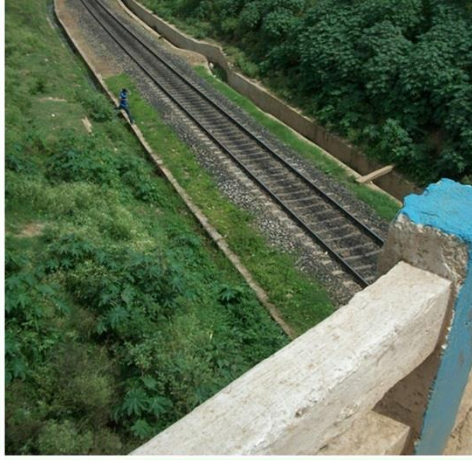

Karnataka State
Highways Improvement Project-III
(KSHIP-III)- Group I

Consultancy Services for Preparation of Detailed Project Report cum Transaction Advisory Services for Karnataka State Highways Improvement Project-III (KSHIP III)- Group I

Pre-Feasibility Report

Widening & Strengthening (to Two Lane With Paved Shoulder) of Kumta to Yekkumbi Section of SH-69 from km 5+300 to km 78+700 in the State of Karnataka

CDM Smith Inc.
in Joint Venture with
CDM Smith India Private Ltd.
CRISIL Risk and
Infrastructure Solutions Ltd.

December 2015

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FEASIBILITY REPORT

Widening & Strengthening (to Two Lane With Paved Shoulder) of Kumta to Yekkumbi Section of SH-69 from 5+300 km to 78+700 km in the State of Karnataka

1.1. INTRODUCTION AND BACKGROUND

Government of Karnataka, through the government of India has received in principle approval for a second loan of about US $ 350 million from Asian development bank (ADB) towards Karnataka state highway improvement project III (KSHIP III) for developing state road network adopting innovative financial models under public private participation (PPP).

The executing agency, the public works department, represented by the P.D, project implementation unit and Karnataka state highway improvement unit have undertaken feasibility studies for a stretch of 4403 kms for selected corridor of core road based on these studies 1350 kms of state highway is intend to improve under ADB finance and adopting appropriate PPP models such as Toll, VGF + Toll, Annuity, Hybrid- Annuity and so on.

In this regard, M/s CDM Smith Inc. in Joint Venture with M/s CDM Smith India Private Limited and M/s CRISIL Risk Infrastructure Solutions Ltd., has been appointed by P.D, PIU - KSHIP, Bangalore, Karnataka, India for the "Consultancy Services For Detailed Project Report cum Transaction Advisory Services for Karnataka State Highway Improvement Project-III (KSHIP-III) Group I", for the project covering the following list of roads as given in Table 1.1.

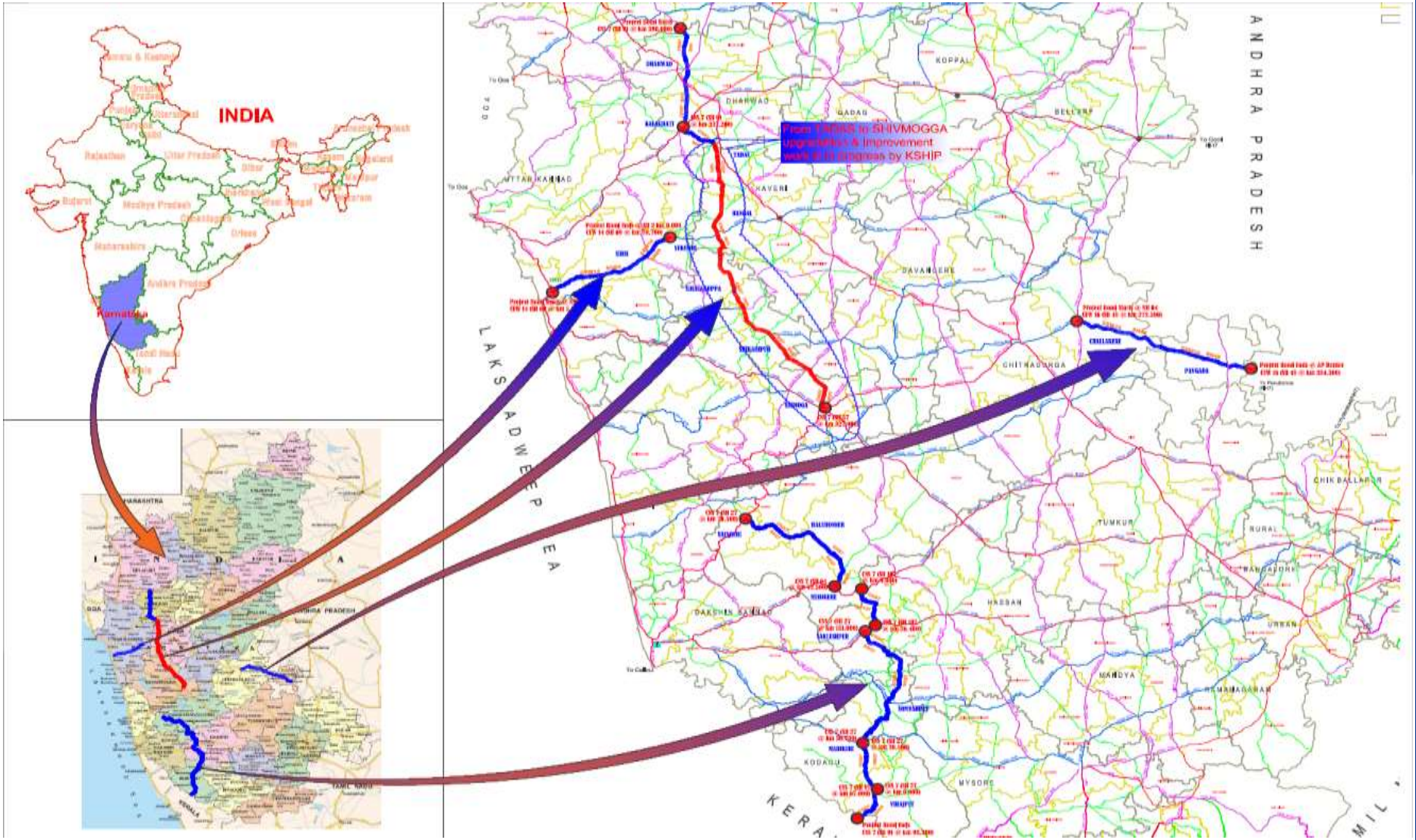
Table 1.1 List of Roads

Sl. No	Corridor No (SH No.)	Project Corridors	App. Length (km)
1	CNS7 (SH 1,SH 57, SH 27,SH 91)	**MH Border to Kerala border** from before Uppina Bettageri to Tadas, Tadas to Shimoga(SH 1,SH 57)Sringeri to Sakleshpura, Donigal to Madkeri, Madkeri to Kerala border near Heggala (SH 27,SH 91)	507
2	CEW 14 (SH-69)	Kumata to Yekkumbi Kumta-Sirsi-yekkumbi along SH 69	79
3	CEW 16 (SH-48)	Chitradurga to AP border Chitradurga-Chellkere-Pavagada along SH 48	110
		Total Length (km)	696

The primary objective of the consultancy is to prepare the project in terms of technical, financial, economic, environmental and social safeguards, procurement structuring and documentation for loan appraisal involving ADB. PPP mobility in the project is required in order to bring in the private sector investments and associated efficiencies in building and maintaining road. The work would be taken up with corridor concept with free main carriageway and better connectivity to adjacent tourism location and industrial estates.

The improvement mechanism consist of upgrading of existing carriageway to two lane with paved shoulders, green field construction of bypasses, widening, strengthening of culverts and bridges, construction of new bridges, cross-drainage structure, and structure for resettlement and rehabilitation.

Key/Location map of the Project Corridors under KSHIP-III Group I as per TOR and actual study is shown in Figures 1.1 & 1.2.


