TRAFFIC SIMULATION WITH PTV VISSIM FOR EFFICIENT JUNCTION DESIGNS IN HUBLI-DHARWAD

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SPECTRUM TECHNO-CONSULTANTS

- Established in 2004 by highly experienced professionals in order to bridge the gaps existing in specialised infrastructure consultancy sector
- Extensive work in the transportation and power sector
- Completed more than 200 projects in last 12 years
- Robust organization structure with highly qualified professionals leading functional teams

Areas of Expertise

Transportation	• Roads, Highways and Bridges • Flyovers, RoBs, Metro, Monorails systems • Aviation Infrastructure • Railways, Railway bridges
Power	• Cooling Towers and Chimneys • Water Management Systems • Ash and Coal Handling Systems • Mini Hydro-Electric Plants
Ports And Maritime Structures	• Quay walls • Jetties, Wharfs and Break Waters • Berthing Platforms • Dry Docks
Water Resources	• Water Intake Structure • Large Pump Houses including Concrete Volute • Water Treatment, Conveyance and Distribution • Storage Systems
Nuclear safety Related Structures	• Nuclear Reactor Buildings, Containment Structures • Spent Fuel Storage Bays & other facilities • Seismic qualification & retrofitting
Other Buildings	• Industrial Facilities • Commercial Facilities • Townships

Services Matrix

Pre-Engineering Services

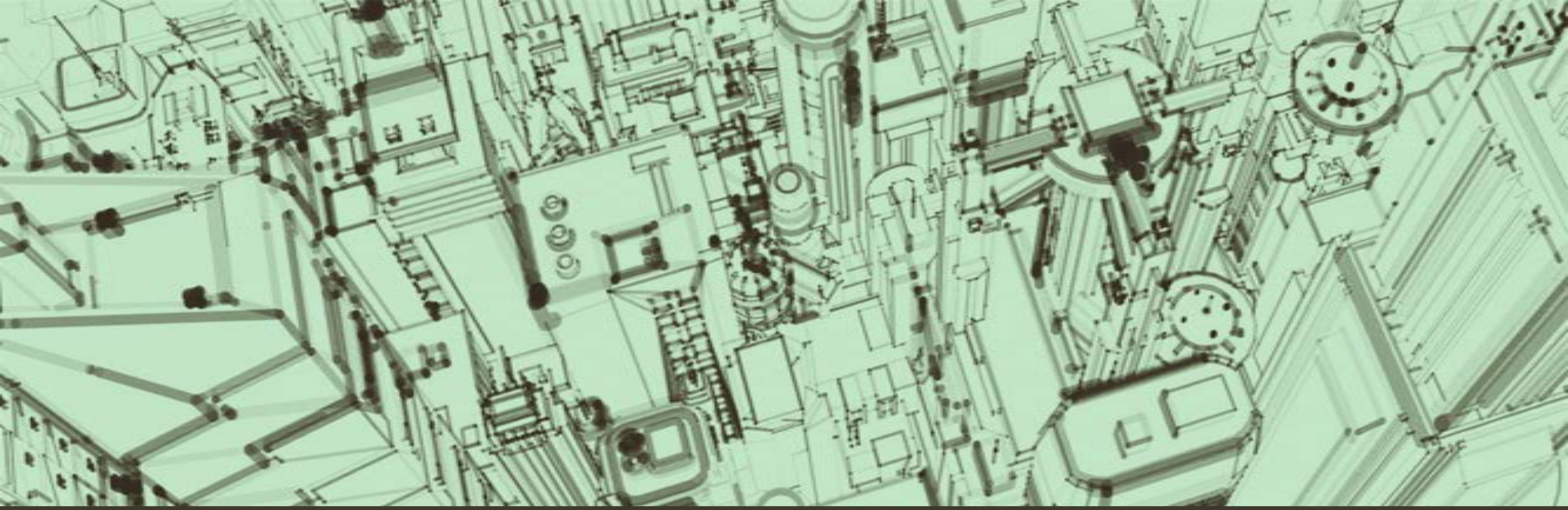
- Feasibility Studies and Engineering Surveys
- Detailed Project Report
- Concept Planning
- Cost Estimations & financial modelling
- Procurement Assistance

Design Engineering Services

- Architectural Design
- Structural Design
- Utility Design
- Design Review & Proof Checking

Project Management Services

- Contract Management
- Construction Supervision
- Technical Audit
- Dispute Resolution
- Quality and Safety Management



HUBLI – DHARWAD: URBAN INTERSECTIONS

IMPROVEMENTS AND REJUVENATION

LOCATIONS OF THE 7 NOMINATED INTERSECTIONS

Map 1: Three nominated junctions in Dharwad depicted in yellow.

DHARWAD

1. DIMHANS CIRCLE (MENTAL HOSPITAL)
2. OLD DSP CIRCLE
3. JUBILEE CIRCLE

Map 2: Four nominated junctions in Hubballi depicted in yellow.

HUBBALLI

1. RANI CHENNAMMA CIRCLE
2. KAMARIPETH JUNCTION
3. NEW ENGLISH SCHOOL JUNCTION
4. BANKAPUR JUNCTION

NOMINATED JUNCTIONS

DHARWAD:

AS PER ORIGINAL TOR:

1. Jubilee Circle;
2. Old DSP office Circle;
3. DIMHANS Circle (Mental Hospital).

ADDITIONAL SCOPE:

1. Court Circle;
2. NTTF Circle;
3. Bagalkote Petrol Pump (BP) Circle;
4. Kalghatagi Toll Plaza Circle;
5. Gandhi Nagar Circle;
6. Yalakki Shettar Colony Road.

HUBBALLI:

AS PER ORIGINAL TOR:

1. Rani Chennamma Junction;
2. Kamaripet Junction;
3. New English Medium School Junction;
4. Bankapur Junction.

ADDITIONAL SCOPE:

1. Rayyanna Circle
2. Market Road Circle
3. Court Circle
4. Glass House Circle
5. Hosur Circle
6. Vikas Nagar Circle

PROJECT JUNCTIONS

DHARWAD

DHARWAD - Three nominated junctions in yellow as per TOR.

DHARWAD Additional Scope - Six Additional junctions in yellow

HUBBALLI

HUBBALLI - Four nominated junctions in yellow as per TOR.

HUBBALLI Additional Scope – Hosur Junction + Six Additional junctions

CURRENT ISSUES

SEVERE TRAFFIC CONGESTION:

1. THROUGH TRAFFIC, LOCAL ACCESS TRAFFIC, PEDESTRIANS, CYCLISTS – ALL VYING FOR SPACE
2. MORE THAN 200 CONFLICT POINTS.
3. LACK OF MODERN TRAFFIC TREATMENTS AND CONTROLS.
4. LACK OF BASIC PEDESTRIAN FACILITIES.
5. ON-STREET PARKING.

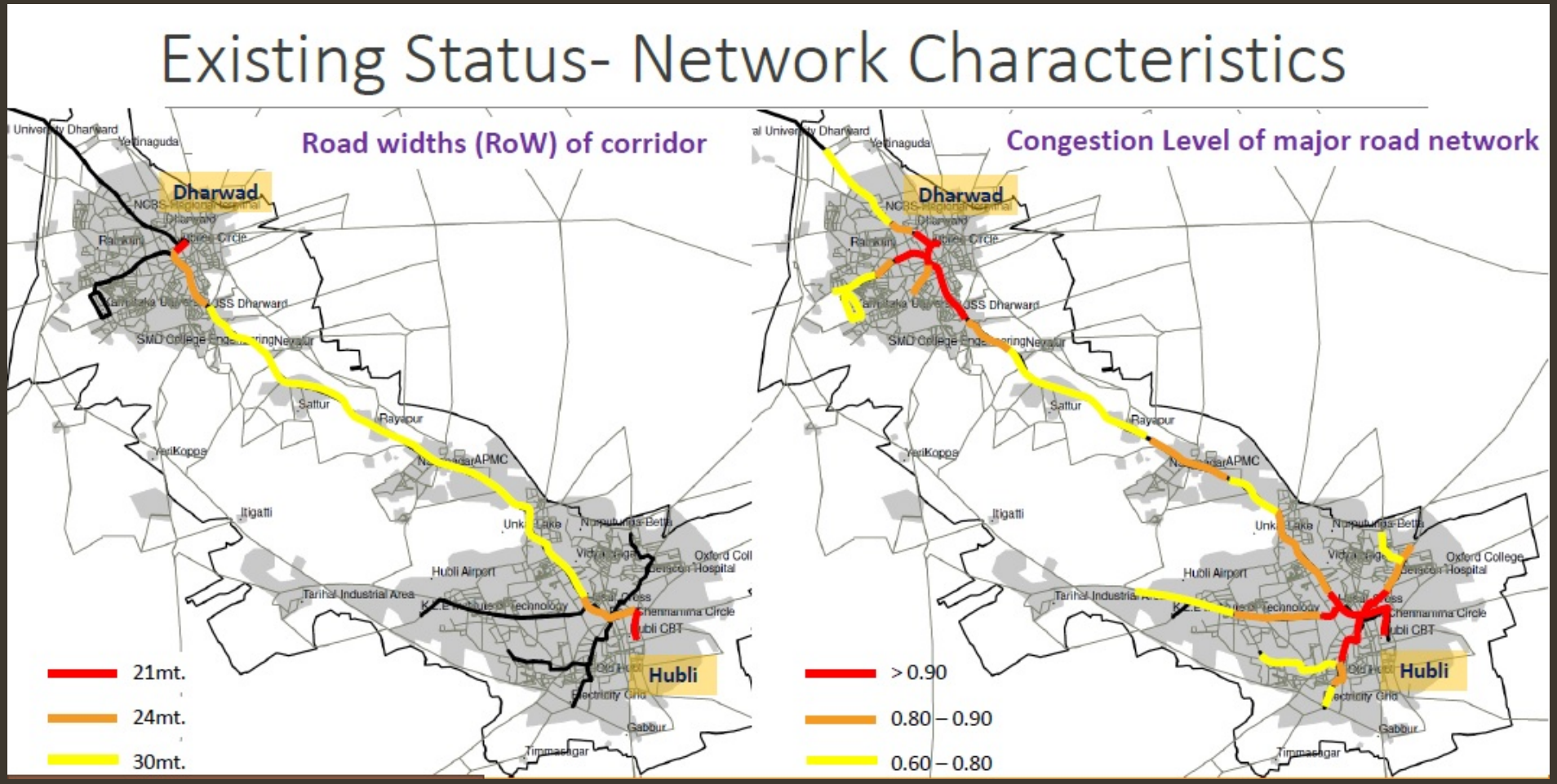
LACK OF STORM WATER MANAGEMENT APPROACH FOR THE INTERSECTIONS.

TRAFFIC DURING BAKRI EID AT RANI CHENNAMMA JUNCTION, HUBLI

The City Development Plan for Hubli-Dharwad 2041 has identified Rani Chennamma Junction & Jubilee Circle as major accident-prone junctions.

