MANGALORE SMART CITY LIMITED

DPR FOR NEHRU MAIDAN ROAD FROM CLOCK TOWER CIRCLE TO A B SHETTY CIRCLE IN MANGALORE CITY UNDER SMART CITY COMPONENTS

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

Lalbagh, M.G. Road, Mangalore – 575003

10/27/2017

ISSUE AND REVISION RECORD

Revision	Date	Originator	Checker	Approver	Description	Standard
1	27/10/2017	WTESL/LBI/ CDAC	URVI BHATT	URVI BHATT/ KAVITA WAKADE	DETAILED PROJECT REPORT	

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ABBREVIATIONS

ABD	Area Based Development
ATM	At The Moment" or "Automated Teller Machine
MCC	Mangaluru City Corporation
MSCL	Mangaluru Smart City Limited
GoI	*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

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

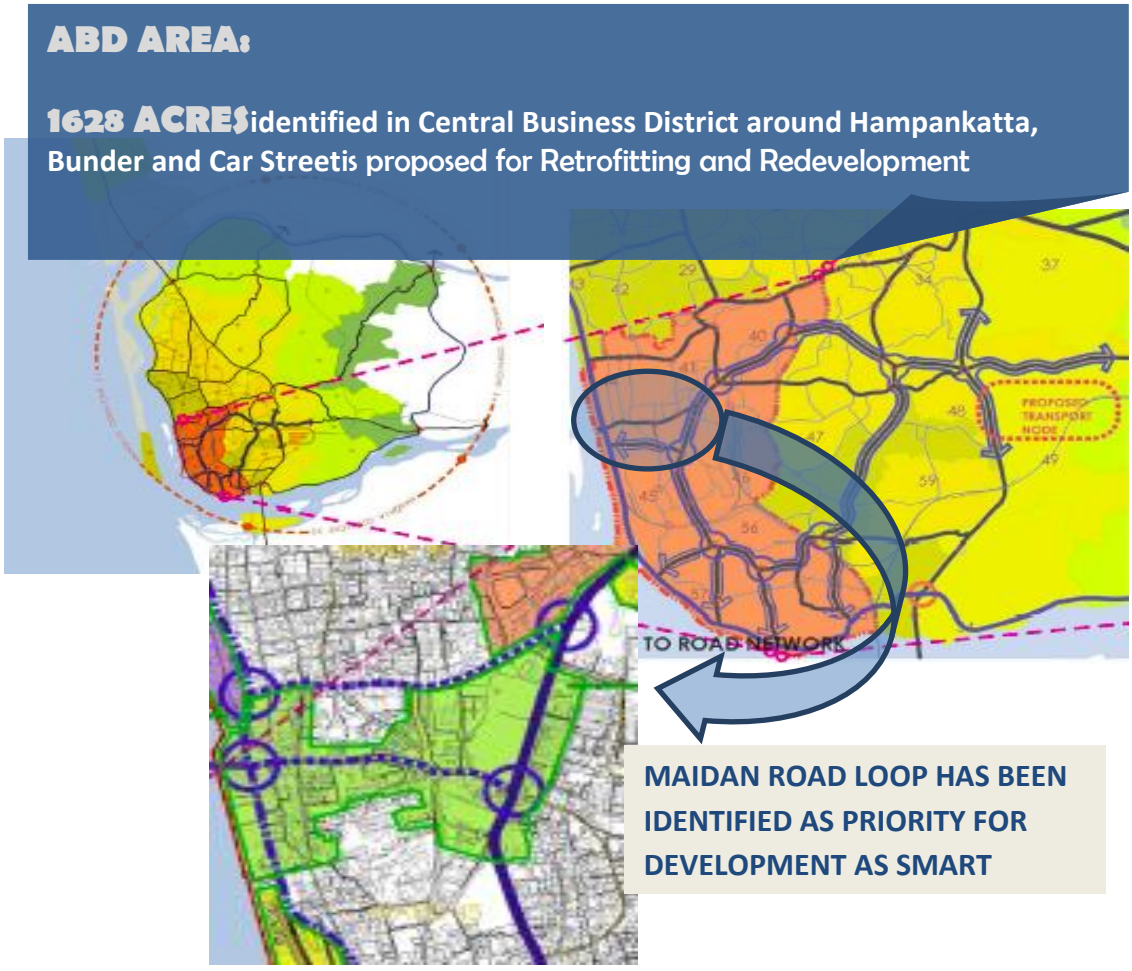
1.1. Mangaluru Smart City Proposal

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

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

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1.2.1. Smart Roads under Mangaluru Smart City

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

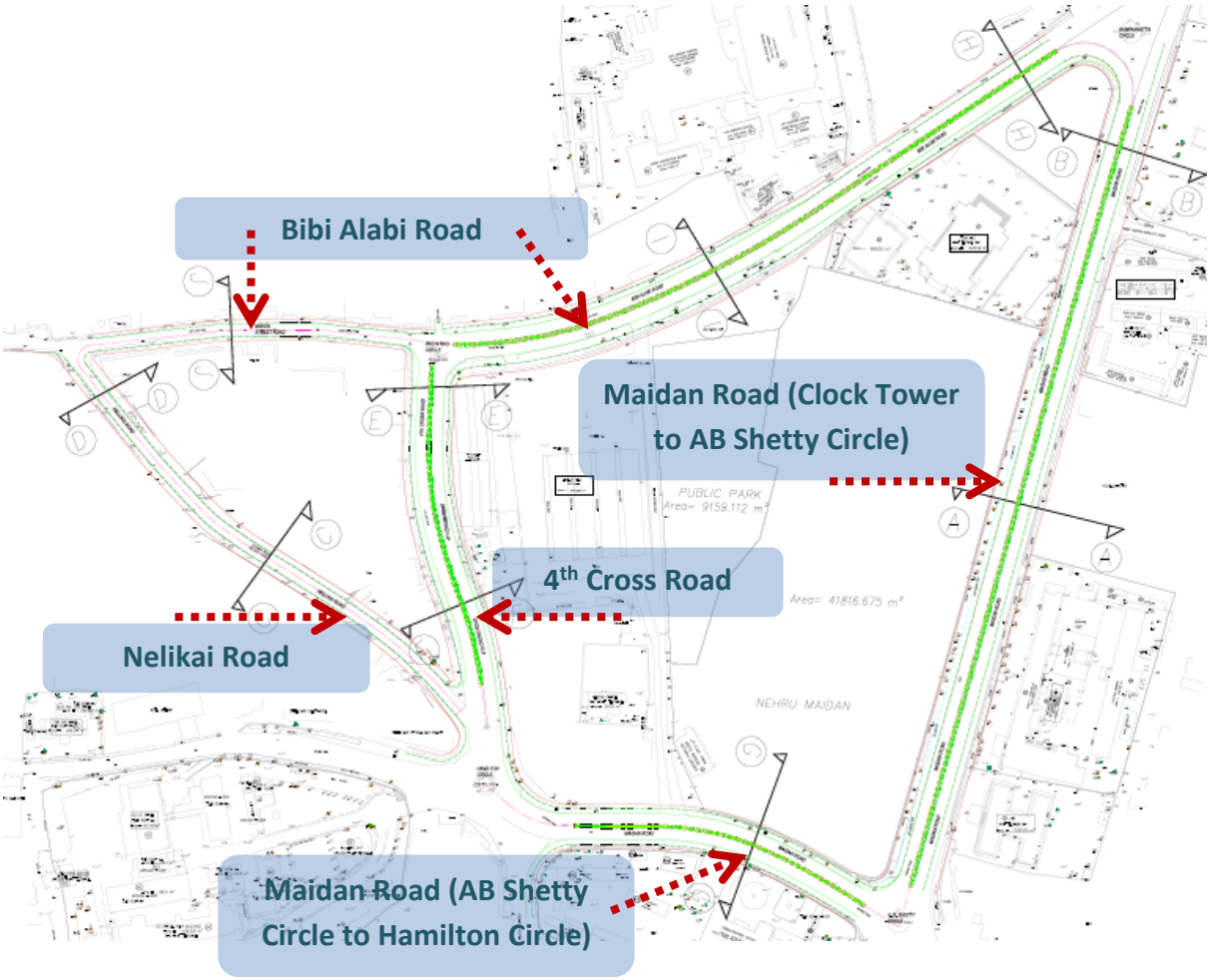
Phase I/Priority Smart Roads are located in the central area of the city adjacent to the Nehru Maidan/Town Hall and include Maidan road (from Clock Tower Circle to AB Shetty Circle), Maidan road (from AB Shetty Circle to Hamilton Circle), 4th Cross Road, Bibi Alabi Road, Nellikai Road