INDIA
Karnataka
From HAVERI to SHIVMOGGA upgradation & Improvement work is in progress by KSHIP
ANDHRA PRADESH
LAKSADWEEPA
KOPPAL
DHARWAD
GADAG
BELLARY
HAVERI
DAVANGERE
CHITRADURGA
TUMKUR
CHIKBALLAPUR
RURAL
BANGALORE
HASSAN
KOLAR
MANDYA
RAMANAGARAM
KODAGU
MYSORE

1.2. Scope of services of the Project

- Review and revalidation of the traffic study, preliminary cost estimation and preliminary financial feasibility report already submitted by previous consultant. Review of all available reports and information about the project roads and the project influence area;
- Detailed reconnaissance;
- Identification of possible improvement in the existing alignment and bypassing congested locations with alternatives, evaluation of different alternatives comparison on techno-economic and other considerations and recommendations regarding most appropriate option;
- Inventory and condition survey for roads;
- Inventory and condition surveys for bridges, ROB, RUB, VUP, PUP etc. cross-drainage structures and drainage provision;
- Detailed topographic survey using total station and GPS;
- Pavement investigation; Geo technical investigation: sub-grade characteristics and strength:
- Investigation of required sub grade and sub soil characteristics and strength for road and embankment design and subsoil investigation;
- Identification of sources of materials;
- Safety audit plan; Review the safety aspect of the existing road at different stages of design and carrying out road safety audit; collection of accident statistics; preparation of traffic safety and work zone safety plans, corresponding items of works, specification etc.
- Detailed design of road, its x-section, horizontal and vertical alignment and design of high embankment.
- Detailed design of structure fir river bridges, flyovers, ROBs, RUBs, VUPs, PUPs etc., preparation of GAD and construction drawings etc., and assist the client in pursuing the railways/GOI/GOK authorities for approval of the GAD and proof checking.
- Identification of the type and design of the intersection;
- Identify the cycle track wherever necessary.
- Design of complete drainage system and disposal point for storm water; rain harvesting.
- Recommendation as regard toll plaza locations, layout and details.
- Location of and layout of truck lay byes/bus lay byes; way side facilities; parking areas.
- Quality Assurance Plan
- Traffic management plan during construction and implementation; detailed proposal for road signage, road marking, road furniture and safety devices. Encumbrances plan; strip plan

indicating the scheme for carriageway widening, location of existing utility services (both over and underground)and the scheme for their relocation, trees to be felled and planted.

- Preparation of detailed project report, engineering design, cost estimate, drawings of ''Good fors construction'' standard, rate analysis, detailed bill of quantities, bid document for execution of civil works.
- Environmental and impact assessment, including such as related to cultural properties, natural habitats, involuntary resettlement etc.
- Public consultation with various stakeholders at all the different stages of assignment.
- Preparation of environmental management plan: environmental statutory clearance; plan for tree plantation and arboriculture.
- Landscape strategy and action plan
- Preparation of land plan schedule (LPS) as per the requirement of KSHA 1964/ other applicable laws and requirements incorporating the extended of land acquisition on the review map and at the field and assessing the requirement for the proposed road improvement works.
- Value analysis /value engineering and project costing;
- Economic analysis
- Financial analysis for PPP roads; value for money(V fm) analysis
- Contract packaging and implementation schedule for feasible PPP mode of contracts.
- Preparation of bid document appropriates for tendering based on ADB requirements.
- Provide transaction advisory service for the procurement of concessionaries and independent engineers for the project works.
- Development of key performance indicators for the project as per KSHIP and ADB requirements
- In addition to the scope & objectives as per TOR, Consultant's approach in design and proposals includes the following:
- Cement Concrete pavements in most of the built up areas and at sharp curves/steep gradients in Ghat sections in order to reduce the maintenance cost.
- Recycling of existing pavements layer materials.
- Use of modified bitumen such as plastics, rubber, polymers etc.,
- Improvement of connecting roads w.r.t riding quality leading to important places such as tourist and pilgrims places within 20 km from main corridor.
- Minimum tree cutting shall be adopted by selecting most economic widening scheme.

- Separate Cycle tracks in built-up locations wherever possible

2.1. DESCRIPTION OF THE PROJECT ROAD

Project road stretch starts at NH 17 junction near Kumta at km 0+000 of SH 69 and ends after Yekkumbi Village at km 76+000 (SH 2 junction). Total length of the project stretch is 76.000 km. Entire stretch is of Intermediate-lane configuration with earthen shoulders for most of the length, the terrain comprises of rolling and hilly. **Plate 2.1** shows the views of Start and End of the Project stretch**.**

Start of the Project Road at CH 5+300

End of the Project Road at CH. 78+700

Plate 2.1: Views of Project Start and End Points

Carriageway of project road is of bituminous surface. At few locations in sharp curves/hairpin bends it is concrete pavement. Lanes configuration is of Intermediate and two lane. Divided carriage way for few lengths exists in sirsi builtup. Earthen shoulder exists on either sides of the carriageway. RCC rectangular drains are found at some built-up locations. Plate 2.2 shows the view of carriageway and formation

Two lane configuration at CH.58+900

Intermediate lane configuration at CH.10+400

Concrete Pavement @ CH: Kms 21+700

Plate 2.2: Views of Carriageway and Formation

Project road passes through rolling and hilly terrain. Both horizontal and vertical geometry of the road in plain terrain requires improvement at many sharp curve locations. Plate 2.3 shows the geometric features of the highway.

Curve at CH 10+000

Hair Pin Bend at CH 20+400

Curve at CH: kms 9+600

Plate 2.3: Views of Road Geometrics

Project road stretch is in rolling and hilly terrain. Land use is agricultural and forest with pockets of major & minor built-ups. Major built-ups falling within the stretch is Sirsi. Plate 2.4 shows the views of Land-use & major built-up areas

Forest Land at km 56+800

Sirsi Built-up at Km 65+200

Plate 2.4: View of land use pattern & major built up

It is also noted that majority sections of project road have trees planted very close to the carriageway and widening proposal of project road may have impact as such the same need to be formulated to have minimal impact on such environmentally sensitive locations.

2.3. Major Towns along the Project Road

2.4. Issues along the Project Road:

- In addition to the minor built-ups, there are number religious structures including temples, schools and water body. All these features are socially very sensitive and needs critical care in preserving them during widening. **Plate 2.5** shows the various sensitive features along the project road.

School at Km 80+050 **Temple at Km 63+600**

Plate 2.5: Views of Sensitive Features along the Project Road

- Wayside amenities in the form of petrol pumps are present along the project road. Truck lay byes, terminals, bus bays are absent. Passenger shelters are observed along the project stretch at few locations. Utilities like OFC, electric poles and transformers are present along the built-up areas and high-tension line cross at regular intervals.
- Generally, the pavement surface condition observed is Good to Fair except from Km 63.0 to km 67.5, it is poor. Plate 2.6 shows the view of pavement surface condition.


Pavement condition at Km.6+600 **Pavement condition at Km.26+000**

Plate 2.6: View of Pavement Surface Condition

3. SURVEY AND INVESTIGATION

3.1. General

The Consultant's approach to the project will be in accordance with the "Description of Services" given in the Contract Document and understanding of the project objectives; however, Cognizance will also be given to the discussions that will be held with Client during the progress of the project study. Following is the brief scope of work as reproduced from the RFP Document

- Reconnaissance Survey of the Roads
- Inventory surveys for existing road, junctions, villages, settlements,
- Inventory and condition survey of cross drainage structures
- Collection of details such as Railway crossings, Forest Areas and terrain details
- Collection of road development details, if already done, by KRDCL/ KSHIP/SHDP/ NH
- Conducting Classified Traffic Volume Count (Both manual and Videography)

- Conducting Intersection Volume Count Survey
- Conducting Origin Destination Survey
- Conducting Registration plate survey
- Carrying Traffic Demand Assessment and Traffic Forecasting
- Preliminary Cost Estimation
- Submission of reports and relevant details

3.2. Collection of Secondary Data

All relevant reports and data, development plans concerning to the proposed project and the project influence area was collected directly or with the help of the Client from concerned Departments of Government of India (GOI) and Government of Karnataka, public bodies or Non-Governmental Organizations (NGOs). Existing Traffic volume and past records were located from PWD department along with existing ROW data. Details of delineated Reserved Forest areas were collected from the Forest Department, Govt. of Karnataka. Hydrological data for five stream crossing project road was collected from Central Water Commission (CWC) and the Department of Irrigation, Karnataka jointly monitoring the Discharge and HFL data through their well-established network of G&D sites.

3.3. Topographical Survey

3.3.1. Introduction

CDM Smith India Pvt Ltd, has carried out the Topographical Survey required in connection with preparation of Detailed Project Report. This report covers the technical details for establishment of control framework and subsequent detailed Topographical Surveys for the project road.

3.3.2. Objective

The basic objective of topographical survey is to determine three dimensional positions of all ground features in the form of x, y and z coordinates with respect to a defined reference system to generate accurate digital terrain model of the project road corridor for preparation of strip plan and designing and working out improvement, rehabilitation, and up-gradation of the project road, design additional facilities, alterations and additions for its development.

