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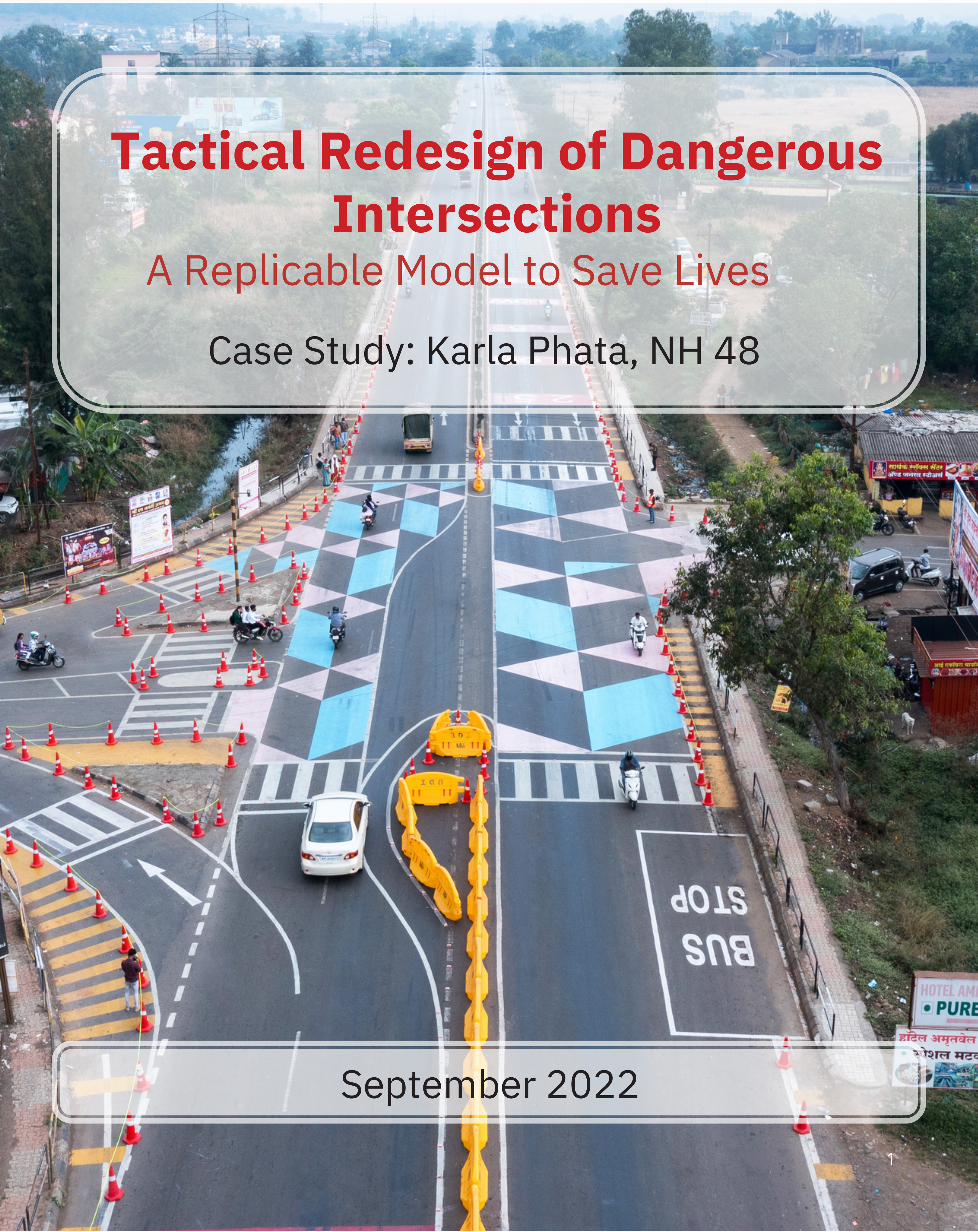
SaveLIFE FOUNDATION

SAVING LIVES ON ROADS IN INDIA AND BEYOND

सड़क परिवहन एवं राजमार्ग मंत्रालय
MINISTRY OF ROAD TRANSPORT AND HIGHWAYS

सत्यमेव जयते



Tactical Redesign of Dangerous Intersections

A Replicable Model to Save Lives

Case Study: Karla Phata, NH 48

September 2022

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This project was accomplished with the help of the support received from Škoda Auto Volkswagen India Private Limited through their CSR program.

Tactical Redesign of Dangerous Intersections

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What is Tactical Redesign?

Tactical Redesign or Tactical Urbanism refers to the utilisation of low-cost, temporary changes to build a user-friendly environment. It adapts different techniques and methods to improve and redesign street infrastructure at black spots and accident-prone areas to ensure road safety for end users, especially the vulnerable road users.

Design Tools

Cones and Barricades

Road Paint

Signages

Why this Approach?

- Small-scale and short-term in nature
- Specified to the minutest detail
- Inclusive in nature
- Cost effective and efficient
- Joint ownership and responsibility

Stages of Tactical Redesign

STEP 1

Site Selection and Crash Analysis

The first step involves selecting a site based on listed parameters, further validated by detailed crash analysis.

- Crash Data Collection
- Crash Data Decoding
- Stakeholder Identification
- Site Visibility
- Area Extent

STEP 2

Site Appraisal

After the site selection, the next step involves developing a profound understanding of the site through observation/photographic or videographic documentation.

- Site Context
- Site Topography
- Pedestrian and Vehicular Infrastructure
- Pickup and Drop-off
- Pedestrian and Vehicular circulation (Documentation through observation, photography and videography)

STEP 3

Traffic Surveys and Community Outreach

After site appraisal, the next step involves the quantification of existing traffic circulation and count, pedestrian footfall, speed, conflict and user/ community perception through surveys.

- Road Safety Audit
  - Topographic Survey
  - Pedestrian and Vehicular Count
  - Speed Analysis
- User Perception Survey
- Identification of Conflict Points

STEP 4

Design and Preparation

The next step includes the development of a pragmatic solution based on the learnings from the earlier steps. The solution must adhere to the existing standards and guidelines acceptable nationally and/or internationally.

- Intervention based on Issues Identified
- Good for Construction Drawings
- Bill of Quantities Preparation

STEP 5

Tactical Redesign Trials

This stage involves a detailed work plan for site execution and requires coordination between all agencies involved.

- Light and Quick Site Installation
- Define Trial Period
- Volunteers, Stakeholders Participation
- Awareness Campaign

STEP 6

Impact Analysis

This prominent aspect captures user perception of the interventions through a data based approach using comparative analysis that employs parameters to gauge the probability of road crashes at a given site.

- Community Outreach
- Surrogate Safety Measures
- Post User Perception Survey
- Photography and Videography
- Documentation to Capture Interventions

STEP 7

Permanent Design Recommendations

Based on the findings of the trials, and after determining what works and what does not for the site, permanent changes are proposed.

- Permanent Changes
- Cost of Implementation

IMPACT TILL DATE

UNDRI CHOWK, PUNE

BEFORE

Overall **48%** reduction in pedestrian exposure distance

176% Increase in public realm

AFTER

BHALSWA CHOWK, DELHI

BEFORE

70% reduction in pedestrian exposure distance

50% reduction in pedestrian conflict with fast moving traffic

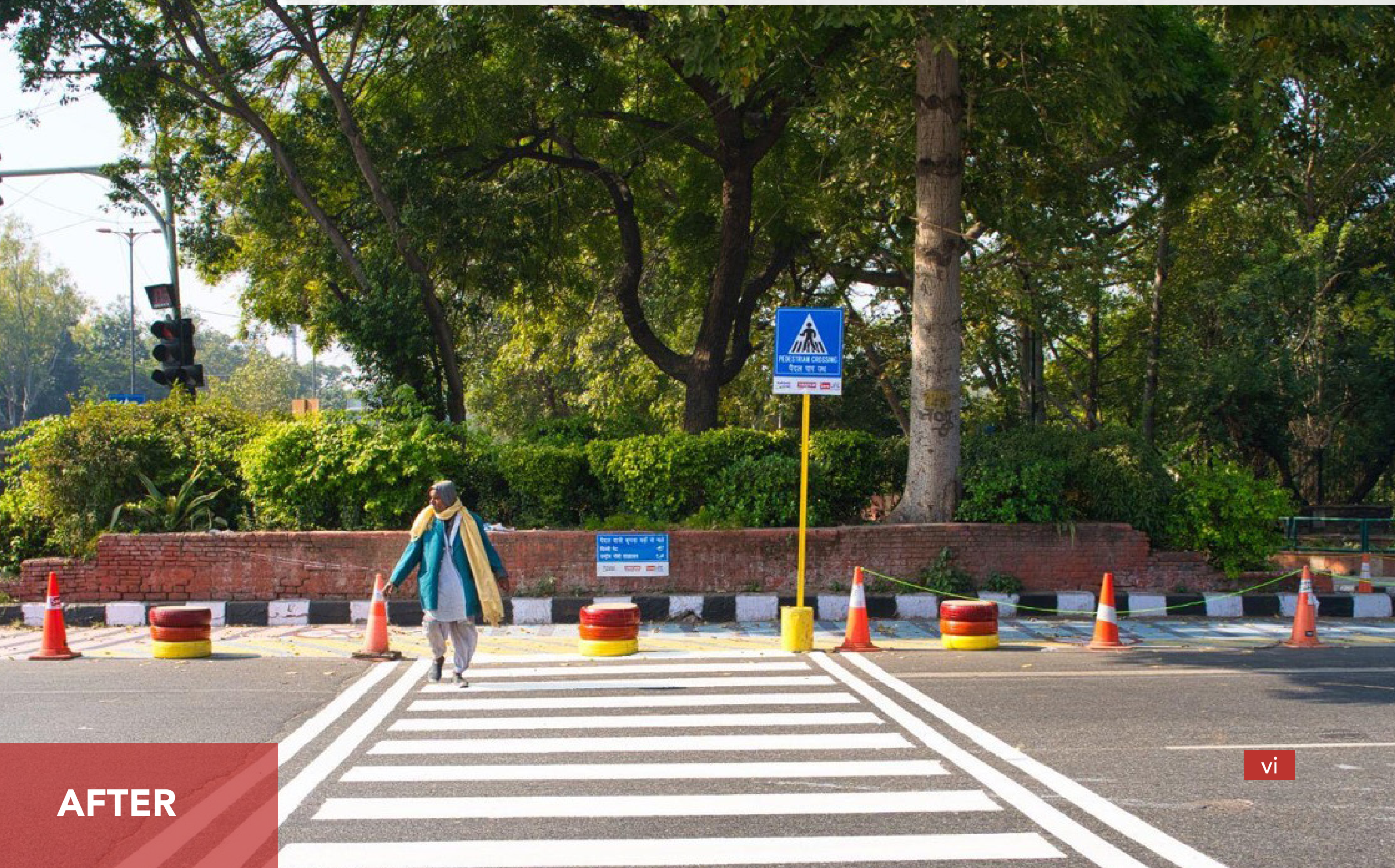
AFTER

RAJGHAT INTERSECTION, DELHI

BEFORE

47% reduction in pedestrian exposure distance and **30%** reduction in pedestrian exposure time

81% reduction in vehicle-to-vehicle conflict



AFTER

BURARI CHOWK, DELHI

BEFORE

51% reduction in pedestrian exposure distance and **52%** reduction in pedestrian exposure time

Over **94%** of all road users felt safe while crossing the junction

AFTER

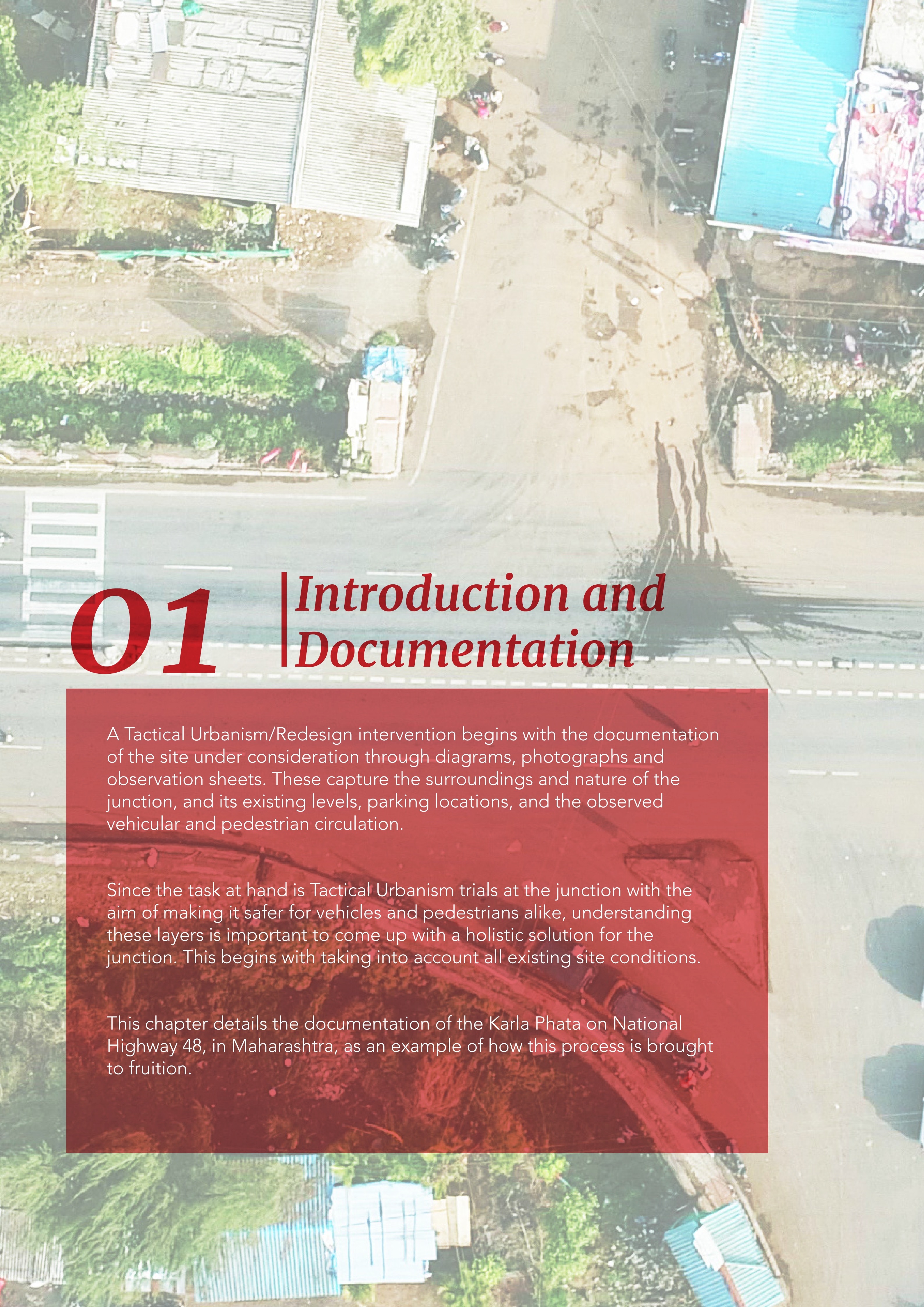
Pan India Projects

The ultimate goal of Tactical Redesign is to instrument permanent constructive changes aimed towards safer roads and intersections for all types of road users, especially the most vulnerable ones.

Case Study:
Karla Phata, NH 48

The following case study is a detailed description of the ideation, research, methodology and implementation of the Tactical Redesign undertaken at a high-fatality spot on the National Highway 48, at Karla Phata.

Contents



01 Introduction and Documentation

A Tactical Urbanism/Redesign intervention begins with the documentation of the site under consideration through diagrams, photographs and observation sheets. These capture the surroundings and nature of the junction, and its existing levels, parking locations, and the observed vehicular and pedestrian circulation.

Since the task at hand is Tactical Urbanism trials at the junction with the aim of making it safer for vehicles and pedestrians alike, understanding these layers is important to come up with a holistic solution for the junction. This begins with taking into account all existing site conditions.

This chapter details the documentation of the Karla Phata on National Highway 48, in Maharashtra, as an example of how this process is brought to fruition.

A. Project Methodology

TRAFFIC + PEDESTRIAN SURVEY

- Road Safety Audit Report; traffic counts at peak hour, Speed Analysis, Identification of conflict points
- Pedestrian Survey Report
- Topographic survey and high resolution photography using drones
- Cameras set up to study vehicular and pedestrian circulation, observing and interviewing various stakeholders around the junction

DESIGN TRIAL PERIOD

Light, quick, cheap installation of the Tactical Urbanism recommendations is carried out to gather data on successes and what isn't working

PERMANENT DESIGN CHANGES

Based on the findings of the trials, make and suggest permanent changes to the intersection design.

BEST PRACTICE RESEARCH

- Study global and Indian examples
- Study execution as well as best practices highlighted of each example
- Study the impact created and also the possibility of replication and adaptation within the given context

Opportunities and issues on the site are observed and a design is developed that enhances safety for all users, is low cost and easy to implement as a trial using Tactical Urbanism methods.

TACTICAL URBANISM RECOMMENDATIONS

Source: A tactical urbanism guidebook by MoHUA-GOI

B. Tactical Urbanism and its stages

Tactical Urbanism focuses on taking swift action employing short-term, low-cost and scalable interventions to catalyse long-term change.

04. Implementation and Evaluation

O4. This stage involves a detailed work plan for execution requiring coordination between all agencies involved. In particular, a traffic management plan needs to be drawn up with the traffic police for road/lane closures during the execution and changes as per design during implementation.

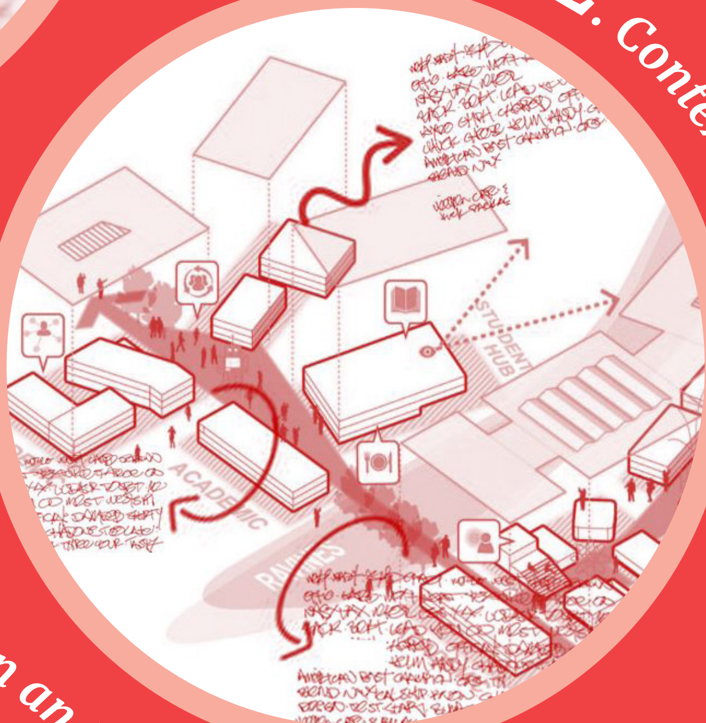
Municipal workers and/or volunteer groups must be organised to help with work on the ground. The site itself needs to be prepared i.e. cleaned and levelled to commence work.

Post-implementation evaluation is the central aspect of a Tactical Urbanism project, i.e. how users are responding to the changes. The preparation of an engagement strategy to seek feedback from users is an important activity during this stage.

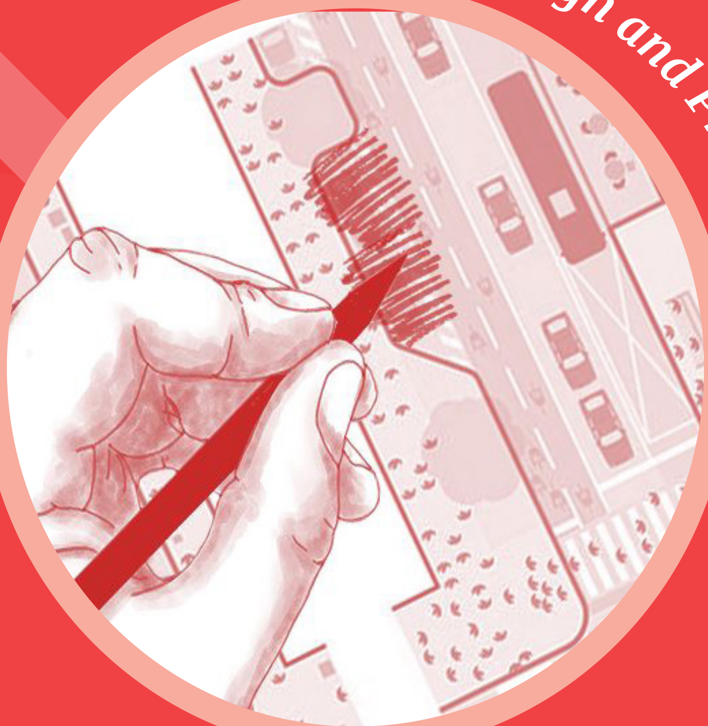
01. Site Selection

01. This first step is to select a site that holds an important space in the local context and is not fulfilling its ability to be a safe space for all road users due to its design, and is witness to high number of fatalities.

02. Context Appraisal



03. Design and Preparation



02. The next stage is to get a deeper understanding of the site, its context, opportunities and constraints based on on-ground data mapping, user surveys, topography, vehicular and pedestrian volumes etc.

03. This stage includes the development of an implementable solution to address the challenges at hand. The designs will have to be a contextual, creative response to learnings from Step 2, while also adhering to existing standards and guidelines. At this stage, a block estimate for approval is also created.

Source: A tactical urbanism guidebook by MoHUA-GOI

01. Site Selection

Identification of a stretch of site as per the criteria

Government Officials

Engineers

Municipal Workers

Traffic Police

Police

Services

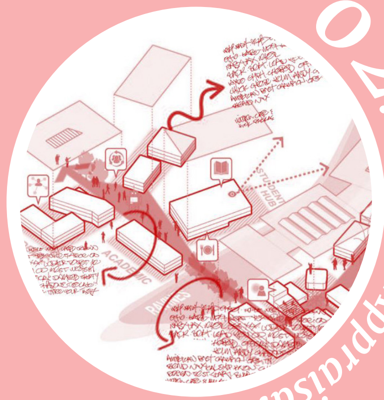
Designers

Contractor

Surveyor

Volunteer

Visual Documentation team

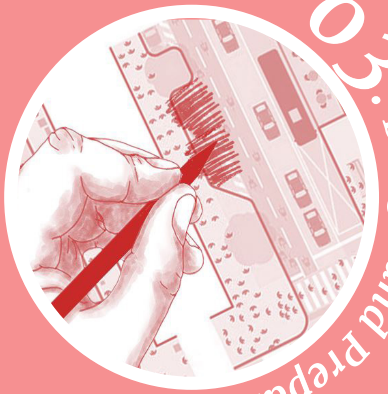


02. Context Appraisal

Mapping the site selected for the Intervention

- Physical attributes of the site
- Traffic study including pedestrian and vehicular counts, and parking
- Speed and conflict point analysis
- Activity mapping and Socio-Cultural-Economic aspects
- Stakeholder survey and analysis
- Other relevant analysis based on type of intervention

Site Survey



03. Design and Preparation

Pre-implementation user survey and apprising stakeholders of the planned Tactical Urbanism project

Preparation of conceptual design, block estimate for approval

Seeking approval from the relevant government agencies to proceed to detailed design stage

Preparation of detailed designs and cost estimates

Preparation of material for post-implementation evaluation survey and other engagement materials for stakeholders based on detailed designs

04. Implementation and Evaluation

Seeking approval from the relevant government agencies to commence implementation stage activities

Identification of contractor

Procurement of materials

Visual documentation of existing conditions before implementation

Implementation on ground

Recording user responses

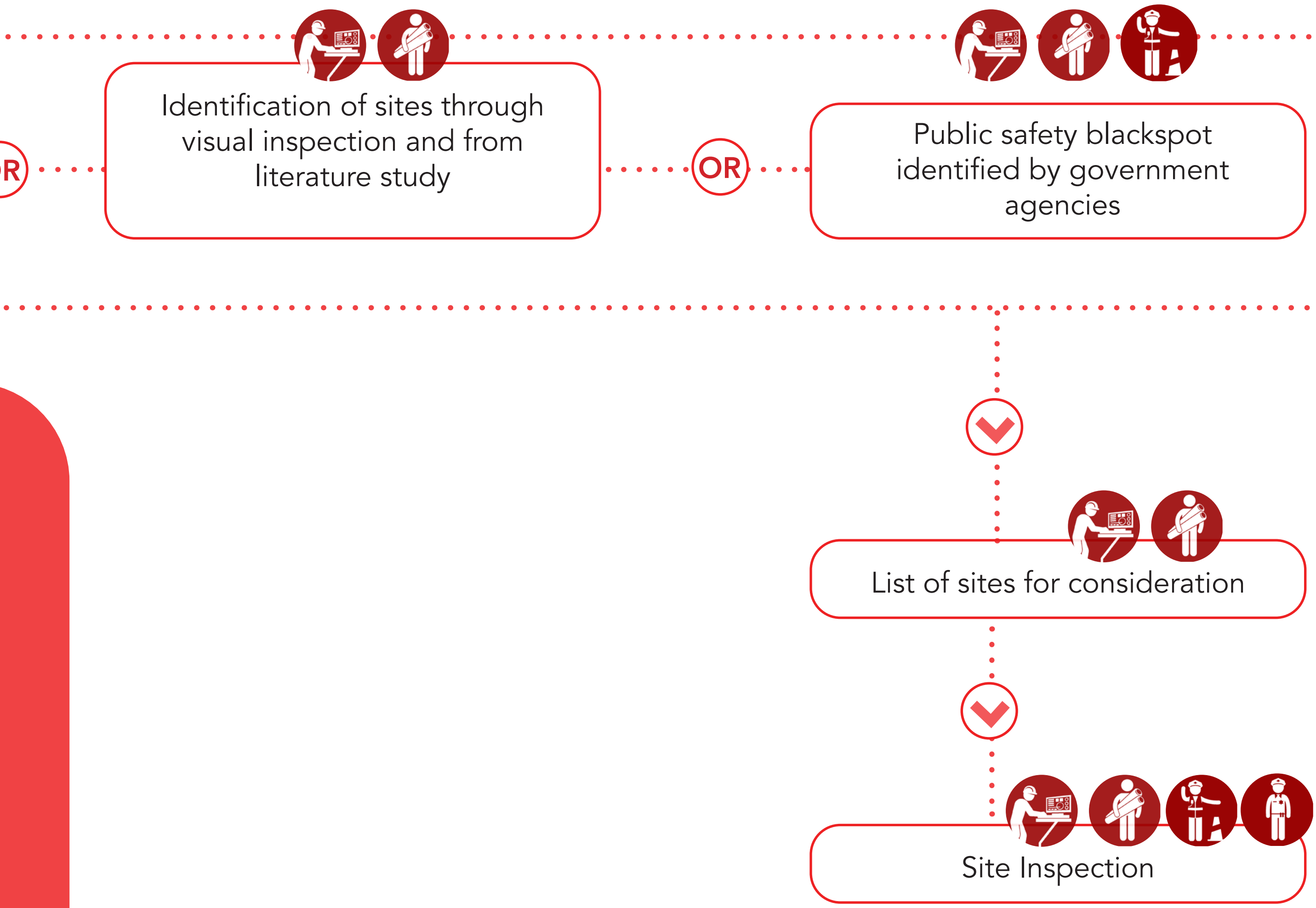
Visual documentation post implementation

Recommendation for permanent design

Source: A tactical urbanism guidebook by MoHUA-GOI

Review street design proposals planned in the near future or Planning reports such as CMP/ CDP and Smart City Projects

C. Site Selection and Context



Source: A tactical urbanism guidebook by MoHUA-GOI

Site Context

1. Location Plan of Karla Phata

Detailed ahead is an example of how a site context is established for a location under investigation.
Karla Phata is an intersection located on the Old Mumbai Pune Highway - NH 48 at the point where the Ekvira Devi Road meets the highway. The junction lies within the vicinity of the Karla Village, which is a gram panchayat, situated in the Mawal Taluka of Pune district, in the state of Maharashtra. Karla and its surrounding areas are witnessing rapid urbanisation with several new residential and hospitality developments in the vicinity of the Karla Phata, which is an important junction on the NH 48.

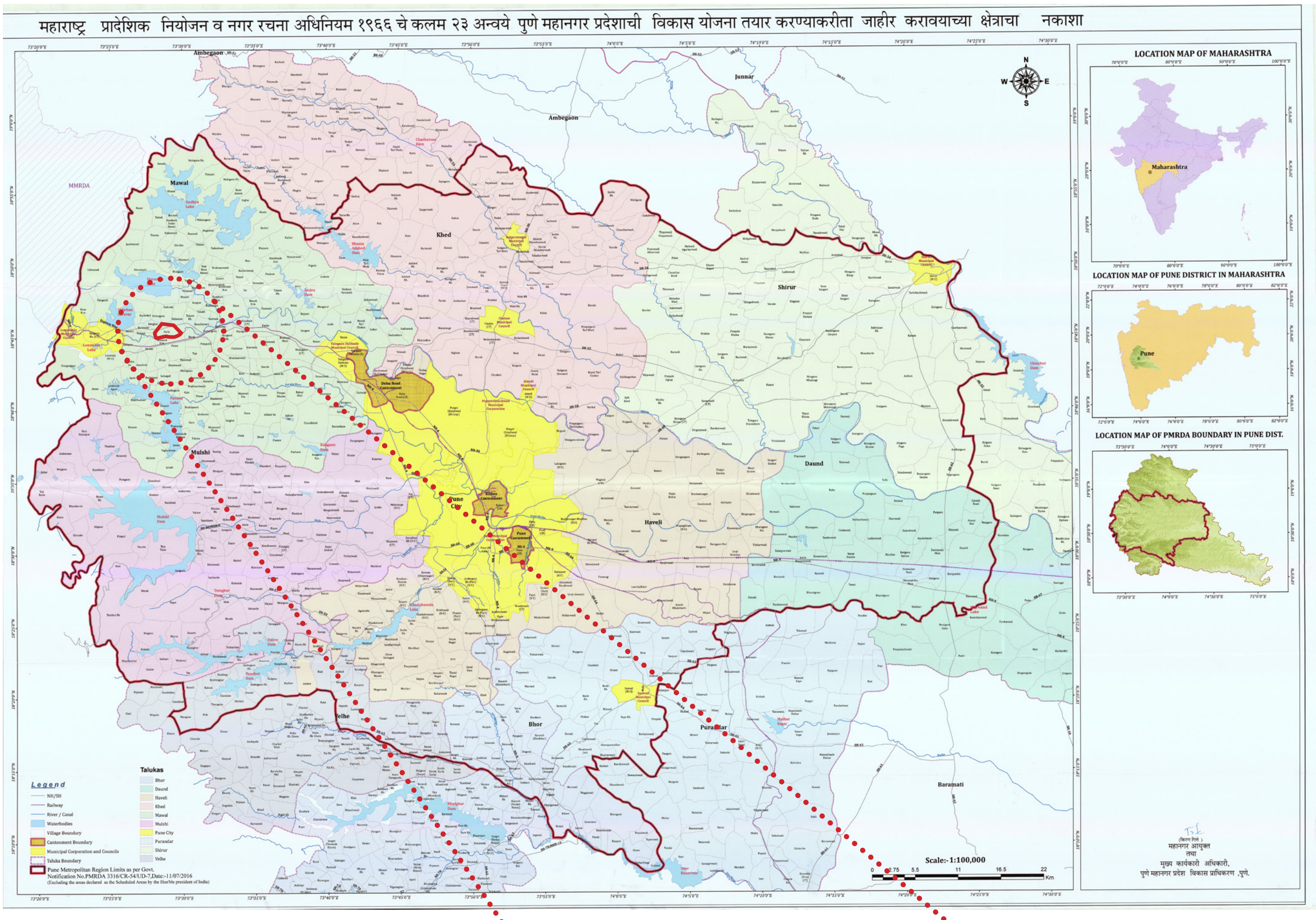


Fig 1.1: Location Map of PMRDA boundary in Pune District highlighting Karla Phata

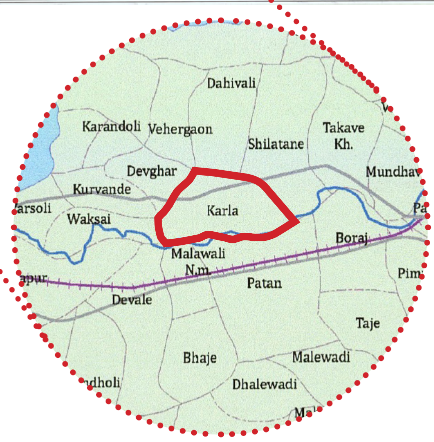


Fig 1.2: Location Map of Karla Phata

Source: www.pmrda.gov

2. *Jurisdiction Plan of Karla Phata*

Pune City aims to develop the city by introducing commercial, residential and industrial projects of varying scales under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). Maval Taluka forms a part of the project with 181 villages under its jurisdiction.

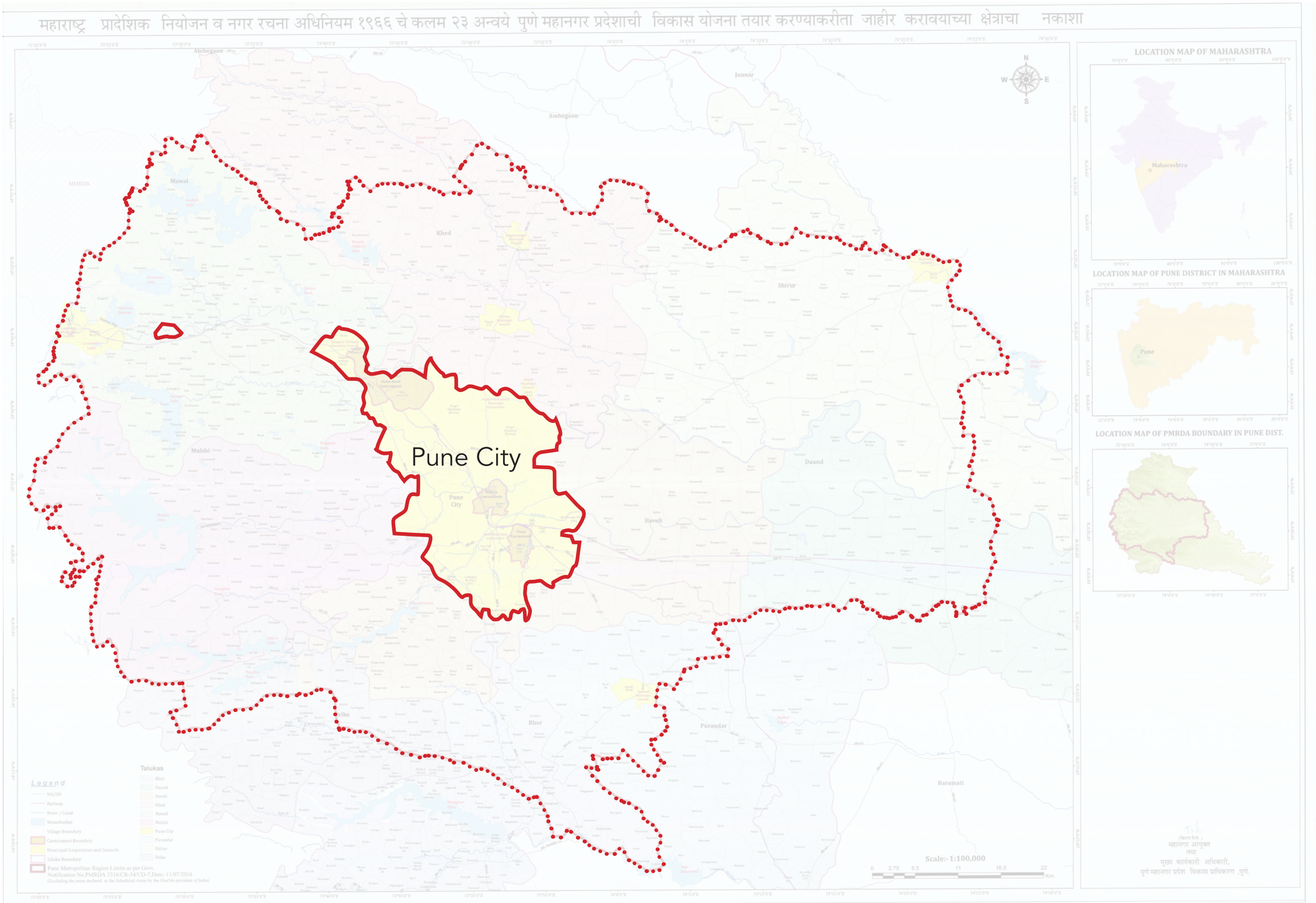


Fig 1.3: Location Map highlighting the Pune City and PMRDA boundary

Legend

•••••• PMRDA Limits

Source: www.pmrda.gov

3. Site Proximity (5 km)

Karla Phata is an intersection located on the Old Mumbai Pune Highway - NH 48 at the point where the Ekvira Devi Road meets the highway. The junction lies within the vicinity of the Karla Village, which is a gram panchayat. It is situated in the Mawal Taluka of Pune district, in the state of Maharashtra.

Towards the north of the junction, on the hills, is the Ekvira Temple shrine which is frequented by devotees throughout the year.

Also in vicinity of the junction are the famous Karla Buddhist Caves dating back to the 5th century CE. The caves are a protected monument under the Archaeological Survey of India (ASI).

Another destination that can be reached from the junction is the hill fort of Visapur (also called the Visapur Fort) which is a part of the Lohagad-Visapur fortification.

Fig 1.4: Google Earth Map showing site proximity of 5 km radius

Legend

Temples

Tourist Destinations

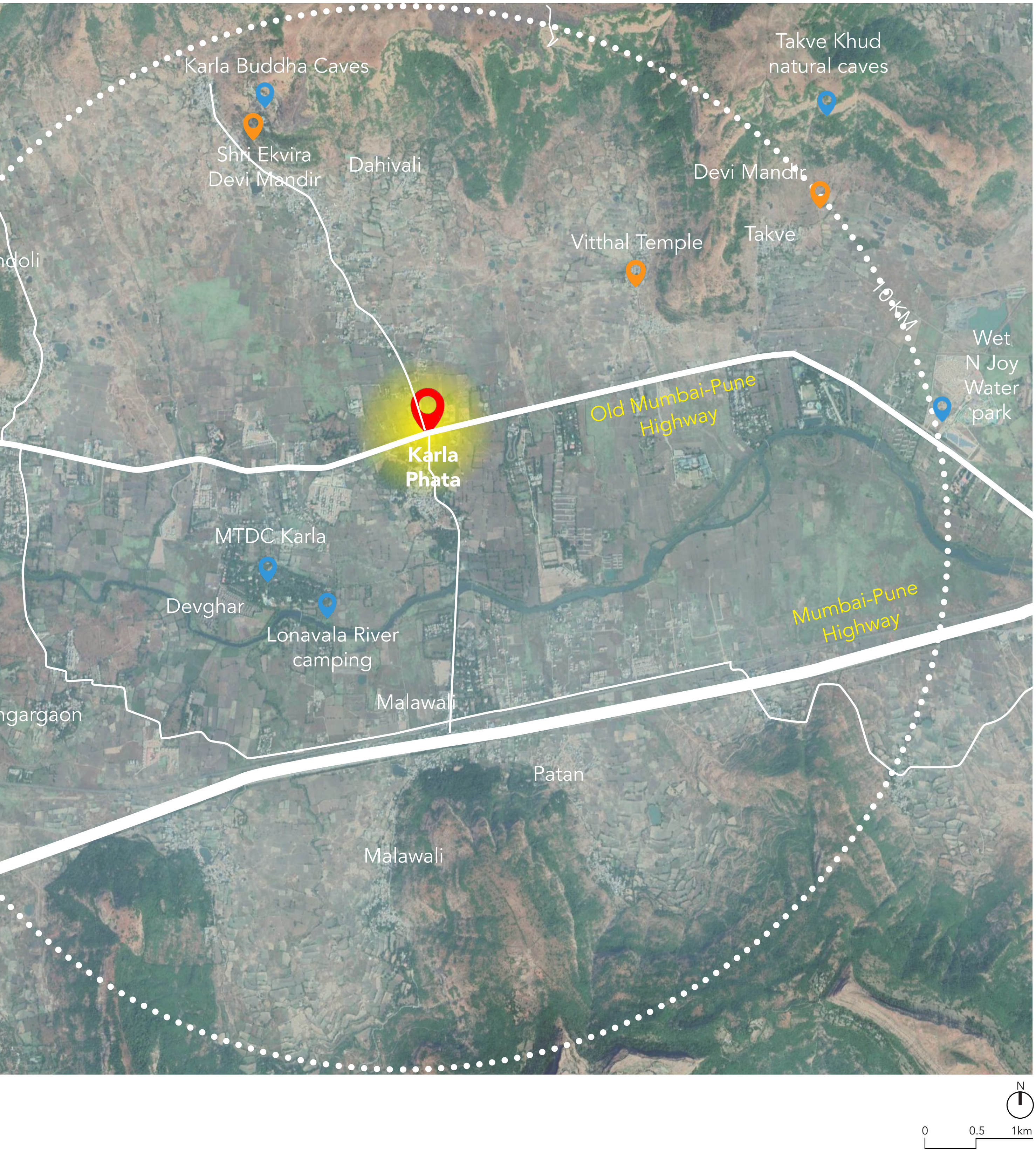


Photo Courtesy: Google Earth

4. Site Proximity (2 km)

The junction is surrounded by mostly commercial establishments such as restaurants and shops that serve as a refreshment pit stop for commuters using the old highway connecting Mumbai to Lonavala, Kamshet and Pune.

The junction also serves as a transit stop for buses and auto rickshaws ferrying people from Karla Village and other surrounding villages to Lonavala and Kamshet.

The junction is flanked by *nallas* on both sides with some designated parking spaces, mostly occurring informally. These details have been indicated further ahead in the report.

Fig 1.5: Google Earth Map showing site proximity of 2 km radius

Legend

- Temples
- Tourist Destinations
- Commercial Infrastructure

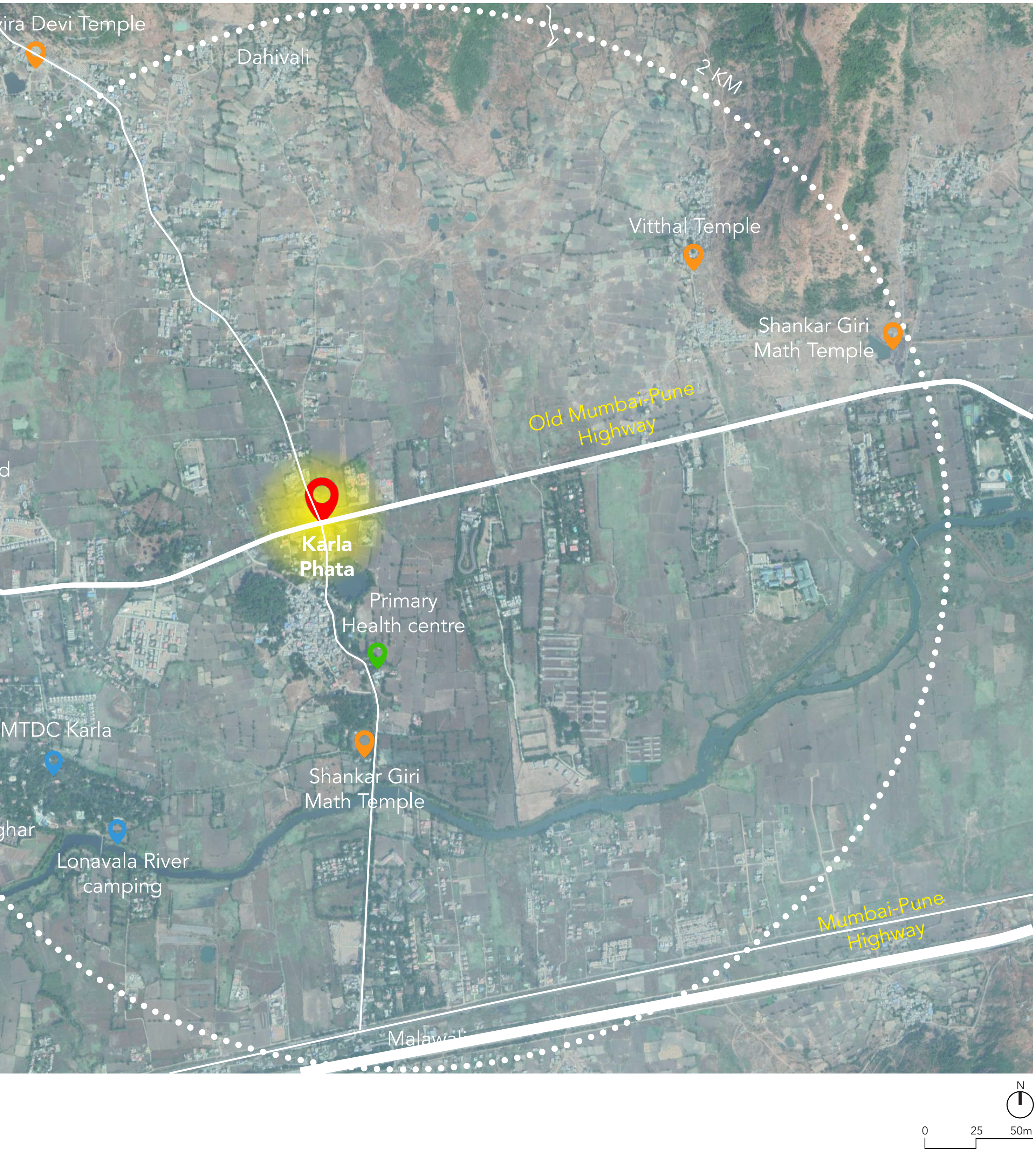
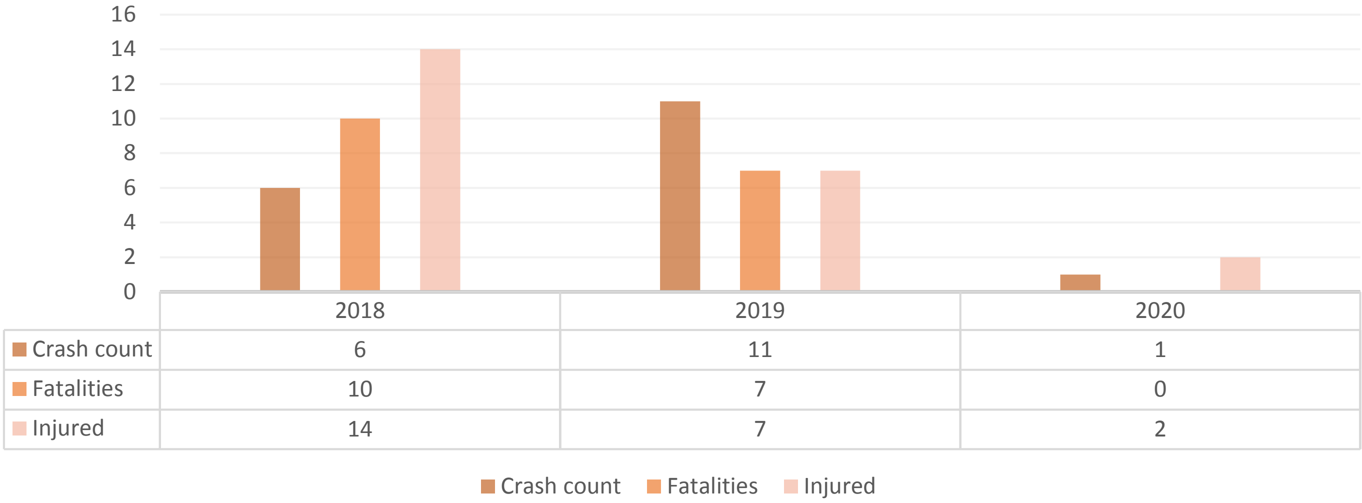


Photo Courtesy: Google Earth

D. Road Crash Statistics

1. Karla Phata - NH 48



	2018	2019	2020
Crash count	6	11	1
Fatalities	10	7	0
Injured	14	7	2

Fig 1.6: The bar chart depicts comparison of road crash statistics at Karla Phata

The next stage involves the collation of road crash statistics for the time period under investigation.
For example, this chart represents the road crash statistics for three years, namely 2018, 2019 and 2020 for the Karla Phata Junction. The crash statistics are broadly classified into: Number of crashes, number of fatalities and number of injuries. Karla Phata had 6 crash incidents in the year 2018 with 10 fatalities and 14 injuries, whereas 11 crashes, 7 fatalities and 7 injuries were recorded in 2019. In 2020, until October, 1 crash and 2 injuries were recorded.

Source: Data provided by Pune-Mumbai Police

Total crashes in 2018, 2019 and 2020

18 Nos

Nature of accidents

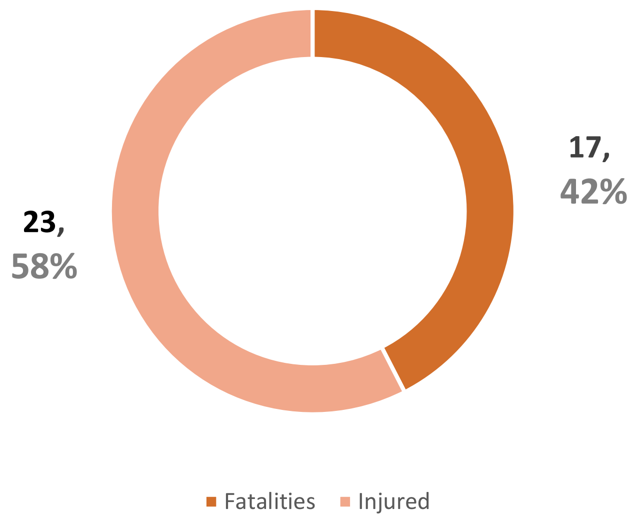
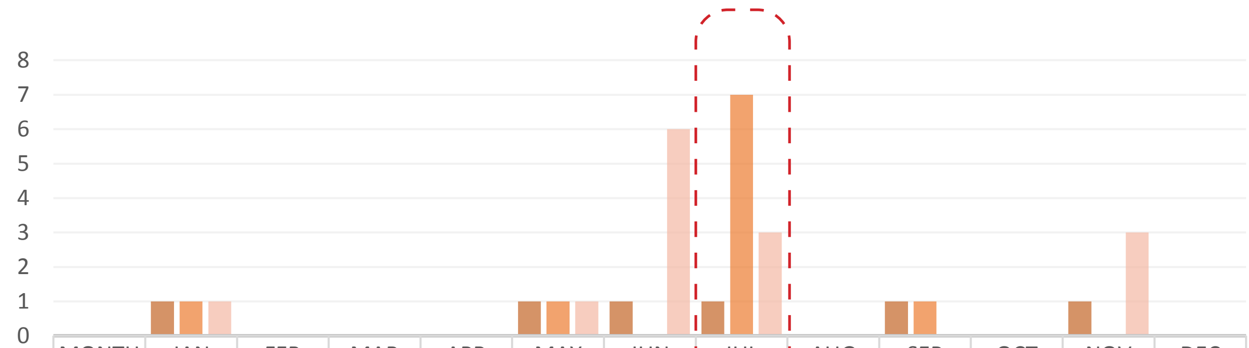


Fig 1.7: Classification of crashes based on their nature

2. Classification of road crashes on the basis of timeline

(Month wise distribution)

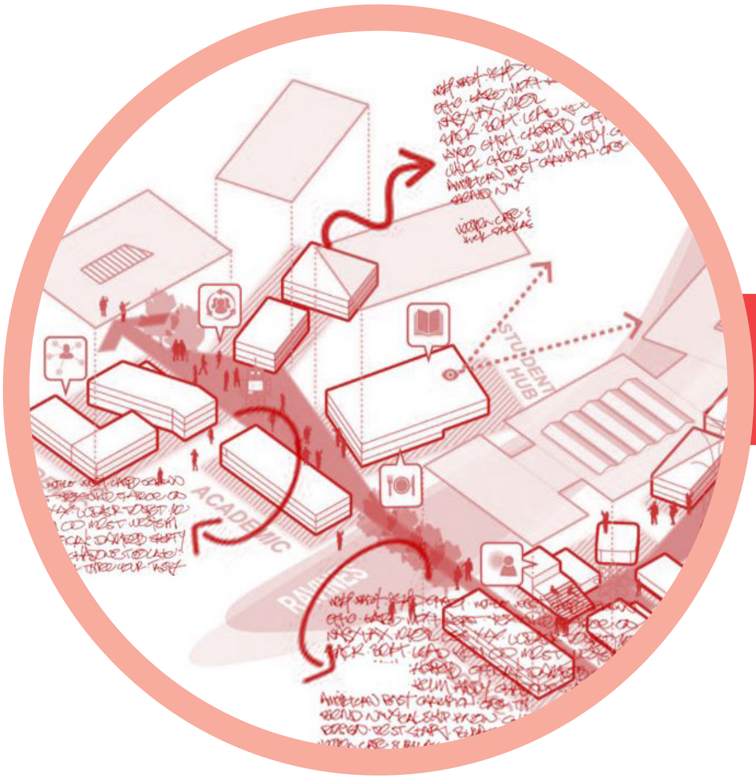


MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Crash Count	0	1	0	0	0	1	1	1	0	1	0	1	0
Fatalities	0	1	0	0	0	1	0	7	0	1	0	0	0
Injured	0	1	0	0	0	1	6	3	0	0	0	3	0

Crash Count Fatalities Injured

Fig 1.8: The bar chart depicts classification of road crashes on a monthly basis for the year 2019

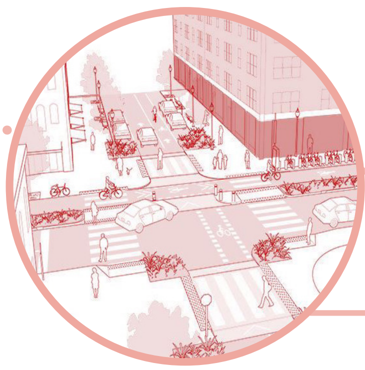
Source: Data provided by Pune-Mumbai Police

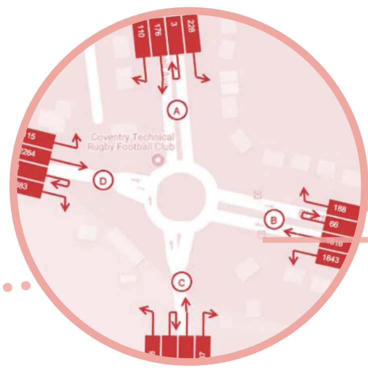


E. Site Appraisal

Pre-implementation user survey and apprising stakeholders of the TU project that is being planned

Study related to the special case scenario, activity mapping and socio-economic aspects





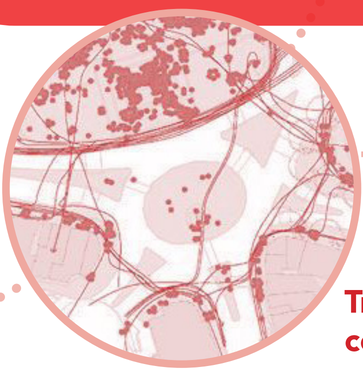
Topographic Survey

Detailed survey of the site including the built and natural elements of the site

Understanding the site, documenting it, and noting observations, to plan the next course of action

Condition of the intervention surface such as the road

Condition and attributes of public realm such as the pavements



Pedestrian movement patterns

Traffic flow analysis, vehicular counts and parking study

User groups and stakeholders around the intervention zone

The next stage involves getting a deeper understanding of the site, its context, opportunities and constraints based on on-ground data mapping, user surveys, topography, vehicular and pedestrian volumes etc.

Source: A tactical urbanism guidebook by MoHUA-GOI

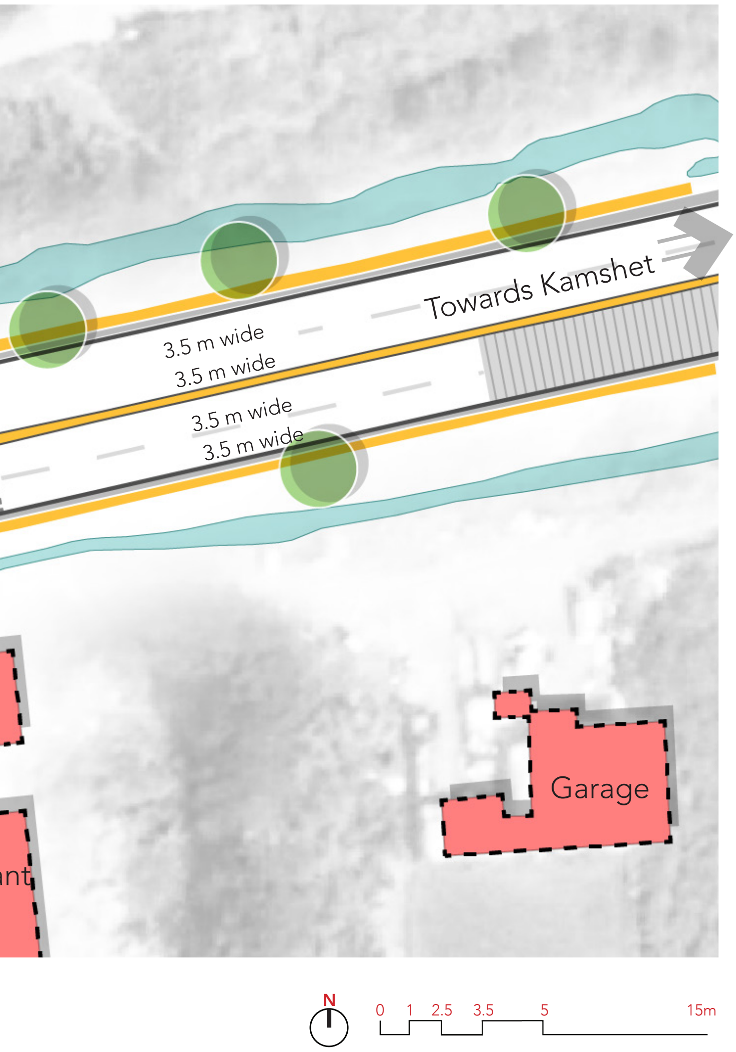
Understanding the Site

1. Site Context

Fig 1.9: Image of Karla Phata showing site context

1 Restaurants near the junction

2 Restaurants near the junction



This Junction is the access point to the Ekvira Devi Temple, the historic Karla Caves and the Visapur Fort, as well as the nearby residential developments.

These abutting land uses and sites give the intersection a unique user profile that have to be carefully considered.

3 Small tea stalls on the footpath

4 Garage along the highway

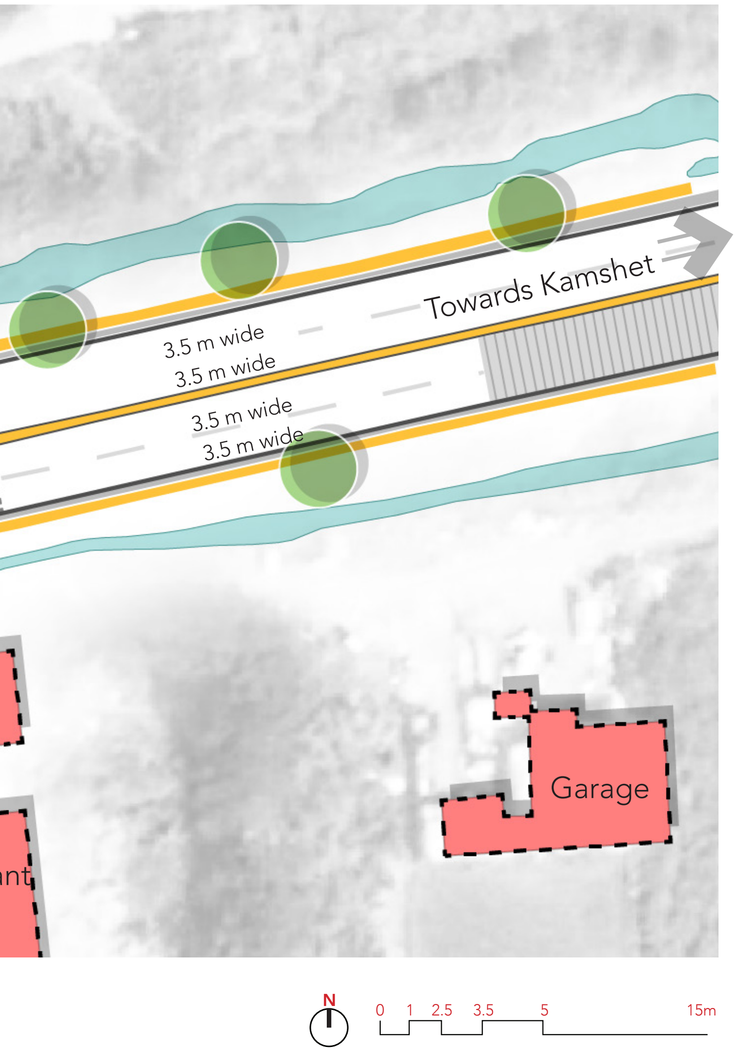
Fig 1.10: Series of images highlighting site context

2. Site topography

Fig 1.11: *Image of Karla Phata highlighting nallas*

The only topographic feature in the immediate vicinity is the *nalla* that runs on either side of the highway. The *nalla* plays an important role in carrying rain water run-off from the highway and the surrounding areas.

Upon interactions with business owners in the vicinity of the intersection, it was learnt that on occasions when the rainfall is extremely heavy, the *nalla* overflows onto the highway.