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),Emmekere Road and Ferry Road,Marnamikatta Road

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

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

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



1.2.2. Need for Intervention

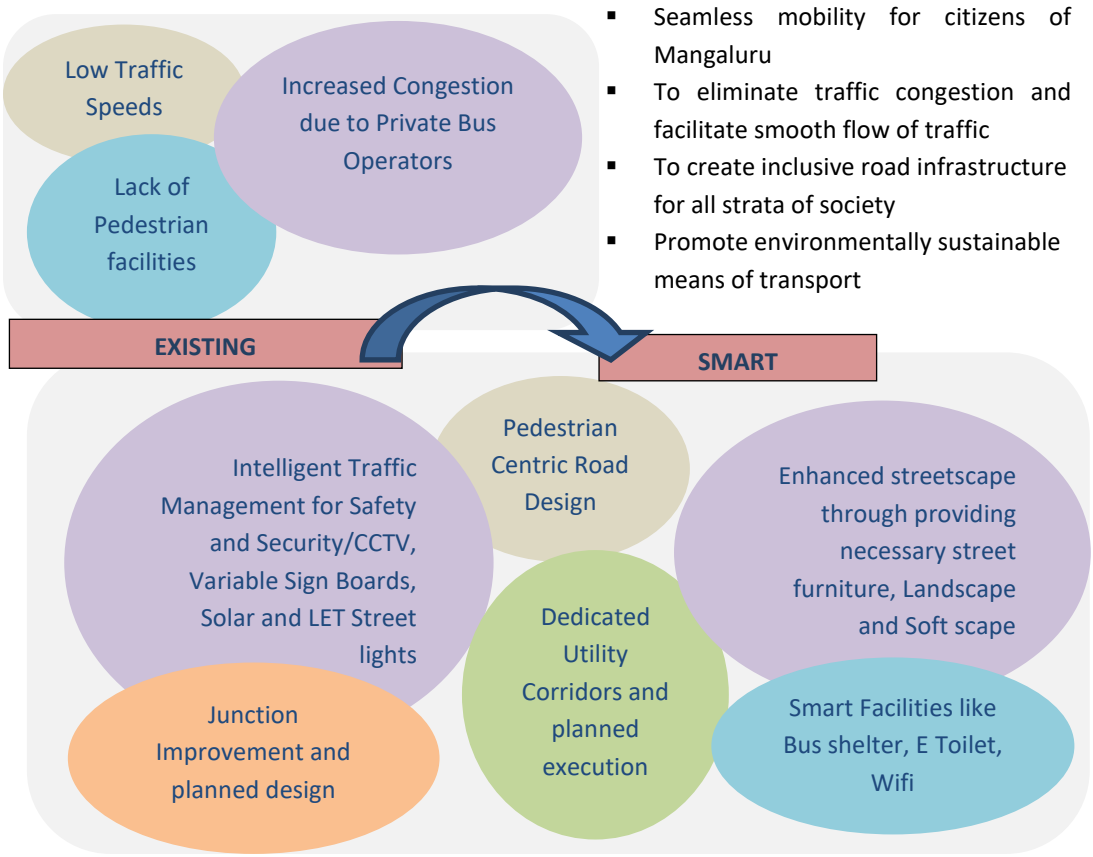
The existing road infrastructure and transport facilities in Mangalore are proving to be inadequate to meet the requirements of the city. 63% of the roads have speeds below 30 kmph as noted during the Comprehensive Traffic and Transportation Study of Mangalore. The delay is both due to traffic signals 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 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:

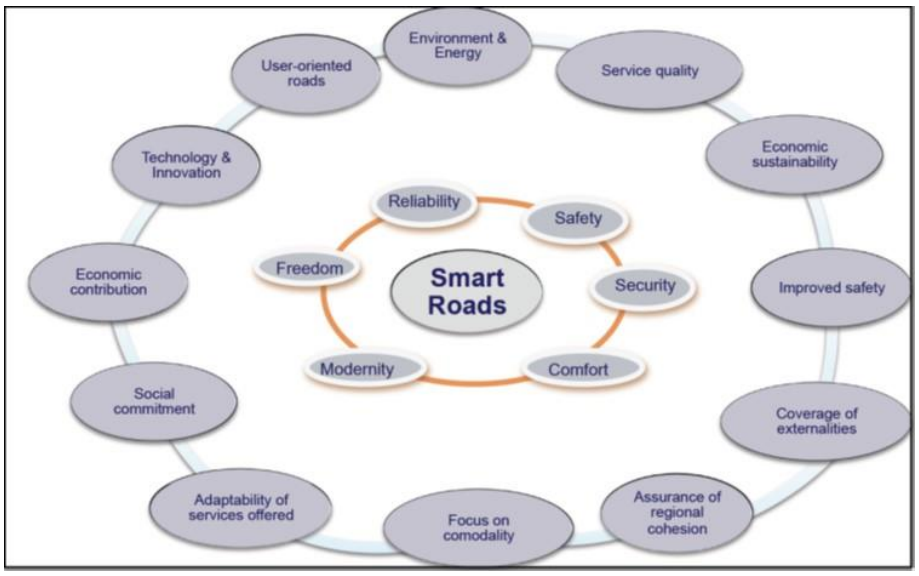
1) **EFFICIENT AND SAFE STREETS**: This involves road re-channelization whereby the effective width of the carriageway is reduced in order to achieve systemic improvements. Roads with clearly demarcated spaces for vehicles, pedestrians, cyclists and dedicated on-street parking to minimize conflicts between 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 Maidan 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 and solar powered 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 Nehru Maidan 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 –Nehru Maidan – 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 – Timeline for Execution
- Chapter 8–Monitoring and Evaluation
- Chapter 9–Drawings
- Chapter 10 –Cost Estimates
- Annexures

2. NEHRU MAIDAN – SITE RECONNAISSANCE AND SITUATION ANALYSIS

Detailed Site Reconnaissance was carried out along Maidan Road between Clock Tower Circle to A B Shetty Circle to assess the existing situation in terms of pavement condition, traffic situation/movements, existing facilities/structures, smart elements that can be proposed along Nehru Maidan Road. Section below describes brief of existing condition of Nehru Maidan Road

VIEW OF AB SHETTY CIRCLE & MAIDAN ROAD

The Maidan Road has an average carriage way of 7 m each with provision of footpath on both sides. The road is in fairly good condition, with rigid pavement and wide carriageways divided by a central median.Adjacent figure shows view of AB Shetty Circle and Maidan Road. The traffic is observed as one way along the partial length and two ways along the balance length

FOOTPATH ADJACENT TO PWD AND RTO BUILDINGS ON MAIDAN ROAD

The existing footpaths are paver type and has good amount of green cover. Figure below shows the existing condition of the footpath along the Maidan Road

FOOTPATH ADJACENT TO NEHRU MAIDAN

BUS LANE AND EXISTING BUS SHELTER AT MAIDAN ROAD

The stretch has facility of Car parking (intermittent locations) along the Maidan Road Side and the Bus Shelters along the Offices/Building side. There is provision of dedicated bus lane for the movement of buses along the road

The adjacent figure shows the Bus Lane and existing Bus Shelter along the Maidan Road

The urban elements/ facilities along the Maidan Road includeAuto Rickshaw Stand, street lights along both side of the road and median, marking for pedestrian crossings.

Presently, there are 29 Nos. of Street light. Sodium vapour lamps and fluorescent tube lights are used for street illuminations.