3.3.3. Scope of Work

The detailed scope of services is enclosed in the contract agreement. This report covers Topographical Surveys component of the contract agreement. Broad outline of the scope of services are:

- Fixing of control frame work comprising of the following activities:
  - *Establishment of Main Control by DGPS*
  - *Establishment of Subsidiary Control Points by Total Station..*
  - *Establishment of Height Control by Digital Level*
- Detailed Topographical Survey to generate Digital Terrain Model of the defined corridor of the project road.

- Additional survey as required for geometric improvements like designing of junctions, ROB, bridge site, hydrological requirements and bypasses/realignment.

3.3.4. General Terrain

Generally Project Road for approx. 50 Km is in Plain terrain and reminder section in Rolling or hilly terrain.

3.3.5. Methodology

The complete methodology adopted for conducting topographical survey for the project road comprises of the following activities.

3.3.6. Establishment of Main Control by DGPS

- Fixing of Monuments

Keeping in view the importance and stability of control points, RCC pillars of specified dimensions 15cm x 15cm at the top, 20 cm x 20 cm at the bottom and 45 cm in height with an iron pin fixed at the top center of each pillar were got pre-casted. After proper curing, these pre cast RCC pillars were embedded in ground projecting about 15 cm above ground level. The balance 30cm was embedded in ground with concrete cement layer all around to ascertain stability of the pillars. The top projected part of the pillar was painted yellow. All pillars were uniquely numbered with red paint. The locations of pillars were arranged in such a way that twin inter-visible points about 200-250m apart are available at an interval of every 5 km along the entire road stretch. Pair of twin GPS pillars has the advantage that every 5 km stretch can be independently used for starting and closing the traverse by Total Station. This 5 km traverse can be adjusted and independent detailed survey can be carried out.

The location of the pillars was suitably selected away from the road but within the ROW so that it is not disturbed by traffic. Also the site was selected in an open area so that the signals from the satellite are received from all around above 15-degree altitude from the horizon. Proper description and sketch of the location of each pillar with respect to the surrounding details was prepared to ensure easy identification and traceability.

- GPS Observations

For the purpose of fixing starting control point to the best possible absolute accuracy, GPS observations were taken at GPS-5 near the beginning of the project continuously for a period of about 6 hours. Based on this long observation, the coordinates of GPS-5 were computed in "single point positioning" mode. Accepting GPS-5 as the fixed point, the other points were observed in continuity and computed in "base line" mode.

GPS observations on other points were carried out in continuation of the observations taken at GPS-5 for a period of about 45 minutes to one hour for a base line of 5 kilometers depending upon the availability of satellites. Two GPS receivers were used for recording simultaneous satellite signals at both ends of the base line. Observations recorded in common time by both the receivers were used for measurement of the base line. Observations were taken in a Leap-Frog method using dual frequency Leica GPS receivers.

Following are the specifications of the GPS instrument used for providing main control for the project surveys.

GPS Set: LEICA 1230

Sensor: GX 1230

Antenna: AX 1202

Controller : RX 1210

Planimetric accuracy of GPS control points (baseline): 5mm +0.5 ppm

- GPS Data Processing

GPS field observations were downloaded to the computer every day and the data was processed using Leica Geo-Office Software in base line mode. Leica Geo-Office displays the status of each computed base line in terms of 'base Line Ambiguity' resolved or not. Ambiguity resolved indicates that baseline measurement has been computed successfully and the results are stored in the database. If ambiguity is not resolved, the field observations were repeated next day. On successful computation of the base line, the latitude and longitude of each point of the base line were stored in the database. These latitude and longitude values were suitably projected on a plain surface to get X and Y Grid Coordinates of all GPS control Points using the Universal Transverse Mercator (UTM) Projection (Zone-44)

3.3.7. Establishment of Secondary Control Points by Total Station Traverse

Secondary Control Points / Bench Marks have been fixed at an interval of about 250m by embedding pre-cast RCC pillars of the same specification as GPS pillars. These pillars have been embedded in concrete up to a depth of 30 cm with 5 cm wide layer all around and the balance 15 cm above ground has been painted yellow. All the pillars have been uniquely numbered by red paint.

After fixing secondary control points, traverse observations were carried out with Total Station starting from one pair of GPS control points and closing at the next pair of GPS control points connecting all secondary control points in between. These traverse observations were processed using standard methods to compute the coordinates of all subsidiary control points. The closing error of the traverse line was checked, to fall within permissible limits of 1:10000, otherwise the observations were repeated. The error, within permissible limits, was suitably adjusted to get the final X and Y coordinates of the subsidiary control points.

3.3.8. Establishment of Bench Marks by Digital Level

The elevations (Z value) of all the GPS control pillars as well as the secondary control points will be established by carrying out leveling from a known GTS Bench Mark. Double tertiary leveling shall be carried out by two leveling teams in fore and back directions using Digital Levels from GTS BM connecting all intermediate GPS and Traverse control points to establish accurate MSL heights of all the control points. Heights (Z values) of all the GPS control points obtained from GPS observations and traverse control points obtained by Total Station traverse will be replaced by their respective leveling heights.

3.3.9. Detailed Topographical Survey

Detailed topographical survey of all natural and manmade topographical features is carried out by picking up their x, y and z coordinates using Total Stations having automatic data recording devices with appropriate feature codes attached to each point. In general, these include:

- Road center line
- Pavement edges
- Outer shoulder edges
- Toe lines of fills and cuts
- Longitudinal and transverse drains/ ditches

All man-made and natural topographical features were surveyed, including:

- Water sources, River etc.
- Structures
- Buildings
- Utilities etc. as visible, falling inside the corridor

At locations, where existing alignment cross other roads, the survey was extended to 100 to 200 m on either side of the road center to allow for the geometric improvements. Cross sections at every 50 m interval in flat terrain and at lesser interval on undulating terrain or horizontal curves were also taken using Total Stations.

3.3.10. Rivers/ Streams/Canals Crossing

All crossing rivers/canals less than 60m wide, are surveyed up to 300m on upstream and downstream sides. Cross Sections across the channel were taken at every 50 meter interval. At major river locations (where proposed bridge / causeway length is between 60m to 200 m), river crossing survey were extended up to 500m on upstream and downstream sides. Other rivers where the channel is more than 200m wide, the cross section survey were extend up to 1000meters on both sides upstream and downstream. Top and bottom of both the banks and centre line of the deepest bed channel has been precisely picked up by total station survey.

3.3.11. Level Crossing

No railway level crossing along the project road.

3.3.12. Manmade Features

Location of all sort of manmade feature such as structure, OFC lines, signal lines, Sewer line, water line, telephone line, electric lines, HT lines, fence line, boundary walls, bore well etc. have been collected by total station within the specified corridor. Minimum two poles locations have been surveyed for all communication / power lines to show their angle of crossing with the center line even if they fall outside the specified corridor. All the four corners of high tension line pylons have been surveyed. Lowest wire height of all the high tension electrical lines crossing the alignment is observed and recorded with suitable feature code.

3.3.13. Data Processing

All data from the total stations, and other field records, was downloaded regularly on to the field computer and processed with Survey Control Centre (SCC), the data processing software, to form proper connectivity of linear features based on the feature code and sequence of points collected on

ground. Based on the heights of linear features and spot heights, Digital Elevation Model was generated to check for any holes or void in the model. The hard copy output of the plan survey drawing on suitable scale was taken to the ground by senior surveyor for physical verification on the ground to check details and for picking up names of the villages and other relevant information. After complete examination, the data was sent to Head Quarters for further processing for design and drawings.

3.3.14. Feature Codes

Surveyors used unique feature codes for all ground features while picking up the X, Y and Z coordinates by Total Station during field survey of topographical details.

3.3.15. Quality Control

Adequate quality assurance measures were incorporated in the methodology, which were followed at every stage. The senior surveyor assigned for the total survey work carried out constant supervision of day-to-day survey activities. The senior surveyor had constant check on the accuracy part including proper adjustment procedures and ensured that criteria of adjustment required for traverse and leveling were within the allowable limits. The final survey sheets were physically verified by the senior surveyor by ground visits. Digital terrain models were generated at the field headquarters to ensure quality output.

3.4. Road Inventory Surveys

To know the existing road characteristics in terms of its geometry, data on roadside land use, right of way, width of carriageway, junctions, road safety features, submergence and utilities were collected along road. The road inventory has been done for the entire project alignment. The findings will serve as guidance to prepare improvement proposal for the proposed project alignment. The findings of the survey are summarized below:

3.5. Culvert Inventory

The culvert inventory was carried out to find the number, type, size and condition of the culvert. There are 249 no. of culverts on the project road. Out of these 249 culverts, the distribution by type is as follows;

- HP 205
- Box Culvert =44

3.6. Major &. Minor Junctions

There are 8 minor junctions and 3 major junction along the project road.