1 *Nalla* running on either side of the highway

2 Trench on either side of the highway

Fig 1.12: Series of images highlighting site topography

3. Pedestrian and vehicular infrastructure

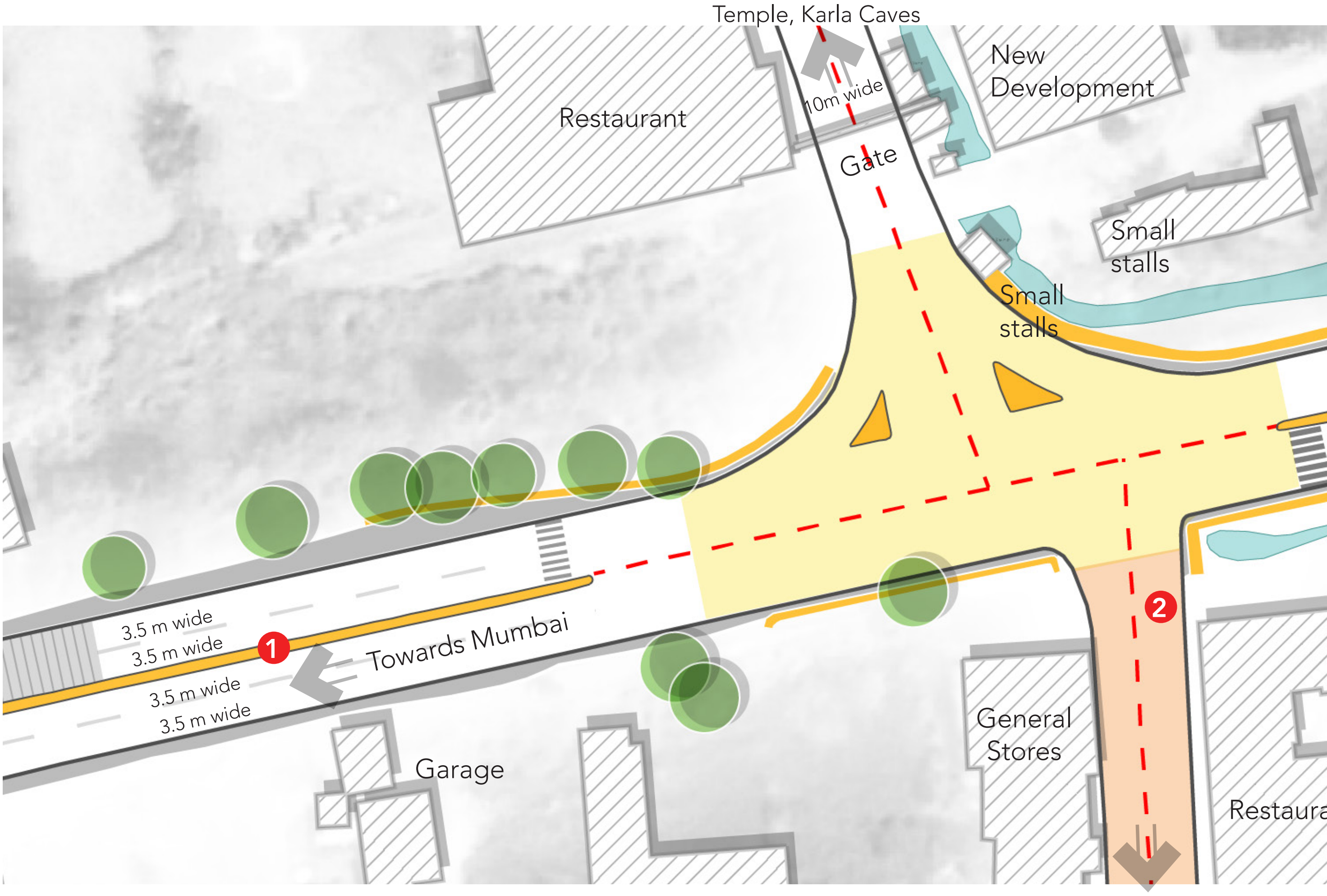
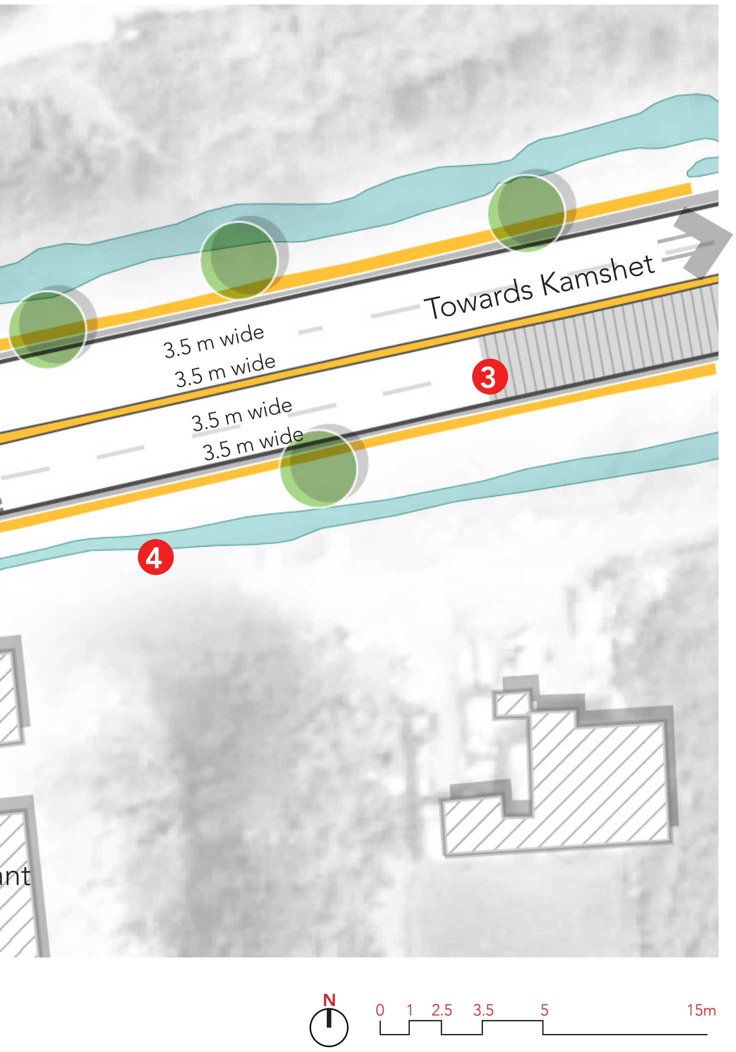


Fig 1.13: *Image of Karla Phata highlighting road infrastructure*

1 Road approaching the junction

2 Uneven road surfaces



1. There are no street lights and signages.

2. The condition of North and South roads are poor. The surfaces are uneven and have pot holes.

3. Rumblers on the highway are away from the junction and do not help in reducing the speed.

4. The *nalla* running along the road overflows during monsoon, increasing the crash possibility.

5. The junctions are misaligned, creating conflicts.

6. The mouth of the junction on the north side is very wide (58 m).

Centre line of Road

Wide Junction

Uneven Surface

Existing *Nalla*

3 Rumblers designed away from the junction

4 *Nalla* flowing along the highway

Fig 1.14: Series of images highlighting road infrastructure

4. Pick up and drop-off

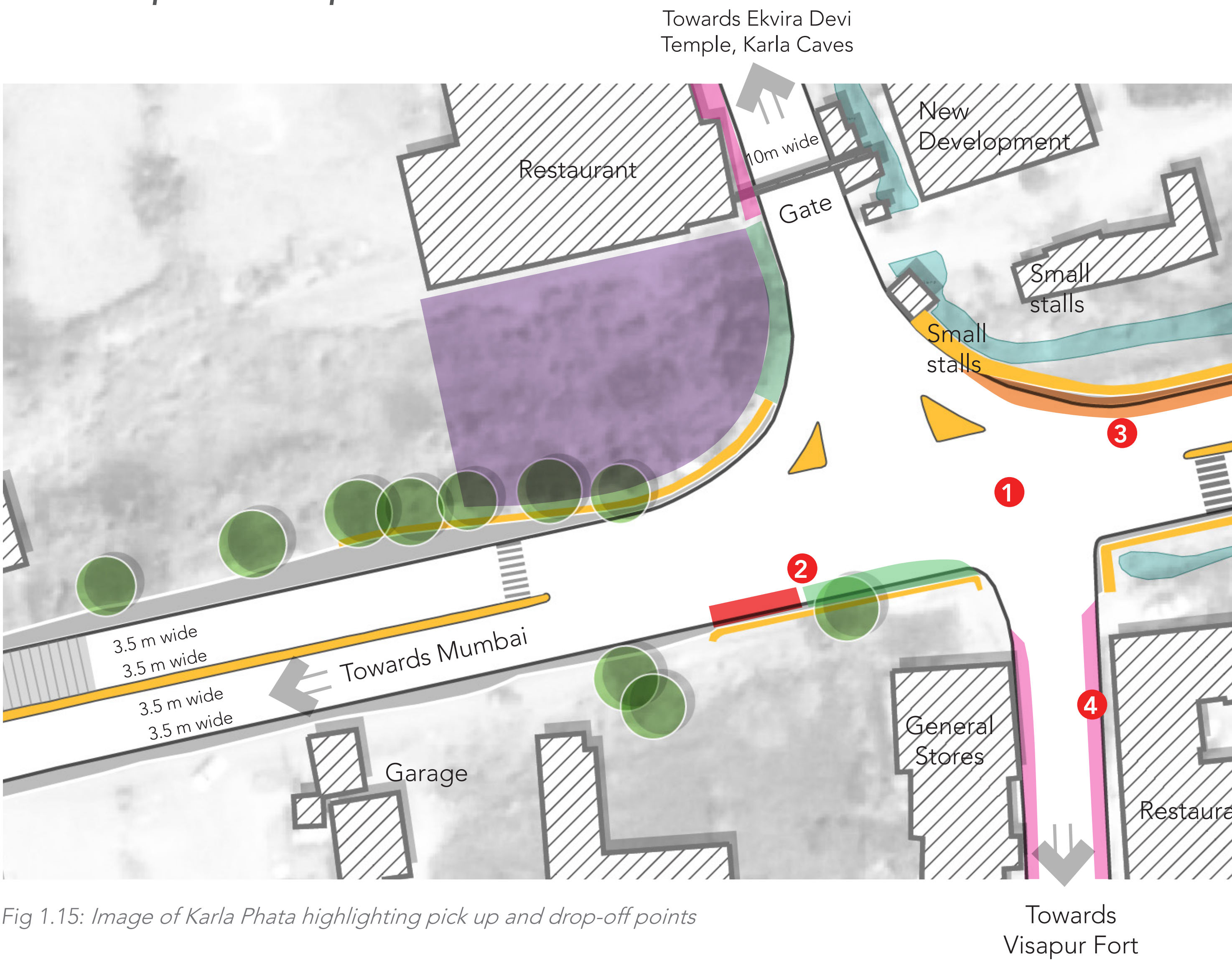
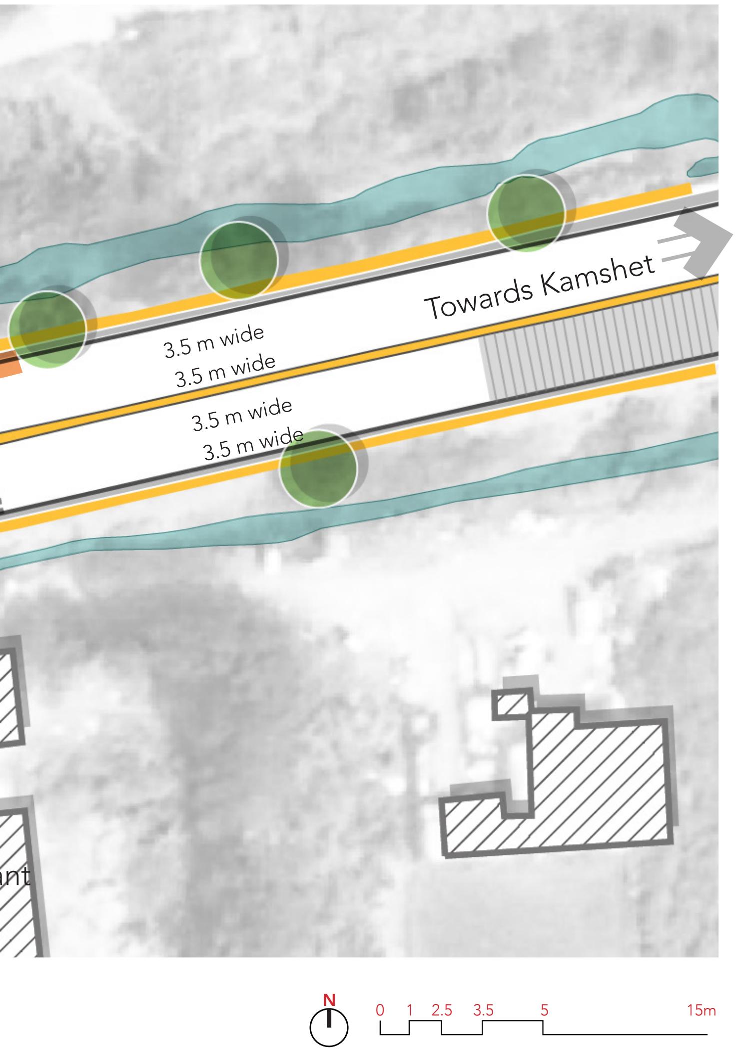


Fig 1.15: Image of Karla Phata highlighting pick up and drop-off points

1 High speed traffic on highway

2 Pick up and drop-off activity taking place.



1. Heavy vehicular and high-speed movement was witnessed throughout the day on the highway.

2. Vehicles were seen stopping to pick up and drop-off people on the carriage way.

3. State Transport bus stop and auto-stands are located at the junction.

4. Tourist and other vehicles were seen parked along the North-South road.

5. Several vehicles were witnessed crossing along the North-South direction, thereby increasing the conflict points.

- Auto Stand
- Bus Stop
- Car Parking
- Pick Up point
- Private Parking

3 Auto stand along the shoulder space.

4 Vehicles parked at no parking zone.

Fig 1.16: Series of images highlighting parking, pick up and drop-off point

5. Pedestrian circulation

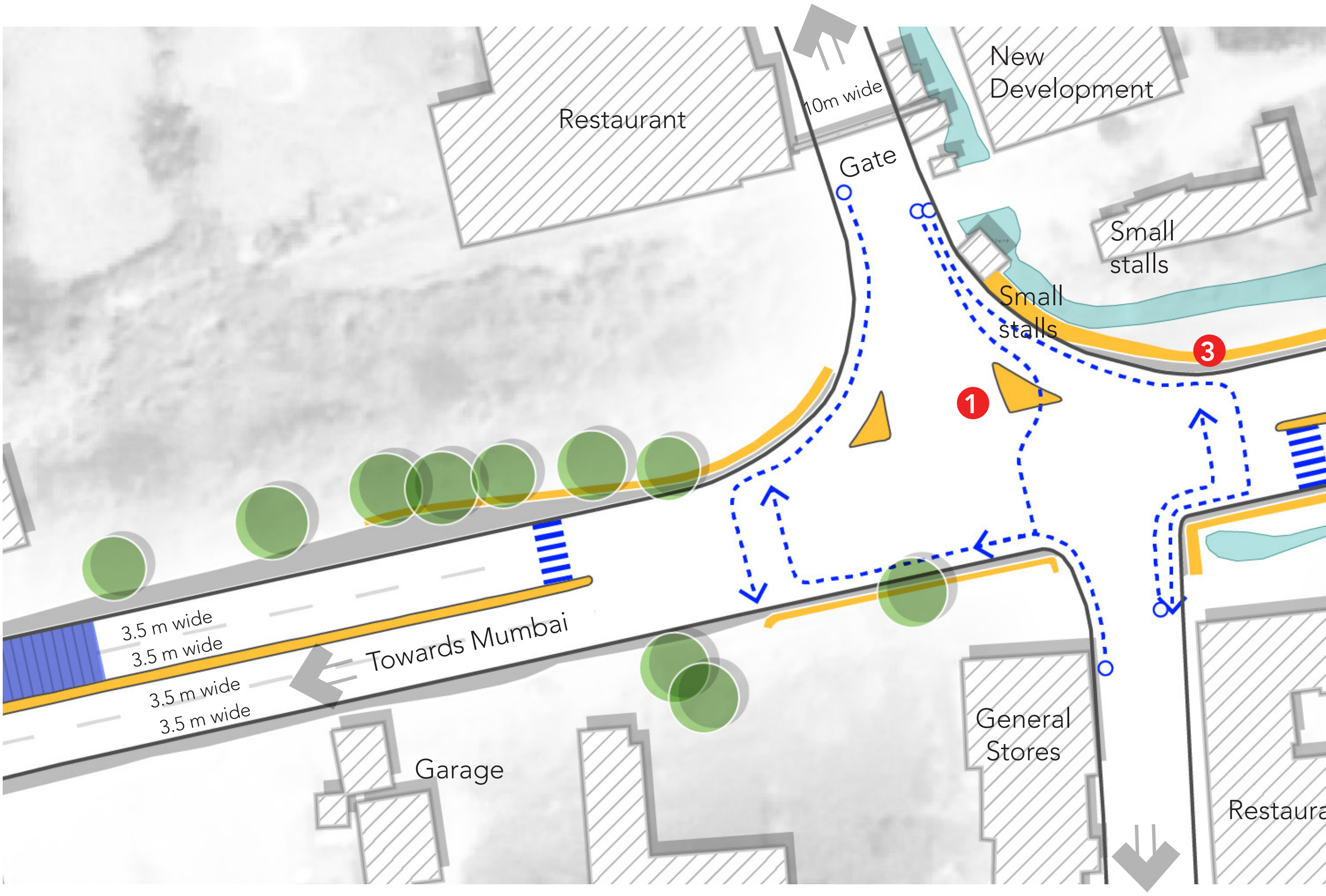
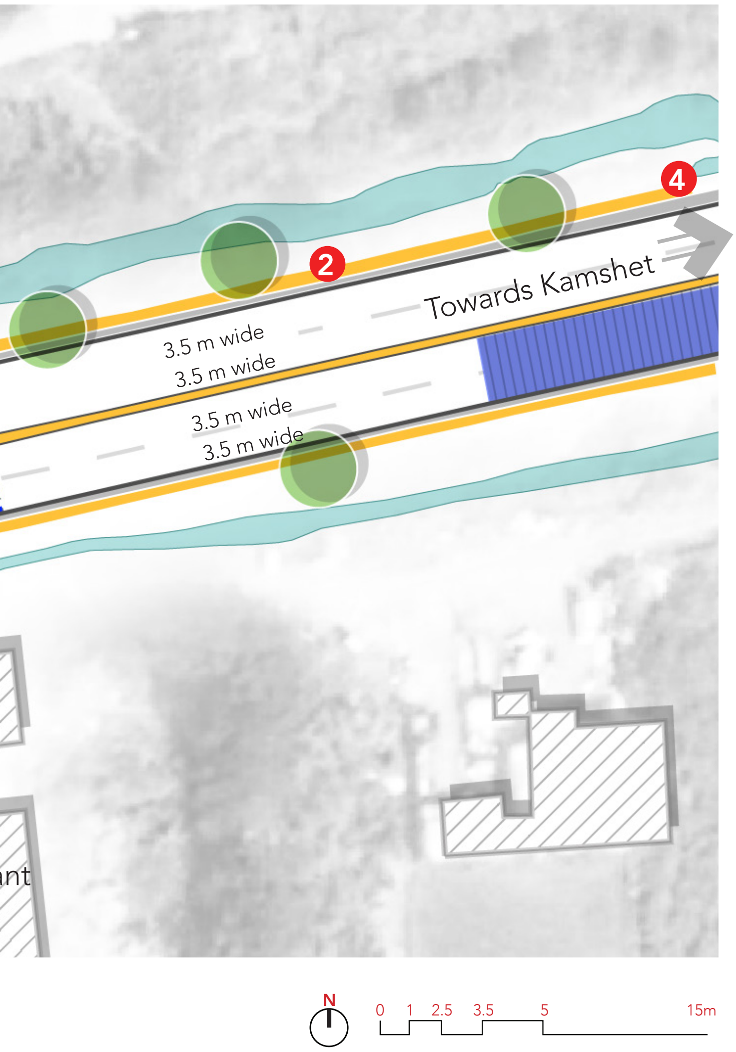


Fig 1.17: *Image of Karla Phata highlighting pedestrian circulation*

1 Pedestrians crossing the carriage way

2 Existing width of the footpath



1. The primary pedestrian movement is along North-South direction.

2. Footpaths are available on both sides, however they are narrow (approx 1m wide), discontinuous and in poor condition.

3. Footpaths also terminate near the lay-by.

4. Islands are small in size, in poor condition and are also very high (approx. 200mm high)

5. Zebra crossings are not continuous and end up at the railing on the footpath. They do not help one to cross the road and reach the other side.

6. Medians are less than 1m wide making the refuge area very narrow.

Footpath

Pedestrian Circulation

Cross walks

3 Existing condition of the footpath

4 Footpaths terminating near lay-by

Fig 1.18: Series of images highlighting existing footpath condition

6. Vehicular circulation

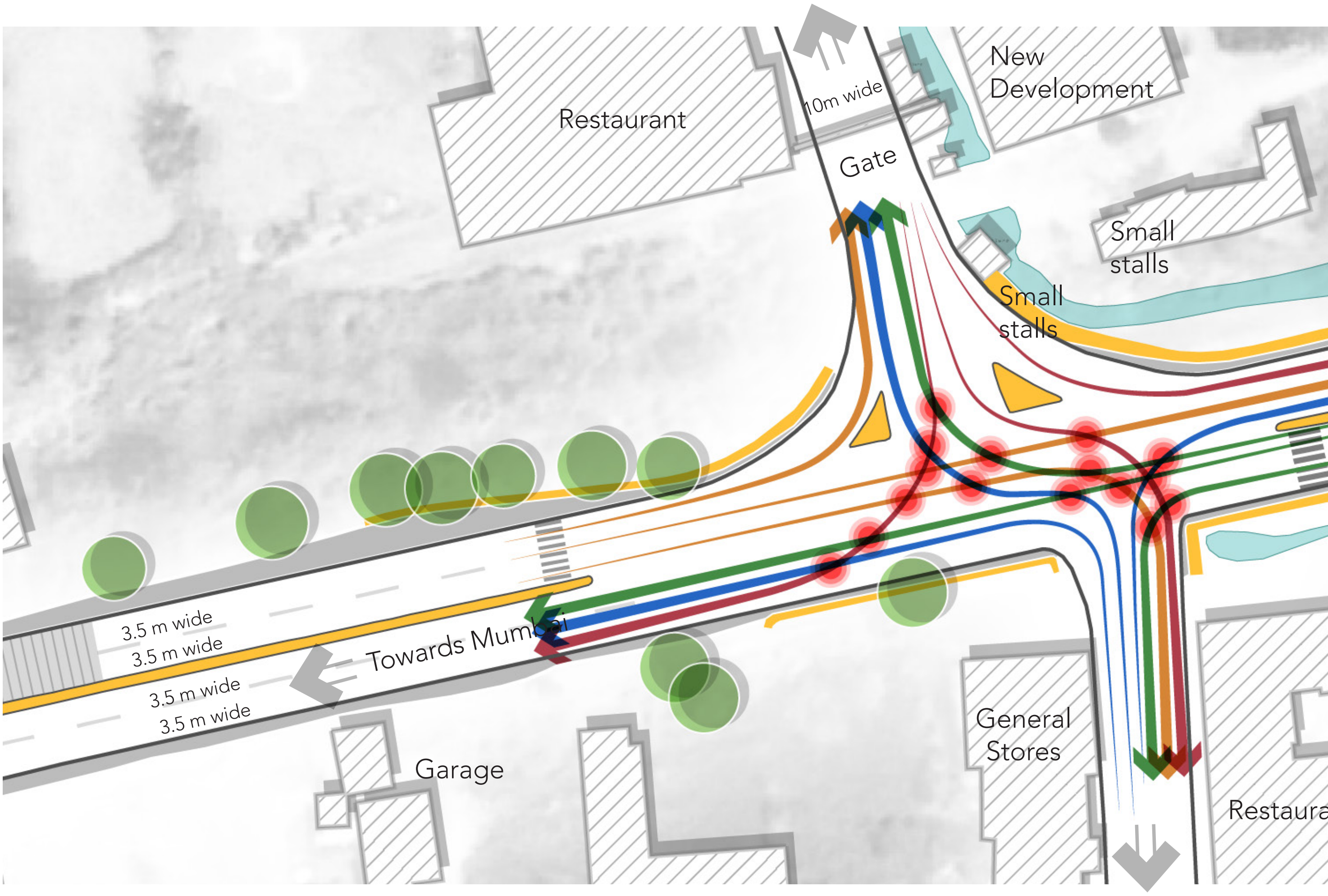
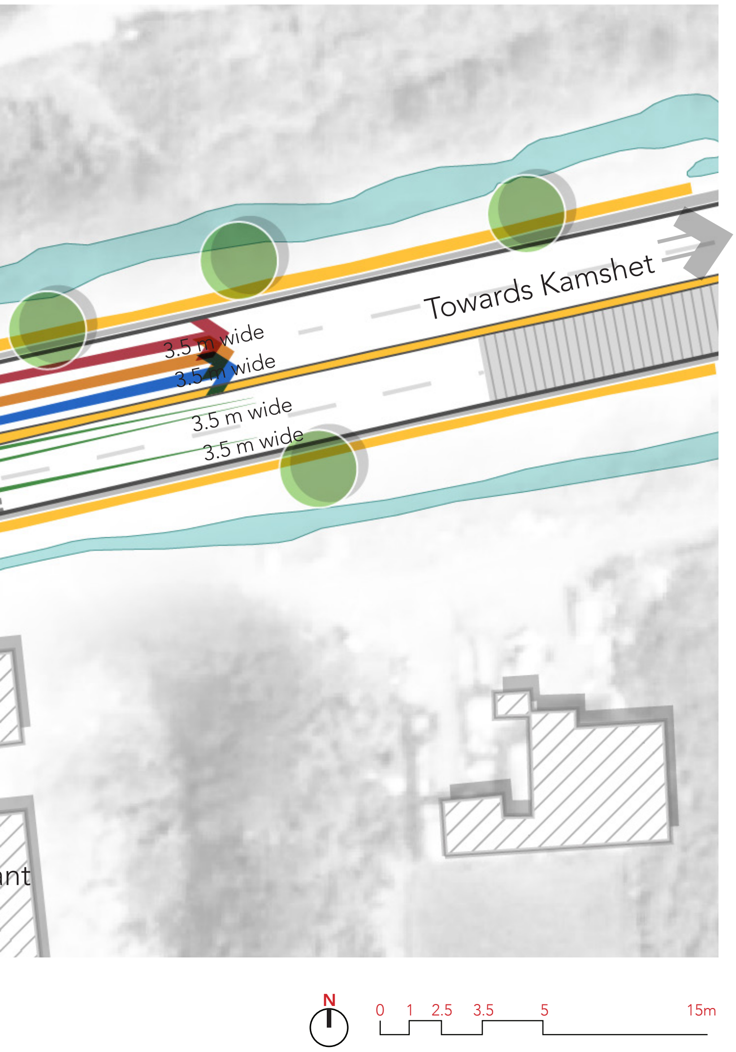


Fig 1.19: *Image of Karla Phata highlighting vehicular movement*

1. Vehicles moving from Karla village towards the junction

2. Conflict at the intersection



1. Heavy vehicular and high-speed movement through out the day on the highway.

2. Vehicles were stopping for pick up and drop-off on the carriage way.

3. ST bus stop and auto stands located at the junction.

4. Tourist and other vehicles parked along the North-South road.

5. Several vehicles cross along the North-South direction, increasing the conflict points.

Traffic from North

Traffic from South

Traffic from West

Traffic from East

3 Conflict at the intersection

4 Conflict at the intersection

Fig 1.20: Series of images highlighting conflict at the intersection

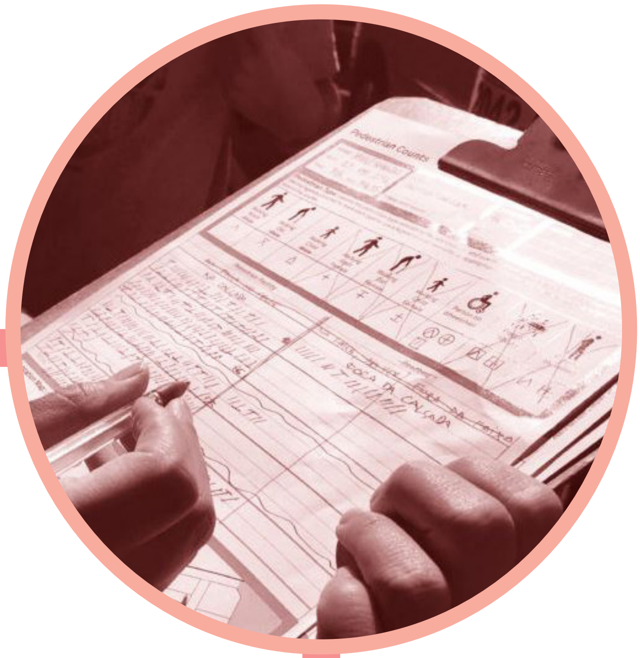
F. Tactical Urbanism to make streets safer

A Cost-Effective and Quick Solution

Through Tactical Urbanism, low-cost, quick-fix solutions can be applied to resolve on-ground issues. These include regulating traffic flow through junction improvements, geometry correction like tighter corner radii to reclaim spaces for pedestrian safety and the introduction of medians to streamline traffic flow.

From Pop-Up to Permanent

Tactical Urbanism acts as a bridge between conceptualising and implementing projects. By testing solutions on the ground, it helps visualise the outcome, gauge the investment needed to make interventions permanent, while also creating awareness about the need and vision of the project.



Small-Scale, but Scalable

Tactical Urbanism is adaptive and can help create immediate solutions that respond to the challenges at hand. Once the need has been identified, desired temporary functions can be applied for testing. If a successful outcome/ model is established, it can be adapted and applied to other areas too.

Deciphering Priorities and Building Consensus

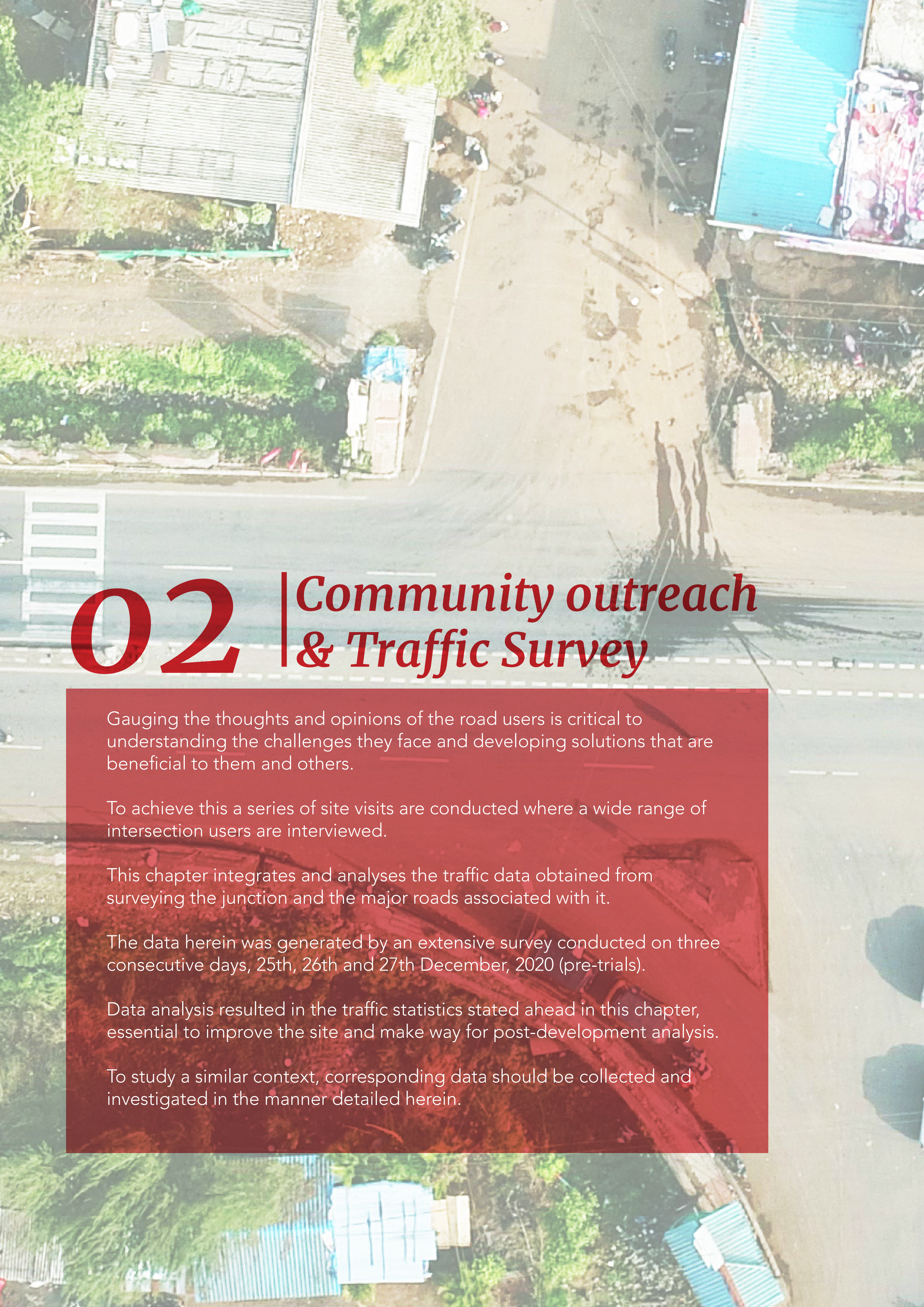
The temporary nature of Tactical Urbanism helps monitor changes in usage and behavioural patterns of users.

It therefore can become a steering decision-making tool. Owing to the flexibility and nature of these experiments, inputs can be taken and acceptance can be recorded, which in turn helps concerned authorities prioritise either the entire project or certain components of it to the next stage of permanent implementation.

Awareness Tool

Addressing issues through Tactical Urbanism helps attain public awareness at two levels. Firstly, physical planning through temporary, small-scale changes helps demonstrate the extent of the changes planned. Secondly, this kind of space reorganisation nudges people to observe the imposed norm while building awareness not just through user experience but also by word of mouth.

Source: A tactical urbanism guidebook by MoHUA-GOI



02 | Community outreach & Traffic Survey

Gauging the thoughts and opinions of the road users is critical to understanding the challenges they face and developing solutions that are beneficial to them and others.

To achieve this a series of site visits are conducted where a wide range of intersection users are interviewed.

This chapter integrates and analyses the traffic data obtained from surveying the junction and the major roads associated with it.

The data herein was generated by an extensive survey conducted on three consecutive days, 25th, 26th and 27th December, 2020 (pre-trials).

Data analysis resulted in the traffic statistics stated ahead in this chapter, essential to improve the site and make way for post-development analysis.

To study a similar context, corresponding data should be collected and investigated in the manner detailed herein.

A. User Behaviour Analysis

In order to understand the user behaviour, questionnaires are created for interviewing people from various stakeholder groups on the site and from the surrounding area.

For the site under consideration, Karla Phata, the following were the stakeholder groups identified:

1. Pedestrians
2. Auto rickshaw drivers
3. Shopkeepers and business owners
4. Ambulances
5. Private vehicle owners

The interviews for this site were conducted in the local language (Marathi) and the responses were noted in English. As is the best practise, all interviews were taken with full consent and after making people aware about the scope of the intervention. Few of the responses were also recorded on camera with the consent of the interviewee.

For the Karla Phata study, a total of 38 personal interviews were conducted. These included:

Pedestrians - 9
Shopkeepers and business owners - 10
Private vehicle owners - 9
Auto rickshaw drivers - 9
Ambulance driver - 1

Extracts from a few of the video interviews are given below.

Questionnaire for Site Interviews				
A	**Pedestrians**			
1	Do you feel safe while crossing the intersection?			
	Yes		No	
	Describe			
2	What is the main purpose for this cross movement?			
	Describe			
3	Does the traffice island help you cross the road?			
	Yes		No	
	Describe			
4	Does the median help you cross the road?			
	Yes		No	
	Describe			
5	Does the zebra crossing help you cross the road?			
	Yes		No	
	Describe			
6	What according to you will make crossing safe?			
	Describe			
7	Do you use the existing footpath?			
	Yes		No	
	Describe			
8	Do you find it easy to locate auto, bus or other vehicle on the intersection?			
	Yes		No	
	Describe			
9	Do vehicles slow down near pedestrian crossing?			
	Yes		No	
	Describe			
10	Have you or any known person been involved in crash near this intersection?			
	Yes		No	
	Describe			
11	Have you or any known person been involved in near miss (or 'almost-crash') on this intersection?			
	Yes		No	
	Describe			
12	Do you feel safe to cross the road at night?			
	Yes		No	
	Describe			
13	What are the key issues you face while crossing at night?			
	Describe			

Table 2.1: Questionnaire used for site interviews for pedestrians

1. Extract from video interviews

Screen grab from video interview footage; All interviews have been taken with full consent and after making people aware about the scope of the interventions

Name
Sanjay Patil

User Category
Ambulance Owner and Driver

Date and Location of Interview
06.01.2021, Karla Phata, Maharashtra

Age group
35 - 45 years

Sanjay owns a private Ambulance Service and 3 ambulances, one of which is always parked at Karla Phata. He is on duty throughout the day and has been helping to take people to the nearby hospitals whenever an accident takes place.

Sanjay telling us about the crashes that happen on the site

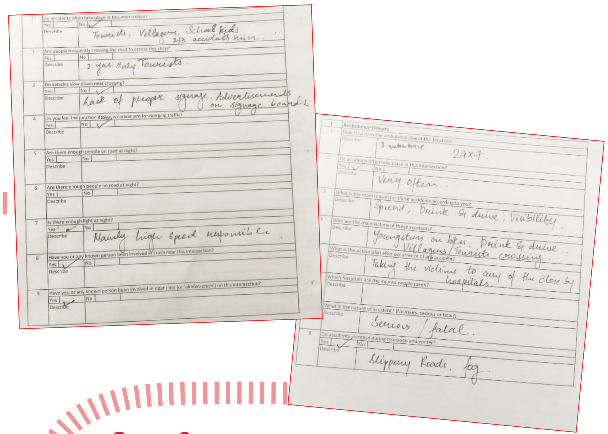
" I have almost helped over 1000 people who met with accidents at this junction. I have seen so many people lose their lives on the spot and have tried to help many by taking them to the nearest hospitals. I am stationed at this junction throughout the night to help people.

Translated from original interview in Marathi "

Sanjay telling us about what he thinks causes the crashes

" Major accidents happen when speeding vehicles try to overtake one another, young bikers speeding on the highway also meet with a lot of accidents at this junction. The people crossing the junction also fail to gauge the speed of the vehicles on the highway.

Translated from original interview in Marathi "



'3 STEP' PROCESS

Step1
Finding the relevant user from our respective user groups, taking their consent and recording their answers to various questions from our questionnaire

Step 2
Documenting the answers on our questionnaire form on site

Step 3
Analysing and inferring from the data collected

Sanjay telling us about what he feels are the key challenges with the junction

> "Vehicles on the highway do not slow down near the junction. During rainy season, the road gets slippery causing more accidents. Lack of street lights, signages for directions also add to the reasons why this junction is unsafe.
>
> Translated from original interview in Marathi "

Sanjay telling us about what he feels could be the possible solutions

> "The speed needs to be regulated as the vehicles approach the junction. Being a tourist destination it is very difficult to control the accidents here as the tourists are unaware of the roads and directions and are often distracted on their phone looking for directions."
>
> Translated from original interview in Marathi

Screen grab from video interview footage; All interviews have been taken with full consent and after making people aware about the scope of our intervention

Vandana Khamkar

User Category

Shopkeeper

Date and Location of Interview

6.01.2021, Karla Phata, Maharashtra

Age group

40-50 years

For 18 years now, Vandana has had a Vadapav shop right at the Karla Phata junction. She was the first commercial vendor at the junction and has witnessed the transformation of the area. She is aware of the rising challenges there.

Vandana telling us about the crashes that happen on the site

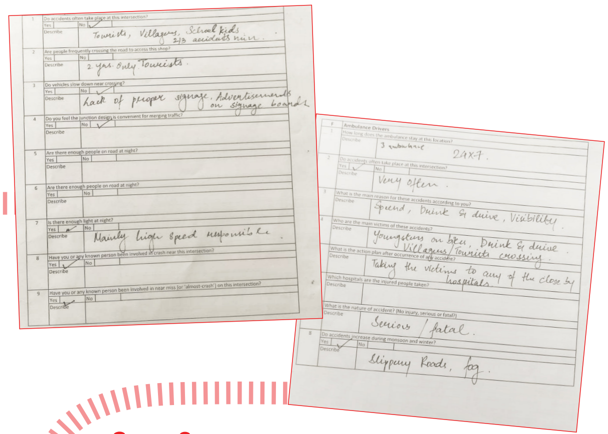
"In 18 years of my time here, I have witnessed many accidents. Especially during weekends and peak seasons the number of accidents increase in the area."

Translated from original interview in Marathi

Vandana telling us about what she thinks causes the crashes

"High speeds of the vehicles on the highway causes major accidents. The priority is always given to the vehicles on the highway. This makes it difficult for the pedestrians and vehicles crossing the junction. The priority should be given to the pedestrians crossing."

Translated from original interview in Marathi



'3 STEP' PROCESS

Step1
Finding the relevant user from our respective user groups, taking their consent and recording their answers to various questions from our questionnaire

Step 2
Documenting the answers on our questionnaire form on site

Step 3
Analysing and inferring from the data collected

Vandana telling us about what she feels are the key challenges with the junction

"The high speed of the vehicles on the highway, the conflict of movements at the crossing and the lack of visibility at the junction is responsible for major accidents. Slippery roads during the monsoons also cause accidents."

Translated from original interview in Marathi

Vandana telling us about what she feels could be the possible solutions

"There needs to be a flyover for the highway, so that the people from the village can cross this junctions easily. Traffic control measures should be put in place with the help of traffic police."

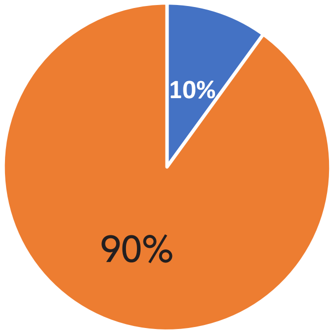
Translated from original interview in Marathi

2. Summary of community outreach

Pre-trial - Pedestrians

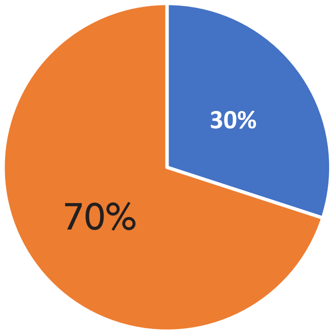
1. Do you feel safe while crossing the junction?

90% people say they do not feel safe while crossing the junction. High speed on the highway is the biggest threat.



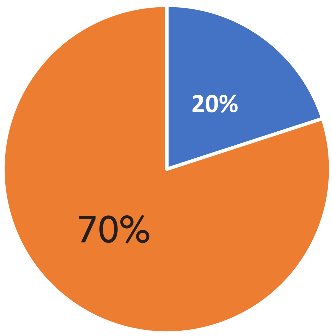
2. Do you feel the junction design is convenient for merging traffic?

70% people say the junction design is not safe for merging traffic.



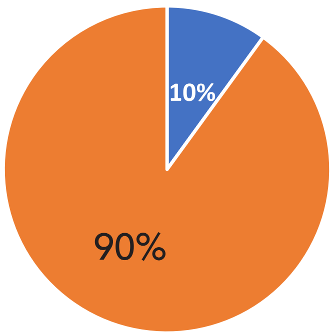
3. Do you use the existing footpath?

70% people do not use footpath due to its poor condition.



4. Do you feel safe using the junction at night?

90% people say they do not feel safe using the junction at night as there is no lighting provision.



Legend

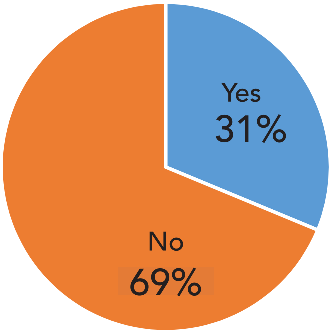
YES

NO

Pre-trial - Motorised Vehicles (includes auto rickshaw, private vehicles)

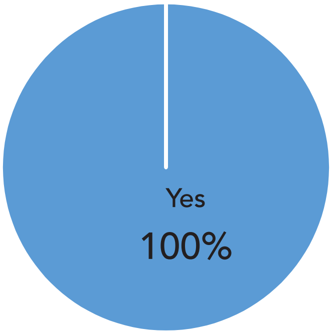
1. Do you feel safe driving at this junction?

69% drivers do not feel safe at the junction.



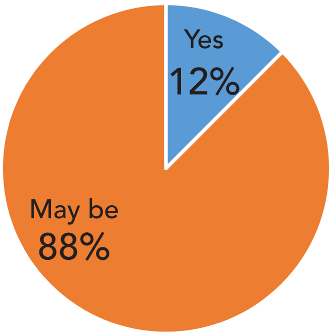
2. Are there any dedicated auto rickshaw stands at the junction?

There are auto rickshaw stands but away from the junction.



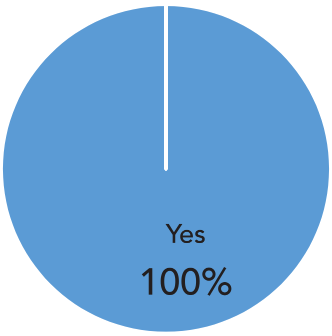
3. Are there any signages for safety or for bus stop/auto stands?

Signages are located at the junction but are away and do not provide all the required information.



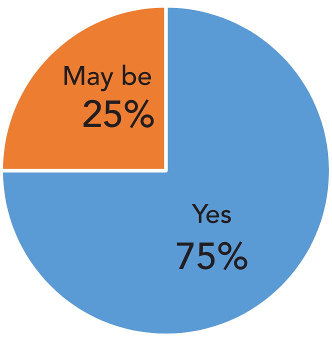
4. Are the speeds of the vehicles very high at the junction?

Drivers say the speeds of vehicles at the junction is very high.



5. Have you or anyone you know, been involved in a crash at this intersection, (or observed it)?

75% of the drivers interviewed have observed a crash atleast once at this junction.



B. Traffic Survey Methodology

1. Camera Locations

Fig 2.1: Drone Image of Karla Phata showing camera setup for the traffic survey

Traffic Study was conducted for 3 days on 25th, 26th, and 27th December, 2020 at Karla Phata. The days on which the survey was conducted were Sunday, Monday, Tuesday.

2. Classified categories for the traffic survey

Traffic Study was conducted for three consecutive days on 25th, 26th, and 27th December, 2020 at Karla Phata. These dates were strategically chosen so as to capture weekend traffic conditions on 25th and work day traffic conditions on 26th and 27th of December, 2020.

Cameras were placed at the locations indicated in the drawing alongside to conduct the survey. These cameras captured all traffic movements at all the junction arms. The data, including volume counts and speed, was categorised hour wise for all three days.

The vehicular types are classified into Light Motor Vehicles (LMV) and Heavy Motor Vehicles (HMV).

Car, Taxi, Auto Rickshaw (AR) and Motorised Two wheelers (MTW) were categorised under LMV.

Bus, Mini, Light Commercial Vehicle (LCV), Truck 2 Axle, Truck 3-Axle and Multi-Axle Vehicle (MAV), were categorised under HMV. In order to calculate average traffic flow, respective PCU counts of the vehicle types were taken into account.

Passenger Car Unit - PCU

Passenger Car Equivalent (PCE) or Passenger Car Unit (PCU) is a metric used in transportation engineering, to assess traffic-flow rate on a highway. Highway capacity is measured in PCU/ hour daily.

C. Traffic Volume

The graph indicates combined data for the three days on NH 48.

Key Plan

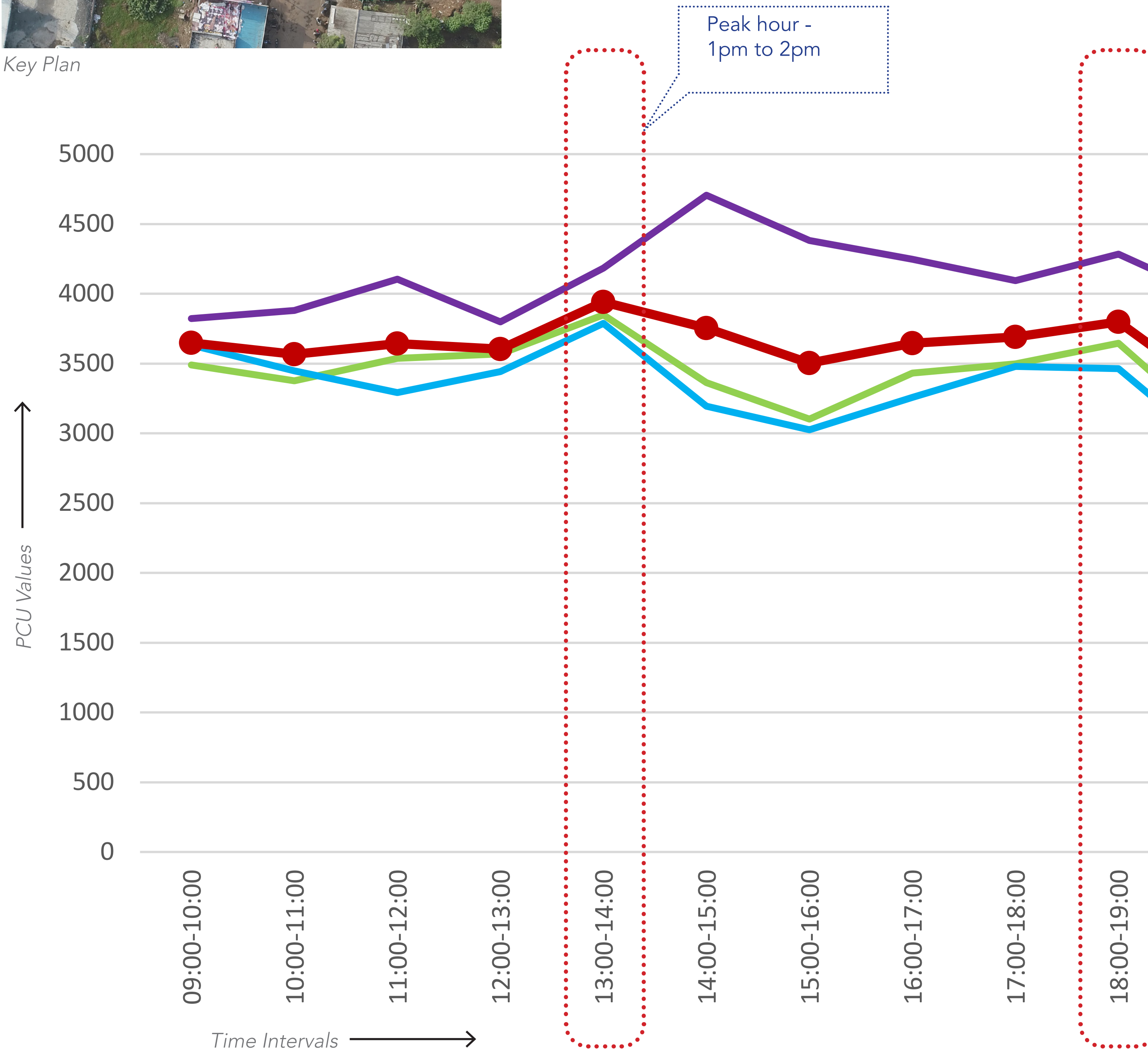
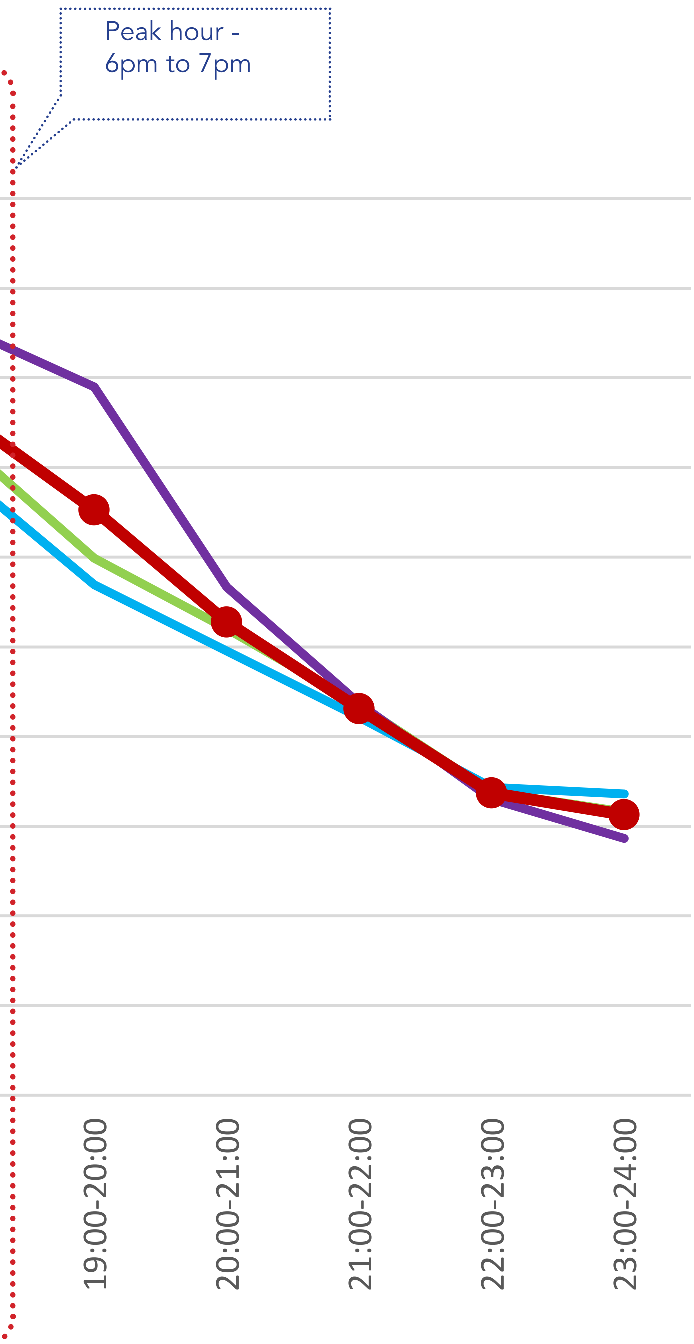


Fig 2.2: Graph showing average traffic volume for 3 survey days based on PCU counts



Observation

The graph indicates the traffic flow trend during the three days individually.

Major traffic flow can be observed from 1 PM to 2 PM.

The peak hour is observed to be at 1 PM - 2 PM and the second peak is observed at 6 PM - 7 PM.

Daily PCU counts range from 45,000 to 55,000.

3 Day PCU Counts

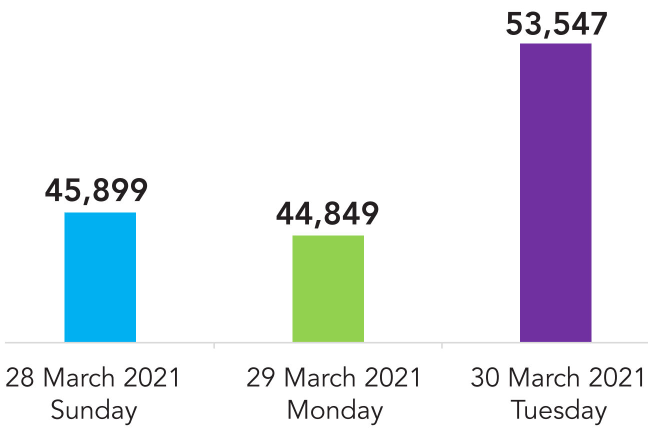


Fig 2.3: Bar graph showing average PCU values for the individual days of survey

Legend

25 December 2020 - Sunday

26 December 2020 - Monday

27 December 2020 - Tuesday

Average PCUs of 3 days

D. Mode Share Percentage

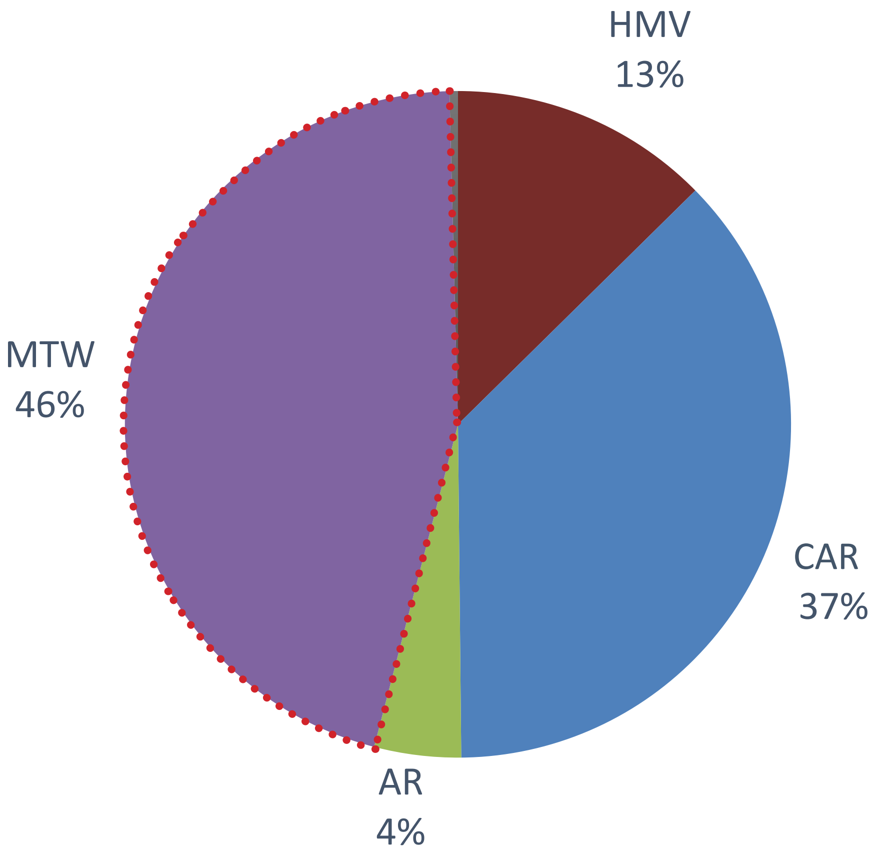


Fig 2.4: The pie chart indicates average mode share percentage on NH 48 during the 3 days of survey

Observation

In 3-days of survey it was observed that Motorised Two-Wheeler vehicles form a major part of the traffic, ranging from 42% to 47%.

As Two-Wheelers are not permitted on the Mumbai-Pune Expressway, therefore, the possibility of higher numbers of Two-Wheelers plying on the NH 48 was witnessed.

The next major share was of LMV ranging from 35% to 40%, and HMV ranging from 10% to 15%.

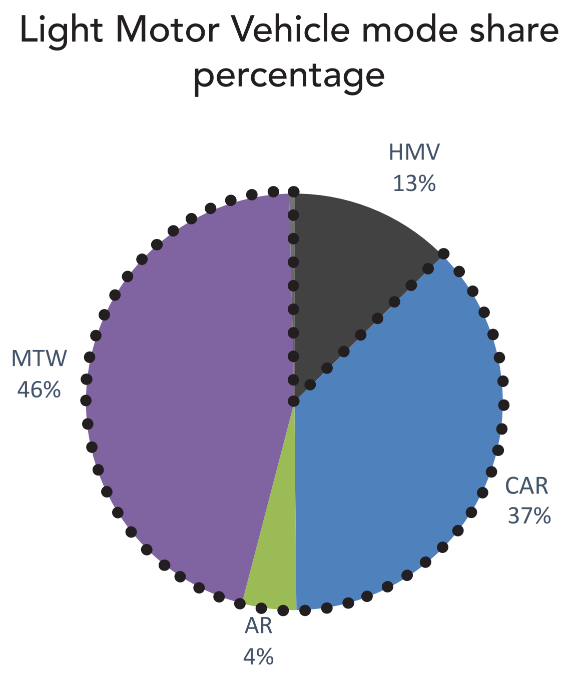


Fig 2.5: The pie chart indicates average mode share percentage of LMVs for the 3 days of survey

Observation

Light Vehicle consists of Car, Taxi and Auto/ Auto Tempo and Motorised Two-Wheeler as shown here.

LMV consist of 87% of the total mode share.

The on-going development and the location of a hospital in the vicinity might be the reason for higher Light Motor Vehicles in this area.

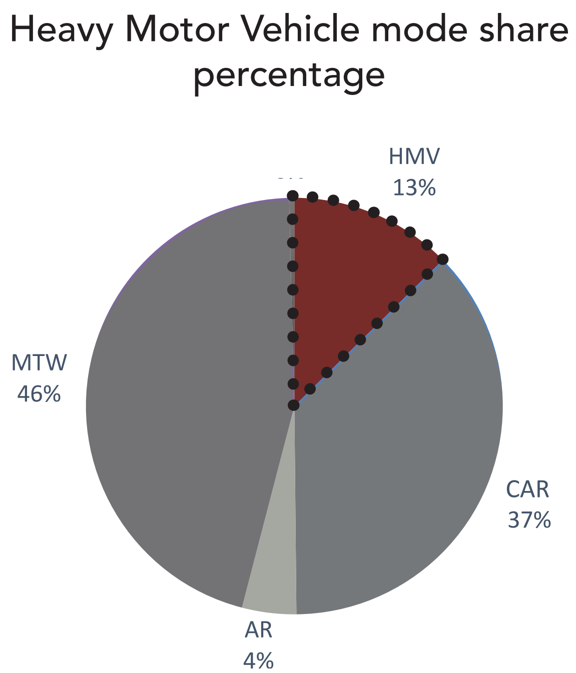


Fig 2.6: The pie chart indicates average mode share percentage of HMVs for the 3 days of survey

Observation

Heavy Motor Vehicles consist of Bus, Mini-bus, LCV, Truck (2-Axle, 3-Axle, MAV) as shown here.

Legend

- Car
- AR
- MTW
- HMV
- Bicycle

E. Traffic Variation

All three days - 25th, 26th, 27th December 2020

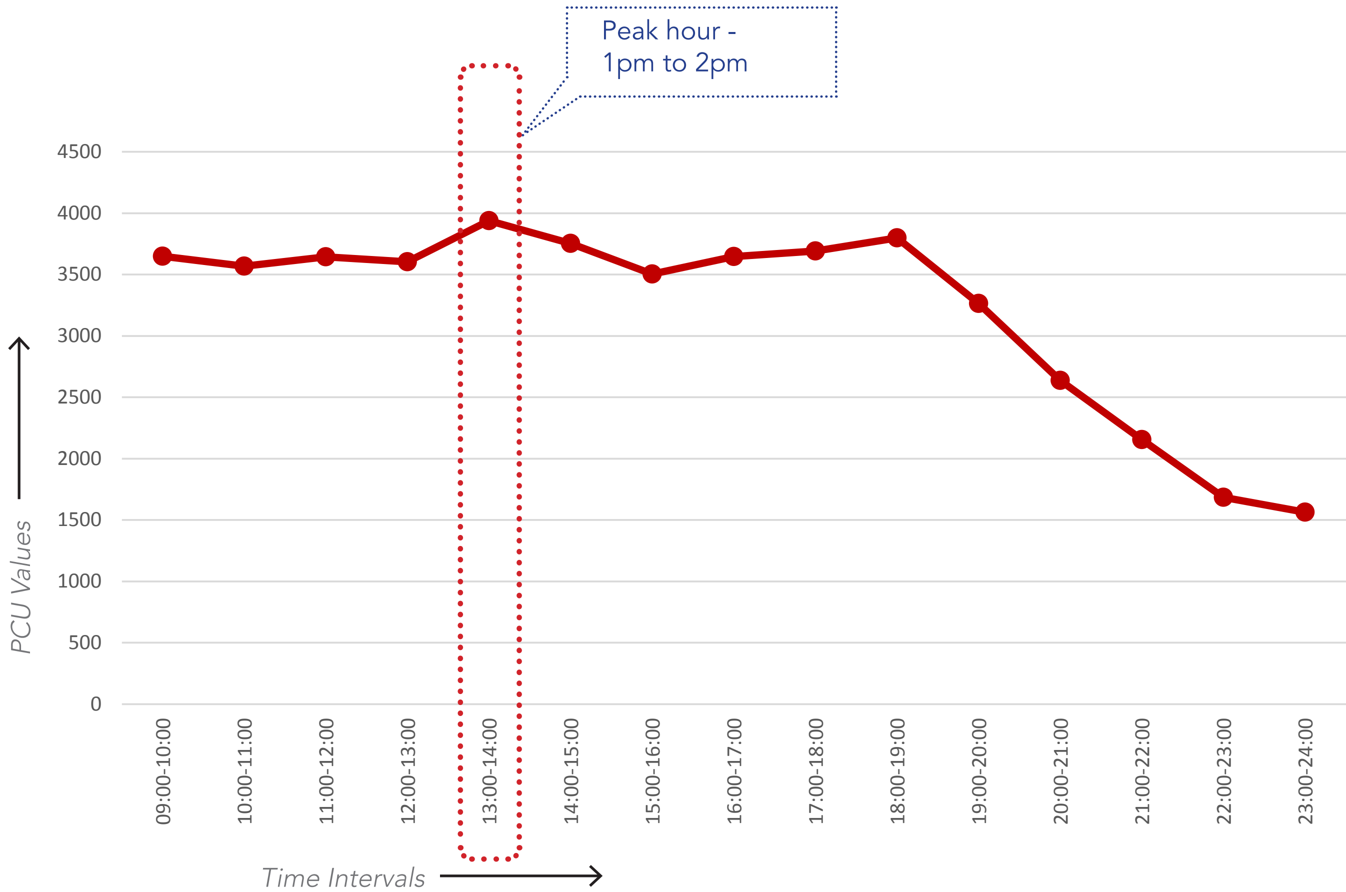


Fig 2.7: The graph indicates average traffic variation for the 3 days of survey

Observation

On 25th December, 2020, the peak hour was observed to be 1 pm to 2 pm, with maximum traffic volume towards Pune at 1 pm.

On 27th December, 2020, the peak hour was observed to be 2 pm to 3 pm, with maximum traffic volume towards Kamshet at 2 pm.

In the 3-day survey period it was observed that Motorised Two-Wheelers form a major part of the traffic ranging from 42% to 47%.

Peak Hour

1PM-2PM

Legend

Average PCUs of 3 days

Traffic Volume

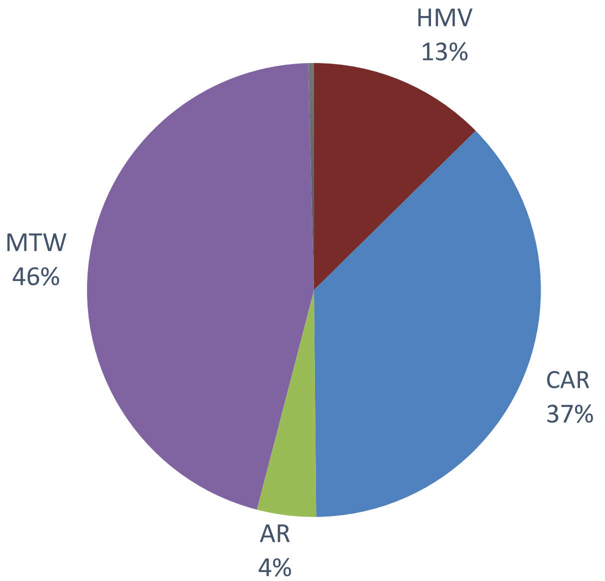


Fig 2.8: The pie chart indicates average traffic volume based on vehicle counts for the 3 day survey period

Traffic PCU Composition

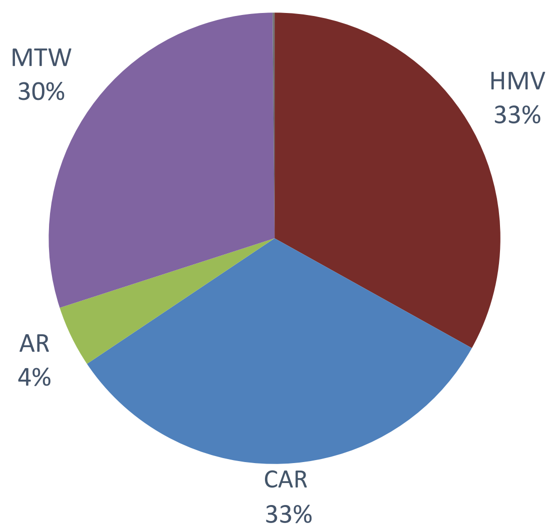


Fig 2.9: The pie chart indicates average traffic volume based on vehicle PCU values for the 3 day survey period

	MTW	CAR+AUTO	HMV
Counts	46%	41%	13%
PCU	30%	37%	33%

Legend
- CAR
- AR
- MTW
- HMV
- Bicycle

F. Vehicular and Pedestrian Movement

1. Turning Movement Diagram

Average traffic volume

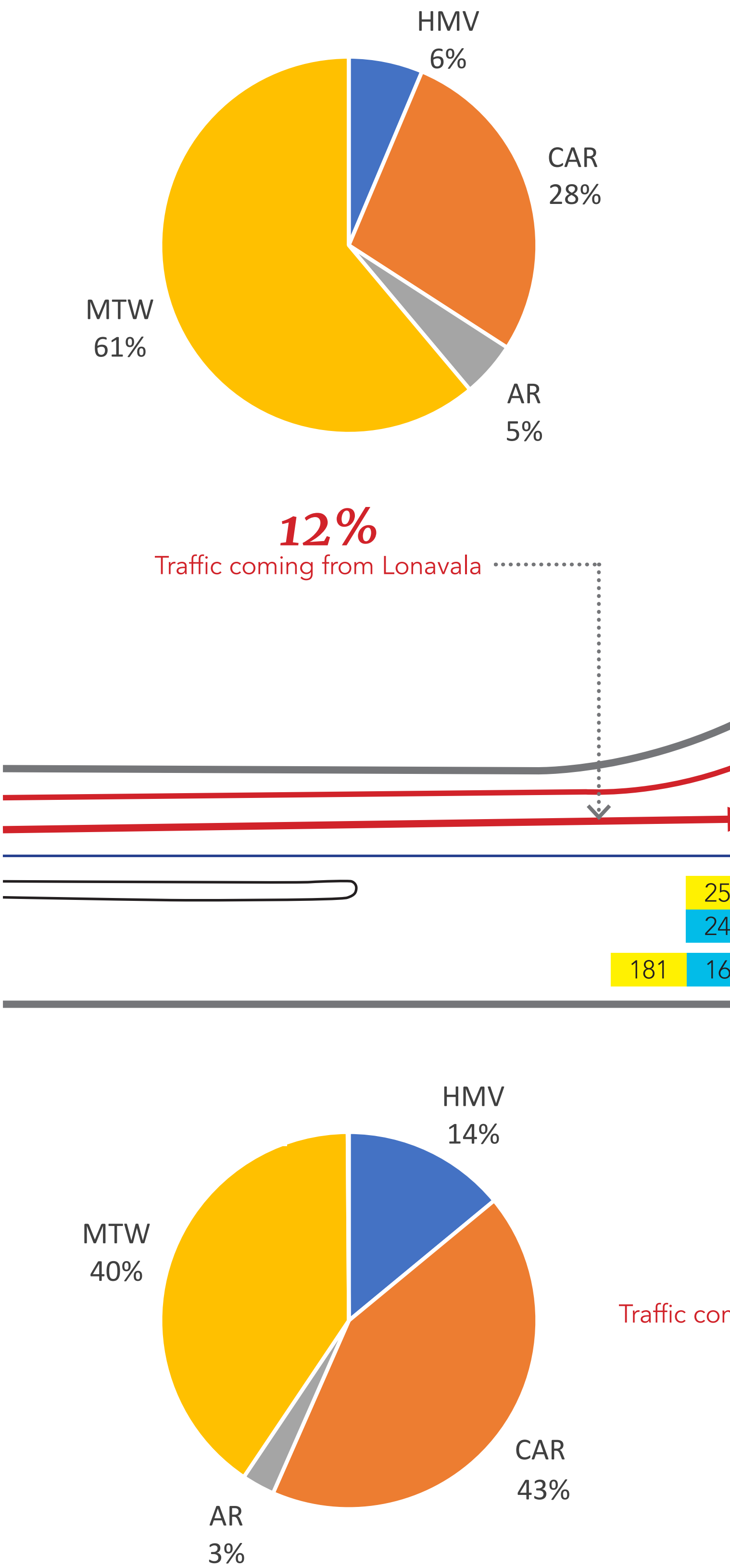
Time - 01:00 PM to 02:00 PM
(Observed Peak Hour Trend)

Observation

From the analysis of the traffic volumes and mode shares it is observed that the primary traffic movements are along the NH 48 in the East-West direction. While the turning movement volumes are lower than the straight-through movement, they are rather significant.

