and pick-up when the hub is large and the flows to be managed are numerous (Geeta Mandir):
  - > *Design passenger drop-off as a fluid queuing system with no parking facilities, to ensure fast drop-off in a small space. Such a system is very efficient and suitable for constrained environments.*
  - > *Provide for time-limited parking (15 minutes) with an appropriate fee for the passenger pick-up. The time required to pick up passengers is more uncertain as it depends on when the passenger arrives.*
- Provide for barriers and appropriate pricing to limit parking time and prevent conflicts of use. If necessary, the desired use can be applied by controls and fines.

5 For cars :

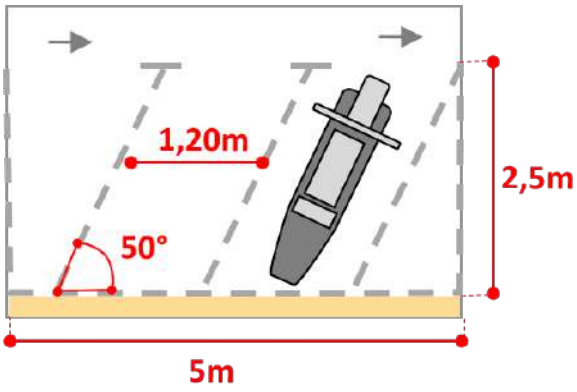




For auto-rickshaws :



For two-wheelers :



Soft Mobility

Global Intents

The density and danger of road traffic currently prevents the development of alternative forms of mobility that are less energy and space consuming. Forgotten cyclists and pedestrians have only few remaining spaces to organise their mobility.

These guidelines make it possible to delimit specific spaces (bicycle lanes, bicycle parking, etc.) for soft mobility. Cyclists and pedestrians will thus be able to enjoy a simplified and secure experience thanks to small road infrastructure.

Guidelines

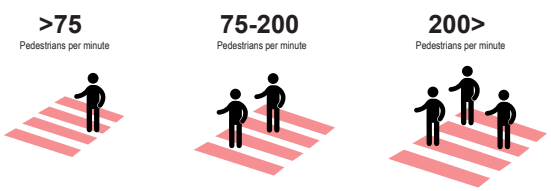
1 Direct, comfortable, and all-accessible pedestrian pathways within the large blocks, with a walkway minimum width of 2m. Walkway widths should be adjusted regarding pedestrians flows in the area:

- Within 200m of the station:
  - > *Under 75 pedestrians per minute: 2m wide,*
  - > *Between 75 and 200 pedestrians per minute: 3m wide,*
  - > Above 200 pedestrians per minute: 1m additional meter every 70 pedestrians per minute.
- Along main traffic lanes
  - > *Under 150 pedestrians per minute: 2m wide,*
  - > Above 150 pedestrians per minute: 1m additional meter every 70 pedestrians per minute
  - > Above 300 pedestrians per minute: 5 m wide
- On other urban axis, along medium to small traffic lanes
  - > *Under 150 pedestrians per minute: 1,5m wide,*
  - > *Above 150 pedestrians per minute: 1m additional meter every 70 pedestrians per minute.*

2 Discourage pedestrians to walk on highways by redirecting them through the pedestrian network and signage to public transport hubs

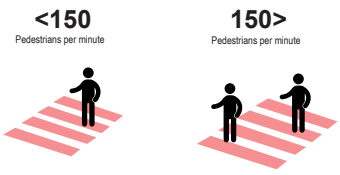
1 Walkway dimensions regarding pedestrian flows

Within 200m of the station



2 meter wide | 3 meter wide | 1m additional meter every 70 pedestrians per minute

On other urban axis, along medium to small traffic lanes

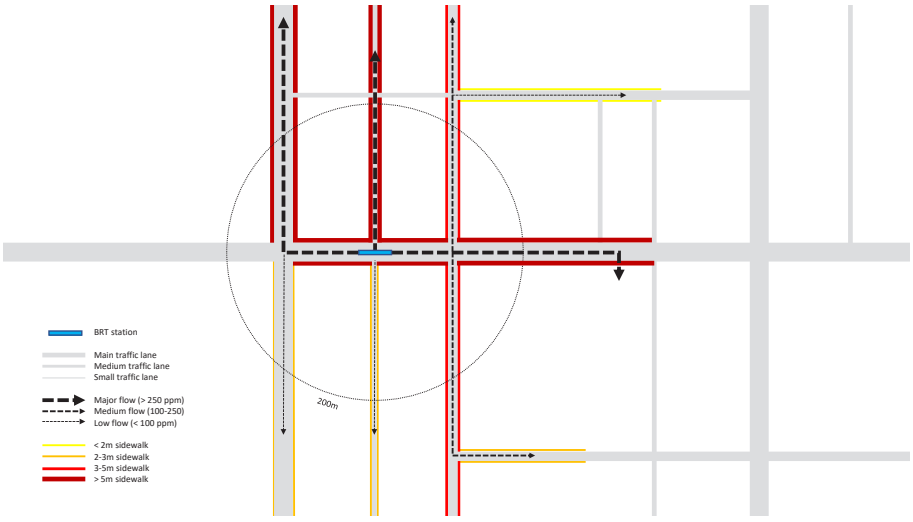


1.5 meter wide | 1m additional meter every 70 pedestrians per minute

Along main traffic lanes

2 meter wide | 1m additional meter every 70 pedestrians per minute | 5 meter wide

2 Exemple of sidewalk network regarding pedestrian flows and street typology



3. Within a 500m of the station, implement crosswalks every 200m on urban roads (and available within 50m of each bus stop and at each end of BRT platforms), every 500m on high speed roads and on each intersection road.

4. Within a 500m of the station, pedestrian crossing should be a minimum of 3m wide or 15% of its length

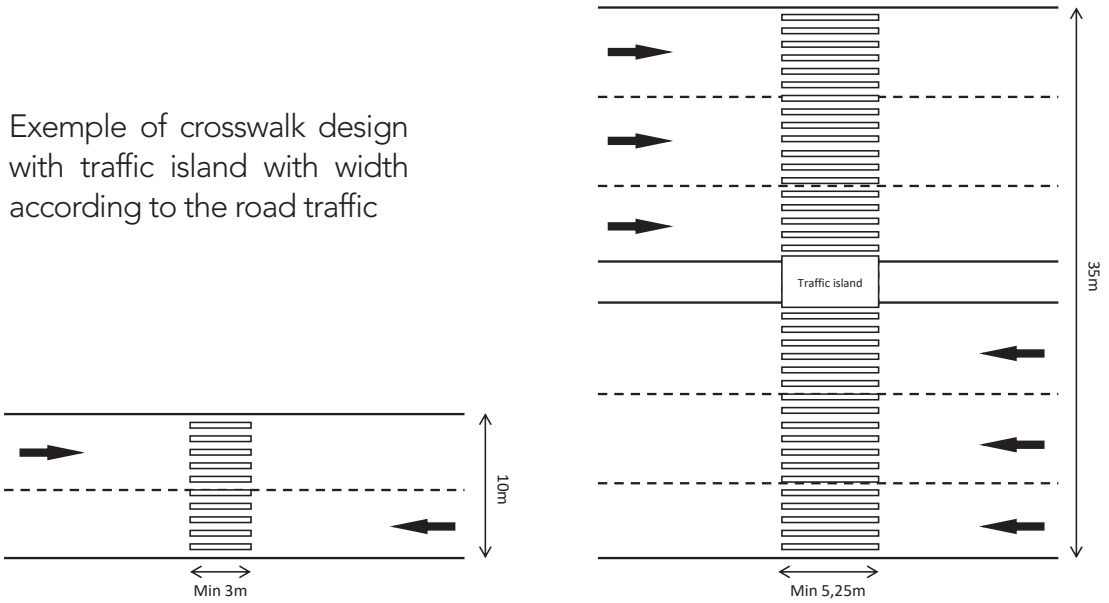
5. At crossing longer than 12m, reduce crossing distance with traffic islands (length at least 2m and same width than the crosswalks), especially in between BRTS lanes and large and busy traffic roads

6. Development of «Shared Zones» in areas where there are high numbers of pedestrians and low numbers of vehicle movements. Speed limits to 20 km/h

7. Pedestrian waiting time at crossings should not exceed:

- 70 seconds in station hubs
- 120 seconds in station neighbourhood
- 240 seconds in station areas

Exemple of crosswalk design with traffic island with width according to the road traffic



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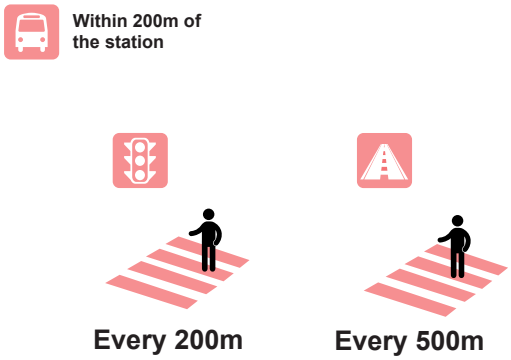
3 Crosswalks implementation



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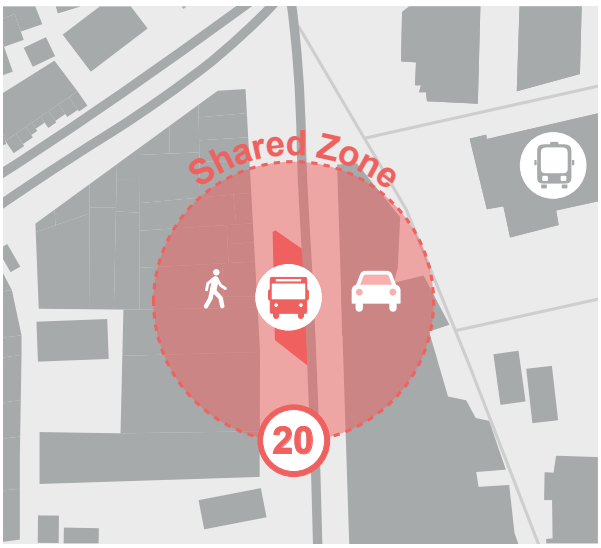


Shared zones will help slow down road traffic

Signage to increase the visibility of the crosswalk, UK

Traffic island, USA

+ Cycling

■ Global intents

In the city centre, cycling on dedicated lanes might be faster than driving, especially when roads are congested. Outside the city centre, cycle is an alternative to connect transports hubs and residential/industrial areas,

Secure and accessible cycle parking should be located as close as possible to transport hubs to ensure quick transfer

Guidelines

1. Bikes should have their own dedicated lanes along densely circulated road, with physical separation to ensure safety. Unidirectional cycle lane minimum width: 1,5m; bidirectional cycle path minimum width: 2.5m

2. On medium to small road, bikes can have their own lane (unidirectional cycle lane minimum width: 1m; bidirectional cycle path minimum width: 2m) or can share roads with cars with signage on the road and with a dedicated zone in front of the traffic lights to ensure that cyclists are visible by cars when the light goes green.

3. Bikes should be allowed to circulate on bus lanes when relevant

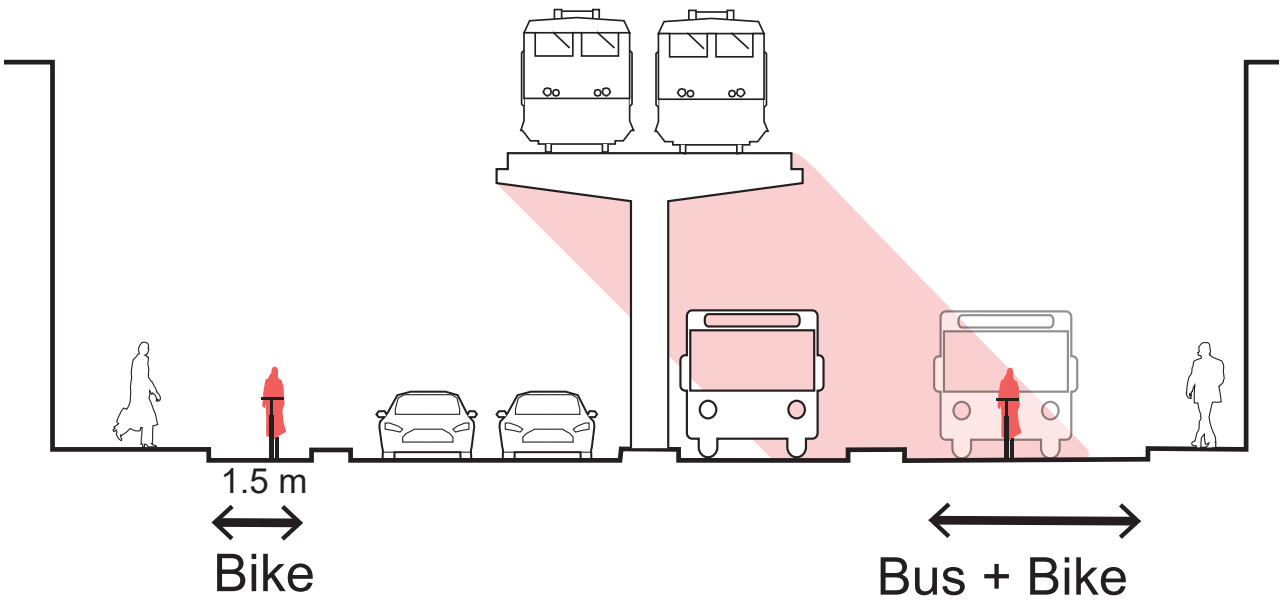
4. When cycle lanes are implemented through or as part of pedestrian areas, cycle lanes should be implemented with efficient signage (painted lanes, use of different material) and without leveling to ensure pedestrians safety. Cycle will be incentive to slow down in these areas.

1

Dedicated cycle lane on major axis, Brest, France

Cycle crossing with dedicated waiting space within the traffic island, Mulhouse, France

2 3



5 Bikes should stay on the road or within their dedicated lanes. Therefore, bikes should stop and go at junction following traffic lights.

- Crossing priority on direct routes with clear sightliness. Turning traffic should give rights to passing bikes
- If no priority, waiting space (minimum area: 6m² = 3 bikes) to allow cycles to cross following the crosswalks
- Pedestrian crossings should be identified to cross bike lanes.

6 Ensure visibility of all cycle corridors (dedicated or shared) to avoid dangerous crossings and accidents with other users (cars/pedestrians)

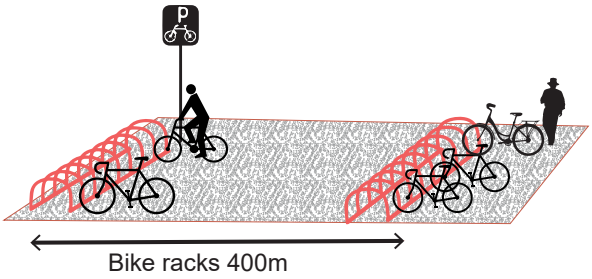
7 ¨Provide ample, secure, and accessible cycle parking in each transport hubs, with 2 to 4 parking slots for 100 people boarding public transport per day (in France, the goal is to implement 4 parking slots per 100 transport users around train stations). These parkings should be located within transport hubs, or else be close and visible from these hubs.