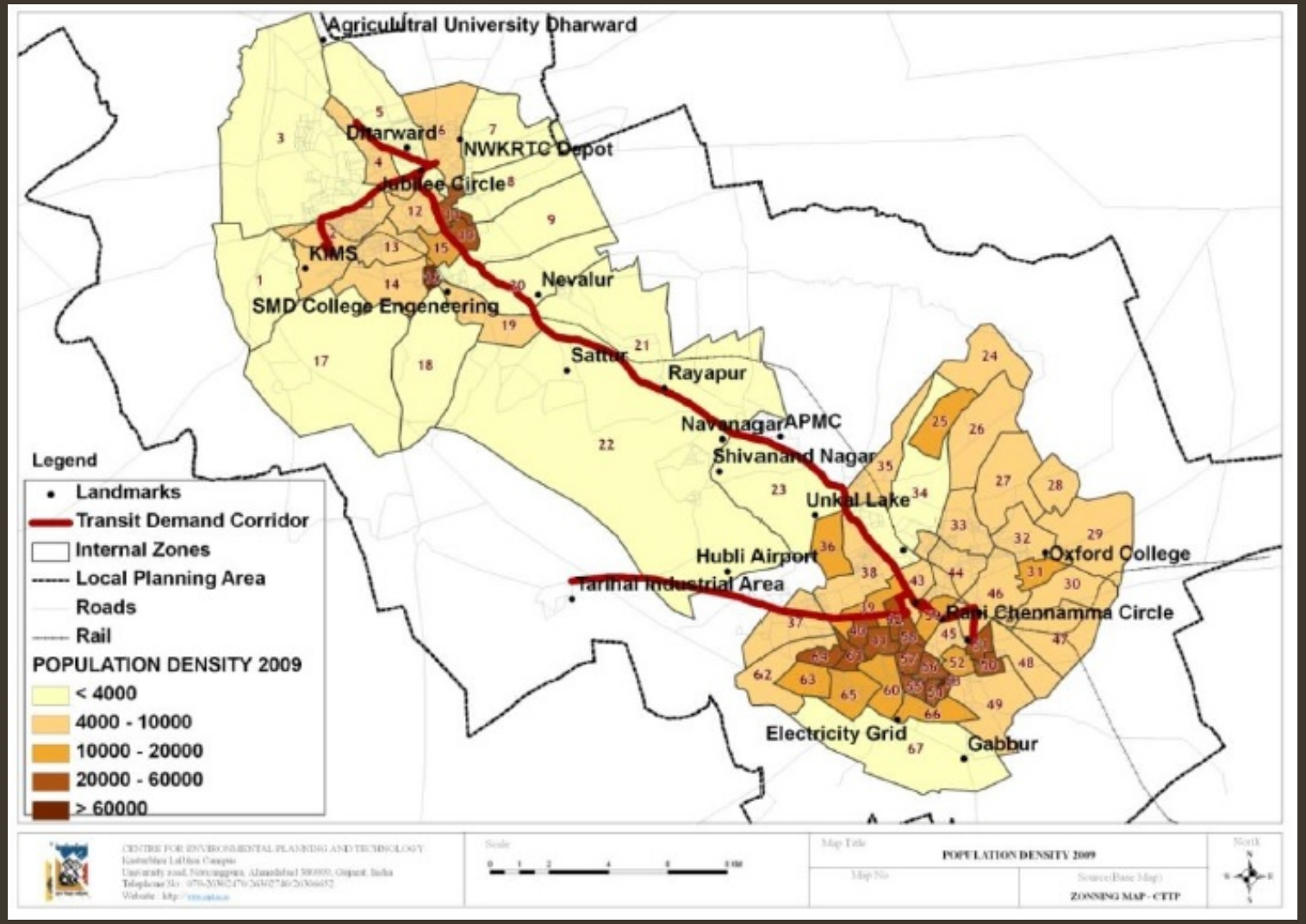
India loses Rs 60,000 crore due to traffic congestion: *Study by Transport Corporation of India and IIM, Calcutta*

EXISTING STATUS



As per the CTTP Report, the Volume by Capacity Ratio (V/C Ratio) calculated on major stretches (even after public transport improvement and construction of ring road) indicates that certain stretches would still have unacceptable values of V/C ratios. Alternatives recommended to control private vehicular movement include measures such as construction of grade-separated structures in these stretches.

POPULATION DENSITY



The effect of the authorities through CDP and CTTS is to contain the city growth within the municipal area. The future growth is likely to be mainly along the corridor between Hubli-Dharwad. The gross densities are expected to go up from the current 47 persons per hectare to 76 persons per hectare.

EVOLUTION OF THE SCHEMES – A RIGOROUS PROCESS

1. FIELD WORK & FIELD DATA
2. STAKEHOLDER IDENTIFICATION
    1. REVIEW OF REPORTS/MASTER-PLANNING STUDIES/LAND-USE PLANS/REPORTS INCLUDING CTTP
3. TRAFFIC STUDIES & STATE-OF-THE-ART VISSIM SIMULATION
4. STAKEHOLDER LIASION – CLIENT AND BRTS
5. SITE VISITS
6. EXISTING AND PROPOSED LAND-USE PLANS
7. HUBLI – DHARWAD COMPREHENSIVE TRAFFIC & TRANSPORTATION PLAN PREPARED BY DULT
8. HUBLI – DHARWAD CITY DEVELOPMENT PLAN FOR 2041 PREPARED BY HDMC
9. BYPASSES
10. CONCEPT DRAWINGS
11. SOCIO-ECONOMIC ASPECTS
12. ENVIRONMENTAL SCREENING
13. R&R SCREENING
14. PRELIMINARY COST ESTIMATES

EVOLUTION OF THE SCHEMES

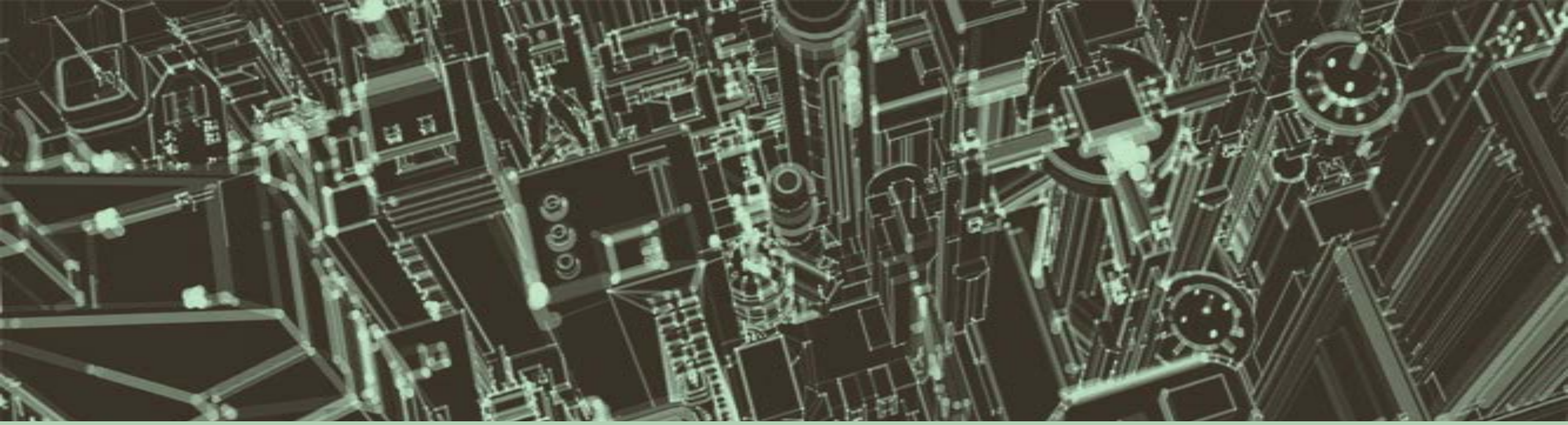
OUR KEY STAKEHOLDER: NH PWD KARNATAKA

1.	**Proposed Smart City Developments**	**Approved Smart City Plan for Hubli-Dharwad**
2.	**DULT (Directorate of Urban Land Transport)**	Comprehensive Traffic and Transport Plan (CTTP) for Hubli - Dharwad
3.	**Hubli – Dharwad Urban Development Authority (HDUDA)**	• Consolidated Proposed Landuse Plan • Zonal Regulations
4.	**Hubli – Dharwad Unified Transport Authority (HDUTA)**	
5.	**Hubli –Dharwad Municipal Corporation**	Revised City Development Plan for Hubli – Dharwad, 2041
6.	**Infrastructure Development Department, KSIIDC-IL&FS Project Development Company (KIPDC)**	Final pre-feasibility report for development of multi-level car parking facilities on PPP format in cities of Karnataka
7.	**HDBRTS**	Implementation and Project Mgt of BRTS
8.	**REVENUE DEPT**	RoW
9.	UTILITIES	Utility related information

KEY STAKEHOLDERS AND REPORTS

ROLES AND RESPONSIBILITIES OF LINE AGENCIES

Agency	Key roles and responsibilities	Tools
HDUDA	• Regulations for Transit Oriented Development • Develop a comprehensive mobility network • Policies/ guidelines for pedestrian and NMT oriented road design • Guidelines for station area design and multimodal integration • Demarcation of public open spaces, ecologically sensitive zones in the Master Plan • Regulations to minimize surface parking • Provide mixed use as a category in the DCR and land use plan • Provision for Transit-supportive uses in a mobility node	Master Plan CTTP DPR Local Area Plans Town Planning Schemes Development Regulations
HDMC	• Sanctioning for buildings to be based on TOD regulations • Maintenance of mobility network infrastructure • Adopt pedestrian and NMT infrastructure guidelines • Adopt Station Area Design guidelines prepared by HDUDA • Demarcate parking zones and management • Demarcate IPT zones and management • Provide necessary infrastructure for public spaces	DPR Stake Holder meetings TP Scheme Acquisition Financial / Construction Incentives
NWKRTC	• Assess the feasibility of BRT feeder systems with HDUDA; identify stops and infrastructure requirements for the same • Manages operations of the BRTS • Manages operations of the Feeder System	CTTP DPR
HDBRTSCL (SPV)	• Implementation of BRTS in Hubli-Dharwad, implementation of TOD demonstration project, overarching co-ordination related to all the urban land transport initiatives within the region	



SPECTRUM'S DESIGN APPROACH

SAFE INTERSECTIONS THAT ARE **FUNCTIONALLY EFFICIENT**, **PEDESTRIAN-FRIENDLY** & **FLEXIBLE**

FLYOVERS OR UNDERPASSES ?

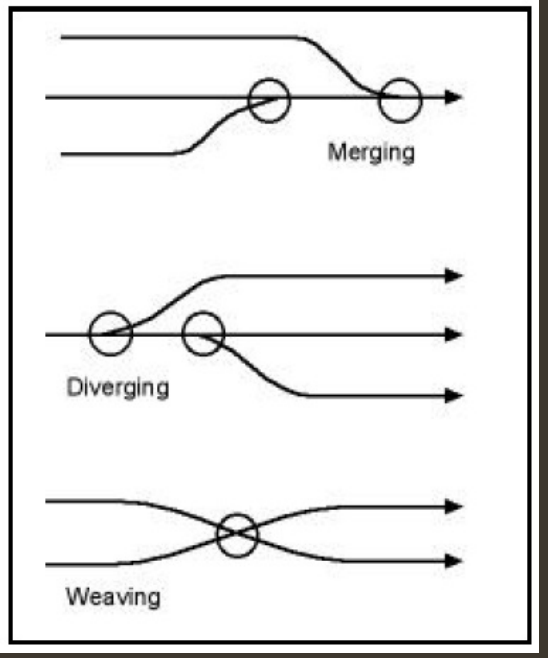
- At all the nominated intersections stipulated in the original TOR, **Vehicular subways** were investigated for the principal major traffic directions identified from the traffic analyses.