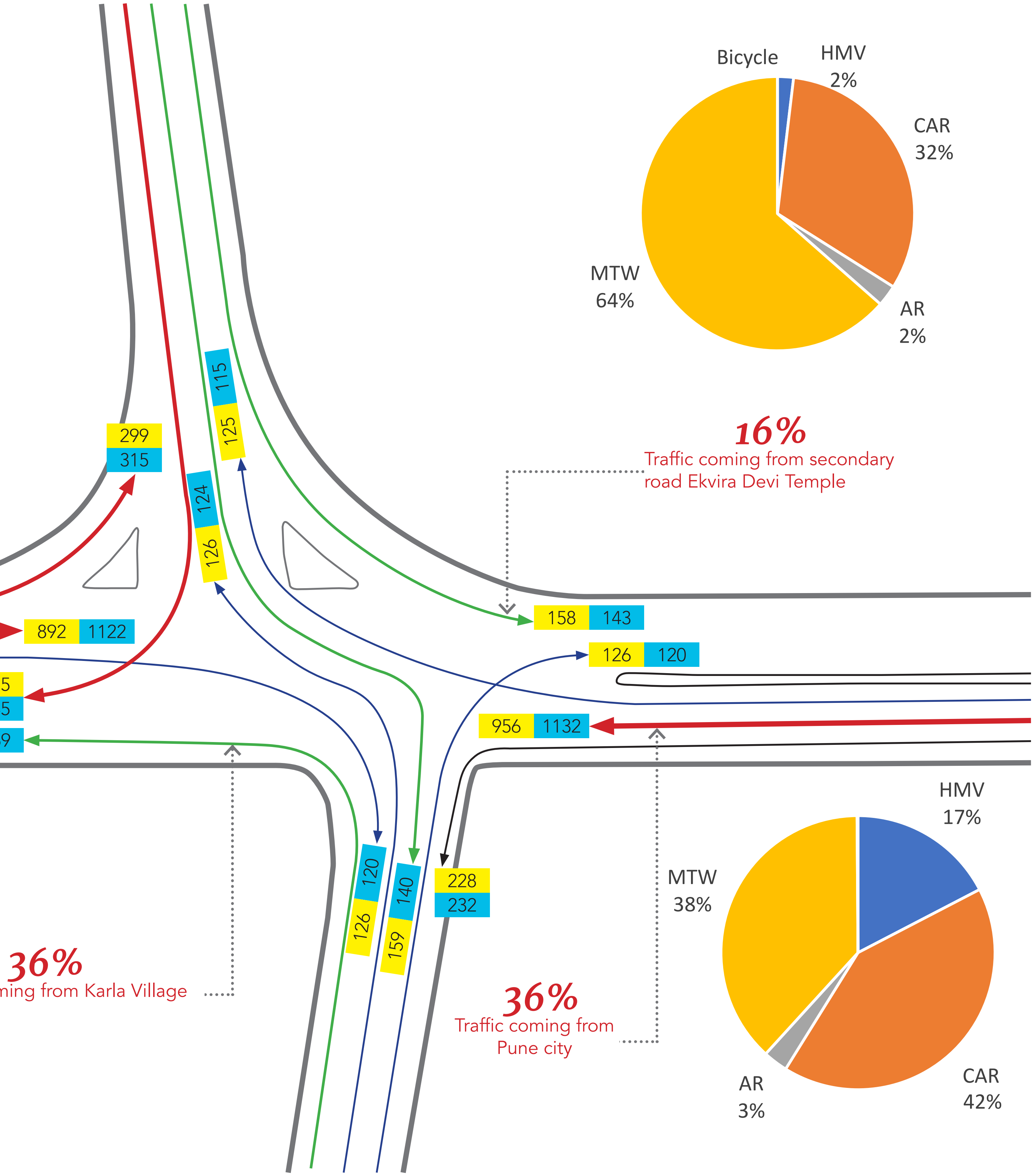
Considering the connectivity that the roads meeting the NH 48 provide to the commercial and religious developments in the vicinity and the Karla Village, Two-Wheelers have the highest mode-share of over 60%. Majority of the traffic originating from the roads meeting NH 48 merges with the traffic and heads towards Pune or Lonavala. With the new developments at the North of the junction there is North-South movement of vehicles, to and from the Karla Village to the North road.

Approximately 15% of the turning volume towards Karla Village from NH 48 comprises heavy vehicles. At the moment, the turning radius is very large which allows them to travel at higher speeds at the turns. Addressing this is important to enhance the safety of pedestrians and vehicles at the intersection.



Legend
Volume Counts
PCUs

Fig 2.10: This diagram depicts different directions for the flow of



traffic along with their volume and PCU counts

2. Pedestrian Movement

Average traffic volume

Time : 01:00 PM - 02:00 PM, 06:00 PM - 07:00 PM

(Observed Peak Hour Trend)

Observation

From the analysis and video survey it was found that because of the Karla Village and the places of religious significance in the vicinity, there are more number of pedestrians. It was also observed that due to the lack of pedestrian crossings and broken footpaths, people walk in whichever direction they choose to, making it riskier at the junction, as the junction witnesses heavy, high-speed traffic.

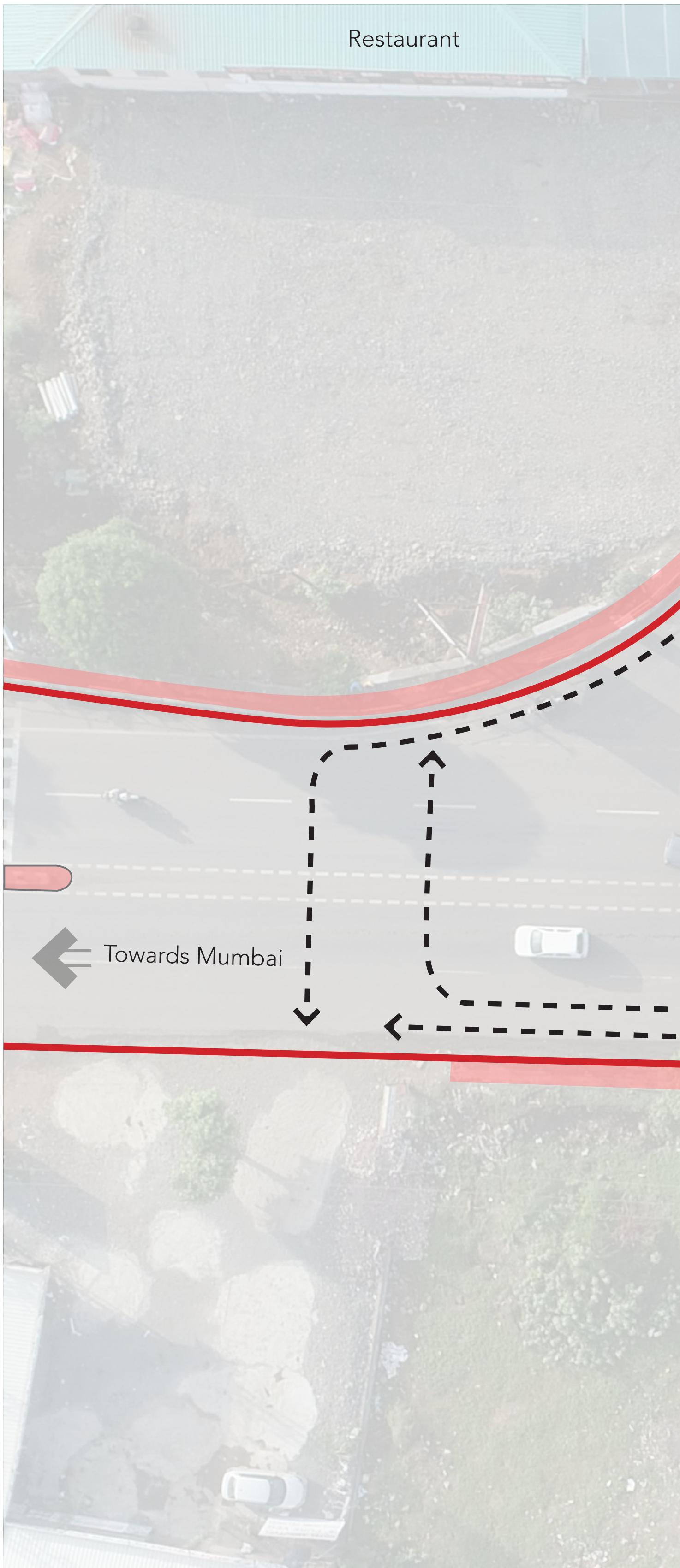
At the junction, most pedestrians travel from the Karla Village to the roadside stalls or wait for the public transport on the road.

At the moment a higher turning radius, unavailability of designated waiting space and broken footpath, together make it riskier for pedestrian. Addressing this is important to enhance the safety of pedestrians and vehicles at the intersection.

DATE	TIME	TOTAL PEDESTRIAN COUNT
25.12.2020	13:00 - 14:00	111
26.12.2020	13:00 - 14:00	137
26.12.2020	13:00 - 14:00	228

DATE	TIME	TOTAL PEDESTRIAN COUNT
25.12.2020	18:00 - 17:00	268
26.12.2020	18:00 - 17:00	208
26.12.2020	18:00 - 17:00	250

Table 2.2: Table showing total pedestrian count for peak hours of the 3 survey days



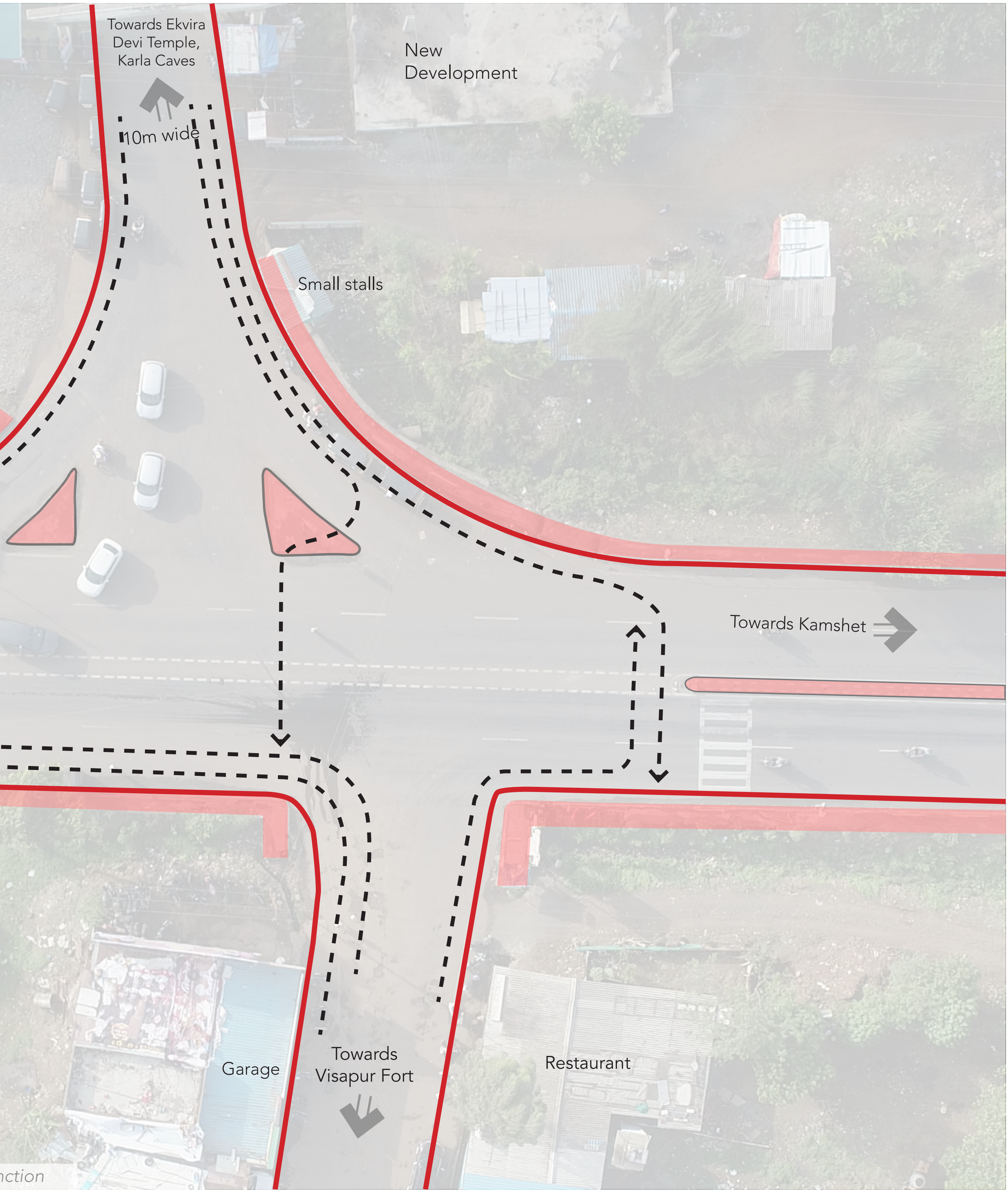
Legend

Existing footpath/median

Existing road geometry

Pedestrian movement

Fig 2.11: This diagram depicts pedestrian movement at the jur



Towards Ekvira Devi Temple, Karla Caves
10m wide
New Development
Small stalls
Towards Kamshet
Garage
Towards Visapur Fort
Restaurant
nction

3. Behavioural Analysis Diagram

Observation

From the analysis of the behavioural patterns it was observed that a land abutting restaurant is being used as a parking space and auto stand, on the road which travels towards the Ekvira Devi Temple.

It has been observed that no dedicated spaces are provided for IPT stops and buses. Pedestrians wait on the road for public transport and autos and buses too stop accordingly.

Hence, people and pedestrians are exposed to the road as they don't use the footpath and walk on the road, as per requirement.

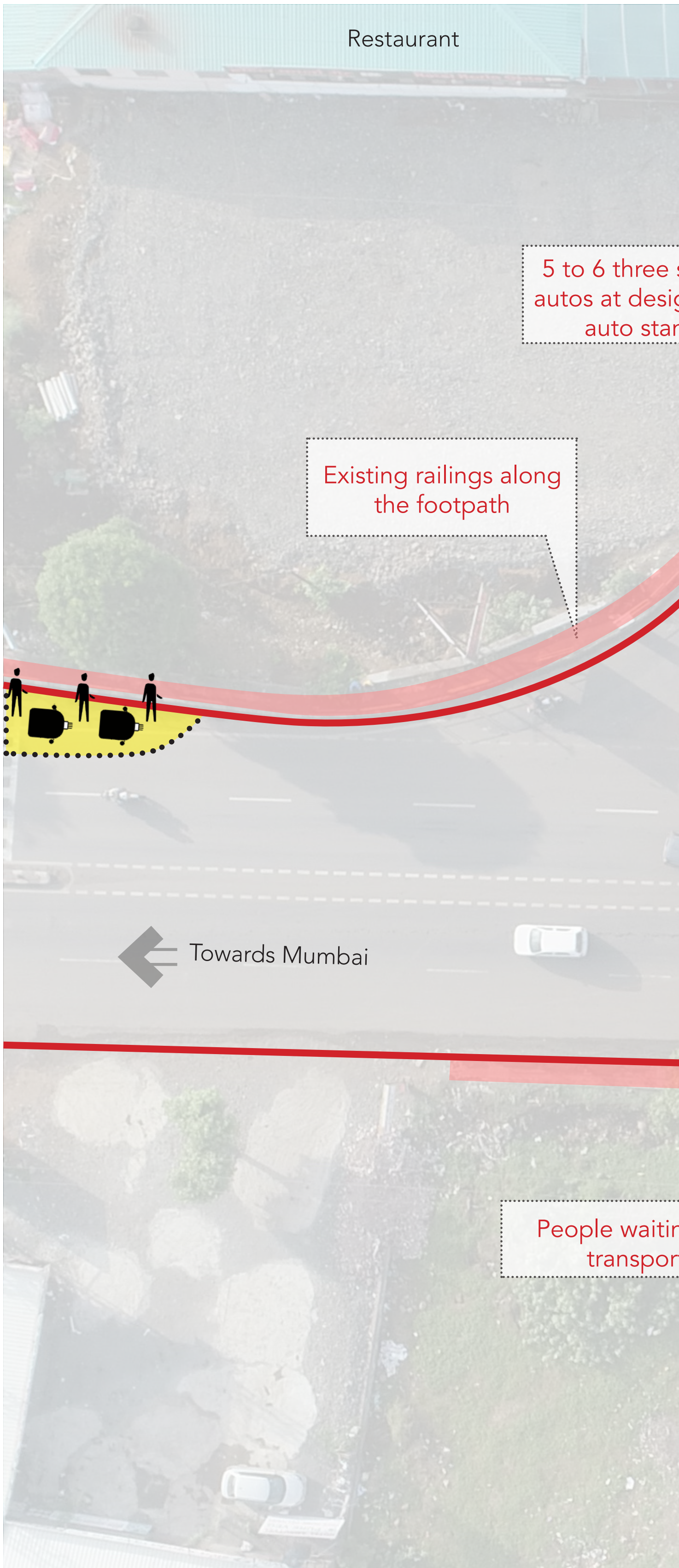


Fig 2.12: This diagram depicts the behavioural pattern at the j

Legend

- Existing footpath/median
- Illegal parking
- Existing road geometry


Towards Ekvira Devi temple, Karla caves
New Development
10m wide
seater
gnated
nd
Small stalls
2 to 3 six seater autos waiting for passengers
Towards Kamshet
ng for
t
Garage
Towards Visapur Fort
Restaurant
unction

4. Crossing Vehicular Conflicts

Observation

From the analysis and video survey it has been observed that vehicular movement happens in 12 directions and there are a total 16 vehicular conflict points.

It has also been observed that vehicles on NH 48 run at 45 km/hr while crossing the junction. Due to the unavailability of the waiting car space, vehicles are exposed to conflicts. Also, pedestrians crossing in the North-South direction are exposed to fast moving vehicles at the junction.

Addressing this is important to enhance the safety of both pedestrians and vehicles at the intersection.

1488 Vehicles (PCU)
move from Mumbai towards the junction

1510 Vehicles (PCU)
move from Kamshet towards the junction

437 Vehicles (PCU)
move from Karla Village road towards the junction

515 Vehicles (PCU)
move from Ekvira Devi Road towards the junction

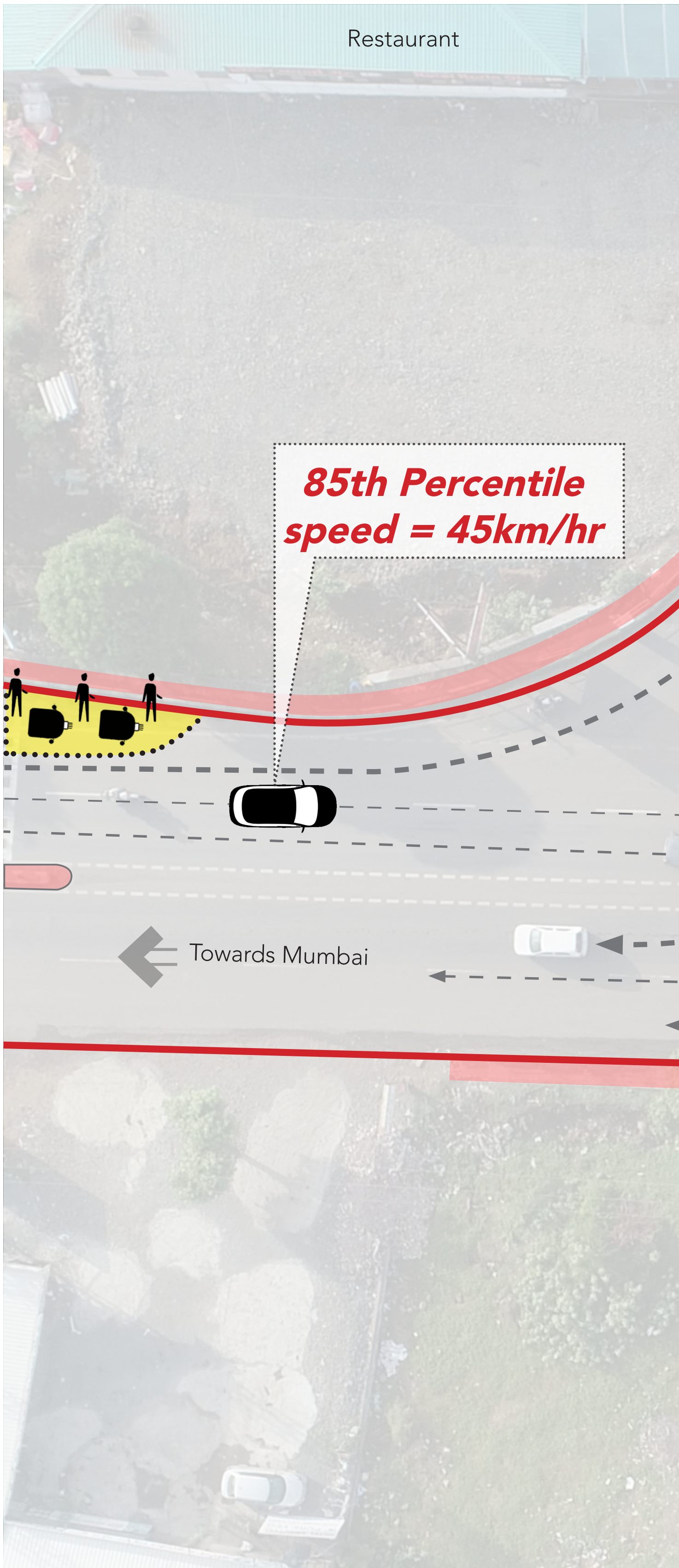
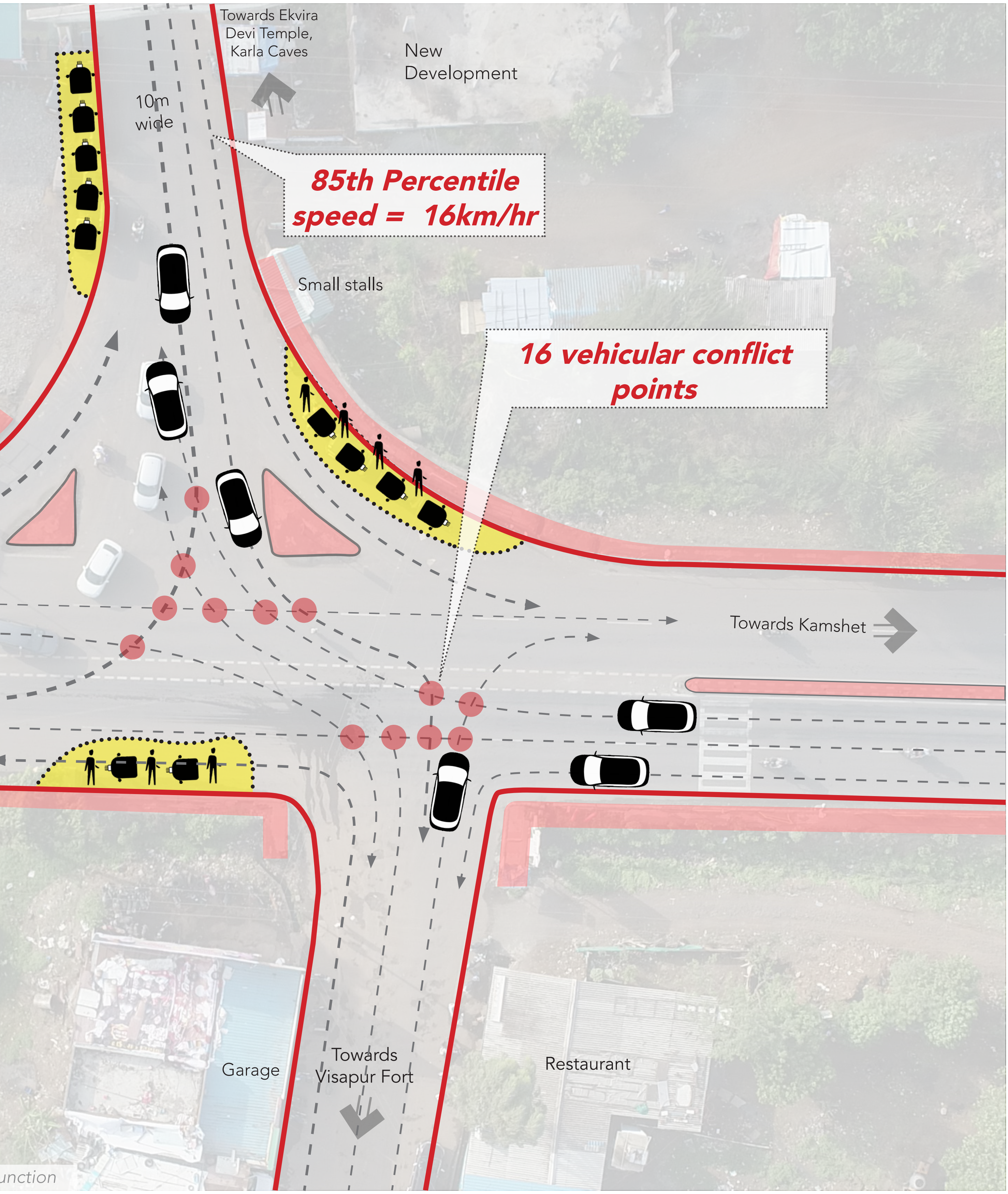


Fig 2.13: This diagram depicts vehicular conflict points at the j

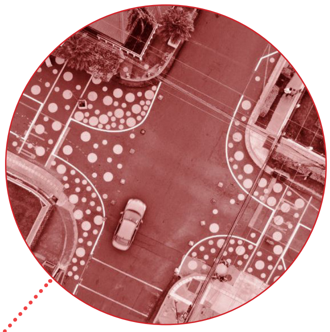

Towards Ekvira Devi Temple, Karla Caves
New Development
10m wide
85th Percentile speed = 16km/hr
Small stalls
16 vehicular conflict points
Towards Kamshet
Garage
Towards Visapur Fort
Restaurant
unction

03 | Concept Design

On the basis of the analysis of the data collated, a concept design is created which helps in moving ahead with the Tactical Urbanism trial. To study a similar context, corresponding data should be collected and investigated in the manner detailed herein.

This chapter details the various strategies developed to deal with the existing issues at the site under consideration, the Karla Phata intersection, and to make it safer. The strategies mainly involve the reduction of speed at NH 48, provision of a safer space for public transport, creation of safer road geometry, safer public realms, and pedestrian crossings, and the enhancement of night visibility. These strategies are further explored in this chapter, elaborating every single aspect of them in detail.

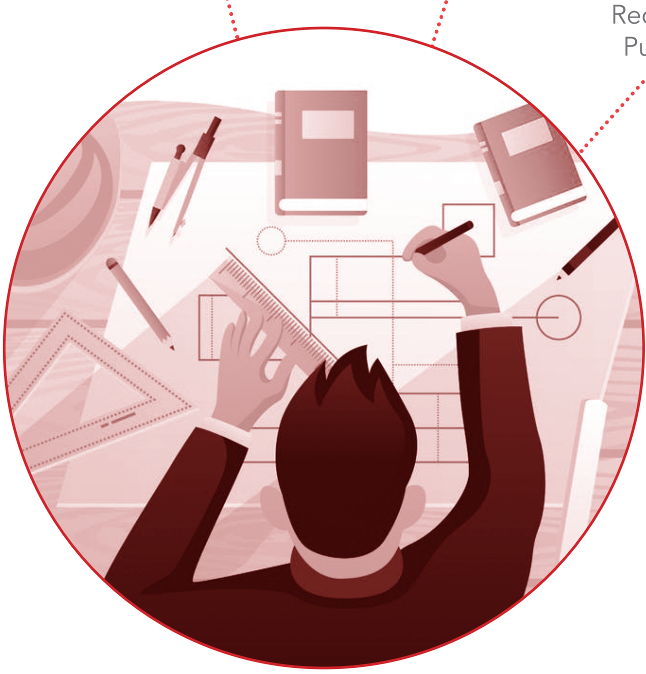
A. Our Approach: Design Principles

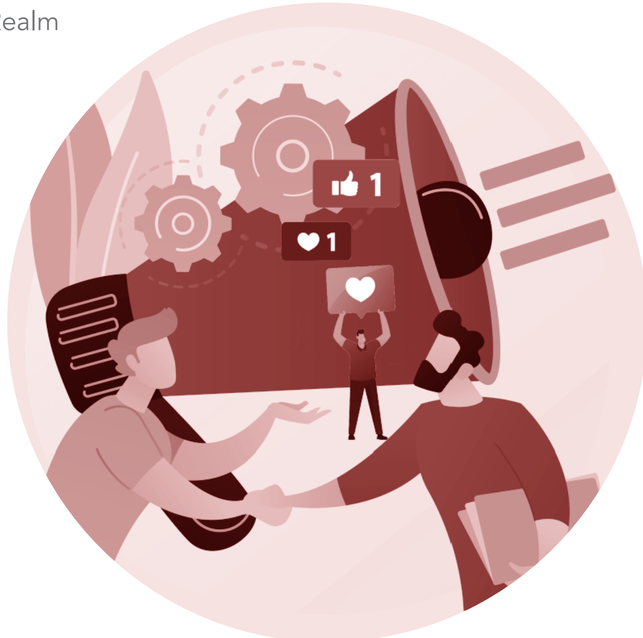


Safer Pedestrian Circulation

Reduced Vehicle-to-Vehicle conflict

Reclamation of Public Realm





Engineering

By analysing ground data through observation during site visits and digital documentation, the design is engineered by re-imagining road geometry, reclamation of pedestrian realm and other tactical strategies such as the usage of signages to reduce the number of pedestrian-vehicle conflict points and vehicle-vehicle conflict points, making the junction safer for pedestrians and motorists alike.

Education

By applying a tactical and temporary method to first test out the engineered design for ease and safety of pedestrian and vehicular circulation, the design shall act as a medium to spread awareness about road safety.

By involving stakeholders in the process, the design encourages participatory planning and helps set up feedback loops for implementation of the intervention.

Enforcement and Advocacy

Data regarding existing condition at the junction and post implementation stage of the intervention is generated and compiled. This helps the authorities involved to come up with a robust enforcement plan.

Data and impact of the intervention is also used to propose policy changes in two broad areas: Crash Prevention and Post-Crash Response.

Emergency Responsiveness

The Tactical Urbanism design also helps test reduction in conflict points between vehicles and pedestrians, thereby helping the emergency response team to chart out plans accordingly.

The design should also ensure adequate space for parking emergency vehicles in case there services are needed at the junction.

B. Key Interventions at Karla Phata

Fig 3.1: Image indicating the high traffic volume and high speeds at the intersection

Fig 3.2: Image showing pedestrians crossing the road in an unsafe manner

1. Reduce speed on NH 48

A survey was conducted for 3 days on the NH 48 in both the directions in order to determine the average speed at the Karla Phata Junction. This survey found that majority of the moving traffic broke the speed limit, therefore making the junction unsafe.

The interventions included vertical signages and speed limit markers to alert the drivers of the upcoming intersection almost 50 m before it, so that they may begin reducing their speed.

2. Create safer public realm and pedestrian crossings

Due to raised splitter islands and unsafe road geometry, it was difficult for pedestrians to cross the multiple different lanes of the junction.

Interventions included an additional dedicated waiting area for the pedestrians, improvement of the carriageway and crossing as per user requirements.

The pedestrian crossings were marked with the help of synthetic enamel paint and helped reduce the exposed walking distance covered on the road by the pedestrian.

Fig 3.3: Image showing pedestrians waiting on the carriageway due to lack of shoulder space

3. Create safer road geometry

Due to the existing shoulder space not being appropriately demarcated and the footpath being broken, the pedestrians used the carriageway space.

All the roads along the intersection were corrected through changes in road geometry using bollards and barricades. Alongside the public realm on the respective shoulder spaces was widened and the existing traffic triangle was redefined.

Fig 3.4: Image showing IPT and buses stopping on the carriageway for pick up and drop-off

4. Provide space for public transport

It was observed that there were no dedicated bus-stops. Hence, the buses stopped according to the people standing near the junction. This led to the carriageway being used as a stopping space by bus users.

A new bus-stop was proposed considering the location and available space at the junction.

1. Challenge A

Reduce Speed on NH 48

85th Percentile Speed chart on NH 48

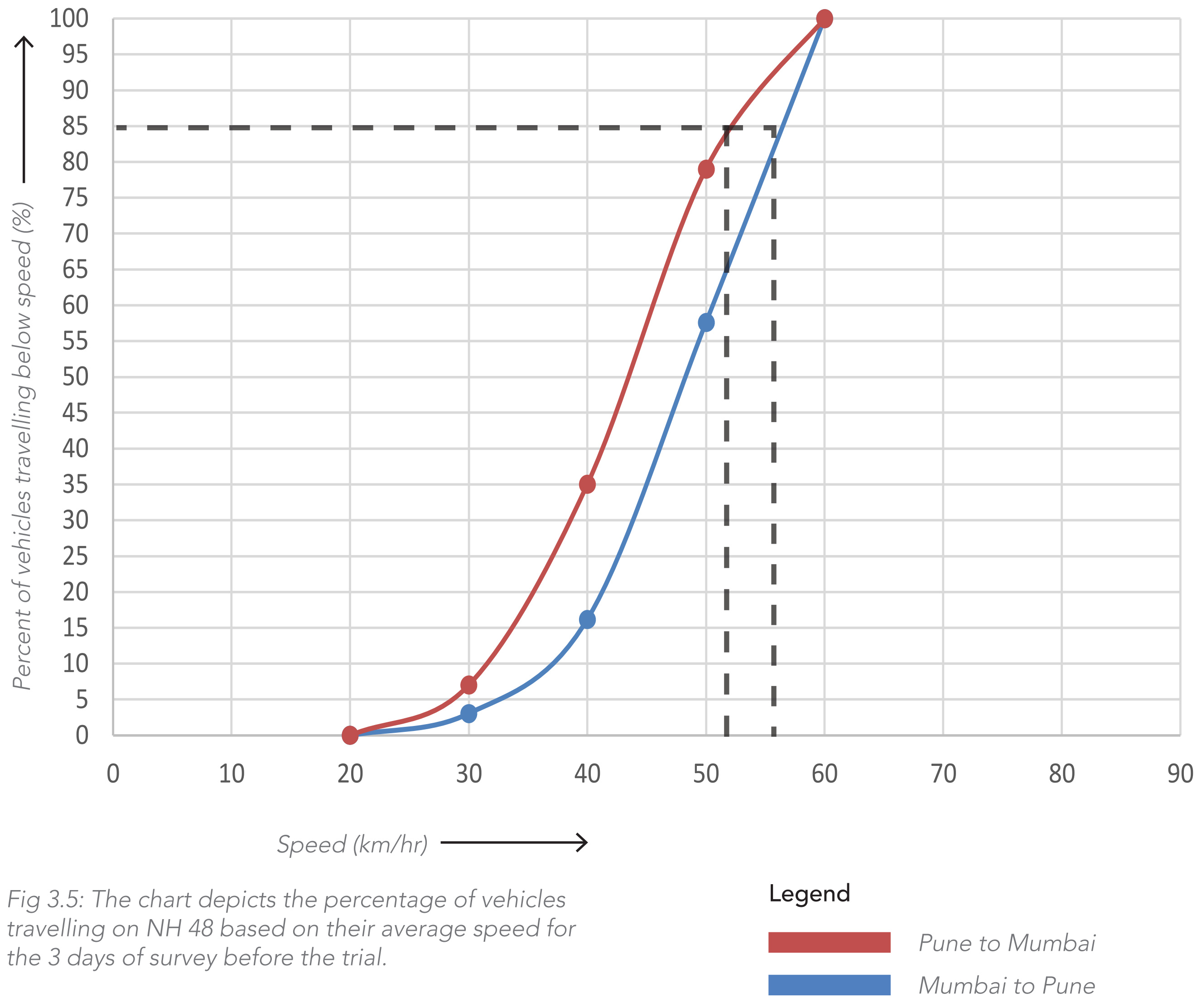


Fig 3.5: The chart depicts the percentage of vehicles travelling on NH 48 based on their average speed for the 3 days of survey before the trial.

Pune to Mumbai : 52 km/hr

Mumbai to Pune : 56 km/hr

85th Percentile Speed chart towards Ekvira Devi road

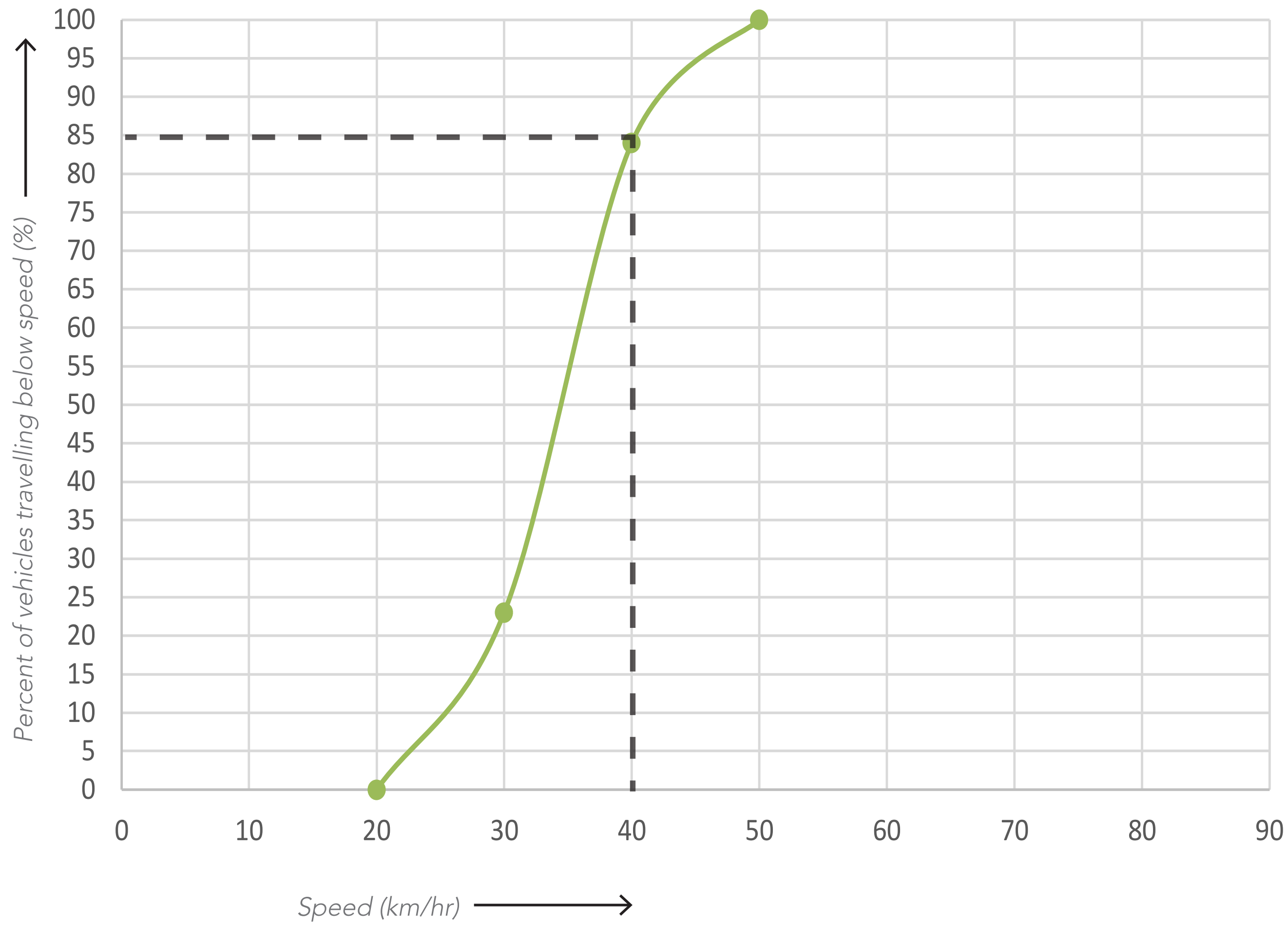


Fig 3.6: The chart depicts the percentage of vehicles travelling towards Ekvira Devi road based on their average speed for the 3 days of survey before the trial.

Legend

Mumbai to Ekvira Devi road

Mumbai to Ekvira Devi : 40 km/hr

The recommended speed on NH 48 is 50 km/hr.

As per the survey conducted for 3 day, 85 percent speed of vehicles on NH 48 towards Pune and towards Mumbai were observed to be 52 and 56 km/hr, respectively. Whereas the speed of vehicles towards Ekvira Devi road was observed to be 40km/hr.

As the intersection is more urban in nature, speeds of vehicles are very high on NH 48 as well as on the connecting internal roads.

Solution

1. Vertical Signage

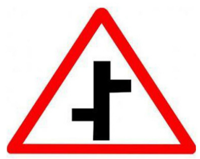


Fig 3.7: Staggered Intersection Ahead Signage

Located 45-50 m before the intersection

Fig 3.8: Pedestrian Crossing Signage

Located 10-20 m before the pedestrian crossing

Fig 3.9: Narrow road ahead

Located 45-50 m before the narrowing of the road starts

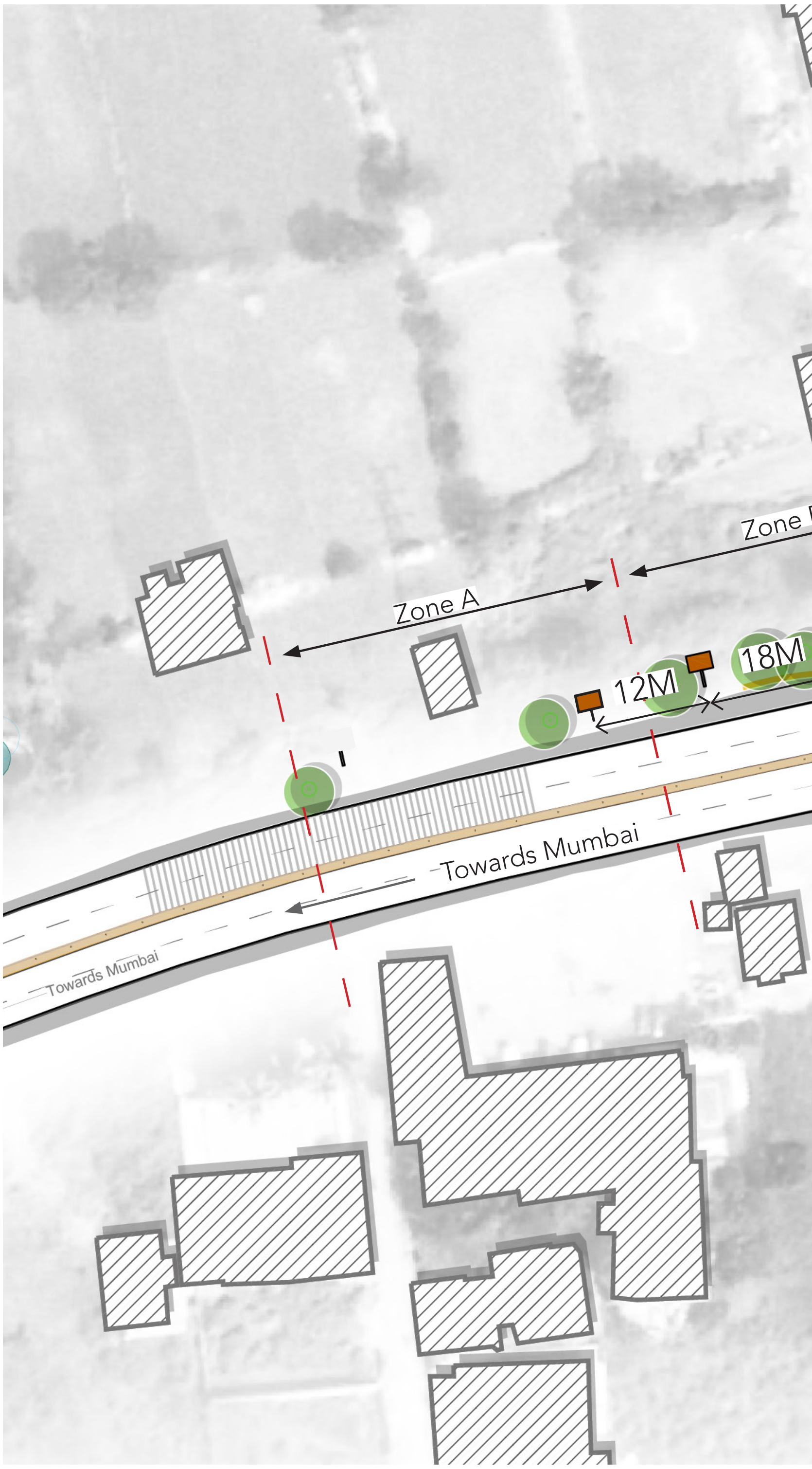


Fig 3.10: Plan depicting proposed location of vertical signage

Source: From IRC:67-2001

Proposed Condition

Solution

2. Horizontal Signage

Fig 3.11: Speed limit markers painted on road

Source: USDOT - Federal Highway Administration

Speed limits painted with the help of synthetic enamel paint to indicate the proposed speed limit starting at 100 m from the intersection.

Speed sign written on the road require the person driving to focus down and assimilate the information.

This catches the attention of the driver and leads to an average speed reduction of 6 to 15 kmph. Hence this method was proposed.

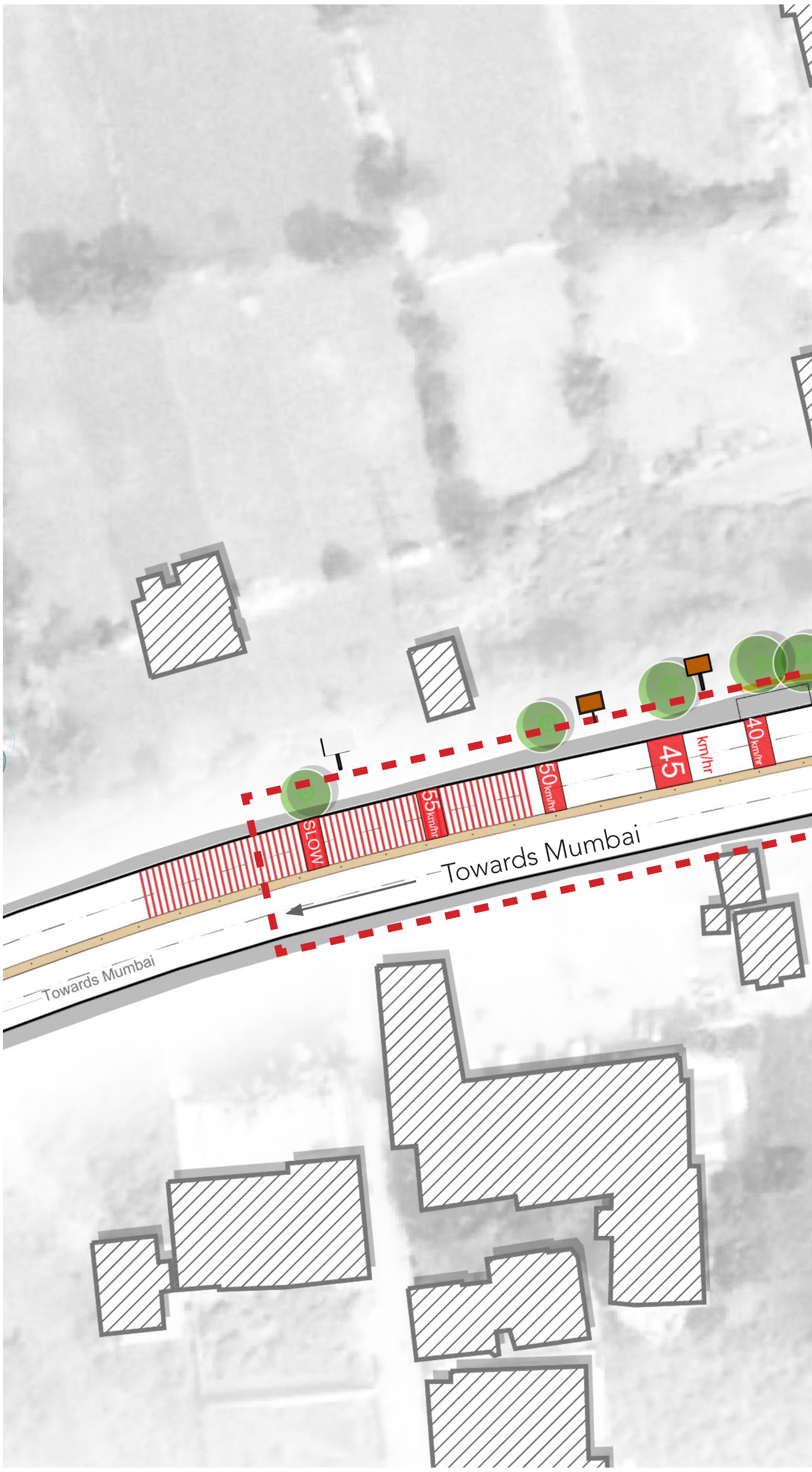
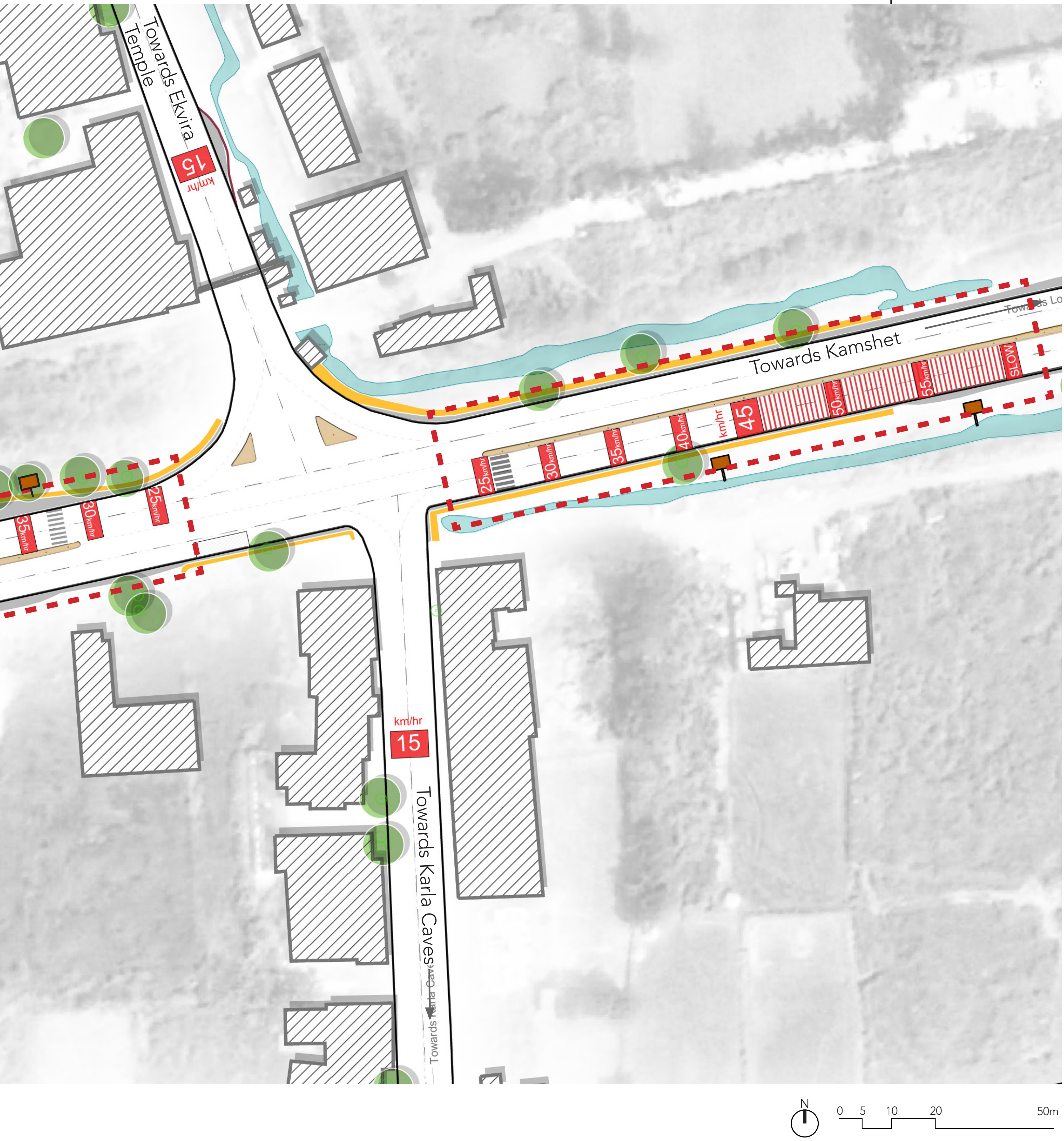


Fig 3.12: Plan depicting proposed location of horizontal signages

Proposed Speed limit

25 km/hr

Proposed Condition

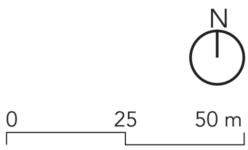


2. Challenge B

Providing space for public transport

Existing location used by public transport

Fig 3.13: Plan depicting existing locations used by public transport



Observation

There was neither a dedicated bus stop for the Kamshet to Mumbai approach, nor for the Mumbai to Kamshet approach.

Buses and auto rickshaws wait according to the people standing and nearer to the junction.

Legend

Preferred location

The bus and auto rickshaws utilised the carriageway for pick up and drop-off activities.

This led to passengers waiting on the carriageway due to lack of sufficient shoulder space.

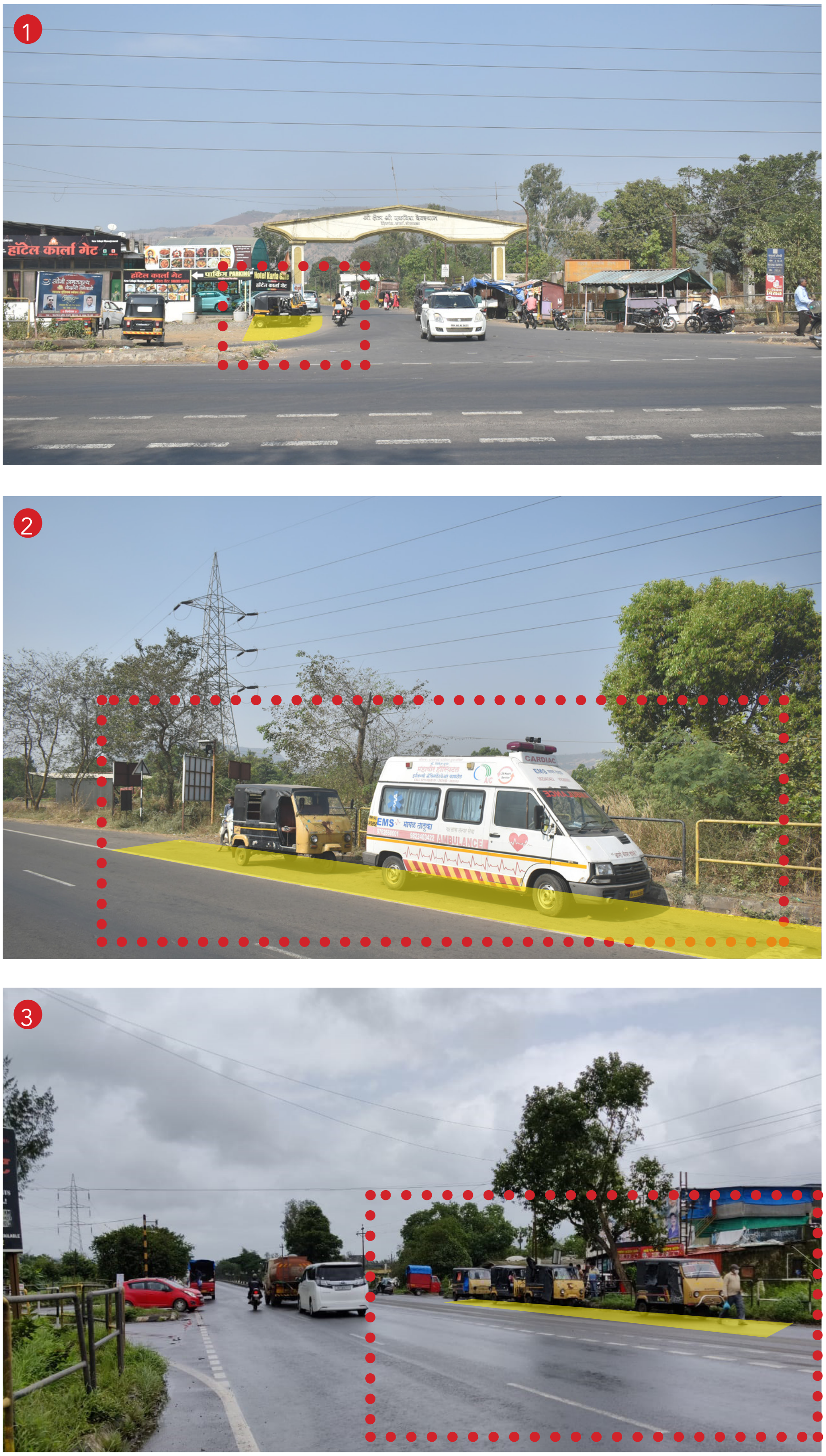


Fig 3.14: Series of images showing auto rickshaws and pedestrians utilising the carriage way for pick up and drop-off activities

Mode Share Percentage

Average Mode share percentage of the three day survey conducted - 25th, 26th, 27th December, 2020

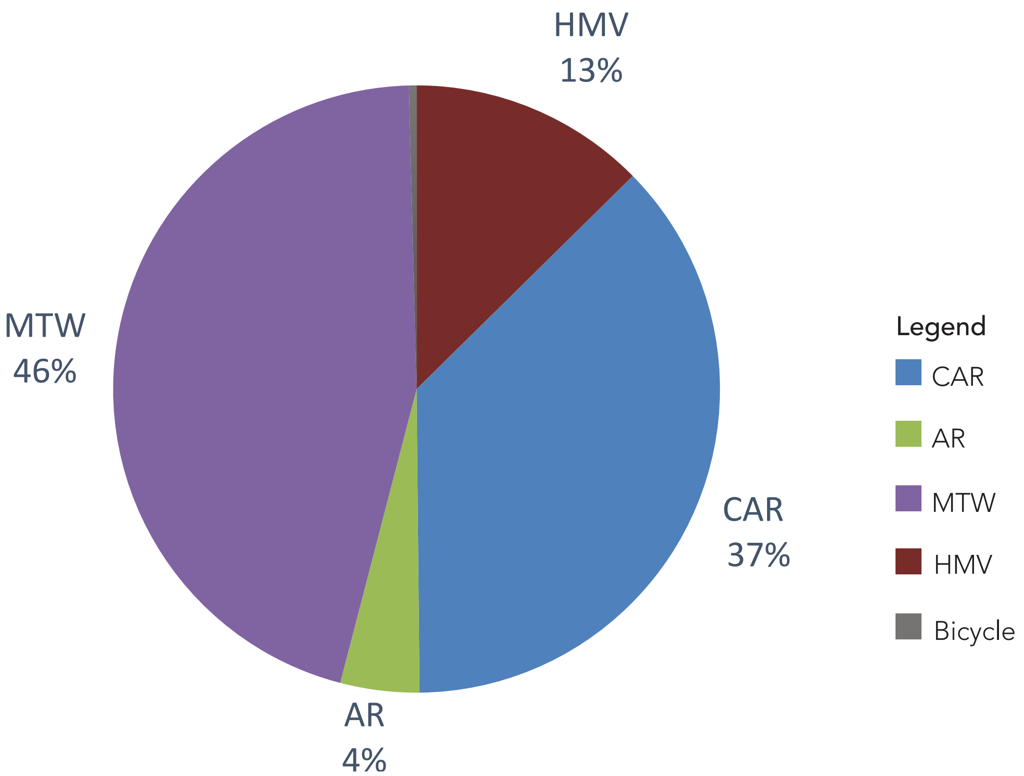


Fig 3.15: The pie chart indicates average mode share percentage on NH 48 during the 3 days of survey.

Auto rickshaw

Counts	***1768/day***
PCU	***2122/ day***

Bus

Counts	***238/day***
PCU	***714/ day***

Observation

The mode share percentage of the buses were observed to be low, however, the daily count was 238 buses, whereas the mode share percentage of the auto rickshaws were observed to be high. The count was 1,768 auto rickshaws on an average day.

There was no bus stop and auto stand near or around the junction.

At present, the buses and auto rickshaws stop on the carriageway for pick up and drop-off of passengers. A dedicated bus stop and IPT will provide passengers with proper waiting space and also move the buses off the highway into a dedicated bus lane.

Design Intent

Bus Bay Marking

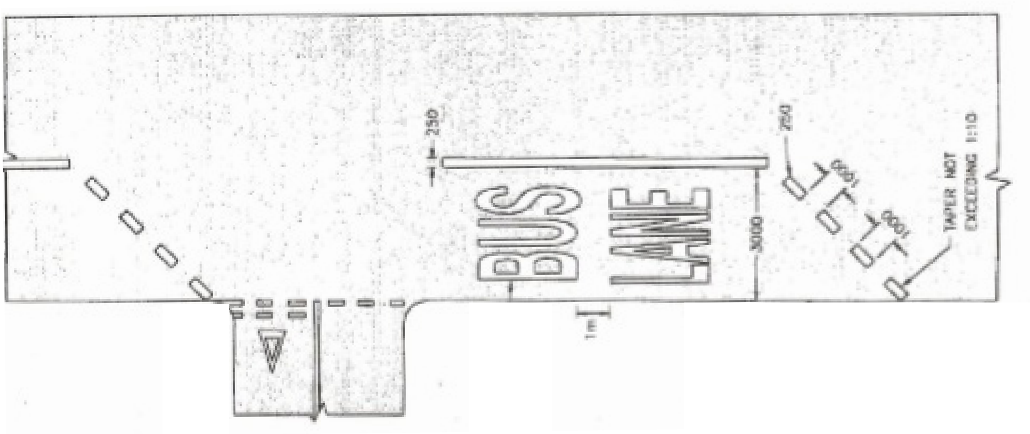


Fig 3.16: Reference image of Bus Bay marking as per IRC 35:-1997

At minor intersections, a gap of 60 m from the tangent point of the intersection to start/end of lay-by is desirable, particularly for a minor intersection (village road in this case).

Source: From IRC:80-1981

Reference Image

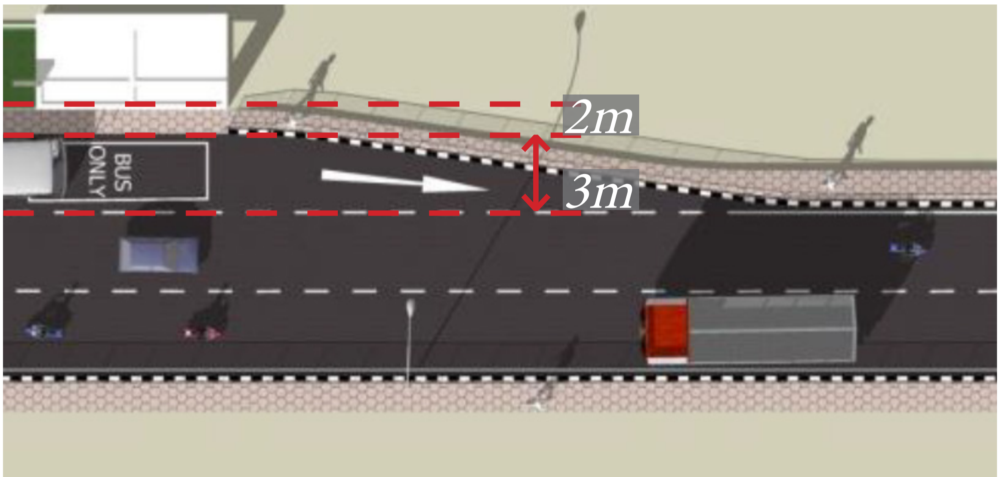


Fig 3.17: Reference image of Bus Bay marking as per Roads & Buildings Department, GoG

A dedicated bus stop was proposed in the shoulder space available after correcting the road geometry. This proposed bus stop is located off the highway and offers wide shoulder space to be used by the passengers to disembark or wait for the next bus. Sufficient length has been provided as per the turning radius for the bus to enter and exit this lane smoothly.

Solution

Proposing bus stop on NH 48

Two bus stops were proposed on NH 48 (one for each direction). Towards Mumbai, the proposed bus stop is 30 m away from the intersection and towards Kamshet, the bus stop is proposed 60 m away from the intersection. This is because there is sufficient shoulder space available to create a dedicated bus lane as per IRC standards. The bus stop towards Mumbai (highlighted in red) cannot be proposed as per IRC standards due to space constraint.

Advantages of the new bus stop location

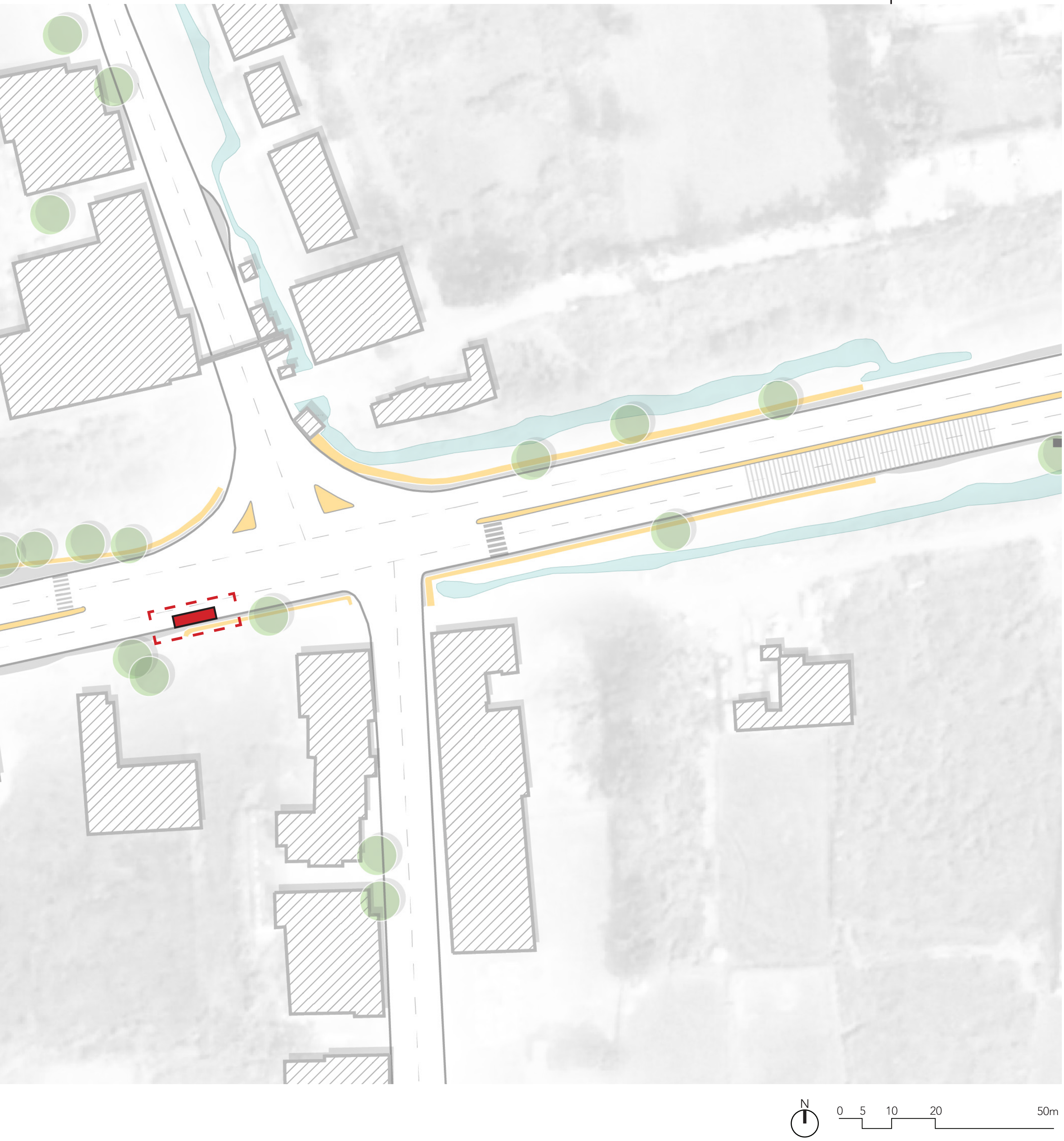
Utilising available shoulder space for bus bays.

Moving the buses off the highway in the dedicated bus lanes to avoid the moving traffic.

Providing dedicated waiting space for users.

Fig 3.18: Plan depicting proposed bus stops

Proposed Condition



3. Challenge C

Create safer road geometry

Existing traffic movement

Existing shoulder space along the edge of the road was not demarcated appropriately and the footpath was narrow and broken. Hence people ended up using the space on the carriageway.

