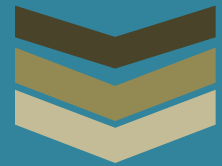


PROJECT MANAGEMENT CONSULTANCY FOR IMPLEMENTATION OF SMART CITY MISSION PROJECTS FOR MANGAL URU CITY

DETAILED PROJECT REPORT – PRIORITY LOOP ROAD

VOLUME I - REPORT



The purpose of the Detailed Project Report is to provide details of various considerations made towards the elements proposed for the project as mentioned in the title above. It aims to give a basic design idea to all the stakeholders before proceeding for final design and estimates.

**MANGALORE SMART CITY
PROJECT**

Lalbaug, M.G. Road, Mangalore
- 575003

3/28/2018

ISSUE AND REVISION RECORD

Revision	Date	Originator	Checker	Approver	Description	Standard
1	19/01/2019	WTESL/LBI/ CDAC	MANI NARAYAN	URVI BHATT/ KAVITA WAKADE	DETAILED PROJECT REPORT	

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ABBREVIATIONS

ABD	Area Based Development
ATM	Automated Teller Machine
MCC	Mangaluru City Corporation
MSCL	Mangaluru Smart City Limited
Gol	Government of India
GoK	Government of Karnataka
SCP	Smart City Proposal
SPV	Special Purpose Vehicle
IRC	Indian Road Congress
IUT	Institute of Urban Transport
KUIDFC	Karnataka Urban Infrastructure Development & Finance Corporation Limited
SCP	Smart City Proposal
SLNA	State Level Nodal Agency
ROW	Right of Way
MESCOM	Mangalore Electricity Supply Company Limited
KSRTC	Karnataka State Road Transport Corporation
LED	Light Emitting Diode
CCTV	Closed-circuit Television
GCP	Ground Control Points
DTM	Digital Terrain Model
LCV	Light Commercial Vehicle
ADT	Average Daily Traffic
PCU	Passenger Car Units
MoUD	Ministry of Urban Development
IT	Information Technology
ICT	Information and Communication Technology
ITS	Intelligent Transport System
ITMS	Intelligent Traffic Management System
OFC	Optical Fiber Cable
O&M	Operation and Maintenance
DPR	Detailed Project Report
RFP	Request for Proposal

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

SOR	Schedule of Rates
PWD	Public Works Department
RTO	Regional Transport Office

LIST OF REFERENCE CODES, STANDARDS, AND GUIDELINES

The following Codes and Standards have been referred in preparing the document

1. Indian Roads Congress (IRC) Codes & Standards
 - IRC: 86-1983 - Geometric Design Standards for Urban Roads in Plains
 - IRC: 106-1990 - Guidelines for Capacity of Urban Roads in Plain Areas
 - IRC: 38-1988 - Guidelines for Design of Horizontal Curves for Highways and Design Tables (First Revision)
 - IRC: SP:23-1983 - Vertical Curves for Highways
 - IRC: 65-1976 - Recommended Practice for Traffic Rotaries
 - IRC: 69-1977 - Space Standards for Roads in Urban Areas
 - IRC: 70-1977 - Guidelines on Regulation and Control of Mixed Traffic in Urban Areas
 - IRC: 92-1985 - Guidelines for the Design of Interchanges in Urban Areas
 - IRC: 99-1988 - Tentative Guidelines on the Provision of Speed Breakers for Control of Vehicular Speeds on Minor Roads
 - IRC: 103-2012 - Guidelines for Pedestrian Facilities
 - IRC: SP:12-2015 - Guidelines for Parking Facilities in Urban Roads
 - IRC: SP:41-1994 - Guidelines on Design of At-Grade Intersections in Rural & Urban Areas
 - IRC: 35-2015 - Code of Practice for Road Markings
 - IRC: 67-2012 - Code of Practice for Road Signs

2. Documents prepared for Institute of Urban Transport, Ministry of Urban Development
 - Code of Practice Part I – Cross Section
 - Code of Practice Part II – Intersections
 - Code of Practice Part III – Road Marking
 - Code of Practice Part IV – Signage
 - Code of Practice Part V – Traffic Calming

1. INTRODUCTION

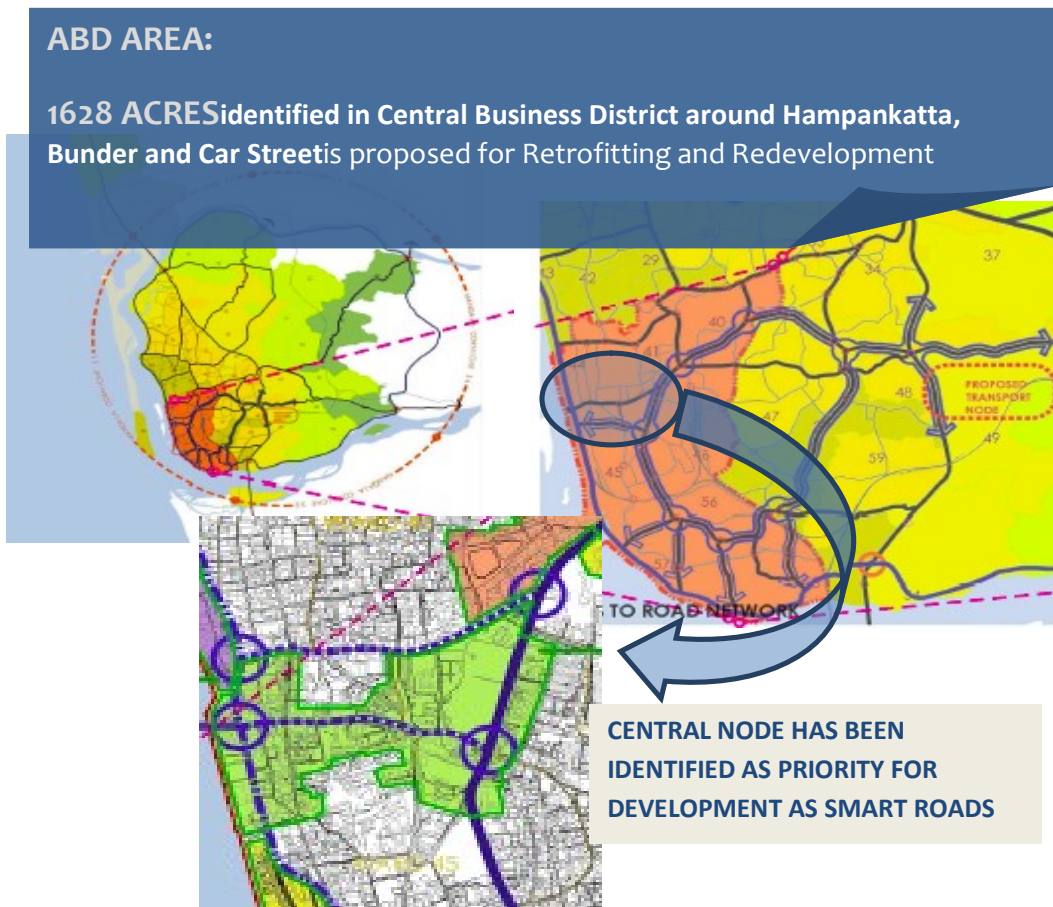
1.1. Mangaluru Smart City Proposal

Karnataka Urban Infrastructure Development & Finance Corporation Limited (KUIDFC) is the State Level Nodal Agency (SLNA) for the Smart Cities Mission in Karnataka. **Mangaluru was a proud Participant in second round of this Challenge and now aspires to translate the vision i.e. the broad components across both ‘area-based’ and ‘pan-city’ heads identified in the Smart City Proposal (SCP) into Reality.**

Mangaluru Smart City Proposals (SCP) is considered as Area Based Development Proposals (ABD) and Pan City Proposals. The SCP has identified 65 projects/sub projects to be taken up under ABD and Pan City Proposal

Figure 1-1 shows the ABD area considered under Mangaluru Smart City Proposal and the priority roads for development as smart roads


Figure 1-1 ABD area considered under Mangaluru Smart City and Priority Roads Identified for Development as Smart roads



1.2. Smart Road Proposals under Mangaluru Smart City Project

Transforming existing roads into Smart Roads has been envisaged under the Smart City Mission. In this regard, Mangaluru Smart City Ltd (MSCL) intends to develop world class road infrastructure that is efficient mode of transport and inclusive to all strata of society. This entails comprehensive upgrading of the public Right of Way (ROW) of the streets which includes refurbishment of existing carriageway, laying of new footpaths and cycle tracks, creating utility corridors, developing pedestrian facilities, development works for landscape, hardscape, street furniture, signage, lighting, etc.

The following projects proposed under Mangaluru SCP have been clubbed together and considered under Design and Development of Smart Roads

	Specialized Pedestrian Facilities along certain road sections	S NO. 19	ABD COMPONENT
	Widening of Roads	S NO. 21	ABD COMPONENT
	Upgradation of Roads with footpaths	S NO. 23	ABD COMPONENT
	Provision of Road side plantation	S NO. 25	ABD COMPONENT

1.2.1. Smart Roads under Mangaluru Smart City

The development of smart roads has been perceived in phased manner.

Phase I included Maidan road (from Clock Tower Circle to AB Shetty Circle

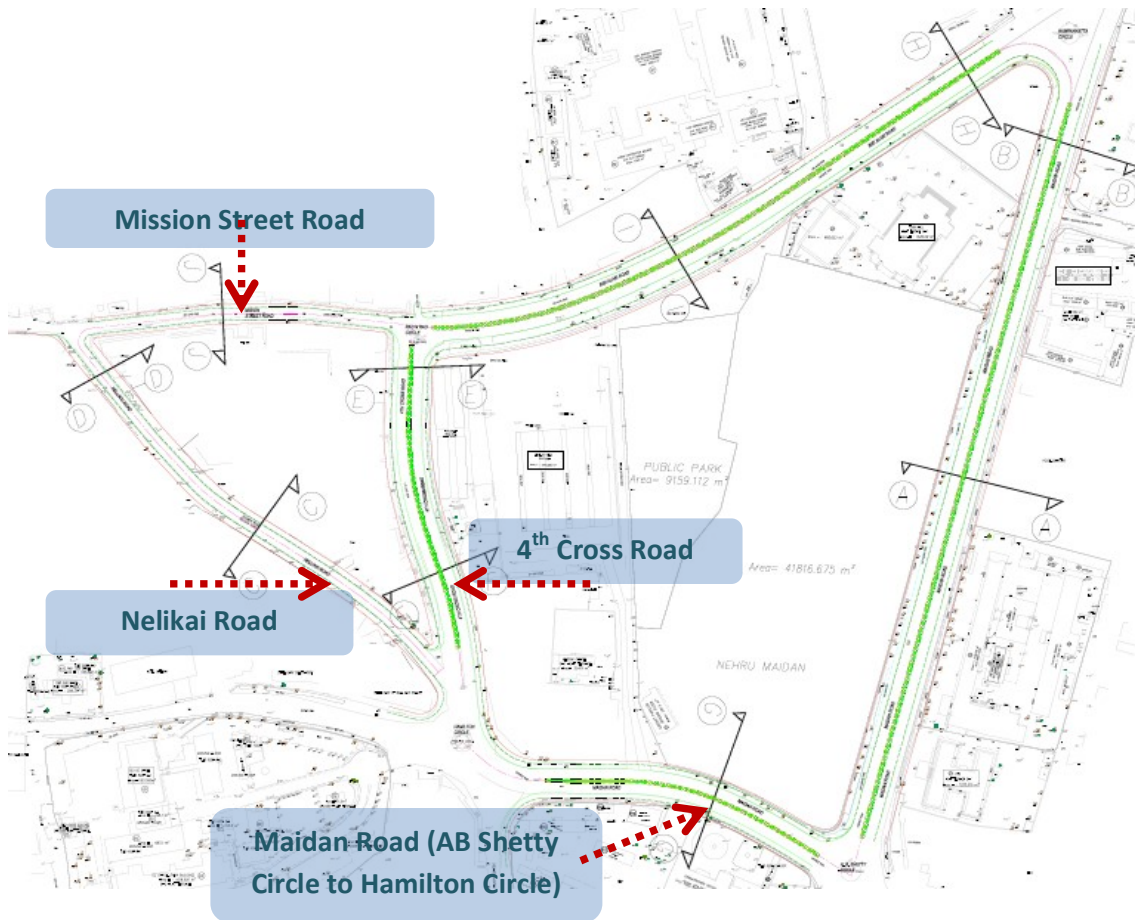
Priority Loop Smart Roads include Maidan road II (from AB Shetty Circle to Hamilton Circle), 4th Cross Road, Mission Street Road, Nellikai Road.

Other Roads to be developed in future phase(s) include Mangaladevi Road, Bunder road (from Hamilton Circle to Bunder), Rosario Church road (from Hamilton Circle to Hoige Bazaar), Car Street (from Sri Venkatramana Temple to Tile Factory), Bibi Alabi Road (from Junction with Nellikai Road to Bengre Ferry), Bunder Road (from Junction with Old Port Road to Hoige Bazaar), Marnamikatta Road

Junction Improvements are considered as integral part of smart roads design and development

Figure 1-2 shows the Priority Smart Road considered for development as smart road and are part of this DPR

Figure 1-2Phase I/Priority Smart Road considered for development as smart road



1.2.2. Need for Intervention

The existing road infrastructure and transport facilities in Mangalore are proving to be inadequate to meet the requirements of the city. 63% of the roads have speeds below 30 kmph as noted during the Comprehensive Traffic and Transportation Study of Mangalore. The delay is both due to traffic signals and interference of traffic movements, such as turning vehicles, parking and un-parking vehicles, pedestrians etc.

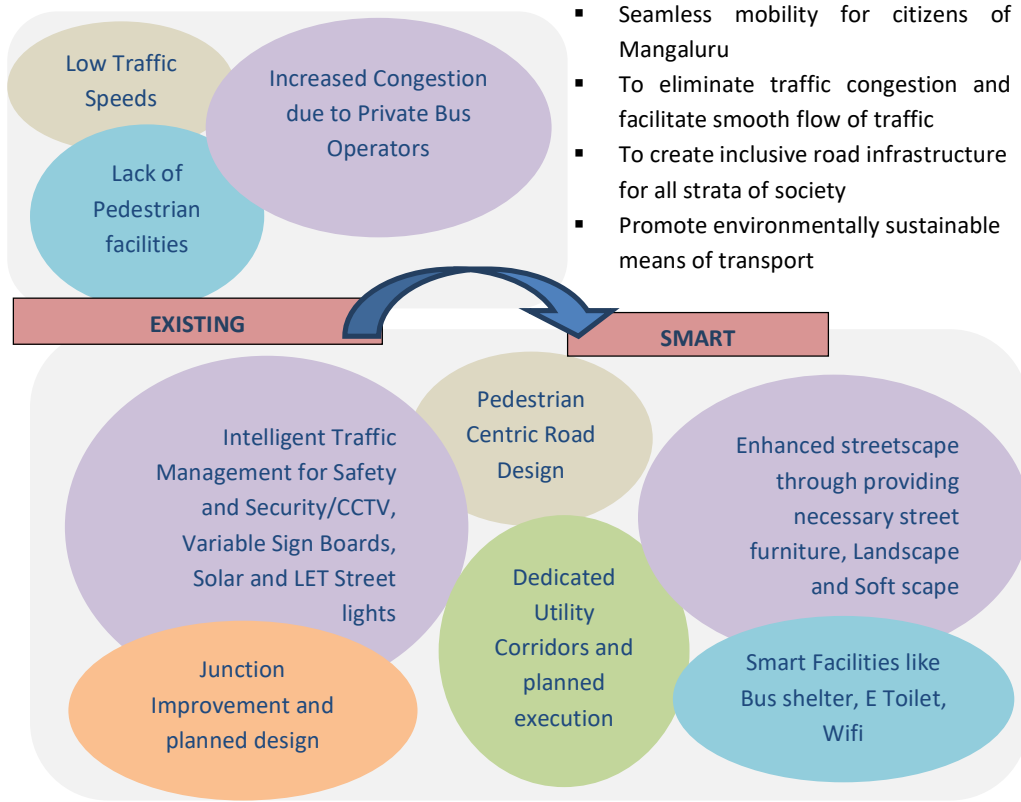
Due to substantial increase in the number of city buses in operation in addition to mixed flow of heavy traffic, the city is facing many traffic problems.

Further, with the increase in the commercial activity in some of the important areas like Hampankatta, Bejai, etc., there is an increased demand for better pedestrian facilities. The increase in vehicular traffic has given rise to widening the carriageway width to accommodate the vehicles resulting in reduction in the size of the foot paths. This in turn has given room for pedestrians to spill over to the carriageway, thereby affecting the flow of vehicles. Considering the present scenario the

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

main arterial roads and junctions require up gradation to improve the traffic and transport facilities for the citizens.

There is hence a need to transform the existing roads with above concerns into smart roads as depicted in diagram below



1.2.3. Proposed Interventions

The proposed intervention aims to achieve the following:

- Seamless mobility for citizens of Mangaluru
- To eliminate traffic congestion and facilitate smooth flow of traffic
- To create inclusive road infrastructure for all strata of society
- Promote environmentally sustainable means of transport



Smart Roads include Four Broad Objectives, namely:

- 1) **EFFICIENT AND SAFE STREETS:** This involves road re-channelization whereby the effective width of the carriageway is reduced in order to achieve systemic improvements. Roads with clearly demarcated spaces for vehicles, pedestrians, cyclists and dedicated on-street parking to minimize conflicts between vehicular and pedestrian traffic.
- 2) **RESILIENT STREETS:** Streets with defined utility corridor including undergrounding overhead utilities where upgraded utilities can withstand severe natural and man-made disasters. Streets that provide infrastructure allowing safe walking experience in night through pedestrian lighting and clean public space through dustbins at regular intervals.
- 3) **INCLUSIVE STREETS:** Universal accessible design that allow safe walking experience with shaded walkways to all citizens and specific facilities for elderly and people with special needs.
- 4) **STREETS AS PUBLIC SPACES:** Streets that provide spaces outside our homes for social, cultural or intellectual interactions, to walk or to just breathe fresh air.

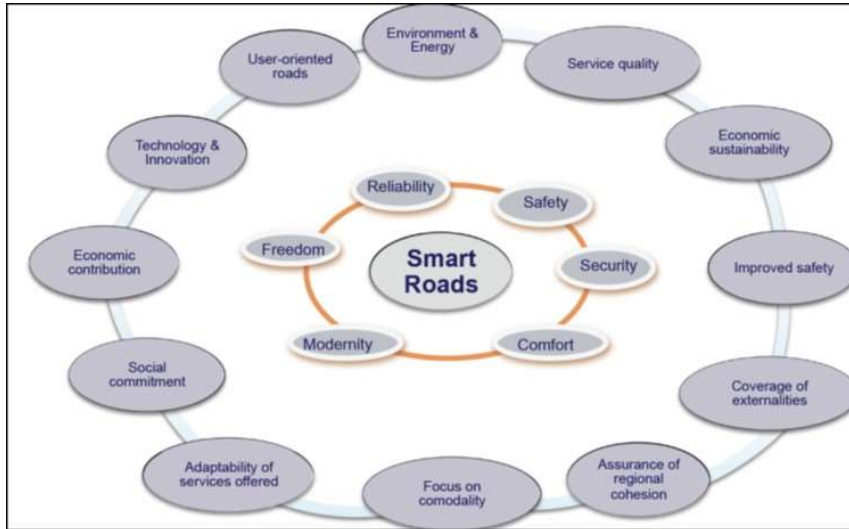
The Smart Road proposal would consist of the following specific interventions:



Details of proposed smart elements along the Priority Loop Road are covered in subsequent sections

1.2.4. Expected Benefits

The proposed up gradation of roads to Smart Roads would provide the following benefits to Mangaluru city:



1.2.5. Assumptions/Prerequisites

The assumptions for implementation of the Smart road are:

- There is no land acquisition involved and the selected road stretches are free of unauthorized encroachments
- The information about location of underground utilities and their alignment is available with the local authority
- Mangaluru City Corporation will facilitate the development of this project through facilitation of various statutory approvals and consultation with stakeholders
- 30% of median lighting poles to be replaced by new lighting poles.