AUTO STAND AT A.B.SHETTY CIRCLE

The adjacent figure shows the existing Auto Stand near the AB Shetty circle

The existing utilities along the Maidan Road Include Storm Water Drains, Water Supply, Electrical Cables, OFC Cables etc

Storm water drains are provided on both sides of roads with width varying from 1.0m to 1.5 m and cover slabs of drain are damaged and giving undulations to the pedestrians. The drains are further continuing to AB Shetty circle on side and Cloak tower on other side of road. The Gully chambers and connecting pipes in damaged condition. Around 30 to 40 % the cover slabs of drains are in damaged state and required to replace with new.

At present there is no sewerage network is passing along the Maidan road, as topography of Maidan Road falls in higher elevation to surrounding buildings and roads which is against to the gravity flow sewage. Sewerage networks of surrounding buildings are conveyed to lower elevation roads. Accordingly, no new sewerage network is proposed along the Maidan road.

At present, Maidan road is provided with existing water supply line with 200 mm diameter towards the office buildings. As per the proposal under project 24 x7 water supply by

KUIWIM, 1 Feeder line with 2 distribution lines with service lines are proposed along this road.

OFC CABLE TRENCH ALONG THE MAIDAN ROAD

The adjacent figure shows the OFC cable chamber along the Nehru Maidan Road

With regards to the ICT infrastructure, Mangaluru Police through Maurya Infotech has deployed 5 CCTV at A B Shetty Circle and 3 CCTV at Clock Tower circle

Following Telecom providers/ISP have laid OFC cable across Maidan Road: BSNL, Airtel, RIL, RJIO.

3. SURVEYS AND INVESTIGATIONS

3.1. Road Inventory Survey

A detailed road inventory was done along the Maidan Road between Clock tower and AB Shetty circle

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 drawing showing existing details along the Maidan Road including AB Shetty and Clock Tower is included as "WTE_2292_00_R_2.01 - EXISTING FEATURES OF MADIAN ROAD (SHEET 1 OF 1) and WTE_2292_00_R_3.01 EXISTING CROSS SECTION OF MADIAN ROAD (SHEET 1 OF 1)"in Section 9 of the report.

3.2. Traffic Surveys

Based on the roads and junction identified under Priority /Phase I, detailed primary surveys and investigation were carried out. Table 3-1 below defines various Traffic surveys and investigations carried out along the Nehru Maidan Road including Clock Tower and AB Shetty Circle

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 Nehru Maidan Road

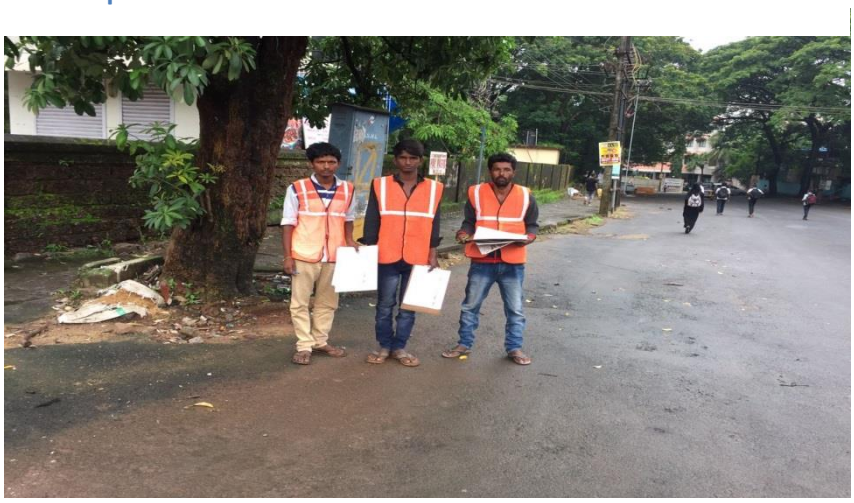
Sl No.	Road name	Type of survey	Chainage
1	Maidan road (from Clock Tower Circle to AB Shetty Circle)	7 days Classified Total Volume Count	0.25 km south of Clock Tower Circle
		1 Day Turning Movement Count	• Clock Tower Circle • Junction of Maidan road and Old Kent Road • A.B. Shetty Circle

		Pedestrian Count	• Clock Tower Circle • A.B. Shetty Circle

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 3-1 shows the traffic survey in progress at the Project site.

Figure 3-1 Phase I/Priority Smart Road considered for development as smart road



For carrying out the counts, the vehicles were grouped under the categories given in **Error! Reference source not found.**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.

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

- Clock Tower Circle
- Junction of Maidan road and Old Kent Road
- A.B. Shetty Circle

Pedestrian Counts were done at AB Shetty Circle and Clock Tower Junction.

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 intable 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

		PCU Factors	
	Vehicle Type	**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 Ricksaw	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 Maidan Road

Vehicle Type	Maidan road (from Clock Tower Circle to AB Shetty Circle)
2W	12122
3W-P	7499
3W-F	205
Car	10350
Taxi	787
M-Bus	507
Bus	2138
M-LCV	266
LCV-P	50
LCV	218
2-Axle	119
3-Axle	18
4-6 Ax	14
>6Axle	13
Others	233
Total	34539
PCU	36122

(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 Maidan Road is presented in table 4-3 below

Table 4-3: Traffic split at Maidan Road

Vehicle Type	Maidan road (from Clock Tower Circle to AB Shetty Circle)
Passenger Vehicles	97%
Commercial Vehicles	3%

Since this is an urban street so it is assumed that traffic behaviour 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 Maidan Road between AB Shetty Circle and Clock Tower Circle is shown in figure 4-1 below. Table 4-4 provides details of Hourly variation of Traffic: Peak Hour Traffic

Figure 4-1 Phase I/Priority Smart Road considered for development as smart road

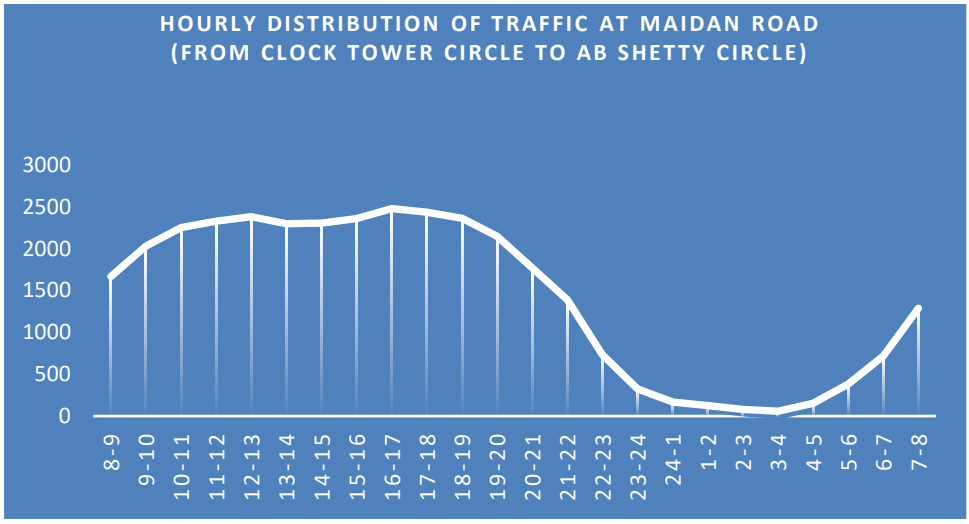


Table 4-4: Hourly Variation of the Traffic: Peak Hour Factors

	PHF/Peak Hour	Peak Hour Volume	Peak Hour PCU
Maidan road (from Clock Tower Circle to AB Shetty Circle)	7.24% / 16 – 17 Hours	2479	2565

Daily variation of traffic volume / Average Composition of traffic/ Directional distribution of traffic

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

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 analyzed 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.

