Republic of India
Hyderabad Growth Corridor Limited

REPUBLIC OF INDIA

THE ASSISTANCE FOR THE INTRODUCTION OF ITS RELATED TO HYDERABAD OUTER RING ROAD CONSTRUCTION PROJECT

FINAL REPORT

SUMMARY

October 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

ALMEC CORPORATION
EAST NIPPON EXPRESSWAY COMPANY LIMITED

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Table of Contents

List of Tables

List of Figures

Abbreviations

AP	Andhra Pradesh
APSRTC	Andhra Pradesh State Road Transport Corporation
BOT	Build-operate-transfer
DSRC	Dedicated short range communication
EOI	Expression of Interest
ETC	Electronic toll collection
GHMC	Greater Hyderabad Municipal Corporation
GPRS	General packet radio service
GPS	Global positioning system
HGCL	Hyderabad Growth Corridor Limited
HTMS	Highway Traffic Management System
HMDA	Hyderabad Metropolitan Development Authority
HUDA	Hyderabad Urban Development Authority
IC	Interchange
IT	Information technology
ITS	Intelligent transportation system
JICA	Japan International Cooperation Agency
MoRTH	Ministry of Road Transport and Highways
MoUD	Ministry of Urban Development
NHAI	National Highway Authority of India
OBU	On-board unit
ORR	Outer Ring Road
PCU	Passenger car unit
PPP	Public-private partnership
PQ	Prequalification
RFP	Request for proposal
SAPI	Special Assistance for Project Implementation
T&G	Touch and Go
TCC	Traffic Control Centre,
TMS	Toll management System
TOR	Terms of reference

Summary

1. Introduction

1.1 Project Background

In 2005, the state government of Andhra Pradesh decided to construct the Outer Ring Road (ORR) to ease traffic in the city centre and to contribute to the development of the local economy. A loan agreement to finance Phase 2-B of the ORR was signed in November 2008 between the governments of Japan, through the Japan International Cooperation Agency (JICA), and the Republic of India with the Hyderabad Growth Corridor Company HGCL) as executing agency. The ORR Phase 2-B includes a component on the introduction of intelligent transportation systems (ITSs).

In order to support the implementation of the ITS components, JICA conducted a Special Assistance for Project Implementation (SAPI) from September 2008 to May 2009 and formulated an implementation plan that included a proposal for an institutional setup to manage the ITS. The implementation plan recommended HGCL to introduce Toll Management System (TMS) and Highway Traffic Management System (HTMS) to the entire stretch of the ORR.

Based on the SAPI recommendations, HGCL decided to construct these systems on the ORR and requested JICA a technical assistance for the project as they don't have knowledge and experience of these advanced systems. Technical assistance project called "Assistance for the Introduction of ITS Related to the Hyderabad Outer Ring Road Construction Project in the Republic of India" started in February 2010. The technical assistance project assisted HGCL in establishing TMS and HTMS on the ORR, in formulating suitable organization to manage these systems, and in operating and maintaining these systems. The technical assistance project was completed in September 2013.

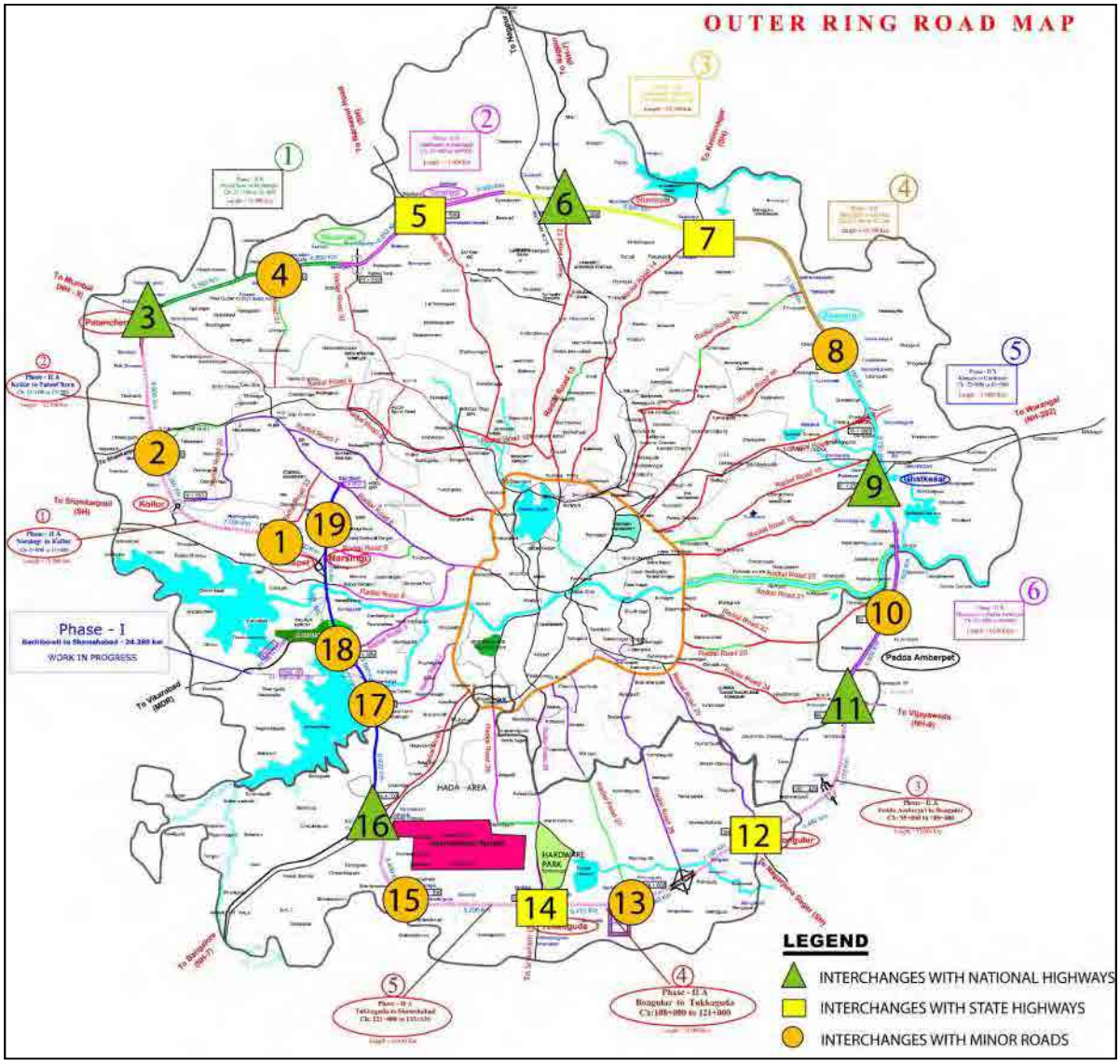
1.2 Objectives of the Project

The objectives of the project are to enhance the benefits of developing the Hyderabad Outer Ring Road, the objectives of this project are to assist HGCL in the following area:

- Introduce ITS services on the Hyderabad Outer Ring Road;
- Establish efficient operation and management system; and,
- Introduce ITS to relevant organizations.

1.3 Project Area

The project area covers the Hyderabad Outer Ring Road and related roads. The outline of the Outer Ring Road and its interchanges are shown in Figure S. 1.



Source: HGCL

Figure S. 1: Location of the Outer Ring Road and Its Interchanges

2. ITS in India

2.1 Overview of ITS in India

Three electronic toll collection (ETC) systems are in operation on a commercial basis in India. The toll roads with ETC are Delhi Gurgaon Expressway, Delhi Noida Toll Bridge (DND Flyway) and Mumbai-Pune Expressway.

2.1.1 Delhi Gurgaon Expressway

Delhi Gurgaon Expressway is the 27.7 km long access-controlled toll express road completed in January 2000.

Delhi Gurgaon Expressway has three toll plazas, i.e., the Indira Gandhi International (IGI) Airport Toll Plaza with 6 lanes, the Km 24 Toll Plaza at Delhi Gurgaon Border on NH-8 with 32 lanes, and the Km 42 Toll Plaza near Haldiram on NH-8 with 18 Lanes. Manual, Smart Card, and Smart Tag toll collection equipment are used for the toll collection. The present price of Smart Tag is Rs. 2000, in which Rs. 1500 is for onetime administrative fee (non-refundable) for Smart Tag OBU device and Rs. 500 is for pre-charge fee.

2.1.2 Delhi Noida Direct Flyway

DND Flyway is a 9.2 km, eight-lane access controlled road which connects Delhi and Noida, an industrial suburb of the capital city. The Flyway operator is Noida Toll Bridge Company Ltd which constructed the facility on a Build Own Operate Transfer (BOOT) basis. The Noida Toll Bridge Company Ltd chose its ETC technology from an Austrian company Efkon, which uses infrared ISO CALM (Communication Air-interface Long and Medium) standard.

The payment options for the toll are Gold Card, which uses infrared OBU (On Board Unit), Silver Card, which is the touch & go pre-paid IC card, and cash by manual. The price of OBU device is Rs 2000 plus Rs. 500 for security deposit (refundable). The discount rates are available for corporate fleets.

2.1.3 Mumbai - Pune Expressway

The Mumbai Pune Expressway, or officially “Yashwantrao Chavan Expressway” is 93 km in length connecting Mumbai, the administrative capital of Maharashtra State and the financial capital of India, with Pune, an industrial hub and cultural capital of the state.

The payment options for the toll are the touch & go pre-paid IC card, and cash by manual. EPC (Electronic Product Code) global C1Gen2 passive RFID (Radio Frequency Identification) using UHF frequency (860-960 MHz), based ETC system is installed on the two Major Interchanges at Khalapur and Talegaon.

2.1.4 ETC Pilot Projects by Ministry of Road Transport and Highways

National Highway Authority India (NHAI) had launched a pilot project to decide an appropriate ETC technology for Indian highway operation under the approval of Ministry of Road Transport & Highways (MoRTH). MoRTH has identified three locations for these Pilot Studies for the technological comparison. Three technologies tested in these Studies are 5.8 GHz microwave (passive), 5.8 GHz microwave (active), and Communication Air-interface Long and Medium Range-infra red (CALM-IR).

Partly because the lack of technological specifications from the NHAI and partly because ETC selections are imposed upon the BOT contractors who do not have technological backgrounds, the pilot project halted and actual operation ETC was not implemented.

2.1.5 ETC Committee and its Report

In January 2010 MoRTH Minister Mr. Kamal Nath took initiatives to establish an ETC Committee which is independent from MoRTH. On 28 June, 2010, ETC Committee submitted the Report to

Mr. Nath and the proposed scheme would be implemented in the next 18-20 months.