1.2.6. Stakeholders/ Organizations involved

- Citizens
- Mangaluru Smart City Limited (MSCL)
- Mangaluru City Corporation (MCC)
- Mangaluru Smart City PMC
- Karnataka Public Works Department – Mangalore Division
- Traffic Police / RTO
- Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC)
- Mangalore Electricity Supply Company Limited (MESCOM)
- Karnataka State Road Transport Corporation (KSRTC)
- Private Bus Operators Association

1.2.7. Target Beneficiaries

The proposed up gradation of roads to Smart Roads would benefit the following:

- **Citizens:** The citizens would get better transport facilities for their mobility needs. The road improvement project would reduce traffic congestion; thereby result in travel time savings for the citizens. Smart roads also offer multiple mobility options such as walking, cycling, and public transport or through private vehicles. The upgraded roads would be inclusive to all citizens, i.e. would have facilities that would make them accessible to elderly or physically challenged persons.
- **Local Authority/ MCC:** The municipal corporation would get upgraded roads with more traffic handling capacity, smooth traffic flow and lesser congestion. Roads upgraded with state-of-the-art technology would result in fuel savings and lesser maintenance costs. Smart Roads would also help the local government in energy saving through energy efficient LED street lighting.
- **Local Economy:** The improved mobility and reduced travel times would result in improving the productivity of the citizens and thus benefit the local business and the city's economy.

1.3. Objective of the Report

The purpose of the Detailed Project Report is to provide details of various considerations and the elements proposed for the Priority Loop Smart Road. It aims to give a basic design idea to all the stakeholders before proceeding for final design and estimates.

1.4. Structure of the Report

This report is organized as follows:

- Chapter 1 – Introduction
- Chapter 2 – Priority Loop Road – Site Reconnaissance and Situation Analysis
- Chapter 3 – Surveys and Investigations
- Chapter 4 - Traffic Analysis and Recommendations
- Chapter 5 – Carriageway and Junction Improvement
- Chapter 6 – Proposed Smart Road Components – Urban Design, Landscape and ICT
- Chapter 7 – Traffic Management Plan
- Chapter 8 –Timeline for Execution
- Chapter 9– Monitoring and Evaluation
- Chapter 10 – Drawings
- Chapter 11 –Cost Estimates
- Annexures

2. PRIORITY LOOP ROAD - SITE RECONNAISSANCE AND SITUATION ANALYSIS

Detailed Site Reconnaissance was carried out along Priority Loop Road to assess the existing situation in terms of pavement condition, traffic situation/movements, existing facilities/structures, smart elements that can be proposed along Priority Loop Road. Section below describes brief of existing condition of Priority Loop Road

2.1. Nellikai Road

Nellikai Road stretches from Hamilton circle to Nellikai Junction

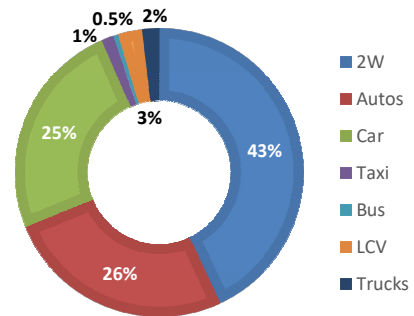
Facts:

1. Total length of road= 308.11m
2. Min. width = 14.20m
3. Max. Width = 15.59m
4. Slope: 3%; 1:28
5. Type of Carriage way: Bituminous in a poor condition

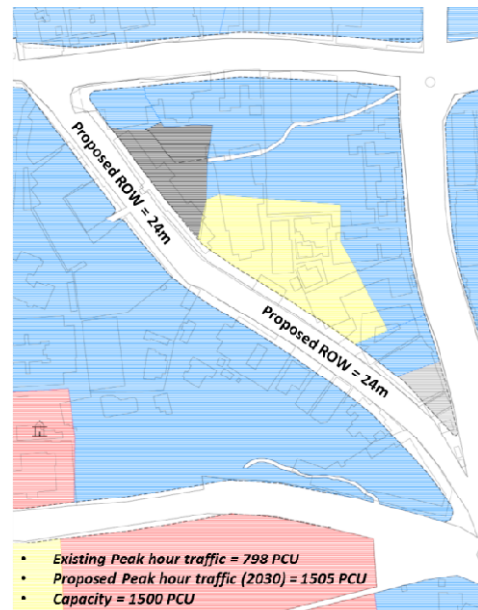
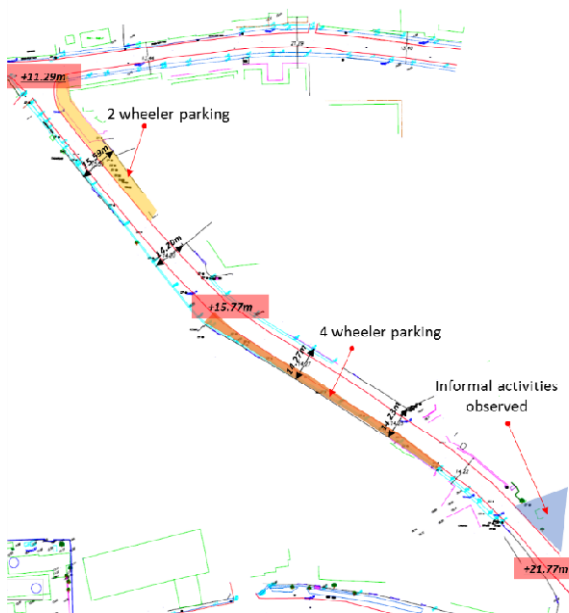
Existing Utilities:

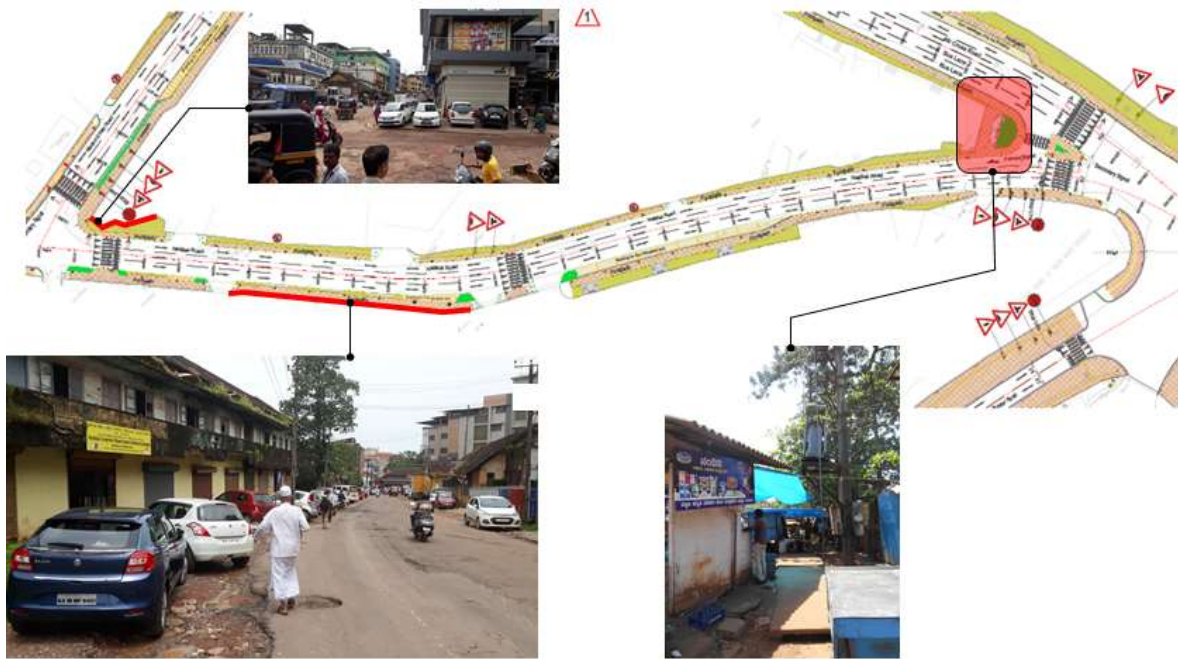
1. The electrical lines are present above ground
2. Storm water drains are present on both sides of the road
3. Waterline is present on both side of the carriage way.

MODAL SPLIT NELLIKAI ROAD



Present Scenario Master plan 2021 Proposal

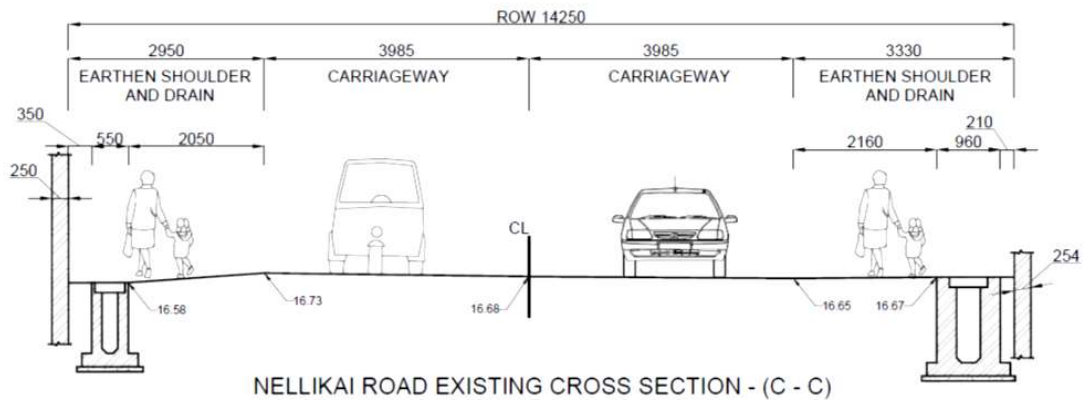




Observations:

1. Narrow ROW. The proposed ROW is 24m in the master plan of Mangalore.
2. Bottle neck is observed at the junction at Nellikai junction and sharp turning radius towards Bombay Lucky restaurant.
3. The commercial land use is present along both side of the road. This results in increasing traffic volumes on this road. Less scope of road widening
4. Random parking is present on both side of the carriage way which obstruct the flow of the current vehicular traffic.
5. As the levels of the adjacent buildings to the eastern edge of the road are lower than the road level, storm water management is necessary to be addressed at this area.
6. Informal commercial activity is found at the junction near Hamilton junction which needs to be organized

Existing Section for Nellikai Road





Random parking is observed to both the side of the road.



The structures on the eastern side of the road are the lower level than the road level.

2.2. 4th Cross Road

4th cross road stretches from Hamilton circle to Rao and Rao Junction

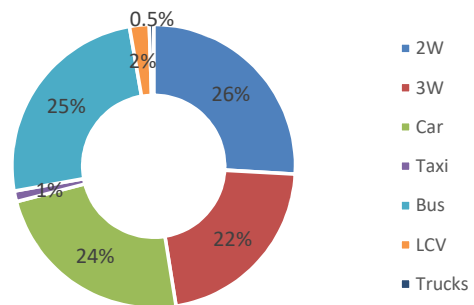
Facts:

1. Total length of road= 254.25m
2. Min. width = 24.40m
3. Max. Width = 29.90m
4. Proposed road width = 24m
5. Slope: 3%; 1:35
6. Type of Carriage way: Cement concrete

Existing Utilities:

1. The overhead electrical lines are to the west of the carriage way.
2. Storm water drains are present on to the east of the carriage way.

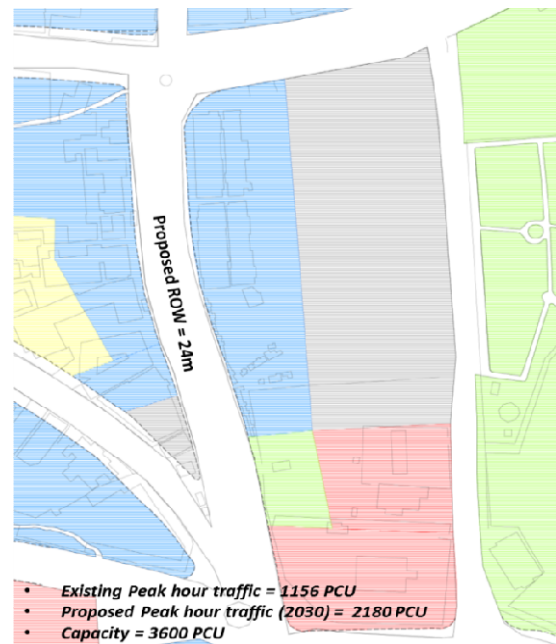
Modal Split - 4th Cross Road



Present Scenario



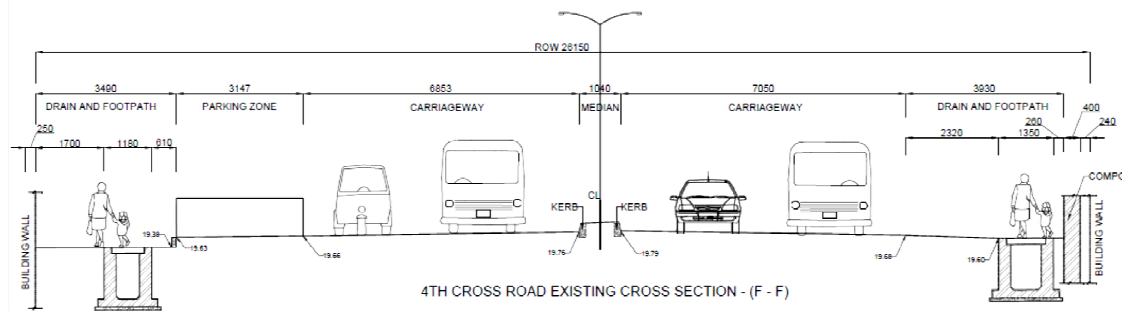
Master Plan Proposal 2021



Observations:

1. It is observed from the traffic study that the total volume at peak hour is 1156 PCU and the capacity of the road is 3600 PCU. So this road is running under capacity. Still a lot of congestion is observed on this road due to disorganized activities. The random parking encroached informal activities over the footpath and the random bus parking over the western part of the road adds to the chaotic situation.
2. The commercial and institutional land use is present along both side of the road. At the Hamilton junction rickshaw stand is observed.
3. As the levels of the adjacent buildings to the western edge of the road are lower than the road level, storm water management is necessary to be addressed at this area.
4. As a lot of informal activities is observed on this road, it is necessary to provide proper Hawking zone so that the footpath bellows free from any obstructions.

Existing Section for 4th Cross Road





Drain present at the lower level than the road level



Randomness on to the road – encroachments and Hawking spaces on the footpath, double parking etc.

2.3. Mission Street Road:

Mission street road stretches from Nellikai Junction to Rao and Rao Junction.

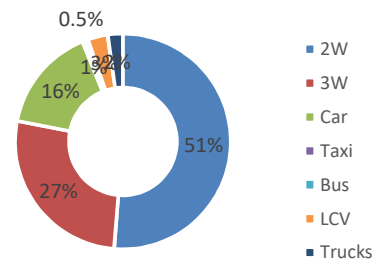
Facts:

1. Total length of road= 206.73m
2. Min. width = 13.40 m
3. Max. Width = 21.29 m
4. Slope: 2%; 1:50
5. Type of Carriage way: Bituminous in poor condition

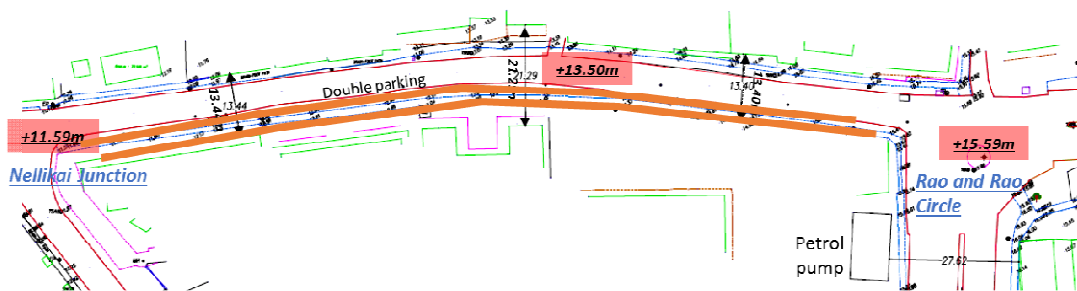
Existing Utilities:

1. Storm water drains are present on both sides of the road
2. Waterline is present on both side of the carriage way.
3. Electrical cable above the ground to both side of road.

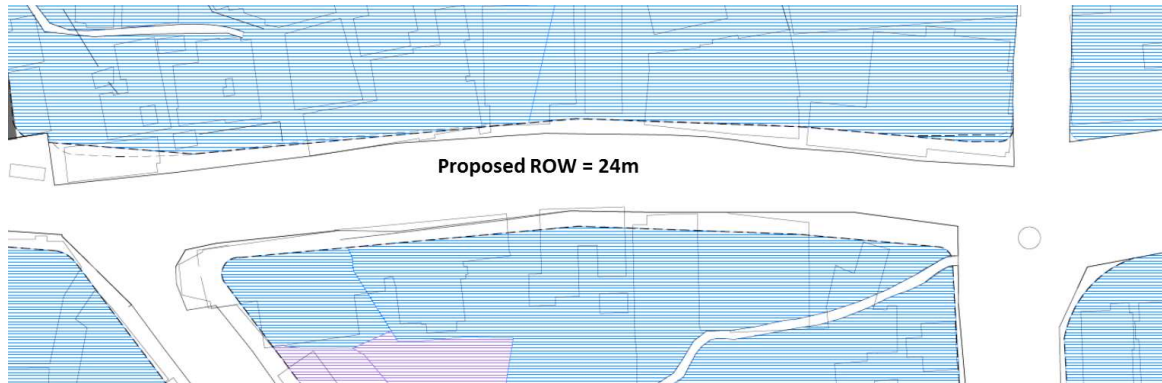
**Modal Split :
Mission Street Road**



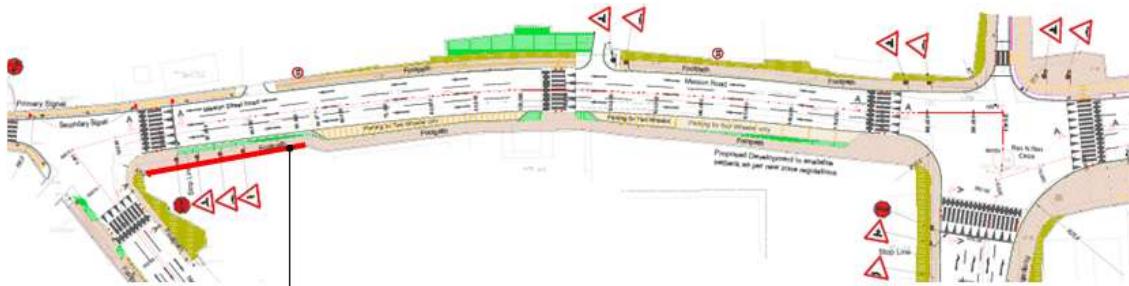
Layout showing existing condition of Mission Street Road



Masterplan of Mangalore 2021 – Landuse Analysis around Mission Street Road



- Existing Peak hour traffic = 932 PCU
- Proposed Peak hour traffic (2030) = 1757 PCU
- Capacity = 1500 PCU



Half of the carriage way is occupied in parking- double parking is seen

Observations:

1. Narrow ROW. Proposed ROW is 24m. As the building edge demarked the edge of the ROW, there is no scope of road widening.
2. As it is very close to the central market, a lot of floating population is observed on this road.
3. Commercial land use is observed to both side of the road. Hence no compound wall is observed. Thus, the tendency of people to park just outside the shops is seen which results into congestion in the road.
4. The double parking is observed on both the sides of the road.