Fig 3.19: Series of images showing pedestrians using the carriageway due to lack of shoulder space

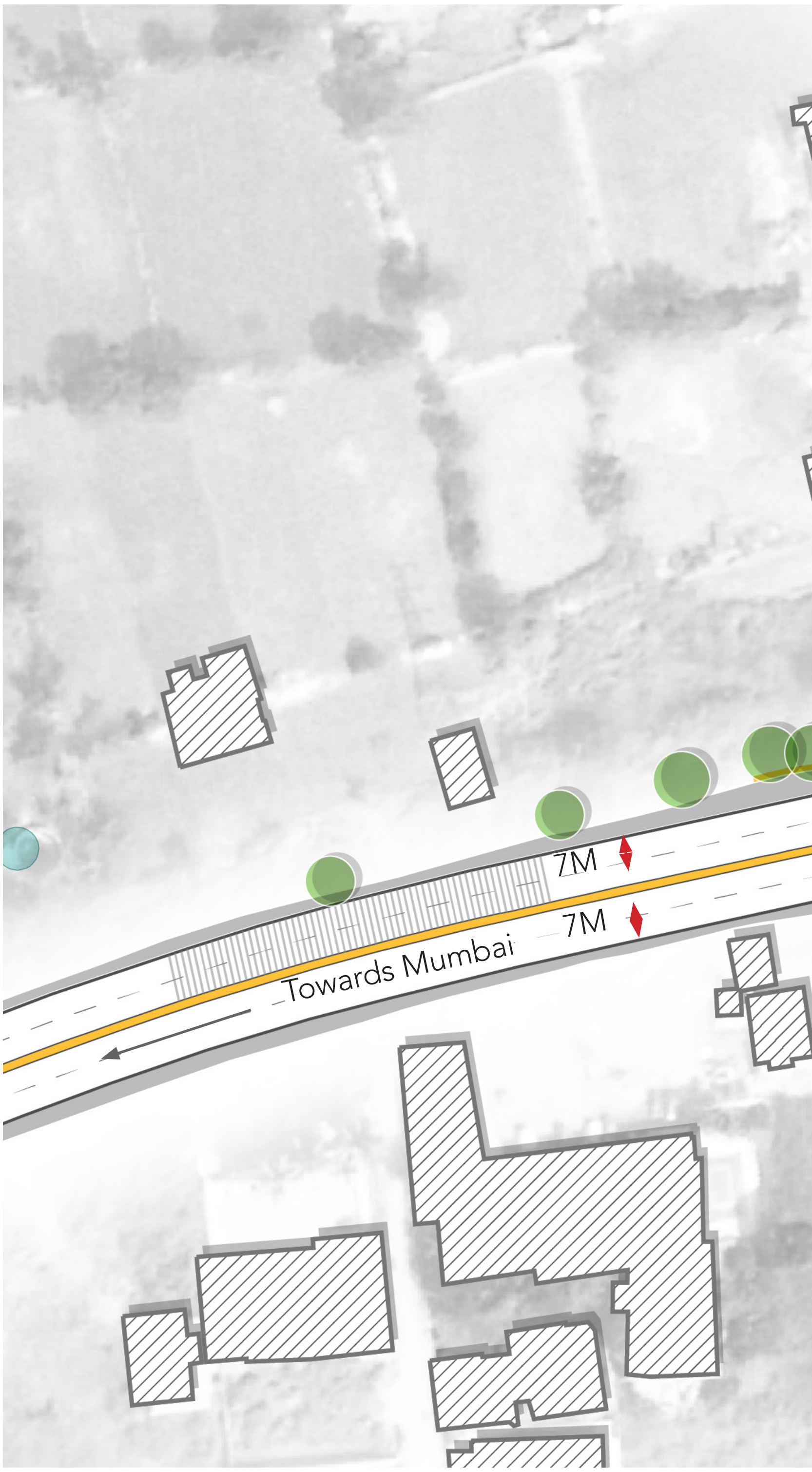


Fig 3.20: Plan depicting existing road profile


Towards Ekvira Temple
7M
Towards Kamshet
7M
7M
1
2
7M
Towards Karla Caves
N
0 5 10 20 50m

Solution

Correcting road geometry

Correcting the road geometry with the help of bollards and barricades will help define the carriageway and the shoulder space.

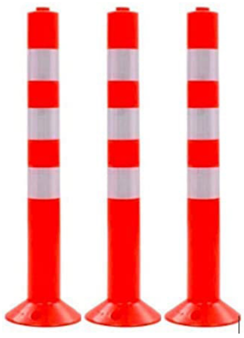


Fig 3.21: Bollards

Fig 3.22: Barricades

Detail A

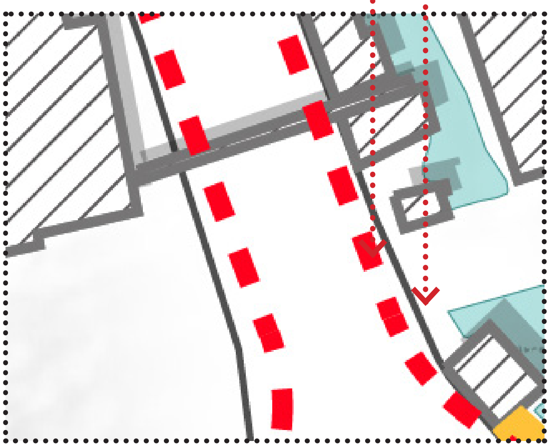
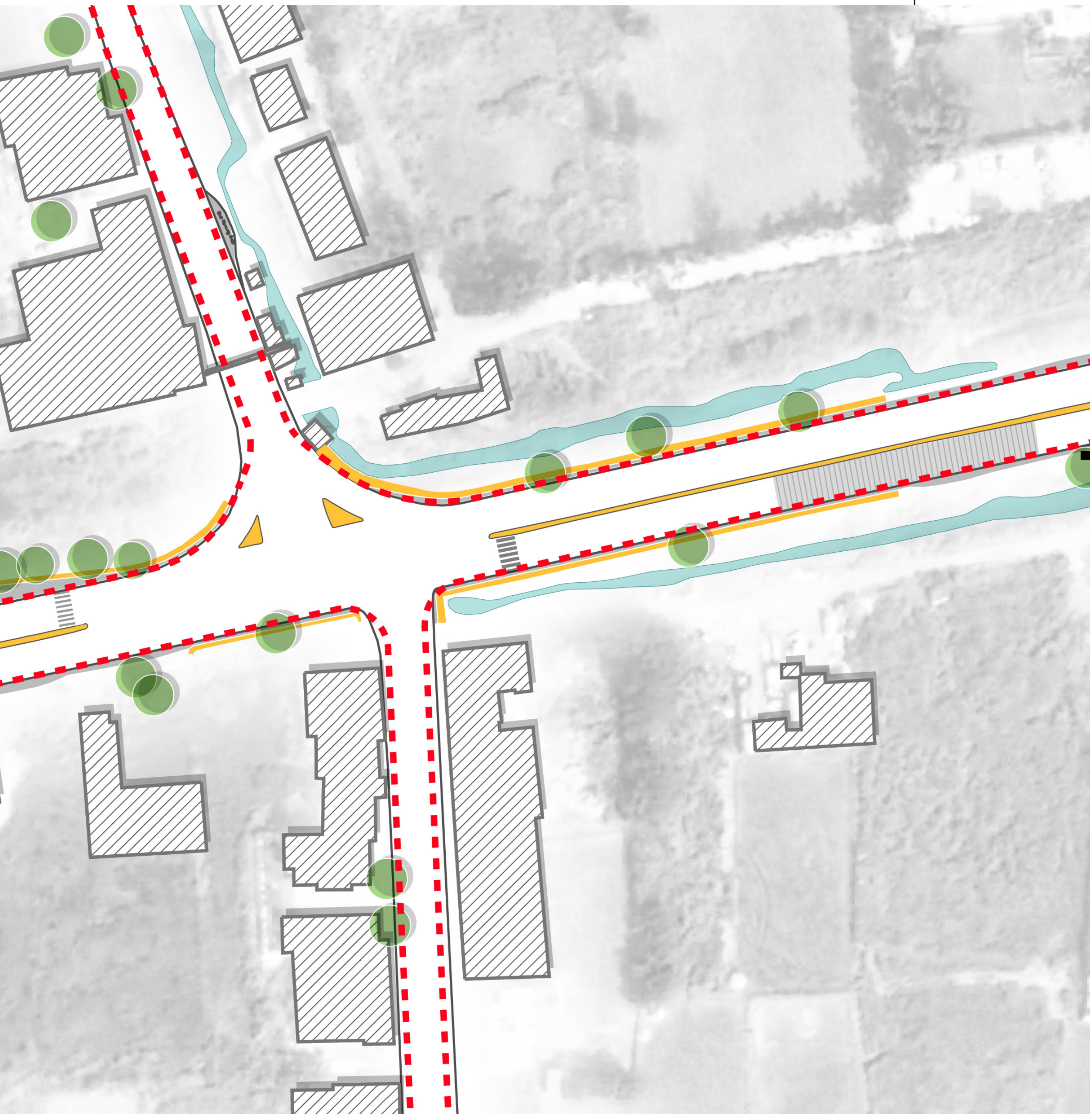
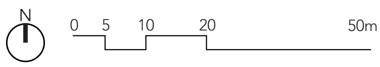


Fig 3.23: Detail showing comparison of road profile after road geometry correction

Fig 3.24: Plan depicting modified road profile after road geometry corr

Proposed Condition





4. Challenge D

Decreasing conflict points

Existing vehicular movement

Existing vehicular movement shows that there are a lot of conflict points between vehicles-to-vehicles and between pedestrians-to-vehicles.

Hence, a safer intersection design is required.

Fig 3.25: Series of images showing conflict points on the carriageway

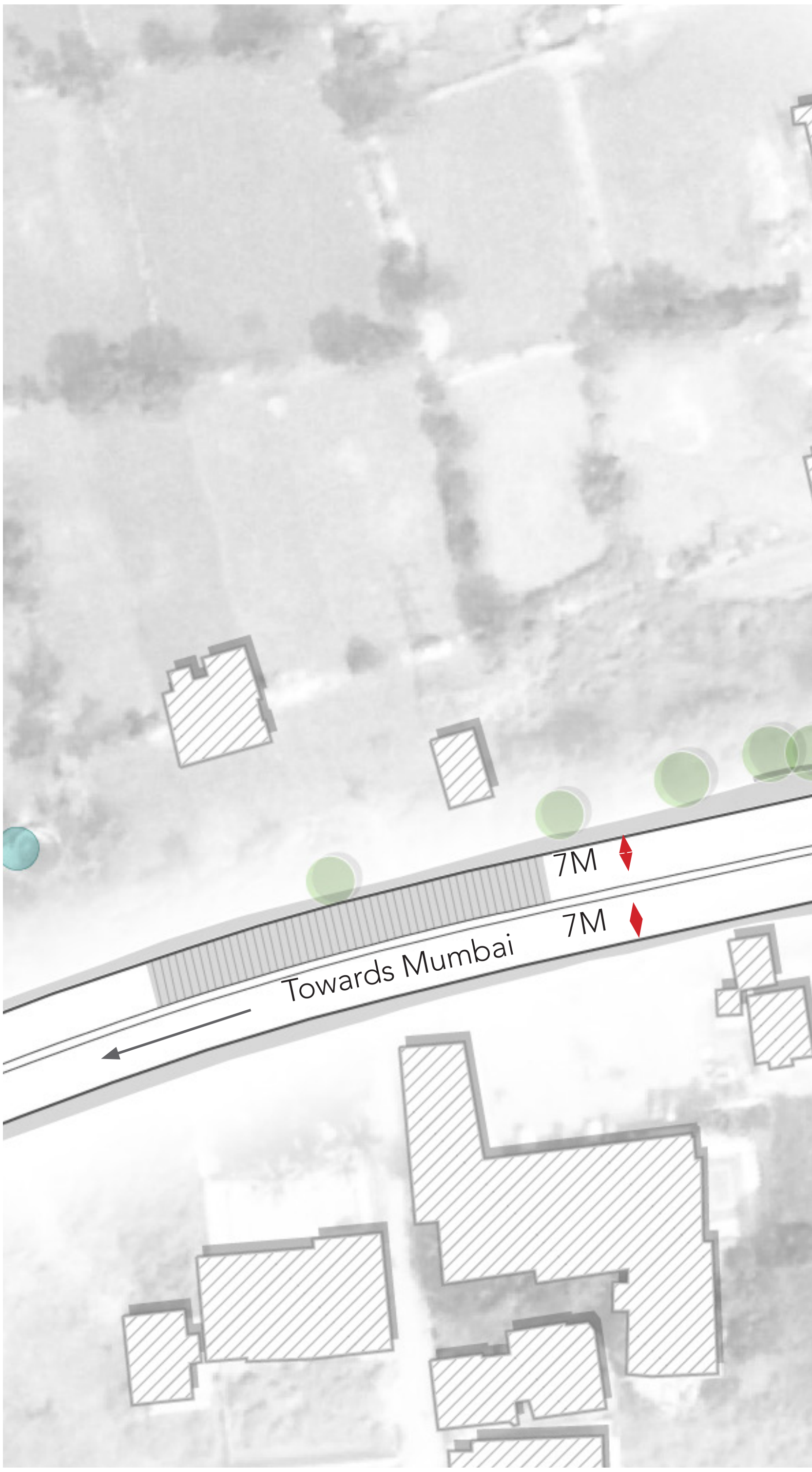


Fig 3.26: Plan depicting vehicular movements and their conflict points


Towards Ekvira Temple
7M
Towards Kamshet
7M
7M
1
2
7M
Towards Karla Caves
N
0 5 10 20 50m

Solution

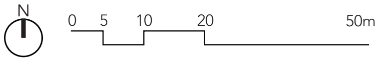
Retaining the existing islands

Keeping the existing traffic islands intact, the primary circulation was altered to avoid the major conflict zone (highlighted in red) that was identified from site and traffic survey.

Fig 3.27: Plan showing primary circulation being altered to avoid major conflict zone.

Fig 3.28: Plan depicting proposed circulation on NH 48

Proposed Condition



Proposed median and extending traffic island

The primary circulation was altered by modifying the shape of the existing median (highlighted in red).

To make the intervention safer for pedestrians, the existing traffic islands were increased in size. This also helped in geometry correction for vehicular circulation.

The extension of traffic islands also helped cut down the distance of the pedestrian crossing by acting as a refuge island. Hence, a safer network for pedestrians was created.

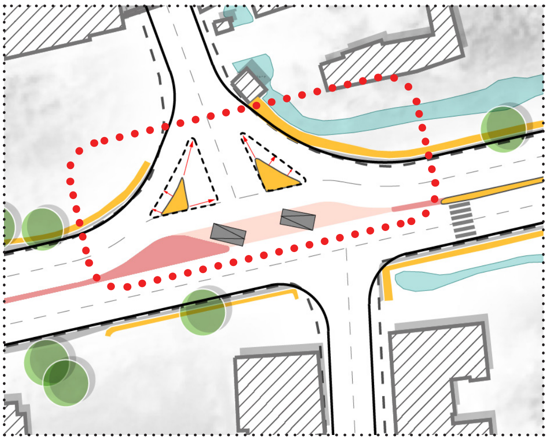


Fig 3.29: Plan showing extended median to avoid major conflict zone.

Fig 3.30: Plan depicting extension of median and increasing the size of

Proposed Condition

f traffic islands

Proposed circulation

By proposing new median (highlighted in red), the circulation of the primary road was altered. This helped in the speed reduction of the vehicles running on the primary road, and created a waiting zone of 112 sqm to make the crossing safer. This also educed vehicle-to-vehicle and vehicle-to-pedestrian conflicts.

Vehicles moving from primary to secondary road or vice versa could safely wait at the waiting area before crossing the intersection.

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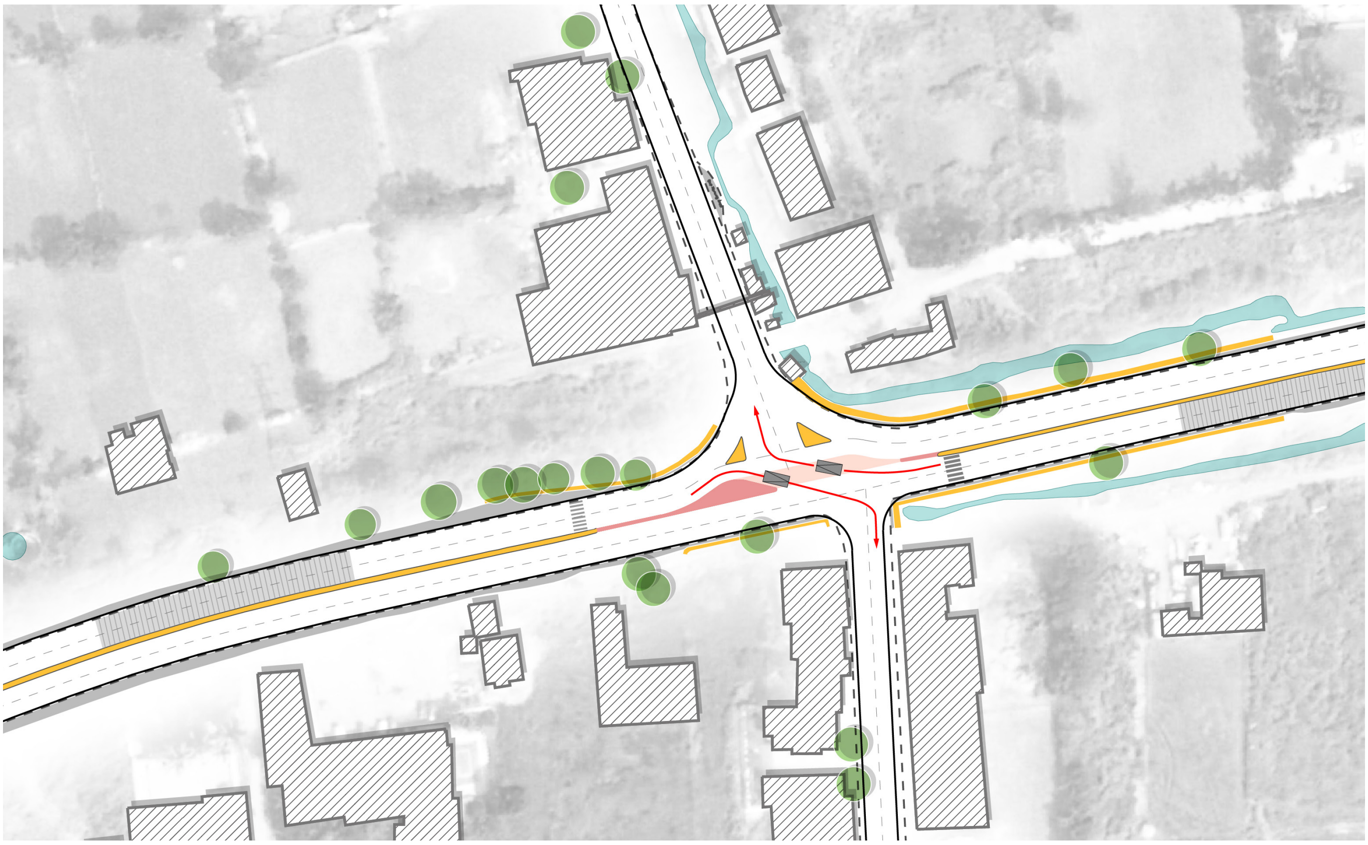


Fig 3.31: Plan depicting proposed circulation and waiting space at the intersection

Proposed Condition

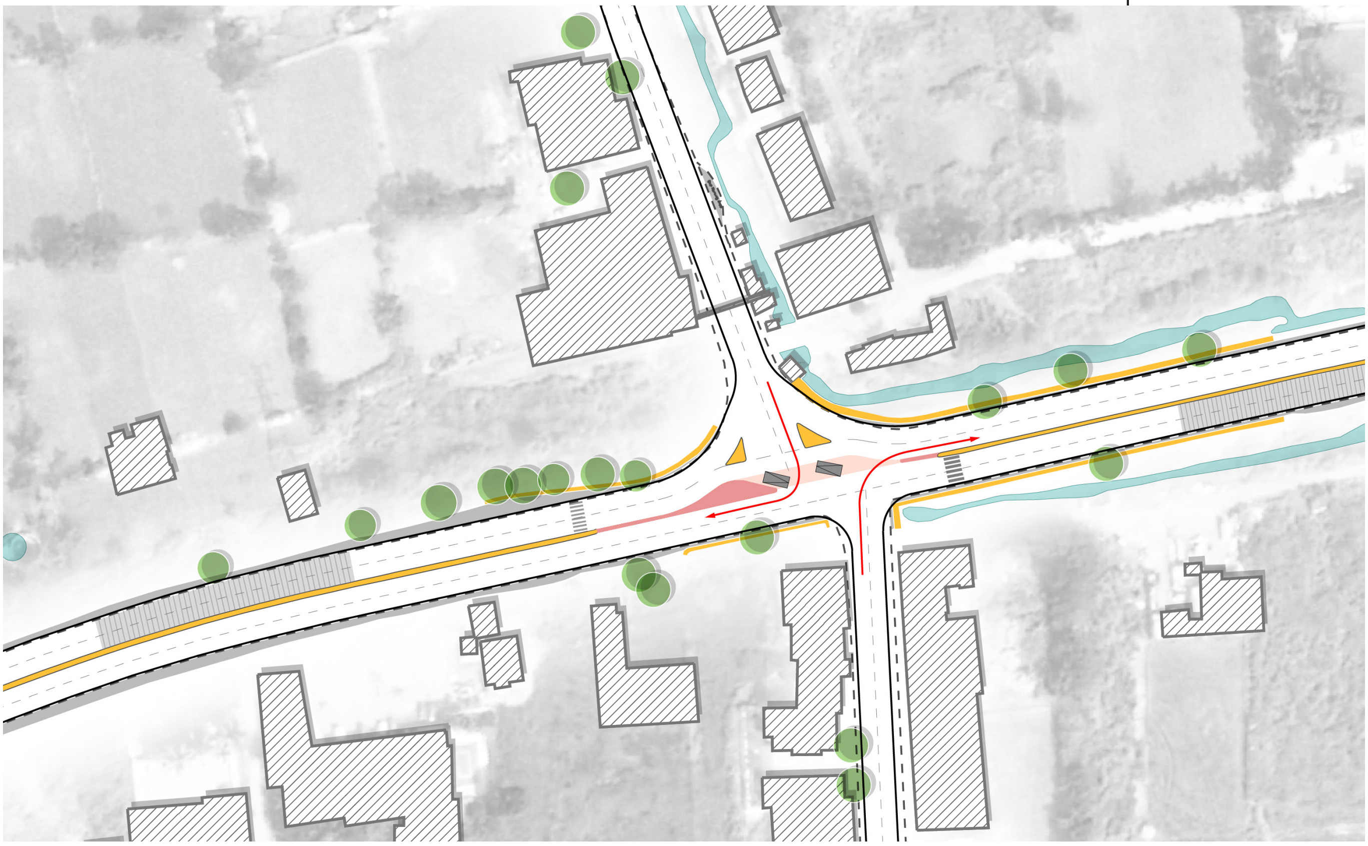


Fig 3.32: Plan depicting proposed circulation from the N-S direction

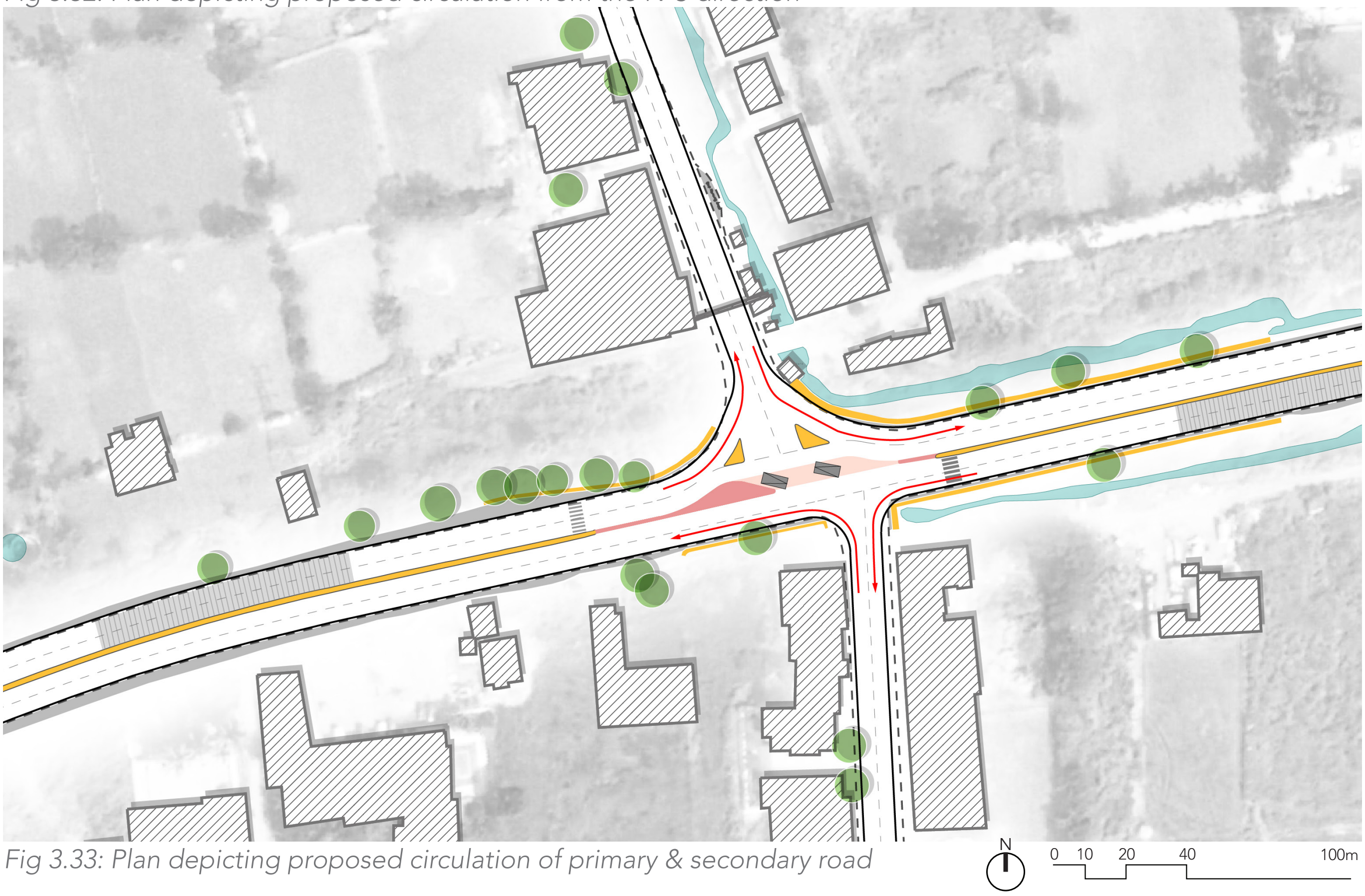


Fig 3.33: Plan depicting proposed circulation of primary & secondary road

5. Challenge E

Create safer pedestrian crossing

Existing pedestrian movement

Existing shoulder space along the edge of the road was not demarcated appropriately and the footpath is narrow and broken. Hence people ended up using the space on the carriageway. Also, there were no waiting spaces or crossings for people to use.

Fig 3.34: Series of images showing pedestrians using the carriageway to cross the road

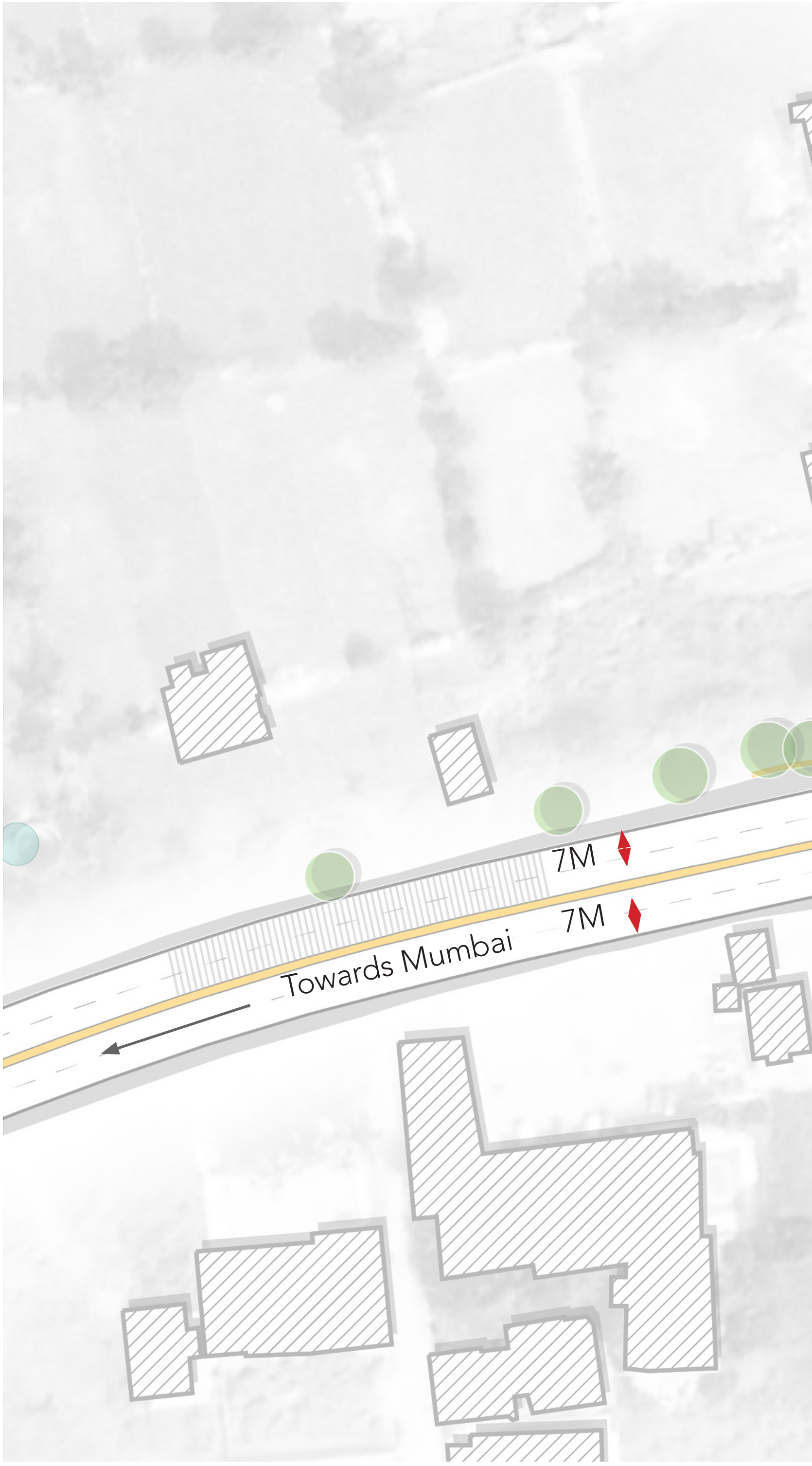
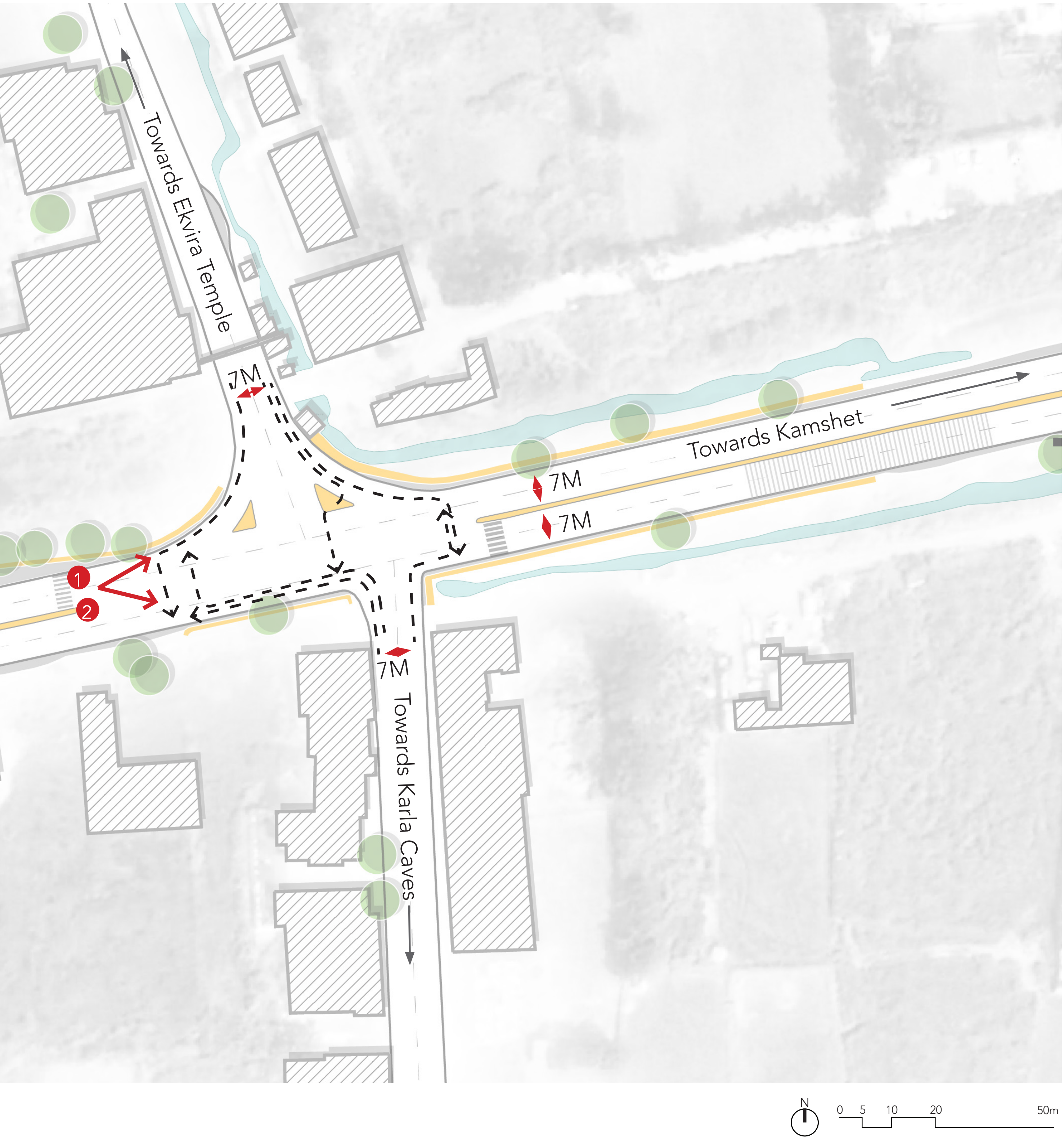


Fig 3.35: Plan depicting existing pedestrian movement


Towards Ekvira Temple
7M
Towards Kamshet
7M
7M
1
2
7M
Towards Karla Caves
N
0 5 10 20 50m

Solution

Creating new pedestrian crossing

The primary circulation was altered by modifying the shape of the existing median. To make the intervention safer for pedestrians, the existing traffic islands were increased in size.

The extension of traffic islands and the proposed median at the intersection cuts down the total distance of the pedestrian crossing by acting as a refuge island. Hence, creating a safer network for pedestrians.

Existing Public Realm **290 sqm.**

Proposed Public Realm **910 sqm.**

214%
Additional public realm

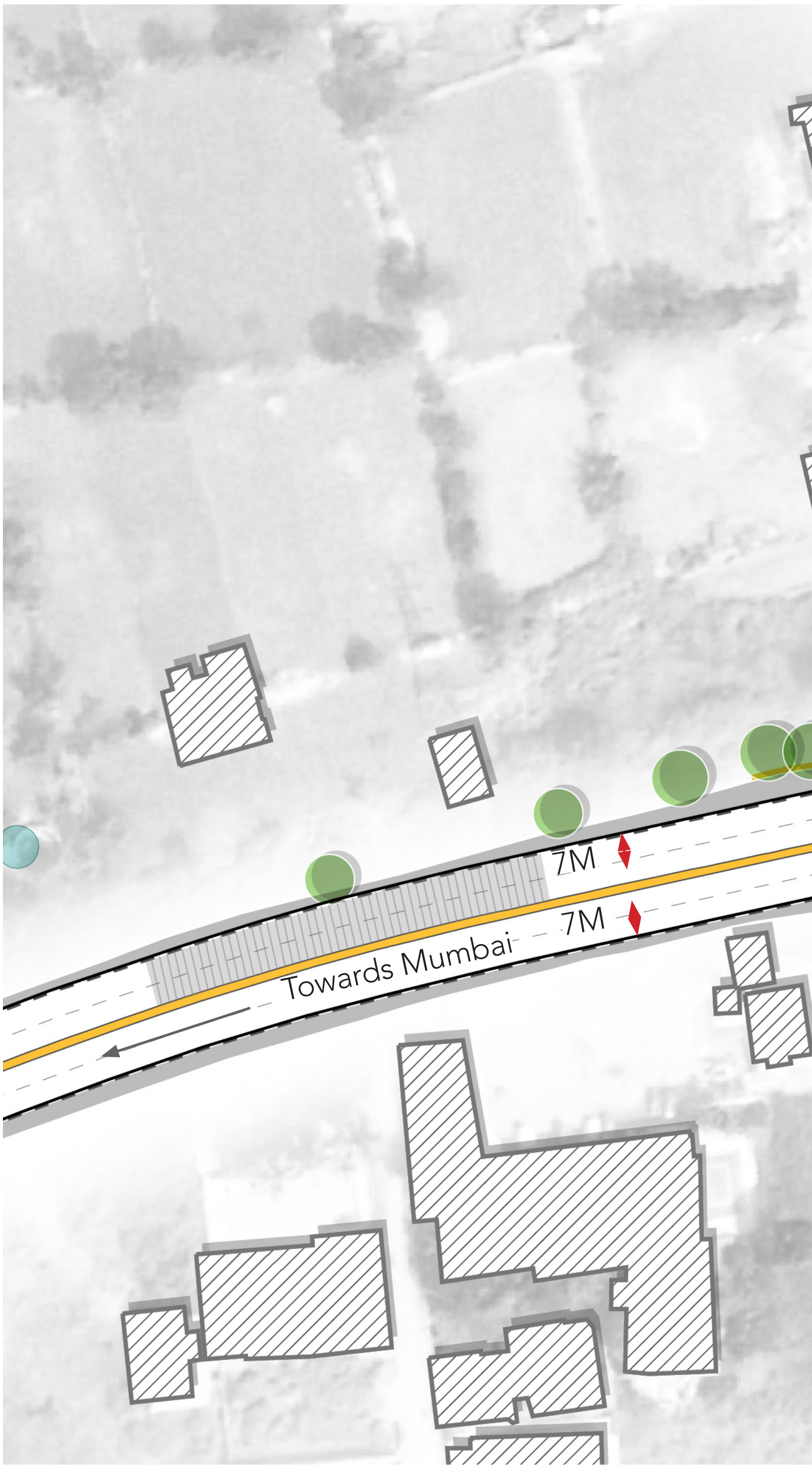
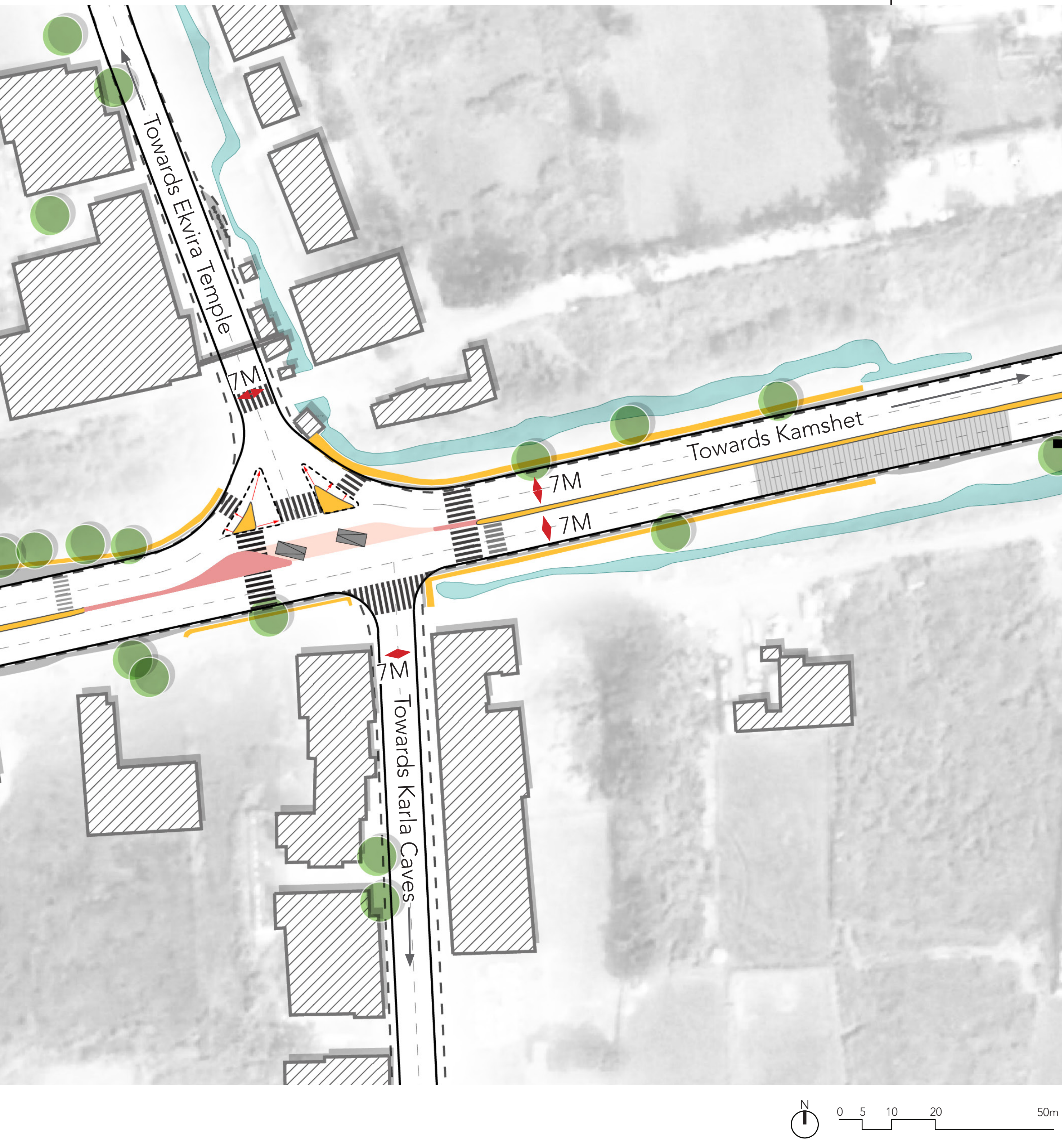


Fig 3.36: Plan depicting proposed pedestrian crossings

Proposed Condition



04 | Design Detailing

The next essential step required for suggesting Tactical Interventions within a similar context encompasses gaining a scientific understanding of the design model of the location. This can be accomplished through the help of technical drawings that are essential for understanding the specific concerns unique to the site. This understanding helps to envision the subsequent interventions that can contributed towards making the site safer and more user-friendly for different kind of road users. This endeavour is extremely crucial to explore the conditions of a site from a visual point of view.

As an example of it, this chapter explores the design model of the Karla Junction in great detail with the help of technical drawings, to explain all the key interventions via an integrated plan. Every element introduced in theory is further captured through the lens of 3D visualisation of the junction. As evident here, this helps in addressing every particular element down to the most minute detail.

A. Technical drawing

1. Key Interventions

1. To reduce speed on NH 48
2. To provide space for public transport
3. To create a safer road geometry
4. To create a safer public realm and pedestrian crossings

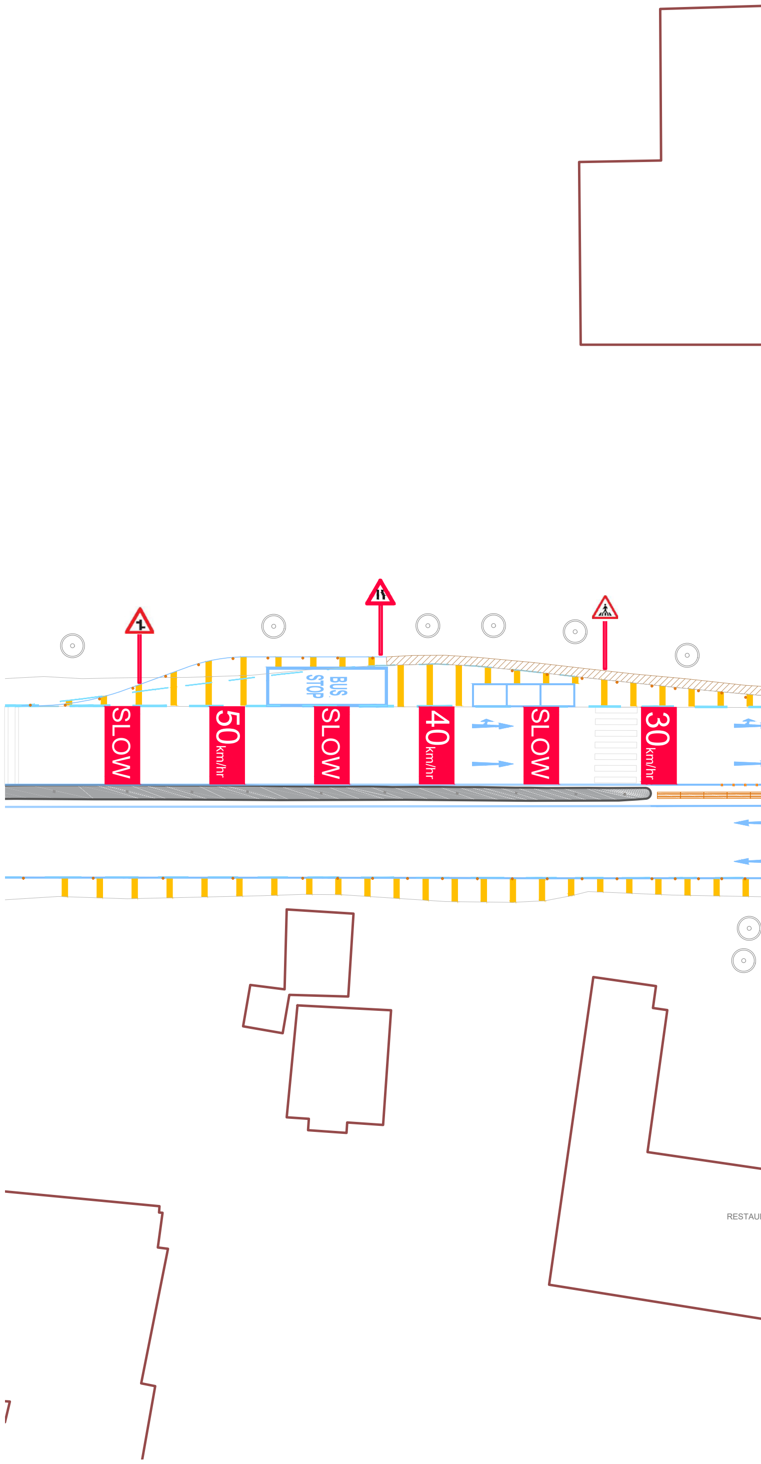
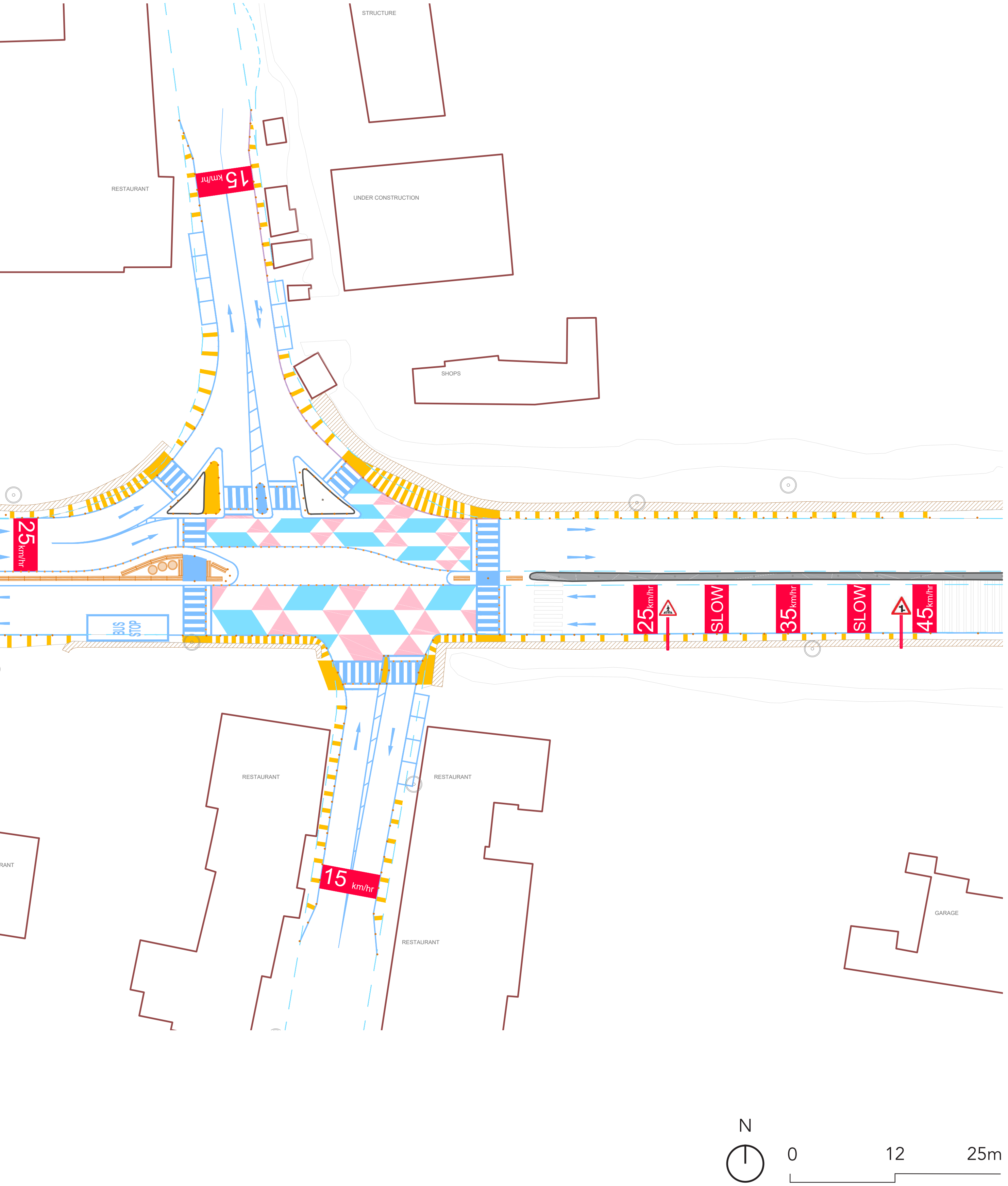


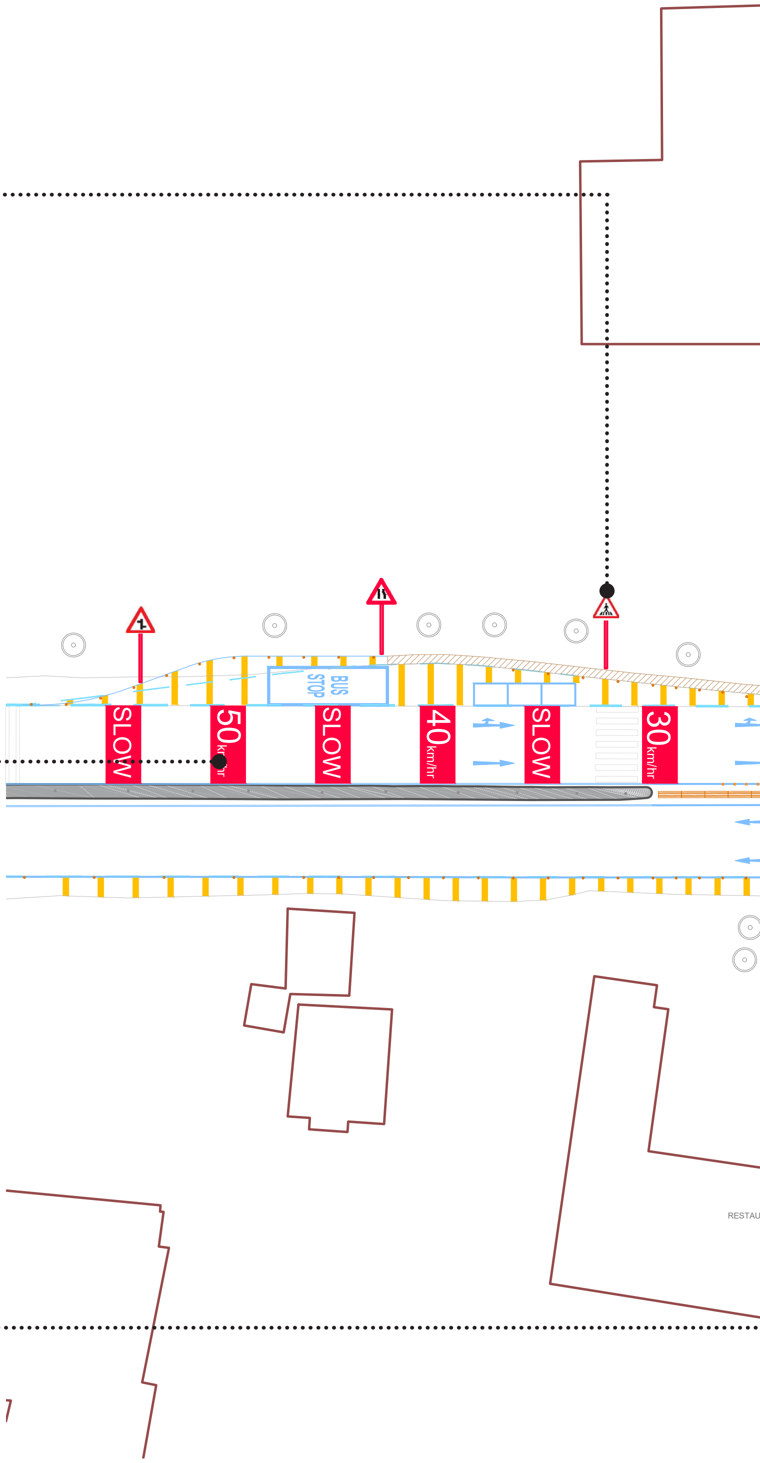
Fig 4.1: Proposed plan (Technical drawing)


STRUCTURE
UNDER CONSTRUCTION
SHOPS
RESTAURANT
15 km/hr
25 km/hr
BUS STOP
25 km/hr
SLOW
35 km/hr
SLOW
45 km/hr
RESTAURANT
RESTAURANT
15 km/hr
RESTAURANT
GARAGE
N
0
12
25m

1. To reduce speed

Fig 4.2: Vertical Signage

Fig 4.3: Horizontal Signage



2. To provide space for public transport

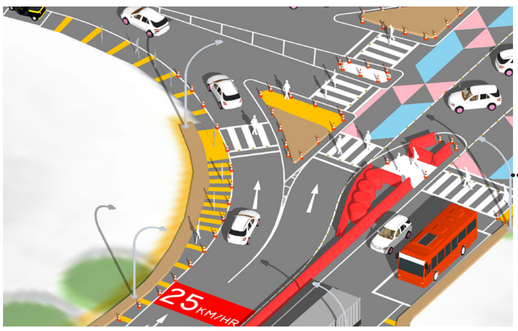
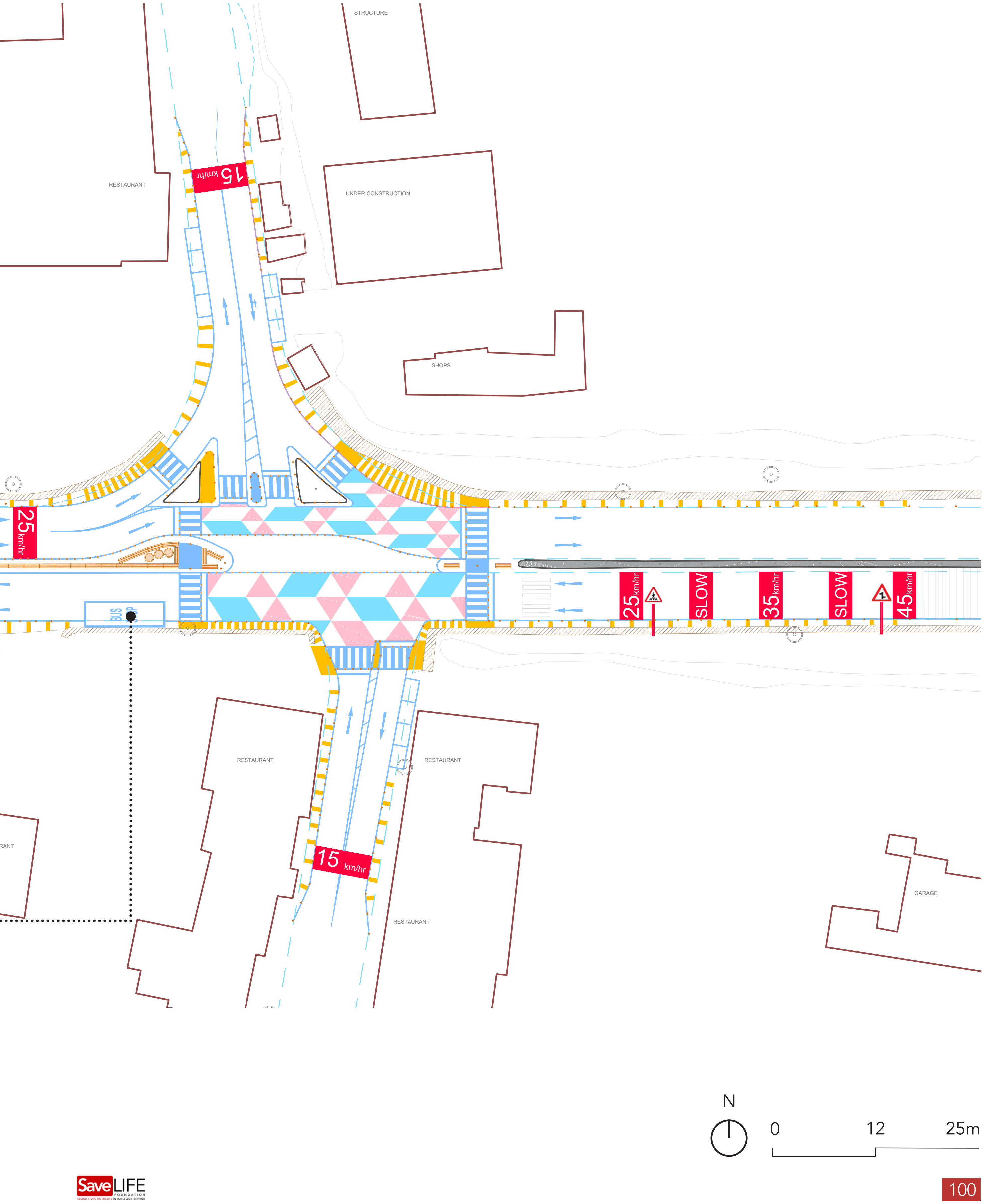


Fig 4.4: Bus Bay


STRUCTURE
RESTAURANT
15 km/hr
UNDER CONSTRUCTION
SHOPS
25 km/hr
BUS STOP
25 km/hr
SLOW
35 km/hr
SLOW
45 km/hr
RESTAURANT
RESTAURANT
15 km/hr
RESTAURANT
GARAGE
N
0
12
25m

3. To create safer road geometry

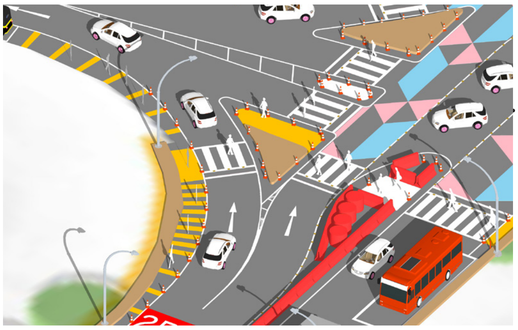
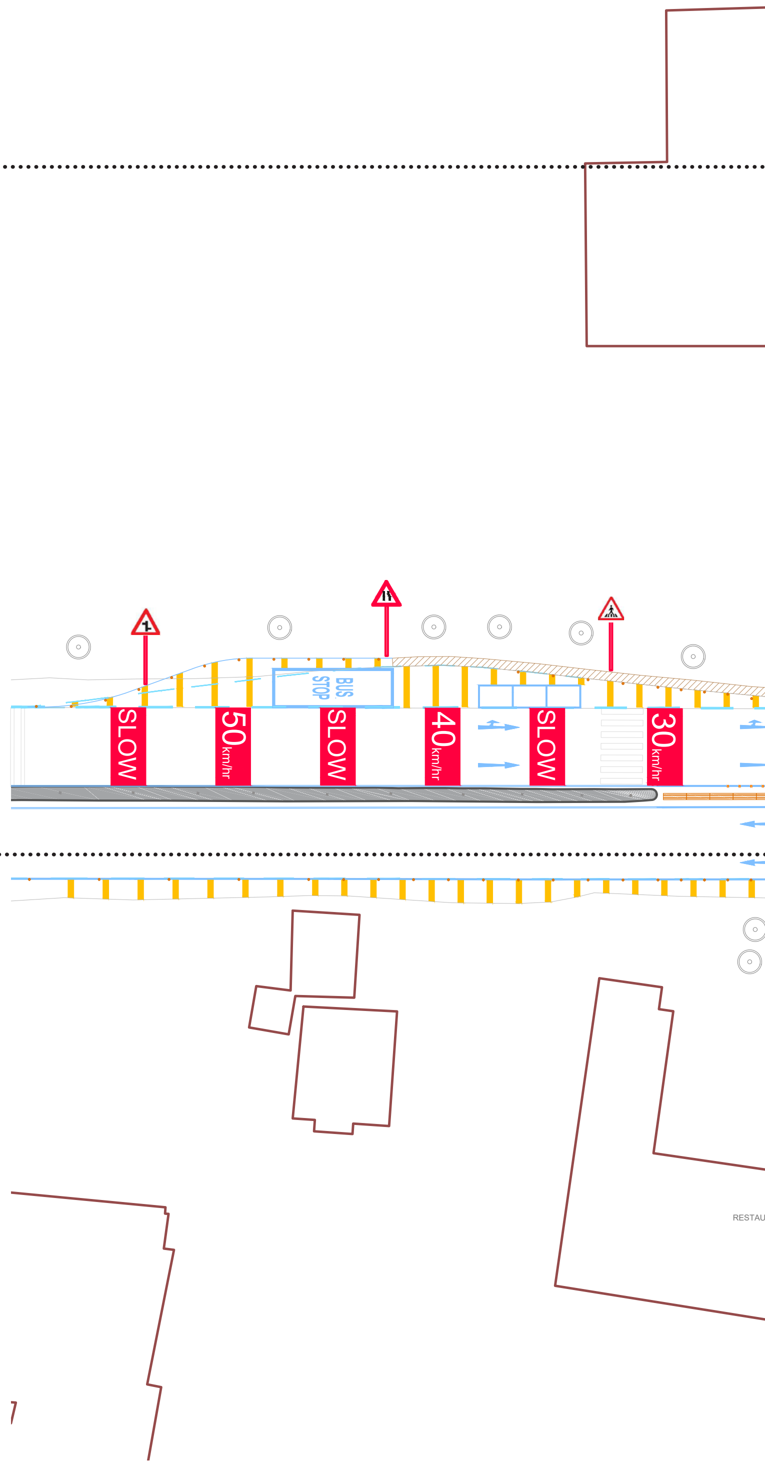


Fig 4.5: Modified Road Geometry



4. To create safer public realm and pedestrian crossings

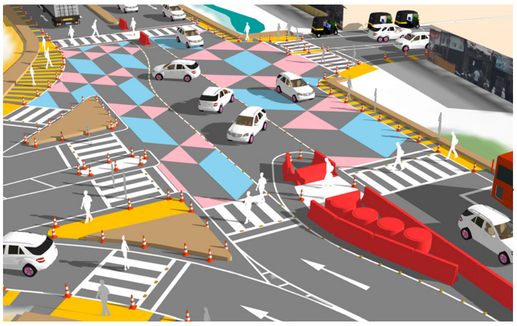
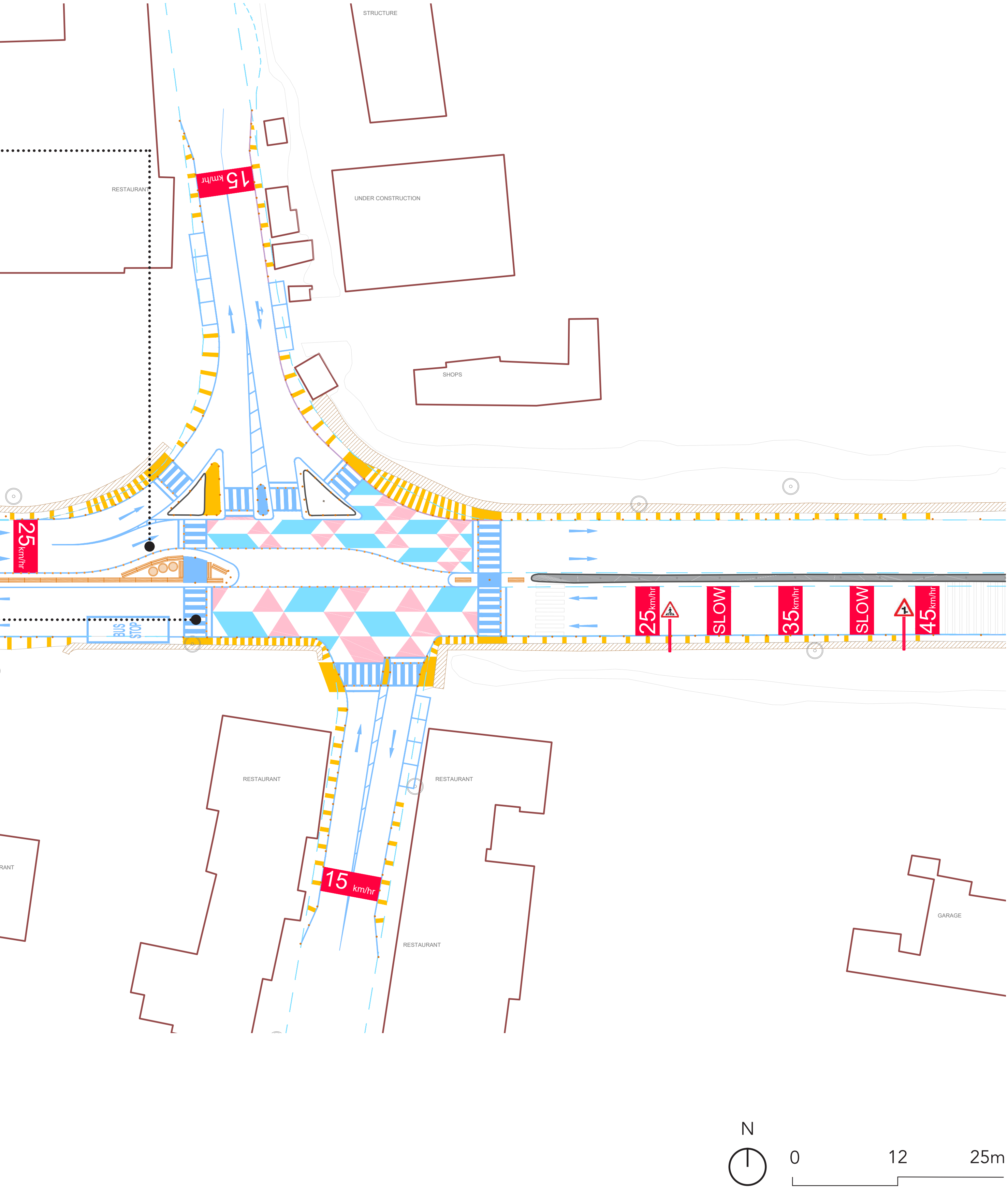


Fig 4.6: Pedestrian Crossing


STRUCTURE
UNDER CONSTRUCTION
RESTAURANT
SHOPS
15 km/hr
25 km/hr
BUS STOP
SLOW
35 km/hr
SLOW
45 km/hr
RESTAURANT
RESTAURANT
RESTAURANT
15 km/hr
GARAGE
N
0
12
25m