The Report recommended adopting RFID based on EPC, Gen-2, ISO 18000-6C standard for ETC on National Highways in India. EPC (Electronic Product Code) global C1Gen2 is the most common passive RFID (Radio Frequency Identification) using UHF frequency (860-960 MHz), known as the "ten-cent tag." The Report emphasized that "the most persuasive reason in favor of passive tag is the cost and low maintenance."

2.2 Promotion of ETC in India

Three kinds of activities are proposed to promote by the project. They are:

Public relations and marketing

Public relations and marketing promotions should be indispensable at least at the introductory phases. The PR should be based on media-mix including newspapers, magazines, radio programs, TV channels, and Internet web pages. Feedbacks, i.e., users' opinions and claims should be properly treated by appropriate sections established for this purpose.

ETC Trial Operation

In order to demonstrate the convenience of ETC system, an ETC trial operation ot project was planned. The scheme of trial operation is presented in the chapter of ETC trial operation

Fare discount for ETC users

ETC users should be beneficial for the usage of the Touch & Go smart card and the OBU based ETC. It is notable that road operator and fee collectors are beneficial from pre-paid ETC system because it allows a fund deposit which yields interest. Significance of the introduction of special discount rate for ETC users is well proven in Japan.

3. Traffic Survey, Demand Forecast and Toll Rate Setting

3.1 Traffic Survey

Traffic survey was conducted:

1) To identify possible conversion traffic to ORR.

2) To identify drivers time value and willingness to pay toll road.

Two kinds of surveys were carried out at 22 locations in this study. All survey locations are near the ORR.

1) Traffic Count Survey

2) Roadside OD Interview Survey including willingness to pay

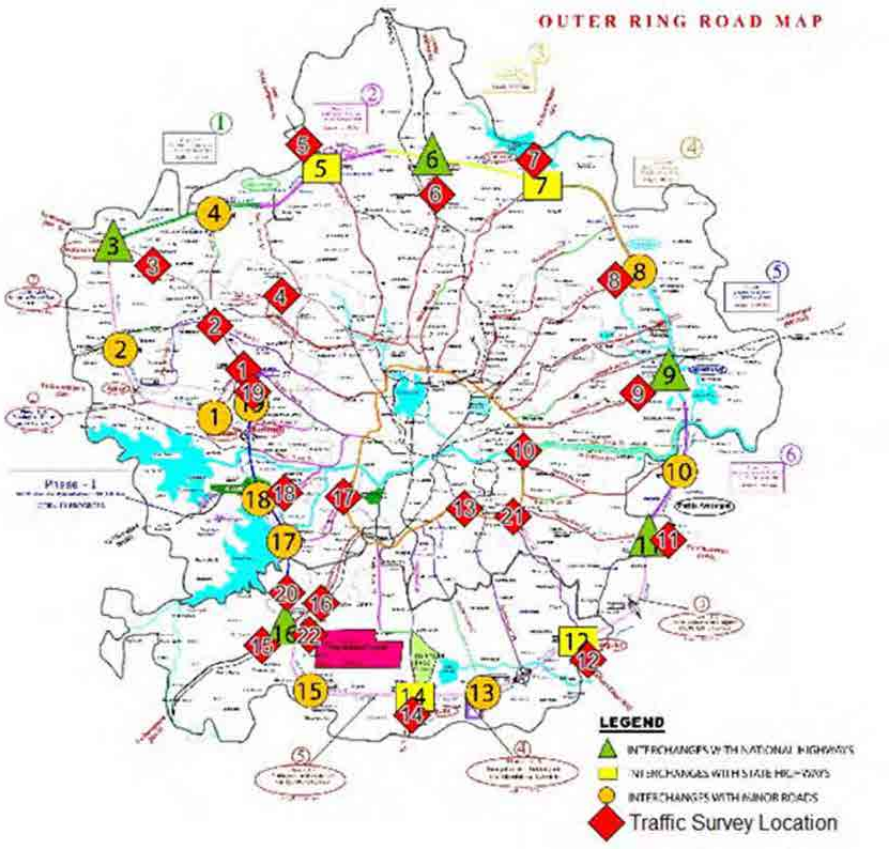


Figure S. 2: Traffic Survey Location

Some of the observed characteristics are listed below.

- Location 4, 6, 7, 10, 13, 16 and 21 are higher vehicle volume, more than 15,000 vehicles by both directions.
- Daily average percentage of 2 & 3 wheeler is 34.3 %. Location 1, 3, 5, 8, 13 and 14 are higher rate more than 40 %. On the other hand, location 9, 11 and 22 with ORR tentative operating sections, location 19 and 20 are lower rate less than 25 %.
- Daily average percentage of passenger vehicle except 2 & 3 wheeler is 37.0 %. Location 22 with ORR tentative operating sections, location 19 and 20 are higher rate more than 50 %. On the other hand, location 5, 8, 9, 11 and 13 are lower rate less than 30 %.
- Traffic volume of all types of increased 35% as compared with the traffic count survey

conducted in 2008 by JICA SAPI Study.

3.2 Traffic Demand Forecast

Three following scenarios are adopted in this study.

Table S. 1: Development Scenario

No.	Scenario
1	Trend scenario following HUDA Master Plan.
2	Trend scenario with development along ORR. HGCL anticipates development in the area 1 km from ORR on both sides like the same levels city area.
3	Same development along ORR as Scenario 2 with congestion on IRR

Other parameters used in demand forecast are as follows.

Table S. 2: Method and Parameters for Demand Forecast

Item	Contents
Network	Present network and future network in 2020 and 2030 are used in the demand forecast..
Model	Frater Method Trip Distribution Model
OD Table	shown in Figure S. 3
Traffic assignment	Calibrated present daily average link volume is shown in Figure S. 4 and future volume in 2030 shown as future maximum volume case in Figure S. 5

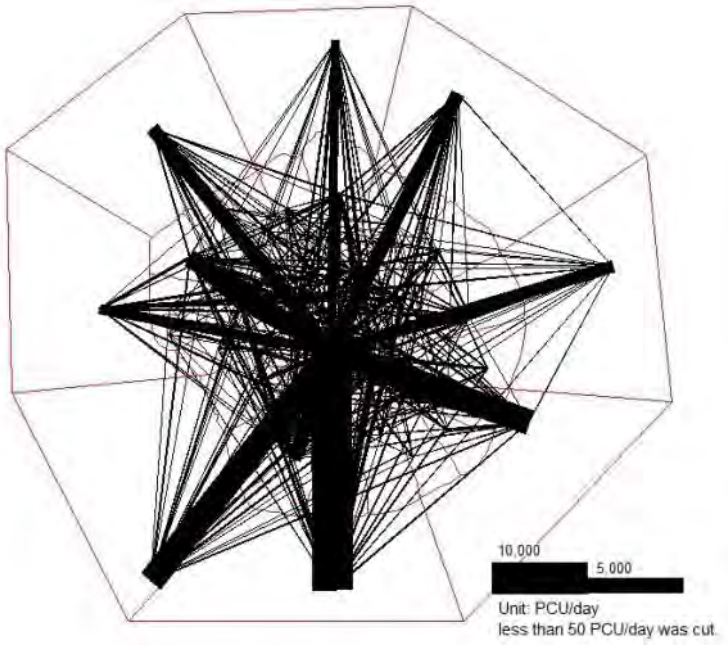


Figure S. 3: Present OD Desired Line made by Traffic Survey in 2010

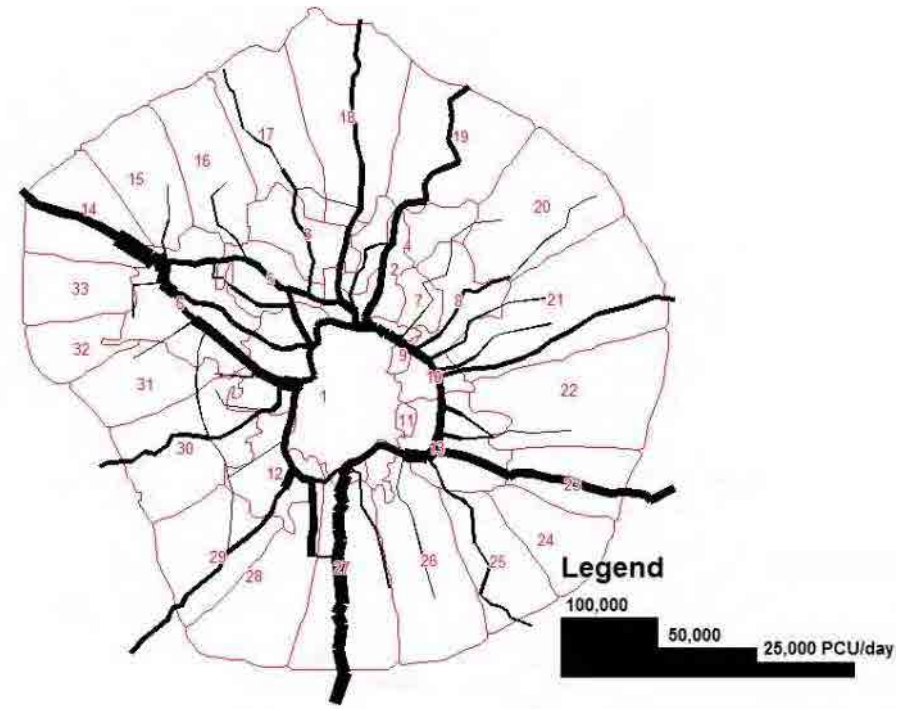


Figure S. 4: Present Daily Average Traffic Volume in 2010

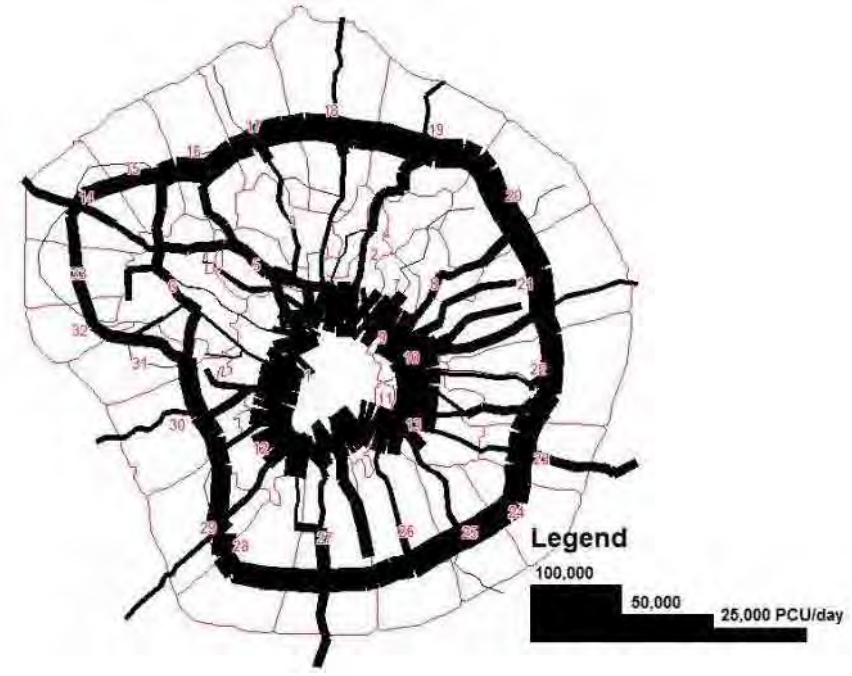


Figure S. 5: ORR Maximum Volume Case in 2030 (Scenario 3, without toll)

3.3 Sensitivity Analysis for ORR Toll

Methodology of sensitivity analysis is orthodox to estimate demand and revenue fluctuation by changing toll under same OD table and network in each scenario. In Scenario 3 maximum revenue case is 1.3 Rupees/km.