8 Provide public on-street bike parking located within 100m of each key destinations

5

When shared space between cars and cycle, dedicated cycle space in front of traffic lights allow cyclists to be more visible, Paris, France

8



Bike parkings should be equipped with racks

Secure cycle parking, London, UK

6

Shared lane with pedestrians, with appropriate signage, Marseille, France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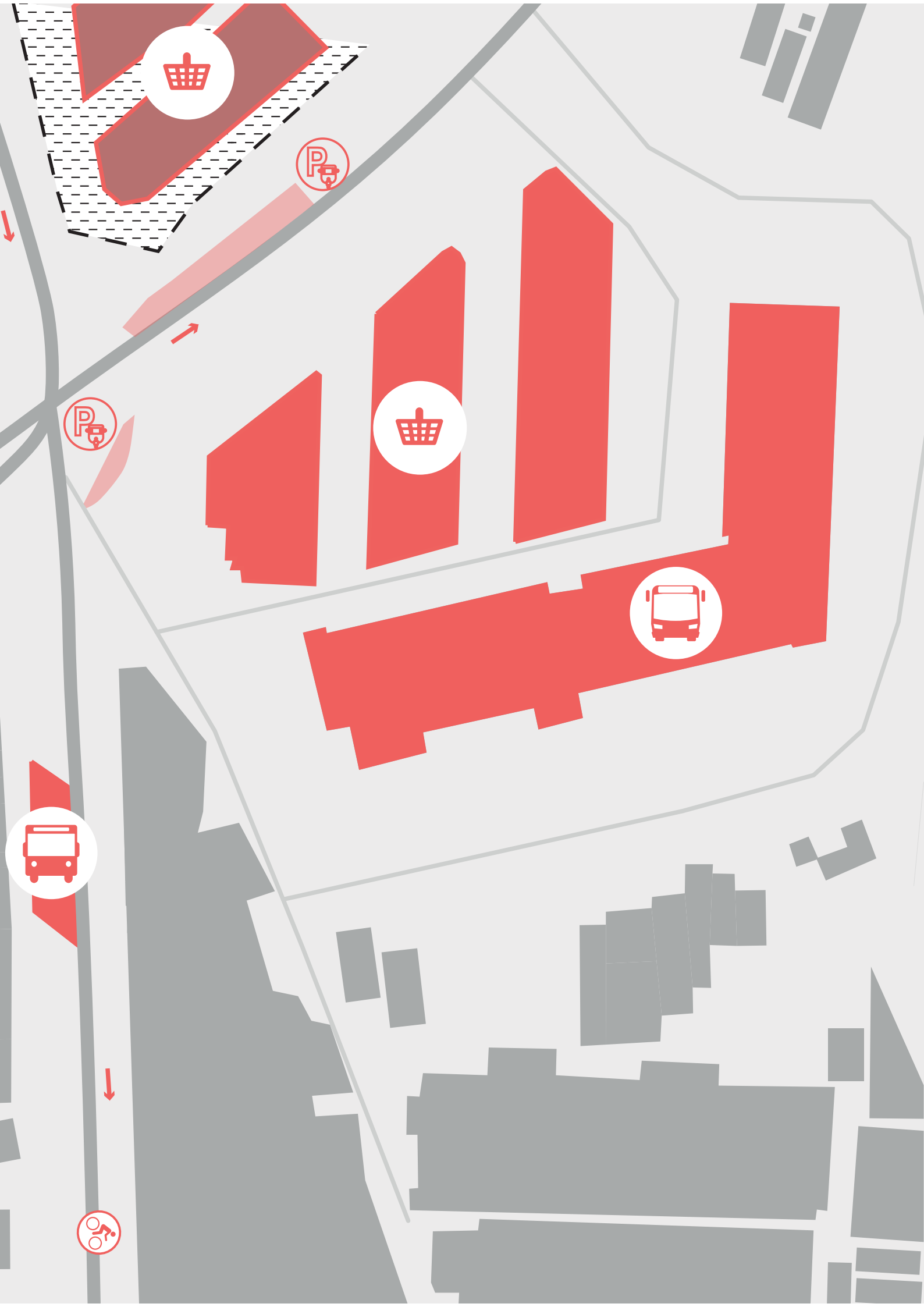
URBAN DESIGN GUIDELINES

BRT stations are indeed great levers for developing the surrounding urban areas: the pedestrian flows they bring is a great opportunity for small and big businesses.

New transport facilities must be designed in relation to their urban fabric: comfortable, green, and well-shaded transit spaces can become vibrant places. It is important to create a space where passengers can feel that they can do more than just pass through. Well-designed spaces that accommodate small shops and outdoor activities can help to integrate the station into its urban environment



1 | Urban Design to improve pedestrian experience

Global intents

Surrounding plots are often impenetrable and need to be more permeable. While creating alternative crossing solutions, we should leverage the therefore created spaces to integrate new parks and open spaces.

Sidewalks and main avenues' walkability should also be improved so that the area become comfortable for pedestrians.

Guidelines

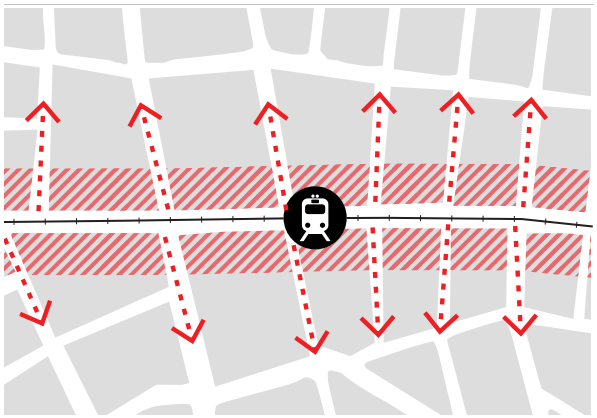
1 Reduce pedestrian journey time to enhance public transport use

- Near the station, reduce uncrossable large public parcels (civic, universities, hospitals, etc) by creating internal pathways
- Large public parcels should provide gateways identifying main pedestrian pathways inside parcel
- Large private, gated developments should enhance crossability and consider the introduction of pathways publicly accessible - at least during the daytime

2 Create nice and pleasant pedestrian journey

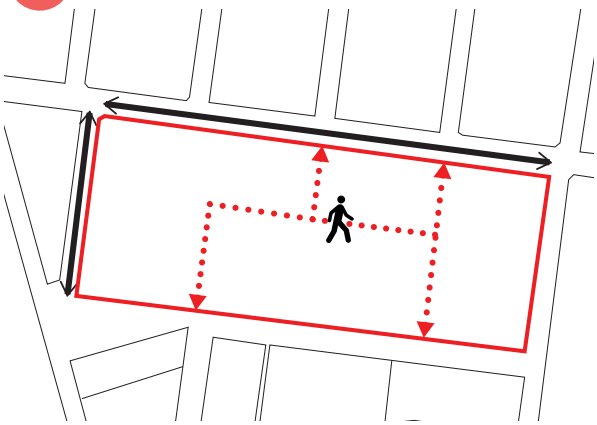
- Parks, open spaces, and outdoor facilities should form networks of pedestrian-friendly areas in station areas.
- Outdoor facilities should be, as much as the specific use design allows so, crossable in the daytime.
- Station areas should provide a variety of park types (recreation, leisure, play), even if they must be smaller.
- o Elaborate a policy for typical sizes and types of public, open spaces to foster informal and active recreation serving the intensity and type of station areas' development.

1

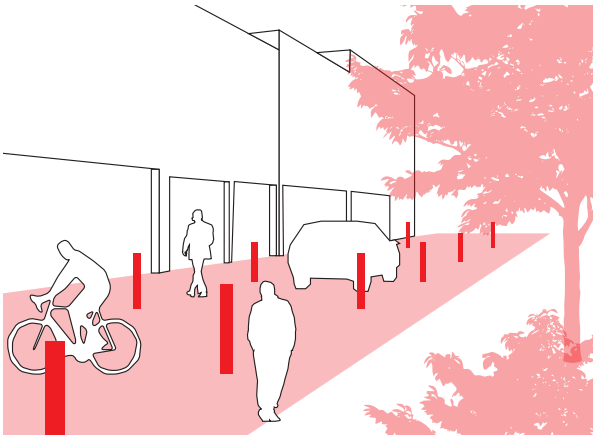


Multi modal hubs must be connected to their neighborhoods, so that we should have a dense network of alleys to serve them locally

2



Large housing blocks should be walkable: new paths can be created to make them more permeable



Streets should be provided with street furniture and pavements or other pedestrian areas should be protected from traffic by bollards or barriers (Sources: Poitiers, France)

2 | PUBLIC SPACE DESIGN FOR PEDESTRIAN COMFORT AND SECURITY

Global intents

Given Ahmedabad's climate and sun exposure, it is necessary to provide plenty of shade and vegetation in public spaces.

Green spaces help to cool the local climate and improve the visual and architectural quality of the area. Green spaces can also be used to support other efforts, such as emphasizing pedestrian spaces or supporting the sharing of the road.

Guidelines

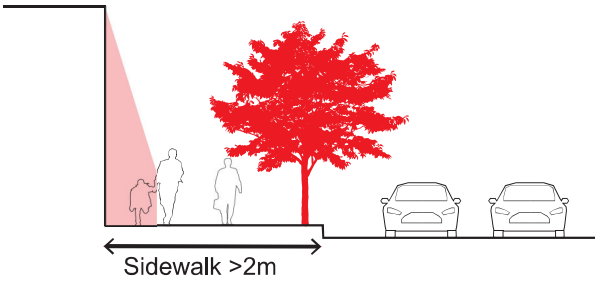
1 Enlarge spaces dedicated to pedestrian for security and comfort

- Explore a new ROW (Right Of Way) standard, based on having only pedestrian and bike flow in streets.
- Improve the street ROW dedicated to soft mobilities on existing roads to develop zones more centred on pedestrian and bike flows. This could be achieved by redesigning roads configuration and limiting traffic lanes to the minimum while dedicated the remaining space to soft mobilities.
- All sidewalks should be wider than 2 meters.
- At least 25% of available space should be dedicated to public spaces in the station area

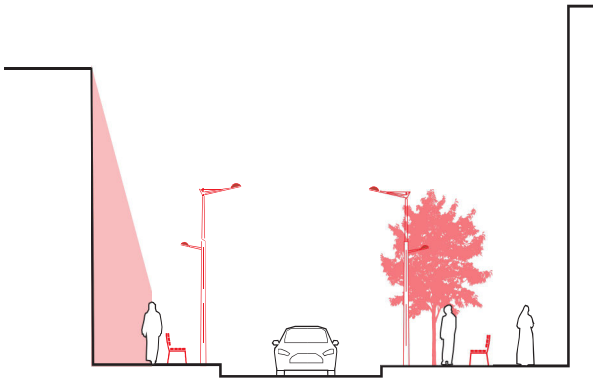
2 Design sidewalk for pedestrian security

- Provide security devices to separate pedestrian flows from traffic and discourage informal parking
- Sidewalks height should be reduce when facing a pedestrian crosswalk, to ensure easy transition for all
- Ensure pedestrian sidewalk are continuous, free from obstacles (trees, lightning and information devices, banks, utility network infrastructure, ...)
- Ensure pedestrian sidewalk are free from an authorized uses: informal parking, private

1



Streets should be provided with street furniture and pavements or other pedestrian areas should be protected from traffic by bollards or barriers (Sources: Poitiers, France)



2

A continuous pavement can be made up of different pavement layers that indicate landscaped areas, drain excess water, etc. (Sources: France)

entrance stairs, commercial activities, garbage, …) and easy to walk

- Improve sidewalk floor treatment: regular pavment...
- Develop rainwater drainage system to ensure sidewalk walkability even during monsoon season

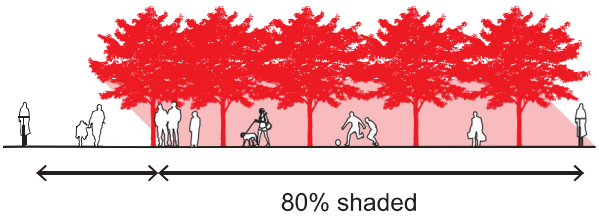
Enhance public space vegetalization:

3

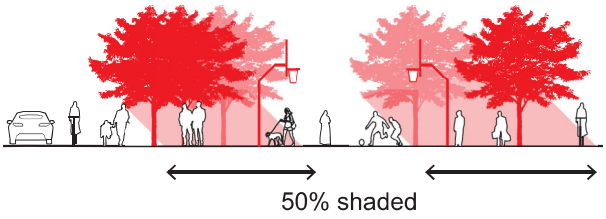
- All park pathways should be 80% shaded, and open spaces 50% shaded;
- All parks should be 60% planted with shading trees or dense shrubs.
- All plazas should be 20% planted with shading trees or dense shrubs
- Design a range of shading structures adapted to sidewalks/ street widths and other constraints. Shading structures shall offer a full coverage and adapted to continuous long distances.
- Improve street orientation prior to different uses during the day:
  - Morning activities (e.g. commuting) shall favor North-South orientation;
  - Midday to Evening activities shall favor East-West orientation
  - Promote shadow-casting architectural typologies: arcades, projections above ground floors, etc… Building heights should also be considered (Height to width ratio ranging from 1 to 2.5 in most cases)

3

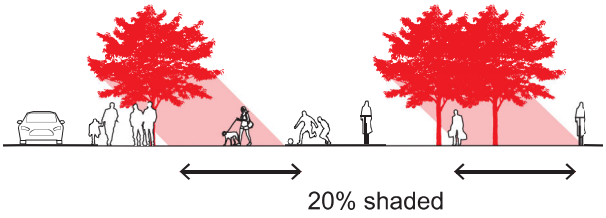
PARKS

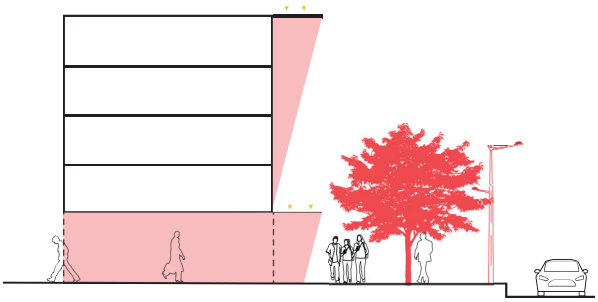


OPEN SPACES

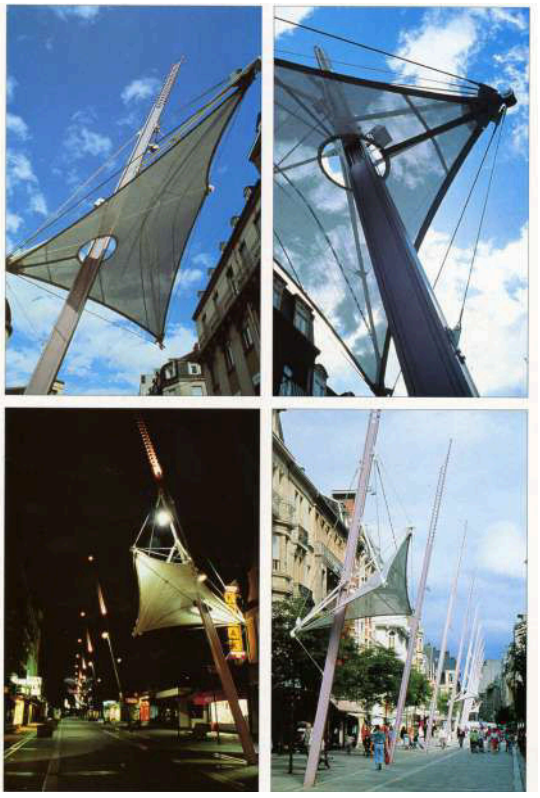


PLAZA





Example of shadow-casting architecture : the galleries allow people to move around sheltered from the sun, while the sails create shaded areas in the passageways or waiting areas