2. Intersection Zone

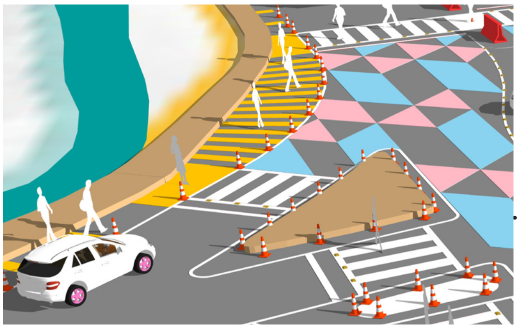


Fig 4.7: Modified road profile using traffic cones at 2 m c/c

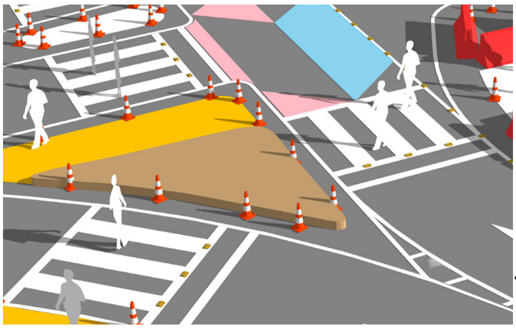


Fig 4.8: Road Studs at 1 m c/c help indicate pedestrian crossings at night

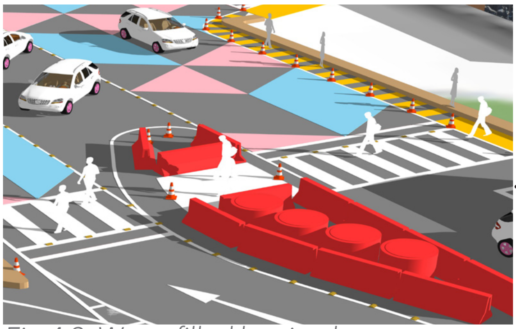


Fig 4.9: Water filled barricades to demarcate the waiting zone

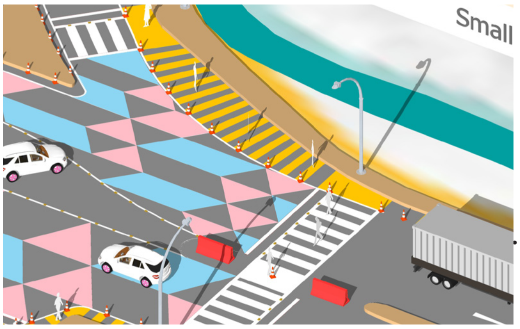
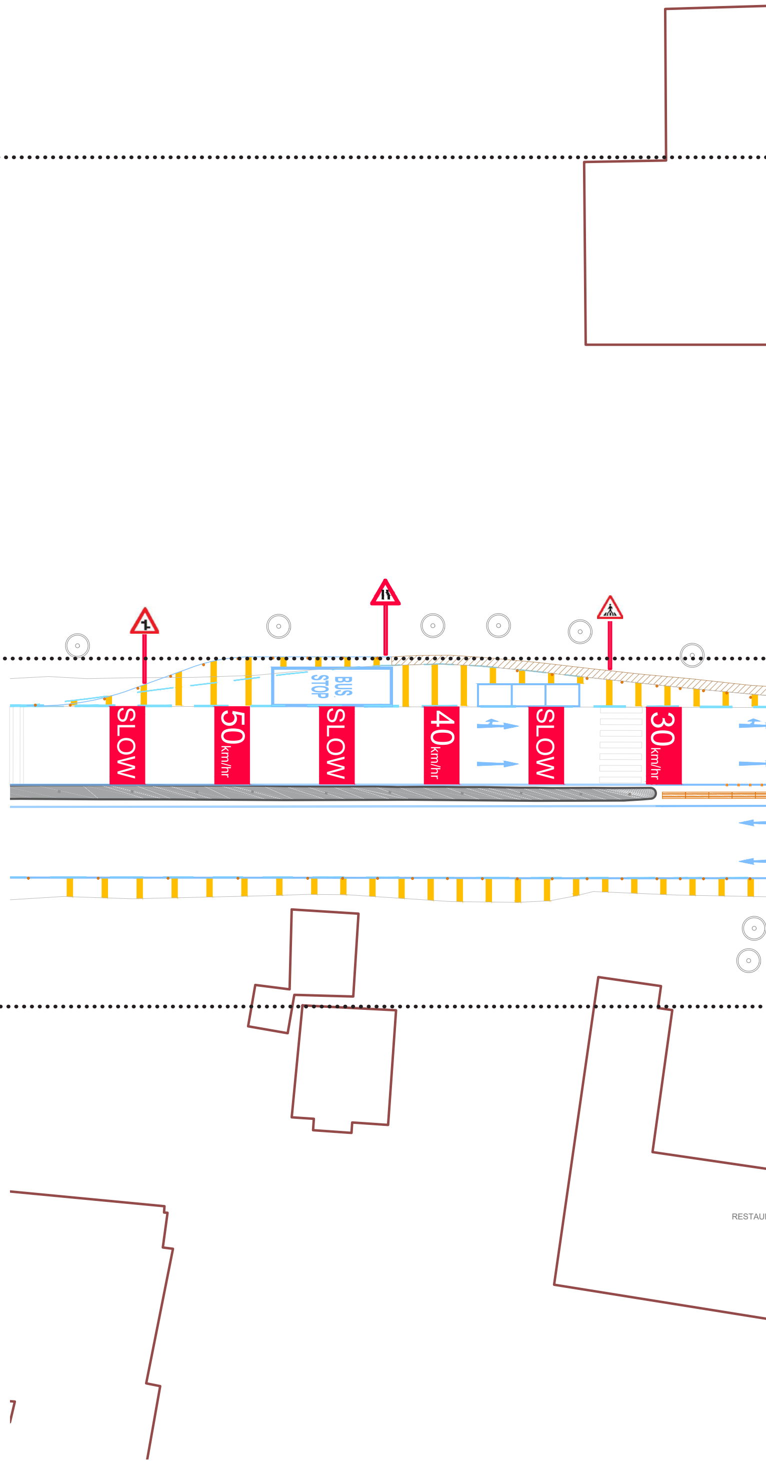


Fig 4.10: Water filled barricades to ensure people do not move haphazardly and use dedicated pedestrian crossings instead



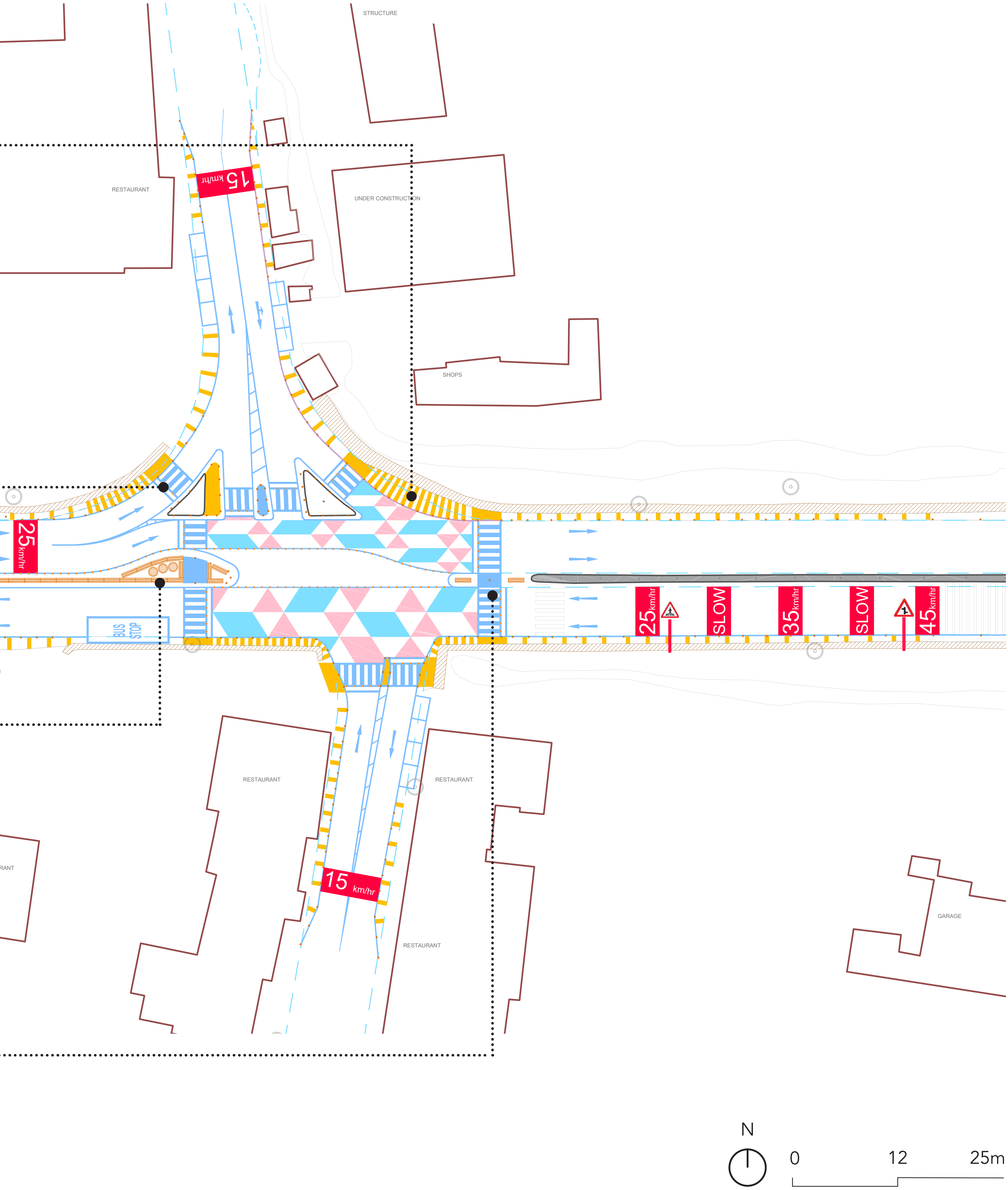

STRUCTURE
RESTAURANT
15 km/hr
UNDER CONSTRUCTION
SHOPS
25 km/hr
BUS STOP
25 km/hr
SLOW
35 km/hr
SLOW
45 km/hr
RESTAURANT
RESTAURANT
15 km/hr
RESTAURANT
GARAGE
N
0
12
25m

Fig 4.11: Pedestrian Crossing using synthetic enamel paint

Fig 4.12: Lane Markings

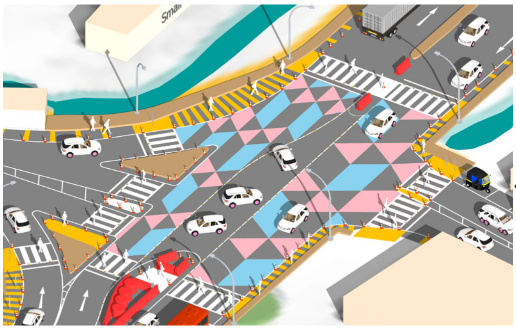
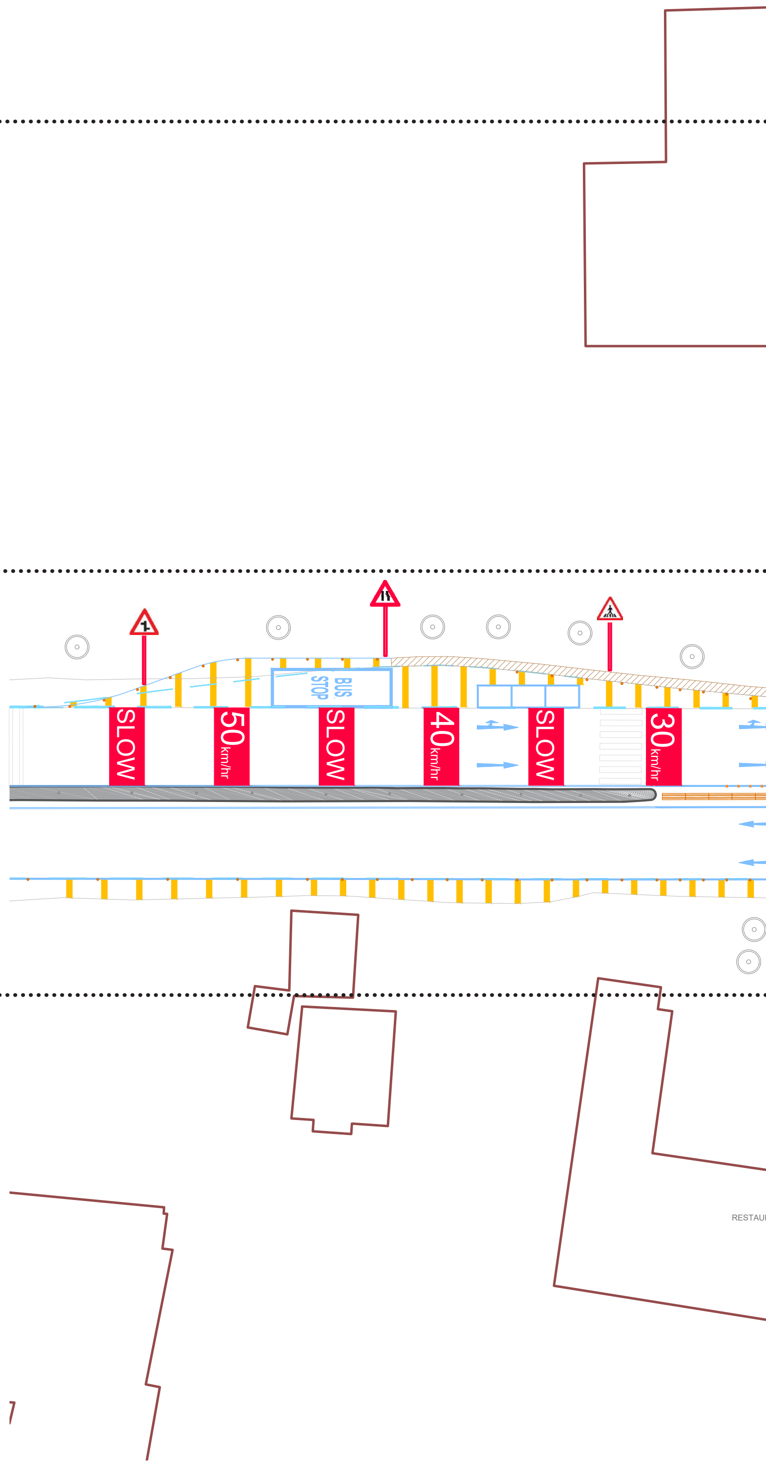
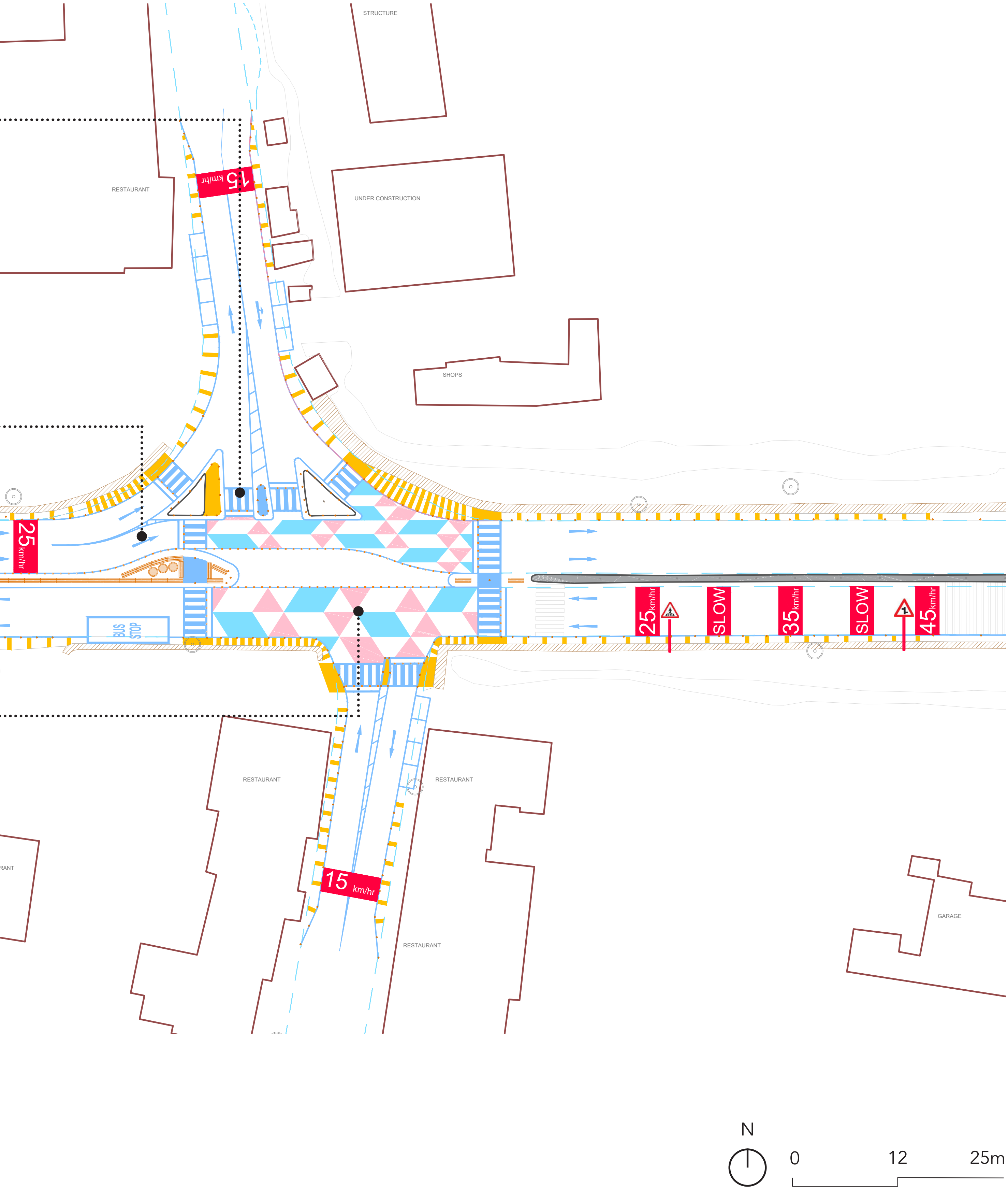


Fig 4.13: Intersection Zone using synthetic enamel paint

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RESTAURANT
15 km/hr
RESTAURANT
GARAGE
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12
25m

3. Intermediate Public Transport (IPT) Stops

There were no IPT stops at the intersection and auto rickshaws waited there to pick up passengers. As a result, pick up and drop-off activities were happening right on the carriageway.

Auto rickshaws consist of only 4% of the total mode share vehicles in the area.

Majority of the auto rickshaws moved towards the Ekvira Devi Temple and NH 48.

Therefore, four dedicated areas were proposed. One was located on NH 48 with 4 dedicated spaces, while the other two locations were on the Ekvira Devi Temple Road with seven dedicated spaces. The last one was located on the Karla Village road with four dedicated spaces.

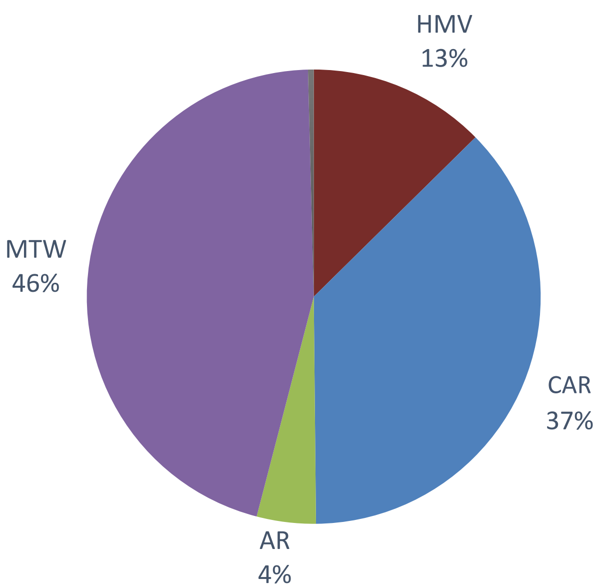
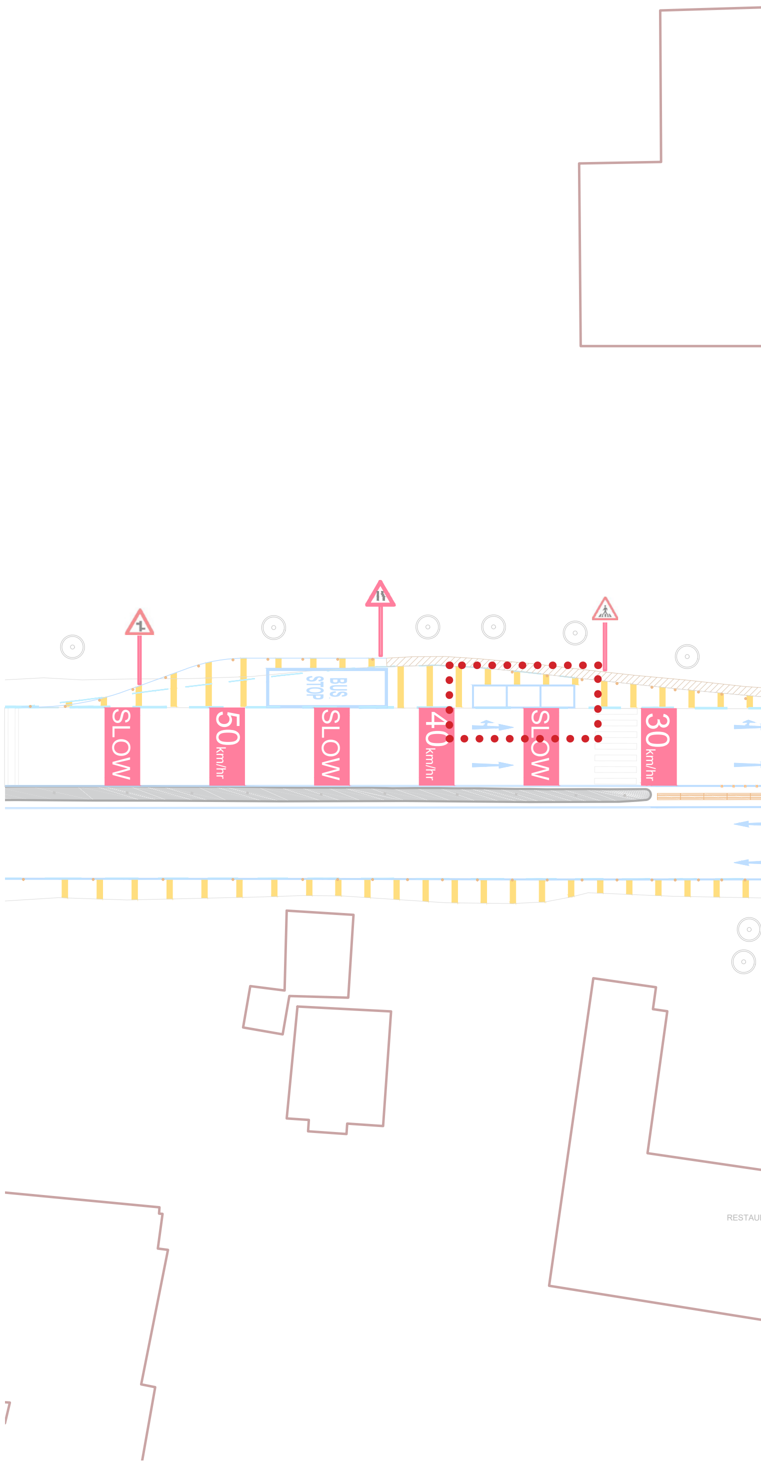
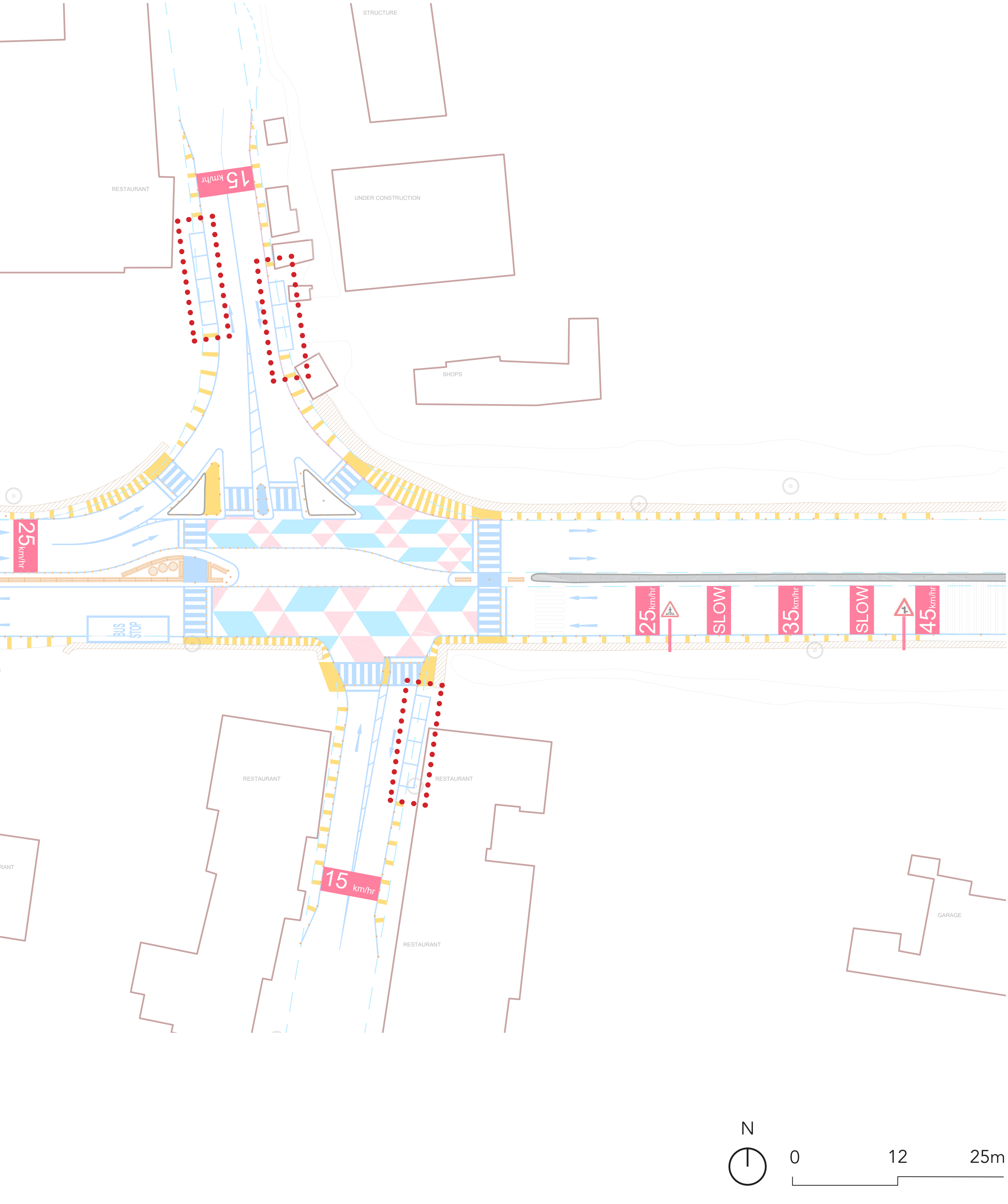


Fig 4.14: The pie chart indicates average mode share percentage on NH 48 during the 3 days of survey



Mode share percentage of auto rickshaws at Karla Phata Junction was 4%, which was an average of 1,750 autos per day.


STRUCTURE
RESTAURANT
15 km/hr
UNDER CONSTRUCTION
SHOPS
25 km/hr
BUS STOP
25 km/hr
SLOW
35 km/hr
SLOW
45 km/hr
RESTAURANT
RESTAURANT
15 km/hr
RESTAURANT
GARAGE
N
0
12
25m

B. Conceptual 3D Visualisation

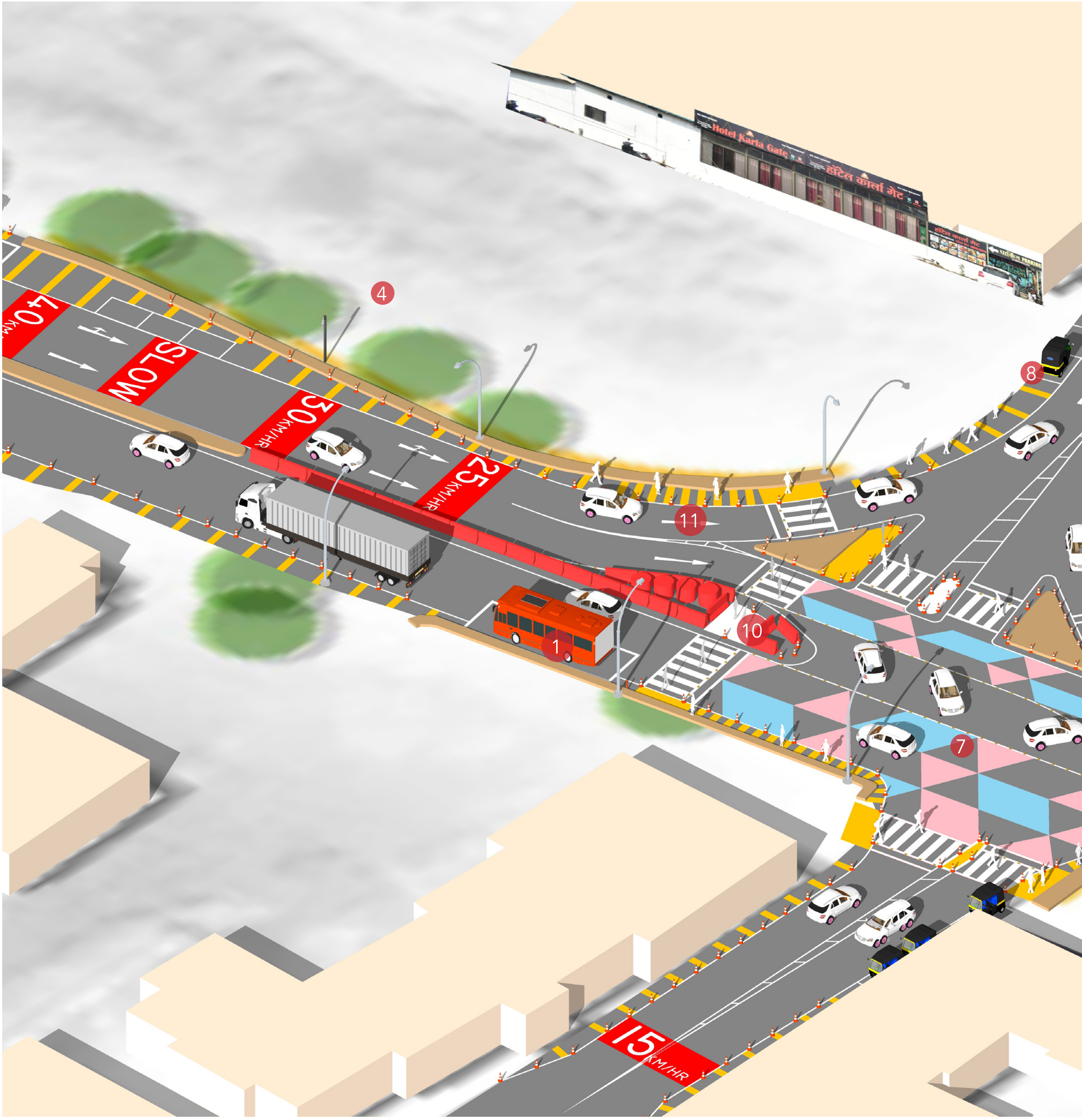
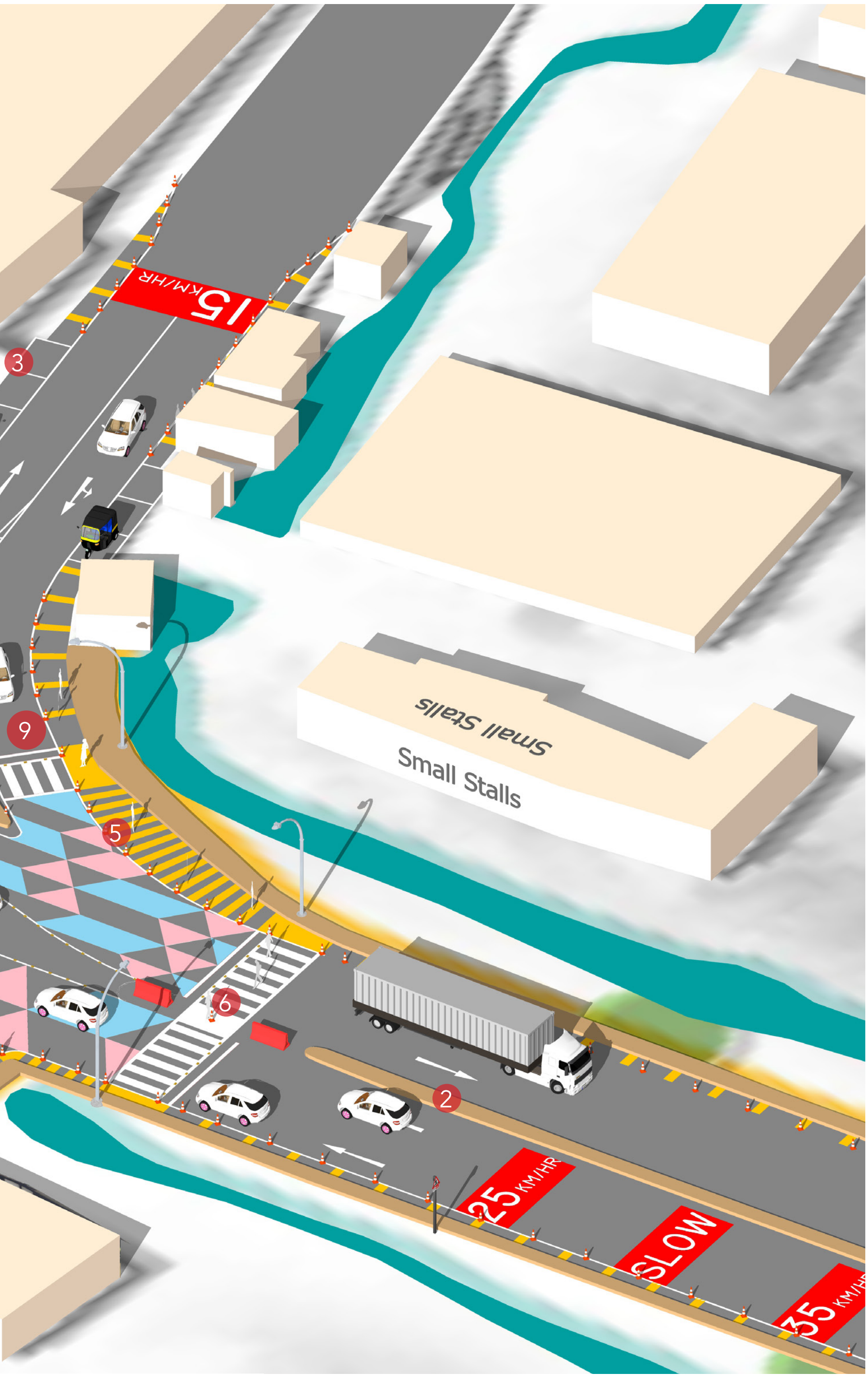
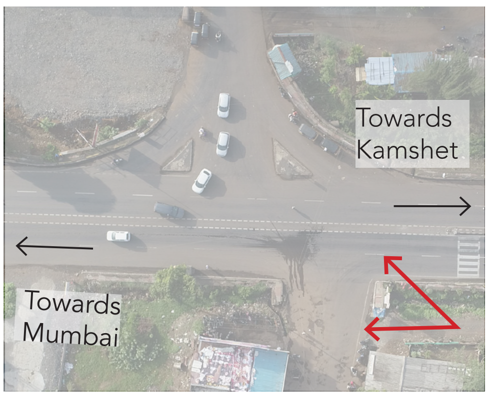


Fig 4.15: Aerial view of the junction with all the proposed key interventions

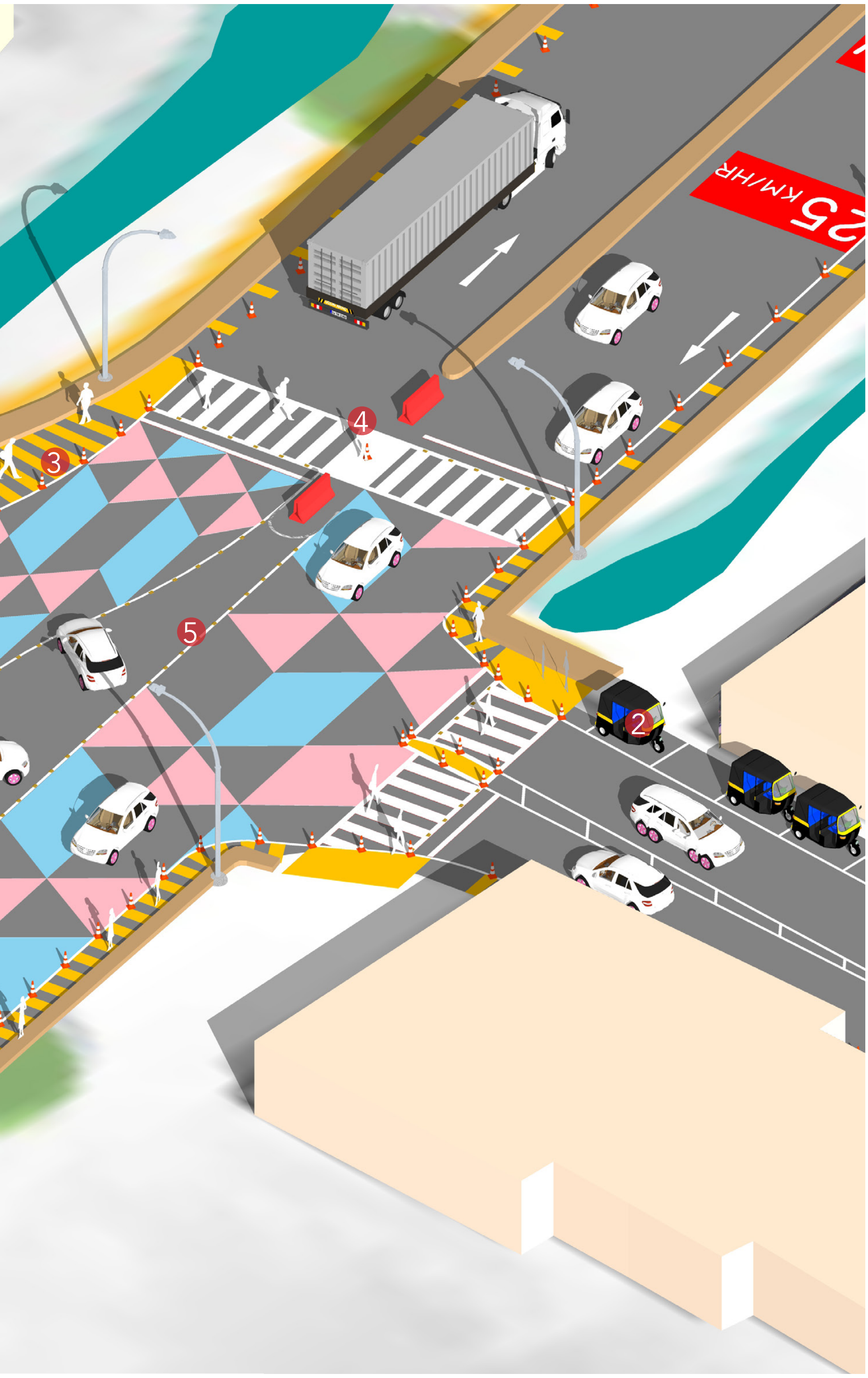


1. Proposed Bus Bay
2. Speed limits marked on the road with the help of synthetic enamel paint
3. IPT stops
4. Proposed signages
5. Traffic cones at 2 m c/c
6. Proposed barricades to prevent jaywalking
7. Intersection marked with help of synthetic enamel paint
8. Shoulder space created after road geometry correction
9. Proposed pedestrian crossing
10. Waiting space created for pedestrians using traffic cones in the middle of the road
11. Proposed water filled barricades for altered road geometry

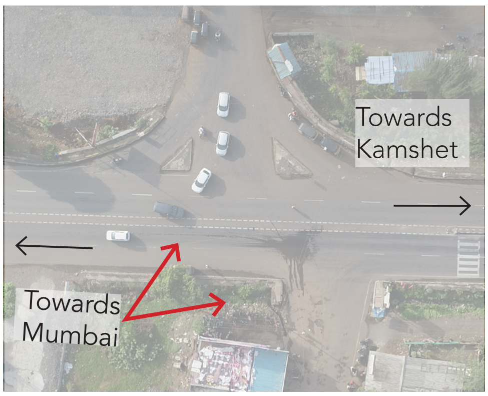


Key Plan

Fig 4.16: Aerial view of the intersection with all the proposed key interventions



1. Speed limits marked on the road with the help of synthetic enamel paint
2. IPT stops
3. Traffic cones at 2 m c/c
4. Proposed barricades to prevent jaywalking
5. Intersection marked with help of synthetic enamel paint
6. Shoulder space created after road geometry correction
7. Proposed pedestrian crossing
8. Waiting space created for pedestrians using traffic cones in the middle of the road
9. Proposed water filled barricades for altered road geometry



Key Plan

Fig 4.17: Eye level view of the intersection when travelling towards Mumbai

1 Speed limits marked on the road with the help of synthetic enamel paint

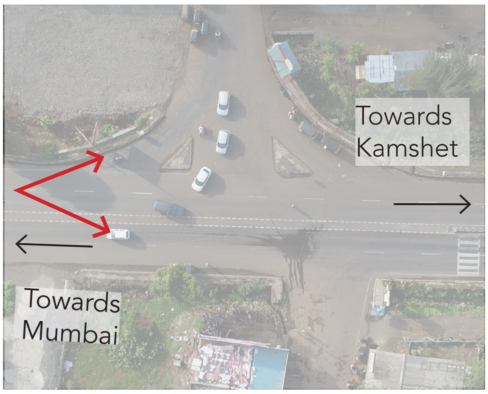
2 Proposed IPT stop

3 Proposed signages

4 Traffic cones at 2 m c/c

5 Proposed pedestrian crossing

6 Intersection marked with the help of synthetic enamel paint



Key Plan

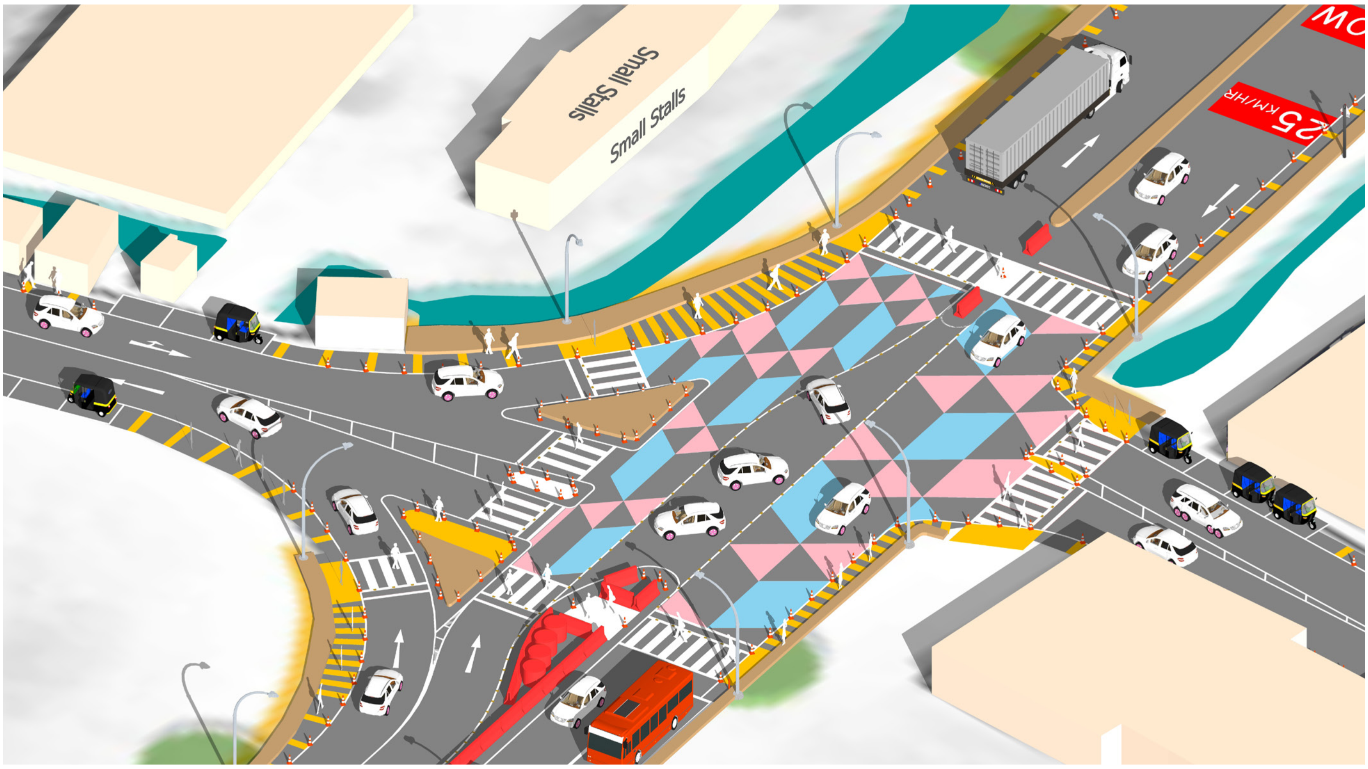
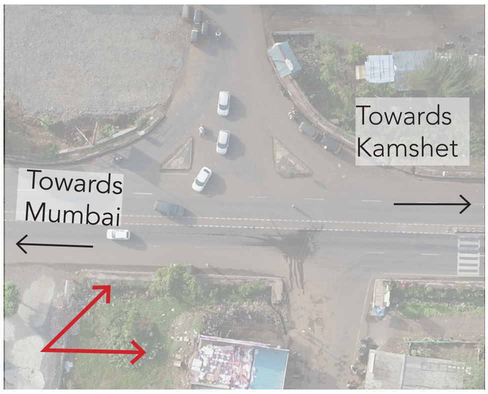


Fig 4.18: Aerial view of the intersection

The median was extended using barricades and traffic cones to create a waiting space for pedestrians crossing the NH 48 and also to deviate and slow down the vehicles.

The intersection zone was marked with the help of synthetic enamel paint and a buffer space was created to ease vehicles making a turn.

Traffic cones and barricades were used to demarcate between the carriageway and the shoulder space.



Key Plan

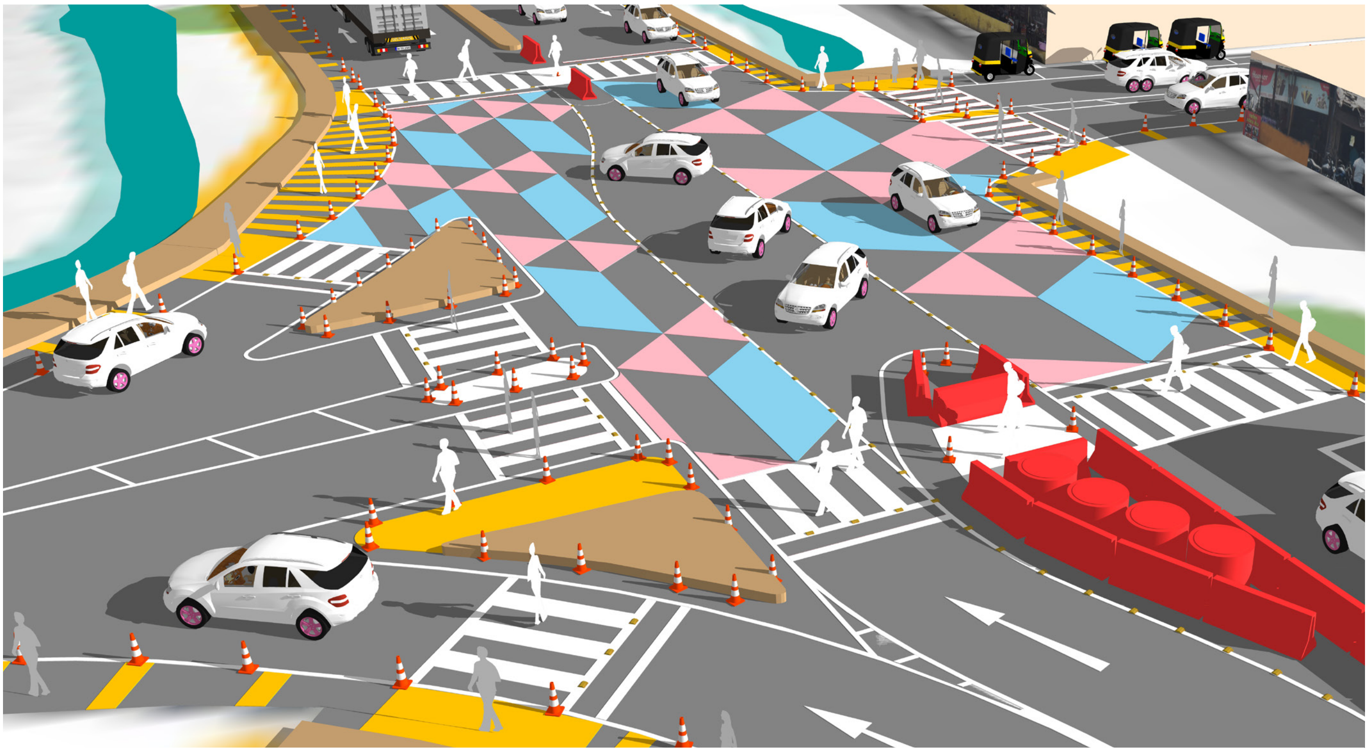
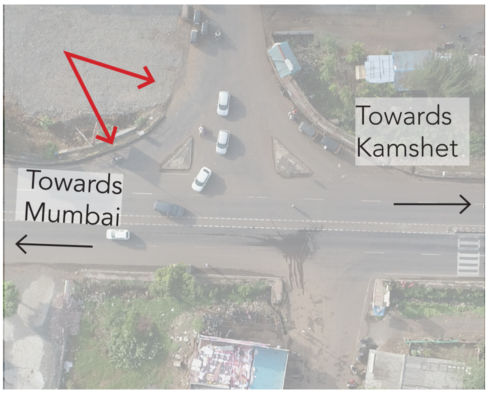


Fig 4.19: Aerial view of the intersection

The traffic island was extended through the use of traffic cones to create a refuge space for the pedestrians crossing. The extended space was marked with the help of yellow synthetic enamel paint.

Traffic cones and barricades were used to demarcate between the carriageway and the shoulder space.

Barricades were used along the road to prevent pedestrians from jaywalking.



Key Plan

05 | Impact Analysis

After introducing the Tactical Urbanism interventions and recording the resultant data generated, comes the pertinent step that helps us understand their overall impact. For this, we need to study the pre- and post-intervention impact on the motorised and pedestrian movement at the location under consideration.

As an example, this chapter demonstrates a pre- and post-intervention impact analysis for vehicular and pedestrian movement. Within it, the key safety parameters analysed in the pre- and post-scenarios include: (i) pedestrian crossing time and distance (ii) available public realm for pedestrians (iii) critical gap acceptance (iv) vehicle speeds on all arms (v) intersection geometry (vi) public transport infrastructure and signage.

The metric of impacts have been categorised as Static and Dynamic. The Static comparison includes the exposure time and distance while the Dynamic comparison includes the speed and conflict impact.

A. Pedestrian Impact Analysis

1. Pedestrian Crossing Distances

Pre-trial

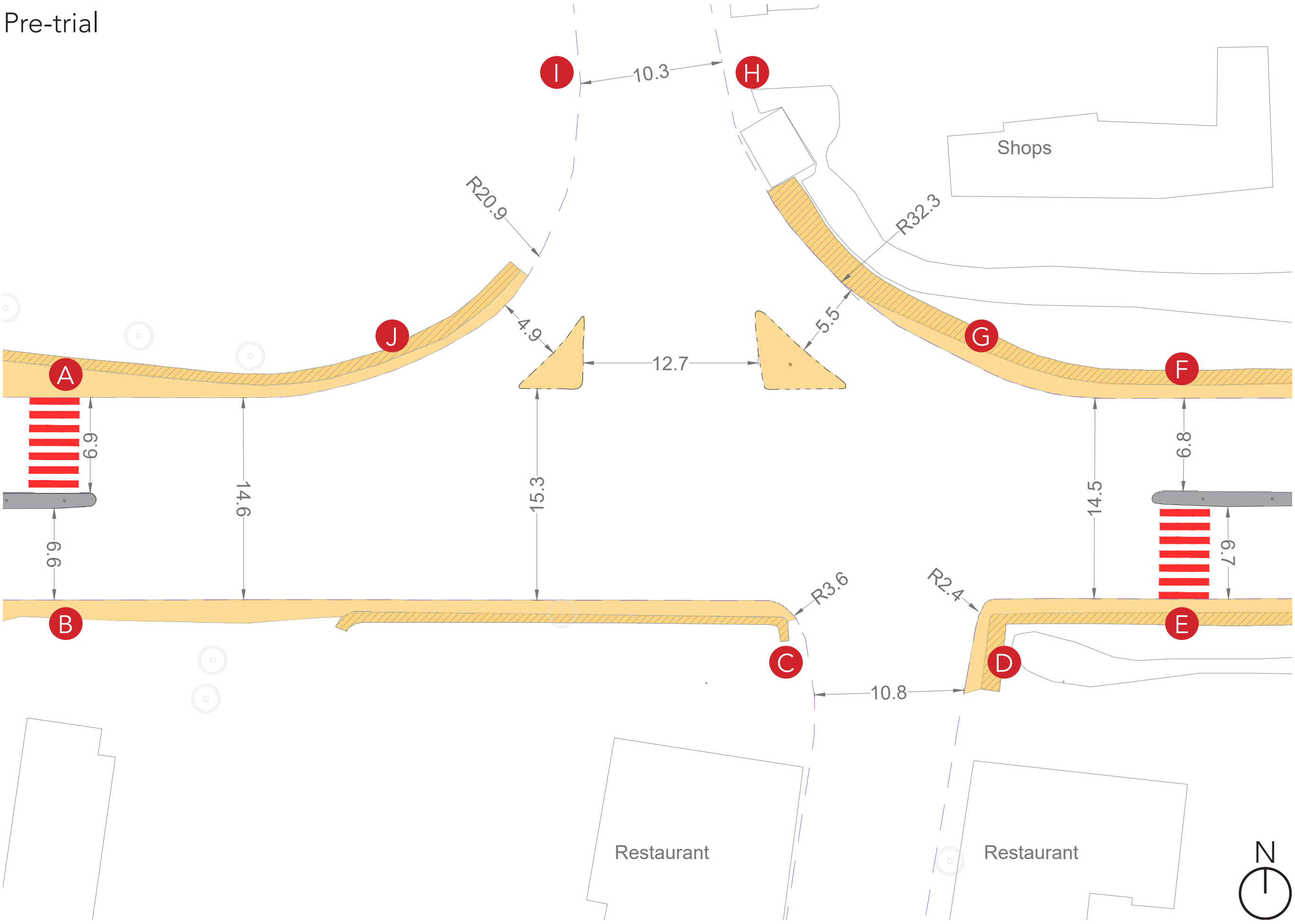


Fig 5.1: Plan highlighting existing pedestrian crossings at the intersection

The existing pedestrian crossings marked on the site were located over 50 m from the junction and were marked on only one half of the carriageway. Further, the zebra crossings started/ended at a railing and there was no pedestrian refuge which made them both unsafe and unusable.

It was observed that people walked at the centre of the intersection instead of the dedicated pedestrian crossings marked as it was the shortest distance between the crossing origin and destination.

As a result of this pedestrian crossing behaviour, the distance and time that pedestrians were exposed on the carriageway was very high.

The proposed pedestrian crossings were marked as per the pedestrian pattern observed during the three-day survey and were in line with IRC standards for the location of the pedestrian crossings. Further, the pedestrian crossings were integrated with the footpaths thereby, creating a continuous public realm.

Along the median pedestrian refuges were created which served as a safe waiting space for them.

The distance and time pedestrians were exposed on the carriageway while crossing was significantly reduced, thereby enhancing their safety. The details are provided in the table alongside.

During trial

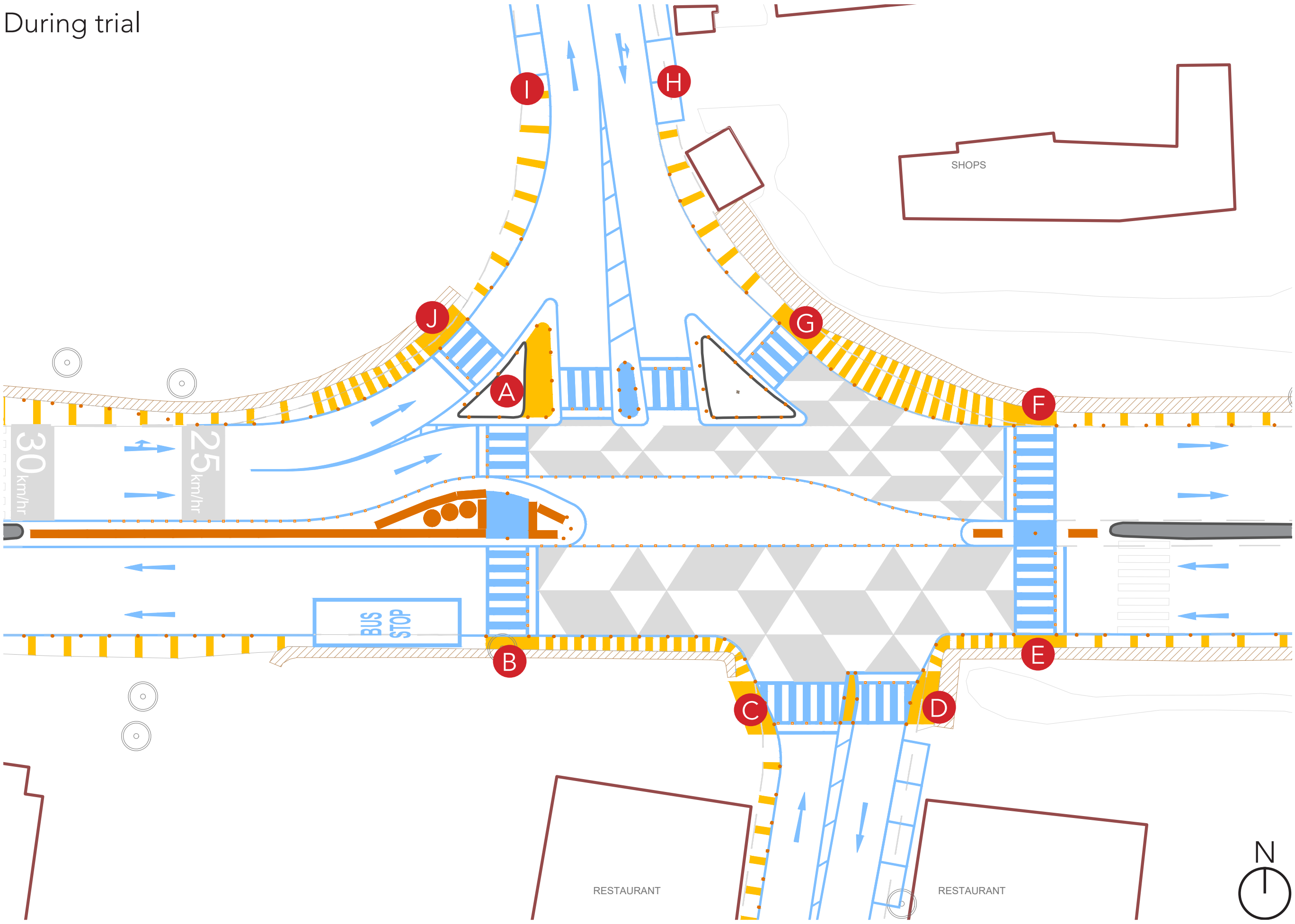


Fig 5.2: Plan highlighting proposed interventions for pedestrian crossings at the intersection

Distance exposed on road		
Points	**Existing**	**Proposed**
A to B	15.3 m (15.3 m exposed on road)	15.3 m (11.6 m exposed on road)
C to D	10.8 m (exposed on road)	08 m (exposed on road)
E to F	14.5 m (14.5 m exposed on road)	14.5 m (13.5 m exposed on road)
G to J	23.2 m (23.2 m exposed on road)	23.2 m (14 m exposed on road)
H to I	10.3 m (exposed on road)	7 m (exposed on road)

Table 5.1: Table summarising the distances travelled by pedestrians in existing and proposed condition

Pedestrian Crossing Distances - Example 1

Pre-trial

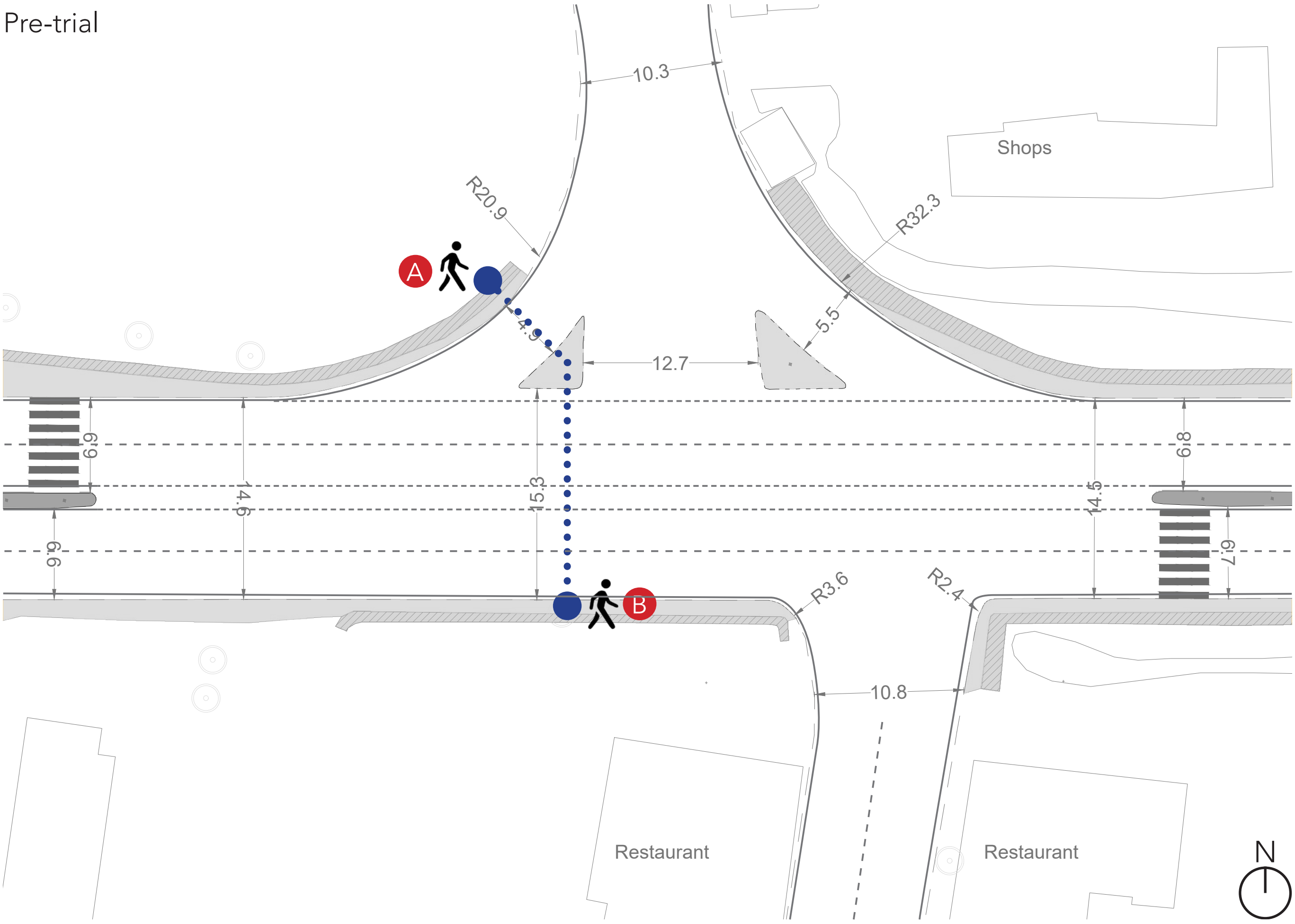


Fig 5.3: Plan highlighting existing pedestrian crossing route from A to B.

22.3 m

Distance traveled to reach from point A to B

20.2 m

Walking distance exposed on road

For a person to walk from point A to point B in both existing and proposed conditions, the distance remains the same.

However, the route in the proposed condition is much safer as compared to the existing condition with adequate waiting points and less distance exposed on the carriageway.

During trial

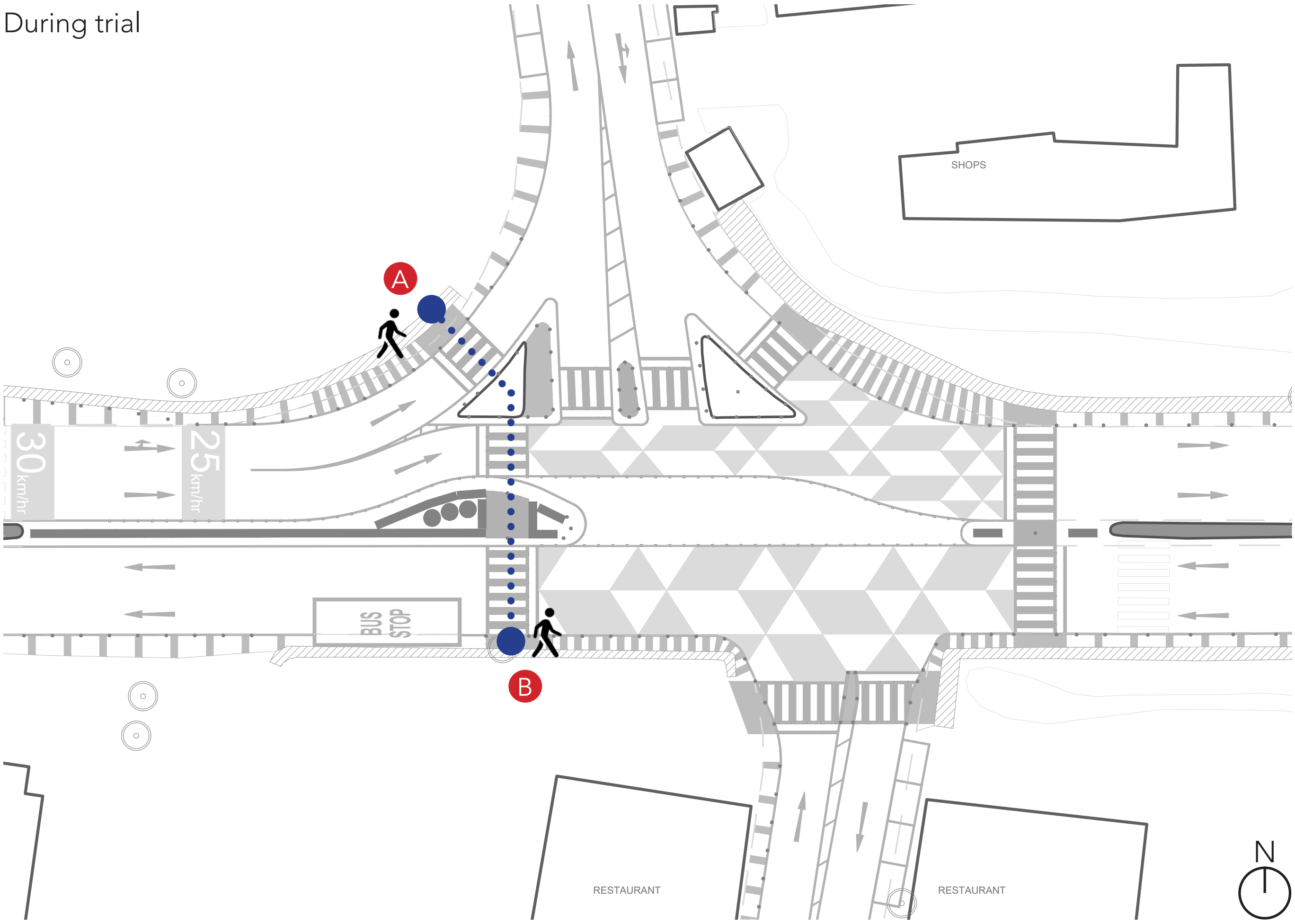


Fig 5.4: Plan highlighting proposed pedestrian crossing route from A to B.

22.3 m

Distance traveled to reach from point A to B

14 m

Walking distance exposed on road

30% Reduction in distance exposed on road

A refuge area for pedestrians was provided after every two vehicular lanes.