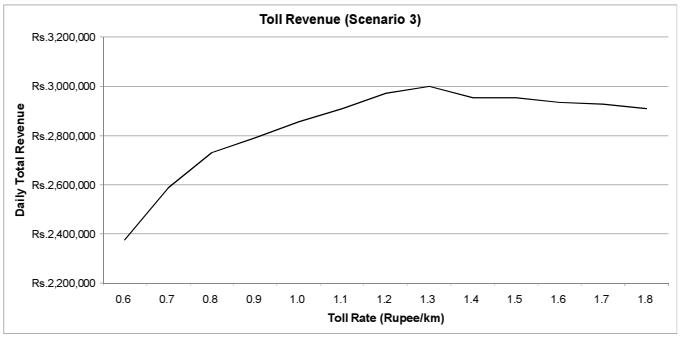


Figure S. 6: Sensitivity Analysis for ORR Toll (Scenario 3)

3.4 Summary of Demand Forecast

ORR minimum traffic volume and minimum revenue scenario is Scenario 1, trend case. In Scenario 3 of IRR congestion consideration, ORR demand and revenue is higher than other scenarios.

In case of Scenario1 in 2030, ORR section demand is 3,500 - 18,400 PCU/day. In Scenario 2, ORR section demand is 5,200 - 24,900 PCU/day. In Scenario 3, ORR section demand is 2,200 - 26,800 PCU/day

Daily revenue is 1.4 million Rupees in Scenario1, 1.9 Rupees in Scenario 2 and 3.0 million Rupees in Scenario 3.

3.5 Recommendation

Maximum demand and revenue case is 1.3 Rupees/km of toll rate in Scenario 3. However, traffic volume inside of IRR and IRR itself are not clearly understood at this moment by following reason.

- After 2002, traffic survey is not conducted inside of IRR and IRR itself.
- Latest population in study area was by 2001 census. Already 9years past.

4. Toll Management System

4.1 Outline of system

A closed type toll management system will be introduced to the ORR and drivers will be charged with a toll corresponding with the distance travelled. Tolls will be collected from all motorized vehicles using the ORR with the exception of VIP car movement, emergency services, high personages and military convoys and other exemptions.

Three type of toll collection method will be adopted; Electronic Toll Collection (ETC), Touch & Go (T&G), and manual. ETC will be installed at dedicated lanes while all other lanes will be equipped with both manual and touch & go facilities. ETC and T&G will use prepaid payment system and the same contactless IC card will be interchangeably used for ETC and Touch & Go. No post paid payment system will be introduced to the toll management system.

A set of toll lane equipment will be installed in the tollbooth, on the toll island or its vicinity for toll collection operation. The operation of all lane equipment will be monitored continuously by a plaza computer system that will compile; audit and prepare the statistical data for print out, for display in the Plaza building control room or onward transmission to Traffic Control Centre (TCC). A Main Traffic Control Centre will be constructed at Nanakramguda and a Sub Traffic Control Centre will be constructed at Ghatkesar interchange. Two traffic control centre systems will be constructed for backup purpose and they will be identical in the system configuration.

The Plaza Computer System (PCS) will also provide management functions such as attendance recording, reconciliation between declared and expected toll collection and control of cash transferred from the plaza to the bank.

Each plaza will operate as an autonomous system with no data communication between plazas and between plaza and Traffic Control Centre being necessary. A data communication network via fibre optical cable will be provided under a separate contract. However, a complete data communication link from the Toll Lane Controller to the PCS and between PCS and TCC system and all the necessary interfaces to this data communication network will be provided by the TMS Contract.

4.2 Design Policy and System Configuration

4.2.1 Vehicle Classification and Toll Fare

Vehicles will be classified into five (5) types based on the number of axles, height of vehicle at first axel. All software, display formats and print-outs will be designed to cater for these five classifications.

4.2.2 Cards used with the System

The contactless smart card complying with the ISO/IEC 14443 Type A standard will be used as:

(a) Ticketing media (Transit Card) for manual collection;

(b) Prepaid card to be used with ETC and Touch & Go; and

(c) S Identity cards for the staff of HGCL, toll management system operator and other relevant organizations.

The storage capacity of the ISO 14443 Type A card will be minimum 1K.

4.2.3 Code system

In order to process all data and information related to the toll collection system efficiently, a code system will be established for transaction, toll collection system facilities, and the employer of toll collection operation organization..

4.2.4 Transaction

All transactions will be identified uniquely with an ID as part of transaction data. Transactions at both entry and exit interchange will be separately maintained. No data matching between entry transaction and exit transaction is required.

The ID part of the transaction data will consist of the following data:

(a) Date and time

(b) Exit interchange and lane ID

(c) Sequential number assigned based on the data above

Each transaction data will contain at least the following information:

(a) Vehicle classification (by toll collector at entry, by toll collector at exit, by AVC at entry)

(b) Discrepancy in vehicle classification

(c) Toll collector ID (manual entry and exit lanes) in case of manual toll collection

(d) Toll amount collected

(e) Fine and other amount charged

(f) Exceptional transaction (exemption, high patronage, military convoy and other cases)

It will be possible to search the transaction data with the keys which are any combination of the items listed above.

Date and time information will be the date and time of the system clock. In the event the lane equipment operates on a standalone mode due to interruption of data link between lane equipment and toll plaza server, the transaction time data produced by the lane equipment will be checked against the system clock and difference if any will be corrected.

4.2.5 System Components

The equipment and services to be supplied under the Contract will comprise the following:

(a) Manual and Touch & Go Entry Lane Equipment

(b) Manual and Touch & Go Exit Lane Equipment

(c) ETC Lane Equipment

(d) Plaza computer systems and peripherals

(e) Traffic Control Centre System & peripherals

Configuration of lane equipment inside and outside of toll booth is summarized in the table below.

Table S. 3: Configuration of Lane Equipment (Inside Toll Booth)

		Entry		Exit	
		Manual/T&G	ETC	Manual/T&G	ETC
1	Toll Lane Controller (TLC)	○		○	
2	ETC Lane Controller (ETC-TLC)		○		○
3	Toll Collector Terminal (TCT)	○		○	
4	Receipt printer (RPR)			○	
5	Contactless IC card	○		○	

	reader/writer (CSCRW)				
6	Emergency footswitch (FSW)	○		○	
7	Intercom slave communication unit (ISCU)	○		○	

Table S. 4: Configuration of Lane Equipment (Outside Toll Booth)

		Entry		Exit	
		Manual/T&G	ETC	Manual/T&G	ETC
1	Manual lane barrier (MLB)	○	○	○	○
2	Overhead traffic light (OHTL)	○	○	○	○
3	ETC antennae 1 & 2		○		○
4	Lane traffic light (LTL)	○	○	○	○
5	Arrow traffic light (ATL)		○		○
6	Optical barrier with loop detector		○		○
7	User fare display (UFD)	○	○	○	○
8	Automatic lane barrier (ALB)	○	○	○	○
9	Amber siren beacon (ASB)	○	○	○	○
10	Incident capture camera	○	○	○	○
11	Automatic vehicle classifier system (AVC)	○	○	○	○
12	Contactless IC card reader/writer (CSCRW)	○		○	

4.2.6 Plaza Computer System

The Plaza Computer System (PCS) will be understood to be the computer system installed at each Interchange plaza building and will consist of the following:

(a) Toll Plaza Servers

(b) Auditor's console

(c) LSDU workstations

(d) Audit workstation

(e) Snapshot image workstation

(f) CCTV monitoring workstation

(g) Tour of duty workstation

(h) Point of sales workstation

(i) Networking system components

(j) printers

(k) Master communication unit

Auditor's console accommodates lane status display unit workstation, audit workstation, snapshot image workstation, CCTV monitoring workstation and master communication unit.

A plaza computer system (PCS) will be provided in each interchange plaza building control room. The PCS will have two main functions::

(a) Data acquisition from lane equipment and provision of real time monitoring facilities via visual display unit in the control room of the plaza building.

(b) Data processing and plaza management via visual display units, printer terminals and data transfer facilities.

4.2.7 Traffic Control Centre System

The Traffic Control Centre system (TCC) will be understood to be the computer system installed at the main Traffic Control Centre building and at the sub control centre on ORR and will consist of the following:

(a) TCC Server

(b) TCC administration workstation

(c) TCC reporting workstation

(d) Financial management workstation

(e) Snapshot image workstation

(f) CCTV monitoring workstation

(g) Networking system components

(h) Printers

Two Traffic Control Centres will be provided at the Nanakramguda Interchange and Ghat Kesar Interchange. The TCC system will have the following main functions: -

(a) Data acquisition from PCS.

(b) Data processing and validation via visual display units, printer terminals, portable memory modules and data/parameter transfer facilities.

(c) Downloading of operational parameters to PCS.

(d) Interfacing with Main TCC system and Sub TCC system for backup and standby operations.

The TCC system will be interfaced, via optical fibre cable network to the PCS. The TCC system will make available operating parameters relating to plaza operations for transfer to the PCS and will receive data files from the PCS.

Visual display units and printer terminals will be provided for control, selection and data input and output.

4.2.8 Software

A set of software will be composed of operation of the servers, workstations and computers of lane computer system, Plaza Computer system, Traffic Control Centre system and other computers to be provided under the TMS Contract.

The set of the software will consist of those provided by third party and those specifically developed for the project. All third party software will be legally licensed and there will be no restriction on the use in the toll management system.

The software to be specifically developed for the Project will be fully tested and will be free from bugs.