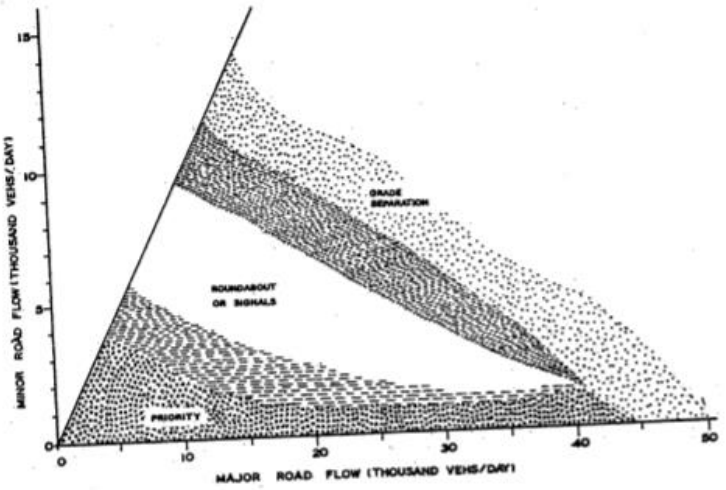


Fig. 1.1. Intersection Selection based on Traffic Flow Combination (U.K. Practice)

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

- Clock Tower Circle
- Junction of Maidan road and Old Kent Road
- A.B. Shetty Circle

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			
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	Clock Tower Circle	6451	10508	17116	2017
2	4 Leg	Junction of Maidan road and Old Kent Road	761	1240	2019	NA
3	3 Leg	A B Shetty Circle	7197	11723	19096	2017

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	4 Leg	Clock Tower Circle	38013	18810	61919	30640	100860	49909
2	3 Leg	Junction of Maidan road and Old Kent Road	5100	2598	8307	4232	13532	6893
3	3 Leg	A B Shetty Circle	38991	7582	63512	12350	103455	20117

Based on the above table and analysis carried out with reference to IRC SP 41 Clock Tower, 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 4-2Directional Traffic Flow Diagram for Clock Tower Circle

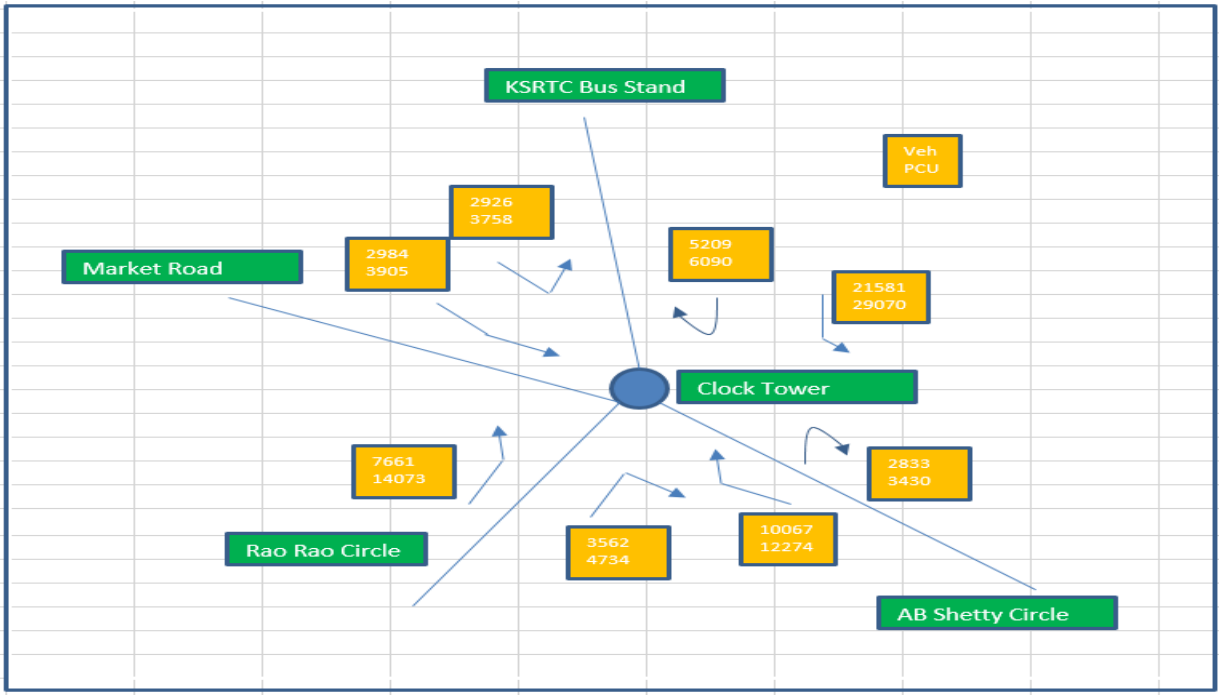


Figure 4-3Directional Traffic Flow Diagram for Maidan – Kent Road Junction Traffic

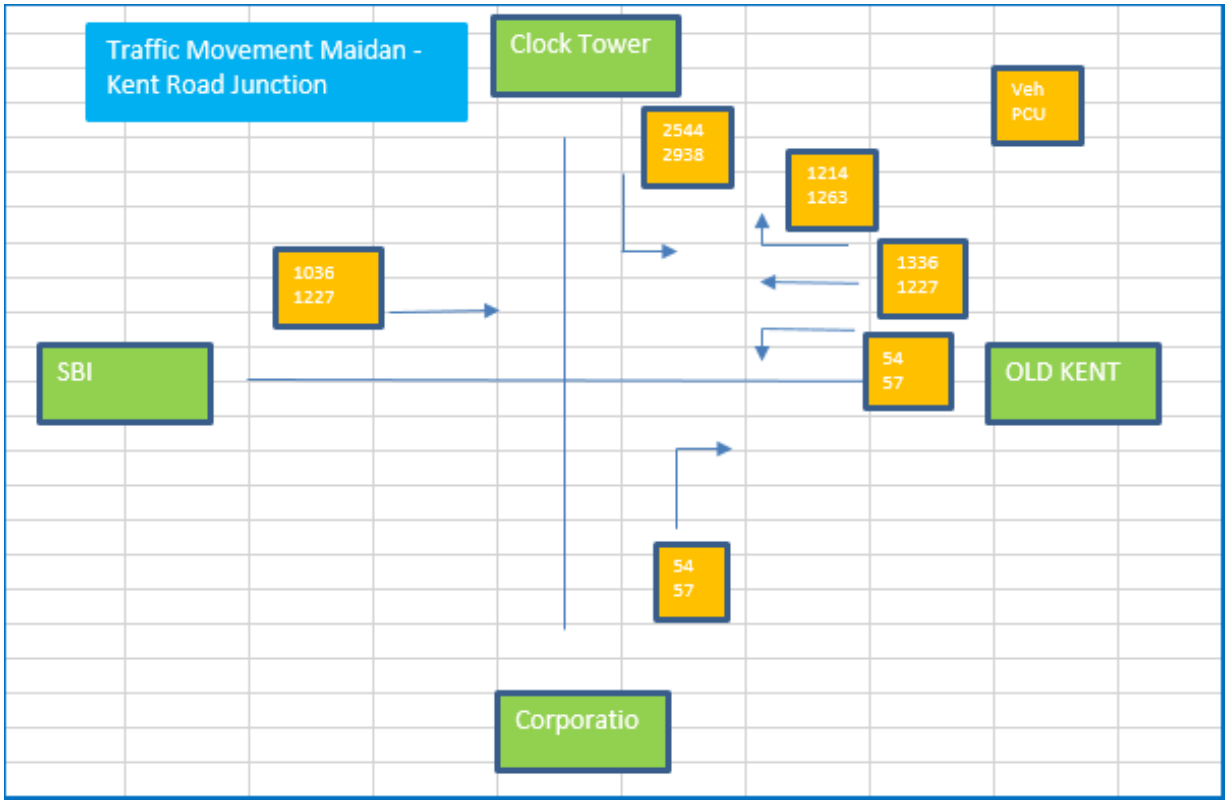
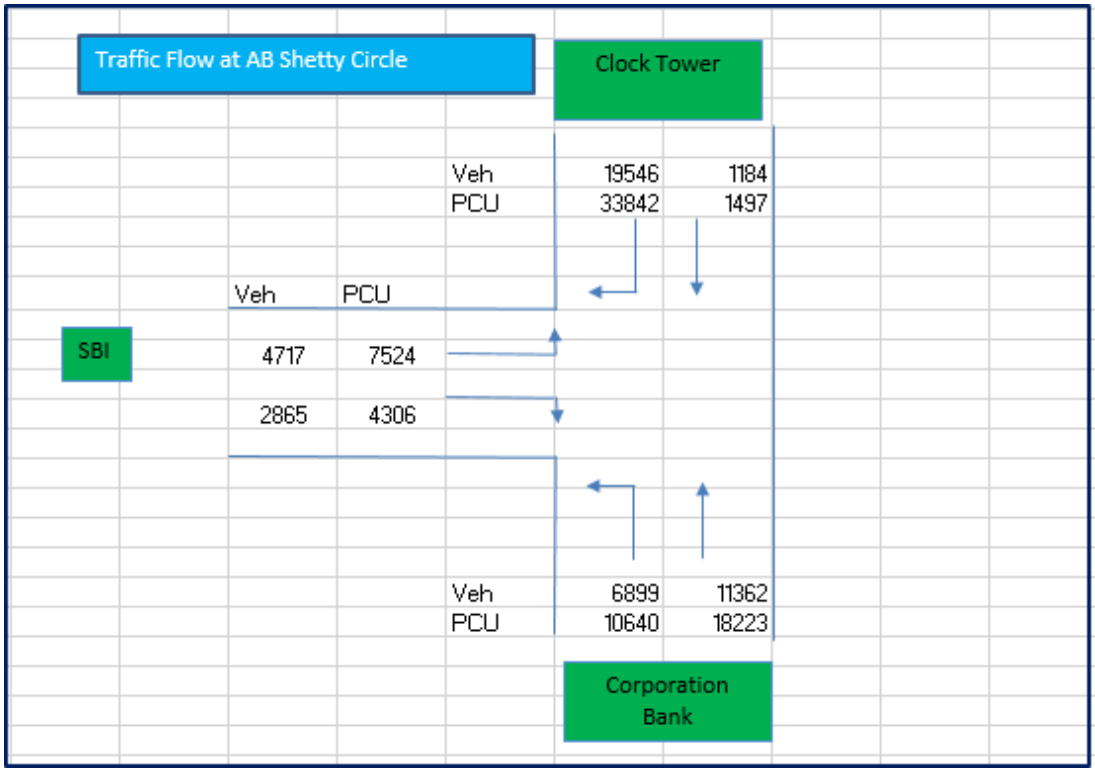