Pedestrian Crossing Distances - Example 2

Pre-trial

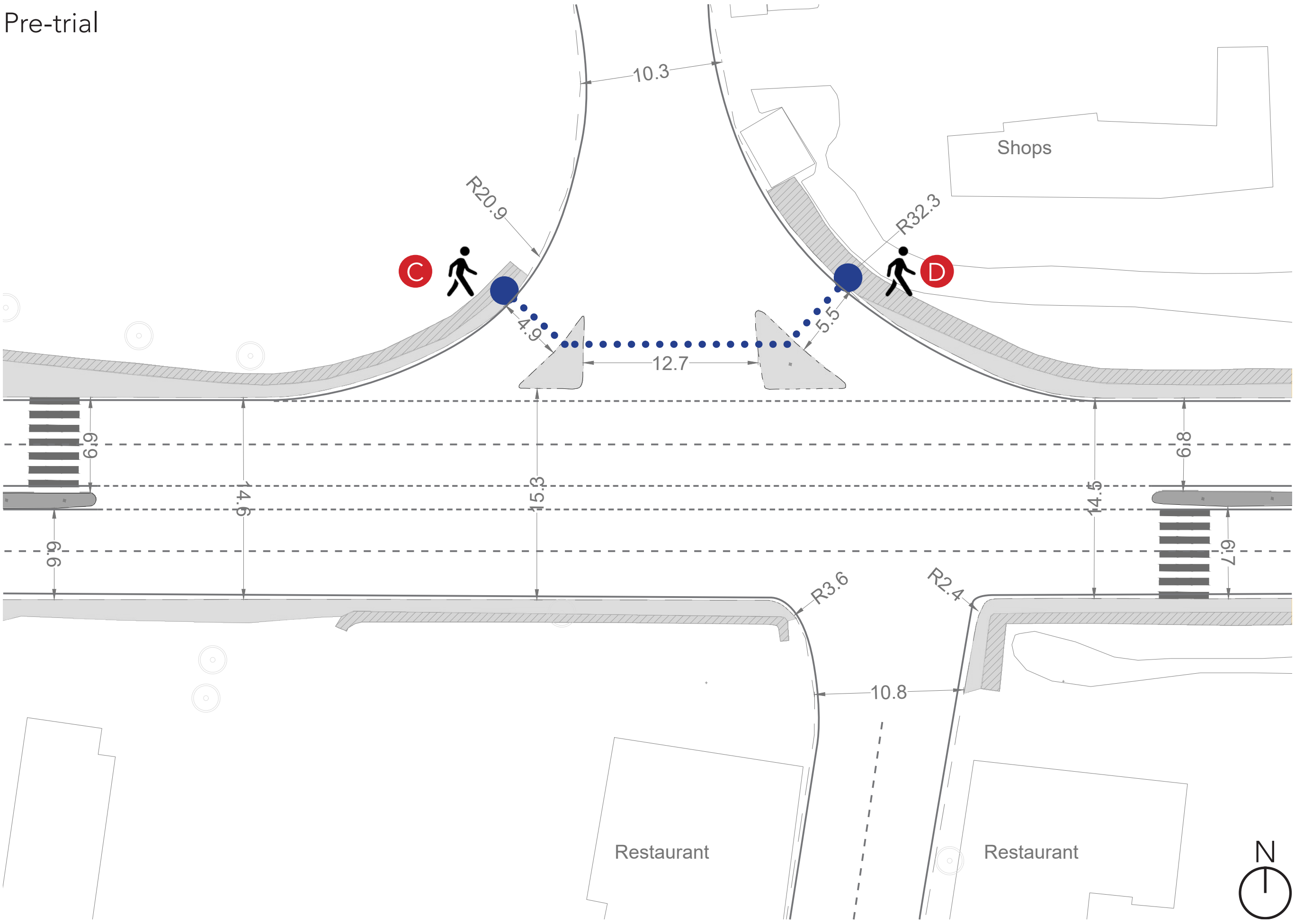


Fig 5.5: Plan highlighting existing pedestrian crossing route from C to D.

27 m

Distance traveled to reach from point C to D

23.4 m

Walking distance exposed on road

For a person to walk from point C to point D in both the existing and proposed condition, the distance remains the same.

However, the route in the proposed condition is much safer compared to the existing condition with adequate waiting points and less distance exposed on the carriageway.

During trial

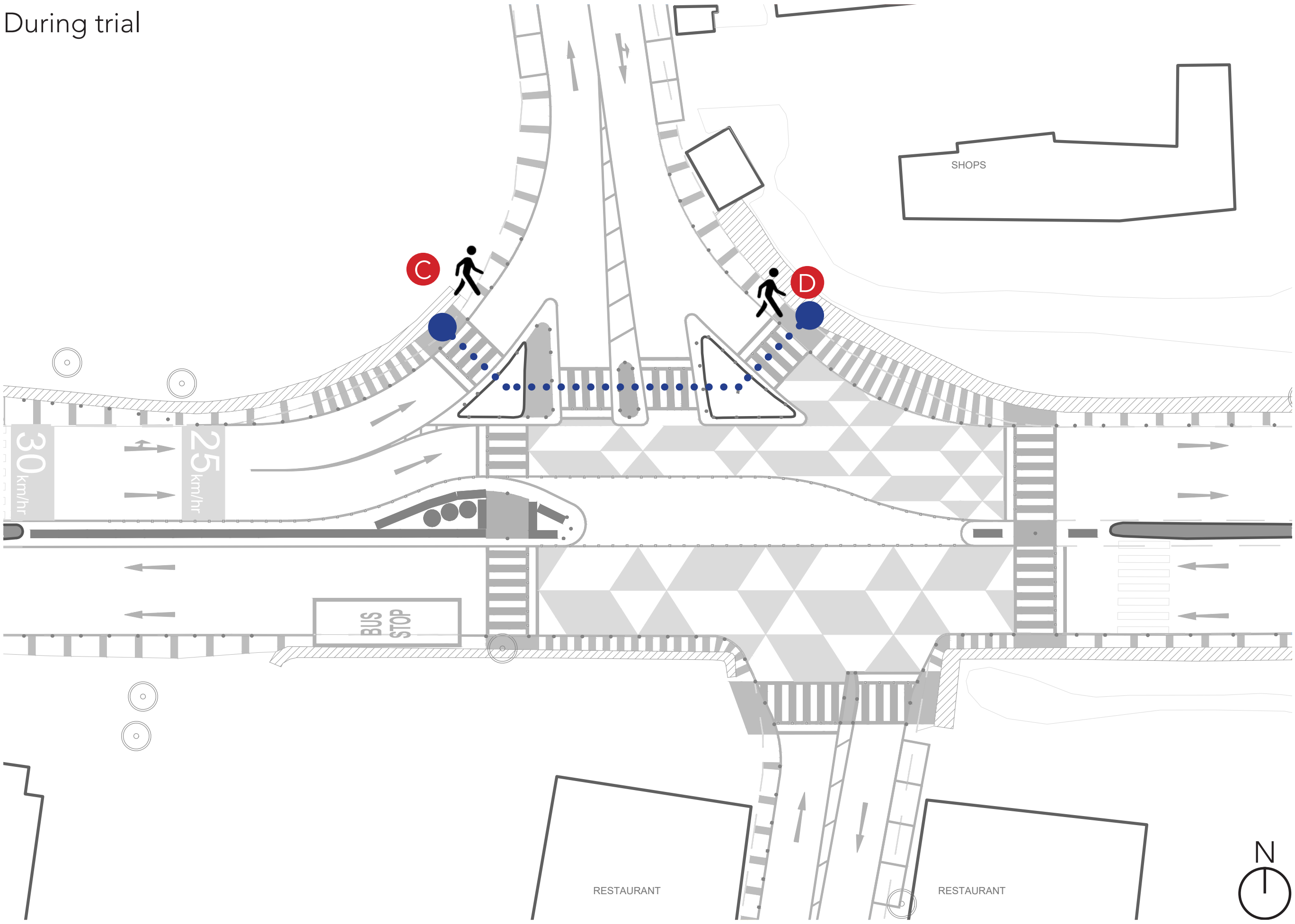


Fig 5.6: Plan highlighting proposed pedestrian crossing route from C to D.

27 m

Distance traveled to reach from point C to D

14 m

Walking distance exposed on road

40% Reduction in distance exposed on road

A refuge area for pedestrians was provided after every two vehicular lanes

2. Pedestrian Crossing Time

Pre-Trial

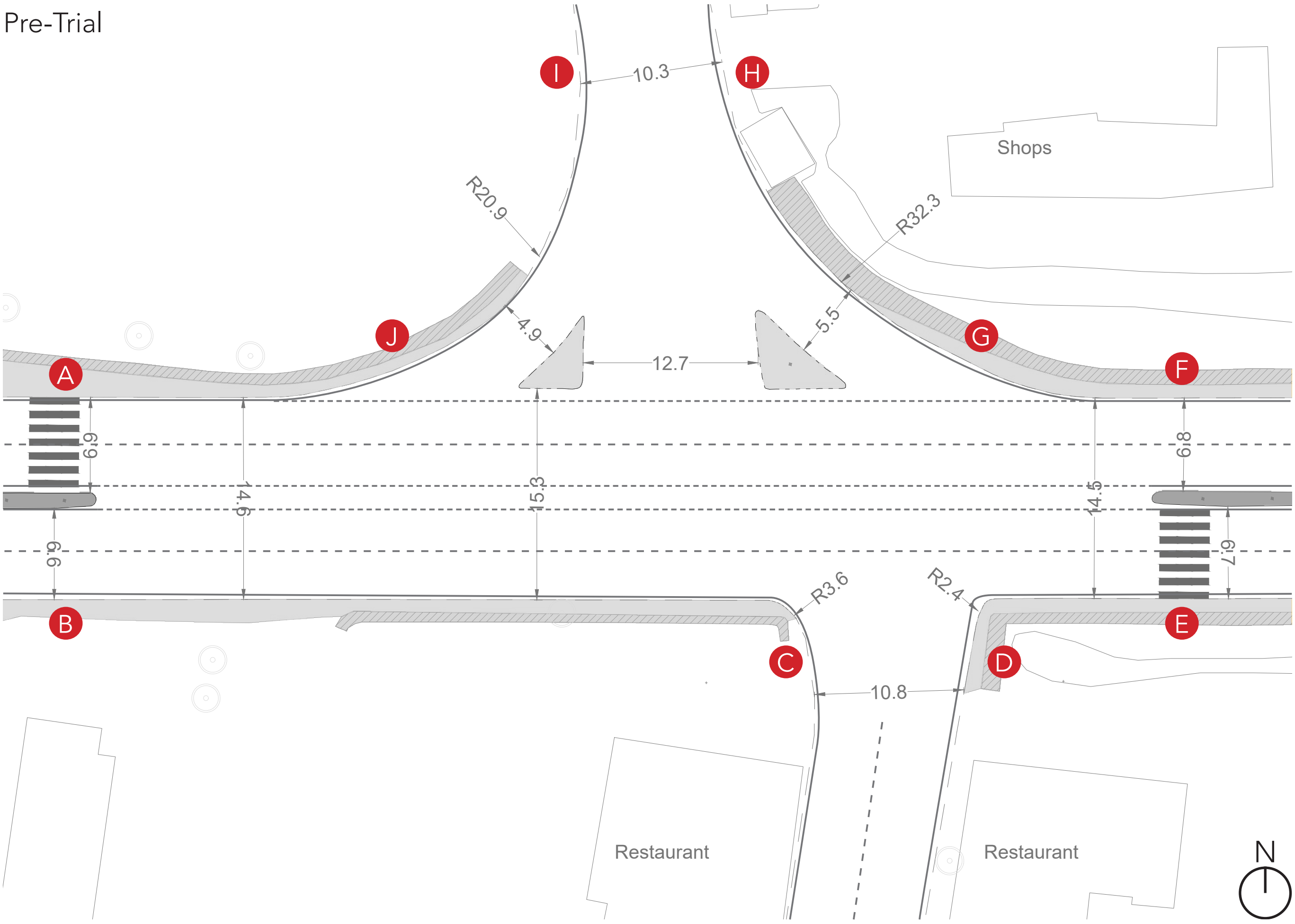


Fig 5.7: Plan highlighting existing pedestrian crossing route.

The table indicates the average time required for pedestrians to traverse across the junction.

As the intersection is not signalised, pedestrians have to find a safe gap between the moving vehicles on NH 48 before crossing the road. Therefore, maximum waiting time was observed for pedestrians moving from A to B and E to F.

Time travelled from points		
Points	**Time to cross**	**Waiting time**
A to B	40 sec	25 sec
G to J	45 sec	25 sec

Table 5.2: Table summarising time taken to travel from various points in existing condition

During trial

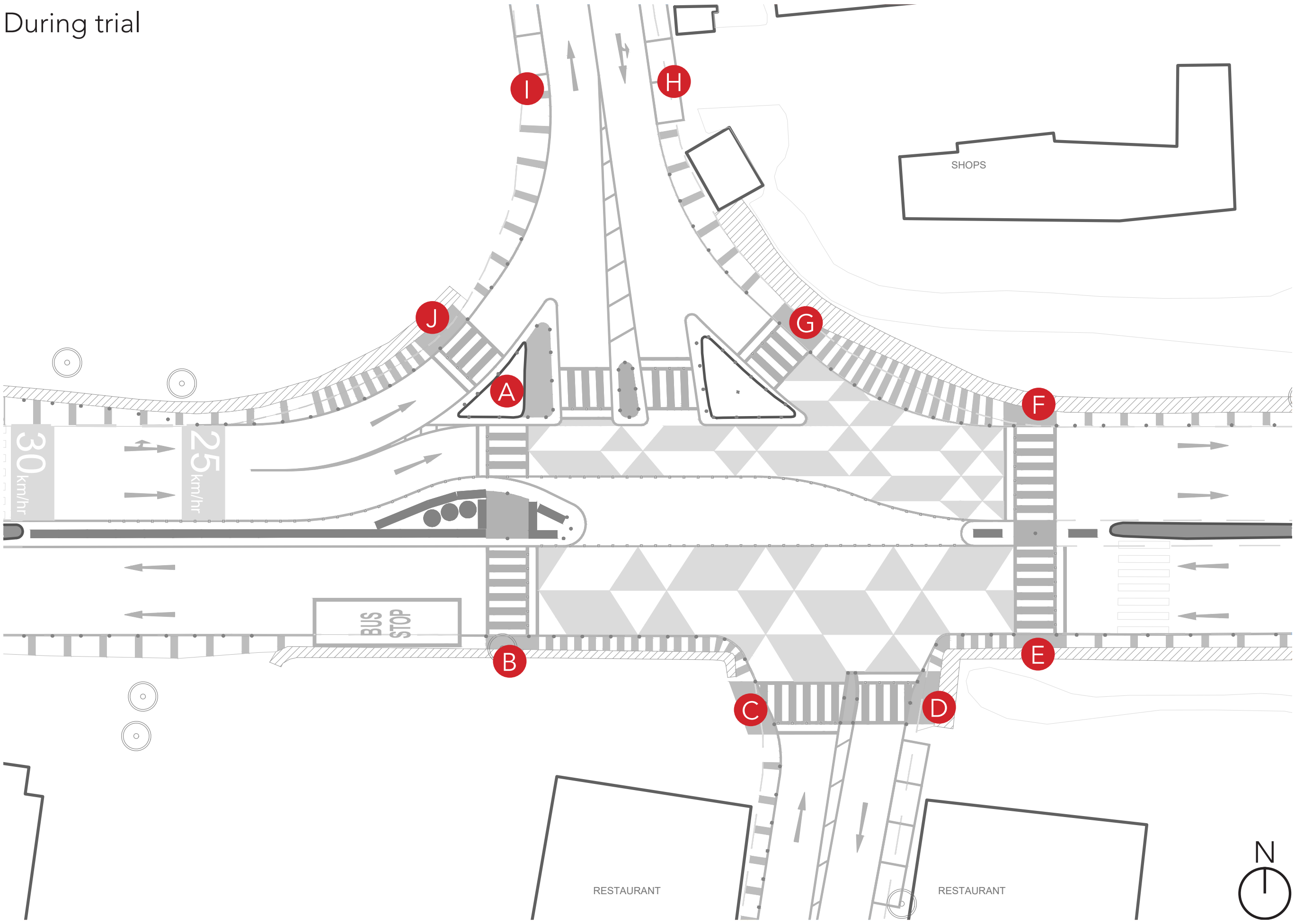


Fig 5.8: Plan highlighting existing pedestrian crossing route.

The proposed condition attempts to reduce the exposure time of pedestrians on the carriageway.

Providing pedestrian crossings and introducing refuge islands reduced the distance for which pedestrians were exposed on the carriageway and the time required for the crossing.

Time travelled from points		
Points	**Time to cross**	**Waiting time**
A to B	30 sec	15 sec
G to J	38 sec	15 sec

Table 5.3: Table summarising time taken to travel from various points in proposed condition

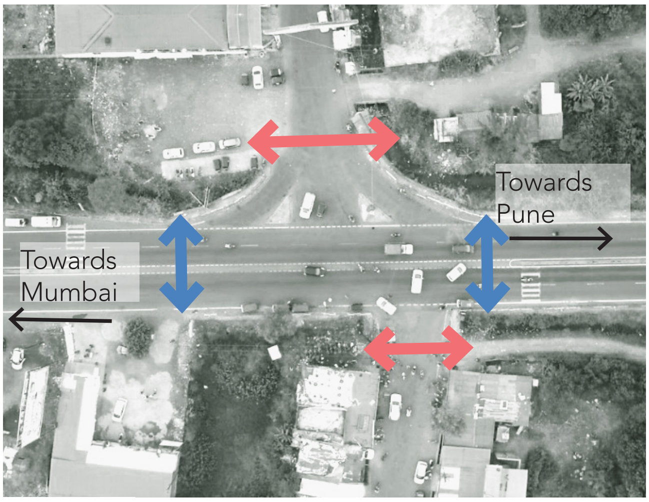
3. Pedestrian counts

Pre-trial

DATE	TIME	TOTAL PEDESTRIAN COUNT
12/25/2020	13:00 - 14:00	111
12/26/2020	13:00 - 14:00	137
12/27/2020	13:00 - 14:00	228

Fig 5.9: Table showing total pedestrian count for peak hours

Pedestrian crossing NH 48



Key Plan

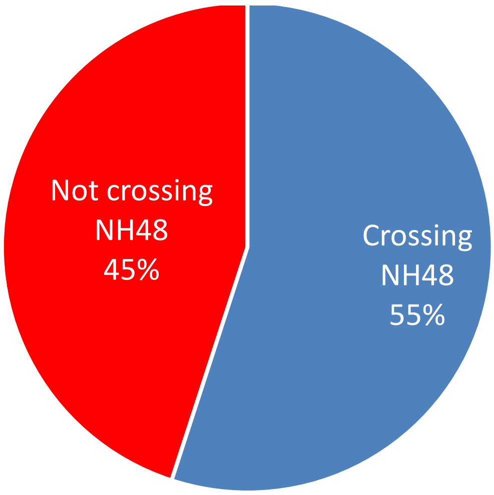


Fig 5.10: The pie chart shows distribution between pedestrians crossing NH 48 or the internal roads for existing situation

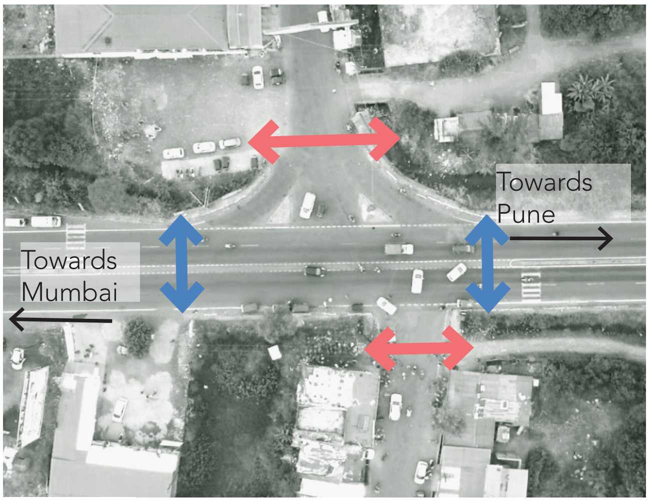
Out of total pedestrian counts on 3 days on Karla junction, it can be observed that about 55% pedestrian cross NH 48.

During trial

DATE	TIME	TOTAL PEDESTRIAN COUNT
12/22/2021	13:00 - 14:00	576
12/23/2021	13:00 - 14:00	484
12/24/2021	13:00 - 14:00	458

Fig 5.11: Table showing total pedestrian count for peak hours during trial

Pedestrian crossing NH 48



Key Plan

Out of the total pedestrian counts on 3 days on Karla Junction, it was observed that about 61% pedestrian cross NH 48.

The difference in the pedestrian footfall during the pre-intervention and intervention survey period was due to the COVID-19 lockdown restrictions imposed in the city.

However, it was observed that the pattern of pedestrian movement was similar when captured for both the pre- and during-trial periods.

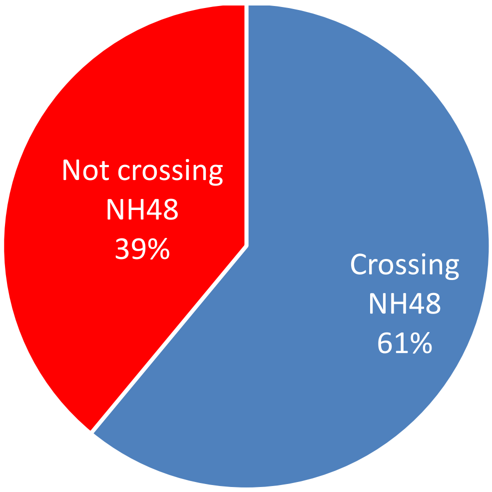


Fig 5.12: The pie chart shows distribution between pedestrians crossing NH 48 or the internal roads after implementation

4. Public Realm

Pre-trial

Fig 5.13: Plan highlighting existing public realm

290 sqm

Existing public realm

(Includes entire scope of intervention)

The public realm which can be used by pedestrians increased significantly in the proposed condition, as compared to the existing condition.

This was achieved by modifying the road geometry and extending the existing traffic island.

The new public realm was painted with the help of synthetic paint and demarcated with the help of traffic cones and barricades.

During trial

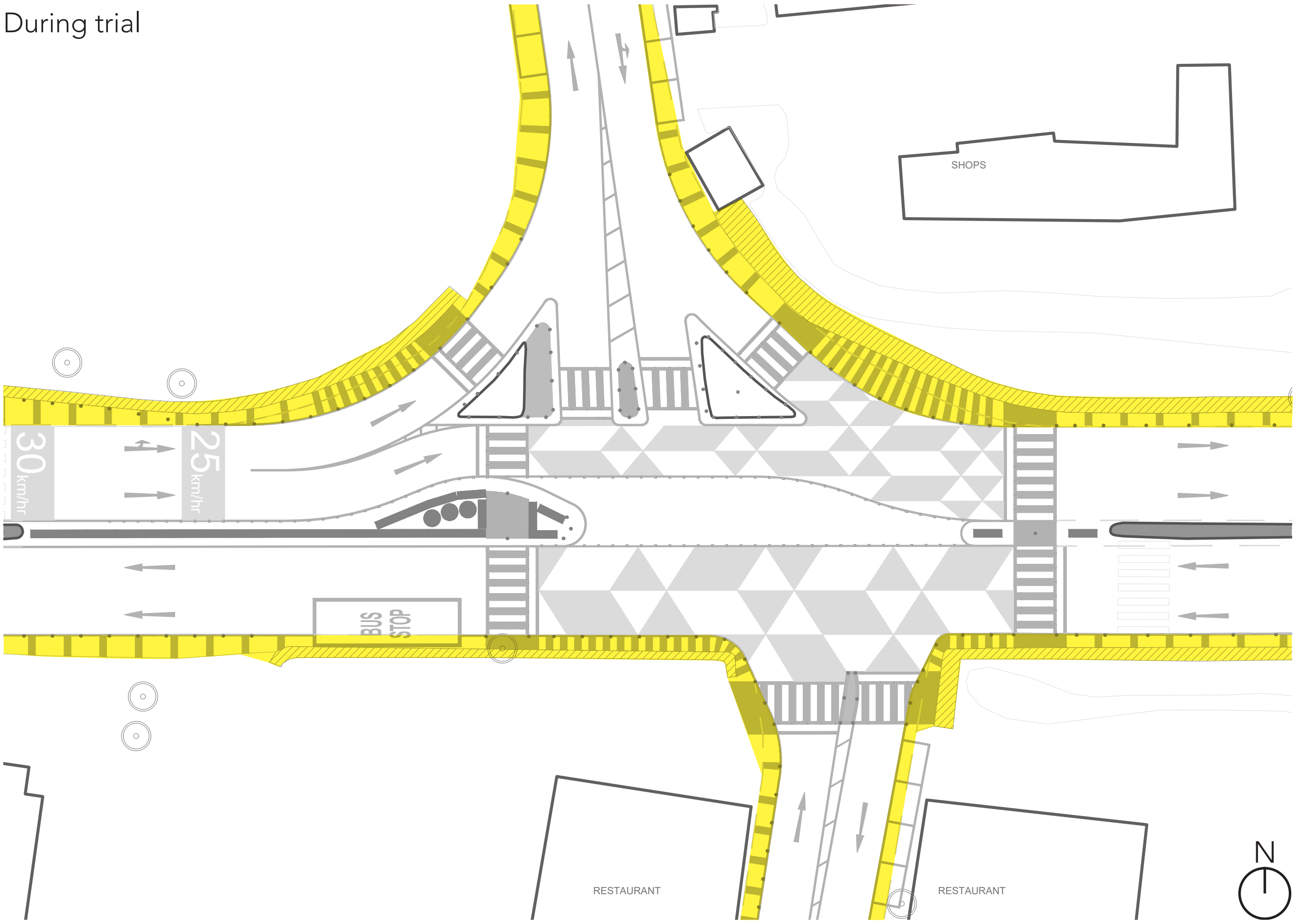


Fig 5.14: Plan highlighting proposed public realm

960 sqm

Proposed public realm

(Includes entire scope of intervention)

231% Increase in public realm

5. Refuge area

Pre-trial

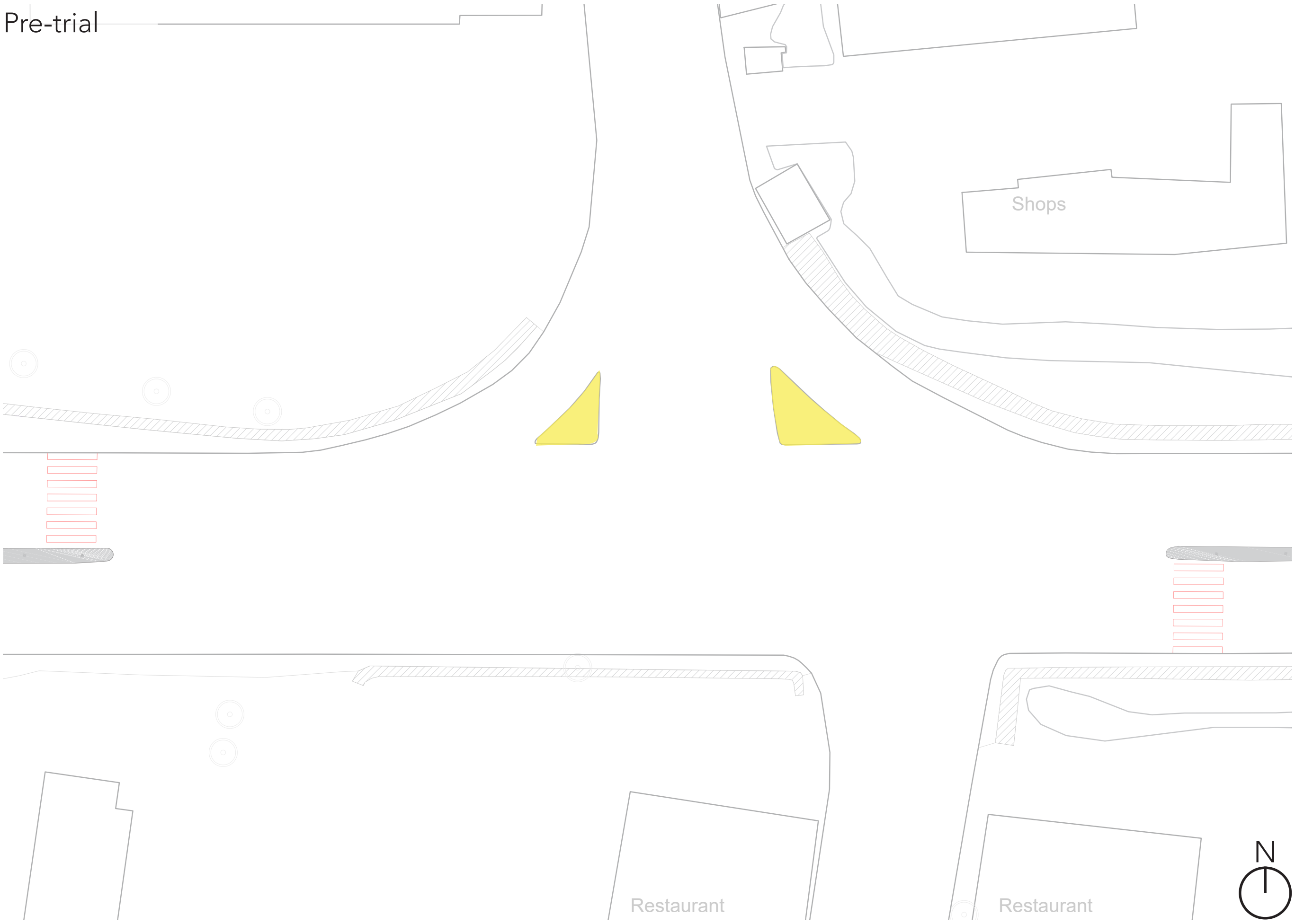


Fig 5.15: Plan highlighting existing refuge area

30.60 sqm

Existing refuge area

(Includes entire scope of intervention)

The refuge area for pedestrians and vehicles increased significantly in the proposed condition as compared to the existing condition.

This was achieved by modifying the road geometry and extending the existing traffic islands.

The refuge islands were painted with the help of synthetic paint and were demarcated with the help of traffic cones and barricades.

This helped pedestrians and vehicles have a dedicated space to wait before crossing the intersection.

During trial

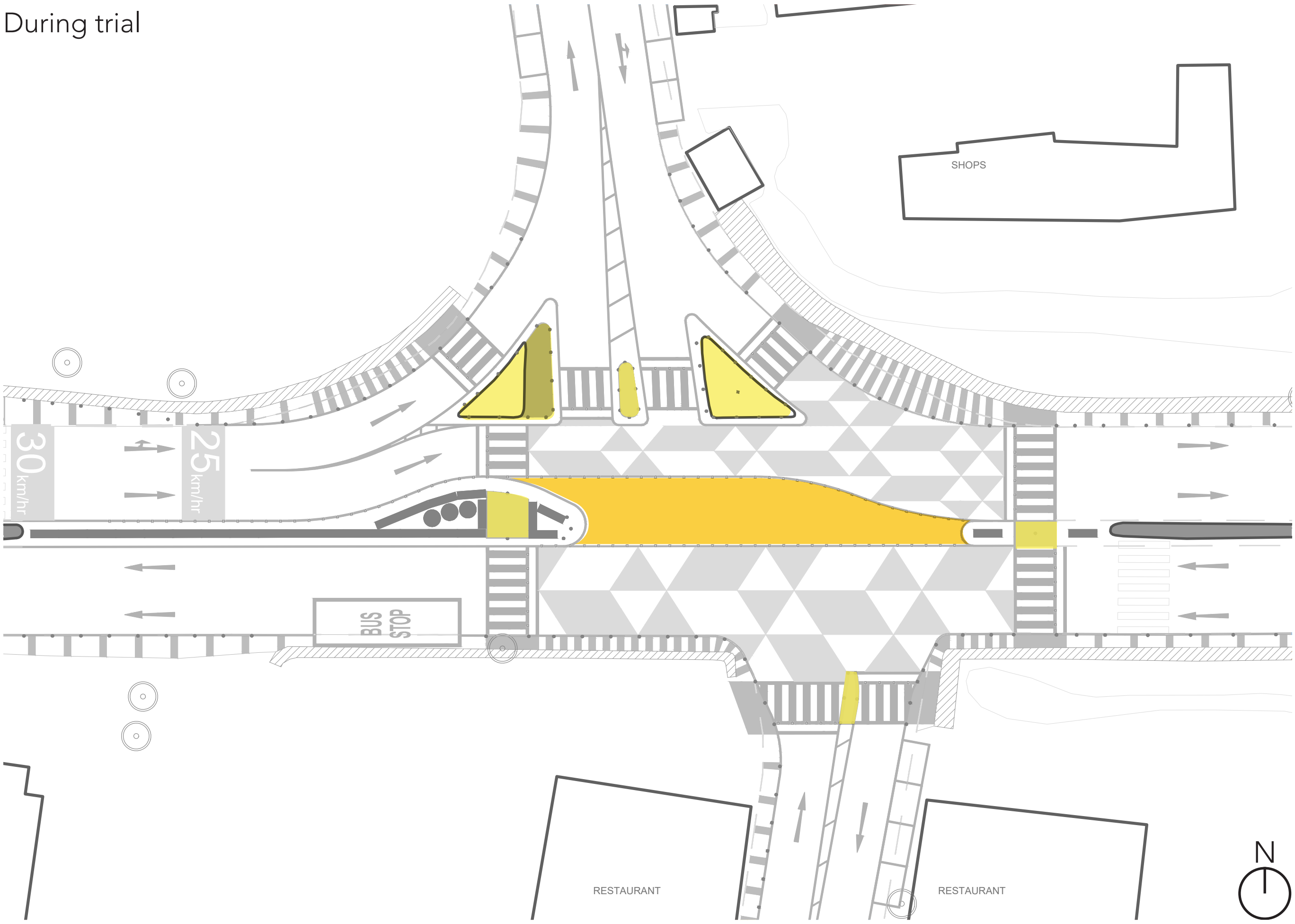


Fig 5.16: Plan highlighting proposed refuge areas

148.1 sqm

Proposed refuge area

(Includes entire scope of intervention)

Pedestrian refuge area: 36.76 sqm
Vehicular refuge area: 111.34 sqm

383% Increase in refuge area

Legend

- Pedestrian refuge
- Vehicular refuge

B. Vehicular Impact Analysis

1. Vehicular Speed - 85th Percentile speed chart

Pre-Trial

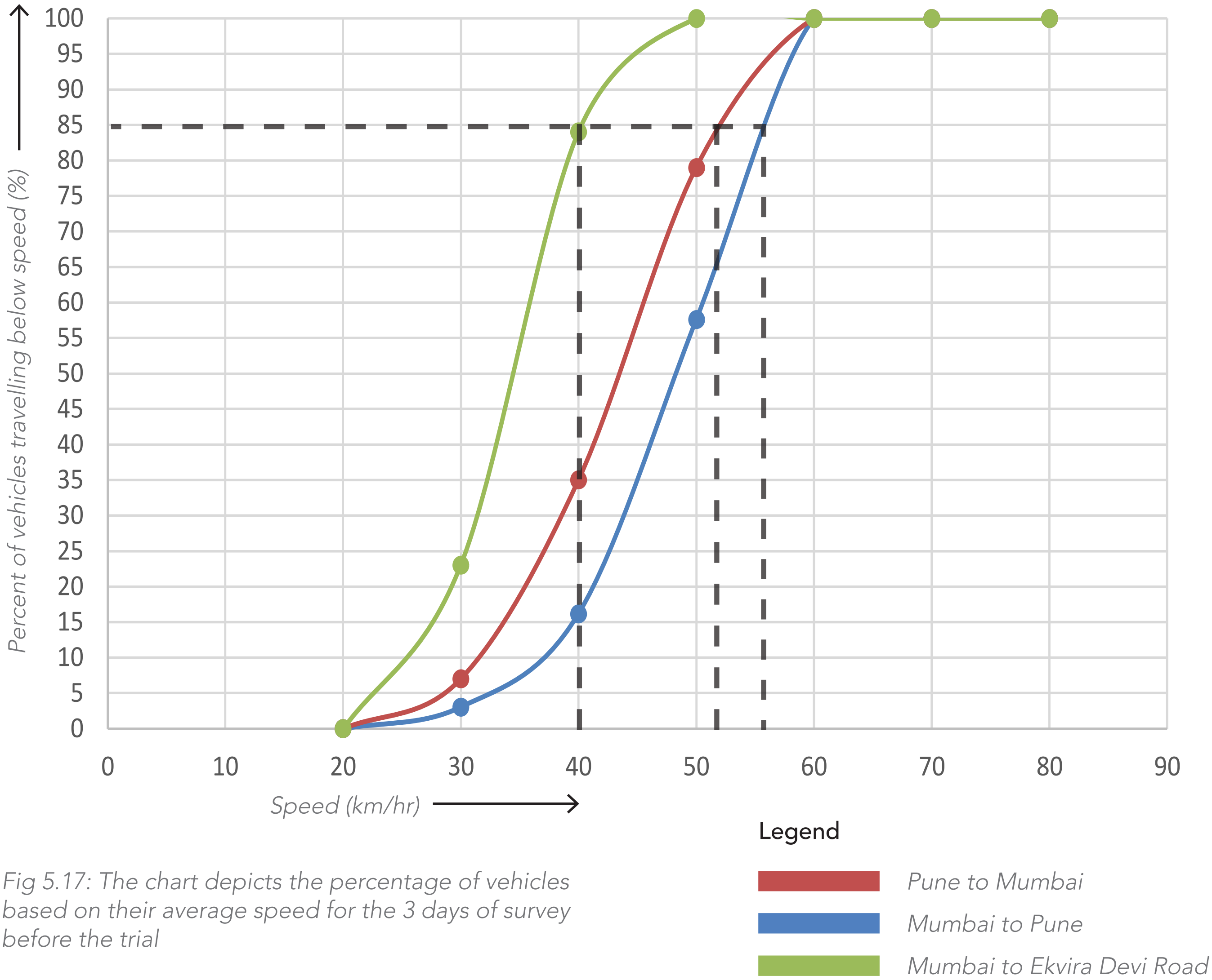


Fig 5.17: The chart depicts the percentage of vehicles based on their average speed for the 3 days of survey before the trial

Pune to Mumbai: 52 km/hr

Mumbai to Pune: 56 km/hr

Mumbai to Ekvira Devi: 40 km/hr

The recommended speed on NH 48 is 50 km/hr.

As per the survey conducted for 3 days, 85th percentile speed of vehicles on NH 48 was observed to be 52 and 56 km/hr, respectively.

As the intersection is more urban in nature, speeds of vehicles were found to be very high.

During trial

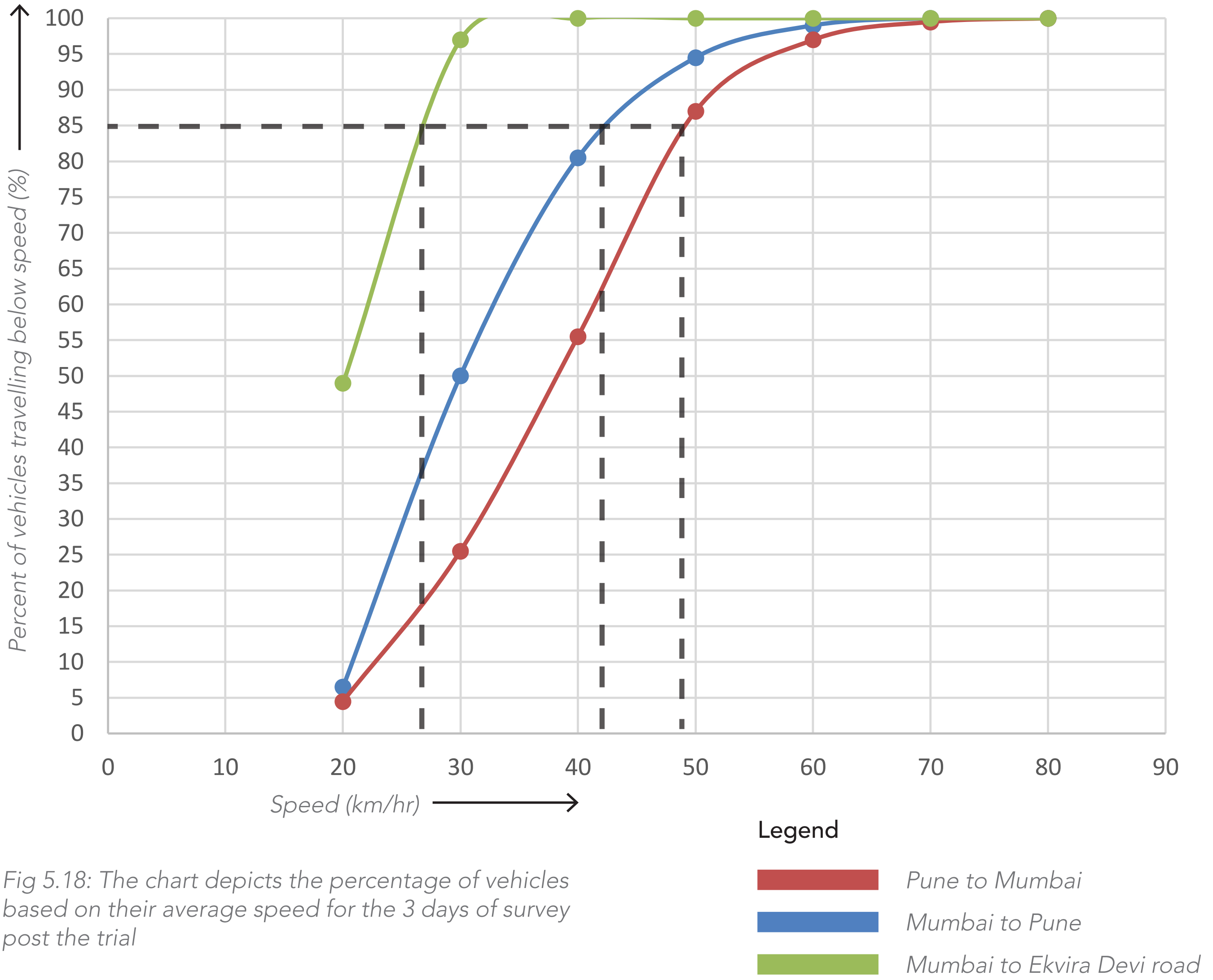


Fig 5.18: The chart depicts the percentage of vehicles based on their average speed for the 3 days of survey post the trial

Pune to Mumbai: 48 km/hr

Mumbai to Pune: 43 km/hr

Mumbai to Ekvira Devi: 26 km/hr

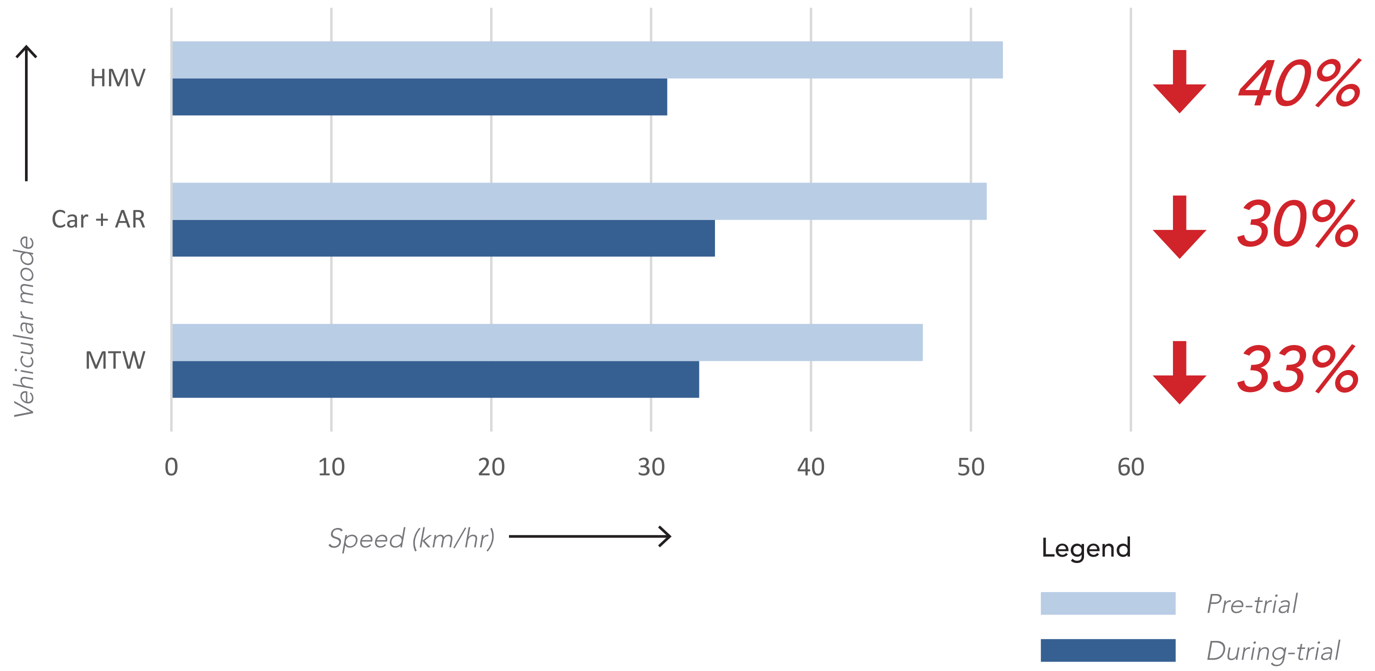
1. As a result of road geometry correction and carriageway width reduction in the Mumbai to Pune direction, there was a 24% reduction in speed.

2. In the Pune to Mumbai direction there was a minimal carriageway width reduction; hence the speed reduction observed was less too.

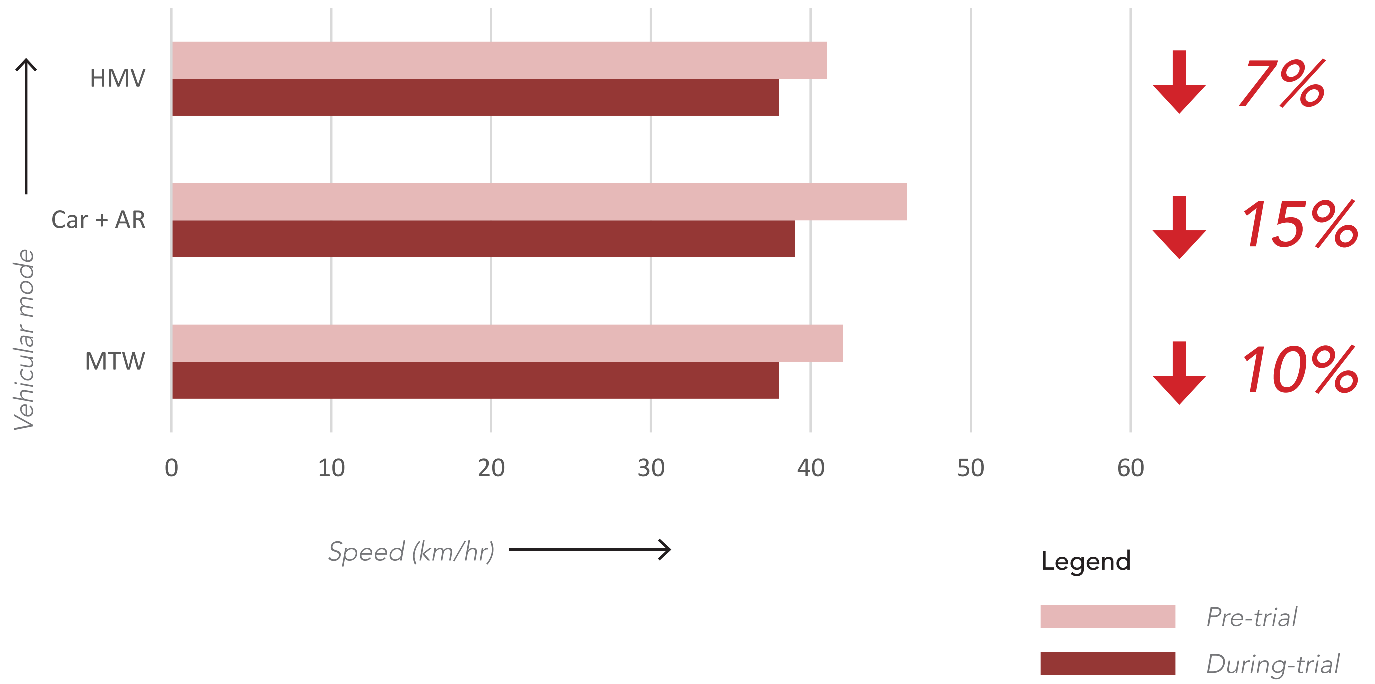
3. As a result of the reduction in the turning radius, a 35% reduction in speed of vehicles turning towards the Ekvira Devi Road from Mumbai, was witnessed.

2. Average vehicular speed

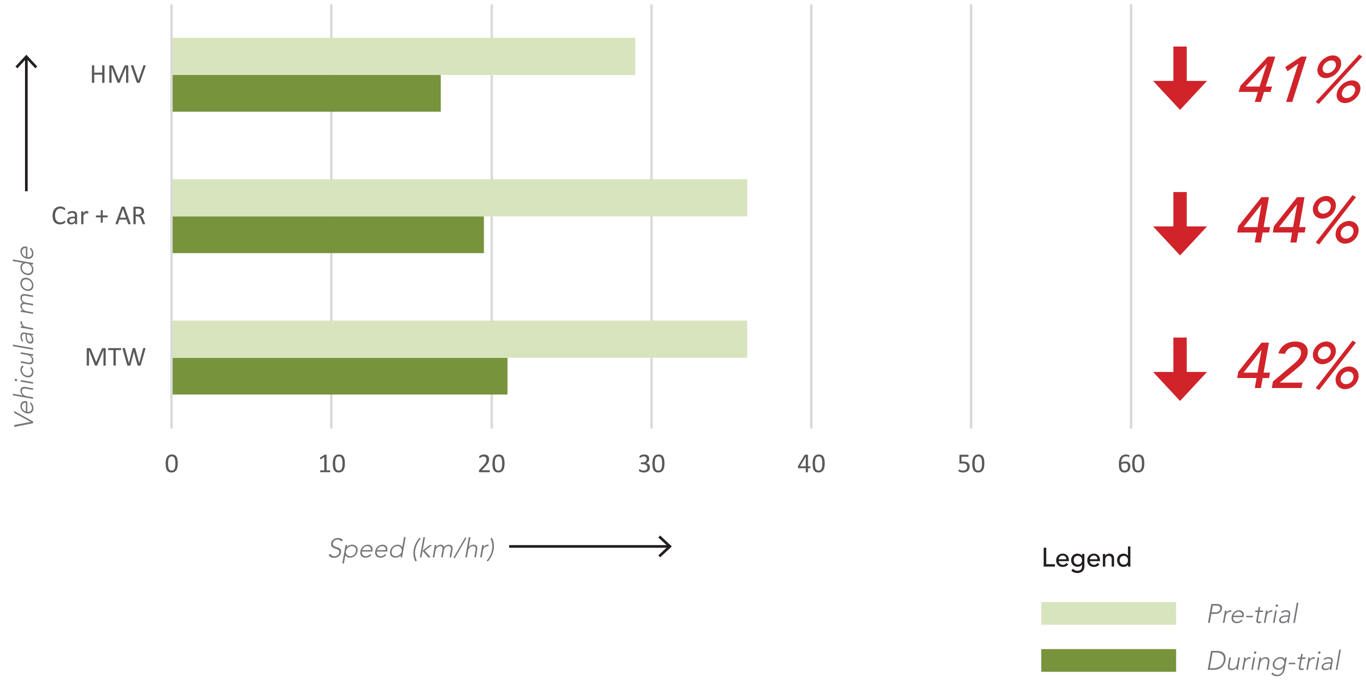
Mumbai to Pune



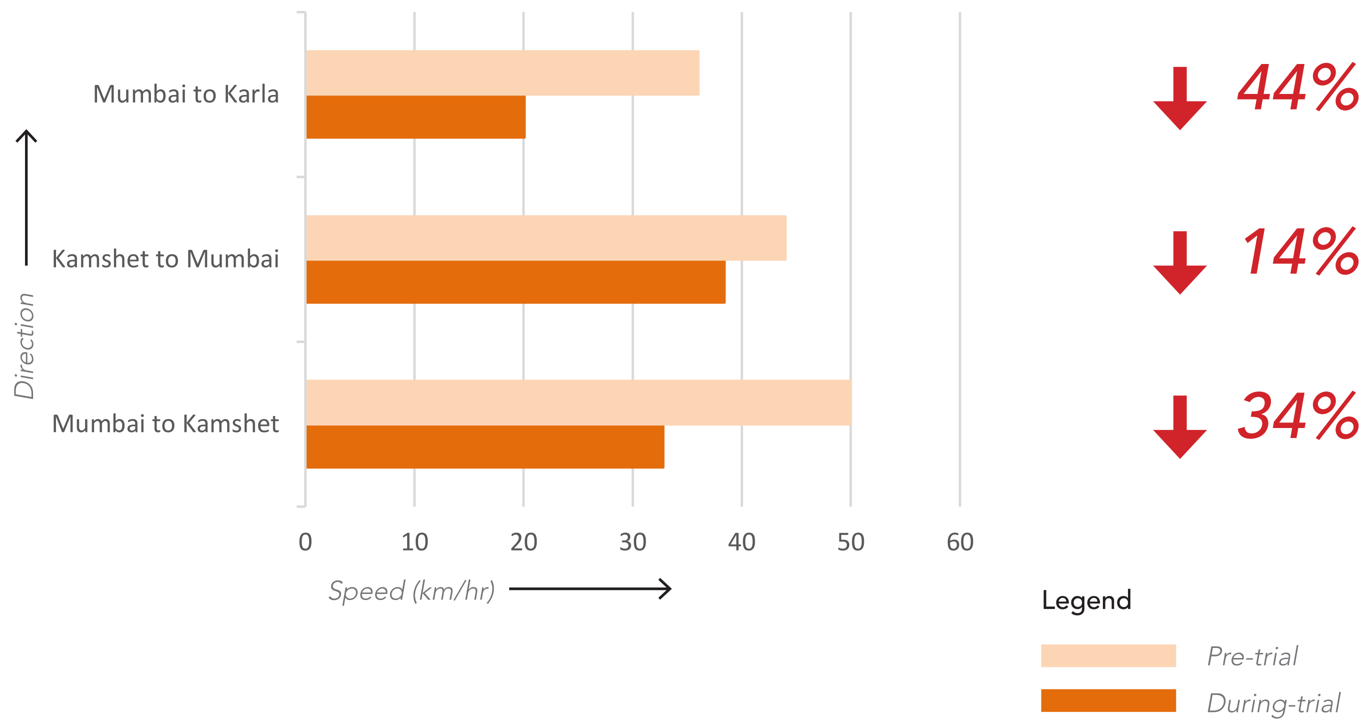
Pune to Mumbai



Mumbai to Ekvira Devi Road



Average Speed



3. Critical gap acceptance

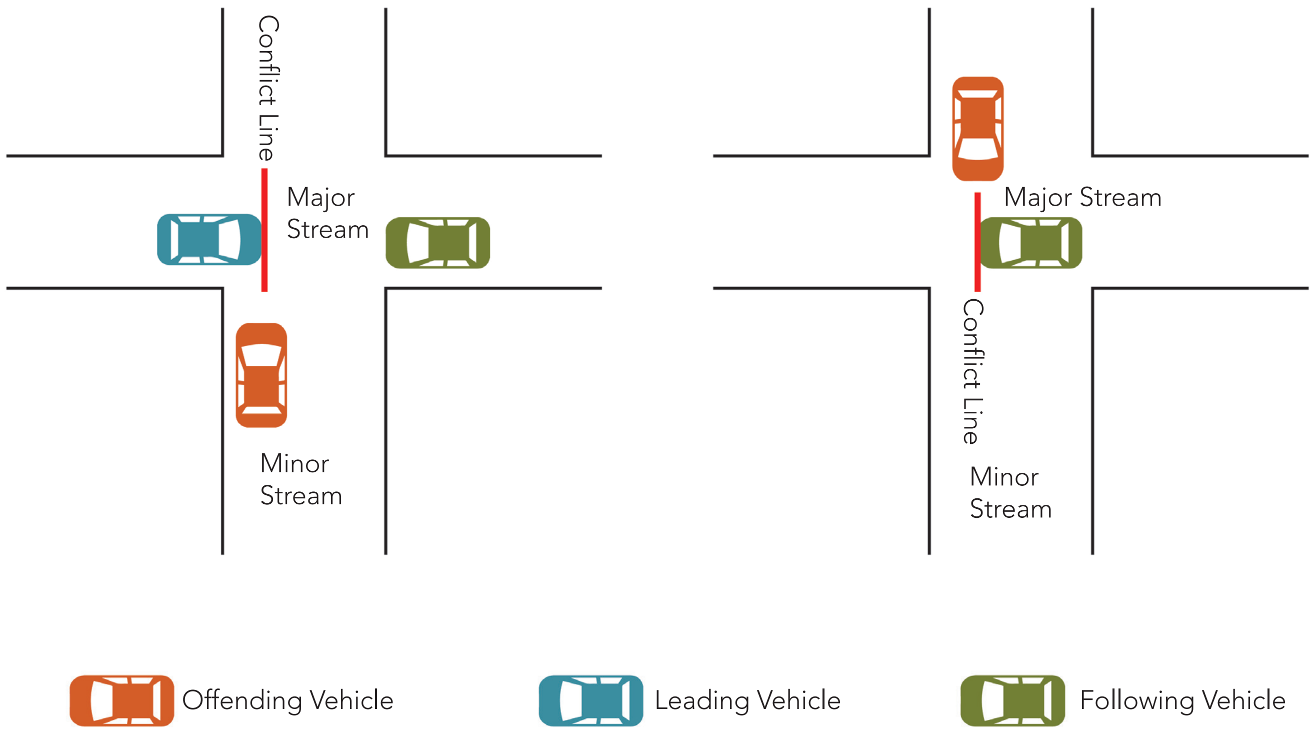


Fig 5.19: Critical gap acceptance diagram

At a priority-controlled intersection, critical gap is usually considered as a fixed value. The major stream and minor stream are both one-way traffic flows at the priority-controlled intersection. Critical gap is the threshold by which drivers in the minor stream judge whether to accept a gap. If the gap is larger than the critical gap, drivers accept it and enter the intersection; otherwise, drivers reject the gap and wait for the next gap.

When the minor street vehicles accept the available gap in the major stream and manoeuvre through the intersection, that particular gap is called the accepted gap.

If minor street vehicle rejects the available gap in the major stream, that particular gap is rejected gap.

After sample collection, the nature of risk at the intersection is analysed by making calculations based on the accepted gap and critical gap ratio. Similar data is collected after intervention and the analysis can be quantified before and after the Tactical Urbanism redesign.

How to read the graph?

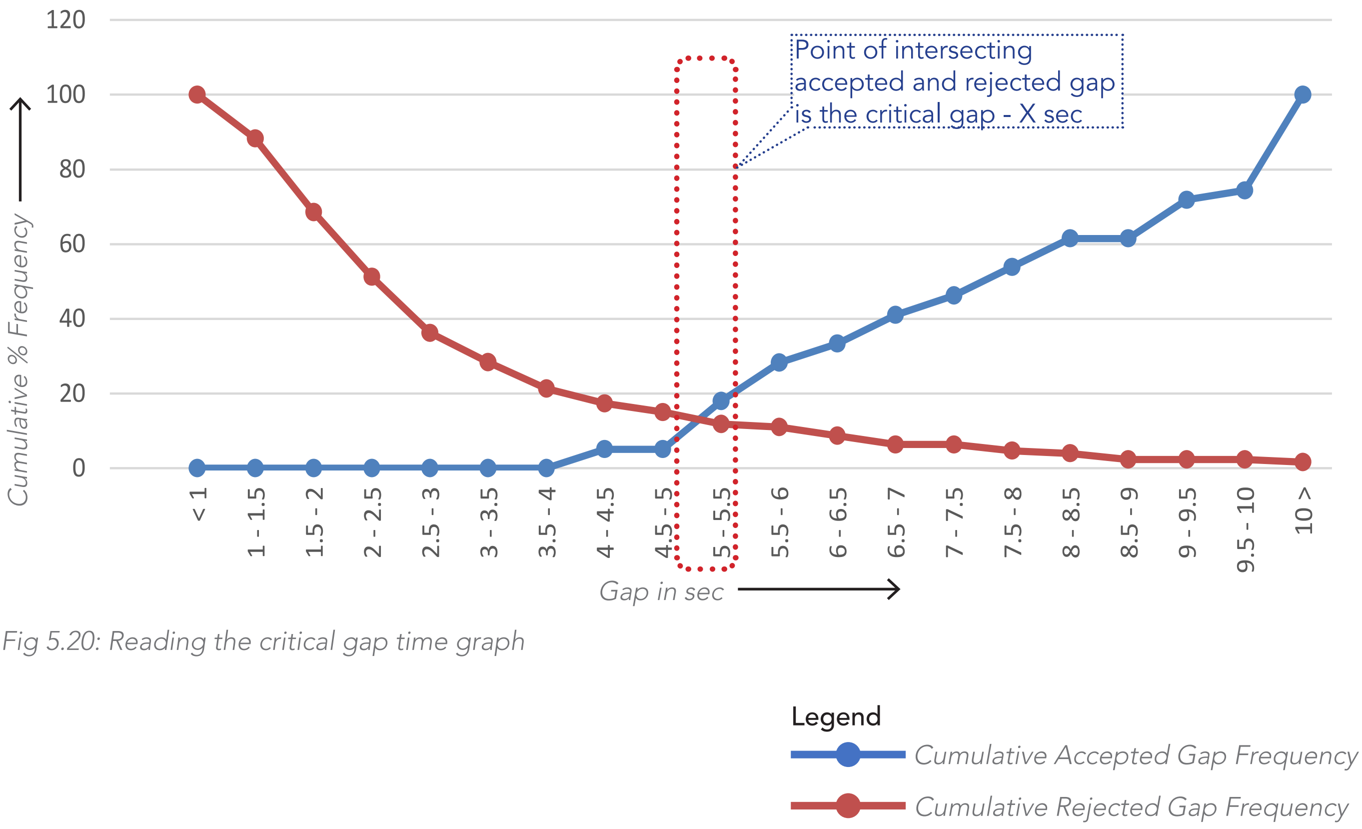


Fig 5.20: Reading the critical gap time graph

How to read the table?

Ratio (Accepted gap/Critical gap)	Risk characterisation for two-wheelers	Nature of Risk
0-1	X %	Serious conflict
1-1.5	X %	Non-serious conflict

Table 5.4: Reading Risk characterisation table

If the ratio of accepted gap/critical gap falls under 0-1, the nature of risk has been categorised as Serious Conflict.

Pre-trial

For two-wheelers moving from the Ekvira Devi Road to Mumbai

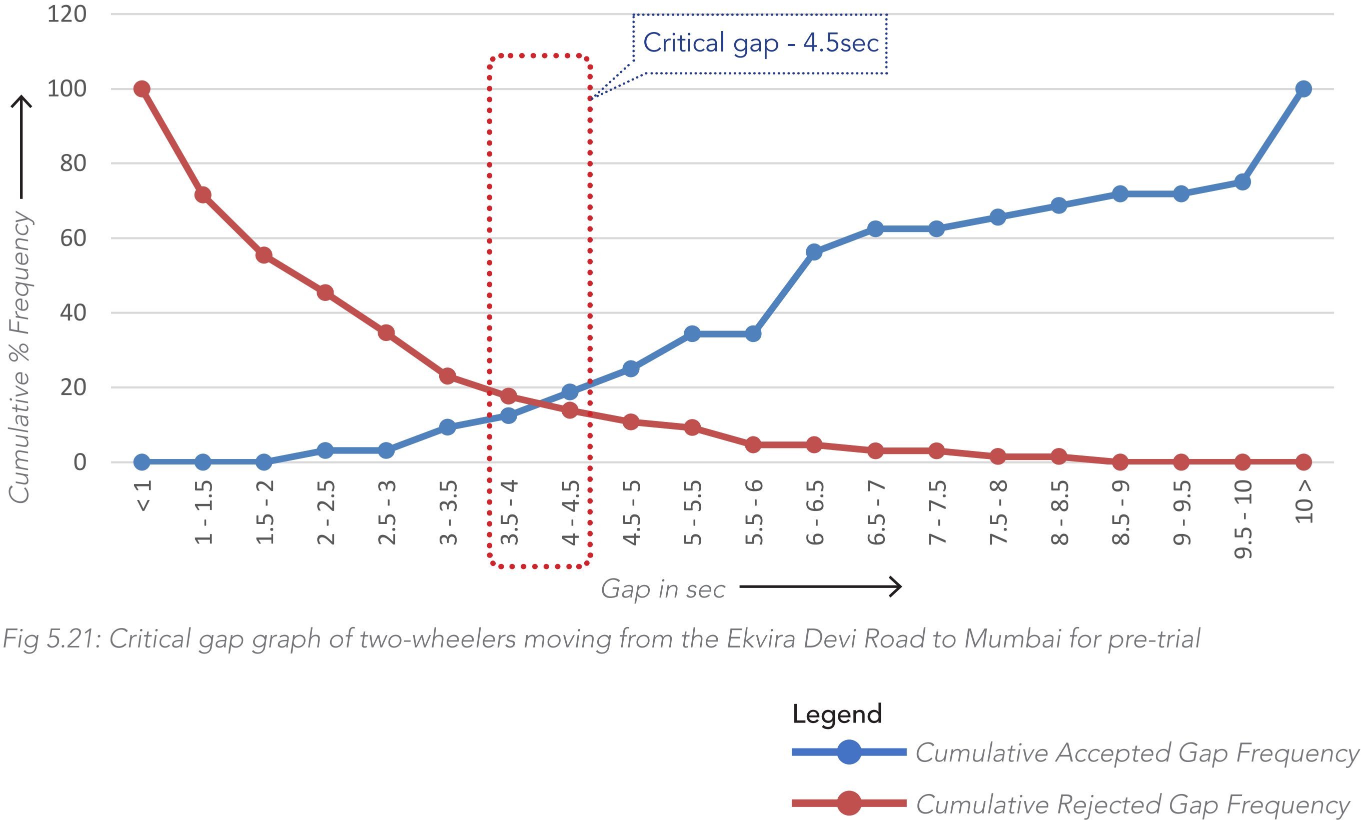


Fig 5.21: Critical gap graph of two-wheelers moving from the Ekvira Devi Road to Mumbai for pre-trial

Risk characterisation for two-wheelers

Ratio (Accepted gap/Critical gap)	**Risk characterisation for two-wheelers**	**Nature of Risk**
0-1	18%	Serious conflict
1<	82%	Non-serious conflict

Table 5.5: Risk characterisation table for two-wheelers

If the ratio falls under 1, the nature of risk has been categorised as Serious Conflict. It is observed that in the sample size of 100 vehicles, 18% of the two-wheelers were at a risk of serious conflict.