Following were some of the adverse impacts and reasons that rendered these unfeasible:

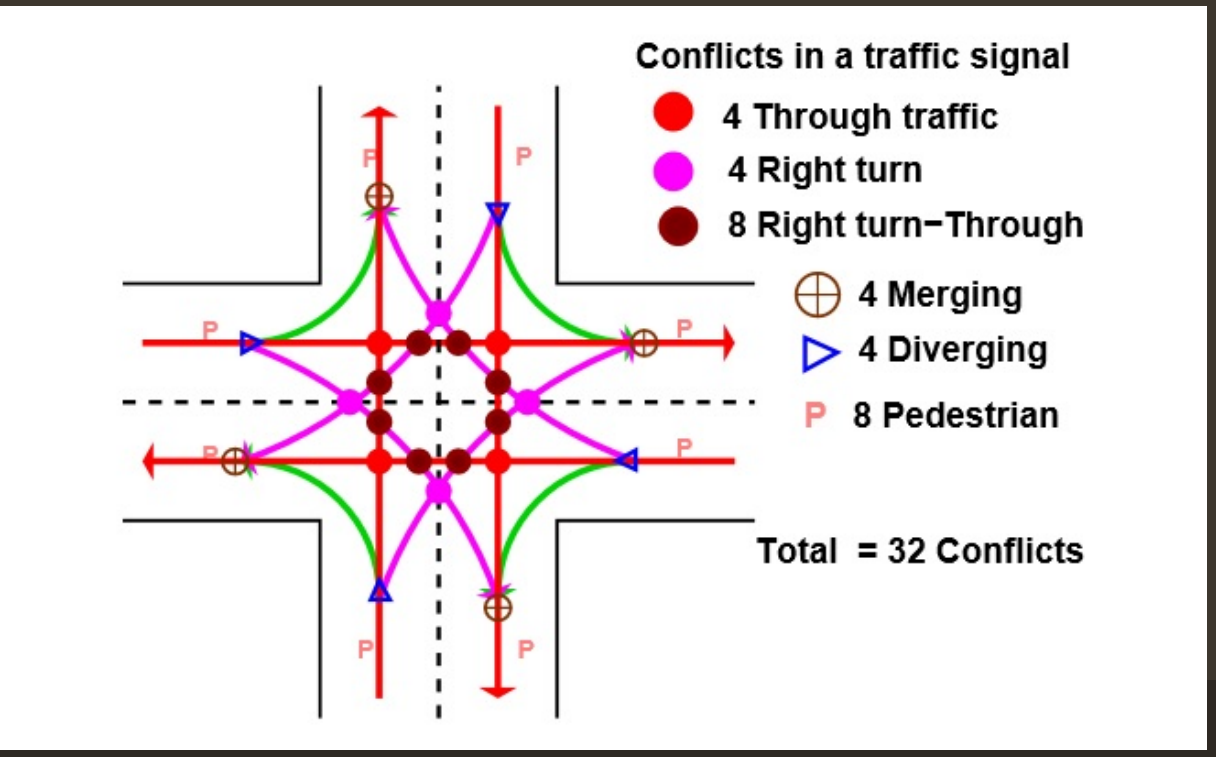
- Constraints on efficient geometrical arrangement for safe and efficient traffic operations – now and into the future;
- Urban space constraints for required carriageway widths, merging and demerging lanes;
- Existing urban buildings in close vicinity and the impact on their foundations;
- Subways investigated for Jubilee Circle (5-legged) and Rani Chennamma Junction (7-legged) do not address the traffic problems and safety/functionality requirements warranted for such dangerous intersections.
- Intersection drainage issues;
- Sight distance and safety issues;
- BRTS proposals

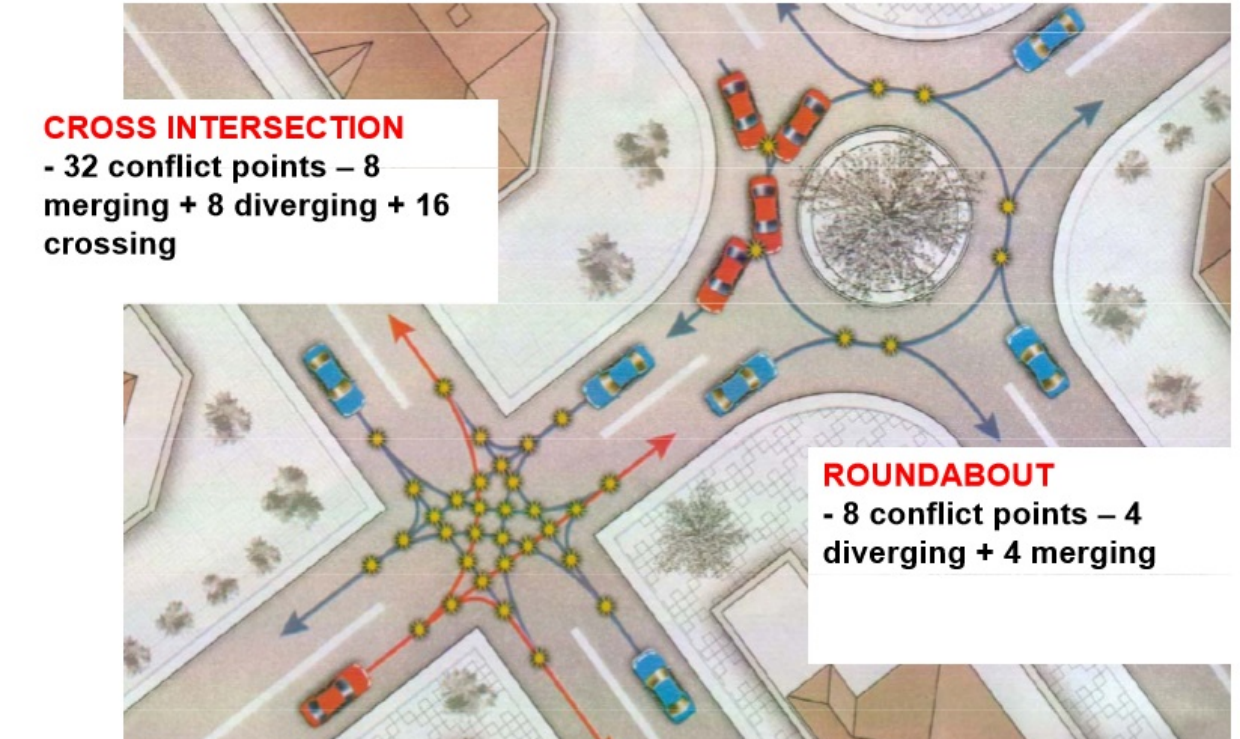
- At-grade intersections always have a potential for accidents due to conflicting crossing and turning vehicular movements, regardless of layout, signing and signalization. By separating the levels of intersecting roadways, both accidents and delays are reduced.
- Considering the above, flyovers as an option was investigated.

SAFETY ASPECTS - CONFLICT POINTS



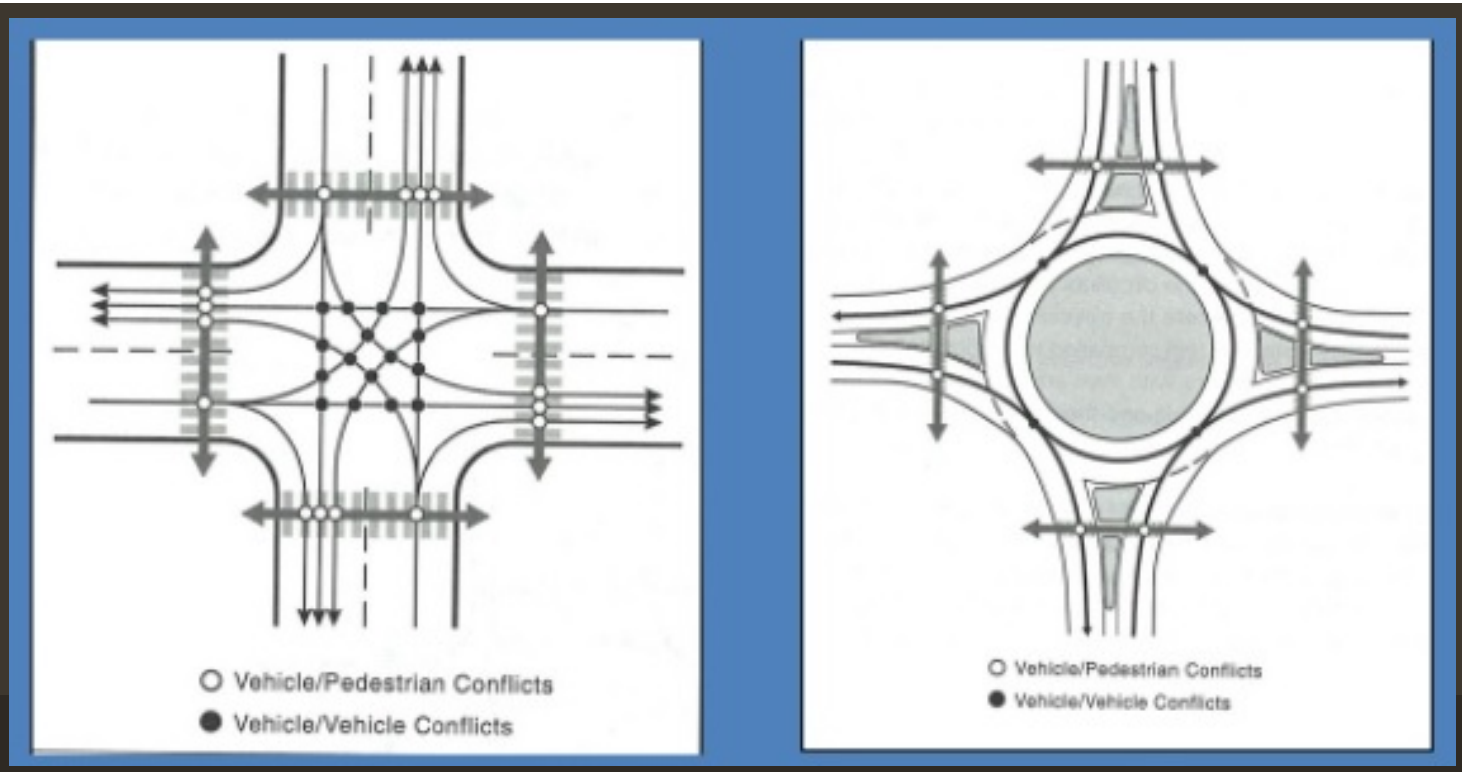
A **conflict point** is the **point** at which a road user crossing, merging with, or diverging from a road or driveway **conflicts** with another road user using the same road or driveway. It is any **point** where the paths of two through or turning vehicles diverge, merge, or cross.