3 | VIBRANT AREAS / ACTIVE FRONTAGES

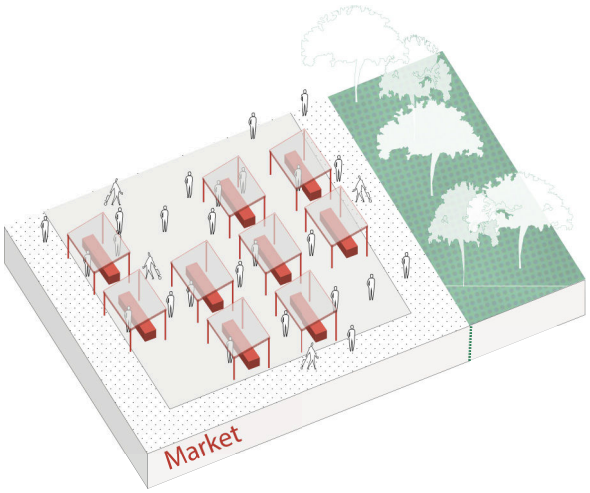
Global intents

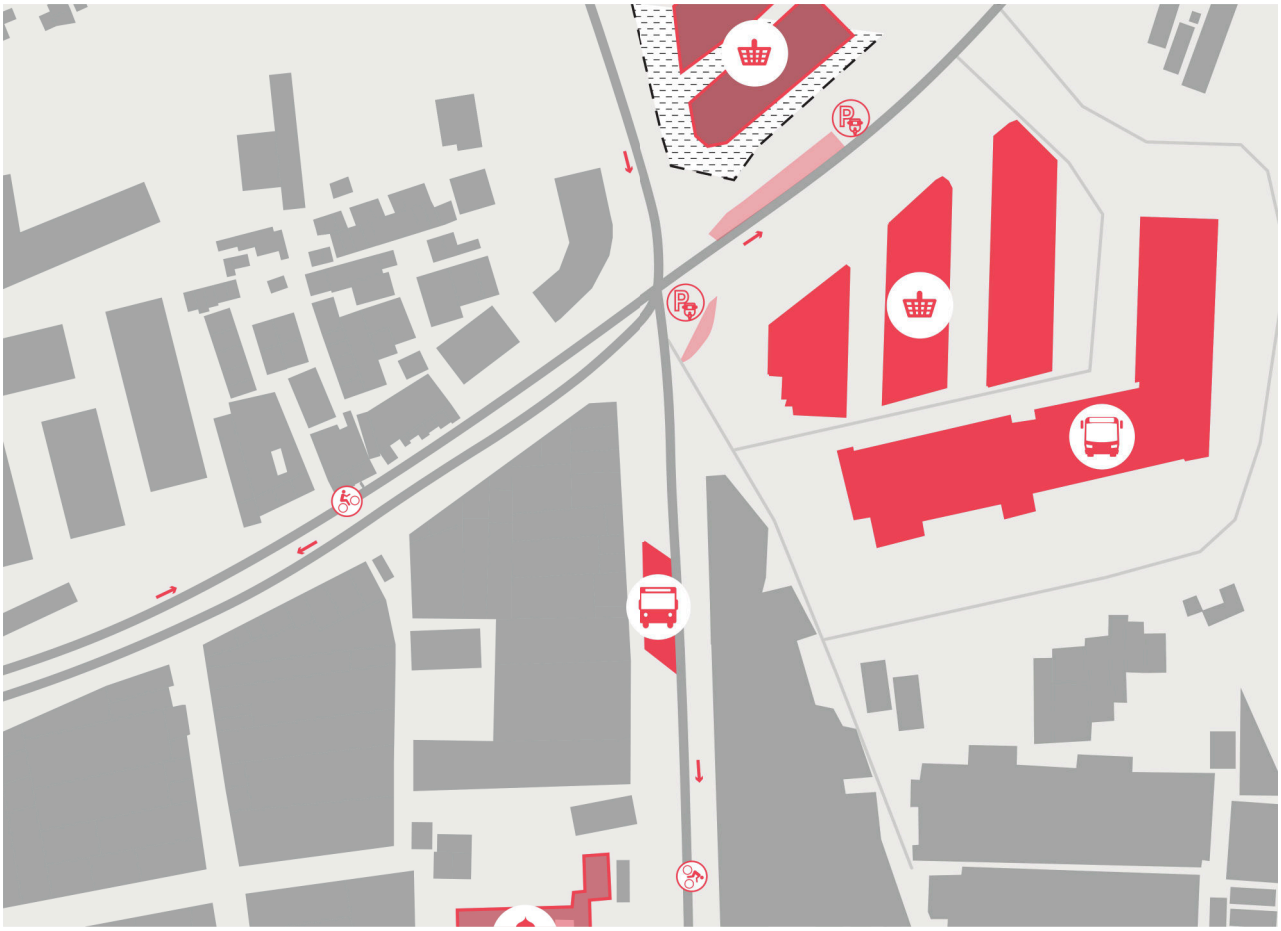
Geeta Mandir is the busiest of the three stations studied and demonstrates the importance of linking commercial or social activities to transport infrastructure. We should then create vibrant areas for users within the range of the stations.

Guidelines

1. Ground floor areas should have a positive relationship with the public space. Active frontage at the ground floor should adopt a layout and scale that provide a good sense of continuity, enclosure and overlooking of the street, achieving high quality urban form.
2. Heat producing units of retail spaces such as refrigerating or cooling units shall not be placed on street frontages. This to avoid both visually inactive and heat producing frontages.
3. Promote visually integrated residential frontages: openings, awnings, planted setbacks, etc.
4. Provide a zoning overlay across transit plazas to foster the presence of shopping areas and commercial, vibrant places
5. Convenient stores should be available within a 100m meters radius across station entrances.
6. Ensuring flexibility of land uses within the Station Area to enable it to respond to changing socio-economic demands
7. Provide dedicated space for street vendors: it should be located close to pedestrian flow, on a dedicated area, it should not disturb pedestrian flow

Markets and external activities will shift transit plazas into vibrant areas during the day





Transit interchanges help develop commercial opportunities, such as the new mall in construction north of Geeta Mandir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CONCEPT PLANS

1 | SABARMATI STATION CONCEPT PLAN

■ 2 DESIGN OPTIONS:

Option 1: Comfortable and highly secure design of transport facilities on Private Southern land

Option 2: On the road design option

■ URBAN DESIGN

In order to improve the experience of the BRT users and the connectivity between the BRT station and the other transport facilities such as the future metro station and the high speed railway station that are under construction, we designed a large public space shared with other transport modes in the vicinity of the station where the traffic is expected to be most important.

It is also designed to be an interchange square between the three main blocks that forms the urban landscape of the station area: the residential area, transport infrastructure and the future railway station. Is also designed to be a vibrant and dynamic square that can host street vendors, and be used by the power station workers during lunch and dinner breaks.

■ PRIVATE VEHICLES AND BUS TRAFFIC

The main principle for Sabarmati station is implementing a clear space organisation. Each mode should be in dedicated spaces to limit conflicts,

- We have reduced the space allocated to the road and clearly defined lanes.

- As soon as possible a lane is dedicated to buses to avoid congestion

- We have promoted pedestrian spaces. Reducing the width of the road in order to enlarge the sidewalks. We have used differently both sides of the street to organize all mobility services:

- In the North West side, all the transit facilities (bus stop, auto rickshaw and private vehicles pick-up and drop-off) are organized in a clearly separated area to avoid the heavy road traffic of the highway. A traffic light manages the flows and gives priority to the buses to let them come back in the main transit flow.

- In the south side, land is private so we have reduced the space allocated to the mobility facilities. Bus stop, pick-up and drop-off are managed thanks to a notch but in direct access to the main road. A traffic light system guarantees the safe crossing of pedestrians at the same time as easy access to the notches.

Using both sides of the street permits to attract vehicles in the two directions, from East and West.

We have improved the connection between side streets and BRT station by systems to reduce speed of vehicles (signalization, traffic lights and pedestrian platform for example) and protected pedestrians crossing by traffic lights. These measures are particularly important for the south side of the street.

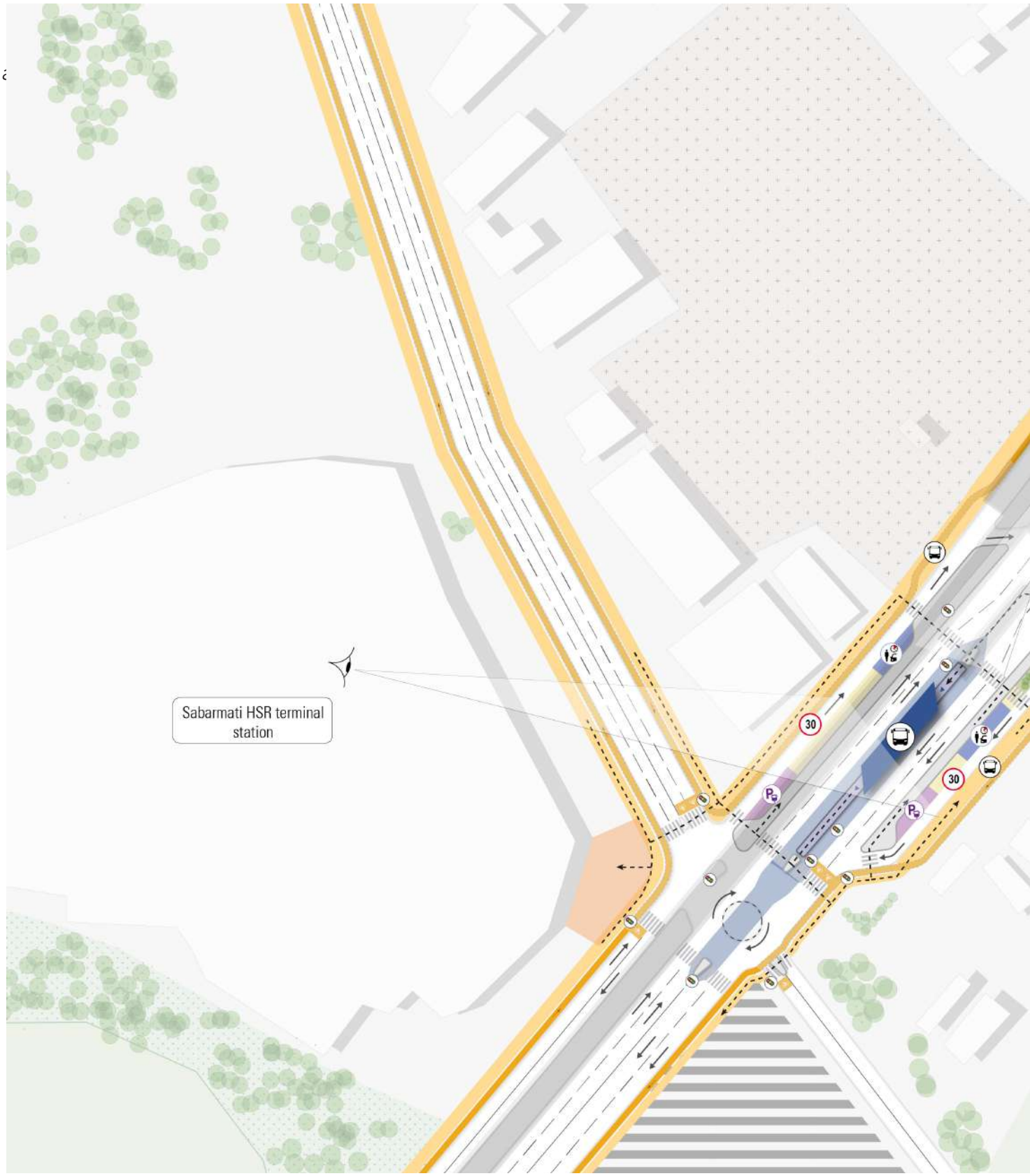
Given its location in relation to the existing road network (along a motorway), the lanes in the vicinity of the Sabarmati station should be sufficiently wide (3.5 m). It will be all the more important to reduce this speed on the approach to the station. This speed can be reduced by a pedestrian platform or by reducing the width from 3.5 to 3m

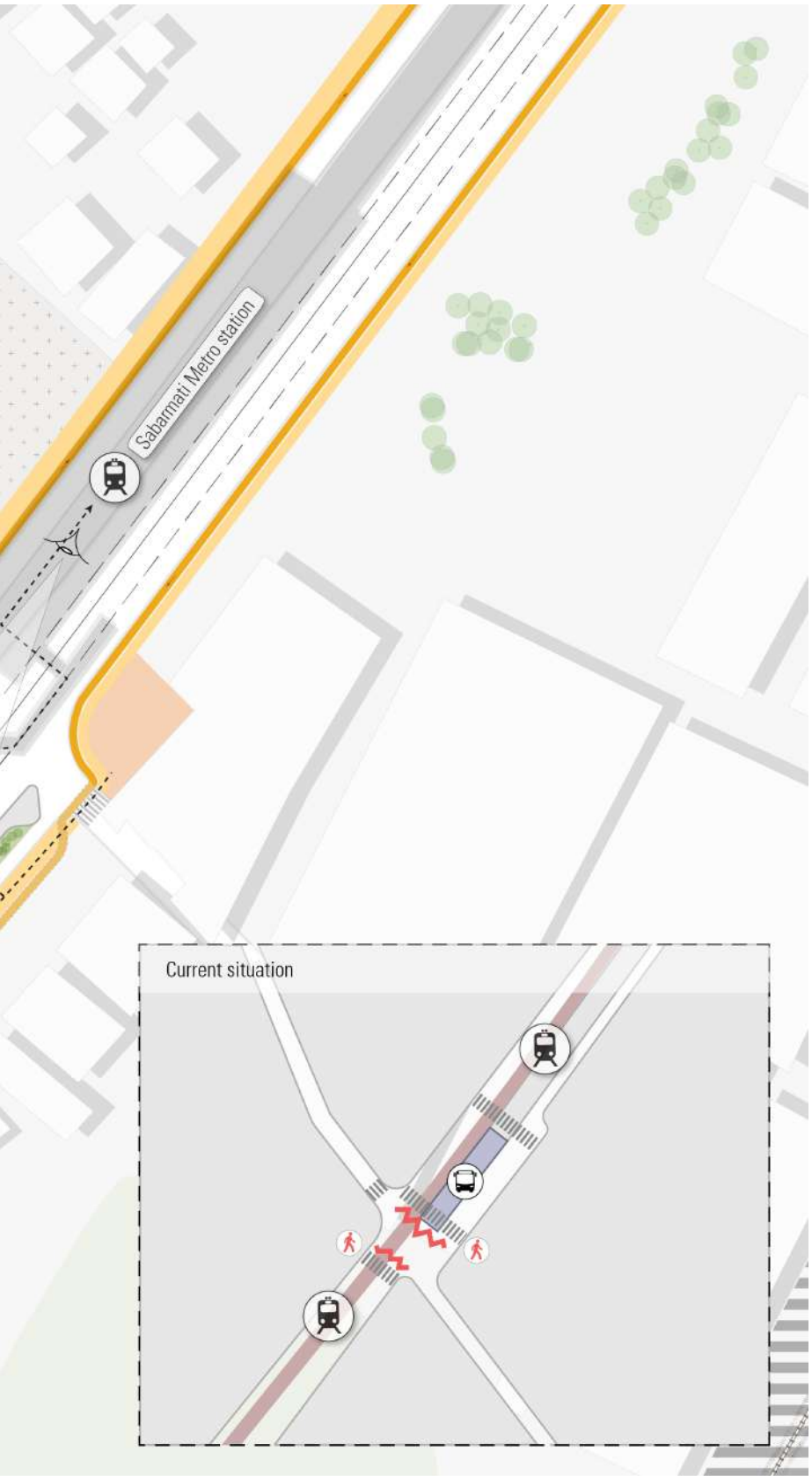
SOFT MOBILITY

At Sabarmati, we implemented crosswalks on each side of the BRT station to avoid jaywalking. As the highway is wide (approx. 30m), we designed crosswalks wider than the minimum width (approx. 4m), and implemented traffic islands and traffic lights to ensure safe crossings. Larger sidewalks are implemented particularly in the vicinity of Sabarmati BRT station on each side of the highway to accommodate important pedestrian flows as well as other activities such as street vendors; on the other hand, sidewalks should be less wide on residential roads north of the station, with a minimum of 2m.

As the highway is densely circulated, we implemented unidirectional dedicated bike lanes along the highway outside of the station perimeter. Near the station, the designed shared bike lanes are not physically separated from sidewalks but only with signage. Moreover, to ensure safe crossing of the large intersection located west of Sabarmati BRT station, we installed bike boxes, as well as direct bike path when turning left or going straight ahead involves crossing small or no road. Finally, secure bike parking should be implemented on each side of the station, along with street bike parking around the station.