During trial

For two-wheelers moving from the Ekvira Devi Road to Mumbai

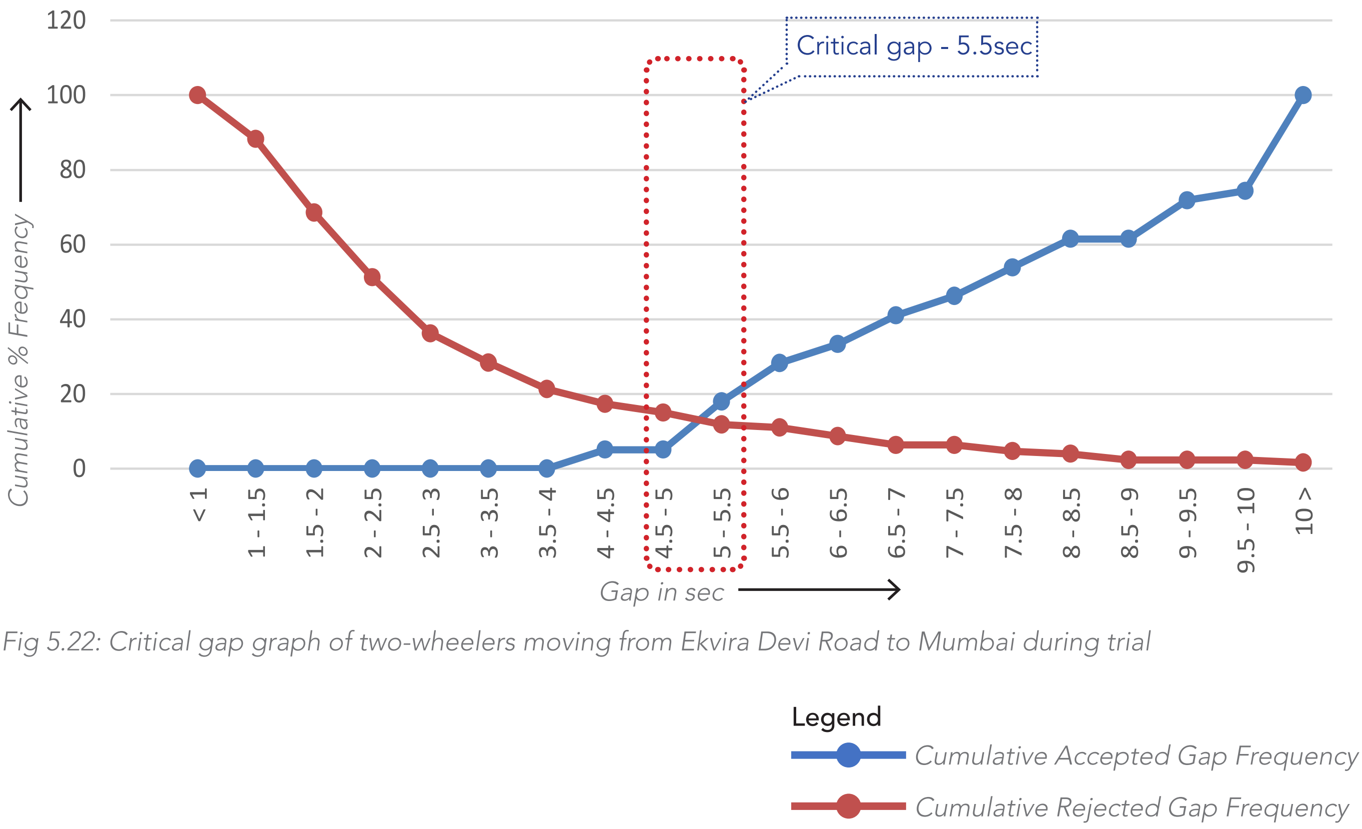


Fig 5.22: Critical gap graph of two-wheelers moving from Ekvira Devi Road to Mumbai during trial

Risk characterisation for two-wheelers

Ratio (Accepted gap/Critical gap)	Risk characterisation for two-wheelers	Nature of Risk
0-1	3%	Serious conflict
1<	97%	Non-serious conflict

Table 5.6: Risk characterisation table for two-wheelers

It is observed that in the sample size of 100 vehicles, the critical gap increased to **5.5 seconds** and there was a reduction of two-wheelers that accepted a gap of less than 4.5 seconds. The percentage of vehicles where the ratio of accepted gap/original critical gap is less than 1 was 3%.

Pre-trial

For four-wheelers moving from Ekvira Devi Road to Mumbai

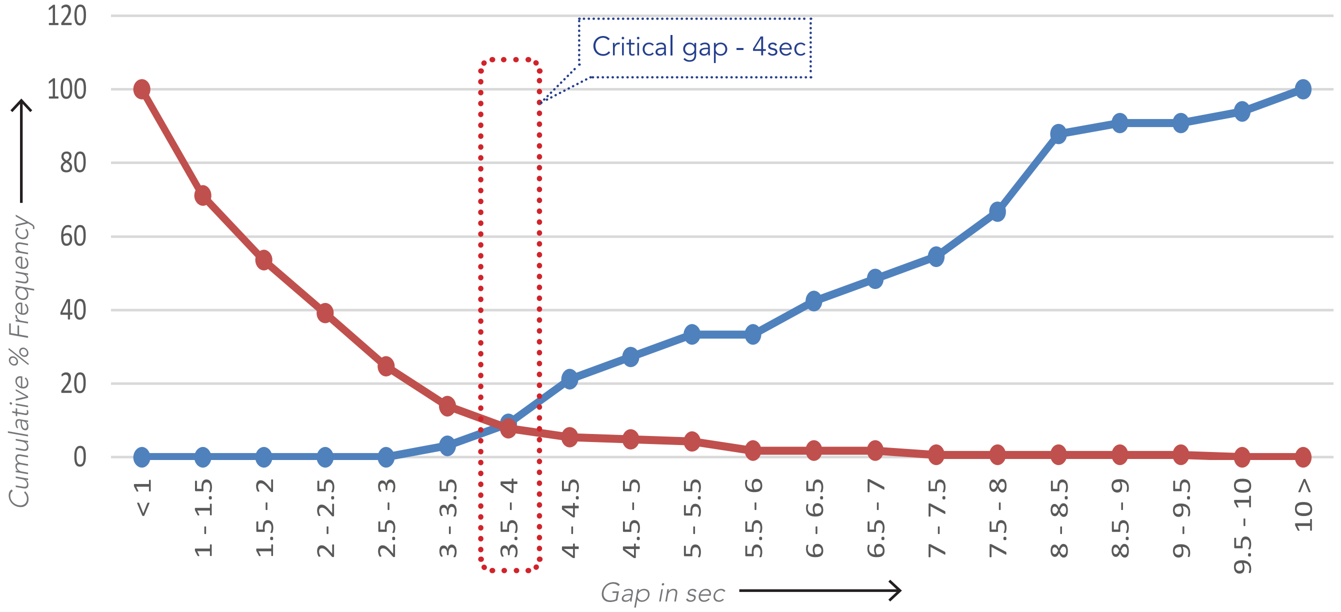


Fig 5.23: Critical gap graph of four-wheelers moving from the Ekvira Devi Road to Mumbai for pre-trial

Legend

Cumulative Accepted Gap Frequency

Cumulative Rejected Gap Frequency

Risk characterisation for four-wheelers

Ratio (Accepted gap/Critical gap)	Risk characterisation for four-wheelers	Nature of Risk
0-1	6%	Serious conflict
1 <	94%	Non-serious conflict

Table 5.7: Risk characterisation table for four-wheelers

If the ratio falls under 1, the nature of risk has been categorised as Serious Conflict. It is observed that in the sample size of 100 vehicles, 6% of the four-wheelers were at a risk of serious conflict.

During trial

For four-wheelers moving from the Ekvira Devi Road to Mumbai

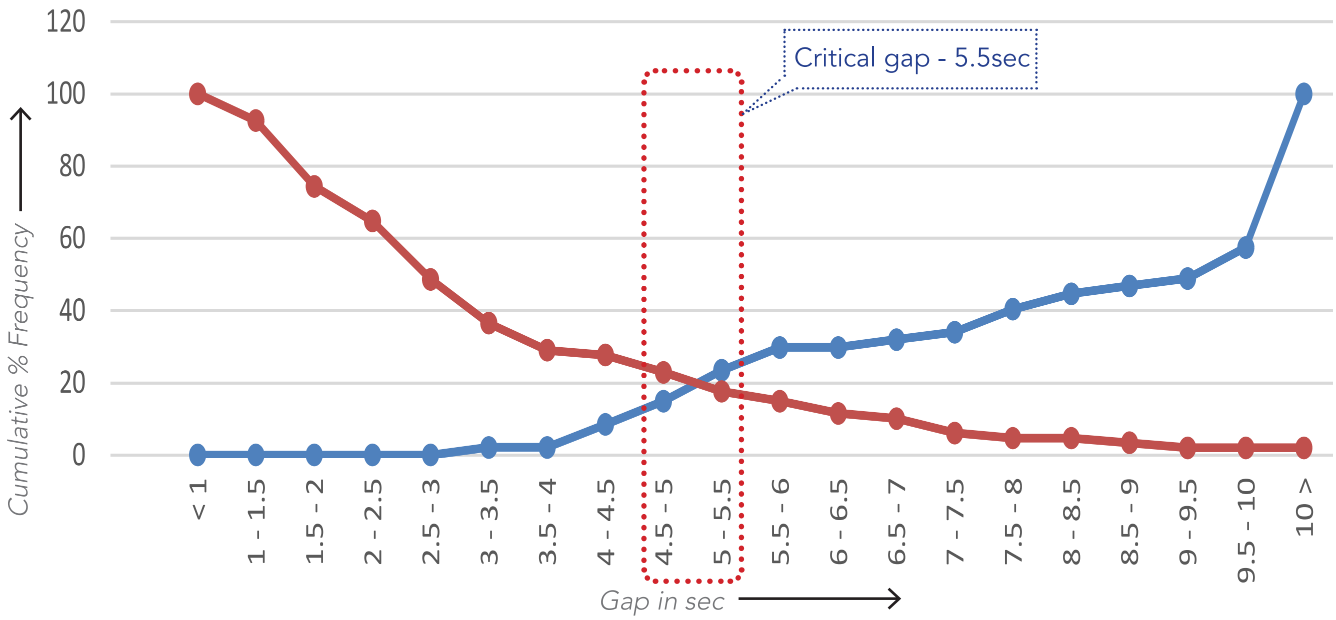
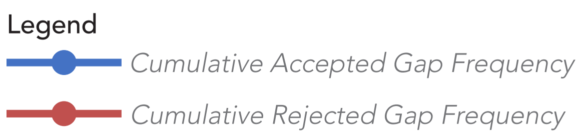


Fig 5.24: Critical gap graph of four-wheelers moving from Ekvira Devi Road to Mumbai during the trial



Risk characterisation for four-wheelers

Ratio (Accepted gap/Critical gap)	Risk characterisation for four-wheelers	Nature of Risk
0-1	2%	Serious conflict
1 <	98%	Non-serious conflict

Table 5.8: Risk characterisation table for four wheelers

It is observed that in the sample size of 100 vehicles, the critical gap has increased to 5.5 seconds and there is reduction of four-wheelers who accepted a gap of less than 4 seconds. The % of vehicles where the ratio of accepted gap/original critical gap is less than 1 is 2%.

Pre-trial

For two-wheelers moving from Karla Village to Pune

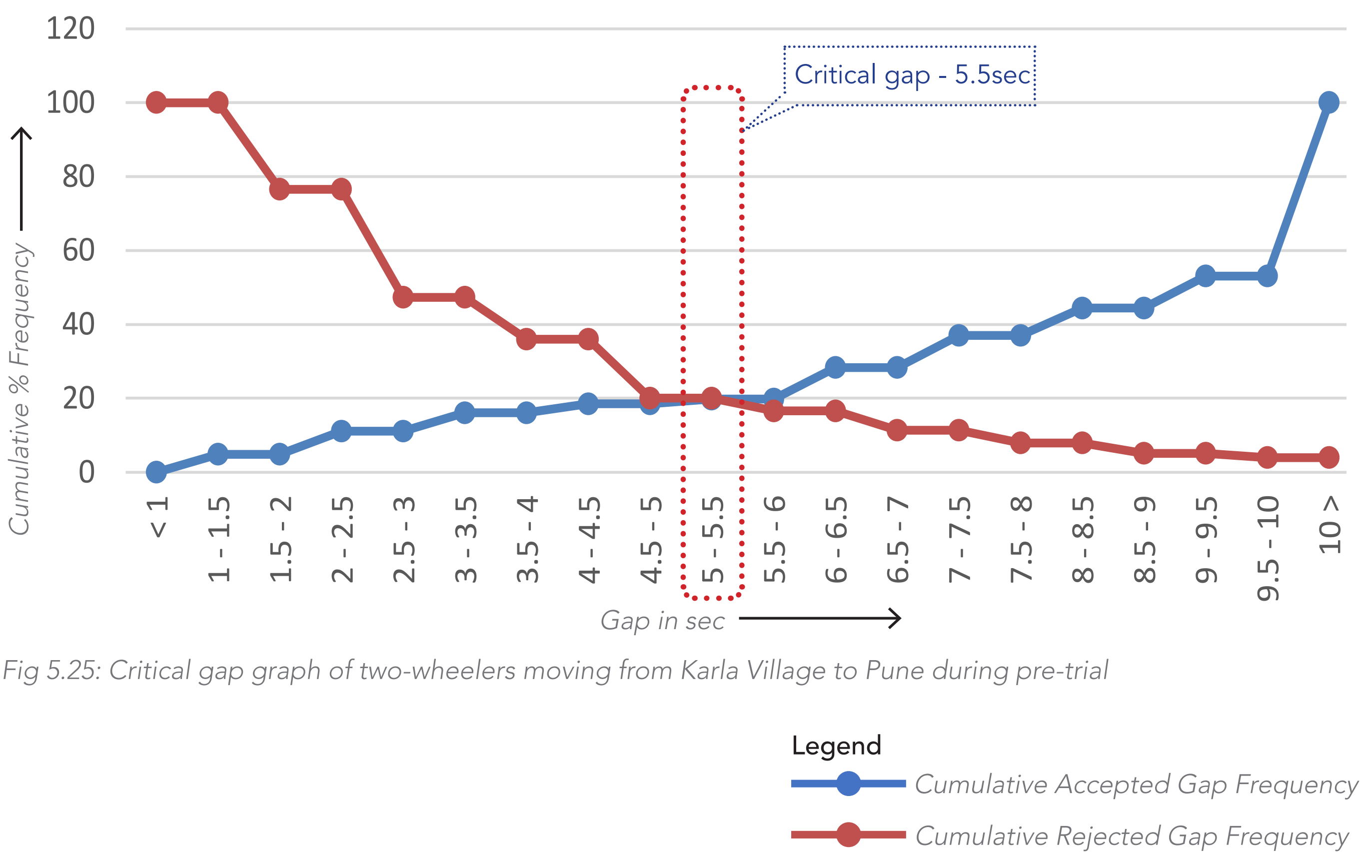


Fig 5.25: Critical gap graph of two-wheelers moving from Karla Village to Pune during pre-trial

Risk characterisation for two-wheelers

Ratio (Accepted gap/Critical gap)	Risk characterisation for two-wheelers	Nature of Risk
0-1	20%	Serious conflict
1 <	80%	Non-serious conflict

Table 5.9: Risk characterisation table for two wheelers

If the ratio falls under 1, the nature of risk has been categorised as Serious Conflict. It is observed that in the sample size of 100 vehicles, 20% of the two-wheelers were at a risk of serious conflict.

During trial

For two-wheelers moving from Karla Village to Pune

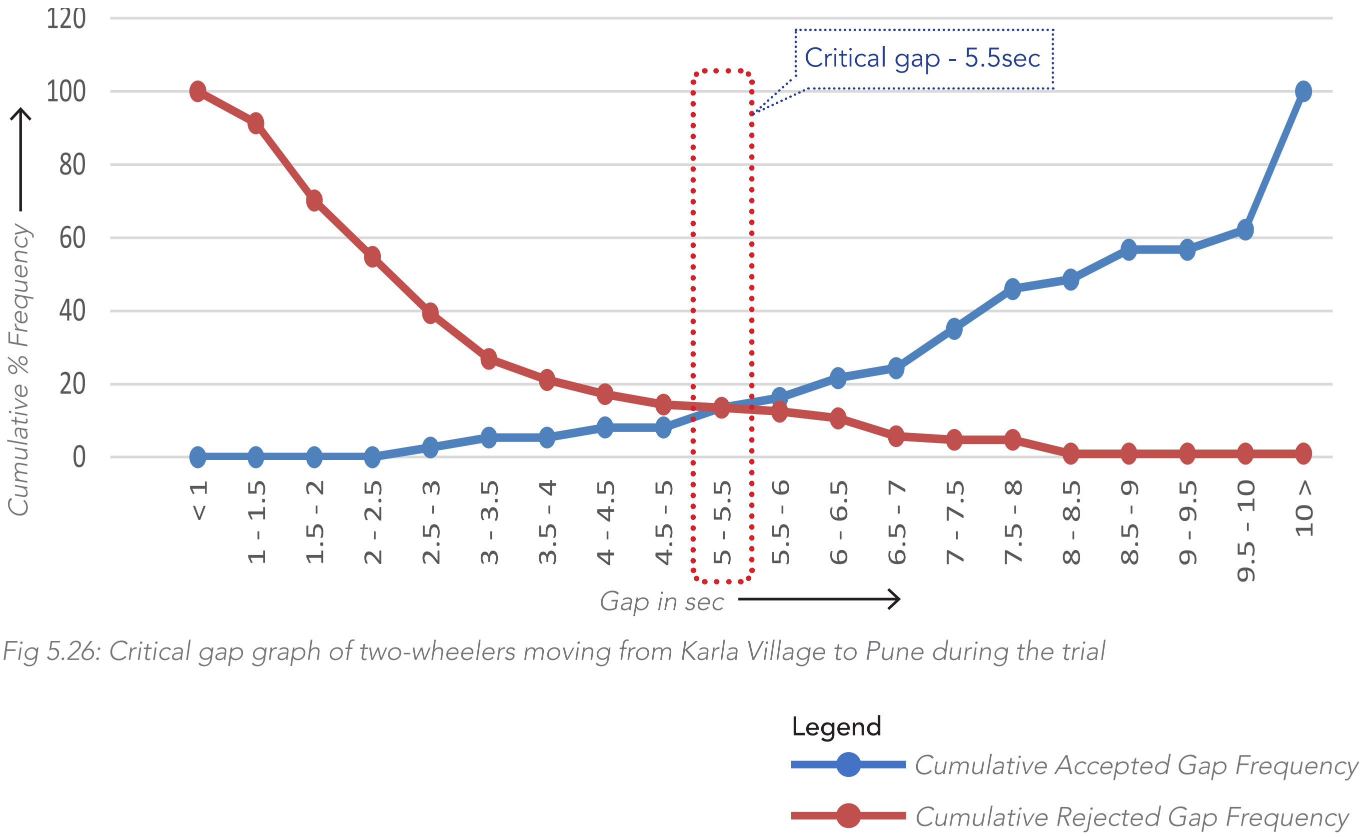


Fig 5.26: Critical gap graph of two-wheelers moving from Karla Village to Pune during the trial

Risk characterisation for two-wheelers

Ratio (Accepted gap/Critical gap)	Risk characterisation for two-wheelers	Nature of Risk
0-1	8%	Serious conflict
1 <	92%	Non-serious conflict

Table 5.10: Risk characterisation table for two wheelers

It is observed that in the sample size of 100 vehicles, the critical gap has stayed the same at 5.5 seconds; however there is reduction of two-wheelers that accepted a gap of less than 5 seconds. The % of vehicles where the ratio of accepted gap/original critical gap is less than 1 is 8%.

Pre-Trial

For four-wheelers moving from Karla Village to Pune

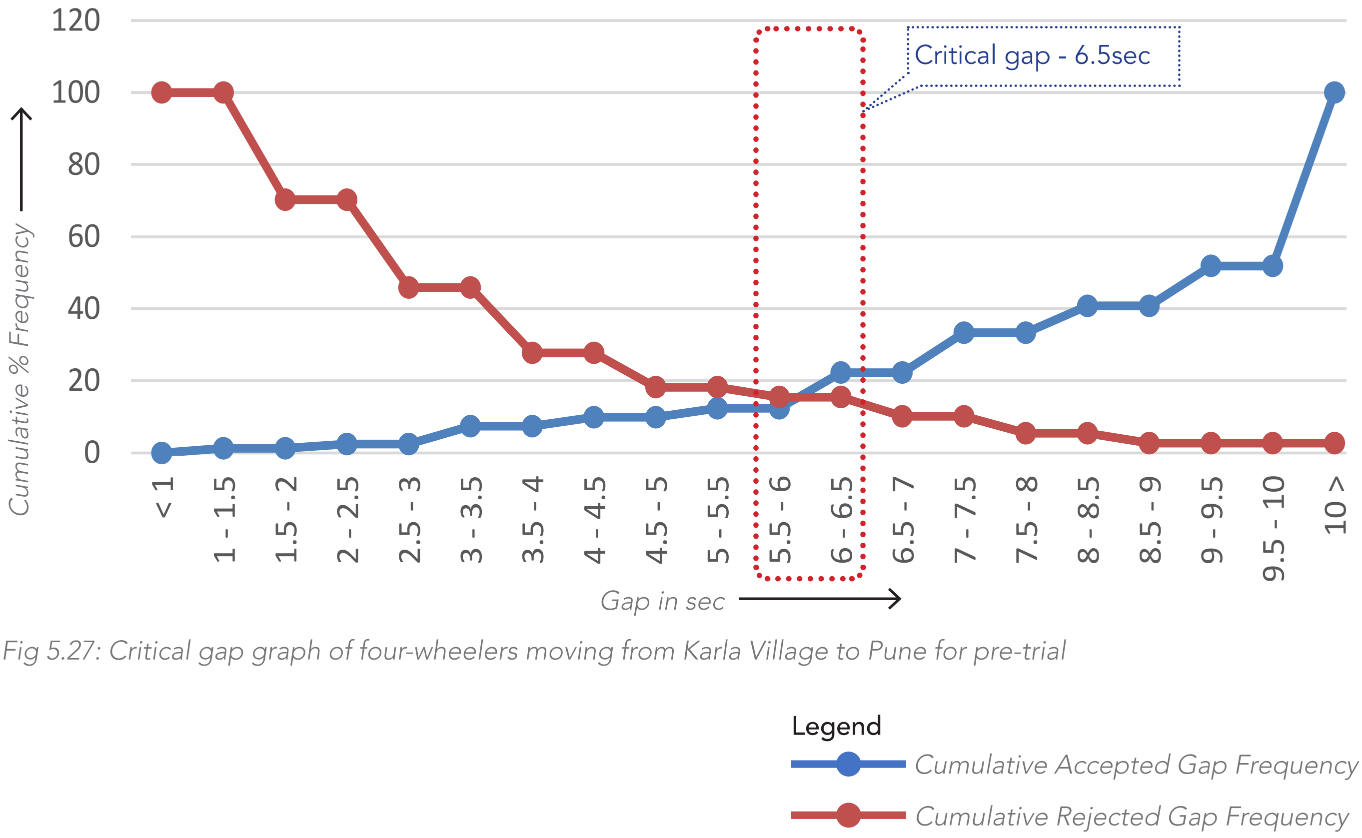


Fig 5.27: Critical gap graph of four-wheelers moving from Karla Village to Pune for pre-trial

Risk characterisation for four-wheelers

Ratio (Accepted gap/Critical gap)	Risk characterization for four-wheelers	Nature of Risk
0-1	25%	Serious conflict
1 <	75%	Non-serious conflict

Table 5.11: Risk characterisation table for four wheelers

If the ratio falls under 1, the nature of risk has been categorised as Serious Conflict. It was observed that in the sample size of 100 vehicles, 25% of the four-wheelers were at a risk of serious conflict.

During trial

For four-wheelers moving from Karla Village to Pune

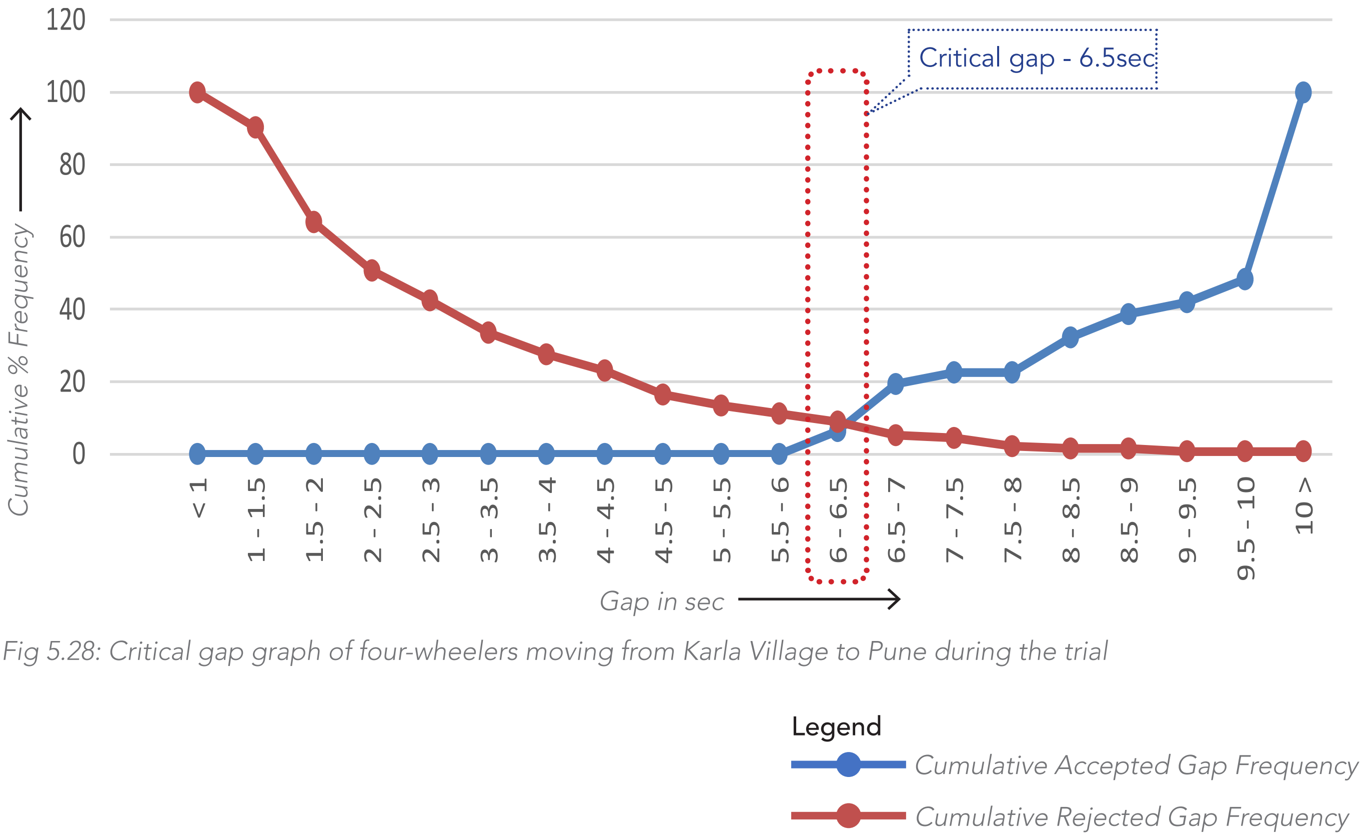


Fig 5.28: Critical gap graph of four-wheelers moving from Karla Village to Pune during the trial

Risk characterisation for four wheelers

Ratio (Accepted gap/Critical gap)	Risk characterisation for four-wheelers	Nature of Risk
0-1	0%	Serious conflict
1 <	100%	Non-serious conflict

Table 5.12: Risk characterisation table for four wheelers

It was observed that in the sample size of 100 vehicles, the critical gap stayed the same at 6 seconds; however there was a reduction of four-wheelers that accepted a gap of less than 6 seconds. The % of vehicles where the ratio of accepted gap/original critical gap is less than 1 was zero.

4. Vehicle turning speed

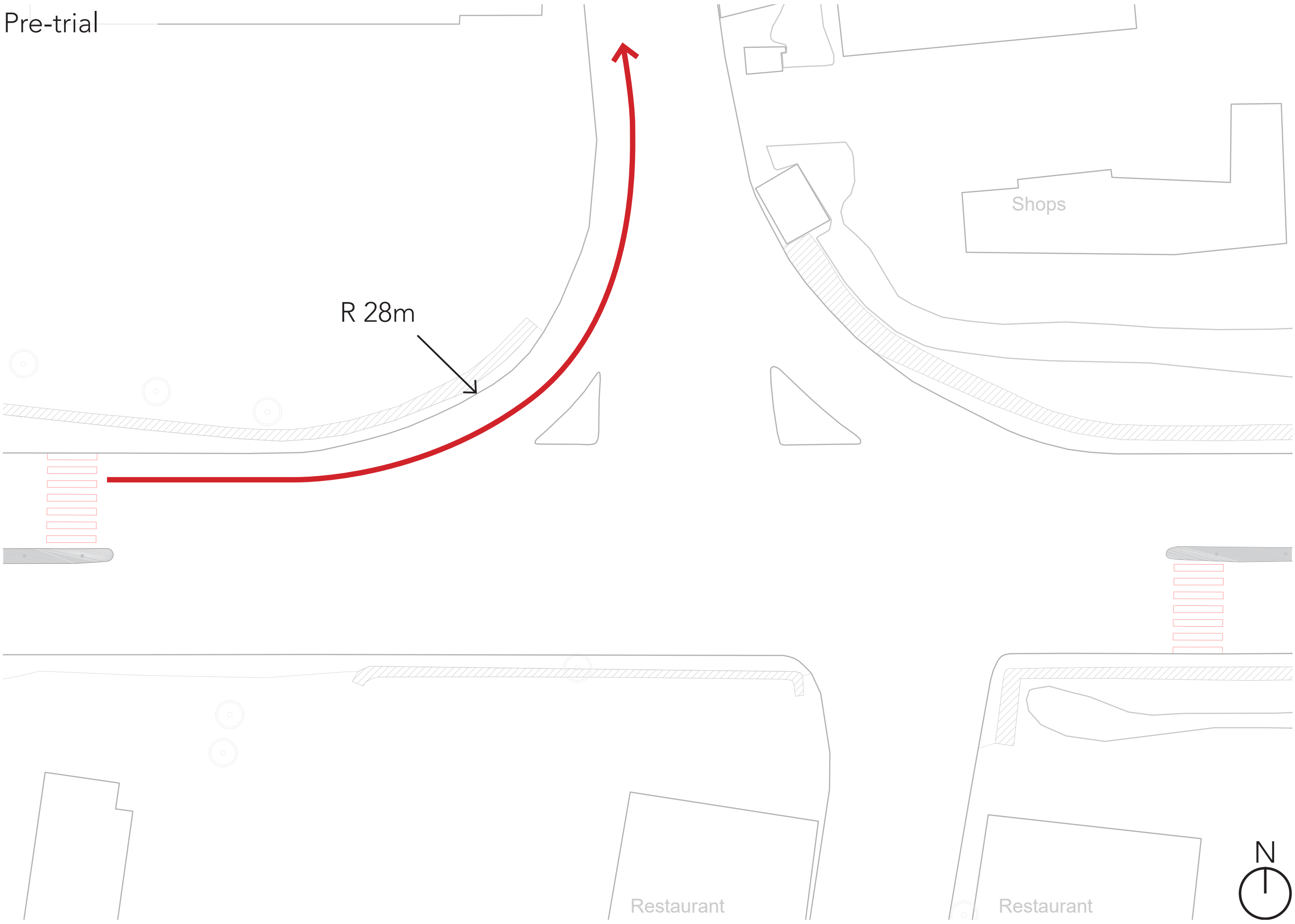


Fig 5.29: Plan highlighting existing turning radius at the junction

35 km/hr

Vehicle turning speed (median speed)

As the turning radius was high in the existing case, vehicles moved at high speed while turning.

This made it very difficult for pedestrians crossing the road at this point.

The turning radius was 20m in the proposed case which was adequate for all types of vehicles. It helped vehicles reduce their speed before making the turn and helped create safer conditions for pedestrians crossing at this point.

The targeted speed post implementation was between 20-25 km/hr.

During trial

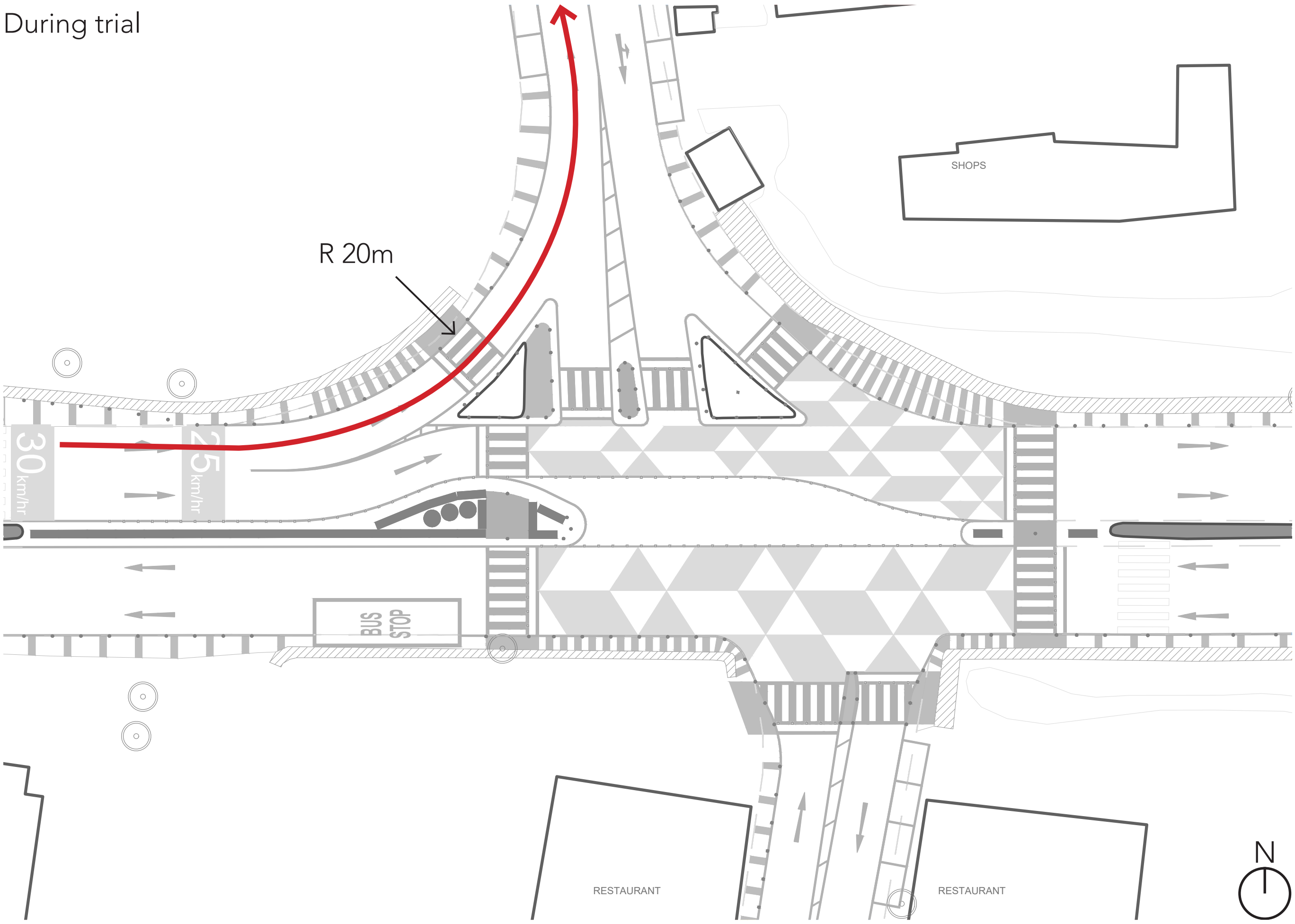


Fig 5.30: Plan highlighting proposed turning radius at the junction

20 km/hr

Vehicle turning speed (median speed)

As a result of road geometry correction and reduction in the turning radius towards Ekvira Devi Road, a 43% reduction in speed of vehicles turning towards the Ekvira Devi Road from Mumbai was witnessed. This helped achieve the vehicular turning speed target of 20km/hr.

5. Public Transport

Pre-trial

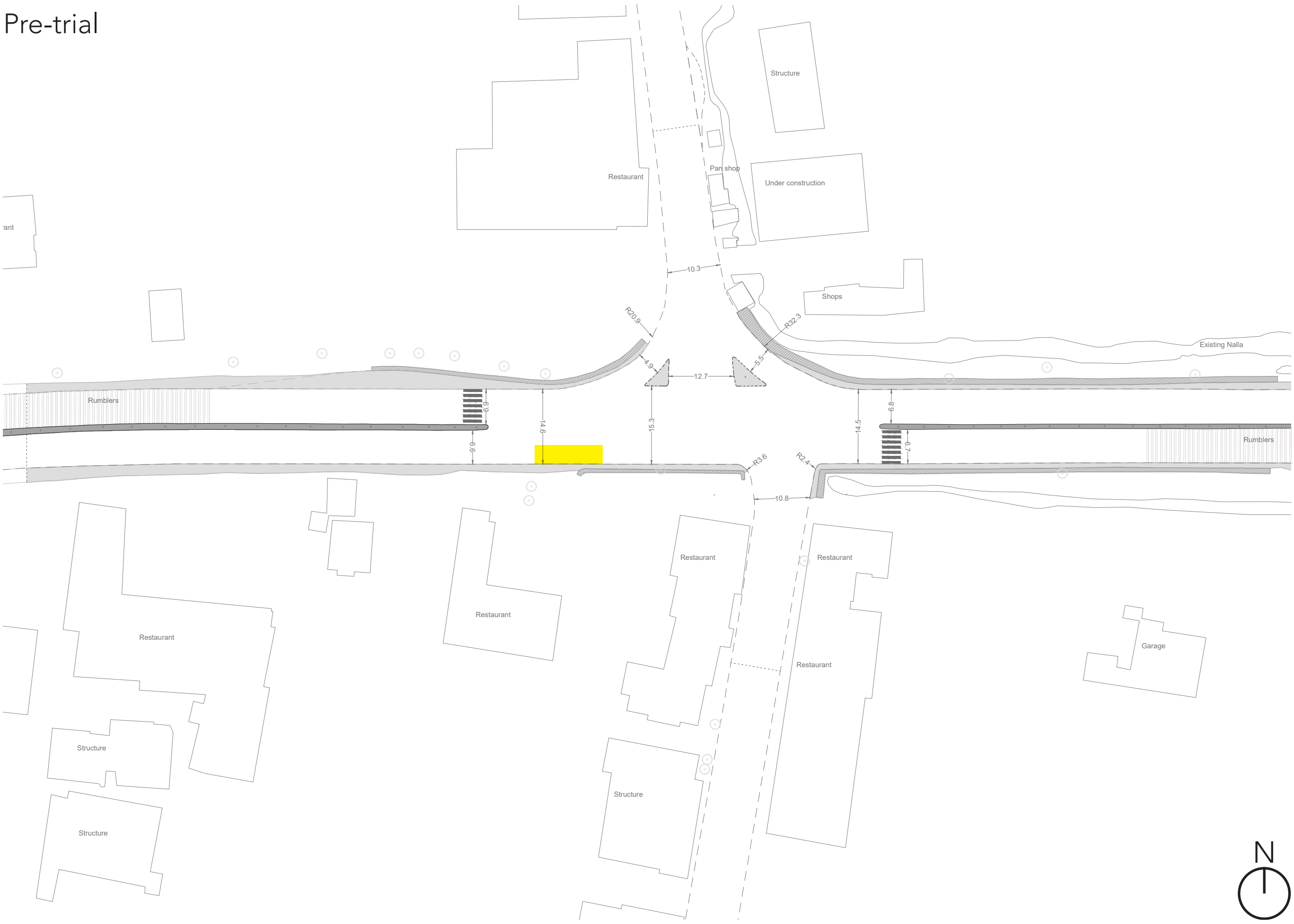


Fig 5.31: Plan highlighting location of existing bus-stops at the intersection

1 No.

Existing bus stops on highway NH 48

The buses on NH 48 waited for pickup and drop-off on the carriageway, affecting the traffic behind.

As the number of buses moving in the area were high, using the available space to create dedicated bus bays was possible on the lane moving from Mumbai towards Pune. This will move the buses off the carriageway during pickup and drop-offs.

Since there were no signages or bus stop shelters present for buses moving from Pune to Mumbai, bus stop space was demarcated with the help of paint on the carriageway. A dedicated bus bay was not possible due to lack of shoulder space in this direction.

During trial

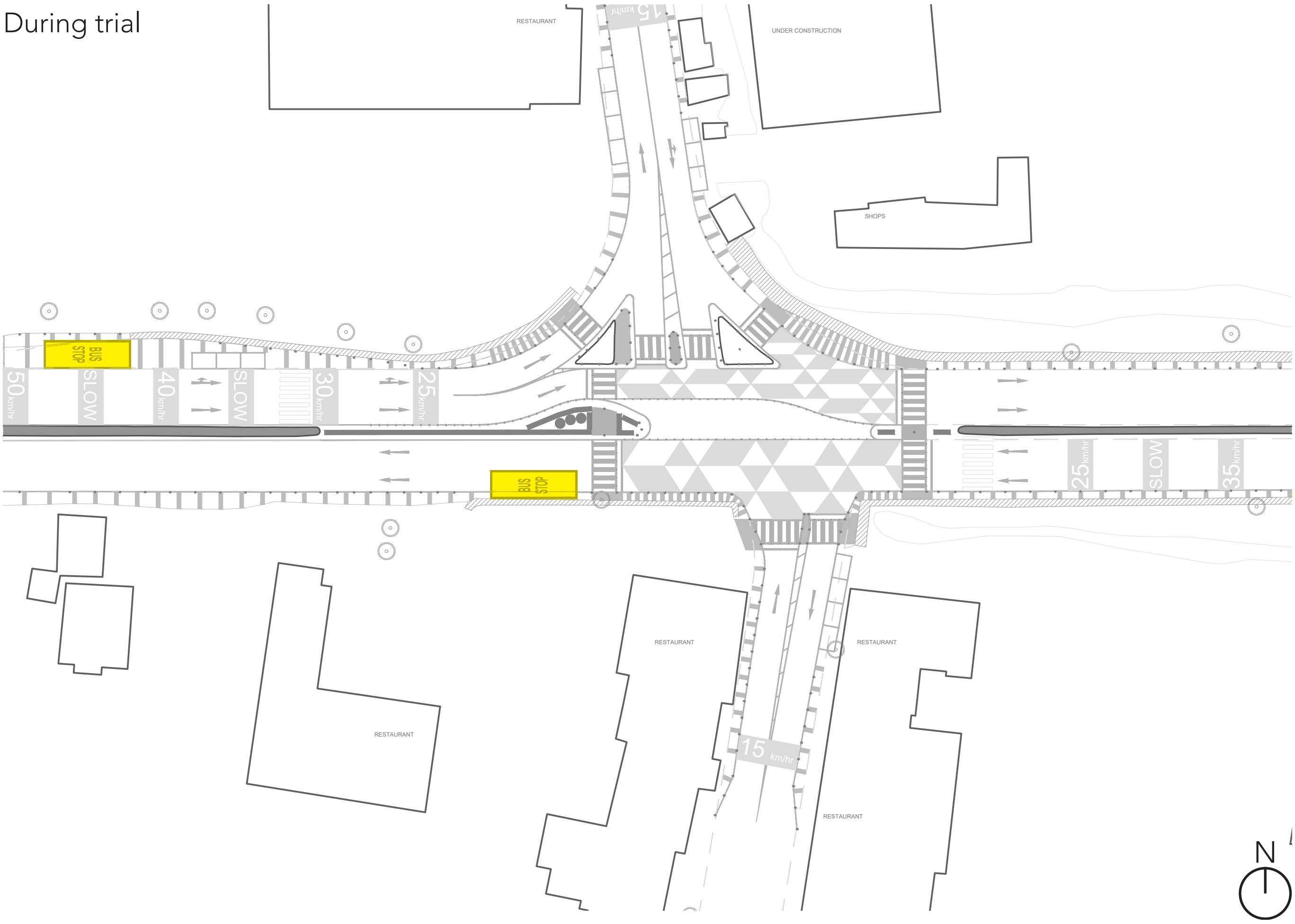


Fig 5.32: Plan highlighting location of proposed bus-stops at the intersection

2 Nos.

Proposed bus stops on highway NH 48

1 New bus stop added

6. Signages

Pre-trial

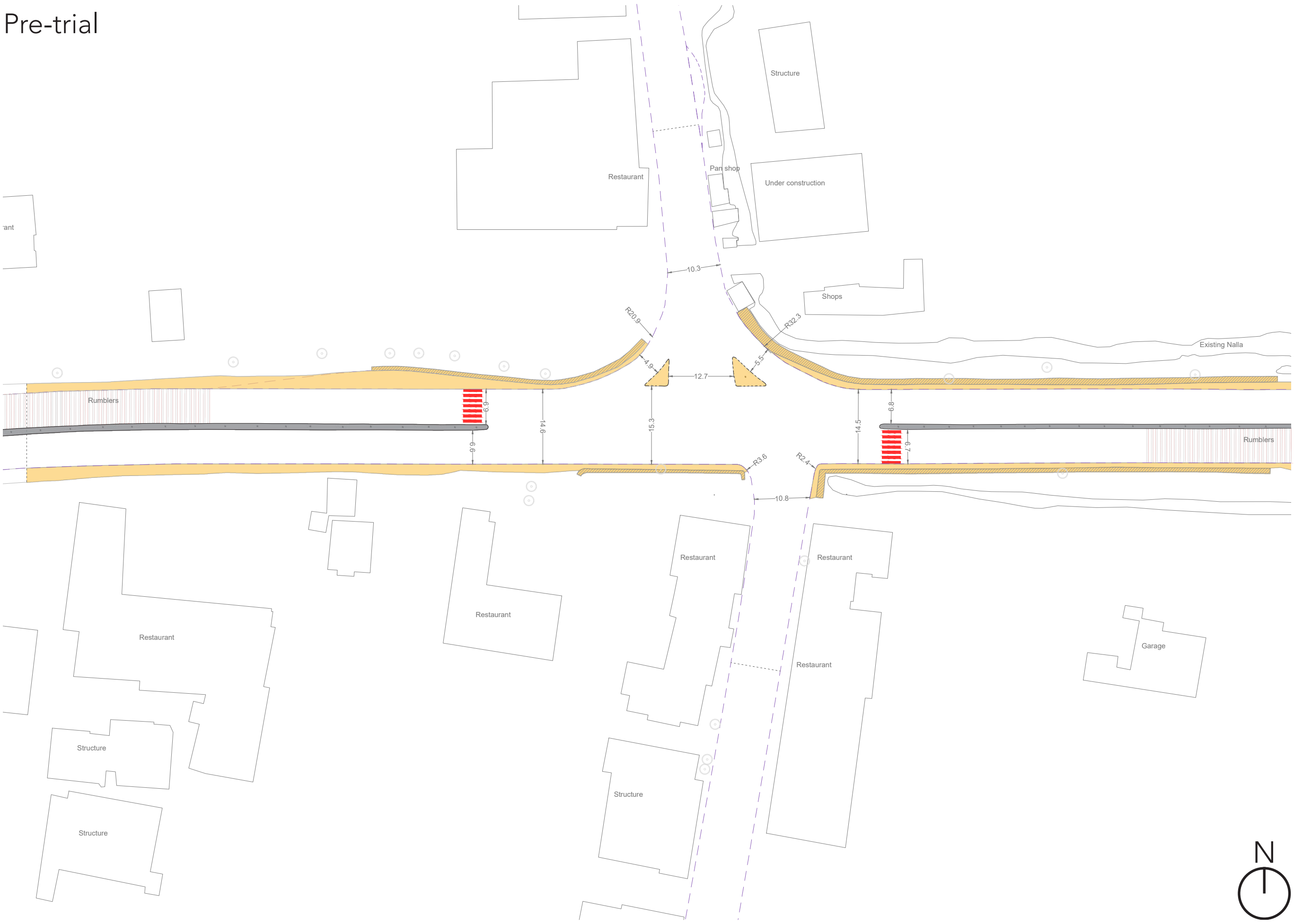


Fig 5.33: Plan highlighting existing location of signages at the intersection

Appropriate signages at locations as per the IRC guidelines are very important to alert the drivers on the highway.

All the required signages were installed as per the guidelines.

During trial

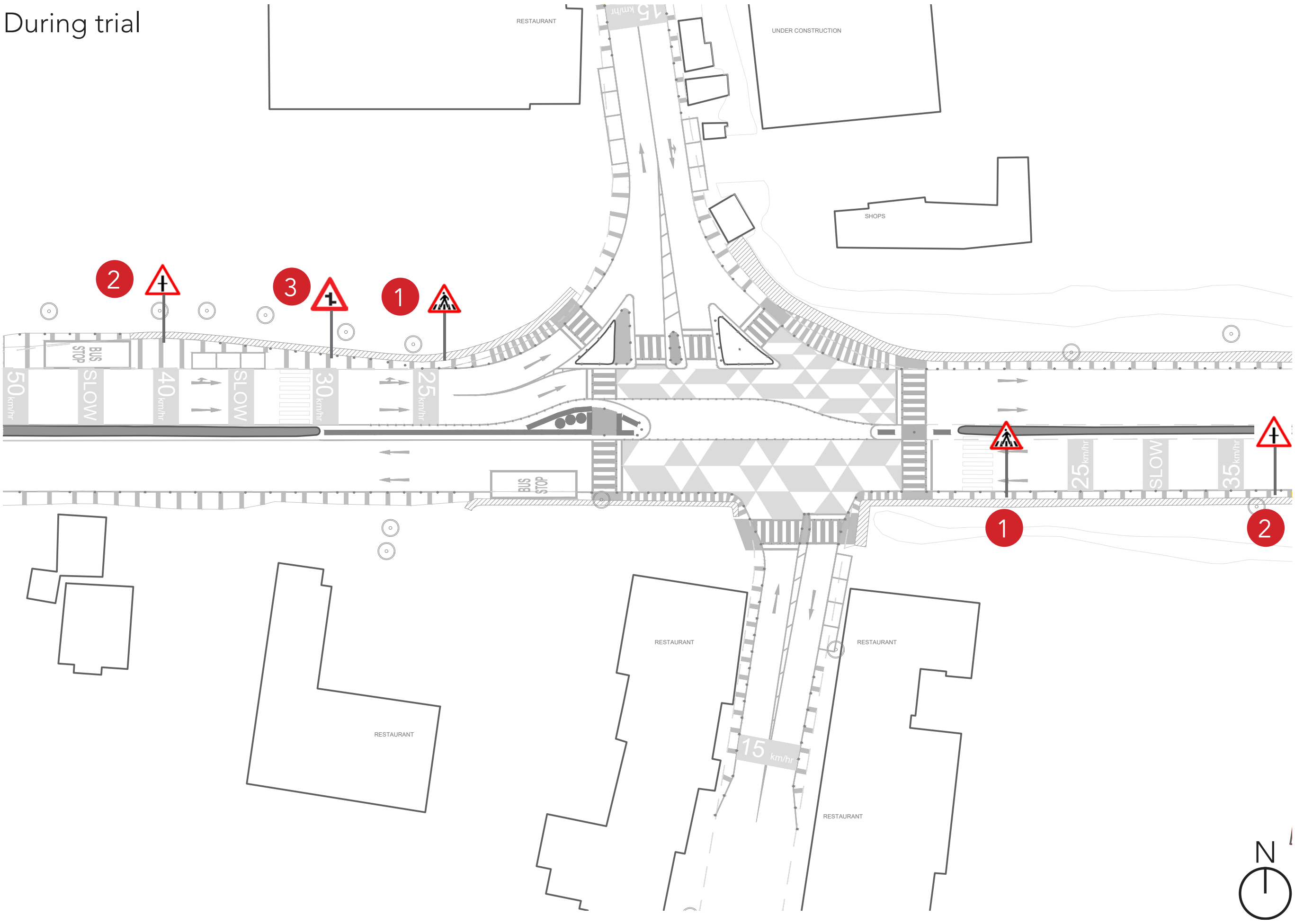
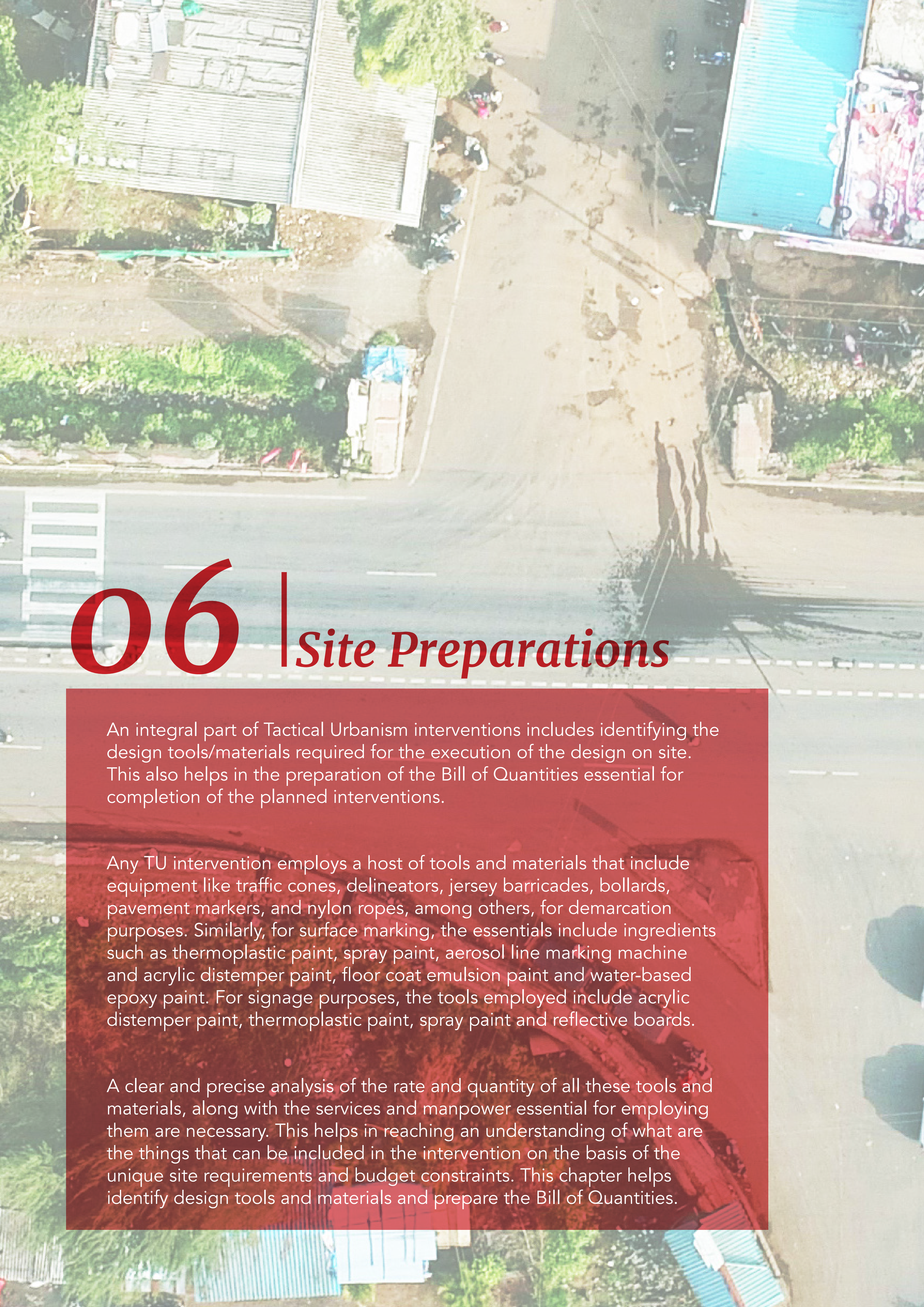


Fig 5.34: Plan highlighting location of proposed signages at the intersection

Proposed Signages						
Sr No	**Signages**	**Placement**	**Type**	**Design**	**IRC Code**	**Quantity**
1	Pedestrian Crossing	15 m before bus stop	Informatory signs		IRC:67-2001	2
2	Intersection Ahead	30 m and 60 m before crossing	Cautionary signs		IRC:67-2001	2
3	Diversion Ahead	60 m before crossing	Cautionary signs		IRC:67-2001	1

Table 5.13: Table summarising proposed signages at the intersection

5 Nos
Total signages proposed

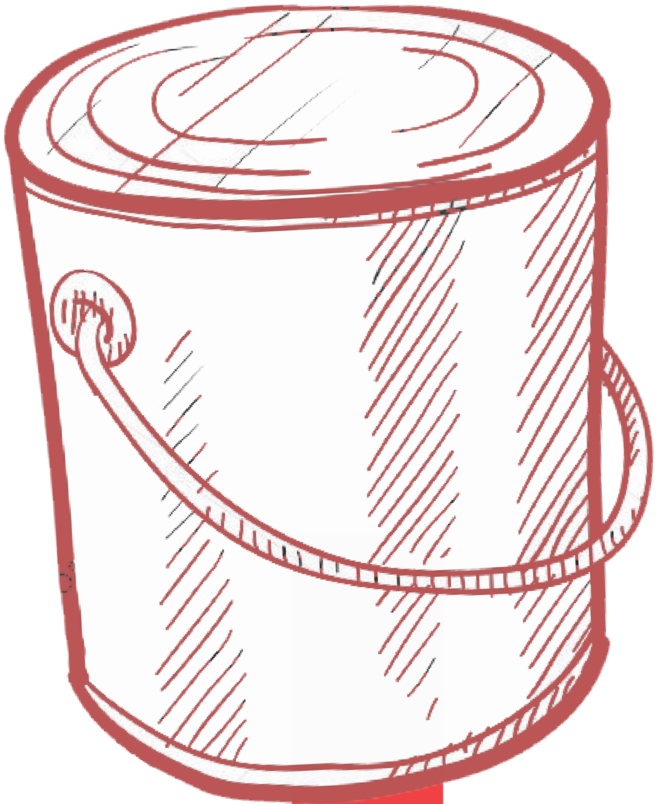


06 | Site Preparations

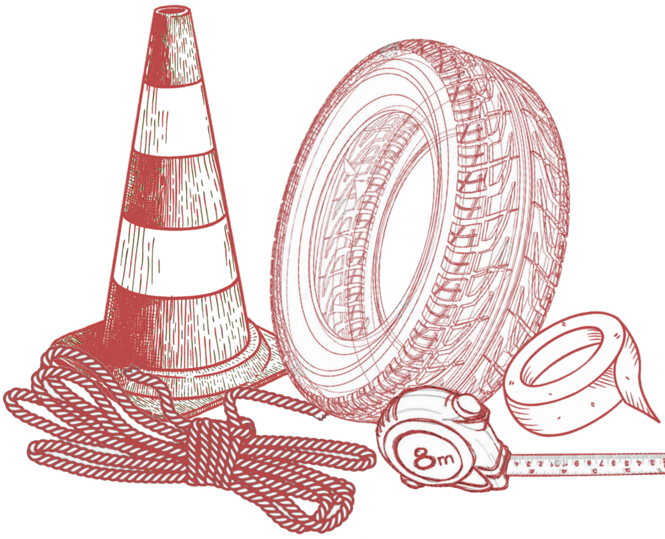
An integral part of Tactical Urbanism interventions includes identifying the design tools/materials required for the execution of the design on site. This also helps in the preparation of the Bill of Quantities essential for completion of the planned interventions.

Any TU intervention employs a host of tools and materials that include equipment like traffic cones, delineators, jersey barricades, bollards, pavement markers, and nylon ropes, among others, for demarcation purposes. Similarly, for surface marking, the essentials include ingredients such as thermoplastic paint, spray paint, aerosol line marking machine and acrylic distemper paint, floor coat emulsion paint and water-based epoxy paint. For signage purposes, the tools employed include acrylic distemper paint, thermoplastic paint, spray paint and reflective boards.

A clear and precise analysis of the rate and quantity of all these tools and materials, along with the services and manpower essential for employing them are necessary. This helps in reaching an understanding of what are the things that can be included in the intervention on the basis of the unique site requirements and budget constraints. This chapter helps identify design tools and materials and prepare the Bill of Quantities.



1 **DEMARCATION**



- Traffic cones
- Delineators
- Jersey barricades
- Bollards
- Pavement mark
- Nylon ropes

Painting - Tips and Considerations

Appropriate for applications, such as re-design of intersection trials or pilot plazas intended to last 1 - 3 months.

May require re-application, especially if pressure washed frequently as part of routine maintenance.

Recommended Applications and Installation

Public Realm: Use paint to identify the footpaths and spaces to be used only by Non-Motorised Transport (NMT) users.

Pedestrian Crossings: Use paint to create artistic/ decorative pedestrian crossings.

Kerb Extensions/Plazas: Create coloured surfaces to enliven public space and clearly differentiate pedestrian space from vehicular space. Work with local artists to develop unique designs.

Roundabouts/Activated Alleys: Colourful mural surface treatments add beauty, define space, and help calm traffic.

A. Design Tools for Tactical Intervention

Barricades Recommended Applications and Installation

Edge of Public Realm: Place along the edge of the public realm, to create physical separation of vehicular and pedestrian spaces.

Median Islands: Place approximately 1m apart to demarcate the median area. Provide a minimum break for pedestrian crossing/accessibility.

Tips and Considerations

Re-usable, and easy to source but only appropriate for very short-term projects.

Easily knocked down — require monitoring when used as barrier element.

Opt for reflective cones for use during the evening or overnight

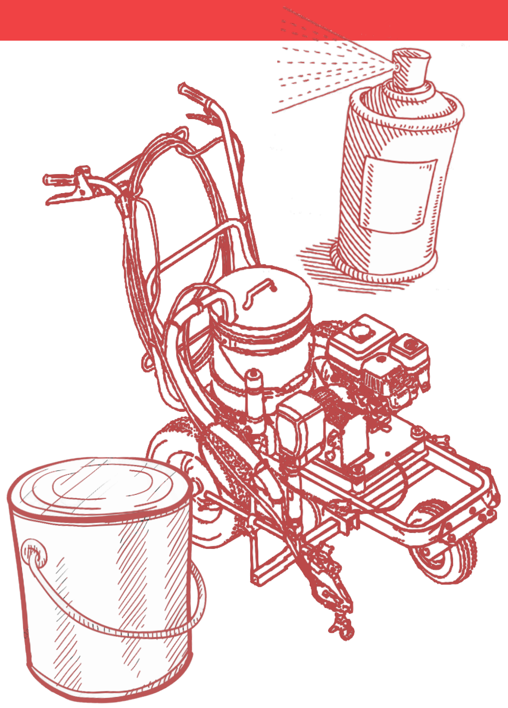
Potential Sources

Borrow from the city public works or the transportation department

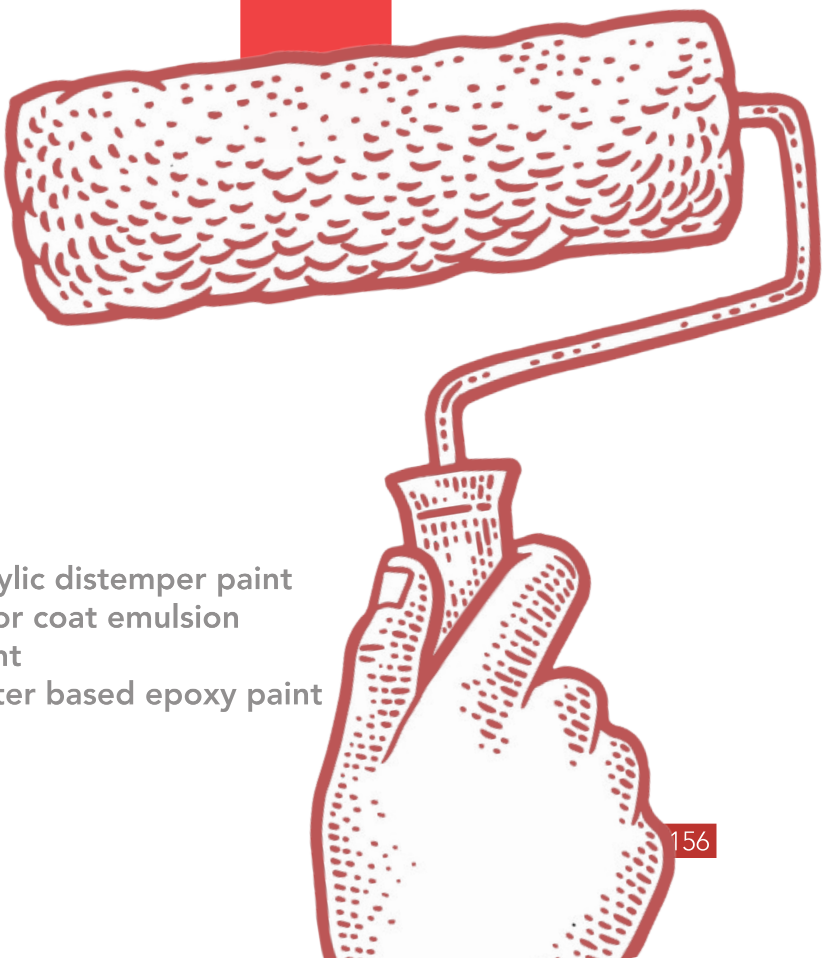
Buy/rent from the traffic control equipment suppliers or construction companies.

ers

- Wooden pallets
- Tyres
- Floor marking tape
- Reflective tape



- Thermoplastic paint
- Spray paint
- Aerosol line marking machine



- Acrylic distemper paint
- Floor coat emulsion paint
- Water based epoxy paint

SURFACE MARKING

2

SIGNAGE 3

WHY SIGNS?

Signs may be required to meet safety or design requirements for the project.
Signs notifying people of a temporary change to parking configurations, traffic control signs during a project installation, way finding signs describing the proximity of nearby destinations, or signs governing the use of public space.

Signs will help people understand how to use a new public space type that they may have never seen before.

Signs can be used to create a cohesive "brand" for a public space program.

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MATERIALS

- Acrylic distemper paint
- Thermoplastic paint
- Spray paint
- Reflective boards

Recommended Applications and Installation

Informational signs: Can help communicate project goals or explain the benefits and purpose of unfamiliar infrastructure or methods such as Tactical Urbanism.

Traffic signs: Signs may be required to meet safety or design requirements for a project. For TU projects, consider fixing signs to traffic barricades, or movable metal post/base structures.

Homemade Signs: Place signs at high visibility spots and key decision points. Make sure to scale the text/ graphics appropriately so that they may be seen by the intended audience (signs for drivers should be scaled very differently than those intended for people traveling by foot or by bicycle).

Tips and Considerations

Bundling sign rentals with traffic control services can help reduce costs.

Try to find existing poles on which to mount signs.

Use plain and friendly language to provide information - avoid professional jargon.

May become interactive by integrating elements like QR Codes, web links, or phone numbers to text.

Homemade Signs: To attach lightweight, temporary signs to existing street furniture or other vertical elements, punch holes in signs and use zip ties or string for easy removal. Customised templates can be downloaded to create simple signs that are colorful and easy to apply in any context.

B. Bill of Quantities

Tendering Process

Bill of Quantities help one understand the list of items along with their exact quantity required for any project to be executed.

Apart from listing the required items, various contractors should be approached to get the best rate for the project. Below is the final BOQ prepared before site execution.