3.7. Pavement Roughness

3.8. Inventory of Existing Bridges

The inventory of all bridges / structures having length more than 6m was carried out and summarized below:

Major bridges (length ≥ 60m)	1

Minor bridges (length > 6m and < 60m)	11
Total	12

4. TRAFFIC SURVEY AND ANALYSIS

4.1. Data Base

For carrying out the traffic demand analysis, most up to date data and related information are required, so in the present analysis for the project road. For developing the approach and methodology for the traffic data collection, the Consultants carried out the task in a systematic manner, which included first the reconnaissance field visits to the project influence area to appreciate the traffic movement, road network, type of vehicles using the project road, consultations with the road users, etc., followed by obtaining information available through several reports, studies, etc. Accordingly relevant traffic information available for the project road were collected from Karnataka PWD and reviewed.

In view of the above, the Consultants organized the traffic surveys comprehensively on the project road, so that the required data could be collected with a fair level of confidence, which will be the basic data for the traffic analysis in view of pavement design and a reliable economic analysis.

4.2. Identification of Traffic Homogeneous Sections

After preliminary site reconnaissance, the project corridors are divided into various homogenous sections based on the following:

- Site reconnaissance, connectivity, urban settlements
- Traffic intensity and characteristics
- Major traffic generators and deviation from/to the project corridor
- Important crossing of state highway/MDR

The identified homogeneous sections for various corridors are presented below.

The project corridor is an important connectivity between Yekkambi and Kumta. It passes through Uttara Kannada district. The project stretch is considered as two homogeneous sections. The homogeneous section details are indicated in Table 3.1.

Table 3.1: Homogenous Sections of CEW 14: Kumta - Yekkambi

Sl No.	Section No.	Section name	Road No	District	Length in Kms
1	HS-1	Kumpta - Sirsi	SH 69	Uttara Kannada	59
2	HS-2	Sirsi -Yekkambi	SH 69		20

Figure 3.1 Homogenous sections CEW14 (Kumta - Yekkambi)

As per IRC-108 (1996), three to seven day traffic count is the requirement for highway planning. In our proposal during bidding it was proposed to carry out 7 day 24 hours traffic volume count. Since 7 day 24 hour volume count is available and the scope is to validate the available results, consultant with the available traffic data intends to carry out 3 day traffic volume counts at the locations where traffic count survey was carried out in the previous study report to validate the traffic data and its characteristics. Accordingly, three day volume count including two working days and one weekend is suggested at locations, where traffic volume count is available.

However, seven day counts are suggested at additional locations, based on the identified homogeneous sections along the corridors.

Also O-D data and analysis results like O-D travel pattern, zone wise O-D influence and commodity movement etc., and junction turning movement details are available in the previous study. The local enquiry during site visit indicated that there has no major change in the land use in the last one year and hence no major change in the travel pattern is expected. Hence no additional OD & commodity movement surveys and junction turning count surveys are suggested for the present DPR study.

The surveys proposed for the study are listed below:

4.3. Additional Classified Traffic Volume Count Surveys

Direction-wise classified traffic volume count survey will be carried out for 24 hours on three working days (two week days and one week end) for the locations where traffic data is available and seven days for additional locations (2 nos.). The volume count survey locations are given in Table 3.2 and Figure 3.2. The vehicle classification system will be basically confined to all vehicular traffic as per TOR and of IRC: 64 -1990.

Table 3.2: volume count survey locations

CEW 14: Kumta - Yekkambi (SH-69)			
1	Classified Traffic Volume Count Survey (3 Days, 24 hrs.)	Kumpta – Sirsi	Near Amminalli
2	Classified Traffic Volume Count Survey (3 Days, 24 hrs.)	Sirsi – Yekkambi	Near Isloor

4.4. Axle Load Survey

Axle load surveys will be carried out for one normal day (24 hours) to capture the axle load carried by the commercial traffic so as to ascertain the Vehicle Damage factor (VDF), which forms the critical input in pavement design (As given in ToR). The locations for Axle load surveys are given in **Table 3.3.**

Table 3.3. Locations for Axle load surveys

CEW 14: Kumta - Yekkambi (SH-69)			
1	Axle Load Survey – 1 day, 24 hrs.	Kumta – Yekkambi	Near Amminalli

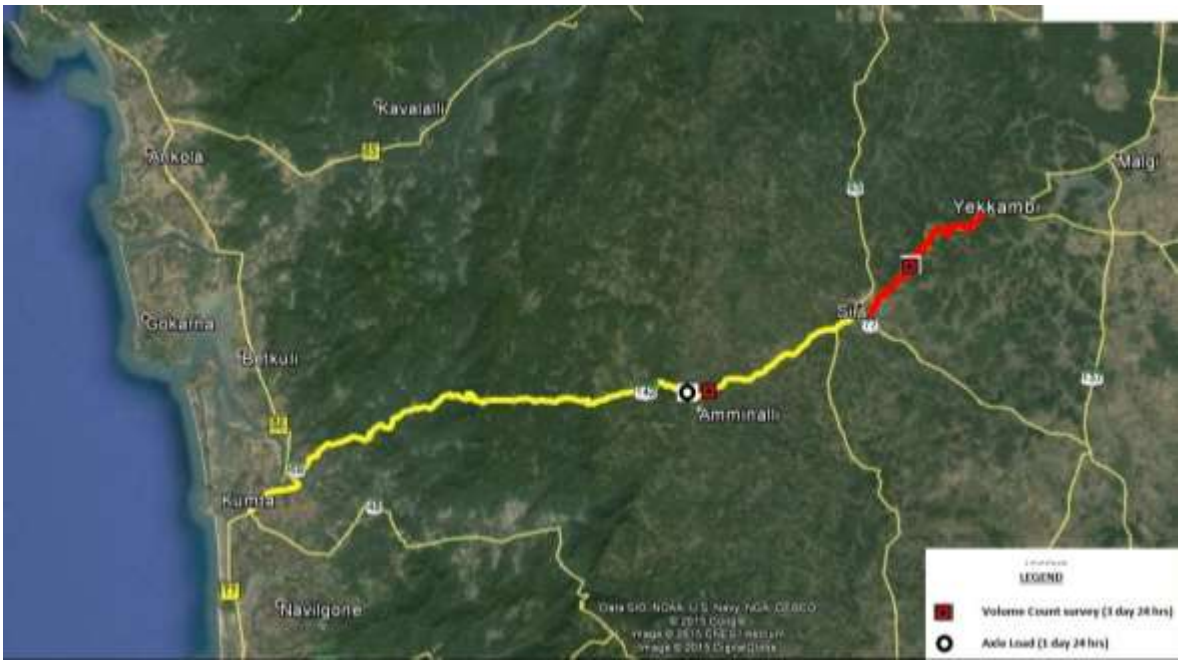


Figure 3.2: Traffic Survey Locations (Kumta - Yekkambi) (SH-69)

4.5. Speed & Delay Surveys

Speed & Delay Survey will be carried out for the project road and competing roads to assess the current journey speed and delay.

4.6. Pedestrian /animal cross traffic Surveys

Pedestrian surveys will be carried out at major settlement, commercial areas, road intersections and sensitive land use areas for peak hours. The pedestrian count survey locations are given in Table 3.4.

Table 3.4: Pedestrian Count Survey Locations

CEW 14: Kumta - Yekkambi (SH-69)			
1	Pedestrian Count Survey	Kumta – Yekkambi	Sirsi

4.7. Truck Terminal Surveys

No truck terminals are present along the study corridors. Hence information on truck parking/ demand areas will be assessed.

4.8. Analysis of Traffic Volume Count

Traffic data collected through traffic surveys will be analyzed to assess:

4.8.1. Existing Traffic Scenario

The following characteristics of the traffic are derived,

- *Average Daily Traffic (ADT) (in terms of total vehicles, total PCU) on traffic homogenous sections on the project road;*
- *Intersection turning volumes from previous study;*
- *Vehicle Damage Factor (VDF) from axle load surveys;*
- *Pedestrian traffic along built-up areas – from pedestrian volume counts;*
- *Passenger and commodity movement patterns – from Origin– Destination (OD) Surveys of previous study;*
- *Road user willingness for toll – from willingness to pay survey;*
- *Average journey speeds and junction delays – from speed and delay survey.*

4.9. Traffic Forecast

Traffic forecast will be made for the period of 30 years for all categories of vehicles, based on the O-D survey and adopted growth factors. From the O-D survey, it could be seen what percentage of the vehicles plying the project stretch has its origin and destination beyond the stretch. This established whether there would be any local impact or not, and the zone of influence. The traffic growth factor presented for the present year and every 5 years interval up to 30 years is based on:

- *Past traffic growth rate on the project stretch;*
- *Vehicle registration figures as per zone of influence for at least the last 5 years;*
- *Population growth rate as per zone of influence;*
- *NSDP / GDP growth rate for Regional/National respectively at 2004-2005 constant prices;*
- *Vehicle ownership;*
- *Elasticity of Road Transport Demand in relation to GNP/GDP;*

A flow diagram for derivation of growth factor is given in **Figure 3.3.**

All available traffic reports and forecasts were reviewed to compare with the established growth factor.