Sabarmati Concept Plan option1

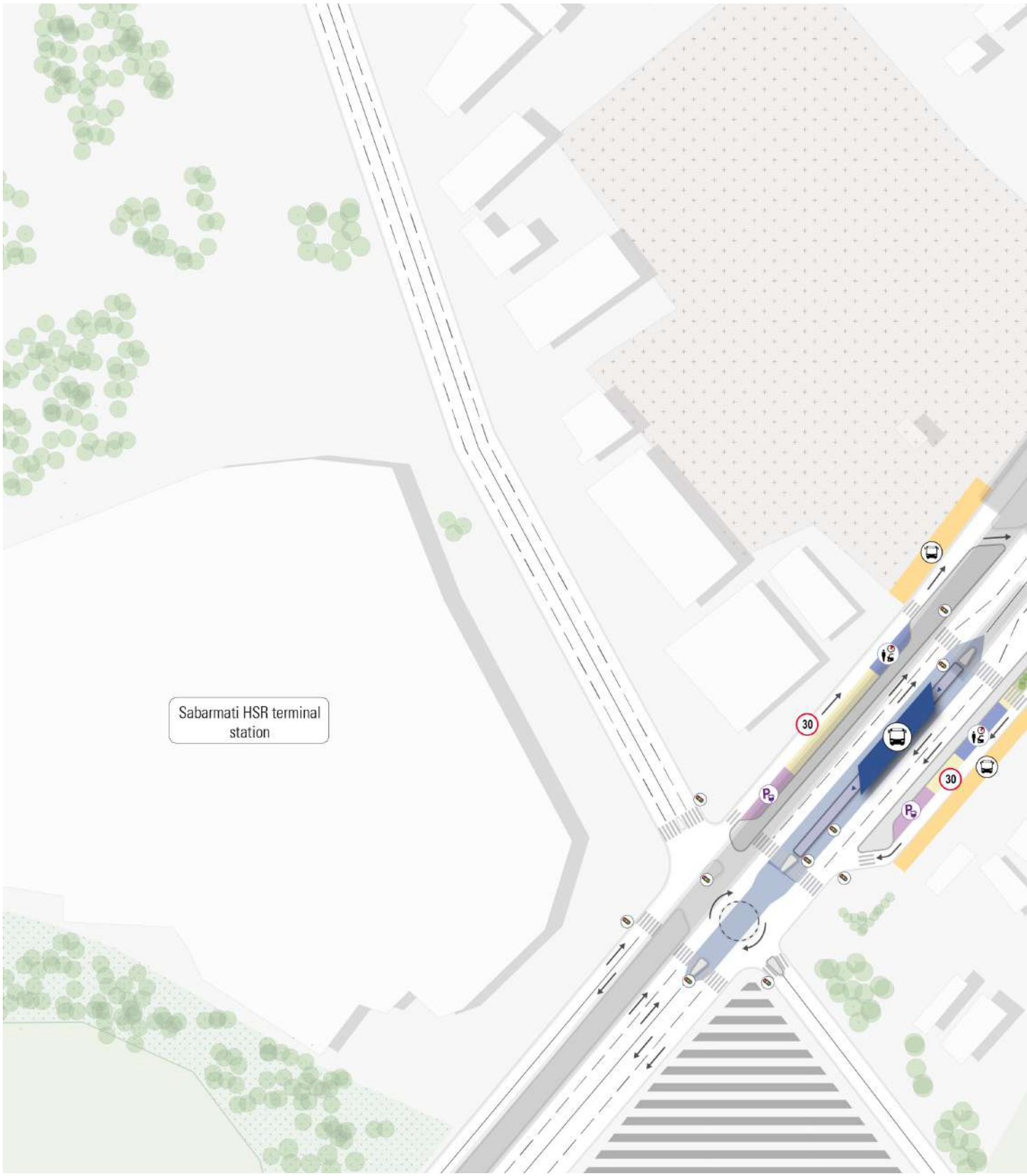




MAP KEY

- BRT Station
- Design secure, large public spaces in the direct vicinity of the BRT station
- Set-up large, confortable, sidewalks to secure the direct vicinity of the stations
- Implement continuous and direct pedestrian routes from/to the BRT station
- Set-up crosswalks at the vicinity of the BRT entrance and exit
- Enhance station visibility from the main landmarks
- Design cycle parking close to transport hubs to ensure quick transfer
- Implement secure cycle lanes of the stations
- Plant public spaces with shading trees or dense shrubs.
- Reduce the bus speed to 30km/h in the public/pedestrian areas
- Reduce the car speed to 30km/h in the public/pedestrian areas
- Implement traffic light to secure pedestrian crossways
- Design cars drop-off and pick area close to pedestrian flow allowing station visibility
- Design parkings for the rickshaws close to pedestrian flow allowing station visibility
- Design public bus drop-off area
- Design separate entries and exits in the BRT station
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces

Sabarmati Traffic map option1



MAP KEY

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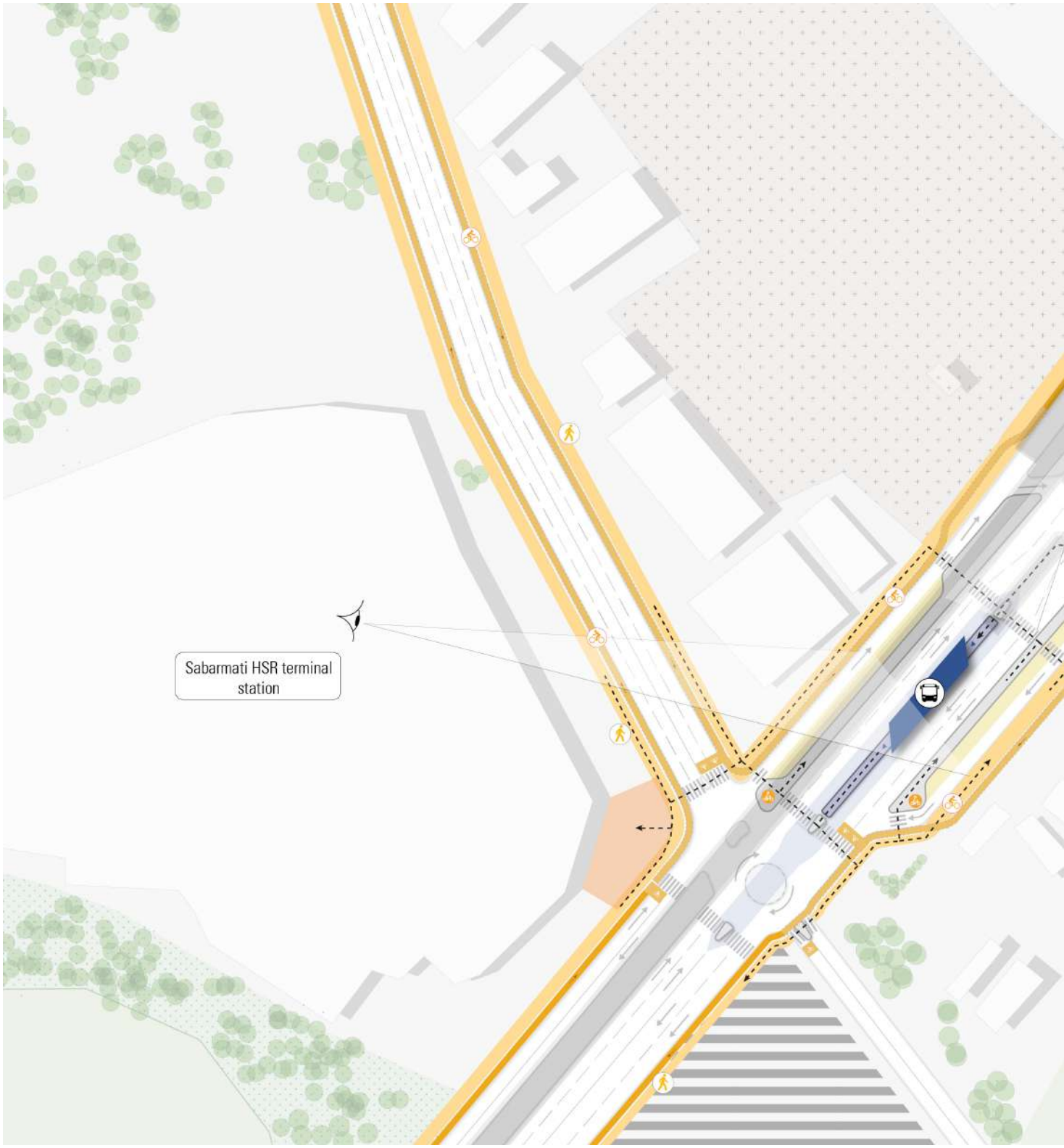
- Surface allocated to motor vehicles

Sabarmati / Soft mobility modes and urban integration map option1



MAP KEY

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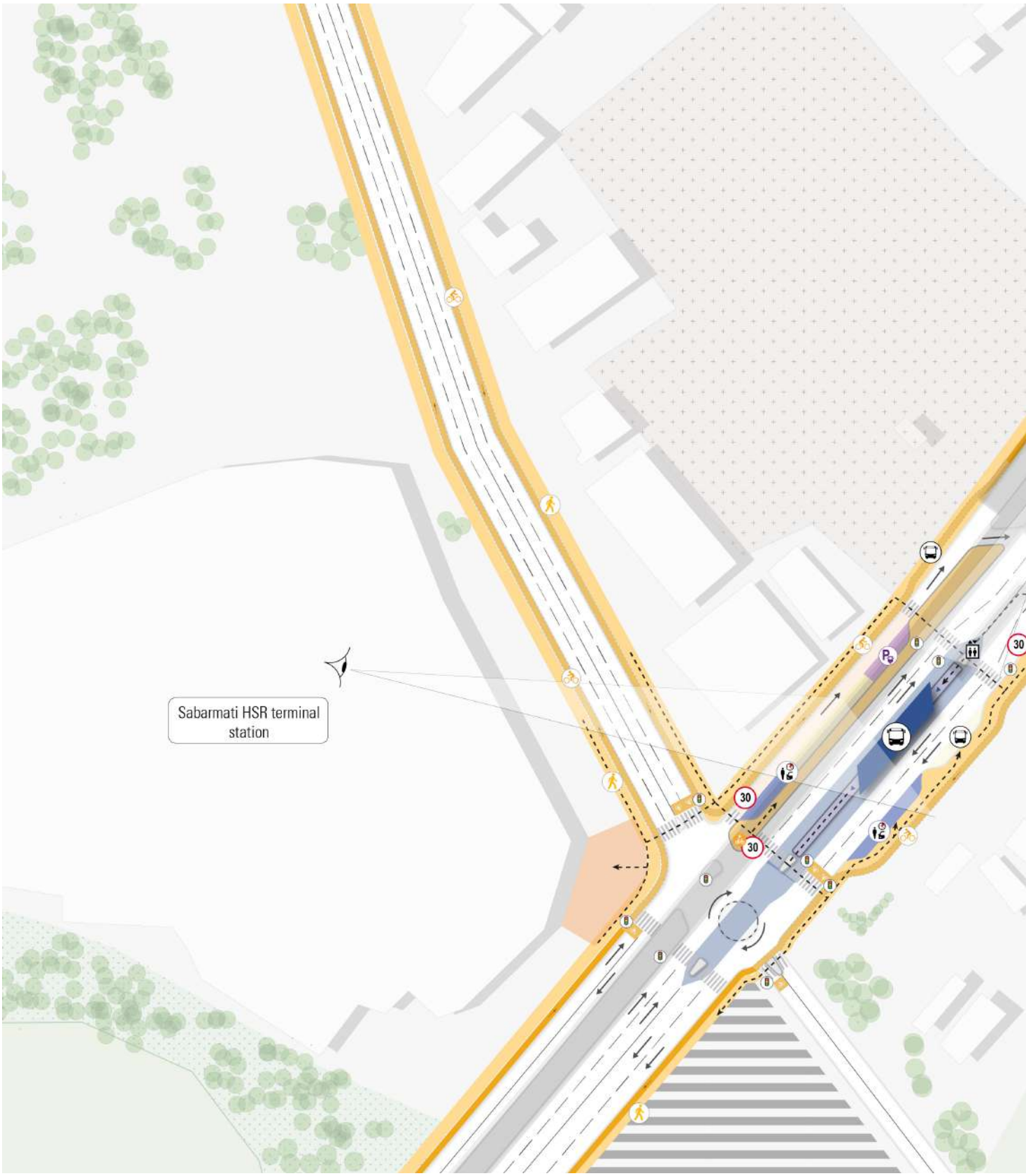
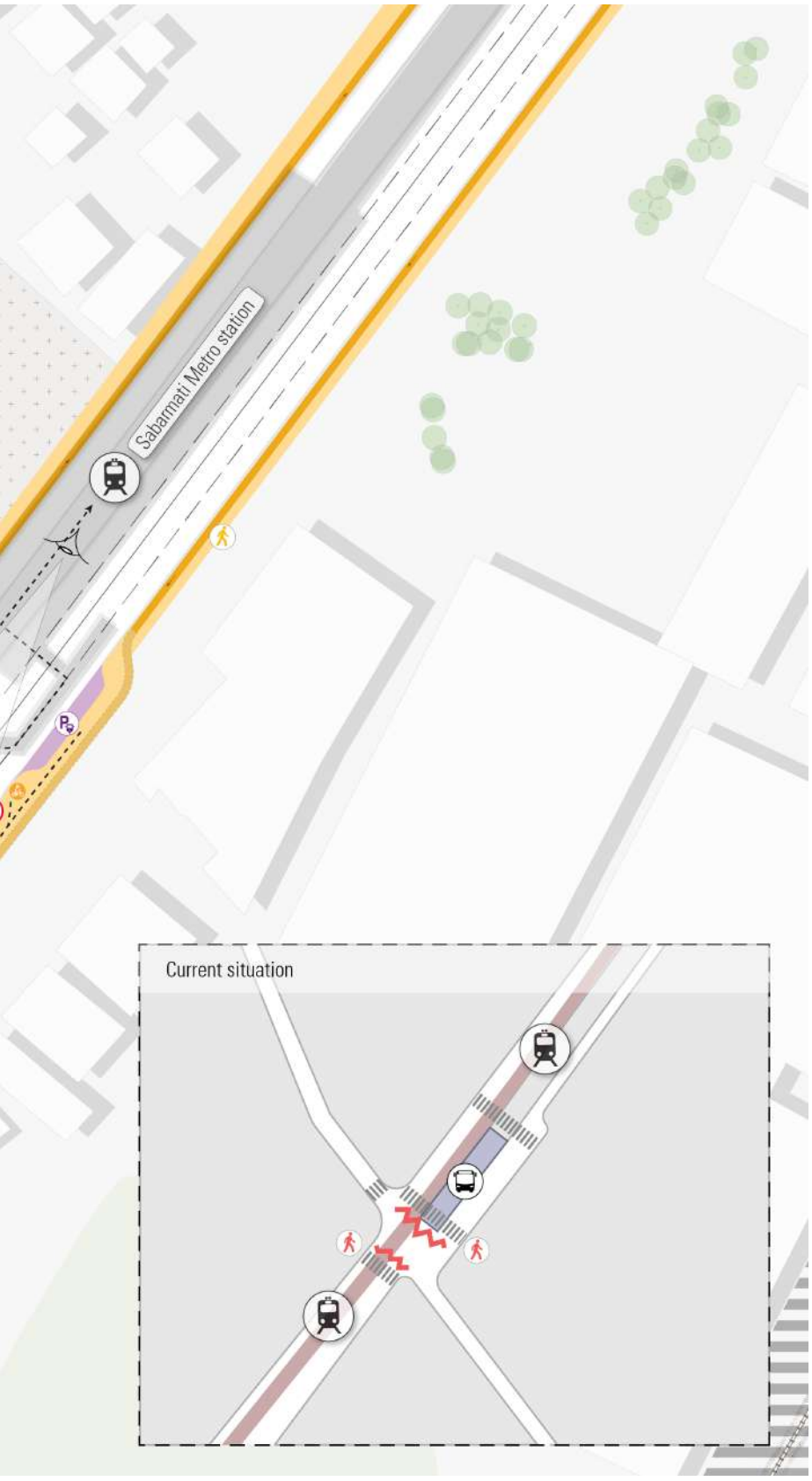
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces

Sabarmati Concept Plan option2





MAP KEY

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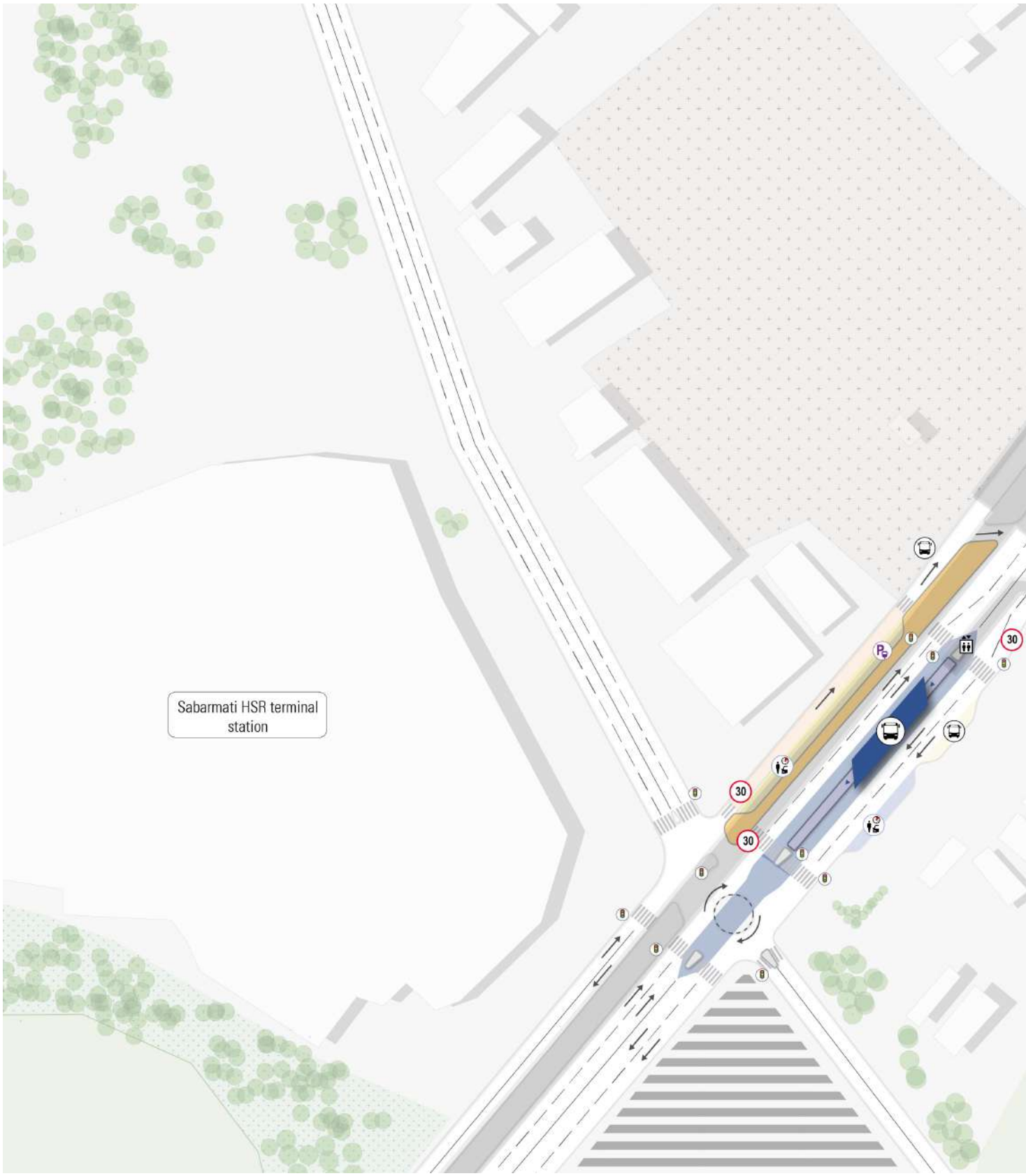
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces

Sabarmati Traffic map option2



MAP KEY

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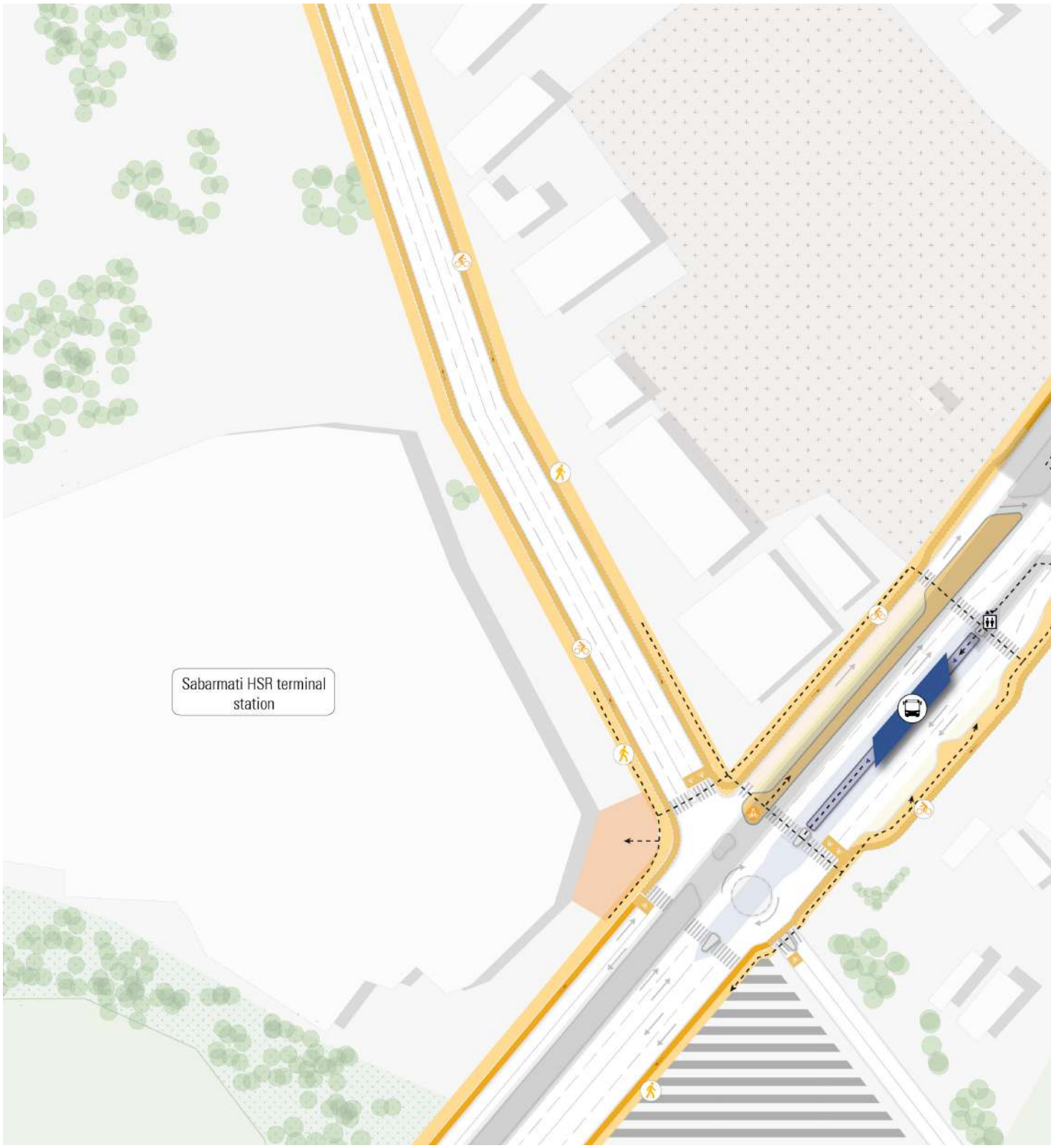
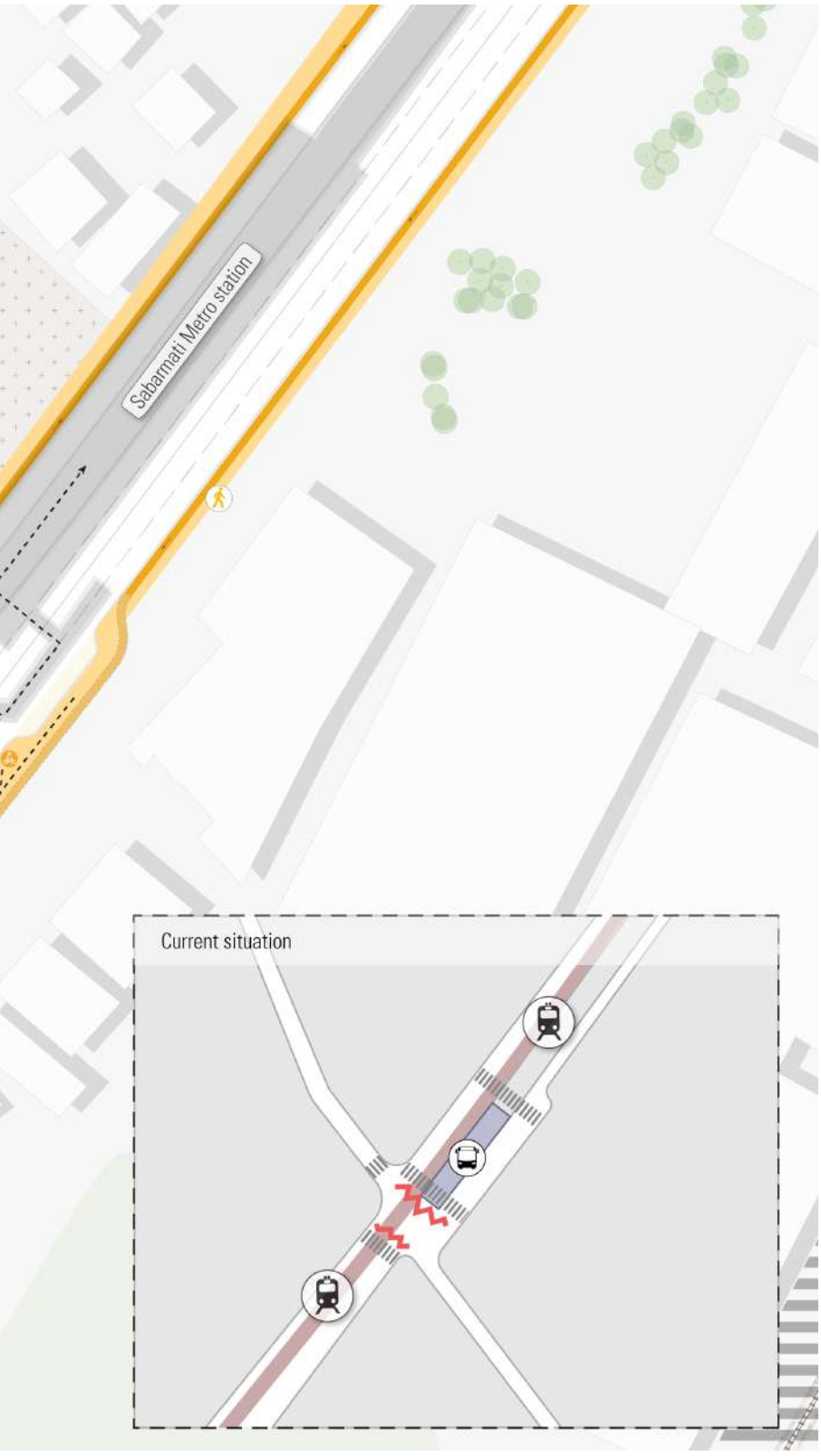
- Reduce the car speed to 30km/h in the public/pedestrian areas
- Implement traffic light to secure pedestrian crossways
- Design cars drop-off and pick area close to pedestrian flow allowing station visibility
- Design parkings for the rickshaws close to pedestrian flow allowing station visibility
- Design buses drop-off area
- Building lot, traffic island
- Surface allocated to motor vehicles
- Bus lane

Sabarmati Soft mobility modes and urban integration map option2





MAP KEY

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- Implement secure cycle lanes of the stations
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces

2 | GEETA MANDIR STATION CONCEPT PLAN

■ URBAN DESIGN

For Geeta Mandir station we decided to take advantage of the great potential of the GSRTC plaza by redesigning a large transit plaza that connects the BRT station directly to GSRTC bus station and the neighboring residential and commercial areas. The main objective of this design is to create a real transport hub that connects the bus station, the BRT station and other transport modes such as rickshaws in order to secure and facilitate walkability in the station area.

Parts of the plaza will be shaded and equipped with street furnitures in order to foster informal activities such as street vendors and food corners and also active recreation for the passengers and the BRT users.

In addition to that, we created internal pathways inside the residential plots located East of the station in order to reduce uncrossable large residential areas and enhance crossability. This helps reduce pedestrian journey time and enhances public transport use since it connects the BRT station directly to the transit plaza.

■ PRIVATE VEHICLES AND BUS TRAFFIC

The main objective of this hub was to compact the crossroad and the space dedicated to drivers which is huge. This compaction limit conflicts area, simplify the crossroad management and allow us to give more space to pedestrians.

We reduced every road to 3 lanes clearly delimited. We are convinced that with an efficient crossroad management, keeping more lanes is not efficient to regulate traffic flows.

We believe a roundabout with traffic light is a good solution to do this efficiently. There is also a dedicated lane and phase to BRT to let it cross the intersection through the roundabout safely and avoid congestion.

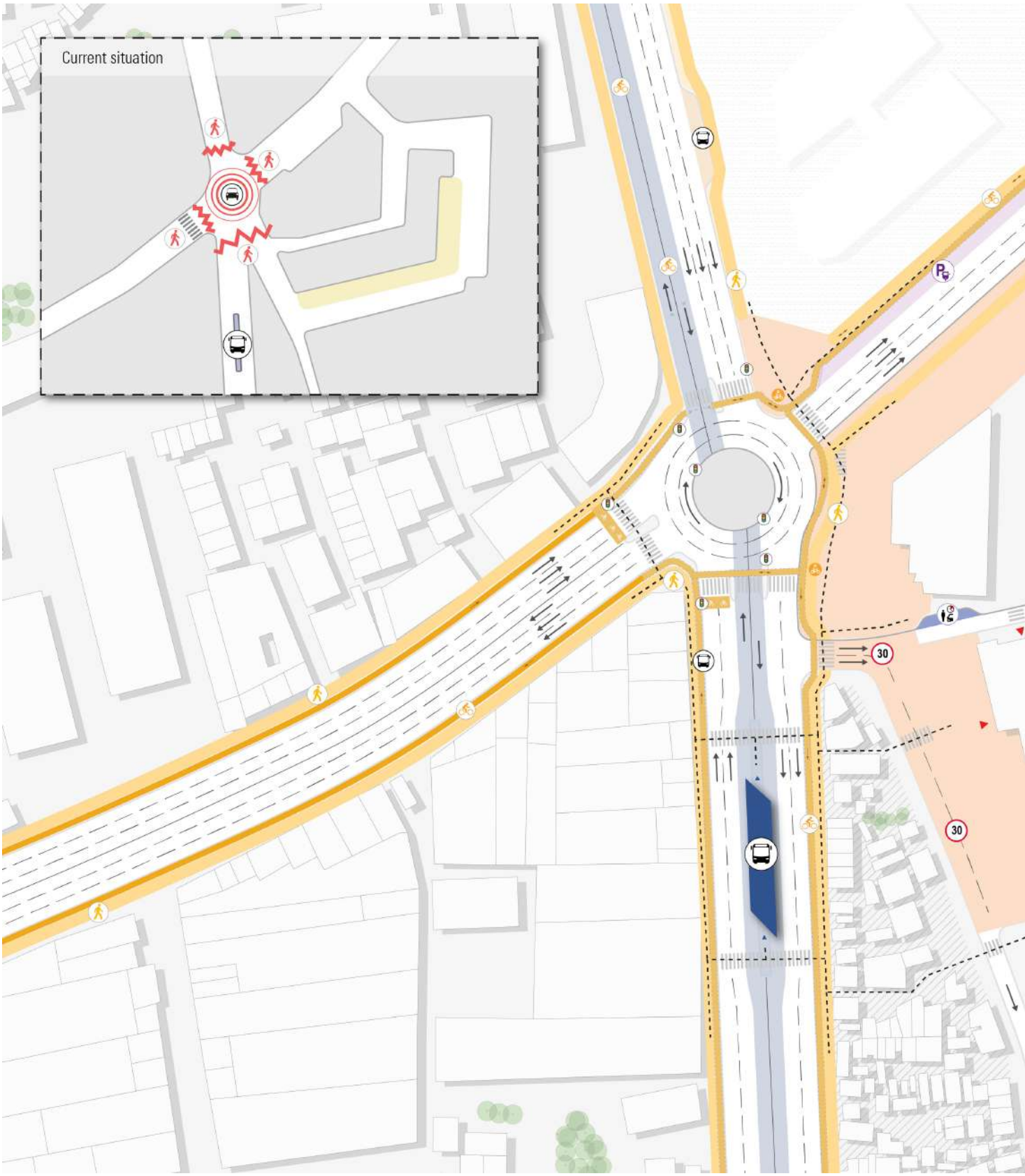
Due to the very central and dense location of Geeta Mandir, the space available is very limited. The traffic lanes will therefore be narrower (between 2.5 and 3m) and the speed limit should be 30km/h