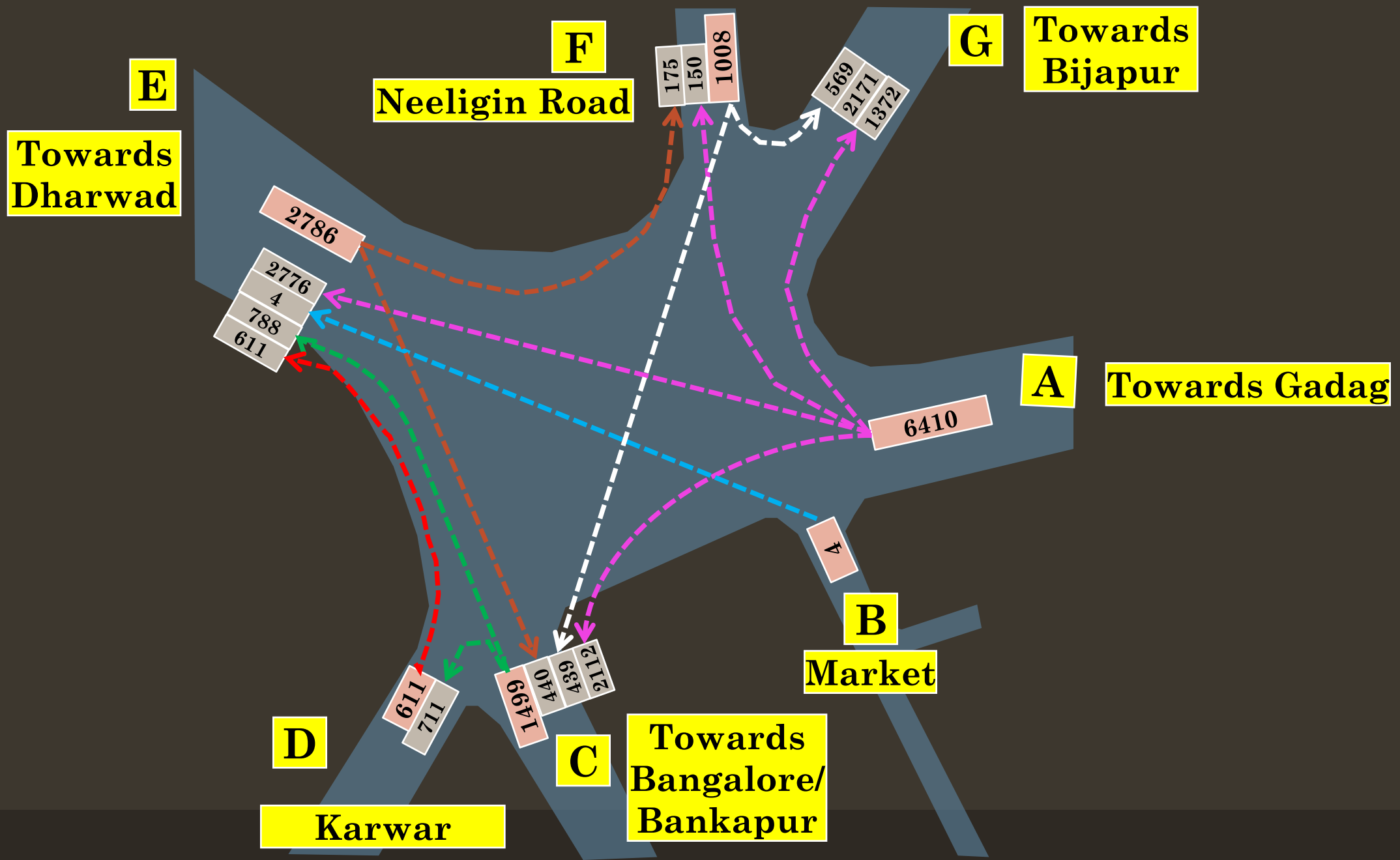
CONFLICT POINTS

Number of intersection legs	Number of conflicts
3	9
4	32
5	80
6	168



RANI CHENNAMMA CIRCLE

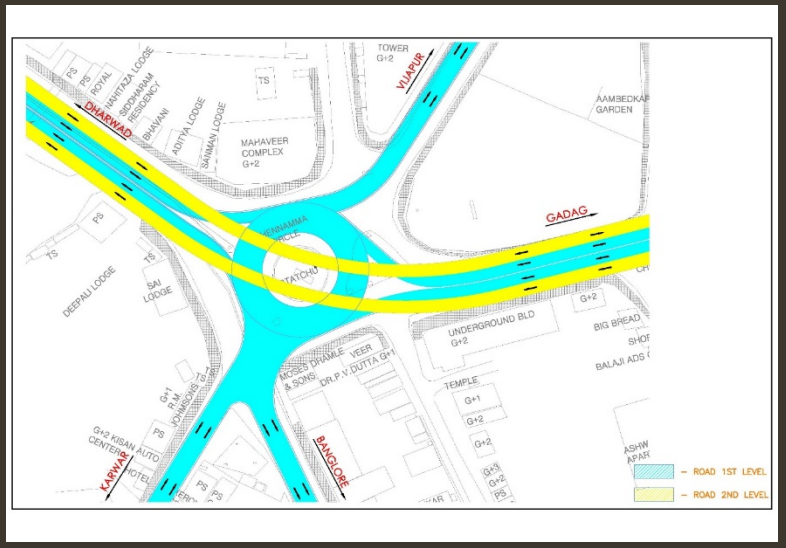
RANI CHENNAMMA CIRCLE – TRAFFIC DISTRIBUTION



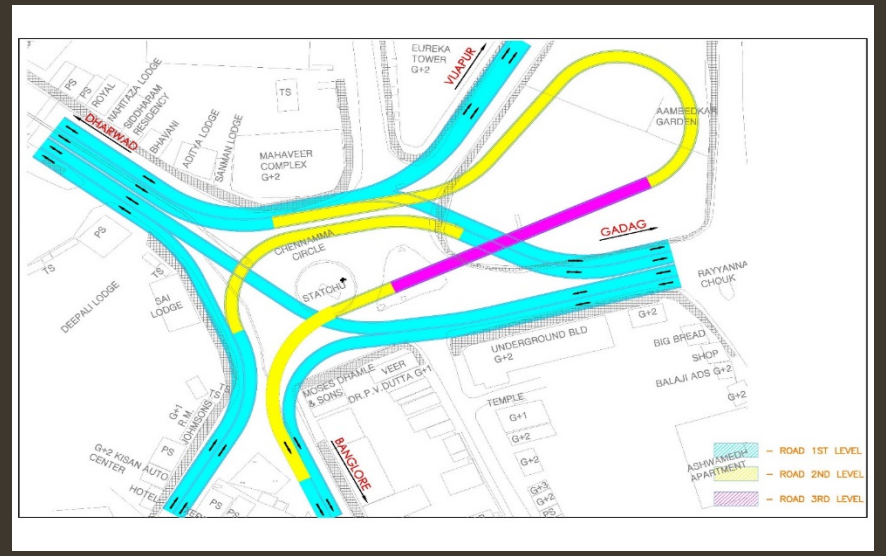
TRAFFIC FORECAST - HUBBALLI

S. No	Intersection Name	Intersection Type	Volume in 2027	Volume in 2037	Traffic Manage Measures
1	Rani Chennamma Circle	7 Legged	17460*	24630*	Elevated Rotary Interchange Proposed and Major directions are lifted up
2	Kamaripeth	4 Legged	6004	8469	Elevated 4 lane – 2 way flyover is proposed
3	New English School	5 Legged	7699	10860	Elevated 4 lane – 2 way flyover is proposed
4	Bankapur Chowk	4 Legged	5943	8383	Elevated 4 lane – 2 way flyover is proposed

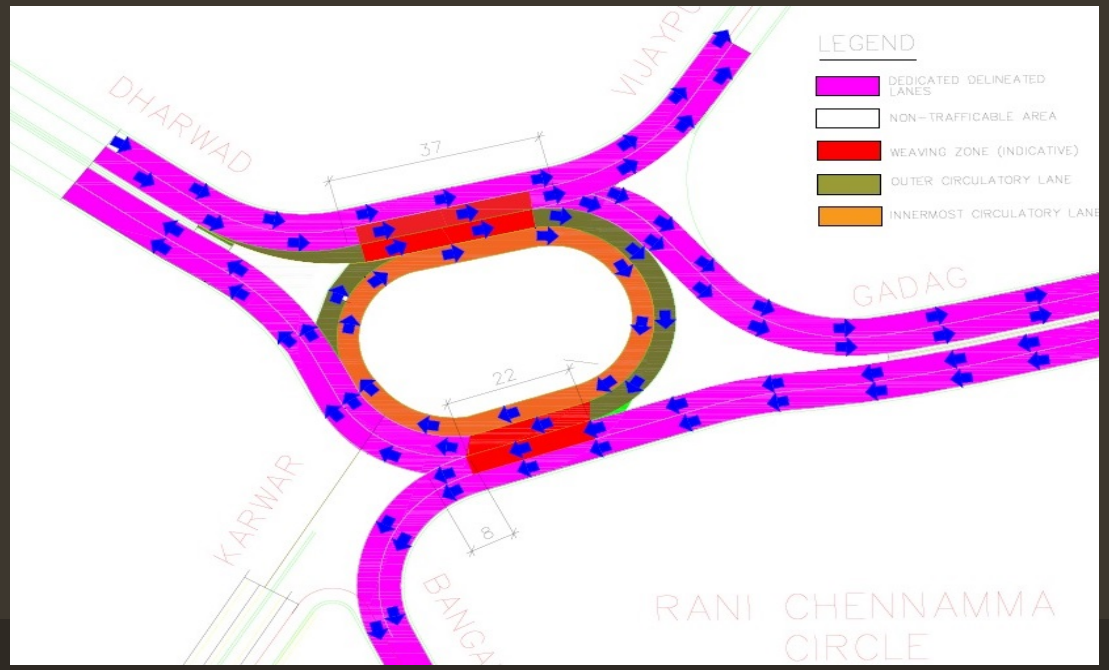
RANI CHENNAMMA CIRCLE - OPTIONS INVESTIGATED