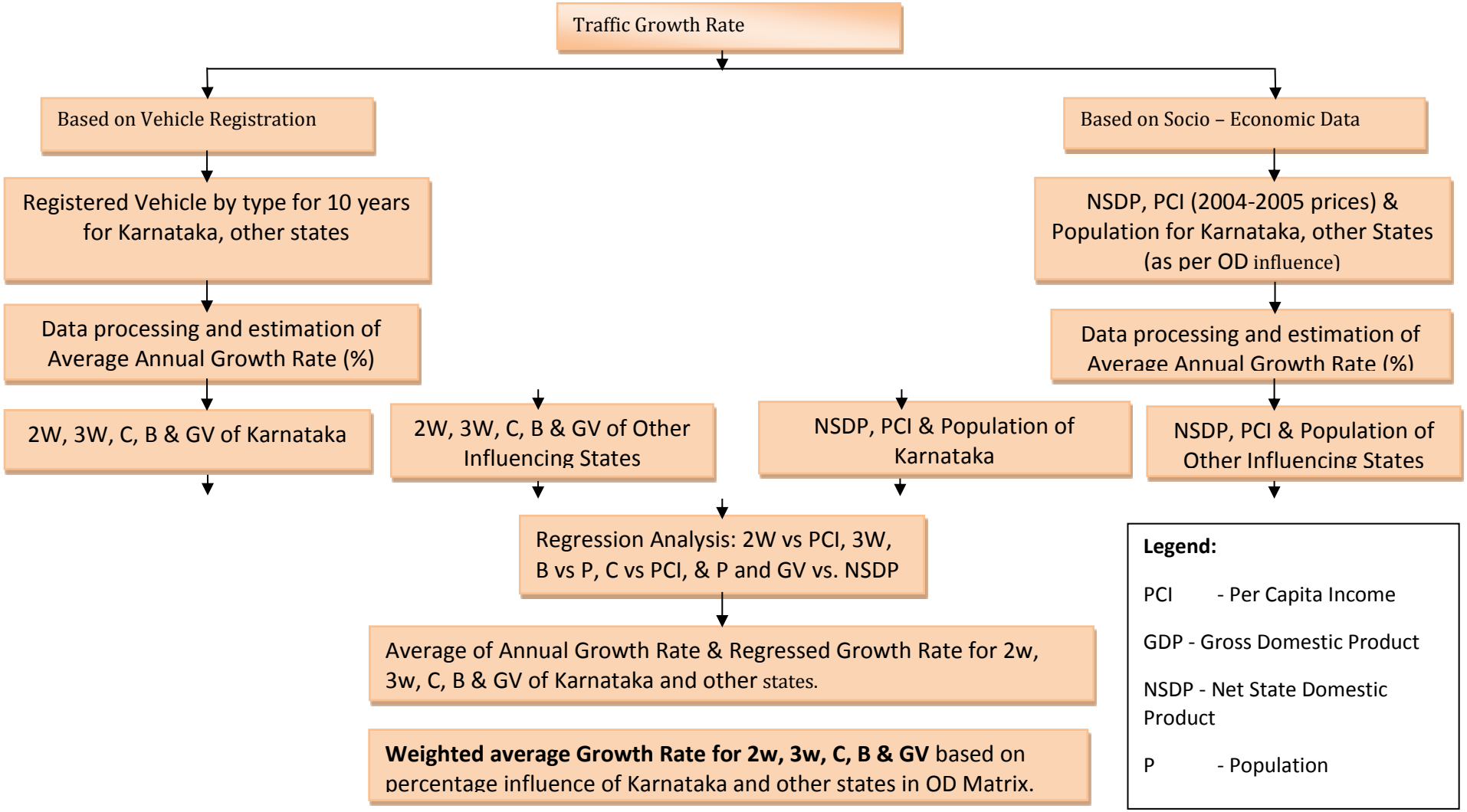


Figure 3.3: Flow Chart for Traffic Projection

4.8.2. Outputs

The following will be the outputs from the traffic surveys and analysis

- *AADT (Annual Average Daily Traffic of the base year*
- *Traffic influencing regions from the OD analysis for traffic forecast*
- *Traffic projections for design period*
- *Existing capacity and Level of service for present and future years*
- *Road widening proposals*
- *Junction improvements*
- *Pedestrian volume, recommendations on pedestrian facilities*
- *Journey speeds and delays on the project corridors*
- *Requirement of truck terminals*
- *Requirement of bicycle lanes*
- *Toll plaza locations and toll traffic (if project on PPP)*

5.1. SALIENT FEATURES OF THE PROJECT ROAD

Salient Features of the project road is summarized below:

Table 4.1: Summary of Salient Features of the Project Road

Sl. No.	Particulars	Details	Remarks
1	Start km	SH 69 - km 0+000	NH 17 Junction
2	End km *	SH 69 - km 76+000	SH 2 Junction
3	Total Length	76.000 Km	
4	Districts	1 No.	Uttara Kannada
5	Terrain	Plain & Hilly	
6	Carriage way	Intermediate lane for most of the length. 2 lane at few locations	12m carriageway was found in Devimane ghat section near Hair pin bends with 1.1m shoulders on either side and CC drain.
7	Major Built-ups	1 No's	Sirsi
8	Major Bridges	1	1 RCC Girder Bridge.
9	Minor Bridges	11	5 RCC Slab, 4 RCC Girder and 2 Stone Masonry Arch Bridges
10	Culverts	249	HP - 205, RCC Slab/ RCC Box – 44
11	Major Junction	3 No's	NH 17, SH 142, SH 2
12	Utilities	OFC's, Electric Poles, HT Line Crossing	
13	Sensitive Features	21 No's	Temples, mosques, churches etc.

6.1. DESIGN STANDARDS

Design standards for this project will conform with "Manual for Specification and Standards" for two laning of Highways with Paved Shoulder (IRC:SP:73-2015), "Manual for safety in Road Design" by Government of India, Ministry of Road Transport & Highways (Road Wing -September 1998), Manual of specification & standards for four laning (IRC:SP:84-2014), Road Safety Audit Manual (IRC:SP:88-2010) and various relevant standards published by Indian Roads Congress. All notations, abbreviations and symbols used in the reports, documents and drawings shall be as per IRC:71-1997.

- This section lays down the standards for Geometric Design and general features for upgrading the existing roads to two-lane with paved shoulders.
- Stretches passing through built up areas shall normally be provided 4-Lane Divided carriageway with / without service road.
- Existing Horizontal Curves, which are found deficient in radius, layout, transition lengths or super-elevation shall be corrected to the specified standards. Similarly deficiencies in the vertical alignment shall also be addressed. Safety Audit (as per IRC code checklist) shall be done at each stage of project preparation.