4.2.9 Network Equipment

Network equipment will be installed at each interchange toll plaza building to connect plaza computer system with toll lane system and Traffic Control System with plaza computer systems.

The network between the Toll Operation Centre system and toll plaza system will use the optical fibre cable network along the ORR to be installed by other party and a data communication network will be established using Layer 3 Switch.

4.3 Contractor Procurement Process

4.3.1 JICA Guidelines

The contractor procurement process will follow the JICA's Guidelines.

Tenderers will submit technical proposal and financial proposal simultaneously in two separate envelopes. The technical proposals will be opened first and reviewed to determine whether they conform to the Technical Specifications or not. After technical review, the financial proposals of the tenderers whose technical proposals have been determined to conform to the Technical Specifications are opened publicly. The financial proposals of the Tenderers who technical proposals have been determined not to conform to the Technical Specifications will be returned unopened.

4.4 Assistance in Tendering

4.4.1 Prequalification

A total of ten (10) applicants submitted the prequalification document on or before the extended submission deadline of 7th May, 2010. The applications were reviewed with the criteria stated in the prequalification documents.

4.4.2 Role of ITS Introduction Assistance Team

The ITS Introduction Assistance Team is tasked to assist HGCL during the tendering of TMS in the following manner:

(a) Preparation of TMS tender documents

(b) Preparation of clarification to the queries presented by the prospective tenderers

(c) Preparation of evaluation criteria

(d) Evaluation of technical proposal and financial proposals

(e) Negotiation of contract

4.4.3 Tender Evaluation

The financial proposals of the two tenderers whose tender had been judged responsive were opened on 2 September, 2011. Because of the court case mentioned above and as HGCL was ordered by the court not to proceed with the tender process after opening of the financial proposal, nothing has been done since then.

4.5 System Construction Issues

Toll management system will be constructed or installed at toll plaza and toll plaza building that

were already constructed or will be constructed by other contractors. These works undertaken by other contractor must be of suitable quality for the toll management system to function properly. But the site survey of the works already completed found that certain works are not of the quality required. This section presents the issues about site condition that will affect the smooth and timely introduction and efficient operation of the system.

The issues found are:

- Cable duct that is used to connect set of toll lane equipment together and also with toll plaza system is not at right place. Additional conduit work is required.
- Toll lane is inclined toward toll booth area and rain water will accumulate at the place where vehicles will stop once toll island is constructed.
- Ceiling and floor of tunnel connecting toll plaza building and toll island are not leveled.

Cable duct found outside of island

Toll lane not levelled and inclined toward booth

Tunnel not levelled and lowest at centre

Water accumulated inside tunnel

Opening of 80cm x 80cm too small for stair

Opening of 140cm x 140cm, sufficient for stair

5. Highway Traffic Management System

5.1 General

The Highway Traffic Management System (HTMS) is a system that helps the Hyderabad Growth Corridor Limited (HGCL), an administrator of the Hyderabad Outer Ring Road (ORR), to safely and efficiently manage the traffic on the ORR. The conceptual system configuration is shown below. The system consists of three parts of information collection, information processing and surveillance, and information dissemination.

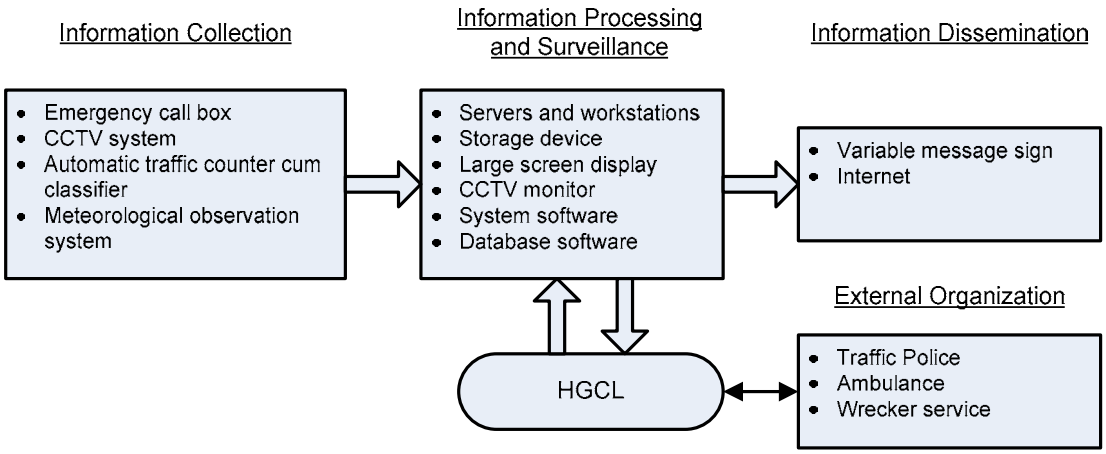


Figure S. 7: Conceptual System Configuration

ITS assistance team assisted in the detailed design, cost estimates, and tender document preparation for the HTMS. The summary of the works provided by the ITS assistance team is provided in the sections below.

5.2 Outline of the system

In order to ensure safe and comfortable flow of traffic along its entire stretch of Hyderabad Outer Ring Road, a Highway Traffic Management System (HTMS) will be introduced. The system will have a main Traffic Control Centre (TCC) at Nanakramgguda to oversee traffic control 24 hours a day, 365 days a year. In addition, a sub-centre will be established at Ghathesar IC to handle traffic control whenever the main TCC becomes inoperative.

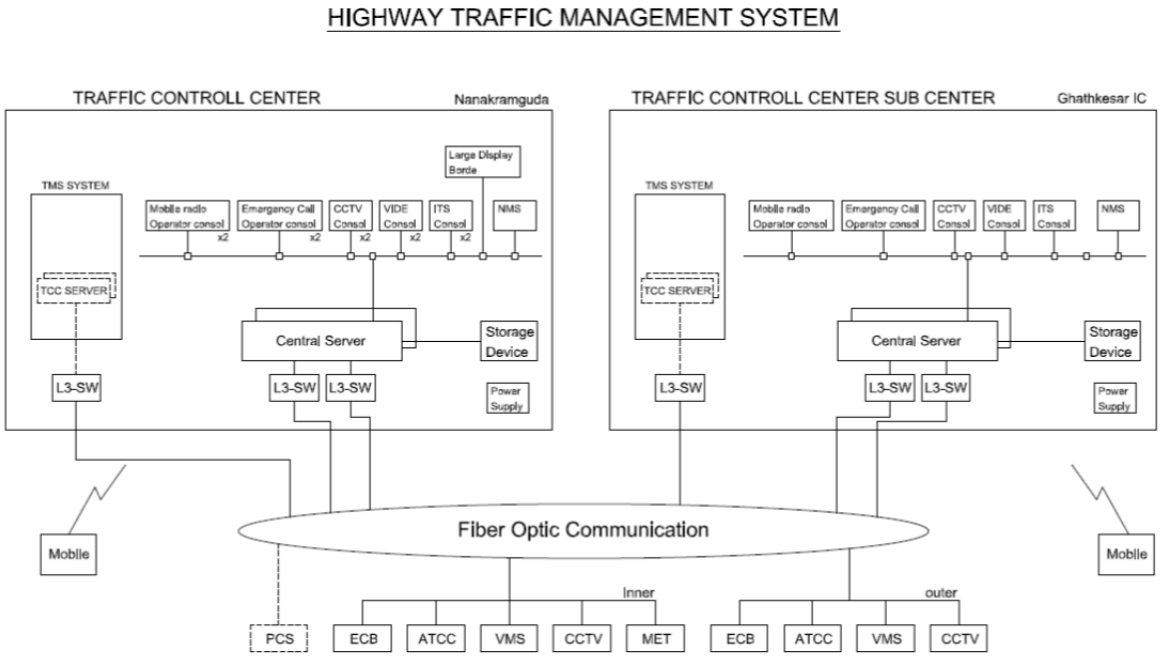


Figure S. 8: Configuration of Highway Traffic Management System

5.3 Features of the System

Highway Traffic Management System for the ORR was designed with the following design concept:

(1) Highly reliable system

(2) Intensive use of optical fibre cable

(3) Use of solar power

(4) Use of Video Vehicle Detector

5.4 HTMS Component Facilities

HTMS consists of various field devices for information collection and dissemination. They are summarized in Table S. 5. In addition to these devices, data transmission system using optical fibre cable will be installed along the ORR to connect these field devices with the Control Centres.

Table S. 5: HTMS Component Facilities

Facility	Function/Objective
Emergency Call Box (ECB)	Provide communication tool between ORR users and traffic management body to provide assistance in case of accident, breakdown and other incidents.
Closed Circuit Television (CCTV)	Monitor traffic operation at key sections of ORR. Detect incident automatically and issue an alarm to the operator for his action.
Automatic Traffic Counters-cum-classifier (ATCC)	Measure traffic volume at each section of ORR between ICs.
Meteorological Data System (MET)	Detect rainfall, measure precipitation, wind velocity, wind direction, and visibility. Inform / warn the ORR users of adverse driving condition through VMS.

Variable message sign （VMS）	Provide traffic, road, weather condition and other information to ORR users.
Fibre Optic Cable & A Digital Transmission System	System which utilizes fibre optic cables to digitally transmit data between the ORR HTMS equipment and the TCC and TCC-Sub-Centre

Source: ITS Assistance Team

These field devices will be installed at the locations selected based on the facility deployment standard as presented in Table S. 6 to standardize the location. It is noted that locations are adjusted for a short distance to avoid the place which is not suitable for installation. For example, location of emergency call box is adjusted if it falls on the bridge section. The quantities shown in the table would also be possibly adjusted.

Table S. 6: Facility deployment standard

Facility	Location	Quantity
Emergency Call Box（ECB）	Every 1km on both sides of ORR.	328
Closed Circuit Television (CCTV） camera	Merging section at on-ramp of each IC and junction.	41
Automatic Traffic Counters-cum-classifier (ATCC）	Each Section between ICs. Off-ramp at each IC.	73
Meteorological Data System （MET）	Four locations along ORR. - Shamirpet, Ghatkesar, Tukkuguda, APPA	4
Variable message sign（VMS）	Upstream of off-ramp at all interchanges. On national highway before IC with ORR.	47

Source: ITS Assistance Team

5.5 Cost Estimate

Cost of each of the above-mentioned systems was estimated as follows:

The cost was estimated using the reference prices obtained through a survey conducted in India for the prices of equipment that can be procured in India and a survey in Japan for the prices of the equipment that is not easily procured in India.

It is expected that the price of the servers, workstations, CCTV cameras, network equipment and UPS to be quoted by contractors differs little because these are general-purpose equipment and the specifications and prices of general-purpose equipment is relatively easy to obtain.