2.4. Maidan Road II:

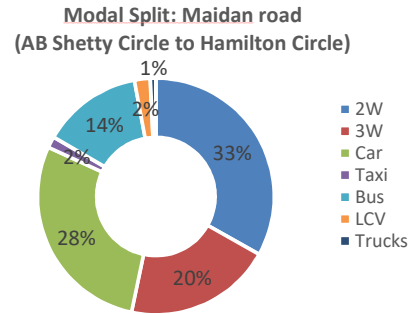
Maidan Road stretches from Hamilton circle to AB Shetty Junction.

Facts:

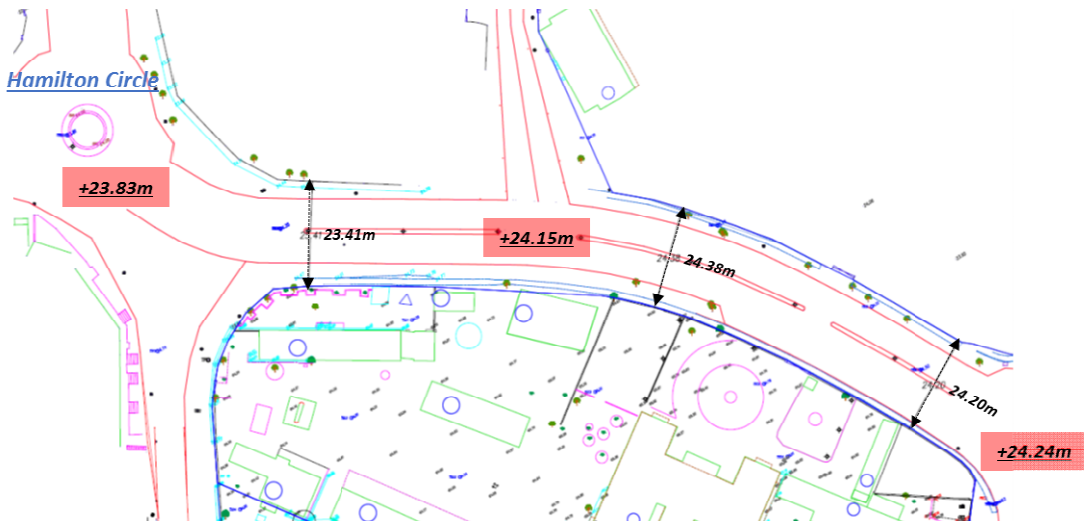
1. Total length of road= 253.94m
2. Min. width = 23.41 m
3. Max. Width = 24.38 m
4. Slope - negligible
5. Type of Carriage way: Cement Concrete

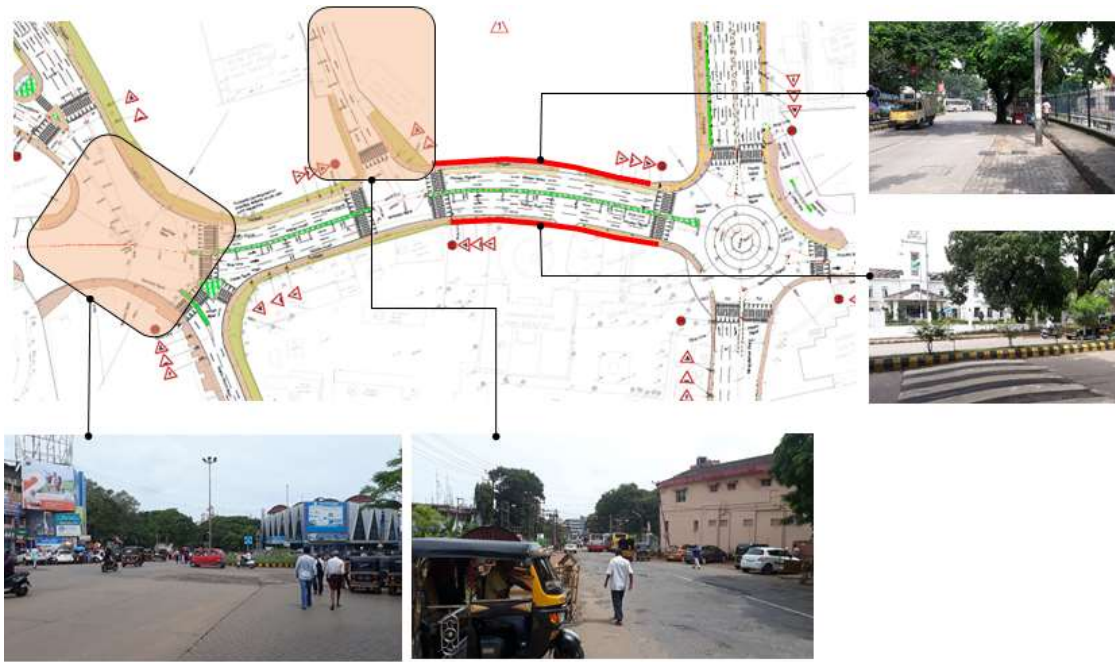
Existing Utilities:

1. Storm water drains are present on both sides of the road
2. Waterline is present on along the Commissioner’s office
3. Electrical cable are overhead



Present Scenario





Masterplan 2021 Proposal



Existing Peak hour traffic = 2565 PCU

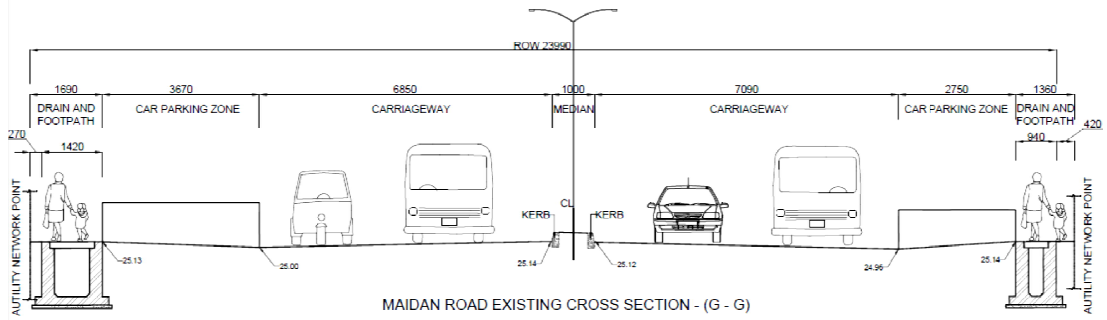
Proposed Peak hour traffic (2030) = 4128 PCU

Capacity = 3600 PCU

Observations:

1. The existing carriageway is sufficient to carry the traffic volume till 2025 and there is no need of road widening.
2. Parking is observed to the north of the road.
3. Narrow footpath is observed towards the south of the road.
4. Trees are observed at the shoulder of the road.

Existing Section of Maidan RoadII



3. SURVEYS AND INVESTIGATIONS

3.1. Road Inventory Survey

A detailed road inventory was done along the Priority Loop Road

At onset, the Ground Control Points (GCPs) were established using precision DGPS at appropriate intervals which shall be captured during DTM (Digital Terrain Model) for further geo referencing and Traversing using Total Station.

All the existing and proposed features, such as land-use, limits of right-of-way, embankment, structures, intersecting roads, existing utilities, electric and telephone installations (both O/H as well as underground), access roads, connectors, wayside amenities, safety structures, buildings, fencing and trees, street lights along the median/road side, oil and gas lines etc. falling within the extent of survey complete and levels were picked up (using Auto Level) at an interval of 10m X 10m grid.

The following drawing in section 10 of the report shows details of existing features along the Priority loop

WTE_2292_00_R_1.02	EXISTING FEATURES OF MADIAN ROAD - PART2 (SHEET 1 OF 1)
WTE_2292_00_R_1.03	EXISTING FEATURES OF NELLIKAI ROAD (SHEET 1 OF 1)
WTE_2292_00_R_1.04	EXISTING FEATURES OF 4TH CROSS ROAD (SHEET 1 OF 1)
WTE_2292_00_R_1.05	EXISTING FEATURES OF MISSION STREET ROAD (SHEET 1 OF 1)

3.2. Traffic Surveys

Based on the roads and junction identified under Priority Loop Road, detailed primary surveys and investigation were carried out. Table 3-1 below defines various Traffic surveys and investigations carried out along the Priority Loop Road

The overall objective was to capture traffic flow characteristics, travel pattern; speed characteristics, on traffic passing through the project road and other characteristics related to miscellaneous requirements on the project road

Table 3-1: Traffic Surveys and Investigations conducted along the Priority Loop Road

SI No.	Road name	Type of survey	Chainage
1	Maidan road (from AB Shetty Circle to Hamilton Circle)	3 days Classified Total Volume Count	0.1 km West of AB Shetty Circle
		1 Day Turning Movement Count	Hamilton Circle
		Pedestrian Count	Hamilton Circle
2	4 th Cross Road	3 days Classified Total Volume Count	0.1 km North of Hamilton Circle
		1 Day Turning Movement Count	Rao and Rao Circle
		Pedestrian Count	Rao and Rao Circle

SI No.	Road name	Type of survey	Chainage
3	Mission Street Road	3 days Classified Total Volume Count	0.1 km East of Rao and Rao Circle
		1 Day Turning Movement Count	Junction of Bus Stand Service Road and Bibi Alabi Road
		Pedestrian Count	Junction of Bus Stand Service Road and Bibi Alabi Road
4	Nellikai Road	3 days Classified Total Volume Count	0.1 km North West of Hamilton Circle
		1 Day Turning Movement Count	Junction of Nellikai Road and Bibi Alabi Road
		Pedestrian Count	Junction of Nellikai Road and Bibi Alabi Road

Table 3-1 below shows locations where Traffic surveys and investigations were carried out along the Priority Loop Road

Figure 3-1 Traffic Survey Location

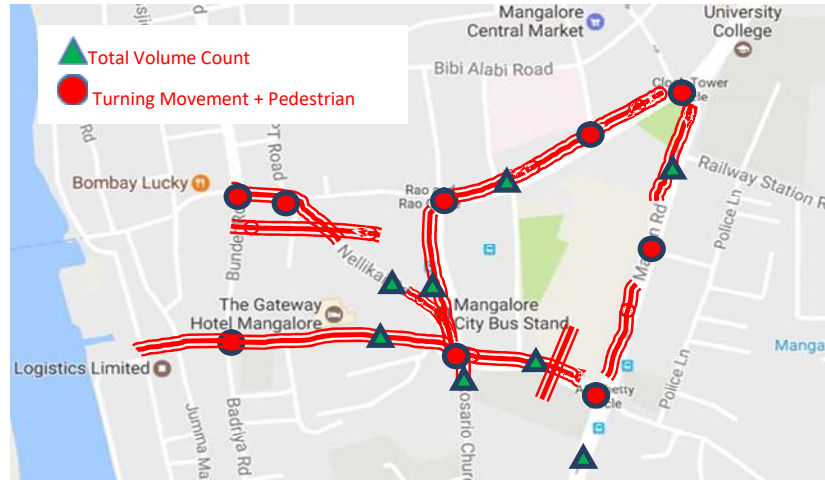


Figure 3-2 Survey work in progress



The Traffic Volume Counts were conducted as per guidelines illustrated in IRC: SP: 19 – 2001, 'Manual for Survey, Investigation and Preparation of Road Projects'.

Figure 3-2 shows the traffic survey in progress at the Project site.

For carrying out the counts, the vehicles were grouped under the categories given in Table 3-2 below.

Table 3-2: Traffic Surveys - Vehicle Classification system

Category	Examples of Vehicle Types
Two Wheelers	Scooters, Bikes, Motor cycles and Mopeds
Three Wheelers	Auto Rickshaw
Car	Car, Jeep, Taxi, and Vans
Bus	Mini Bus, Government Bus, Private Bus
Trucks	Light Commercial Vehicle (LCV), 2, 3, 4, 5, 6 and >6 Axle Trucks
Other	Tractor, Tractor & Trailer
Non-Motorized	Bicycle, Cycle Rickshaw, Animal drawn vehicles, Hand Cart

Intersection turning movement surveys have been carried out at all the major intersection locations. Classified traffic volume counts of all types of vehicles have been made separately for each direction including left and right turning traffic. The surveys have been conducted for successive 15 minutes interval for a period 24 hours.

The complete details of above mentioned primary Traffic Survey and Investigations have been enclosed as Annexure 1 to the Report

4. TRAFFIC ANALYSIS AND RECOMMENDATIONS

4.1. Traffic Analysis

4.1.1. Classified Traffic Volume Counts

The classified traffic volume survey data for two count locations was analyzed in order to obtain the following traffic characteristics:

- Average hourly variation of traffic volume
- Daily variation of traffic volume
- Average Composition of traffic
- Directional distribution of traffic
- Average Daily Traffic (ADT) volume

Daily and hourly variation of classified traffic flow is recorded by conducting traffic counts at two strategically selected traffic count stations. Recorded traffic data has been converted into Passenger Car Units using PCU factors as shown in table 4-1 below.

These equivalency factors are extracted from IRC: 106 – 1990, ‘Guidelines for Capacity of Roads in Urban Areas’.

Table 4-1: Traffic Surveys - Vehicle Classification system

	Vehicle Type	PCU Factors	
		Percentage Composition of Vehicle Type in Traffic Stream	
		5%	10% and Above
1	Two Wheeler	0.50	0.75
2	Car	1.00	1.00
3	Auto Rickshaw	1.20	2.00
4	LCV	1.40	2.00
5	Truck or Bus	2.20	3.70
6	Agricultural Tractor Trailer	4.00	5.00
7	Cycle	0.40	0.50
8	Cycle Rickshaw	1.50	2.00
9	Tonga	1.50	2.00
10	Hand Cart	2.00	3.00

Average Daily Traffic (ADT)

Traffic volume count data for 7 days at two locations were carried out to determine Average Daily Traffic (ADT) and is shown in table 4-2 below

Table 4-2: Average Daily Traffic at Priority Roads

Vehicle Type	Maidan road (from AB Shetty Circle to Hamilton Circle)	4 th Cross Road	Mission Street Road	Nellikai Road
2W	8080	2593	2839	4326
3W-P	4628	1716	2254	2424
3W-F	303	448	138	154
Car	6956	2355	1099	2476
Taxi	379	120	10	139
M-Bus	70	486	5	25
Bus	3268	2027	80	28
M-LCV	0	20	0	68
LCV-P	0	20	0	0
LCV	527	185	171	201
2-Axle	164	43	43	175
3-Axle	19	6	2	9
4-6 Ax	4	0	2	3
>6Axle	0	0	0	0
Others	1	1	2	4
Total	24399	10011	6645	10032
PCU	27750	14849	9062	9814

(2W: Two Wheeler, 3W: Three Wheeler, P: Passenger, F: Freight, M: Mini, LCV: Light Commercial Vehicle)

Further, Traffic split was conducted to understand the % of commercial vehicle and Passenger Vehicle. Traffic Split at Priority Road is presented in table 4-3 below

Table 4-3: Traffic split at Priority Roads

Vehicle Type	Maidan road (from AB Shetty Circle to Hamilton Circle)	4 th Cross Road	Mission Street Road	Nellikai Road
Passenger Vehicles	97%	97%	97%	95%
Commercial Vehicles	3%	3%	3%	5%

Since this is an urban street so it is assumed that traffic behavior will remain same round the year, so Annual Average Daily Traffic (AADT) will remain the same as ADT.

Hourly Variation of Traffic

Average hourly variation of traffic for Priority Roads is shown in figure 4-3 to 4.7 below. Table 4-4 provides details of Hourly variation of Traffic: Peak Hour Traffic