Table-5.1 Design Standards

Sl.				
1.	Design Speed Ruling Minimum	Km / hr	Plain / Rolling	Hilly
			100	60
			80	40
2.	ROW	m	Plain / Rolling	Hilly
	Rural (open country with isolated built up areas)		30 - 45	24
			28 - 45	20
	Urban (built-up)		60	-
3.	Lane Width	m	3.5	
4.	Kerb Shyness (for 4-lane in Built up	m	0.50	
5.	Raised Median (for 4-lane in Built up	m	1.50	
6.	Footpath (In Built up area)	m	1.50	

7.	Shoulder terrain (plain / rolling)	m	Type	Paved	Un-	Total
			Rural	1.5	2.0	3.5
			Built-up	2.5	--	2.5
			Approaches to grade	2.0	--	2.0
			Approaches to bridges	1.5	2.0	3.5
8.	Mountainous / Steep Terrain	m	Type	Paved	Un-	Total
			Hill side (Rural)	1.5	--	1.5
			Valley side (Rural)	1.5	1.0	2.5
			Hill side (Built-up /	0.25+	--	1.75
			Valley side (Built-up	0.25+	--	1.75
9.	Camber Carriageway Paved Shoulders Earthen Shoulders	%	Flexible	Rigid		
			2.5	2.0		
			2.5	2.0		
			3.0	2.5		
10.	Gradients Plain and Rolling Mountainous	%	Ruling	Limiting		
			2.5	3.3		
			5.0	6.0		
11.	Super elevation	%	7.0			
	R) Desirable minimum/urban		5.0			
12.	Crossover (Maximum)	%	-0.5% reverse on outer edge			
	Minimum Horizontal Curve Radius		Plain &. Rolling			
13.	Minimum Horizontal Curve Radius	m	400	Mountainous &. Steep		
14.	Desirable minimum Absolute minimum	m	100 km /hr	150 75		
14.	Sight Distance Stopping Sight Distance	m		80km / hr		
15.	Intermediate Sight Distance Overtaking Sight Distance		100 km /hr	120 240		
	Absolute Minimum Vertical Curve					
	Absolute Minimum Vertical Curve Length (SSD case)			80km / hr		
15.	Summit Sag					
16.	Widening at curve locations 75-100 m 101-300 m	m	0.9	32.6A*		

Note: A* in the above table is the algebraic difference in grades expressed as percentage.

7.1. IMPROVEMENT PROPOSALS

The main objective of geometric design for the project alignment is to provide an optimal geometry, which will satisfy the following criteria:

- Enable the Road Facility to perform its desired function with optimal safety considerations.
- The uniformity of the Design Standards shall be maintained throughout the length.
- Existing Horizontal Curves, which are found deficient in radius, layout, transition lengths or super-elevation, shall be corrected to the specified standards. Similarly deficiencies in the vertical alignment shall also be addressed.
- Minimize the Construction, Operations and Maintenance Costs.

- Minimize Environmental and Social Impacts to the users in particular and community at large.
- Locations not conforming to design standards for the design speed limit as per IRC standards, sharp right angle and sections prone to accidents were corrected by short realignments and also locations where alignment is passing through short stretches of congested areas and roadway improvements would have had social impact and difficulty in acquiring required ROW were resolved by proposing short realignments.
- Based on traffic analysis Project road qualifies for 2 lane with paved shoulders on both sides between year 2020 & 2025 when it reaches 12000 plus PCU which just 3 to 4 years from the year of construction. Based on traffic requirement project road is recommended to be improved with 2-lane with paved shoulders. However improvement for sections passing through wildlife is not considered based on MOeF circular. Detailed traffic summary is provided in Table 5.1.

7.2. Horizontal Design

Highway design for all geometric elements should, as far as economically practical, to provide safe, continuous operation at a speed likely to be observed under the normal conditions for the highway. Alignment section in existing condition is predominantly 3.75 m to 7.0 m carriageway and 1 to 2.0 m earthen shoulder. It is noticed in existing condition majority locations, horizontal curves do not conform to IRC standards. In the proposed improvement proposal deficiency in the geometrics of the road is removed for safe flow of traffic as per guidelines below:

- Improve deficiency of curve radius as per codal provision for 100/80 km /hr. speed limit.
- Short realignment for locations with sharp horizontal curve radius and hot spot location is provided to reduce impact due to proposed improvement proposal.
- Sufficient sight distance was provided to enable a vehicle travelling at or near the design speed to stop, before reaching a stationary obstruction.
- The requisite sight distance shall be made available across the inner side of the horizontal curves.
- Super-elevation for design horizontal curve as per standards for smooth transition of vehicles along the curve

7.3. Vertical Profile

The topography of the land traversed has an influence on the alignment of roads and streets. Alignment section is passing through plain terrain and runs on embankment generally 0.5 m to 1.5 m except in portion of approaches to bridges and culverts, where the height of embankment goes to 5m to 8m. In level terrain highway sight distances, generally governed by both horizontal and vertical restrictions, are generally long and can be constructed without much difficulty or major expense. As discussed earlier in this chapter, design speeds are used as a means for design, by correlation of various geometric features of the highway and guidelines below,

- The vertical alignment is designed so as to provide a smooth longitudinal profile and desired sight distance.
- A gradient corresponding to the ruling gradients is followed in the vertical alignment design

- Long Vertical Curves shall be provided at all grade changes.

7.4. Typical Cross Sections

Typical cross sections for different road sections were developed and is summarized in **Figure** 5**.12.-**

- **Figure 7.1** TCS–1 Two lane carriageway with paved shoulder in rural areas
- **Figure 7.2** TCS–2 Two lane carriageway with paved shoulder in rural area embankment more than 3.0 m height (new construction)
- **Figure 7.3** TCS–4 Two lane carriageway with paved shoulder in Urban / Village area
- **Figure 7.4** TCS–5 Four lane Carriageway with footpath cum Drain in Urban
- **Figure 7.5** TCS–10 Two lane Carriageway with retaining wall in Hill/Ghat section
- **Figure 7.6** TCS–11 Two lane Carriageway without retaining wall in Hill/Ghat section
- **Figure 7.7** TCS–12 Two lane Carriageway with footpath, retailing wall & Parapet in Hill/Ghat section built-up areas

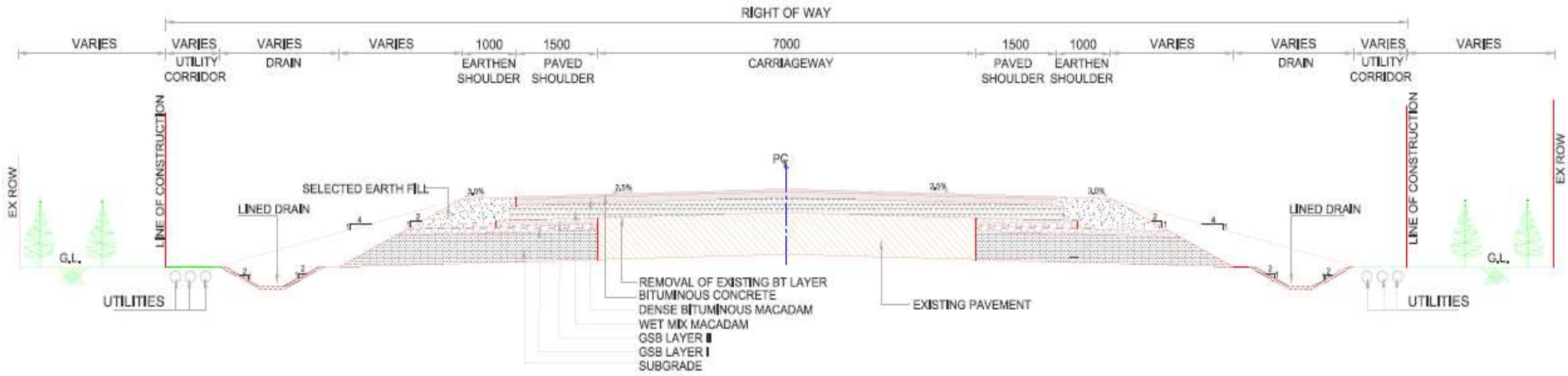


Figure 7.1 TCS–1 Two lane carriageway with paved shoulder in rural areas

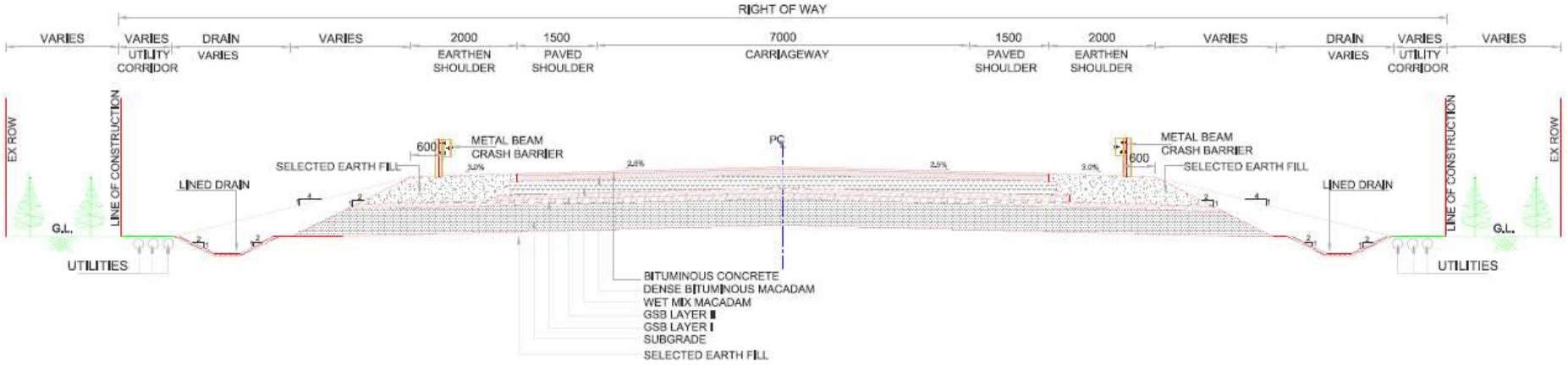


Figure 7.2 TCS–2 Two lane carriageway with paved shoulder in rural area embankment more than 3.0 m height (new construction)