On the other hand, the prices of the large screen display at Traffic Control Centre, Emergency Call Box system, Automatic Traffic Counter cum Classifier system, Meteorological system, Variable Message Sign system and Traffic Control Centre software to be quoted by contractors are likely to differ significantly as they are for specific purposes.

5.6 Tender Documents

The selection of the contractor for HTMS is to be made in accordance with JICA's guidelines. A pre-qualification was held to select qualified tenderers before the tendering. ITS Assistance Team prepared draft pre-qualification documents and draft tender documents.

5.6.1 Pre-qualification

Pre-qualification documents was prepared based on the JICA's sample document entitled "Sample

Prequalification Documents under Japanese ODA Loans" version 1.0 dated April 2010. One of the sections "Section III: Qualification criteria and requirements" was prepared newly and the requirements specific to HTMS project were defined.

5.7 Optical Fibre Cable Installation Issues

5.7.1 Poor quality duct work

All HTMS roadside equipment will be connected to traffic control centre through optical fibre cable to be placed inside duct that is provided by the civil work contractor as part of their work. However, the cable duct work done was found very poor quality and the existing ducts are useless for placing optical fibre cable inside at numerous sections. In particular, the ducts inserted inside parapet at bridge section are not suitable for cable installation at all. New duct needs to be constructed along the outside of the parapet by either the civil works contractor or by HTMS contractor.

The photos below show the defective works found.

Ducts at different level and duct half covered with concrete (left)

Duct not connected to underground section and clogged duct (lower side)

At some bridges, duct was installed along the outside of parapet without fixing. This installation practice is not acceptable as the duct and the cable inside are suceptible to damage. The conduit must be fixed to the parapet at one meter interval. Example of duct installation at bridge section is shown below.

Hanging duct not fixed to parapet

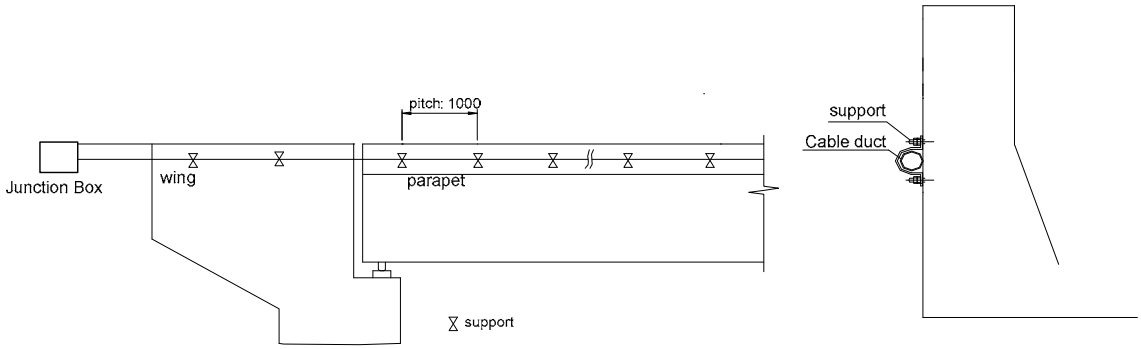


Figure S. 9: Fixing of Duct at Bridge section

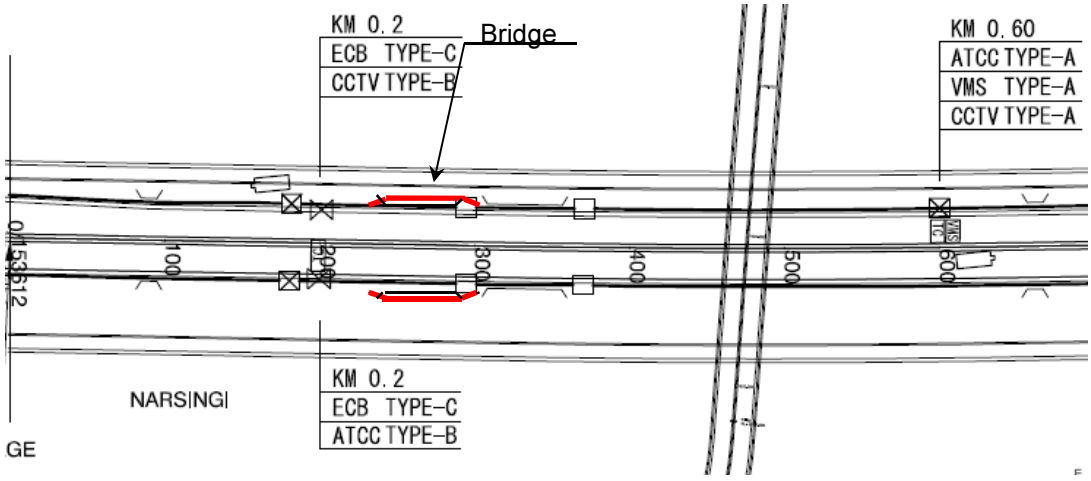


Figure S. 10: Plain Plan of Duct Installation

6. ITS Construction Supervision Consultant

6.1 General

The construction supervision of the TMS and HTMS will be undertaken by a consultant to be hired by HGCL, who is not the civil work consultant for the ORR construction. The consultant will be called ITS construction supervision consultant.

It is one of the tasks of ITS Assistance Team to prepare a set of tender documents for the procurement of ITS construction supervision consultant. This Chapter summarized the works related to the procurement of ITS construction supervision consultant that was undertaken by ITS Assistance Team.

6.2 Tender Procedure

The selection of ITS construction supervision consultant is made in accordance with JICA guidelines "Guidelines for the Employment of Consultants under Japanese ODA Loans" dated March 2009. Among the selection method mentioned in the guidelines, quality-based selection (QBS) was adopted. Thus only technical proposal is required at the time of tendering and the contract amount will be negotiated with the consultant whose technical proposal is ranked first.

6.3 Tender Documents

ITS Assistance Team prepared a draft Request for Proposals based on "Sample Request for Proposals under Japanese ODA Loans" dated September 2009. Among the documents listed above, Terms of Reference (TOR) is specific to the project and ITS Assistance Team prepared the draft TOR.

6.4 Terms of Reference

Terms of Reference defines the tasks to be undertaken by the ITS Consultant. It covers the following items:

Table S. 7: Request for Proposal for ITS Construction Supervision Consultant

Section	Title
1.	Background
2.	Objectives
3.	Works on ORR
4.	Scope of the Services
5.	Report, Deliverables and Time Schedule
6.	Manpower Requirements
7.	Data, Local Services, Personnel and Facilities to be Provided by HGCL
8.	Performance Security
9.	Consultant's Proposal

Source: ITS Assistance Team

6.5 Proposal Evaluation

The ITS Assistance Team prepared a draft evaluation criteria, which consist of three parts, namely experience of the firm, quality and contents of technical proposal and qualification of the

personnel proposed. Each category was further divided into evaluation item and weights are assigned to them.

Table S. 8: Evaluation Criteria

Evaluation category	
Experience of the firm	
a.	Experience of international projects of comparable size, complexity and technical specialty.
b.	Experience of projects in developing countries under comparable condition
Quality and contents of the proposal	
a.	Technical approach and methodology
b.	Work plan
c.	Organization and staffing
Personnel Proposed	
a.	General qualifications
b.	Adequacy for the assignment
c.	Experience in region and language

Weight is given to each evaluation items. The distribution of weight is shown below.

Source: ITS Assistance Team

7. Overall Organizational Setup

7.1 Overview

India has an experience of installing toll plazas along BOT constructed/rehabilitated roads and collecting tolls and performing road operation and maintenance. However, the existing toll collection systems operate as open system in which fixed toll is collected at tollgate. Thus it does not require coordination among interchanges to implement closed toll collection system. Such being the case, it does not have experience of the sort of expressway described above.

In order to establish an effective and efficient system of maintaining and operating the ORR, the proposed organizational set up takes into consideration the HGCL system as well as necessary outsourcing.

7.2 Proposed HGCL organization

7.2.1 Maintenance Office Site Planning

The example of Japan indicates that right after the start of service, each maintenance office was responsible for roughly 30 to 50 km of road section. Maintenance offices were initially established for each section. However, the maintenance offices was abolished and integrated with other centres. In other words, over the course of many years of operation experience, a process of streamlining has extended the length of each maintenance office's administrative area to roughly 100 km.

If this example of each maintenance office being responsible for 100km of road length is adopted, the ORR with the total length of 158 km would likely need two maintenance offices. As mentioned above, however, India does not have administrative experience with such expressways. If the example of Japan at the time of start of service for its expressways taken up as a reference, instead of current practice, the ORR should have three to four maintenance offices at its start of service, with each office responsible for roughly 30 to 50 km of road section.

The location of the maintenance offices should be at interchanges that connect with main roads so that the offices can liaise with outside organizations such as police, fire departments, wrecking companies, etc. In the case of the ORR, these offices should be at access interchanges connecting to national, state and other major roads. However, as the plan is to have ORR start of service occur in phases, it might also be a good idea to select interchanges located at intermediate positions within control zones.

7.2.2 Proposed Organizational Setup for HGCL

The administrative body responsible for the ORR is Hyderabad Growth Corridor Limited (HGCL). Considering the limitation of the HGCL's resources available for operation and management of the ORR, it is suggested to outsource some of the operation and maintenance tasks. At the level of operation and maintenance, it is advisable that tasks be grouped together and assigned to specialized companies so that greater organizational efficiency can be achieved.

Operation and maintenance in India is performed in some cases by BOT concessionaires. This is also the case of the ORR, where BOT scheme is being implemented for some sections and where road operation and maintenance will be conducted by BOT concessionaires for the specified period following the start of service. In some cases the same BOT concessionaire is expected to conduct traffic and road inspection patrols, and HGCL considers that such arrangement is not necessarily inexpedient. In consideration of the situation in India in general and the ORR in particular, the following four types of operational and maintenance outsourcing are proposed.

(a) HTMS operation

(b) Road Patrol and Maintenance operation

(c) TMS operation

(d) TMS Maintenance

Based on the discussion presented above, the overall organizational setup for the operation of the ORR including TMS operation and maintenance, HTMS operation and maintenance, and road maintenance is proposed as shown in FigureS.11 together with duties to be performed by each organization.