SR NO	Item	Zones	Refe
1	**Preparing surface** (Existing footpath to edge of carriageway) Clearing dirt and dust from the roadway surface so as to get a clean surface to apply paint on		
2	**Alternate Material- PVC Traffic cone** whith a height of 500 mm and Cone Diameter of 180 mm with a weight of approximately 3.5-4 kgs		
3	**Temporary Barricades**- P/f Polyethylene plastic water/sand fillable Barricades having approx. size 2000mm. X 560mm. X 1000mm., (LxWxD), 20-23 Kgs empty wt. and tank capacity 80-100 lits., manufactured by M/s. B.D. Industries or equivalent ISO Certified Company having minimum experience of 3 years in manufacturing and supplying to the Govt./Semi Govt./Other reputed organisations alongwith necessary fixing and interlocking arrangement as specified and directed by the Engineer Incharge.		
4	**Signages**-Providing and fixing Cautionary/Warning sign boards in Equilateral Triangle size of 600 mm made out of 3mm aluminum composite material (ACM) sheet bonded with white retro reflective sheeting of Class C (Type XI Micro prismatic grade sheeting) having pressure sensitive/heat activated adhesive retroreflective specified background, border and back side retroreflective symbols, letters, numerals, arrow as per IRC:672012 Table No 8.3 supported on one no. of M. S. angle iron post of size 65 mm X 65 mm X 6 mm, 3.45 m long, duly painted with flat oil paint having alternate black and white bands of 25 cm width including G.I. fixtures etc; fixing the boards in M25 grade concrete block of size 60cm X 60cm X 75cm including transportation etc; complete. ClassC (Type XI Micro prismatic grade sheeting) shall have 10 years written warranty from the manufacturer & authorised distributor/convertor issued for field performance including the screen printed areas and cut out sheeting and cutout durable transparent overlay film and this warranty certificate in original should be submitted to the Engineer in charge by the contractor/supplier.		  
5	**Signage Reinstallation / Removal / Relocation**		
6	**Road Stud -** Providing/ Fixing road studs. The road stud shall be manufactured of materials with adequate chemical, water, and UV resistance. The height and width of the road stud shall not exceed 20.3 mm and 100 mm respectively. The angle between the face of the road stud and the base shall be no greater than 45°. The base of the road stud shall be flat within 1.3 mm (0.05 in.). The base of the road stud shall be substantially free from gloss or substances that may reduce its bond to adhesive.		

rence image	Parameters		Karla Phata	
	Units	Rates	Quantity	Amount
	Sqm	20	5,714	1,14,280
	Unit Rate	475	250	1,18,750
	Unit Rate	3,200	26	83,200
	Unit rate	11,500	2	23,000
	Unit rate	11,500	2	23,000
	Unit rate	11,500	1	11,500
	Unit rate	2,000	1	2,000
	Unit Rate	245	136	33,320

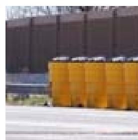
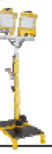
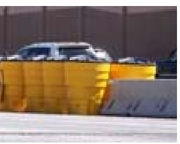
7	**Painting**- Applying exterior Synthetic enamel floor paint as per the traffic norms and as directed by the Engineer. (Apex Floor Guard) Surface preparation- Ensure that the surface to be painted is free from any damp, loose paint, dust, wax or grease and other contaminants. Remove all contaminants such as dirt, grease, oil, dust etc. with soap powder solution using a scrubbing brush. Apply TruCare Bioblock on algae or fungus affected area after cleaning. Dry for minimum of 4 - 6 hours before painting. Moisture content in the surface should be less than 10%. Repainting surface- Check random areas for adhesion of existing paint film. If problems are observed, total removal of old paint is required. Sand smooth and glossy surfaces to improve adhesion. (Colours - Red, White, and Yellow)	Intersection (Blue)	
		Intersection (Pink)	
		Lane Marking (White)	
		Bus bay and IPT stops (White)	
		Crosswalks (White)	
		Shoulder (Yellow)	
		Median and island (Yellow)	
		Speed markings (Red)	
		Speed markings (White)	
8	**Site Managers** (Full time) - 1 month (2 PERSON)		
9	**Traffic Marshal** (Full time) - 1 month (4 PERSON)		
10	**Site maintainance-** Cleaning of site once in every two weeks (all cleaning materials to be arranged by contractos (4 PERSON)		
11	**Road studs removal**		
12	**Anti Glare Boards-** Providing Anti-glare boards plain and green with optic fibre on both the sides. Dimensions: 150mm X 230mm X 900 mm (Excluding Installation charges). Hazard boards (Yellow and Black markings of reflective paint) of thickness 3 mm. Dimension: 750 mm X 600 mm. Includes a pole each for support. Spacing of 2m.		
13	**Fixed Circular plastic bollards** of 750mm, diameter 114 mm, thickness 2mm with grouting provision at pedestal and Interlinking Provision for chains, manufactured by M/s. B.D. Industries or equivalent ISO Certified Company having minimum experience of 3 years in manufacturing and supplying to the Govt./Semi Govt./Other reputed organisations alongwith necessary fixing and interlocking arrangement as specified and directed by the Engineer Incharge.		
14	**Lighting:** Providing Solar Light poles made of aluminium, height 6 meters. The solar plate is attached on the top of the light as shown in the picture. LED 60 W. Includes a battery. (Excluding Installation charges).		
15	**Water filled crash barriers (Bullnose barrier)**- P/f Polyethylene plastic water/sand fillable Barricades having approx. size 1185mm. X 1355mm. X 990mm., (LxWxD), and tank capacity 500 lits., manufactured by M/s. B.D. Industries or equivalent ISO Certified Company having minimum experience of 3 years in manufacturing and supplying to the Govt./Semi Govt./Other reputed organisations alongwith necessary fixing and interlocking arrangement as specified and directed by the Engineer Incharge.		

Table 6.1: Bill of Quantities

	Sqm	200	118	23,600	
	Sqm	200	97	19,400	
	Sqm	200	96	19,200	
	Sqm	200	30	6,000	
	Sqm	200	98	19,600	
	Sqm	200	160	32,000	
	Sqm	200	12	2,400	
	Sqm	200	275	55,000	
	Sqm	200	107	21,400	
	Per Day	900	60	54,000	
	Per Day	800	120	96,000	
	Per Day	750	4	3,000	
	Unit rate	90	136	12,240	Additional Items
	Unit Rate	1,300	NA	NA	
	Unit Rate	825	250	2,06,250	
	Unit Rate	23,000	8	1,84,000	
	Unit Rate	22,000	3	66,000	
	Transportation charges			**40,000.00**	
	Total			**8,00,650.00**	
	GST (18%)			**1,44,117.00**	
	Contingency (10%) on Base Amount			**80,065.00**	
	GST (18%) on Contingency			**14,411.70**	
	Total Amount			**10,39,243.70**	

C. Site Work

Site Work Timeline

	DAY 1 29 Nov 2021 Monday	DAY 2 30 Nov 2021 Tuesday	DAY 3 01 Dec 2021 Wednesday	DAY 4 02 Dec 2021 Thursday	DAY 5 03 Dec 2021 Friday
Site Cleaning (Clearing dirt and dust from the roadway surface)					
Road Geometry (Marking points on site and applying primer)					
Intersection Pattern (Marking points on site and applying primer)					
IPT Markings (Marking points on site and applying primer)					
Bus stop Markings (Marking points on site and applying primer)					
Crosswalk Markings (Marking points on site and applying primer)					
Shoulder Paint (Marking points on site and applying primer)					
Signages and Painting (Preparing base for signage and painting red/ yellow/white paint)					
Speed Markings (Marking points on site and applying primer)					
Arrows and Road studs (Using stencils to mark arrows/speed number and fixing road studs)					

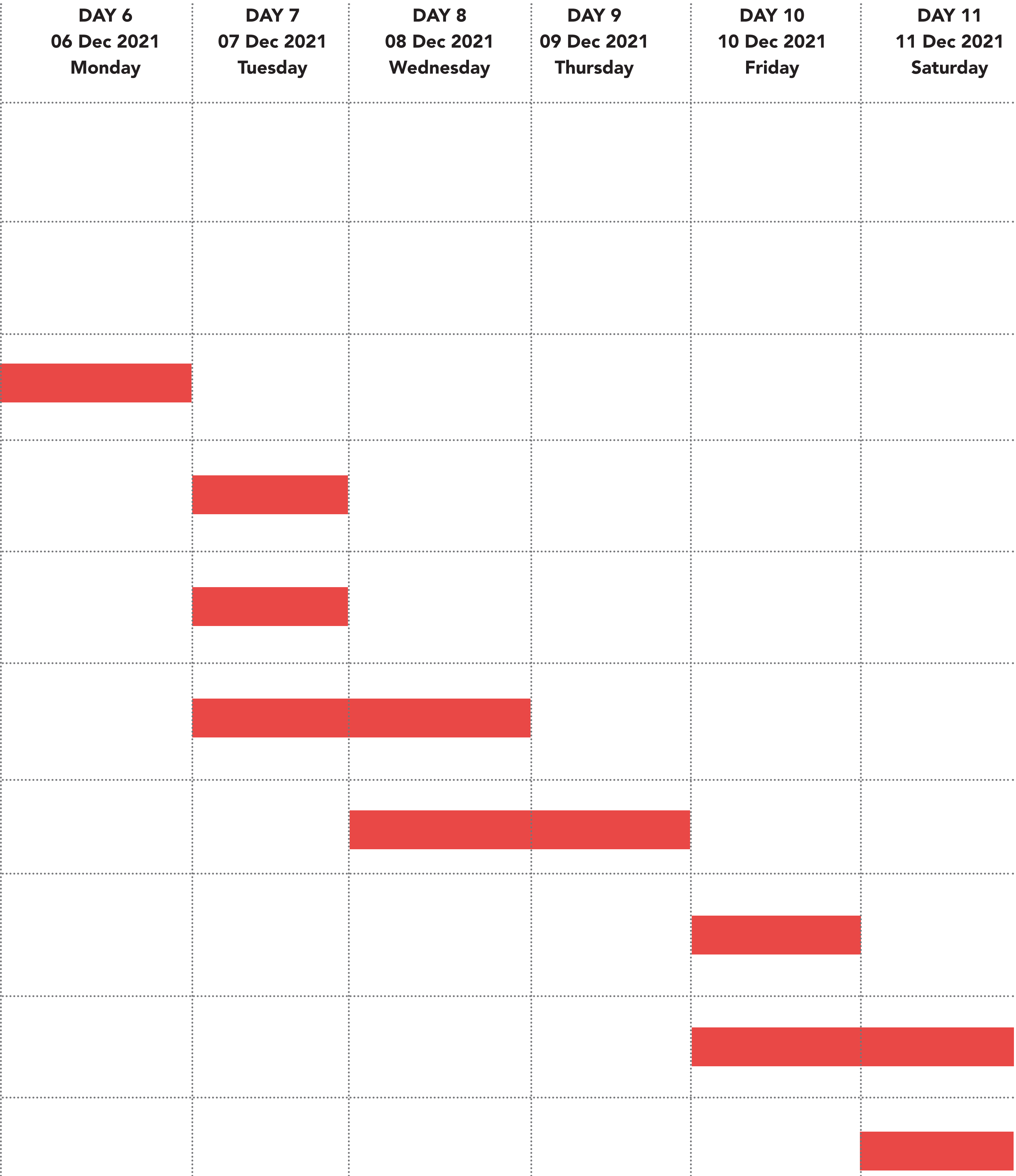


Fig 6.1: Bar graph showing site work timeline

Work in Progress Pictures

1. Road geometry correction by chalk marking

2. Using primer as base before painting

3. Median marking on secondary road

4. Extending the NH 48 median

5. Intersection marking and primer application

6. Crosswalks marking

Fig 6.2: Series of images showing site update

7. Shoulder space marking/painting over primer

8. Bus stop marking

9. Arrow markings with stencils

10. Horizontal speed markings

11. Barricades and cones installation

Fig 6.3: Series of images showing site update

Before-After Images

Pre-Trial

Fig 6.4: Image showing drone shot taken before trial

Envisioned design

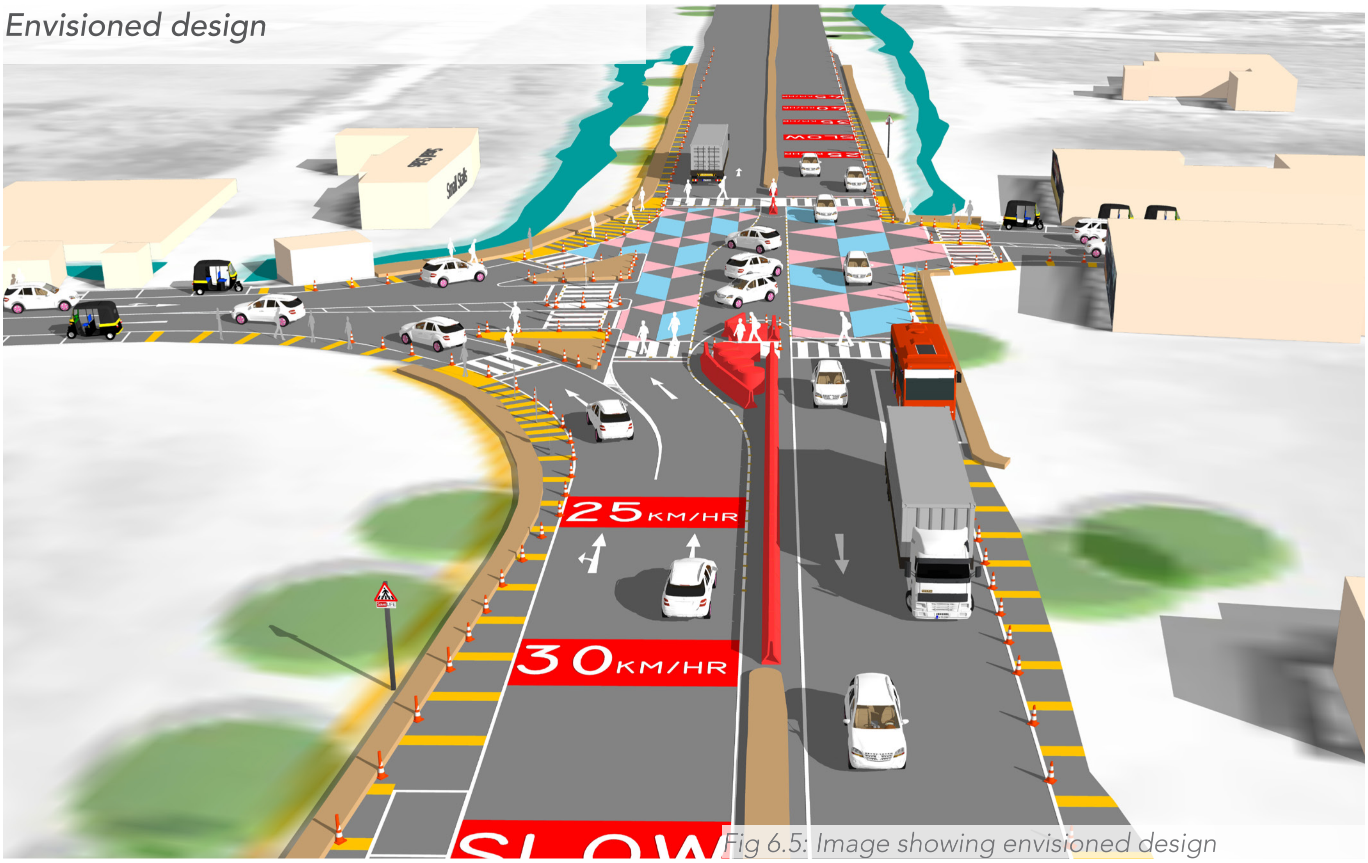
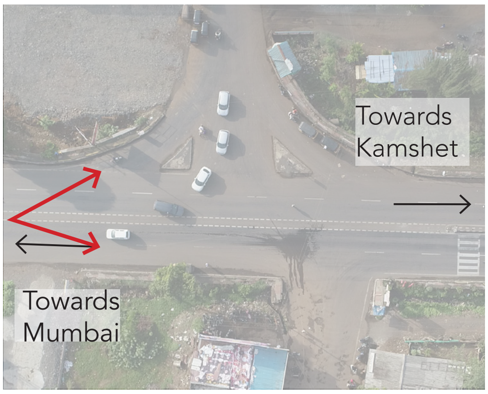


Fig 6.5: Image showing envisioned design

During-Trial

Fig 6.6: Image showing drone shot taken during-trial

1. Bus Bay
2. Signages installed
3. Water filled barricades for altered road geometry
4. Intersection marked with help of synthetic enamel paint
5. Shoulder space created after road geometry correction
6. Pedestrian crossing
7. Waiting space created for pedestrians.



Key Plan

Before-After Images

Pre-Trial

Fig 6.7: Image showing drone shot taken before trial

Envisioned design

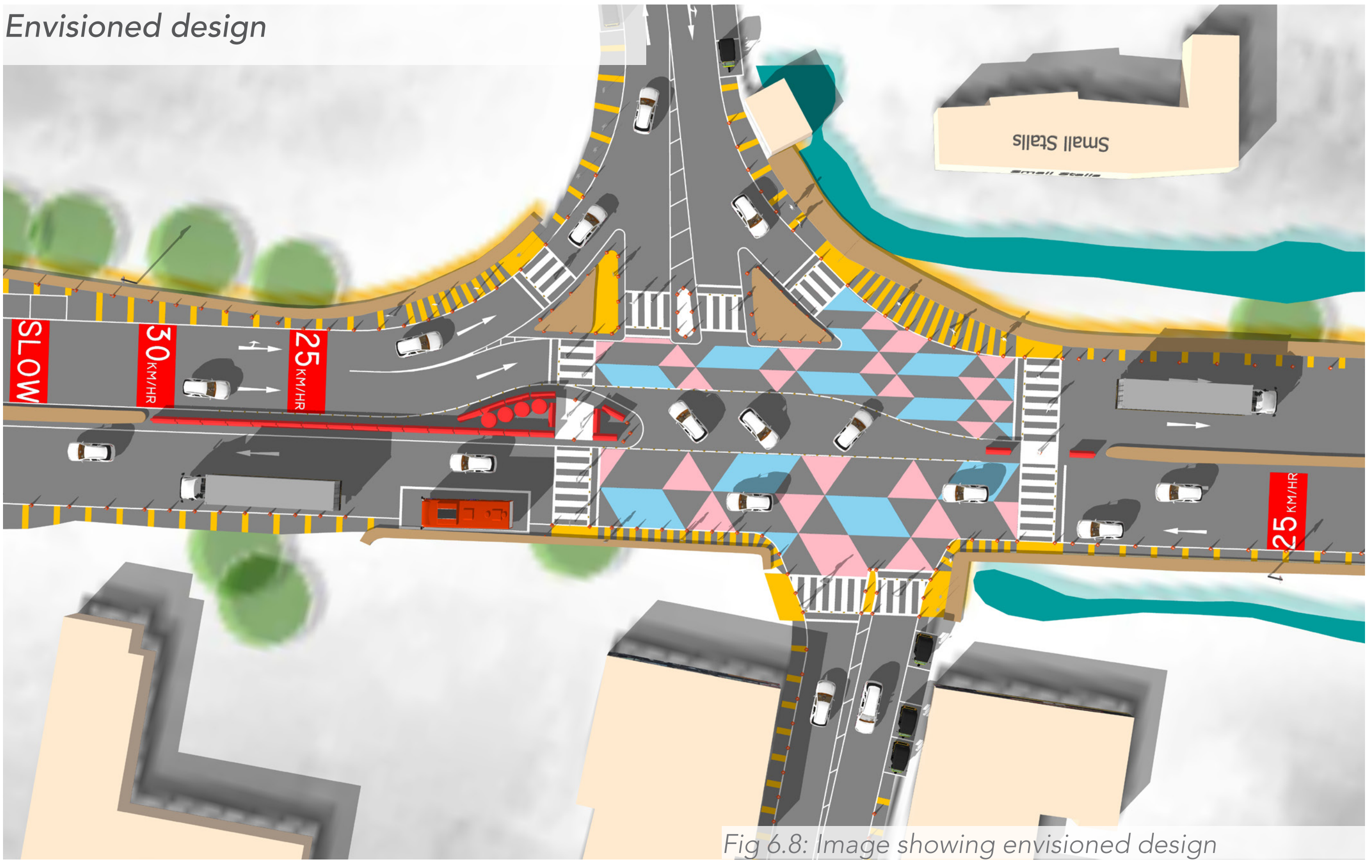
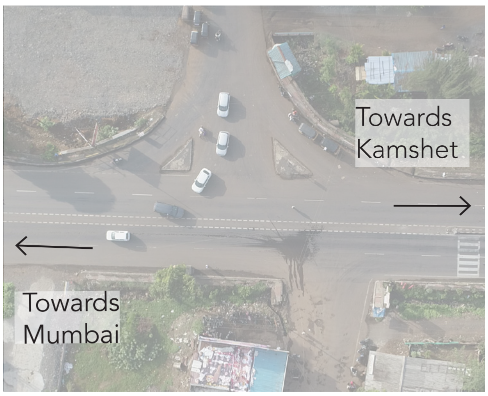


Fig 6.8: Image showing envisioned design

During-Trial

Fig 6.9: Image showing drone shot taken during trial

1. Vehicular refuge area
2. Pedestrian refuge area
3. Speed limits marked on the road with the help of synthetic enamel paint
4. IPT stops
5. Waiting space created for pedestrians



Key Plan

Before-After Images

Pre-Trial

Fig 6.10: Image showing drone shot taken before trial

Envisioned design

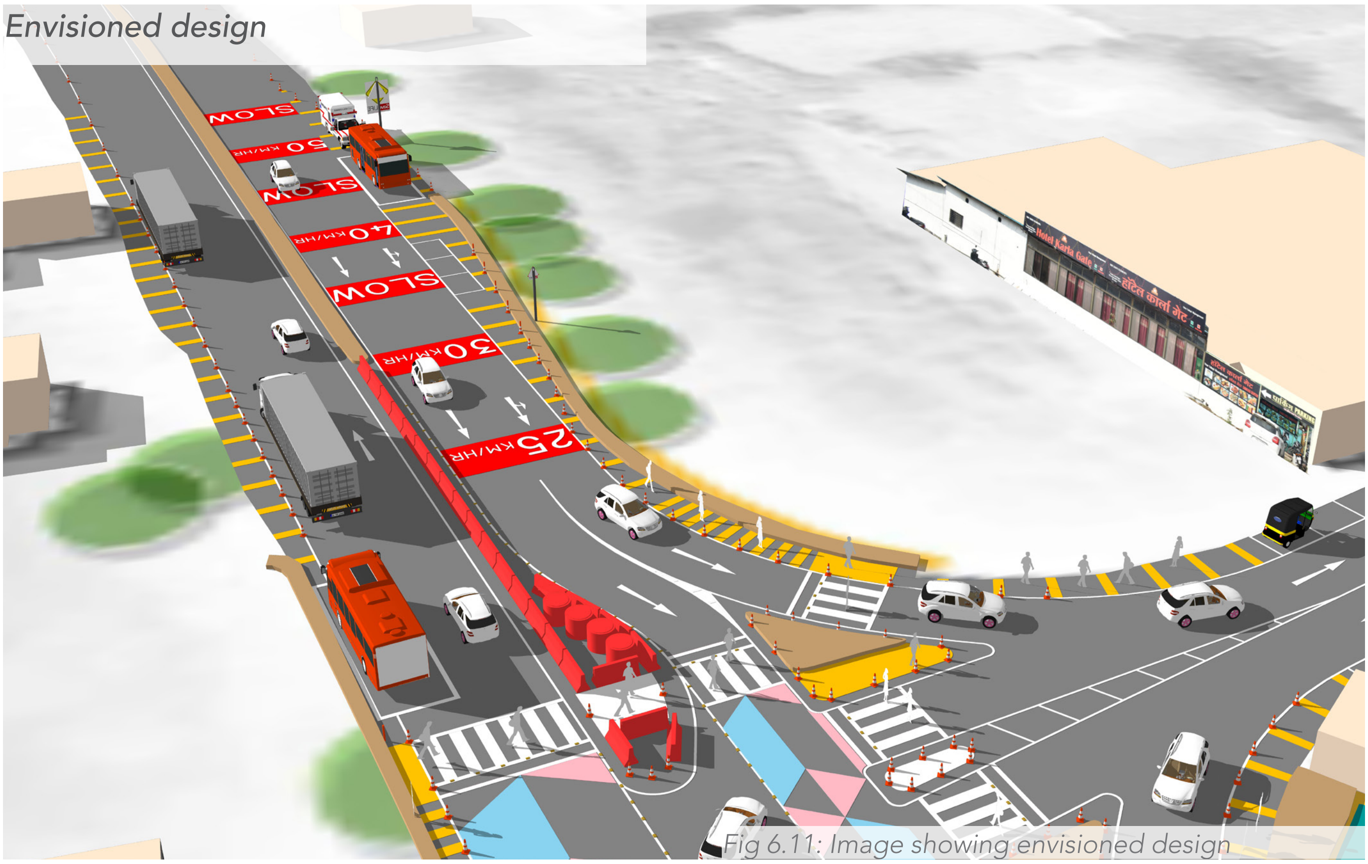
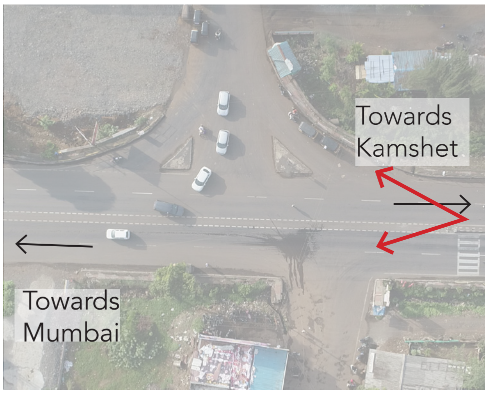


Fig 6.11: Image showing envisioned design

During-Trial

Fig 6.12: Image showing drone shot taken during trial

1. Traffic cones at 2 m c/c
2. Speed limits marked on road with the help of synthetic enamel paint
3. Extended median on NH 48
4. Secondary median marked with the help of synthetic enamel paint
5. Arrow markings done on the carriageway with the help of synthetic enamel paint
6. Pedestrian refuge area



Key Plan

07 | Conclusion

The final chapter draws a conclusion on the basis of the learnings and observations extracted from the Tactical Urbanism trials conducted. On the basis of these learnings, a set of key recommendations are put forth to the concerned authorities who can then take it forward.

The primary aim of such a report is studying a site that requires intervention for designing and executing these changes to then come up with a set of solutions that can help make the location a safe space for all kinds of road users. It is then of utmost importance to use the recommendations in a timely manner to make the pertinent alterations identified and revise the road and site geometry. Failure to do so, is a lost opportunity and one that makes any investigation and analyses redundant in the face of the changing ground realities.

This chapter includes the learnings and observations drawn from the Tactical Urbanism trials conducted at Karla Phata, and the key recommendations suggested for being taken forward.

A. Key interventions proposed at Karla Phata

In chapter 3, four major key interventions required as per the site condition and the traffic survey conducted were listed.

The proposed design was aimed at finding solutions to address these four key points.

Fig 7.1: Image indicating vehicles running at slower speeds

Fig 7.2: Image showing safer public realm used as a footpath

1. Reduced Speed on NH 48

The carriageway closer to the intersection was reduced to bring down the speed of the vehicles. During implementation, a survey was conducted for 3 days on the NH 48 in both the directions to determine the average and 85th percentile speed at the Karla Phata Intersection. This survey indicated that majority of the moving traffic witnessed significant speed reductions, thereby making the intersection safer.

Further, a wider refuge for vehicles was created at the centre of the road to allow for turning vehicles to employ a two-stage crossing as opposed to a one-stage crossing.

2. Creating safer public realm and pedestrian crossings

The new pedestrian crossings and revised road geometry helped create additional space for pedestrians and also shortened the distance and time that they were exposed on the carriageway while crossing. This also significantly improved the safety of the pedestrians.

Fig 7.3: Image showing road geometry correction using enamel paint and traffic cones

Fig 7.4: Image showing bus stop being marked to provide dedicated public transport infrastructure

3. Creating safer road geometry

The turning radius at the junction was modified by using a series of traffic cones and barricades which resulted in vehicles turning at much lower speeds. This also allowed for the widening of the public realm on the respective shoulder spaces and redefining the existing traffic triangle.

4. Providing space for public transport

A new bus-stop location was proposed slightly away from the intersection considering the ideal distance from it and the availability of space. Although, it was observed that due to lack of enforcement, buses were still halting at the intersection, resulting in passengers waiting on the carriageway.

1 Reducing speed on NH 48

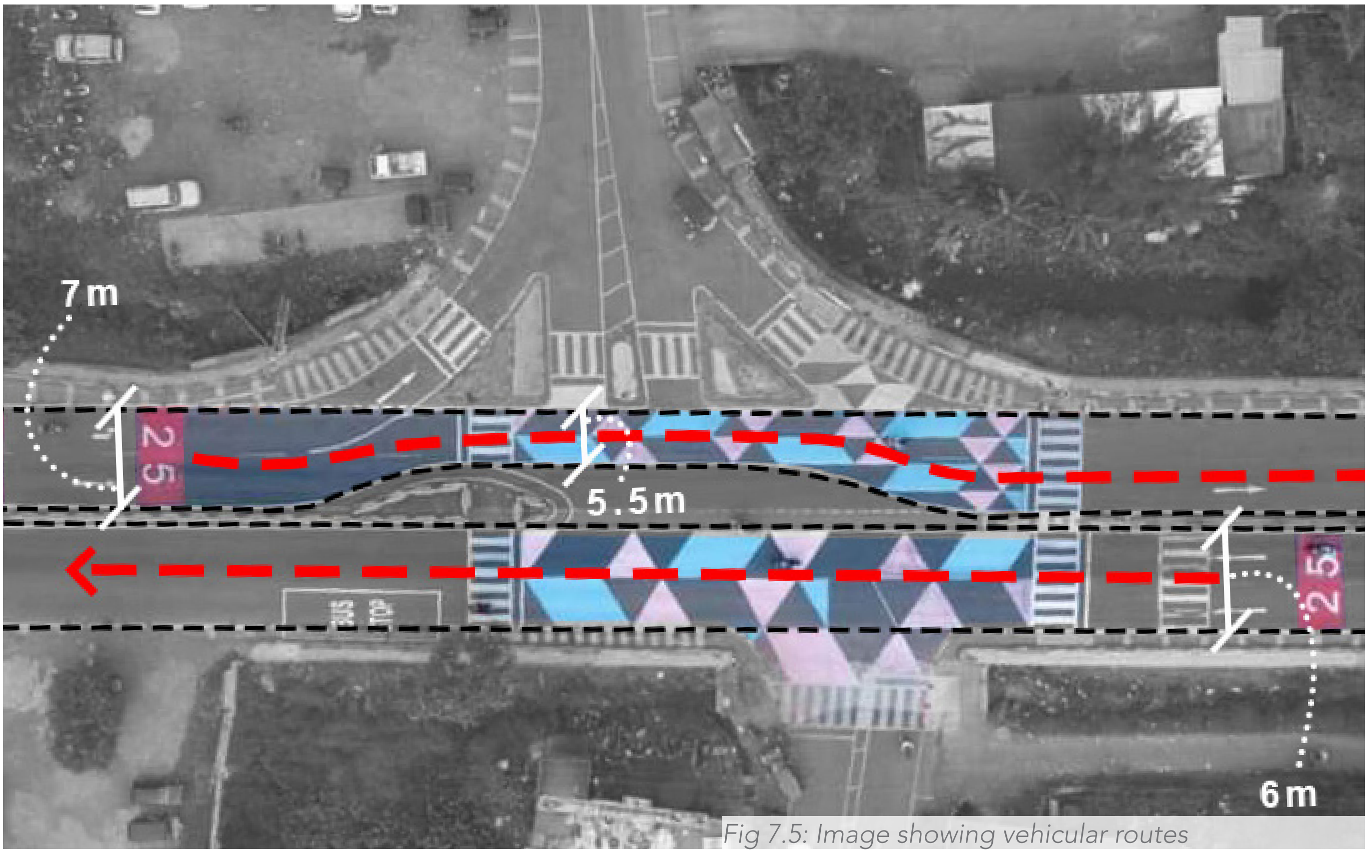


Fig 7.5: Image showing vehicular routes

Existing

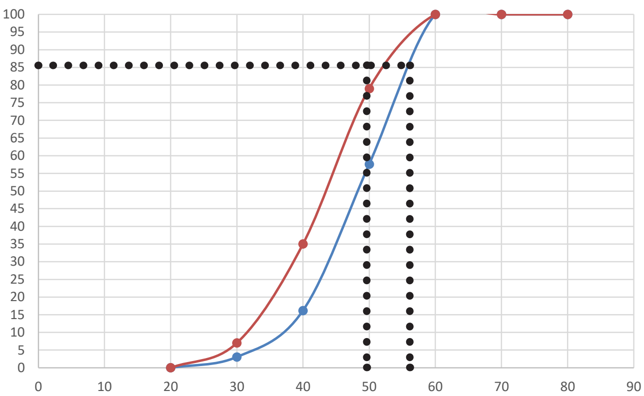


Fig 7.6: Graph showing 85th percentile pre-trial speed chart

During Implementation

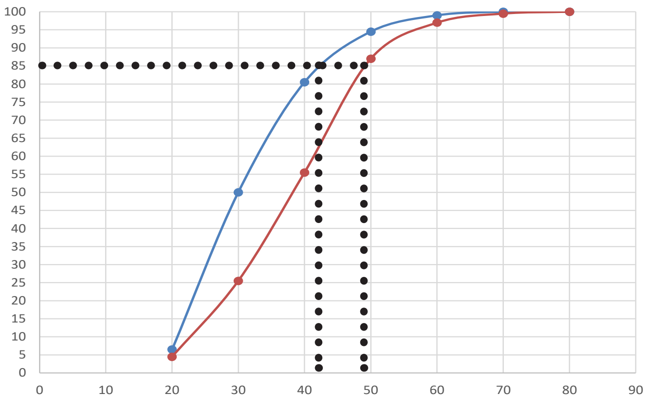


Fig 7.7: Graph showing 85th percentile during-trial speed chart

Legend

Pune to Mumbai

Mumbai to Pune

Pune to Mumbai: 52 km/hr

Mumbai to Pune: 56 km/hr

Pune to Mumbai: 48 km/hr

Mumbai to Pune: 43 km/hr

Fig 7.8: Picture highlighting waiting space being used by a vehicle while other vehicles are passing by

- As a result of road geometry correction and carriageway width reduction in the Mumbai to Pune direction, a 24% reduction in speed was witnessed.
- Comparatively, in the Pune to Mumbai direction there was only a minimal carriagway width reduction; hence the resultant speed reduction was also less.

Fig 7.9: Picture highlighting horizontal speed limit markings

Average speed comparison

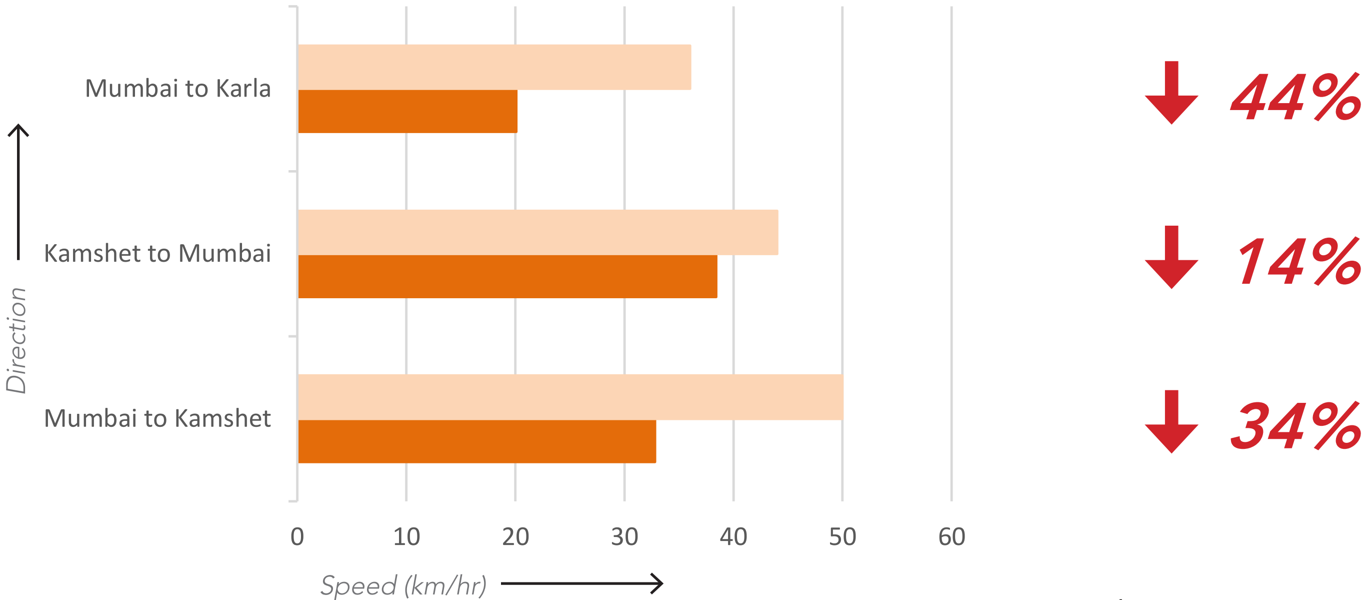


Fig 7.10: Bar graph shows comparison of average speed between pre- and during-trial

Fig 7.11: Picture highlighting cautionary vertical signages installed during the trial to reduce speed

- Horizontal signages with speed markings were painted on the road using enamel paint to help reduce vehicular speed on NH 48.

- Intersection was also lacking cautionary and informative signages and hence it was made sure that signages like Pedestrian Crossing, Intersection Ahead and Diversion Ahead were installed.

- As shown in the figure 7.10, there was significant speed reduction due to the proposed design. The speed reduction was more in the Mumbai to Karla and Mumbai to Pune direction.

2 Creating safer public realm and pedestrian crossing

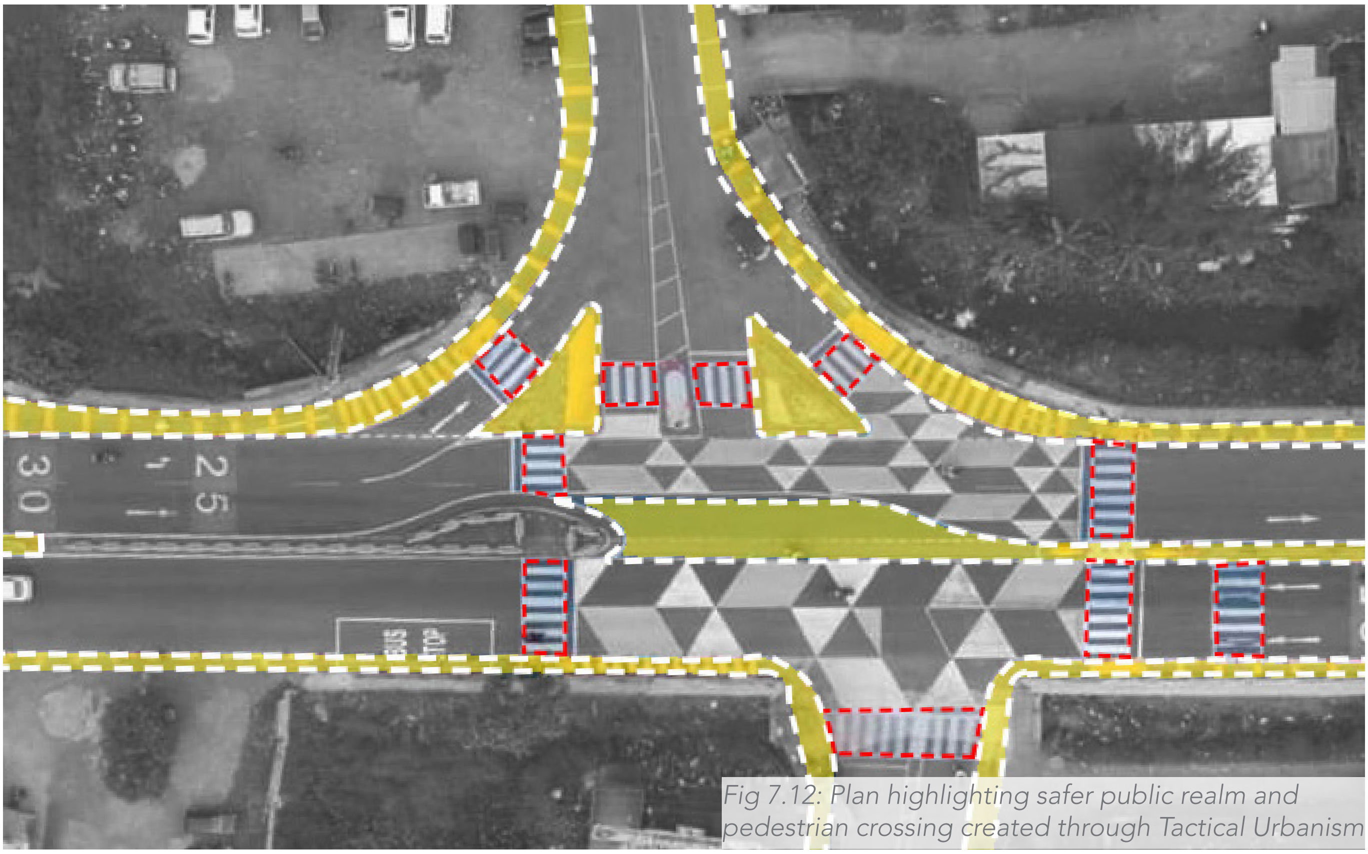


Fig 7.12: Plan highlighting safer public realm and pedestrian crossing created through Tactical Urbanism

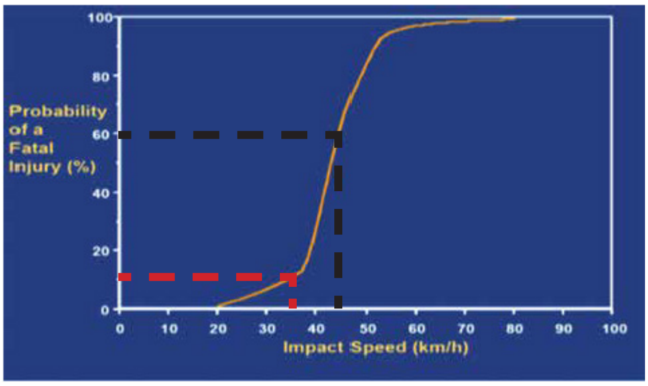


Fig 7.13: Probability of the pedestrian being fatally injured by the speed of the car on impact

Legend

Pre-trial 45 km/hr

During-trial 35 km/

Change in	Change in Mean Speed					
	Speed Reduction			Speed Increase		
	-10%	-5%	-1%	+1%	+5%	+10%
Deaths	-38%	-21%	-4%	+5%	+25%	+54%
Serious Injuries	-27%	-14%	-3%	+3%	+16%	+33%
Other injuries	-15%	-7%	-1%	+2%	+8%	+15%
Property damage crashes	-10%	-5%	-10%	+1%	+5%	+10%

Table 7.1: Effect of deaths and injury by change in mean speed

Source : IRC-99-2018

Fig 7.14: Picture highlights safer footpath created for pedestrians

Refuge area: 148.1 Sqm
Pedestrian refuge area: 36.76 Sqm
Vehicular refuge area: 111.34 Sqm

383% increase in total refuge area

- It was observed that the mean speed at the intersection reduced to 35 km/hr from 45 km/hr. Hence, the probability of fatal injury of pedestrians on impact, owing to the speed of the vehicle went down to 15%, leading to reduction in deaths by 38% and serious injuries by 27%.
- Hence, the survey suggests that the intersection is much safer for pedestrians as well as vehicles than before.

3 Creating safer road geometry

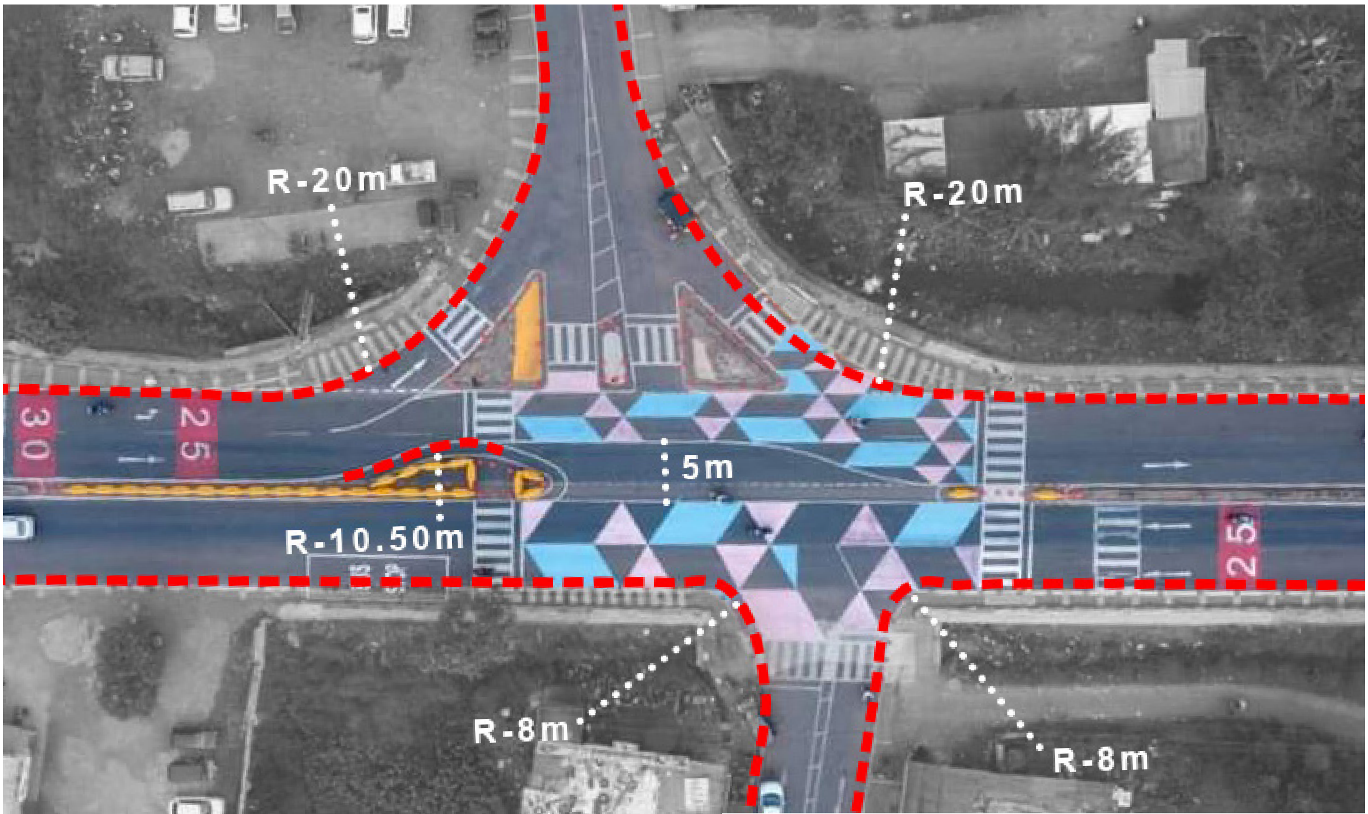


Fig 7.15: Plan highlighting road geometry correction

Existing

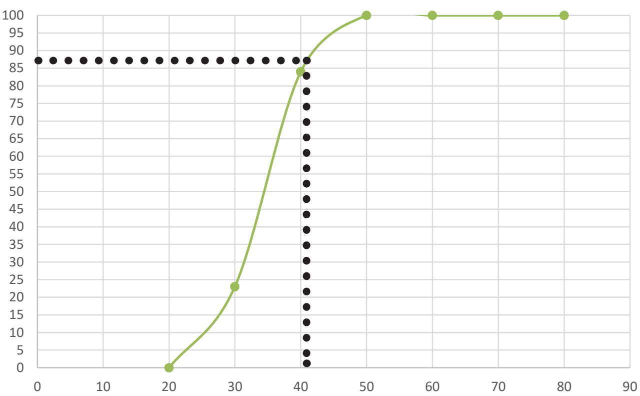


Fig 7.16: Graph showing 85th percentile pre-trial speed chart

During Implementation

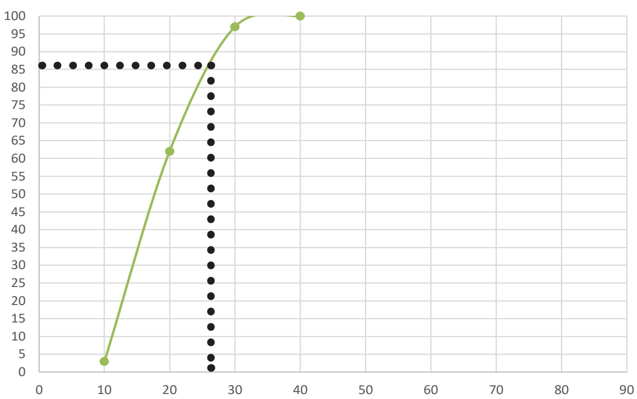


Fig 7.17: Graph showing 85th percentile during-trial speed chart

Legend

Mumbai to Ekvira Devi Road

Mumbai to Ekvira Devi road: 40km/hr

Mumbai to Ekvira Devi road: 26km/hr

Fig 7.18: Picture highlighting corrected road geometry and reduced lane widths

- Existing medians on both the sides were extended closer to the intersection.
- A bulge was introduced for vehicles travelling from Mumbai towards Kamshet that reduced the two lane carriage (7 m) to a single lane (5.5 m) one, in order to slow the vehicular speed.
- As a result of road geometry correction and reduction in the turning radius towards Ekvira Devi Road, there was a 35% speed reduction of vehicles travelling in that direction.
- Due to road geometry correction, safer footpaths for pedestrians were possible.

Fig 7.19: Picture highlighting a safer public realm created due to road geometry correction

4 Providing space for public transport

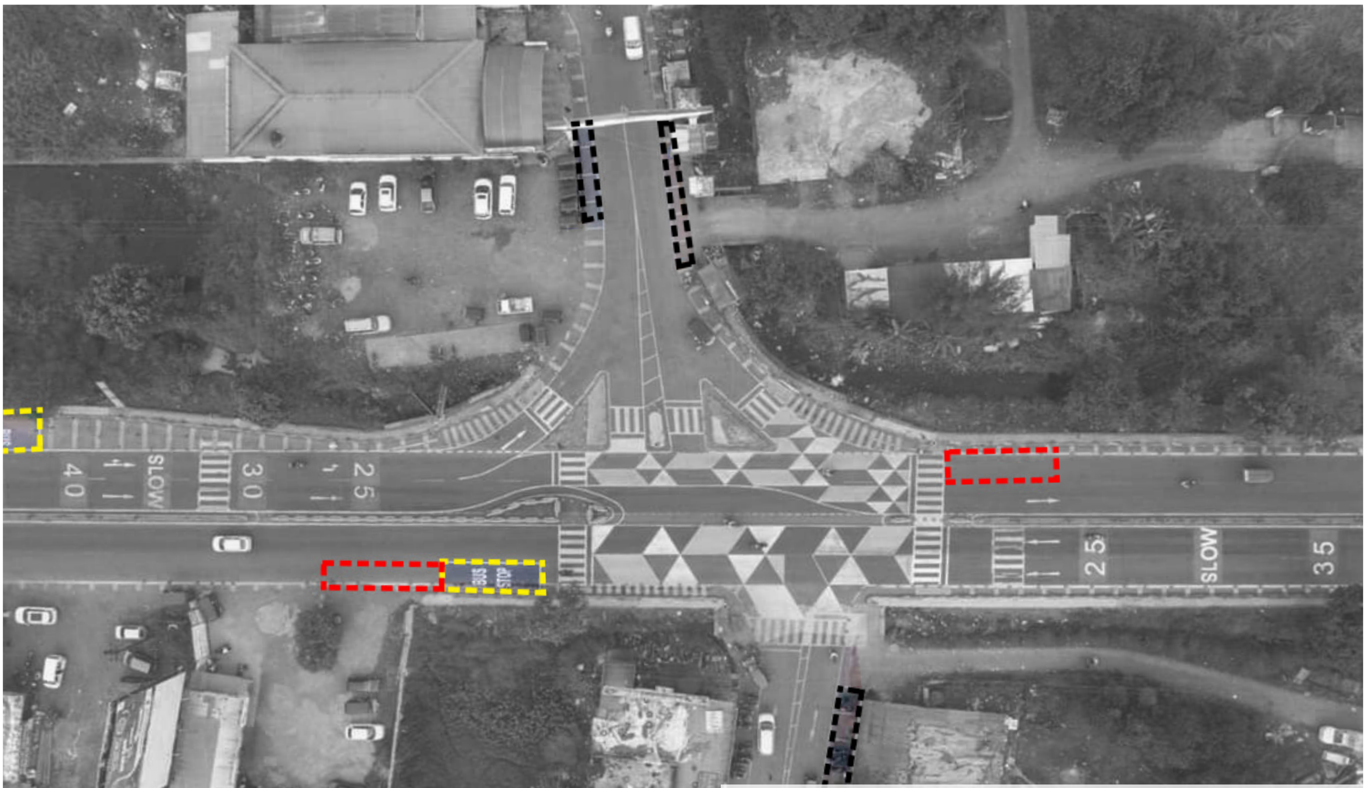


Fig 7.20: Plan highlighting proposed and existing public transport location

Fig 7.21: Picture highlighting the proposed bus stop location

Existing Bus Stop: 1
Proposed Bus Stop: 1

Legend

- *Proposed Bus Stops* (yellow)
- *Proposed Rickshaw Stands* (black)
- *Recommended Bus stop and Rickshaw Stand* (red)

Fig 7.22: Picture highlighting bus stopping near intersection and proposed bus stop not being used

- 1 bus stop and 3 IPT stop locations were proposed within the recommended limit from the intersection.
- However, due to the lack of enforcement, the bus stop proposed for the Mumbai Pune direction was not successful.
- The proposed bus stop was within the recommended limit and off the carriage space, making it easy for pickup and drop-off activity.
- It was observed that buses prefer stopping near the intersection, but due to lack of space, use the carriageway.
- A recommended position for a bus stop has been highlighted in red in figure 7.20. The bus stop should be designed in such a way that it is off the carriage space.
- The bus stop location for the Pune - Mumbai side was well accepted.
- However, due to site constraints it was still located on the carriage way.
- It is highly recommended to move them off the carriageway by providing additional by-lane, and moving the existing taxi stand to its dedicated space.

5 Provide lighting on the road

During implementation

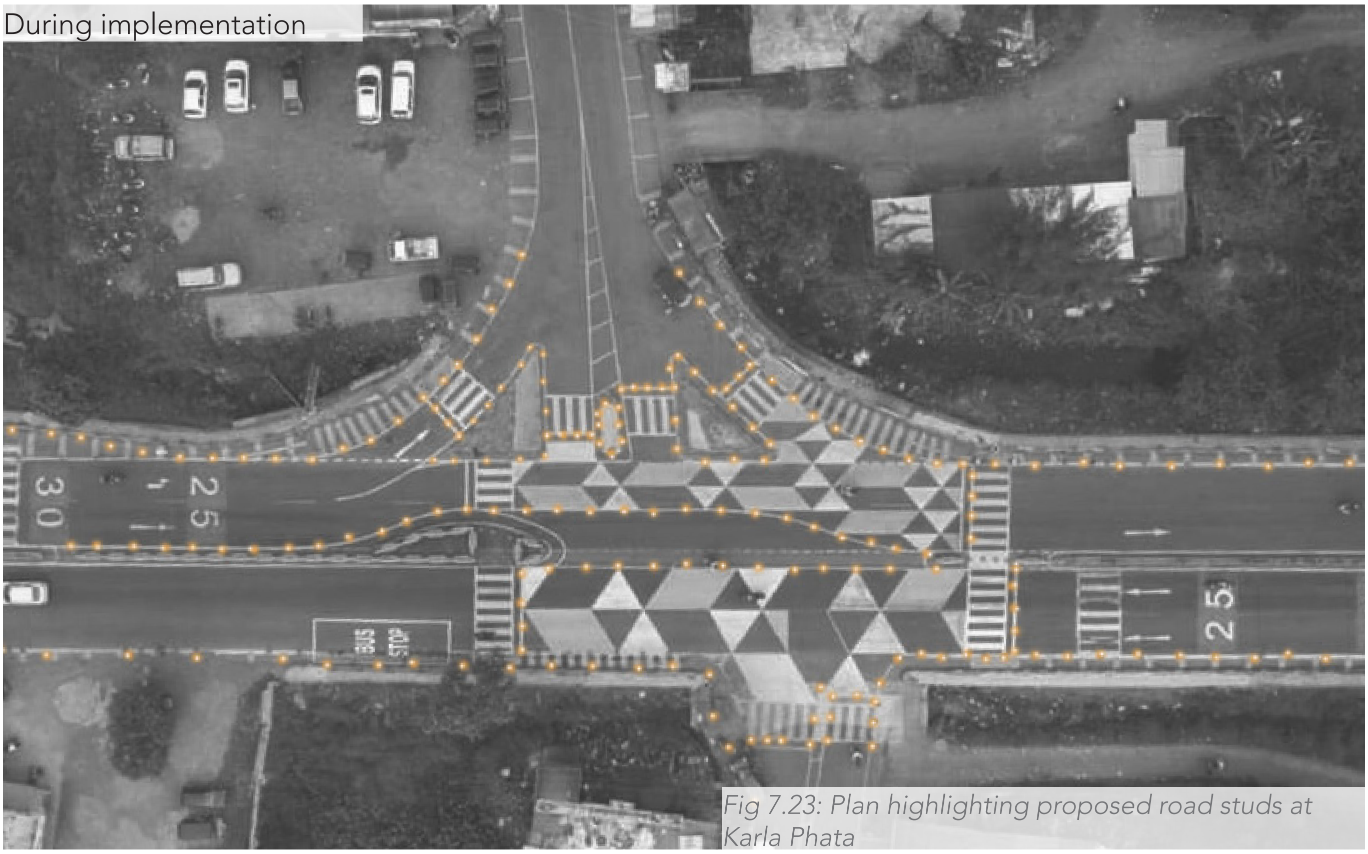


Fig 7.23: Plan highlighting proposed road studs at Karla Phata

Fig 7.24: Image showing intersection with the proposed design

Recommended

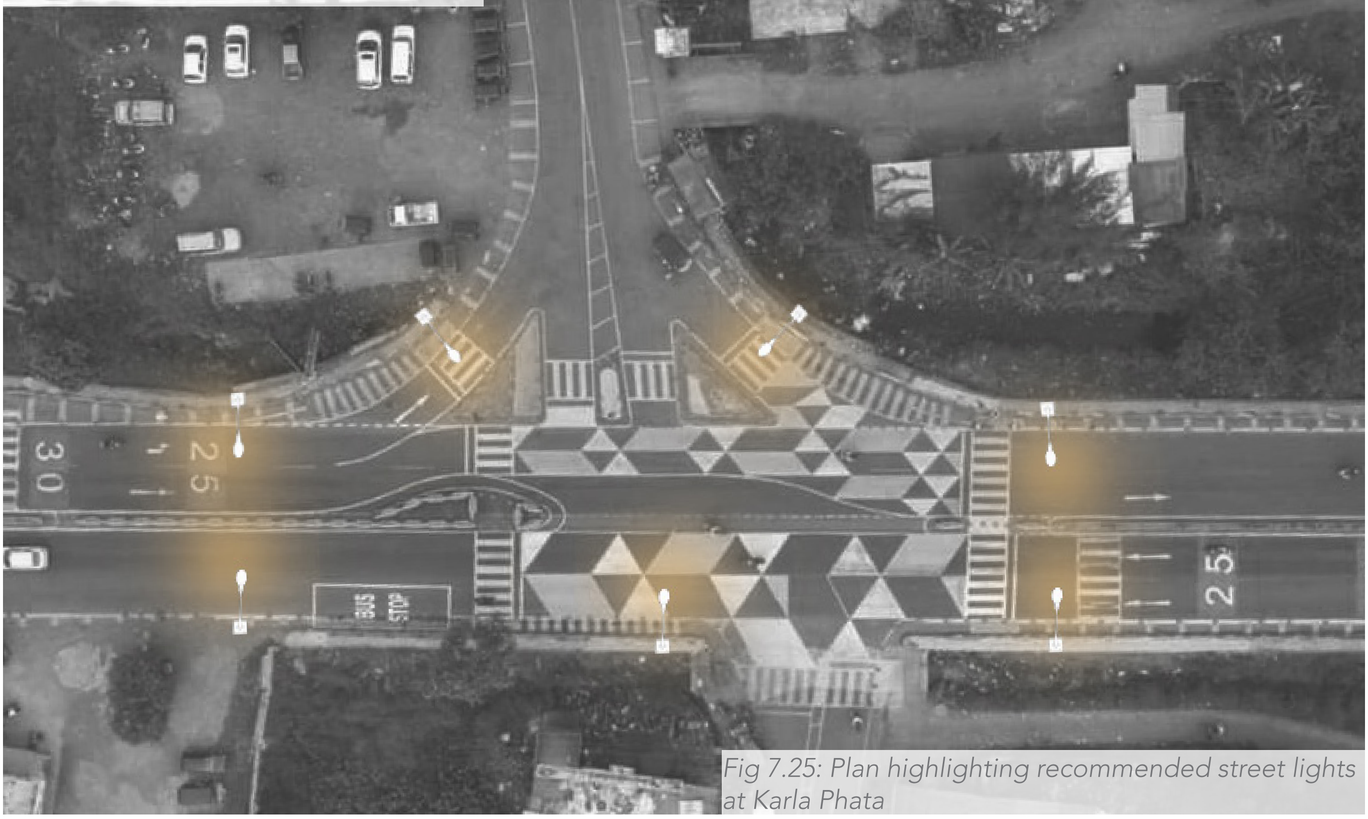


Fig 7.25: Plan highlighting recommended street lights at Karla Phata

- As there was no lighting available at the intersection, road studs were proposed to make it safer for vehicles passing by at night.
- However, it is recommended to install street lights at the intersection as it is difficult for vehicles as well as pedestrians to cross the intersection at night.

Fig 7.26: Image showing the dark intersection without any street lights

B. Permanent Design Recommendation

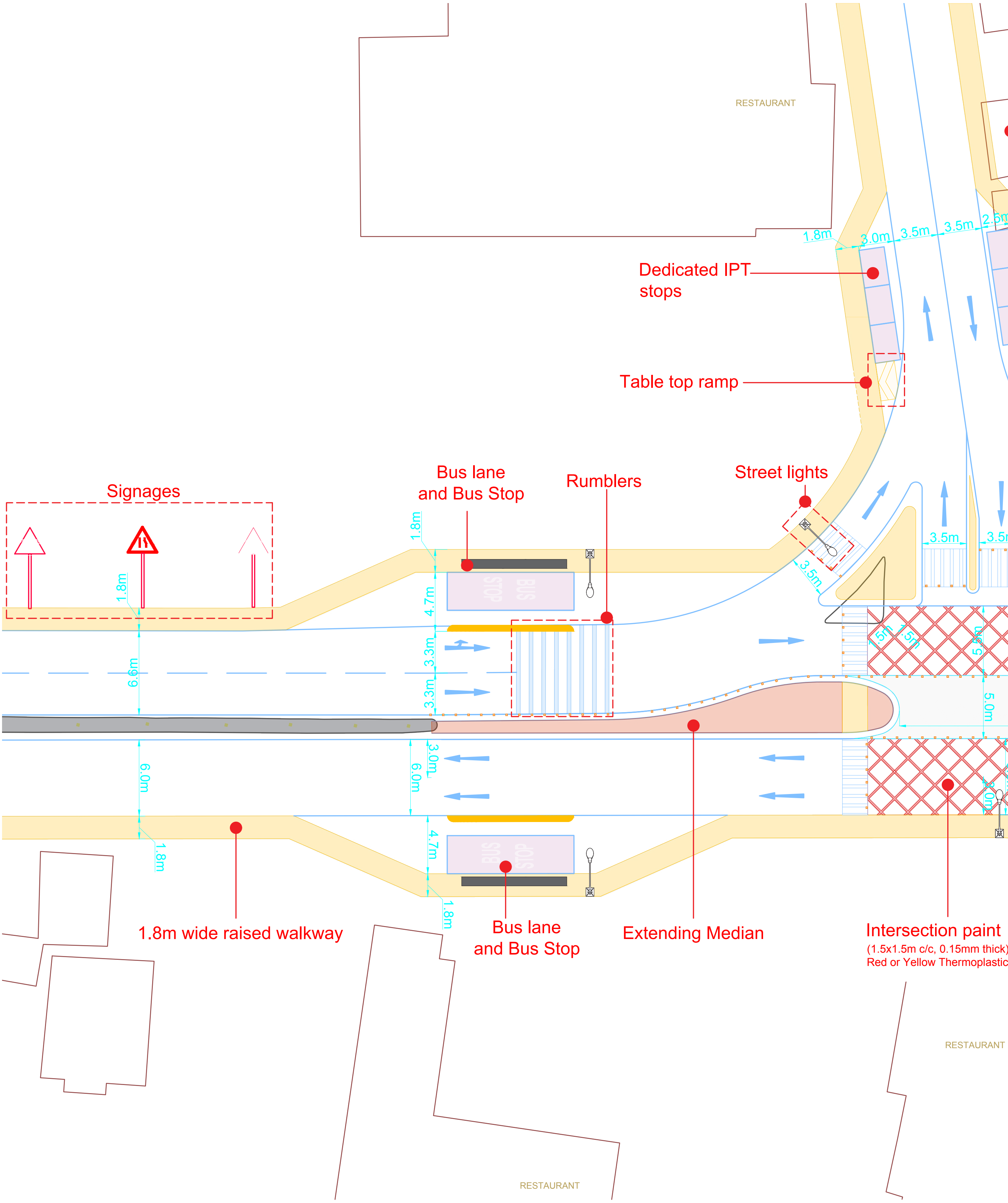
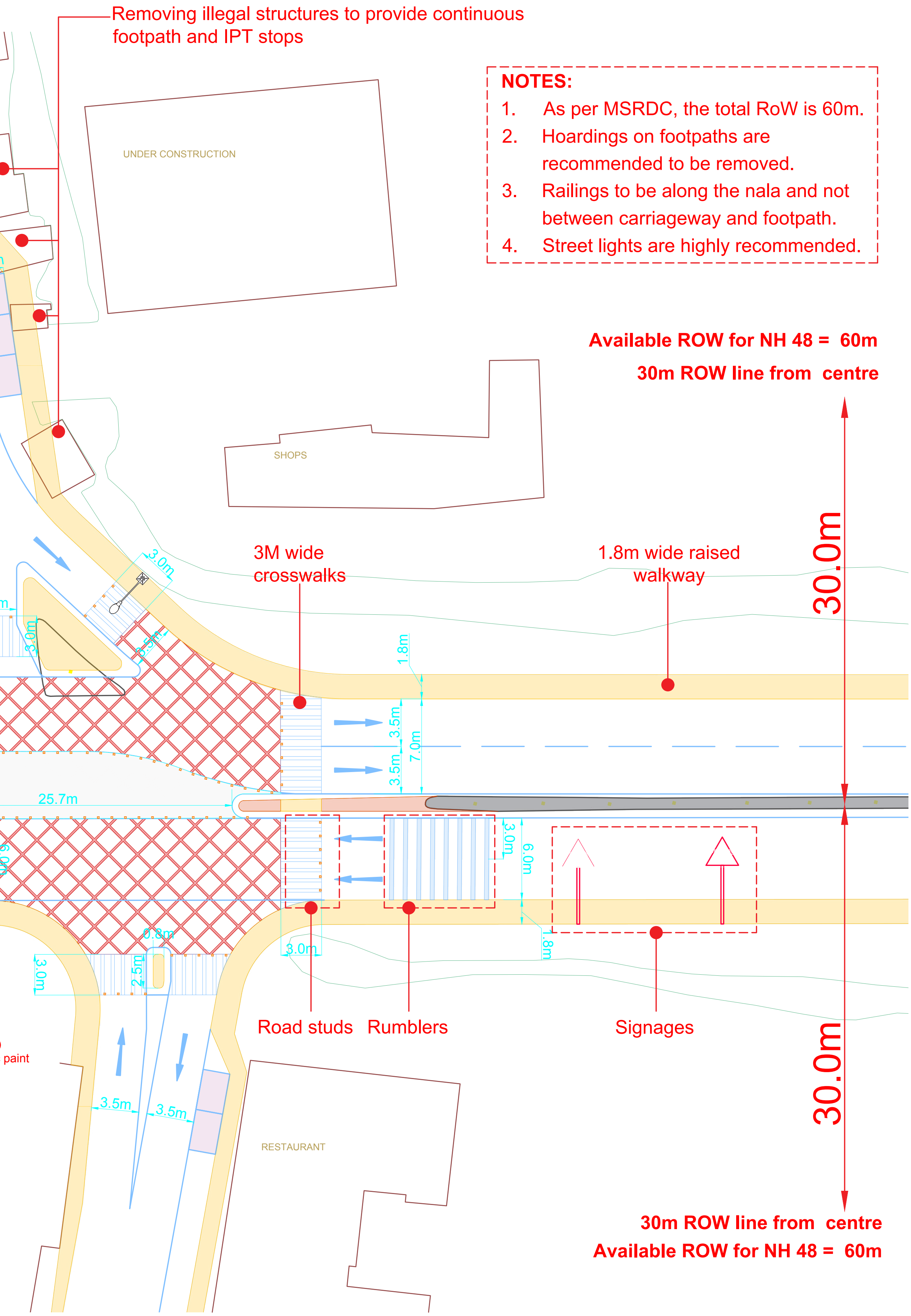


Fig 7.27: Plan highlighting recommended permanent design solution at Karla Phata


Removing illegal structures to provide continuous footpath and IPT stops
NOTES:
1. As per MSRDC, the total RoW is 60m.
2. Hoardings on footpaths are recommended to be removed.
3. Railings to be along the nala and not between carriageway and footpath.
4. Street lights are highly recommended.
UNDER CONSTRUCTION
Available ROW for NH 48 = 60m
30m ROW line from centre
SHOPS
30.0m
3M wide crosswalks
1.8m wide raised walkway
3.0m
1.8m
3.5m
7.0m
3.5m
25.7m
3.0m
6.0m
1.8m
0.8m
3.0m
2.5m
3.0m
Road studs
Rumblers
Signages
paint
3.5m
3.5m
RESTAURANT
30.0m
30m ROW line from centre
Available ROW for NH 48 = 60m

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