Figure 4-3 Hourly Traffic Variation on AB Shetty and Hamilton Circle

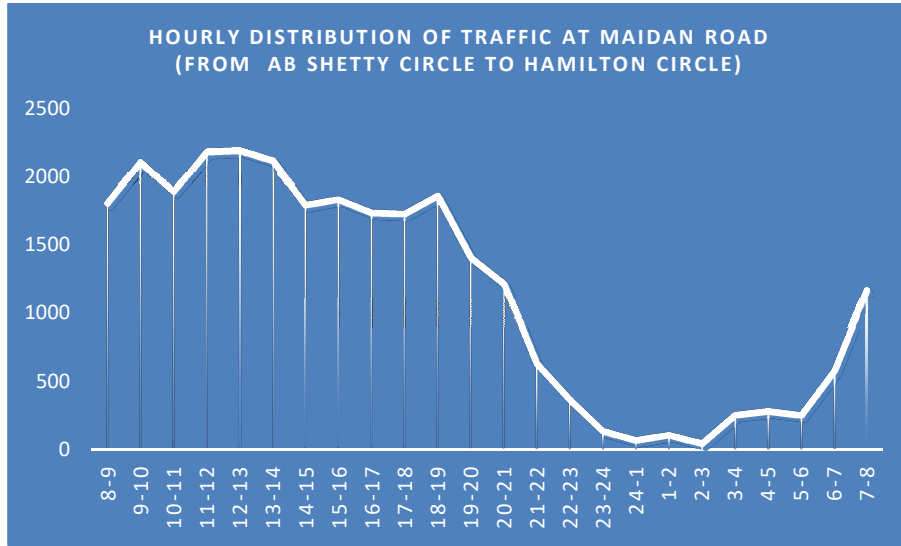


Figure 4-4 Hourly Traffic Variation on 4th Cross Road

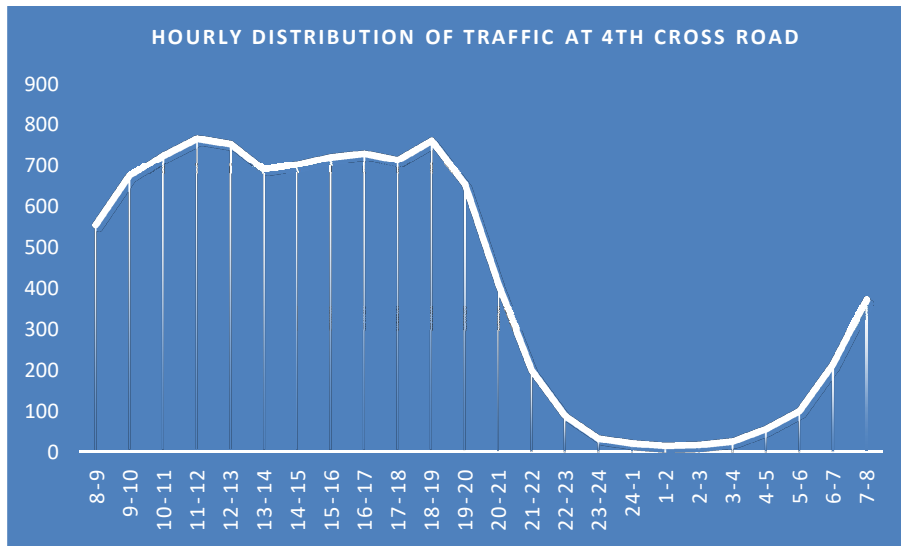


Figure 4-6 Hourly Traffic Variation on Nellikai Road

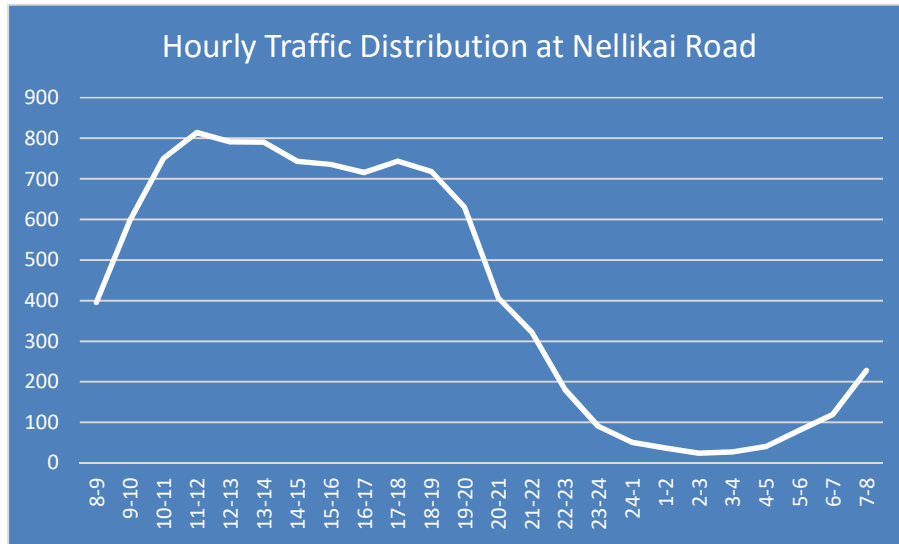


Figure 4-7 Hourly Traffic Variation on Mission Street Road

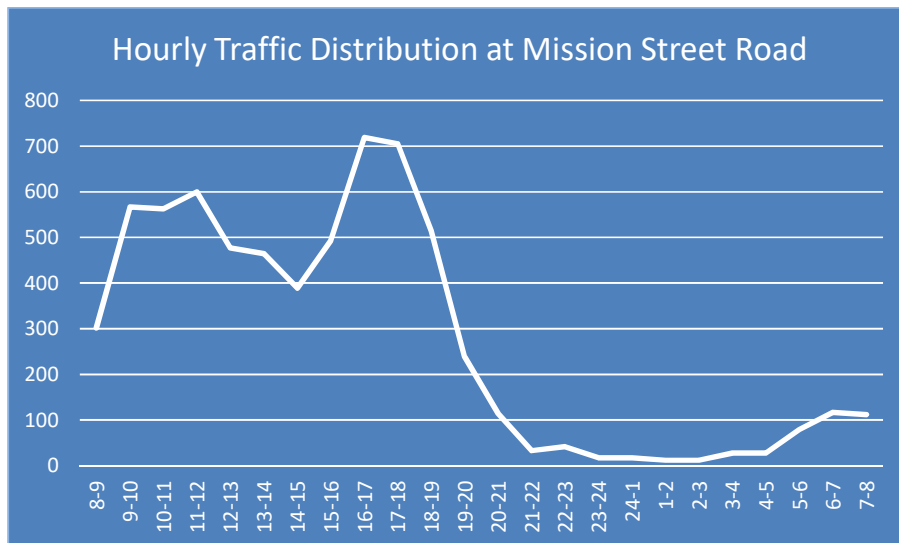


Table 4-4: Hourly Variation of the Traffic: Peak Hour Factors

	PHF/Peak Hour	Peak Hour Volume	Peak Hour PCU
Maidan road (from AB Shetty Circle to Hamilton Circle)	8.07% / 11-12 Hours	1969	2189
4th Cross Road	7.65% / 11-12 Hours	766	1156
Mission Street Road	10.82% / 16-17 Hours	719	932
Nellikai Road	8.12 % / 11 – 12 Hours	814	798

The exhaustive details of the daily variation of traffic volume, average composition of traffic, Directional distribution of traffic has been covered and provided at Annexure 1 to the report

4.1.2. Turning Movement Count

Intersection turning movement surveyed at all the major intersection locations and classified traffic volume counts of all types of vehicles have been made separately for each direction including left and right turning traffic. (Refer Annexure 1 for details).

The surveys have been conducted for successive 15 minutes interval for a period 24 hours. Based on traffic growth rate of 5% used in this report all junctions had been analysed to understand the need of grade separation, signalization or any other traffic calming methods at these junctions as per IRC 92 and IRC SP 41.

Highway grade separators are envisaged at intersection of divided road if the ADT (fast vehicles only) on the cross road within the next 5 years is likely to exceed 5000 and otherwise the need for such facilities could be kept in view for future consideration / construction.

An interchange may be justified when an at-grade intersection fails to handle the volume of traffic resulting in serious congestion and frequent choking of the intersection. This situation may arise when the total traffic of all the arms of the intersection is in excess of 10,000 PCU/ hours.

As per IRC SP 41 following figure gives the measure required for junction functioning at correct LOS.

Turning Movement Count has been conducted at following junctions of Maidan road:

- A.B. Shetty Circle
- Junction of Maidan road and Old Kent Road
- Hamilton Circle
- Rao Rao Circle
- Junction of Bus Stand Service Road and Bibi Alabi Road
- Junction of Nellikai Road and Bibi Alabi Road

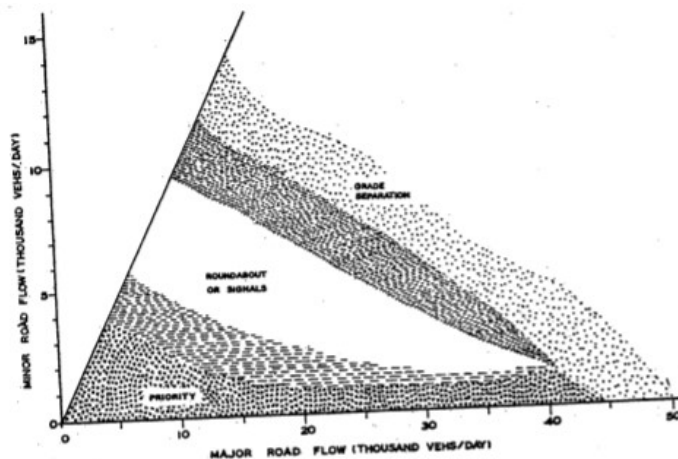


Fig. 1.1. Intersection Selection based on Traffic Flow Combination (U.K. Practice)

Table 4-5 below provides detailed analysis of junction traffic at present condition and for future years as per IRC 92.

Table 4-5: Detailed Analysis of Junction Traffic for Present Condition and Future Projections (As per IRC 92)

Junction Traffic Analysis			IRC 92 Criteria				Remarks
Sl No.	Jn. Category	Name of Intersection	Peak Hour PCU (2017)	Peak Hour PCU (2027)	Peak Hour PCU (2037)	Year (Grade Separation Warranted)	
1	4 Leg	Junction of Maidan road and Old Kent Road	761	1240	2019	NA	
2	3 Leg	A B Shetty Circle	7197	11723	19096	2017	Space Constraint – Regular Signal Recommended
3	4 Leg	Hamilton Circle	4716	7682	12513	2019	Space Constraint – Signalized junction without any central island.
4	4 Leg	Rao Rao Circle	2075	3380	5506	2036	
5	3 Leg	Bibi Alabi Junction	2366	3853	6277	2032	Free Left Turn
6	4 Leg	Nellikai Road Jn	2729	4445	7242	2031	Nellikai Road One way will ease traffic.

Table 4-6 below provides detailed analysis of junction traffic at present condition and for future years as per IRC 92.

Table 4-6: Detailed Analysis of Junction as per SP 41

Junction Traffic Analysis			IRC SP 41 Criteria (Vehicle Per Day)					
Sl. No.	Jn. Category	Name of Intersection	2017		2027		2037	
			Major Rd	Minor Rd	Major Rd	Minor Rd	Major Rd	Minor Rd
1	3 Leg	Junction of Maidan road and Old Kent Road	5100	2598	8307	4232	13532	6893
2	3 Leg	A B Shetty Circle	38991	7582	63512	12350	103455	20117
3	4 Leg	Hamilton Circle	24388	13234	39725	21557	64709	35114
4	4 Leg	Rao Rao Circle	11244	4370	18315	7118	29834	11595
5	3 Leg	Bibi Alabi Junction	17442	1790	28411	4153	46278	6765
6	4 Leg	Nellikai Road Junction	17684	4747	28805	7732	46921	12595

Based on the above table and analysis carried out with reference to IRC SP 41, AB Shetty and Hamilton Circle is candidate for grade separation and Maidan – Old Kent Road Junction is at normal traffic flow.

Figures below depict the directional traffic flow diagrams along with Vehicle and PCU at various intersections.

Figure 4-1 Directional Traffic Flow Diagram for Maidan – Kent Road Junction Traffic