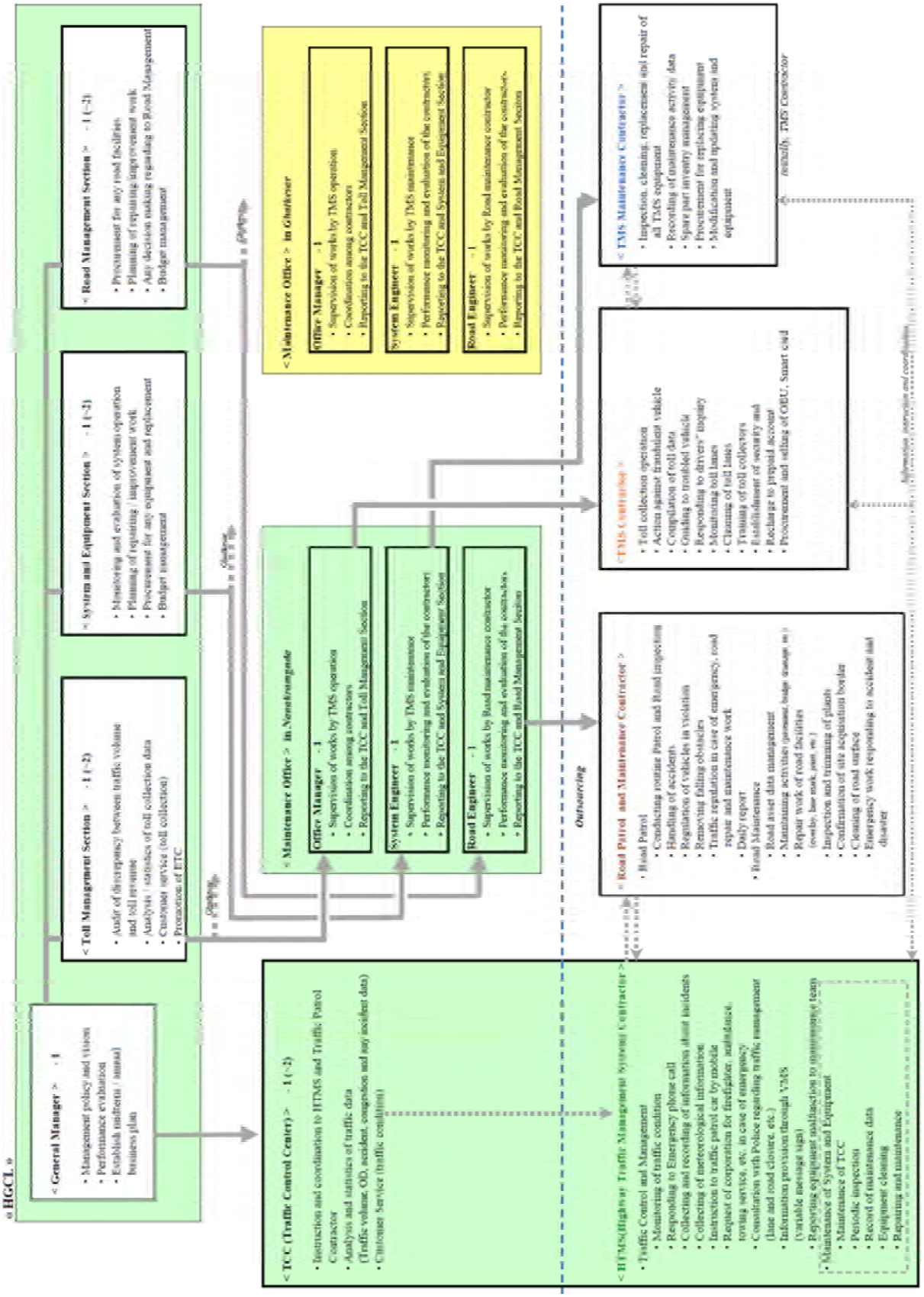


Figure S. 11: Hyderabad ORR - Organizational Setup

8. Toll Management System Operation

8.1 Examples of Existing Toll Collection Operation

In order to collect the information on how the existing toll plaza is operated, two toll plazas located in the environs of Hyderabad were visited and interview was conducted with the staff operating the toll plaza.

(1) Jadcherla Toll Plaza (National Highway No. 7)

(2) GVR: Chillepally Toll Plaza (bridge toll collection)

8.2 Proposed Toll Collection Organization and Staff

Toll collection organization was developed for the operation of toll management system of the ORR. The organization plan was prepared based on the discussion with HGCL officials, information collected on the current practice of other toll plazas and the experience of toll collection operation in Japan.

Table S. 9: Position and Job Description

	Position
1	Head cashier banking
2	Clerk
3	Shift In charge
4	Supervisor
5	Collector
6	Cleaning Helper
7	Peon
8	Security Shift In charge
9	Security Guards
10	Gunman

Source: ITS Assistance Team

The number of staff at each interchange and the total number of staff required to operate the toll management system of the ORR is summarized in Table S. 10. A total of 672 persons are required. The figure does not include peon, security shift-in-charge, security guard and gunman.

Table S. 10: Required Number of Staff

		Head casher	Clerk	Shift in charge	Supervisor	Toll collector	Total
Number of staff		19	76	76	199	302	672

Source: ITS Assistance Team

8.3 Annual Operation Cost

Annual cost of toll collection operation incurred by the toll collection operator was estimated based on the number of staff required for the toll collection operation and the cost of indirect expenses. The summary of the estimated cost is presented below. The cost was estimated based on the prices prevailing as of July 2011. The total estimated cost is 350 million Rs. per year.

Table S. 11: Estimated Cost of Toll Collection Operation

	Particular	Annual Cost (Rs.)
1	Staff cost	214,920,000
2	Utilities	9,145,800
3	Human relation	97,276,800
4	Boarding and lodging	28,218,000
	Total	349,560,600

Source: ITS Assistance Team

8.4 TMS Administrator

TMS Administrator is a HGCL staff member in charge of administrating and supervising the toll collection operation undertaken by a TMS Operator who is to be selected through competitive tendering. HGCL is planning to newly recruit a TMS Administrator.

8.5 Prevention of Fraud by Toll Collectors

In any toll collection system, there is a possibility of fraud by either persons of toll collection system operator or by drivers. Preventing fraud is therefore an important factor in the design of toll management system. This section summarizes the possible fraud practice and countermeasures. It is pointed out that those who try to steal money sometimes invent a tactics that could not have been expected. Thus it is necessary to review the operating procedure and detect any abnormality in the toll collection operation, and develop additional countermeasure after the system is put into operation.

8.6 TMS Operator Procurement Scheme

TMS operation will be contracted out to a contractor called toll collection agency. The agency will be selected through competitive bidding. Different procurement and contract schemes are possible and each type of contract has merits and demerits. Tender document for the procurement of TMS Operator was prepared based on the principles listed below.

Table S. 12: Outline of TMS Operating Agency Tendering

Item	Contents
Type of Tender	1-stage / 1-envelop type
Type of Contract	Fixed amount contract. The Tender Documents specify the number of lanes to be opened and the minimum number and types of staff deployed
Eligible tenderer	The tender for TMS operation agency is open to Indian companies, corporations, or joint ventures
Prequalification	Separate prequalification will not be conducted. Instead, Tenderers will be required to submitted information and data indicating their qualification at the time of tendering
Tender by organization/agency involved in ORR construction	There is no restriction on the tenderer's qualification with regard to the ORR construction proj]ects.
Section under Tendering	The construction of the ORR is divided into three sections, Section 1, Section 2 and Section 3. It is expected that the Sections 1 and 2 will be put into operation at the same time and the operation of the Section 3 will be one year late. As this is the first tendering for the toll collection operation of the ORR, the

	tendering will cover Section 1 and 2 only
Contract period	12 months
Tender document on the web	the tender document will be posted on HMDA web site and can be downloaded

Source: ITS Assistance Team

8.7 Regulations and Operation Manuals

8.7.1 Notice and Regulations

The ORR is a closed-toll expressway and a vehicle becomes subject to the toll charge for use of the road from the moment it enters the ORR at an interchange. In this point ORR differs from the other toll roads in India, which are open-toll roads.

In order to make clear the relationship between HGCL and the road user with relation to the use of the ORR when the Users use the ORR, it is necessary for the HGCL to determine and announce in advance its operating regulations and toll amount for (1) establishing the grounds on which the toll is levied; (2) establishing the grounds on which vehicles are able to use ORR; (3) establishing the responsibilities of HGCL and of the Users; and (4) establishing the grounds on which for claims in the event of expressway structures being damaged due to an accident, etc.

The following notice and regulations are required for the toll collection on the ORR.

Table S. 13: Operating Regulations

No	Regulation
1	Notice of Toll Amount and Starting Date of Toll Collection of ORR
2	ORR Operating Regulations
3	Regulations for Use of Touch & Go / ETC Cards
4	Regulations for Use of ETC system
5	Regulations for Use of Touch & Go system

Source: ITS Assistance Team

8.7.2 Toll Collection Manuals

ITS Assistance Team drafted two manuals that define the duties to be performed and the procedures to be followed by the toll collection agency in charge of toll collection operation.

Table S. 14 Operation Manuals

No	Manuals
1	Agency's Toll Collection Manual
2	Smart Card Management Guidelines

Source: ITS Assistance Team

8.7.3 Forms for TMS operation

To implement TMS operation smoothly, various forms are required for efficient audit and execution of regulations. There are two types of forms, the forms related to smart card used for

Touch & Go / ETC, and forms for TMS operation as listed in the tables below.

Table S. 15 Forms for Smart Card

Title	Forms
Regulations for Use of Touch & Go / ETC Cards	Issue Application
	Reissue Application
	Refund Application

Source: ITS Assistance Team

Table S. 16: Forms for TMS Operation

Title	Major Forms
Agency's Toll Collection Manual	Duty Check-Sheet
	Vehicle Class Discrepancy Record
	Duty Report
	Monthly Report
Smart Card Management Guidelines	Smart Cards Distribution Record
	Touch & Go / ETC Card Issue Report
	Record of Discard Smart Card

Source: ITS Assistance Team

9. ETC Trial

9.1 Outline of ETC Trial Operation

The outline of the ETC trial operation is presented in this chapter. Trial use of on-board unit (OBU) and smart-cards, which are already charged with certain amount of rupees in credit will be distributed free of charge during the monitoring period to groups likely to benefit from the use of ETC, on the condition that they serve as trial monitors. When the monitoring period is complete and the completed questionnaires have been returned, the on-board unit and smart cards will be awarded to those participants.

The distribution will be decided by ITS Assistance Team and HGCL and monitors will be selected from potential frequent users of the section of the ORR under trial among applied candidates.

The implementation schedule of the ETC trial is shown inFigure S. 12.