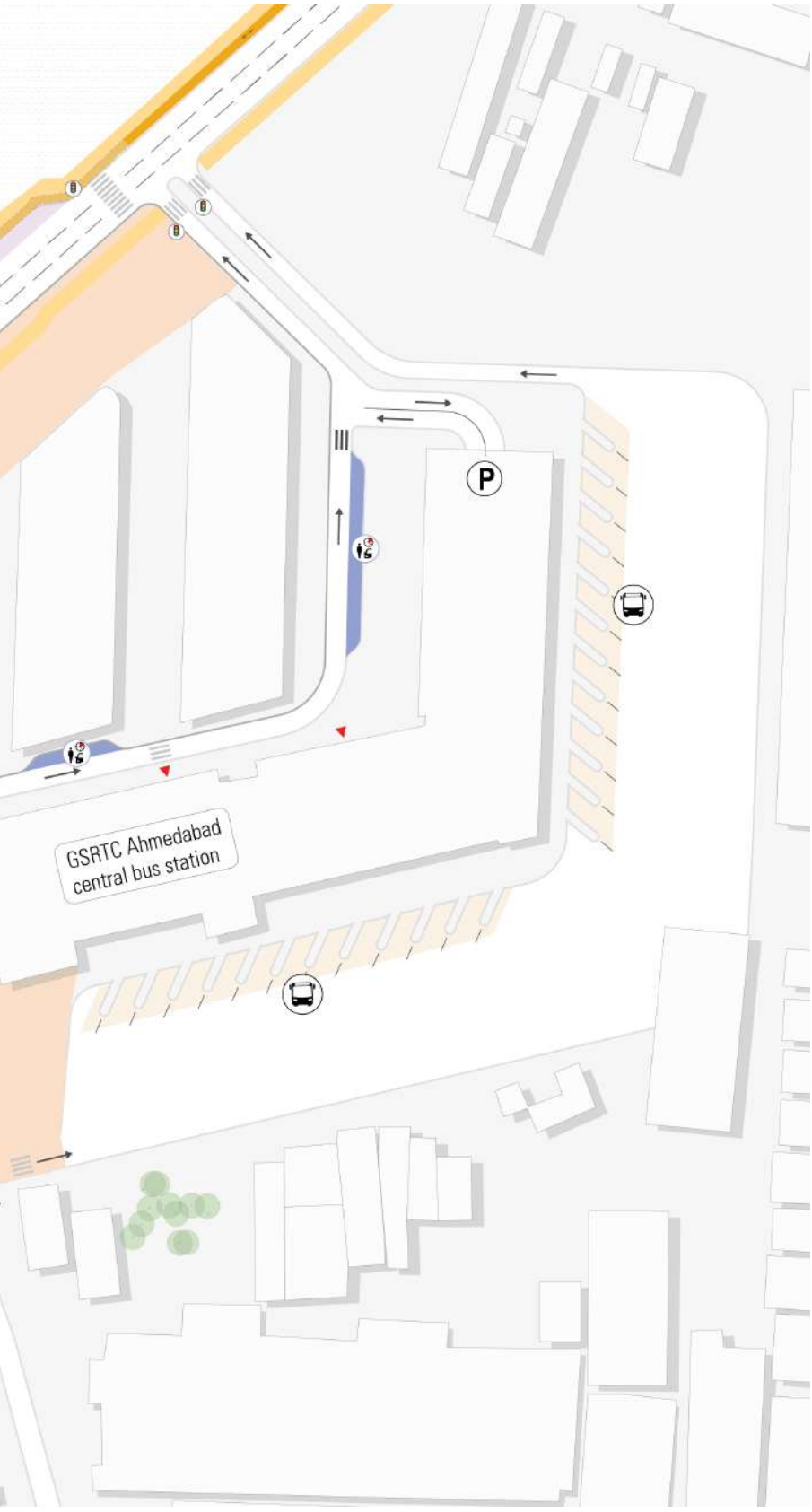
SOFT MOBILITY

We implemented crosswalks on each side of Geeta Mandir BRT station as around the main roundabout, with traffic islands and traffic lights to avoid conflicts between cars and pedestrians and ensure safe crossings. As pedestrian flows are important around the BRT and the GSRTC stations, sidewalks should be wide, especially around the GSRTC station where a large shared space, a plaza, should be implemented to promote pedestrians and make cars more aware of them.

Bike lanes should be dedicated on the west road (densely circulated) but should be shared elsewhere, especially within the pedestrian plaza in front of the GSRTC station. As the roundabout will be densely circulated as well, a cycle lane has been implemented around it to ensure safe crossings. In the north, bike lanes are shared with the BRT lanes. Bike parkings should be important especially in front of the GSRTC bus station as transit is important.

Geeta Mandir Concept Plan





MAP KEY

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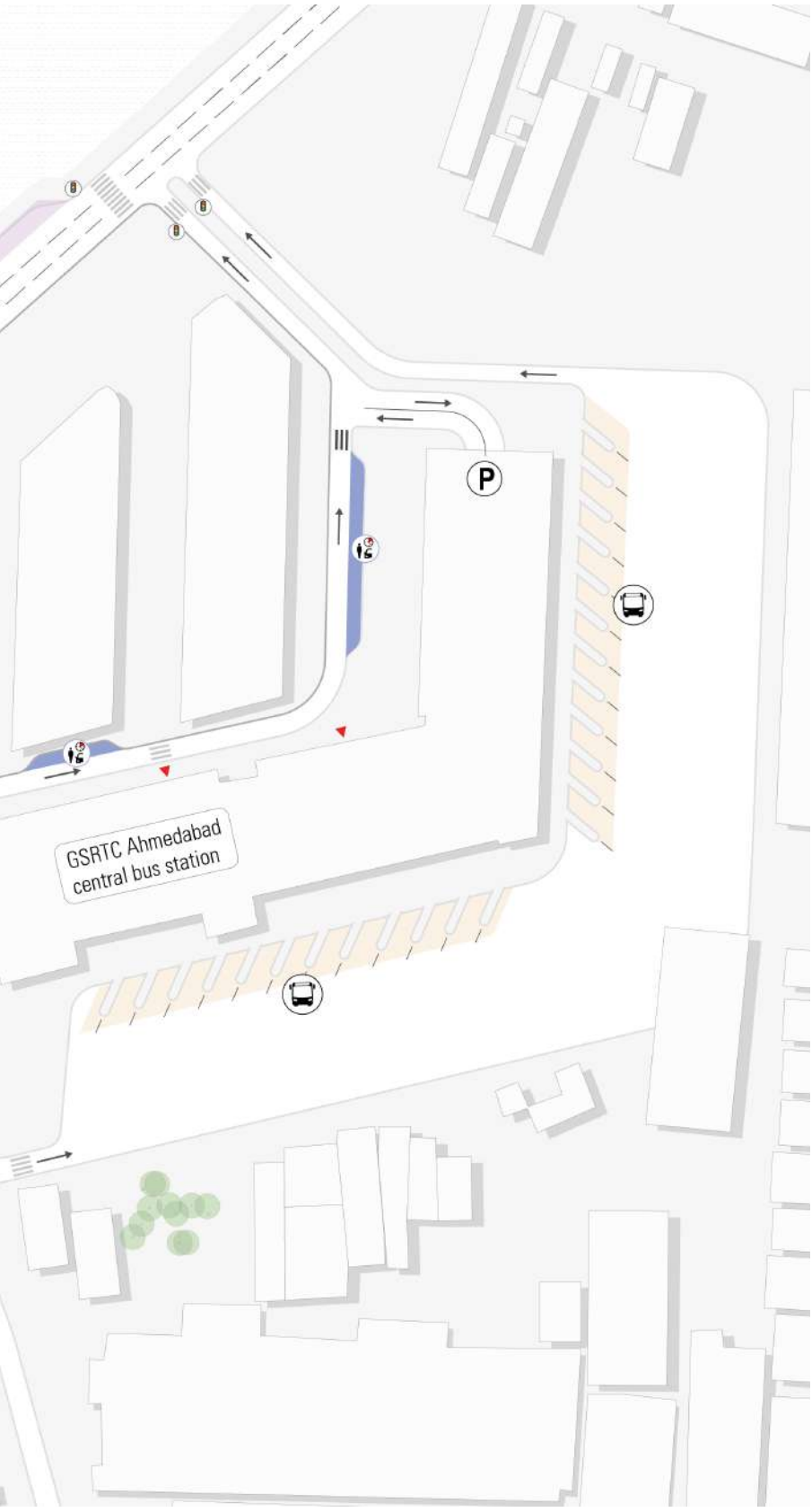
- Design parkings for the rickshaws close to pedestrian flow allowing station visibility
- Design public bus drop-off area
- Design separate entries and exits in the BRT station
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces

Geeta Mandir / Traffic map



MAP KEY

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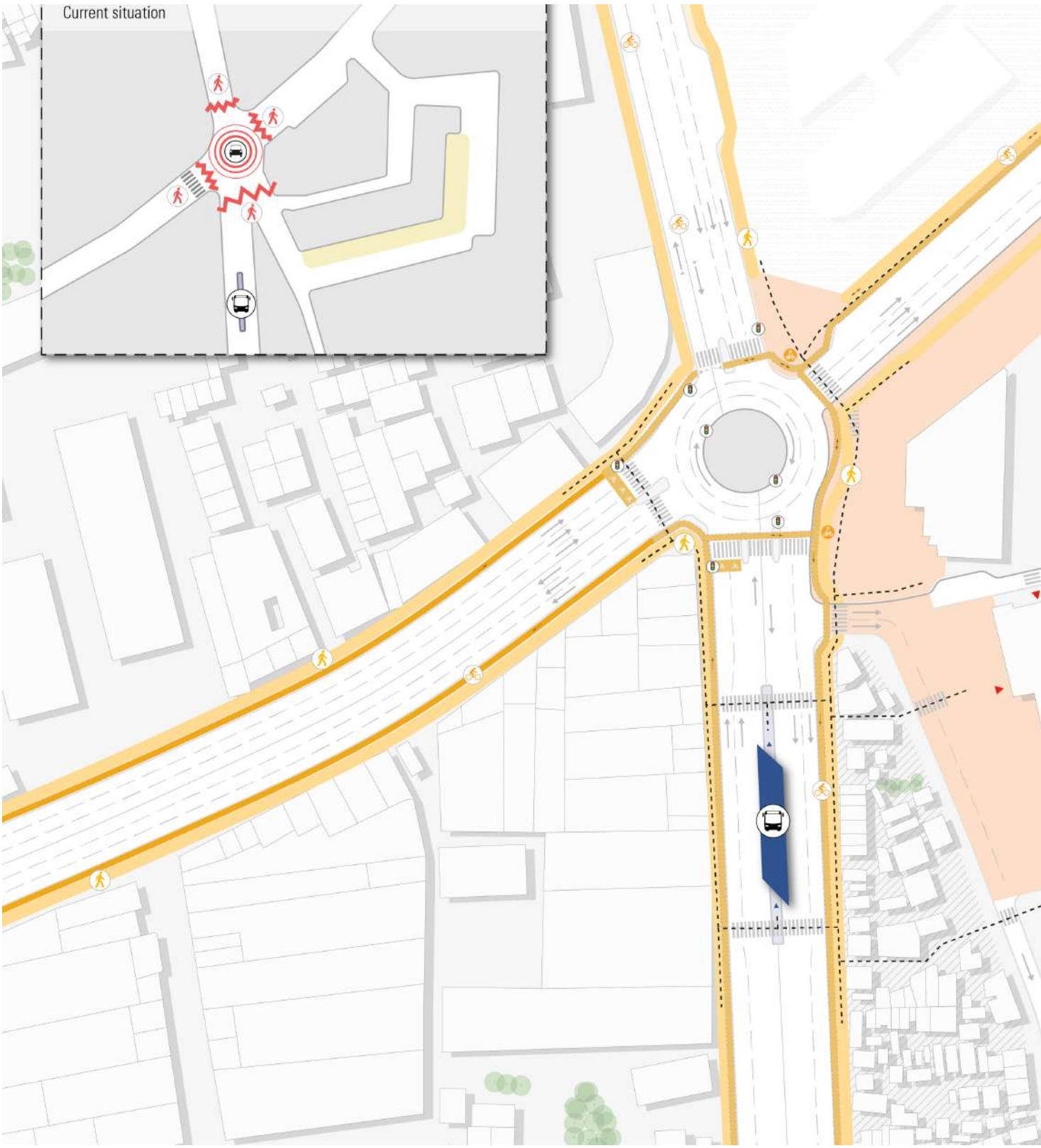
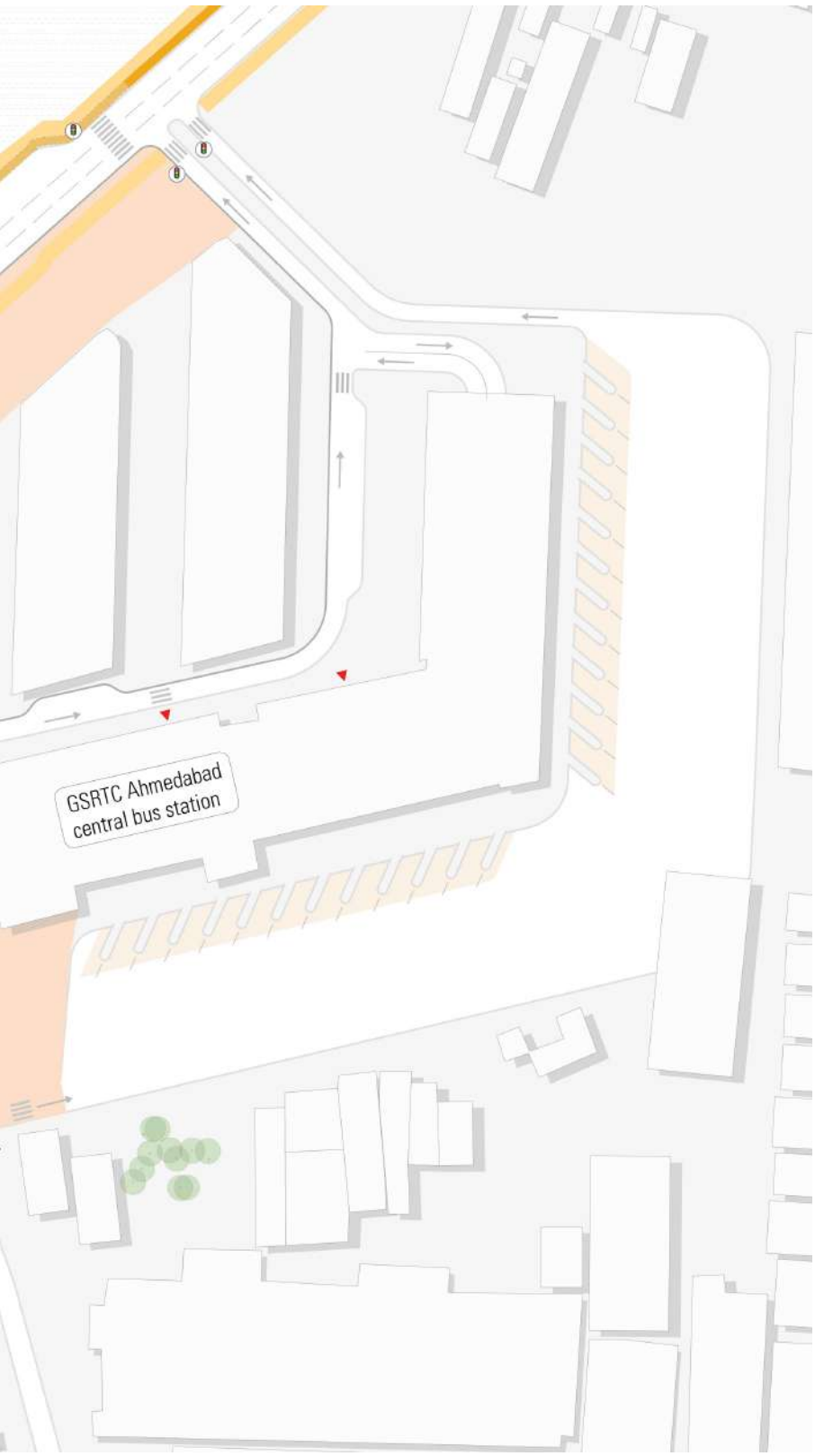
- Design buses drop-off area
- Building lot, traffic island
- Surface allocated to motor vehicles
- Bus lane

Geeta Mandir / Soft mobility modes and urban integration map





MAP KEY

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- Enhance station visibility from the main landmarks
- Design cycle parking close to transport hubs to ensure quick transfer
- Implement secure cycle lanes of the stations
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces

3 | RANIP STATION CONCEPT PLAN

■ URBAN DESIGN

In terms of urban design, we applied the same concept as Sabarmati by designing a single central open transit plaza that connects the existing and futures transport infrastructure (GSRTC bus station, the future metro station and the BRT station).