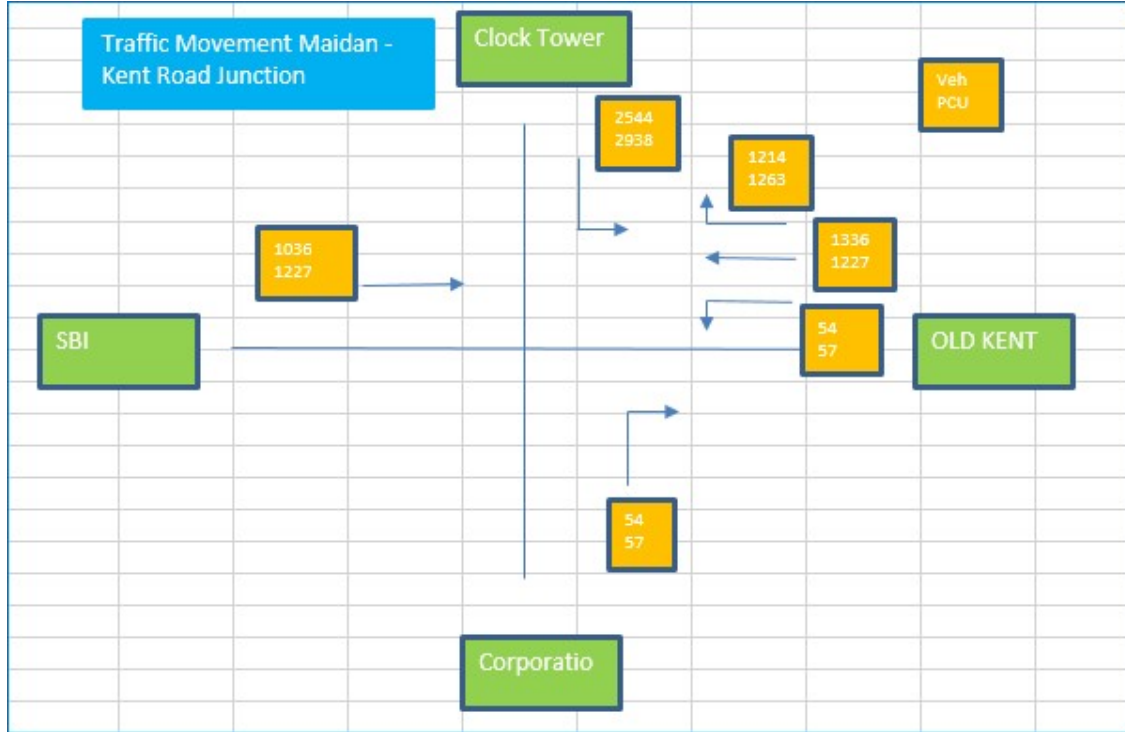


Figure 4-2 Directional Traffic Flow Diagram for A B Shetty Circle

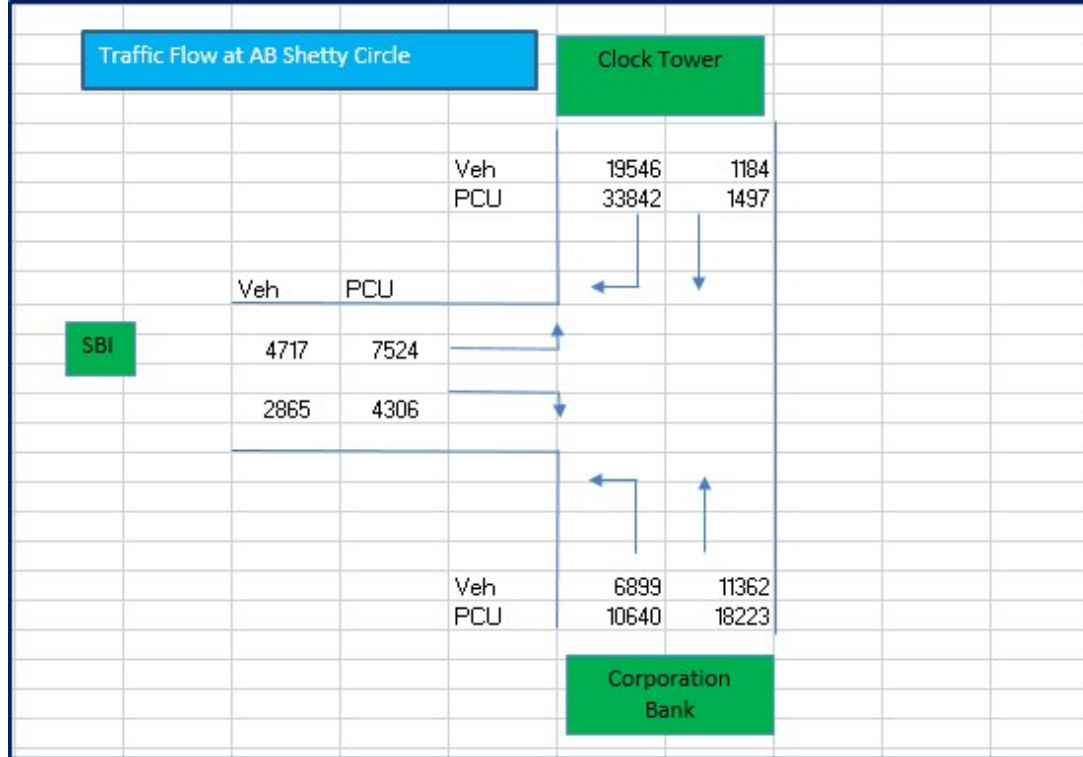


Figure 4-3 Directional Traffic Flow Diagram for Hamilton Circle

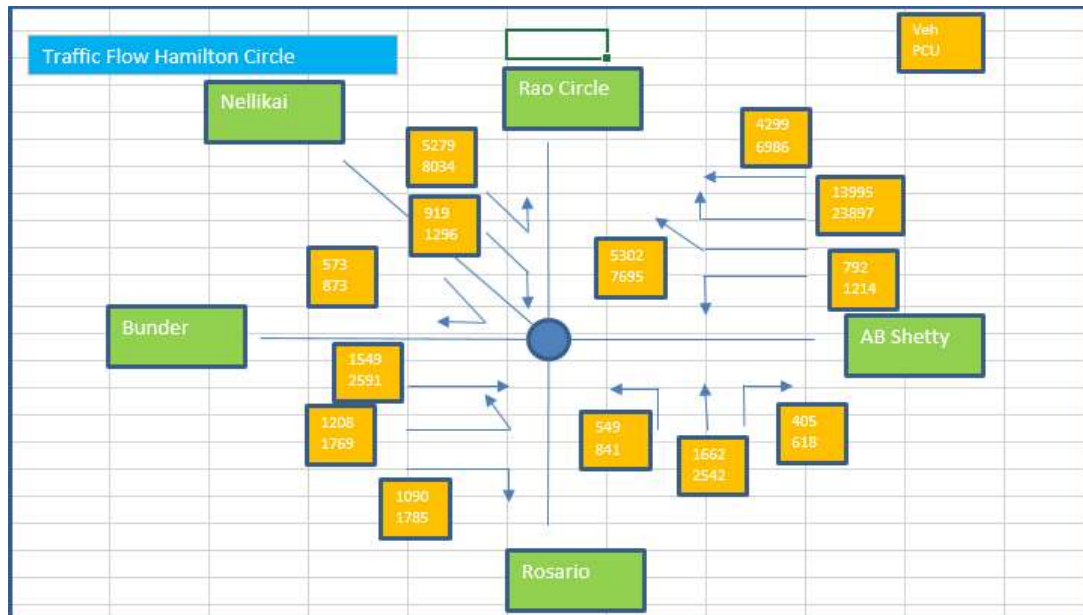


Figure 4-4 Directional Traffic Flow Diagram for Rao Rao Circle

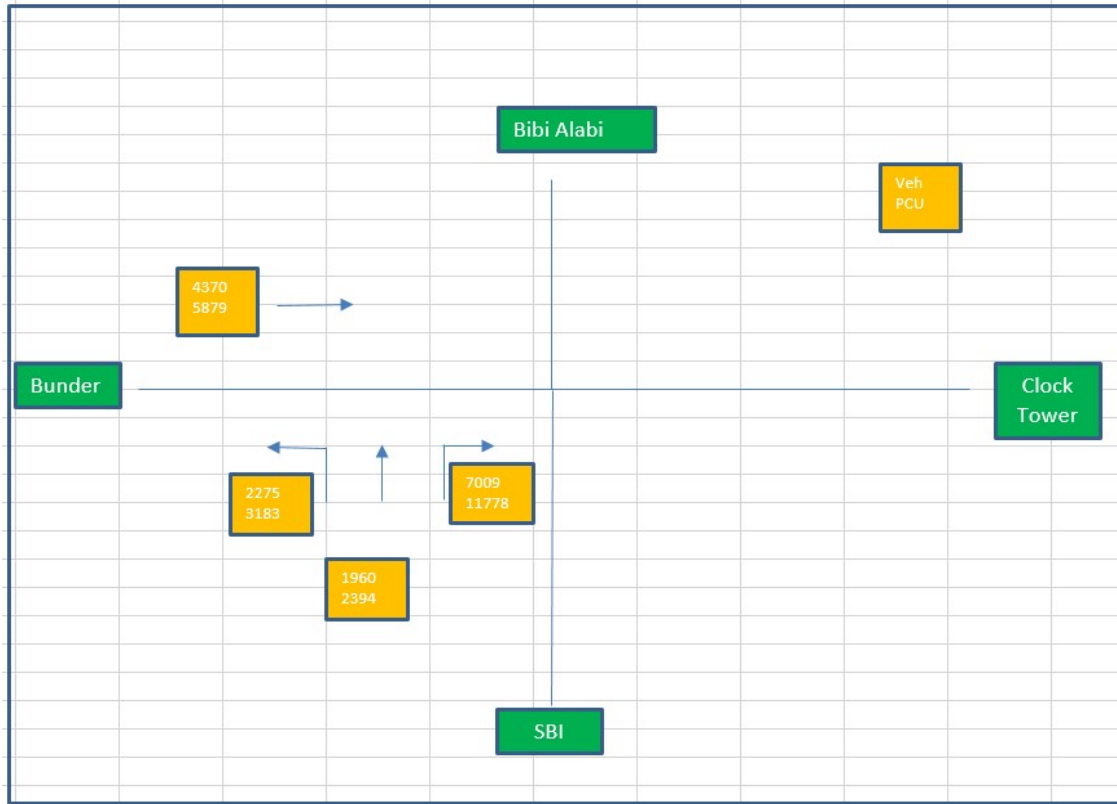


Figure 4-5 Directional Traffic Flow Diagram for Bibi Alabi Road Junction

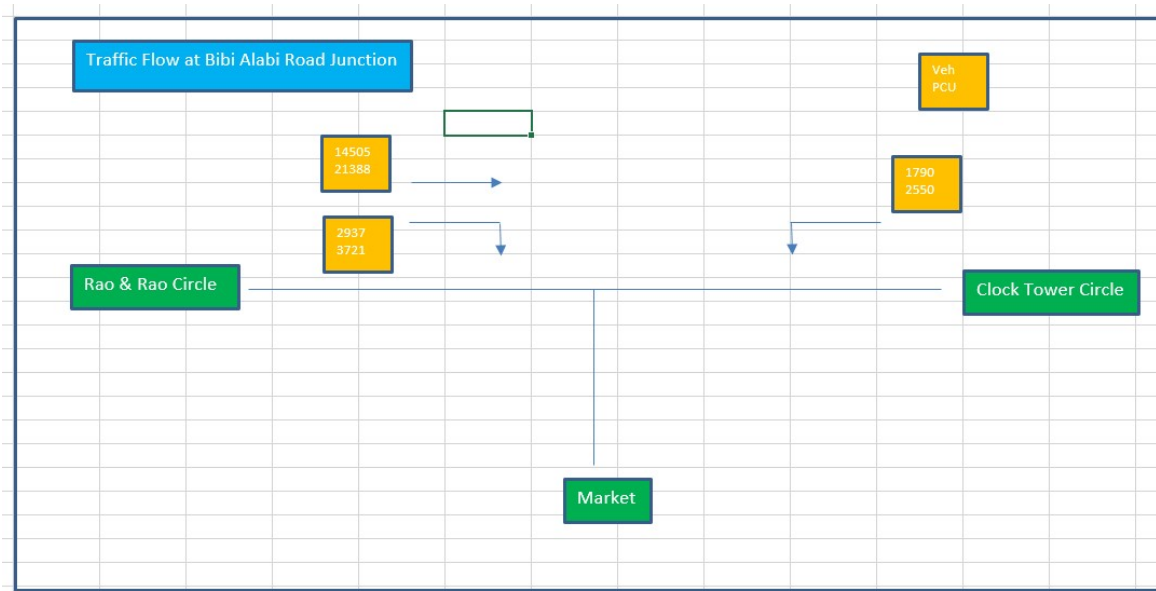
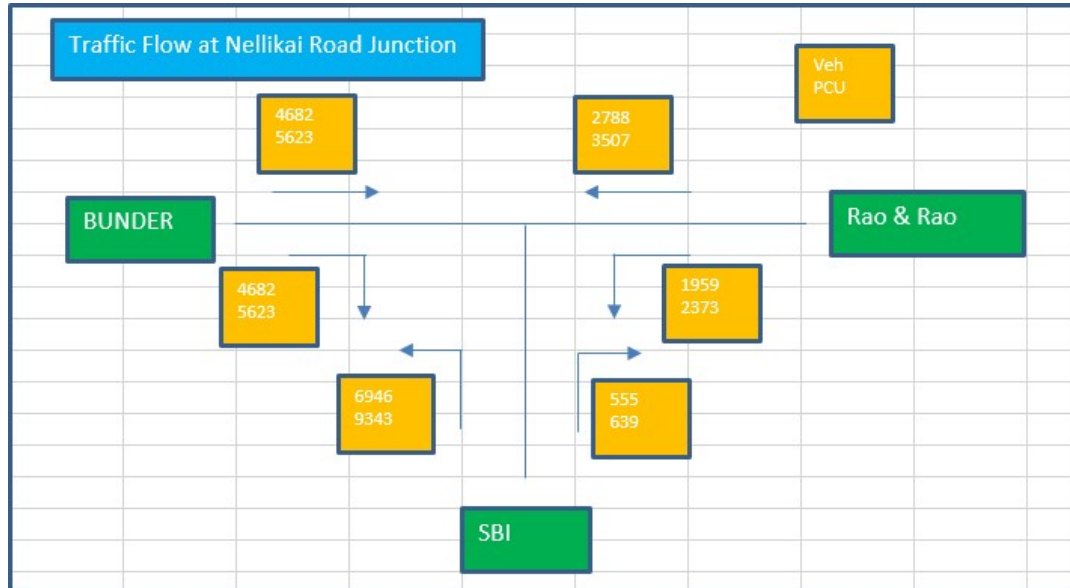


Figure 4-6 Directional Traffic Flow Diagram for Nellikai Road Junction



4.1.3. Pedestrian Count Survey

Intensity of pedestrians/animals crossing the project road will be used for deciding on locations requiring grade separators in the form of RUB, pedestrian or cattle crossing.

Pedestrian-vehicular conflict can be effectively studied through the indicator suggested in IRC 103-1988, 'Guidelines for Pedestrian Facilities'.

The code suggests some form of control measure at mid blocks and intersections where the indicator PV^2 is greater than or equal to 2×10^8 and for Zebra crossing PV^2 should be greater than 1×10^8 Where 'P' is the peak hour pedestrian volume and 'V' is the number of vehicles in that peak hour.

The analysis was undertaken separately for each of the intersection where traffic surveys were conducted. A summary of the peak values for PV^2 and the hour in which the same is observed is presented in Table 4-7 below

Table 4-7: Pedestrian Vehicular Conflict at Major Arm

Name of Intersection	Peak Hour	P	V	PV^2 X10 ⁸	Proposal
A B Shetty Circle	10:00-11:00	144	2112	6.45	-do-
Hamilton Circle	17:00 – 18:00	480	1965	18.5	-do-
Rao Rao Circle	10:00 – 11:00	1133	943	10.07	-do-
Bibi Alabi Junction	12:00-13:00	202	1474	4.38	-do-
Nellikai Road Junction	16:00 – 17:00	357	1565	8.74	-do-

Capacity of grade separator should be worked out as per IRC 70 guidelines i.e 50 persons per minute per meter.

4.2. Traffic Forecast and Capacity Analysis

For any urban stretch of road traffic growth is calculated based on vehicle registration, PCI and NSDP trend analysis. Typically any urban stretch of road a 5% yearly traffic growth is on conservative side and is used for this study.

Table 4-8 below gives the traffic in PCU during peak hour for next 20 years in order to understand capacity of the project roads.

Table 4-8: Traffic Forecast – 2037 for Priority Loop Road

Year	Maidan road (from AB Shetty Circle to Hamilton Circle)	4 th Cross Road	Mission Street Road	Nellikai Road
2017	2189	1156	932	798
2018	2298	1214	979	838
2019	2413	1274	1028	880
2020	2534	1338	1079	924
2021	2661	1405	1133	970
2022	2794	1475	1189	1018
2023	2933	1549	1249	1069
2024	3080	1627	1311	1123
2025	3234	1708	1377	1179
2026	3396	1793	1446	1238
2027	3566	1883	1518	1300
2028	3744	1977	1594	1365
2029	3931	2076	1674	1433
2030	4128	2180	1757	1505
2031	4334	2289	1845	1580
2032	4551	2403	1938	1659
2033	4778	2523	2034	1742
2034	5017	2650	2136	1829
2035	5268	2782	2243	1920
2036	5531	2921	2355	2017
2037	5808	3067	2473	2117

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

In order to understand the lane requirement of the roads following table extracted from IRC 106:1990 is used for capacity analysis.

8.3. Design service volumes for different categories of urban roads corresponding to above referred conditions are given in Table 2.

TABLE 2. RECOMMENDED DESIGN SERVICE VOLUMES (PCUs PER HOUR)

S. No.	Type of carriageway	Total Design Service Volumes for Different Categories of Urban Roads		
		Arterial*	Sub-arterial**	Collector***
1.	2-Lane (One-Way)	2400	1900	1400
2.	2-Lane (Two-Way)	1500	1200	900
3.	3-Lane (One-Way)	3600	2900	2200
4.	4-Lane Undivided (Two-Way)	3000	2400	1800
5.	4-Lane Divided (Two-Way)	3600	2900	—
6.	6-Lane Undivided (Two-Way)	4800	3800	—
7.	6-Lane Divided (Two-Way)	5400	4300	—
8.	8-Lane Divided (Two-Way)	7200	—	—

Source: IRC 106:1990

Table 4-9 below gives the Lane Requirement for Nehru Maidan road for future

Table 4-9: Lane Requirements for Nehru Maidan Road

Lane Requirement	Maidan road (from AB Shetty Circle to Hamilton Circle)	4 th Cross Road	Mission Street	Nellikai Road
2 Lane One Way	NA	Upto 2028	NA	NA
2 Lane Two Way	NA	NA	Upto 2023	Upto 2020
3 Lane One Way	NA	Upto 2037	NA	NA
4 Lane One Way	NA	Beyond 2037	NA	NA
4 Lane Divided Two Way	Upto 2027	NA	Upto 2037	Upto 2034
6 Lane Divided Two Way	Upto 2035	NA	Beyond 2037	Beyond 2037
8 Lane Divided Two Way	Beyond 2037	NA	NA	NA

Note: 4TH Cross, Mission Street are Considered Sub arterial and Bibi Alabi, Nellikai Road are Considered Collector Road. Rests of the Roads are Considered Arterial.

4.3. Alternate Mobility Plan and Analysis

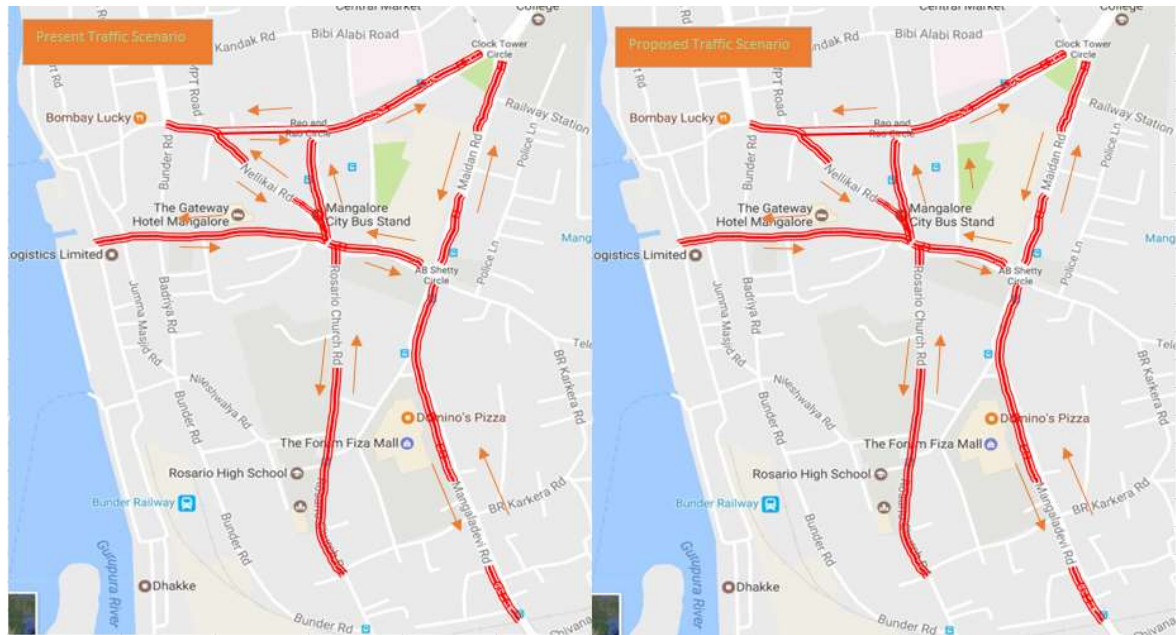
Looking at current movement of traffic on presented road network with given constraints, consultant wish to propose some alteration in mobility of traffic. Following proposal are taken into consideration in alternate travel scenario.

- a) One way traffic movement from Nellikai Junction to Hamilton Circle
- b) Additional traffic shifted from Nellikai Road on 4th Cross Road
- c) One way traffic movement on Mission Street Road

Based on above mobility arrangement capacity analyses of roads and junctions were analyzed and considered.

Following figures give existing and proposed mobility of traffic on considered road movement.

Figure 4-24 Traffic Mobility Plan Existing Vis a Vis Proposed



Based on alternative/change mobility scenario Nellikai Road, 4th Cross Road, Mission Street Road, Bibi Alabi Road will have positive or negative impacts and also Nellikai Junction, Hamilton Circle, Rao Rao Circle and Bibi Alabi Junctions will be impacted. The section below described the impact on proposed roads due to alternative proposed mobility

4.3.1. Impact on Road Links due to Proposed Mobility Plan

Following table gives the average daily traffic on affected roads after proposed mobility plan.

Table 4-10: Traffic at Affected Road after Altered Mobility

Vehicle Type	4 th Cross Road	Mission Street	Nellikai Road
2W	4801	2056	2901
3W-P	2937	1825	1633
3W-F	528	114	98
Car	3879	993	1059
Taxi	200	8	61
M-Bus	502	5	10
Bus	3225	0	40
M-LCV	88	0	0
LCV-P	20	0	0

LCV	264	150	143
2-Axle	153	40	69
3-Axle	12	2	4
4-6 Ax	3	2	0
>6Axle	0	0	0
Others	2	0	5
Total	16613	5251	6022
PCU	18819	7997	4883

Table 4-11: Detailed Analysis of Junction Traffic for Affected Junctions (As per IRC 92)

Junction Traffic Analysis			IRC 92 Criteria			Year (Grade Separation Warranted)	Remarks
Sl No.	Jn. Category	Name of Intersection	Peak Hour PCU - 2017	Peak Hour PCU - 2027	Peak Hour PCU - 2037		
1	4 Leg	Hamilton Circle	3357	5468	8907	2026	Space Constraint – Signalised junction without any central island.
2	4 Leg	Rao Rao Circle	2826	4603	7499	2029	Signalised junction with small central island (Dia. Not more than 4m)
3	4 Leg	Nellikai Junction	1660	2704	4404	NA	Signalized junction without any central island

Table 4-12: Lane Requirement for affected Road

Lane Requirement	4 th Cross Road	Mission Street	Nellikai Road
2 Lane One Way	Upto 2022	Upto 2037	Upto 2037
3 Lane One Way	Upto 2031	NA	NA
4 Lane One Way	Upto 2036	NA	NA

Note – Above lane requirement will be warranted as Nellikai road is made one way. The recommendation provided in Table 4.9 for these roads will not be applicable.

Based on the technical analysis, 2 lane one way is sufficient for Nellikai and Mission Street Road. However, based on the client requirements and insistence, Nellikai and Mission Street Road are proposed are 3 lane one way

4.4. Conclusion and Summary of Results

Priority roads identified for smart roads in the ABD area are typical urban road with respect to traffic pattern. Present carriageway width is sufficient to handle traffic on midblock at all the roads. Two junctions’ at, A B Shetty circle, Hamilton Circle are heavily congested and need grade separation or some traffic calming measures. Grade separated facility for pedestrians are also needed at these junctions based on analyses.

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

In alternate mobility, scenario smooth movement of traffic will be observed at Nellikai, 4th Cross Road (Without Bus Parking) but additional congestion will be observed at Hamilton Circle and Rao Rao Circle.

5. CARRIAGEWAY AND JUNCTION IMPROVEMENT

5.1. Carriageway Improvement

5.1.1. Right of Way (ROW)

Total four roads are being improved in this phase namely:

1. Maidan Road II – From A B Shetty Junction to Hamilton Intersection
2. 4th Cross Road – From Hamilton Intersection to Rao and Rao Junction
3. Mission Street Road – From Rao and Rao Junction to Nellikai Road Junction
4. Nellikai Road – From Nellikai Road Junction to Hamilton Intersection.

Existing Right of Way (ROW) are 24.0m to 26.0m, 25.0m to 27.0m, 15.0m to 18.0m and 13.0m to 15.0m for Maidan Road II, 4th Cross Road, Mission Street Road and Nellikai Road respectively. As per the classification as adopted by MoUD for Urban roads, these roads are considered under sub arterial road category. As the name suggests, this category of road follows all the functions of an Arterial Urban road and are characterized by mobility, and cater to through traffic with restricted access from carriageway to the side and hence it carries little less traffic volumes than that of arterial roads. Due to its overlapping nature, Sub arterial roads can act as arterials. This is context specific and is based on the function and the land use development it passes through and caters to a speed limit of 50 km/h.

It is proposed to retain the same ROW for all these roads.

The following drawings enclosed in section 10 of the Report provides details of Plan and Profile for Priority Loop Road

WTE_2292_00_R_2.01	PLAN AND PROFILE OF MADIAN ROAD - PART2 (SHEET 1 OF 1)
WTE_2292_00_R_2.02	PLAN AND PROFILE OF NELLIKAI ROAD (SHEET 1 OF 1)
WTE_2292_00_R_2.03	PLAN AND PROFILE OF 4TH CROSS ROAD (SHEET 1 OF 1)
WTE_2292_00_R_2.04	PLAN AND PROFILE OF MISSION STREET ROAD (SHEET 1 OF 1)

5.1.2. Design Speed

Design speed is related to the function of a road. Keeping in view the type of functions expected on these roads, design speed has been considered as 40 to 50 Kmph.

5.1.3. Traffic Lanes

Based on the traffic analysis and recommendation in section 4.2 and 4.3, it is proposed to develop these roads as follows:

1. Maidan Road II as “4 Lane Divided Two Way” (i.e 2 lanes on each side). Lane width has been considered as 3.1m as per the MOUD guidelines ‘Code of Practice Part I – Cross Section’.

Separate parallel parking lane has been provided on Hamilton Intersection to A B Shetty Circle bound carriageway.

Similarly, dedicated Bus Lane is provided on A B Shetty Circle to Hamilton Intersection bound carriageway

2. 4th Cross Road as “4 Lane Undivided One Way”. Two lanes of right hand side of carriageway are dedicated as Bus Lanes and lane width has been provided as 3.5m and two lanes of left hand side of carriageway are for other vehicles and the lane width has been provided as 3.1m.

Separate parallel parking lane has been provided on left hand side of the carriageway.

3. Mission Street Road as “3 Lane One Way”. Lane width has been considered as 3.1m. Separate parallel parking and two wheeler parking have been provided on right hand side of the carriageway wherever space is available.

4. Nellikai Road as “3 Lane One Way”. Lane width has been considered as 3.1m. Separate parallel parking and two wheeler parking have been provided on right hand side of the carriageway wherever space is available.

The following drawings enclosed in section 10 of the Report provides Plans and details of Road Signage’s and Markings along Priority Loop Road

WTE_2292_00_R_3.01	ROAD SIGNAGES - PLAN AND ROAD MARKING OF MADIAN ROAD (SHEET 1 OF 1)
WTE_2292_00_R_3.02	ROAD SIGNAGES - PLAN AND ROAD MARKING OF NELLIKAI ROAD (SHEET 1 OF 1)
WTE_2292_00_R_3.03	ROAD SIGNAGES - PLAN AND ROAD MARKING OF 4TH CROSS ROAD (SHEET 1 OF 1)
WTE_2292_00_R_3.04	ROAD SIGNAGES - PLAN AND ROAD MARKING OF MISSION STREET ROAD (SHEET 1 OF 1)
WTE_2292_00_R_6.01	ROAD SIGNAGES AND MARKING DETAILS (SHEET 1 OF 1)

5.1.4. Camber / Cross Fall

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Since existing carriageway is being retained for Maidan Road II and 4th Cross Road, existing camber will be maintained. For Mission Street Road and Nellikai Road 2.5% camber has been provided.

5.1.5. Geometry / Alignment

Geometric design & Alignment design has been done in accordance with IRC and MoUD guidelines.

5.2. Intersection Improvement

Road intersections are critical element of road section. They are normally a major bottleneck to smooth flow of traffic and a major accident spot. Function of a designed intersection is to control conflicting and merging streams of traffic, to minimize the delay including pedestrian traffic.

Intersection design influences the capacity of the corridor and the safe movement of conflicting directions. The pattern of the traffic movements at the intersection and the volume of traffic on each approach, during peak period of the day determine the lane widths required.

The general design principles of intersection design are the approach speeds, restriction on available land, sight distance available and the presence of the larger volume of all the road users in urban areas.

5.2.1. Function of Intersection Design

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

The aim of the design of an intersection is to achieve with a minimum number of conflict points while following the basic principle to limit the number of conflict points between cars, buses, trucks, bicycles and the pedestrians as much as possible.