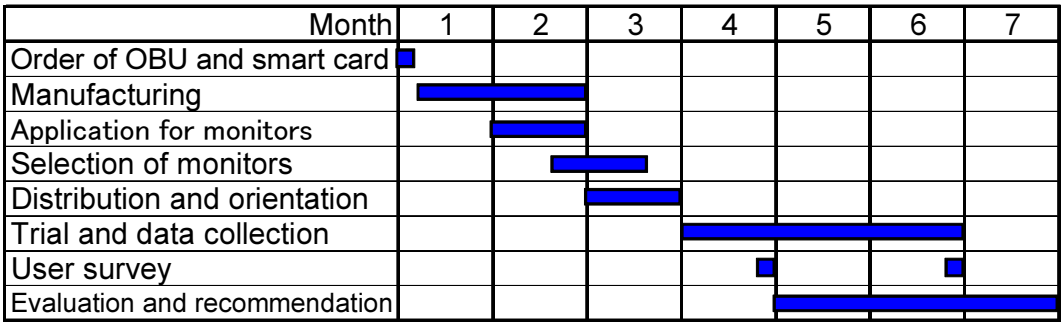


Figure S. 12: Implementation Schedule of ETC Trial

9.2 Procurement of OBUs and Smart Cards

A total of 1,000 OBUs and 3,000 smart cards will be procured by ITS Assistance Team. Out of the 3,000 smart cards, 1,000 cards will be used together with OBUs. To ensure the compatibility and interoperability of the OBUs and roadside antenna, OBUs will be procured from the supplier who supplies OBUs for the ORR TMS project. Procurement of smart cards will also be from the same supplies to avoid security code setting problem.

9.3 ORR section for Trial Operation

There are a total of 12 interchanges in the southern section. Among these interchanges, the ETC system will be installed at five interchanges with a total of 13 lanes. The section between Nanakramguda and Shamshabad will be selected as the trial section.

9.4 Monitoring and Evaluation of ETC Trial

The data necessary for evaluating performance and service level will be collected from the seven ETC lanes located along the Nanakramgudaandamd - Shamshabad section of the ORR.

Quantitative evaluation will be made by analysing the data from the OBUs and smart cards as well as the number of ETC users. Service quality of toll collector in case of trouble will be evaluated by questionnaire. Questionnaires will be conducted in Nanakramguda and Shamshabad. Questionnaire registration will begin one month after the launch of ETC service until the end of the monitoring period. Assessments will then be made on the monitoring.

9.5 Recruiting Monitors for ETC Trials

ETC and T&G Trials will be conducted to confirm the operations of ETC and T&G related equipment along the ORR, make overall assessments of ETC and T&G, and make improvements.

In order to recruit monitors for ETC trial, HGCL will notify the relevant organizations and also general public. The same number of monitors as OBU and T&G card will be recruited.

The monitor for ETC must own or drive a car that is allowed to travel on the ORR (2-wheeers and 3-wheelers excluded), can be equipped with the OBU and use the trial section (Nanakramguda Interchange - Shamshabad Interchange) at least once a week. The monitor for T&G card is a frequent travellers of the trial section.

10. Highway Traffic Management System Operation

10.1 Organizational Setup for HTMS Operation

In order to achieve objectives of HTMS, proper organization shall be set up. Detailed functions of HTMS and operation procedures will be provided in the operation manual separately prepared in the project.

10.1.1 Scope of works

The Agency will engage in the works listed below.

(1) Monitoring of traffic on the ORR

(2) Monitoring of weather condition

(3) Detection of incident

(4) Reception of incident information from users or other organizations

(5) Countermeasure implementation and monitoring of progress

(6) Information dissemination through VMS

(7) Monitoring of equipment operation

(8) Communication with patrol agency

(9) Information exchange with other organizations concerned

(10) Keeping operation log

10.1.2 Staff

An operation team consists of five (5) persons of a traffic management chief and four operators with the task assigned as shown below.

Table S. 17: Operation Team

Position	Task and responsibility
Traffic management chief	Responsible for overall management of HTMS
Operator 1 (ECB operator / Mobile operator)	ECB workstation and Mobile phone workstation
Operator 2 (CCTV operator / VMS operator)	CCTV workstation and VMS workstation
Operator 3 (Traffic operator / System operator)	ITS workstation and Network management workstation
Operator 4 (backup)	Whenever any of the operators 1-3 above is not available, operator 4 will take over the task and be in charge of its workstation.

A total of three (3) teams are required taking rest time and leaves into consideration.

10.2 Tender Document for HTMS operation agency

In accordance with HGCL's policy, HTMS operation will be contracted out to a contractor called HTSM operation agency. The agency will be selected through a competitive bidding. Tender document for the procurement of HTMS Operator was prepared based on the principles listed below.

Table S. 18: Outline of HTMS Operating Agency Tendering

Item	Contents
Type of Tender	1-stage / 1-envelop type
Type of Contract	re-measurement contract with the measurement method. The total amount to be paid for a service to the Agency will be determined by the quantities of the Service actually performed, measured and certified by the Client.
Eligible tenderer	The tender for HTMS operation agency is open to Indian companies, corporations, or joint ventures
Prequalification	Prequalification will not be conducted. Instead, Tenderers will be required to submitted information and data indicating their qualification at the time of tendering
Tender by organization/agency involved in ORR construction	there is no restriction on the tenderer's qualification with regard to the ORR construction projects.
Section under Tendering	all sections of the ORR will be managed by one HTMS and its operation is carried out by HTMS operation agency.
Contract period	24 months
Tender document on the web	the tender document will be posted on HMDA web site and can be downloaded

Source: ITS Assistance Team

10.3 Organizational setup among agencies related to HTMS operation

The following institutions and agencies are involved in the road traffic in Hyderabad area:

- Hyderabad Traffic Police
- Secunderabad Traffic Police
- Andhra Pradesh State Road Transport Corporation (APSRTC)
- Greater Hyderabad Municipal Corporation (GHMC)
- National Highway Authority of India (NHAI)
- Road and Building Department of AP Government

10.4 Information Exchange with City ITS

10.4.1 Purpose of information exchange

The ORR and HTMS to be constructed on the ORR are intended to provide alternative route to the inter-city traffic to help ease the traffic congestion inside the city. On the other hand, City ITS is intended to mitigate the traffic congestion inside the city, in particular along the Inner Ring Road and on the roads inside it.

Considering these objective of the respective systems, information on the conditions of the ORR is useful to the City ITS, while the road and traffic conditions at city centre is of little use for the ORR as the ORR is far from the city centre.

10.4.2 Information to be provided to City ITS

As the Traffic Control Centre of ORR and City ITS will be located at the same building, most of the information can be easily exchanged with direct connection. The following information is considered useful for the City ITS.

(1) Incident information

(2) Contents of VMS

(3) Meteorological data

(4) CCTV image

11. Traffic Signs

11.1 General

Traffic sign is intended to promote road safety and efficiency. They are used to provide guidance, warnings, notice and regulatory information to expressway users. On the expressway, traffic signs also provide information on the entry to and exit from the expressway as well as destination. The importance of traffic signs must be considered in the process of expressway project for ensuring comfortable, safe and smooth driving.

This Section deals with the following items of traffic sign:

- Guide traffic signs on access road leading to interchange
- Guide traffic signs on expressway for exit through interchange
- Guide traffic signs for toll plaza
- Exclusive motor way sign
- Interchange name and sign at toll plaza
- Traffic sign for ETC (Electric Toll Collection)
- Distance marker

11.2 Guide Traffic Sign on Access Road (Interchange Entrance)

11.2.1 Recommendation

(1) Sign at Roundabout

Roundabout is used for connection with general road at interchanges along ORR. With regard to the traffic sign at roundabout, Adoption of the guide sign presented in "Know Your Traffic Signs – Official edition" issued by the Department of Transport in U.K. is recommended.

<Map type>

<Stack type>

Figure S. 13: Signs at Roundabout

(2) Recommendation of an idea for the diversion point on Access Road

When considering the provision of direction guide signs to the expressway entrance, the

distance between interchanges, the location of other expressways and the density of housing must be taken into account. The first guide sign for the ORR must be set up at a location of reasonably large intersection, or somewhere with an unobstructed view 3 to 4 km before the interchange

As for the direction signs at the interchange entrance, since as mentioned above the ORR has many different types of ramp, signs should be placed in accordance with the Indian standard, Code of Practice for Road Signs and Guidelines for Expressways.

11.3 Guide Traffic Sign on Expressway for Exit at Interchange

A series of three advance guide signs will be installed upstream of an interchange exit to inform drivers of the diversion point as shown below.

Figure S. 14: General Guidelines for Designing the Road Signs for ORR

11.4 Guide Traffic Sign for Toll Plaza

11.4.1 Recommendation

In the Indian Standard, Guidelines for Expressways (Volume-II; Chapter 10) stipulates to use guide traffic signs for toll plazas along the main roadway in Figure S. 15. For expressways with closed system, advance guide sighs must be provide at 1 km and 0.5 km in advance of the toll plaza area. At exit toll gate, distance based toll rates sign as shown Figure S. 16 must be provided.

Figure S. 15: Toll Plaza Sign

Figure S. 16: Toll Rate Sign at Exit

11.5 Sign for Exclusive Motor Vehicle Way

11.5.1 Exclusive motorway

Signs indicating that the road is exclusive for motorized vehicles must be installed at entrances and exits of expressways to inform the drivers of the type of the road. Since the ORR is planned as a toll road exclusively for motor vehicles, boundary between toll-road section and general road must be clearly marked. Installation of the signs shown in Figure S. 17: No Entry Sign of ORR Figure S. 18: Expressway Symbol Signis recommended.

Figure S. 17: No Entry Sign of ORR

Expressway Symbol

End of Expressway

Figure S. 18: Expressway Symbol Sign

11.6 Interchange Name Sign and Signs at Toll Plaza

Indian Standard, Guidelines for Expressway (Part-1 Volume-II; Chapter 10), has a section of toll plaza design. Toll plazas in India do not have signboards showing interchange name, or do not indicate interchange name clearly. Displaying interchange name and displaying interchange code number have its advantages and disadvantages. It is desirable to use both name and code number together. In particular, by displaying place names at interchanges, it could become a landmark for that area, so it is important to display the interchange name on the roof of the toll gates.

11.7 Guide Traffic Sign for ETC

In the Indian Standards, Guidelines for Expressways (Volume-II, Chapter 10 and Volume-III, Chapter 1) stipulates ETC sign and marking as shown in Figure S. 19.

The guidelines also stipulates that ETC lane must be indicated by pavement marking such as white chevron marking on blue background and the word ETC is written on the pavement surface.

11.7.1 Recommendation

Advance gantry signs must be installed in accordance with the Guidelines for Expressways of India, including the colouring on the signs.