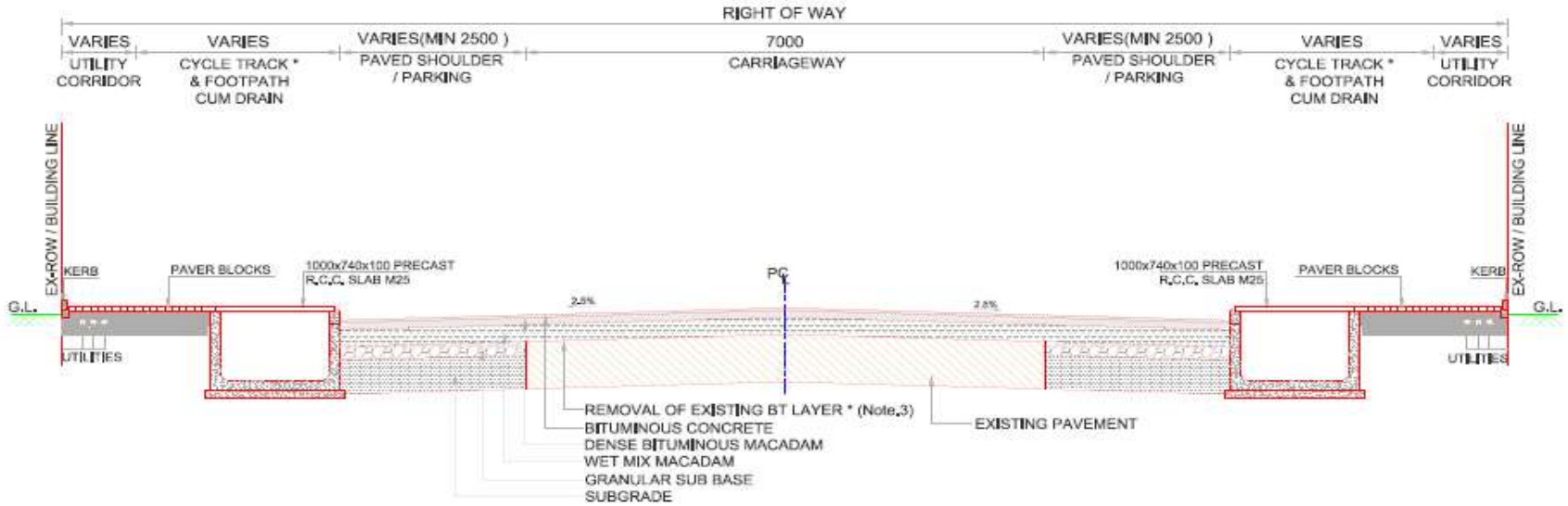


Figure 7.3 TCS–4 Two lane carriageway with paved shoulder in Urban / Village area