Figure 4-4Directional Traffic Flow Diagram for A B ShettyCircle



4.1.3. Pedestrian Count Survey

Intensity of pedestrians/animals crossing the project road will has 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 x 108 and for Zebra crossing PV^2 should be greater than 1 x 108 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
Clock Tower Circle	17:00 – 18:00	664	2348	36.6	Grade Separation
A B Shetty Circle	10:00-11:00	144	2112	6.45	-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 Maidan Road

Year Maidan road (from Clock Tower Circle to AB Shetty Circle)	Traffic Forecast - Maidan road (from Clock Tower Circle to AB Shetty Circle)	Year Maidan road (from Clock Tower Circle to AB Shetty Circle)	Traffic Forecast - Maidan road (from Clock Tower Circle to AB Shetty Circle)
2017	2565	2027	4178
2018	2693	2028	4387
2019	2828	2029	4606
2020	2969	2030	4837
2021	3118	2031	5079
2022	3274	2032	5332
2023	3437	2033	5599
2024	3609	2034	5879
2025	3790	2035	6173
2026	3979	2036	6482
		2037	6806

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 Clock Tower Circle and AB Shetty Circle
4 Lane Divided Two Way	Upto 2024
6 Lane Divided Two Way	Upto 2033
8 Lane Divided Two Way	NA

4.3. Conclusion and Summary of Results

Maidan road is a typical urban road with respect to traffic pattern. Present carriageway width is sufficient to handle traffic on midblock. Three junctions' at Clock tower circle, A B Shetty 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.

5. CARRIAGEWAY AND JUNCTION IMPROVEMENT

5.1. Carriageway Improvement

5.1.1. Right of Way (ROW)

Right of way (ROW) of existing Maidan road is about 30.0m. As per the classification as adopted by MoUD for Urban roads, the Maidan road fall 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. It carries same traffic volumes as the 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 along the Maidan Road

The proposed plan and Profile of Nehru Maidan has been shown in Drawing "WTE_2292_00_R_1.01 - PLAN AND PROFILE OF MADIAN ROAD (SHEET 1 OF 1)" in section 90 of the Report

The typical cross section of the Nehru Maidan Road is as shown in Drawing "WTE_2292_00_R_3.01- TYPICAL CROSS SECTIONS OF MADIAN ROAD (SHEET 1 OF 1)" in section 9 of the Report

5.1.2. Design Speed

Design speed is related to the function of a road. Keeping in view the type of functions expected on Maidan road, design speed of Maidan road has been considered as 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 Maidan Road as "6 Lane Divided Two Way" (i.e 3 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 proposed on A B Shetty Circle to Clock Tower intersection bound carriageway.

Similarly, dedicated Bus Lane is provided

The Lane and Signage marking has been shown in drawing WTE_2292_00_R_4.01 - ROAD SIGNAGES - PLAN AND ROAD MARKING OF MADIAN ROAD (SHEET 1 OF 1)in section 9 of the Report

Refer Drawing WTE_2292_00_R_6.01 -ROAD SIGNAGES AND MARKING DETAILS (SHEET 1 OF 1)in section 9 of the Report for typical signage and marking details

5.1.4. Camber / Cross Fall

Since we are retaining the existing carriageway, existing camber will be maintained.

5.1.5. Geometry / Alignment

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

5.1.6. On Street Parking

Parallel parking lane has been proposed on A B Shetty Circle to Clock Tower intersection bound carriageway.

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 pedestriansas 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 for Nehru Maidan road for future

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
- 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 Clock Tower Junction

Clock Tower Junction This is three legged intersection and based on the primary details obtained for Average Daily Traffic and Peak traffic mentioned in table 5-2 below, it is recommended to go for signalized roundabout design for Clock Tower Junction

Table 5-2: Average daily traffic and peak hour traffic at Clock Tower Intersection

Clock Tower Circle	Average Daily Traffic		Peak Hour Traffic	
	Vehicles	PCU	Vehicles	PCU
KSRTC bus stand to A B Shetty Circle	21581	29070	1787	2528
Market Road to KSRTC Bus Stand	2926	3758	234	296
Rao & Rao Circle to KSRTC	7661	14073	469	899
A B Shetty to KSRTC Bus Stand	10067	12274	934	1053

Rao & Rao Circle to A B Shetty Circle	3562	4734	294	385
A B Shetty to A B Shetty Circle	2833	3430	271	358
Market Road to A B Shetty Circle	2984	3905	257	315
KSRTC Bus Stand to KSRTC Bus Stand	5209	6090	524	616

The proposed Junctions Improvement at Clock Tower Junction has been shown in drawing WTE_2292_00_R_5.01 - PROPOSED JUNCTION IMPROVEMENT CLOCK TOWER INTERSECTION ROUNDABOUT (SHEET 1 OF 1) in section 9 of the Report

5.2.7. Recommendations for Intersection Design at A B Shetty Junction

A B Shetty Circle is a four legged intersection and based on the average daily traffic and peak hour traffic at A B Shetty Intersection as mentioned in table 5-3, it is considered for designing for improvement as regular signalized intersection and signalized roundabout. Since the capacity of roundabout is less as compared to regular signalized intersection we hereby recommend regular signalized intersection to be developed at this junction.