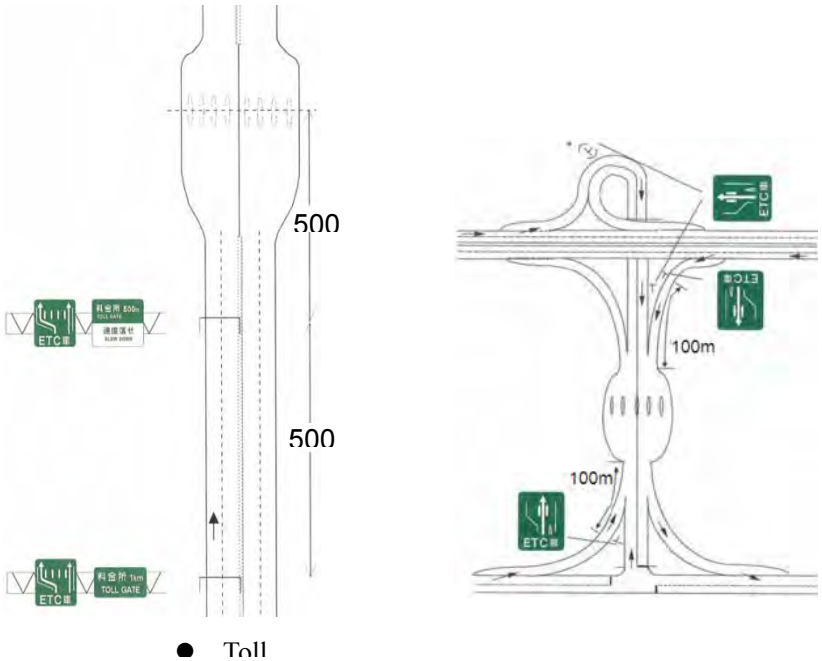


Figure S. 19: Installation Layout of ETC Signs

(1) Guide Sign on Toll Lane Portal

It is advised to install signs showing a logo and/or the name of the ETC system specifically for the ORR, in spite of the provisions of the Guidelines for Expressways of India.

(2) ETC Lane Marking

Installation of the ETC lane markings on ORR is strongly recommended.

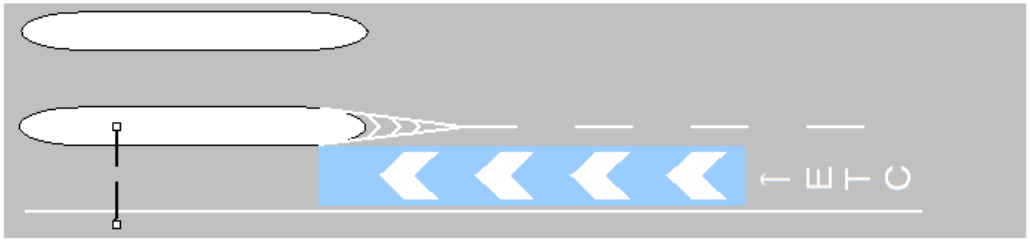


Figure S. 20: Design of ETC Lane Marking

11.8 Distance Marker

Distance markers are necessary for clearly referring to a specific location on the ORR. With the aid of distance marker, expressway maintenance, repair, and improvements can be rapidly carried out. It also helps road users to inform others of their position.

11.8.1 Recommendation

The proposed standards for the application of distance markers to ORR in terms of traffic origins, installation interval, ramp naming, name boards, and method of reading is presented below.

(1) Reference Point for Distance

It is desirable that the reference point is set in such a way that it is easily understood by patrols, road operators, and users. During construction of ORR, reference distance is set clockwise starting from Narsingi Junction (current name during construction). There would be no problem if the same method is adopted after the commencement of service,

(2) Installation Intervals

If the distance markers on ORR are installed at 1km intervals as on Indian national highways, the interval may be too rough for identification of location in case of accidents and for other purposes. The road alignment would not be same along 1 km section. Thus it will not be possible to achieve the objectives of documenting the record of accidents. Therefore, in accordance with the Guideline for Expressways, it is recommended to install the distance markers at 100 m intervals.

(3) Name Boards

For the 1 km markers, the scheme in Figure S. 21is proposed for ORR.

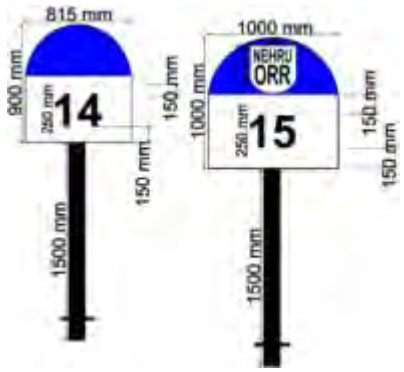


Figure S. 21: Design of 1 km marker

12. Conclusion and Recommendations

12.1 Conclusion

ITS Assistance Team has been conducting the Project since its inception in February 2010 and fulfilled the assigned tasks. Major achievements are summarized below.

Task 1: To conduct survey on toll collection and ITS introduction

- ITS Assistance Team conducted a number of surveys. Based on the survey data collected by the Team, a demand forecast model was developed and origin-destination demand was forecasted under three different development scenarios. The demand was then assigned to the road network and traffic volume on each link including the ORR was estimated. The assignment took the toll rate into consideration.
- Sensitivity analysis against toll rate was conducted to find the toll rate that maximizes the toll revenue. It was found that maximum toll revenue is achieved at the toll rate of Rs. 1.3/km for passenger car.
- Toll management system (TMS) that uses electronic toll collection (ETC) and Touch & Go system, and highway traffic management system (HTMS) composed of various roadside equipment for data collection and information provision, and a traffic control centre system were selected as ITS components to be introduced to the ORR. The detailed design of these systems was also conducted by ITS Assistance Team as summarized below.

Task 2: To provide assistance for the procurement of ITS components

- ITS Assistance Team reviewed the design of TMS prepared by the previous technical assistance team and updated the design to reflect the technical advance made since the last design.
- ITS assistance Team engaged in the detailed design of highway traffic management system, and prepared employer's requirements (technical specifications) and drawings to be used for HTMS tendering.
- ITS Assistance Team prepared prequalification (PQ) and a set tender documents for highway traffic control system (HTMS). The team also assisted HGCL in evaluating PQ submitted by applicants and prepared draft PQ evaluation report.
- ITS Assistance Team prepared expression of interest (EOI), request for proposal (RFP), and tender documents for ITS consultant who will engage in the construction supervision of ITS on the ORR. The team also assisted HGCL in evaluating the proposals submitted by consultants by preparing evaluation criteria.
- As HGCL decided to outsource the operation of toll management system (TMS), ITS Assistance Team prepared a set of tender documents for procurement of TMS operating agency. As local firm is expected to engage in the work and as the nature of the work is different from system construction, different contract conditions, requirements and procurement method are proposed.
- ITS Assistance Team engaged in the capacity building of HGCL in the tender evaluation by preparing a set of evaluation criteria and forms that covers not only the technical evaluation of the technical proposal but also other documents that are required for the tenderers to submit.

Task 3: To provide assistance for institutional setup to achieve optimal operation and management of toll collection system for the ORR

- In order to propose organizational setup for HGCL after completion of ITS, surveys were conducted and the existing toll management systems were visited by the ITS Assistance Team and detailed interview as to the operation organization and their daily operation was held. The information thus collected was reflected to formulating a proposal for organizational setup.
- A proposal for the organizational setup including the relationship among HGCL, TMS contractor, TMS operating agency, HTMS contractor, HTMS operating agency and road patrol and maintenance contractor was prepared by the ITS Assistance Team.

Task 4: To conduct trial experiments on ETC

- As the trial was not conducted due to the delay in the procurement of TMS, detailed trial plan was prepared in which the procedure for ETC trial is presented. Questionnaires for ETC monitor and other ORR users were also prepared.

Task 5: Development of HTMS operational structure

- ITS Assistance Team prepared HTMS operation manual including forms that will be used by the HTMS operation agency. As actual operation of the HTMS equipment depends on the devices supplied by the HTMS contractor, another set of operation manual needs to be prepared by HTMS contractor.
- ITS Assistance Team prepared a set of tender documents for the procurement of HTMS operation agency including Employer's Requirements for HTMS operation. The document assumes that HTMS will be operated by a local company who has experience of operating similar systems.
- ITS Assistance Team examined the institutions and agencies involved in the road and traffic management inside and outside of the ORR, demarcated their roles and defined kind and manner of information exchange with the ORR HTMS.
- A City ITS that provides ITS services to the users of city roads is planned by HMDA. The information to be exchanged between ORR HTMS and City ITS was examined and proposal was prepared.

12.2 Recommendation

ITS Assistance Team has the recommendation as listed below.

(a) Strengthening of HGCL's capacity on ITS

It was felt necessary for HGCL to strengthen its capacity in the field of information technology and ITS. It is recommended for HGCL to recruit an engineer who has IT background and assign him on a full time basis to the ITS project. He must be at a higher position and must be involved in the decision making process of HGCL regarding information technology and ITS.

(b) Use of external resources

In order to supplement the HGCL's lack of knowledge and experience in the highly technical project like toll management system and highway traffic management system, it is recommended to utilize external resources such as those in academic institutions, government research institutions and consultants, who are at neutral position and has no interest in the project from the early stage of the project.

(c) More strict tender evaluation

It is necessary to apply strictly the evaluation criteria and rules set beforehand in the review and evaluation of tenders and proposals to ensure high quality of the systems and services.

(d) Urgent introduction of HTMS

It is highly required to expedite the introduction of HTMS. HTMS construction work includes installation of optical fibre cable along the ORR. The cable is a component of digital transmission system, which is used by both TMS and HTMS. If the introduction of HTMS is delayed, TMS cannot function as the system requires data exchange between toll plazas and Traffic Control Centre through digital transmission system.

(e) ETC trial

ETC trial, which was not conducted in the project, be held when the TMS is completed and put into operation. The trial will have two objectives. It is intended to collect data from the ETC equipment and from the ETC monitors to analyse and improve system operation. In addition, the trials is a good showcase of ETC and promoting its use.

(f) Financial analysis

The toll revenue is expected to be not sufficient to cover the operation and maintenance costs of the systems and road for a prolonged period after the ORR completion. Thus a financial support by the state government is essential for the sustainable operation of the ORR. Financial analysis prepared by the ITS Assistance Team be updated with the latest data in particular the actual toll rate and actual traffic volume at the section already open for public. Budget requirements must be prepared for the next five years so as to secure the budget necessary for the ORR operation.

(g) Review of toll rate

As a part of financial analysis, the toll rate must be reviewed and the possibility of revising toll rate must be examined so as to maximize toll revenue and decrease the dependence on the state budget.

(h) Upgrading of operation manuals

The existing operation manuals were prepared without the actual experience of system operation. It is necessary to review and update the operating manuals and forms based on the experience of TMS and HTMS operation once they are put into operation.