OPTION 1



OPTION 2



OPTION 3

PROPOSED TREATMENTS –
GRADE SEPARATION OF THROUGH TRAFFIC & LOCAL ACCESS TRAFFIC

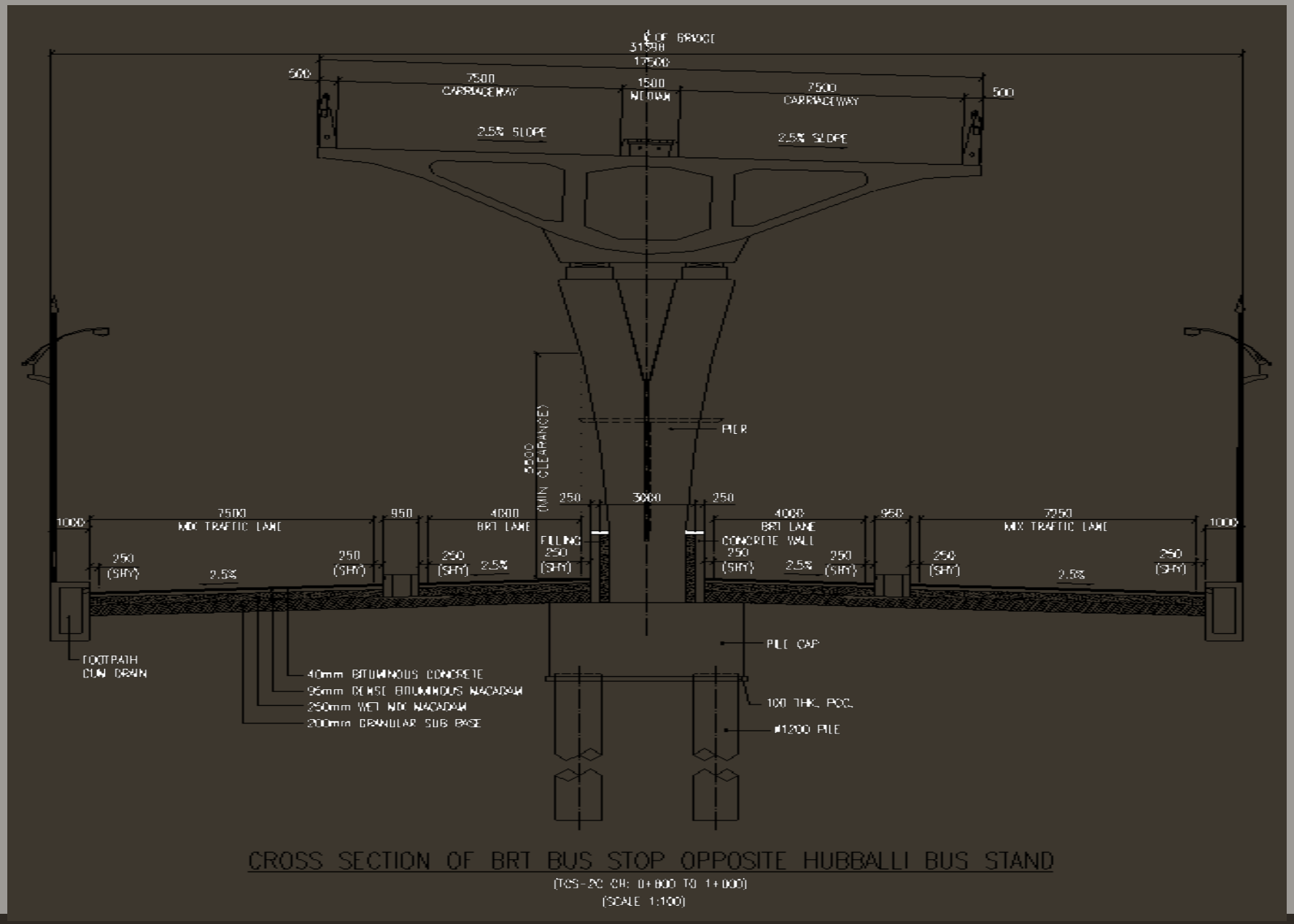
3D VIEW

ELEVATED ROTARY INTERCHANGE FOR THROUGH AND TURNING TRAFFIC

&

AT-GRADE TREATMENTS FOR LOCAL ACCESS TRAFFIC

CROSS SECTION AT BRTS BUS STOP OPP OLD HUBLI BUS STAND

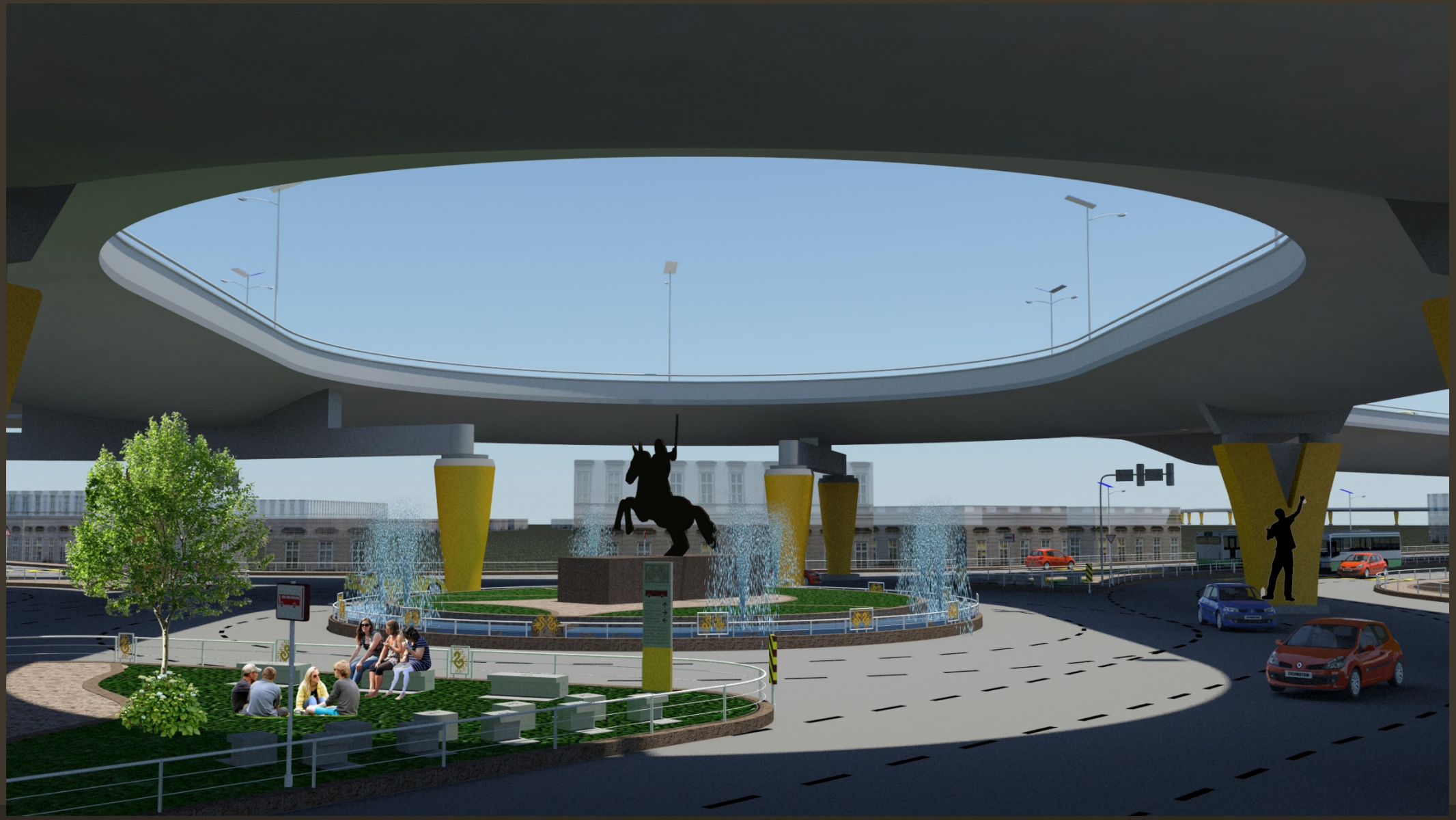


CROSS SECTION OF BRT BUS STOP OPPOSITE HUBBALLI BUS STAND

(TCS-2C CH: 0+800 TO 1+000)

(SCALE 1:100)

ARCHITECTURAL & URBAN INTERVENTIONS



ARCHITECTURAL & URBAN INTERVENTIONS

URBAN ELEMENTS

URBAN ELEMENTS
FOR HUBLI DHARWAD TRAFFIC JUNCTIONS

ISLAND WITH LANDSCAPE, HARDSCAPE & WATERBODY

URBAN FURNITURE (BENCHES, DUSTBINS, DRINKING WATER FOUNTAINS ETC)

SOFTSCAPE WITH CLUSTER PLANTS, SHRUBS, PLANTERS, LAWN ETC

BROWN GRANITE CURB, SAND FINISHED

PAVING (COMBINATION OF ROUGH RED GRANITE, GRASS JOINT PAVERS AND TACTIE FLOORING)

GRAPHICS ON PIERS

TRAFFIC SIGNALS

WATER FOUNTAIN

MS RAILING, COMBINATION OF STANDARD & DESIGN PANELS

DIRECTIONAL, INSTRUCTIONAL, INFORMATION SIGNAGES AND ROAD MARKINGS, ZEBRA CROSSINGS ETC

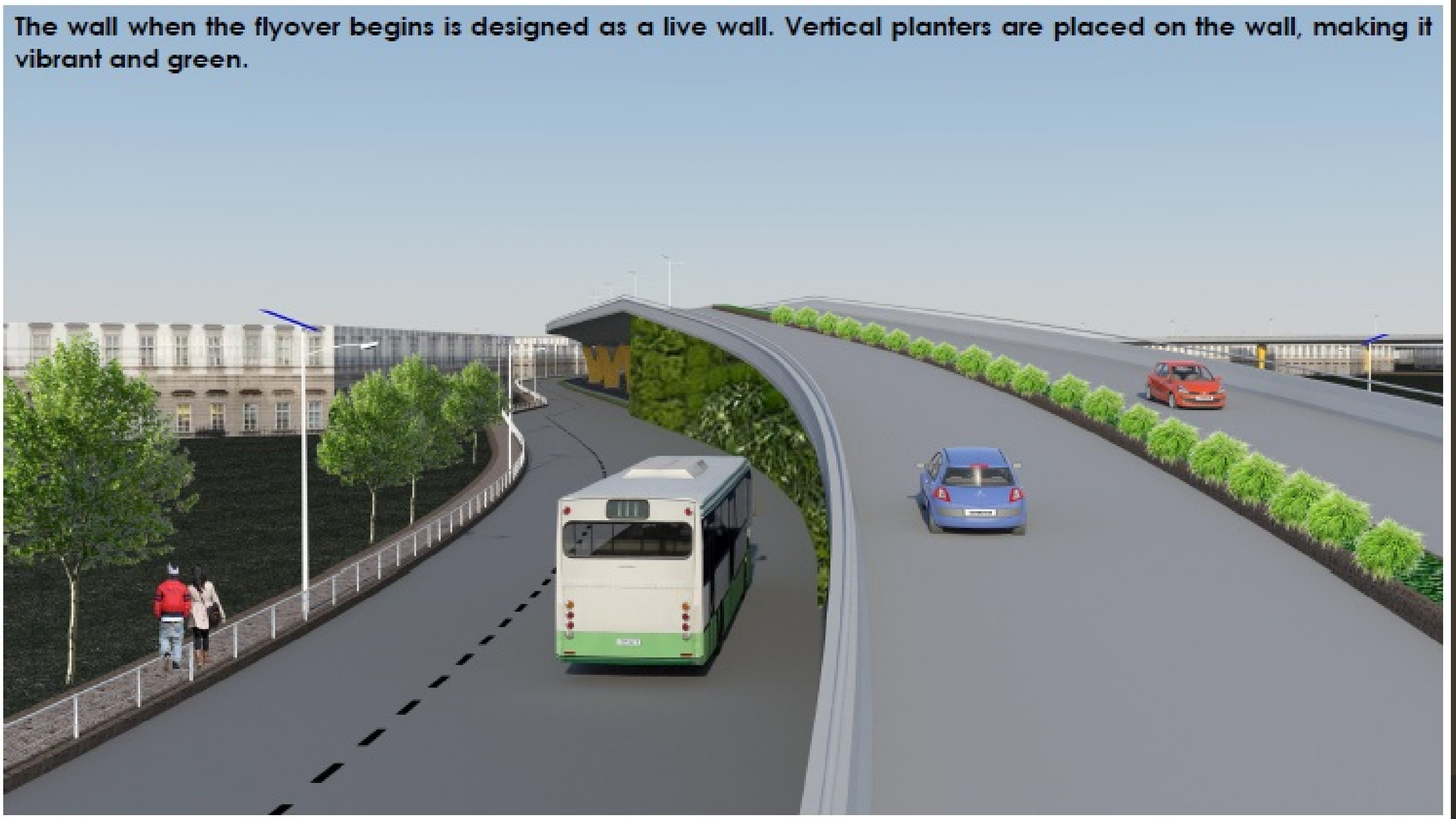
APART FROM ABOVE URBAN ELEMENTS, FOLLOWING ELEMENTS SHOULD BE PROVIDED

- VERTICAL GREENS BELOW FLYOVER SLOPE
- LED+SOLAR STREET LIGHTS, LED BOLLARDS, LED UPLIGHTERS ETC

LIST OF URBAN ELEMENTS

ARCHITECTURAL & URBAN INTERVENTIONS

ARCHITECTURAL & URBAN INTERVENTIONS

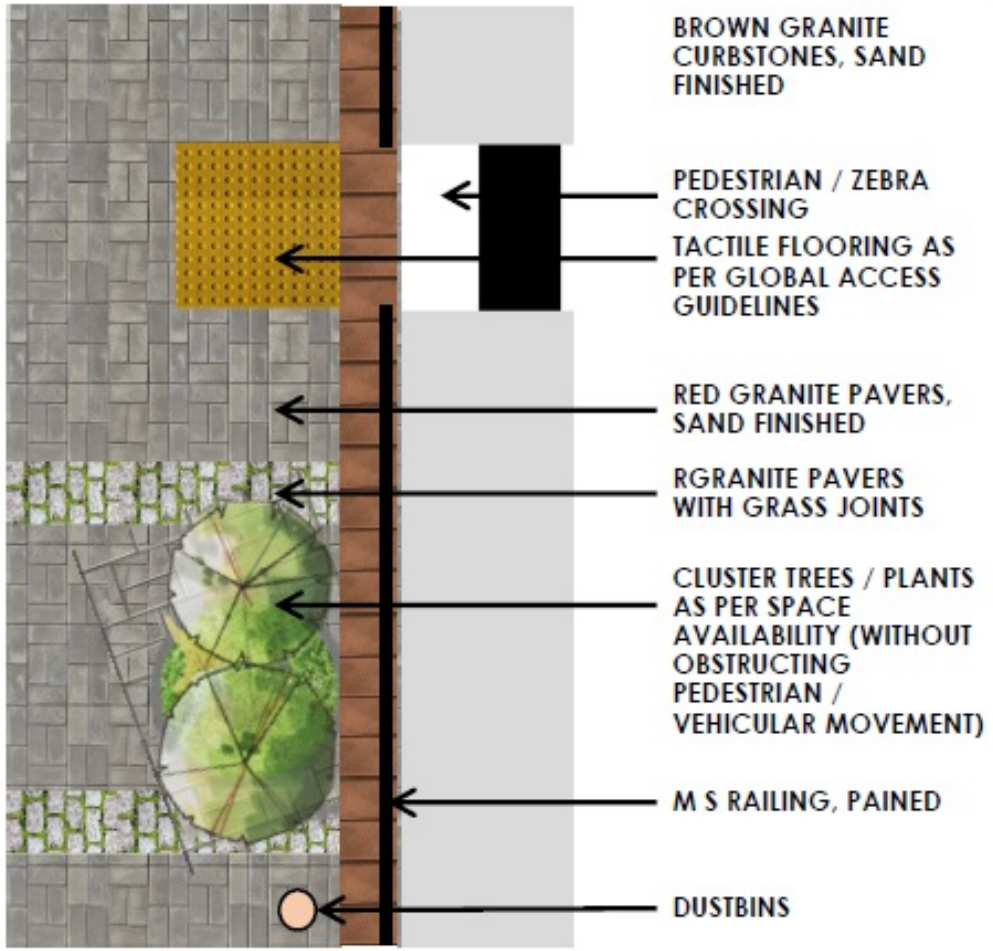


MODERN URBAN ELEMENTS

URBAN ELEMENTS
FOR HUBLI DHARWAD TRAFFIC JUNCTIONS

Footpath requirements:

- The footpath will have two patterns, one with red granite stone (sand finished) and the other with a band of cobbled stone with grass joints placed at regular intervals.
- Foot path should comply to Global Access:
  - The footpath will have tactile floor panels for the visually disabled.
  - Footpath should facilitate wheelchair movement.
- At footpath & pedestrian crossing junction, the traffic pole with button for pedestrians should be provided.
- Footpath will have railings for access control.
  - Regular M.S. railing (Painted) panels
  - M S Design Panels (Painted) at intervals.
- Dustbins should be placed on footpath at suitable locations.
- Required signage should be placed on footpath without compromising pedestrian movement. The footpath will have two patterns, one with red granite stone (sand finished) and the other with a band of cobbled stone with grass joints placed at regular intervals.