5.2.2. Classification of Intersections types

Intersection functions to control conflicting and merging traffic and to achieve this, intersections are designed on certain geometric parameters and are broadly classified into three main heads and are as follows:

- Un signalized intersection,
- Signalized Intersection and
- Roundabouts

Un-signalized intersection: There are two types of un-signalized intersections:

- Uncontrolled Intersection: These are the intersections between any two roads with relatively lower volume of traffic and traffic of neither road has precedence over the other.
- Intersection with Primary Control: In this type there are theoretically no delay occurring on the major road and vehicles on the minor road are controlled by 'GIVE WAY' or 'STOP' signs and marking

Signalized Intersection:

Signalization is applied at junctions where higher motorized vehicle volumes require control by traffic lights. Traffic movement of different arms entering the intersection is controlled by traffic lights.

Roundabouts:

A roundabout is an intersection with a central island around which traffic must travel clockwise and in which entering traffic must ‘GIVE WAY’ to circulating traffic.

Table 5-1 below depicts the Pros and Cons of type of Intersection Lane Requirement

Table 5-1: Pros and Cons of Signalized Intersection and Roundabout

Signalized Intersection	Roundabout
Pros	
Signalized intersection can handle high traffic volumes	Reduces number of conflicts
Safety is ensured by eliminating conflicts through signalization	Ensures safety through speed reduction by design
	Minimum delays for all road users
Cons	
Higher delays for all road users	Roundabouts are not very effective for more than two circulatory lanes
	Roundabouts have capacity limitations and may not be able to handle a very high volume of traffic.

5.2.3. Objectives for Intersection Design

The main objective of intersection design is to facilitate the convenience, ease and comfort of people traversing the intersection while enhancing the efficient movement of passenger cars, buses, trucks, bicycles and pedestrians. The need for flexibility dictates the choice of the most suitable intersection type.

5.2.4. Consideration for Intersection Design

Design of a safe intersection depends on following major factors:

- Design and actual capacities
- Design hour traffic turning movements
- Variety of movements
- Vehicle Speeds
- Pedestrian movements
- Geometric features

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- Traffic control devices
- Cost of improvements
- Energy consumption

Design Traffic Volumes:

Intersections are normally designed for peak hour flows. Mid-block traffic volume count and turning movement count have been carried out and the data has been used after estimation of future traffic for intersection design.

Capacity of Intersections:

Intersection capacity is the maximum hourly rate at which vehicles can reasonably be expected to pass through the intersection under prevailing traffic, roadway and signalized conditions. Capacity is influenced by traffic and roadway conditions. Traffic conditions includes volumes on each approach, the distribution of vehicles on each arm of intersection, the vehicle types distribution within each movement, pedestrian traffic flows and parking movements on approaches to the intersection.

Traffic control at intersections limits the capacity of the intersecting roadways, defined as the number of users that can be accommodated within a given time period.

Capacity of an intersection depends on the following factors:

- Physical and operating conditions like width of approach, one way or two way operation and parking conditions etc.
- Traffic characteristics like turning movements, number of commercial vehicles including buses, peak hour factors, number of pedestrians and geometry.

As per IRC: SP: 41-1994 “Guidelines on Design of At-Grade Intersections in Rural & Urban Areas”, the intersection capacity is 700 to 1200 PCU’s per hour per lane for one way traffic and 450 to 750 PCU’s for two way traffic.

5.2.5. Traffic Calming Techniques

Traffic calming and speed management measures such as road humps are considered to discouraging traffic from entering intersection areas with high speed. These measures are always backed up by speed limits of 30 km/hr or less. Management of speed by engineering the road with the purpose to bring the design of the road in accordance with the desired speed is called speed management by design or traffic calming.

Trapezoidal Humps and Raised Pedestrian Crossing (Table Top)

A hump, which constitutes 150 mm, raised, flat section of a carriageway with ramps on both sides is called a trapezoidal hump. Trapezoidal humps can be used as pedestrian crossings.

- Since there is no negotiation in change of level, it improves walking and makes it more comfortable and convenient to the pedestrians.
- Makes the pedestrian alert and safe from entering and exiting vehicles.
- It gives the utmost comfort to people with disability and follows the concept of universal design.

5.2.6. Recommendations for Intersection Design at Hamilton Intersection

This is five legged Intersection and based on the primary details obtained for Average Daily Traffic and Peak traffic mentioned in Chapter 4 above, it is recommended to go for signalized at grade intersection

The proposed Junctions Improvement at Hamilton Intersection has been shown in drawing WTE_2292_00_R_4.01- PROPOSED JUNCTION IMPROVEMENT HAMILTON INTERSECTION (SHEET 1 OF 1) in section 10 of the Report

5.2.7. Recommendations for Intersection Design at Rao and Rao Intersection

Rao and Rao Intersection is a four legged intersection and based on the average daily traffic and peak hour traffic at this intersection as mentioned in Chapter 4 above, it is considered for designing for improvement as regular signalized at grade intersection.

The proposed Junctions Improvement at Rao and Rao intersection has been shown in drawing WTE_2292_00_R_4.02- PROPOSED JUNCTION IMPROVEMENT RAO AND RAO INTERSECTION (SHEET 1 OF 1) in section 10 of the Report.

5.2.8. Recommendations for Intersection Design at Nellikai Road Intersection

Nellikai Road Intersection is a three legged intersection and based on the average daily traffic and peak hour traffic at this intersection as mentioned in Chapter 4 above, it is considered for designing for improvement as regular signalized at grade intersection.

6. PROPOSED SMART ROAD COMPONENTS – URBAN DESIGN, LANDSCAPE AND ITMS

6.1. Urban Design and Landscape

Transforming existing roads into Smart Roads has been envisaged under the Smart City Mission. The design of Smart roads intends to develop world class road infrastructure inclusive to all strata of society with consideration for pedestrian safety and security as a prime importance. This entails comprehensive upgrading of the public Right of Way (ROW) of the streets which includes refurbishment of existing carriageway, laying of new footpaths and cycle tracks, creating utility corridors, developing pedestrian facilities, development works for landscape, hardscape, street furniture, signage, lighting, etc.

The proposed intervention aims to achieve the following:

- Seamless mobility for citizens of Mangaluru
- To eliminate traffic congestion and facilitate smooth flow of traffic
- To create inclusive road infrastructure for all strata of society
- Promote environmentally sustainable means of transport

As mentioned in Chapter 1, the Smart Road proposal for Priority Loop Road would consist of the following specific interventions:



Proposals for Carriageway Improvement, Roads and Signage's, Junction Improvement have been covered under Chapter 4 and 5 of the Report. The Subsequent Sections provide details of other proposed smart elements, mentioned above, along the Priority Loop Road, including Junctions

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

Design of Smart roads in Mangaluru is with compliance to following guidelines:

1. Indian Road Congress code
2. MoUD – Indian Urban Transport Guidelines.

6.1.1. Proposed Design Considerations

Proposed Design Consideration for Nellikai Road:

1. As there are some new constructions seen on this road, they have left setbacks as per the new DP roads proposed. These areas are converted into Plaza spaces where innovative designed benches are proposed.
2. Wider road widths are observed in some stretches of these areas and keeping the carriageway uniform, diagonal parking is feasible at these areas. Landscape pockets so formed are interlocked within the parking spaces creating a shaded environment at the parking spaces and the plaza space. Seating areas are proposed under these shaded areas for a pleasing environment for the pedestrians.
3. Table cross crossings are proposed at 300m intervals on the road considering the commercial aspect of the road.



Nellikai Road : Before



Nellikai Road : After

Proposed Design Consideration for 4th Cross Road:

1. The existing ROW is organized and the traffic is segregated on this road. 2 Bus lanes are proposed, out of which one acts as a bus bay for the buses to stop and the other is a freeway for the buses to have a smooth movement of the buses.
2. Considering the Fish market and other hawking areas on this road, parallel parking is proposed to the east of the road intercepted by landscape pockets.
3. Table cross crossings are proposed at 300m intervals on the road considering the commercial aspect of the road.



4th Cross Road : Before



4th Cross Road : After

Proposed Design Consideration for 4th Cross Road:

1. As the ROW is narrow and no scope for road widening, this road is made one way considering the projected traffic volumes. The movement of the vehicles is proposed from Rao and Rao circle to Nellikai Junction.
2. The spaces where wider ROW is available two wheeler and 4 wheeler parking is segregated and proposed to the south of the road.



Mission Street Road : Before



Mission Street Road: After

Proposed Design Consideration for Maidan Road II:

1. Bus lane is proposed on Maidan road.
2. The footpaths are wider and the utilities are proposed underground.
3. Parallel parking is proposed to the north of the road intercepted by seating and landscape pockets.

6.1.2. Urban Design Features

Salient Features of Smart Roads for Priority Loop Road:

1. Road Cross Section:
 - a. **Carriage way:** As per IRC codes, the lane widths proposed in the priority loop roads is 3.1m.
 - b. **Parking Lane:** The parking lane of 2.5m is proposed for priority loop roads. Wherever space constraints were observed, parking lane was planned by adopting the Parking Norms as per the Managalore Zonal Regulations (1.25 m). Permeable grass pavers are proposed at the parking lane so that it helps to percolate the rain water and increase the ground water table.
 - c. **Median:** Tall shrubs are proposed at the median on Maidan Road – 2 to discourage on surface crossing for pedestrian safety.
2. Pedestrian Facilities and Smart Elements:



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- a. **Footpath:** Wide footpath of minimum width 1.5m to maximum 4m are proposed taking into consideration the pedestrian count on the priority loop road.
- b. **Barrier free design:** Tactile paving is proposed at the centre of the footpath on all the priority loop roads. Curb ramps are present at the property entrances and parking bays for wheel chair access. Audio visual signals for blind people at the junctions.
- c. **Bollards:** Bollards are proposed at the property entrances and parking bays in order to



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heeler movements on the footpath.

- d. **Footpath lighting:** Pole lights are proposed at a distance of 10m c/c for illumination of footpath for pedestrian safety and security. The pole lights are incorporated with the advertisement panels which is one of the means for revenue generation.



- e. **Street furniture:** Street Furniture includes some interactive seating spaces, benches along the footpath. Dustbins, signages like parking sign, stop sign, pedestrian crossing, bus stop are proposed at proper locations.

- f. **Table top crossing:** Table top crossing is proposed at junctions so as to have a smooth pedestrian movement and subsequently resulting into reduction of speed of the vehicles at the junction.



- g. **Other smart features** included are **LED street lights** to illuminate the carriage way, **smart poles at the junction** and **audio-visual signals** at the pedestrian crossings for differently abled people.



Table 6-2 below provide details of various Smart Features proposed along the Maidan Road

Table 6-1: Maidan Road – Proposed Smart Features

Sl no	Road details	MUBs (trench)	Bus shelter with E-toilet	LED lights with solar panels	Street furniture like signages, dustbins, benches, advertisement boards	Smart poles	Audio-visual signals
SMART FEATURES							
1	MISION STREET ROAD (RAO N RAO CIRCLE TO NELLIKAI ROAD JN.)	√	×	×	√	×	√
2	NELLIKAI ROAD (MISION STREET ROAD JN. TO HAMILTON CIRCLE)	√	×	×	√	√	√
3	4 TH COSS ROAD (RAO N RAO CIRCLE TO HAMILTON CIRCLE)	√	√	√	√	√	√
4	MAIDAN ROAD (HAMPANKATTA CIRCLE \ CLOCK TOWER TO A B SHETTY CIRCLE)	√	√	√	√	√	√
5	MAIDAN ROAD (A B SHETTY CIRCLE TO HAMILTON CIRCLE)	√	√	√	√	√	√

Table 6-3 below provide details of various Pedestrian Facilities proposed along the Maidan Road

Table 6-2: Priority Loop Road – Proposed Pedestrian Facilities

Street Elements							
Sl no	Road details	Road side plantation with tree grates	Pedestrian crossing	Tactile paving and wheel chair access	Spaces for Informal commercials	Subways or FOBs	Parking for Auto-rickshaws
PEDESTRIAN FACILITIES							
1	MISION STREET ROAD (RAO N RAO CIRCLE TO NELLIKAI ROAD JN.)	×	√	√	×	×	×
2	NELLIKAI ROAD (MISION STREET ROAD JN. TO HAMILTON CIRCLE)	√	√	√	×	×	×
3	4 TH COSS ROAD (RAO N RAO CIRCLE TO HAMILTON CIRCLE)	√	√	√	√	×	×
4	MAIDAN ROAD (HAMPANKATTA CIRCLE \ CLOCK TOWER TO A B SHETTY CIRCLE)	√	√	√	×	√	√
5	MAIDAN ROAD (A B SHETTY CIRCLE TO HAMILTON CIRCLE)	√	√	√	×	×	√

The following drawings enclosed in section 10 of the Report provides details of various Urban Design Proposals along Priority Loop Road

WTE_2292_00_UD_1.01	URBAN DESIGN PROPOSAL OF MAIDEN ROAD PART-2 (SHEET 1 OF 1)
WTE_2292_00_UD_1.02	TYPICAL CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 1 OF 1)
WTE_2292_00_UD_2.01	URBAN DESIGN PROPOSAL OF NELLIKAI ROAD (SHEET 1 OF 1)
WTE_2292_00_UD_2.02	TYPICAL CROSS SECTION OF NELLIKAI ROAD (SHEET 1 OF 1)
WTE_2292_00_UD_3.01	URBAN DESIGN PROPOSAL OF 4TH CROSS ROAD (SHEET 1 OF 1)
WTE_2292_00_UD_3.02	TYPICAL CROSS SECTION OF 4TH CROSS ROAD (SHEET 1 OF 1)
WTE_2292_00_UD_4.01	URBAN DESIGN PROPOSAL OF MISSION STREET ROAD (SHEET 1 OF 1)
WTE_2292_00_UD_4.02	TYPICAL CROSS SECTION OF MISSION STREET ROAD (SHEET 1 OF 1)

6.1.3. Landscaping

Roads like the any other transportation hub gives an identity to the place. It plays a vital role in visual experience of user. Mangaluru city has a composition of terrain from plains towards the coastal region to undulating topography toward the Western Ghats on the east. Owing to which the road also has varying gradient and character.

The Road side landscape would enhance the experience of the commuter in terms of microclimate and aesthetics along with ensuring safety. Further it would enrich the experience of the commuters with the natural seasonal dynamism of the plant species

Roads in Central node are one of the prominent roads in the city and encircles the eminent open space along the Town hall. This road also has some of the very old and huge rain trees which give it an identity.

Landscape design has been deliberated with understanding the complex nature of the site, the dynamic relationship between the natural and built environment and overlaying cultural context.

Landscape intervention has been proposed considering the above principle; consequently, have carved out green spaces between the carriage way and footpath to refrain and restrict pedestrian crossing at random locations. This would ensure systematic and swift pedestrian and vehicular circulation.

The median has been designed with a thick green hedge with appropriate height to ensure sight of vehicle in the adjacent lane and cut the glare. This would also restrict pedestrian movement to cross at vulnerable spots.

Further, following aspects should be considered while proposing landscape design

- Use landscape and aesthetics tools to reduce the visual complexity at intersections
- Focus on the use of visual contrasts in material textures and colors to make the functional components of the highway intersection visually prominent.
- Accessibility for maintenance must also be considered
- Select plant materials that will not obstruct critical views as they mature
- Provide a neutral visual background to the intersection where possible Shall have distinct features than the adjacent to mark the entrance
- Plants should help focus the view on the intersection
- Shrubs should be avoided within the appropriate sight triangle at an intersection

The following drawings enclosed in section 10 of the Report provides details of various Landscape Proposals along Priority Loop Roads

WTE_2292_00_PL_1.01	PLANTING PLAN OF MAIDEN ROAD PART-2 (SHEET 1 OF 2)
WTE_2292_00_PL_1.01	PLANTING PLAN OF MAIDEN ROAD PART-2 (SHEET 2 OF 2)
WTE_2292_00_PL_1.02 (R0)	PLANTING PLAN OF NELLIKAI ROAD (SHEET 1 OF 1)

6.1.4. Centralized street lighting control

“Conversion of Conventional Street Lights into LED with Smart Lighting Solutions” is one of the projects under MSC with an objective of reducing energy consumption as well as to reduce impact on environment by conventional lamps. The existing street lights are proposed to be converted into LED on PPP basis under a separate project.

Smart LED street lighting system adopts centralized control system which will result in further saving of electrical energy. This system offers following Merits –

- Central control, fault detection
- Generation of burn hours reports
- Automatic operation with astronomical timers
- Manual operation from a central location through GPRS / GSM system
- Dimming operation
- Remote metering
- Voltage stabilization

Energy consumed by the LED lighting is much less as compared to the sodium vapour lighting. This will reduce the energy bill of street lights to great extent.

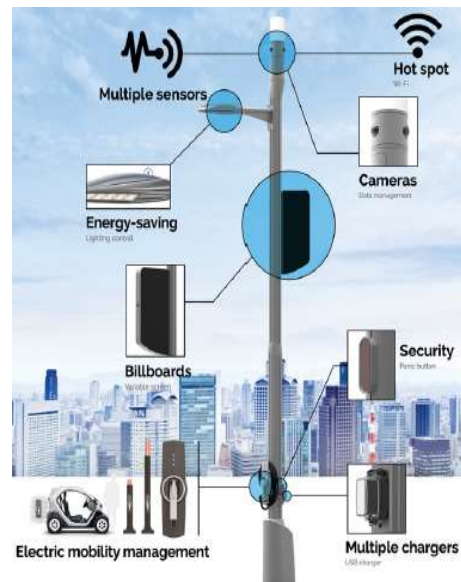
The 9 m lighting poles are provided only in the median. To illuminate the footpaths, 4 m high lighting poles with 40 w LED lighting fixtures has been considered at an interval of 10 m

SMART STREET LIGHTING SOLUTIONS PROPOSED UNDER SMART ROADS WILL BE TAKEN UP UNDER SEPARATE TENDER FOR LED STREET LIGHTS PPP PROJECT COMPONENTS. FOOTPATH LIGHTING IS PART OF THIS TENDER

6.1.5. IT/ICT Elements

The following IT/IC Elements are considered along the Bus Shelter and Smart Pole

- IT/ICT components in Smart Bus Shelter
 - CCTV (dome camera)
 - Wifi Access Point
 - Display units
- IT/ICT component in Smart Pole at Traffic Junction
 - Wifi Access Point
 - Environment Sensor
 - Possible push button for the pedestrian crossing
- PTZ CCTV at Junction



6.1.6. Planned Utilities

Dedicated and planned utilities are one of the key features of smart roads. Various utilities planned under priority loop road include wet utilities include Water Supply, sewerage and storm water drainage system as well as dry utilities like Street Lights, Power Distribution and OFC.