Table 5-3: Average daily traffic and peak hour traffic at A B Shetty Intersection

A B Shetty Circle	Average Daily Traffic		Peak Hour Traffic	
	Vehicles	PCU	Vehicles	PCU
Clock Tower Circle To SBI	19546	33842	1834	2698
Clock Tower To Corporation Bank	1184	1497	1514	1923
Corporation Bank to SBI	6899	10640	598	717
Corporation Bank To Clock Tower	11362	18223	977	1148
SBI to Corporation Bank	2865	4306	232	261
SBI to Clock Tower Circle	4717	7524	402	451

The options considered for proposed Junctions Improvement at A B Shetty Circle Junction has been shown in drawing WTE_2292_00_R_5.02- PROPOSED JUNCTION IMPROVEMENT A. B. SHETTY INTERSECTION ROUNDABOUT (SHEET 1 OF 1) and WTE_2292_00_R_5.03- PROPOSED JUNCTION IMPROVEMENT A. B. SHETTY INTERSECTION SIGNALIZED in section 9 of the Report

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 Nehru Maidan 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 Maidan Road, including Clock Tower Junction and A B Shetty Junction

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. *Urban Design Features*

Salient Features of Smart Roads for Maidan Road:

1. Road Cross Section:
    a. **Carriage way:** As per the traffic analysis, 3 lane carriage way with 3.1m lane width of each lane have been proposed at Maidan road.
    b. **Parking Lane:** The parking lane of 2.5m is proposed at the Maidan side. 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 to discourage on surface crossing for pedestrian safety.

Table 6-1 below provide details of Maidan Road – Existing Details and Carriageway Recommendations as per IUT

Table 6-1: Maidan Road – Existing Details and Carriageway Recommendations as per IUT

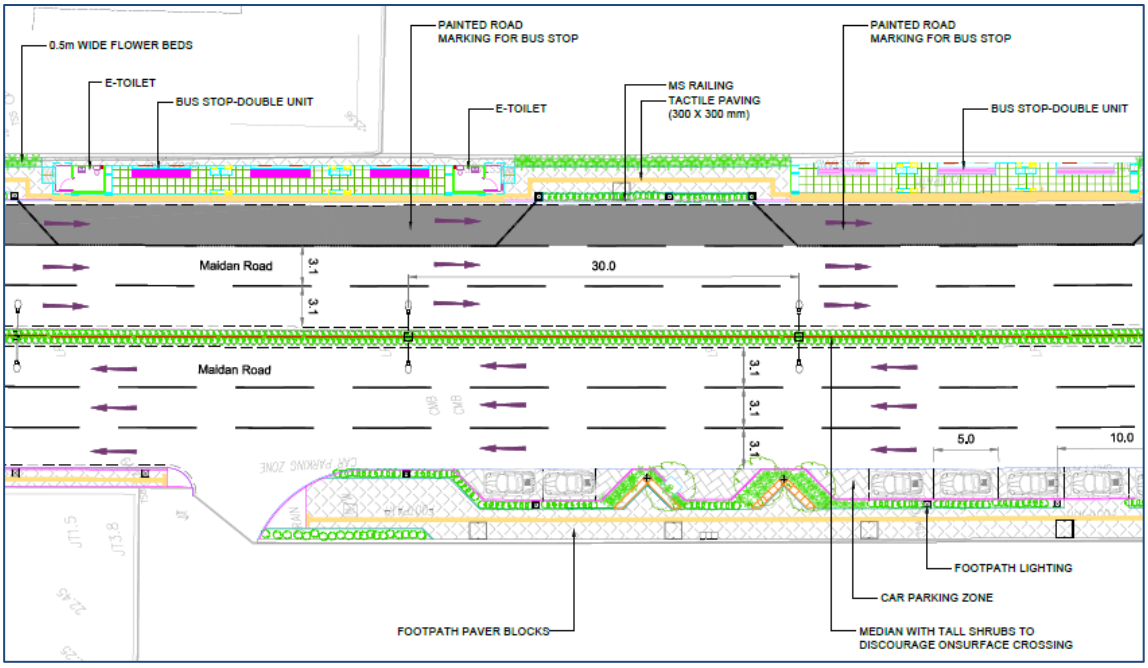
				Recommendations as per IUT				
S.no.	**Road details**	**Road (Length)**	**ROW (m)**	**Median**	**No. of Lanes with Road markings**	**Bus Lane**	**Parking Lane**	**Footpaths**
				PHYSICAL FEATURES				
1	MAIDAN ROAD (HAMPANKATTA CIRCLE \ CLOCK TOWER TO A B SHETTY CIRCLE	541.092	27.10m (min) to 29.50m (max.)	1m	3 lanes of 3.1m width	3.1m painted bus lane	2.3m	3m (including the curbs) with min 1:20 gradient

2. Pedestrian Facilities and Smart Elements:

a. **Footpath:** Wide footpath of minimum width 2.5m to maximum 4m are proposed taking into consideration the pedestrian count on this road .

b. **Barrier free design:** Tactile paving is proposed at the centre of the footpath throughout the stretch of 500m for differently abled people. Curb ramps are present at the property entrances and parking bays for wheel chair access. Audio visual signals for blind people have been proposed at the pedestrian crossing at AB Shetty circle.

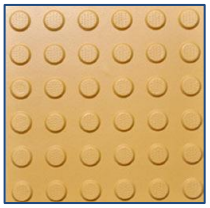
c. **Bollards:** Bollards are proposed at the property entrances and parking bays in order to avoid two wheeler movements on the footpath.



d. **Footpath lighting:** Pole lights are proposed at a distance of 10m c/c for illumination of footpath for pedestrian safety and security.

e. **Street furniture:** As Nehru Maidan is present along the Maidan Road, the footpath adjacent to Maidan side, have been designed as

recreational corridor. A continuous jogging track is proposed along the Maidan. Also some interactive seating spaces, benches, children play equipment are proposed along the footpath. Dustbins, signages like parking sign, stop sign, pedestrian crossing, bus stop are proposed at proper locations.



f. **Continuous corridors of planter beds** are proposed at the edge of the footpath in order to discourage on surface crossings.

g. **Table top crossing:** Table top crossing is proposed at A B Shetty circle so as to have a smooth pedestrian movement and subsequently resulting into reduction of speed of the vehicles at the junction.

h. **Bus stop:** The bus stops are clustered so as to organize the cluttered bus lane. 3 clusters are proposed having 3 bus stops in first 2 clusters and 2 bus stops in the last cluster.

i. **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 6-2: Maidan Road – Proposed Smart Features

S.no.	Road details	Utility duct	Bus shelter with E-toilet	LED lights	Street furniture like signages, dustbins, benches, advertisement boards	Smart poles	Audio-visual signals
1	MAIDAN ROAD (HAMPANKATTA CIRCLE \ CLOCK TOWER TO A B SHETTY CIRCLE	√	√	√	√	√	√

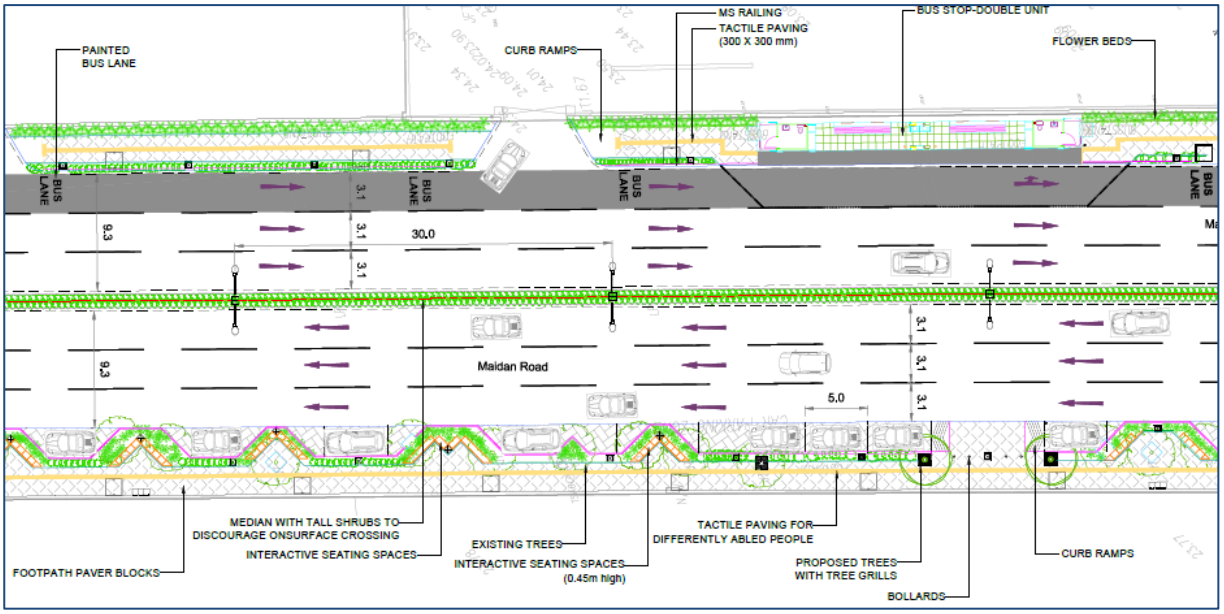


Table 6-3 below provide details of various Pedestrian Facilities proposed along the Maidan Road