The main objective is to create a direct,visible and defined link from/to the BRT Station and from/to the Metro Station that is under construction in order to enhance the user comfort and reduce journey times as mentionned for the stations before.

In addition to that, the plaza will accommodate inter modal services such as private vehicles and rickshaws drop off, in addition to shared bike lanes and bike parkings.

The different transport infrastructure will hence work as fully unified and autonomous transport hub linked by an open plaza. It will also accomodate through convenient street furniture recreational activities.

■ PRIVATE VEHICLES AND BUS TRAFFIC

We have applied the same principle as Sabarmati to manage the crossroad and share space between modes. We have also used sides of the main street, which are again very wide, to organize the motorized services. To reduce the space needed, these services are in direct access with the street and organized in two functional strips. We have reduced authorized speed in the main road in front of the plaza to make motorists aware that they are entering a special pedestrian area

We have moved bus stops closer of main street and BRT station and in a line with a pedestrian crossing to the station. This organisation will improve the connections between buses, BRT and metro because users will have direct access to the station and won't be obliged to cross the entire commercial center in order to get to the station. Customers still could access to the shopping center from the platforms.

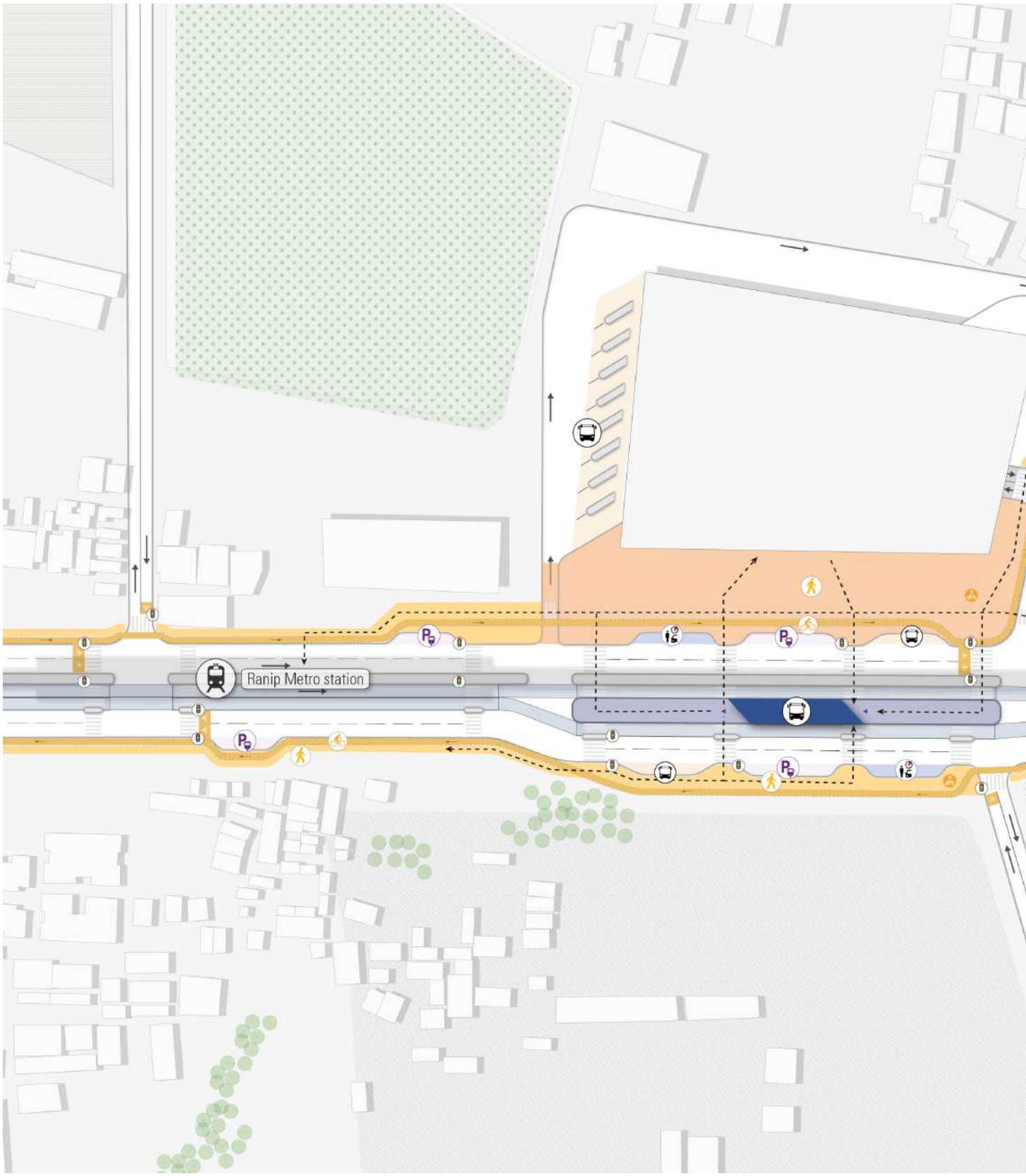
As Ranip's environment is similar to that of Sabarmati, we also propose a reduction in speed on the approach to the station by a plateau or by reducing the width to 3m

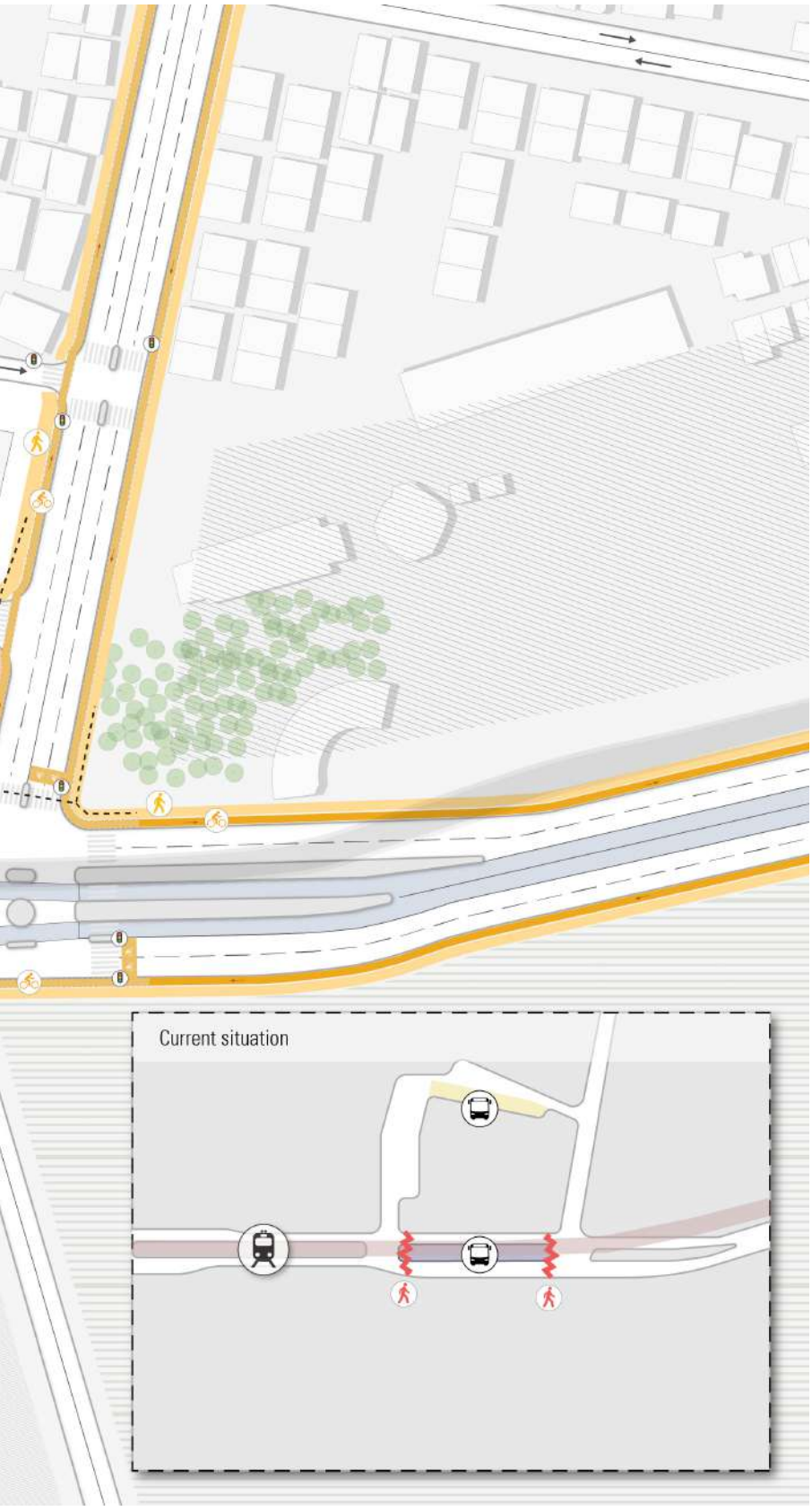
SOFT MOBILITY

Jaywalking is important around Ranip gBRT station; therefore, multiple crosswalks are implemented to offer direct paths towards the bus station as well as towards the subway station and residential areas. As the road is wide, crosswalks approximate width is 4m and traffic islands are implemented.

Dedicated bike lanes should also be designed along the highway on the east, while shared bike lanes should be implemented on residential roads and on the plaza in front of the bus station. In addition to that secure bike parking are designed on the plaza mentioned before.

Ranip Concept Plan





MAP KEY

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- Implement continuous and direct pedestrian routes from/to the BRT station
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- Enhance station visibility from the main landmarks
- Design cycle parking close to transport hubs to ensure quick transfer
- Implement secure cycle lanes of the stations
- Plant public spaces with shading trees or dense shrubs.
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- Reduce the car speed to 30km/h in the public/pedestrian areas
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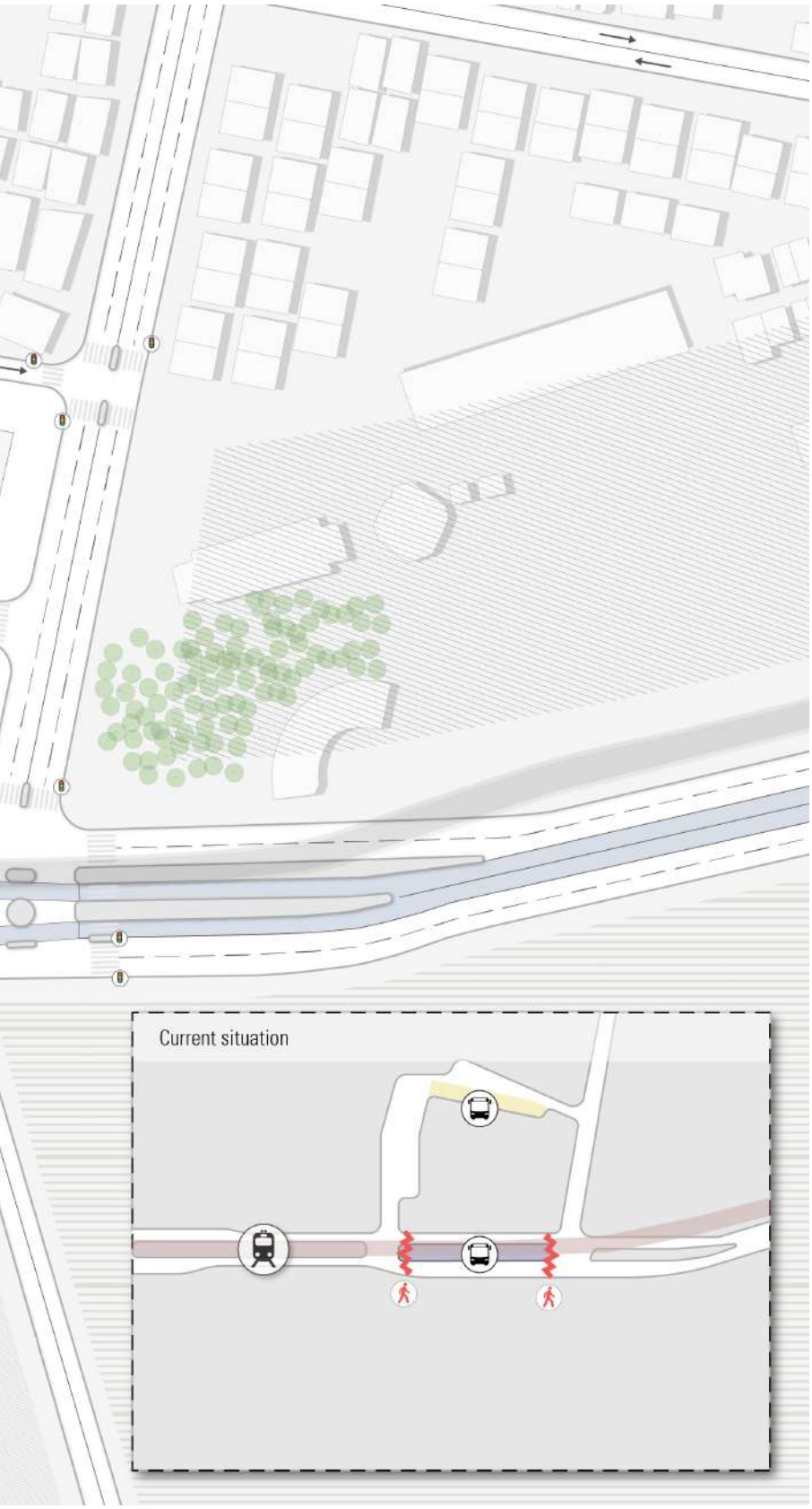
- Design parkings for the rickshaws close to pedestrian flow allowing station visibility
- Design public bus drop-off area
- Design separate entries and exits in the BRT station
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces

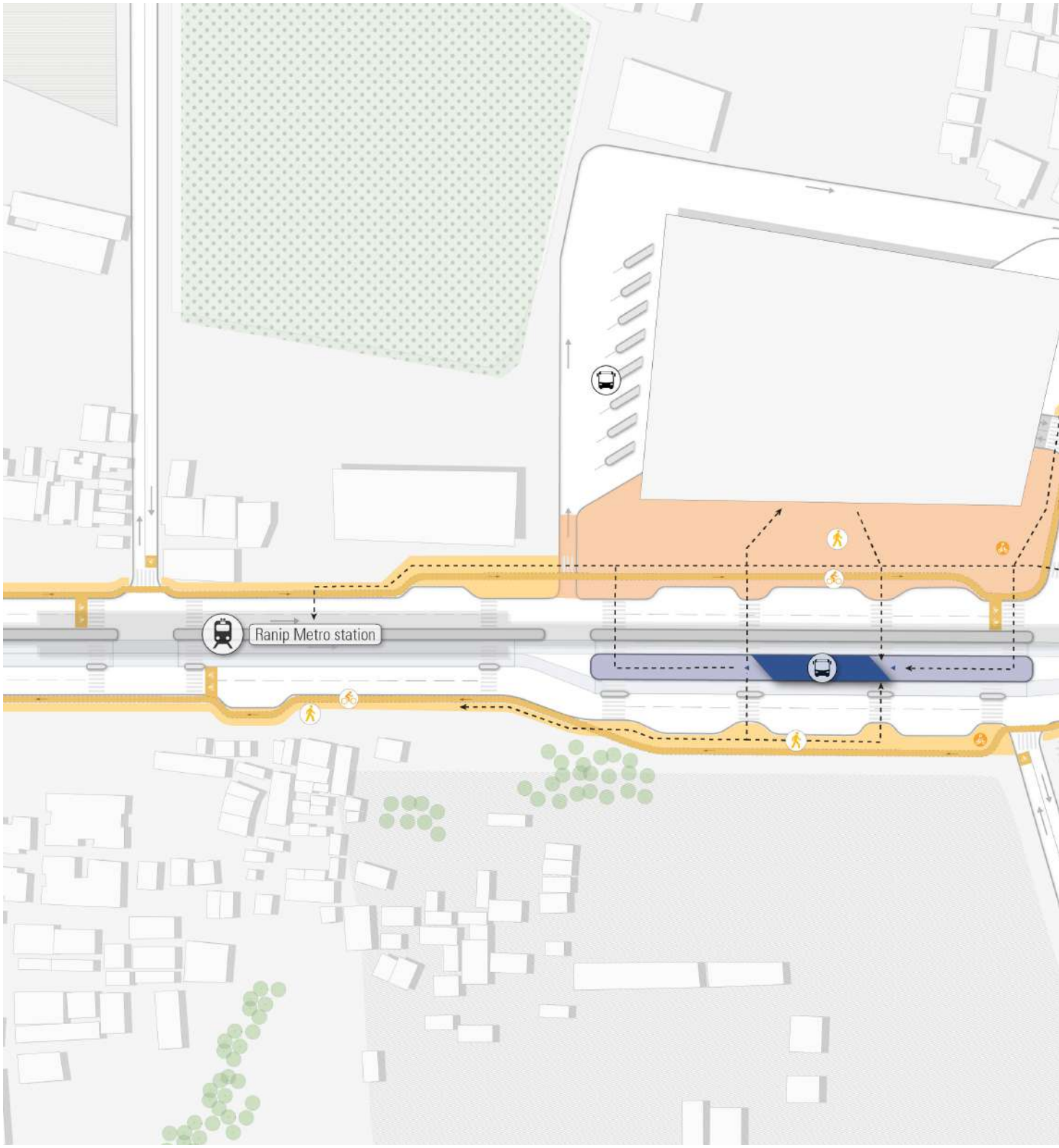
Ranip / Traffic map

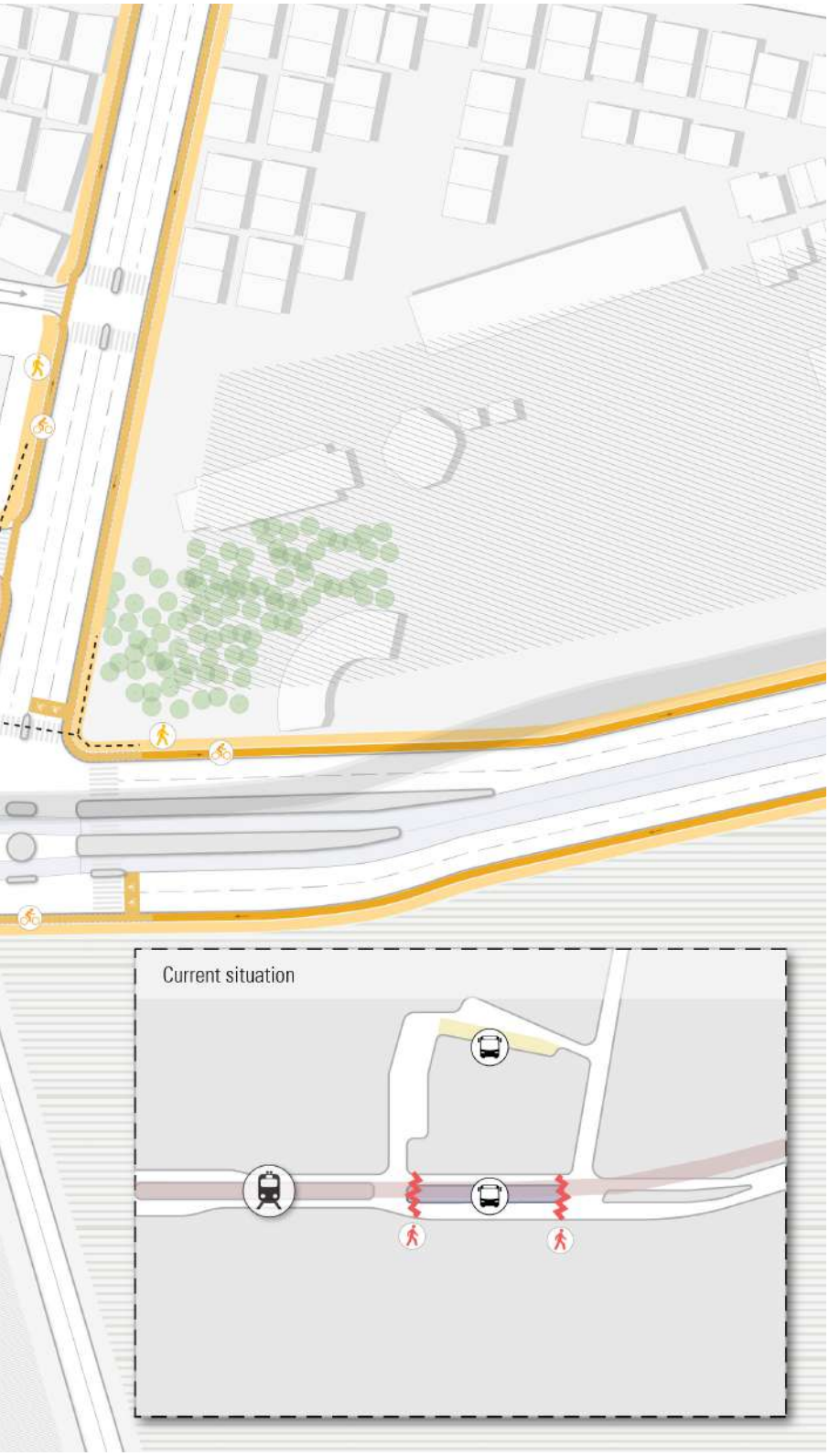


MAP KEY

- Reduce the bus speed to 30km/h in the public/pedestrian areas
- Reduce the car speed to 30km/h in the public/pedestrian areas
- Implement traffic light to secure pedestrian crossways
- Design cars drop-off and pick area close to pedestrian flow allowing station visibility
- Design parkings for the rickshaws close to pedestrian flow allowing station visibility
- Design buses drop-off area
- Building lot, traffic island
- Surface allocated to motor vehicles
- Bus lane

Ranip / Soft mobility modes and urban integration map





MAP KEY

- BRT Station
- Design secure, large public spaces in the direct vicinity of the BRT station
- Set-up large, confortable, sidewalks to secure the direct vicinity of the stations
- Implement continuous and direct pedestrian routes from/to the BRT station
- Set-up crosswalks at the vicinity of the BRT entrance and exit
- Enhance station visibility from the main landmarks
- Design cycle parking close to transport hubs to ensure quick transfer
- Implement secure cycle lanes of the stations
- Building lot, traffic island
- Surface allocated to motor vehicles
- Public spaces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Guidelines Checklist

Chapter	Topic	Tools
Station / station urban integration and access	Station visibility	Signage location
	Station access	Access
	Public spaces	Public space design
		Sidewalks
		Waiting areas
Station / Design	Stations and line identity	Design chart
		Materials and colors
		Access
		Entries and exists
		Waiti

	Objectives (including quantitative obj.)
	Introduce signages within a 500m area (if the BRT station isn't visible from the neighbourhood)
	Implement a visible and unique signage to signal the entrance and exit
	The access path to the station should be briefly visible with a fully signposted route, on the ground and on the walls The approximate radius around the station within which the improved pedestrian access is a must is 500m
	Implement crosswalks directly at the stations' exits and entrances
	Enlarge public spaces around station exit and entrance: Entrances and exits widths with a volume of 70 passengers/min (free of obstacle) should be a minimum of 2 meters. The number of gates needed is based on the volume of passengers entering/exiting the station and the type of gate (in France, gates' average flowrate considered is 35 person per gate per minute), with a minimum of 2 gates. A large gate (accessible for wheelchairs or passengers with luggages) should be implemented at each access of the station.
	Public areas should be designed according to a specific ratio: medium passenger flows per square meter equals a certain
	number of available public spaces
	Implement shaded waiting areas
	Furniture should be installed in waiting areas: waste bins, drinking fountains, banks
	Define a common design chart for all BRT stations in accordance with the entire public transport system
	Based on the volume of passengers boarding/alighting during peak hours, platform
	Define welcoming enclosure system for the BRT station
	Use a continuous design (color, material, textures) between the street and the stations
	Position pedestrian crossings before and after the BRT accesses to the station to avoid conflicts between pedestrians and buses
	Reduce the speed of vehicles to 30km/h in front of the station
	Add traffic islands, particularly where crossings are longer than 25m
	Design separate entries and exits to dissociate incoming and outgoing pedestrians flows , and avoid conflicts.
	Enough space should be considered just after the exit to ensure safety for lost passengers.
	If the station is elevated or underground, add if possible two escalators in each direction or else one escalator going upward. A staircase should be added to these escalators, with a minimum with of 2m.
	Passenger's information (real-time travel information, city and network's' maps)
	Waiting spaces, entries and exists should be designed according to the space standars for physically challenged people.

Multimodal integration / Transit plaza	Transit plaza	Design space for pedest Information device Secondary functions on
Multimodal integration / Buses	Bus stop	Dimensions of a bus sto
Multimodal integration / Buses	Bus stop	Bus stop configurations

	The platform at the top of the ramp should be at least 1.80 m long, if a door swings out onto the platform or towards the ramp.
trians	Factors to be considered in pedestrian flow management of interchange plaza: - direct paths, - clear directions, - confortable spaces Interchange corridors width is designed based on the number of passengers transfering through it and considering 1m every 70 passengers/min (free of obstacle) with a minimum of 2 meters. Transfer signage should be implented every 100m and at each intersection to guide passengers.
	Display travel times by mode for the most popular destinations for passengers: intelligent display and directional aid Highlight modes of transport according to their capacity (e.g. BRT can be highlighted at peak metro times) Prioritise signage according to the desired orientation for each flow
transit plaza	Essential transit lane (bus, cars, …) on the plaza should be reduce to the minimum functions Develop mitigation measure to reduce the speed and ensure pedestrian security crossing these lanes: When busy pedestrian routes are crossing secondary traffic lanes, soft measures such as 20km/h roads or speed bumps can be implemented. When medium to small pedestrian routes are crossing secondary traffic lanes, medium measure such as pedestrian push button to secure crossing
p	Highlight modes of transport according to their capacity (e.g. BRT can be highlighted at peak metro times)
	Set up a secure and legible bus stop Select the type of bus stop according to the location environment from the three possible cases: -Make on-street stops if traffic density is low and stop times are short (bus routes in transit). They make it easier for the bus to dock and to fit into the traffic. -Make notched stops if traffic is very heavy and stops are long (regulation, terminus, heavy load stops). -Make recessed stops under the same conditions as notched stops. The alleyway provides greater safety for users in the event of large flows and can be associated with other mobility functions

Multimodal integration / Buses	Bus station	Bus station configuratio
Multimodal integration / Connections	Connections between modes	Reduce physical and co between modes
Multimodal integration / Road traffic	Crossroad management	Compaction
Multimodal integration / Road traffic	Crossroad management	Traffic light

ns	Provide a necessary and enough platforms. The number of platforms depends on the number of lines, their function (transit or terminus) and the level of service per line (frequency, range of service). The objective is to determine the number of movements per line during the busiest hour, add waiting and regulation times and group this information into a platform occupancy diagram. Based on the maximum occupancy observed, the number of platforms is adjusted. We recommend adding +10 to +20% of the current number of bus platforms to anticipate changes in bus supply.
gnitive distances	- Reduce transfer distance to 200m maximum (1min30 walk) without physical constraints (barriers, major road without secured pedestrian crossing). - Limit the average waiting times for connections to 5min on strong lines and 15min on weak lines and provide comfortable waiting areas when waiting time cannot be reduced. - Ensure the co-visibility of the modes in connection.
	From the knowledge of the number of vehicles on the lanes (counting), number and width of lanes can be optimized : -> Number of lanes : - one lane is sufficient up to 1500 vehicles/h - at the crossroads, one lane allows the flow of 500 to 1000 veh/h depending on the green light time -> Width of lanes : - 4m : on the main roads with heavy traffic and high speeds, included many trucks (>10000 veh/day) - 3.5m : on the main and secondary roads with speeds reduced to 50km/h (>4000 veh/day) - 3m : on more urban and less frequented roads (<4000 veh/day) Wider lanes are rarely useful and narrower lanes can be dangerous or uncomfortable.
	Provide a crossroad management by traffic lights with 2 or 3 stages : - identify flows which are not in direct conflict and can go in the same stage. These are often north-south and east-west routes. - identify the main flow to give it the longest possible green light. - add a supplementary stage to give priority to BRT if possible. - the total time of the traffic light cycle must be between 70 seconds and 120 seconds.

Multimodal integration / Road traffic	Reduction of the vehicules speed	Signalization & Design o
Multimodal integration / Parking	Parking	Size parking spot
Multimodal integration / Pick-up & Drop-off	Pick-up & Drop-off	Design of drop-off/pick-
Urban design / Pedestrian experience	Confortable pathways	Sidewalks width
Urban design / Pedestrian experience	Direct crossings	Frequent crossings

f the street	Gradually reduce speed to 30km/h as vehicules approach stations by the following actions : - Hazard warning signs - Physical traffic calming devices (succession of turns to reduce speed, speed bumps, raised pedetrians crossings) - Lane width reduction - Speed cameras
	Size the areas dedicated to parking motorized modes : - Apply a ratio of 25m² per parking spot for cars and taxis (circulation space included in the ratio) - Apply a ratio of 12m² per parking spot for autorickshaws (circulation space included in the ratio) - Apply a ratio of 4m² per parking spot for autorickshaws (circulation space included in the ratio)
up areas	- Design passenger drop-off as a fluid queuing system with no parking facilities, to ensure fast drop-off in a small space - Provide for time-limited parking (15 minutes) with an appropriate fee for the passenger pick-up
	Implement sidewalks with a minimum width of 2m. Adapt walkway widths adjusted regarding pedestrians flows in the area: -> Within 200m of the station: - Under 75 pedestrians per minute: 2m wide, - Between 75 and 200 pedestrians per minute: 3m wide, - Above 200 pedestrians per minute: 1m additional meter every 70 pedestrians per minute. -> Along main traffic lanes: - Under 150 pedestrians per minute: 2m wide, - Above 150 pedestrians per minute: wide 1m additional meter every 70 pedestrians per minute - Above 300 pedestrians per minute: wide 5 m wide -> On other urban axis, along medium to small traffic lanes - Under 150 pedestrians per minute: 1,5m wide, - Above 150 pedestrians per minute: 1m additional meter every 70 pedestrians per minute.
	Within a 500m of the station, implement crosswalks every 200m on urban roads (and available within 50m of each bus stop and at each end of BRT platforms), every 500m on high speed roads and on each intersection road.

Urban design / Cycling infrastructure	Safe bike corridors	Bike lane types and widt
	Safe bike crossings	Dedicated waiting space
	Safe parking	Dedicated and secure b
	Sufficient parking	Street parking
Urban design / landscape and vegetalization	Public space vegetalization	Parks
		Plazas
		Orientation
		Shading
Urban design / vibrant area	Urban desifn	Street frontages
		Utilities and services
		Urban design

th	On densely circulated road, implement dedicated bike lanes. Unidirectional cycle lane minimum width: 1,5m; bidirectional cycle path minimum width: 2.5m On medium to small road and within pedestrian areas, implement shared lanes identified with efficient signage. Unidirectional cycle lane minimum width: 1m; bidirectional cycle path minimum width: 2m
e	If no priority for bikes at intersections, implement a dedicated waiting space to allow cycles to be seen by cars, with a minimu area of 6m² (approx. 3 bikes)
ike parking	In the vicinity of transport hubs, implement 2 to 4 bike parking slots for 100 people boarding public transport per day.
	Implement public street parking within 100m of each key destinations
	All park pathways should be 80% shaded, and open spaces 50% shaded;
	All parks should be 60% planted with shading trees or dense shrubs.
	All plazas should be 20% planted with shading trees or dense shrubs
	Morning activities (e.g. commuting) shall favor North-South orientation;
	Midday to Evening activities shall favor East-West orientation
	Promote shadow-casting architectural typologies: arcades, projections above ground floors, etc…
	Design a range of shading structures adapted to sidewalks/ street widths and other constraints.
	Allow commercial areas to use street frontage for their activities (e.g. outdoor dining places, outdoor showrooms) without disturbing pedestrian flow
	Heat producing units of retail spaces such as refrigering or cooling units shall not be placed on street frontages
	Promote visually integrated residential frontages: openings, awnings, planted setbacks, etc.
	Convenient stores/utilities should be available within a 100m meters radius across station entrances.
	Provide dedicated space for street vendors: it should be locatec close to pedestrian flow, on a dedicated area,
	Provide a zoning overlay across transit plazas to foster the presence of shopping areas and commercial, vibrant places
	Ensuring flexibility of land uses within the Station Area to enable it to respond to changing socio-economic demands


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