Water Supply Distribution lines are proposed under ADB funding as a separate Project and funding. Necessary coordination with the Consultants working on ADB project and MCC has been carried out to ensure integration of proposals in a holistic manner. Annexure 3 shows details of water supply proposals along priority loop road under ADB funder project

Similarly; UGD (Underground sewerage network) and LED Street lighting are proposed as separate Project under Mangaluru Smart City. The proposal under UGD and LED project have been integrated while planning the utility corridor along priority loop Road

The detailed inventory of existing electrical utilities has been carried out along with MESCOM officials and same is included as following drawings in Section 10 of the report. The space planning for electrical services in the proposed utility corridor is based on the assessment of existing services to be shifted and considered future provisioning for additional lines

WTE_2292_00_E_1.01	EXISTING POWER DISTRIBUTION SYSTEM OF ROADS (SHEET 1 OF 1)
WTE_2292_00_E_1.02	EXISTING POWER DISTRIBUTION SYSTEM OF MADIAN ROAD - PART2 (SHEET 1 OF 1)

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WTE_2292_00_E_1.03	EXISTING POWER DISTRIBUTION SYSTEM OF NELLIKAI ROAD (SHEET 1 OF 1)
WTE_2292_00_E_1.04	EXISTING POWER DISTRIBUTION SYSTEM OF 4TH CROSS ROAD (SHEET 1 OF 1)
WTE_2292_00_E_1.05	EXISTING POWER DISTRIBUTION SYSTEM OF MISSION STREET ROAD (SHEET 1 OF 1)

The design for storm water has been carried out and calculations of the same are attached as Annexure 4 to the report

Based on above holistic and planned approach, an integrated utility corridor is proposed for the priority loop Road. The following drawings in section 10 shows details of the proposed utilities along the priority Loop smart road

WTE_2292_00_U_1.01	PROPOSED UTILITY SERVICES OF MADIAN ROAD - PART2 (SHEET 1 OF 1)
WTE_2292_00_U_1.02	PROPOSED UTILITY SERVICES OF NELLIKAI ROAD (SHEET 1 OF 1)
WTE_2292_00_U_1.03	PROPOSED UTILITY SERVICES OF 4TH CROSS ROAD (SHEET 1 OF 1)
WTE_2292_00_U_1.04	PROPOSED UTILITY SERVICES OF MISSION STREET ROAD (SHEET 1 OF 1)

Further, detailed cross section at every 15 m have been prepared and included in the DPR, including details of underground utilities and above ground road, urban design and street light, parking and other details

The following drawings in section 10 of the report gives detailed cross section at every 15 m interval

WTE_2292_00_R_5.01	PROPOSED CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 1 OF 3)
WTE_2292_00_R_5.01	PROPOSED CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 2 OF 3)
WTE_2292_00_R_5.01	PROPOSED CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 3 OF 3)
WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 1 OF 6)
WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 2 OF 6)
WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 3 OF 6)
WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 4 OF 6)
WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 5 OF 6)
WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 6 OF 6)
WTE_2292_00_R_5.03	PROPOSED CROSS SECTION OF 4TH CROSS ROAD (SHEET 1 OF 3)
WTE_2292_00_R_5.03	PROPOSED CROSS SECTION OF 4TH CROSS ROAD (SHEET 2 OF 3)
WTE_2292_00_R_5.03	PROPOSED CROSS SECTION OF 4TH CROSS ROAD (SHEET 3 OF 3)
WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 1 OF 4)
WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 2 OF 4)
WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 3 OF 4)
WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 4 OF 4)

6.2. Intelligent Traffic Management and Road Surveillance

ITMS is distributed across / coupled with mainly, Intelligent Transport System and Road Surveillance:

6.2.1. Intelligent Transport System (ITS)

The Intelligent Transport along the Nehru Maidan Road will have the following features

- **Vehicle Tracking (Buses) System**

The Buses with mounted GPS will be tracked by the Vehicle Tracking System so that their movement data can be fed to the ITS and the information can be disseminated to the Public Mobility App and Display at the Bus Shelters

- **Information on Bus Transport,**

The Vehicle Tracking System + Road Surveillance System + the Schedule fed in the Database of ITS will relay the information for the Public on the next scheduled buses on the particular route, the delay in the buses running, next available bus to arrive, traffic congestion on particular routes etc.

- **Portable Ticketing**

The bus tickets can be purchased either online or at bus-shelters. Online payment to be availed as well

- **Public Mobility App**

The bus schedule, the buses actual movements and available buses on the routes, to be made available for the passengers in the app or in the bus-shelter

- **Synchronized Signaling**

Green Corridor Creation for Disaster Mitigation / Emergency Response Team / Medical Emergency

6.2.2. Road Surveillance

- **Traffic Rule Violation Detection**

- Red Light Violation
- Speed Violation
- eChallan (if integrated with RTO Database)

The traffic violation detection by the Camera's to be analysed by the Video Analytics Software in the CCC and the ANPR to detect the vehicle number of the vehicles that violate the traffic rule. The identified vehicle number details then to be fetched from the RTO / Vahan -Sarathi systems and eChallan to be sent to the contact details of the person against whose name the vehicle is registered.

- **Automatic Number Plate Recognition**

- **Object Detection (for suspicious objects)**

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If any object is detected to be static / suspicious (based on the rules configured in the Video Analytics Software system) then the alert to be sent to the competent authority defined in the Standard Operating Procedure for such events.

▪ **Road Disaster Alert**

If any accident is detected by the camera or sensitive situation is SOSed by citizen(s) then the alert to be sent to the competent authority defined in the Standard Operating Procedure for such events. The subsequent alert to Emergency Response Team to receive as well

ITMS AND IT/ICT COMPONENTS PROPOSED UNDER SMART ROADS WILL BE TAKEN UP UNDER SEPARATE TENDER FOR ICT COMPONENTS

7. Traffic Management Plan

7.1. Objective

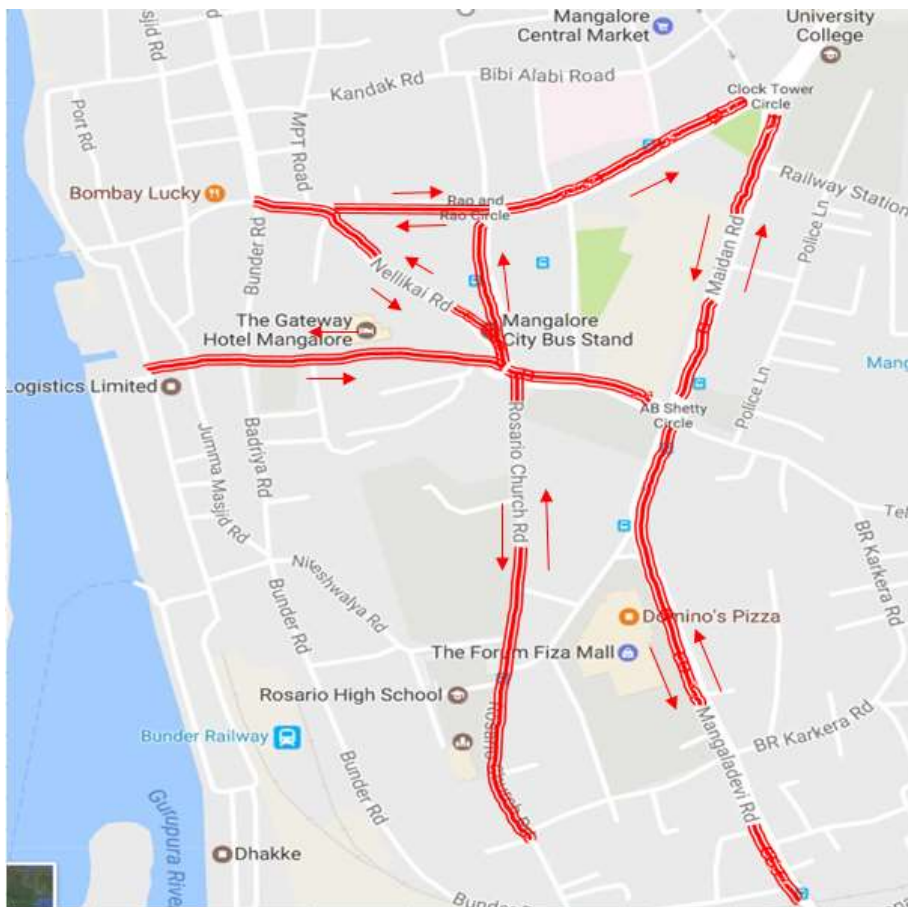
The overall traffic management plan is designed and intended to specify adequate safety measures in advance against identified hazards and stipulated implementation of the said safety measures to ensure safe movement of traffic during the construction operations.

This section gives the mobility scheme of traffic during construction phase.

7.2. Present and Proposed Scenario

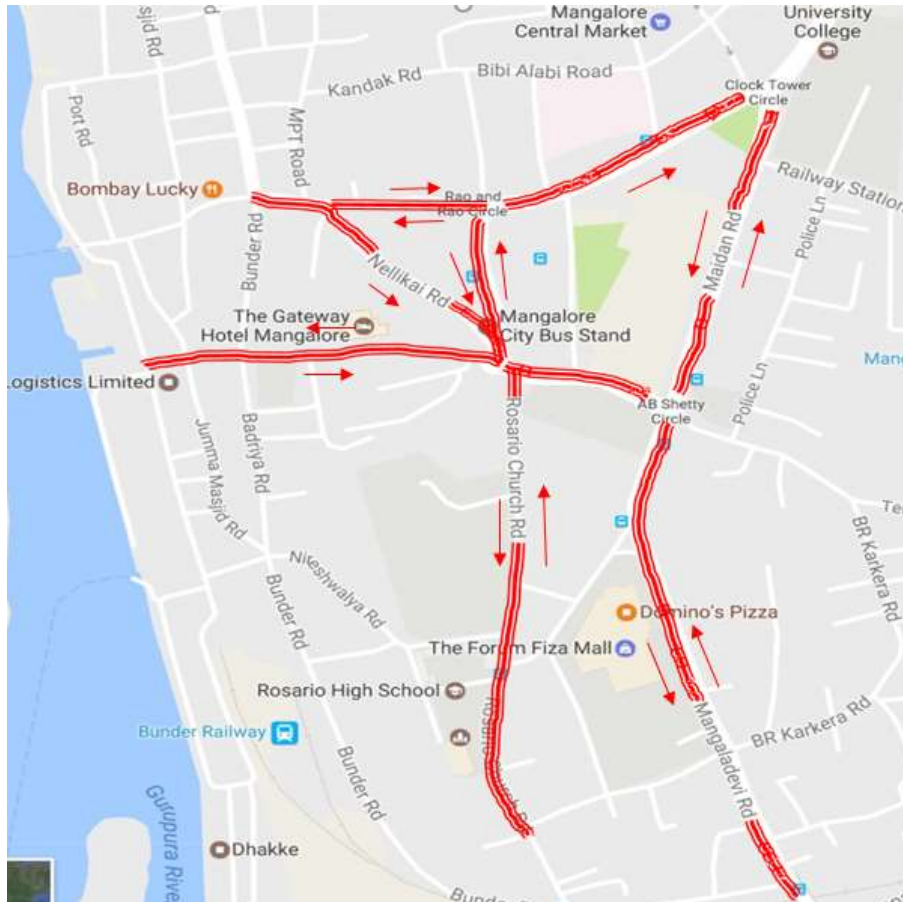
Following figure gives the traffic movement scenario present prevailing at identified road for up gradation

Figure 7-1 Present Traffic Management Scenario at Priority Road



In view of making mobility of traffic better, Nellikai is proposed to be one way (From North to South). Northward traffic is planned to be shifted to 4th crossroad. At present Nellikai road is laid with bituminous pavement and is intended to be converted into concrete pavement. Following figure gives the proposed traffic scenario.

Figure 7-2 Proposed Traffic Management Scenario at Priority Road



7.3. Traffic Management during Construction and Up gradation Works

7.3.1. Nellikai Road

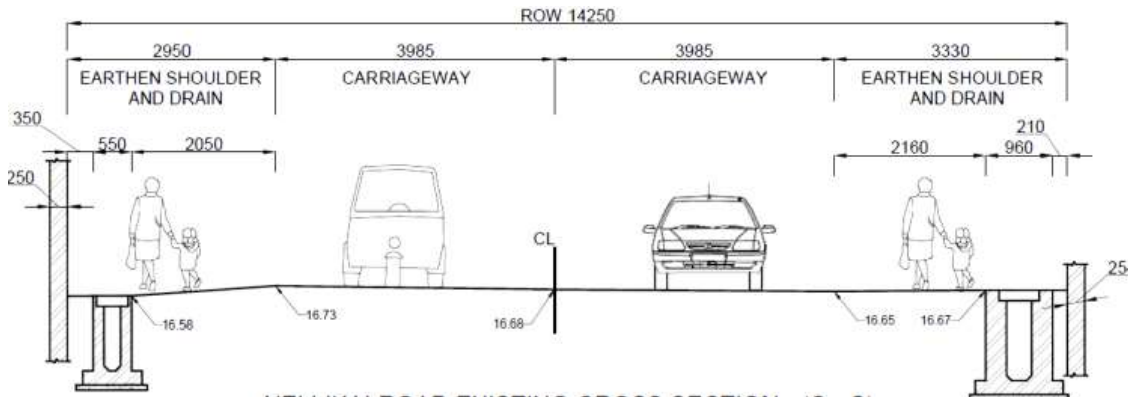
At present, 4600 vehicles ply at Nellikai Road towards Hamilton circle and 5400 vehicles ply northward towards Bibi Alabi Road. Northward traffic is proposed to be shifted to 4TH Cross Road. Traffic management plan for traffic towards Hamilton circle is required to be formulated during construction of Nellikai Road.

Following table gives the composition of traffic southward direction of Nellikai Road.

2 Wheeler	3 Wheeler	Car	LCV	Bus/Truck	Other	Total
2118	1277	1010	121	68	0	4596

Following figure gives the existing cross-section of Nellikai road

Figure 7-3 Existing Cross Section of Nellikai Road



It is evident from above figure during construction lane closure is appropriate option for safe mobility of traffic on Nellikai Road. At peak hour, 400 (388 PCU) vehicles ply towards this direction and most of them are car and two-wheeler. As a single lane have the capacity of carrying 1200 PCU in an hour, **so lane closure during construction period can withstand the load of traffic.**

Adequate safety arrangement provision will be required at construction zone for easier, safer movement of traffic. Section 7.4 describes the safety measures to be adopted during construction

7.3.2. Mission Street Road

Similar to the lines of Nellikai road it is proposed to make Mission Street One Way rigid pavement also. One way Mission Street will have 640 PCU at peak hour. With 13.5 m ROW **lane closure at Mission Street is the plausible solution during construction.**

7.3.3. Maidan Road 2, Bibi Alabi Road, 4th Cross Road

Miadan Road 2, Bibi Alabi Road and 4th Cross Road are already Concrete Roads. As part of up gradation to make smart roads, it is proposed to carry joint filling and other improvements in carriageway of Maidan Road 2 (AB Shetty to Hamilton Circle), Bibi Alabi Road, 4th Cross Road.

Since these roads are predominantly busy repairs works will be done at night time with proper safety and barricades. These roads will be open for public use in daytime.

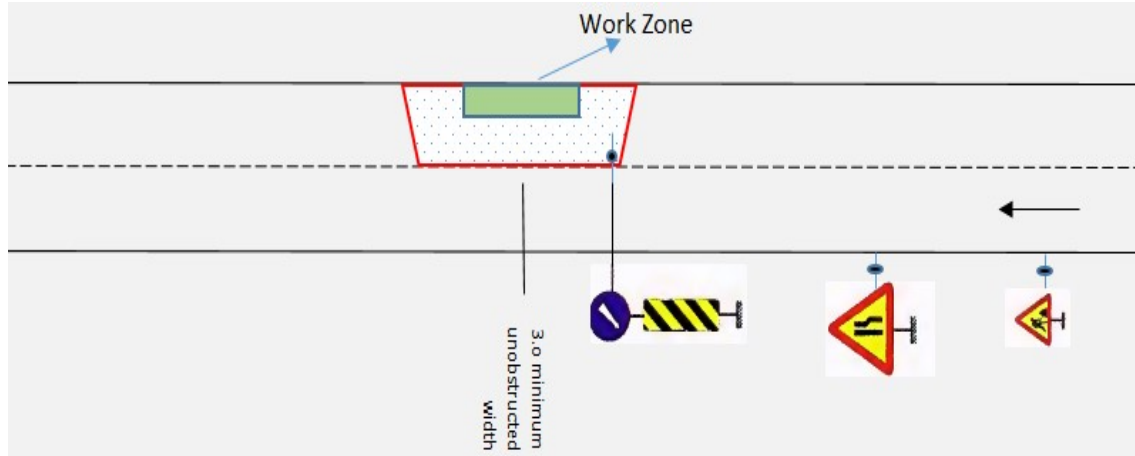
7.4. Safety Measure during Construction

Lanes Closure is the operation in which one or more traffic lanes and any adjacent shoulder are closed to traffic, in case of a multi-lane Roads, for carrying out the necessary repair/up gradation works. Guidelines provided by **(IRC: SP55 GUIDELINES ON TRAFFIC MANAGEMENT IN WORK ZONES)** needed to be followed for safe traffic movement during construction.

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

For road, having less than 20 trucks per hour and speed limit less 50 km/h or less as is Nellikai road and Mission Street Road, following figure gives the arrangement required at construction zone.

Figure 7-4 Traffic Control System along the road during Construction



Length of the works from the start of the lead-in taper to the end of the exit taper should not be more than 50 meters. Drivers approaching from either direction can see both the ends of the site.

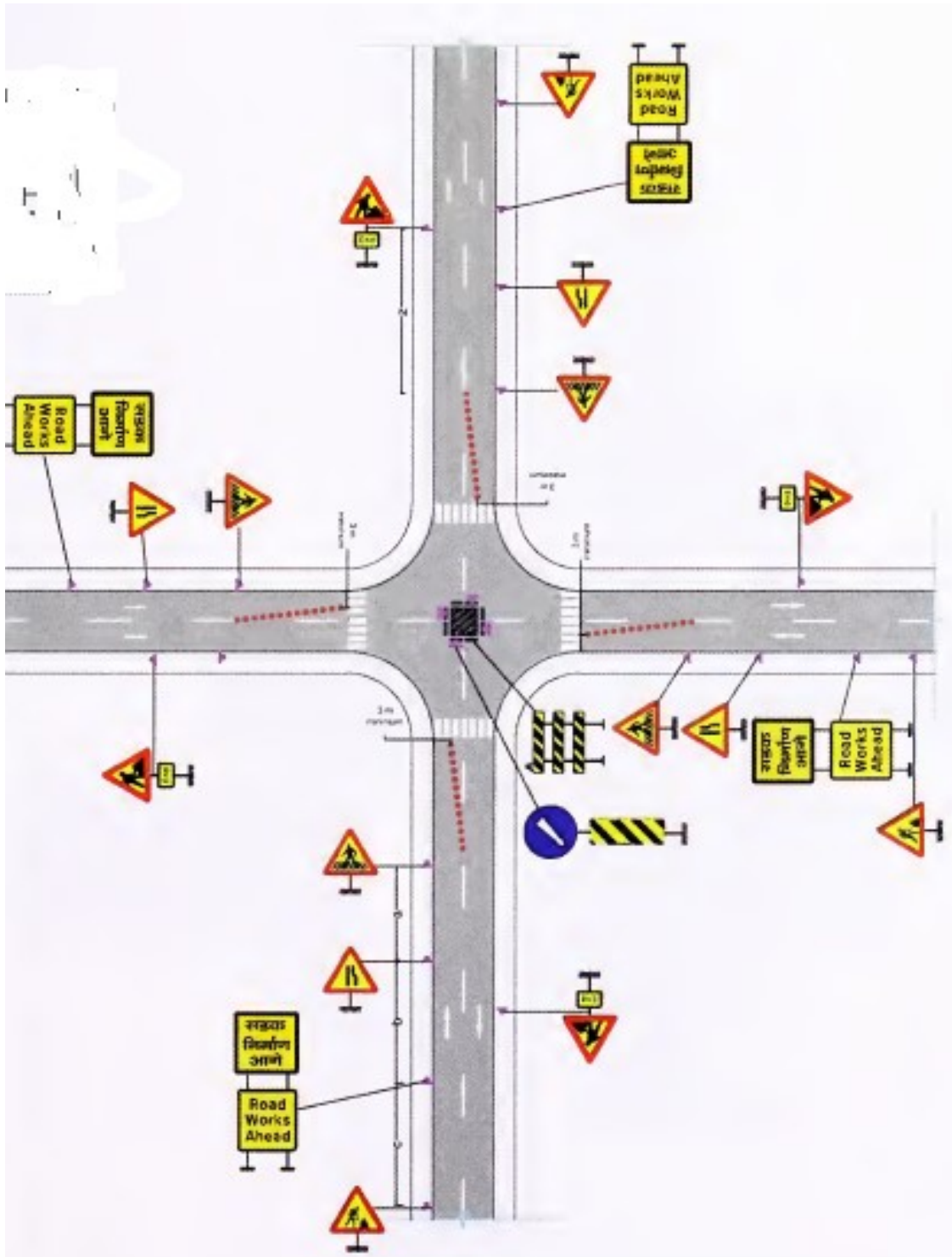
Subsequent paragraphs and figure explain the arrangement can be applicable at Junction during Construction

The regulatory signs to be used in work zones are subdivided as normal regulatory signs and Work zones specific regulatory sign. Regulatory signs are to instruct road users of traffic laws or regulations and to indicate the applicability of legal requirements that would not otherwise be apparent.