Table 6-3: Maidan Road – Proposed Pedestrian Facilities

S.no.	Road details	Road side plantation with tree grates	Pedestrian crossing	Tactile paving and wheel chair access	Subways or FOBs	Parking for Auto-rickshaws
		PEDESTRIAN FACILITIES				
1	MAIDAN ROAD (HAMPANKATTA CIRCLE \ CLOCK TOWER TO A B SHETTY CIRCLE	√	√	√	√	√

The following drawings enclosed in section 10 of the Report provides details of various Urban Design Proposals along Maidan Road and at Clock Tower Junction as well as A B Shetty Junction

WTE_2292_00_L_1.01	URBAN DESIGN AND LANDSCAPE PROPOSAL FOR MADIAN ROAD (SHEET 1 OF 2)
WTE_2292_00_L_1.01	URBAN DESIGN AND LANDSCAPE PROPOSAL FOR MADIAN ROAD (SHEET 2 OF 2)
WTE_2292_00_L_3.01	RAILING DETAILS OF MADIAN ROAD (SHEET 1 OF 1)
WTE_2292_00_IL_1.01	URBAN DESIGN PROPOSAL FOR CLOCK TOWER INTERSECTION (SHEET 1 OF 1)
WTE_2292_00_IL_1.02	URBAN DESIGN PROPOSAL FOR A B SHETTY INTERSECTION (SHEET 1 OF 1)

6.1.2. 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

Maidan road is 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.

Further we have also enhanced seating long the Nehru Maidan footpath to facilitate social interaction and reduce the surface runoff.

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.

Intersections are the most complex transportation elements. Because there is crossing traffic and numerous potential turning movements, intersections account for a majority of all traffic accidents. For this reason landscape and aesthetics development in an intersection requires careful consideration to ensure that safety is not compromised. Issues affecting aesthetics and design of intersections are:

- Visibility

- High concentration of visual information in the form of signage, signals, off-site activities, and advertising
- Complex patterns of shade, shadow, and reflection
- Placement of design elements
- Pedestrian movements (including bicycle)
- Future off-site development
- Accessibility
- Aesthetics of intersections

Above to should be considered while laying the landscape scheme for the intersection

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

Since traffic slows at intersections, development and design detail are more visible and appropriate aesthetic treatment becomes more important.

The following drawings enclosed in section 10 of the Report provides details of various Landscape Proposals along Maidan Road and at Clock Tower Junction as well as A B Shetty Junction

WTE_2292_00_L_1.02	LAYOUT AND FINISHES FOR LANDSCAPE OF MAIDAN ROAD (SHEET 1 OF 2)
WTE_2292_00_L_1.02	LAYOUT AND FINISHES FOR LANDSCAPE OF MAIDAN ROAD (SHEET 2 OF 2)
WTE_2292_00_L_1.03	PLANTING PLAN OF MAIDAN ROAD (SHEET 1 OF 3)
WTE_2292_00_L_1.03	PLANTING PLAN OF MAIDAN ROAD (SHEET 2 OF 3)
WTE_2292_00_L_1.03	PLANTING PLAN OF CLOCK TOWER INTERSECTION (SHEET 3 OF 3)
WTE_2292_00_L_2.01	URBAN DESIGN LANDSCAPE PROPOSAL FOR CLOCK TOWER INTERSECTION ROUNDABOUT (SHEET 1 OF 1)
WTE_2292_00_L_2.02	URBAN DESIGN LANDSCAPE PROPOSAL FOR A. B. SHETTY INTERSECTION ROUNDABOUT (SHEET 1 OF 1)
WTE_2292_00_L_3.01	RAILING DETAILS OF MADIAN ROAD (SHEET 1 OF 1)
WTE_2292_00_L_4.01	LANDSCAPE CROSS SECTION OF MAIDAN ROAD (SHEET 1 OF 1)
WTE_2292_00_L_5.01	TYPICAL SEAT DETAIL OF MAIDAN ROAD (SHEET 1 OF 1)

6.1.3. Centralized street lighting control

MSCL has proposed to change existing conventional street lighting by LED fixtures for reducing energy consumption a well as to reduce impact on environment by conventional lamps in pan Mangaluru under Smart City mission. MSCL has decided to convert present Maidan Road, 500 m long on the priority as "smart road". Existing street lighting fixtures on the median of this road will be replaced by LED lighting fixtures. While doing so, existing poles in bad shape will be replaced by new poles.

LED lighting fixture will be operated by astronomical timer switch. These lights will have dimming facility which will result in further saving of electrical energy.

Smart LED street lighting system adopts centralized control system. 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.

Smart Lighting

For Maidan Road, The 9 m lighting poles are provided only in the median with 2 x 175 w LED lighting fixtures. To illuminate the footpaths, 4 m high lighting poles with 40 w LED lighting fixtures has been considered.

Salient features of LED street lighting

- 2 x 180 W LED lights on the median
- 1 x 25 W LED lights for footpath illumination
- Main supply to Maidan Road Street lighting though a Lighting Panel located at one end of the road.
- Street lights will be operated by astronomical time switch with a manual switching facility.

Outgoing circuits of the Lighting Panel shall have "Earth Leakage" protection along with over current for the safety of the public.

In addition, both sides footpaths will be provided by 4 m high post lamp LED fixtures, 25 W at an interval of 10 m.

Life of (burning hours) this lamp is much less than LED lamps.

Adopting use of LED lamps for illumination has advantage because of low electricity requirement. Burning hours of LED lamps are much higher as compared to FTL and sodium vapour lamps. This reduces maintenance cost.

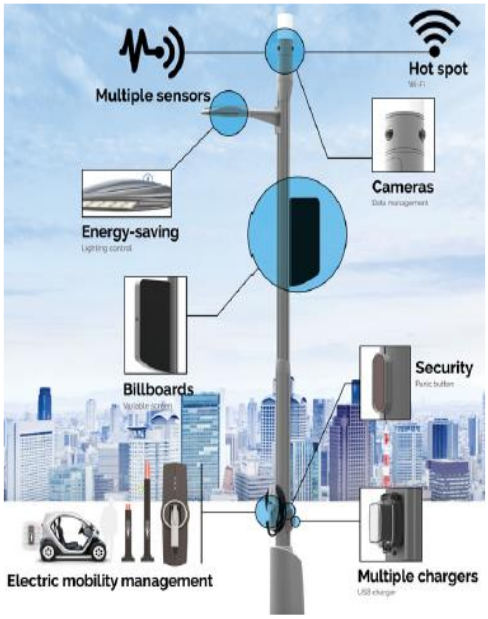
The following drawings enclosed in section 10 of the Report provides details of Street Light Control Panel of Maidan Road

WTE_2292_00_E_1.01	STREET LIGHT CONROL PANEL OF MAIDAN ROAD

6.1.4. 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 radio tower at AB Shetty Circle



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 Signalling**
  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
  - E-Challan (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 E-Challan 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)**
  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. Timeline for execution

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

7.1. Construction Phase

The construction phase is considered as 1 year

7.2. Defect Liability

The Defect Liability period is considered as 2 Years

7.3. Maintenance Period

The Maintenance Period is considered as 3 years

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

8. 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	Up gradation 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 up gradation 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 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.