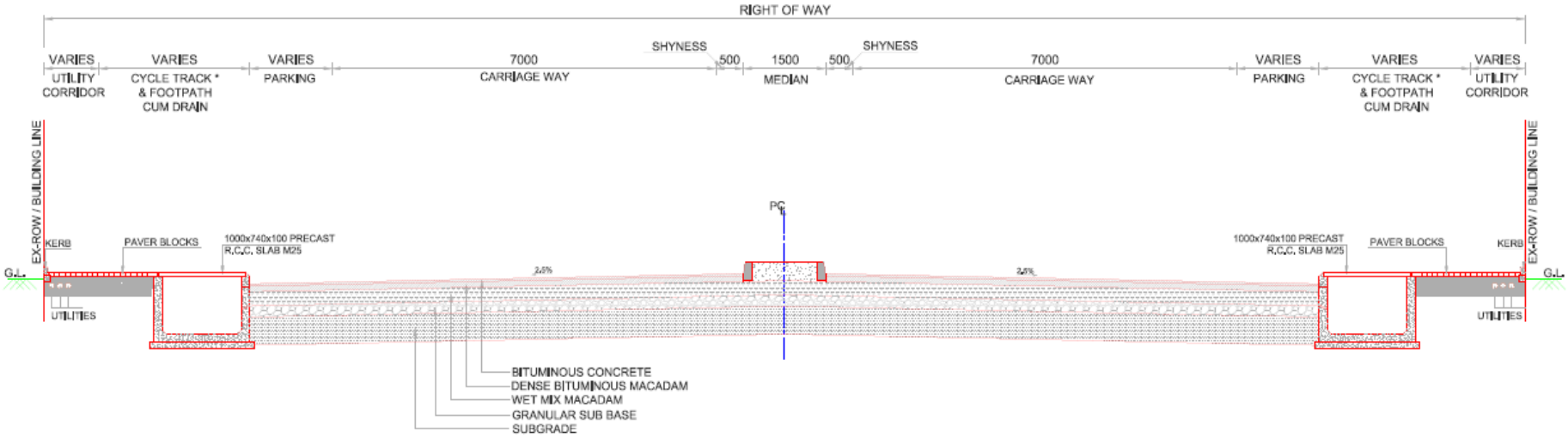


Figure 7.4 TCS–5 Four lane Carriageway with footpath cum Drain in Urban

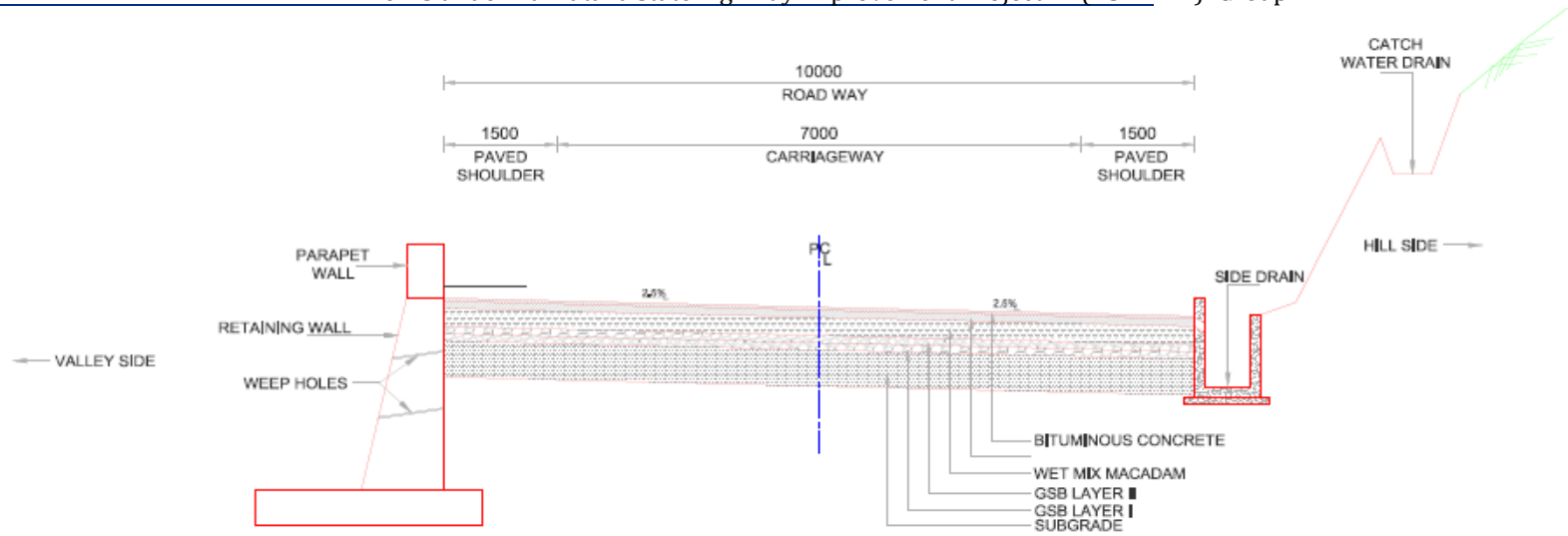


Figure 7.5 TCS–10 Two lane Carriageway with retaining wall in Hill/Ghat section

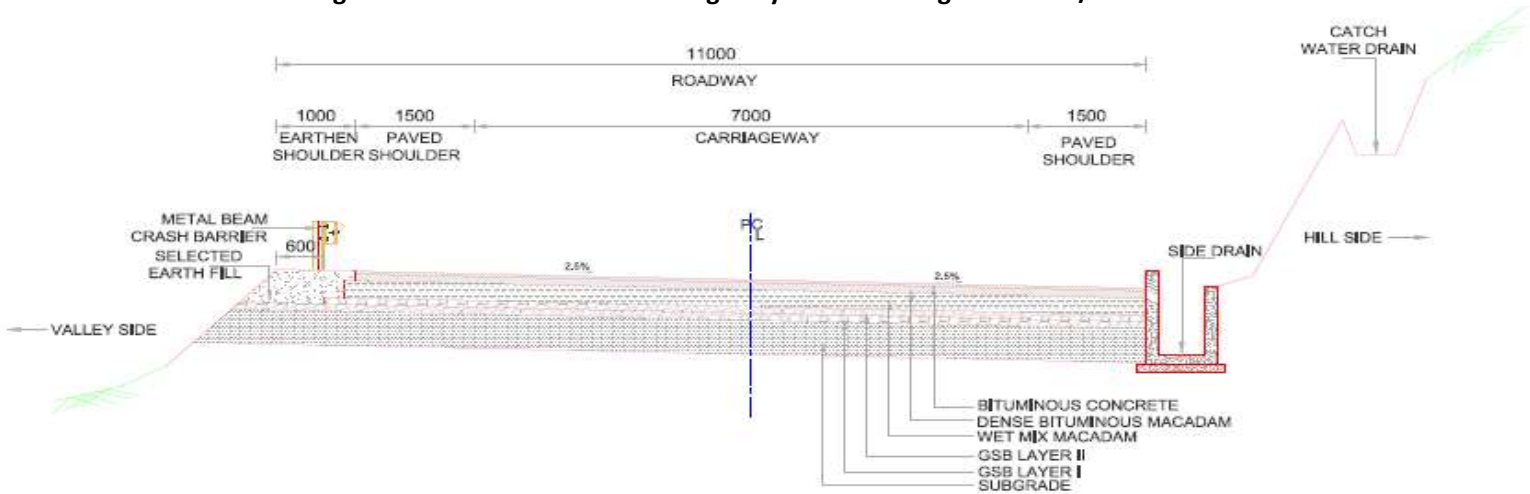


Figure 7.6 TCS–11 Two lane Carriageway without retaining wall in Hill/Ghat section

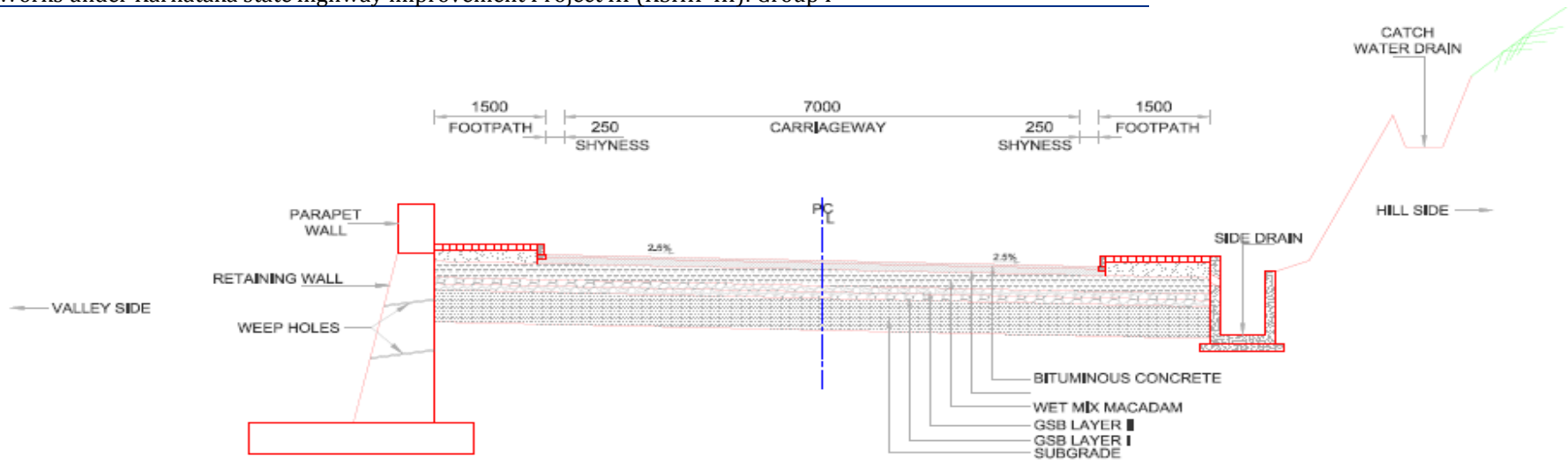


Figure 7.7 TCS–12 Two lane Carriageway with footpath, retailing wall & Parapet in Hill/Ghat section built-up areas

7.5. Construction Materials

Table: 6.1: Table Showing tentative quantities of construction materials and expected sources

Description	Unit	Quantity	Expected Source
Earth	Cum	1219027	Approved borrow areas
Non-Bituminous Courses	Cum	579259	Pre-identified quarry areas
Bituminous Courses	Cum	95660	Refinery
Cement Concrete	Cum	101322	Local Traders
Steel	T	7332	Local Traders
Brick	No.	6864	Local brick Kiln
Sand	MT	370978	Pre-identified quarry areas
Diesel	KL	14839	Local petrol pumps

7.6. Road Safety Devices

The Road Safety Devices shall consist of the following:

- Road Markings
- Traffic Signs
- Roadside Safety Barriers including Pedestrian Railings.

7.7. Road Markings

- Road Markings shall comprise of carriageway markings such as longitudinal markings and object markings such as raised pavement markers (Cat's Eyes or Road Studs).
- All markings shall conform to IRC:35.

7.8. Road Signs

- Three types of Road signs shall generally be provided (such as Mandatory / Regulatory, Cautionary / Warnings, and informatory signs.
- Locations of Signs shall conform to IRC:67-2012 and Section 800 of MoRT&H Specifications.

7.9. Roadside Safety Barriers

The following types of Road Safety Barriers shall be provided on the Project Road Sections:

- Semi-rigid type / rigid type / flexible type safety barriers shall be provided on the high Embankment Section (where the height of embankment is more than 3.0 m)
- Rigid Type such as Concrete Crash Barriers shall be provided on the bridges, isolated structures and its approaches.

7.10. Road Drainage

The general design guidelines for the Road Drainage shall be as under:

- The Design of Drains shall be carried out in accordance with IRC:SP:42 and IRC:SP:50-2013
- For Surface Drainage, the estimation of Design Discharge and the design of Drain Sections shall be as per the procedure given in IRC:SP:42-1994.
- The longitudinal slope of the drain shall not be less than 0.2% for lined drains and 0.3% for unlined drains.
- The Side slopes of the unlined drains shall not be steeper than 2H:1V.
- The Drains on the paved areas shall be provided with CC linings.
- The Drainage of High Embankment shall be provided with the provision of Kerb channel and CC lined chutes.
- The chute drains and drains at toe of the embankment shall be of Plain Cement Concrete.
- Necessary Sub-Surface Drains shall be provided as required.

8.1. PRELIMINARY COST ESTIMATE

Table 7.1: Summary of Cost

SUMMARY OF COST		Pkg 6: Kumta- Yekkumbi Rolling/Hilly
Sl.	**Particulars**	**Amount (Rs.)**
1	Bill No. 1: Site Clearance	7,630,862.12
2	Bill No. 2 : Earth Work	475,091,120
3	Bill No. 3 : Granular Sub	996,380,315
4	Bill No. 4: Bituminous	1,069,650,087
5	Bill No. 5 : Culverts	313,475,655
6	Bill No. 6A: Minor	55,766,400
7	Bill No. 6B: Major	101,981,250
8	Bill No. 7A : ROB	
9	Bill No 8 : Drainage and	320,335,606
10	Bill No. 9 : Traffic signs,	345,921,001
11	Bill No.10: Bus/Truck lay	106,186,643
12	Bill No.11: Electrical	52,657,543
13	Bill No.12: Rest area	22,200,000
14	Bill No.13: Miscellaneous	23,723,519
	TOTAL	**3,891,000,000**
	In crores	**389**
	Length of the project	**74**
	CIVIL CONSTRUCTION	**52,581,081**
	Say in crores	**5.26**