For ensuring legibility and emphasis at night, the signs shall be retro-reflective of at least Grade Type III, i.e. high intensity grade conforming to 801 of Specifications for Roads & Bridges, Ministry of Road Transport and Highways.

The material shall be smooth, sealed outer surface or illuminated to depict the same shape and similar color for both day and night. Sign illumination may be either internal or external and the signboards may be made of rigid or flexible material.

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD



7.5. Conclusion

As mentioned above lane closure alternately can adequately handle traffic at Nellikai, Mission Street Road during construction period. Nighttime construction is preferred alternative for up gradation works at other road on the loop.

IRC 55 guideline diagrams as given in this section need to be adhered for safe traffic movement.

8. Timeline for execution

The Total timeline for project are divided into 3 broad categories:

8.1. Construction Phase

The construction phase is considered as 1 year

8.2. Defect Liability

The Defect Liability period is considered as 2 Years

8.3. Maintenance Period

The Maintenance Period is considered as 5 years from date of construction completion

Note: Detailed schedule shall be during the final DPR and RFP Stage

9. Monitoring and Evaluation

The key components under smart road to be monitored are listed below:

- Development and strengthening of carriage way with uniform lane widths and geometric designs of roads and junctions as per street design standards.
- Development of footpath and cycle lanes wherever feasible - with uniform footpath widths, pedestrian friendly ways and barrier-free designs.
- Construction of utility ducts for water, sewerage, drainage, power, gas and optical fibre cables (OFC), wherever essential – with suitable provision for O&M.
- Construction bus bays, auto bays and on-street parking wherever essential.
- Beautification and landscaping including greenery and carbon sinking,
- Provision of smart street furniture and public utilities such as including communicative signage, lane marking. (passenger shelters, bus stops, parking, green toilets, first aid care, traffic police booth etc), public leisure spaces etc.
- Smart street-poles with LED lights, CCTV and various sensors as per city requirement.
- Accessibility standards as prescribed by the MoUD, etc.
- Particular focus on safety of women, children, elderly, etc

Risk assessment and mitigation strategy: Any project development is averse to various types of risks during the life cycle of the project. Identifying these risks and allocating them to the stakeholders who are able to address them the best is the most acceptable form of mitigation. In this context, a key risk associated with the project along with the assessment is presented below:

Sl. No	Risk Type	Degree (High/ Moderate/ Low)	Mitigation Strategy
1	Construction Phase Risks		
1a	Land Acquisition Delay	Low	Upgradation of roads does not involve any land acquisition. Therefore there is no land acquisition risk for this sub-project
1b	Delay in receipt of statutory approvals to the project	Moderate	The statutory requirements of the project would include approval of traffic management plan and for utility shifting. MCC can provide the requisite facilitation to MSCL for obtaining the necessary approvals for the proposed project.
1c	Time and Cost Over runs during construction	Moderate	The project involves upgradation of urban roads wherein no engineering or structural challenges are foreseen. PMC would monitor the overall progress of the project and suggest appropriate remedies/ actions to be taken by MSCL.
2	Regulatory risk		
	Change in law/ policy	Low	Change in policies leading to material adverse impact on the urban infrastructure sector is

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

			not envisaged. The present policies in force are expected to pave the way for Smart City development over the long term.
3	Force Majeure.		
	Act of God (Fire, earthquake, etc)	Low	Such risks shall be mitigated through insurance cover. The contractor would be mandated to keep in force insurance covering all project assets during the construction and contract liability phase for insurable events.

10. DRAWINGS

Table 10-1 below provides list of drawings included as volume 2 of the DPR

Table 10-1: List of Drawings

No.	Drawing no	Drawing Title
1	WTE_2292_00_R_1.01	MANGALORE CITY MAP
2	WTE_2292_00_R_1.02	EXISTING FEATURES OF MADIAN ROAD - PART2 (SHEET 1 OF 1)
3	WTE_2292_00_R_1.03	EXISTING FEATURES OF NELLIKAI ROAD (SHEET 1 OF 1)
4	WTE_2292_00_R_1.04	EXISTING FEATURES OF 4TH CROSS ROAD (SHEET 1 OF 1)
5	WTE_2292_00_R_1.05	EXISTING FEATURES OF MISSION STREET ROAD (SHEET 1 OF 1)
6	WTE_2292_00_R_2.01	PLAN AND PROFILE OF MADIAN ROAD - PART2 (SHEET 1 OF 1)
7	WTE_2292_00_R_2.02	PLAN AND PROFILE OF NELLIKAI ROAD (SHEET 1 OF 1)
8	WTE_2292_00_R_2.03	PLAN AND PROFILE OF 4TH CROSS ROAD (SHEET 1 OF 1)
9	WTE_2292_00_R_2.04	PLAN AND PROFILE OF MISSION STREET ROAD (SHEET 1 OF 1)
10	WTE_2292_00_R_3.01	ROAD SIGNAGES - PLAN AND ROAD MARKING OF MADIAN ROAD (SHEET 1 OF 1)
11	WTE_2292_00_R_3.02	ROAD SIGNAGES - PLAN AND ROAD MARKING OF NELLIKAI ROAD (SHEET 1 OF 1)
12	WTE_2292_00_R_3.03	ROAD SIGNAGES - PLAN AND ROAD MARKING OF 4TH CROSS ROAD (SHEET 1 OF 1)
13	WTE_2292_00_R_3.04	ROAD SIGNAGES - PLAN AND ROAD MARKING OF MISSION STREET ROAD (SHEET 1 OF 1)
14	WTE_2292_00_R_4.01	PROPOSED JUNCTION IMPROVEMENT HAMILTON CIRCLE INTERSECTION SIGNALIZED (SHEET 1 OF 1)
15	WTE_2292_00_R_4.02	PROPOSED JUNCTION IMPROVEMENT RAO N RAO CIRCLE INTERSECTION SIGNALIZED (SHEET 1 OF 1)
16	WTE_2292_00_R_5.01	PROPOSED CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 1 OF 3)
17	WTE_2292_00_R_5.01	PROPOSED CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 2 OF 3)
18	WTE_2292_00_R_5.01	PROPOSED CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 3 OF 3)
19	WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 1 OF 6)
20	WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 2 OF 6)
21	WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 3 OF 6)
22	WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 4 OF 6)
23	WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 5 OF 6)
24	WTE_2292_00_R_5.02	PROPOSED CROSS SECTION OF NELLIKAI ROAD (SHEET 6 OF 6)
25	WTE_2292_00_R_5.03	PROPOSED CROSS SECTION OF 4TH CROSS ROAD (SHEET 1 OF 3)
26	WTE_2292_00_R_5.03	PROPOSED CROSS SECTION OF 4TH CROSS ROAD (SHEET 2 OF 3)
27	WTE_2292_00_R_5.03	PROPOSED CROSS SECTION OF 4TH CROSS ROAD (SHEET 3 OF 3)
28	WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 1 OF 4)
29	WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 2 OF 4)
30	WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 3 OF 4)
31	WTE_2292_00_R_5.04	PROPOSED CROSS SECTION OF MISSION STREET ROAD (SHEET 4 OF 4)
32	WTE_2292_00_R_6.01	ROAD SIGNAGES AND MARKING DETAILS (SHEET 1 OF 1)
33	WTE_2292_00_U_1.01	PROPOSED UTILITY SERVICES OF MADIAN ROAD - PART2 (SHEET 1 OF 1)
34	WTE_2292_00_U_1.02	PROPOSED UTILITY SERVICES OF NELLIKAI ROAD (SHEET 1 OF 1)
35	WTE_2292_00_U_1.03	PROPOSED UTILITY SERVICES OF 4TH CROSS ROAD (SHEET 1 OF 1)

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36	WTE_2292_00_U_1.04	PROPOSED UTILITY SERVICES OF MISSION STREET ROAD (SHEET 1 OF 1)
37	WTE_2292_00_E_1.01	EXISTING POWER DISTRIBUTION SYSTEM OF ROADS (SHEET 1 OF 1)
38	WTE_2292_00_E_1.02	EXISTING POWER DISTRIBUTION SYSTEM OF MADIAN ROAD - PART2 (SHEET 1 OF 1)
39	WTE_2292_00_E_1.03	EXISTING POWER DISTRIBUTION SYSTEM OF NELLIKAI ROAD (SHEET 1 OF 1)
40	WTE_2292_00_E_1.04	EXISTING POWER DISTRIBUTION SYSTEM OF 4TH CROSS ROAD (SHEET 1 OF 1)
41	WTE_2292_00_E_1.05	EXISTING POWER DISTRIBUTION SYSTEM OF MISSION STREET ROAD (SHEET 1 OF 1)
42	WTE_2292_00_UD_1.01	URBAN DESIGN PROPOSAL OF MAIDEN ROAD PART-2 (SHEET 1 OF 1)
43	WTE_2292_00_UD_1.02	TYPICAL CROSS SECTION OF MAIDAN ROAD-PART2 (SHEET 1 OF 1)
44	WTE_2292_00_UD_2.01	URBAN DESIGN PROPOSAL OF NELLIKAI ROAD (SHEET 1 OF 1)
45	WTE_2292_00_UD_2.02	TYPICAL CROSS SECTION OF NELLIKAI ROAD (SHEET 1 OF 1)
46	WTE_2292_00_UD_3.01	URBAN DESIGN PROPOSAL OF 4TH CROSS ROAD (SHEET 1 OF 1)
47	WTE_2292_00_UD_3.02	TYPICAL CROSS SECTION OF 4TH CROSS ROAD (SHEET 1 OF 1)
48	WTE_2292_00_UD_4.01	URBAN DESIGN PROPOSAL OF MISSION STREET ROAD (SHEET 1 OF 1)
49	WTE_2292_00_UD_4.02	TYPICAL CROSS SECTION OF MISSION STREET ROAD (SHEET 1 OF 1)
50	WTE_2292_00_PL_1.01	PLANTING PLAN OF MAIDEN ROAD PART-2 (SHEET 1 OF 2)
51	WTE_2292_00_PL_1.01	PLANTING PLAN OF MAIDEN ROAD PART-2 (SHEET 2 OF 2)
52	WTE_2292_00_PL_1.02 (R0)	PLANTING PLAN OF NELLIKAI ROAD (SHEET 1 OF 1)

11. COST ESTIMATES

The section of the report deals with the Cost Estimates for Priority Loop Smart Roads

11.1. Assumptions

- SOR rates as per Mangalore Circle SOR
- 12% weightage has been added to SOR rates of Mangalore Circle PWD
- Non SOR Items based on Vendor Quotations
- Landscaping rates as per EOI and Mangalore Circle PWD
- Water Supply Package are to be executed under ADB Project and as separate package, hence cost not to be considered in smart road tender cost
- UGD (sewer network) Package will be floated as separate tender, hence cost not to be considered in smart road tender cost
- LED Street Light Package will be floated as separate tender, hence cost not to be considered in smart road tender cost
- ICT Package will be floated as separate tender, hence not to be considered in smart road tender cost

11.2. Summary of Estimate

Summary of the estimate is as stated in tale 11-1 below:

Table 11-1: Priority Loop Smart Road – Summary of Estimate

Sr. No.	Description	Cost In INR
1	Road and Other Works	10,48,06,661
2	Street Lighting	18,72,611
3	Landscape Work	5,68,177
	Sub Total	10,72,47,449
	Maintenance Cost	60,90,294
	Provision for Third Party Damages and Maintenance at 1 st Year(DLP)	11,23,806
	GST @ 12%	92,26,821
	Escalation and Tender Premium at 10%	107,24,745
	Add 3% Contingency	32,17,423
	Miscellaneous and Rounding off	9,462
	Grand Total	13,76,40,000

11.3. Detailed BOQ

Detailed BOQ has been enclosed as Volume III of the Detailed Project Report

ANNEXURES I – DETAILS OF TRAFFIC SURVEY AND INVESTIGATIONS

ANNEXURES II – SPECIFICATIONS

ALL THE WORKS TO BE EXECUTED AS PER RELEVANT MORTH, IRC, KSRB DETAILED SPECIFICATION & NATIONAL BUILDING CODE & AS PER RELEVANT BUREAU OF INDIAN STANDARD SPECIFICATIONS

LANDSCAPE DETAILS AS PER SPECIFICATIONS MENTIONED IN DRAWINGS FOR PLANTING DETAIL

SOME SPECIFIC SPECIFICATIONS CONSIDERED ARE AS MENTIONED BELOW

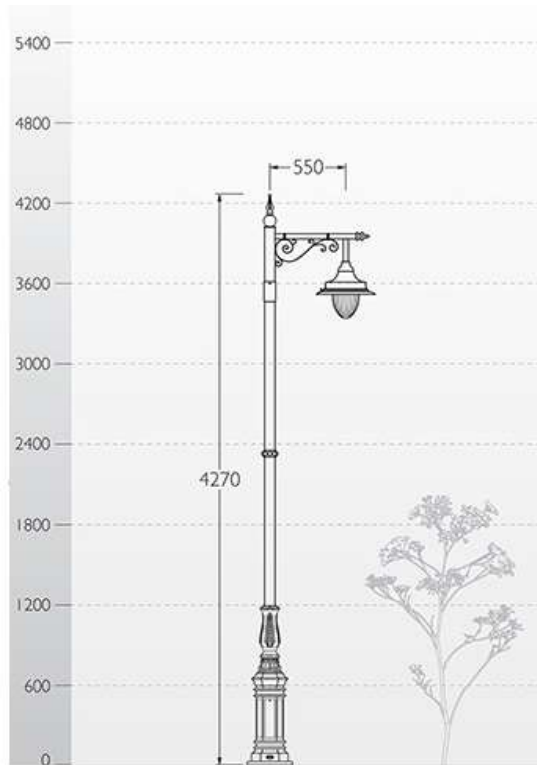
LIGHT FIXTURE FOR FOOTPATH

Make : K-LITE

MODEL : VICENT LIGHTING POLE

Code : KP-450

HT : 4270MM



PERMEABLE ECO-FRIENDLY PAVERS DETAILS

PAVER OPTION FOR CAR PARK AREA: UNILOCK - ECO-OPTILOC

Description: s

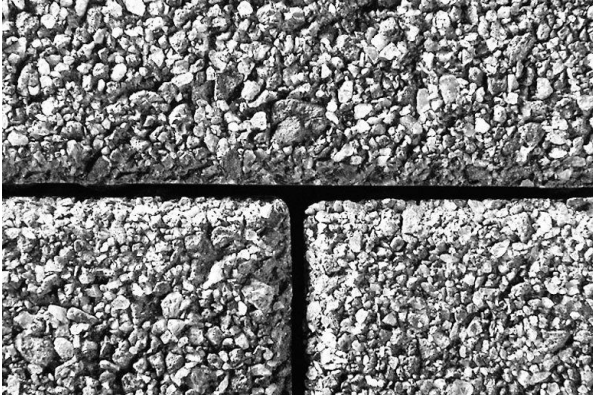


Figure 1 washed finish

This paver has gained world-wide acceptance as the paver-of-choice for performance, and as an environmental solution for drainage. Only the patented “L” shaped design allows you to achieve a superior lock-up that can withstand even the heaviest of loads residentially and commercially. The innovative design creates small voids between the pavers providing drainage into the sub-base.

Standard size: 26 cm x 26 cm x 8 cm i.e. 10.25" X 10.25" X 3.125".

Handling and Installation

- A protective pad is recommended when doing the final paver compaction. These products can be installed mechanically or by hand.
- Jointing Material and Joint Stabilization
- Use only select graded stone chips for void filling Unilock EasyPro
- Product may be sealed but it is not absolutely required Unilock, Unicare, Surebond, BP Pro and Techniseal sealers can be used.
- Select type for desired aesthetics.
- Product must be cleaned before sealing
- Cleaners – Any paver cleaner may be used for color restoration or general cleaning. Follow manufacturer’s dilution rates and application procedures.

PAVER OPTION FOR FOOTPATHS: BASANT BETONS - ECOLOC

Description:

Ecoloc permeable interlocking concrete pavers are aimed to reduce storm water runoff. It is an ideal choice for driveways & parking lots. They can also be used for heavy duty applications for ports and storage yards. They form good usage for pavement in all sorts of landscapes including residential dwellings for water harvesting, as these offer great environmental benefits of being able to infiltrate water through the pavement surface into the ground below.

- Maximizes ground water recharge enabling water harvesting for reuse.
- Reduces nonpoint source pollutants in storm water thereby mitigating impact on surrounding surface waters and also would reduce downstream flooding and earth erosion.

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

- Facilitates efficient land use planning and productive use of land for greater financial benefits offering great help where land prices are high.
- To lessen project costs by reducing or eliminating retention and drainage systems.
- Useful in designing variety of storm water management requirements.

Dimensions:

Thickness : 3 1/8 inches (80mm)

Outside Length : 8 7/8 inches (225mm)

Inside Length : 4 1/2 inches (112.5mm)

Pavers Per Sft : 2.41

Percentage of drainage “opening” area per sft : 12.18%



Figure 2 Terracotta 70%-grey 30%

PEDESTRIAN SIGNAL:

Salient features of Traffic Signal Heads

- Special Quality LEDs for uniform high output for extended period and much longer overall life
- Uniformly spaced LEDs give larger and uniform view for dot matrix & high Flux
- Light Intensity & Colour wavelength of LEDs are measured at our optical lab to comply with International specifications
- Complies minimum viewing angle specifications
- The Assemblies use no reflector and LEDs have no colour in off condition eliminates sun phantom effects.
- Available in different voltage versions in AC and DC
- Optical unit and housing protected to IP65/IP54
- Better than 0.9 power factor in AC mains version
- Intensity loss on single LED failure less than 2%
- CE Certified & in compliance with BSEN12368



Pedestrian Traffic Light

ROADSIDE DUSTBIN:

Product Name	Outdoor Dustbin Steel 55L
Size	55liters
Capacity	55L /75L /100L
Material	SS 304 Steel



BOLLARDS:

- 304/ 316 grade polished stainless steel
- Machined flat cap
- Optional cover skirts available
- Versatile products for decorative covers, removable traffic parking control, bike parking and safety security

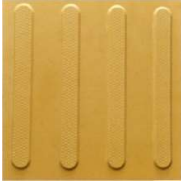
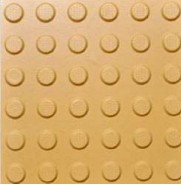
Features

1. Higher resistance to corrosion
2. Greater resistance to pitting and staining
3. Low Maintenance
4. Recyclable



TACKTILE PAVING

DETAILED PROJECT REPORT – PRIORITY LOOP SMART ROAD

Parameter	Specification	Area	Photo
Directional Tile	Size: 300x 300 x 60 mm Colour: Yellow Grade of Concrete: M-30	356 sq.m.	
Stop tile	Size: 300x 300 x 60 mm Colour: Yellow Grade of Concrete: M-30	100 sq.m.	

ANNEXURES III – DESIGN PROPOSALS FOR WATER SUPPLY UNDER ADB FUNDED PROJECT

ANNEXURES IV – DESIGN CALCULATIONS FOR STORM WATER DRAINAGE