9. DRAWINGS

Table 9-1 below provide details of various Pedestrian Facilities proposed along the Maidan Road

Table 9-1: 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 (SHEET 1 OF 1)
3	WTE_2292_00_R_1.03	EXISTING CROSS SECTION OF MADIAN ROAD (SHEET 1 OF 1)
4	WTE_2292_00_R_2.01	PLAN AND PROFILE OF MADIAN ROAD (SHEET 1 OF 2)
5	WTE_2292_00_R_2.01	PLAN AND PROFILE OF MADIAN ROAD (SHEET 2 OF 2)
6	WTE_2292_00_R_3.01	TYPICAL CROSS SECTIONS OF MADIAN ROAD (SHEET 1 OF 1)
7	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 1 OF 8)
8	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 2 OF 8)
9	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 3 OF 8)
10	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 4 OF 8)
11	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 5 OF 8)
12	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 6 OF 8)
13	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 7 OF 8)
14	WTE_2292_00_R_3.02	CROSS SECTIONS OF MADIAN ROAD (SHEET 8 OF 8)
15	WTE_2292_00_R_4.01	ROAD SIGNAGES - PLAN AND ROAD MARKING OF MADIAN ROAD (SHEET 1 OF 1)
16	WTE_2292_00_R_5.01	PROPOSED JUNCTION IMPROVEMENT CLOCK TOWER INTERSECTION SIGNALIZED (SHEET 1 OF 1)
17	WTE_2292_00_R_5.02	PROPOSED JUNCTION IMPROVEMENT A. B. SHETTY INTERSECTION SIGNALIZED (SHEET 1 OF 1)
18	WTE_2292_00_R_6.01	ROAD SIGNAGES AND MARKING DETAILS (SHEET 1 OF 1)
19	WTE_2292_00_L_1.01	URBAN DESIGN AND LANDSCAPE PROPOSAL FOR MADIAN ROAD (SHEET 1 OF 2)
20	WTE_2292_00_L_1.01	URBAN DESIGN AND LANDSCAPE PROPOSAL FOR MADIAN ROAD (SHEET 2 OF 2)
21	WTE_2292_00_L_1.02	LAYOUT AND FINISHES FOR LANDSCAPE OF MAIDAN ROAD (SHEET 1 OF 2)

22	WTE_2292_00_L_1.02	LAYOUT AND FINISHES FOR LANDSCAPE OF MAIDAN ROAD (SHEET 2 OF 2)
23	WTE_2292_00_L_1.03	PLANTING PLAN OF MAIDAN ROAD (SHEET 1 OF 3)
24	WTE_2292_00_L_1.03	PLANTING PLAN OF MAIDAN ROAD (SHEET 2 OF 3)
25	WTE_2292_00_L_1.03	PLANTING PLAN OF CLOCK TOWER INTERSECTION (SHEET 3 OF 3)
26	WTE_2292_00_L_2.01	URBAN DESIGN LANDSCAPE PROPOSAL FOR CLOCK TOWER INTERSECTION ROUNDABOUT (SHEET 1 OF 1)
27	WTE_2292_00_L_3.01	RAILING DETAILS OF MADIAN ROAD (SHEET 1 OF 1)
28	WTE_2292_00_L_4.01	LANDSCAPE CROSS SECTION OF MAIDAN ROAD (SHEET 1 OF 1)
29	WTE_2292_00_L_5.01	TYPICAL SEAT DETAIL OF MAIDAN ROAD (SHEET 1 OF 1)
30	WTE_2292_00_E_1.01	STREET LIGHTS CONTROL PANEL OF MAIDAN ROAD (SHEET 1 OF 1)
31	WTE_2292_00_A_1.01	PLAN AND SECTION OF BUS SHELTER (SHEET 1 OF 1)
32	WTE_2292_00_U_1.01	PROPOSED AND EXITING UTILITY SERVICES OF MADIAN ROAD (SHEET 1 OF 1)

10. COST ESTIMATES

The section of the report deals with the Cost Estimates for Nehru Maidan Smart Roads

10.1. Assumptions

- SOR rates as per Mangalore Circle SOR
- 12% weightage has been added to SOR rates of Mangalore Circle PWD Circle
- Non SOR Items based on Vendor Quotations (Market Rate)
- ICT Package will be floated as separate tender, hence not to be considered in smart road tender cost

10.2. Summary of Estimate

Summary of the estimate is as stated in tale 10-1 below:

Table 10-1: Maidan Road – Proposed Pedestrian Facilities

Grand Summary for Maidan Road

Sr. No.	Description	Cost In INR
1	Road and Junction Pavement and Bus Shelter	33320080
2	Footpath and Parking	11494097
3	Storm Water Drainage	1811215
4	Water Supply	622869
5	Street Lighting	6413251
6	Hardscape and Landscape	3995631
	Total	**57,657,143**
	Contingency @ 3%	1,729,714
	O and M Cost @ 10% of Total Cost	5,765,714
	Misc Cost	47,428.00
	Grand Total	**65,200,000**

10.3. Detailed BOQ

Enclosed below are the detailed BOQ

Grand Summary for Maidan Road

Description	Cost In INR
Road and Junction Pavement and Bus Shelter	33320080
Footpath and Parking	11494097
Storm Water Drainage	1811215
Water Supply	622869
Street Lighting	6413251
Hardscape and Landscape	3995631
Total	**57,657,143**
Contingency @ 3%	1,729,714
O and M Cost @ 10% of total Cost	5,765,714
Misc Cost	47,428.00
Grand Total	**65,200,000**

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 DRWINGS FOR PLANTING DETAIL

SOME SPECIFIC SPECIFICATIONS CONSIDERED ARE AS MENTIONED BELOW

LIGHT FIXTURE FOR FOOTPATH

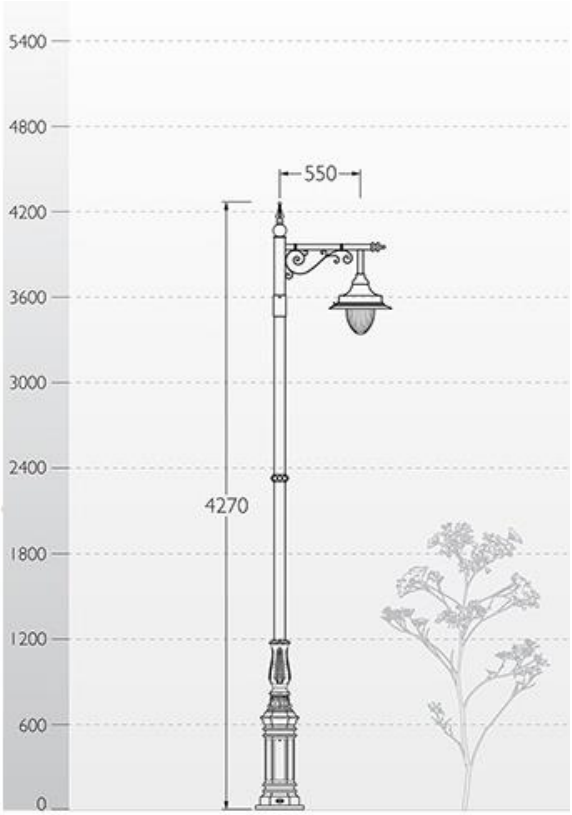
NEHRU ROAD

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:

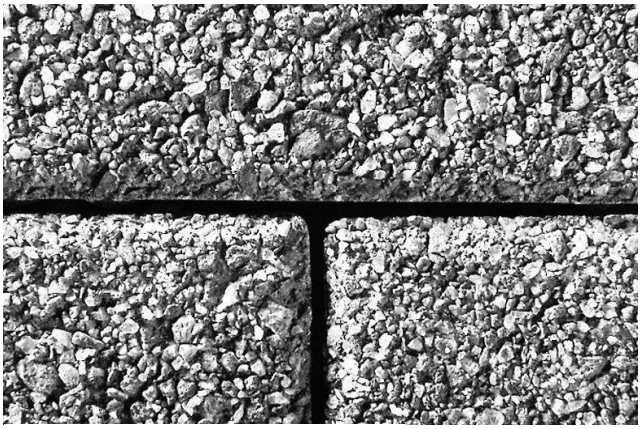


Figure 1 washed finish

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. This product can beinstalled 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.
- 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 ½ 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 angel 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

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.