FOOTPATHS

MODERN URBAN ELEMENTS

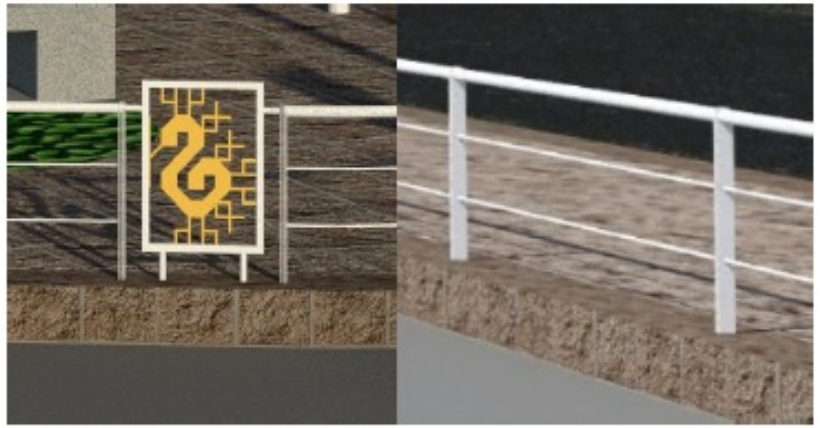
URBAN ELEMENTS
FOR HUBLI DHARWAD TRAFFIC JUNCTIONS

The main Chenamma circle consist of the statue which will be retained with good light focusing on the statue.

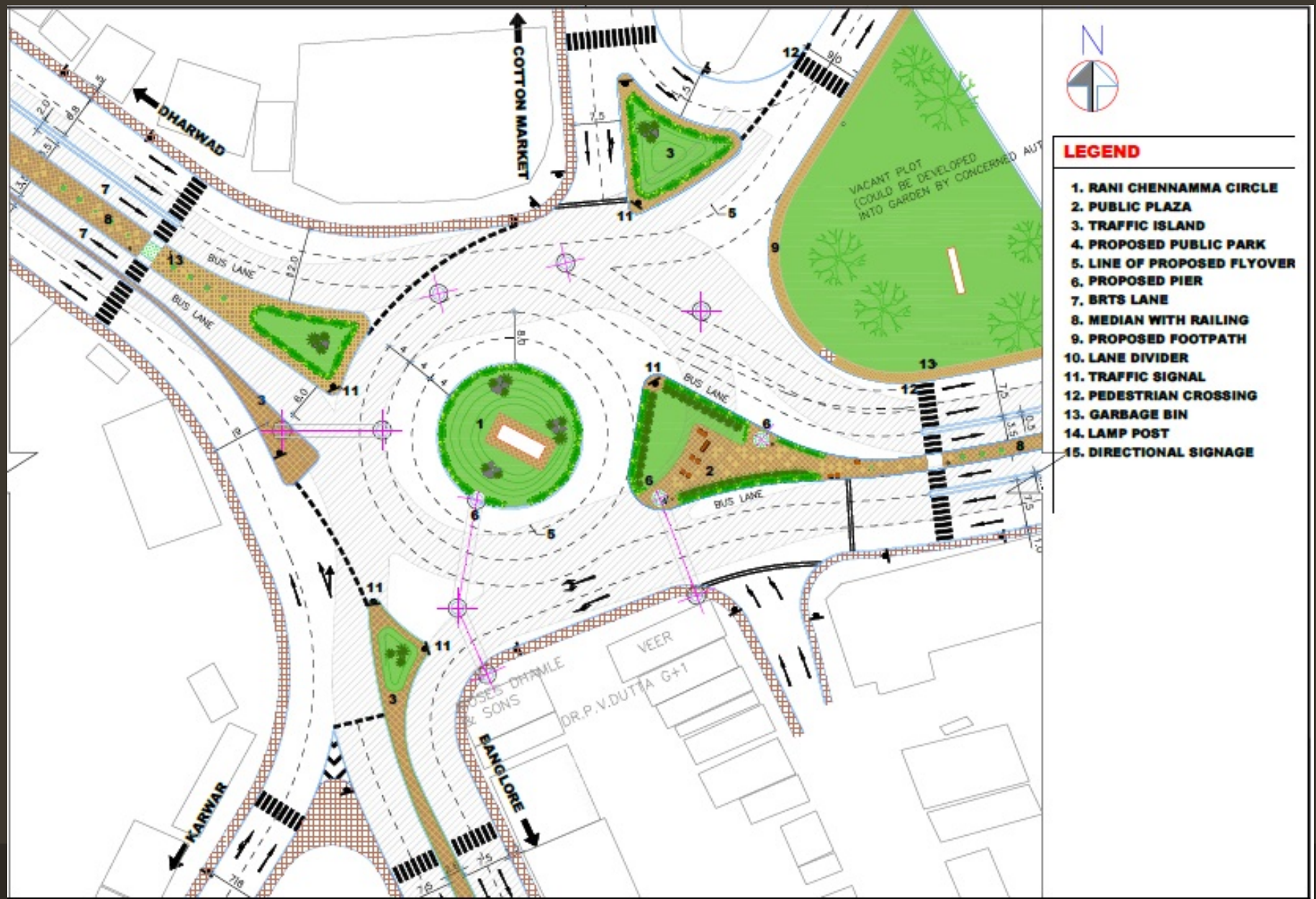
The base of the island will be cladded with the similar pattern as the footpath, to continue with the overall design.

The benches are simple concrete design with the logo engraved on it.

Regular M.S. railing (Painted) panels
M S Design Panels (Single & Double, Painted) at intervals.



URBAN TREATMENTS @ RANI CHENNAMMA JUNCTION



BIRDS' EYE VIEW OF PROPOSED CHENNAMMA JUNCTION

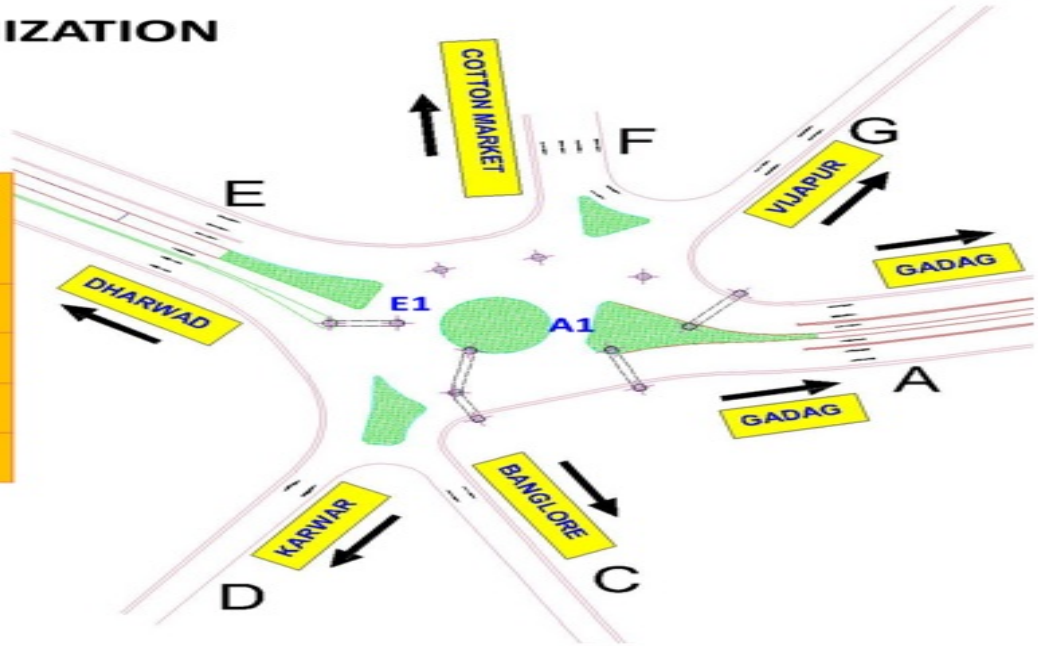
MODELLING & SIMULATION IN PTV VISSIM

- Spectrum supplied the CAD files of the existing terrain, aerial images, CAD files of the proposed concept along with traffic data to GMD.
- VISSIM 5.4/ VISSIM 9 was used for the modelling.
- Modelling requirements were quite complex given the geometry of the interchange. The existing situation was modelled by collecting data on aspects such as turn movements and queue lengths, as well as by taking aerial photographs. A base model was then created using this information. Base model was then validated for present conditions.
- On the Base model, the proposed option was modelled using the CAD files as background. Proposed model was then refined at junctions/crossings/turns to remove conflicts as well as for smooth movements.
- Fixed time signals were used to model the signals at junctions. Once the model stabilised, multiple iterations were done to extract the results. The model studies confirmed the need for signal optimisation at-grade due to the long queue lengths at the junction legs.

QUEUE LENGTHS

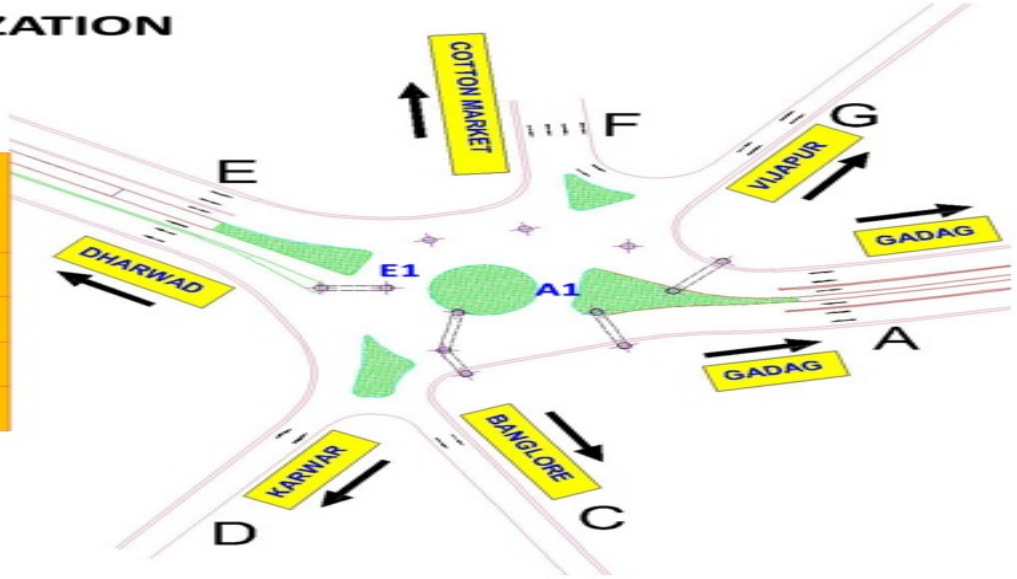
QUEUE LENGTHS - BEFORE SIGNAL OPTIMIZATION

Location	Average Queue Length In Meters	Maximum Queue Length In Meters
A - From Gadag Leg	366	694
D - From Karwar Leg	14	66
E - From Dharwad Leg	39	171
F - From Cotton Market Leg	16	60

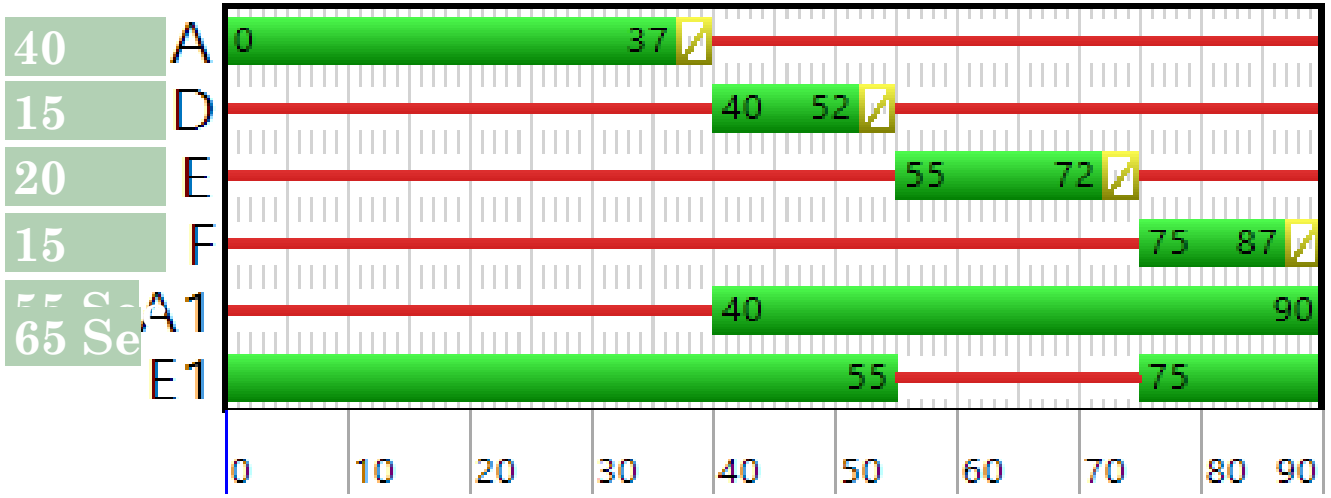


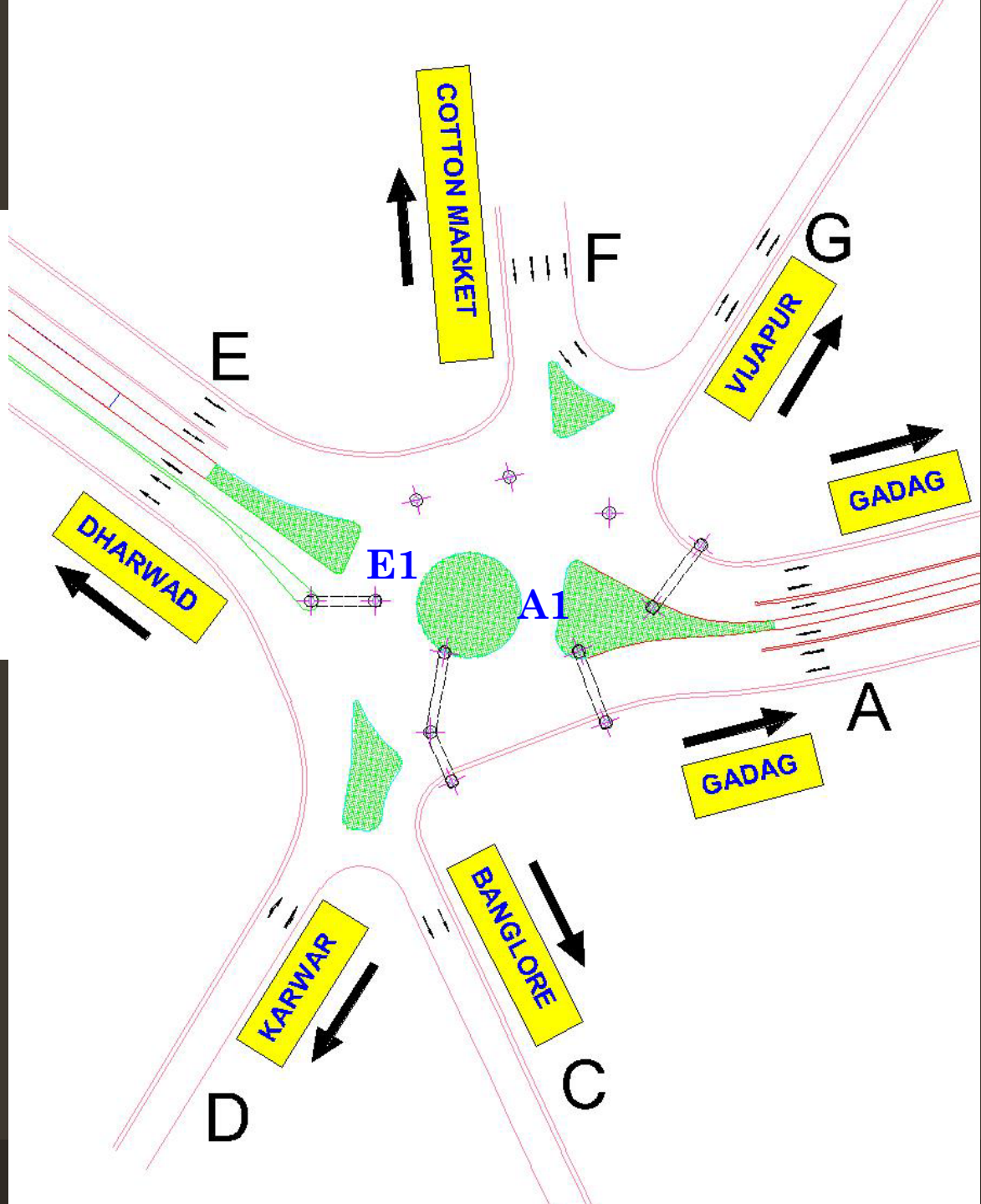
QUEUE LENGTHS - AFTER SIGNAL OPTIMIZATION

Location	Average Queue Length In Meters	Maximum Queue Length In Meters
A - From Gadag Leg	22	108
D - From Karwar Leg	8	48
E - From Dharwad Leg	10	98
F - From Cotton Market Leg	10	44

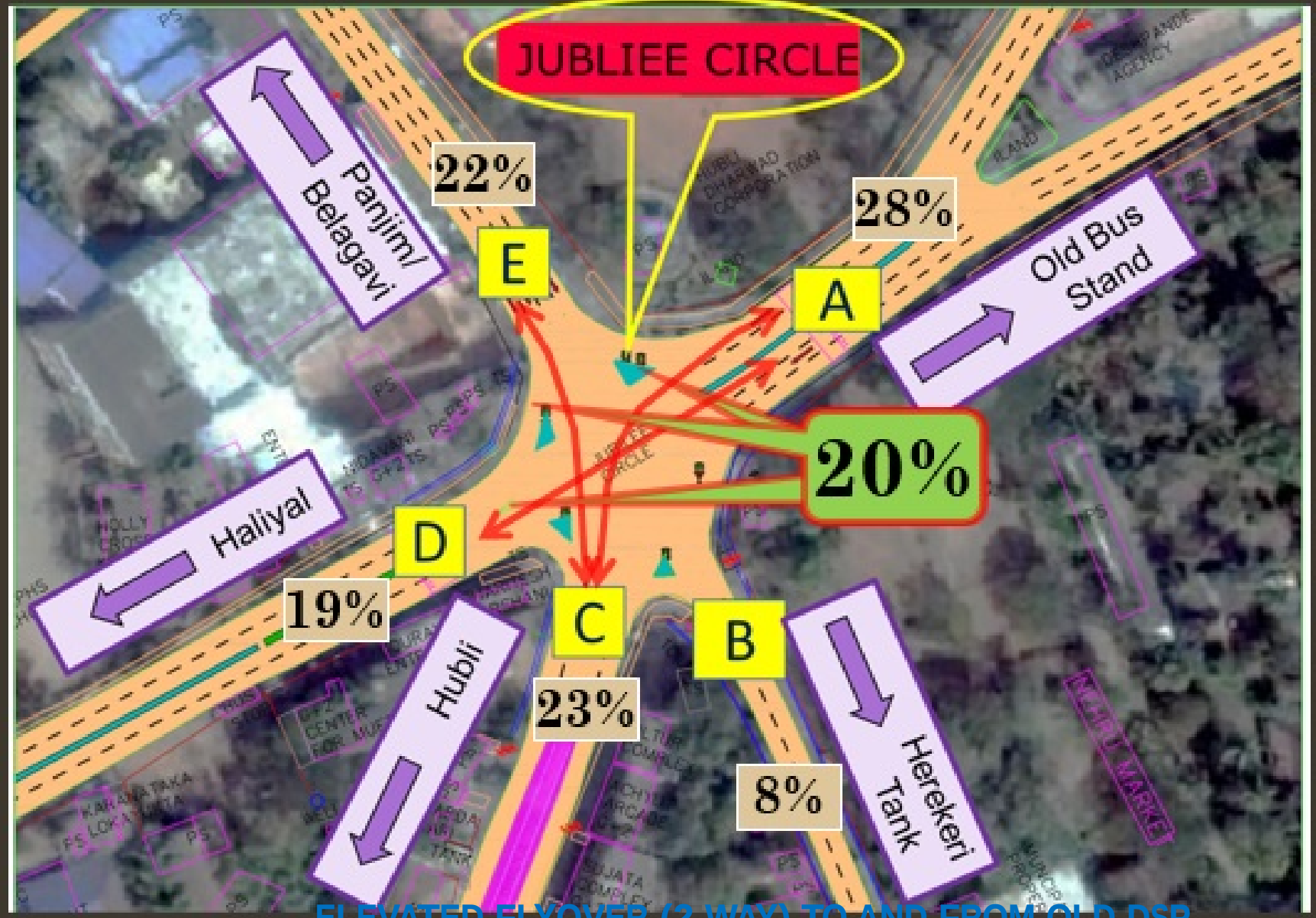


RANI CHANNAMMA CIRCLE - SIGNAL TIME





JUBILEE CIRCLE – TRAFFIC DISTRIBUTION



ELEVATED FLYOVER (2 WAY) TO AND FROM OLD DSP JUNCTION PAST BRTS BUS-STOP

TRAFFIC FORECAST – JUBILEE CIRCLE, DHARWAD

Intersection Name	2017		2027		2037	
	Elevated Traffic PCU**	Balance Traffic PCU*	Elevated Traffic PCU	Balance Traffic PCU	Elevated Traffic PCU	Balance Traffic PCU
Jubilee Circle	956	4751	1557	7739	2537	12606

** above balance traffic is from all arms,*

***considered elevated through traffic b/w Panjim – Hubli*

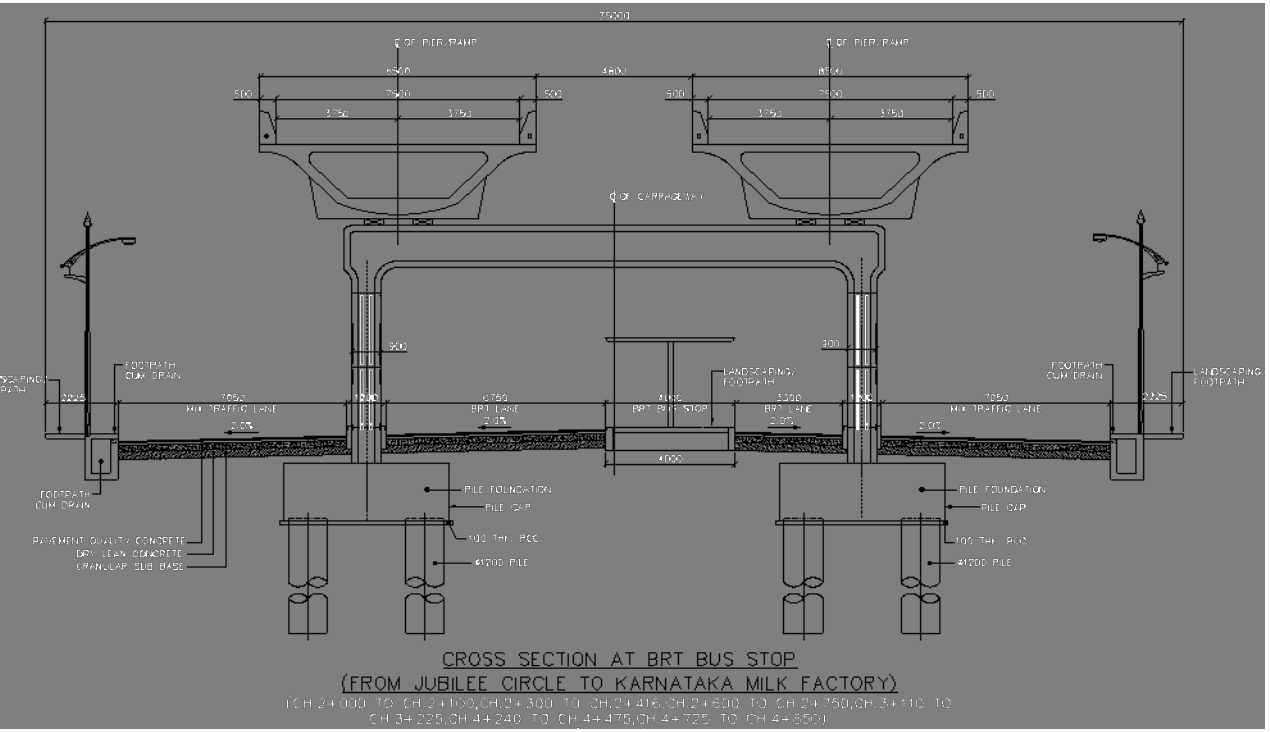
JUBILEE CIRCLE – FLYOVER FOR THROUGH TRAFFIC & AT-GRADE TREATMENTS - FOR LOCAL ACCESS TRAFFIC

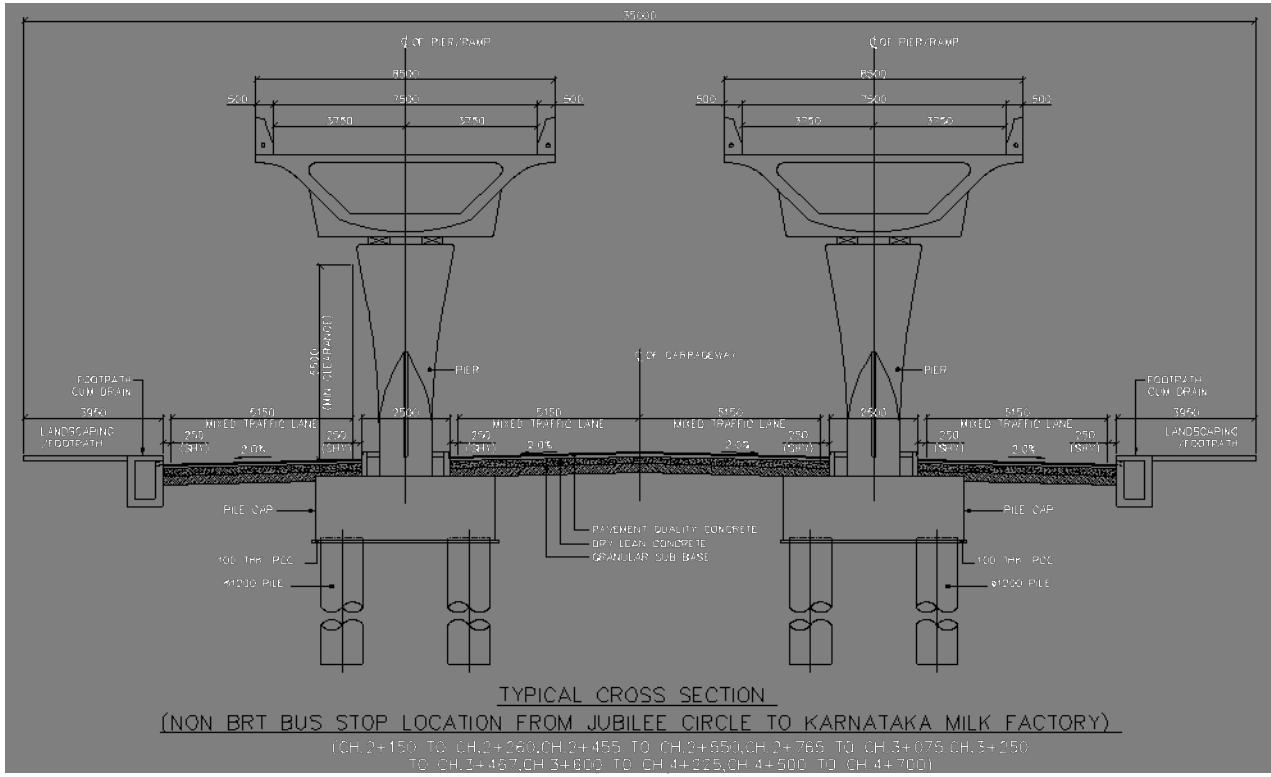
BRTS BUS STOP AT-GRADE

TRAFFIC TREATMENTS TO CHANNELISE TRAFFIC AND REDUCE CONFLICT POINTS

PROVISION FOR PEDESTRIAN CROSSINGS, REFUGE ISLANDS AND MEDIANS

CROSS SECTIONS - JUBILEE CIRCLE





BENEFITS OF PTV VISSIM

- VISSIM allowed us to simulate and visualize exact traffic patterns and different scenarios. Simulation in VISSM helped us with observing vehicular interactions and actual conflict points and design remedial measures to reduce conflicts.
- The 3D visualizations made complex traffic situations appealing and understandable to all. 3D visualizations of the concepts helped present convincing and comprehensible measures to the decision-makers/stakeholders.
- Present conditions are validated using the VISSIM model and signal optimization was carried out.
- It enabled us to analyze trip lengths and the likelihood of traffic using the proposed flyovers/interchange and vice-versa.
- Cost savings are achieved through the reduction in queue lengths, delays as predicted by the VISSIM simulation.
- This had a positive impact on travel times, emissions and traffic flow.

Rani Chennamma Junction - Safe, Inclusive and Welcoming intersection for All

- A rotary is an intersection where traffic flows in a circular pattern. Outer dedicated, delineated arms are provided for through traffic that need not enter the circulatory motion.
- Rotaries allow for the **movement of more traffic in less time** than a normal intersection because they do not have stop signs or traffic lights.
- Rotaries can also **improve the safety of an intersection** as there are no left turns in front of oncoming vehicles & also act as a traffic calming measure since traffic moves slower through the intersection.
- Studies have shown modern rotaries to eliminate head on and high speed collisions resulting in a **90% reduction in fatalities**, **80% reduction in injuries** and a **40% reduction in overall collisions**.
- Requires minimal to no land acquisition at Rani Chennamma Junction. Flexibility is built into the interchange design to **accommodate possible future changes**, particularly **when changes to land use** are likely to **substantially alter traffic patterns**.

The proposed solutions separate the major crossing movements and enable maximum traffic volumes to operate uninterrupted.

By minimising conflicts, the proposed solutions offer safer and welcoming intersections that are functionally efficient & aesthetically pleasing.

For Rani Chennamma Junction flexibility for future expansion without reconstruction is provided.

Gives a visually pleasing view of the historically significant and heritage listed Rani Chennamma statue when travelling over the rotary thereby enhancing the community character and pride of the locals.

BENEFITS OF THE PROPOSED TREATMENTS/SOLUTIONS

- ✓ **EFFICIENT OPERATION:** Accommodates the **warranted turning & through movements** identified through the traffic analysis;

- ✓ **SAFE:**
  - ✓ Substantially **reduces the number of conflict points** between heavy through traffic and local access traffic. Improves the safety of the at-grade intersection and interchange by grade separating heavy vehicles from pedestrians and local access traffic. Makes the at-grade intersections more welcoming and pedestrian-friendly.
  - ✓ **Traffic calming measures** are incorporated in the design concept.

- ✓ **STAKEHOLDER REQUIREMENTS:** Considers **Smart City & relevant authority requirements** for pedestrian safety/movements at the at-grade level by separating heavy through traffic and a proportion of local access traffic thereby making the at-grade intersection safer.

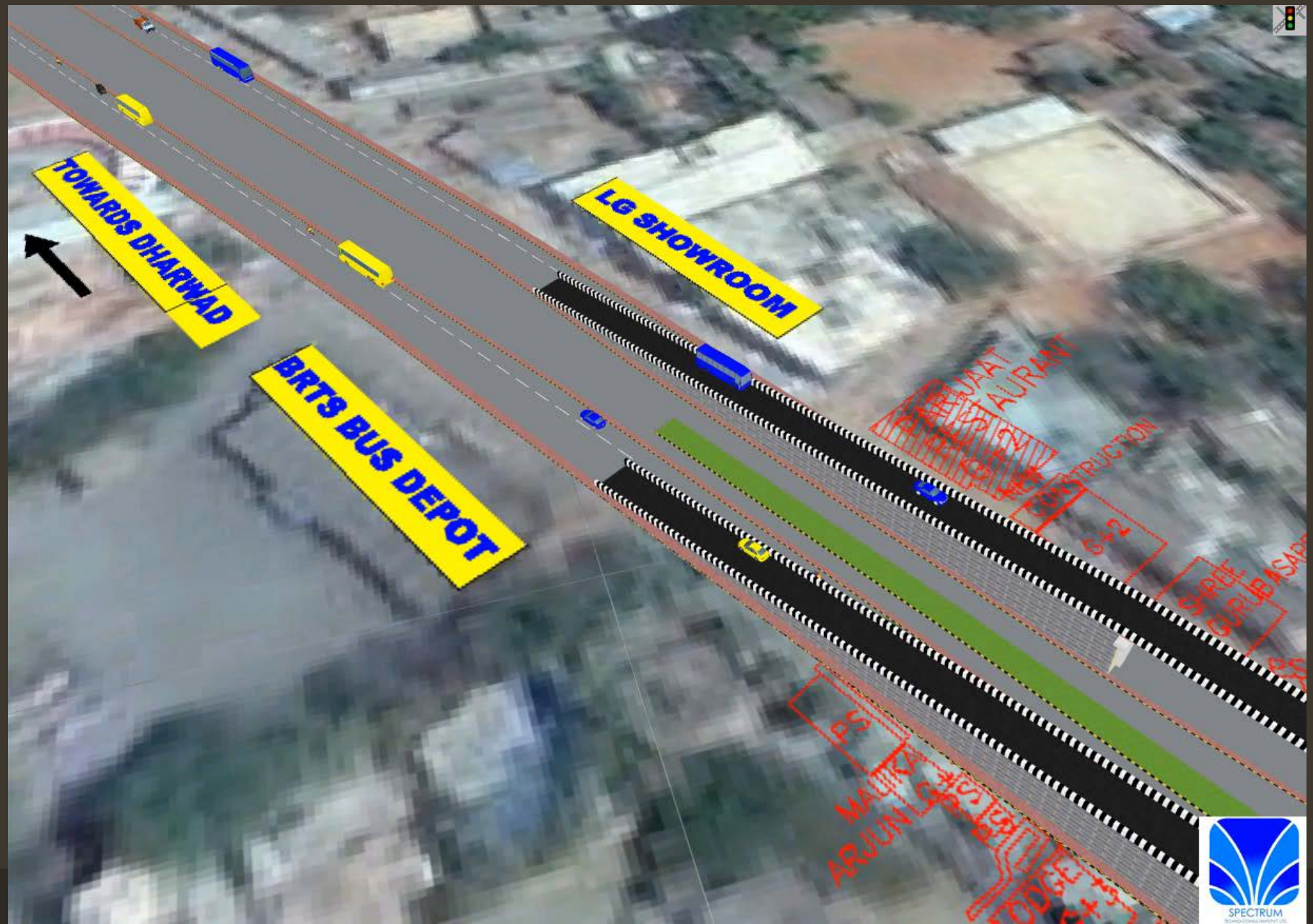
- ✓ **AT-GRADE:** Helps **better planning and design** of the at-grade traffic treatments which would cater mainly to local access traffic, pedestrians, cyclists, buses travelling to and from the nearby bus stands and BRTS.

- ✓ **INCLUSIVE:** At the at-grade level, safely accommodates and makes allowances for **multiple modes** (i.e. pedestrians, cyclists, BRTS and low to medium density local access vehicular traffic) thereby making it safer and more functional and in line with Smart City requirements.

- ✓ **FUNCTIONAL:** Improves overall **traffic operations** by appropriate restriction of access & enforcing consistent traffic behavior to allow the local road system and the heavy through traffic to operate effectively and efficiently. Treatments proposed are **aesthetically pleasing** in **form & function.**

- ✓ **CAPACITY:** Reduces/eliminates **capacity and congestion issues** associated with vehicular parking at and in the vicinity of the at-grade intersections. For Rani Chennamma Junciton, **flexibility** is provided for **future expansion without reconstruction**.

HUBBALLI - SIMULATION IN PTV VISSIM



DHARWAD - SIMULATION IN PTV VISSIM

THANK YOU